

# 1 Briefing Document

# FLOOD WARNING SYSTEMS

## Definitions

A Flood Warning System (FWS) provides accurate information to allow individuals and decision-makers to make informed decisions about whether to take emergency action (e.g., evacuation) during a flood event. Some flood warning systems simply provide real-time data on flood conditions, but others use real-time data to predict future flood conditions several hours in advance.

A Flood Alert System (FAS) notifies individuals and decision-makers when predefined actions need to be taken. These alerts are targeted to specific locations, and are pushed out, rather than requiring someone to monitor a website. A flood alert system driven by a predictive flood warning system can give individuals notice of future flooding in their specific neighborhood with enough time to evacuate or move possessions out of harm's way.

National Weather Service (NWS) provides flash flood and other warnings via text message and local media. However, these warnings are typically for broad, city-wide or regional, weather patterns or large river systems.

Advanced Hydrologic Prediction Service (AHPS) is used by the NWS to predict water levels and provide flood and other hydrologic warnings every 6 hours at locations where USGS river gages are available (14 in all of Harris County, neighboring counties have 0-6 per county). This information is provided in the form of hydrographs making it difficult for the general public to understand, and the system lacks the spatial and temporal resolution needed to provide detailed information about water levels in all 22 watersheds in Harris County.

## Current Harris County Flood Warning System

Harris County Flood Control District (HCFCD) has strategically placed 133 gages to monitor rainfall and water levels in the bayous and their tributaries. This real-time information is available to the public online and is updated every 15 minutes. However, the system does not predict future water levels in the bayous; it tells the public what is flooded right now, rather than what will flood.

## Advanced SSPEED Flood Alert Systems

The Severe Storm Prediction, Education, and Evacuation from Disasters (SSPEED) Center at Rice University has built localized Flood Alert Systems for the Texas Medical Center (TMC FAS4), Sugar Land, and the Texas Department of Transportation (TxDOT). These systems use real-time radar rainfall data to predict flood levels at critical locations. For example, the TMC uses FAS4 to determine when to implement emergency protocols regarding the placement and/or closing of gates and doors that prevent damages to the TMC from flooding. These systems are designed for use by specific end-users, but the real-time predictions and flood warnings are also available to the public online.

## Success & Limitations of FAS4

The system provides real-time predictions of water levels in the Texas Medical Center, supporting mitigative action ahead of imminent flooding. The FAS system has been validated for accuracy over dozens of events dating back to 1997. Annual training of TMC personnel on how to utilize the system has helped reduce vulnerabilities at the TMC during the event, and increased performance in real-time. However, it is important to note that all flood alert systems are non-structural and must be implemented in combination with other measures to prevent structural or property damage.



Figure 1 Example of the AHPS Prediction During Harvey

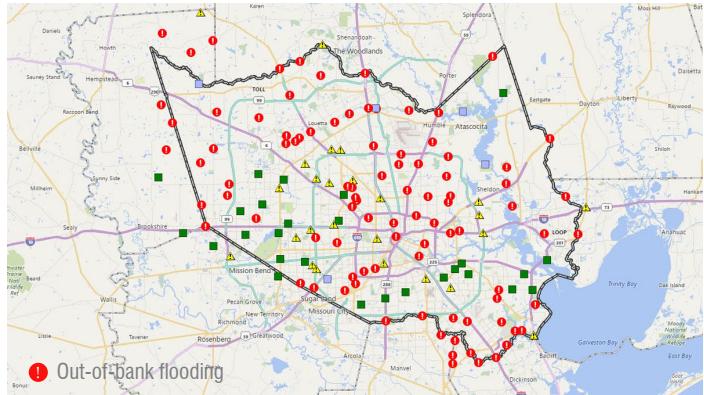


Figure 2 Stream Gage Map on HCFCD Website on 08/28/17

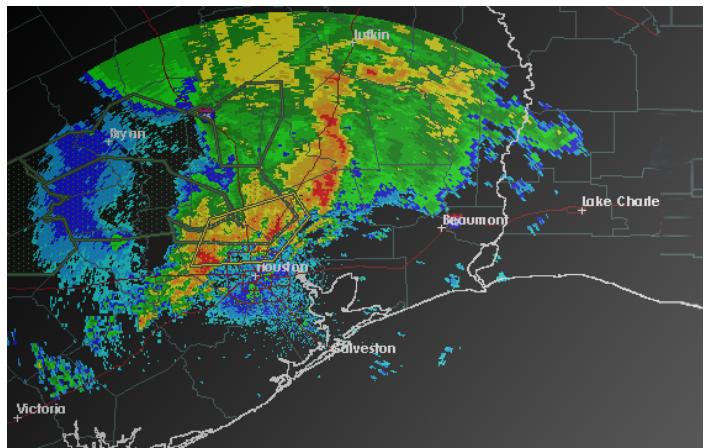


Figure 3 SSPEED Center

## What Is Needed to Implement a FAS in Harris County?

In Harris County, gages and NEXRAD rainfall are already in place from HCFCD and the NWS. However, funding is needed to update and build real-time models for all 22 watersheds and to maintain servers which can run the models every 15 minutes. The physical elements for the system are in place, however the model development and additional computing capability is required to implement a FAS4 or similar system in Harris County.

