

We can be safer.
We can mitigate
more damage.

We can do
better.



Hurricane Harvey 2017:
A Case Study for
Utilities

The Damage

In 2017, Hurricane Harvey cost an estimated US\$125 billion in damages across the East Coast. The primary impact from Hurricane Harvey was disastrous flooding.

13 Million

People affected

\$125 Billion

Total Damages

250 Thousand

Homes without Power

Power utilities, like AEP, had US\$525m in recovery losses, not to mention millions in lost revenue from outages. Some utilities suffered legal losses as a result of being underprepared for the severity of the storm.

Real-time and hyper-localized hourly flood forecasts and updates could have significantly reduced the resulting damage, increased safety and allowed for a more effective and rapid emergency response for staff and assets.



The Flood

Hurricane Harvey formed as a tropical depression, developing into a category 4 hurricane which made landfall along the Texas coast near Port Aransas around 10:00 p.m. on August 25th, 2017. Harvey brought widespread, sustained high intensity rainfall across the Harris County on the evening of August 26th, 2017 which developed into flash flooding between 8:00 p.m. to 11:00 p.m.

On August 29th, Harvey slowly moved southeast and back offshore, resulting in continued heavy rainfall across Harris County which further contributed to widespread and devastating flooding. Record flooding was observed in widespread river and channel systems including the San Jacinto River, Langham Creek Buffalo Bayou and White Oak Bayou, with Rivers peaking between August 29th - 31st.



Figure 1. River Peaks for a select number of river Gauges in Houston during Hurricane Harvey.

Hurricane Harvey is the **most significant tropical cyclone rainfall event to impact the United States** in terms of peak rainfall and scope since this country started maintaining reliable precipitation records in the 1880s.

The US Department of Commerce National Oceanic and Atmospheric Administration (NOAA) undertook a Service Assessment in June 2018: “August–September 2017 Hurricane Harvey” to evaluate its performance before and during Hurricane Harvey. In relation to river flood forecasting, the service assessment noted that the following forecast products were available:

- 1 On August 23rd, The West Gulf River Forecast Centre (WGRFC) provided daily Hurricane Harvey briefings which highlighted the outlook for significant river flooding (Figure 2).
- 2 Non-routine river forecasts, generated only during high flows/flooding situations, were issued on 30 consecutive days, beginning August 25 and ending September 24. Prior to August 25, there were no river forecasts for the non-routine forecast locations on the AHPS Hydrograph Web Pages (Figure 3).
- 3 WGRFC did highlight the devastating flooding expected for Texas and Louisiana in their Harvey DSS Briefings to partners (Figure 4) and in the Significant River Flood Outlook product.
- 4 In addition to the river forecasts, the WGRFC produces an ensemble river forecast product graphic based on 72 hours of WPC's PQPF for extended guidance. (Figure 5 left).

