FINAL REPORT

# They had the facts, why didn't they act?:

## Understanding and improving public response to National Weather Service's coastal flood forecasts

Prepared by Nurture Nature Center and RMC Research Corporation, 2015 for the New Jersey Sea Grant Consortium and National Sea Grant College Program, NOAA, U.S. Department of Commerce.

THE NURTURE NATURE CENTER

RMC RESEARCH

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## List of Acronyms Used in this Report

| | |
|---|---|
| EM | Emergency Managers |
| FEMA | Federal Emergency Management Agency |
| GFS | Global Forecast System |
| MARFC | Middle Atlantic River Forecast Center |
| MAT | Maximum Astronomical Tide |
| MHHW | Mean Higher High Water |
| MLLW | Mean Lower Low Water |
| Mph | Miles per hour |
| MSL | Mean Sea Level |
| NA | No Answer |
| NHC | National Hurricane Center |
| NOAA | National Oceanic and Atmospheric Administration |
| NNC | Nurture Nature Center |
| NWS | National Weather Service |
| SLOSH | Sea, Lake and Overland Surges from Hurricanes model |
| T-# | Days before target landfall |
| TWC | The Weather Channel |
| WFO | Weather Forecast Office |

## ACKNOWLEDGMENTS

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**Project team:**




# EXECUTIVE SUMMARY

Nurture Nature Center's research team conducted a series of focus groups, surveys, and interviews designed to elicit feedback from coastal community residents, emergency personnel and broadcast meteorologists about how they understand and use products from the National Weather Service's (NWS) suite of coastal flood and storm surge forecast and warning products and tools. The study particularly focused on use of the emergency briefing packages (briefings), which are issued by the NWS Weather Forecast Offices during extreme weather events and which became an important public tool during Superstorm Sandy in 2012. Participants from two New Jersey counties affected by Sandy were presented with a day-by-day scenario based on the storm's actual path up the East Coast of the United States. Through this scenario, resident and emergency management participants examined a series of NWS products that were issued during that storm, and in particular were asked to respond to briefings that were distributed to emergency personnel and the public over the course of the storm by the Mt. Holly, NJ Weather Forecast Office (WFO) during Sandy. Participants gave feedback about how the timing, the verbal and graphic clarity of the information conveyed, and the inclusion of uncertainty information affected their understanding of and response to the storm (actual or anticipated). Broadcast meteorologists were interviewed to understand how they currently use briefings and to gather additional recommendations for their improvement. Key findings include:

## NWS forecast and warning tools

- Residents of coastal flood-prone communities in New Jersey rely on NWS forecast and warning products and tools as part of a suite of resources they use to evaluate their flood risk, including deliberations with friends, family, and neighbors, personal experience, contacts from local officials; and weather reports from mass media as well as social media. Residents expect and want local municipal officials and emergency managers to deliver NWS information and directions on how to prepare.
- Residents rely on locally specific information to determine their coastal flood risk and their need to prepare. They observe that seeing their specific community, rather than region, named in an NWS or other media storm forecast will motivate them to take protective actions.
- Residents report they would be motivated to act by visual evidence of past storm impacts and other comparisons to previous storms.
- Both residents and emergency personnel identify the overly technical nature and confusing visual presentation of NWS forecast and warning tools as major barriers. This study incorporates participant feedback and makes suggestions for revising some key products used in coastal flood forecasts and in briefings.

## Briefing Packages

- Residents and emergency personnel value briefing packages as an important, integrated, and simplified mechanism for receiving coastal storm information. Residents have less familiarity with the briefings than emergency personnel, but identify the briefings as important and something they would want to receive.
- Residents and emergency personnel prefer a balance of text and graphics, and prefer substantially less text than is used in current briefings.
- Residential audiences request that language in the briefings be kept very simple, with the executive summary focusing on impacts, actions, and key take-away messages, rather than technical storm details.
- Emergency personnel prefer that briefings offer close-up perspectives on their region rather than national maps.
- Residential participants report they are most likely to use the briefings 4 and 5 days in advance of a storm.
- Emergency personnel rely heavily on briefings as a source of information and are the earliest users of the packages, with heaviest use 6 and 7 days in advance of the storm (and further out if possible). Residents use the briefings differently, and do not "tune in" until 4 or 5 days before a storm, recognizing the uncertainty of the forecast prior to that time frame and understanding the time frame needed to consider preparations.
- Broadcast meteorologists who were interviewed for the study report the briefings have important value, with some acknowledging that they use the briefings as confirmation of their own forecasts. These broadcasters value the briefings for their ability to convey tone and urgency about an upcoming storm. Most who were interviewed do not receive the briefings routinely and several reported discovering them only during Superstorm Sandy.
- The inclusion of a personal and emotional appeal in briefings was highly effective in motivating residents to take action.

## Information Sources

- Emergency personnel relied most heavily on Internet websites and smartphone apps for information about severe weather, followed by television and radio. Internet websites were by far the most heavily used source for flooding information by residents, followed by television, radio, and to a lesser extent, Facebook. Half of Round 1 respondents, representing a slightly younger age group, relied on smartphone apps; smartphone apps can reasonably be expected to become a key source of information in the future.
- Residents said they were more likely to seek information about impending storms (e.g., particular meteorological details and anticipated impacts) than they were to look for information about preparing for storms.

## Focus group process

- Focusing discussion on recommendations for improvement, rather than on liking or not liking products or tools, appears to be an effective approach to developing user-friendly and useful forecast and warning tools.
- The focus group process carried out in this project, including the use of a scenario and solicitation of community input, involvement, and buy-in to the design (visual and language) of forecast and warning tools, is an effective communications and engagement strategy and merits consideration as a model for NWS outreach and education.

# INTRODUCTION

Scientific and technological advances have made predictions of hazardous weather more accurate and more timely. The National Weather Service (NWS) issues a state-of-the art, comprehensive suite of flood forecast and warning products about imminent coastal and storm surge flooding, and an abundance of media channels, including the Internet, television, radio, social media, and local notification systems, publish flood predictions and warnings widely. Indeed, predictions of coastal flooding and storm surges were accurate well in advance of Superstorm Sandy, a category 3 Hurricane that struck October 22-31, 2012 (Sullivan and Uccellini, 2013). Yet residents and communities in coastal areas of New Jersey and New York were unprepared. A survey of New Yorkers affected by the storm found that, despite warnings, respondents did not believe the storm posed a danger (Gibbs and Holloway, 2013). In the storm's aftermath, residents told clean-up crews that they knew the storm would be bad, but were unprepared for just how bad.

The current study, "They Had the Facts, Why Didn't they Act? Understanding and Improving Public Response to NWS Coastal Flooding Forecasts," conducted between May and November 2014, sought to understand 1) how coastal residents and emergency personnel navigate and translate the many NWS products made available leading up to and during the storm and 2) whether and how a relatively new tool, "emergency briefing packages," could improve public understanding and responses to coastal flooding messages.

The study was undertaken by the Nurture Nature Center (NNC), a non-profit in Easton, Pennsylvania with a strong focus on flooding issues, and builds on an earlier NNC study for the NWS, "Flood Risk and Uncertainty: Assessing National Weather Service Flood Forecast and Warning Tools." Both studies were designed to draw on and contribute to the social science research on motivating populations in harm's way to take appropriate actions to protect lives and property and to generate practical recommendations for the NWS on product modifications to improve public receptivity to extreme weather forecasts.

This project was directed by co-Principal Investigators Rachel Hogan Carr, NNC Executive Director, and Dr. Burrell Montz, Professor and Chair of the Department of Geography, Planning and Environment at East Carolina University and a noted hazards researcher. NWS partnering offices and staff included: Mt. Holly, NJ/Philadelphia, PA Weather Forecast Office, Gary Szatkowski (Meteorologist-in-Charge) and Middle Atlantic River Forecast Center, Peter Ahnert (Hydrologist-in-Charge) and Patricia Wnek (Service Coordination Hydrologist).

The National Oceanic and Atmospheric Administration (NOAA), which funded this study, has identified the need for a social science understanding of its forecast technology. In its 2011 strategic plan for developing a "Weather-Ready Nation," the NWS stated:

> We must go beyond the production of accurate forecasts and timely warnings and build in improved understanding and anticipation of the likely human and economic impacts of such events. We must enable our users to better exploit NWS information to plan and take preventive actions (NOAA, 2011).

The social science research on this topic has identified a range of factors that motivate citizens to protect themselves in the face of weather emergencies. They include the reputation of the informant, the listener's age, gender, socio-economic status, past experience, and available options (Leik et al., 1980; Mileti and Sorenson, 1990; Phillips and Morrow, 2007; Zahran et al., 2008; and Haynes et al., 2009). A critical element is the extent to which readers or viewers understand and personalize their risk (Mileti and Sorenson op. cit.; and Sorenson, 1991).

The current study examines factors in how the message is framed and conveyed to facilitate public understanding and motivate action. Specifically, the study looks at how residents of the New Jersey coast understood and valued the coastal flood forecast and warning products issued by NWS during Hurricane Sandy, with a particular emphasis on Emergency Briefing Packages. "They Had the Facts, Why Didn't They Act?" was one of ten 14-month projects funded through NOAA's Coastal Storm Awareness Program and administered by New Jersey Sea Grant Consortium to understand decision-making during extreme weather events.

This report explains the methodology, findings, and deliverables for this project. The report contains general findings as well as specific product recommendations to improve coastal flood forecast and warning products so that public audiences understand them more easily and immediately, and are motivated by them to take appropriate protective actions.

## METHODOLOGY

The NWS issues numerous flood risk and warning products when extreme weather events are forecast. This study sought to understand how focus group participants understand and use current NWS coastal flood forecast products and how products might be revised so that they are 1) easier to understand and 2) more likely to motivate people to take appropriate actions in response to forecasts.

To address these goals, the project aimed to advance our knowledge of how people seek out, understand, use, respond to, and share information about coastal flooding risks during severe storms, and how participants would suggest adapting the products to make them more "user friendly." Specifically, the project tested a set of emergency briefing packages issued by NWS during Superstorm Sandy and distributed widely to emergency management personnel as well as through social media to the public. The briefings presented information from commonly available NWS products, including the National Hurricane Center Track Forecast Cone, the Weather Prediction Center Surface Prognosis Map, a 5-Day Quantitative Precipitation Forecast Map, a Temperature Map, an Extratropical Surge Forecast, and a Wind Speed/Gust Forecast Map. The all-text Coastal Flood Watch and Coastal Flood Warning products were not included in the briefings but were discussed with focus group participants.

The research team conducted four focus groups in Brick, New Jersey and one in Long Branch, New Jersey. Participants were recruited through outreach by partnering organizations, including the Jacques Cousteau National Estuarine Research Reserve, as well as local emergency management offices, social media, outreach to regional nonprofit and community organizations, such as libraries and Chambers of Commerce, and business district organizations. RMC Research Corporation was engaged to evaluate the focus group process and analyze the findings with the aim of making recommendations to the NWS on selected products.

The research team developed a seven-day scenario of Superstorm Sandy's approach to the New Jersey coast, using products that were issued by NWS during the course of the actual storm. Scenario planning is a commonly used social science, educational and decision-making tool, first associated with the work of Herman Kahn in the 1960s (Kahn, 1962). Typically used to posit a hypothetical yet plausible emerging event, scenarios prompt participants to reflect on a possible future. In this instance, the scenario drew on an actual event—Superstorm Sandy's arrival on the New Jersey coast in October 2012—that could plausibly recur. The research team was assisted by Gary Szatkowski of the Mt. Holly, NJ WFO in identifying the commonly used coastal flood products, learning the technical components of the products, and locating archived products for use in the scenario. He also provided technical counsel during the revision of products to ensure changes did not disrupt the integrity of the products or forecast.

### Focus Group Process

In May 2014, Round 1 commenced with three focus groups held in Ocean and Monmouth Counties (Figure 1). The first focus group took place in Brick, NJ, for residents of Ocean County. A second focus group in Brick centered on emergency management personnel from both Ocean and Monmouth Counties. The third focus group, for residents of Monmouth County, NJ, was held in West Long Branch, NJ. Round 2, in November 2014, comprised two focus groups for residents of Ocean and Monmouth Counties, and was held in Brick, NJ. In each focus group, Dr. Montz presented the storm scenario and facilitated a group discussion about the storm day-by-day (T-7, etc.) using images of weather forecast and warning products available from the NWS (and, by extension, news media and emergency personnel) in the days leading up to landfall. In addition to discussions about the message each NWS product conveyed and the circumstances under which they saw each as useful or potentially useful, participants also looked at the products as presented in the Mt. Holly WFO emergency briefing packages and made recommendations for improving individual products and the briefings. Improvements were offered in the context of motivating residents to respond appropriately to forecasts and warnings. Participants received modest compensation and were asked to complete both pre- and post-session surveys. Focus group sessions were taped with participants' permission.

Findings from the Round 1 surveys (n=18) and focus groups informed the redesign of 5 of the 8 NWS Coastal Flood Forecast and Warning tools (including the briefings). Based on participants' concerns, the research team identified a series of strategic changes to layout, color, and text of the products.

NNC Art Director Keri Maxfield led the redesign of products in cooperation with the research team and employed best design practices to create new versions of the products that addressed participants' questions and confusions. NWS partners were consulted during this process to ensure changes did not interfere with technical accuracy. The research team attempted to propose changes that were within the apparent and reasonable capacity of NWS to implement.

During Round 2, the same scenario was presented to participants as in Round 1, except that the Round 2 scenario and surveys (n=21) included the revised mocked-up products as the basis for discussion and questioning.

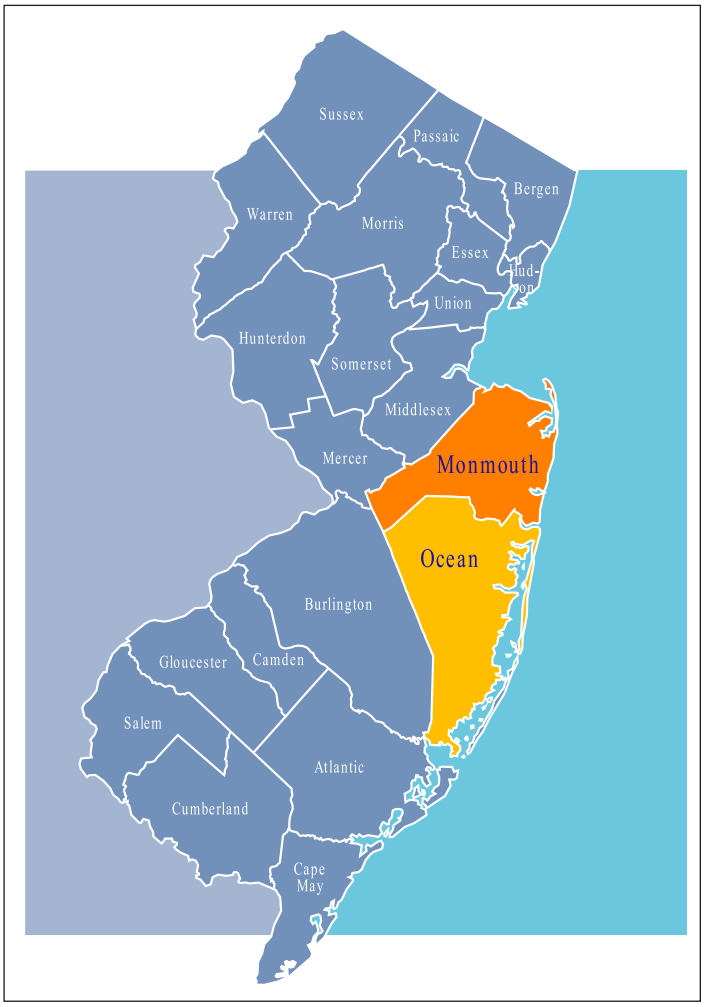
Survey data were analyzed using SPSS software; open-ended survey responses were hand-coded; and a content analysis of the focus group discourse was conducted using NVivo software.

## Characteristics of the Study Sites

Monmouth County is the northernmost county on the New Jersey coast, with a population of 630,380 (U.S. Census, 2010). It is ranked among the top 100 counties in the U.S. with respect to per capita wealth. Much of the landscape is low-lying, but there are coastal bluffs and other higher areas within the county. To its south, Ocean County has a population of 576,567 (U.S. Census, 2010), and is the fastest growing county in the state. Like Monmouth County, much of Ocean County is flat. Both counties were especially hard hit by Superstorm Sandy. Houses and businesses on Barnegat Peninsula, the barrier island near Brick, NJ, were destroyed; 20-foot waves breached the barrier, flooding inland areas and dropping up to four feet of sand. Coastal winds in excess of 80 mph brought life to a standstill, with roads and bridges closed, widespread power outages, and transit system closures. The timing of residents' returns to their homes varied significantly and at least one focus group respondent had still not returned home at the time of the May 2014 round of focus groups. Thus, even those who live in the same area had somewhat different experiences with the event, suggesting that the focus group participants' reactions, responses, and recommendations are representative of the region's population.

Despite the enormous destruction, citizens and emergency personnel in both counties responded rapidly to mobilize local resources, evacuating residents, opening shelters and storm recovery centers, and arranging fuel shipments to keep hospital and water treatment plants in operation. (For one 24-hour period, emergency personnel across the state were responding to emergency calls at the rate of one per minute.) These counties were selected as study sites because of the extent of Sandy's impact, as well as the anticipated involvement from municipal and regional government and organizations in recruiting emergency personnel and residential participants.

**FIGURE 1. Map of Region**



# FINDINGS

## Pre-Focus Group Survey Findings: Participant Characteristics and Flooding Experiences

Before Dr. Montz began the presentation, participants answered a brief survey. These surveys collected demographic data as well as information on respondents' length of time in the community, flood experience, perceived risk of flooding, sources for learning about hazardous weather, and typical actions taken during past floods. Not all respondents answered all questions (see Appendix A for survey instruments).

### *Demographics of Participants*

Round 1 respondents as a group were somewhat younger than those in Round 2 (Figure 2); the majority of residents were female and the majority of emergency personnel were male (Figure 3). More than three-quarters of all respondents had Bachelor's or post-graduate degrees (Figure 4). All emergency personnel, and more than three-quarters of residents, had lived near the coast in Ocean or Monmouth Counties for 8 or more years (Figures 5 and 6). More than half of the residents indicated that they lived in a flood zone (emergency personnel were asked about their community experience rather than personal experience).

