

# How do we assess damages?

Flood events cause a great deal of disruption to the daily lives of people and to the economy. After a flood event, in order for a city to recover and rebuild with greater resiliency, it is important to accurately identify which homes were flooded, which neighborhoods and their infrastructure experienced the greatest stress, and why. However, every method is incomplete and can take months to collect. Additionally, most metrics focus on quantity of damage rather than the ability of someone affected to recover from that damage.

Damage assessments are necessary to identify the need for aid, as well as what type of projects are needed for future flood mitigation. Displaced families need refuge and relocation, damaged properties need repair or buyouts, and the city needs projects to mitigate future flooding. Studying the types and causes of damage helps identify areas for research and policy changes, for example, developing new building codes for higher resiliency.

## TYPES OF DAMAGE

**Minor home flooding** can be repaired with new flooring, walls, and insulation.

**Major home flooding** could require families to seek extended refuge or permanently relocate.

**Emergency needs** such as boat rescues or medical needs.

**Food needs** at shelters or in homes during extended flooding events or displacement.

**Utilities damage** such as water and power outages could cause temporary or permanent relocation.

**Vehicle damage** may prevent people in areas without public transit options from getting to work.

**Road closures** may prevent people from being able to get to work or schools.

**Small businesses** may temporarily lose employees or revenue due to damage.

**Schools** may close and require students to relocate to other schools.

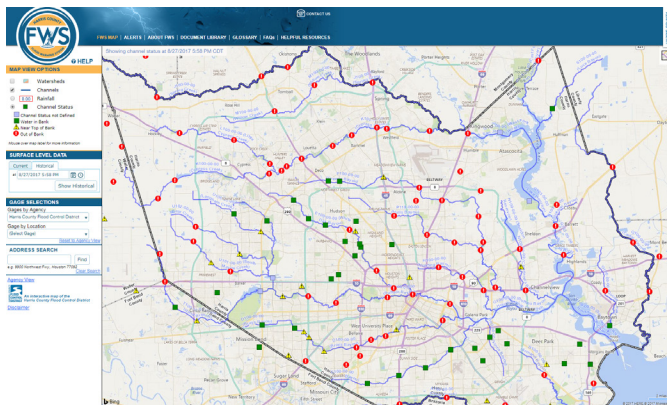


Figure 1 Stream gage map on HCFCF website

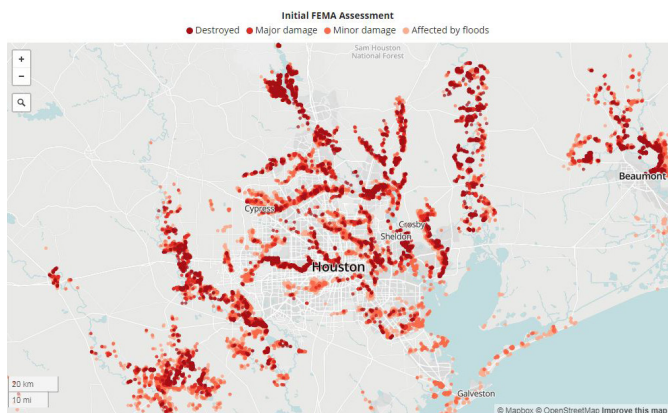


Figure 2 FEMA Initial Assessment

## 1 STREAM GAGES Timing: Real-time

Water levels of waterways are measured continually and this information is available in real-time to public and emergency management officials.

### How they work

*Stream gages* are placed along waterways by Harris County Flood Control District (HCFCF) and provide live information on the elevation of the water. The map on the left is a snapshot of stream gages during Harvey. It shows green markers where the water was in its banks and a red exclamation mark where it had overflowed.

### Benefits and Limitations

Stream gages are extremely accurate at measuring water levels; however, they leave several gaps in information. They are spaced 1-5 miles apart and provide no information on street or neighborhood flooding outside the stream's floodplain. Also, multiple gages were destroyed during Harvey and stopped providing information as the storm continued.

## 2 INUNDATION MODELING Timing: 0-3 Weeks

FEMA runs inundation models immediately after a storm, and media outlets, such as *New York Times*, use them to map initial damage assessments within days of the event.

### How it works

*Inundation models* typically feed predicted or observed rainfall amounts into standard hydrological models to calculate where the water flows along major streams. This information is overlaid with data on built structures to estimate which structures may be damaged along modeled streams.

