Flooding from Hurricane Harvey during August and September 2017 in southeastern Texas and southwestern Louisiana

By Kara Watson (kmwatson@usgs.gov)
Glenn Harwell (gharwell@usgs.gov)
Sam Wallace (dswallace@usgs.gov)
Toby Welborn (twelbor@usgs.gov)
Victoria Stengel (vstengel@usgs.gov)
Jeremy McDowell (jmcdowell@usgs.gov)
Hurricane Harvey, August, 25 2017

NASA TERRA MODIS INFRARED IMAGE OF HARVEY AT 0419 UTC 26 AUGUST 2017 JUST AFTER LANDFALL AS A CATEGORY 4 HURRICANE IN TEXAS. IMAGE COURTESY OF UW/CIMSS.

Hurricane Harvey Rainfall Totals

Rainfall totals, in inches, from August 25 through September 1, 2017

- Nederland = 60.58 inches
- Groves = 60.54 inches
- Previous event record was 48 inches.
- For Harvey, 20 NOAA stations reported totals in excess of 48 inches.
Streamflow Measurements

- During August and September 2017 USGS personnel made more than 180 streamflow measurements in the study area by direct methods.
- Indirect streamflow measurements were made in the study area at 97 locations.
- Record peak streamflows at 54 percent (40 out of 74 stations) with at least 15 years of record and for which the Harvey-related streamflow ranked within the top five of all annual peaks. Thirty-four percent (25 out of 74) of the peak streamflows ranked second or third and 12 percent (9 out of 74) ranked fourth or fifth.
USGS streamflow-gaging station 08072600, Buffalo Bayou at State Highway 6 near Addicks, Texas looking south on State Highway 6
USGS/FEMA Interagency Agreement

- Collect high-water marks (HWMs)
- Indirect measurements if needed
- Flood inundation mapping
- Flood frequency analysis
- Documentation
  - Scientific Investigations Report
  - ScienceBase Data release
High-Water Mark Data Collection

- Best identified immediately following the peak stage
- After identification, a more permanent mark is established such as a Parker-Kalon nail with a disk, a stake, a chiseled mark, or a paint line
- GPS used to obtain location and photos taken
- Marks surveyed to standard vertical datum, NAVD88, for elevation above land surface
- Stain lines on buildings, fences, and other structures provide excellent marks
High-Water Mark Data Collection cont.

- USGS field crews began work on September 2 and continued through October 5, 2017 identifying and surveying HWMs.
- USGS field work consisted of 73 staff members from 9 Water Science Centers including Texas, New Mexico, Oklahoma, Arizona, Missouri, Florida, New York, Nebraska, Mississippi.
- USGS field crews surveyed 2,123 HWMs, resulting in 1,258 water-surface elevations.

Hydrologic Technician with the USGS North Texas Program Office in Fort Worth, Texas, flagging a debris line on a telephone pole approximately 14.3 feet above the ground and located about 245 feet east of bridge on Keith Road over Boggy Creek.
USGS STN Flood Event Viewer

https://water.usgs.gov/floods/FEV/
Streamflow Rank

- 40 stations with peak of record
- 18 stations ranking 2\textsuperscript{nd}
- 7 stations ranking 3\textsuperscript{rd}
Annual Exceedance Probability

- Period of record ranged from 18 to 105 years, average of 55 years
- AEP estimates for the analyzed streamflow-gaging stations ranged from less than 0.2 to 14.0 percent with a median of 1.4 percent
- 30 streamgages had an AEP of 1.0 percent or smaller for observed peak streamflow from August and September 2017 flood
  - 100 year recurrence interval
- 2 streamgages had an AEP of 0.2 percent or smaller
  - 500 year recurrence interval
Percent Differences

Percent difference between 2017 Harvey-related peak and previous peak of record
High-Water Mark Derived Flood Documentation Map

- Use collected HWM elevation data to interpolate water-surface elevation
  - ArcGIS Topo to Raster tool using cross section lines or point data
- Create depth estimates for inundated areas
- Use the best lidar DEM layer available
- Layers created and published include:
  - Depth raster, inundation polygon, model boundary, and HWMs
High-Water Mark Derived Flood Documentation Map

- Use USGS streamgage data if available along reach
- Geographic limit placed on extent of reach
  - Based on distribution of HWMs
  - Lidar data availability
  - Understanding natural hydrologic flow in the area
Issues Observed

• DEM issues
  – Some areas lacked full lidar digital elevation model (DEM) data

• HWM coverage
  – Mapped boundaries were cut in locations lacking HWM coverage

• Coastal/low-lying flood areas
  – Use point interpolation with Topo to Raster
  – Limit overland flood water extent with model boundary

• Multiple tributaries along a reach
  – Separate each tributary for processing, then merge
Inundation mapping locations

• 6 watersheds and coastal area basins
Brazos River Mapping

- Divided into 2 maps—upper and lower
- 99-mile reach Brazos River, 43-mile reach Bessies Creek, 9-mile reach Mill Creek
- 46 HWMs used
- HWM height above ground ranged from 0 to 8.6 ft.
- Precipitation range 13-39 inches within the watershed

Peak of record at 08116650 Brazos River near Rosharon
2nd highest peak at 2 other gages used in mapping