**FIGURE 2. Age of Participants in Study**

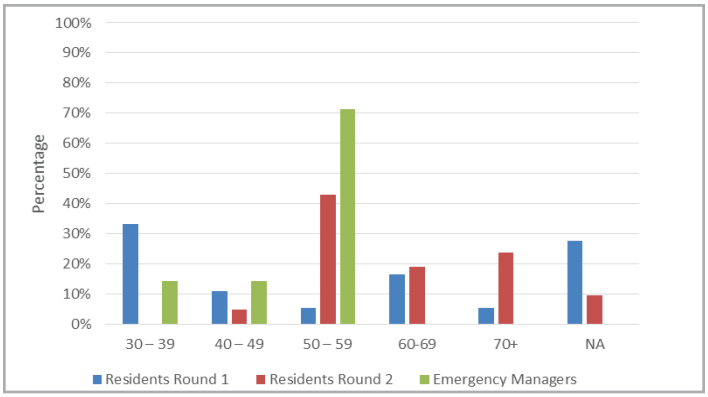



**FIGURE 3. Gender of Participants in Study**

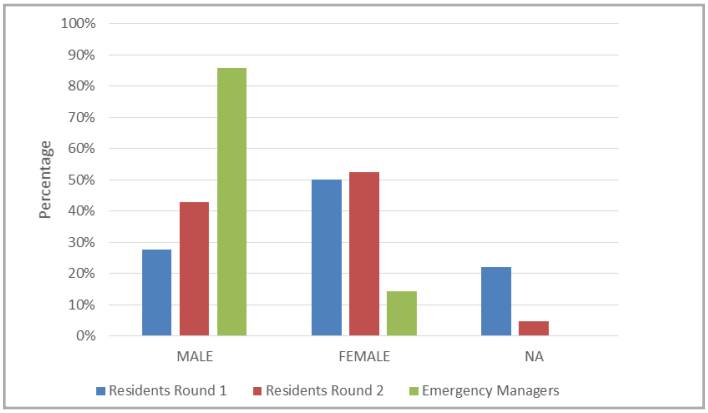



**FIGURE 4. Education Level of Participants in Study**

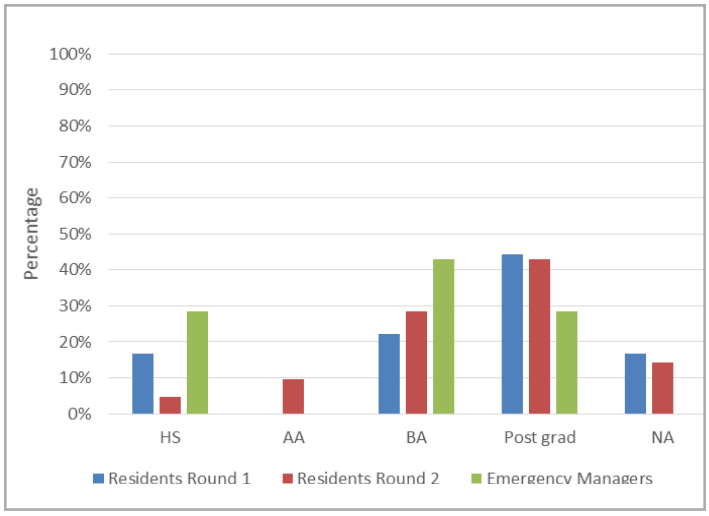



**FIGURE 5. Years Living in Coastal Area Among Participants**

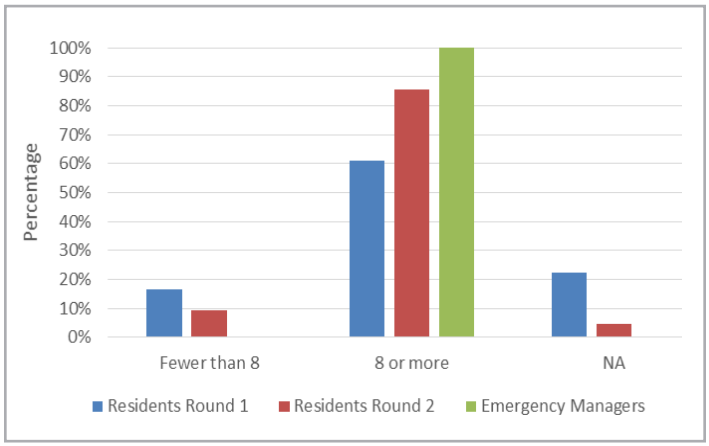
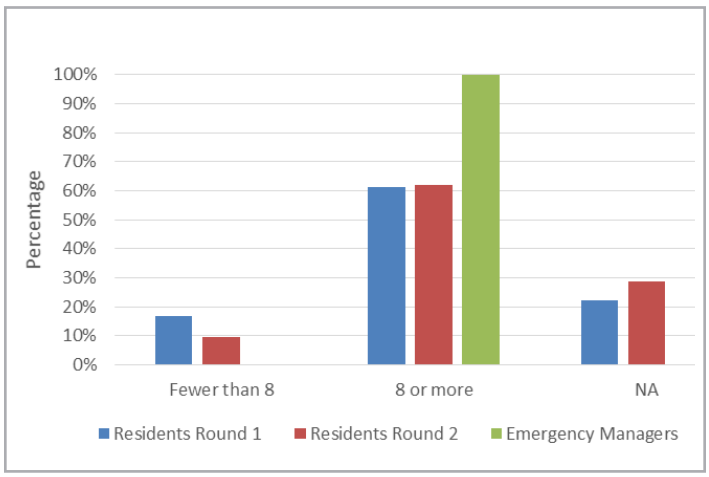



**FIGURE 6. Years Living in Monmouth/Ocean County**



### Previous Flood Experience and Responses

Almost all of Round 1 respondents, and more than half of Round 2 respondents, had experienced floods personally or through friends and family (Figure 7), most within the last five years (Figure 8). Nearly three-quarters of all residents experienced damage to their home or business during Superstorm Sandy (Figure 9). More than three-quarters of Round 1 participants responded to warnings, as did more than half of Round 2 participants (Figure 10). Round 2 respondents rated their flood risk nearly twice as low as did Round 1 respondents (Figure 12). This accounts for the high numbers of NA, no answer, replies to a question about how they responded to official warnings (Figure 11).

**FIGURE 7. Flood Experience of Participants**

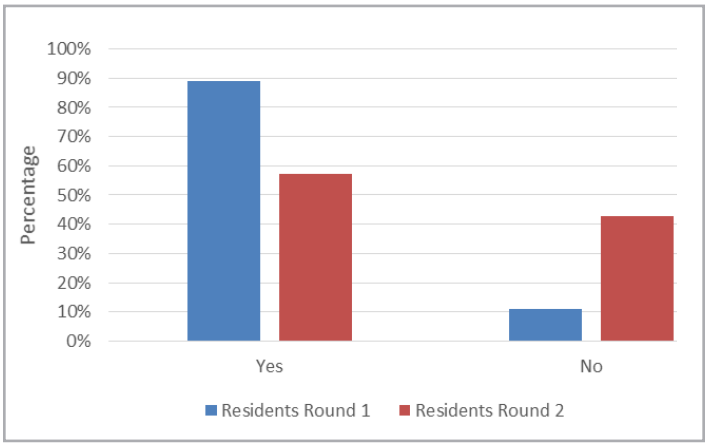



**FIGURE 8. Timing of Flood Experience Among Participants**

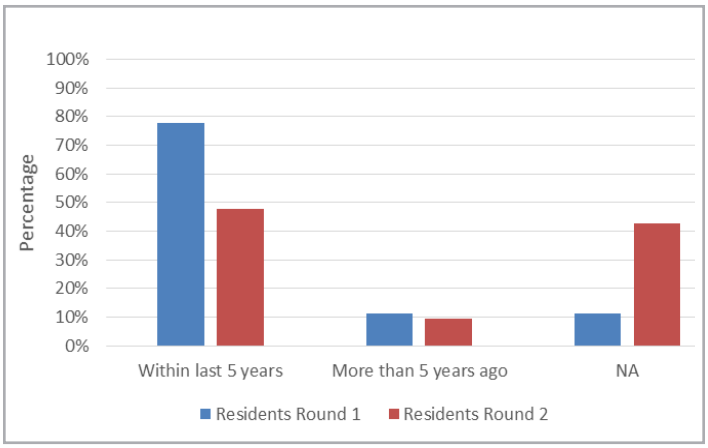



**FIGURE 9. Damage Experienced from Superstorm Sandy Among Participants**

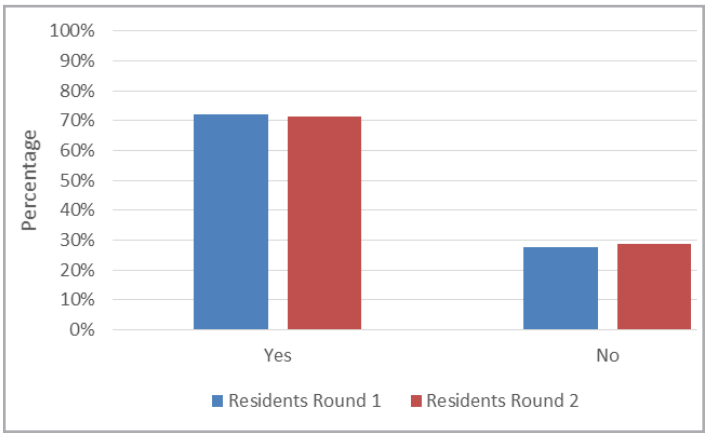



**FIGURE 10. Percentage of Respondents Who Responded to Past Weather Warnings**

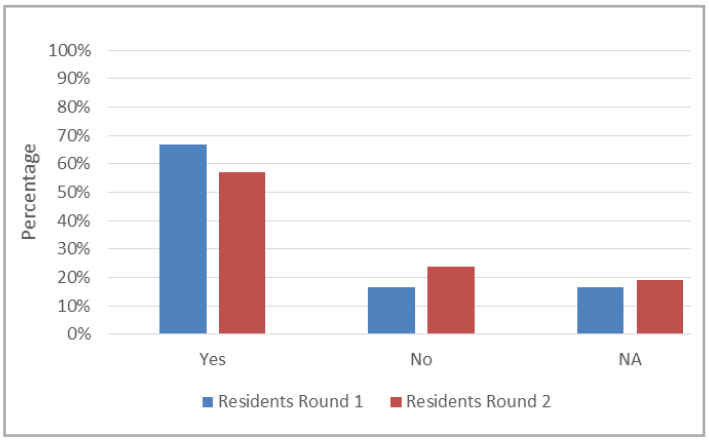



**FIGURE 11. Response Taken to Past Weather Warnings Among Participants**

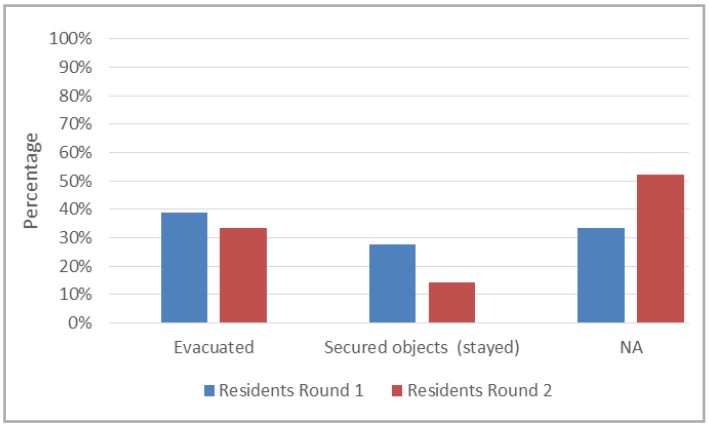
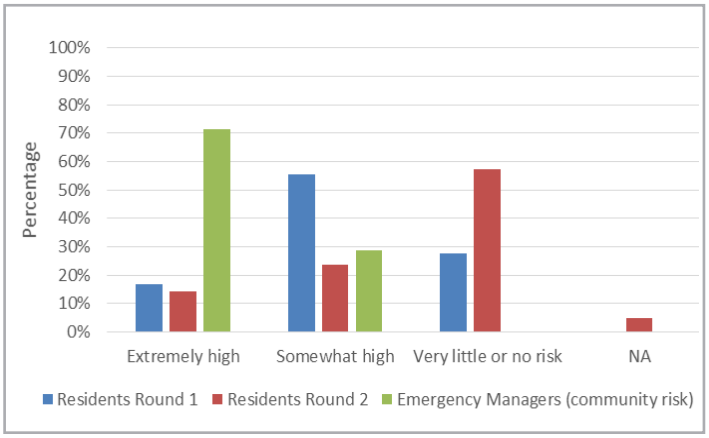



**FIGURE 12. Perception of Personal Flood Risk Among Participants**



## Information Sources Consulted

Internet websites were the most often cited source of information about extreme weather forecasts by Round 1 respondents and emergency personnel; Round 2 respondents identified television slightly more often than they did the Internet. The three major sources of weather information—the Internet, television, and radio—remain significant, although smartphone apps appear to be gaining currency among all three groups. All emergency personnel relied on smartphones and half of Round 1 Respondents, a slightly younger group than Round 2 respondents, used smartphone apps (Table 1).

Asked about information sources concerning how to prepare for extreme weather and/or flooding, Round 1 respondents relied more heavily on Internet websites and less heavily on radio. Round 2 respondents chiefly cited television, Internet websites, and radio (Table 2).

**TABLE 1: Information Sources on Severe Weather**

| SOURCE | ROUND 1 RESPONDENTS | ROUND 2 RESPONDENTS | EMERGENCY PERSONNEL |
|---|---|---|---|
| Internet (websites) | 89% | 81% | 100% |
| Television | 72% | 86% | 86% |
| Radio | 61% | 76% | 86% |
| Facebook | 56% | 19% | <3 |
| Smartphone apps. | 50% | 36% | 100% |

**TABLE 2: Information Sources on Severe Weather Preparations**

| SOURCE | ROUND 1 RESPONDENTS | ROUND 2 RESPONDENTS |
|---|---|---|
| Internet (websites) | 83% | 71% |
| Television | 64% | 81% |
| Radio | 36% | 60% |
| Facebook | 27% | 0% |
| Smartphone apps. | 27% | 20% |

## Typical Actions Taken in the Face of Severe Weather

Respondents in both Rounds showed similar patterns in their responses to imminent coastal or storm surge flooding: most opted to discuss the situation with family and friends, followed by seeking more information and gathering supplies. Contacting local officials was not as common an action (Table 3).

**TABLE 3: Respondents' Actions Related to Severe Weather Forecasts**

| SOURCE | ROUND 1 RESPONDENTS | ROUND 2 RESPONDENTS |
|---|---|---|
| Discuss with family and friends | 87% | 90% |
| Seek more information | 73% | 80% |
| Gather supplies | 67% | 70% |
| Contact local officials | <3 | 20% |

## USE AND SALIENCE OF BRIEFING PACKAGES

During Superstorm Sandy, while news media of all sorts were offering near-continuous coverage of the approaching storm, the NWS WFO in Mt. Holly, NJ was disseminating information directly to the public through its website. Seven days prior to the storm, the WFO issued the first briefing for the storm. This was the first product to formally alert the public about the potential for a significant weather event. As the storm progressed, the NWS WFO issued daily briefings with increasingly detailed information. The WFO began sharing updates about the availability of new briefings via social media, and the briefing, which had historically been a tool for emergency personnel, became more widely used by public audiences than it had previously. Notably, in the two days leading up to landfall, Meteorologist-in-Charge of the Mt. Holly WFO, Gary Szatkowski, included a "Personal Plea" in the briefing, a strongly worded request for residents to take the storm seriously and evacuate when told to.

These briefings were issued as multi-page .pdf documents accessible through a website link. The briefings contain a number of other products NWS issues to describe the anticipated characteristics of an impending storm, such as wind speed and gust maps, temperature maps, precipitation forecasts, and extratropical surge maps. Along with the graphics, the briefings include text with key information highlighted and, sometimes, direct calls to action.

This project centers on understanding how the audiences used various tools, particularly the briefings, to determine their effectiveness in motivating public action, and identifying best practice recommendations for future briefings. Participants were asked to consider the timing of the briefings, which products should be included, how the information should be presented, and at which thresholds they should be issued.

As the primary focus of this study, the briefings are discussed first. Following that, individual products in the briefing are discussed, both as they currently influence situational understandings and as they might be revised to facilitate such understandings. The discussion is reported in the present tense to reflect the dynamic nature of the conversation.

## DETAILED FINDINGS AND ANALYSIS OF NWS PRODUCTS

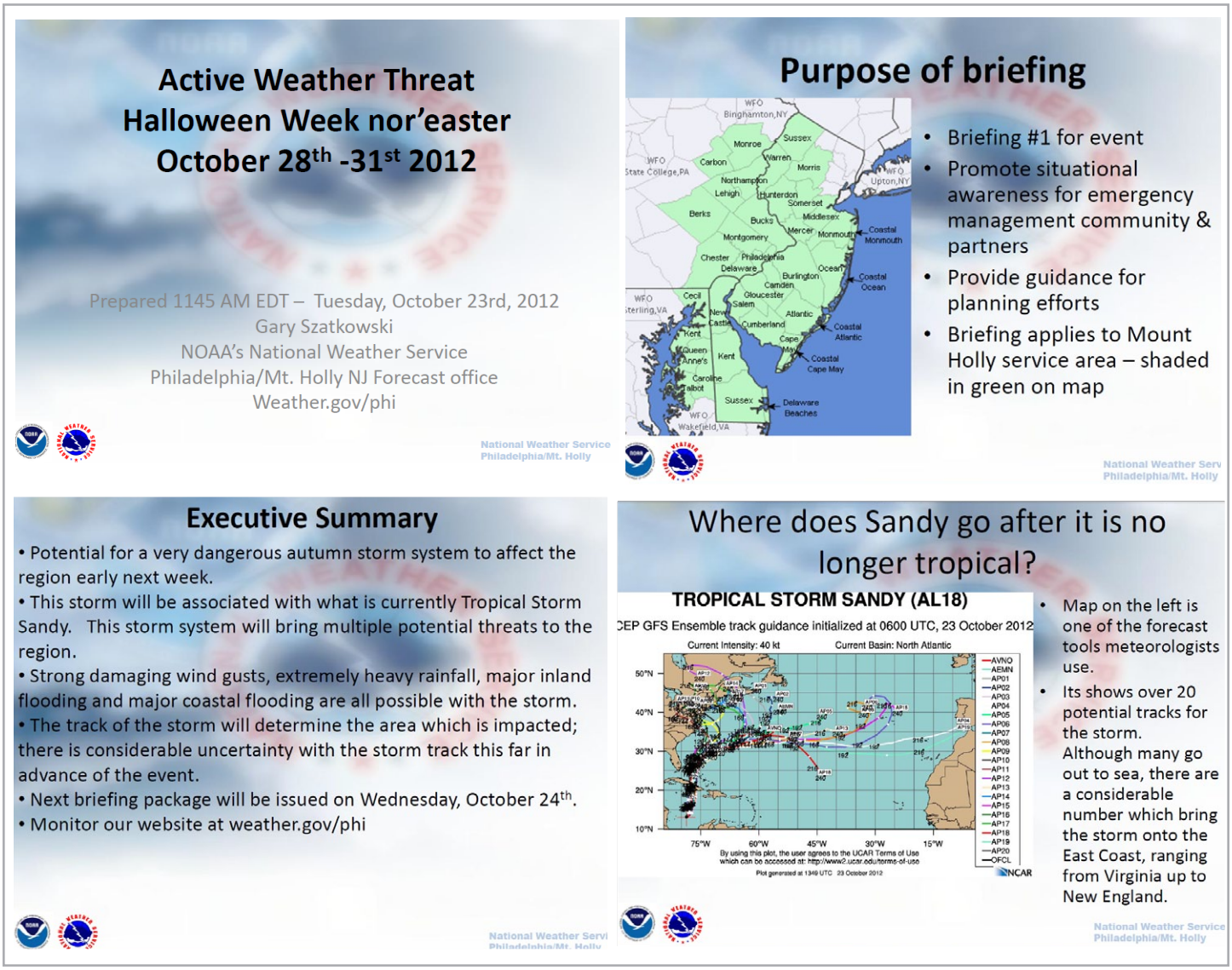
### NWS Briefing Packages

Overall, focus group participants would welcome access to the briefings in advance of a major coastal storm. Emergency personnel already consider the briefings an essential or critical tool in their storm preparations. Although some resident participants were less familiar with the briefings than other NWS coastal products shared during the scenario, all suggested it would be a useful package to receive. Many offered improvements to make the briefings easier to understand and use in decision-making about which actions to take, and when.

Participants in Round 1 were shown two briefing packages at the end of the scenario. These were the actual briefings that were issued by NWS on days T-6 (Tuesday, Oct. 23, 2012) and T-1 (Sunday, Oct. 28, 2012) leading up to Superstorm Sandy. The briefings were presented to Round 1 participants after all of the other products were discussed in order to facilitate a focused discussion about the layout and potential of the briefing format itself (rather than discussion about the individual products the briefings contained). Round 2 participants were shown three briefing packages, which were presented alongside other products during the course of the storm on days T-6, T-4, and T-1. These Round 2 briefings were mocked-up versions created by the research team in response to Round 1 feedback from residents and emergency managers. Presenting the briefings during the scenario allowed the research team to see how participants responded to them in context with the other information they were seeking and receiving about the storm. Because the briefings contain multiple pages and would be too lengthy to present in full here, sample thumbnail images are shown below to provide a representation of what the briefings looked like. A description of changes to Round 2 briefings is included below.