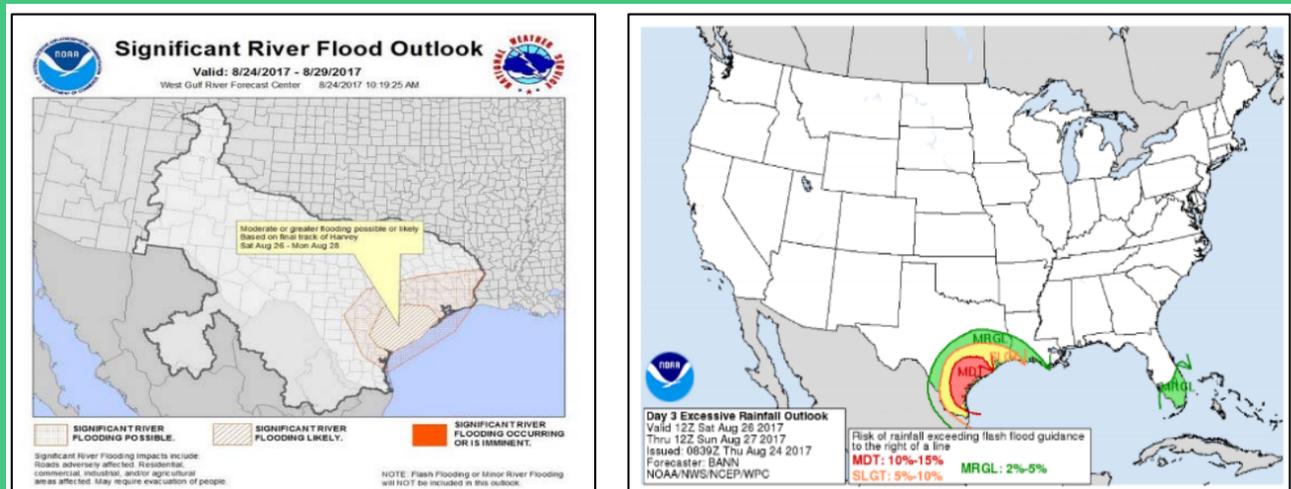


Figure 2. Left: The Significant River Flood Outlook product issued on August 24 by the WGRFC indicating moderate or greater flooding likely.

Right: The Excessive Rainfall Outlook issued on the same day with areas showing a moderate risk of exceeding flash flood. Source: WGRFC. Extracted from NOAA Department of Commerce, June 2018.

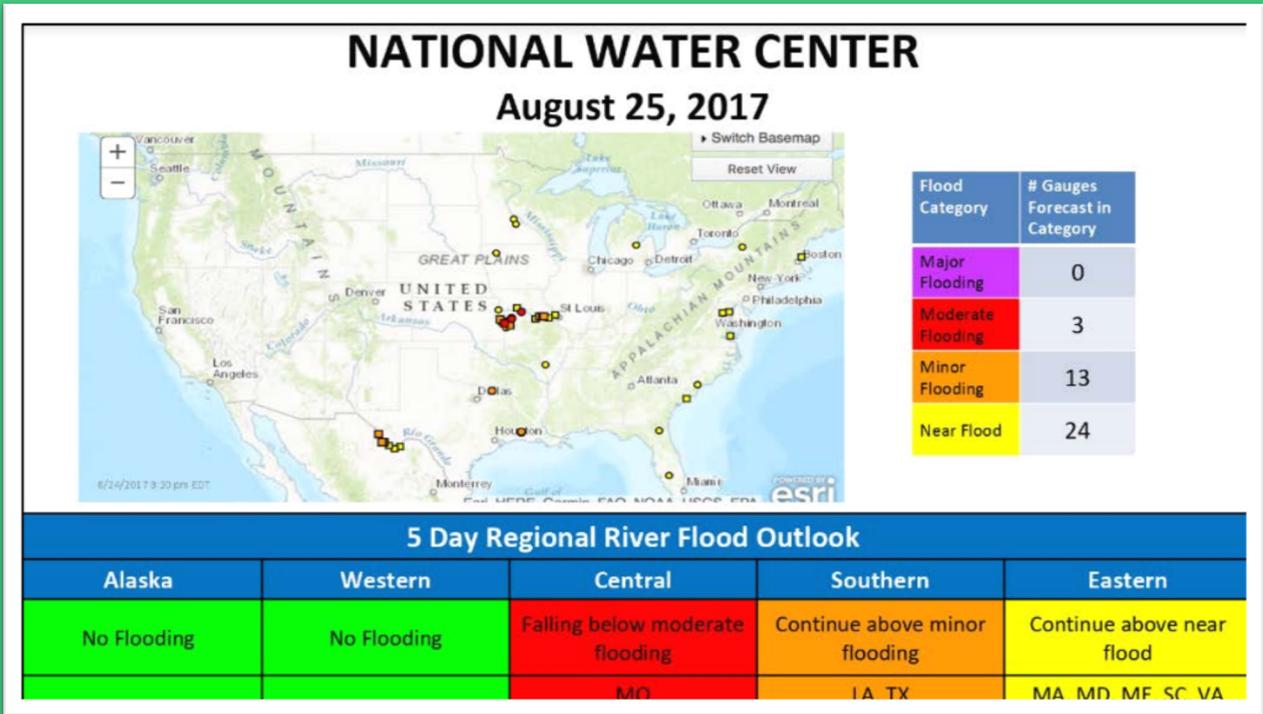


Figure 3. Above: National Weather Centre Briefing on August 25, 2017 prior to Hurricane Harvey. Source: Extracted from NOAA Department of Commerce, June 2018.



