HURRICANE LAURA

August 27, 2020
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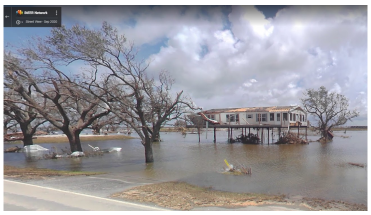
NHERI DesignSafe Project ID: PRJ-2888

DATA REPORT



FAST Imagery: (from top left, clockwise) sample streetview image of elevated home in Creole, example of recurring theme of buckled garage doors, FAST-1's Justin Marshall documenting high water mark at South Cameron High School in Cameron, FAST-2 in front of vehicle equipped with RAPID EF streetview platform

FAST-1: Lead: David Roueche, Auburn Univ. Justin Marshall, Auburn Univ. **FAST-2:** Lead: Sabarethinam Kameshwar, LSU Naqib Mashrur, LSU **FAST-3:** Lead: MIke Vorce, SiteTour 360	**VAST (Remote Damage Assessors):** Kevin Ambrose, Auburn Univ. Hadiah Rawajfih*, Auburn Univ. Lily Rodriguez*, Univ. of Notre Dame Olivia Childress*, Auburn Univ. Dylan Fox*, Auburn Univ. Kaitlyn Morris*, Auburn Univ. Christian Brown, Auburn Univ. **also served as Data Librarian*
Mission Coordinator: Tracy Kijewski-Correa, University of Notre Dame	**StEER DE/QC Coordinator:** David Roueche, Auburn University

PREFACE

The National Science Foundation (NSF) awarded a 2-year EAGER grant (CMMI 1841667) to a consortium of universities to form the Structural Extreme Events Reconnaissance (StEER) Network (see https://www.steer.network for more details). *StEER builds societal resilience by generating new knowledge on the performance of the built environment through impactful post-disaster reconnaissance disseminated to affected communities.* StEER achieves this vision by: (1) deepening structural engineers' **capacity** for post-event reconnaissance by promoting community-driven standards, best practices, and training, as well as their understanding of the effect of natural hazards on society; (2) **coordination** leveraging its distributed network of members and partners for early, efficient and impactful responses to disasters; and (3) **collaboration** that broadly engages communities of research, practice and policy to accelerate learning from disasters. StEER works closely with other extreme event reconnaissance organizations and the Natural Hazards Engineering Research Infrastructure (NHERI) to foster greater potentials for truly impactful interdisciplinary reconnaissance after disasters.

Under the banner of NHERI's CONVERGE node, StEER works closely with the wider Extreme Events Reconnaissance consortium including the Geotechnical Extreme Events Reconnaissance (GEER) Association and the networks for Interdisciplinary Science and Engineering Extreme Events Research (ISEEER), Nearshore Extreme Event Reconnaissance (NEER), Operations and Systems Engineering Extreme Events Research (OSEEER), Social Science Extreme Events Research (SSEER), and Sustainable Material Management Extreme Events Reconnaissance (SUMMEER), as well as the NHERI RAPID equipment facility, the NHERI Network Coordination Office (NCO), and NHERI DesignSafe CI, long-term home to all StEER data and reports.

While the StEER network currently consists of the three primary nodes located at the University of Notre Dame (Coordinating Node), University of Florida (Atlantic/Gulf Regional Node), and University of California, Berkeley (Pacific Regional Node), StEER aspires to build a network of regional nodes worldwide to enable swift and high quality responses to major disasters globally.

StEER's founding organizational structure includes a governance layer comprised of core leadership with Associate Directors for each of the primary hazards as well as cross-cutting areas of Assessment Technologies and Data Standards, led by the following individuals:

- **Tracy Kijewski-Correa (PI),** University of Notre Dame, serves as StEER Director responsible for overseeing the design and operationalization of the network and representing StEER in the NHERI Converge Leadership Corps.
- **Khalid Mosalam (co-PI),** University of California, Berkeley, serves as StEER Associate Director for Seismic Hazards, leading StEER's Pacific Regional node and serving as primary liaison to the Earthquake Engineering community.
- **David O. Prevatt (co-PI),** University of Florida, serves as StEER Associate Director for Wind Hazards, leading StEER's Atlantic/Gulf Regional node and serving as primary liaison to the Wind Engineering community.
- **Ian Robertson (co-PI),** University of Hawai'i at Manoa, serves as StEER Associate Director for Coastal Hazards, serving as a primary liaison to the coastal engineering community and ensuring a robust capacity for multi-hazard assessments.
- **David Roueche (co-PI),** Auburn University, serves as StEER Associate Director for Data Standards, ensuring StEER processes deliver reliable and standardized reconnaissance data suitable for re-use by the community.

ACKNOWLEDGMENTS

This material is based upon work supported by the National Science Foundation under Grant No. CMMI 1841667. Any opinions, findings, and conclusions or recommendations expressed in this material are those of StEER and do not necessarily reflect the views of the National Science Foundation. All authors and editors listed on the cover page participate as volunteer professionals. Thus, any opinions, findings, and conclusions or recommendations expressed herein are those of the individual contributors and do not necessarily reflect the views of their employer or other institutions and organizations with which they affiliate.

Special thanks to Spatial Networks for their ongoing partnership and generous support, making available, at no cost, the Fulcrum Community mobile platform for StEER Damage Assessments. FAST-1 appreciates the assistance of Darrell Williams, Assistant Administrator of the Cameron Parish Police Jury, in getting access to Creole, LA. FAST-2 appreciates support from Randy Osborne and Dr. George Voyiadjis at Louisiana State University for providing contacts in Cameron Parish to help gain access to damaged areas.

Data was collected in part using equipment provided by the National Science Foundation as part of the RAPID Facility, a component of the Natural Hazards Engineering Research Infrastructure, under Award No. CMMI: 1611820. StEER appreciates the RAPID EF's Michael Grilliot's prompt responsiveness to our evolving needs during these deployments.

The sharing of logistical details, images/videos, damage reports and briefings via Slack by the entire NHERI community was tremendously helpful and much appreciated. StEER especially welcomed the exchange of information between the various teams deploying instrumentation in advance of Laura's landfall, including the Florida Coastal Monitoring Program (University of Florida), Texas Tech University, and the University of Illinois at Urbana Champaign, and the Nearshore Extreme Events Reconnaissance (NEER) Association. StEER is especially thankful to Manuel "Manny" Perotin of CDM Smith, whose work with FEMA MAT has led to a sustained, fruitful collaboration with StEER. This sharing of potential targets and other intel via Slack was especially valuable to StEER's rapid deployment strategy for this event. Finally, StEER recognizes the efforts of the DesignSafe CI team who continuously supported and responded to StEER's emerging needs.

ATTRIBUTION GUIDANCE

Citing Images, Data or Data Derivatives from this Dataset

The use of images from this published data set and the use of these or any other data to conduct additional analyses or prepare various visualizations or data derivatives should use the full citation information and DOI from DesignSafe (these are available at https://www.steer.network/products).