**Round 1 Briefing Discussion (Residents)**

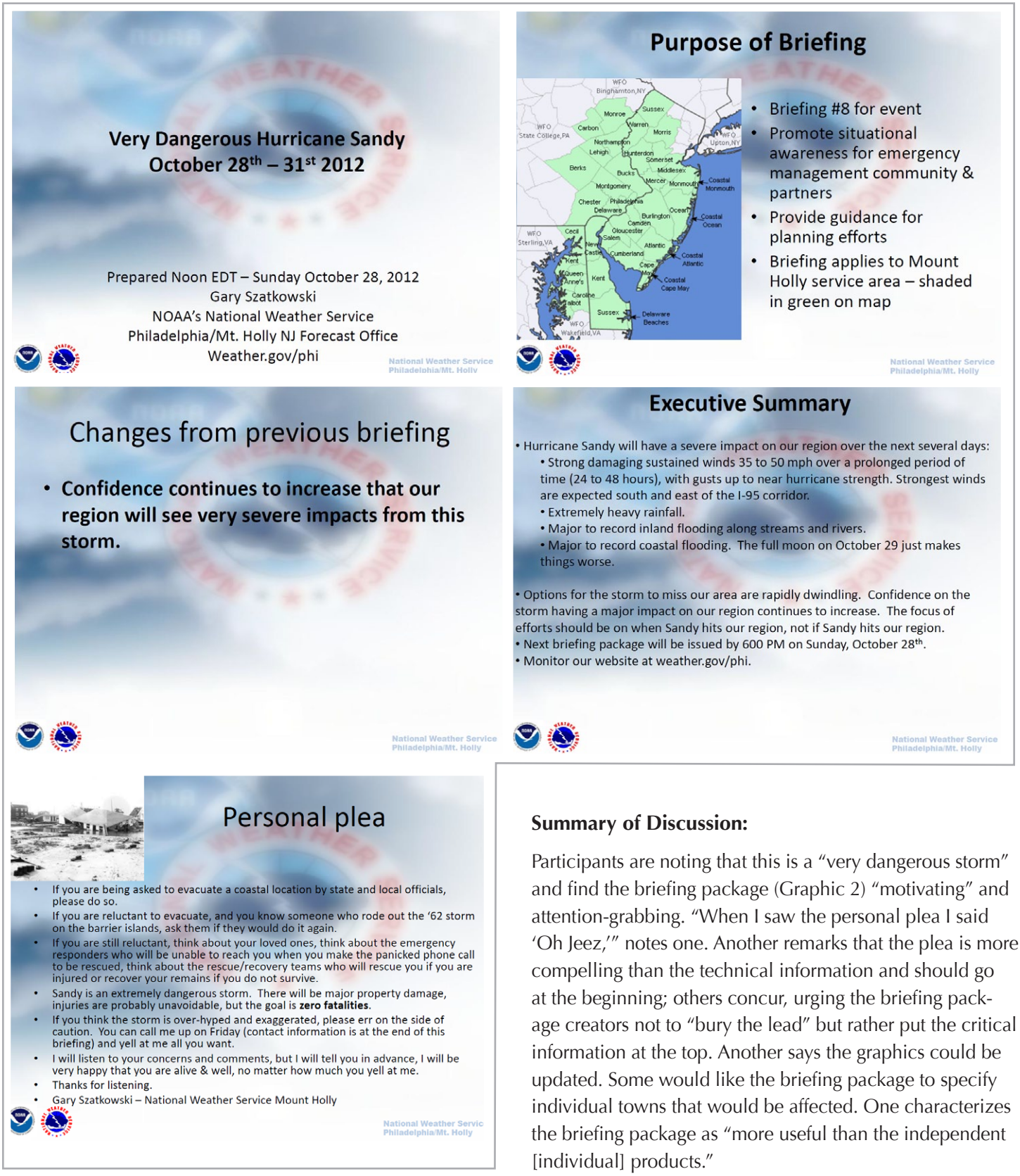
**Graphic 1. Round 1 Emergency Briefing Number One, Shown T-6.**




**Summary of Discussion:**

A few are familiar with the briefing packages and one "uses it a lot." One notes "it would have been helpful" and others say they like it, especially the explanatory material (Graphic 1). Some would like still more explanation, such as legends. One whose company purchases professional weather forecasts says, "this is similar to the one we pay for." Participants note there is no mention of the moon or indication of how big the storm is. One person says T-4 is a good time to have it; another would be more interested in a later one.

**Graphic 2. Round 1 Emergency Briefing Number Two, Shown Day T-1.**




**Summary of Discussion:**

Participants are noting that this is a "very dangerous storm" and find the briefing package (Graphic 2) "motivating" and attention-grabbing. "When I saw the personal plea I said 'Oh Jeez,'" notes one. Another remarks that the plea is more compelling than the technical information and should go at the beginning; others concur, urging the briefing package creators not to "bury the lead" but rather put the critical information at the top. Another says the graphics could be updated. Some would like the briefing package to specify individual towns that would be affected. One characterizes the briefing package as "more useful than the independent [individual] products."

## Emergency Personnel Briefing Discussion:

Although one participant has high praise for the briefing — "I used them and would not change them…they give you every aspect—wind, rain, coastal impacts, surge statement"— others are more critical. Suggested improvements relate to what is included in the packages, timing of the briefings, and models that might be more helpful. Key comments and suggestions included:

- Show highs as well as lows on the US map.
- Make it more Atlantic Ocean based. (I don't care what's going on in California.)
- Use North American GFS.
- We need better models; we're watching the European ones.
- Tighten it up or don't show it to us.
- EM discussing upgrading the storm surge model: [you should] go to FEMA [to see how they are presenting storm surge].
- We need the storm surge information earlier.
- The display [needs to be] better for the layperson.
- Add the tides and the moon.
- The moon is missing from mostly everything, even apps. The full moon adds feet to the tide.

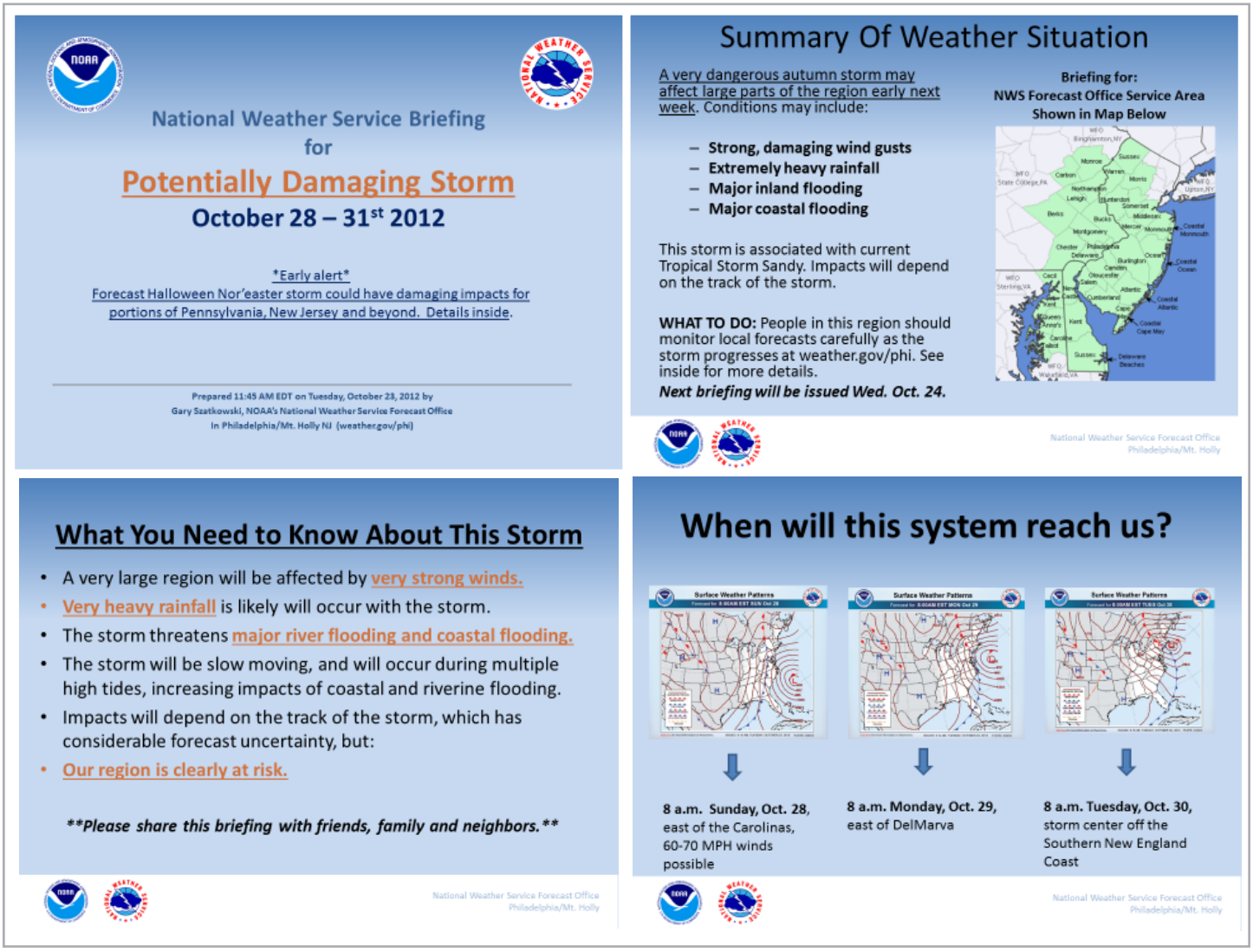
Consensus that the briefing packages are useful —"our operations center was always looking at it" says one — is mixed with debate on how much and what kind of detailed information it should contain. For some, the package contains too much information for the public: "It's got to be simple." Related comments include, "Put the bottom line first," and, "they don't understand a lot of this." On the other hand, some participants assert that the briefing package should be as complete as possible for emergency personnel: "More information for us is good. It's not a good thing for the public. We can disseminate [it]." Adds one, "it should be on a need-to-know basis for the public." Because the briefing packages are online, it is suggested that there be a "click" for public use right on the website. Asked about the personal plea in the briefing package, all agree that it helped save lives. "He was 100% accurate," says one, recalling rescuing people from their attics in a 79 mph wind.

## Round 2 Briefing Discussion (Residents):

In response to feedback gathered during discussions and surveys (survey data are below), the redesign of the briefings focused on reducing the length of the briefings and putting the most critical information, including highlighting action steps, first. More meteorological detail was moved toward the end of the briefings. The effort was to balance the needs of various audiences—residential audiences wanted short, concise information not too far in advance, whereas emergency managers wanted more complete information as far in advance as possible.

Overall, briefings (Graphic 3, 4, and 5) were significantly shortened and the all text slides minimized as much as possible. The background logo was removed to enhance visual clarity. The agency logos were put on the front page along with the dates and type of storm (e.g., potentially damaging storm, very dangerous hurricane, etc.). A simple take-away summary message/alert states the potential effects and areas anticipated to be affected. The date, time, and name of the preparer of the briefing is included at the bottom of the first page. The color red was used to indicate immediate threats and calls to action, and the color orange was selectively used to indicate important warning information. The second page was changed to include the main summary of the weather situation, including recommended actions ("What to do"), and was drafted so that if viewers never got beyond this point they would still grasp the main points necessary to understand the risk. Key highlights included the area affected (shown as a map) and a list of impacts ( e.g,  damaging winds, inland flooding, heavy rainfall). Directives to the public (monitor, act, etc.) are included as is the date of the next briefing. The third page focuses on "what you need to know about the storm" and includes a bulleted list of the characteristics of the storm and its impacts as well as the forecast confidence. The fourth page focuses on "actions you should take to prepare." Various NWS forecast products follow, from the National Hurricane Center Track Forecast Cone graphic, weather front maps, and possible paths of the storm to coastal flood levels and wind speeds. These graphics have a small amount of explanatory text alongside them. The ending page provides contact information and websites for the latest information. In the briefing that included the "personal plea," the plea was put up front on the third page, rather than on the final page as it was issued originally.

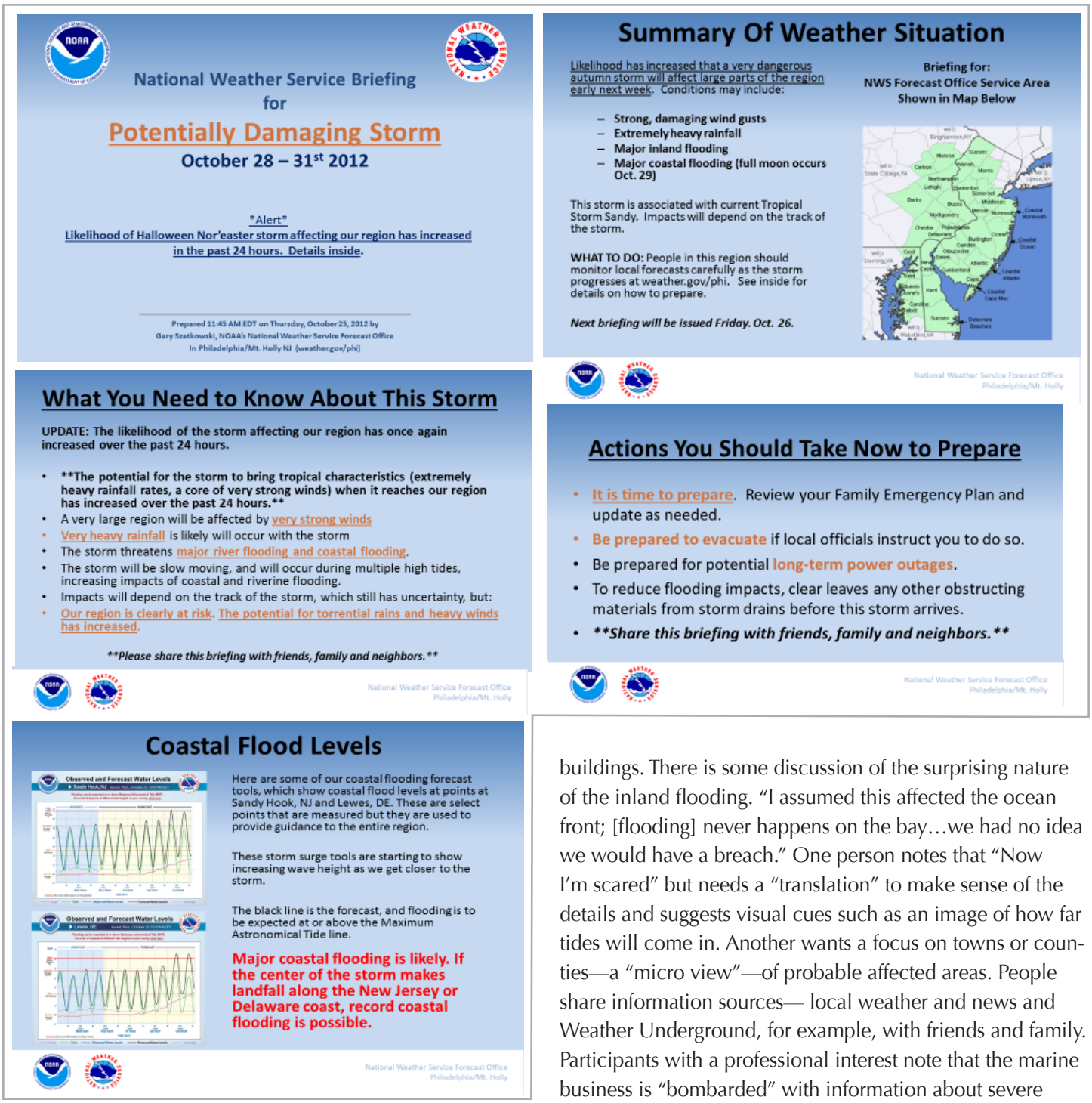
**Graphic 3. Round 2 Briefing Number One, Shown Day T-6.**




**Summary of Discussion:**

A few have seen the briefing package before. Initial responses range from "Not helpful, too broad brush" to "It shows we're a direct hit." Those whose professions, or relatives' professions, are linked to weather conditions note they are receiving warnings even at T-6 and taking action. Participants appear to trust messages from emergency personnel rather than weather reporters, as skepticism of the media persists. One concludes, "The package as a whole would be good. You would keep your eye on it." Asked about the mix of text and graphics, participants concur that the balance is good. There is some conversation about whether and how much past experience with storms and floods colors people's understanding of risk. "I see people looking at real estate two years out [from Sandy] and people aren't asking any questions." Another notes that government programs, aided by cheap flood insurance, encourage rebuilding in flooded areas —"That insulates people."

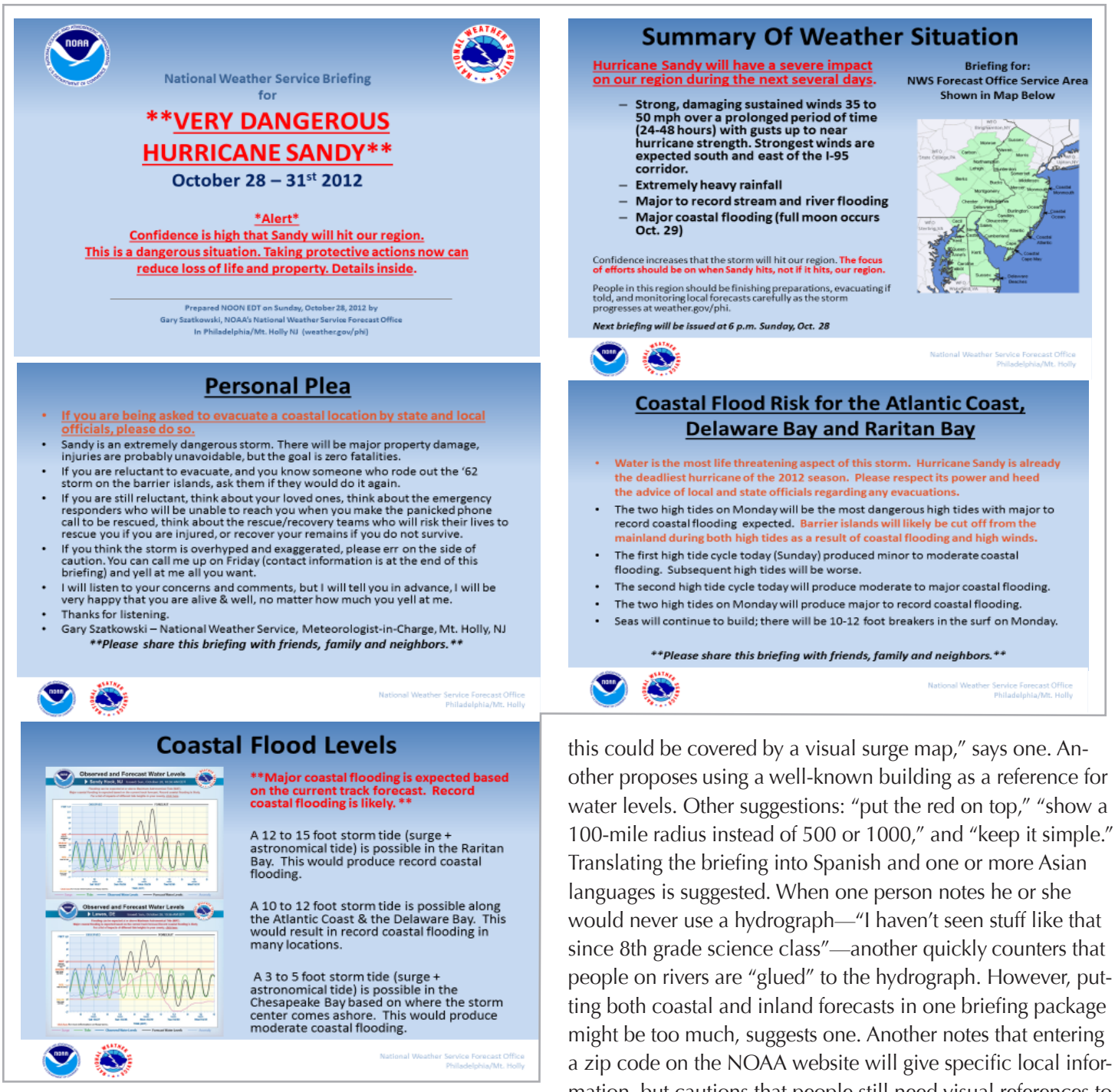
**Graphic 4. Round 2 Briefing Number Two, Shown Day T-4.**




**Summary of Discussion:**

Participants are clearly interested. All say they have begun preparing. One interprets the package as predicting strong winds, a full moon, and both inland and coastal flooding. "We're clearly at risk," says one. "We're taking it seriously at this point." A few suggest that the briefing could be more concrete, showing, for example, images of the impacts of high winds on buildings. There is some discussion of the surprising nature of the inland flooding. "I assumed this affected the ocean front; [flooding] never happens on the bay…we had no idea we would have a breach." One person notes that "Now I'm scared" but needs a "translation" to make sense of the details and suggests visual cues such as an image of how far tides will come in. Another wants a focus on towns or counties—a "micro view"—of probable affected areas. People share information sources— local weather and news and Weather Underground, for example, with friends and family. Participants with a professional interest note that the marine business is "bombarded" with information about severe storms. Skepticism still remains, however, as participants cite the danger of "crying wolf" and dismiss media hype. There is discussion about how information travels; some favor a "concerted" message from all media sources "in the same voice." It is suggested that supermarkets post weather warning web links "right on the milk case" or handed out by cashiers. Others suggest digitizing the briefing and customizing messages via cell phones, similar to "reverse 911" calls.

**Graphic 5. Round 2 Briefing Number Three, Shown Day T-1.**




**Summary of Discussion:**

Confidence levels in predictions are now high. "Television is being interrupted and schools are closing and I'm running around," says one. One person notes that the briefing mentions the moon only incidentally: "That should be added to the picture." People mention the governor's admonition ("Don't be an ass") and the personal plea from Gary Szatkowski who wrote the briefing. One suggested recording Gary's voice for voicemail calls. Some continued to find the briefing too dense. "All this could be covered by a visual surge map," says one. Another proposes using a well-known building as a reference for water levels. Other suggestions: "put the red on top," "show a 100-mile radius instead of 500 or 1000," and "keep it simple." Translating the briefing into Spanish and one or more Asian languages is suggested. When one person notes he or she would never use a hydrograph—"I haven't seen stuff like that since 8th grade science class"—another quickly counters that people on rivers are "glued" to the hydrograph. However, putting both coastal and inland forecasts in one briefing package might be too much, suggests one. Another notes that entering a zip code on the NOAA website will give specific local information, but cautions that people still need visual references to understand the forecasts. "I understand what it says but there's no picture of what that wind speed does. Translate that to the layperson: Trees could fall." There is a brief discussion of how to prepare. One expresses nostalgia for television figures who coached viewers on preparing; another relies on lessons learned at school, such as filling a bathtub with clean water and having four weeks' worth of food and water. By this point "everyone is prepared." Noting wind gusts and the sudden loss of electricity, one says: "I guess this is starting."