## How Does the FAS4 Work?

**Data** - Collected on live rainfall information using Radar rainfall (NEXRAD), flow and stage gage data, and water levels via cams.

**Modeling** - Used to predict flood extents, these data are overlaid with models and maps, such as, Hydrologic Engineering Center's HEC-HMS, HEC-RAS, and floodplain mapping.

**Prediction** - Together, these produce, real-time rainfall, flow hydrographs, and floodplain map library (FPMI).

**Communication** - With established warning thresholds, warnings are sent out via, text, email, FAS website, digital roadside warnings, news, and radio.

## Case Studies

### City of Austin Flood Early Warning System (ATXfloods)

ATXfloods has existed since 1985 and is maintained by the City of Austin Flood Early Warning System (FEWS) team. It was built in large part to monitor flooded roadways in Austin's surrounding 8-county area. The system uses 130 gages and cameras to monitor water levels in the creeks and at low-water crossings. Individuals can sign-up online to receive flood alerts via email, text message, and/or phone call. In addition, Austin has placed flashing lights and automated barricades at fifteen low water crossings to prevent motorists from driving into high water.

### Lower Colorado River Authority Flood Operations Notification Service (LCRA FONS)

Because releases from flood control dams on Highland Lakes or Bastrop Dam in Central Texas can cause flash flooding, the Lower Colorado River Authority (LCRA) operates a flood alert system to warn residents living below Lake Austin when flood releases are occurring. Individuals can sign-up online to receive flood alerts via email, text message, and/or phone call when flood operations begin. LCRA FONS is intended to supplement NWS warnings and prompts individuals and businesses to take mitigative action in advance of flooding (e.g., evacuation).

## KEY POLICY QUESTIONS

Could localized flood mitigation strategies be developed behind accurate flood warning systems to prevent flood damages?

Could a regional flood alert system be used to quickly allocate emergency services and personnel during a storm?

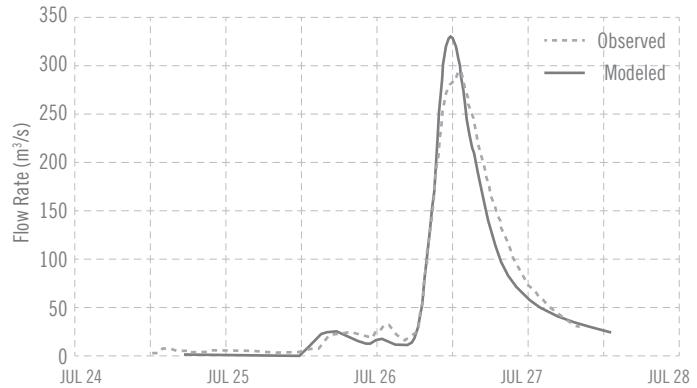


Figure 4 FAS2 HEC-1 Modeled Hydrograph vs USGS Observed at Main St. (July 2006)

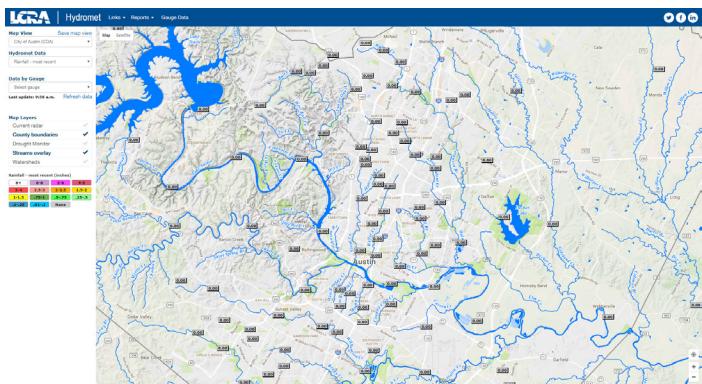


Figure 5 Rainfall gage map in Austin, TX

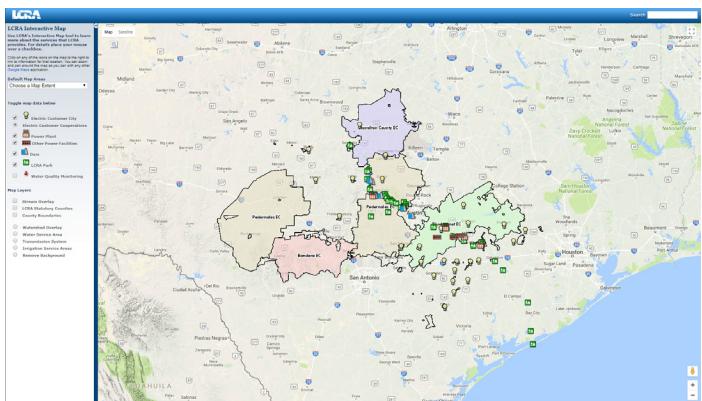


Figure 6 Real-time road closure information

## For More Information Visit

SSPEED

[sspeed.rice.edu](http://sspeed.rice.edu)

HCFCD Real-Time Gages

[HarrisCountyFWS.org](http://HarrisCountyFWS.org)

Austin Real-Time Information

[ATXFloods.com](http://ATXFloods.com)

Greater Houston Flood Mitigation Consortium

[HoustonConsortium.com](http://HoustonConsortium.com)