For a full listing of all StEER products (briefings, reports and datasets) please visit the StEER website: https://www.steer.network/products

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1.0 Event Summary and Team Configuration

Hurricane Laura made landfall as a strong Category 4 storm near Cameron, LA in the early hours of 27 August 2020, tying the Last Island Hurricane of 1856 as the strongest land-falling hurricane in Louisiana history. Wind speeds are estimated to have reached or exceeded the design wind speeds for Risk Category II buildings and other structures, as defined in ASCE 7-16 and the 2018 International Building Code (MRI = 700 years), by as much as 5 mph near Lake Charles, LA (specifically, northeastern Calcasieu Parish and the eastern half of Beauregard Parish). Meanwhile storm surge resulted in high water marks of over 17 feet above ground in Oak Grove, LA in Cameron Parish. As the storm's well-predicted track facilitated coordinated, multi-entity surface measurements of wind fields and storm surge, Laura is one of the best documented storm events and thus provides novel opportunities to understand the vulnerabilities underpinning losses across a diversity of building occupancies and other critical infrastructure. Additional details of the hazard characteristics and resulting damage, as distilled from public reports and field observations, were documented in StEER's prior publication on this event:

Joint Preliminary Virtual Reconnaissance Report (PVRR) an Early Access Reconnaissance Report (EARR)	PRJ-2888	https://doi.org/10.17603/ds2-ng93-se16

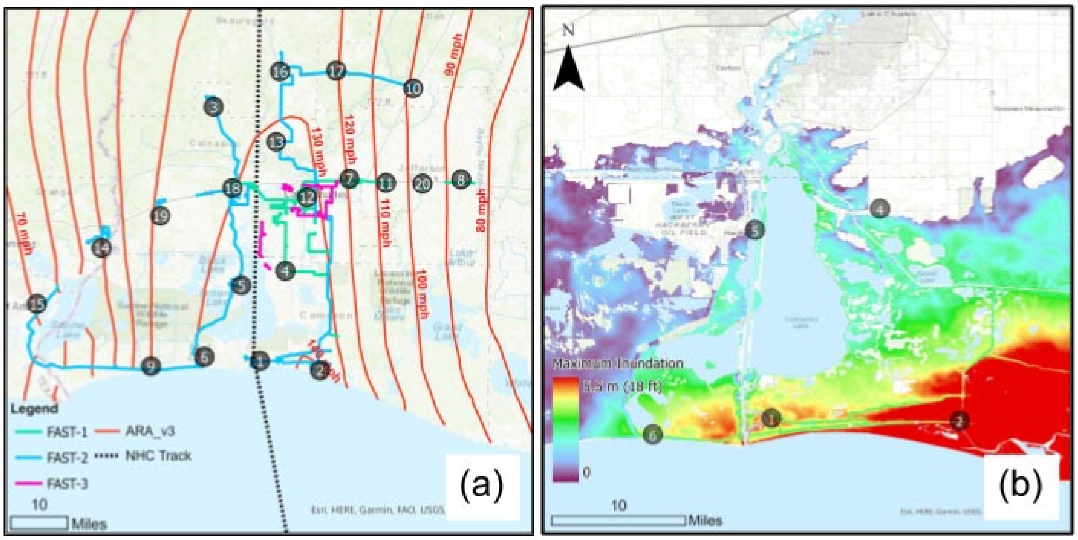
In order to balance the need to capture high-quality perishable data for this event while minimizing the COVID-19 exposure of its Field Assessment Structural Teams (FAST) and the impacted community, StEER organized a unique field response: swiftly mobilizing a series of FASTs to collect street-level panoramic imagery between 27 August and 12 September 2020. FAST-1, led by David Roueche and Justin Marshall, mobilized immediately, reaching the impacted areas at 1 pm CDT on 27 August 2020. FAST-1 collected street-level panoramas and imagery using Unmanned Aerial Systems (UAS) through 29 August in Lake Charles, LA and surrounding communities, as access allowed. FAST-1 was followed on 2 September 2020 by FAST-2 led by Sabarethinam Kameshwar and Naqib Mashrur, who continued to collect street-level panoramas, accessing some of the coastal areas impassable to FAST-1. A final round of panoramic imaging and UAS data collection was completed by Michael Vorce 11-12 September 2020. FAST members are listed in Table 1.1. The panoramas were uploaded to Google Maps, permitting rapid access to the Virtual Assessment Structural Team (VAST) triangulating this data with UAS aerials to remotely complete structural assessments of specific buildings in the impacted areas. VAST members are listed in Table 1.2 These assessments were then processed using StEER's Data Enrichment and Quality Control (DE/QC) process described in Section 4.1. A subset of these VAST members served as Data Librarians in this process (denoted by * in Table 1.2).

Table 1.1: Field Assessment Structural Team Members		
Team Member	**Affiliation**	**Team Assignment**
David Roueche	Auburn University	FAST-1 Lead, UAS Operator
Justin Marshall	Auburn University	FAST-1 Member
Sabarethinam Kameshwar	Louisiana State University	FAST-2 Lead
Naqib Mashrur	Auburn University	FAST-2 Member
Michael Vorce	Site Tour 360	FAST-3 Lead, UAS Operator

Table 1.2: Virtual Assessment Structural Team Members	
Name	**Affiliation**
Hadiah Rawajfih*	Auburn University
Lily Rodriguez*	University of Notre Dame
Olivia Childress*	Auburn University
Dylan Fox*	Auburn University
Christian Brown	Auburn University
Kaitlyn Morris*	Auburn University
Kevin Ambrose	Auburn University
**also served as Data Librarian*	

2.0 Data Collection Methodology

The response leveraged small, self-contained, regional FASTs deploying in phases to collect rapid assessment data using vehicle-mounted street-level panoramic imaging platforms, with select use of UAS. Routes selected for street-level imaging were based on inventory data and sites of post-Rita construction to ensure a range of building classes/occupancies, typologies, and vintages were canvassed. Given the excellent coverage of wind field observations in this event, emphasis was placed on documenting areas in close proximity to deployed wind instrumentation, as well as documenting performance along the hazard gradient to the east and west of the storm's track. The FASTs covered a wide geographical area from Port Arthur, TX to the west, all the way to Jennings, LA to the east, Longville, LA to the north, and Holly Beach, LA to the south. Figure 2.1 provides an overview of the regions sampled by the three FASTs.



1.	Cameron	6.	Holly Beach	11.	Lacassine	16.	Ragley
2.	Creole	7.	Iowa	12.	Lake Charles	17.	Reeves
3.	DeQuincy	8.	Jennings	13.	Moss Bluff	18.	Sulphur
4.	Grand Lake	9.	Johnson Bayou	14.	Orange	19.	Vinton
5.	Hackberry	10.	Kinder	15.	Port Arthur	20.	Welsh

Figure 2.1. Visual summary of surveyed communities relative to (a) preliminary Hurricane Laura track from the National Hurricane Center (NHC) and standardized gust wind speed estimates (3-second averaging time, 10 m height, open exposure) from Applied Research Associates (Version 3 wind field), including FAST street-level panorama routes; and (b) maximum inundation depth above ground from ADCIRC hindcast (NHC best Track).

2.1 Structural Assessments

IMPLEMENTATION: Remotely populated by VASTs using panoramic aerial imagery
PUBLIC ACCESS POINT: [StEER's Fulcrum Community page]

While not the primary intent of the FAST deployments for Hurricane Laura, structural assessments were generated in select circumstances by FAST-1 (spot evaluations) and three collaborators -- Dean Ruark and Lynn Miller (PGT Innovations) and John Cleary (University of South Alabama) -- while some clusters were remotely assessed by the VAST when street-level panoramas and/or UAS orthomosaic data was available. For the virtual assessments, Data Librarians sampled every structure to complete structural assessments in Fulcrum, emulating the process normally undertaken by FAST members in the field. These were documented using the Fulcrum mobile app: *StEER Building - US (Windstorm),* which focuses on primary structural typologies and component types, construction materials, and damage levels. These assessments, including adopted damage ratings, followed the *StEER Field Assessment Structural Team (FAST) Handbook* (2019) available at https://www.steer.network/resources. Appendix A lists the fields acquired by this Fulcrum Application.

