StEER STRUCTURAL EXTREME EVENTS RECONNAISSANCE	**EVENT BRIEFING**	
	Event:	Hurricane Sally
	Region:	Gulf Coast (Gulf Shores, AL)

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Key Lessons

- ❏ FAST observed very isolated structural damage (i.e., damage to the vertical and lateral force resisting systems of buildings) overall. In the coastal areas (Fort Morgan, Gulf Shores, Orange Beach, Perdido Key, Big Lagoon and Pensacola Beach), damage of some kind occurred in ~50% of observed buildings, most of which were residential. The vast majority of damage in all areas observed by FAST was minor, consisting of <20% roof cover loss and/or wall cladding loss. More consistent and more severe damage was found in Fort Morgan and Big Lagoon (near Pensacola).
- ❏ Damage was much less extensive in Baldwin and Escambia Counties in Alabama and Florida as compared to Hurricane Laura in Lake Charles, despite comparable gust wind speed measurements. A peak wind gust of 120 mph (10 m, open terrain) was measured between Perdido Key and Orange Beach from Hurricane Sally, which was less but comparable to the peak wind gust of 132 mph measured by the University of Florida FCMP instruments in Lake Charles during Hurricane Laura. However, damage was more extensive in Lake Charles than in the coastal areas impacted by Hurricane Sally. One likely factor involved is the vulnerability of these two regions. Lake Charles has a design wind speed of 130 mph, while coastal areas impacted by Hurricane Sally have design wind speeds between 150 and 165 mph (ASCE 7-10, 700 year return period). Further, both

Alabama and Florida have a high number of code plus buildings (e.g., FORTIFIED) that possess even greater resistance to windstorms than what is required by code. Alabama alone has over 15,000 homes registered with the FORTIFIED program. Thus, while the hazard may have been comparable between Laura in Lake Charles and Sally in coastal AL/FL, there was less vulnerability in coastal Alabama and Florida due to heightened design requirements, and the prevalence of code plus construction, helping reduce impacts.

- Rainwater ingress and interior damage may have been less prevalent than expected for such a slow-moving storm. Albeit somewhat anecdotally, FAST encountered a number of building occupants during their assessments (representing low-rise and high-rise residential buildings) and somewhat surprisingly only encountered a few that reported significant water ingress. This was by no means a structured sample, so this observation should be confirmed with a structured study to understand the true prevalence and extent of rainwater ingress and subsequent damage.
- While wind and surge damage caused by Sally were minor overall from a structural perspective, this in no way diminishes the very real and severe impacts the storm had on the affected communities. Flooding damage was extensive in Pensacola. Water damage was present in a number of buildings with little to no visible exterior damage. Further, even minor structural damage (e.g., partial loss of roof cover) may have led to severe interior damage, particularly in a slow-moving storm like Sally. Structural performance is just one of many components of hurricane-resilient communities, and Sally illustrates how impactful a hurricane can be even when wind speeds are well below design levels.

1.0 Event Description

Hurricane Sally made landfall as a Category 2 hurricane on 16 September 2020 in Gulf Shores, AL, at approximately the same location and exactly 16 years to the day when Hurricane Ivan made landfall as a Category 3 storm in 2004. Notably, Sally's slow forward speed (only 2 mph as it moved inland) led to heavy rainfall, making flooding a significant hazard in this event (Chincar, 2020). Two have been reported dead in Alabama — a drowning and a death during the cleanup in Baldwin County, while Florida authorities were still looking for a missing kayaker feared dead in Escambia County, at the time this briefing was released. Millions of dollars in losses have already been reported as officials in Alabama and the Florida panhandle continue to assess the storm's impacts (Wang and Reeves, 2020). Since Sally was not a major hurricane and responses to Hurricane Laura were just concluding, StEER did not formally activate a Field Assessment Structural Team (FAST) for this event. However, with a number of StEER members residing in the affected area and intending to assess damage in their home state, StEER helped to support their efforts using its Fulcrum platform, while a small VAST compiled information on the hurricane and its impacts for this Event Briefing, which also includes a summary of the field observations of regional StEER members.

2.0 Hazard Description

Initial reporting on Hurricane Sally by the NHC began on Friday, September 11, 2020 5 pm EDT as the system quickly organized into a tropical depression near the Bahamas. The storm followed the progression shown in Figure 2.1, reaching Category 2 strength At 12:00 am CDT Wednesday, September 16, 2020, with maximum sustained wind speeds of 100 mph, minimum central pressure of 970 mb, with forward speed of 2 mph. Hurricane Sally made landfall at approximately 4:45 AM CDT on September 16, 2020 near Gulf Shores, AL as a Category 2 hurricane with maximum sustained winds of 105 mph (165 km/h) and minimum central pressure of 965 mb. Hurricane force winds spread inland through southeastern Alabama and the western portion of the Florida Panhandle, decreasing to tropical storm force winds as Sally progressed inland.