## Survey Responses to Briefing Packages

**Round 1 Respondents:**

More than half of Round 1 respondents (59%) were unfamiliar with the briefing packages before the focus group. Most (63%) ranked them highly or very highly. Fewer than a third (31%) ranked them as somewhat valuable. Motivations respondents cited for using the briefing packages included:

- Locational precision (as opposed to general areas) and references to specific towns
- The combination of factual language and graphics
- Detailed information, clarity, and inclusion of timeframes
- The call to action
- "Things to be aware of" page and preparedness ideas
- Good summary
- As an NWS product, [it is] updated regularly.

**Round 2 Respondents:**

Most (77%) were unaware of the briefing package before the focus group. Of 17 rating the briefing package's value, 88% rated it as valuable or very valuable; the remainder rated it as somewhat or not very valuable. Most anticipated using the briefing package at T-5 and T-4, with some indicating use at T-7. None anticipated using it at T-1. Asked to describe features of the briefing package that would motivate them to use it, respondents noted:

- Valuable predictions (storm surge, rainfall, wind)
- Clear explanations and presentation
- Graphics
- Bold warnings and concise "impact" and "actions to take"
- Combination of text and graphics
- Local information
- Real-time information
- Credibility
- Unpredictable nature of hurricanes

**Emergency Personnel:**

Most respondents (86%) were familiar with the briefing package before the focus groups. Of five respondents who rated this product, all rated it valuable or highly valuable. The greatest numbers of respondents would access it at T-7 and T-3. Respondents described their motivation for using the briefing package in terms of maps, particularly the rainfall and a wind surge map; one requested more use of tables.

**Summary:**

Clearly the briefings are a valued product by all participants. Suggestions from participants concerned ways of improving an already useful product:

- Highlight critical information by featuring it at the beginning of the briefing.
- Use less jargon and present more concise, yet clear, text.
- Localize text warnings to the extent possible.
- Cite location-specific (municipal-specific rather than regional) information whenever possible.
- Use visual cues, such as maps indicating anticipated waterlines or photographic evidence of past devastation, to help residents assess their risk more accurately.
- Distribute information through multiple channels (email, internet, smartphone app, and publish address for briefing link in public spots such as grocery store).

Briefing redesign for Round 2 began to address some of these concerns. The redesign worked to reduce the length of the briefings and to prioritize key risks and action steps at the very front, in anticipation that many consumers of the product will not read through the entire document. Detailed meteorological information can be located toward the end of the briefing for more sophisticated users and emergency personnel. Despite the extent of flooding that many participants had experienced, and despite generally favoring NWS products as the most trustworthy, many participants were still unfamiliar with quite a few of the NWS products presented.

## Other NWS Coastal Flood Forecast Products

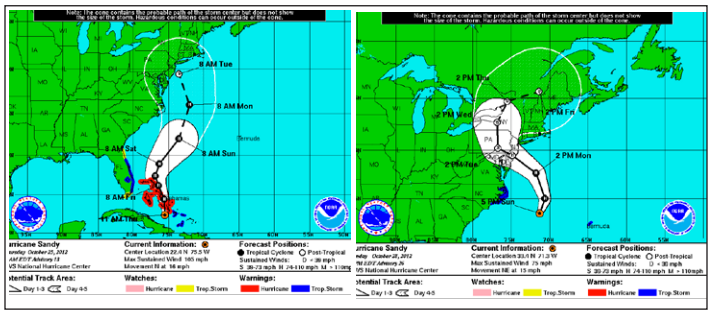
In addition to reviewing the briefings, the research team gathered reflections from participants about each of the individual NWS products during focus group discussions and through post-session surveys. Below is a product-by-product summary of feedback from participants. The products are reviewed in the order they were presented in the scenario. Note that some products appeared multiple times during the scenario, as individual products as well as within the briefings. For each product, Round 1 discussion is first (Residents and Emergency Managers) followed by changes to the product and Round 2 discussion. Discussion includes participants' comments about and suggestions for revising the products (for Round 1), as well as other non-product related conversations that took place while discussing specific products.

### National Hurricane Center Track Forecast Cone (shown days T-6, T-4, T-1)

**Round 1 Discussion:**

Aware the storm is heading north, participants note they are talking to people but are not yet moved to act and are waiting. By T-4, people are checking supplies and shopping; some are starting to worry. "This is when my curse words start," says one. Others are checking the news and talking to other people. One notes that despite evacuating for the last big storm, they "got nothing." One admits ultimately "scrambling" and had not done anything at this point. By T-2 and T-1, the Cone is extraneous; the focus is on preparing for the storm.

**Graphic 6. National Hurricane Center Track Forecast Cone**




In surveys, most respondents (88%) noted they were familiar with the Cone (Graphic 6) before the focus group and rated it highly or very highly. Fewer than three respondents rated it as somewhat valuable. Some respondents found it useful each of the seven pre-storm days except day T-6; more than a third (35%) said they consulted it one day before the storm's landfall; three said they would consult it five days out and three said they would consult it three days out. The remaining three would consult it at T-2 or T-4. The strongest motivating feature of the Cone respondents cited was the visual simplicity of the storm track. Other comments:

- Storm track direction, landfall
- Simple and easy to read
- Local focus
- Its visual aspect
- If it had arrows pointing to areas at high risk

**Emergency Personnel:**

The product is shown at T-4. All note that "everybody" uses the Cone. One participant is looking at the lows and highs to try to figure out the storm's track.

In surveys, all emergency personnel were familiar with the Cone and all rated it as valuable or highly valuable. None anticipated using the cone from T-4 on. The 67% "range of uncertainty" illustrated by the Cone was identified as a key motivation for its use.

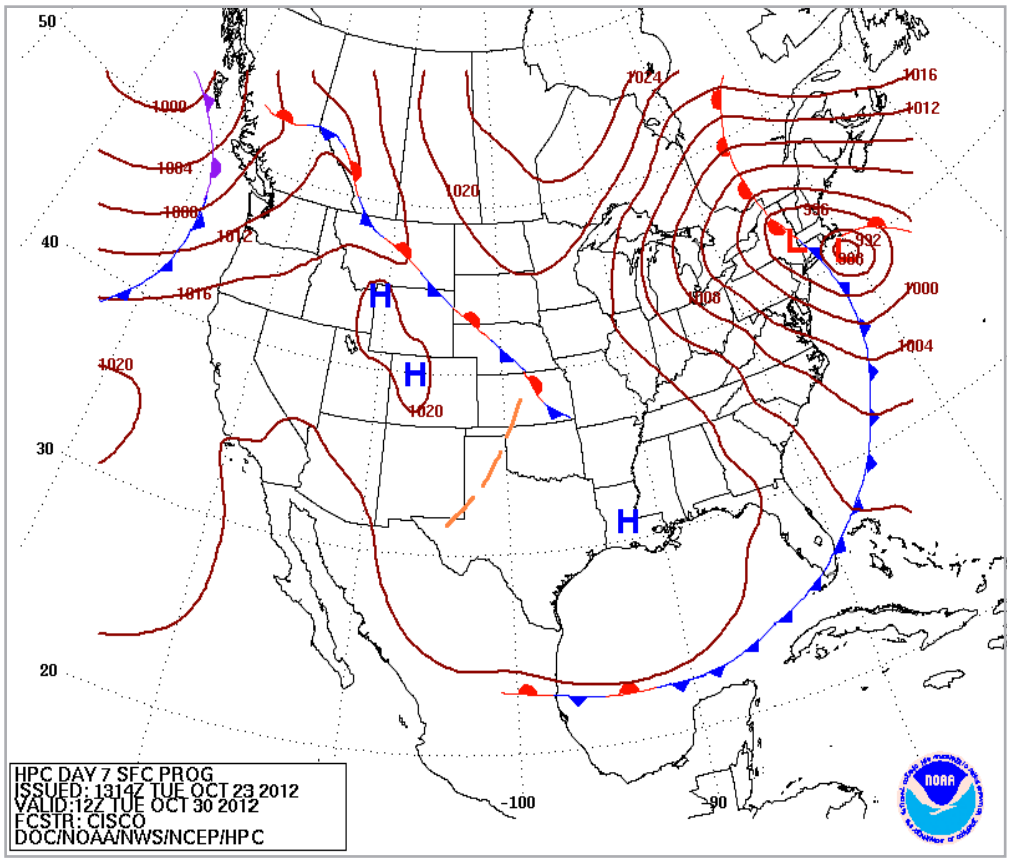
**Round 2 Discussion (Note: the Hurricane Cone was not selected for revision for Round 2 focus groups):**

All are aware of the Cone but some are still waiting —"it could head out to Sea." Others express concern about family in southern states who could be affected. One watches as a fisher: "Hurricanes in Florida make it worse for fishing in New Jersey." Another, a hospital worker, observes that by T-6, the hospital is in emergency mode. By T-4, the fact that the "the line" went to New Jersey elicits attention. Several are surprised to learn that the cone reflects a 67% probability. By T-2 and T-1, attention to the Cone is minimal. One participant notes, "By the time you know [this], you're screwed."

In surveys, most Round 2 respondents (75%) were aware of the Cone before the focus group and 85% ranked it as valuable or highly valuable. The remainder ranked it as somewhat valuable or of little value. Respondents appeared disposed to turn to the Cone at each day before landfall, with heaviest use at T-5, T-7, and T-4. No respondents would use it at T-1. Motivations for using the Cone cited by respondents include:

- Shows projected path of storm and local impacts
- Aid in planning/preparing
- Graphics
- Localized
- Availability
- Real-time updates

Graphic 7. Weather Prediction Center Surface Prognosis Map




## Weather Prediction Center Surface Prognosis Map (Shown Day T-6)

### Round 1 Discussion:

During Round 1, a series of surface prognosis maps (Graphic 7) was shown, highlighting a low pressure system moving up the coast. Among resident participants, most find the product confusing. One or two think it is potentially useful. One finds it noteworthy and alarming. Others are still watching and waiting.

In surveys, slightly more than half of Round 1 respondents (53%) were familiar with this product before the focus group. Most (71%) rated it as useful or somewhat useful; none rated it as very useful and 19% rated it as not very useful or not useful at all. Of 13 respondents who identified when they would consult this map, almost one third (31%) indicated day T-5. No respondents would use it on day T-3 and fewer than three would use it any of the other days. Asked what would motivate them to use the map, responses included:

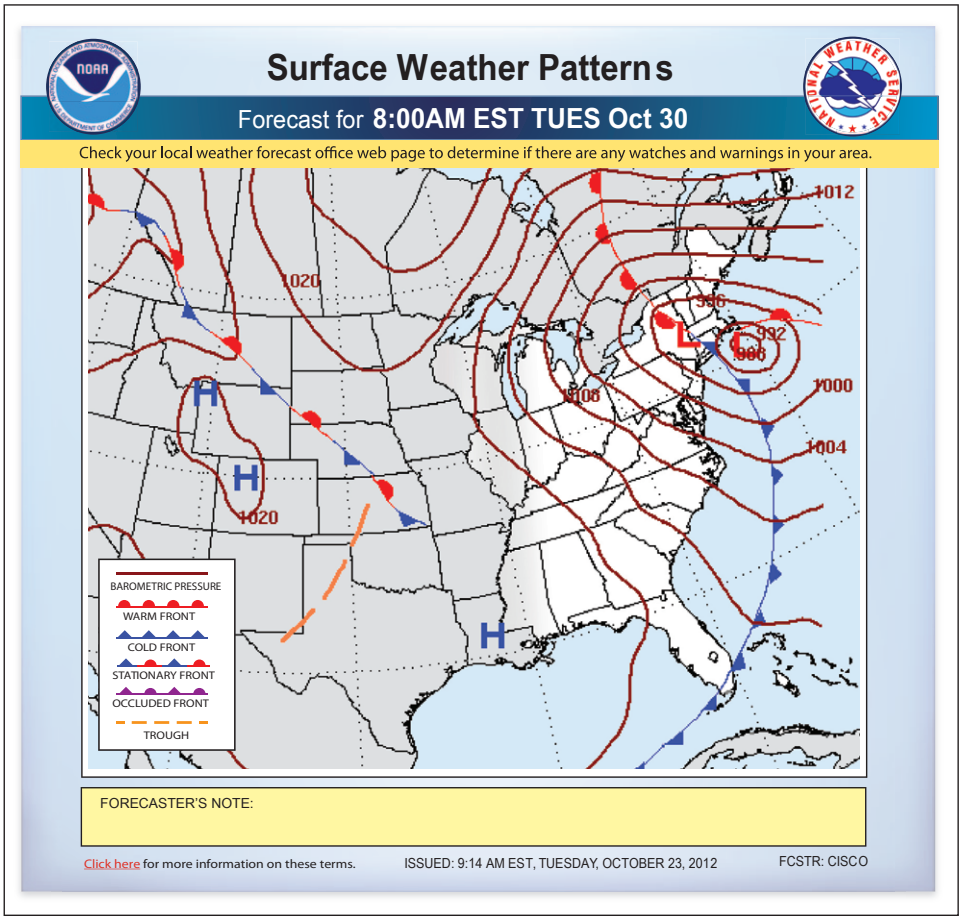
- If it were easier to understand (needs more information, better legend)
- Knowing the possible path of a storm
- If I were holding an outdoor event

### Emergency Personnel:

"We're going to have a good storm," notes one, who describes reaching out to coastal communities and looking for potential breaches in flood barriers, adding that these maps would be useful at T-7. One suggests they may be "tightening up preparations now" and another would send out notices to Nixle or Code Red "to make sure people start to watch. You don't want to wait to the last minute to evacuate." Another notes that the evacuation threshold is 72 hours. Shown the map again at T-4, one jokes, "I'm making sure I have enough M&Ms." The general conversation is about preparing for the storm—attending meetings, contacting officials such as the governor, and notifying communities. "We were getting hammered with texts and emails from the state and county," with information coming from state police and county EMs. "I lived on Hurrevac and the Internet," says one.

Nearly all Emergency Personnel respondents (86%) were familiar with this map. Most (57%) rated it from somewhat to highly valuable. Its greatest anticipated use was at T-7, and the sole expressed motivating factor for this product's use was the track of the storm.

**Graphic 8. Round 2 Surface Prognosis Map (renamed Surface Weather Patterns)**




**Round 2 Discussion (product renamed Surface Weather Patterns):**

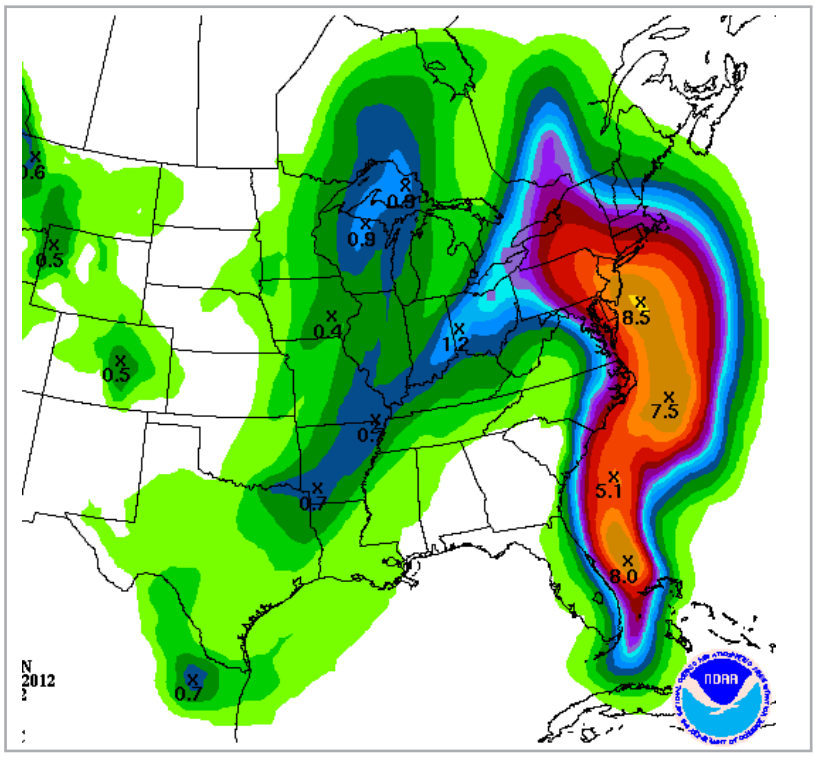
Several changes were made to the Surface Prognosis Map (Graphic 8) to enhance readability, including highlighting the geographic locale of focus and making the forecast date and time front and center. Logos of the source agencies were moved to the top and made consistent throughout all products. The name of the product was renamed more simply to "Surface Weather Patterns" and placed prominently at the top. A colored bar (yellow, orange, or red) under the forecast date indicates whether there is an advisory, watch, or warning in effect. The geographic area of the forecast is highlighted (white) to stand apart from the rest of the country but much of the rest of the country is still shown so that approaching fronts can be seen. Water was also colored to more easily distinguish features. An abbreviated legend of the most common fronts and those used in the current graphic is shown on the lower left and a box for a forecaster's explanatory note is added to the lower right (which can also be colored yellow, orange, etc.).

In discussion, some Round 2 participants were familiar with weather pattern maps but at T-6 found the maps were lost among the many scenarios shown. One says, "Now I know what those lines mean. How close they are together means the intensity of the wind and such." Another notes the high pressure to the west and suggests the storm could be pushed out to sea.

In surveys, most Round 2 respondents (75%) were aware of the Surface Weather Patterns product before the focus group and most (85%) also ranked it as valuable or highly valuable. The greatest number of respondents indicated they would use this product at T-5, followed by T-7 and T-4. None indicated they would use it at T-1 and fewer than three would use it at T-6 or T-2. Motivations for using this product include:

- Advance warning of what areas storm will affect
- Local impacts
- Graphics
- Credibility
- [Value in] planning/preparing
- Availability
- Real-time updates

**Graphic 9. Round 1 Precipitation Forecast Map**




### NWS Precipitation Forecast Map (Shown Days T-4, T-2 and T-1)

**Round 1 Discussion:**

One person says the NWS Precipitation Forecast Map (Graphic 9) "scares me—that's a lot of water." Another notes that an arrow points right at New Jersey. Several are taking into account which way the wind is coming from ("a south wind means a definite flood") and are aware that high tides may increase flooding. By T-2, one participant notes seeing the map on television. Most, however, are occupied with preparing for the storm.

In surveys, nearly all (94%) respondents were familiar with this map before the focus group. Most (76%) rated it highly or very highly valuable; the remainder (23%) rated it somewhat valuable. The greatest number of respondents (41%) would refer to the map five days before the storm; 18% would use it six days out. None would use it on days T-3 or 2; it could see slight use at T-7 and T-1. Motivations for using the map include:

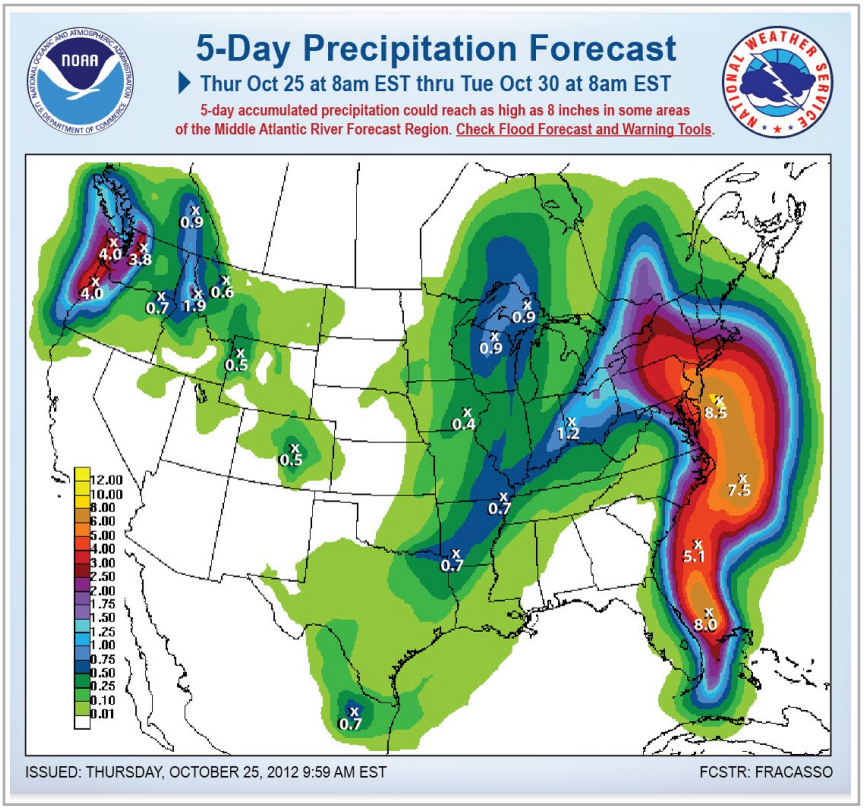
- Anticipating total precipitation
- Helps to anticipate/prepare for flooding
- Clearly showing the level and type of precipitation
- Ease of reading
- Local focus

**Emergency Personnel:**

"Without a doubt," participants are using all available products, translating messages for non-weather professionals. They offer suggestions for these products: "the more user-friendly, the better for everyone" and "use contour maps to show where elevations would be." One describes a new risk map put out by FEMA Region 2 that shows normal and projected water levels, indicated by color. "This would be the thing to show," says one: "It's simple." Others discuss how they compare information from different sources (Stevens Institute, FEMA, county "SLOSH model" maps) to establish minimum and maximum flooding projections, with a caveat that a 30 MB image loads too slowly. Some note that some people who evacuated for Hurricane Irene regarded Sandy warnings as "crying wolf" and did not evacuate.

