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Evaluation of National Weather Service Flood Severity Categories and Use of Gage Station Flood History Information



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Executive summary

Situation

The mission of the National Weather Service (NWS) is to provide ... *weather, hydrologic, and climate forecasts and warnings...for the protection of life and property and the enhancement of the national economy.* If the NWS is to accomplish this and protect life and property, the forecasts and warnings must be accurate, and they must be communicated clearly and effectively to those who must act.

Today, NWS relies on indices for communicating risk and urgency of forecasts and warnings, two of which are: (1) flood severity indices and (2) historical flood information. But questions about the efficacy of these indices arose after devastating inland flooding in North Carolina due to 1999's Hurricane Floyd. Questions were asked about whether emergency responders received information from the NWS that was useful, clear, and complete so that they could make appropriate decisions to protect the public.

Tasks

In response to the questions raised, the NWS, at the direction of Congress, initiated an assessment of the effectiveness of their communications, seeking to determine if change was merited. Specifically, the NWS commissioned the study reported herein to:

- Evaluate the effectiveness of the flood severity information provided today.
- Recommend improvements if the current severity information does not meet the needs of emergency responders.
- Evaluate the effectiveness of historical flood information provided today.
- Recommend improvements if the current use of historical information does not meet the needs of emergency responders.

Actions

To complete the assessment, we took the following actions:

- Reviewed available literature and held discussions with NWS personnel.
- Held in-depth telephone conversations with 24 emergency managers from 20 different agencies to discuss the severity categories and use of gage station flood history. Telephone calls lasted between 30-75 minutes each. The conversations with emergency managers yielded a much more complete picture of their use and opinion of the categories and gage station history than could have been gathered by other means.
- Talked informally and asked for input from attendees at the 2004 January American Meteorological Society (AMS) annual meeting and the NWS partners meeting in Seattle, Washington.

Findings

From the research, we found that emergency managers:

- Clearly and uniformly are interested in the form of the messages provided by the NWS (as they should be).
- Expect to be included as partners with NWS in determining how information is communicated.
- Are familiar with the flood severity categories, but do not believe that the public is equally familiar.
- Welcome the products that will be provided (or that are already provided) as a results of the AHPS initiative—especially the graphical products.
- Understand and use effectively the historical flood information.
- Do not want significant changes to either the flood severity indices or the historical flood information.

Recommendations

The current form of forecast and warning messages provided by the NWS is not popular with all emergency managers. Some want more information, some want less information, and many want this fact or that forecast in a slightly different format. However, on the whole, we found that the information provided effectively communicates the risk of flooding. Therefore, we recommend that the NWS continue to use the existing flood warning severity categories. No new scheme is necessary.

We recommend further that the NWS use the indices as a *supplemental* means to communicating risk, continuing to provide in bulletins forecasted crests and impacts.

We recommend the following to improve further the use of the severity indices and historical information:

- Continuous, easy-to-find and easy-to-understand presentation of the meanings of the severity indices on Web sites, in bulletins, in educational materials, and elsewhere.
- Consistent use of the severity indices amongst Weather Forecast Offices (WFOs).
- Expanded public education efforts to reinforce the definitions of the severity indices in the public's mind.
- Continued effort to expand and improve the graphical presentation of forecasts and warnings, with special care taken for users with color deficient sight (color blindness).

Flood severity categories

Situation

NWS uses flood indices

The National Weather Service (NWS) includes in flood warning bulletins (and occasionally in flash flood warning bulletins) a category to communicate the expected severity of flooding (NWS 2002a). These categories are defined by NWS Manual 10-950 as:

Minor flooding - minimal or no property damage, but possibly some public threat or inconvenience.

Moderate flooding - some inundation of structures and roads near stream. Some evacuations of people and/or transfer of property to higher elevations is necessary.

Major flooding - extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.

Record flooding - flooding which equals or exceeds the highest stage or discharge at a given site during the period of record keeping (NWS 2002b).

Flood severity categories are defined for forecast points along rivers and streams. Since the severity of expected flooding at any given forecast point can vary due to differing channel/bank characteristics or the existence of levees, the severity category assigned is typically associated with the most significant flood impacts that will occur in the reach (NWS 2002b). Each NWS weather forecast office (WFO) determines whether or not to use the categories in their bulletins, depending on the needs of their local customers. Each WFO determines what the category means for specific forecast points. Thus, there is no consistency from office to office on the use of categories. The decision to use or not to use the severity categories depends on the unique needs and expectations of each WFO's customers.

Congress directed improvements

In response to devastating inland flooding from Hurricane Floyd, Representative Bob Etheridge introduced legislation authorizing the National Oceanic and Atmospheric Administration (NOAA) to conduct research, training, and outreach activities to improve inland flood forecasting and awareness. The Inland Flood Forecasting and Warning System Act of 2002 was approved and signed by President Bush October 29, 2002. Under this legislation, NOAA is directed to:

1. Improve the capability to forecast accurately inland flooding, including flooding caused by coastal and ocean storms.
2. Develop, test, and deploy a new flood warning index to give the public and emergency management officials more detailed, understandable, and

accurate information about the risks and dangers posed by expected floods.

3. Train emergency management officials, NWS personnel, meteorologists, and others in improved flood forecasting methods, risk management techniques, and use of the new inland flood warning index.
4. Conduct outreach and education activities for local meteorologists and the public regarding the dangers of inland flooding and the use of the warning index.
5. Assess the long-term trends in frequency and severity of inland flooding along with how shifts in climate, development, and erosion patterns might make certain regions vulnerable to continual or escalating flood damage in the future (Public Law 107-253; NWS 2002c).

In response to this direction from Congress, NWS initiated the effort described herein, which is intended to identify needs for improvements to flood warning indices.

Tasks

Solicit opinions from the print and broadcast media

NWS completed a survey in 2003 of the print and broadcast media. This was intended to assess the effectiveness of flood severity information provided by NWS. The survey results show the following:

- Media participants are familiar with the use of flood severity categories. The study found that 72% of the media participants were familiar with the use of current categories in NWS flood warnings.
- Media participants find the current severity categories useful. Participants of the study were asked to rate the usefulness of flood severity categories for interpreting the impact of flooding. The mean response was 7.96 on a scale of 1-10 (where 1 means not at all useful and 10 means very useful).
- Current flood severity categories are helpful to the media in communicating the impact of river flooding to constituents. The mean response to a question regarding how helpful the categories are was 8.02 on a scale of 1-10.
- Graphical displays showing potential flood inundation using severity categories are helpful to media in interpreting the impact of river flooding and communicating the impact to constituents. Questions regarding the use of graphical display received a mean score of 8.48 (on a scale of 1-10) for interpreting the impact of flooding and 8.40 (on a scale of 1-10) for communicating the impact to constituents (NWS 2003).

Solicit opinions from emergency management community

NWS commissioned this assessment of the utility of the current flood indices to the emergency management community. The intent of this assessment is to determine how effective the indices are to emergency managers, how effective

emergency managers believe the indices are to their public, and what modifications, if any, would enhance the effectiveness of the indices.

Actions

To meet the objective, we took the following actions:

1. Identified flood severity information providers within WFO staff and queried them to learn of their experience with users of severity information.
2. Queried participants at the American Meteorological Society (AMS) to learn of their use, satisfaction, and recommendations for flood severity information.
3. Identified flood severity information users within the emergency management community and queried them to learn of their satisfaction and recommendations.
4. Analyzed the results of these interviews to identify patterns, trends, and common opinions of the index.

Findings

WFO community responses

To learn of the experience and opinions of WFO staff, we contacted staff by telephone and e-mail. We talked to or received comments via e-mail from 17 WFO staff during this project. Following are some of the comments:

- “I too have been very involved with this subject even prior to Rep. Etheridge's and my own state was flooded by 1999 Hurricanes Dennis and Floyd. It seems the TPC [Tropical Prediction Center] should have a say in this as well and I recommend you include their comments. During flash flooding the classification does not work as noted below. It is also my belief that during tropical systems it will add to confusion. If a hurricane is a category 3 but moving through an area fast and is a low category for flooding - do you evacuate? Will it be dangerous to me? If the tropical storm is moving inland and the river flooding classification is high - same questions. We currently have a system of measuring possible flooding - the measurement is called "inches." We need to do a better job of explaining what so many inches of rain in the next 8 hours means to the users. That is where I would like to see our efforts applied.”

Wasting time on vague categories is not beneficial. Instead the message should say how the weather or flood will affect Public Joe. Use terms like "the streets in your city will be impassible, 1/5 of the yearly rainfall will fall in the next 24 hours, your car is not safe in this situation, your city will flood tonight." *Joe Cline, Regional Operation Service Meteorologist/ Regional WCM Program Manager, Pacific region.*

- “The flood classifications refer strictly to riverine flooding...the levels are associated with flood stages at river forecast points. I have never seen any classification assigned to flash flooding. I do not think such a classification would be advisable. Flash flooding can be nearly a point discontinuity in

some cases. Minor road flooding can lead to death in the wrong circumstances.” *Nezette Rydell, WCM, Honolulu, HI.*

- “Others might also have comments, but my biggest concern is the use of the title ‘Inland Flood Classification’. As we know, there are two types of inland flooding – river type flooding (usually on a large scale) and more of a flash flooding situation (usually on a small scale). The classification seems to apply much more to the large type, river flooding and much less to the flash flooding, small scale flooding. So either they need two types of classification, or a more broaden type of classification that would apply to both.” *James Weyman, Area Manager/Meteorologist in Charge (AM/MIC), Honolulu, HI.*
- “I know the words minor, major, and moderate seem self explanatory, so do watch and warning. There is something confusing when the categories begin with the same letter. Just once I think we should learn from previous mistakes and pick other adjectives.” *Vince Dicarlo, WCM, Greenville-Spartanburg, SC.*
- Severity categories are not used by WFO Sacramento as they would not provide value to users. It is not practical to assign an index to areas with levees – if it is not overtopping it is not flooding. When asked if the NWS needs uniformity when using flood severity categories, she noted that local offices would balk at this as they would get a negative response from their users. Each office is familiar with what their users want, need, and are used to. *Cindy Matthews, SSH, Sacramento, CA.*
- The severity categories will be used formally when VTEC is released. Categories are now used in E-19 statements. *Ted Buehner, WCM, Seattle, WA.*
- WFO Reno uses severity categories in the impact statement. The public needs something to know how bad the conditions will be. In addition to the standard four categories (minor, moderate, major, record), WFO Reno uses “significant” as a category between moderate and major and “disastrous” for flooding that will exceed the record. WFO Reno also always includes historical references “worse than flood of 1997,” for example, in the body of the message. *Gary Barbato, SH, Reno, NV.*
- WFO Los Angeles/Oxnard does not use the severity categories as they want their statements to be brief and succinct. Based on research they have done and what they know of their customers and the public needs, they include basic information such as the start and end time of rain, flood levels, and reference to historical flooding. *Tim McClung, WMC, Oxnard, CA.*
- WFO Denver/Boulder has no official policy on the use of severity categories. River flooding in their area is infrequent. They might include category or say “significant” for larger events. *Robert Glancy, WCM, Denver/Boulder, CO.*
- WFO Grand Junction does use categories. However, based on experience, would say that emergency managers rely on the numbers, such as water level, more than on categories. *Brian Avery, SH, Grand Junction, CO.*

- WFO Raleigh uses categories. Graphical representation of the categories will be useful to emergency managers, media, and the public. They are now experimenting with inundation mapping to show what the categories will be. Perhaps these inundation maps will draw media attention during future events. During Hurricane Floyd, it was hard to get the media to focus on flood potential. Does not have a feel for whether users would prefer a numerical category. The public may become confused if mixing scales, such as a category three hurricane with category two flooding. Also, it may be hard to define five levels for flooding. A three category system seems easy to understand. Responders and emergency managers are more focused on values. *Jeff Orrock, WCM, Raleigh, NC.*

American Meteorological Society

We attended the American Meteorological Society (AMS) annual meeting and talked informally to participants to learn about their satisfaction with the flood severity indices. We also made a brief presentation to attendees at the NWS partners meeting held in conjunction with the AMS meeting and distributed a flyer asking for comments and feedback on existing flood severity categories.

We found that the participants at AMS and the partners meeting are not familiar with the NWS use of flood severity categories. In these two meetings, we talked to approximately 50 meeting attendees. Two noted they were familiar with the current flood severity categories. Two others initially indicated they were familiar with the categories, but in talking with them it was apparent they were thinking of other indices. All others we talked to did not know the NWS had categories for expected flooding.

Following are a few of the comments we received at AMS:

- The NWS cannot successfully assign severity categories for forecasted river flooding. They simply do not have enough staff to accomplish such a large task.
- Most hazard indices have five levels. Maybe the flood severity index should have five as well.
- A severity category for flooding is a good idea, but may be difficult to implement nationally.

Emergency management community responses

We identified emergency managers across the nation from different levels of government (local, county, and state) and asked for their participation in this project. Between March 1 and April 20, 2004, we held telephone conversations with 24 emergency managers from 20 different agencies. (Some agencies had more than one person participate in the call.)

Emergency managers were told that their agency would be identified, but that details of the conversation would not be correlated with their agency. This step was taken because it allowed participants to share information freely without fear of liability issues, and because a few asked to be anonymous. Table 1 identifies emergency management agencies that participated.

Table 1. Emergency management agencies participating in project

NWS region (1)	State (2)	Level of government (3)	Agency (4)
Alaska	Alaska	State	Alaska State Division of Homeland Security and Emergency Management
Alaska	Alaska	County	Municipality of Anchorage Office of Emergency Management
Central	Colorado	Local	City of Fort Collins Emergency Management
Central	Iowa	County	Winneshiek County Emergency Management Agency
Central	Kansas	County	Johnson County Emergency Management and Homeland Security (EMHS)
Central	North Dakota	County	Bismarck/Burleigh Emergency Management & Combined Communications
Eastern	¹	State	Office of Emergency Management
Eastern	Maine	State	Maine Emergency Management Agency (MEMA)
Eastern	North Carolina	County	Transylvania County Office of Emergency Management
Southern	Arkansas	County	Benton County Department of Emergency Management
Southern	Florida	State	Florida Division of Emergency Management
Southern	Oklahoma	Local	Tulsa Area Emergency Management Agency
Southern	Texas	County	Harris County Office of Emergency Management
Southern	Texas	Local	Lower Colorado River Authority
Southern	Texas	Local	Victoria Fire Department
Western	Arizona	County	Maricopa County Department of Emergency Management
Western	California	County	San Joaquin County Office of Emergency Services
Western	Nevada	County	Clark County Office of Emergency Management
Western	Washington	County	Snohomish County Department of Emergency Management
Western	Washington	State	Washington State Department of Emergency Management

Note: 1. Agency requested anonymity as condition of participation.

Prior to our call, emergency managers were provided with background information about the project and examples of NWS graphics to review. Our conversations focused on these topics:

- Emergency management use and understanding of the flood severity categories.
- Emergency management views of the public's use and understanding of the categories.
- Usefulness of flood severity categories in conveying information to take appropriate action.
- Modifications needed to make flood severity categories more effective. If emergency managers did not mention it on their own, we did specifically mention changing the current severity categories to either a five category numerical scale similar to Saffir-Simpson and Fujita scales or to a scale similar to the Department of Homeland Security (DHS) advisory system. For completeness, information about these scales is provided in Appendix A.
- Effectiveness of NWS examples. These examples are included in Appendix B.

These conversations were largely participant led; thus, not all topics were addressed by every participant. For example, 17 emergency managers discussed how familiar the public is with severity categories. The number of emergency managers who provided input is noted in each finding.

Findings from conversations are summarized here. Additional conversation notes with each emergency management agency are provided in Appendix C.

Following are findings from our conversations with emergency managers:

1. Emergency managers are familiar with the NWS flood severity categories.

All 20 emergency management agencies provided comments on their familiarity with the severity categories during telephone discussions. The majority indicated they are familiar with the flood severity categories. A few noted that they have recently had conversations with the NWS or with others about the usefulness of the categories.

Some regional differences were found regarding familiarity with the categories. Emergency managers from the western and central region are not as familiar with the categories as are emergency managers from other regions. Most emergency managers from the western region (3 of 5) and most from the central region (3 of 4) indicated they were *somewhat* or *not at all familiar* with the use of these categories. These were either county level or local level emergency managers.

Column 4 of Table 2 includes summaries of comments from emergency managers about their familiarity with the categories.

2. Emergency managers do not think the general public is familiar with the NWS flood severity categories.

Seventeen emergency management agencies representatives discussed their thoughts about public familiarity with the flood severity categories.

Most indicated the public is not familiar with or is probably not familiar with the use of these categories. Column 6 of Table 2 summarizes comments from emergency managers about public familiarity with the categories.

3. Emergency managers are split on the usefulness of the severity categories.

Eighteen emergency management agencies commented on the usefulness of the categories. (The two who did not are in areas where the categories are not used and riverine flooding is not typically an issue.) Of those who commented, half used terms such as *useful*, *helpful*, and *beneficial* when discussing the severity categories in relation to the work they do. On the other hand, half commented that the terms were *subjective*, *not-useful*, *vague*, or *subjective*.