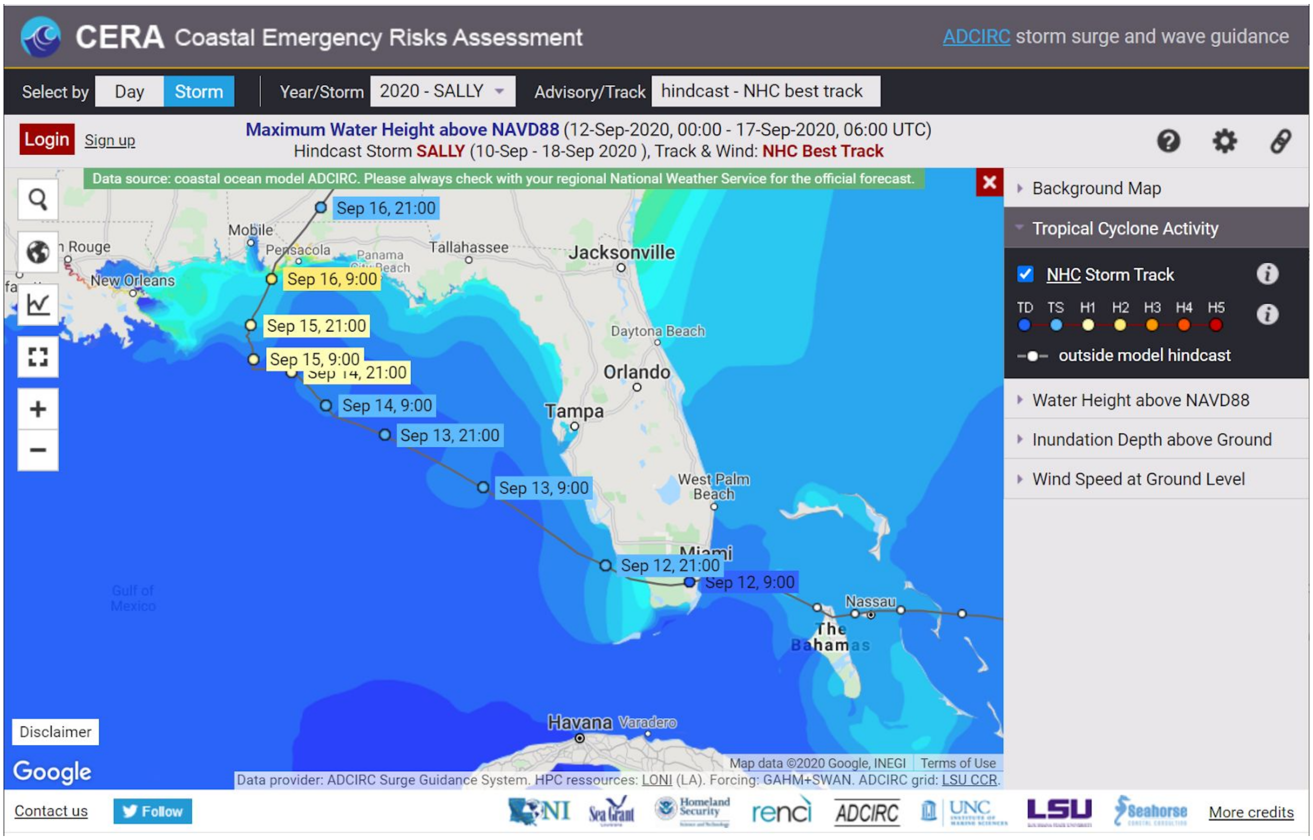


Figure 2.1. Hurricane Sally strengthening to category 2 as it moved toward the US Gulf Coast (Source: CERA).

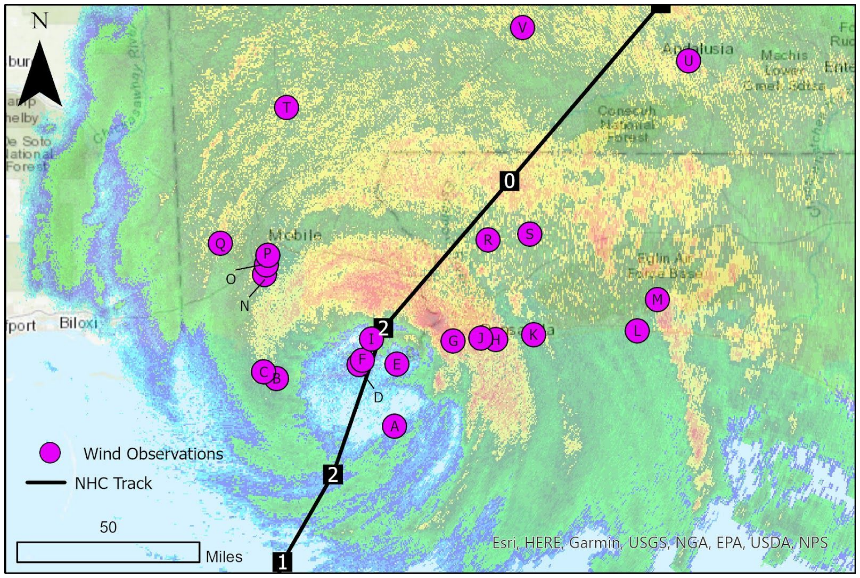
2.1 Observed Hazard Conditions

The NHC reported at 10:00 am CDT historic and catastrophic flooding (including riverine flooding) just inland of Tallahassee, FL to Mobile Bay, AL. The highest directly measured storm surge was in Pensacola, where a tidal gauge measured 5.6 ft of inundation relative to the Mean Higher High Water (MHHW) datum. Inundation depths elsewhere were approximately 3 ft or less, but there was a significant gap in inundation instruments in areas east of Sally's track, where surge may have been highest. Inundation depths reported by NOAA tidal stations are summarized in Table 2.1.

Table 2.1. Summary of peak inundation measurements during Hurricane Sally

Location	Station ID	Latitude	Longitude	Peak Inundation (ft, MHHW)	Time (CST)	Date
Pensacola (FL)	8729840	30.403	-87.212	5.60	6:54 AM	16-Sept
Dauphin Island (AL)	8735180	30.250	-88.075	3.10	10:36 AM	15-Sept
Bayou La Batre (AL)	8739803	30.407	-88.248	2.38	11:30 AM	15-Sept
East Fowl River (AL)	8735523	30.443	-88.113	2.34	2:18 PM	15-Sept
West Fowl River (AL)	8738043	30.377	-88.158	1.83	11:48 AM	15-Sept
Weeks Bay (AL)	8732828	30.417	-87.825	2.19	10:36 AM	16-Sept
Dog River (AL)	8735391	30.565	-88.088	1.99	12:48 PM	15-Sept
Coast Guard Sector, Mobile (AL)	8736897	30.648	-88.058	1.95	11:54 AM	15-Sept
Mobile State Docks (AL)	8737048	30.705	-88.04	1.60	12:12 PM	15-Sept
Chicasaw Creek (AL)	8737138	30.782	-88.073	1.35	12:48 PM	15-Sept

Figure 2.2 summarizes surface wind observations measured during the passage of Hurricane Sally. The highest preliminary surface gust measurement (~ 33 ft above ground level) was 120 mph, measured in the right eyewall by the CSWR DOW8, near Perdido Pass in open terrain. A 121 mph wind gust was also measured at Fort Morgan, but the instrument was located 118 ft above ground level. Wind gusts at 33 ft (10 m) above ground level would have been approximately 100 mph based on adjustments using the Kz factor from ASCE 7-16.



ID	Station	Network	Lat	Long	Max Gust (mph)	Min Pressure (mbar)	Height (ft)	Terrain
A	Orange Beach Buoy	NDBC / Buoy	30.065	-87.555	110	979	16	Marine
B	Fort Morgan	COOPS	30.2282	-88.024	121	-	118	Marine/Open
C	Dauphin Island	NDBC / CMAN	30.2504	-88.075	98	981	44	Marine/Open
D	T1	FCMP	30.27515	-87.6956	76	-	33	Suburban
E	DOW8	CSWR	30.27661	-87.5469	120	-	33	Open
F	T5	FCMP	30.29121	-87.6837	93	-	33	Open
G	Pensacola NAS	ASOS	30.3564	-87.3233	92	984	33	Open
H	Gulf Breeze	WeatherFlow / Hurrnet	30.3603	-87.1552	76	988	50	Suburban
I	Gulf Shores - Foley	WeatherFlow / Hurrnet	30.363	-87.6479	93	966	34	Open
J	Fair Point Light 2	WeatherFlow / Professional	30.3659	-87.2136	82	988	15	Marine
K	Santa Rosa Sound DB127	Weatherflow / Professional	30.3776	-87.0051	71	992	22.5	Marine
L	Okaloosa Island Pier	Weatherflow / Professional	30.391	-86.5932	70	-	45	Marine
M	Eglin Air Force Base	FAA / AWOS	30.4968	-86.5135	59	1000	33	Open
N	Buccaneer YC	WeatherFlow / Hurrnet	30.5817	-88.0708	62	987	34	Marine/Suburban
O	Mobile Downtown Airport	ASOS	30.6147	-88.063	75	991	32	Open
P	Coast Guard Sector Mobile	CO-OP	30.648	-88.058	65	-	30	Marine/Open
Q	Mobile Airport	ASOS	30.6882	-88.246	81	995	32	Open
R	Pace Fire Rescue	Private	30.6999	-87.1848	74	-	-	Open
S	Whiting Field North	Private	30.72	-87.02	64	990	-	Open
T	EW0390 Calvert AL	Private	31.1483	-87.9833	47	-	-	Suburban
U	Andalusia	ASOS	31.3061	-86.3902	53	997	32	Open
V	Evergreen	ASOS	31.4191	-87.0484	45	999	32	Open

Figure 2.2. Summary of wind speed observations relative to ASCE 7-10 design wind speed contours (700-year return period). Data sourced from the WeatherFlow DataScope platform.

