RISK COMMUNICATION AND PUBLIC ENGAGEMENT IN SEA LEVEL RISE RESILIENCE RESEARCH SERIES

PAPER NO. 2
User Preferences for Flood Alerts

COMMONWEALTH CENTER FOR RECURRENT FLOODING RESILIENCY

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CCRFR Report 4 | November 2017

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TABLE OF CONTENTS

ABOUT THE RISK COMMUNICATION AND PUBLIC ENGAGEMENT IN SEA LEVEL RISE RESILIENCE RESEARCH SERIES

Improving risk communication is key to building resilience in areas at risk to all types of flooding. The National Research Council has defined risk communication as an interactive process of exchange of information and perspectives among individuals, groups and institutions[1]. Risk communication is a two-way dialogue that requires communicators to understand their audience in order to deliver the correct messages at appropriate times in order to achieve the desired outcome. Key to producing useful and actionable risk communications products is understanding audience risk perceptions, information needs and ability to respond to messages.

The goal is to examine key elements of risk communication necessary for effectively delivering impactful information about flooding, adaptation, and resilience.

Likewise, public engagement is a best practice in many fields of resilience including planning, preparedness, policy and decision-making. Public engagement leads to more informed residents; better actions, impacts and outcomes; more community buy-in and support; faster implementation and more trust in local government[2]. Since meaningful stakeholder engagement efforts require having informed and educated stakeholders and are based on effective communication of critical information, these two areas are closely linked together.

This research series focuses on communicating and engaging with stakeholders regarding vulnerabilities, risks, preparedness, and adaptation. The goal is to examine key elements of risk communication necessary for effectively delivering impactful information about flooding, adaptation, and resilience. The efficacy of information supply hinges on user adoption and having the correct communication technologies and mechanisms in place. The studies in this research series focus on the factors driving use of information and specific approaches for communicating information and educating, and encouraging action. This research series include studies of modeling and visualization, adaptation preferences, information seeking, gamification, and social learning.

Studies in the Risk Communication and Public Engagement in Sea Level Rise Resilience Research Series are led by interdisciplinary faculty of the ODU Resilience Collaborative, a consortium of leading scholars actively engaged in research, education, and outreach on critical issues for resilience at the community, regional, national, and global levels.

This project, User Preferences for Flood Alerts, was funded by the Commonwealth Center for Recurrent Flooding Resiliency.

1. National Research Council. 1989. *Improving Risk Communication.* Washington, DC: The National Academies Press. https://doi.org/10.17226/1189.

2. National Research Council. 2008. *Public Participation in Environmental Assessment and Decision Making.* Washington, DC: The National Academies Press. https://doi.org/10.17226/12434.

INTRODUCTION

This study in the Risk Communication and Information Logistics Research Series focuses on information and communication preferences of lay audiences via a flood alert system. The goal is to understand, from a flood alert perspective, why residents want flooding information, what information residents want, the format of the information, and the timing of the information search.

Working with faculty and staff from Old Dominion University's Center for Coastal Physical Oceanography, we developed a "straw man" website for users to sign up to receive flood alerts. The flood alert is based on tidal projections for the Sewell's Point tide gauge available from the National Weather Service through the meteorological development laboratory (http://www.nws.noaa.gov/mdl/etsurge/index.php) and sends alerts for projected water level. We recruited study participants for one-on-one interviews. Participants were asked to interact with the flood alert signup interface and respond to specific questions about their preferences for flood alerts. We used findings of the one-on-one interviews to create profiles of flood alert users that could be used to inform development of flood alert systems and other flood communication tools.

RESEARCH APPROACH

This project used a qualitative research approach, incorporating one-on-one interviews where participants responded to specific questions as they completed the flood alert signup form. Research participants were observed as they interacted with the "straw man" flood alert interface. First, they were asked to sign up to receive flooding alerts and their interactions with the interface were noted. Participants were asked to verbalize out loud their thoughts as they explored the interface and weighed options such as preferred method of contact and frequency of alerts. As they responded to the various sign up requirements, participants were prompted to discuss why they chose the specific responses. After participants completed the signup page, they were asked a series of additional questions about the interface and their preferences for flood information (see Appendix for the list of questions).

Research Participants

Study volunteers completed a screening questionnaire to collect demographic information about participants and select participants that lived, worked or attended classes in the geographic area that was the focus of the mapped portion of the alert. Participants were also selected to provide a balanced sample of the population living and traveling in the mapped neighborhoods. The study included 23 participants who were either residents of Larchmont or Colonial Place neighborhoods (in Norfolk) or Old Dominion University (ODU) students, faculty or staff.

