Design Principles for Near Real-Time Flood Forecast Inundation Mapping

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Objectives

• Compare/contrast various types of flood inundation maps.
• Discuss the unique user needs for near-real time flood forecast inundation mapping.
• Describe the design principles for near-real-time flood forecast inundation mapping.
• Describe how AHPS flood forecast inundation maps have incorporated the design principles.
• Connect the design principles to recent social science research on NWS AHPS.
Comparison of Flood Inundation Mapping Techniques

- **Flood Inundation Mapping**
  - **Flood Forecast Inundation Mapping**
    - Static
    - Dynamic
  - **Historical Flood Documentation Map**
  - **Flood Mapping Studies**
    - Flood Insurance
    - Engineering Design
    - Environmental & Ecological Assessments
    - Flood Frequency

Legend:
- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Special Floodway
- Area of Undetermined Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Future Conditions 1% Annual Chance Flood Hazard
- Area with Reduced Risk Due to Levee
Comparison of Flood Inundation Mapping Techniques

Flood Inundation Mapping

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Photo Credit: Riley County, KS Emergency Management

Flood of 1993
Manhattan, KS
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Information Needs of NWS AHPS Flood Forecast Inundation Mapping Users

- Majority of users of the NWS AHPS website are emergency managers and the public interested in planning for mitigation and response during a flood.
- Users are interested in quick, reliable and actionable information to make their mitigation and response decisions.
- Reaching the users: social media, community website referrals and direct links to AHPS.
National Weather Service (NWS)
Flood Forecast Inundation Mapping

http://water.weather.gov/
National Weather Service (NWS)
Flood Forecast Inundation Mapping

Map Overlays

- Inundation Study Boundaries
- 1% Annual Exceedance Flood Probability
- 0.2% Annual Exceedance Flood Probability
- Floodway
- 1072.0 Water Level

Graphical representation of flood inundation for NWS flood categories are based on steady state hydraulic modeling of water surface elevations for incremented discharges. Map shows approximate inundation areas for given water surface elevations and should not be used for navigation or permitting or other legal purposes, but strictly as a planning reference tool.

Site-specific information:
The shopping center located west of Seth Childs Road and south of Anderson Ave is subject to localized flooding conditions. Localized flooding may occur at elevations lower than 1055 ft at this location, and the localized flooding may be more severe than the conditions depicted by the flood inundation map.

Extended rating:
Rating Curve Extension - The Rating Curve Extension is calculated by using either a linear, logarithmic, or hydraulic technique to extend the rating curve above the currently established relationship between stage and flow.

Flood Categories (in feet)
- Major Flood Stage: 25
- Moderate Flood Stage: 17
- Flood Stage: 14
- Action Stage: 9

Historic Crescences
- (1) 17.53 ft on 06/10/2014
- (2) 10.18 ft on 08/02/2013
- (P): Preliminary values subject to further review.

Recent Crescences
- (1) 17.53 ft on 06/10/2014
- (2) 10.18 ft on 08/02/2013
- (P): Preliminary values subject to further review.

Low Water Records
- Currently none available.

Flood Impacts

If you notice any errors in the below information, please contact our Webmaster.

23 Flood waters flood the road going into the Highland Ridge Apartment complex and water nearing the actual buildings. In the Garden Way area downstream of Seth Childs Road, some apartment buildings are either under water, or completely surrounded by flood waters. In addition extensive road and parking lot flooding occurs in the Garden Way area.

22 Water flows into the retail area adjacent to the parking lot north of the Highland Ridge Apartments. The Garden Way area downstream of Seth Childs Road is completely flooded, with 100 percent of the street under water.

17 Flood waters continue to slowly rise. The highest levees are approximately 20 feet from the flow, and the highest levees are approximately 100 feet from the flow.

16 Flood waters begin to reach North 1220 Road, commonly known as Wildcat Creek Road, just upstream of the Scenic Drive bridge.

14 Flood waters reach Polk Road, just north of Fort Riley Boulevard.

U.S. Geological Survey (USGS) Data and Site Info for Manhattan Scenic Drive

Other Data Sources

USA.gov

Kansas Department of Agriculture

Riley County

FloodSmart.gov
National Weather Service (NWS)
Flood Forecast Inundation Mapping

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23. Flood waters flood the road going into the Highland Ridge Apartment complex and water near the actual buildings. In the Garden Way area downstream of Seth Childs Road, some apartment buildings are either taking on water, or completely surrounded by flood waters. In addition extensive road and parking lot flooding occurs in the Garden Way area.

