SHORECREST FALL 2017

SOUTH FLORIDA KING TIDES

King Tide Safety and Tips

- Floodwater may contain unseen hazards such as trash and pollutants picked up from the environment, wildlife, broken glass and other debris. Do not enter floodwater and do not allow children to play in floodwater. If you or your children come into contact with floodwater, be sure to clean skin with soap and hot water.
- Driving through floodwater is not advisable. Do not drive through floodwater as it may be deeper than it appears, and unseen debris could cause flat tires.
- Do not park your vehicle in low lying areas.
- Vehicles that have come into contact with floodwater should be checked and cleaned.
- Boaters should be aware that king tides can cause lower clearance levels than normal under fixed bridges.
- Properties in low lying areas should use flood mitigation options such as sand bags, etc.
- If you see standing water for more than 48 hours, please report it via 311. Remember to drain and cover.

Dates of King Tides*

September 19 – 21 with peak on Sept. 20

October 5 – 9 & 17 – 21 with peak on Oct. 7

November 3 – 8 with season peak on Nov. 5

*NOAA. NOAA Tide Predictions, Virginia Key, FL. 7/13/17

King tides are the highest tides of the year and occur September through November in Miami

They may result in tidal flooding along waterways and sometimes inland

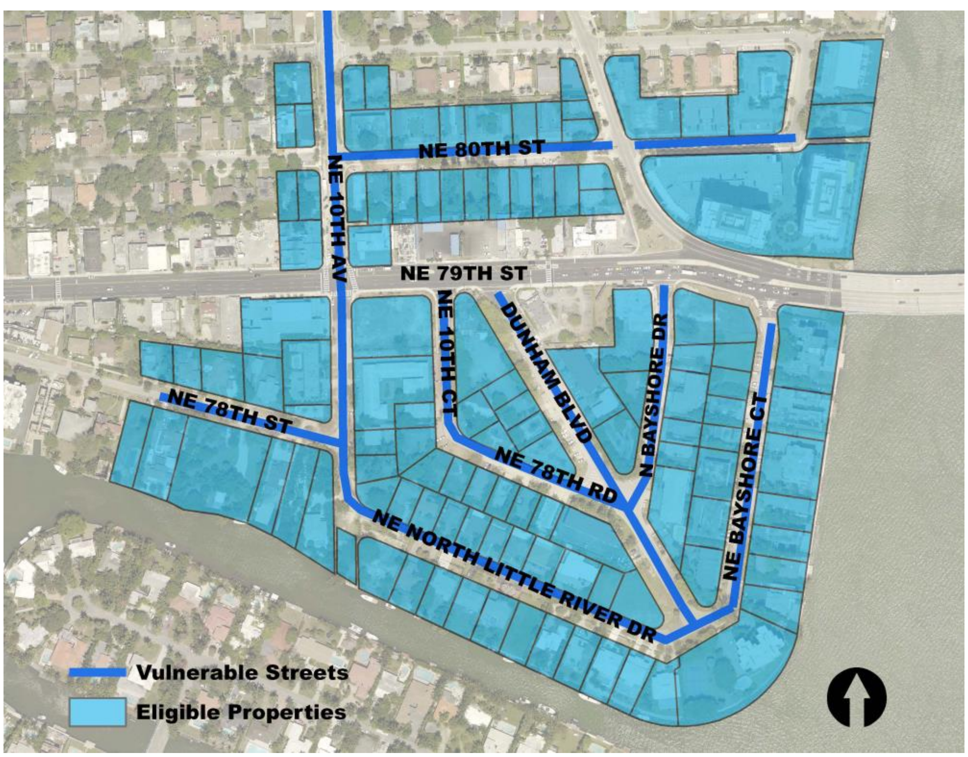
Take steps to mitigate the effects of tidal flooding

CITY OF MIAMI
Office of Resilience and Sustainability

444 SW 2nd Ave
Miami, FL 33130

The following properties are eligible to receive a parking permit during tidal flood events. These permits allow residents to park in designated locations outside of flooded areas.