Of the 23 research participants, 43% were ODU faculty, staff or students, 30% were residents of Larchmont, and 26% were residents of Colonial Place.

Thirty percent were male and 70% were female. Only one participant indicated he had not been impacted by flooding while living in or traveling around the ODU campus or nearby neighborhoods. Seventy percent indicated they have and use a strategy to determine how flooding will affect them, their travel or their property. The age distribution of participants is provided in Figure 1. Participants' educational levels are summarized in Figure 2.

Figure 1

Age of Research Participants

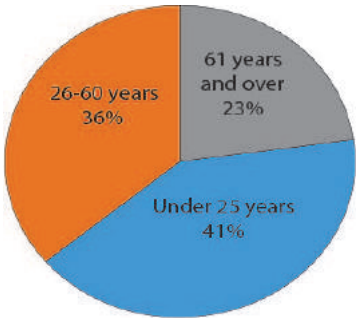
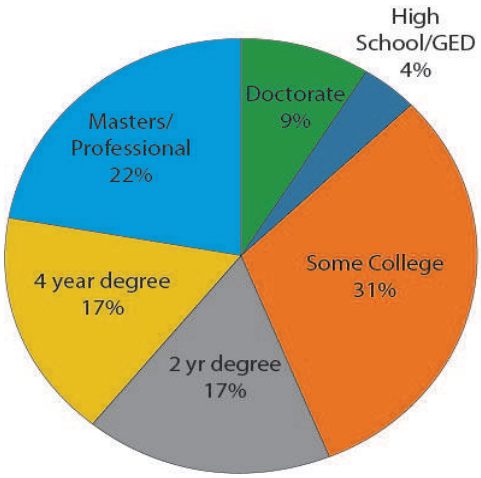


Figure 2

Educational Attainment of Research Participants



About the Flood Alert

The flood alert was designed to provide flood warnings based on water level predictions using data from the National Oceanographic and Atmospheric Administration (NOAA) tidal gauge at Sewell's point. The National Weather Service combines astronomical tide, wind/surge tide and anomalous additive factors (likely the effect of currents) in a model to provide a total water level forecast for up to 3 days into the future. Users were explicitly notified that rainfall is not included in the prediction, but that rainfall could increase flooding risk. Figure 3 shows the flood alert sign up interface that study participants interacted with.

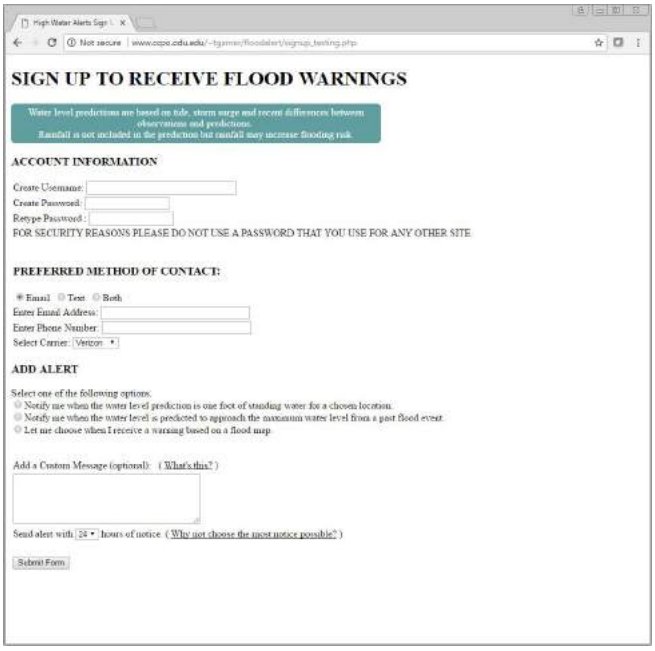
The Flood Alert signup interface provides the option for participants to choose to receive flood alerts based on a map option, location or landmark option, or based on flooding associated with a historical storm.