### Benefits and Limitations

Typical inundation models are useful for estimating stream flooding, but only provide a simulation of structures that may have flooded by the stream overflowing. They fail to evaluate localized and street flooding not caused by stream overflow. During Harvey, for example, there were some severely flooded neighborhoods that did not appear on these stream floodplain maps.

### 3 AERIAL IMAGERY Timing: 0-3 Weeks

Aerial imagery captures a visual account of flooding at one point in time.

#### How they work

Aerial photos are produced in collaboration by National Ocean Service, Texas Parks & Wildlife, Digital Globe, OpenStreetMap, ESRI, and others.

#### Benefits and Limitations

These are useful in visualizing the areas and extents of damage, but they cannot be taken during the storm because clouds obstruct the view of the ground. They are taken after the storm has cleared so they only capture areas where the water does not recede quickly, and usually do not show the maximum height of flooding.



**Figure 3** Before / after satellite imagery

### 4 EMERGENCY CALLS Timing: 3-6 Weeks

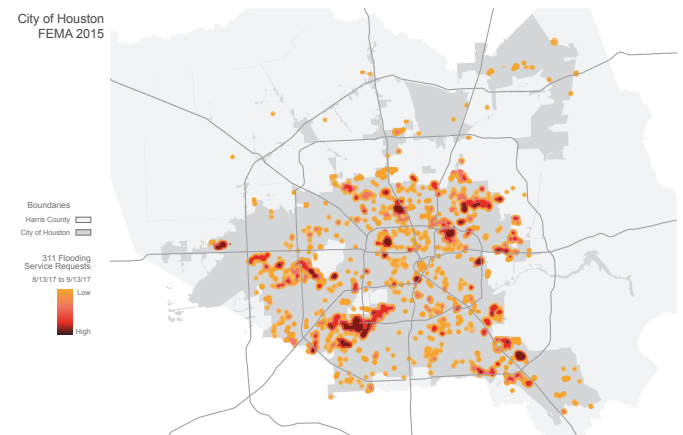
311, 211, and 911 emergency calls are directed to the City by people in need of aid.

#### How they work

Every 311 call is recorded and archived. Within weeks of a flooding event, the city and public agencies gather data on 311 calls and produce a map identifying areas of high call volumes.

#### Benefits and Limitations

While this method is slower than inundation models, it provides a more accurate picture of the areas that need attention. However, most of the call information is manually entered leaving lots of room for error. Additionally, not everyone in an emergency is able to make a call and therefore is not counted in this method. Often, even if someone is able to make the call, they may choose to just call family or friends for help instead of 311.



**Figure 4** 311 call data by City of Houston, mapped by CDRC

### 5 INSURANCE & FEMA CLAIMS Timing: 6 months - 1 year

HCFCFCD highly encourages everyone to purchase flood insurance through the National Flood Insurance Program (NFIP). Flood insurance is only required by mortgage lenders for homes within the 100-year floodplain. FEMA disaster relief funding is available to help homeowners, small business owners, and non-profits.

#### How they work

After a flood event, homeowners with flood insurance file claims and others file for disaster relief funding from FEMA. A comprehensive, door-to-door analysis of insurance claims is conducted by the NFIP and FEMA compiles a thorough set of disaster relief applications.

#### Benefits and Limitations

This is one of the most accurate methods of assessing damages because it is not a modeled estimate. However, it may take up to a year to collect and does not count anyone who does not file a claim. For example, many homeowners who own their homes outright without a mortgage (as is the case in many low-income neighborhoods), or live outside the 100-year floodplain, do not own flood insurance. Since renters often do not own flood insurance and are also under-counted in this method. FEMA disaster relief applications are available to everyone; however, not everyone applies because of the lengthy and complicated process.

#### KEY POLICY QUESTIONS

Are major decisions on flood mitigation projects and policies made with incomplete information?

How can we make sure we get the same quality of information in all neighborhoods?

Can we improve damage assessments?

#### For more information visit:

Kinder Institute Harvey Story Map:

<https://tinyurl.com/hurricaneharvestory>

Harvey-related 211 Calls Data Dashboard:

<http://www.datahoustan.org/story/UnitedWay211.html>

FEMA Assistance Dashboard:

<http://www.datahoustan.org/story/FEMAassistance.html>

Stream Gages:

<https://www.harriscountyfws.org/>

Disaster Aerial Imagery:

<http://www.esri.com/services/disaster-response/hurricanes>

Greater Houston Flood Mitigation Consortium:

<http://houstanconsortium.com>