In surveys, all emergency personnel respondents were familiar with this map. Almost all (83%) rated it as valuable or highly valuable; one rated it somewhat valuable. Three-quarters of respondents would use it at T-7. Product features that would motivate its use were its accuracy and [illustration of] impact areas.

**Graphic 10. Round 2 Precipitation Forecast Map (renamed 5-Day Precipitation Forecast Map)**




**Round 2 Discussion (product renamed 5-Day Precipitation Forecast Map):**

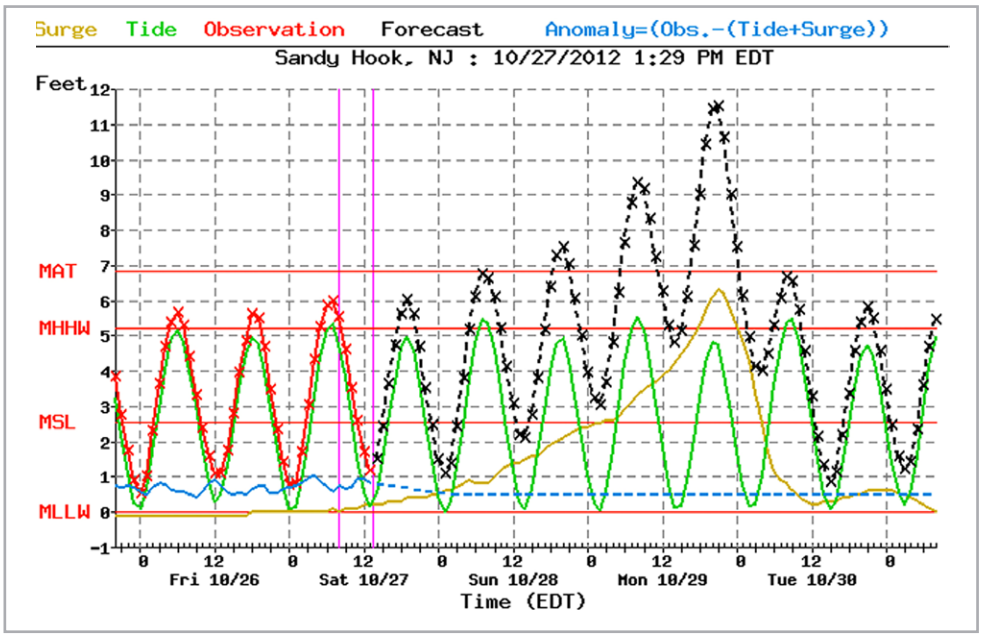
Similar to the Surface Prognosis Map, the top of the Precipitation Forecast Map (Graphic 10) was made consistent to other revised products with the source agency logos, a clear map title renamed to clarify that it is a 5-day forecast, and the dates of the forecast front and center. A brief one-sentence summary under the title and date gives the main take-away message and location (i.e., 8 inches of rain in the Middle Atlantic River Forecast Region) and links to other forecast tools of interest, such as the hydrograph. On the map itself, the numbers and X symbols of those readings were made easier to read in all color ranges by super-imposing white over black to create contrast instead of the black originally shown (which was difficult to read on top of darker colors). Additionally, the key for the colors and rain quantities is included on the lower left of the map. At the bottom is the date the forecast was issued and the name of the forecaster who issued it.

In discussions, this product was not familiar to most participants before Sandy. One recalls that "we were still thinking Irene," and except for one participant who had a family member professionally involved in weather who warned, "This one is not hype" and advised to be emotionally prepared for devastation, others are recalling that they didn't do much at this stage. "I think I'll pay attention now," says one. By T-1, one participant exclaims, "Hell yes, this would be useful!" Others have already made plans by this time. "You're done," says one person. "I'm talking to people, making sure everyone is safe," says another. Concedes one, "My river never came up this high before. …I've never seen anything like it before." Another notes, "[This] would be helpful…if they didn't give me ten alternatives. I live in a blue-collar area. Show me what 8 inches of rain looks like."

In surveys, slightly more than half of respondents (55%) were familiar with this precipitation forecast map before the focus group. Most (80%) rated it as valuable or highly valuable. The greatest number of respondents would refer to this map at T-5 and T-4. Motivations respondents cited for using the map include:

- [Valuable for] planning; shows impacts
- Local/state map (not all US)
- Graphics
- Availability
- Prior accuracy

**Graphic 11. Extratropical Surge Forecast Map**




## Extratropical Surge Forecast (Shown Days T-4, T-2)

**Round 1 Discussion:**

Participants express bafflement on viewing the Extratropical Surge Forecast Map (Graphic 11). Although there is a general sense that tidal flooding will occur, participants struggle to understand the graph even after it is explained. One suggests it is "raw data" while others note that they don't know how to interpret the x marks. Terms such as "mean higher high water" need definition and clear legends are critical. One notes that the wind direction is more critical than tide levels, because flooding occurs with winds from the south but not from the north.

By T-2, one participant says, "This changes my thought." Another adds, more bluntly: "That's a 'holy shit!' for me." Several call for more specific information: "The reference point is 2-3 feet above normal," asserts one, "99% of people don't know what normal is and how to translate that into 11 feet," noting that 11 feet is high anywhere on the Jersey Shore. Others are very concerned about 11 or 12-foot high waves. "Obviously this is worse than the prediction of the T-4 map," says one person, and another counters, "Who cuts these maps out… and compares them? Nobody. Write it down, tell people, and not in science terms, what it means to where you live."

In surveys, although only one third (35%) of respondents had seen this forecast product before, most (82%) rated it as somewhat valuable, valuable, or highly valuable. Anticipated interest in using the forecast peaked at T-7 and T-5 (29%). No respondents anticipated using it during T-3, T-2, or T-1. Despite its being rated as valuable, positive response to this product was scant. Most respondents indicated they would not use it—it was "too technical," more useful to emergency personnel, or they would need additional information to use it. The sole motivation named was "good predictor of storm conditions."

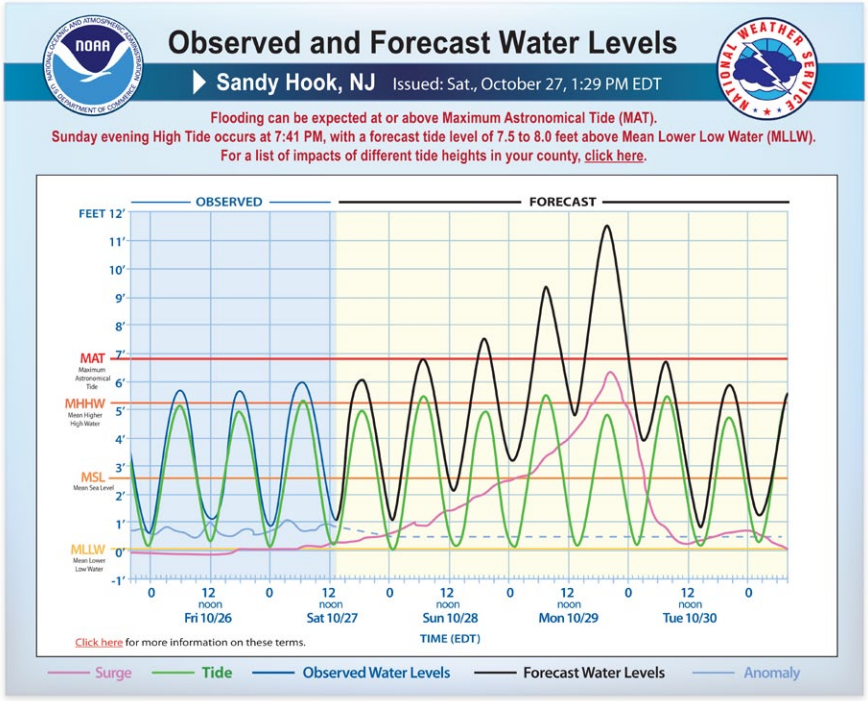
**Emergency Personnel:**

In surveys, most (80%) were familiar with the Extratropical Surge forecast before the focus group. All responding rated it as valuable. Times of anticipated use were T-7, T-5, T-4, and T-2.

**Round 2 Discussion (product renamed Observed and Forecast Water Levels)**:

The Extratropical Surge Graphic was one of the most significantly modified products (Graphic 12), due to its importance in understanding flooding risk and the high degree of visual "noise" contained in the original. The top panel was made consistent with other revised products: source agency logos at the sides, a prominent and renamed title, and a banner highlighting the location and date issued. Since there was concern that the public would not readily seek out "Extratropical Surge" or understand its meaning, the title was changed to a more intuitive "Observed and Forecast Water Levels." A summative short sentence in red was included under the location/time banner to quickly alert the viewer of the main take away message (flooding expected at Maximum Astronomical Tide [MAT]), as well as a link to impacts for the specific location.

**Graphic 12. Round 2 Extratropical Surge Forecast Map (renamed Observed and Forecast Water Levels)**




The graph itself was demarcated as observed or forecast so that it was clearly labeled what are actual measurements of the water levels versus what are projections for the future and the risk for flooding. Forecasted levels are highlighted with the white region compared to the shaded blue region of the observed. To reduce visual noise, the symbols along the lines were removed and the hatched background grid was made solid and muted. The observed water level line was changed from red to blue due to possible confusion of red as warning/danger sign. The surge line was made a purple color to make it stand out more. The MAT line was made darker and thicker due to its importance for flood risk. The labels for the different water level thresholds (such as MAT) were included under each symbol on the left of the graph. The y-axis number labels of feet were marked with the foot symbol for further clarification and the x-axis time labels were clarified with the date and "noon." A link included at the bottom enables viewers to learn more about the terms included on the graph. The legend was made more obvious and placed under the graph with colored lines and labels instead of just the text labels.

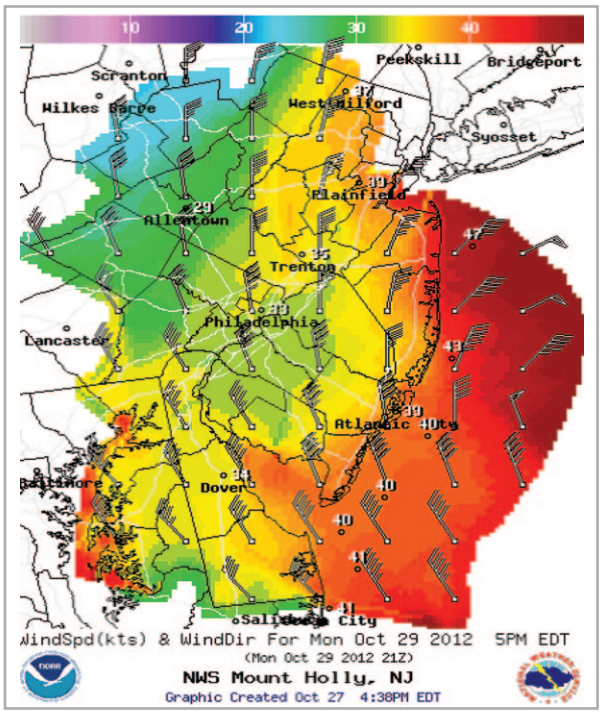
In discussions, confusion about interpreting the graph remains. Although a couple of participants note that the graph means things are getting worse—"if you live right on the water, it tells you you are going to be living in the water if you're not careful"—others maintain they don't know what it means. One participant proposes creating a map or chart of the area on which the graph data could be superimposed to identify "where 5 feet will be, here is where 6 feet will be… this goes right over my house! That will get your attention."

By T-2, the graph evokes some laughter as participants grasp the severity and immediacy of the storm. "It looks really nasty," says one; "Now it's really scary. The other [earlier version] said 7 feet and now they're saying 12." Several note they will use this product in the future: "We learned what 12 feet [of tidal surge] looks like" and will pay attention. Another wonders whether people will know what that level looks like in the future. There is some discussion about the fact that they didn't realize how far upstream the tidal waters would go.

In surveys, just under half (47%) were familiar with this product before participating in the focus group. Nearly all (90%) rated it as valuable or highly valuable. Of 18 respondents who indicated on which days they were most likely to refer to the product, most said T-5 and T-4. No one identified T-1 as a day to refer to the product; its anticipated use at T-7 and T-6 was minimal. Motivations noted for using it include:

- Concern over where flooding is
- Local; Impact on my area
- Evacuation
- Graphics
- Availability
- Showing MLLW, flood stages, storm surges

**Graphic 13. Wind Speed/Direction Forecast Map**




### Weather Forecast Office Wind Speed/ Wind Gust Forecast (Shown Days T-2, T-1)

**Round 1 Discussion:**

At T-2, all are paying attention now, yet participants find the barbs on the Wind Speed/Wind Gust Forecast Map (Graphic 13) confusing and suggest the wind speed be noted in mph rather than knots.

By T-1, although they note the use of the color red to indicate danger is good, participants still find the map confusing: "The flags are misleading." "This is too busy with the symbols and interpretation, [show] a couple of arrows." There is discussion about coastal and inland impacts. Some people call again for visual demonstrations of wind or storm impacts. Confusion remains about the wind barbs and knot speed. One says, "I want time frames, tide times, and rainfall numbers;" another notes the importance of the moon on tidal flooding. One describes the fire department knocking on the door and warning that "if you stay you're on your own." (They left.) Most are also preparing to leave. At the same time, there is concern about media treatment of the storm—"television overdoes it," and "I tune it out."

In surveys, two thirds of respondents (67%) were familiar with the maps before the focus groups. More than half (53%) rated the map as highly or very highly valuable, and 30% rated it as somewhat valuable. The remaining respondents rated it as not very valuable or not valuable at all. Nearly one third (29%) would refer to these maps at T-5 and 24% would use it at T-4. A small percentage (15%) indicated they would use it T-7 and T-1; none would use it at T-3 or T-2. Reasons cited for using these maps include:

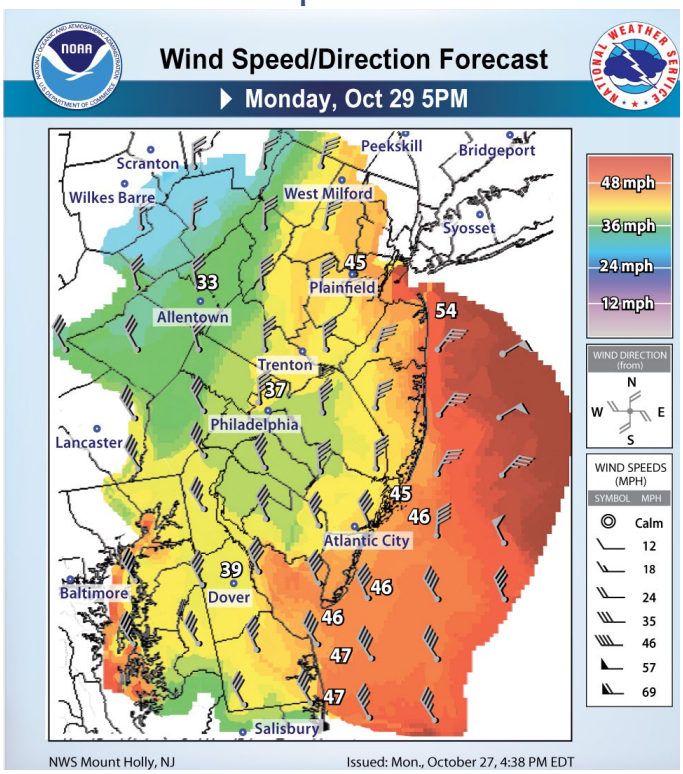
- High wind warning would make me secure home/ prepare the outside.
- Local maps clearly show wind impact—speed and direction of winds.
- The color is great and easy to use.
- Would only use it as the storm got closer.
- Not very motivated by that format—would like the information, but presented differently.

**Emergency Personnel:**

At T-4, one describes how wind forecasts help them understand how much water will "pile up" and for how long, noting that wind direction affects the likelihood of floods. One participant notes that old-timers in the Raritan Bay know to look at wind and weather forecasts, but the majority of residents are new and "have no idea what's going on" and questions whether the wind direction means anything to them.

In surveys, all respondents were familiar with these maps and all rated them as valuable or highly valuable. None would use it after T-3.

**Graphic 14. Round 2 Revised Wind Speed/Direction Forecast Map**




**Round 2 Discussion:**

With the Wind Speed and Direction Forecast Map (Graphic 14), the top panel was made similar to other revised products with source agency logos bracketing a clear title and a prominent banner indicating the date and time of the forecast. The colors indicating the wind speed were slightly muted to make the labels easier to distinguish and the city names backlit with white to further reading ease. The wind speed symbols were made gray with black shadows to reduce visual clutter. Importantly, the color key bar was moved from horizontal to a short vertical bar to the right side of the map. The numbers in the key are noted with the unit (revised to mph rather than knots, which confused Round 1 participants) to differentiate and distinguish this map from the temperature map which had a similar color key but was in degrees Fahrenheit. Legends for the wind direction and speed are included below the color key and symbols explained. A compass indicating direction the wind is coming from helps the reader to better understand these complex symbols. Location and date issued are included at the bottom of the graphic.

In discussions, this product appeared confusing until it was interpreted for participants. Despite modifications to simplify them, the barbs/flags still seem unnecessarily complex: "Simplify it. Just show the [wind directional] arrow" was a common suggestion. The color red catches people's attention. By T-1, most say they are packing by now and talking to many people. "We were talking to so many people we went way over our minutes. People were burning up the wires." Talk is mostly about whether to stay or go. Others are stocking up on flashlights, batteries, and matches. The Weather Channel and weather radio are the primary sources of information; Facebook and other social media are consulted and frequently used to "push" information out to others. Discussion returns to the topic of hype. "It's Hollywood…You don't trust it," says one. A couple of participants call for something more scientific or technical. Scientists, police, and emergency personnel are named as trustworthy sources.

In surveys, more than half (53%) of respondents were familiar with wind speed and gust forecast maps before the focus group. Of 19 respondents, 79% rated the maps as valuable or highly valuable. The majority indicated they would use the maps at T-5, followed by T-4, T-3, and T-2. No respondents indicated use at T-1 and anticipated use at T-7 and T-6 was minimal. Motivations for using the maps include:

- Impact on our area, particularly trees and power lines
- Availability
- Accuracy
- Wind effect on flooding

## NWS Coastal Flood Watch/Flood Warning (Watch shown T-2, Warning Shown T-1)

### Round 1 Discussion:

With the high surf advisory, attention is strong and fears about flooding emerge. Some are planning to safeguard household goods; one or two are preparing to leave. Others characterize the products (Graphic 15) as "old school," alienated by the use of all capital letters. They concur that critical information should appear at the top, particularly because one participant notes that coastal flooding occurs 365 days a year so a specific directive for extreme conditions is needed.

In surveys, nearly all respondents (94%) were familiar with watches and warnings before the focus group. A majority (59%) of respondents rated the products as highly valuable; the remainder (41%) judged them as valuable or somewhat valuable. Interest in using these products peaked on T-5 (35%) and again at T-1 (17%). Reasons cited for the products' value include:

- [They show] area & expected severity of floods
- High risk of flooding in my area, so I look for this
- Appreciate/feel greater sense of urgency when watch turns to warning
- [Useful for] planning ahead for travel, in storm situation for potential evacuation
- Clear language with specifics to local area
- The scale is easy to understand

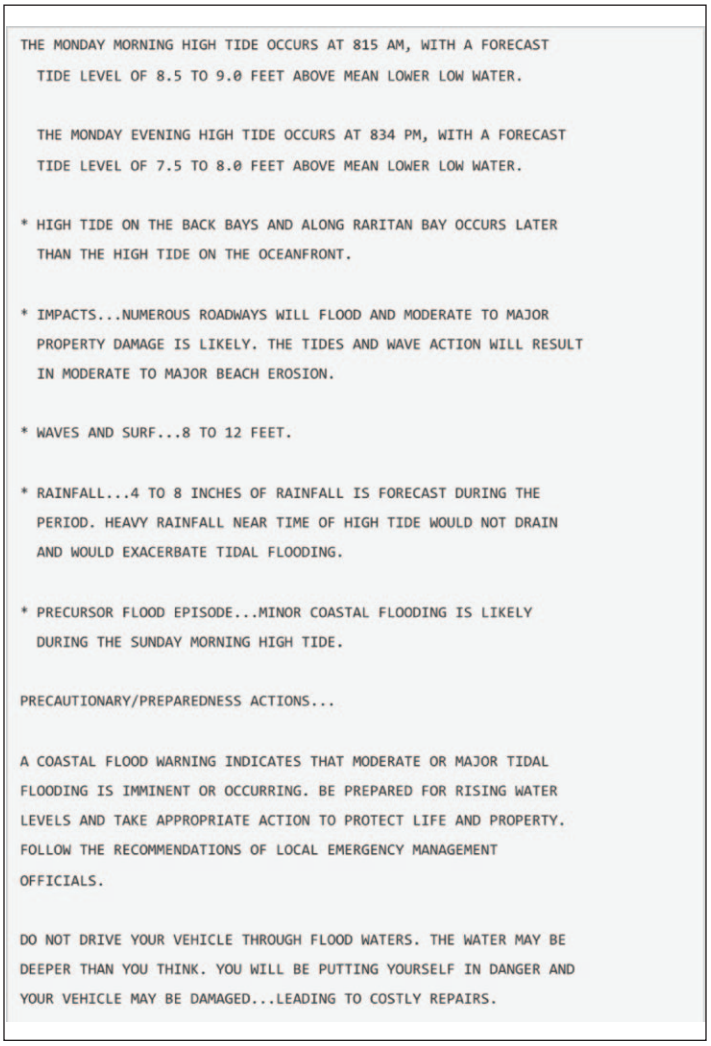
### Emergency Personnel:

All were familiar with the watches and warnings. Of three emergency personnel responding, all rated it as valuable or very valuable; each would use the watches and warning at a different time: T-7, T-6, T-5, T-4, and T-2.