After participants completed the Flood Notification Alert form signup page, they were asked to review all three options for choosing a flood notification (map, location, or historical storm). When participants selected the 'chosen location' option, they were given three choices: (a) Hampton Boulevard at Larchmont Library, (b) Powhatan at 49th Street, and (c) Bluestone at 49th Street. These three locations are known to experience several inches of water covering the road on a frequent basis. Participants who selected the 'past flood event' option were able to select from seven flooding events associated with historical storm events. These events were:

- Hurricane Isabel (September 2003)
- Nor'Ida (November 2009)
- Hurricane Irene (August 2011)
- Hurricane Sandy (October 2012)
- Hurricane Joaquin (October 2015)
- Hurricane Hermine (September 2016)
- Hurricane Matthew (October 2016)

Figure 3

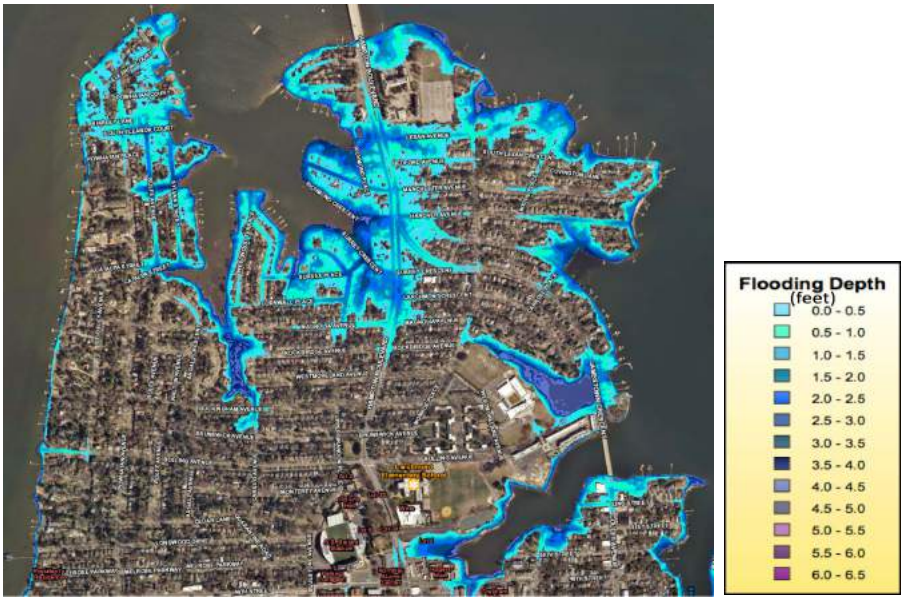
Flood Alert Interface



Finally, as shown in Figure 4, the map option allowed participants to view a map that showed different flooding depths (in feet). Participants could then select the level of flooding at which they prefer to receive an alert.

Figure 4

Map Shown in the Flood Alert Interface



KEY FINDINGS

Analysis of the one-on-one interviews of study participants identified the following key findings.

When flooding is expected, the majority of participants (73%) prefer to have flooding information sent to them, while 26% prefer to access the flood information themselves. Participants who wanted the flood information sent to them (i.e., push notification) stated that the alert would provide an easy way to get accurate information and that it would save them time. They noted that location and time relevant flooding information can be cumbersome or hard to find. Some participants indicated that receiving the flooding information would act as a trigger and enable them to prepare for the predicted flooding. Several participants indicated that they would like the flood alerts to include links to web pages that would provide more in-depth information about predicted flooding that they could access if they were interested.

Those participants that indicated that their preference was to access flooding information on their own indicated that they were concerned about the timing in which they would receive flooding information as well as the quantity and quality of information that would be sent to them.

In terms of options for receiving flood alerts based on a map option, location or landmark option or based on flooding correlated to a historic storm, the majority of participants initially chose to receive flood alerts based on a landmark or specific location. As shown in Figure 5, 57% of participants selected the landmark or specific location option, while 24% and 19% selected historical storm and map, respectively.

Participants provided additional explanations for their choice between the map, location/ landmark, or historical storm options:

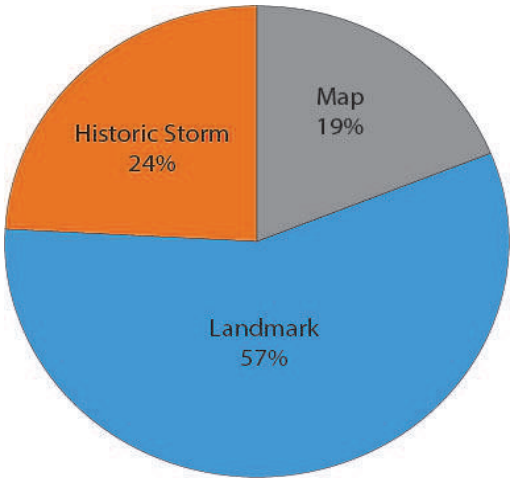
- Map option: Participants were asked about their ability to locate their areas of flooding concern using a map option. Eighty-seven percent of participants indicated that they were able to easily locate the area of flooding using the map option. Many of the participants indicated that they were familiar with the portion of the city that was shown on the map, which increased their ability to locate their areas of flooding concern. However, several participants indicated that they would like the map to be larger and cover a larger area of the city or that some of their locations of concern were not shown on the map.