Virtual structural assessments relied upon the street-level panoramas, orthomosaics and point clouds (derived from UAS imagery), if available, the NOAA Hurricane Laura aerial imagery (Hurricane LAURA Imagery), 2D and 3D Waldo imagery from FEMA (no longer publicly available), parish GIS assessor sites (CPPJ.totaland.com), and public realtor sites. Where reliable information on a few buildings in a cluster was captured on-site by FAST-1, and all buildings in the cluster were built around the same time, information from the on-site assessments was extrapolated to other buildings in the cluster of the same age (e.g., roof-to-wall connections, garage door wind rating). Otherwise, assessments were primarily completed based on what could be directly observed through the sources listed above. For some buildings, the backside of the building was not captured in street-level panoramas, nor was UAS imagery available. In these cases, wall and fenestration component-level damage ratios were extrapolated based on the damage visible from the three sides.

2.2 Street-level Panoramic Imaging Platforms

IMPLEMENTATION: FAST-1, FAST-2, FAST-3

PUBLIC ACCESS POINT: Google Maps Street View, Mapillary

GoPro Driving Pilot: YouTube Video of GoPro Pilot | panoramas extracted from GoPro Pilot
GoPro Walking Pilot: YouTube Video of GoPro Pilot | panoramas extracted from GoPro Pilot
NCTech iStar Pulsar+ Imagery: Mapillary

FAST-1, FAST-2 and FAST-3 employed the NCTech iStar Pulsar+ camera (FAST-2's unit was leased from the RAPID EF facility), recording spot observations of representative performance using the Fulcrum App as discussed in Section 2.1, and identifying areas for follow-up assessment based on damage and accessibility. The NCTech Pulsar used in this investigation consists of four cameras mounted together to gather a 360 x 145 degree field of view. Each camera has a resolution of 12.3 MP, sensor size of 3042x4062, and uses fisheye lenses with fixed focus and aperture size of f/2.6. GNSS-tracking via a U-BLOX Neo M8N receiver geotagged each image location with ~2.5 m accuracy. Frames were captured every 4 m along the routes driven, capturing near-continuous coverage of exterior building performance.

FAST-3 also piloted the use of GoPro Max to collect 360 imagery from a vehicle, with the GoPro attached using a magnetic car mount. The demonstration on E. McNeese & Louisiana In Lake Charles generated 1.32 miles of data collected as 5.6K 360 video. FAST-3 also piloted the use of GoPro Max on foot, with the GoPro attached to a selfie stick, walking along an overturned set of rail cars at (30.1596308, -93.1481539) to collect 0.08 miles of data as 5.6K 360 video. These routes are displayed in Figure 2.2.

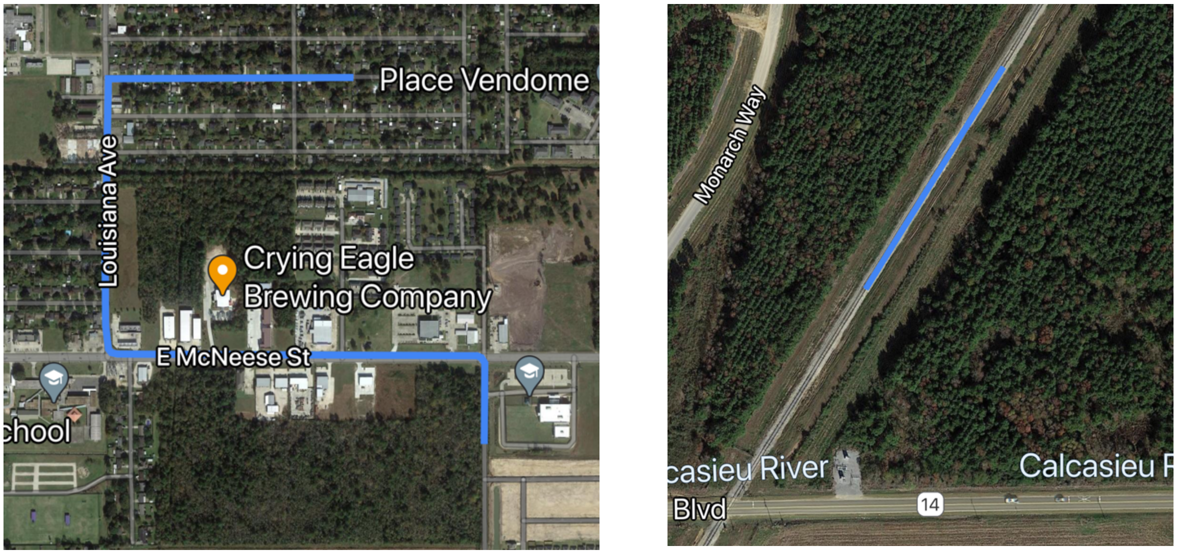


Figure 2.2. Routes used for FAST-3 GoPro pilot: (a) car mounted route, (b) route on foot.

Collectively, FAST-1, FAST-2 and FAST-3 cataloged just over 842 km of imagery with approximately 842,496 individual images (4 individual photographs make one panorama) as summarized in Table 2.1 and mapped in Figure 2.2. The images collected from the system were stitched together into seamless 360 degree panoramas made available on DesignSafe under this project (PRJ-2888) and are also now available publicly via the Google Maps StreetView and Facebook Mapillary platforms to enable valuable pre-post comparisons. The FAST-3 data on DesignSafe is only a partial dataset of the entire capture. Approximately 43.5 km of routes were uploaded to the Google Maps platform but the stitched panoramas were not able to be recovered from the NCTech cloud processing platform for inclusion in this DesignSafe project.

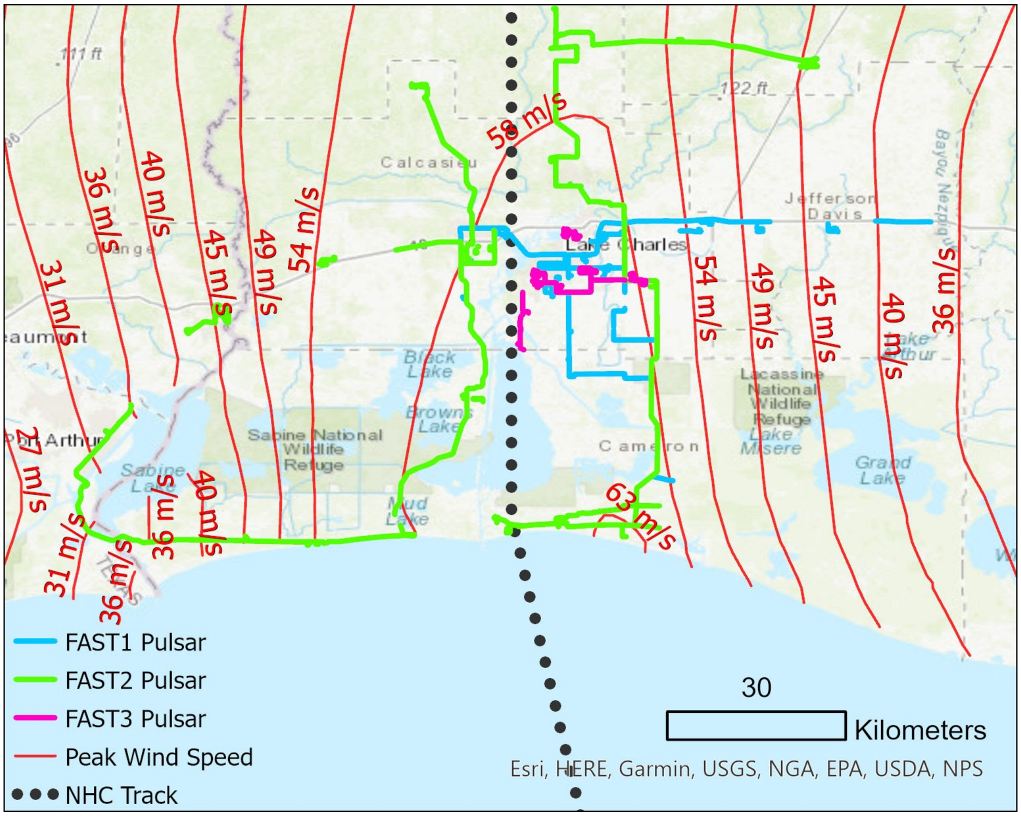


Figure 2.3. Street-level panoramic imagery routes relative to preliminary Hurricane Laura track from the National Hurricane Center and standardized gust wind speed estimates (3-second averaging time, 10 m height, open exposure) from ARA (Version 3 wind field).