2.2 Rainfall

Several days prior to Sally making landfall, the NOAA Weather Prediction Center (WPC) was calling for record-breaking rainfall along coastlines of the Florida Panhandle and southern Alabama. The quantitative precipitation forecast (QPF) projection models performed well (Figs. 2.3 and 2.4), highlighting the same regions that experienced significant rainfall. Areas from Pensacola, FL to Panama City, FL witnessed over 20 inches of total precipitation during the three-day period from September 14 to September 17. In all, over 1.7 million people and 850,000 homes were exposed to more than 10 inches of rainfall. The effects of the high rainfall totals are also evident in the hydrographs throughout the Florida Panhandle and southern Alabama (Fig. 2.5). Many of the streams and rivers in the region reached either record water levels or major flooding categories.

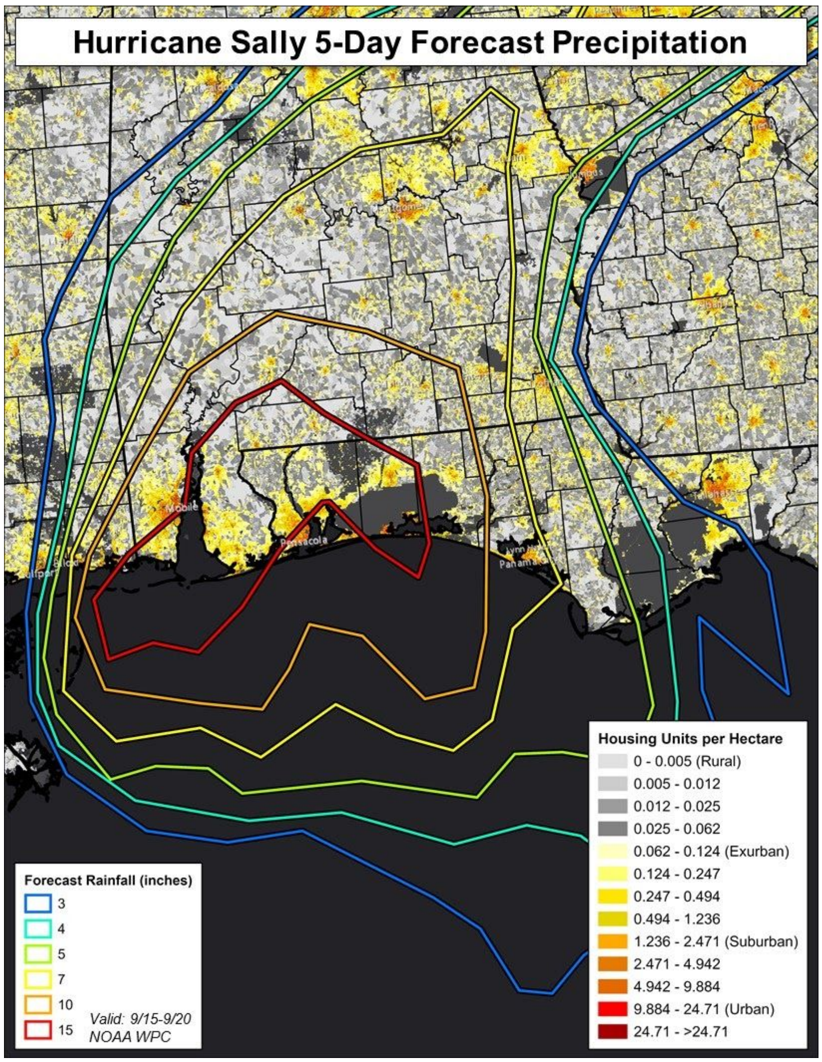


Figure 2.3. Hurricane Sally 5-day forecast precipitation from 15 Sep 2020 to 20 Sep 2020 and housing density. Sources: NOAA WPC and EPA. (Created by Stephen Strader)

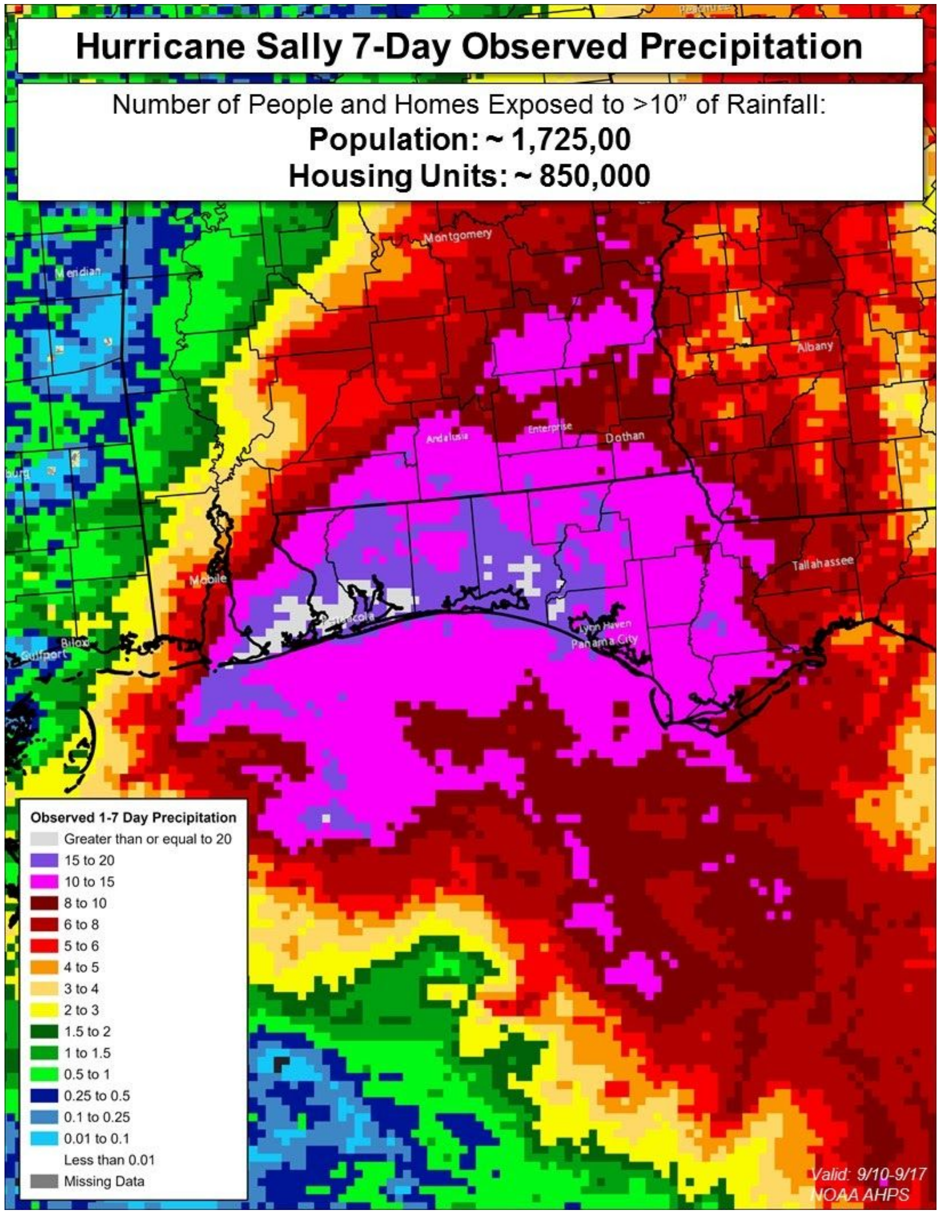


Figure 2.4. Hurricane Sally 7-day observed precipitation from 10 Sep 2020 to 17 Sep 2020. The number of people and housing units exposed to greater than 10 inches of total rainfall is also annotated. Source: NOAA WPC. (Created by Stephen Strader)