7900 NE 10 AV	929 NE 78 ST	1020 NE 80 ST	7889 NE BAYSHORE DR	7851 DUNHAM BLVD
7815 NE 10 AV	910 NE 78 ST	1071 NE 80 ST	7777 NE BAYSHORE CT PH	7848 DUNHAM BLVD
7800 NE 10 CT 4	1020 NE 78 RD	1060 NE 80 ST	7801 N BAYSHORE DR	7811 DUNHAM BLVD
8021 NE 10 AV	1010 NE 78 RD	1070 NE 80 ST	7825 NE BAYSHORE CT	7868 DUNHAM BLVD
7843 NE 10 AV	967 NE 78 ST	1035 NE 80 ST	7881 NE BAYSHORE DR	1076 NE LITTLE RIVER DR
8100 NE 10 AV	960 NE 78 ST	1125 NE 80 ST	7969 NE BAYSHORE CT	1018 NE LITTLE RIVER DR
7800 NE 10 CT	955 NE 78 ST	1025 NE 80 ST	7848 N BAYSHORE DR	1000 NE LITTLE RIVER DR
7950 NE 10 AV	1025 NE 78 RD	1061 NE 80 ST	7950 NE BAYSHORE CT	1056 NE LITTLE RIVER DR
8020 NE 10 AV	922 NE 78 ST	1001 NE 80 ST	8001 NE BAYSHORE CT	1064 NE LITTLE RIVER DR
7865 NE 10 AV	945 NE 78 ST	1040 NE 80 ST	7820 NE BAYSHORE CT	1031 NE LITTLE RIVER DR
7851 NE 10 AV	1014 NE 78 RD	1030 NE 80 ST	7783 NE BAYSHORE CT	1050 NE LITTLE RIVER DR
8012 NE 10 AV	1038 NE 78 RD	1005 NE 81 ST	7860 NE BAYSHORE CT	1032 NE LITTLE RIVER DR
7843 NE 10 AV 4	1010 NE 78 RD 3	7950 NE BAYSHORE CT	7800 NE BAYSHORE CT	1074 NE LITTLE RIVER DR
7890 NE 10 AV	990 NE 78 ST	7899 NE BAYSHORE CT	7969 NE BAYSHORE CT	1080 NE LITTLE RIVER DR
7850 NE 10 AV	1060 NE 79 ST	7999 NE BAYSHORE CT	7831 N BAYSHORE DR	1065 NE LITTLE RIVER DR
7811 NE 10 CT	1060 NE 79 ST	7845 NE BAYSHORE CT	7720 NE BAYSHORE CT	1039 NE LITTLE RIVER DR
7825 NE 10 AV	1093 NE 80 ST	7839 N BAYSHORE DR	7836 NE BAYSHORE CT	1037 NE LITTLE RIVER DR
7810 NE 10 CT	1045 NE 80 ST	7805 NE BAYSHORE CT	7890 NE BAYSHORE CT	1040 NE LITTLE RIVER DR
8010 NE 10 AV	1091 NE 80 ST	7800 NE BAYSHORE DR	7777 NE BAYSHORE CT	1005 NE LITTLE RIVER DR
8120 NE 10 AV	1051 NE 80 ST	7969 NE BAYSHORE CT	7879 NE BAYSHORE DR	1075 NE LITTLE RIVER DR
1036 NE 78 RD	1101 NE 80 ST	7880 NE BAYSHORE CT	7950 NE BAYSHORE CT	1026 NE LITTLE RIVER DR
1041 NE 78 RD	1080 NE 80 ST	7795 NE BAYSHORE CT	7999 NE BAYSHORE CT	1041 NE LITTLE RIVER DR
924 NE 78 ST	1050 NE 80 ST	7899 NE BAYSHORE CT	7889 N BAYSHORE DR	1021 NE LITTLE RIVER DR
995 NE 78 ST	1090 NE 80 ST	7829 N BAYSHORE DR	8000 N BAYSHORE DR	1057 NE LITTLE RIVER DR
980 NE 78 ST	1010 NE 80 ST	7846 NE BAYSHORE CT	7999 NE BAYSHORE CT	1011 NE LITTLE RIVER DR
994 NE 78 ST	1096 NE 80 ST	7751 NE BAYSHORE CT	7841 DUNHAM BLVD	
1040 NE 78 RD	1000 NE 80 ST	7805 NE BAYSHORE CT 9	7721 DUNHAM BLVD	
1032 NE 78 RD	1081 NE 80 ST	7751 NE BAYSHORE CT	7858 DUNHAM BLVD	