Table 2.1. Summary of street-level panorama data collections

Team	Date	Number of Routes	Total Length (km)	Approximate Panoramas Count*
FAST-1	8/27/2020	33	94.4	23597
FAST-1	8/29/2020	54	170.5	42625
FAST-2	9/2/2020	15	30.7	7675
FAST-2	9/3/2020	35	225.3	56335
FAST-2	9/4/2020	48	226.5	56617
FAST-3	9/11/2020	57	67.7	16925
FAST-3	9/12/2020	17	27.2	6800
	Total	**259**	**842.3**	**210,574**

* Approximate panoramas count based on 4 m capture interval

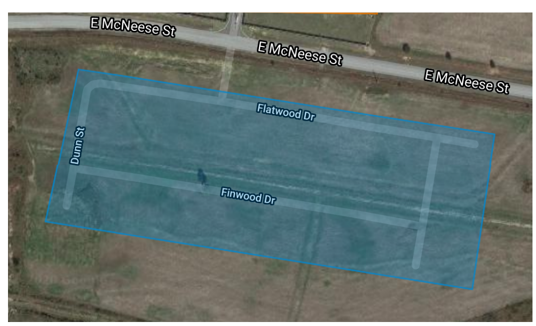
2.3 Unmanned Aerial Systems

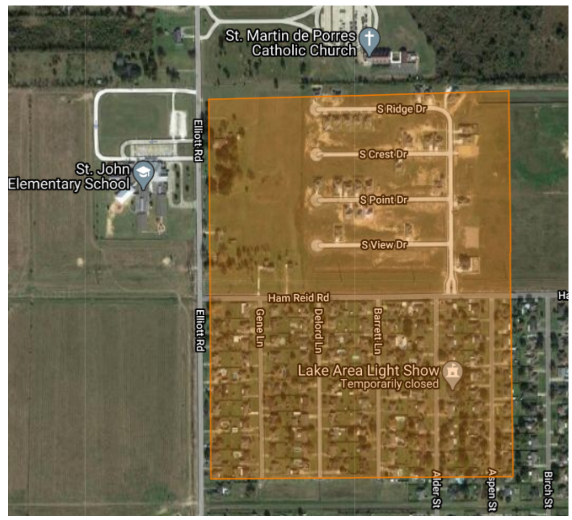
IMPLEMENTATION: FAST-1 and FAST-3

PUBLIC ACCESS POINT: Capital One Building Panorama on Google Maps

The use of UAS in this StEER deployment was limited due to the mission objectives, rain, operator availability, and temporary FAA flight restrictions (including VIP no-fly zone during Day 3 of the FAST-1 mission). FAST-1 used UAS to document four neighborhoods: two just south of Chennault International Airport, one off of Ham Reid Rd in Lake Charles, and one in Moss Bluff, north of Lake Charles, as documented in Table 2.2. FAST-1 also captured a few photos of Cameron High School. The UAS operated by FAST-1 included a DJI Mavic and DJI Inspire with ZenMuse 5 camera (Operators: D. Roueche and J. Marshall). The UASs were used to capture high-resolution nadir or oblique (off-nadir) photographs suitable for generation of orthomosaics and 3D models in two sites near the Chennault International Airport (with FAA approval). At two other sites, free-flight photographs were collected to provide high-resolution aerial views of structures. Appendix B includes estimated flight altitudes with respect to the resulting ground sampling distance (GSD). FAST-3 also captured panoramic imagery of the Capital One Tower using a Mavic Pro and the Litchi App. All images are JPG formatted and include required data such as GPS coordinates for future processing.

Table 2.2. Summary of UAS missions logged by FAST-1

Flight Type	Number of Photos	GPS	Map
Free-flight	379	30.178833, -93.151835	
Single-grid	696	30.176190, -93.151487	

Free-flight	50	30.319848, -93.187646	
Free-flight	19	30.155612, -93.262517	

2.4 Other Ground-Based Observations

IMPLEMENTATION: FAST-1, FAST-2, FAST-3
PUBLIC ACCESS POINT: N/A

While conducting reconnaissance, investigators at times acquired additional photos/videos on their personal mobile devices or DLSR cameras. Additional observations/notes similarly recorded outside of the Fulcrum mobile application are included in the Daily Summaries FAST-1 and FAST-2 prepared each day using the standard StEER template.

3.0 Chronology and Geospatial Distribution of Data Collection

The approximate coverage of the three FASTs is summarized in Table 3.1. See [FAST Target/Route Map] for targets selected for assessment. [Master Google Map] provides locations of wind field and storm surge by other investigators.

Table 3.1. FAST Daily Data Collection Activities

Date	Geography	Team Members
27 August 2020	1. I-10 WB from Jennings to Lake Charles 2. Chennault Airport and surrounding region 3. Lake Charles (primary thoroughfares, e.g., McNeese St) 4. Sulphur	FAST-1 D. Roueche, J. Marshall
28 August 2020	1. Grand Lake (south of Lake Charles) 2. Lake Charles 3. Moss Bluff (north of Lake Charles) with UAS and drive-by DSLR	FAST-1 D. Roueche, J. Marshall
29 August 2020	1. East to West damage gradient (Welsh, Lacassine, Iowa) 2. Neighborhoods south of Chennault International Airport 3. LA-27 / LA-384 intersection down to Creole 4. LA-27 towards Cameron and LA-82 5. Cameron to Lake Charles via LA-384	FAST-1 D. Roueche, J. Marshall
2 September 2020	1. Hackberry 2. Holly Beach 3. Industrial area near Sulphur	FAST-2 S. Kameshwar, N. Mashrur
3 September 2020	1. LA 108 S from I-10 to LA 27 2. Vinton 3. Orange 4. Port Arthur 5. Johnson Bayou 6. Communities between Johnson Bayou and Holly Beach 7. DeQuincy	FAST-2 S. Kameshwar, N. Mashrur
4 September 2020	1. Kinder 2. Reeves 3. Ragley 4. Moss Bluff 5. Cameron 6. Bullwhip Road, South East of Lake Charles	FAST-2 S. Kameshwar, N. Mashrur
11 September 2020	1. East Lake Charles along US-90 2. East Lake charles along LA-14 3. Single-family communities in Lake Charles east of Chennault International Airport, including manufactured home communities 4. Interior Lake Charles south of McNeese St (single- and multi-family communities)	FAST-3 M. Vorce
12 September 2020	1. Downtown Lake Charles including Capital One Tower & surrounding buildings 2. Along LA-384 south of Lake Charles	FAST-3 M. Vorce

4.0 Data Processing

4.1 Structural Assessments

Each record in the Fulcrum database underwent StEER's Data Enrichment/Quality Control (DE/QC) process outlined in *Virtual Assessment Structural Team (VAST) Handbook: Data Enrichment and Quality Control (DE/QC) for US Windstorms* (2019). Records were updated by the Data Librarians denoted in Table 1.2 and were immediately available within the Fulcrum Community portal at each stage of the DE/QC Process. As each record completed one of these stages, the code is updated within the record. A QC notes field is also provided for the Data Librarian to include any relevant information regarding changes made to the record in the process.