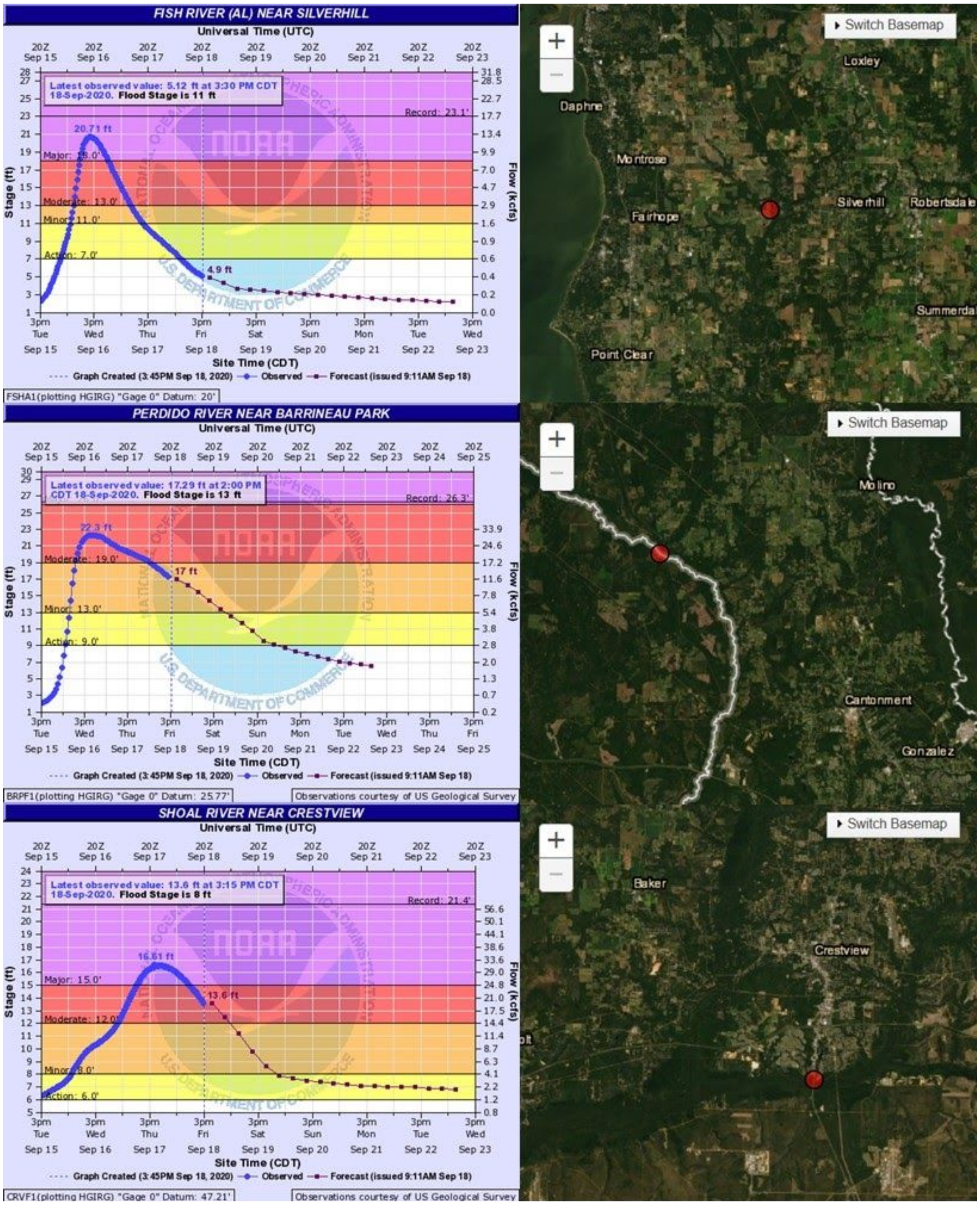


Figure 2.5. Selected stream gauges and associated hydrographs across the Florida Panhandle and southern Alabama region. Source: NOAA AHPS.

3.0 Damage to Structures

The following sections summarize the preliminary reports of damage to structures from public and social media, triangulated against aerial imagery from NOAA.

3.1 Buildings

Although the maximum recorded 3-second gust was 120 mph (Fig. 2.2), which is significantly less than the design wind speeds for the landfall area (per ASCE-7-16, design winds speeds for Risk Category II between 150 and 160 mph), limited wind-induced damage was reported to buildings:

- **Envelope damage:** limited reports from minor to moderate envelope damage, with loss of roof and wall cover (Figs. 3.1-3.2); isolated reports of significant curtain wall damage (Figs. 3.3-3.4)
- **System-level failures:** isolated reports of significant structural roof damages (Figs. 3.5-3.6), in some cases propagating into partial or complete failure of walls (Figs. 3.7-3.9). Major collapses were infrequent and largely confined to wood-framed construction. Several severe structural failures to homes were reported in Fort Morgan, AL (see drone footage from WXChasing), including complete destruction of the second story.
- **Tree Falls:** damage was due to fallen trees was also widespread and did cause structural damage in some cases (Fig. 3.10). Significant tree loss throughout the region blocked roadways and damaged the power distribution network.

A particularly useful resource for the VAST in assessing damage in Pensacola, FL was an online damage assessment dashboard hosted by the City of Pensacola (2020), see Figure 3.11. The dashboard provides a damage assessment heat map, damage observations, and an assessment count. At the time of this briefing, the dashboard listed 524 assessments indicating 418 properties with minor damage, 96 properties with major damage, 8 properties destroyed, and 2 properties affected. Figure 3.12 illustrates the variety of damage observed in Pensacola, but these should not be considered typical performance. Pensacola has 24,939 total housing units including 2,857 built prior to 1940, with 1970 as the median year built. Most properties sustained little or no visible wind damage.