Some regional differences were found regarding those who find the categories useful and those who do not. We found that emergency managers from western and central regions do not find the severity categories as useful as emergency managers from other regions. Comments regarding the usefulness of the flood severity categories are located in column 3 of Table 3.

4. Emergency managers say the specific information included in NWS warning messages is more important than the severity categories.

While emergency managers may be split on the usefulness of the severity categories, all noted that the categories are just one piece of information the NWS provides. Information such as flood stage, current stage, forecasted crest, and impact statements are essential. They report that this information is clear and helps with decision making. Many emergency managers recommend additional information always accompany the severity categories. This includes specific impact information, historical references, what actions the public should take, real-time maps, and images/graphics with local examples. Column 3 of Table 4 list comments on other NWS flood warning information used.

5. Emergency managers do not think the severity categories are understood by the public.

Eight of the participants commented on the usefulness of the severity categories to the public. Of those who commented, the majority noted that the categories were not useful to the public and did not move the public to take protective actions when required. Table 5 includes comments about the usefulness of severity categories to the public.

6. Emergency managers do not want the NWS to change to a new flood category system.

Changing the severity categories to a numerical five category scale or a scale like the DHS was discussed with every participant. The majority commented that the category system should be left as is.

As shown in Table 6, there was some regional variation in who recommends the system change. We found that most emergency managers who want to change the system are from the western region. Likewise, there was some variation evident in the level of government of those who want the system to change. Around half of county level and local

level people recommend changing to a new scale, while none of those at the state level do.

Changing to a numerical scale was recommended by 4 participants. One participant suggested a numerical scale – the Victoria scale (described in Appendix A). Changing to the DHS scale was recommended by 2, and 1 suggested doing away with the category system entirely. Table 7, Table 8, and Table 9 list comments about the existing system, comments about changing to a numerical system, and comments regarding changing to the DHS scale.

7. Emergency managers recommend that NWS better define the categories, provide additional public education, and use categories consistently.

Eleven of the participants provided recommendations on how to enhance the existing flood severity categories. The most frequently stated recommendations are as follows:

- Four emergency managers recommend the NWS do a better job of defining the categories. To do so, they suggest the NWS: (1) include the definitions of all categories in every flood bulletin; (2) include definitions every place that the categories are listed; (3) write the category definitions, and all of the warning, in non-technical language; and (4) make definitions easy to find. For example, one emergency manager noted he was on a river forecast page and was looking for the definition of the terms. He found them accidentally when he ran his cursor over the terms and the definitions were displayed. He suggested making the definition obvious, instead of “hidden.”
- Four emergency managers mentioned providing additional public education about the severity categories. Since the public must be aware of the risk of flooding (even following drought conditions), and must know how to respond to warnings, additional public education is essential. Also, since the public is largely unaware of these categories, all categories and their definitions should be included in each flood warning bulletin.
- Three emergency managers suggest that categories be used consistently. This means that all warnings issued by an individual WFO consistently use categories and that all warnings issued in a state use the categories consistently. They suggested too, that it would be helpful if these were used consistently nationwide.

These and other recommendations regarding enhancing the existing flood severity categories are listed in Table 10.

8. Emergency managers consider most of the graphical examples to be beneficial, especially the severity maps.

Emergency managers were provided with 10 NWS graphics to review. Six of these related to the flood severity categories and are discussed here. These are shown in Appendix B. Comments regarding the graphics follow:

- Examples 3 and 4 – AHPS gage status graphics. Emergency managers from 14 agencies commented on these examples. Of those who commented, 5 used favorable terms such as helpful and useful. Two

emergency managers said they were not helpful or not useful. Suggestions for enhancing the effectiveness of these examples are listed in Table 11.

- Example 5 – graphic showing current and forecast status at gages. Emergency managers from 10 agencies provided comments on example 5. Of those that commented, 9 used favorable terms such as helpful, useful, good, or like. Comments about example 5 are summarized in Table 12.
- Examples 6 and 7 – severity maps. Emergency managers from 14 agencies provided comments on examples 6 and 7. Of those that provided comments, 11 used favorable terms such as like, helpful, useful, and good. Some noted that these would be helpful to show to the public and to media, and a few noted they would like to have these available in their area. Only 1 emergency manager commented negatively on the severity maps. Comments about and suggestions for enhancing these graphic are listed in Table 13.
- Example 8 – hydrograph with severity categories. Emergency managers from 12 agencies provided comments on this example. Nine used favorable terms such as helpful, useful, or like. The use of severity categories in relation to the hydrograph was seen as positive by 4 and were not liked by 2. Comments about example 8 are summarized in Table 14.

Table 2. Familiarity with flood severity categories

Region (1)	Level (2)	EM familiar? (3)	Comments on EM familiarity with categories (4)	Public familiar? (5)	Comments on public familiarity with categories (6)
Alaska	State	Yes	Used occasionally in NWS bulletins.	Probably not	Based on nature of the environment here, our public is used to interpreting similar categories.
Alaska	County	Yes	Only sees yearly at state OEM meeting.	Yes	Familiar with categories due to media use.
Central	County	No	Has seen terms in flood warnings, did not know they were categories.	No	Positive the public does not have any idea there are categories for flooding.
Central	County	Somewhat	Local level emergency managers (EM) pay closer attention to categories.	Probably not	Public understands the terms, but they do not pay attention to them.
Central	County	No	–	Probably not	–
Central	County	Yes	Knowing the current stage and the flood stage is most helpful.	Probably not	Public probably does not pay particular attention to categories.
Eastern	State	Yes	Not sure if WFO uses them or not.	–	–
Eastern	State	Yes	Have recently had discussions with NWS about effectiveness of categories.	No	–
Eastern	County	Yes	–	Some	Some members of the public are familiar with the terms.
Southern	Local	Yes	–	–	–
Southern	Local	Yes	Public safety people are very familiar with terms, as they have been used in this area for quite some time.	No	The public is not at all familiar with categories.
Southern	Local	Somewhat	Still have to look up exactly what these mean, but terms are fairly intuitive.	No	Not sure the public knows what these are.
Southern	State	Yes	Have spent time talking to NWS and RFC about categories.	Probably not	Not sure the public makes a distinction between the terms.
Southern	County	Yes	–	Probably not	–
Southern	County	Yes	Very familiar with categories.	Yes	–
Western	County	No	Do not know how these can be applied to flooding.	–	–
Western	County	No	Have heard terms in warnings but did not know was a category.	No	–
Western	County	No	Not really used in this area.	No	–
Western	State	Yes	Very familiar with categories.	No	Public does not pay attention to categories.
Western	County	Yes	–	Probably not	–

Table 3. Comments on usefulness of flood severity categories to emergency managers

Region (1)	Level (2)	Comments (3)
Alaska	State	Very beneficial to OEM; lets staff know what can be expected. Especially helpful in conveying information to field, "I'm not a weather person, so it helps me to convey concern to others."
Central	County	Useful to emergency manager
Central	County	Not useful to emergency manager; cautions against putting too much emphasis on one word.
Central	County	Probably difficult on lengthy stretches of river to have different severity categories and/or to have the impact information for all areas along the river.
Central	County	Not helpful in determining what actions to take.
Eastern	County	Useful.
Eastern	State	Categories are fine, but there is room for improvement.
Eastern	State	Vague.
Southern	County	Useful.
Southern	Local	They are nice.
Southern	Local	Helpful in conveying information to local emergency management coordinators.
Southern	Local	Somewhat.
Southern	County	What is definition?
Southern	State	Issuing a minor flood warning when the river overflows banks, but does not impact people, is not useful. Terms such as minor, moderate, major cannot alone convey adequate information for people to take actions.
Western	State	We pay close attention to "major" or "record."
Western	County	Not a believer in categories; subjective.
Western	County	Categories do not have a great deal of impact. What does moderate mean?
Western	County	Not useful. Subjective.

Table 4. Comments regarding categories in comparison to other NWS flood warning information

Region (1)	Level (2)	Comments (3)
Central	County	Only one source of information that is looked at.
Central	County	We look at the accompanying information more than the category. Accompanying information is useful.
Central	County	Only one piece of the puzzle in conveying information to both emergency managers and to the public.
Central	County	Actions our office takes really depends of what is going on with the various cities.
Eastern	State	Not the only information they look at.
Eastern	County	Not the only information used to make decisions.
Southern	County	It is the information along with the category that is important, such as crest level. We report crest and other information to the public as well.
Southern	Local	Crest information is what is really important – to both emergency management and to the public.
Southern	Local	Not the only information we look at to make decisions.
Southern	Local	Mostly look to engineer for guidance.
Western	County	The current stage and flood stage is the useful information.

Table 5. Usefulness of severity categories to public

Region (1)	Level (2)	Comments (3)
Central	County	Not useful to the public at all.
Central	County	Public hears the information but does not pay attention. Really, unless there is a barricade in place, people will drive through low water crossings, regardless of the use of these categories in the NWS bulletins.
Eastern	County	Public often does not pay attention to flood warnings.
Southern	State	Specific impact information must be included.
Southern	Local	Not helpful in getting the public to take action.
Southern	Local	“Moderate” flood warning did not move people to action in 1998.
Western	State	Not as useful in conveying information to the public as it is to emergency personnel.
Western	County	Public does not understand categories.

Table 6. Recommendations on best scale to use for floods

Region (1)	Level (2)	Leave categories as is (3)	Use numerical scale (4)	Use DHS scale (5)	Do not use categories (6)
Alaska	State	X			
Alaska	County	X			
Central	County	X			
Central	County	X			
Central	Local	X			
Central	County	X			
Eastern	County		X		
Eastern	State	X			
Eastern	State	X			
Southern	Local		X		
Southern	Local		X		
Southern	State	X			
Southern	Local	X			
Southern	County	X			
Southern	County	X			
Western	County		X		
Western	County			X	
Western	County			X	
Western	County				X
Western	State	X			

Table 7. Comments on the current severity category system

Region (1)	Level (2)	Comments (3)
Alaska	State	The public is already used to these terms and they are fairly simple to understand. Changing would cause confusion. The current categories convey some sort of meaning that people can understand.
Central	County	Changing would create more confusion and would make it more difficult to remember what is what.
Southern	County	The categories are self explanatory, terms are understandable. Would leave the levels as they are, as they are very clear.
Southern	County	Do not want to see the categories changed.
Southern	Local	Terms have been around long enough. People have learned what minor, moderate, and major mean. Do not confuse them by changing.

Table 8. Comments regarding using a numerical scale

Region (1)	Level (2)	Comments (3)
Alaska	State	Would not be helpful.
Alaska	County	Would not be beneficial.
Eastern	County	Would be beneficial. The media has made such a big deal over these scales that people have grown to know what they mean.
Southern	County	Would people know that 5 is worse than 1? Maybe not. There are a lot of uneducated people in this county.
Southern	State	Just because it is used widely for hurricanes and tornadoes does not mean it will be an easy change.
Southern	County	"Oh no!"
Southern	Local	Category 1-5 for flooding really is a different situation than hurricanes and tornadoes. This might lead to confusion. Cannot assume that people will automatically have the knowledge of what a "category 5" is.
Southern	Local	Category 1-5 would be most useful to EM and to the public. EM understands the numeric scale more than word categories.
Southern	Local	Preferable as it is already used for hurricanes and tornadoes. In this county, people are very aware of the difference between a category 1 and a category 5 tornado.
Western	County	The problem with 1-5 scales is that no one knows what is critical – the 1 or the 5.
Western	County	People would relate well to a number system because it is what we use for tornadoes, hurricanes, and earthquakes.

Table 9. Comments about using the DHS advisory system

Region (1)	Level (2)	Comments (3)
Alaska	State	Would cause concern. Using the DHS scale for flooding might be confusing to the public and might cause undo panic if the public saw a “high” or “severe” level alert for flooding and thought it was for terrorism.
Alaska	County	Would not want people to get confused between DHS status and flood status. It would cause too much to worry about.
Southern	County	Using the DHS system would be confusing and flooding is such a different issue than terrorism that they should be kept separate.
Southern	Local	DHS is having enough trouble communicating their scale.
Southern	Local	Public safety people are still having trouble understanding the homeland security scale. EM has ready access to the definitions and what their associated actions should be, but still has to look up the difference between some of the colors.
Western	County	Suggests that the flood scale matches the DHS scale. County has adopted the DHS scale and has worked out steps that each agency must take during their daily business.
Western	County	<p>Might not be a bad idea to use DHS. It would be good to have a unified message for all hazards.</p> <p>This system would be very easy for the press to use. A picture on the front cover of the scale, with the yellow “elevated” bar highlighted and the word “flood” over the graphic would maybe encourage people to seek additional information.</p>

Table 10. Recommendations on enhancing the existing severity categories or communication of the categories

Region (1)	Level (2)	Recommended changes (3)
Alaska	State	Use categories consistently from all WFOs in the state. Include categories in all flood warnings.
Central	Local	Define categories as specific as possible and include impact information. Use visualization techniques as shown in examples 6 and 7 to show people what the terms means.
Central	County	Use detailed impact information. Include which areas will flood, how deep, and for how long. The more specific the better. Include real-time maps – either of inundation or of gage activity.
Central	County	Some type of color scale might be helpful.
Eastern	State	Provide some key that is meaningful to public, that they can relate to. For example, state what will be impacted during moderate flooding or relate the forecast to a flood in which they remember. Provide a benchmark so people can compare the forecasted flood level to a flood that affected them.
Eastern	State	Define categories on each flood warning; it is hard for some to know what “moderate” is. Adjust categories for each geographic area. For example, one area in the region is flooded routinely; so, the local municipalities think it should be minor flooding, but by NWS standards it is called moderate flooding.
Eastern	County	Provide more education so the public knows flooding potential can be worse than what they are used to. Use localized examples. For example, in the past have shown slides of areas in other states and slides of the neighboring county. There are always “ooohs” from the crowd when showing the pictures close to home. People can relate to them more, if the picture is from something too far away, they easily believe that it will never happen to them.
Southern	State	Be consistent. Warnings should be uniform, not just regionally, but nationwide. Include in warning, 1) what the warning is about; 2) what/who will be impacted, as specifically as possible; and 3) what actions people should take, such as “Take these steps a, b, c.” More public education. People have to get the warning, understand the warning, and know how to act. This cannot be done without public education that precedes the hazard and public education during hazard.
Southern	Local	Define terms. For example, say “minor flooding – flooding that will cause is expected...” Include definition of all categories on every one of the flood warnings sent. Include a definition of the terms everywhere terms are used and make definitions obvious and easy to find. For example, on the Gulf RFC web page, you must run your cursor over the category name to get the definition. It is easy to miss. Be consistent from forecast point to forecast point nationally – such as moderate is 3 ft of water pooling...1 ft of fast moving water.
Western	County	Use less academic terms and more plain English terms. Warnings with words such as crest, coulees, datum, are not useful. If the NWS wants to reach the general public these terms need to change.
Western	County	Provide additional information along with categories. Tell when to expect high water and how high it will be.

Table 11. Comments about examples 3 and 4

Region (1)	Level (2)	Comments (3)
Alaska	State	Have something similar to example 4 that is useful.
Alaska	County	Have access to these graphics via the web but do not use them frequently.
Central	County	Like these graphics. Have not seen them before. The green in the legend and the green on the graphic, in example 4, are not the same.
Central	County	These are somewhat helpful. If this showed the gages for our area it would be very beneficial.
Central	County	Use these images.
Eastern	State	The gray and white symbols are hard to see on the map. Perhaps a different color would be more beneficial.
Eastern	County	Do not really use example 3, but do look at gages closer to our area.
Southern	County	Have not seen these examples before, even though work quite closely with NWS. Used to looking at own gages and talking to NWS.
Southern	Local	These are very helpful. Can quickly get an overview of what is going on then can click on selected gages to get additional information.
Southern	Local	Useful map.
Western	County	Categories used in 3 and 4 not helpful as they are subjective. What does "near flood stage" mean?
Western	County	Color blind, so at a real disadvantage with these types of graphics. Can see differences, but when the gages are all clumped together in a small area or the colors are too similar, they just are not distinguishable. Recommend the colors used be very distinct – such as dark red, light yellow, bright blue. Yellows and greens run together, as do similar shades of blue. Also, it might be helpful to use distinct shapes in addition to distinct colors.
Western	County	Example 3 not useful, but good information. Example 4, "Can't we get current stage data next to these circles"?

Table 12. Comments regarding example 5

Region (1)	Level (2)	Comments (3)
Central	County	Useful, but a little harder to read.
Central	Local	This example is helpful too – but must keep in mind is only a forecast.
Central	County	This is good information, to have both the current and the forecasted levels.
Central	County	Does a good job of showing rivers.
Eastern	State	Symbols are small and hard to see. Bigger symbols would be better.
Southern	County	Good information, helpful. Have something similar.
Southern	Local	Like to see the forecast category too. Also, like because can get quick regional information at a glance.
Southern	Local	Useful, more than previous example.
Western	County	Can see how this graphic could be useful as it shows forecast information at a glance.
Western	County	Flood control district does something similar using real-time gages This is especially useful in their problem washes.