For all data captured by *StEER Building - US (Windstorm)* app**,** the StEER DE/QC process was executed at a minimum to Stage 2 for all individual records (N=418), meaning basic attributes such as location, building type, damage ratings, number of stories, and component-level damage ratings were assessed with reasonable confidence. Where insufficient information was available to have a reasonable degree of confidence in the Stage 2 fields, a Stage 2e code is used to warn potential users of the data that the information therein may be more incomplete or uncertain than typical records. Where high quality data was available for a given record, typically through overlapping data sources (e.g., audio recordings, on-site photographs, satellite imagery, and/or street-level panoramas), Stage 3 was executed, which includes more fine details of the building attributes, structural load path, and damage specifics. Table 4.1 summarizes the number of records for which each Stage was executed. Once each record was advanced to its final Stage in the DE/QC process, the final database was downloaded from Fulcrum for curation in DesignSafe in CSV and GeoJSON formats.

For the majority of assessments, at least two data librarians participated in the DE/QC process of each record separately to help catch errors and reduce uncertainties. In addition, the entire dataset underwent a number of macro-level QC checks to identify potential errors, such as filtering the dataset for blank entries in the number of stories, searching for invalid field entries (e.g., 72 was entered for first floor elevation (ft) due to unit error), and more. Finally, a random sample of 60 records was assessed by four Data Librarians (each assessing 15 records that they did not participate in gathering data for originally) to estimate an error rate. Altogether, out of 4500 fields for the 60 records (excludes fields that were not used or always blank), 45 changes were made during the final QC, resulting in an error rate of 1%. The complete quality control checklist and workflow for StEER D2D data is still being developed but every effort was made to find and fix major errors or inconsistencies using the methods described above. Despite the best efforts of the data librarians, there are likely to be small errors in a few records, and there is also uncertainty present due to incomplete data and/or use of engineering judgement. Despite these, additional QC should not be necessary for most research applications, but may be warranted for any analysis particularly sensitive to errors and uncertainties. Consumers of the data are encouraged to conduct additional stages in the DE/QC process in accordance with StEER's *Virtual Assessment Structural Team (VAST) Handbook: Data Enrichment and Quality Control (DE/QC) for US Windstorms* (2019) available at https://www.steer.network/resources.

Table 4.1: Breakdown of records by maximum DE/QC stage executed

Stage	Brief Description	Number of Records
1	The location of the record has been verified and existing attributes QC'd, but the record is unsuitable for further enhancement. This field is generally reserved for general area assessments that are not specific to a single building or structure.	0
2	The minimum information required for a completed assessment has been verified or added. For example, the correct building type is assigned, overall damage ratings are confirmed to be in agreement with the quantitative guidelines, and basic building attributes, e.g., number of stories, are identified.	7
2e	There is insufficient information to meet the minimum data standards for a complete assessment, or there is considerable uncertainty in assignment of one or more critical fields. If a record is at 2e, it may not be possible or worthwhile to advance into additional stages and caution should be used in conducting analysis that includes this data.	3
3	The majority of fields up through Stage 3, as described in the DE/QC handbook, have been completed and validated with reasonable confidence in accuracy and precision.	368
3e	Some or all Stage 3 fields have been completed, but lack of data (e.g., only 2 sides of the structure are visible) or other circumstances adds high levels of uncertainty.	40

4.2 Street-Level Panoramic Images

Individual images from the panoramic imaging platforms were processed into seamless panoramas using the NCTech Immersive Studio software for FAST-1 and FAST-2, and through the NCTEch VR.World cloud-processing platform for FAST-3. Panoramas were stitched and output at 4m intervals. No objects in the images were blurred during processing. All panoramas were uploaded to the Mapillary platform under the username *steer360network* using the Mapillary command line executable and custom MATLAB scripts. FAST-3 panoramas were also uploaded to Google through the VR.World platform. The final resolution of the processed panoramas is 11000 x 5500 pixels. Two data quality issues were noted in the captures, both involving FAST-1. On Day 1 of FAST-1, some routes are overexposed due to changes in lighting conditions throughout the day that were not adjusted for in the camera settings. On the Day 2 of FAST-1, the Pulsar orientation was inadvertently rotated 180 degrees.

The driving and walking GoPro pilots were Processed to create a H.264 video file with GPS metadata. That video was then processed using GoThru Streetbuilder to extract georeferenced panoramas at 3 meter spacing. These panoramas were uploaded to GoThru and published to Google Maps Street View platform.

4.3 Unmanned Aerial Systems

In cases where imagery from a UAS was acquired sufficient to generate other data products, the geolocated dataset is ingested into a standard UAS-compatible photogrammetry desktop application, in this case Pix4DMapper Pro (licensing provided through the NHERI RAPID Experimental Facility at the University of Washington), which:

1. Checks the photo dataset for its integrity and positional accuracy based on the geolocation coordinated in the metadata of each image.
2. Establishes desired coordinate system (i.e., WGS 1984 or others) and units of measurement.
3. Establishes options for processing quality, processing speed, data outputs, and other related parameters.
4. Generates data outputs such as point clouds, 3D models, Digital Elevation Models, and Orthomosaics using proprietary Structure-from-Motion algorithms.

Resulting data products can be ingested into a variety of proprietary and non-proprietary software, including Potree (available through DesignSafe Workspace) for points clouds and QGIS (also available through DesignSafe Workspace) for Digital Elevation Models and Orthomosaics. Area, Linear, and Volumetric measurements can also be generated from the point cloud. Meanwhile, the software PTGUI was used for stitching the acquired image of the Capital One Building into a panorama.

4.4 Other Ground-Based Observations

Media acquired outside of Fulcrum was reviewed to remove poor quality, redundant, ambiguous or irrelevant photos/videos. Time, date and coordinates can be extracted from the metadata of each geotagged photo and are also available in a geojson file.

5.0 Archived Data Products

This section details the directory structure created in DesignSafe-CI and the contents therein.

🖿 Directory D0. Planning Documents

FORMATS = PDF

Pre-deployment briefing used to plan the mission and data collection strategy.

🖿 Directory D1. Structural Assessments

FORMATS = CSV, GeoJSON, JPG, PNG

This directory contains the final enriched and quality controlled dataset (as CSV and GeoJSON) with all the response fields in Appendix A. Not all response fields have values, for reasons described in Section 4.1. Each media file (e.g., photograph, audio file in Photos folder) is linked to a specific record by a unique alpha-numeric string. This unique string is both the filename of the media file, and also listed in the corresponding data field (e.g., photos, audio) for the record it is associated with in the CSV or GeoJSON database. The folder also contains two photo logs, one for the overview photos (showing overall views of the front, left, back, and right of the building, if available) and one for the detail photos. These provide all available photo metadata for each photograph or media file associated with a record. Note that since most of the assessments (390 out of 419) were performed remotely, most of the media files are screenshots of the street-level panoramic imagery. The GPS location of the record can be used to find nearby panoramas if the full-resolution images are needed.