(a) (b)

Figure 3.1. Envelope damage in Sally: (a) siding loss on a house in Pensacola, FL; (b) roof cover loss on a house in Gulf Shores, AL. (Sources: (a) www.pnj.com, (b) abcnews.go.com)

Figure 3.2. Loss of siding on strip mall in Gulf Shores, AL (Source: https://globalnews.ca/)

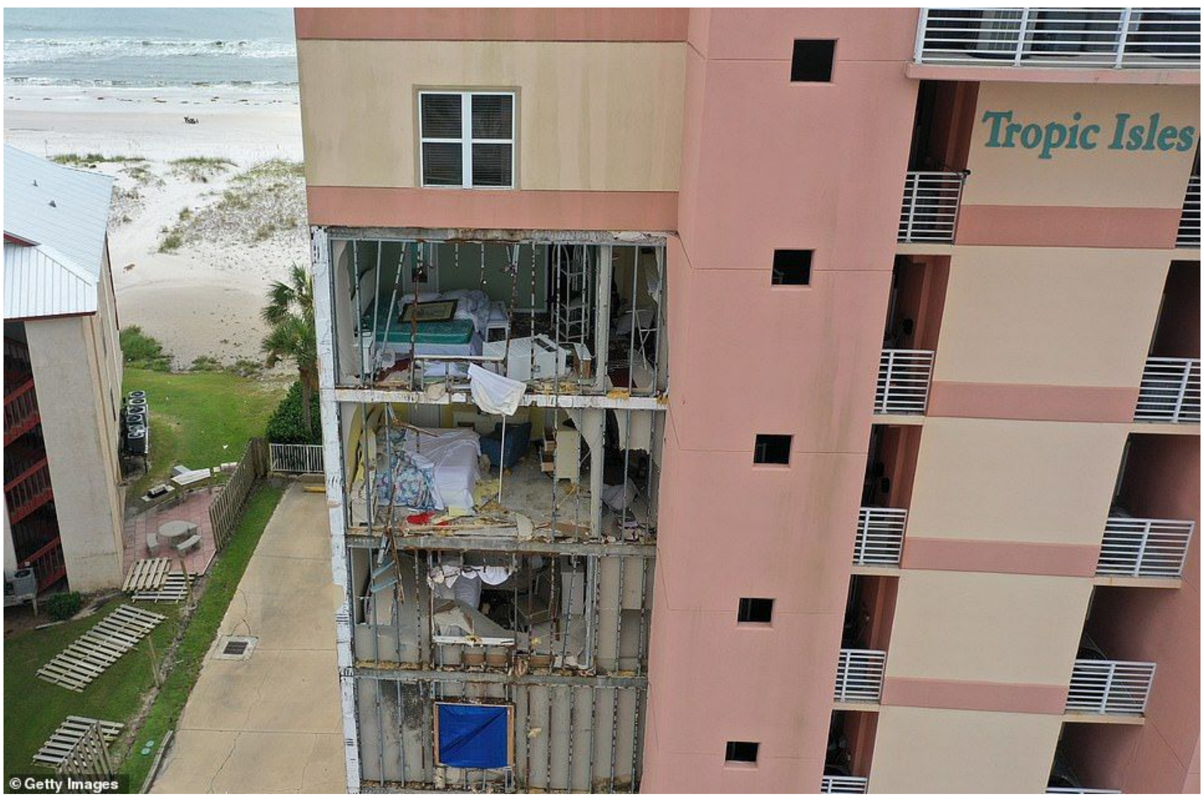


Figure 3.3. Aerial image (by drone) capturing failure of curtain wall on the 9-story Tropic Isles complex building in Gulf Shores, AL (Source: www.dailymail.co.uk)

Figure 3.4. Aerial image (by drone) shows loss of curtain wall on high-rise building in Fort Morgan, AL (Source: [WXChasing www.youtube.com](https://www.youtube.com))

Figure 3.5. Structural roof damage at the Paradise Inn hotel in Pensacola, FL (Source: [CBS This Morning www.youtube.com](https://www.youtube.com))

(a) (b)

Figure 3.6. Roof to wall connection failures in Sally: (a) church steeple toppled in Mobile, AL; (b) failure of roof system on a commercial building, splayed over adjacent single-family building. (Sources: (a) abcnews.go.com, (b) www.usatoday.com)

Figure 3.7. Roof damage at a commercial building in Brownsville (West Pensacola) causing failure of infill masonry walls and brick veneer. (Source: www.pnj.com)

(a) (b)

Figure 3.8. Major structural damages in Sally: (a) complete loss of second floor of a mixed use building in Perdido Key, FL; (b) Extensive roof and wall damage of house on shoreline of Fort Morgan, AL (Sources: (a) www.dailymail.co.uk , (b) www.cnn.com)

(a) (b)

Figure 3.9. Structural damage in Sally: (a) end wall collapse of an elevated, wood-frame home in For Morgan, AL with well-performing homes in the background; (b) roof and wall collapse of a wood-frame home in Fort Morgan, AL (Sources: WXChasing).

(a) (b)

Figure 3.10. Tree fall damage at single family homes: (a) rescue of trapped resident in Mobile, AL; (b) tree limb penetrating ceiling of house in Guyton, GA (b). (Sources: (a) www.dailymail.co.uk, (b) www.dailymail.co.uk)

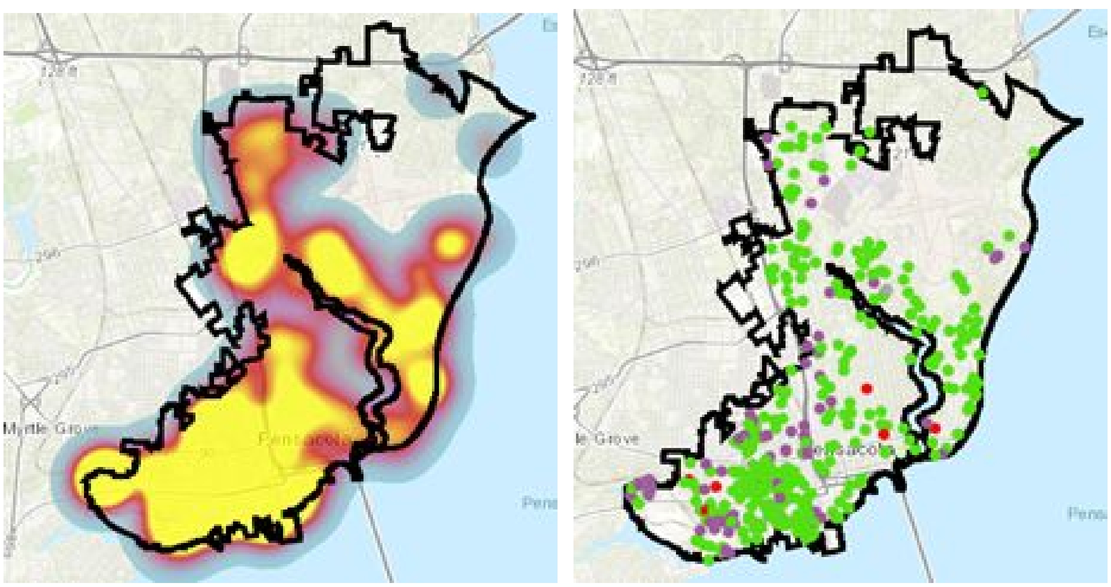


Figure 3.11. City of Pensacola damage assessment dashboard: (a) Damage Assessment Heat Map; (b) Damage Assessment Data (City of Pensacola, 2020).