Table 13. Comments regarding examples 6 and 7

Region (1)	Level (2)	Comments (3)
Alaska	State	Would like to see these maps for their areas, especially for the bigger communities. Visual person, so conveys good information. Would be useful in determining what a “moderate” flood might look like. Would be helpful to share with the public. Would help people know what to expect. Like the colors. Not sure about extending major flood all the way to flood of record, may be difficult in this location. Leave “record” off of map.
Alaska	County	Really like the inundation maps and think it would be useful for areas that experience flooding.
Central	County	Very useful. Would probably be pretty hard to find someone who did not like these maps. This would be useful to the media and to the public – in helping them understand the approximate extent of the flood.
Central	Local	Very useful for planning and for the public to know what minor, moderate, and major might mean. EM uses something similar for 10-year, 50-year, 100-year flooding. However, would have to keep up with changes from mitigation projects. The maps must be accurate.
Central	County	These are very helpful in the planning stages, but may be too much information for the public.
Central	County	Would like to see these for this area – it would be very helpful. However, the county is probably way at the bottom of the totem pole for receiving this. EM questions the color scales and the use of red as moderate? Used to a progression of yellow, orange, red.
Eastern	State	Helpful, especially to homeowners who can get a sense of whether or not their homes are at risk for forecast event. Like the colors. In bar chart, make text on gage height and elevation face the same direction. Show what the flood of record is on the map and if expecting greater, say “the impact will be greater than...”
Eastern	County	These graphics are beneficial to emergency management and to the public.
Southern	County	Good for the public. Better if they were issued with each forecast. Someone from USGS recently showed EM something similar that could be done in real time. However, where would the funding come from?
Southern	Local	Somewhat useful for planning, but not for emergency response. Something like what is shown in example 9 can be included. Would rather see forecast maps.
Southern	Local	Already have many of these kinds of maps.
Western	County	If using the DHS categories, could use the same colors here so that all messages are consistent. So we do not have to learn new colors. Magenta?
Western	County	These examples are more valuable to emergency management than to others.
Western	County	Regarding, the inundation map with dike – what does this mean? It is subjective. It does not make sense; terms are mixed and matched with flooding in relation to the dike. Is this 3 ft of water or 3 in? More than just water height is involved.

Table 14. Comments regarding example 8

Region (1)	Level (2)	Comments (3)
Alaska	State	Use this type of information regularly. Like the use of severity categories on the hydrograph.
Central	County	Do not look at hydrographs, but looking at it in the example, like seeing the trend.
Central	Local	Helpful to the storm water people, but the emergency management people probably do not need.
Central	County	Does not use, but could see how information would be good for storm water. Good that the lines for flooding are shown on the graph.
Central	County	Helpful to have the different lines showing flood stage, moderate, and major flooding.
Eastern	State	Like that the flood line is red so it pops out. Maybe show benchmarks for past floods as well. The two blue colors are too similar.
Eastern	County	The hydrograph showing where flooding begins, moderate flooding, and major flooding is helpful. The information used to make the hydrograph must be up-to-date.
Southern	County	Hydrographs are used from county gages - similar to this example.
Southern	Local	Very helpful. Like to be able to see the trends. Like to have the category lines on the hydrograph.
Southern	Local	Stormwater crews use this type of information on a daily basis and report to emergency management.
Western	County	Problem with the red line used for flood stage ("Do we need anything over flood?") and with the term datum.
Western	County	Typical, useful. Do not need the lines for moderate and major.

Recommendations

Based on findings of this research, we recommend the following:

1. NWS should continue to use the existing indices instead of adopting another system as proposed in the Inland Flood Forecasting and Warning System Act of 2002.

Changing to another index system will not improve emergency response. Changing indices will not improve use by emergency managers or understanding by the public. What will improve public use and understanding of the indices is the way in which they are communicated.

2. NWS should continue to use flood severity categories as a *supplemental* means to convey risk to the public.

Severity categories should communicate additional information about risk to the public. NWS should include the indices if additional time and resources are available to do so. For example, time must be spent communicating crest,

impact, and historical gage information before determining and communicating severity.

3. Each WFO should be consistent in the way the use severity categories.

We recognize that each WFO has an obligation to understand and respond to specific needs and expectations of their constituents. We also recognize that the indices are not practical in all areas, such in areas of the western United States that have extensive levee systems. Thus, we recommend that each WFO have the choice as to whether or not to include the categories in the products they distribute. However, if used at all, the use must be consistent.

4. NWS should modify how the indices are presented in flood bulletins.

The public is not aware that these categories exist. If the categories are used, they must be used in a way in which they are firmly established as indices of current or expected flooding. This can be done by improving the way categories are communicated to the public. The indices should be presented as a specific category instead of an adjective in the warning message. For example, following are two ways in which the indices have been used recently within flood bulletins:

- Example 1:

For the Nueces River near Bluntzer. (NWS, WFO Corpus Christi, 2004)

Latest flood category: Moderate

Forecast flood category: Major

Latest stage: 21.5 feet at 8 am Tuesday

Flood stage: 18 feet

Bankfull stage: 11 feet

- Example 2:

As a result of the heavy rain this morning and additional rain in the forecast...moderate flooding is expected along the Duck River. At 930 am...the stage on the Duck River at Centerville was 8.2 feet...and rising. Flood stage is 17 feet. The river is forecast to rise and exceed the flood stage early Friday...then crest near 28 feet on Sunday (NWS Nashville TN, 2004).

When the indices are included in the body of the message, as in the second example, they tend to become part of a descriptive sentence and do not stand out. In that case, the public unfamiliar with the terms as indices may miss the message. On the other hand, the first example makes clear that the terms *moderate* and *major* are specific NWS categories. The categories are not easily overlooked when presented in this way. In fact, all the information is easier to find and read when it is presented in a list fashion. WFOs should be encouraged to present flood information in this format.

5. NWS should educate the public on the indices.

Simple ways in which this can be accomplished are as follows:

- Define categories on every NWS bulletin. Include the definition of each of the categories at the end of bulletins, as a footer. For example, a bulletin

for minor flooding should include as a footer the definition of minor, moderate, major, and record.

- Define categories every place they are used. The definitions should be easy to find, clear, and concise. One emergency manager noted that while on his local River Forecast Center (RFC) site he could not find the definitions to the categories. He accidentally ran the cursor over the right area on the Web site and the definitions became available. We recommend these definitions be clearly identified in an obvious location.
- Define categories to include specific impact information on the WFO Web sites. Many WFOs include the general definitions of each category on their AHPS site. This reads as follows:

The following terminology is used when describing floods:

*The term **Minor Flooding** is used to indicate minimal or no property damage. However, some public inconvenience is possible.*

*The term **Moderate Flooding** is used to indicate the inundation of secondary roads. Transfer to higher elevation may be necessary to save property. Some evacuation may be required.*

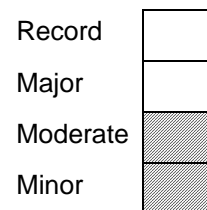
*The term **Major Flooding** is used to indicate extensive inundation and property damage, usually characterized by the evacuation of people and livestock, and the closure of both primary and secondary roads.*

Instead of the generic definitions listed above, we recommend using this section of each WFO Web site to communicate specific impact information at the location in question. For example, a specific definition such as “minor flooding at this location means that flooding will cover the parking lot and roadway in Discovery Park” would be more helpful.

6. NWS should communicate indices graphically when possible.

As noted previously, most emergency managers who participated in this study found the severity images useful, especially examples 6 and 7. These example provide yet another opportunity to communicate risk to the public. The media has long used powerful images for other natural hazards, such as hurricanes. Examples 6 and 7 might serve this purpose for flooding. We recognize, however, that these images are not real-time forecast maps, and this would need to be emphasized to users. Still, if the images are available, they might help the public envision the impacts of the forecasted flood. Suggestions by the emergency management community for improving these images should be carefully reviewed and should be incorporated where possible.

The challenge will be developing the images for all of the gage sites and keeping the images up-to-date. The idea of using less elaborate graphics on the Web site should be explored as well. For example, a one column bar, such as that shown here, can be shaded to indicate the severity of forecasted flooding. This would add value without excessive cost.



7. NWS graphics need to use colors that can be distinguished by people who have color deficient sight (color blindness).

Several of the emergency managers we talked to during this project have indicated they are color blind. They report that many of the colors used in NWS images are not distinguishable. NWS should attempt to use distinct colors and/or distinct shapes that can be seen by everyone.

Use of gage station flood history information

Situation

A number of NWS Weather Forecast Offices (WFO) use river gage station flood history information to communicate risk and flood severity in their flood bulletins and on their Web site. This historical information comes from WS form E-19 reports that are completed for every river gage station used for public forecasts.

As part of the Inland Flood Forecasting and Warning System Act of 2002, NWS was directed to evaluate the effectiveness of communicating the river gage station flood history information to emergency managers and to the public.

In response to this direction from Congress, NWS initiated the effort described herein, which is intended to identify needs for improvements to flood warning indices.

Tasks

Solicit opinions from North Carolina customers/partners

NWS collected input from North Carolina customers and partners in 2003 regarding proposed AHPS products. One product shown to participants was the E-19 bar graph shown in Appendix B, example 9. The majority of participants noted that this graphic is *very useful* or *useful* (NWS, 2003b).

Solicit opinions from emergency management community

NWS commissioned this assessment of the use of river gage station flood history information. The intent of this assessment is to determine how effective the use of river gage station flood history information is to the emergency management community and how effective emergency managers believe the use of this information is to the public.

Actions

To meet the objective, we took the following actions:

1. Identified gage station flood history information users within the emergency management community, and queried them to learn of their satisfaction with and recommendations regarding flood history information.
2. Analyzed the results of these interviews to identify patterns, trends, and common opinions on the use of river gage station flood history information.

Findings

We identified emergency managers across the nation from different levels of government (local, county, and state) and asked for their participation in this project. Between March 1 and April 20, 2004, we held telephone conversations with 24 emergency managers from 20 different agencies. (Some agencies had

more than one person participate in the call.) These telephone conversations were in conjunction with those held for evaluating the effectiveness of severity categories.

Emergency managers were told that their agency would be identified, but that details of the conversation would not be correlated with their agency. Table 1 identifies emergency management agencies that participated.

Prior to our call, emergency managers were provided with background information about the project and examples of NWS graphics to review. Our conversations focused on these topics:

- Emergency management use and understanding of river gage station flood history information in NWS products.
- Public use and understanding of river gage station flood history information in NWS products.
- Effectiveness of NWS examples using river gage station flood history information. These examples are included in Appendix B.

Conversations were largely participant led; thus, not all topics were addressed by every participant. For example, 14 emergency managers provided comments on the E-19 bar chart shown in example 9. Findings from conversations are summarized here. Additional conversation notes with each emergency management agency are provided in Appendix C.

1. Emergency managers say the use of gage station flood history information in NWS products is beneficial to them and to the public and recommend the NWS continue to use this information.

As shown in Table 15, all participants had positive comments about the use of gage station flood history in NWS products. Most noted that the public could relate better to those NWS warnings that have historical reference than those that do not and might even prompt some people to take additional protective actions than they would have without the reference. Many emergency managers noted that the use of historical information was helpful even to newcomers, as these new people might have heard of the flood of 1997, for example, or could ask their neighbors what happened during that event.

Most noted that the use of historical information was useful to emergency managers too. In fact, most report that they already use this kind of information to help communicate with constituents.

Six participants expressed concerns about the use of historical information. Specifically, a few said that the historical references might not be beneficial to all members of the public, such as those who are new to the area or those not previously effected by flooding. One participant noted that past flooding has been so localized that some people were effected while others were not. Thus, the notion of “flooding greater than that of 1997” might be misinterpreted. One noted that so many modifications and improvements had been made that the same water level would not cause the same problems. However, all think this historical information is beneficial or at least “cannot hurt.”

Column 3 of Table 15 includes summaries of comments from emergency managers about the usefulness of gage station flood history information in NWS products.

2. Emergency managers find the examples using river gage station flood history useful. Many offer recommendations on how to improve these graphics.
 - Examples 1 and 2 – flood warning bulletins. Emergency managers from 15 agencies commented on examples 1 and 2. The majority of emergency managers said something positive, such as *like*, *useful*, and *beneficial*, regarding the use of historical information within the text of the NWS bulletin. Two emergency managers noted that the layout used in example 1 made the bulletin easier to read. A few noted that impact information was very useful, but that the stage information was still the most important. Comments regarding examples 1 and 2 are listed in Table 16.
 - Example 9 – E-19 bar chart showing severity categories, water level, impacts, and historical flooding. Emergency managers from 14 agencies commented on example 9. Positive remarks, such as *like*, *helpful*, and *good* were made by 12 participants. A few noted that this would be good material for the media or that it would be good to use in presentations to constituents.

Concerns were expressed by 4 participants. One noted that the image is not useful for decision making, and one noted it might be too much information for the public. One emergency manager remarked that the image could be better, and another said he would not take the time to interpret the image.

Recommendations for improving the image were provided by 8 participants. Specifically, they recommend that this image be incorporated into the graphic shown in examples 6 and 7, that dates of the referenced events be included too, and that the current and forecasted flood stage be shown. One emergency manager strongly recommends that NWS work closely with local emergency managers in making these graphics. Comments regarding example 9 are listed in Table 17.

- Example 10 – map of gage location, historical crests, low water events, and impacts. Emergency managers from 12 agencies commented on example 10. While most comments were positive, emergency managers were not as enthusiastic about example 10 as they were about examples 2 and 9.

The majority of participants noted that this information is useful to them or to the public. They noted that this is good for public education, useful for the media, and that it is helpful to have both water level and flow rate provided. Two participants stated this information is not of use and one noted this information could probably be found elsewhere.

Recommendations for improvement were provided by two participants. Specifically, they recommend that the NWS change the map of the gage location to illustrate which areas were flooded in the past or, perhaps, to map what the water levels listed under the impacts section. Comments regarding example 10 are listed in Table 18.

Table 15. Comments regarding usefulness of gage station flood history information

Region (1)	Level (2)	Comments (3)
Alaska	County	Reference to historical storms is used frequently to convey risk to people in this municipality.
Central	County	Very useful in flood warning bulletins. Gives the public something that they can relate to. Lets them know about what to expect. Provides information to give to the media too, without having to dig for it.
Central	County	Use of historical information does not hurt, especially if you use a flood that was large enough and impacted a big multi-jurisdictional area. Maybe helpful to the public. Especially beneficial for planning purposes. The broadcast media may make good use of this.
Central	County	Use of historical flood information can be both good and confusing. Helpful to EM and helpful to the public who remembers the referenced flood; they can remember how high they had to sandbag, for example. Confusing to new homeowners. The message would be lost on them.
Eastern	County	Very useful. People remember what actions they had to take and what the damage was.
Southern	County	Do not know how useful it is because so many new people are moving to the area. Should be used nonetheless.
Southern	County	Quite useful. Even newcomers will likely get the message as their neighbors pack up to leave.
Western	County	Historical information is somewhat useful.
Western	County	Historical information is more useful than the categories. Even to people who have not lived there for a long period of time. Would be useful to tie whatever category NWS uses to the past floods: 1993 flood was 4; 1983 was major.
Western	County	Helpful to emergency manager; not useful to the public. The area has been leveed for so long that no one can remember past events.
Western	County	Not a bad idea. Many people can relate. If you say the flood of 1995, many will have a good idea what to expect.
Central	Local	Useful, especially if it was a large event that impacted many people. Problem is that modifications/improvement have been made to the channels and mitigation projects have occurred since the last flood, so the same flow will not necessarily cause the same problems.
Southern	Local	Like the use of historical information. People remember. If they are new, they might have heard of the event or will ask their neighbor.
Southern	Local	Probably not useful to emergency management, but helpful to the public.
Southern	Local	May be helpful in communicating to constituents, but not helpful for everyone. Not everyone knows what happened in 1998, for example, as 1) many new people have moved in 2) most of the city did not know what was going on as only the areas near the river were flooded.
Alaska	State	Useful? Absolutely! Internally often refer to how an event compares to a past event. Helpful to the public as well, as the public tends to do this themselves. Based on historical information some might take a more active response to the warning.
Eastern	State	Very useful in communicating risk to the public.
Eastern	State	Gives people a benchmark so they can understand how the flood might affect them. However, some floods have been so local that it affected one town and not the other.
Southern	State	Very useful in helping people understand what the impact is to them. Helps people relate to the warning. Historical information is particularly useful with river floods.
Western	State	Very helpful. This gets a lot of attention from the public. Many new people moving into the area, but with a strong public education, the message may get through.