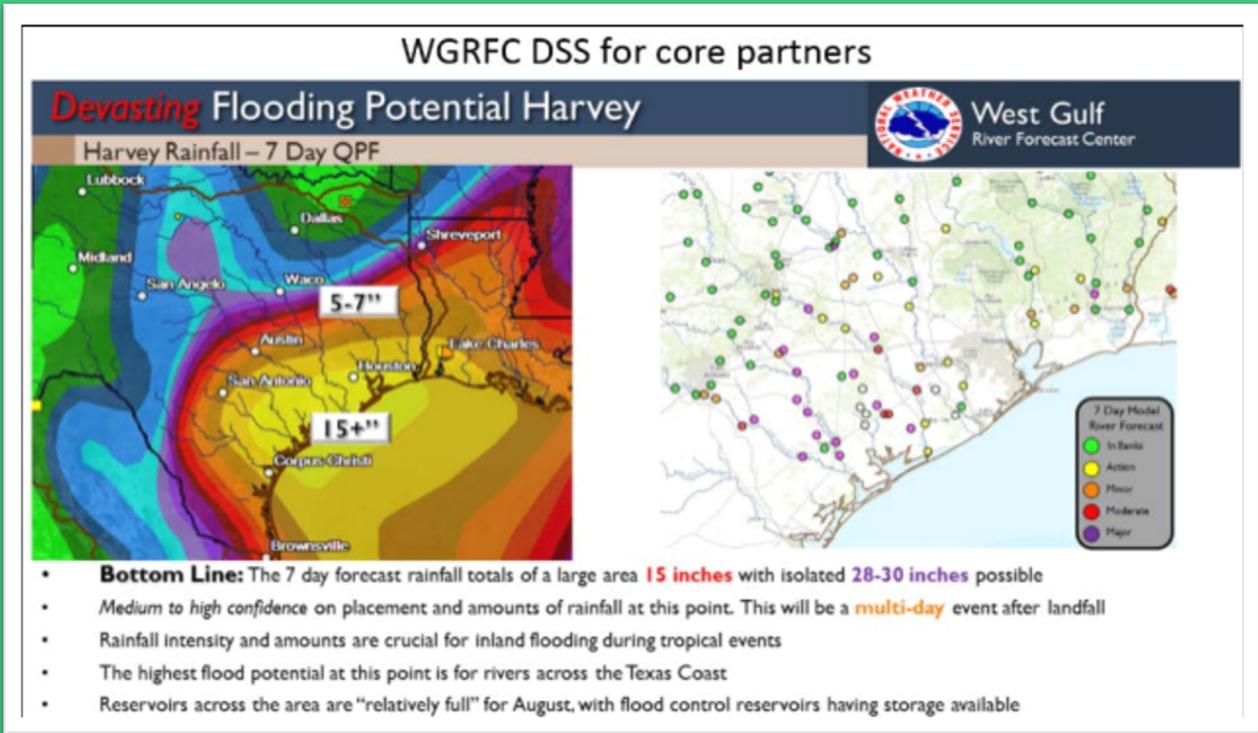


Figure 4. Above: Rainfall and River Forecast briefing issued to partners by West Gulf River Forecast Centre August 25, 2017 prior to Hurricane Harvey. Source: Extracted from NOAA Department of Commerce, June 2018.