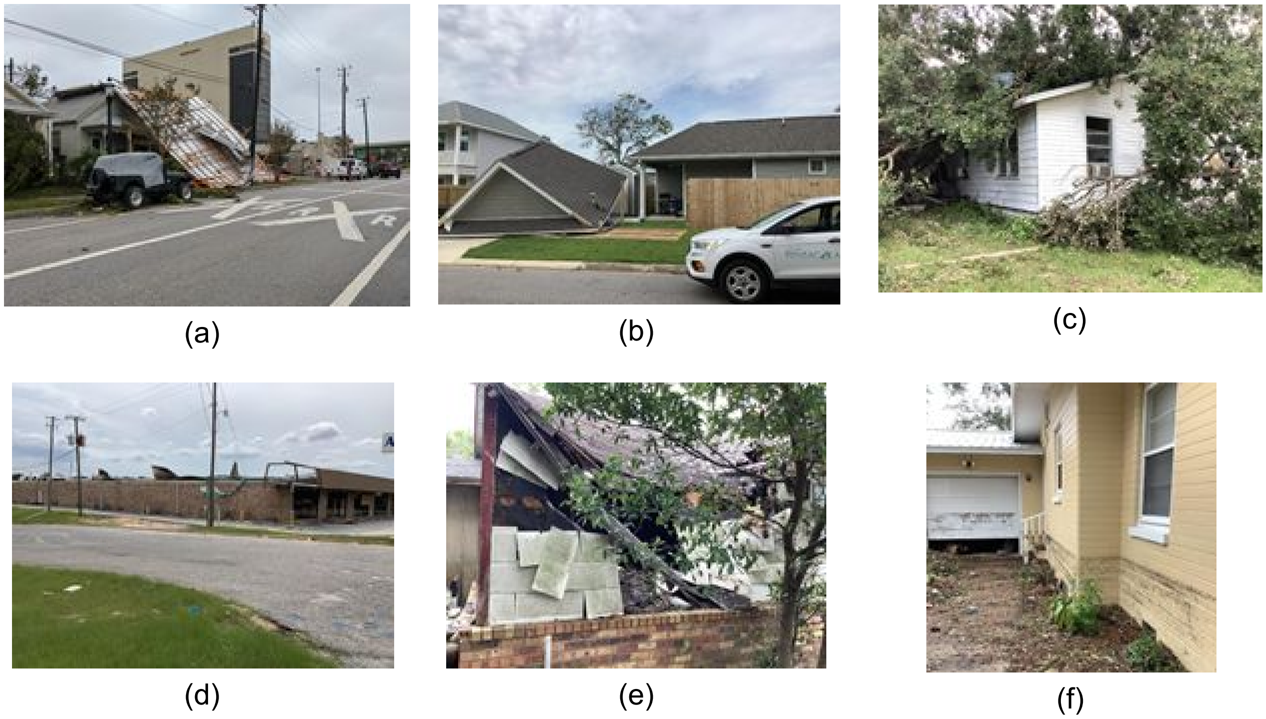


Figure 3.12. Illustrative damage in Pensacola sourced from the City of Pensacola: (A) roof damage, year built unknown; (B) carport collapse, built 1947; (C) damage by tree fall, built 1987; (D) commercial roof damage, year built unknown; (E) collapsed roof and wall, built 1938; (F) flood damage (~4ft); built 1953 (City of Pensacola, 2020).

While acknowledging these instances of wind-induced damage, preliminary reports suggest that flooding was the primary driver of losses over a significant area, with high storm surge as major driver in this slow-moving hurricane. This coupled with high rainfall totals over 20 inches led to food waters up to 3 feet in some areas, most notably in Pensacola (Fig. 3.13).

(a) (b)

Figure 3.13. Examples of flooding in Sally: (a) flooded streets of Pensacola downtown, FL; (b) flooding in West Pensacola, FL near the Bayou Grove and Mulworth neighborhoods (Source: (a) www.dailymail.co.uk, (b) weather.com)

3.2 Other Infrastructure

Over 440,000 residents were left without power across the Gulf Coast, with at least 234,103 in Alabama, 204,410 in Florida and 5,406 in Mississippi (Impelli, 2020). In addition to widespread power outages, the initial assessments of damage to roads, bridges and public buildings total nearly $29 million of damage in Escambia County and the City of Pensacola (Little, 2020). The most notable structural damage to infrastructure reported in public media is a collapsed section of the newly built Pensacola Bay Bridge between Gulf Breeze and Pensacola, FL, known to locals as the Three Mile Bridge (Fig. 3.14) (Kaur and Burnside, 2020). Reports suggest that the bridge's partial collapse resulted from the impacts of two loose barges: one barge wedged under the bridge (Fig. 3.14b), cranes from the other barge rammed against the bridge deck, damaging one section (Fig. 3.14c-e). The recently renovated Gulf State Park Pier in Gulf Shores, AL also lost several sections in the storm (Fig. 3.15). Marinas also sustained significant damage from the storm surge (Fig. 3.16), leading to debris, in the form of marooned boats, impacting the surrounding areas (Fig. 3.17).

(a) (b) (c) (d) (e) (f)

Figure 3.14. Damaged Pensacola Bay Bridge between Gulf Breeze and Pensacola, Florida: (a) view from deck of lost section, (b) photo of barge wedged under bridge, (c)-(d) crane of second barge damages bridge deck, (e) side view of damage caused by barge/crane impact, and (f) side view of collapsed bridge segment battered by rising waters (Sources: (a) https://weartv.com, (b)Destin-Fort Walton Beach, Florida, (c) City of Gulf Breeze, (d) Fight the Blight,(e)https://twitter.com/wxkaitlin, (f) https://www.moultonadvertiser.com)

(a) (b)

Figure 3.15. Damaged pier at Gulf State Park in Gulf Shores, AL (Source: (a) https://www.fox10tv.com, (b) https://www.moultonadvertiser.com)

(a) (b)

Figure 3.16. (a) Damaged boats and (b) ferry in Pensacola, FL (Source: https://www.moultonadvertiser.com)

Figure 3.17. Flooded roads with boats washed ashore in Orange Beach, AL (Source: https://www.moultonadvertiser.com)

4.0 Field Observations

Within 24 hours of landfall, local FAST scout teams from the University of South Alabama and Auburn University were on site performing rapid, targeted assessments and logging observations in Fulcrum. Their observations are organized below by region. Approximate hazard conditions for each region are provided in the section headers, sourced from data summarized in Figure 2.2 and the National Weather Service (NWS, 2020a; NWS, 2020b). Wind speeds provided in the headings are intended to represent 3-second gusts at 33 ft (10 m) height in open exposure, but are estimated from a variety of non-standardized sources, for some of which no metadata is available. As such, these estimates should be used with caution.