Table 16. Comments regarding examples 1 and 2

Region (1)	Level (2)	Comments (3)
Alaska	County	Text like is shown in example 2 is used frequently in this municipality for other types of hazards.
Central	County	Like example 2, think it would be very helpful. Public can relate to the historical information when it is included inside the bulletin in this way.
Central	County	EM is used to this. Use of historical information in example 2 cannot hurt. Like impact information the most.
Central	County	Example 1 is more useful. It provides information easily – you do not have to hunt for it. Cleaner layout than text example 2. Suggest the text columns go from general to specific. For example: bankful level, flood level, current height, forecast height. Like the use of historical information in example 2.
Eastern	County	Very useful. People can relate well to the forecast this way, they know what actions they had to take and what impact the flooding had.
Southern	County	Please change this to mean sea level. EM has been after NWS to do so for some time. Use of historical information in example 2 is good.
Western	County	Historical information in example 2 is somewhat helpful.
Western	County	Like the historical information.
Western	County	Example 1. If the term “moderate” was not highlighted, would have read right over it. EM finds the information on stage more useful. Example 2 . “The stage at Duck River is...” text is the most useful.
Central	Local	Like example 2 which shows both impacts and historical information.
Southern	Local	Really like the historical information in example 2. Like impact information as is listed.
Southern	Local	Example 1 is quite useful, it really tells a lot of information at a glance because of the way it is laid out. Example 2 may be helpful to the public, not necessarily to emergency management.
Alaska	State	Historical information shown in example 2 is absolutely helpful.
Eastern	State	Like the historical information in example 2.
Western	State	Like the impact statement and the historical information shown in this example.

Table 17. Comments regarding example 9

Region (1)	Level (2)	Comments (3)
Central	County	Great example and highly useful. The media would surely use this graphic if it were in a format they could obtain from the NWS. Recommends adding the dates (instead of Hurricane Hugo, for example, in this area the month and year of the flood would be more helpful in reaching people).
Central	County	Good for planning purposes, may be too much information for the public. Also might be helpful for cities if it showed where the flooding is.
Central	County	EM probably would not use for decision making, but might use in presentations to community groups or to city council.
Eastern	County	Helpful. EM already uses something similar in their operations. Would be helpful to the public as well.
Southern	County	Good information for the public. Would strongly recommend NWS include local coordinators in emergency management in making these graphics. Critical to get local input.
Western	County	This is good but can be better. “Can this be shown over a DEM using isobars to show the impacts?” Showing where flooding from hurricane Floyd was, for example, or where major flooding begins (like examples 6 and 7) – using colors consistent with whatever warning categories are used.
Western	County	Useful to EM and useful to the public. EM suggested something like this graphic while looking at examples 6 & 7 (as opposed to what is in place there now) – before looking at example 9.
Western	County	Specific. Useful, if could be obtained in an expedient manner. Like “32.00 ft causes minor street flooding in Tarboro.”
Central	Local	Helpful, EM has something similar they use in their offices.
Southern	Local	Add the current and forecasted stage as this is really useful information. Maybe incorporate this with examples 5 and 6.
Southern	Local	Not useful, would not take time to interpret.
Alaska	State	Like this example. Shows what might occur at moderate flooding, for example.
Eastern	State	Good image. Gives people some benchmarks. Will surely mean something to someone – based on their personal experiences with the previous floods. What does “action stage” mean? Needs some definition.
Western	State	Very useful, has specific and relevant information.

Table 18. Comments regarding example 10

Region (1)	Level (2)	Comments (3)
Central	County	Media would use.
Central	County	Good for planning purposes and public education.
Central	County	Could probably get this from elsewhere.
Southern	County	EM provides this information to the public via Web site as well. Useful to the public.
Western	County	Immediate thought was “so what – what does this mean to me.” Maybe make it possible to click on the historical crest of 9/18/1945; for example to see a general inundation map. Low water events section is useless. Impacts, what does “considerable amount of lowlands flooded” mean – his street? What is a “gagehouse” and who lives there?
Western	County	Historical crests and impacts useful. Use date of flooding.
Western	County	Useful to professionals, those who have more background information, and who know the changes that have occurred since then.
Central	Local	Good for public education – telling people about the history. Not useful for daily operations.
Southern	Local	Used to do something similar to this when in emergency management at the state level. Also used an image similar to example 9. Like.
Southern	Local	Nothing really to comment about this information, not really of use.
Eastern	State	Like that information is provided in both feet and cfs. Would like to see all NWS products with data displayed both ways. Recommend defining the term “record flooding” on the WFO web site, where other terms are defined. May want to show on the map in example 10 the impacts from 5 top historical crests – what roads were inundated, for example.
Western	State	Nice to have.

Recommendations

Based on findings from this research, we recommend the following regarding use of historical information:

1. NWS should continue to use gage station flood history in flood bulletins and on WFO Web pages.

Research has long shown that people must not only hear a warning, but must also understand, believe, and personalize a warning prior to making a decision on whether or not to respond. The continued and increased use of gage station flood history in flood bulletins is one way to communicate risk to the public in a way to which they can relate. It will help them understand and personalize the warning. This will prompt them to respond quicker or to take additional protective actions than they would take otherwise.

Thus, we recommend the NWS continue to use this information in their flood bulletins and on their Web pages. WFOs that do not currently use gage station flood history should be encouraged to do so. (We recognize that each WFO has a good sense of what their local constituents need and expect.) Since text from NWS bulletins potentially reaches more people than the Web does, we recommend the NWS make it a priority to include the historical information in bulletins before Web sites.

2. NWS should develop and provide the E-19 bar chart as often as possible.

The E-19 bar chart is helpful to emergency managers and the public. More importantly, it is useful to the print and broadcast media. Providing the media with powerful images helps to get the message across to the public more effectively. The public is used to seeing powerful images associated with some hazards, such as hurricanes. Flooding, on the other hand, has never had strong images to use. The increased development of images such as the E-19 bar chart will help the NWS communicate the message more effectively.

NWS should improve the images by adding the current and forecasted stage when possible and by adding the dates of events on the chart. This chart should be used with the severity maps shown in examples 6 and 7. The E-19 bar chart can replace the chart shown on these maps.

3. NWS should work closely with local emergency managers and officials to customize and regionalize the presentation of historical information.

We recognize that the NWS makes an effort to work closely with local emergency managers and officials and want to encourage NWS to continue or increase this practice.

NWS should work closely with local emergency managers and officials to collect river gage station flood history information, such as is required for examples 9 and 10.

Appendix A. Other severity indices

Included here are select severity indices used for hazards or for terrorism. These are included in this report because they were discussed with participants as examples of scales or were brought up by participants during our conversations with them.

Saffir-Simpson hurricane scale

The Saffir-Simpson hurricane scale is a five category numerical scale. It is based on a hurricane's present intensity and is used to give an estimate of the potential damage and flooding expected along the coast. As can be seen in Table 19, wind speed is the leading factor of the scale.

Fujita tornado damage scale

The Fujita tornado damage scale is a five category numerical scale. This scale is used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over buildings and other property in its path.

Department of Homeland Security advisory system

The Department of Homeland Security (DHS) advisory system is a five category, color coded scale to warn of the risk of terrorist attacks. Unlike the Saffir-Simpson and the Fujita, the DHS advisory system uses words instead of numbers to convey level of risk. Many government agencies, including some who participated in this project, have specific actions they must take for each category. The public is also provided with suggested actions for each category. Table 21 describes the advisory system categories and the levels of risk associated with each.

Victoria scale

In 1998, a fire chief from Victoria Texas proposed the implementation of the Victoria scale. The Victoria scale is similar to the Saffir-Simpson scale used for categorizing expected hurricane intensity. Categories proposed in the Victoria scale are described in Table 22.

Table 19. Saffir-Simpson scale (adapted from NOAA, National Hurricane Center)

Category (1)	Description (2)
1	Winds 74-95 mph (64-82 kt or 119-153 km/hr). Storm surge generally 4-5 ft above normal. No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Some damage to poorly constructed signs. Also, some coastal road flooding and minor pier damage.
2	Winds 96-110 mph (83-95 kt or 154-177 km/hr). Storm surge generally 6-8 feet above normal. Some roofing material, door, and window damage of buildings. Considerable damage to shrubbery and trees with some trees blown down. Considerable damage to mobile homes, poorly constructed signs, and piers. Coastal and low-lying escape routes flood 2-4 hours before arrival of the hurricane center. Small craft in unprotected anchorages break moorings.
3	Winds 111-130 mph (96-113 kt or 178-209 km/hr). Storm surge generally 9-12 ft above normal. Some structural damage to small residences and utility buildings with a minor amount of curtainwall failures. Damage to shrubbery and trees with foliage blown off trees and large trees blown down. Mobile homes and poorly constructed signs are destroyed. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the center of the hurricane. Flooding near the coast destroys smaller structures with larger structures damaged by battering from floating debris. Terrain continuously lower than 5 ft above mean sea level may be flooded inland 8 miles (13 km) or more. Evacuation of low-lying residences with several blocks of the shoreline may be required.
4	Winds 131-155 mph (114-135 kt or 210-249 km/hr). Storm surge generally 13-18 ft above normal. More extensive curtainwall failures with some complete roof structure failures on small residences. Shrubs, trees, and all signs are blown down. Complete destruction of mobile homes. Extensive damage to doors and windows. Low-lying escape routes may be cut by rising water 3-5 hours before arrival of the center of the hurricane. Major damage to lower floors of structures near the shore. Terrain lower than 10 ft above sea level may be flooded requiring massive evacuation of residential areas as far inland as 6 miles (10 km).
5	Winds greater than 155 mph (135 kt or 249 km/hr). Storm surge generally greater than 18 ft above normal. Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. All shrubs, trees, and signs blown down. Complete destruction of mobile homes. Severe and extensive window and door damage. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the center of the hurricane. Major damage to lower floors of all structures located less than 15 ft above sea level and within 500 yards of the shoreline. Massive evacuation of residential areas on low ground within 5-10 miles (8-16 km) of the shoreline may be required.

Table 20. Fujita scale (NOAA)

Category (1)	Description (2)
0	Light damage (<73 mph); Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
1	Moderate damage (73-112 mph); Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off road.
2	Considerable damage (113-157 mph); Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
3	Severe damage (158- 206 mph); Roofs and some walls torn off well-constructed houses, trains overturned; most trees in forest uprooted; heavy cars lifted off ground and thrown.
4	Devastating damage (207- 260 mph); Well-constructed houses leveled; structure with weak foundations blown off some distance; cars thrown and large missiles generated.
5	Incredible damage (261- 318 mph); Strong frame houses lifted off foundations and swept away; automobile sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.

Table 21. DHS advisory system (adapted from DHS)

Condition (1)	Color (2)	Level of risk (3)
Low	Green	Low risk of terrorist attacks.
Guarded	Blue	General risk of terrorist attacks.
Elevated	Yellow	Significant risk of terrorist attacks.
High	Orange	High risk of terrorist attacks.
Severe	Red	Severe risk of terrorist attacks.

Table 22. Categories proposed for the Victoria scale

Category (1)	Description (2)
1	Rivers, creeks, and streams may go out of banks. Minor lowland flooding. Deaths and injuries unlikely.
2	Rivers, creeks, and streams will go out of banks. Major lowland flooding. Injuries possible.
3	Rivers, creeks, and streams will go out of banks. Damage to buildings, structures, and agriculture very likely. Injuries very possible.
4	Rivers, creeks, and streams out of their banks. Damage to property, agriculture is probable. Deaths and injuries probable.
5	Rivers, creeks, and streams out of their banks. Large volumes of water or severe flash flooding expected. Deaths and injuries very likely. Very dangerous flood!

Appendix B. Graphical examples

The following examples were provided to participants via the Internet <<http://troca.ford-consulting.com/severity/examples.htm>> prior to our discussions with them. Emergency managers were asked to look at the examples and evaluate them as if they were being used for their local areas.

Example 1. Flood warning example using severity index

FLOOD WARNING
NATIONAL WEATHER SERVICE
905 PM CDT SAT OCT 11 2003

...THE NATIONAL WEATHER SERVICE HAS ISSUED A RIVER
FLOOD WARNING FOR THE GUADALUPE RIVER AT HUNT...

GUADALUPE RIVER AT HUNT.

LATEST STAGE: 12.4 FEET AT 9 PM SATURDAY.
BANKFULL STAGE: 10.0 FEET.
FLOOD STAGE: 12.0 FEET.
FORECAST: RIVER IS ALREADY IN FLOOD AND
WILL REACH 15 FEET BY EARLY SUNDAY MORNING AND COULD
POSSIBLY GO HIGHER. AT 15 FEET...**MODERATE** LOWLAND
FLOODING PUTS A FEW FEET OF WATER OVER THE HIGHWAY 39
BRIDGE NEAR HUNT. NUMEROUS SECONDARY ROADS AND BRIDGES
ARE FLOODED AND VERY DANGEROUS.

RAIN...HEAVY AT TIMES...WILL CONTINUE THROUGH SUNDAY.
ADDITIONAL RAINFALL MAY CHANGE THIS FORECAST.

Example 1. Bulletin using severity category

Example 2. Flood warning using severity index and historical information

FLOOD WARNING
NATIONAL WEATHER SERVICE
1233 PM CST THU FEB 05 2004

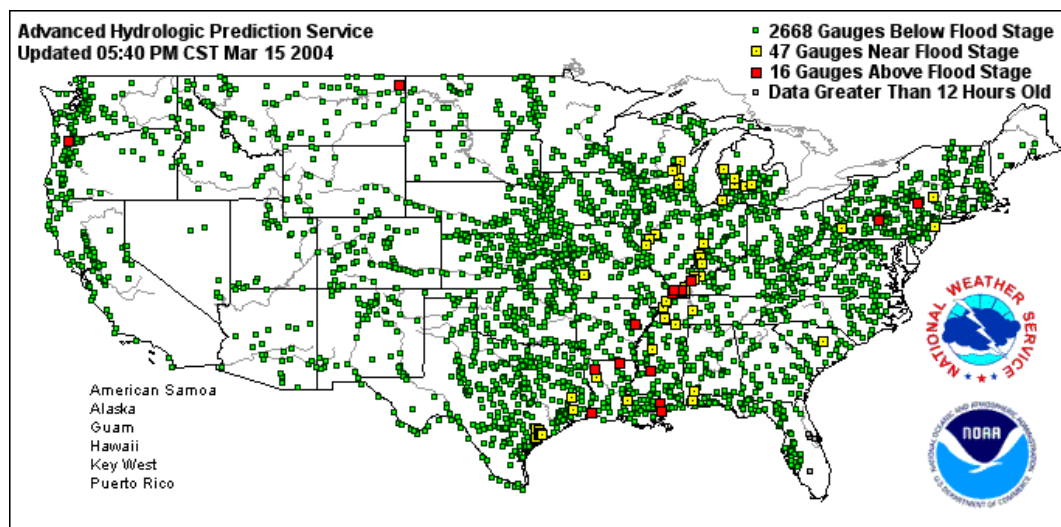
...THE NATIONAL WEATHER SERVICE HAS ISSUED A RIVER FLOOD WARNING FOR THE DUCK RIVER AT CENTERVILLE...

AS A RESULT OF THE HEAVY RAIN THIS MORNING AND ADDITIONAL RAIN IN THE FORECAST...**MODERATE FLOODING** IS EXPECTED ALONG THE DUCK RIVER. AT 930 AM...THE STAGE ON THE DUCK RIVER AT CENTERVILLE WAS 8.2 FEET...AND RISING. FLOOD STAGE IS 17 FEET. THE RIVER IS FORECAST TO RISE AND EXCEED THE FLOOD STAGE EARLY FRIDAY...THEN CREST NEAR 28 FEET ON SUNDAY.

AT THESE LEVELS...FLOOD WATERS WILL COVER THE SOCCER FIELDS AND BOTTOMLAND ALONG THE RIVER. HICKMAN SPRINGS ROAD, DEFEATED CREEK ROAD, AND LEATHERWOOD ROAD WILL BE IMPASSABLE. DEFEATED CREEK WILL FLOOD DUE TO BACKWATER FROM THE DUCK RIVER. **THIS CREST COMPARES TO THE CREST OF MARCH 2002**

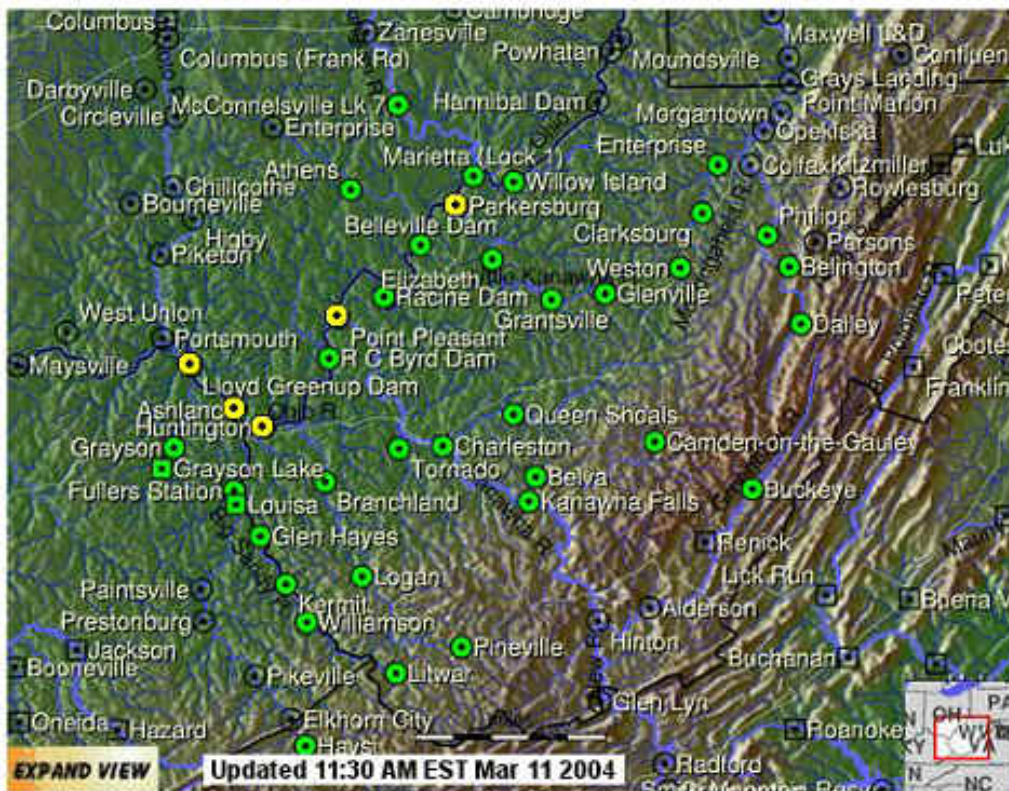
IF POSSIBLE...AVOID THE RIVER. MOVE TO HIGHER GROUND TO ESCAPE FLOOD WATERS AND REMEMBER...NEVER DRIVE THROUGH WATER OF UNKNOWN DEPTH.