### Round 2 Discussion:

Because the Coastal Flood Watch and Warning products were seen to be monotonous and text heavy, they were revised to be shorter, less dense, have prominent action steps, and varied text emphasis (Graphic 16). Significant information was called out in bold red text and affected areas clearly identified. The date and time of the watch/warning was made bold and placed front and center with either an "Act Now" or "Prepare Now" statement at the top with a brief summary of the main take-away message and threat. To break up the monotony of the text, sections

**Graphic 15. NWS Coastal Flood Watch/Flood Warning**



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THE MONDAY MORNING HIGH TIDE OCCURS AT 815 AM, WITH A FORECAST
  TIDE LEVEL OF 8.5 TO 9.0 FEET ABOVE MEAN LOWER LOW WATER.

  THE MONDAY EVENING HIGH TIDE OCCURS AT 834 PM, WITH A FORECAST
  TIDE LEVEL OF 7.5 TO 8.0 FEET ABOVE MEAN LOWER LOW WATER.

* HIGH TIDE ON THE BACK BAYS AND ALONG RARITAN BAY OCCURS LATER
  THAN THE HIGH TIDE ON THE OCEANFRONT.

* IMPACTS...NUMEROUS ROADWAYS WILL FLOOD AND MODERATE TO MAJOR
  PROPERTY DAMAGE IS LIKELY. THE TIDES AND WAVE ACTION WILL RESULT
  IN MODERATE TO MAJOR BEACH EROSION.

* WAVES AND SURF...8 TO 12 FEET.

* RAINFALL...4 TO 8 INCHES OF RAINFALL IS FORECAST DURING THE
  PERIOD. HEAVY RAINFALL NEAR TIME OF HIGH TIDE WOULD NOT DRAIN
  AND WOULD EXACERBATE TIDAL FLOODING.

* PRECURSOR FLOOD EPISODE...MINOR COASTAL FLOODING IS LIKELY
  DURING THE SUNDAY MORNING HIGH TIDE.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

A COASTAL FLOOD WARNING INDICATES THAT MODERATE OR MAJOR TIDAL
FLOODING IS IMMINENT OR OCCURRING. BE PREPARED FOR RISING WATER
LEVELS AND TAKE APPROPRIATE ACTION TO PROTECT LIFE AND PROPERTY.
FOLLOW THE RECOMMENDATIONS OF LOCAL EMERGENCY MANAGEMENT
OFFICIALS.