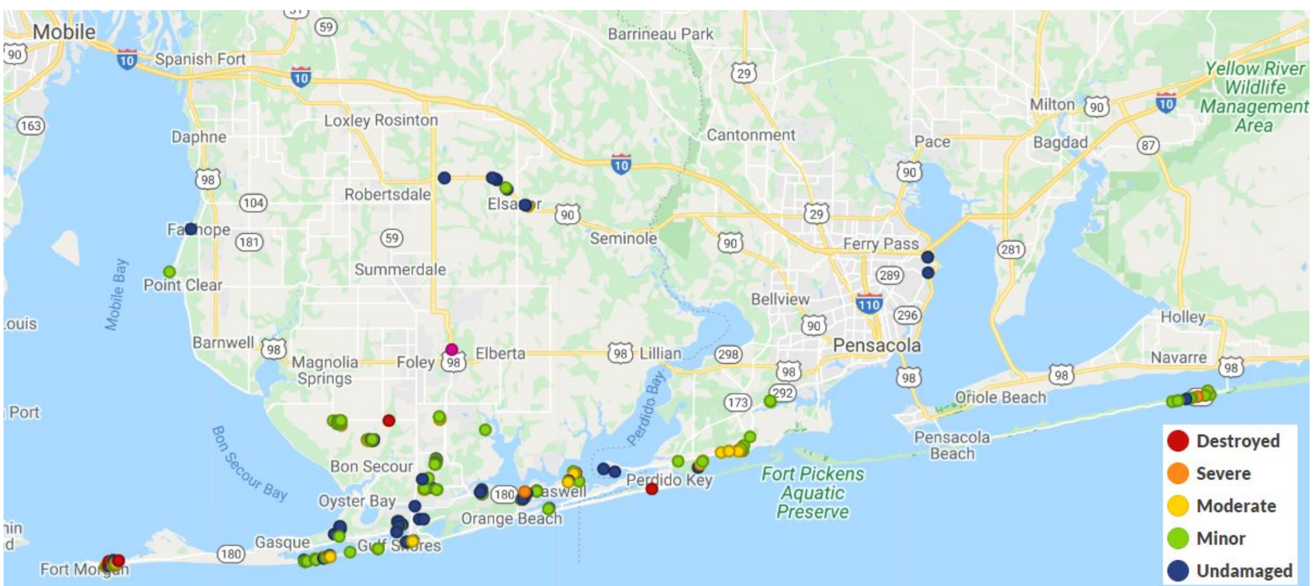


Figure 4.1. Overview of FAST assessments logged in Fulcrum.

4.1. Fort Morgan, AL (Max Wind Speed: ~90-100 mph, Max Surge: 3-4 ft)

FAST was able to access Fort Morgan, a small unincorporated community west of Gulf Shores, on 23 September and conducted assessments to mostly residential buildings that were present. Most buildings were wood-frame and elevated at least 4 ft above ground. A few multi-story condominium buildings are also present in Fort Morgan, along with a marina. A review of historical aerial imagery showed the majority of buildings in Fort Morgan have been in existence since the early 2000s, although some new construction is also present. Performance varied widely, from no visible evidence of damage to complete destruction. Structural damage up to loss of roof structure and collapse of some walls was observed in a few older buildings (Fig. 4.2a,b), but not all older buildings performed poorly, as shown in Fig. 4.2c,d.

(a)

(b)

(c)

(d)

Figure 4.2. Illustrative damage observed by FAST in Fort Morgan, AL, including (a) loss of the roof structure in an elevated, one-story wood-frame home constructed in 1998; (b) collapse of a metal marina building constructed between 1997 and 2006; (d) no visible damage to an elevated 2-story home constructed in 2000, located adjacent to (a); no permits exist on file since original construction other than a roof replacement in 2018; (d) loss of vinyl siding and some roof cover in a one-story, wood-frame home constructed in 1992.

4.2 Gulf Shores, AL (Max Wind Speed: ~90-95 mph, Max Surge: Unknown)

Observations in Gulf Shores were performed primarily on AL 180 (Fr. Morgan Road) and AL 182 (West Beach Blvd) west of AL 59. The most significant impacts in the area were due to storm surge/flooding and tree falls. There were several instances of observed facade and/or roof damage. Typical damage was minor, however, there were several structures that sustained loss of roof sheathing (Fig. 4.3). Damage was primarily observed on older residential structures, with nearby structures undamaged (Fig. 4.4).

Figure 4.3. Atypical damage to a residential roof in Gulf Shores with loss of roof sheathing.

(a) (b) (c)

Figure 4.4. Typical damage observed in Gulf Shores: (a) significant loss of roof cover; (b) no loss of roof cover, but minor loss of cladding; (c) no observed damage.

4.3 Orange Beach, AL (Max Wind Gust: ~90-120 mph, Max Surge: Unk)

The primary areas evaluated in Orange Beach were along AL 180 (commonly referred to as Canal Road) east of the Foley Beach Expressway (i.e., the Wharf). There was one cluster evaluated in a neighborhood off AL 161 as well. Damage in Orange Beach was similar to Gulf Shores with the primary damage being tree falls and some minor roof damage (Fig. 4.5). Evidence of 2-3 ft of surge and flooding was also observed (Fig. 4.6). A neighborhood of modern residential construction off AL 161, including one FORTIFIED Gold home, performed well overall with no observed structural failures or roof cover damage (laminated asphalt shingles), but did suffer consistent minor loss of fiber-cement board cladding (Fig. 4.5b).

(a)

(b)

Figure 4.5. Damage observed in Orange Beach: (a) typical roof damage; (b) minor loss of fiber cement cladding in a FORTIFIED Gold home, but no other observed damage and no water ingress.

Figure 4.6. High water mark (HWM) observed in Bear Point (east end of Orange Beach). Measurements have not yet been taken of observed HWMs.

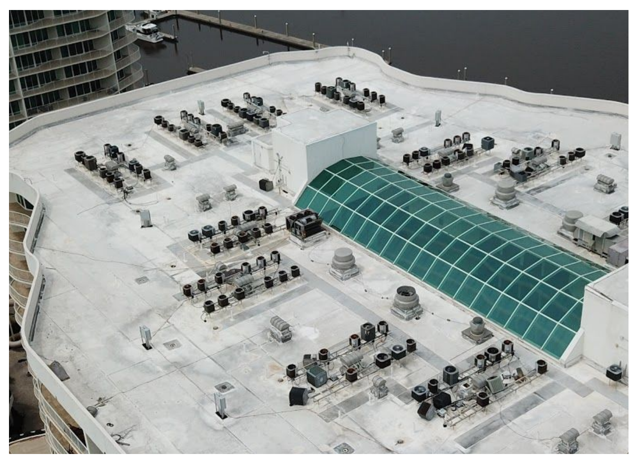
4.4 Perdido Key, FL (Max Wind Gust: ~95-120 mph, Max Surge: Unk)

Most observations in Perdido Key were made along FL SR 292. Structural damage of any kind was isolated. The heaviest damage observed was to a two-story, wood-frame condo constructed in 1986, and a real estate office constructed in 1978, both shown in Figure 4.7. The condo building did not appear to have any hurricane straps or other high-wind connections; connections could not be observed in the real estate office. Overall, most buildings suffered little to no damage, and those that were damaged typically only sustained minor loss of roof cover or loss of a few wall cladding elements (e.g., fascia, fiber cement boards, vinyl siding). FAST members Roueche and Marshall conducted a few more detailed assessments near Perdido Pass (the location of the 120 mph gust measurement), but found little evidence of damage in the few structures located in close proximity, which included two 1-story commercial buildings (constructed in 2009 and 2011) and three 13-story resort buildings constructed between 1999 and 2006. The only observed damage was a partial gutter failure in one of the 1-story buildings, and a few toppled rooftop HVAC units in the 13-story condos. The owner of the resort buildings indicated there were no widespread issues with rainwater ingress.