Example 2. Bulletin using severity category and historical information



Example 3. AHPS graphic showing gage status across U.S.

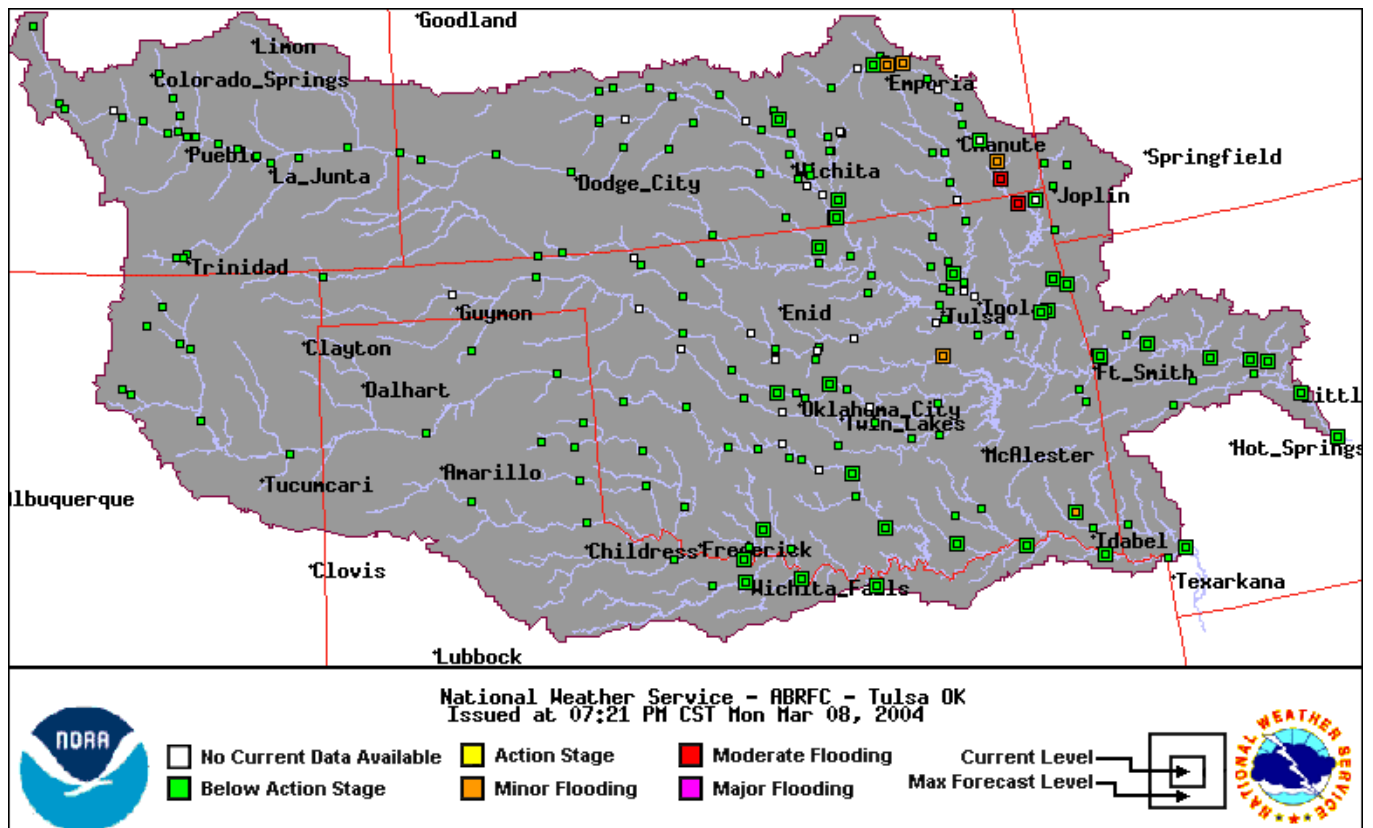
Weather Forecast Office Charleston, WV



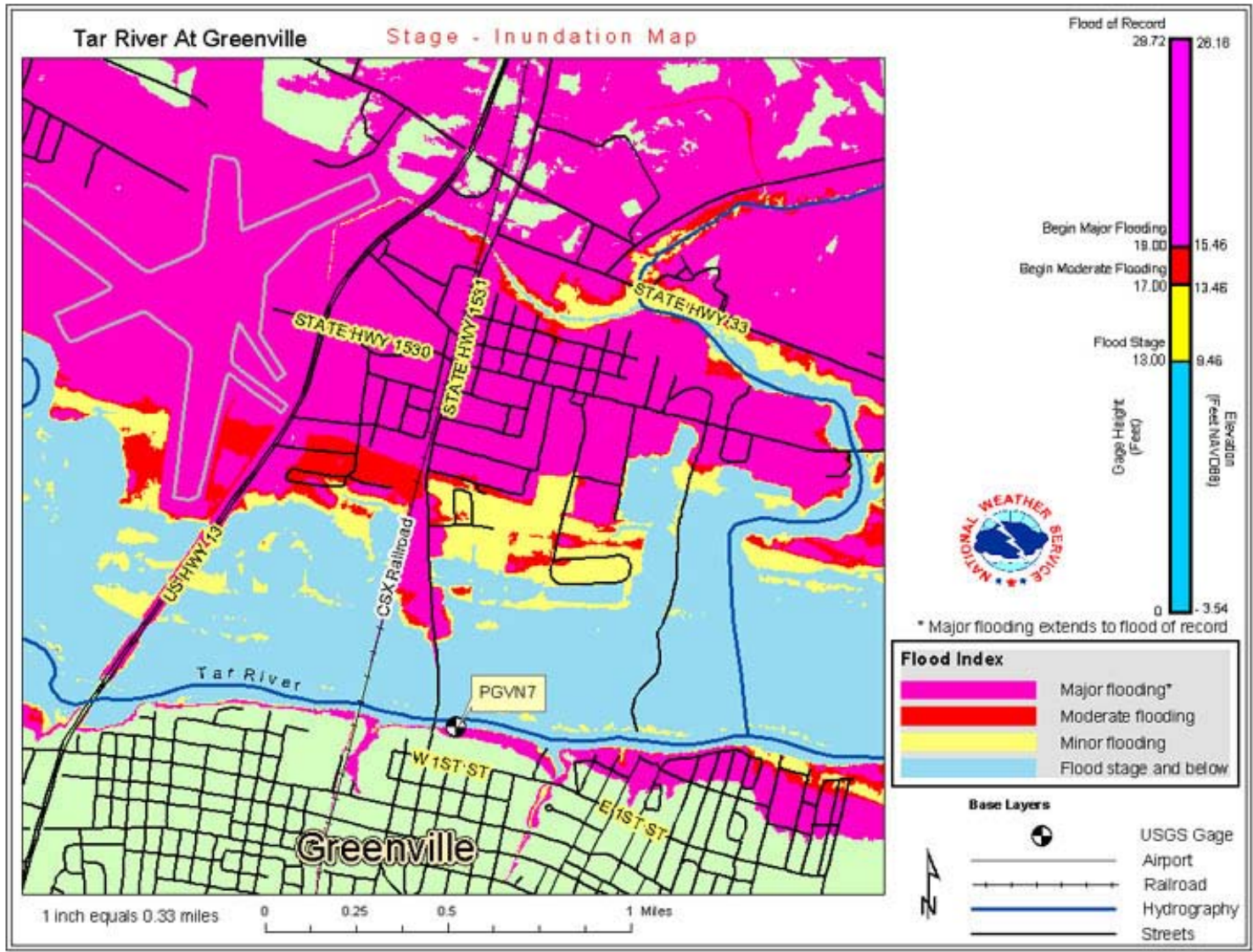
Map Legend

- or ■ at or above Flood Stage
- or ■ high water, below Flood Stage
- or ■ below Flood Stage
- ⊠ or ⊠ observation more than 12 hours old
- ⊠ or ⊠ neighboring area point
- A square indicates that hydrograph information is available
- A circle indicates that both probability and hydrograph information are available

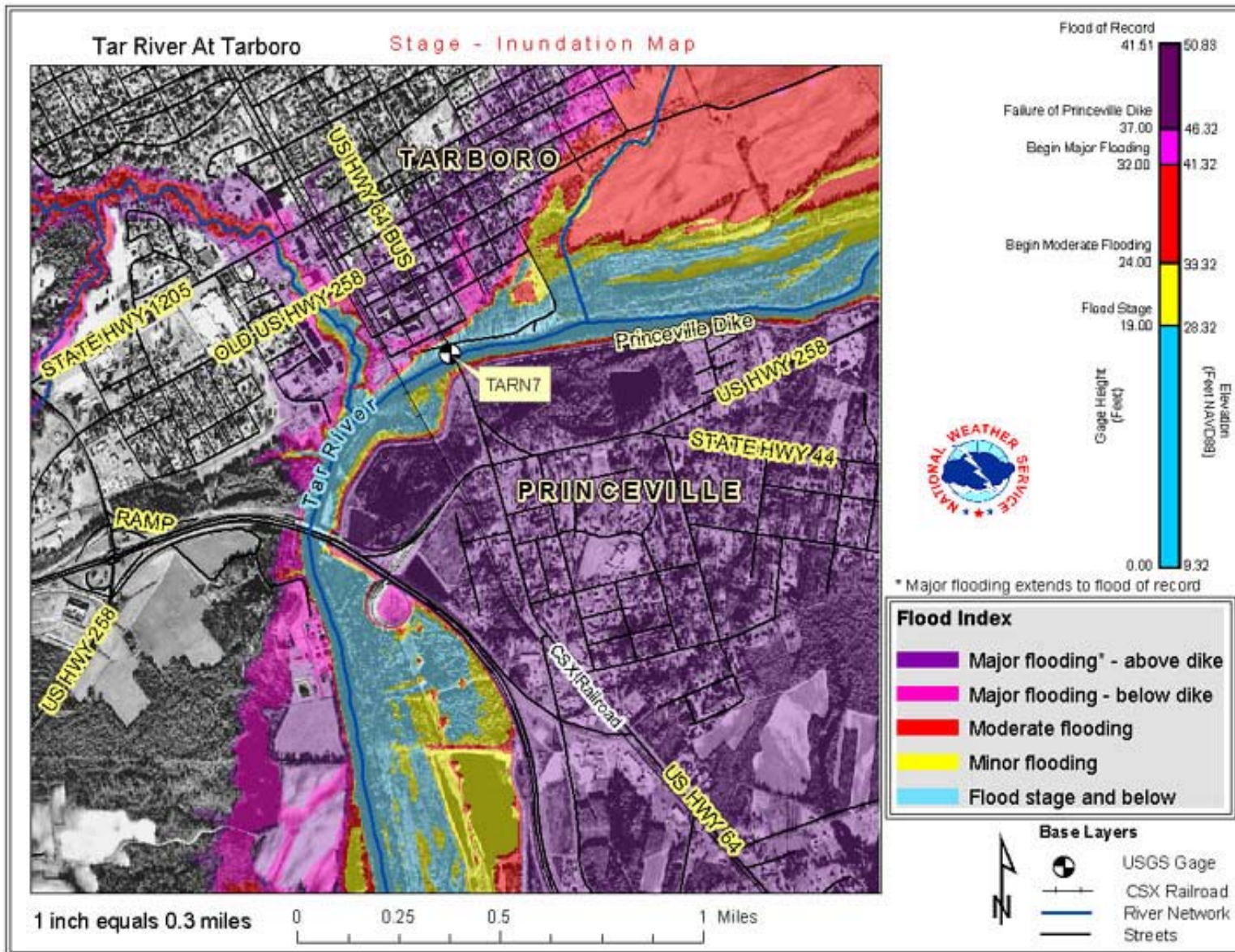
Example 4. AHPS graphic showing local gage status



Example 5. Graphic showing current and forecast flooding

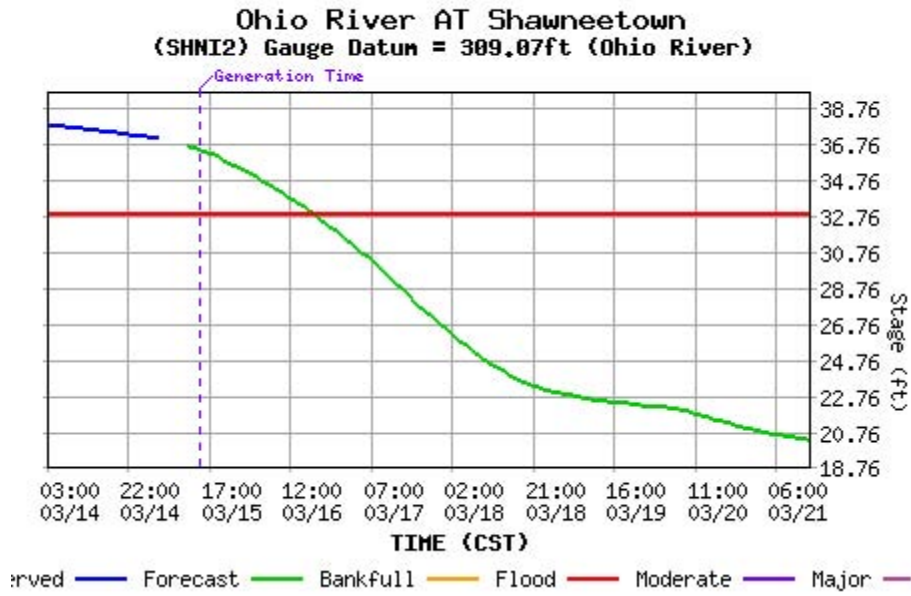


Example 6. Inundation map used to show potential extent of severity

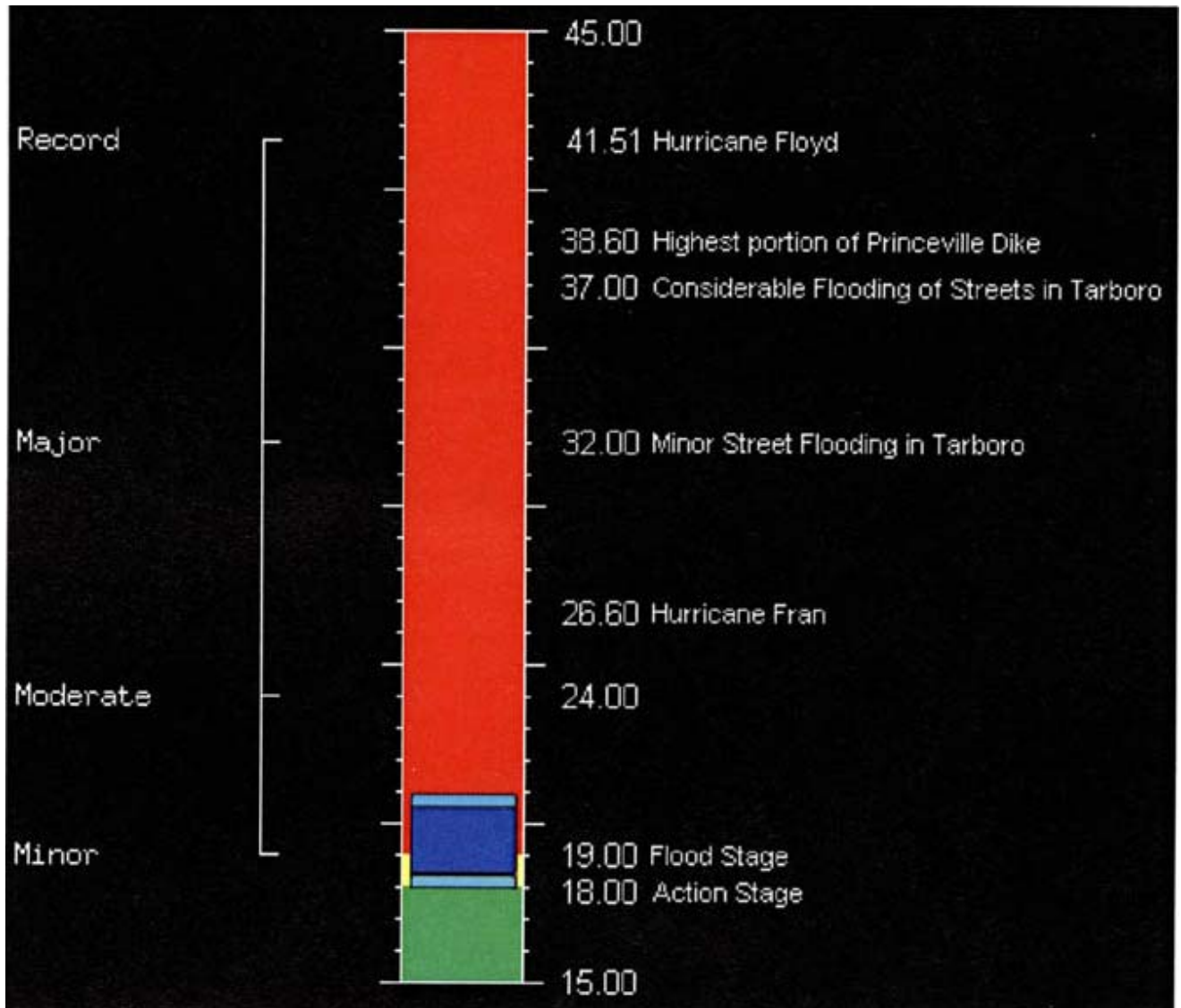


Example 7. Inundation map used to show potential extent of severity, including above and below dike