Upper Brazos River, August and September 2017
Neches River Mapping

- Divided into 2 maps - upper and lower
- 131-mile reach Neches River
- 33 HWMs used
- HWM height above ground ranged from 0 to 11.6 ft.
- Precipitation range 18-52 inches within the watershed

Communities within reach - Beaumont, Evadale, Port Neches, Central Gardens

Counties - Orange, Jasper, Hardin, Jefferson, Tyler

Lower Neches River, August and September 2017
Sabine River Mapping

- Divided into 5 separate maps
- 131-mile reach along the Sabine River - upper, middle, and lower
- Cow Bayou
- Big Cow Creek
- 70 HWMs used to map
- HWM height above ground ranged from 0 to 7 ft
- Precipitation range 19-48 inches within the watershed

Lower Sabine River, August and September 2017
Cow Bayou, August and September 2017
San Jacinto River Mapping

- Divided into 2 separate maps
- West Fork and East Fork San Jacinto River
- 106 HWMs used to map
- HWM height above ground ranged from 0 to 9.6 ft
- Precipitation range 17-43 inches within the watershed
Townsen Boulevard intersects US Highway 59 about 0.65 miles southwest of USGS streamflow-gaging station 08069500, West Fork of the San Jacinto River near Humble, Texas.
Coastal peak water-surface elevation, August and September 2017
USGS Science Base- Data Release

- Data cataloging and collaborative data management platform
- Central repository for project data files
- Historically this data kept of local office servers
- Files provided from the Texas flood report:
  - Inundation polygon
  - Depth raster
  - Boundary
  - HWMs
USGS Science Base - Data Release

- Flood Inundation, Flood Depth, and High-Water Marks for Selected Areas in Texas from the Hurricane Harvey, August 2017 Flood:

https://doi.org/10.5066/F7VH5N3N
Attached Files

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Related External Resources

**Type:** Publication that references this resource

Characterization of Peak Streamflows and Flood Inundation of Selected Areas in Southeastern Texas and Southwestern Louisiana from the August and September 2017 Flood Resulting from Hurricane Harvey

https://doi.org/10.3133/ofr2018xxxx

Purpose

The mapped area boundary, flood inundation extents, and depth rasters were created to support the development of flood inundation maps for the Federal Emergency Management Agency's (FEMA) response and recovery operations following the August and September, 2017 Hurricane Harvey flood event in the communities of southeastern Texas and southwestern Louisiana.
Original Rating No. 26 stopped at Gage Height of 96.2 feet and Discharge of 22,400 cfs

Rating No. 26.1 extended to Gage Height of 103.4 feet and about 40,000 cfs
• 20-mile reach Brazos River, from Holiday Lakes to Lake Jackson
• Peak of record recorded at 08041780 Neches River Saltwater Barrier at Beaumont
• 2nd highest peak at 1 other gage used in mapping
Pine Island Bayou Mapping

- 68-mile reach Pine Island Bayou
- 34 HWMs used
- HWM height above ground ranged from 0 to 14.3 ft
- Precipitation range 24-44 inches within the watershed
- Communities- Hull, Daisetta, Sour Lake, Nome, Bevil, Oaks, Rose Hill Acres, and outskirts of Beaumont
Peak of record recorded at 08041700 Pine Island Bayou near Sour Lake

Pine Island Bayou, August and September 2017
Communities: Newton, Merryville, Bon Wier

- 2nd highest peak of record, recorded at 2 gages used in mapping
Communities: Kirbyville, Buna, Deweyville, Starks
Communities: Newton, Kirbyville

Reach length: 37 miles
San Bernard River Mapping

- Divided into 3 separate maps
- Along the San Bernard River- upper, middle, and lower
- 34 HWMs used to map
- HWM height above ground ranged from 0 to 6.8 ft
- Precipitation range 11-33 inches within the watershed
Community: Sealy
Reach length: 20 miles

• Peak of record recorded at 08117500 San Bernard River near Boling, Tx

Upper San Bernard River, August and September 2017
Communities: Wallis, East Bernard, Kendleton

Reach length: 46 miles
Communities:
Sweeny, Brazoria

Reach length:
33 miles
• Peak of record recorded at 4 streamgages

- 08070000 East Fork San Jacinto River near Cleveland
- 08071000 Peach Creek at Splendora
- 08070200 East Fork San Jacinto River near New Caney
- 08071280 Luce Bayou above Lake Houston near Huffman

East Fork San Jacinto River, August and September 2017
Coastal Basins Mapping

- Divided into 3 separate riverine inundation maps
- One map along coastline showing peak water-surface elevation
- 129 HWMs used to map
- HWM height above ground ranged from 0 to 7.7 ft
- Precipitation range 6.6 - 33 inches within the watershed
East Matagorda Bay Basin Mapping

- Divided into 3 maps
- 1 includes 17-mile reach of Peyton Creek, 16-mile reach of Big Boggy Creek, and a 6-mile reach of Little Boggy Creek
- 2 includes 21-mile reach of Tres Palacios River
- 3 includes 13.5-mile reach of West Carancahua Creek, 14.5-mile reach of East Caranchua Creek, and 9.6-mile reach of Keller Creek
Peyton Creek
Big Boggy Creek
Little Boggy Creek