DO NOT DRIVE YOUR VEHICLE THROUGH FLOOD WATERS. THE WATER MAY BE
DEEPER THAN YOU THINK. YOU WILL BE PUTTING YOURSELF IN DANGER AND
YOUR VEHICLE MAY BE DAMAGED...LEADING TO COSTLY REPAIRS.
```

for affected areas, description, impacts, action, and tides and/or seas are clearly labeled. This combined with indent variations and contrasts between bold, plain, and colored text allows the eye to pick up the critical components of the message.

In discussions of watches, participants report receiving watches via email from county EM and Weatherbug texts. The density of text is daunting to some, particularly for reading on a smart phone. For at least one, constant notices are annoying: "If you're working, you don't have time to read it all." Others want more specific information—how deep floods are predicted to be, and focused on one county rather than two.

Concerning warnings, participants expressed that the words "Act Now" (included in the headline of the revised warning) command attention. "Those words do it," says one person."

"You've got to get it together," says another. There is mention of the threat of rip currents as well as some discussion of the effectiveness of the use of all caps and the length of the message. Governor Cuomo's plea, urging people to leave and not put emergency workers at further risk is compelling. "That's what hit me," says one, "You'd be an idiot not to think it's going to hit." Many have evacuated; a few plan to weather the storm at home: "You open a bottle of wine." Participants describe ongoing conversations and information-seeking: "It was the topic of every conversation," says one. Another, who identifies as a boater, says "You understand what water can do. They [other people] have no clue." Several raise the threat of flooded sewer lines.

In surveys, most respondents (79%) were familiar with the NWS watches and warnings before the focus group and ranked the watches and warnings as valuable and highly valuable. The greatest number of respondents anticipated using them at T-3. Other anticipated uses were at T-7, T-5, and T-4. Use at T-6 and T-2 were minimal; no one anticipated using the watches and warnings at T-1. Motivations cited for using it include:

- Evacuation
- Area of concern; rain level; wind speeds
- Impact on loved ones
- Availability
- Levels of water & flooding that would impact creeks and sewers in my area

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**Graphic 16. Round 2 Revised NWS Coastal Flood Watch/Flood Warnings**

****COASTAL FLOOD WATCH: PREPARE NOW****

Issued 6:47 AM, Saturday, Oct. 27, 201
By NWS Mt. Holly, NJ WF

• **IN EFFECT THROUGH MONDAY AFTERNOON**, for coastal areas, including Delaware Bay and the Tidal Delaware River. A coastal flood watch means conditions are favorable for development of moderate or major coastal flooding.

• **AFFECTED AREAS INCLUDE**: New Castle; Kent; Inland Sussex; Delaware Beaches; Mercer; Salem; Gloucester; Camden; Northwestern Burlington; Montgomery; Bucks; Delaware; Philadelphia.

****DESCRIPTION: Moderate to Major Coastal Flooding is anticipated within 2 to 3 hours o either side of the High Tides on Sunday evening and again Monday morning to midday.****

**IMPACTS:**
• **Long duration tidal flooding** and probable road closures and damage where water encroaches on parking lots and buildings.
• **Considerable damage to beachfront properties** is possible from over-wash from seas (storm surge?).
• **Major river flooding possible**: Rainfall of 4 to possibly 8 inches by Monday will add to the local stream flow on the tidal Delaware.
• For a list of impacts from different tide heights in your county, please go to www.weather.gove phi/tides.htm.

**ACTIONS:**

• Pay close attention to forecasts and statements and take actions to protect life and property.
• Follow directions from local emergency management officials.
• Follow complete forecast at weather.gov/phi. Follow emergency briefings, which will contain more information about impacts and actions.

**TIDES:**

• **At Lewes, DE**, the times of high tide are 8:38 pm Sunday and 8:55 am Monday.
• **At Reedy Point, DE**, the times of high tide are 11:11 pm Sunday and 11:11 am Monday
• **At Philadelphia**, the points of high tide are 1:38 am Sunday and 2 p.m. Monday

**SEAS:**
• Along the Atlantic Ocean Side of Delaware, seas will be 15 to possibly 20 feet
• In the Lower Delaware, seas will be 6 to 10 Feet
• In the Upper Part of the Delaware Bay, seas will be between 2 to 4 feet

**ADDITIONAL INFO:**
• Duration: Moderate or greater tidal flooding may last 3 to 5 hours during high tide cycle
• Precursor flood episode: minor coastal flooding is likely during Sunday morning to midday high tide, but that will be dwarfed by what follows Sunday night and Monday

****COASTAL FLOOD WARNING: ACT NOW****

Issued 5:08 p.m. EDT Saturday, Oct. 27, 2012
By NWS Mt. Holly, NJ WFO
URGENT - IMMEDIATE BROADCAST REQUESTED

• **IN EFFECT FROM 4 PM SUNDAY to MIDNIGHT EDT MONDAY**, for the Atlantic Coast of New Jersey. A coastal flood warning means coastal flooding is occurring or imminent. A High Surf Advisory has also been issued, in effect until 6 PM EDT Tuesday.

• **AFFECTED AREAS INCLUDE**: ATLANTIC COAST OF NEW JERSEY.

****DESCRIPTION: Major coastal flooding is forecast for the Monday morning high tide. Moderate coastal flooding is forecast for the Sunday evening and Monday evening high tides. Serious threats to life and property can be expected.****

**IMPACTS:**
• **numerous roadways will flood** and **moderate to major property damage is likely**.
• **Moderate to major beach erosion** from tide and wave action
• **Life threatening rip currents are possible**. A high surf advisory means high surf will affect beaches.
• **Waves and Surf of 8 to 12 feet**
• Heavy rainfall of 4 to 8 inches forecast during this period will exacerbate tidal flooding
• Minor coastal flooding is likely during the Sunday morning high tide; this is a precursor event to the major flooding
• For a list of impacts from different tide heights in your county, please go to www.weather.gov/phi/tides.htm.

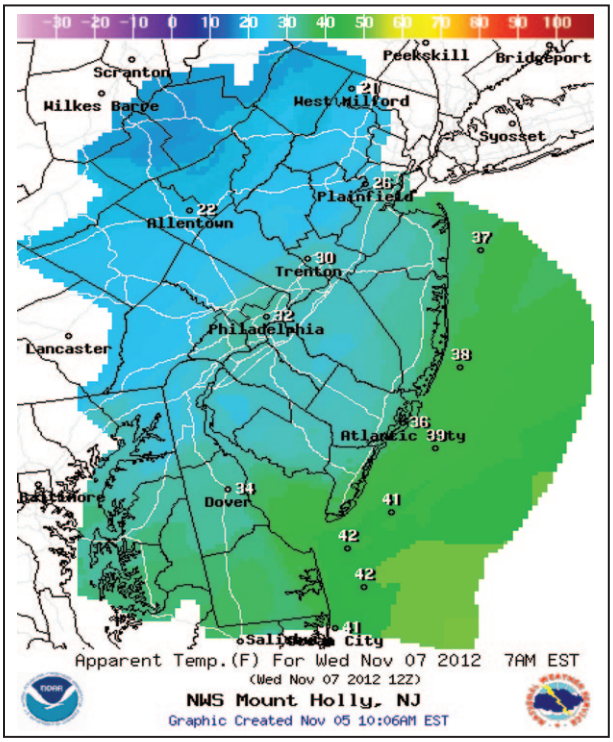
**ACTIONS:**
• Be prepared for rising water levels.
• Take actions to protect life and property.
• Follow recommendations and orders from local emergency management officials. Evacuate if told; do not delay and cause dangerous rescue situations for emergency personnel.
• Do not drive your vehicle through flood waters. The water may be deeper than you think and you can put yourself and others in serious danger and cause costly repairs to your vehicle.
• Follow complete forecast at weather.gov/phi. Follow emergency briefings, which will contain more information about impacts and actions.

**TIDES:**

• **At Sandy Hook, NJ** (Sandy Hook Bay)
….the Sunday evening tide occurs at 7:41 p.m., with a forecast tide level of 7.5 to 8 feet above mean lower low water.

*NOTE:* Round 1 focus groups included presentations of additional briefings related to a secondary snow event that followed on the heels of Superstorm Sandy, complicating the area's recovery from that storm. The following two products (Temperature Forecast Map and Low Tracks Ensemble) were included in those additional briefings but not contained in the Sandy briefings or scenario. Based on findings from Round 1, the research team opted not to show these secondary briefings during Round 2. Because these particular products are sometimes used in emergency briefings related to coastal flooding, however, participant feedback from Round 1 is shared here for general information purposes.

### Graphic 17. Temperature Forecast Map




## NWS Temperature Forecast Map (shown in Round 1 briefings only)

**Round 1 Discussion:**

Most respondents (82%) had seen the NWS Temperature Forecast Map (Graphic 17) before the focus group. Nearly half (47%) rated it somewhat valuable, while 18% rated it as valuable and 24% rated it of little or no value. It was suggested that if the legend were better labeled, it would be more readable. Respondents were most likely to turn to the map at days T-7, T-6, and T-5, indicated by 35%, 18%, and 24% respectively. Reasons for using the map include:

- Easy to read
- To be prepared for cold
- Useful in a predicted extreme event; temp would influence danger
- Knowing wind chill helps prepare

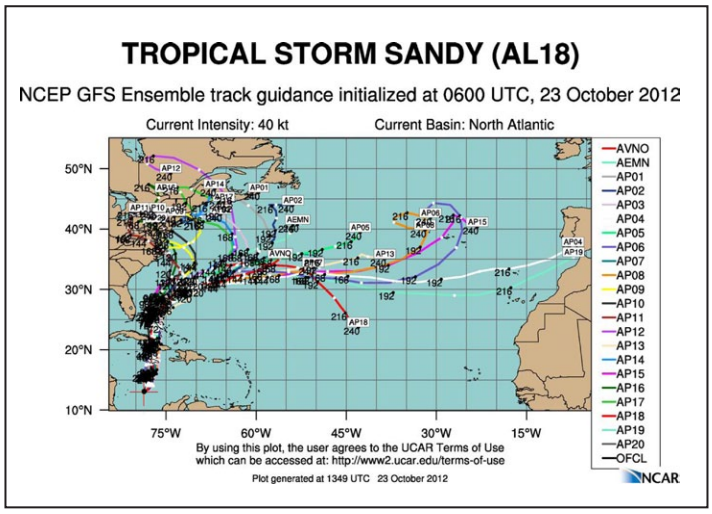
**Emergency Personnel:**

All emergency personnel responding were familiar with this map and all rated it as valuable. Most (60%) would use this map at T-4. None would use it at T-7, T-6, or T-1. Motivations cited for using it were its accuracy and local data.

**Round 2 Discussion:**

NA (not shown).

### Graphic 18. Low Tracks Ensemble Product




## NWS Low Tracks Ensemble Product (shown in Round 1 briefings only)

**Round 1 Discussion:**

Most (88%) were unaware of the Low Tracks Ensemble Product (Graphic 18) until the focus group and 82% rated it from moderate to very high value. Although there was slight interest in this product's storm predictive value, comments on the whole were negative:

- OEM would benefit more from this
- Too technical: what does this even mean?
- I would require more information as to how to use
- Wouldn't use
- Not very useful
- Repeats info on other maps

**Emergency Personnel:**

Most (80%) were familiar with this product. Of three emergency personnel responding to this product, all found it somewhat valuable or valuable. No one noted a motivation for its use.

**Round 2 Discussion:**

NA (not shown).

## OTHER SURVEY FINDINGS

In addition to asking specific questions about the products, the post-session surveys inquired about other issues related to participants' use of coastal flood forecast products. Following are responses from those questions.

### Barriers to Using NWS Products

**Round 1 Respondents:**

More than half (53%) cited difficulties due to lack of explanations for graphs, maps, and figures. Other concerns related to overly technical language and features, an outdated "look," lack of connection to their specific neighborhood or street, time lags between briefings, and concern about the "actual accuracy" of products. A few also mentioned power outages.

**Round 2 Respondents:**

The most common responses were difficulty interpreting the data, knowing about and/or finding NWS products, and lack of access to a computer or smartphone. Other responses included loss of power, a lack of localized information, difficulty navigating the NWS website, and a concern about the reliability of NWS forecasts. In the context of responding to individual products, one Round 2 respondent noted that, with climate change increasingly accepted and rapid technological advances, "I'm going to be more willing to trust you [i.e., NWS]. When you tell me there is going to be a surge, it's going to happen."

**Emergency Personnel**:

Respondents expressed concern about interpreting the data and felt the information should be "extrapolated" into lay terms.

### Preferences for Information Delivery

**Text vs. Graphics**

Majorities in all three groups preferred a 50-50 balance of text to graphics. Overall, 48% of respondents in all three groups (44 total) preferred a balance of both elements; one-third (34%) preferred a graphics to text ratio of 75% to 25%, while 11% preferred text to graphics in the opposite ratio—75% text to 25% graphics, and 7% preferred 100% graphics (Table 4).

**TABLE 4: Preferred Balance of Text and Graphics**

| SOURCE | ROUND 1 RESPONDENTS | ROUND 2 RESPONDENTS | EMERGENCY PERSONNEL |
|---|---|---|---|
| 25% graphics | 18% | 10% | 14% |
| 50% balance | 47% | 45% | 57% |
| 75% graphics | 35% | 35% | 28% |
| 100% graphics | 0% | 15% | 0% |

### Anticipated Time of Product Use

To illustrate what products were preferred when, Figures 13-15 below show the percentage of respondents who indicated the days prior to landfall on which they were most likely to access each individual NWS product. The most notable finding illustrated by these figures (Figures 13 and 14) is that residents' anticipated use of most products was highest at T-5, followed by T-7. This suggests that T-5 may be an optimal day for making NWS products widely available. While there are slight differences between Round 1 and Round 2, the Extratropical Surge maps, briefing package, and precipitation maps are highly preferred.

Emergency personnel (Figure 15) showed a strong preference for advance warning (T-7 or more) of most products and then peak interest in the Track Forecast Cone at T-5, the temperature map at T-4, and the briefing package at T-3.

When considering all products together, preference for information was highest at T-5 in both Rounds 1 and 2 (Figure 16), while emergency personnel had the highest preference at T-7, followed by T-5 and T-3 respectively.

**Figure 13.**
**Percentage of Round 1 Respondents Using Each NWS Product at Each Scenario Day Leading Up to the Storm Event**

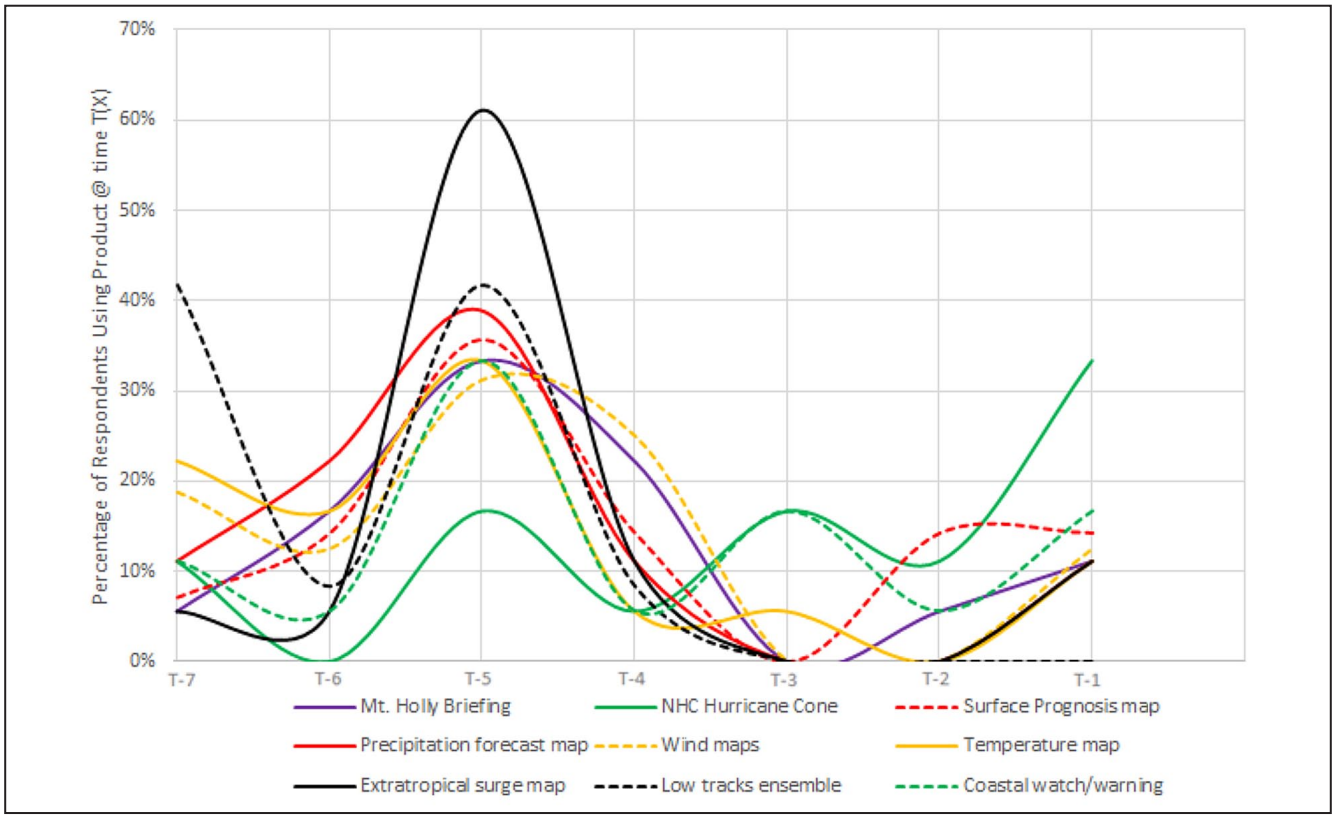



**Figure 14.**
**Percentage of Round 2 Respondents Using Each NWS Product at Each Scenario Day Leading Up to the Storm Event**

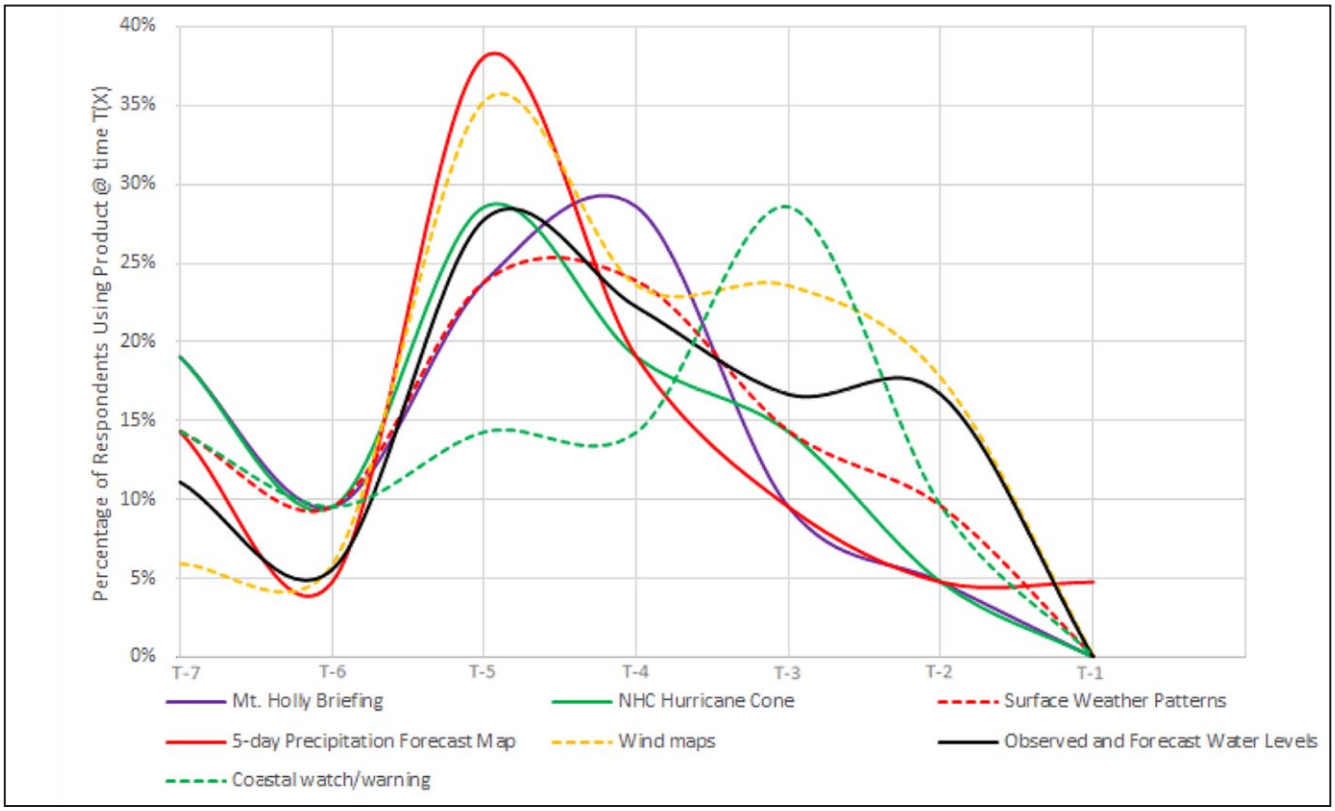


**Figure 15.**
**Percentage of Emergency Personnel Using Each NWS Product at Each Scenario Day Leading Up to the Storm Event**

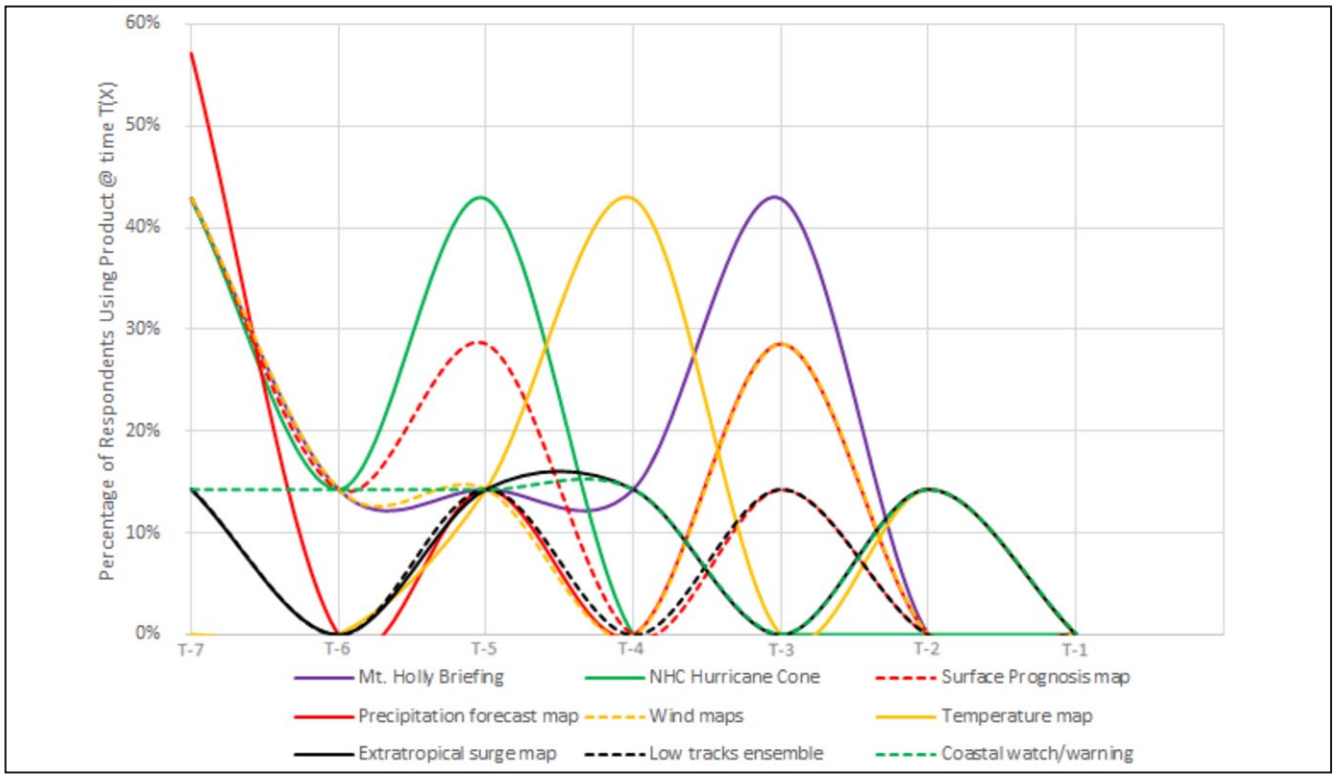
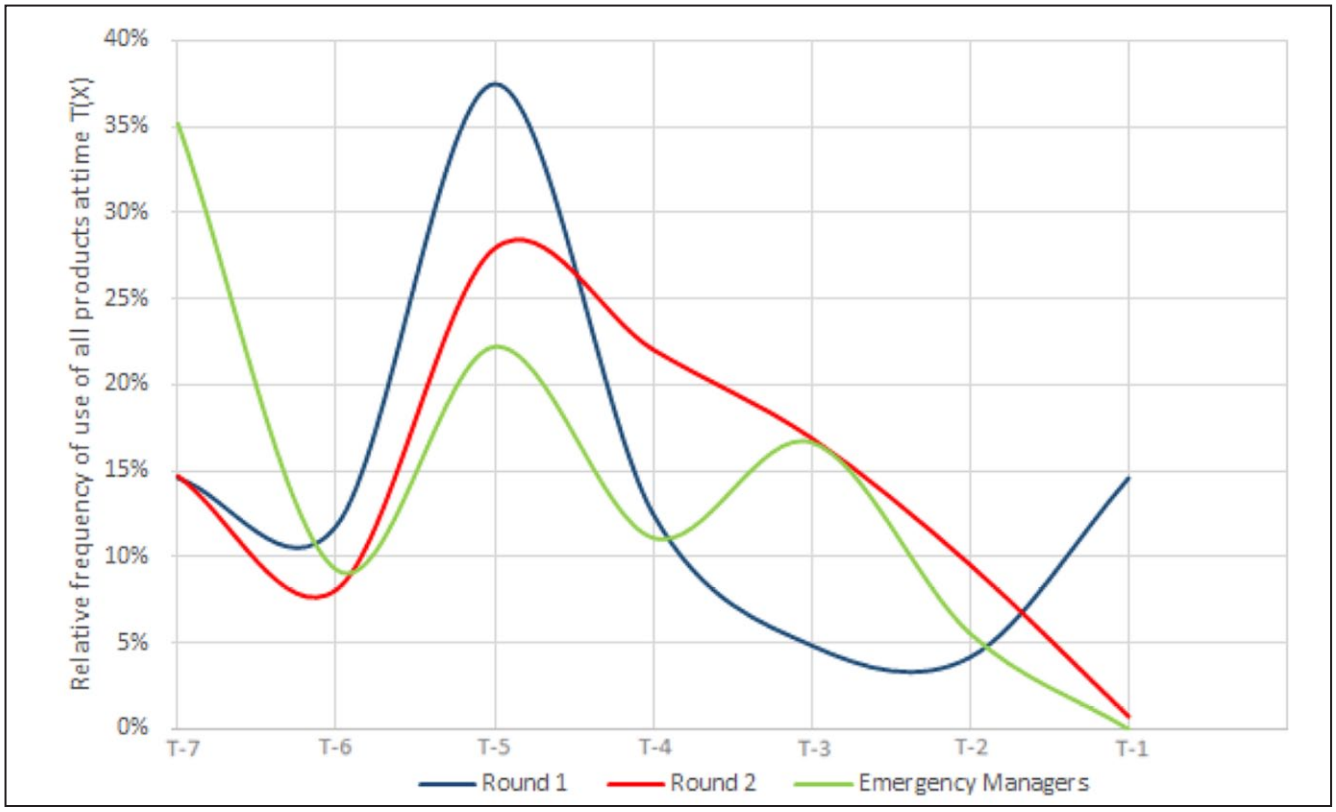



**Figure 16. Preference for All Products Over the Course of the Storm Comparing Round 1, Round 2, and Emergency Personnel Respondents.**



## Social Media and Extreme Weather

Asked about their preferences among social media, respondents often named more than one medium. Overall, respondents preferred Smartphone apps over Twitter or Facebook as information sources about extreme weather. A small number (<3 respondents) cited "other" information preferences in connection with information about impending weather hazards: text alerts, Boat US, and police blotter (Table 5). Reverse 911 was included among these "other" sources for information about preparing for weather hazards (Table 6).

**Table 5: Social Media Preferences for Learning about Weather Hazards**

| SOCIAL MEDIA PREFERENCES: | ROUND 1 RESPONDENTS | ROUND 2 RESPONDENTS | EMERGENCY PERSONNEL |
|---|---|---|---|
| Facebook | 82% | 16% | 71% |
| Smartphone Apps: TWC, Accuweather, wunderground | 59% | 84% | 86% |
| Twitter | <3 | <3 | <3 |

**Table 6: Social Media Preferences for Learning How to Prepare for Weather Hazards**

| SOCIAL MEDIA PREFERENCES: | ROUND 1 RESPONDENTS | ROUND 2 RESPONDENTS | EMERGENCY PERSONNEL |
|---|---|---|---|
| Facebook | 59% | 21% | 57% |
| Smartphone Apps: TWC, Accuweather, wunderground | 29% | 68% | 86% |
| Twitter | <3 | <3 | <3 |

## FOCUS GROUP EXPERIENCE

All Round 1 respondents agreed or strongly agreed that the information was presented clearly, that they felt comfortable voicing their opinions, and felt they could use NWS resources to judge their risk in an extreme weather event. Nearly all agreed they knew more about the NWS resources (fewer than three disagreed and none strongly disagreed) (Table 7). All Round 2 respondents, residents and emergency personnel, agreed or strongly agreed that the information was clearly presented, they felt comfortable voicing their opinions, and felt they could use NWS resources to judge their risk in a future severe event (Tables 8 and 9).

**Points of Confusion.** Nearly all respondents also agreed that the presentation was clear and not confusing. Points of confusion named were, "graphs, acronyms, and the sheer complexity" of weather forecasting, as well as "wind directional tags."

**Additional Comments.** Invited to make "additional comments," many respondents characterized the experience as a new and good learning experience. A small number of concrete suggestions were further added:

- I'd also wish for a product that explains roads that are closed due to flooding, and where detours are in place.
- Jersey Shore Hurricane News' Facebook page is a wealth of information for those at the Jersey Shore. It uses a lot of information from the NWS.
- Lose the capital letters in the briefing package, please.
- Key is getting more useful information to the public; some of that is just too non-localized and not scary enough to lead most to take action.

As a result of participation in the focus groups, most residents gained knowledge of NWS products and all expressed confidence in their ability to use NWS products in future events. It appears that discussing severe weather forecast tools in the context of an unfolding scenario enabled participants to reflect on their past responses to warnings and anticipate responding to future events in a more timely manner.

Participants also found the opportunity to share stories and information with peers in the context of examining NWS coastal products highly valuable. Comments immediately following the formal presentation conveyed appreciation for the experience and described the focus group as intellectually stimulating. The richness of the exchange suggests that this kind of deliberative model may be effective in engaging community members in focusing on weather dangers and acting appropriately in response. This model, rather than typical "one-to-many" lecture formats, may have deeper and more long-lasting effects on disaster preparedness.

**Table 7: Round 1 Respondents' Ratings of the Focus Group (n=17)**

| | STRONGLY DISAGREE | DISAGREE | AGREE | STRONGLY AGREE |
|---|---|---|---|---|
| The information was clearly presented. | | | 6% | 94% |
| I felt comfortable voicing my opinion. | | | 18% | 82% |
| I know more about the National Weather Service (NWS) resources. | | | 47% | 53% |
| I feel I could use NWS resources to judge my risk in an extreme weather event. | | | 53% | 47% |

**Table 8: Round 2 Respondents' Ratings of the Presentation (n=20)**

| | STRONGLY DISAGREE | DISAGREE | AGREE | STRONGLY AGREE |
|---|---|---|---|---|
| The information was clearly presented. | | | 5% | 95% |
| I felt comfortable voicing my opinion. | | | 5% | 95% |
| I know more about the National Weather Service (NWS) resources. | | 5% | 20% | 75% |
| I feel I could use NWS resources to judge my risk in an extreme weather event. | | | 20% | 80% |

**Table 9: Emergency Personnel Ratings of the Focus Group (n=7)**

| | STRONGLY DISAGREE | DISAGREE | AGREE | STRONGLY AGREE |
|---|---|---|---|---|
| The information was clearly presented. | | | 43% | 57% |
| I felt comfortable voicing my opinion. | | | 14% | 86% |
| I know more about the National Weather Service (NWS) resources. | | 14% | 29% | 57% |
| I feel I could use NWS resources to judge my risk in an extreme weather event. | | | 29% | 71% |

# CONCLUSIONS AND RECOMMENDATIONS

## Information Design and Delivery

Results from this study suggest that participants trust information from the NWS more than mass media coverage of hurricanes, storm surges, and coastal flooding. Participants report that NWS information is seen as more technical and scientific as opposed to an exaggerated, thrill-seeking, approach to dangerous weather that characterizes some media coverage. For this reason, it is important that NWS products communicate critical messages as effectively as possible. Findings from this study suggest that factors, including product design, geographic specificity of forecasts, and timing and format of delivery, may significantly affect how public audiences respond to coastal storm and flood forecasts. Findings also suggest that well-designed emergency briefings can be a useful tool for addressing this range of factors, and improving communication about coastal flooding to affected audiences.

The research team found that a range of barriers subsumed under "informational design" may prevent rapid understanding and appropriate action by citizens. Participants expressed a clear preference for a balance of text and graphics, favoring graphics over text in general. Despite this preference for visual information, in the absence of clear legends and explanations, many struggled to understand what some graphics were designed to convey. Improvements suggested by participants concerned visual clarity (the use of color, pattern, outline, and legends), and textual clarity (non-technical language, variations in text size by importance of the content, the use of color to highlight key information, clear explanations, and common measurement units).

Tested revisions to NWS products appeared to help comprehension and interest in the products. For instance, the Extratropical Storm Surge product was significantly modified after it proved quite complicated for both residential and emergency personnel participants. Revisions to the product attempted to improve visual clarity and provide clear emphasis on the critical component—namely, the projected coastal surge above Maximum Astronomical Tide, the point at which coastal flooding is expected to have the greatest impacts on an area. Response during Round 1 to this product was tempered and positive comments were limited, but participant response improved during Round 2, with about 90% of respondents indicating this product would be valuable or very valuable. Similarly, revisions to the Surface Prognosis Maps (renamed Surface Weather Patterns), significantly improved participant response regarding the value of the product. In this case, revisions were design changes that called into focus the geographic area under consideration and clearer labeling and legends. Additionally, the product included a "forecaster's note" box to provide an opportunity for local information and an added color-coded bar at the top to allow for active linking to any current watches and warnings that may be in place for a region.

Overall, while participants trusted the data provided through NWS coastal flood forecast products, they expressed significant concerns about the quality of the graphic representation of the data. Participant feedback suggests that revisions to graphic design and textual clarity, such as those proposed in the Round 2 products, could significantly improve the utility of NWS flood forecast data for populations at risk of coastal flooding.

In addition to issues related to product design, the findings suggest that geographic specificity is critical to residents when making decisions about how and when to prepare. Specificity about where impacts may occur was highly valued by both residents and emergency personnel, and participants suggested that showing impact areas or points of geographic reference would be more motivational for people. For instance, several participants referenced the powerful impact of hearing their municipality's name in national or regional coverage, and many suggested that receiving information from their local police, municipal officials, or emergency personnel motivated them to pay closer attention or take action.

Numerous participants expressed a desire for very local meteorological detail, such as specific tidal elevations (as opposed to "X feet above normal"), and comparisons to previous storms as guides to decision-making. Many also felt that visual illustrations of extreme weather impacts could be persuasive. Several noted how difficult it was, particularly for newcomers, to translate meteorological predictions into actual results. While some felt that an-

nouncing the projected storm surge in measurements of "feet above normal" would help "old-timers" who knew what this meant, others suggested that this figure would be meaningless to many, and should instead be described in terms of impacts and reference points. Making impacts visible may help undercut an "optimistic bias," or the belief that "bad things happen to other people" (NOAA, 2009) and provide newcomers with a vicarious prior experience that may moderate this bias.

This study also looked at the timing of delivery of products. Importantly, emergency personnel clearly wanted information as far in advance as possible, citing factors such as the long lead-time required for arranging evacuations. Residential audiences, however, were less likely to look for information until an event was within five or fewer days of affecting their region, but their search for products slowed down by days T-2 and T-1. These audiences cited the uncertainty in long-range forecasts and the frequency of "out-to-sea" storms as reasons for waiting until impacts are closer to begin preparing; conversely, by day T-2 and day T-1, participants reported being busy with actual preparations, rather than seeking information via NWS products. Survey data showed T-5 (and to some extent T-4) was when participants most anticipated using the variety of coastal products available. For this reason, day T-5 is indicated as a possible optimal time for information delivery to public audiences.

The study also looked at the preferred methods for delivery of information. The Internet was the primary source of information for emergency personnel and Round 1 respondents about both impending coastal flooding and preparing for it. In contrast, Round 2 respondents indicated a slight preference for television in both cases, perhaps reflecting the age difference between the two sets of focus group respondents. Within current social media options—Facebook, smartphone apps, and Twitter—smartphone apps received the highest numbers of responses overall. All emergency personnel preferred smartphone apps and more than half of Round 1 respondents would use Facebook and smartphone apps in roughly equal numbers, but only one third of Round 2 respondents indicated smartphone apps and few indicated Facebook. Twitter did not appear to play a role in information-gathering about flooding among these audiences but continued and growing reliance on Facebook and smartphone apps may be anticipated.