Flood Warning



Example 8. Hydrograph showing severity category level



Example 9. Graphic showing categories and historical information

Information

Top 5 Historical Crests

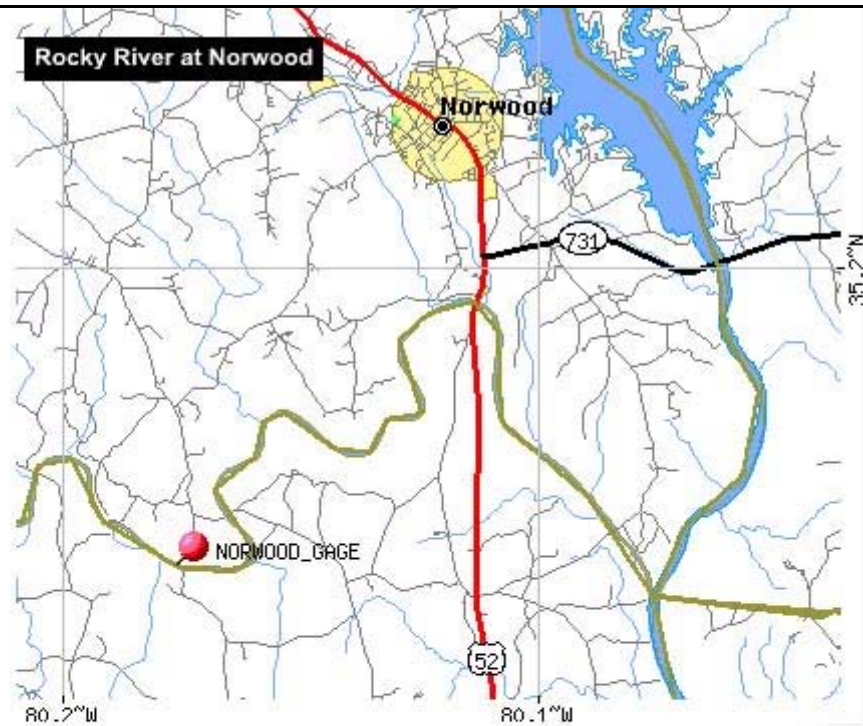
- (1) 46.37 ft on 09/18/1945
- (2) 35.0 ft on 08/01/1908
- (3) 34.0 ft on 08/31/1952
- (4) 33.16 ft on 04/01/1973
- (5) 32.93 ft on 10/11/1990

Crest Flow Information

Top 5 Low Water Events

- (1) 0.0 ft on 10/08/1954
- (2) 0.3 ft on 07/21/1986
- (3) 0.3 ft on 09/16/1980
- (4) 0.4 ft on 09/08/1982
- (5) 0.5 ft on 10/11/1983

Low Water Flow Information



Impacts

- 46.4 GREATEST FLOOD ON RECORD (9/18/45).
- 30.0 MAJOR FLOOD.
- 25.0 MODERATE FLOOD.
- 20.0 CONSIDERABLE AMOUNT OF LOWLANDS FLOODED.
- 17.0 GAGEHOUSE IS INACCESSIBLE AT THIS LEVEL.
- 16.0 OVERFLOW INTO LOWLANDS BEGINS.
- 15.0 FLOOD STAGE. MINOR FLOODING.

Example 10. Historical information and impacts

Appendix C. Conversation notes

Following are notes from our discussions with emergency managers. These are organized by NWS region.

Alaska region

Alaska region emergency manager 1 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	See this information only once a year at statewide meeting as flooding is not usually an issue in this community.
Public familiarity with the categories	The public is familiar with terms due to news coverage of flooding in other parts of the state.
Usefulness of categories in conveying information	Did not discuss.
Modifications needed to make categories more effective	<p>Do not recommend any changes. The public is already used to these terms and they are fairly simple to understand.</p> <p>Changing to another type of scale would cause confusion. Would not want people to get confused between DHS status and flood status – it would cause too much to worry about. A category 1-5 system would not be beneficial either. For example, people there are used to a “high” wind advisory being issued and know what this it means. Changing to say a category 5 wind advisory would cause them to say – “so what” and to scoff.</p>
Examples 3 and 4	Have access to these graphics via the web but do not use them frequently.
Example 5	Did not discuss.
Examples 6 and 7	<p>Really like the inundation maps.</p> <p>Would be useful for areas that experience flooding.</p>
Example 8	Did not discuss.

Alaska region emergency manager 1 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	Reference to historical storms is used frequently to convey risk to people in this municipality. New people get an idea of what the reference means to them by talking to their neighbors. Anytime you use the term “record” people know that it is not a normal event.
Examples 1 & 2	Text like is shown in example 2 is used frequently in this municipality for other types of hazards.
Example 9	Did not discuss.
Example 10	Did not discuss.

Alaska region emergency manager 2 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	Familiar with categories; they are used occasionally in NWS bulletins in this state.
Public familiarity with categories	Public might not be familiar with the fact they are categories, but based on the nature of our environment here, the public in this area is used to interpreting categories such as those used for flooding.
Usefulness of categories in conveying information	<p>The use of severity categories has been helpful. They are very beneficial to those at the state OEM.</p> <p>Especially helpful in conveying information to field emergency managers. Always trying to determine how to best convey my concern to other emergency managers and how to best support field emergency managers, if there is a potential for flooding. Categories help when they are included in statements. They let staff know what can be expected. "I'm not a weather person, so it helps me to convey concern to others."</p> <p>Like the term "record" least of all. If using historical comparisons, don't need to include this term. "Record" might cause "anxiety to the public and to emergency managers more so than saying major flooding."</p>
Modifications needed to make categories more effective	<p>Would like to see the categories used consistently from all WFOs in the state – have them in all flood warnings.</p> <p>Would like to see "flood index map" such as shown in examples 6 and 7 for their area – especially for the bigger communities.</p> <p>A category 1-5 system would not be helpful. The current categories convey some sort of meaning that people can understand. In this state no one would know what a category 3, for example, would mean. Wind warnings use similar terms and the public is used to them; frequent wind warning in this area.</p> <p>A scale similar to DHS system would cause concern. It might be confusing to the public and might cause undo panic if the public saw a "high" or "severe" level alert for flooding and though it was for terrorism.</p>
Examples 3 and 4	Have something similar to example 4 that is useful.
Example 5	Not discussed.
Examples 6 and 7	<p>Visual person. These convey good information.</p> <p>Would be useful to determining what a "moderate" flood might look like.</p> <p>Would be helpful to share with the public (maybe the public would choose not to buy homes in areas subject to flooding as much as they do now). Would help people know what to expect.</p> <p>"Highlights flooding potential."</p> <p>Not sure about extending major flood all the way to flood of record, may be difficult in their location. Leave "record" off of map.</p>
Example 8	This type of information is used regularly. It is helpful to see where water level is because we cannot go out into field. Like the use of severity categories on the hydrograph.

Alaska region emergency manager 2 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	<p>Useful? <u>Absolutely!</u> Internally they often refer to how an event compares to a past event. This is very helpful in knowing what to prepare for.</p> <p>Using historical references is helpful to the public as well, as the public tends to do this themselves. Often people have said “this reminds me of the whatever event.”</p> <p>Beneficial because they remember the impacts of that event. Based on historical information some might take a more active response to the warning.</p>
Examples 1 & 2	Historical information shown in example 2 is absolutely helpful.
Example 9	Like this example. Shows what might occur at, say, moderate flooding.
Example 10	Did not discuss.

Central region

Central region emergency manager 1 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	<p>Would not have necessarily known that “minor, moderate, major, record” were categories, but have seen the terms in flood warnings.</p> <p>EOC does not communicate the terms to the public – only the accompanying information (latest stage, projection, forecast).</p>
Public familiarity with the categories	<p>Positive the public does not have any ideas that there are “categories” for flooding. They are aware of the terms “watch” and “warning” but any additional terms would probably be confusion.</p>
Usefulness of categories in conveying information	<p>Really not useful to EM as EM looks at the accompanying information more than the category to make decisions. Not useful to the public at all. It is the accompanying information that is useful.</p> <p>Caution against putting too much emphasis on one word.</p>
Modifications needed to make categories more effective	<p>Would not recommend changing to another category system such as category 1-5 or the DHS system. What matters is the rest of the information in the warning. Changing would just create more confusion from the public and would make it more difficult to remember what is what.</p> <p>Besides without the accompanying information the category means nothing – it is only one word.</p>
Examples 3 and 4	<p>Like these graphics. Had not seen them before. Looked at graphic for there area during conversation and found that information was fairly up-to-date for some gages, but not for others.</p> <p>The green in the legend and the green on the graphic, in example 4, is not the same.</p>
Example 5	<p>Useful, but a little hard to read.</p>
Examples 6 and 7	<p>Very useful. “Would probably be pretty hard to find someone who didn’t like these maps.”</p> <p>Would be useful to the media and to the public – in helping them understand the approximate extent of the flood.</p>
Example 8	<p>Do not typically look at hydrographs, but looking at it in the example, like seeing the trend. “Gives one another way of processing the information instead of a table of numbers.”</p>

Central region emergency manager 1 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	<p>Very useful in flood warning bulletins. Gives the public something that they can relate to. This area has extreme weather and every year for the past 10 years a disaster has been declared; thus, people remember the weather “like they do the birth of their first child” because the impacts are so great.</p> <p>Use of historical information lets them know about what to expect. Also gives the EMs information to give to the media, without having to dig for it.</p>
Examples 1 & 2	Likes example 2, thinks it would be very helpful. Public can relate to the historical information when it is included inside the bulletin in this way.
Example 9	Great example and highly useful. The media would surely use this graphic if it were in a format they could obtain from the NWS. Recommends adding the dates (instead of Hurricane Hugo, for example. In this area the month and year of the flood would be more helpful in reaching people).
Example 10	Media would use.

Central region emergency manager 2 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	Not really familiar with these categories as river flooding is infrequent in this area.
Public familiarity with the categories	Categories probably don't mean much to the public.
Usefulness of categories in conveying information	<p>The categories are only one piece of the puzzle in conveying information to both emergency management and to the public.</p> <p>Probably difficult on lengthy stretches of river to have different severity categories and/or to have the impact information for all areas along the river.</p>
Modifications needed to make categories more effective	<p>Define categories as specific as possible. Include impact information.</p> <p>Use visualization techniques as shown in the examples (examples 6 and 7) to show people what the terms mean.</p> <p>Would not recommend changing the terms, as new terms or categories such as 1-5 are just as vague. What needs to be modified is the way in which terms are used. With 5 categories, there tends to be a problem defining what number 4 is.</p> <p>Don't use more categories unless they are well defined.</p> <p>If a national category system is needed, maybe it should be based on the number of feet above flood stage, although, this is problematic too.</p>
Examples 3 and 4	Useful.
Example 5	Helpful, but must keep in mind is forecast.
Examples 6 and 7	<p>Very useful for planning and for the public to know what minor, moderate, and major might mean. EM people uses something similar for 10-year, 50-year, 100-year flooding.</p> <p>Would have to keep up with changes from mitigation projects. The maps must be accurate. Who will keep this information up-to-date?</p>
Example 8	Helpful to storm water people, but EM people probably do not need this information.

Central region emergency manager 2 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	<p>Useful especially if it was a large event that impacted many people. In their case, the flood of 1999 is one that people still tend to remember.</p> <p>Problem is that modifications/improvement have been made to the channels and mitigation projects have occurred since then, so the same flow will not necessarily cause the same problems.</p> <p>Historical information is useful to emergency managers and public official types – even if it is not to the public.</p>
Examples 1 & 2	Like example 2 which shows both impacts and historical information.
Example 9	Helpful, EM has something similar they use in their offices.
Example 10	Good for public education – telling people about the history. Not useful for daily operations.

Central region emergency manager 3 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	Have heard the terms; somewhat familiar with them. Most flooding concerns for this area are for small creek flooding. Cities probably pay closer attention to the categories because the County EM does not start operations until there is a problem big enough that individual cities cannot handle.
Public familiarity with the categories	Public hears the information but does not pay attention. Really unless there is a barricade in place, people will drive through low water crossings, regardless of the use of these categories in the NWS bulletins. This happens every year.
Usefulness of categories in conveying information	People at the local level will probably take steps based on the categories. Local broadcast media probably uses the categories in conveying information to the public. Not helpful in determining what actions to take. The actions county OEM takes really depends on what is going on with the various cities.
Modifications needed to make categories more effective	Like the detailed impact information. This is what is helpful to county OEM and the local constituents. Like to know which areas will flood, how deep, and for how long. The more specific the better. Real-time maps, either of inundation or of gage activity are useful. The categories are fine and understandable as they are. Would not propose changing them.
Examples 3 and 4	Somewhat helpful. Would be very beneficial if examples showed gages for their area.
Example 5	This is good information for the cities in this county. To have both the current and the forecasted levels is good.
Examples 6 and 7	Very helpful in the planning stages, but may be too much information for the public. When dealing with the public the KISS (keep it simple stupid) rule should apply.
Example 8	OEM does not use hydrographs but can see how this information would be good for storm water personnel. Good that the lines for flooding are shown on the graph.

Central region emergency manager 3 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	<p>Use of historical information does not hurt, especially if you use a flood that was large enough and impacted a big multi-jurisdictional area.</p> <p>Especially beneficial for planning purposes.</p> <p>Maybe helpful to the public as well, especially as used in example 2. The broadcast media may make good use of this information as well.</p>
Examples 1 & 2	Used to this. Use of historical information in example 2 cannot hurt. Like the impact information the most.
Example 9	Good for planning purposes, may be too much information for the public. Also might be helpful for cities if it showed where the flooding was at the current time.
Example 10	Good for planning purposes and public education.

Central region emergency manager 4 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	Familiar with categories as they are used in this region.
Public familiarity with the categories	Public probably does not pay particular attention to flood severity categories. They are more in tune with paying attention to the difference between flash flooding and river flooding.
Usefulness of categories in conveying information	Useful to EM, but categories are really only one source of information. EM usually looks at much of the NWS and Corps provided information on the Internet. Flood categories are used in this area even though there are dikes in place. People do not care the flooding is from river water or snowmelt when it is in their basement. The categories are still applicable.
Modifications needed to make categories more effective	Knowing what the current stage and flood stage is the most helpful. The NWS cannot make everyone happy. The job they are doing now is great and this EM is satisfied. Because of time spent in another region of the country, EM is familiar with five scale categories. Does not recommend changing to a numerical 5 category scale or to the DHS scale. Some type of color scales might be helpful; but in general, leave the categories as is. When the terms minor, moderate, and major are used, people have some understanding of what this means.
Examples 3 and 4	Use these examples.
Example 5	Examples do a good job of showing rivers.
Examples 6 and 7	Would love to see these for this area; it would be very helpful. "Love these inundation maps!" However, probably way at the bottom of the totem pole for receiving these. Question the color scales used and the use of red as moderate. Used to a progression yellow, orange, red.
Example 8	Helpful to have the different lines showing flood stage, moderate, and major flooding.