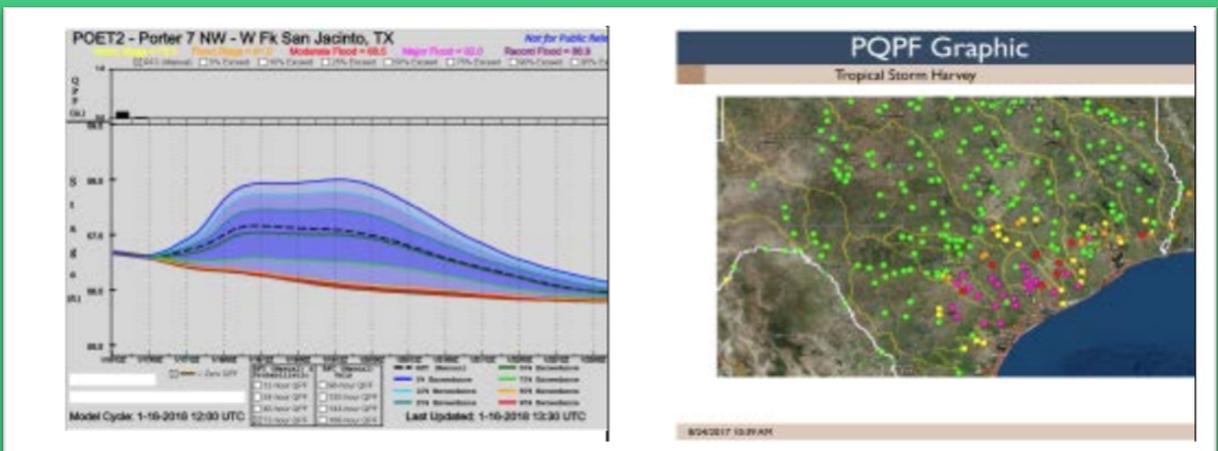


Figure 5. Above: WGRFC IDSS sample hydrograph and graphic based on WPC PQPF. Source: Extracted from NOAA Department of Commerce, June 2018.

The Challenge

Although broad rainfall and river flood warnings were issued across the region, no real-time or predictive flood inundation maps were available. The service assessment had the following findings in relation to the need for real-time flood mapping:

“Basin and emergency managers have day-to-day needs and base operational decisions on events that have happened in the past 24-36 hours. The addition of real-time flood inundation maps to [River Forecast Center] RFC/ [Weather Forecast Office] WFO daily briefings would be extremely valuable to these partners’ decisions. Local EMs are concerned with traffic, road safety, and debris removal in their jurisdictions. Those interviewed commented that

more detailed road/street networks and active road/street closures should be included on real-time flood inundation maps.”

It is likely that flood hazard maps from previous flood studies were available and utilized in an effort to understand the magnitude of the event (i.e. the 1 in 100-year flood zone). However, the 2D hydraulic flood models used in flood studies are too computationally intensive to create real-time flood forecast inundation areas as a map. Unfortunately, this kind of static flood hazard data cannot inform rapid operational decisions required to ensure the best public safety protocols, staff resourcing and reliability of the energy network.

“

No power utility provider in Harris County had access to real-time or truly predictive flood inundation maps. Hence power utilities did not have the operational capability to accurately predict, and subsequently mitigate, damage from Hurricane Harvey, days prior to the event.

”

Our Solution

FloodMapp is a world-first flood modelling solution purpose built for flood forecasting and early warning. Aimed at improving safety and preventing damage, FloodMapp provides highly accurate, real-time, property-specific and dynamic flood inundation and depth insights for businesses exposed to flooding.

FloodMapp combines big data analytics, automation and machine learning techniques with novel hydrology and hydraulic models to achieve large-scale, rapid flood modelling. Our proprietary technology reads in real-time and

forecasted rainfall and river height data, which our models use to estimate predicted peak river heights and generate inundation mapping at scale.

Using the highest quality elevation data available, FloodMapp predicts the inundation extent and depth of an impending flood event up to 4 days prior, down to an individual street address, with instantaneous updates to predictions to reflect changes in the real-time data inputs.

Products are available as a custom dashboard or API.