22. Water just overtops the retaining wall adjacent to the parking lot north of the Highland Ridge Apartments. The Garden Way area downstream of Seth Childs Road, the road is flooded in a couple of spots on Garden Way.

17. The low spot in Annereig Circle is flooded with water very close to the golf course clubhouse.

16. Flood waters begin to reach North 1200 Road, commonly known as Wildcat Creek Road, just upstream of the Scenic Drive bridge.

14. Flood waters reach Polska Lane, just north of Fort Riley Boulevard.
Four Design Principles for Flood Forecast Inundation Mapping

A flood forecast inundation map must be:

1. **current**, accurate and representative of present hydrologic forecast conditions.

2. **clear** to the user on if and when they will be impacted, as well as advise the appropriate actions to take.

3. **concise** to communicate the forecast related flood risk quickly, directly and effectively.

4. **consistent**, reliable, robust, always available to the user, and supported 24X7.
Validating the Design Principles with Social Science

- **Nurture Nature Center** conducted a series of focus groups/surveys on NWS flood products.
- Participants were from two flood-prone towns in the Delaware basin.
- Provided feedback on the timing, clarity, graphic elements and inclusion of uncertainty information affected their understanding and anticipated responses.
- Key findings from the study are presented
Principle 1: The Map Must Be Current

A current map is accurate and representative of present hydrologic forecast conditions.

Critical Elements:
• Hydrograph connection
• Site selection – Is static appropriate?
• Reach length selection
• Model calibration to rating curve
• Reach-wide model calibration
Social Science for P1: The Map Must Be **Current**

- Residents rely heavily on the **hydrograph**, which shows observed and forecast river levels, for determining personal and community risk.
- Respondents sought information about **impending storms** more than they sought information about preparing for storms.

http://socialscience.focusonfloods.org/
Example

P1: The Map Must Be **Current**
Principle 2: The Map Must Be **Clear**

A **clear** map provides the user with direct information on if and when they will be impacted, as well as the appropriate actions.

**Critical Elements:**

- Focus map on inundation
- Minimize additional layers
- Satellite imagery
- Geocoding
- Provide actionable information
Social Science for P2: The Map Must Be **Clear**

- Visual factors in products - including the use of **color, patterning and font** – affected participants’ understanding of products in both helpful and unhelpful ways, and must be carefully considered.
- Inundation depiction with **depth grids** have confused some users.

http://socialscience.focusonfloods.org/
Example
P2: The Map Must Be **Clear**
Principle 3:  
The Map Must Be **Concise**

A **concise** map communicates the forecast related flood risk quickly, directly and effectively.

**Critical Elements:**
- Simple presentation
- What You See Is What You Get (WYSIWUG)
- Standardization of map cartography
- Flood categories align with map
Social Science for P3: The Map Must Be **Concise**

- **Overly technical products**, and the use of unfamiliar terms or unclear/inadequate explanations **are a barrier** to the use of warning products.

- Respondents preferred that products contain a combination of **graphic and text** information, citing the need for both quick visual identification of risk, along with more detailed explanations and specificity from the text.

http://socialscience.focusonfloods.org/
Example

P3: The Map Must Be **Concise**
Principle 4: The Map Must Be **Consistent**

A *consistent* map is reliable, robust, always available to the user, and supported 24X7.

**Critical Elements:**
- 24x7 Support
- 24x7 Web availability

**Critical Elements:**
- Consistency between NWS products
- Consistency between other sources of FFIM products
Social Science for P4: The Map Must Be **Consistent**

- The **Internet** was by far the **most heavily used source** for flooding information, followed by TV and radio; to a lesser extent, Facebook and smartphone apps are accessed for flooding information.
- More than any other action, residents identified:
  a) discussing information about storms with friends and family and
  b) **seeking more information** as they begin to take action during flood events.

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

P4: The Map Must Be **Consistent**
Example
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Questions?

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water.weather.gov

socialscience.focusonfloods.org