Central region emergency manager 4 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	<p>Use of historical flood information can be both good and confusing.</p> <p>It is helpful to EM and helpful as well to the public who remembers the referenced flood. They can remember how high they had to sandbag, for example.</p> <p>It might be confusing to new homeowners. The message would be lost on them.</p>
Examples 1 & 2	<p>Example 1 is more useful. It provides information easily – you don't have to hunt for it. Cleaner layout than text example 2.</p> <p>Suggest the text columns go from general to specific. For example, bankful level, flood level, current height, forecast height.</p> <p>Like the use of historical information in example 2.</p>
Example 9	<p>EM probably would not use for decision making, but might use in presentations to community groups or to city council.</p>
Example 10	<p>Could probably get this from elsewhere.</p>

Eastern region

Eastern region emergency manager 1 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	Familiar with the use of severity categories. Have recently had discussions with NWS personnel about effectiveness of categories.
Public familiarity with categories	Public is not aware that there are categories.
Usefulness of categories in conveying information	Categories are fine as is, but there is room for improvement in the way the categories are conveyed.
Modifications needed to make categories more effective	A category system like 1-5 would be ok, but recommend that the NWS sticks with minor, moderate, and major. Recommend the following changes: <ul style="list-style-type: none"> • Categories are defined on each flood warning as it is hard for some to know what “moderate” is. • Categories are adjusted somewhat for each geographic area. For example, one area in the region is flooded routinely so to the local municipalities it should be minor flooding, but to NWS standards it is called moderate flooding.
Examples 3 and 4	Example 4 useful.
Example 5	Did not discuss.
Examples 6 and 7	Did not discuss.
Example 8	Did not discuss.

Eastern region emergency manager 1 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	Very useful in communicating risk to public.
Examples 1 & 2	Did not discuss.
Example 9	Did not discuss.
Example 10	Did not discuss.

Eastern region emergency manager 2 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	Aware of the categories. Not sure if WFO uses severity categories.
Public familiarity with categories	Not discussed.
Usefulness of categories in conveying information	<p>Not the only information EM looks at. Pay more attention to the real-time and forecasted crest instead of relying on a vague category.</p> <p>Guess that minor means the flood is out of banks and that some lowland flooding is occurring. Moderate flooding means some roads are flooded.</p>
Modifications needed to make categories more effective	<p>Public would pay more attention if some key was provided that was meaningful to them or that they could relate to. Such as noting what will be impacted during moderate flooding or relating the forecast to a flood in which they remember. In 1987 they had their flood of record; people who are still in the area remember what that flood meant to their particular dwelling and to the routes they travel to/from work. People have a tendency to forget, so it is necessary to remind them by giving as much information as possible on what the impacts will be.</p> <p>Recommend giving a benchmark so people can compare the forecasted flood level to a flood that affected them.</p> <p>Recommend use of the term “record” flooding in addition to minor, moderate, major – to let people know that the forecasted flooding will be significantly bad, their way of life will be severely impacted; there will be damage to homes and businesses.</p> <p>Any scale is ok as long as there is more of a definition attached to the scale. Better to leave scale as minor, moderate, major, record – just beef up the definitions and add historical benchmarks.</p>
Examples 3 and 4	Gray and white symbols are hard to see on the map. A different color would be more beneficial.
Example 5	Symbols are small and hard to see. Bigger symbols would be better.
Examples 6 and 7	<p>Helpful, especially to homeowners who can get a sense of whether or not their homes are at risk for forecasted event. Like the colors.</p> <p>In bar chart, make text on gage height and elevation face the same direction (so that one does not have to swivel neck around so much).</p> <p>Show what the flood of record is on the map and if expect greater, say the impact will be greater than....</p>
Example 8	<p>Do use hydrographs. Like that the flood line is red so it pops out.</p> <p>Maybe show benchmarks for past floods as well.</p> <p>The two blue colors are too similar.</p>

Eastern region emergency manager 2 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	<p>Gives people a benchmark so they can understand how the flood might affect them. However, some floods have been so local that it affected one town and not the other.</p> <p>The message would get to some people – based on whether they were there for that flood and how old they were.</p>
Examples 1 & 2	Like the historical information in example 2.
Example 9	<p>Good image. Gives people some benchmarks.</p> <p>Will surely mean something to someone – based on their personal experiences with the previous floods.</p> <p>What does “action stage” mean? Needs some definition.</p>
Example 10	<p>Like that information is provided in both feet and cfs.</p> <p>Would like to see all NWS products with data displayed both ways.</p> <p>Recommend defining the term “record flooding” on the WFO web site, where other terms are defined.</p> <p>May want to show on the map in example 10 the impacts from 5 top historical crests – what roads were inundated, for example.</p>

Eastern region emergency manager 3 – severity categories

Subject (1)	Comments (2)
Familiarity with categories	Familiar with categories. There is a lot of flooding in this county.
Public familiarity with categories	Some members of the public are familiar with the terms, but it is really mixed.
Usefulness of categories in conveying information	<p>Categories are useful to EM, but are not the only information used to make decisions.</p> <p>EM does initiate actions when a warning is given from the NWS. Minor flooding to EM means put up road barricades because some roads will be impassible, side ditches are full, routine flooding will occur. Major flooding to EM means debris is blocking roadways, landslides occur, damage is done to roads and to structures, and people have to be evacuated. Do not really have a distinction for what moderate flooding is.</p> <p>The public, either because they have become complacent or because they do not know the terms, often does not pay attention to flood warnings. This area has minor flooding frequently – frequent enough to refer to this as normal flooding. Public knows that roads close to the river will be inundated but that in 12-18 hrs everything will be fine. Last fall had flooding and it surprised a bunch of people because it was worse than normal. Some of them had to be evacuated from their homes.</p>
Modifications needed to make categories more effective	<p>Maybe more education can be provided so the public knows flooding potential can be worse than they are used to. For example, county had been in a drought for a year or so, when they came out of the drought, public education would have been useful just to let people know flooding was possible again.</p> <p>Recommend using information specific to the area – or graphics of what happened or will happen to the county or to adjacent counties. Impact information is important; tell them what is going to happen and where. Use historical information too.</p> <p>Use localized examples. In the past have shown slides of areas in other states and slides of the neighboring county. There are always “ooohs” from the crowd when showing the pictures close to home. People can relate to them more, if the picture is from something to far away, they easily believe that it will never happen to them.</p> <p>A numeric system like is used for hurricanes would be beneficial. The media has made such a big deal over these scales that people have grown to know what they mean. Still, impact information will have to be used in order for people to understand the warning. For example, category 1 means localized flooding will occur and roads near the river will be inundated; 3 means roads not normally closed in routine flooding will be closed; and 5 means landslides, structural damage, and loss of life.</p>
Examples 3 and 4	Does not really use example 3, but does look at gages closer to this area. Knows from experience that if a certain gage is at a certain elevation, flooding will occur. Also, knows from experience that if a storm is coming in a certain direction, flooding will occur. Often will call WFO and report condition; they take this seriously. “WFO is very interested in what locals have to say.”
Example 5	Not discussed.
Examples 6 and 7	These graphic are beneficial to EM and to the public.
Example 8	The hydrograph showing where flooding begins, moderate flooding, and major flooding is helpful. However, it must be “terrestrially based.” There have been many homes developed, which changes the runoff and stream flow. Information used to make the hydrograph must be up-to-date.

Eastern region emergency manager 3 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	Very useful. People remember what actions they had to take and what the damage was.
Examples 1 & 2	Very useful. People can relate well to the forecast this way, they know what actions they had to take and what impact the flooding had.
Example 9	Helpful. EM already uses something similar in their operations. Would be helpful to the public as well.
Example 10	Did not discuss.

Southern region

Southern region emergency manager 1 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	Very familiar with categories.
Public familiarity with categories	Public is familiar with categories as well.
Usefulness of categories in conveying information	Useful. When it is minor flooding, EM typically does not need to take action. When it is moderate flooding, EM closes some roads, bridges, and parks areas and sends warnings through the media.
Modifications needed to make categories more effective	Categories are self explanatory; terms are understandable. Using the DHS system would be confusing. Flooding is such a different issue than terrorism that the two categories should be kept separate. A 1-5 category system would be ok since it is at least another weather related hazard. However, would people there know that 1 is worse than 5? Maybe not. There are a lot of uneducated people in the county. EM could add this to the flood awareness public education if it were changed. Also, now only have four levels: minor, moderate, major, record – what would be the 5th level? If had to vote, would leave the categories as they are. Categories are very clear.
Examples 3 and 4	Did not discuss.
Example 5	Did not discuss.
Examples 6 and 7	Did not discuss.
Example 8	Did not discuss.

Southern region emergency manager 1 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	Interesting, but do not know how useful it is because so many new people are moving to the area. It should be used.
Examples 1 & 2	Did not discuss.
Example 9	Did not discuss.
Example 10	Did not discuss.

Southern region emergency manager 2 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	Familiar with the categories. Have spent time talking to the NWS offices in this state and the regional river forecast office about the use of these categories.
Public familiarity with categories	Not sure the public makes a distinction between the terms.
Usefulness of categories in conveying information	<p>Issuing a minor flood warning when the river overflows banks, but does not impact people, is not useful. Warnings are most powerful products issued by the NWS and should only be issued when a response is required from the public. If not asking the public to do anything, than the product issued should be an advisory or statement. If we continuously issue warnings when the water is over the banks, but does not impact people, public becomes desensitized.</p> <p>Terms such as minor, moderate, major cannot alone convey adequate information for people to take actions. Specific impact information and use of historical references must be included.</p>
Modifications needed to make categories more effective	<p>Have talked with NWS about using historical references within warnings, which NWS has begun to do. Historical information helps people to relate to which impacts might occur.</p> <p>NWS offices should be consistent, if all the offices in this state issued warnings using different terms, it would be confusing. Warnings should be uniform, not just regionally, but nationwide.</p> <p>Warnings must be sacred, not overused. They must ask people to change their behavior. They must convey 1) what the warning is about; 2) what/who will be impacted as specifically as possible; and 3) what actions people should take – “take these steps a, b, c.”</p> <p>Warnings must be specific to areas. For example, if a river is at a certain height, 200 people are impacted. These 200 need to get the message, others in the county do not. If the river rises a few feet, thousands of people need to be warned. So, warn for specific areas (the 200 first, then the thousands) not just for the entire county. Also, both floods are probably considered a major flood, so specific impact information must accompany the warning(s). The NWS alone cannot do this, it takes a partnership with local emergency management and emergency responders. This partnership is probably the best thing that came out of the modernization of the NWS; now each NWS office has a WCM who works closely with local partners.</p> <p>A 1-5 category warning system would be fine, but it is not necessarily a quick fix. People still would need to be educated about what each category will mean to them and what actions they should take. Just because it is used widely for hurricanes and tornadoes does not mean it will be an easy change. The use of historical reference, would be beneficial here too. For example, if you talk about a category 5 hurricane, people have no concept. If you talk about Hurricane Hugo, they definitely get the picture.</p> <p>People have to not only get the warning, they have to understand the warning, and know how to act. This cannot be done without public education that precedes the hazard and public education during hazard.</p>
Examples 3 and 4	Did not discuss.
Example 5	Did not discuss.
Examples 6 and 7	Did not discuss.
Example 8	Did not discuss.

Southern region emergency manager 2 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	<p>Very useful in helping people understand what the impact is to them.</p> <p>Helps people relate to the warning. If you talk about a category 5 hurricane, for example, people have no concept. If you talk about Hurricane Hugo, they definitely get the picture.</p> <p>Historical information is particularly useful with river floods.</p>
Examples 1 & 2	Did not discuss.
Example 9	Did not discuss.
Example 10	Did not discuss.

Southern region emergency manager 3 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	OEM familiar with categories.
Public familiarity with categories	Public probably not as familiar.
Usefulness of categories in conveying information	It is the information along with the category that is important. EM looks at crest level. EM reports crest and other information to the public as well. Public is used to looking for this information off of the EM's web site.
Modifications needed to make categories more effective	What is the definition of minor, moderate? In one example, the river is 11 ft out of banks and it is called a moderate flood; if that flood occurred in this area, it would be like Noah's Arc. "Should these categories be based on elevation, instead of impact?" Should other categories such as DHS or a numerical 1-5 be used? "Oh no." Do not want to see the categories changed.
Examples 3 and 4	Have not seen these examples before even though work quite closely with NWS. Used to looking at own gages and talking to NWS.
Example 5	Good information, helpful. Have something similar.
Examples 6 and 7	Good for public. Better if they were issued with each forecast. Someone from USGS recently showed them something similar that could be done in real time. However, where would the funding come from?
Example 8	Hydrographs are used from county gages - similar to this example. Want to know what the crest will be and when the river will crest.

Southern region emergency manager 3 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	<p>Quite useful.</p> <p>Currently use historical information on the EM web site associated with each gage. Gives the public something to relate to.</p> <p>Often tell people “if your house flooded in 19XX, you’ll flood again.”</p> <p>Even newcomers will likely get the message as their neighbors pack up to leave.</p>
Examples 1 & 2	<p>Please change this to mean sea level! EM has been after NWS to do so for some time.</p> <p>Use of historical information in example 2 is good.</p>
Example 9	<p>Good information for the public.</p> <p>Would strongly recommend NWS include local coordinators in emergency management in making these graphics. Critical to get local input.</p>
Example 10	<p>EM provides this information to the public via web site as well.</p> <p>Useful to the public.</p>

Southern region emergency manager 4 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	Somewhat. Still sometimes have to look up exactly what they mean, but terms are fairly intuitive.
Public familiarity with categories	Not sure that the public knows what these terms mean.
Usefulness of categories in conveying information	<p>Helpful, but not the only information EM looks at to make decisions.</p> <p>Helpful in conveying information to local EM coordinators. Even though they have access to the same information, the local folks still call on this position for information. Helpful in communicating to constituents.</p>
Modifications needed to make categories more effective	<p>Better wording of the terms. For example, say “Minor flooding – flooding that will cause is expected.”</p> <p>Additional public education. Recommends that on every one of the flood warnings sent, the definition of minor, moderate, major are listed. Sent example of a heavy rain situation report showing how they list the 4 levels of activation.</p> <p>Was looking on the Gulf RFC web page for a legend to tell him what the categories meant; accidentally ran cursor over the category name and the definition was shown. Suggest that a definition always accompany the terms and be obvious, not hidden.</p> <p>Need to be consistent from forecast point to forecast point nationally, such as “moderate flooding is 3 ft of water pooling...1 ft of fast moving water.” Do not recommend using “category 1-5” as flooding really is a different situation than hurricanes and tornadoes. This might lead to confusion. Cannot automatically assume that people will automatically have the knowledge of what a “category 5 hurricane is.” DHS having enough trouble communicating their scale. Do not recommend using DHS scale. Going to a 5 level system is only good if there is clear reason to do it, otherwise will lose some clarity. Staying with 3 levels is less likely to cause confusion. Problem with 5 levels is, what is the difference between 4 and 5? Since DHS came out with their 5 category scale, many agencies have had to go from a 4 to a 5 scale. This leads to trouble differentiating between some levels. Guess that there are 5 scales now if use in DHS way: 1 – no flooding; 2 – minor flooding; 3 – moderate flooding; 4 – major flooding; 5 – record flooding.</p> <p>Suggest leaving categories as is. Terms have been around long enough. People have learned what minor, moderate, and major mean. Do not confuse them by changing. Just provide more details on the categories.</p>
Examples 3 and 4	Very helpful. Can quickly get an overview of what is going on then can click on selected gages to get additional information. RFC page was somewhat difficult (example 4) as at first didn’t see highlighted gages and had to make an educated guess as to what ones were from example 3. Then found that if you pass over the gage with the mouse, can see if the gage was at flood stage.
Example 5	Like to see the forecasted category too.
Examples 6 and 7	<p>Somewhat useful for planning, but not for emergency response. Something, like is shown in example 9, can be included.</p> <p>Have no problem with “record” flooding.</p> <p>Would rather see forecast maps – that would be much more useful, but realized this may cause liability issues.</p>
Example 8	Very helpful. Like to be able to see the trends, and cannot do that with other examples. Like to have the category lines on the hydrograph.

Southern region emergency manager 4 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	Like the use of historical information. People remember. Or, if they are new, they might have heard of what happened during X flood, or would ask their neighbor “what happened to my property during that flood?”
Examples 1 & 2	Really like the historical information in example 2. Like impact information as is listed.
Example 9	Add the current and forecasted stage as this is really useful information. Maybe incorporate this with examples 5 and 6.
Example 10	Used to do something similar to this when in emergency management at the state level. Also had a graph similar to example 9. Like this example.

Southern region emergency manager 5 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	Local WFO uses these categories. EM knows categories.
Public familiarity with categories	Public knows categories
Usefulness of categories in conveying information	Nice, but the crest information is what is really important to both emergency management and to the general public.
Modifications needed to make categories more effective	No modifications come to mind. Category 1-5 would be useful to him and to public. EM understands the numeric scale more than existing categories.
Examples 3 and 4	Useful map.
Example 5	Useful, more than previous example.
Examples 6 and 7	Already have many of these kinds of maps.
Example 8	Storm water crews use this type of information on a daily basis and report to EM.

Southern region emergency manager 5 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	Probably not so useful to emergency management, but helpful to the public.
Examples 1 & 2	Example 1 is quite useful, it really tells a lot of information at a glance because of the way it is laid out. Example 2 may be helpful to the public, not necessarily to emergency management.
Example 9	Not useful, would not take time to interpret.
Example 10	Nothing really to comment about this information, not really of use.