- Location option: For the location option, participants were provided with three specific locations (street intersections) that experience nuisance flooding on a regular basis. The majority (95%) of participants indicated that they were familiar with the given locations. However, several participants indicated that their preference would be to put in a specific address for flooding notification, rather than set specific locations.
- Historical storms option: Participants were given seven historic storms to choose from that occurred from 2003 to 2016. Participants gave various explanations for which of these seven storms they chose to prompt their flood alert notification. Participants mostly selected historical storms based on recency (i.e., the most recent storm that affected the region) and their experiences with a previous storms (e.g., they lived in the area when the storm hit, the storm was most memorable, they experienced or saw evidence of flooded roads or property damage). A few participants noted that this option was not meaningful to them because they do not remember the storms or their impacts.

After they interacted with the flood alert signup page and clicked the 'Submit' button, participants were asked to review all three options for selecting the flood alert notification. After reviewing all options, 50% of participants indicated that they would change their preferred option. Of those who indicated that they would change the basis of their flood alert notification (11 participants in total), eight chose maps in lieu of their original choice and 3 chose location in lieu of the original choice. No participant chose the historical storms option in the post-interaction interview.

Figure 5

Initial Selection of Basis for Flood Alert Interface

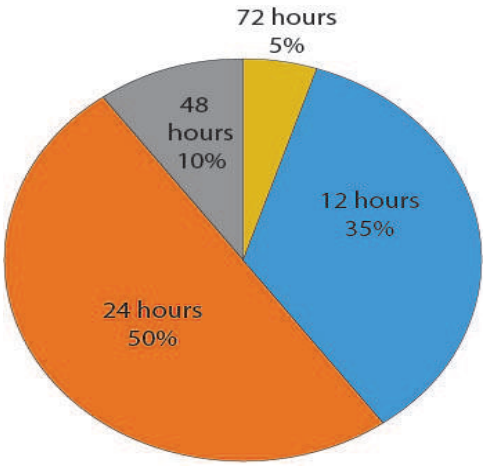


Participants were asked questions related to the types of information that should be included in the alerts as well as the timing of alerts and updating of forecasts. Their responses are discussed below:

- The flood alert was for tidal and storm surge flooding only. **Seventy-seven percent of participants indicated that they would like the alert to include a link to the weather forecast for rainfall.**
- **The majority of participants (85%) chose a notification time frame of 12 hours or 24 hours.** Figure 6 provides a breakdown of participant choices for the flood alert notification, and 24 hours was the largest category of responses. Participants indicated several reasons for the 12 to 24 hour notification timeframe, including that it provides enough time for planning and preparing, and that the forecast is likely to be more accurate within those time frames.

Figure 6

Initial Selection of Basis for Flood Alert Notification

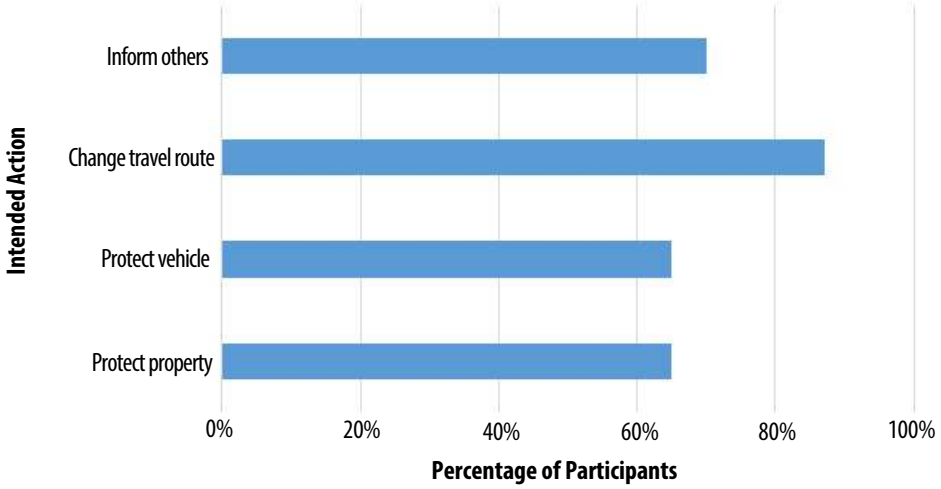


- Participants were asked how often they would like to receive the flood alert notification. Specifically, would they prefer to receive notifications at regular time intervals or only if the forecast changes? The majority (78%) indicated that their preference was to receive an initial alert and then additional alerts only if the forecast changes.
- The flood alert notification had the option for creating a personalized message to accompany the notification. Seventy eight percent of participants indicated that having a personalized message was not important to them.