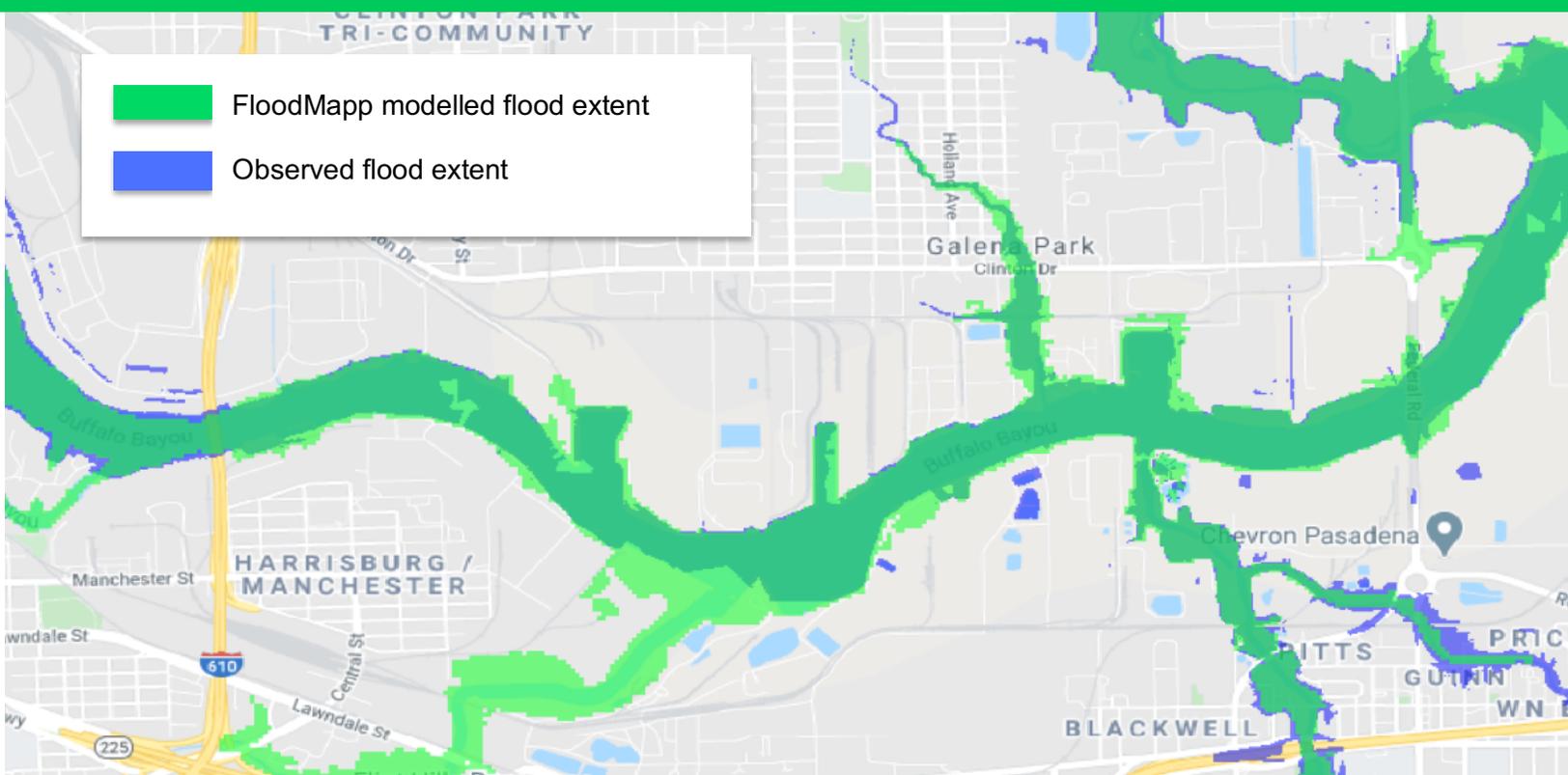
4 days

Warning time

Asset Level

Flood Inundation maps

FloodMapp Forecast™



Model Validation

FloodMapp carried out a model validation test in which we compared our FloodMapp Forecast™ rapid flood inundation extent predictions across Houston with observed post-event flood inundation areas, based on high water marks.

In the figures below, the blue flood areas represent the observed inundation extent

and the green flood areas demonstrates the FloodMapp Forecast™ model results.

Our real-time FloodMapp Forecast™ model predicted the extent of flooding up to 4 days prior to the flood peaks (i.e. August 26, 2017) to a block-by-block resolution and a high level of accuracy (Figure 6-7).