🖿 Directory D2. Street-Level Panoramic Imagery

FORMATS = JPG, CSV (Processed files: SQL, PHP, XML)

This directory contains files organized in folders by FAST (**FAST-1, FAST-2, FAST-3**). Each FAST folder contains subfolders for **Processed** and **Raw** data, as well as the daily routes (.kml/.kmz). Note that FAST-3 only contains Processed data due to license limitations discussed previously. The **Raw** folders contain subfolders for each route (the name of which corresponds to a polyline in the route KMZ file), which in turn contain the raw .mkv files from each of the four camera sensors of the Pulsar along with timestamp files, GPS metadata, and Inertial Measurement Unit (IMU) data files as delimited text files. These data files can be used to stitch new 360 panoramas, if needed, using the Immersive Studio software from NCTech. The **Processed** folder contains output folders for each route, with the name of each folder corresponding to a route in the FAST-xx Day-xx KMZ file. Each output folder contains the 360 panoramas as .jpg files, along with image metadata (GPS position, IMU) as delimited text files and the GPS position of each image as a .kml.

🖿 Directory D3. Unmanned Aerial Systems

FORMATS = .JPG, .TIFF, .TFW, .OBJ, .LAS, .P4D

This directory contains files organized in folders by FAST (**FAST-1, FAST-3**). Within the FAST-1 directory are subdirectories defining different locations where UAS data was acquired, with the following naming convention: YYYYMMDD_Locale where YYYY=year, MM=month, DD=day and Locale=shorthand for location when/where data was captured. Each subdirectory may contain up to two additional directories: **Raw** and **Processed**. The former contains the raw images (.JPG) acquired at that site; the latter contains the processed photogrammetric data products. These include:

- .P4D executable file
- Data products including point clouds (.LAS), orthomosaics and Digital Elevation Model (.TIFF with associated .TFW providing georeferencing details)
- Various supporting files, logs and reports documenting the data processing

Note that at a number of sites, the UAS was used by FAST-1 only to capture a limited amount of images to obtain a bird's eye view of the property, so only raw data are curated. The table below catalogs each location and the availability of raw and processed vs. solely raw data. The 20200829_LakeCrestDr collection does contain Processed outputs, but the raw images were captured via free-flight due to a malfunction with the DJI geofencing in this area. The processed products have some defects, particularly towards the edges of the covered area, where images were not stitched together well using default parameters in Pix4D. The quality of the Processed outputs could likely be improved with manual reprocessing (e.g., adding a few manual tie-points).

FAST-3 used UAS only to document the Capital One Tower, with a pair of folders including the Orbital Flights at the Low and High elevations around the tower (raw .JPG image files) and the processed Aerial Panorama.

📁 **FAST-1**		
↳ 📁 20200828_RidgeDr	↳ 📁📁 Raw	
↳ 📁 20200828_WineberryDr	↳ 📁📁 Raw	
↳ 📁 20200829_CameronHighSchool	↳ 📁📁 Raw	
↳ 📁 20200829_FlatwoodDr	↳ 📁📁 Raw	↳ 📁📁Processed
↳ 📁 20200829_LakeCrestDr	↳ 📁📁 Raw	↳ 📁📁Processed
📁 **FAST-3**		
↳ 📁 Capital One Tower	↳ 📁📁 Orbital Flights	↳ 📁📁 Aerial Panorama

📁 Directory D4. GPS Data

FORMAT = .KML

This folder contains GPS route data (as polylines/tracks and as individual track points) for FAST-1 and FAST-3, providing time-stamped locations during all data collection periods.

📁 Directory D5. Other Ground Imagery

FORMAT = JPG, MP4, MOV, GEOJSON

This directory contains additional photos captured by investigators outside of Fulcrum. Subdirectories are organized by FAST Team (**FAST-1, FAST-2, FAST-3**):

- **FAST-1** contains DSLR Photos (.JPG) and a geojson file of photo metadata
- **FAST-2** contains DSLR Photos (.JPG), videos (.MP4) and a geojson file of metadata
- **FAST-3** is organized by two sites:
  - **Train Car Derailment:** (30.1596308, -93.1481539) photos (.JPG) and videos (.MOV)
  - **Capital One Tower:** (One Lakeshore Dr, Lake Charles, LA 70629) photos (.JPG)

📁 Directory D6. Daily Summaries - StEER

FORMAT = PDF

This directory contains daily summaries (6 in total) capturing key observations and illustrative examples of the damage documented by FAST-1 and FAST-2, using a StEER standard template.

6.0 Contacts

For inquiries on specific sets of data, please contact the following individuals:

FAST-1 Data Collection	**FAST-2 Data Collection**
David Roueche dbr0011@auburn.edu	Sabarethinam Kameshwar skameshwar1@lsu.edu
FAST-3 Data Collection	**General Inquiries**
Mike Vorce mike@sitetour360.com	Tracy Kijewski-Correa tkijewsk@nd.edu

7.0 References

Kijewski-Correa, T., Roueche, D., Mosalam, K., Prevatt, D., Robertson, I. (2019) “Field Assessment Structural Team (FAST) Handbook,” Version 1.0 (available at www.steer.network/resources)

Roueche, D., Kijewski-Correa, T., Mosalam, K., Prevatt, D., Robertson, I. (2019) “StEER: Virtual Assessment Structural Team (VAST) Handbook: Data Enrichment and Quality Control (DEQC) for US Windstorms,” Version 1.0 (available at www.steer.network/resources)

Roueche, D. Kameshwar, S. Marshall, J. Mashrur, N. Kijewski-Correa, T. Gurley, K. Afanasyeva, I. Brasic, G. Cleary, J. Golovichev, D. Lafontaine, O. Lombardo, F. Micheli, L. Phillips, B. Prevatt, D. Robertson, I. Schroeder, J. Smith, D. Strader, S. Wilson, M. Ambrose, K. Rawajfih, H. Rodriguez, L. (2020) "Hybrid Preliminary Virtual Reconnaissance Report-Early Access Reconnaissance Report (PVRR-EARR)", in StEER - Hurricane Laura. DesignSafe-CI. https://doi.org/10.17603/ds2-ng93-se16.

Appendix A. Buildings - Windstorm App Fields

Column		Column Header	Field	Format	Response Choices/ *Description*	Percentage Filled[1]
1	A	fulcrum_id	Record ID	Text	Auto-populated	100%
2	B	status	Damage State	Single Choice	0=No Damage 1=Minor 2=Moderate 3=Severe 4=Destroyed	100%
3	C	project	Project	Text	<Auto-populated list of all StEER Projects in Fulcrum>	100%
4	D	latitude	Latitude	Decimal	Auto-populated	100%
5	E	longitude	Longitude	Decimal	Auto-populated	100%
6	F	name_of_investigator	Name of Investigator	Text	*user-supplied name of investigator*	100%
7	G	date	Date	MM/DD/YYYY	Auto-populated	100%
8	H	general_notes	General Notes	Text	*user-supplied general notes*	5.26%
9	I	assessment_type	Assessment Type	Single Choice	Aerial Drive-by On-site Remote General Area Other	100%
10	J	sampling_method	Sampling Method	Classification Field	Biased - Damaged Structure Biased - Unique failure Biased - Case study Biased - Other Unbiased - Random Sample Unbiased - Within a Cluster Unbiased - Critical Facility Unbiased - Unique	100%