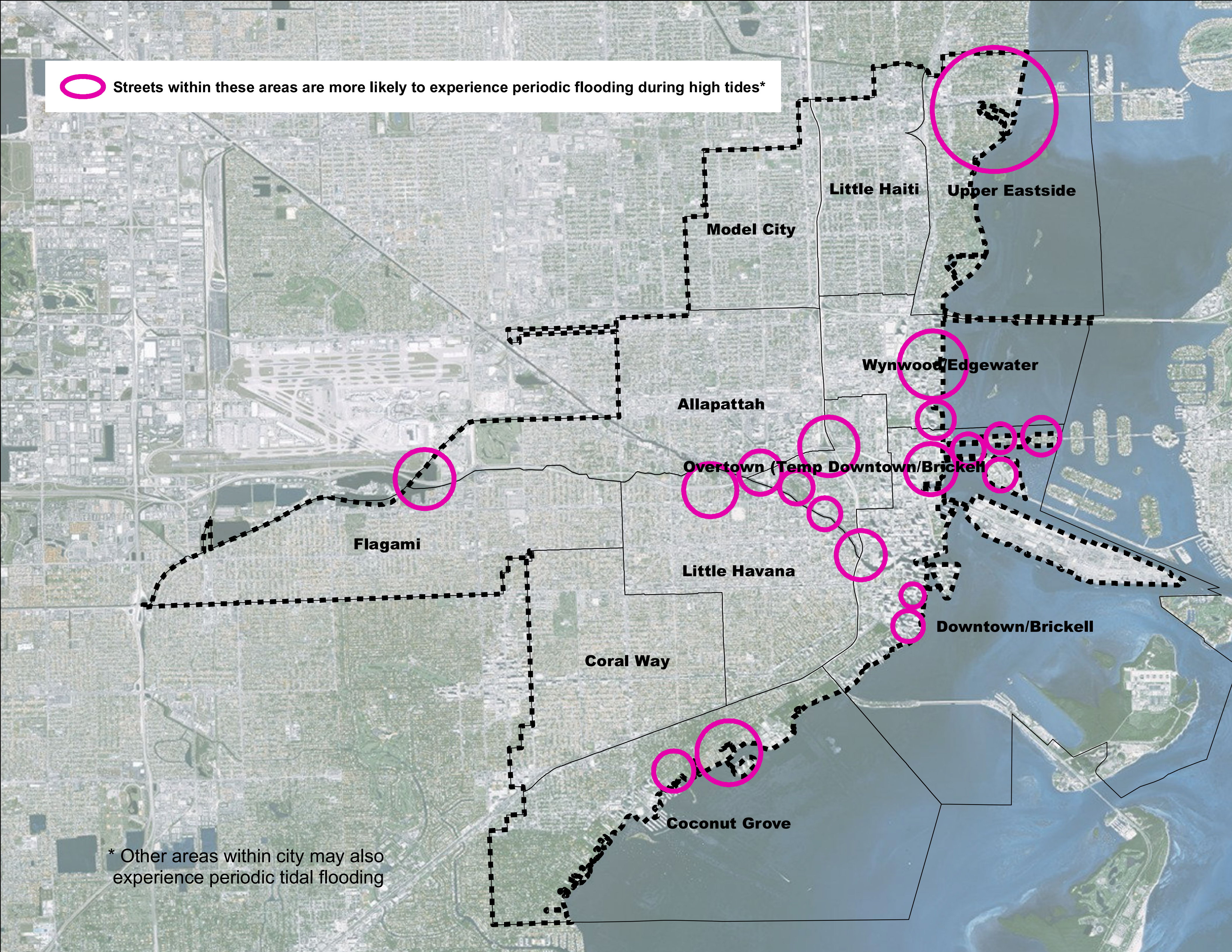
Residents of these properties may request a Parking Permit at:

Upper Eastside NET Office

6599 Biscayne Blvd.
Miami, Florida 33138

Monday - Friday
8:00 AM - 5:00 PM

Please bring ID and proof of residence.



Streets within these areas are more likely to experience periodic flooding during high tides*
Little Haiti
Upper Eastside
Model City
Wynwood/Edgewater
Allapattah
Overtown (Temp Downtown/Brickell
Flagami
Little Havana
Downtown/Brickell
Coral Way
Coconut Grove
* Other areas within city may also experience periodic tidal flooding

CITY OF MIAMI

DEPARTMENT OF PLANNING AND ZONING
444 SW 2ND Avenue
305.416.1400

PROJECT SUMMARY

REPORT DATE	PROJECT NAME
September 18, 2017	Measuring Hurricane Irma Flood Extents in the City of Miami

PREPARED BY

Jeremy Calleros Gauger, Deputy Director of Planning & Zoning

ABSTRACT

On September 14th and 15th, members of City of Miami Planning and Zoning, along with staff from the Office of Resilience, canvassed Miami to locate the crest of storm surge created by Hurricane Irma on September 10, 2017. Julio Mestas of FEMA originally requested flood data in the City Emergency Operations Center. Flood data is typically relatively inaccurate and is based on reports of flooding from property owners with varying individual conditions. We decided to attempt to capture more accurate data in the field based on evidence left by floating debris and interviews with individuals.

On Wednesday, September 13th, I worked with City of Miami Staff, including Mike Sarasti, Jane Gilbert, and Mariela Del Rio, to create a method to rapidly deploy teams to document extents of flooding. We selected an application for phones called Survey123 for ArcGIS to add information to existing Geographic Information System maps in the City of Miami database.

Nine teams of two staff members from Planning, Zoning, and Resiliency, along with 4 volunteer teams from Grove 2030, canvassed the entire city between September 14th and September 16th. Teams attempted to locate the 0' depth line at the maximum horizontal extent of flooding, or collect data at vertical fences or buildings where visible high-water marks were clearly present. In addition, staff interviewed residents and property managers in areas that had already been cleaned. Many shared photos and videos as well which may be correlated with location data.

It is our intent to make data available to researchers for further analysis.

INTRODUCTION

Information about flooding due to storm surge is typically gathered in a haphazard manner, long after flood-waters recede. While storm water and tidal flooding may be recorded via blocked roads and repeated complaints from residents, the intermittent and temporary nature of storm surge flooding makes accurate information difficult to find. Flooding data is typically recorded by tabulating individual insurance claims filed by property owners. Insurance data is imprecise due to varying floor heights and insurance types of properties. For instance, a neighborhood with predominantly newer construction (such as Edgewater or Brickell in Miami), where properties built with high finished floor levels and complying with newer flood codes, may file fewer claims than a less flood prone area with lower houses, (such as areas southeast of Bayshore Drive in Coconut Grove). Differing construction types and dates could skew overall results.