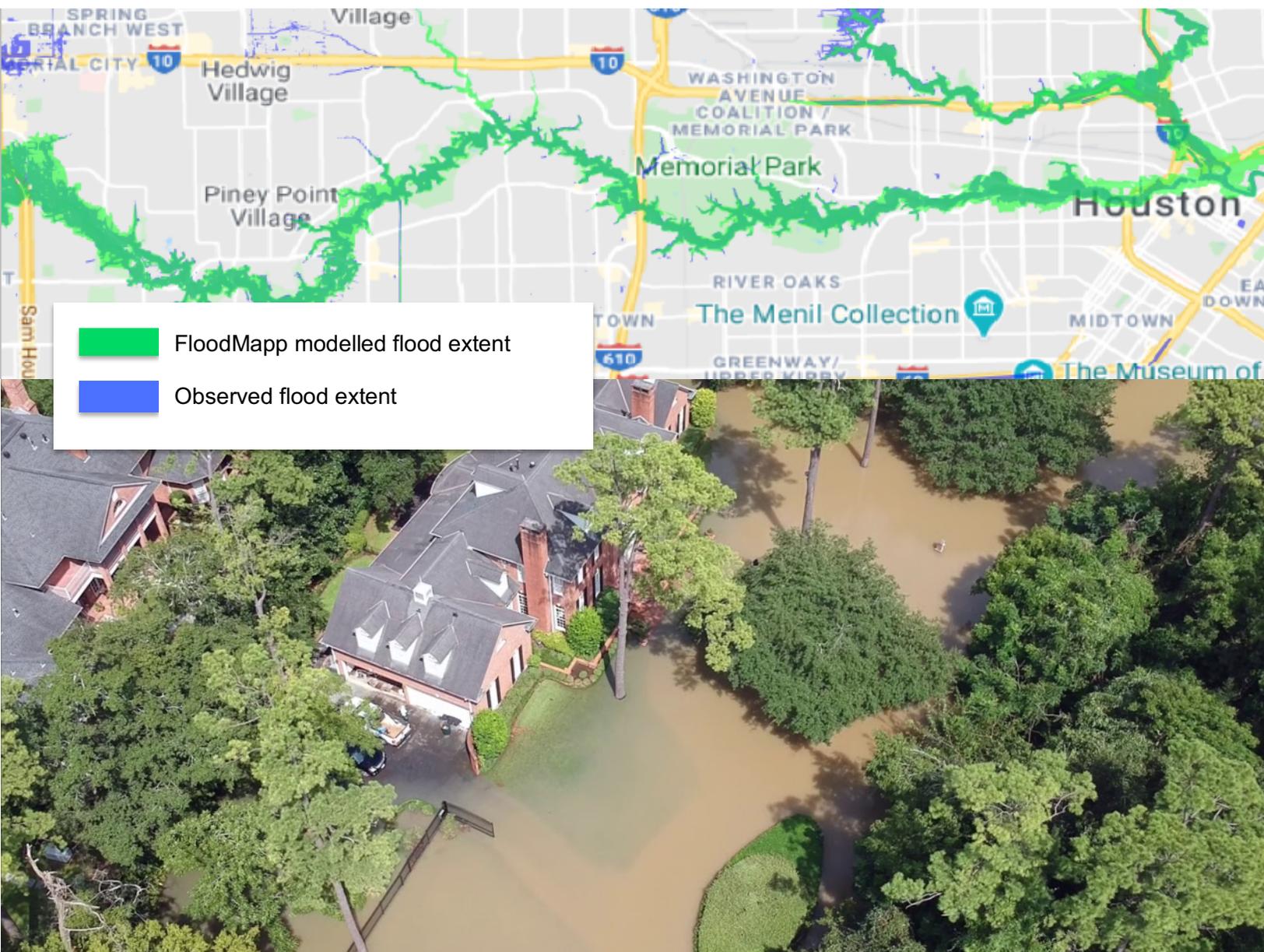


Figure 6. Top: FloodMapp Forecast™ model (green) compared with observed flood inundation extent (blue), from Piney Point Village to Downtown Houston. Bottom: Photo of flooding at Piney Point Village.

“ These rapid inundation map updates give us the foresight to know that our people won’t be stranded in the event of a flooding disaster. ”