Finally, participants were asked what they would do with the information they would receive from the flood alert system. **All participants indicated that they would utilize the information to take action**. The majority indicated that they would change their route for travel, inform their family and friends and protect their vehicles and property. The breakdown of this information is provided in Figure 7.

Figure 7

Intended Action Following Flood Alert Notification



PROFILES OF FLOOD ALERT USERS

Based on the interviews we identified 3 dimensions of alert use that can inform development of future flood alert tools. These dimensions are: search for flooding information, dissemination role, and response and action.

Within each dimension, we can categorize flood alert users. For example, within the first dimension of 'search for flooding information,' we categorize alert users as expert searchers or active searchers. We also have a category of 'passive searcher' but this type of alert user was not included in our study. The three dimensions and categories within the respective dimensions are summarized in Table 1.

Table 1

Dimensions of Flood Alert Use and Categories of Flood Alert Users

Dimension 1: Search for Information about Flooding	Dimension 2: Dissemination Role	Dimension 3: Response and Action
Expert Searcher - Understands causes of flooding and how that relates to predictions (e.g., tidal vs. rainfall). Knows where to find different sources of information. Has preference for information being pushed, but may also prefer to access information on own to allow self-vetting/parsing of information and to access information at own schedule. **Active Searcher** – May understand some causes of flooding, knows limited sources of information, wants information pushed to him/her. **Passive Searcher** – Does not seek out information about flooding (not in the sample of participants).	**Disseminator** – Actively engages in disseminating information to others (e.g., family and friends). May be more likely to be seen as a trusted source of information by those in his/her network. **Receiver** – Receives information and may use information to make decisions for self and family, but plays a limited (if any) information sharing role.	**Proactive** – Wants more advanced notice, forecasted information. Willing to trade-off accuracy for longer notice of potential flooding. Generally only wants updates when forecast changes. Uses information to plan ahead/ prepare in advance (e.g., protect property, protect vehicle). **Responsive** – Wants information closer to real-time so can respond as flooding is about to or is happening. Prefers short time horizons and frequent updates. Uses information to make decisions in shorter-term (e.g., changing route).

Using these dimensions, we created profiles of selected research participants to illustrate differences in how users of a flood alert tool seek information, disseminate information, and/or respond to and act on the information obtained from the flood alert tool. Selected profiles are presented next.

User P09 is an **expert searcher, disseminator,** and is a **combination of both proactive and responsive** – The user understands nuances of flooding in the area. He prefers to have flood information sent/pushed to him via the alert, preferably with links so he can obtain more information. He is very comfortable with maps and was able to quickly identify flood locations that he would like to be alerted to potential flooding. He is interested in a 6- to 12-hour alert notification time frame, because he wants accuracy (24 hours and longer does not give good predictions), and considers 6-12 hours a sufficiently realistic planning horizon for taking action. He is a long-time resident with connections to the community who perceives his role as a disseminator of information and trusted source of information. He actively acts on information received, such as making changes to travel routes or taking actions to protect personal property.

User P05 is an **expert searcher, disseminator** and is **proactive and responsive**. This user understands the local flooding context and understands that the forecast changes, and the most recent forecast is the best. He would like to select multiple ways to view and receive information, and was interested in learning from historic storms to plan for the future. He would contact family and friends with information about potential flooding and to take action to protect property. However, this user was also interested in near real-time information to allow for short-term, immediate responses.

User P13 an **expert searcher, disseminator** and is a combination of both **proactive and responsive**. She prefers to receive alerts both by email and text. She is not as comfortable with maps and was not able to easily identify the areas of flooding concern on the map. She is interested in a 24-hour alert time frame notification as it gives her enough time to plan and take action. She is a long term resident in the community and acts as a disseminator of information. She is interested in protecting her assets in real-time and in the longer term but also wants information for planning purposes such as stocking medications and food.