City of Miami staff determined that a more accurate set of flooding data could be a great resource for our own planning and zoning efforts, and could be made public and open to the larger community of researchers and scientists. We redirected staff normally tasked with reviewing plans and meeting with applicants to field-work in order to directly observe evidence of flooding and interview constituents in areas where evidence had been cleaned. Staff realized that time was of the essence since evidence and debris were being removed rapidly and eyewitness accuracy would also deteriorate over time. Within 30 hours of conceiving the plan, staff was in the field gathering data.

Figure 1: Wrack line at Biscayne Island

Since flood waters had all receded, we instructed data collectors to determine the maximum extents of flooding by looking for evidence in the form of remaining debris similar to wrack lines on beaches. Dead or dying plants and turf grass, high water marks on buildings, and debris collected on fences also provided direct evidence of surge. Interviews with residents and review of photos and videos provided additional data. Using these techniques, staff collected data at over 700 locations within the City of Miami.

Data points include the entirety of the coastal area fronting Biscayne Bay, inhabited islands, and Virginia Key. Miami and Little Rivers, as well as other canals and waterbodies experienced minimal flooding due to Irma and were largely ignored after initial inquiries. We set a goal of collecting data at 100 foot intervals along the coast, though private property often made this impossible. We considered one point per block on streets perpendicular to the bay sufficient. In heavily populated areas, like Downtown and Brickell Avenue, debris had been cleaned but there were abundant building managers with detailed information about water levels. In less populated areas, such as parks and campuses, lines of formerly floating debris remained.

Figure 2: Vertical datum on Brickell Ave.

The rapid conception and deployment of this technique, as well as varied teams of collectors, will create inaccuracies in the data. Techniques should be refined for future events. However, it is our hope that this data set provides a unique, (for now), opportunity for researchers to correlate and compare tidal gauges, storm surge models, climate change projections, and other predicted outcomes with hard data. In addition, the readily accessible GIS format of the data will allow overlays with existing LiDAR, bathymetry and other data. We hope this is fruitful to researchers and our own urban planning efforts.

MATERIALS & METHODS

The primary data collection tool was a map and surveying application for smart phones which allowed data collectors to quickly and accurately document locations throughout the city. Our team realized time was of the essence, since direct evidence of flooding in the form of debris would be removed and memories would become less reliable. It was easier to find debris evidence earlier in the week than later, in fact, by Thursday September 14th most of Downtown and Brickell Avenue were completely cleaned.

We decided to limit data collection efforts to staff whom we could train, rather than make this a crowd-sourced effort. Crowd-sourcing can create excellent data when thousands of data points reinforce and confirm trends. For instance, crowd-sourced information for tidal flooding from King Tides should become a reliable dataset. The repetitive nature of tidal and storm water flooding allows confirmation by multiple data entries at similar locations over time to build consensus.

Limited ability to recruit a large number of people on a short schedule eliminated any possibility of crowd-sourcing in this instance. In any case, a more limited number of better-trained data collectors are a better option for a single-instance event such as storm-surge flooding from Hurricane Irma. Precision of each individual data point is more important in the case of surge-related flooding.

Lack of time and practicality also guided our selection of the data-gathering application. Staff knew of two pre-existing applications which might be adapted to our needs. Either Collector or Survey123, both for ArcGIS might have worked. Collector for ArcGIS may be more appropriate for crowd-sourcing using pre-defined quadrants and filling in information about zones, whereas Survey123 [1] seemed appropriate for a discreet group of data collectors and would better sort the data. Mike Sarasti and Mariela Del Rio set up specific forms within Survey123 on Wednesday, September 13. They created a "Flood Area Survey" form which prompted users for the following information: location information with either automatic location or a map, an option to attach an image, optional comment field, and the flood depth, with default as zero.