					Structure Unbiased - Other	
11	K	overall_photos_front_left_right_back	Overall Photos (Front, Left, Right, Back)	Photos	*user-supplied photos*	100%
12	L	overall_photos_front_left_right_back_caption	Overall Photos Captions	Text	*User-supplied photo captions*	1.20%
13	M	overall_photos_front_left_right_back_url	Direct Path to Photo Hosted on Fulcrum	URL	Auto-populated	100%
14	N	detailed_photos	Detailed Photos	Photos	*user-supplied photos*	65.79%
15	O	detailed_photos_caption	Detailed Photos Captions	Text	*User-supplied photo captions*	24.40%
16	P	detailed_photos_url	Direct Path to Photo Hosted on Fulcrum	URL	Auto-populated	65.79%
17	Q	audio	Audio	Audio	*user-supplied audio*	0%
18	R	audio_caption	Audio Captions	Text	*User-supplied audio captions*	0%
19	S	audio_url	Direct Path to Fulcrum Entry	URL	Auto-populated	0%
20	T	overall_damage_notes	Overall Damage Notes	Text	*user-supplied damage notes*	5.98%
21	U	hazards_present	Hazards Present	Multiple Choice	Flood Rain Surge Tree-fall Wind Wind-borne debris Unknown Other	100%
22	V	wind_damag	Wind	Single Choice	-1=Not Applicable	100%

		e_rating	Damage Rating		0=No Damage 1=Minor 2=Moderate 3=Severe 4=Destroyed	
23	W	surge_damage_rating	Surge Damage Rating	Single Choice	0=No Damage or Very Minor Damage 1=Minor 2=Moderate 3=Severe 4=Very Severe 5=Partial Collapse 6=Collapse	0.72%
24	X	rainwater_ingress_damage_rating	Rainwater Ingress Damage Rating	Single Choice	-1=Unknown 0=None Visible 1=Minor Ingress 2=Moderate 3=Severe 4=Destroyed	33.49%
25	Y	damage_indicator	Damage Indicator	Numeric	*User-supplied value defining the type of structure,relating to the Enhanced Fujita Scale (primarily used for tornadoes)*	2.39%
26	Z	degree_of_damage	Degree of Damage	Numeric	*User-supplied value defining an overall damage state, relating to the Enhanced Fujita Scale (primarily used for tornadoes).*	2.15%
27	AA	attribute_notes	Attribute Notes	Text	*User-supplied attribute notes*	11.72%
28	AB	address_sub_thoroughfare	House Number	Text	House number supplied by user	99.76%
29	AC	address_thoroughfare	Street Name	Text	Street name supplied by user	100%
30	AD	address_suite	Suite Number	Text	Suite number supplied by user	0.24%
31	AE	address_locality	City/Town	Text	City or town supplied by user	100%

32	AF	address_sub_admin_area	County	Text	County supplied by user	100.%
33	AG	address_admin_area	State	Text	State supplied by user	100%
34	AH	address_postal_code	Zip Code	Text	Zip code supplied by user	100%
35	AI	address_country	Country	Text	County supplied by user	100%
36	AJ	address_full	Full Address	Text	<Auto-populated by Fulcrum>	100%
37	AK	occupancy	Occupancy	Single Choice	Assembly-Small building and tenant spaces Assembly-Theater Assembly-Restaurant Assembly-Religious facility Assembly-Indoor sports facility Assembly-Outdoors sports facility Assembly-Other Business Educational-School Educational-Daycare facilities Educational-University/College Educational-Other Factory and industrial-Industrial Factory and Industrial-Factory Factory and Industrial Other High-hazard-Hazardous materials storage High-hazard-Contains detonation hazard High-hazard-Contains deflagration hazard High-hazard-Contains materials that are health hazard High-hazard-Semiconductor fabrication facilities High-hazard-Contains	99.28%

						materials posing multiple hazards High-hazard-Other Institutional-Assisted living facilities %Institutional-Alcohol an%d drug rehabilitation Institutional-Medical Care on a 24-hours basis (Hospital/psychiatric hospital) Institutional-Correctional centers/jails/prisons/etc Institutional-Other Mercantile-Departmental stores Mercantile-Drug stores Mercantile-Gas/service station Mercantile-Retail or wholesale stores Mercantile-sales room Mercantile-Other Residential-Single family Residential-Multi-family homes (duplex, triplex, townhome) Residential-Mobile/Manufactured homes Residential-Apartment houses/dormitories/fraternities and sororities Residential-Hotel/motel/boarding houses/congregate living facilities Residential-Other Storage-Moderate-hazard storage Storage-Low-hazard storage Storage-Other Utilities and miscellaneous-Agricultural building Utilities and miscellaneous-Aircraft hangers Utilities and miscellaneous-Barns	

					Utilities and miscellaneous-Carports Utilities and miscellaneous-Fences > 6ft Utilities and miscellaneous-Grain silos Utilities and miscellaneous-Greenhouses Utilities and miscellaneous-Livestock shelters Utilities and miscellaneous-Private garages Utilities and miscellaneous-Retaining walls Utilities and miscellaneous-Sheds Utilities and miscellaneous-Stables Utilities and miscellaneous-Other	
38	AL	number_of_stories	Number of Stories	Integer	1-25	100%
39	AM	understory_pct_of_building_footprint	Understory Area(% of Building Footprint)	Single Choice	0% - 100%	8.37%
40	AN	first_floor_elevation_feet	First Floor Elevation in Feet	Decimal	0-13	81.34%
41	AO	year_built	Year Built	Integer	*User-supplied Four-digit year*	100%
42	AP	roof_shape	Roof Shape	Multiple Choice	Complex Flat Gable Gable/Hip Combo Gambrel Hip Mansard Monoslope Unknown Other	99.52%

43	AQ	roof_slope	Roof Slope	Integer	*User-supplied numerical value (angle relative to horizontal)*	100%
44	AR	front_elevation_orientation	Front Elevation Orientation	Integer	*User-supplied numerical value (degrees with 0=North, 90=East, etc.)*	100%
45	AS	structural_notes	Structural Notes	Text	*User-supplied structural notes*	5.74%
46	AT	building_type	Building Type	Multiple Choice	Wood Light Frame;W1 Wood Frames, Commercial and Industrial;W2 Steel Moment Frames;S1 Steel Braced Frames;S2 Steel Light Frames;S3 Steel Frames with Concrete Shear WallsS4 Steel Frame with Infill Masonry Shear Walls;S5 Steel (unknown) Concrete Moment Frames;C1 Concrete Shear Wall Buildings;C2 Concrete Frame with Infill Masonry Shear Walls;C3 Precast/Tilt-up Concrete Shear Wall Buildings;PC1 Precast Concrete Frames;PC2 Concrete (unknown) Reinforced Masonry Bearing Wall Buildings with Flexible Diaphragms;RM1 Reinforced Masonry Bearing Wall Buildings with Stiff Diaphragms;RM2 Unreinforced Masonry Bearing Wall Buildings;URM Masonry (unknown) Wood (unknown) Unknown	100%

					Other	
47	AU	foundation_type	Foundation Type	Single Choice	Slab-on-grade Cast-in-place concrete piers Ground anchors and strapping Reinforced masonry piers Reinforced masonry stem wall Unreinforced masonry piers Unreinforced masonry stem wall Wood Piers <= 8 ft Wood Piers > 8 ft Unknown Other	99.28%
48	AV	wall_anchorage_type	Wall Anchorage Type	Multiple Choice	Anchor bolts with nuts and washers Anchor bolts with missing nuts and washers Metal straps Concrete nails Unknown	95.22%
49	AW	wall_substrate	Wall Substrate	Multiple Choice (Comma separated text)	Wood, sheathing (continuous) Wood, sheathing (corners only) Wood, dimensional planks Insulated sheathing Insulated foam board Non-engineered wood panel Metal panels Not Applicable Unknown	98.33%
50	AX	wall_cladding	Wall Cladding	Multiple Choice	Aluminum siding Brick Curtain Wall EIFS Fiber-Cement Board Corrugated steel panels Plywood Siding Stucco Vinyl Siding (standard)	99.28%