Southern region emergency manager 6 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	Very familiar with categories. Have been used in this area for quite some time. See them frequently.
Public familiarity with categories	Public is not at all familiar with the categories.
Usefulness of categories in conveying information	<p>When a flood warning is issued, the public safety people look to the county engineer for information on what will be impacted, not at the categories assigned by NWS. The county engineer has developed a method to know what the flow will be downstream based on what it is currently upstream. This is a tested method based on experience. The NWS works with the county engineer to know what areas are impacted – this is the information they put in the warnings.</p> <p>“Moderate” flood warning did not move people to action in 1998.</p> <p>Usefulness in helping to communicate to constituents? Not helpful at all based on experience.</p> <p>Usefulness in helping the public determine the impact and appropriate actions to take? Not helpful at all based on experience.</p>
Modifications needed to make categories more effective	<p>Categories 1-5 or A-F or green, yellow, red are much more helpful than minor, moderate, major. Also, this area has a large Spanish speaking population, so numbers or letters or colors are easier to communicate than terms.</p> <p>Scale 1-5 is preferable as it is already used for hurricanes and tornadoes. In his county, people are very aware of the difference between a category 1 and a category 5 tornado.</p> <p>Public safety still is having trouble understanding the homeland security scale, have ready access to the definitions and what their associated actions should be; however, have to look up the difference between some of the colors. If it had just been red, yellow, green – it would not have been so bad.</p> <p>Could also use a three levels system, but maybe using 5 would be easy since many people are already familiar with it. “There will be category 5 catastrophic flooding.”</p> <p>Recommended the Victoria scale (see Appendix A).</p>
Examples 3 and 4	Did not discuss.
Example 5	Did not discuss.
Examples 6 and 7	Did not discuss.
Example 8	Did not discuss.

Southern region emergency manager 6 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	Maybe helpful in communicating to constituents but not helpful for everyone. Not everyone knows what happened in 1998, for example, as 1) many new people have moved in 2) approximately 80% of the city did not even know what was going on (only the areas near the river were flooded).
Examples 1 & 2	Did not discuss.
Example 9	Did not discuss.
Example 10	Did not discuss.

Western region

Western region emergency manager 1 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	Not familiar with terms – if lived in an area where river floods were more frequent, might be familiar with them (worries mostly about flash flooding in this area).
Public familiarity with categories	Do not think the public is familiar with terms.
Usefulness of categories in conveying information	Not useful as the public does not understand them. They are subjective.
Modifications needed to make categories more effective	<p>These terms are subjective – what one person thinks moderate means is different from what others think. It is just a term.</p> <p>Proponent of using less academic and plainer English terms. Have passed this on to a number of NWS people. Cited an example from an active flood warning in Montana. The warning contained the words “crest” and “coulees” - terms that the general public probably would not understand. Same with “datum” example 9. If NWS wants to reach the general public these terms need to change. Unless you have learned about datum in school, you would not know what the term meant. Public information needs to be written in 8th grade English or less. Recently had to prepare public information for county residents and visitors; these had to be prepared in 14 different languages in order to reach everyone. If English is not a persons first language then that person probably has not learned words like “datum.” Like the phrase “flooding in Sullivan recreational park” in the Montana flood bulletin. This specific information is very useful to the public.</p> <p>Problem with 1-5 scales is that no one knows what is critical – the 1 or the 5. The military used to use similar levels Alpha, Bravo, but which is worse? If use colors there is at least a natural progression from green to red that we are all used to.</p> <p>Suggest that flood categories match the DHS advisory. This county has adopted the scale and has worked out steps that each agency must take during their daily business. Public service people are very familiar now with this scale.</p> <p>Colors NWS uses in communications need to match something; be consistent. If DHS scale is adopted then those colors can be used. The Red Cross has developed a list of actions that can be taken by individuals, business, and so on during each DHS level. Something similar can be done for flooding on an individual basis, so that people are aware of what actions to take.</p> <p>There are five levels of flooding: no flooding (green); minor (blue); moderate (yellow); major (orange); and record (red).</p>
Examples 3 and 4	Not helpful. They are subjective. What does “near flood stage” mean?
Example 5	Can see how this graphic could be useful as it shows forecasted information at a glance.
Examples 6 and 7	If NWS adopts the DHS categories, NWS should use the same colors on these mats so that all messages are consistent. So no one has to learn new colors. Magenta???
Example 8	Have a problem with the red line used for flood stage (“Do we need anything over flood?”) and with the term datum.

Western region emergency manager 1 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	Historical information is somewhat useful.
Examples 1 & 2	Historical information in example 2 is somewhat helpful.
Example 9	This is good but can be better. “Can this be shown over a DEM using isobars to show the impacts?” Showing where flooding from hurricane Floyd was, for example or where major flooding begins (like 6/7) – using colors consistent with whatever warning categories are used.
Example 10	Immediate thought was “so what – what does this mean to me.” Maybe make it possible to click on the historical crest of 9/18/1945; for example to see a general inundation map. Low water events section is useless. In the impacts section, what does “considerable amount of lowlands flooded” mean – his street? What is a “gagehouse” and who lives there?

Western region emergency manager 2 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	Vaguely familiar with the categories. Have heard 'minor' flooding, but not used in a relative context (as a category).
Public familiarity with categories	Do not think the public knows about the categories.
Usefulness of categories in conveying information	Not used. Really, mostly deals with flash floods, sheet flooding, and urban flooding. Do not have river floods except maybe every 10 years. The last was 1993.
Modifications needed to make categories more effective	<p>From time working in Fairbanks, Alaska became well versed with the number system for earthquakes. People would relate well to a number system for floods because it is what we use for tornadoes, hurricanes, earthquakes.</p> <p>There may be some vagueness between category levels such as 3 and 4.</p>
Examples 3 and 4	<p>At a real disadvantage with these types of graphics as am color blind! Can see differences but when the gages are all clumped together in a small area or the colors too similar they just are not distinguishable.</p> <p>Recommends that colors used be very distinct, such as dark red, light yellow, bright blue. Yellows and greens run together as do similar shades of blue. It might be helpful on these types of images to use distinct shapes in addition to distinct colors.</p>
Example 5	Flood control district has something similar to graphic 5 using real-time gages in washes and weather stations in hills to predict [forecast] flooding. Especially useful in their problem washes.
Examples 6 and 7	<p>Examples are more valuable for emergency management than the others. Have similar maps in place. Each year new aerial photos of the county are taken so they can see what will be impacted. Use GIS and modeling with the aerial photos.</p> <p>Have at EOC a large aerial photo of the Salt River they use. Have boundaries of the 10-year; 50-year; 100-year, and 500-year floods taped on the photo so they have an idea of what may occur.</p>
Example 8	Did not discuss.

Western region emergency manager 2 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	<p>Historical information is more useful than the categories to EM and to the general public. Even to people who have not lived there for a long period of time.</p> <p>Would be useful to tie whatever category NWS uses to the past floods: 1993 flood was 4; 1983 was moderate; 1978 was major.</p>
Examples 1 & 2	Like the historical information.
Example 9	<p>Useful to EM and useful to the public.</p> <p>EM suggested something like this graphic while looking at examples 6 & 7 (as opposed to what is in place there now) – before looking at example 9.</p>
Example 10	<p>Historical crests and impacts useful.</p> <p>Use date of flooding.</p>

Western region emergency manager 3 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	Do not understand how these can be applied to flooding. Do not know what each category means. What are the definitions?
Public familiarity with categories	Did not discuss.
Usefulness of categories in conveying information	Not useful.
Modifications needed to make categories more effective	<p>Not a believer in categories. Problem is that they are subjective, depending on the audience. It is just as easy to say “the flood stage is 13 ft, we are currently at 12 ft”. This is useful information. Do away with categories all together.</p> <p>Have run into problems in the past with the use of categories and have gone round and round on the criteria, but in the end have decided it is just better to receive the real information. For example, a level 2 incident might mean there are 10 fatalities. Well, if there are only 5 fatalities and many injured and all the doctors are in surgery, you have a crisis. All those details are necessary in emergency management. Just try evacuating people based on information like “moderate” flooding. Give people the real information. “The stage is at 25 ft, the levee seems to be holding, but there is a possibility that it will break.” Let people make their own decisions. A category is supposed to convey lots of technical information in a streamlined manner, but what will the NWS be conveying?</p> <p>If NWS issues a major flood warning for this area, already know that there is a problem. Currently use categories that are tied to objective criteria – monitor, flood, danger –tied to water surface elevation.</p> <p>Categories do not work in areas where there are levees. If river stage is at 17 ft, for example, and this is a “moderate” flood, well, the river is still in its banks, so it is really not a moderate flood. The degree of flooding from a levee system will depend on a lot of factors such as where the levee fails, how much water is in reservoirs, and so on.</p> <p>Might be more applicable to the general public than to emergency managers. Especially if used in a way such as “minor street flooding” – but not as a category.</p> <p>Can make the NWS put this information into their warnings, but will not be useful to NWS customers in this area.</p> <p>Category 1-5 system would make sense if used for a storm – “expecting so much rain over the next few hours, could cause water levels to...”; but still thinks categories are problematic.</p>
Examples 3 and 4	<p>Example 3 not useful for EM, but good information.</p> <p>Example 4, “cannot we get current stage data next to these circles? That’s how NWS should spend their money. Instead of spending jillions of dollars with consultants to look at categories, the NWS should look at improving technology to provide more information like putting the current stage readings on this graphic.”</p>
Example 5	Did not discuss.
Examples 6 and 7	Example 7, what does this mean? Subjective. Does not make sense, terms are mixed and matched with flooding in relation to the dike. Is this 3 ft of water or 3 in? More than just water height is involved.
Example 8	Typical, useful. But do not need the lines for moderate and major.

Western region emergency manager 3 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	Helpful to emergency manager. Not useful to the public. The area has been leveed for so long that almost no one can remember what happened during the last big flood.
Examples 1 & 2	Example 1. If the term “moderate” was not highlighted, would have read right over it. EM finds the information on stage more useful. Example 2 . “The stage at Duck River is...” text is the most useful.
Example 9	Specific. Useful, if could obtained in an expedient manner. Like “32.00 ft causes minor street flooding in Tarboro.”
Example 10	Useful to professionals, those who have more background information, and who know the changes that have occurred since then.

Western region emergency manager 4 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	Familiar with the use of categories.
Public familiarity with categories	Public probably is not familiar with them.
Usefulness of categories in conveying information	<p>Do not have a great deal of impact. The accuracy of river forecast in this area is not good – in terms of minor, moderate, major, and record. Last year had record flooding and a forecast was not even issued. Usually have to call the NWS SH to ask him/her to “jack up the warning.” This is more of a rule than not. This is not to bash the job of the NWS, as they generally do a good job with everything else and it’s clearly a difficult job.</p> <p>When communicating flood levels to constituents, EM uses minor and major. What does moderate mean? Minor means water is over a few roads, major means there will be major damage. Moderate?</p>
Modifications needed to make categories more effective	<p>Provide additional information along with categories – most important! Tell when to expect high water and how high it will be.</p> <p>Might not be a bad idea to use DHS. Would be good to have a unified message for all hazards. Categories could be green in non-flooding season, bump to blue automatically when flood season arrives, yellow – expect minor flooding, orange – expect significant flooding , red – extreme flooding or major flooding.</p> <p>Would caution NWS, however, to think about what the categories would represent; be careful in the construction of the categories.</p> <p>Should be able to come up with a national index.</p> <p>This system would be very easy for the press to use. One picture on the front cover of the scale, with the yellow “elevated” bar highlighted and the word “flood” over the graphic would maybe encourage people to seek additional information. The OEC has a flood information line they continuously update where people could get additional information. This line gets hundreds of calls during flood season (and if it is not up to date, people get upset).</p>
Examples 3 and 4	Did not discuss.
Example 5	Did not discuss.
Examples 6 and 7	Did not discuss.
Example 8	Did not discuss.

Western region emergency manager 4 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	Use of historical information is not a bad idea. Many people can relate. If you say the flood of 1995, many will have a good idea what to expect.
Examples 1 & 2	Did not discuss.
Example 9	Did not discuss.
Example 10	Did not discuss.

Western region emergency manager 5 – severity categories

Subject (1)	Comments (2)
Familiarity with flood severity categories	Very familiar with flood categories. Collect information from the NWS and disseminates to all the county and local jurisdictions. Receive and send all weather related bulletins. Work very closely with NWS.
Public familiarity with categories	The public does not pay attention to these categories. OEM makes an active effort through public education to explain the differences between the categories. The media frequently calls as well, to ask about the differences. As soon as the EOC is open, have a public information officer (PIO) on staff that issues press releases to help fill in the media’s gap in knowledge. Intensive public education helps to reach the smart people.
Usefulness of categories in conveying information	<p>EM pays close attention, especially when receive something that says major or record flooding. Have set protocols on what to do in these situations. Protocols not activated specifically on the NWS categories, but protocol based on type of message they are sending out. For example, watch vs. flood warning vs. small stream advisory. Office is staffed 365 days per year on a 24X7 basis. Deputy officers receive NWS bulletins and analyze them. If needed, OEM expresses concerns to local jurisdictions. Most jurisdictions are very astute in understanding flood messages since flooding is one of the major hazards in this area and since their last major flood was October 2003.</p> <p>Not as useful in conveying information to the public. Do not have a mandatory evacuation in this state, so some people choose not to leave. Modifications are needed to make categories more effective for EM and for the general public.</p> <p>Work closely with levee, dike, and dam owners during events. For example, there were approximately 15 different levee and dike districts working hand in hand during the Oct. 2003 flood. EM uses categories even with levees, dams, and dikes.</p> <p>A national system of categories might not work, as each WFO knows their unique environment the best. Work extremely closely with NWS and never hesitate to call with questions. In fact, during events, the NWS has had live web casts for the EOC to show exactly what is occurring and forecasted. NWS used graphics similar to examples and explained each.</p>
Modifications needed to make categories more effective	<p>The four NWS offices, OEM gets information from should be consistent with using the categories. Sometimes they are included in warnings, sometimes they are not.</p> <p>All four categories should be defined and listed on all flood warnings sent by NWS. Categories should be defined as specifically as possible, such as “Minor flooding means water will overtop bridge at X and will inundate streets in the neighborhood of”</p> <p>All threats are unique as are responses to threats. Would be a mistake to have severity categories for hurricanes and floods or for terrorism and floods be the same. In terms of adding colors to categories, this is fine, as long as it is consistent. The teletype printout is black and white anyway, so a color coded message will not be helpful, except for on the web. Any changes would lead to more questions from the public.</p>
Examples 3 and 4	The mitigation, analysis, and plans (MAP) unit makes a hazard vulnerability analysis monthly. These people religiously watch the NWS web sites. These examples are useful to the MAP unit, but are not necessarily watched during real-time events.
Example 5	Useful.
Examples 6 and 7	Very, very useful, especially when EM gets calls from locals. Have something similar for dam break emergencies.
Example 8	Have something similar for own gages.

Western region emergency manager 5 – historical information

Subject (1)	Comments (2)
Usefulness of historical flood information	<p>Very helpful.</p> <p>This gets a lot of attention from the public. There are many old timers who were around for one of their biggest floods in 1991 – it was such an impact on them that they do not soon forget.</p> <p>There are many new people moving into the area, but with a strong public education, the message may get through.</p>
Examples 1 & 2	Like the impact statement and the historical information shown in this example.
Example 9	Very useful, has specific and relevant information.
Example 10	Nice to have.

References

- National Weather Service (2002a). *National Weather Service Instruction 10-922 September 17, 2002. Operations and Services, Hydrologic Services Program, NWSPD 10-9. Weather Forecast Office Hydrologic Products Specification.* Silver Springs, MD.
- National Weather Service (2002b). *National Weather Service Manual 10-950 September 26, 2002. Operations and Services Hydrologic Services Program, NWSPD 10-9 Definitions and General Terminology.* Silver Springs, MD.
- National Weather Service (2002b). "President signs bill authorizing development of inland flooding scale." *NWS Focus*. November 12, 2002. Communications Office. Silver Springs, MD. <<http://www.nws.noaa.gov/com/nwsfocus/fs111202.htm>>. April 13, 2004.
- National Weather Service (2003). *National Weather Service media customer satisfaction study 2003 (Draft 2).* Silver Springs, MD.
- National Weather Service (2003b). *North Carolina customer/partner input regarding proposed AHPS products.* Final report.
- National Weather Service, WFO Corpus Christi (2004). Bulletin, Flood warning, Tuesday, April 13, 2004. Corpus Christi, TX.
- National Weather Service, WFO Nashville (2004). Bulletin, Flood warning, Thursday, February 05, 2004. Nashville, TN.
- NOAA (2004). *Tornadoes.* <<http://www.noaa.gov/tornadoes.html>>. April 19, 2004.
- NOAA, National Hurricane Center (2004). *The Saffir-Simpson Hurricane Scale.* <<http://www.nhc.noaa.gov/aboutsshs.shtml>> April 19, 2004.
- U.S. Department of Homeland Security (2004). *Threats & protection. Advisory system.* <<http://www.dhs.gov/dhspublic/display?theme=29>> April 19, 2004.
- U.S. Public Law 107-253. 107 Congress, 2nd session (2002). *Inland Flood Forecasting and Warning System Act of 2002.* <<http://thomas.loc.gov/cgi-bin/query/z?c107:H.R.2486.ENR:>> April 19, 2004.