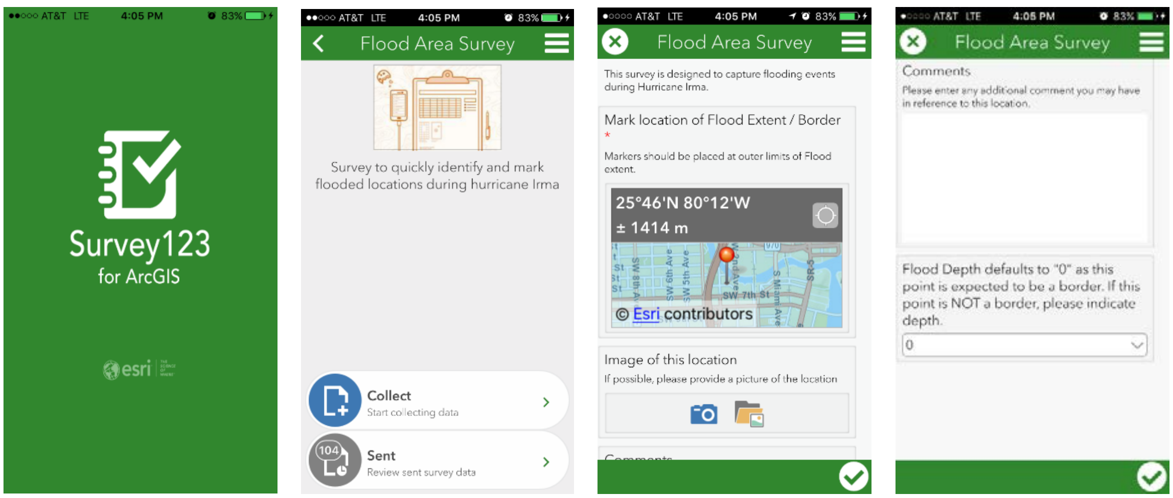


Figure 3: Screen captures of Survey123 with the Flood Area Survey form created in-house

Chief Innovation Officer Mike Sarasti and Zoning Administrator Devin Cejas field-tested the application for accuracy Wednesday evening. Data was accurate within 20-40' of location, though cellular data was limited in this area. Zooming into locations on the map and manually dropping a pin could create more accurate locations, even with the limited automatic accuracy. The ability to send data later if connectivity is limited was also tested. All other aspects of the application were functional.

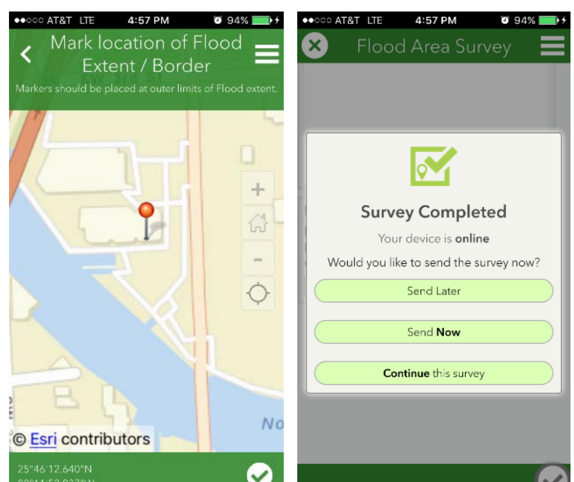


Figure 4: Example of zoom function on the map and ability to send information at a later time.

The following morning, we assessed our physical requirements for data collection. Typically simple items were complicated by the continued recovery from Hurricane Irma. Staff needed personal phones with service and space for the application. Staff also needed to use personal vehicles, since City vehicles were in-use after the storm. While phones and vehicles

[1] Please refer to https://survey123.arcgis.com/help/faq for additional application information

were available, cellular coverage and gasoline were both limited. However, between 18 people forming 9 teams, we were able to meet all requirements.

We instructed staff in data collection very briefly and without previous experience in this type of data collection. Our goal was to document the horizontal extents of storm surge flooding, i.e. the "bathtub ring" or high water mark throughout the city. Evidence of flooding such as wrack lines and deposited floating debris should mark the location. Staff were instructed to stand at the high water line and mark the location with the application. Importantly, this allowed staff to avoid passing *through* potentially dangerous debris or standing water. We also encouraged marking of clear data points on vertical surfaces and emphasized that these should be collected whenever available. The application includes a depth measurement as an addition to the location information which allows for collection adjacent to vertical surfaces.