## Briefing Packages

At the core of this study was a fundamental question: could emergency briefings overcome recognized barriers to understanding and using NWS products? The findings suggest that though current use of briefings by residential populations may be somewhat limited, their potential use by the public is significant. Nearly all participants regarded the emergency briefing packages as valuable or extremely valuable. A small number of residents knew to look for them when Superstorm Sandy was approaching and spoke about the briefings in positive terms. Most residents who encountered them for the first time during the focus groups saw them as valuable summaries of relevant and trustworthy weather information and forecasts. Emergency personnel, who were very familiar with the briefing packages, also valued them highly. Broadcast meteorologists acknowledged referencing the briefings when preparing their forecast presentations, and suggested they also serve as valuable tools for public audiences to refer to directly. The briefings present an opportunity for NWS to consolidate its product delivery and also to enable forecasters to develop a stronger connection with their audiences by customizing content, explaining risks and complicated meteorological concepts, and when needed, issuing serious calls to action. Continued exploration of formats by NWS can continue to improve upon the graphic design suggestions proposed here.

Briefings, as issued in .pdf format via a web-based link, are also easily sharable from person to person. Though many participants were hesitant to take protective actions until a storm came nearer, participants routinely reported that they begin discussing the storm and sharing information with neighbors, friends, and family as early as five days prior to landfall. This discussion and lateral sharing of information among residents is, in fact, the most common action that participants took in preparing for the storm, and presents a great opportunity for sharing NWS products with the public. For this reason, the redesigned briefings all included a bold notice to please share the briefing with friends, family, and neighbors to ensure broad coverage of the information throughout a community. Given the stated trust participants had in their local communities, local emergency managers may consider disseminating the briefings directly to their communities to enhance the utility and effectiveness of the product.

Though residents did not provide specific guidance on what constitutes a briefing-worthy event, they clearly cautioned that briefings should be reserved for high-impact events, and not routine weather nuisances.

Finally, the personal quality of the briefing, specifically the forecaster's plea, was a strong motivator for almost every participant. Response to this portion of the briefing was unequivocal, with many participants suggesting that this was a triggering factor in their understanding of how serious the situation threatened to be. Emergency personnel agreed it was useful and saved lives. Briefings provide a rare opportunity for forecasters to present a "tone" related to the seriousness of the forecast, and this tone seems to matter to participants looking for direction about how to prepare. This issue was mentioned by residents, emergency personnel and broadcast meteorologists alike. Including opportunities for "forecaster's notes" such as that included in the revised Surface Weather Patterns product allows further opportunities for personalization and conveyance of tone within forecasts. When designing and revising products, NWS should look for mechanisms for emphasizing important information and high-impact events to ensure this information is distinguished from routine weather information.

## Implementation

Implementing design recommendations appears eminently feasible. Proposed design revisions to the products evaluated in this project were undertaken in conjunction with our NWS partners to work within existing frameworks of product design and delivery. Particularly in regard to the emergency briefings, forecasters can incorporate recommendations from this study to craft direct, action-oriented briefings that prioritize serious impacts and actions steps, while offering fuller meteorological detail for professional and weather-savvy audiences as supplemental information. Design recommendations included here may be used as guides and tailored to the needs of distinct NWS offices.

NWS should seriously consider the design of the Extratropical Surge forecast product, which was deemed very useful by a large majority of participants who nonetheless found the product difficult to interpret. Tested revisions to this product substantially improved participant response. Similarly, revisions to the Surface Prognosis Maps product appeared to address both resident and emergency personnel concerns about the product's design and to significantly improve user response.

Revisions to the Wind Direction/Gust Forecast product, however, did not significantly modify the product enough to make it easily understood by participants. The traditional wind barb and flag symbol appears to confound users, even with revisions from the research team. NWS should consider options for representing wind direction with simpler arrow formats.

The inclusion of "forecaster's notes" or similar opportunities for situation-specific information should be considered, such as more detailed information about expected impacts at particular locations or other critical information. Consistent formatting of products, as the redesigns here show, should also be considered; they allow users to quickly and easily identify key pieces of information (title, date, and location, etc.). Simpler product titles, such as Surface Weather Patterns rather than Surface Prognosis Maps, can help users interpret data. These recommendations are intended to be easily incorporated into current product design and delivery.

### Other Research Questions

While Sandy's impact was ultimately on coastal flooding for the study site areas, participants reported that news media in the days leading up to the storm emphasized wind until a day or two prior to the storm's landfall. Additionally, many participants explained that they or neighbors failed to evacuate because they had heard similar warnings during Hurricane Irene, which produced limited impacts on the region, and they feared another false alarm. Future research should explore the influence of news media coverage of coastal flooding vs. wind impact as well as the ways in which news media prioritize and discuss coastal flooding compared to other impacts, including riverine flooding.

Additionally, future research on NWS coastal forecast products could continue to test the scenario-based focus group model as an effective means of engaging residents in using and acting on those products. New and possibly fruitful questions could investigate the nuances between first-hand prior experience and that gained through friends and neighbors in perceived risk. It may also be valuable to test variations in language use among participants to see if certain words or phrases are more effective action "triggers" than others. Given the extent of participant request for visualization of coastal flood impacts, it would also be useful to explore the value of visual imagery of impacts for encouraging residents to identify risk, and take action to protect life and property.

## CLOSING

In assessing the feedback from the participants, the influence of localizing the forecasts to discrete geographic areas cannot be overstated. Summing up, one emergency manager says, “localize, localize, localize.” As discussed, this localization process can include naming municipalities in addition to counties or regions and personalizing the tone of the forecast so that it identifies risks and directs actions. Continued study of NWS flood forecast and warning products through scenario-based focus groups and surveys could reveal additional insights about how communities are responding to changing risks and forecast products and help NWS advance its efforts to provide and improve forecasts in order to protect life and property.

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# APPENDIX A: Survey Forms

## Pre-Survey Residents (Page 1)

**Nurture Nature Center**
**National Weather Service Product Study**
**Ocean and Monmouth Counties, New Jersey**

1. **How did you learn about this focus group?** _____

_____

2. **What is your reason for attending?** _____

_____

3. **Did you experience damage to your home or business during Superstorm Sandy?** _ Yes _ No

4. **Other than Superstorm Sandy. have you, a family member, or close friend experienced one or more significant coastal flooding/storm surge events (e.g., experienced damage or loss, had to evacuate)?**

___ Yes ___ No

If Yes, please note whether the most recent event was:

___ within the last 5 years ___ more than 5 years ago

5. **If you have experienced a flood, did you take action in response to official coastal flood/storm surge warning messages?**

___ Yes ___ No

If yes, what action(s) did you take? _____

6. **How do you rate your own chance of being flooded at your home or business?**

___ Extremely high risk ___ Somewhat high risk ___ Very little risk ___ No risk

7. **Where do you go for <u>information *about*</u> imminent extreme weather events, such as coastal flooding?**

| | check all that apply | which one(s) |
|---|---|---|
| | Internet: Website | |
| | Smartphone: App | |
| | Facebook | |
| | Twitter | |

| | check all that apply |
|---|---|
| | TV: Station(s) |
| | Radio: Station(s) |
| | Other: |

**8. Where do you go to <u>learn about steps to take to *prepare*</u> for extreme weather events?**

| | check all that apply | which one(s) |
|---|---|---|
| | Internet: Website | |
| | Smartphone: App | |
| | Facebook | |
| | Twitter | |

| | check all that apply |
|---|---|
| | TV: Station(s) |
| | Radio: Station(s) |
| | Other: |

**9. If you learn that a significant, hazardous weather is approaching your area, what do you typically do with that information?**

**Please check <u>all</u> that apply:**

| | |
|---|---|
| | Discuss with family and friends |
| | Seek further information |
| | Contact local officials |
| | Gather supplies |
| | Other: |

***Please tell us about yourself.***

**10. Age:** ___ under 20 ___ 20-29 ___ 30-39 ___ 40-49 ___ 50-59 ___ 60-69 ___ 70+

**11. Gender:** ___ Male ___ Female

**12. Zip Code**: _____

**13. Length of time living on the New Jersey Shore?**

___ under 1 year ___ 1-2 years ___ 3-5 years ___ 6-8 years ___ 8 or more years

**14. Length of time living in Monmouth/ Ocean County**

___ under 1 year ___ 1-2 years ___ 3-5 years ___ 6-8 years ___ 8 or more years

**15. Do you currently live in an area subject to coastal flooding and/or tidal surges?**

_____ Yes _____ No _____ I don't know

**16. Highest level of education completed:**

___ High School/GED ___ Associate's degree or 2-year college degree

___ Bachelor's degree or other 4-year college degree ___ Post graduate work

*Thank you for participating. Your feedback is valuable*

**Nurture Nature Center**
**National Weather Service Product Study**
**EMERGENCY MANAGERS**
**Ocean and Monmouth Counties, New Jersey**

1. **How did you learn about this focus group?** _____

_____

2. **What is your reason for attending?** _____

_____

3. **How long have you served in your Emergency Management position?**

___ Less than 1 year 1 – 2 years ___2 to 5 years ___ 6 or more years

4. **Please indicate whether your position is:**
__full-time employee __part time employee
__full-time volunteer __part-time volunteer

5. **Have you received training in dealing with extreme weather events?** ___ Yes ___ No

6. **Did you work as Emergency Management personnel during Superstorm Sandy?**

___ Yes ___No

7. **How many significant coastal flooding/storm surge events have you worked through?**

___ 1 ___ 2 – 3 ___ 4 – 5 ___ 6 or more events

8. **How do you rate the risk of flooding in the community you serve as an Emergency Manager?**

___ Extremely high risk ___ Somewhat high risk ___ Very little risk ___ No risk

9. **Where do you go for information *about* imminent extreme weather events, such as coastal flooding?**

| check all that apply | | which one(s) |
|---|---|---|
| | Internet: Website | |
| | Smartphone: App | |
| | Facebook | |
| | Twitter | |

| check all that apply | |
|---|---|
| | TV: Station(s) |
| | Radio: Station(s) |
| | Other: |

## Pre-Survey Emergency Personnel (Page 2)

***Please tell us about yourself.***

**10. Age:** ___ under 20 ___ 20-29 ___ 30-39 ___ 40-49 ___ 50-59 ___ 60-69 ___ 70+

**11. Gender:** ___ Male ___ Female

**12. Zip Code**: _____

**13. Length of time living on the New Jersey Shore?**

___ under 1 year ___ 1-2 years ___ 3-5 years ___ 6-8 years ___ 8 or more years

**14. Length of time living in Monmouth/ Ocean County**

___ under 1 year ___ 1-2 years ___ 3-5 years ___ 6-8 years ___ 8 or more years

**15. Highest level of education completed:**

___ High School/GED ___ Associate's degree or 2-year college degree

___ Bachelor's degree or other 4-year college degree ___ Post graduate work

*Thank you for participating. Your feedback is valuable*

**Nurture Nature Center**
**National Weather Service Product Study**
**Ocean and Monmouth Counties, New Jersey**

1. **Please rate your agreement with the following statements about the focus group. Please check ONE box for each statement.**

| | Strongly Agree | Agree | Disagree | Strongly Disagree |
|---|---|---|---|---|
| The information was clearly presented. | | | | |
| I felt comfortable voicing my opinion. | | | | |
| I know more about the National Weather Service (NWS) resources. | | | | |
| I feel I could use NWS resources to judge my risk in an extreme weather event. | | | | |

2. **What is the biggest barrier you face in using NWS coastal flood forecast/ storm surge warning products?**

_____

_____

3. **Many people prefer a combination of text and graphics in weather warning products. What is your preference the proportion of text to graphics? (Please check <u>one</u> box each for Text and Graphics. The total should not exceed 100%.**

| | 25% | 50% | 75% | 100% |
|---|---|---|---|---|
| **Text** | | | | |
| **Graphics** | | | | |

4. **Please comment on the use of the following products discussed today to learn about and prepare for extreme weather, coastal flooding, and/or storm surge events:**

**4a. Mt. Holly Briefing Package**

Were you aware of these products before today's focus group? __ Yes __No

How many days in advance of the forecast weather event would you turn to these products?
____7 days ____6 days ____5 days ____4 days ____3 days ____2 days ____1 day

What aspect(s) of these products would motivate you to use them?

Please rank the value of these products to you, with 5 being high value and 1 being low value.
1 2 3 4 5

## 4b. National Hurricane Center Tropical Storm Cone

Were you aware of these products before today's focus group? __ Yes __No

How many days in advance of the forecast weather event would you turn to these products?
____7 days ____6 days ____5 days ____4 days ____3 days ____2 days ____1 day

What aspect(s) of these products would motivate you to use them?

Please rank the value of these products to you, with 5 being high value and 1 being low value.
1 2 3 4 5

## 4c. Weather Prediction Center Surface Prognosis Map

Were you aware of this product before today's focus group? __ Yes __No

How many days in advance of the forecast weather event would you turn to this product?
____7 days ____6 days ____5 days ____4 days ____3 days ____2 days ____1 day

What aspect(s) of this product would motivate you to use it?

Please rank the value of this product to you, with 5 being high value and 1 being low value.
1 2 3 4 5

## 4d. National Weather Service Precipitation Forecast Map

Were you aware of these products before today's focus group? __ Yes __No

How many days in advance of the forecast weather event would you turn to these products?
____7 days ____6 days ____5 days ____4 days ____3 days ____2 days ____1 day

What aspect(s) of these products would motivate you to use them?

Please rank the value of these products to you, with 5 being high value and 1 being low value.
1 2 3 4 5

**4f. National Weather Service Temperature Map—OMITTED**

Were you aware of this product before today's focus group? __ Yes __No

How many days in advance of the forecast weather event would you turn to this product?.
____7 days ____6 days ____5 days ____4 days ____3 days ____2 days ____1 day

What aspect(s) of this product would motivate you to use it?

Please rank the value of this product to you, with 5 being high value and 1 being low value.
1 2 3 4 5

**4h. Local Weather Office Extratropical Surge Forecast—RENAMED Observed and Forecast Water Levels**

Were you aware of this product before today's focus group? __ Yes __No

How many days in advance of the forecast weather event would you turn to this product? Please select one response only.
____7 days ____6 days ____5 days ____4 days ____3 days ____2 days ____1 day

What aspect(s) of this product would motivate you to use it?

Please rank the value of this product to you, with 5 being high value and 1 being low value.
1 2 3 4 5

**4i. National Weather Service Low Tracks Ensemble Product—OMITTED**

Were you aware of this product before today's focus group? __ Yes __No

How many days in advance of the forecast weather event would you turn to this product?
____7 days ____6 days ____5 days ____4 days ____3 days ____2 days ____1 day

What aspect(s) of this product would motivate you to use it?

Please rank the value of this product to you, with 5 being high value and 1 being low value.
1 2 3 4 5

**4j. National Weather Service Coastal Flood Watch/ Coastal Flood Warning**

Were you aware of these products before today's focus group? __ Yes __No

How many days in advance of the forecast weather event would you turn to these products?
____7 days ____6 days ____5 days ____4 days ____3 days ____2 days ____1 day

What aspect(s) of these product would motivate you to use them?

Please rank the value of these products to you, with 5 being high value and 1 being low value.
1 2 3 4 5

**5. Which social media would you use to learn about impending coastal flooding/ storm surges near you? Please check all that apply.**

___ Facebook ___ Twitter ___ Weather App Other:_____

**6. Which social media would you use to learn steps to prepare for coastal flooding/ storm surge near you? Please check all that apply:**

____ Facebook ___ Twitter ___ Weather App Other:_____

**7. Which digital platform are you most likely to use to access NWS resources?**

____ Smartphone ___ Tablet ___ PC (desktop, laptop) Other: _____

**8. Was anything in the session confusing?** ___ Yes ___ No

If Yes, please explain: _____

_____

**9. What improvements could be made in the format or content of the focus group?**

_____

_____

_____

**10. Additional comments:**

_____

_____

*Thank you for participating!*
*RMC Research Corporation*
*1000 Market Street, Building 2 Portsmouth, NH 03801*
*rmcportsmouth.com*

**Nurture Nature Center**
**National Weather Service Product Study**
**EMERGENCY MANAGERS**
**Ocean and Monmouth Counties, New Jersey**

1. **Please rate your agreement with the following statements about the focus group. Please check ONE box for each statement.**

| | Strongly Agree | Agree | Disagree | Strongly Disagree |
|---|---|---|---|---|
| The information was clearly presented. | | | | |
| I felt comfortable voicing my opinion. | | | | |
| I know more about the National Weather Service (NWS) resources. | | | | |
| I feel I could use NWS resources to judge my risk in an extreme weather event. | | | | |

2. **What is the biggest barrier you face in using NWS coastal flood forecast/ storm surge warning products?**

_____

_____

3. **Many people prefer a combination of text and graphics in weather warning products. What is your preference the proportion of text to graphics? (Please check <u>one</u> box each for Text and Graphics. The total should not exceed 100%.**

| | 25% | 50% | 75% | 100% |
|---|---|---|---|---|
| **Text** | | | | |
| **Graphics** | | | | |

4. **Please comment on the use of the following products discussed today to learn about and prepare for extreme weather, coastal flooding, and/or storm surge events:**

**4a. Mt. Holly Briefing Package**

Were you aware of these products before today's focus group? __ Yes __No

How many days in advance of the forecast weather event would you turn to these products?
____7 days ____6 days ____5 days ____4 days ____3 days ____2 days ____1 day

What aspect(s) of these products would motivate you to use them?

Please rank the value of these products to you, with 5 being high value and 1 being low value.
1 2 3 4 5

## 4b. National Hurricane Center Tropical Storm Cone

Were you aware of these products before today's focus group? __ Yes __No

How many days in advance of the forecast weather event would you turn to these products?
____7 days ____6 days ____5 days ____4 days ____3 days ____2 days ____1 day

What aspect(s) of these products would motivate you to use them?

Please rank the value of these products to you, with 5 being high value and 1 being low value.
1 2 3 4 5

## 4c. Weather Prediction Center Surface Prognosis Map

Were you aware of this product before today's focus group? __ Yes __No

How many days in advance of the forecast weather event would you turn to this product?
____7 days ____6 days ____5 days ____4 days ____3 days ____2 days ____1 day

What aspect(s) of this product would motivate you to use it?

Please rank the value of this product to you, with 5 being high value and 1 being low value.
1 2 3 4 5

## 4d. National Weather Service Precipitation Forecast Map

Were you aware of these products before today's focus group? __ Yes __No

How many days in advance of the forecast weather event would you turn to these products?
____7 days ____6 days ____5 days ____4 days ____3 days ____2 days ____1 day

What aspect(s) of these products would motivate you to use them?

Please rank the value of these products to you, with 5 being high value and 1 being low value.
1 2 3 4 5

### 4e. Weather Forecast Office Wind Speed/ Wind Gust Forecast Maps

Were you aware of these products before today's focus group? __ Yes __No

How many days in advance of the forecast weather event would you turn to these products?
____7 days ____6 days ____5 days ____4 days ____3 days ____2 days ____1 day

What aspect(s) of these products would motivate you to use them?

Please rank the value of these products to you, with 5 being high value and 1 being low value.
1 2 3 4 5

### 4f. National Weather Service Temperature Map

Were you aware of this product before today's focus group? __ Yes __No

How many days in advance of the forecast weather event would you turn to this product?.
____7 days ____6 days ____5 days ____4 days ____3 days ____2 days ____1 day

What aspect(s) of this product would motivate you to use it?

Please rank the value of this product to you, with 5 being high value and 1 being low value.
1 2 3 4 5

### 4h. Local Weather Office Extratropical Surge Forecast

Were you aware of these products before today's focus group? __ Yes __No

How many days in advance of the forecast weather event would you turn to these products?
____7 days ____6 days ____5 days ____4 days ____3 days ____2 days ____1 day

What aspect(s) of these products would motivate you to use them?

Please rank the value of these products to you, with 5 being high value and 1 being low value.
1 2 3 4 5

**4i. National Weather Service Low Tracks Ensemble Product**

Were you aware of this product before today's focus group? __ Yes __No

How many days in advance of the forecast weather event would you turn to this product?
____7 days ____6 days ____5 days ____4 days ____3 days ____2 days ____1 day

What aspect(s) of this product would motivate you to use it?

Please rank the value of this product to you, with 5 being high value and 1 being low value.
1 2 3 4 5

**4j. National Weather Service Coastal Flood Watch/ Coastal Flood Warning**

Were you aware of these products before today's focus group? __ Yes __No

How many days in advance of the forecast weather event would you turn to these products?
____7 days ____6 days ____5 days ____4 days ____3 days ____2 days ____1 day

What aspect(s) of these product would motivate you to use them?

Please rank the value of these products to you, with 5 being high value and 1 being low value.
1 2 3 4 5

5. **Which social media do you use to disseminate messages and warnings about imminent severe weather events?**

6. **Was anything in the session confusing?** ___ Yes ___ No
   If Yes, please explain: _____
   _____

7. What improvements could be made in the format or content of the focus group?

_____
_____

8. **Additional comments:**

_____
_____

*Thank you for participating!*
*RMC Research Corporation*
*1000 Market Street, Building 2 Portsmouth, NH 03801*
*rmcportsmouth.com*