					Vinyl Siding (high wind rated) Vinyl Siding (unknown) Wood Boards Wood Shake/Shingle Unknown Other	
51	AY	soffit_type	Soffit Type	Multiple Choice	None Vinyl Metal Wood Unknown Other	97.61%
52	AZ	fenestration_protection	Fenestration Protection	Single Choice	Front Left Back Right None Other	86.60%
53	BA	fenestration_protection_type	Fenestration Protection Type	Multiple Choice	None Unknown Impact Resistant Plywood/OSB Panel Hurricane Shutter Other	68.66%
54	BB	large_door_present	Large Door Present	Yes/No	Yes No N/A	99.04%
55	BC	llarge_door_opening_location	Large Door Opening location	Multiple Choice	Front Left Back Right Other	86.12%
56	BD	large_door_opening_type_	Large Door Opening Type	Multiple Choice	None Single garage door (standard) Double garage door (standard) Single garage door (wind-rated) Double garage door (wind-rated) Single garage door (unknown) Double garage door (unknown)	86.36%

					Sectional door Roll-up door Other	
57	BE	roof_system	Roof System	Multiple Choice	Steel, cold formed Steel, hot rolled Steel, joists Concrete slab Wood, rafter Wood, trusses Wood, unknown Unknown Other	98.56%
58	BF	r2wall_attachment	Roof to Wall Attachment	Multiple Choice	Toe-nails Metal ties Metal straps Bolted connection Welded connection Unknown Other	100%
59	BG	r2w_attachment_type	Roof to Wall Attachment Type	Text	*User-supplied description*	13.16%
60	BH	roof_substrate_type	Roof Substrate Type	Multiple Choice	Plywood/OSB Dimensional lumber Metal deck Concrete None Unknown Other	97.85%
61	BI	roof_cover	Roof Cover	Multiple Choice	Asphalt shingles (3-tab) Asphalt shingles (laminated) Built-up with Gravel Built-up without Gravel Clay tiles Concrete tiles Metal shingles Metal, corrugated Metal, standing seam Roll roofing Single ply Wood shake Wood shingle Unknown Other	98.80%
62	BJ	secondary_	Secondary	Multiple	None	84.21%

		water_barrier	Water Barrier	Choice	Closed-cell urethane foam adhesive Fully adhered membrane High performance underlayment Self-adhering membrane over joints Unknown Other	
63	BK	overhang_length	Overhang Length	Integer	*User-supplied numerical value*	96.41%
64	BL	parapet_height_inches	Parapet Height in inches	Integer	*User-supplied numerical value*	57.42%
65	BM	wind_damage_details	Wind Damage Details	Text	*User-supplied wind damage notes*	33.25%
66	BN	roof_structure_damage_	Roof Structure Damage (%)	Numeric	0%-100%	99.28%
67	BO	roof_substrate_damage	Roof Substrate Damage (%)	Numeric	0%-100%	98.56%
68	BP	roof_cover_damage_	Roof Cover Damage (%)	Numeric	0%-100%	99.28%
69	BQ	wall_structure_damage_	Wall Structure Damage (%)	Numeric	0%-100%	98.33%
70	BR	wall_substrate_damage_	Wall Substrate Damage (%)	Numeric	0%-100%	97.37%
71	BS	building_envelope_damage_	Building Cladding Damage (%)	Numeric	0%-100%	98.09%
72	BT	_damaged_windows	Damaged Windows (%)	Numeric	0%-100%	97.85%
73	BU	l_damaged_doors	Damaged Doors (%)	Numeric	0%-100%	97.37%

74	BV	location_of_damaged_fenestration	Location of Damaged Fenestration	Multiple Choice	Front Left Back Right Other	16.27%
75	BW	large_door_failure	Large Door Failure	Multiple Choice	None Front Left Back Right All other	83.49%
76	BX	soffit_damage	Soffit Damage (%)	Numeric	0%-100%	69.62%
77	BY	fascia_damage_	Fascia Damage (%)	Numeric	0%-100%	94.02%
78	BZ	stories_with_damage	Stories with Damage	Text	*User-supplied notes on affected stories*	70.10%
79	CA	water_induced_damage_notes	Water Induced Damage Notes	Text	*User-supplied notes on water-induced damage*	1.67%
80	CB	percent_of_building_footprint_eroded	Percent of Building Footprint Eroded	Numeric	0%-100%	0%
81	CC	__damage_to_understory	% Damage to Understory	Numeric	0%-100%	0.72%
82	CD	maximum_scour_depth_inches	Maximum Scour Depth in inches	Numeric	*User-supplied numerical value*	0%
83	CE	__piles_missing_or_collapsed	% Piles Missing or Collapsed	Numeric	0%-100%	0.96%
84	CF	__piles_leaning_or_broken	% Piles Leaning or Broken	Numeric	0%-100%	0.72%
85	CG	cause_of_foundation_da	Cause of Foundation	Multiple Choice	Erosion Wave	0.48%

		mage	Damage		Flood Floating Debris Velocity Scour None Unknown Other	
86	CH	reroof_year	Reroof Year	Numeric	*User-supplied four-digit year*	0%
87	CI	retrofit_type_1	Retrofit Type (1)	Text	*User-supplied descriptive text*	0%
88	CJ	retrofit_1_year	Retrofit (1) Year	Numeric	*User-supplied four-digit year*	0%
89	CK	retrofit_type_2	Retrofit Type (2)	Text	*User-supplied descriptive text*	0%
90	CL	retrofit_2_year	Retrofit (2) year	Numeric	*User-supplied four-digit year*	0%
91	CM	data_librarians	Data Librarian	Text	*User-supplied name*	90.19%
92	CN	qc_progress_code	QC Progress Code	Single Choice	1 1 2 2e 3 3e	100%
93	CO	qc_notes	QC Notes	Text	*Notes from Data Librarians regarding the DE/QC process*	44.98%

Note: % filled ignores blank or unknown fields

Appendix B. Properties of Unmanned Aerial Surveys

Location ID: **Coordinates:** **Drone Type:** **Flight Date:** **Flight Type:** **Flight Altitude:** **Camera Angle:** **Overlap:** **No. Photos:** **No. Flights:** **Area Covered:** **Average GSD:**	Ridge Dr / Ham Reid Rd 30.155612, -93.262517 DJI Mavic Pro 8/28/2020 Free flight ~ 150 ft Varies N/A 19 1 N/A N/A	
Location ID: **Coordinates:** **Drone Type:** **Flight Date:** **Flight Type:** **Flight Altitude:** **Camera Angle:** **Overlap:** **No. Photos:** **No. Flights:** **Area Covered:** **Average GSD:**	Wineberry Dr 30.318995, -93.187605 DJI Mavic 8/28/2020 Free flight ~ 150 ft Varies N/A 55 1 N/A N/A	
Location ID: **Coordinates:** **Drone Type:** **Flight Date:** **Flight Type:** **Flight Altitude:** **Camera Angle:** **Overlap:** **No. Photos:** **No. Flights:** **Area Covered:** **Average GSD:**	FlatwoodDr 30.1761, -93.1506 DJI Inspire 1 8/29/2020 Single grid 150 ft 80 80% / 70% (front / side) 696 2 0.06 sq. mi. 0.49 in.	

Location ID: **Coordinates:** **Drone Type:** **Flight Date:** **Flight Type:** **Flight Altitude:** **Camera Angle:** **Overlap:** **No. Photos:** **No. Flights:** **Area Covered:** **Average GSD:**	LakeCrestDrive 30.178724, -93.151824 DJI Mavic Pro 8/29/2020 Free-flight 120 - 140 ft Varied Varied 379 1 0.041 sq. mi 0.77 in.