The least certain data, for which we had very little protocol for collection, was the interview of residents and building managers in areas that had already been cleaned. Teams were instructed to get as much evidence as possible from people and attempt to correlate it with physical evidence. In reality, residents were willing to share quite a large number of personal and surveillance photos and videos which will need to be correlated with other information.

We assigned the 9 teams to approximately 1.5 mile segments of coast, with some adjustments made for density and expected ease of data collection. One team was dedicated solely to islands in Biscayne Bay. Teams self-selected areas with which they were already familiar. We also deliberately neglected coverage of the southern neighborhood of Coconut Grove which is an area with multiple civic groups upon which we intended to rely for information and possibly volunteers. In fact, within the day, members of Grove 2030 contacted Chief Resiliency Officer Jane Gilbert and volunteered assistance. We required roughly 90 hours of field work total with an additional 30 hours for in-office work.

RESULTS

Results are approximately 700 data points collected over three days. In most cases, photos are included with each data point in order to determine the type of evidence indicating the high-water mark. Data collectors expressed a high confidence in the accuracy of information gathered.

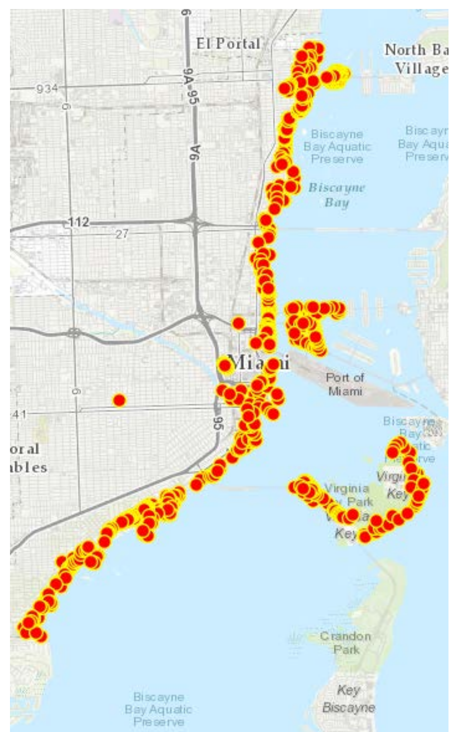


Figure 5: Map showing locations of data-points

We encountered occasional errors when finding more evidence of higher water in the same or a nearby place. In some cases, we would mark a point, only to find additional evidence of higher water close by. In these cases, there will likely be multiple nearby data-points with conflicting depth or elevation data. The higher points should be considered accurate. No instances of the opposite case were reported.

We intend to make the data-set public and open to outside researchers free of charge. We will make use of some of the data within the department of Planning and Zoning directly. However, we expect most analysis and interpretation of the data to be conducted by outside researchers. We expect to have access to analysis in exchange for the use of the data-set.

There is an additional trove of information that is not yet organized. We received many personal photos and videos from residents. While people tended to record inundated areas with little depth information, there are cases of the high-water marks being recorded. In addition, a wealth of information from building managers is available. Many large buildings have time-lapse video or still images from surveillance cameras which accurately record locations, elevations, and times. Fully classifying and correlating images is beyond the scope of this study.

DISCUSSION

Discussion is currently centered on techniques for improving data-collection in the future. Areas for improvement include preparation, timing, interactions with the public, and ways to make data collection more robust. Since this is our first attempt at this data collection, we expect to be able to have improvements in place prior to any upcoming storms and to be able to share techniques with others.