- Emergency and Asset Manager,
National Utility Provider

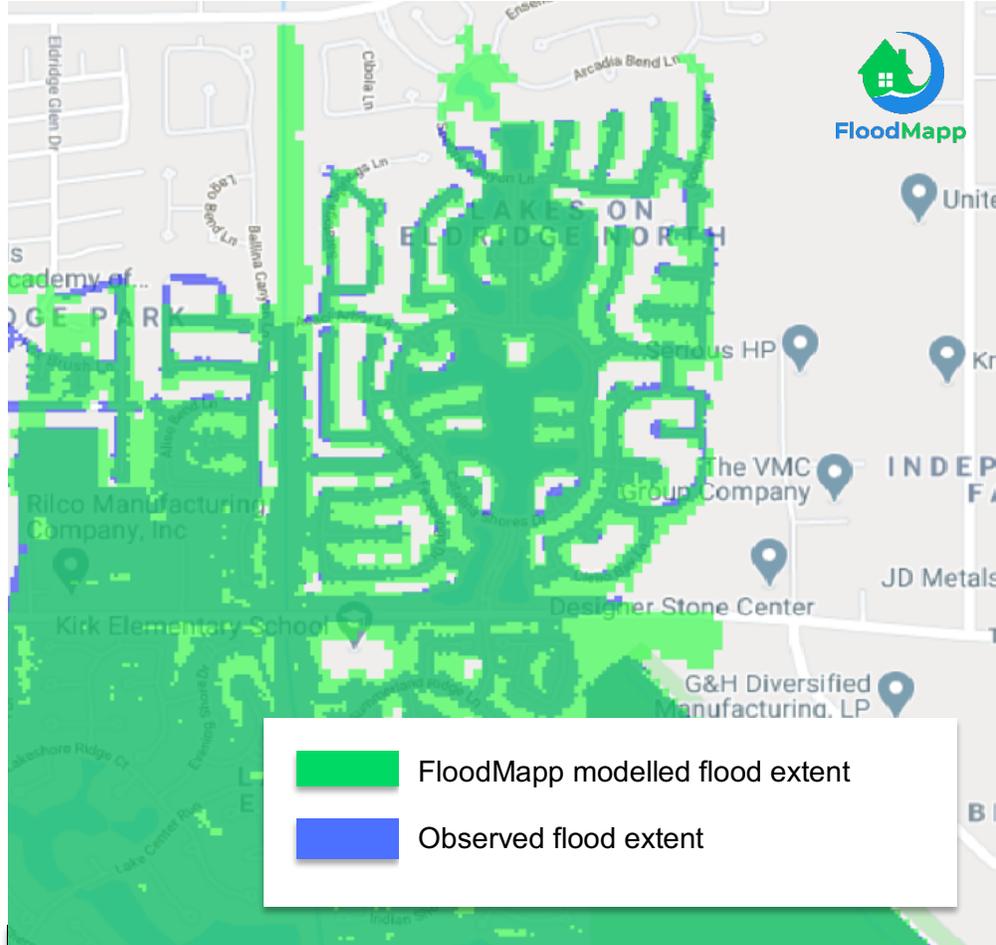


Figure 7. Top: FloodMapp Forecast™ model (green) compared with observed flood inundation extent (blue), at Lakes on Elridge. Bottom: Aerial photo of flooding at Lakes on Elridge.



FloodMapp Nowcast™

Our real-time FloodMapp Nowcast™ model (Figure 8) maintained a high level of accuracy during the flood peaks (August 26 - 29).

We achieved a true near live-stream of the flood extent from a computer desktop with hourly updates from dynamic real-time data inputs.