User P01 is an **expert searcher, receiver,** and is **proactive**. This user understands the different types of flooding (e.g., tidal, storm surge, or precipitation-based flooding) and knows where to find information, but would like an alert to notify him when flooding may be expected. He uses information from the alert to plan his travel route and parking, and wants updates only when the forecast changes.

User P02 is an **active searcher, disseminator** and is both **proactive and responsive**. She understands the local context of flooding, but has limited sources of information about when to expect flooding. This user disseminates information to her family and likes to plan ahead. She has a flexible schedule, so she can cancel activities in a flood-prone area and be more responsive to changes in the forecast.

User P06 is an **active searcher, receiver** and **responsive**. This user would like access to links to find more information and was interested in looking at flooding in a wider area in the region since she is a regular commuter for work and school.

Although she has a plan for how she would respond to flooding (e.g., stay with a friend if she could not travel) she wants only 12 hours or less notice to respond to emerging flood conditions.

User P10 is an **active searcher, receiver** and is a combination of both **proactive and responsive**. She understands the nuances of flooding in the area. She prefers information to be sent to her via text alert, but will also accept emails. She was very comfortable with the interface and maps. She is interested in a 24 hours alert notification time frame to prepare for flooding. She is a short-term resident with little connections to the community other than her peers in her on-campus dorm. She is primarily a receiver who may tell some of her peers about flooding updates. She is interested in protecting her assets and changing her travel routes when flooding is expected.

CONCLUSION

This study focused on the information and communication preferences of lay audiences via a flood alert system. As part of the results, profiles of flood alert users were created that can inform development of flood alert systems and other flood communication tools.

The results of the study found that the majority (73%) of the participants prefer to have flooding information sent to them. In terms of selection options to sign up for the flood alert, participants initially indicated a preference for selection based on landmark (57%) and historical storms (24%). After participants reviewed all sign up options the top two preferences were landmark and maps. Participants indicated that in addition to the tidal and storm surge flood alert they would like the alert to include information on the weather forecast for rainfall. A majority of participants (85%) chose a notification time frame of 12-24 hours. They indicated that this provided enough time for planning and preparing and that the forecast was likely to be more accurate within these time frames. In addition, the majority of the participants (78%) indicated that they preferred one initial alert and then additional alerts only when the forecast changed. All participants indicated that they would use the flood alert information to take action, including changing travel routes, protecting vehicles and property and informing family and friends.

A profile of flood users was developed using the results of the study. The profile includes three dimensions: search for flooding information, dissemination role and responses and actions. This allows for the categorization of flood alert users and will be useful for the developers of other flooding tools.

APPENDIX

Flood Alert User Survey

1. Was the notification about security clear to you? Did you use a unique passcode?
   - ☐ Yes
   - ☐ No
2. Do you understand the difference in forecasting between flooding caused by tide and wind, rather than rainfall?
   - ☐ Yes
   - ☐ No
3. Since this flood alert is for tidal and storm surge flooding only. Would you like the alert to include a link to the weather forecast for rainfall?
   - ☐ Yes
   - ☐ No
4. When flooding is expected, what is your preference for obtaining information? Why?
   - ☐ To have flood information sent to me
   - ☐ To access flood information myself
5. You originally chose to receive flood alerts based on maps/location/historic storms. Why did you prefer this option?

Now, I'd like you to explore the other two options. *Participant will go back to the interface and play around with the different options*

6. Using the map option, were you able to locate the area of flooding concern easily? Why or why not?
   - ☐ Yes
   - ☐ No
7. Using the location option, were you familiar with the given locations?
   - ☐ Yes
   - ☐ No
8. When using the historical storm option, what prompted you to pick a specific storm?

9. After exploring all three options, did it change your preference? If yes, which method did you change to? Why?
   - ☐ Yes — Which option did you change to? ☐ Maps ☐ Location ☐ Historic storms
   - ☐ No

10. Why did you choose your flood alert notification time frame?

11. Is the ability to set a personalized message important to you? Why?
    - ☐ Yes
    - ☐ No

12. How often would you want to receive the flood alert? Why?
    - ☐ Regular intervals (hourly, every 4 hours, etc.)
    - ☐ Only when the forecast changes

13. How could the sign up page be improved?

14. What will you do with the information? (Select as many as apply.)
    - ☐ Protect property
    - ☐ Protect vehicle
    - ☐ Change route for travel
    - ☐ Inform friends and family
    - ☐ No action
    - ☐ Other

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