Our teams would have been able to collect more and better data if we had deployed people sooner. Direct evidence of flooding is more accurate than eye-witness accounts. Marking points directly on the map also does not need correlation and analysis in the same way that reviewing photos and videos requires. However, safety is paramount, and roads must be sufficiently clear of debris for people to travel safely. In the case of Hurricane Irma, one or two earlier days of data collection would have been very helpful and realistic considering the state of the roads. Each future case will be unique, but by having procedures in place beforehand, and prioritizing neighborhoods which are cleaned first, we should be able to capture more direct evidence. Improvements to our public interactions and technologies will become essential when we are able to deploy sooner after storms in the future.

We must make both old and new technologies more robust to capture data effectively sooner after storms. Personal phones are sufficient, but completely offline versions of the map and data-collection applications are vital to making these usable after storms in areas with little or no cellular coverage. In addition, we must make back-up portable phone batteries, charged someplace with reliable power like the emergency operations center, available to staff. Similarly, personal vehicles should be sufficient, but accommodation for gasoline must be in place. Either fuel from General Service's filling stations or pre-arranged commitments from staff to provide fueled vehicles are options. Data collectors will be more robust as well with provision for food, water, mosquito repellant, and sunscreen.

Better identifying staff as city employees should simplify data collection and interactions with the public. While some staff had department shirts, most people relied on I.D. cards exclusively as representation to the public and security guards. Magnetic decals for private cars as well as logoed shirts are simple but effective means to make better first impressions.

Our weakest point during Hurricane Irma was our preparation for public interaction. In many cases, our staff were the first City or Government officials of any kind that people met. Instances of being the first government contact will increase the sooner we deploy. Thus, staff should be prepared to answer common questions and direct people to correct sources of information well outside our scope or typical fields. A suggested script for handling interactions should be part of training. A script should include a brief description of what and why we are collecting data and manage public expectations.

We will also create a flyer or handout reiterating information in the script and containing vital contacts. This will include responses to frequently asked questions with information on: debris removal, water and sewer utilities, power company contacts, and tree removal and repair options. The flyer will also better establish procedures for the public to share information, photos, and videos. A section of our handout will include a centralized email address for receiving information and criteria for sharing: date, time, address, exact location, source of image, and circumstance.

Finally, we intend to create training standards. Staff need more uniform criteria for establishing high-water points. Now that we have collected data once, we have reference images to create a brief instruction manual for establishing points. Determining accurate locations and high-water marks is difficult in the field when wind-driven and water-driven debris are mixed. Clearer standards will create more accurate data. Deploying people sooner after a storm will mean that safety training regarding avoiding floodwater, electrical lines, and other hazards should be included.

CONCLUSIONS

We have not yet drawn conclusions from the data. Initial analysis of quality of the data is ongoing.

ACKNOWLEDGEMENTS

I would like to thank City of Miami staff for conceiving, planning, and executing this work quickly in the midst of difficult post-storm circumstances. Chief Innovation Officer Mike Sarasti and our Chief Resilience Officer Jane Gilbert steered me away from paper maps and toward better technology that allowed this to happen. Within minutes of discussing the idea, Mariela Del Rio of our Information Technology department made excellent snap judgements and set-up an application that worked. Thank you to Kevin Burns, Chief Information Officer and Assistant Director Otto Contreras for additional support. GIS expert Adrienne Saltik received and cleaned up data as it streamed in from the field.

Our data-collectors worked through heat, humidity, and some difficult public interactions:

Maria Gabriela David
Luciana Gonzalez
Wendy Sczechowicz
David Snow
Chris Torres
Alissa Farina
Guillermo de Nacimiento
Jacob Keirn
Ryan Shedd
Jonathan Thole
Eleanor Sue Trone
Joseph Eisenberg
Mario Rojo Jr.
Amanda Smith
Denise Toranzo
Ajani Stewart

Additionally, members of Grove2030 reached out to Jane Gilbert and volunteered services. Less than 20 hours after speaking with Dr. Amy Clement, she and three additional volunteers were collecting information to round out our data set.