(a)

(b)

(c)



(d)

Figure 4.7. Illustrative damage in Perdido Key, including (a) a destroyed two-story condominium constructed in 1986; (b) a destroyed real-estate building constructed in 1978; (c) minimal damage to a restaurant near Perdido Pass constructed in 2009; and (d) a few toppled roof top units as the only evidence of damage to 13-story resort buildings near Perdido Pass (constructed between 1999 and 2006).

4.5 Big Lagoon, West of Pensacola, FL (Max Wind Gust: ~95-120 mph, Max Estimated Surge: 5.6 ft MHHW)

The Big Lagoon included sites located between the Pensacola Naval Air Station to the east and Perdido Key to the west. Damage here was heavier and more consistent than was observed elsewhere, perhaps in part due to the geography of the region. Modern buildings still performed well overall, but were more likely to experience moderate wind damage than other regions. Figure 4.8 illustrates the damage observed in this area.

(a)

(b)

(c)

(d)

Figure 4.8. Illustrative damage in the Big Lagoon region: (a) loss of wind rated vinyl siding to a home constructed in 2016. The home also suffered loss of ~25% of its laminated shingle roof; (b) loss of fiber cement board cladding to a 2018 home; (c) collapsed end wall (windward wall) of a steel-frame marina constructed in 2003; (d) roof sheathing loss in a single family home constructed in 1990.

4.6 Santa Rosa Island (Max Wind Gust: ~70-80 mph, Max Reported Surge: Unk)

Due to closure of the Pensacola Bay Bridge, access to Santa Rosa Island from Pensacola required an eastern detour to FL SR 281 or FL SR 87 via US Hwy 98 with restricted access to Santa Rosa Island. Observations on Santa Rosa Inland Key were made along FL CR 399 from Navarre Beach to Pensacola Beach. Overall, most buildings suffered little to no damage, and those that were damaged typically only sustained minor loss of roof cover or loss of a few wall cladding elements (e.g., fascia, fiber cement boards, vinyl siding). Illustrative examples are provided in Figures 4.9-4.10. Pensacola Beach has 6,465 housing units built between 1940 to present, with 1985 as the median year built, and Navarre Beach has 2,194 housing units built between 1970 to present, with 1996 as the median year built.


(a)


(b)


(c)


(d)


(e)


(f)

Figure 4.9. Illustrative wind damage on Santa Rosa Island: (a) siding damage, built 1999; (b) collapsed garage, built 2001; (c) roof damage - water intrusion, built 2000; (d) wind-borne debris impacts, year built unknown; (e) metal roof damage, built 2003; (f) siding damage, built 2000.

Figure 4.10. Illustrative surge damage on Santa Rosa Island: (left) ground floor damage and siding (wind), built 1992; (middle) ground floor damage, built 1982; (right) scouring damage, year built unknown.

The damage and frequency of damage were both greater in Pensacola Beach than in Navarre Beach. Structures closest to the Santa Rosa Sound experienced more surge damage, and structures closest to the Gulf of Mexico experienced more wind damage. While several structures had damage on the island, collectively the damage appears minor. Asphalt shingle roofs and siding appear to account the majority of the wind damage. While the surge appears approximately 2-4 ft, elevated structures with breakaway walls seemed to have mitigated the impact of the surge damage. The surge did shift large amounts of sand, covering roadways and parking lots, and collecting against building structures, particularly in Pensacola Beach.

4.7 Interior Baldwin County (Max Wind Gust: ~70-80 mph)

The FAST performed a few assessments throughout interior Baldwin County, including Foley, Elsanor, and Magnolia Springs. Observations in Elsanor were made along US Hwy 90. The observations indicate minimal wind damage and no indication of flooding damage (Fig. 4.11). The only wind damage detected was intermittent minor siding and asphalt shingle roof damage. Elsanor has 5,786 housing units built between 1936 to present, with 1992 as the median year built.

Observations were made primarily along County Rd 12 in Magnolia Springs and Foley, and in subdivisions south of Coastal Gateway Blvd and west of the Foley Beach Express. Minimal wind damage was observed. Typical damage consisted of missing shingles, siding, and soffit (Fig 4.12). Most newer homes (~2010+), notably those with FORTIFIED ratings, sustained no damage. Some homeowners described water damage either due to missing shingles or flooding from overflowed retention ponds. Overall impressions were that damage was more common and more severe in older (~<2010) homes. The most severe failure was a collapsed concrete masonry block structure (constructed in 1982). The tenant of the structure attributed the damage to a tornado and pointed to a possible tornado path in the forest behind the structure, rather than the hurricane (Fig 4.13). A metal building southeast of Foley constructed in 2004 suffered an endwall collapse (Fig. 4.14). Many homes in the adjacent neighborhood suffered minor to moderate roof cover and wall cladding damage, but no structural failures were observed.

Figure 4.11. Illustrative damage in Elsanor: (left) roof damage, built 1955; (middle) roof damage, year built unknown; (right) roof & siding damage, year built unknown.

Figure 4.12. Typical damage in Foley, AL included missing shingles, siding, and soffit.

Figure 4.13. An unreinforced masonry block structure in Foley, AL was destroyed.

Figure 4.14. Endwall collapse (north-facing wall) of a metal building near Foley, AL (GPS: 30.356369, -87.659019).

4.8 Pensacola, FL (Max Wind Gust: ~70-80 mph)

The damage in Pensacola was driven by both wind and flooding, with flood damage concentrated along the tributaries and bayous. Since the city of Pensacola experienced heavy flooding, it is unclear if much of the water damage is from storm surge and how much is due to rainfall. One common observation throughout Pensacola, by the FAST and review of supplemental sources, appears to be tree uprooting due to the large amount of rain saturating the ground coupled with strong winds. The uprooted trees induced structural damage and significant impacts to the power infrastructure. Still, Hurricane Sally can be classified predominantly as a flood event in Pensacola.

FAST directly observed a few FORTIFIED properties in eastern Pensacola, one of which experienced partial failure of a single vinyl siding panel but was otherwise undamaged, and the other had no visible exterior damage. FAST also sampled a neighborhood in West Pensacola along Generation Ave that seemed to be the furthest east with consistent roof cover damage visible along FL 292. Most homes assessed within the cluster lost between 5-10% of the 3-tab asphalt shingles (Fig. 4.15). The damage was visible in person, but is not visible in the NOAA aerials. The homes were all wood frame with hip roofs, constructed in 2001, and most shingles appeared to be the original installed roofs.

Figure 4.15. Typical shingle loss in a neighborhood of single-family homes in West Pensacola constructed in 2001.

5.0 Recommendations for Further Study

Due to the challenges associated with the COVID-19 virus, and the minor structural damage observed overall by the FAST scout teams, StEER does not anticipate engaging a full FAST response. Rather, StEER's present response takes the form of this Event Briefing, which shares with the community StEER's impressions of the event and implications for natural hazard research and practice. Information provided herein was gathered from public sources as well as on-site observations from the FAST scout teams. StEER will continue to monitor this event and should the damage to structures warrant the formation of a full VAST or FAST, StEER will notify the community through its standard channels. StEER will also coordinate with any field assessment teams activated from other sources (e.g., FEMA, NIST, NSF RAPID grants, etc).

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