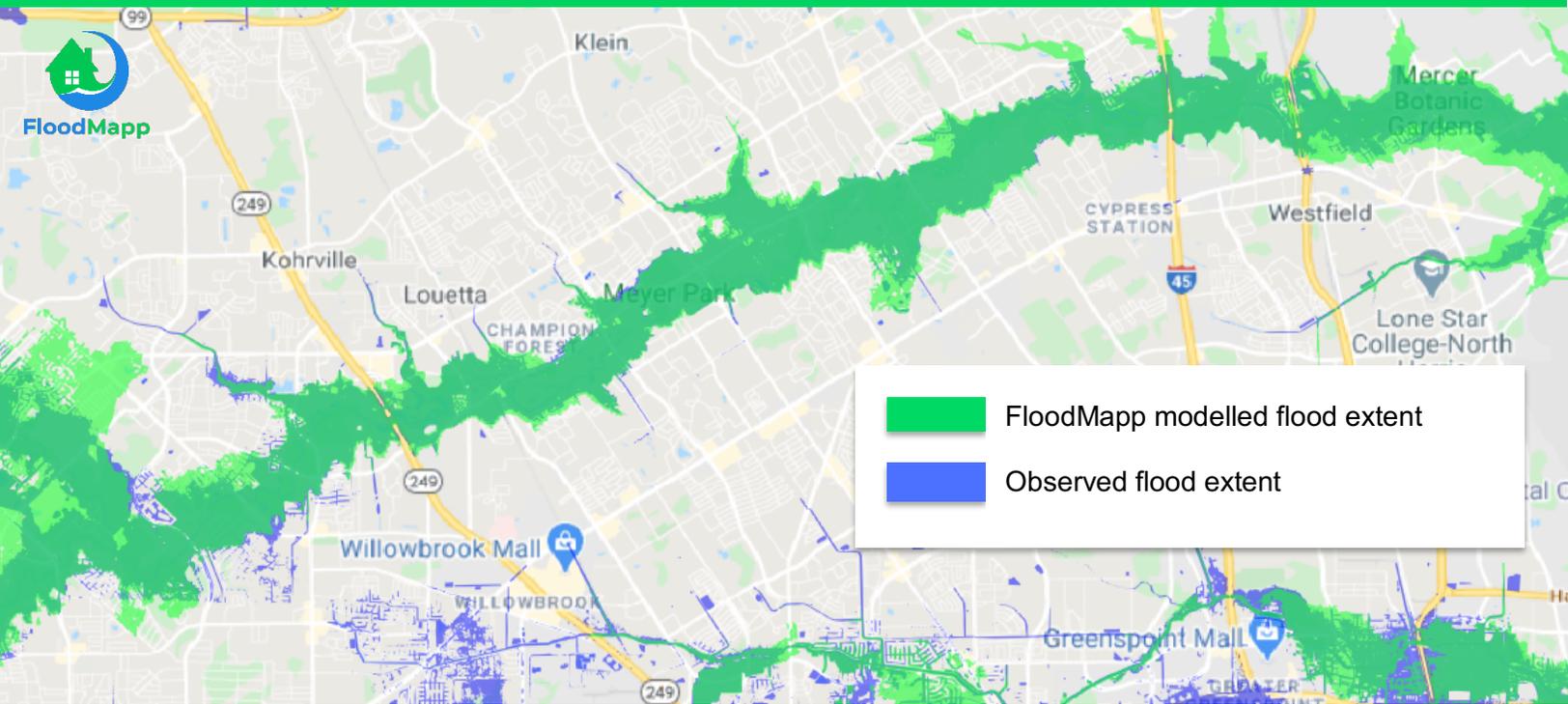


Figure 8. Top: FloodMapp Nowcast™ model (green) compared with observed flood inundation extent (blue), from Louetta to Mercer Botanic Gardens. Bottom: Photo of flooding at Cypress, Louetta.



Business Application

FloodMapp's real-time flood inundation models could have provided critical live forecasted flood insights to help power utility companies:

1. Enhance emergency preparedness and risk mitigation
2. Improve public safety through accurate de-energization of at-risk assets and customers
3. Optimize resource allocation and improve safety – never have stranded staff again
4. Prevent loss to sites and assets
5. Reduce insurance premiums*
6. Implement rapid operational decision-making frameworks and safety protocols.

**We estimate that with this data
the broader utilities industry could have gained*:**

20% increase

In community and staff
safety.

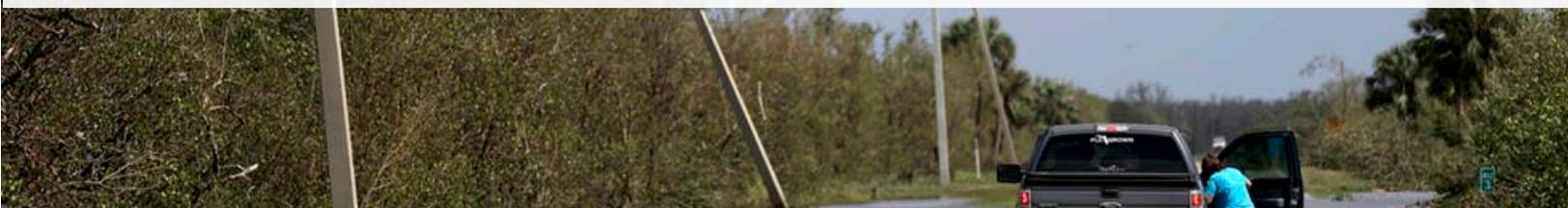
\$ 60 Million

In additional uptime and loss
prevention

\$ 15 Million

Optimized contractor time and
maintenance

**These figures are coarse estimates based on publicly available losses data. Get in contact via info@floodmapp.com for a more accurate approximate return on investment calculation based on your organization's exposure to flooding events like Hurricane Harvey. Insurance premium cost negotiation is dependent on your insurance representative.*



Want to learn more?



Visit our website.
floodmapp.com/products

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