HURRICANE MATTHEW
A GIS PERSPECTIVE

GLYNN COUNTY GIS

Situation

- September 25th – October 9th 2016 Hurricane Matthew tracked its way up the east coast bringing hurricane force winds and flooding from Haiti up to Cape Hatteras, NC.
- **Discussion Includes:**

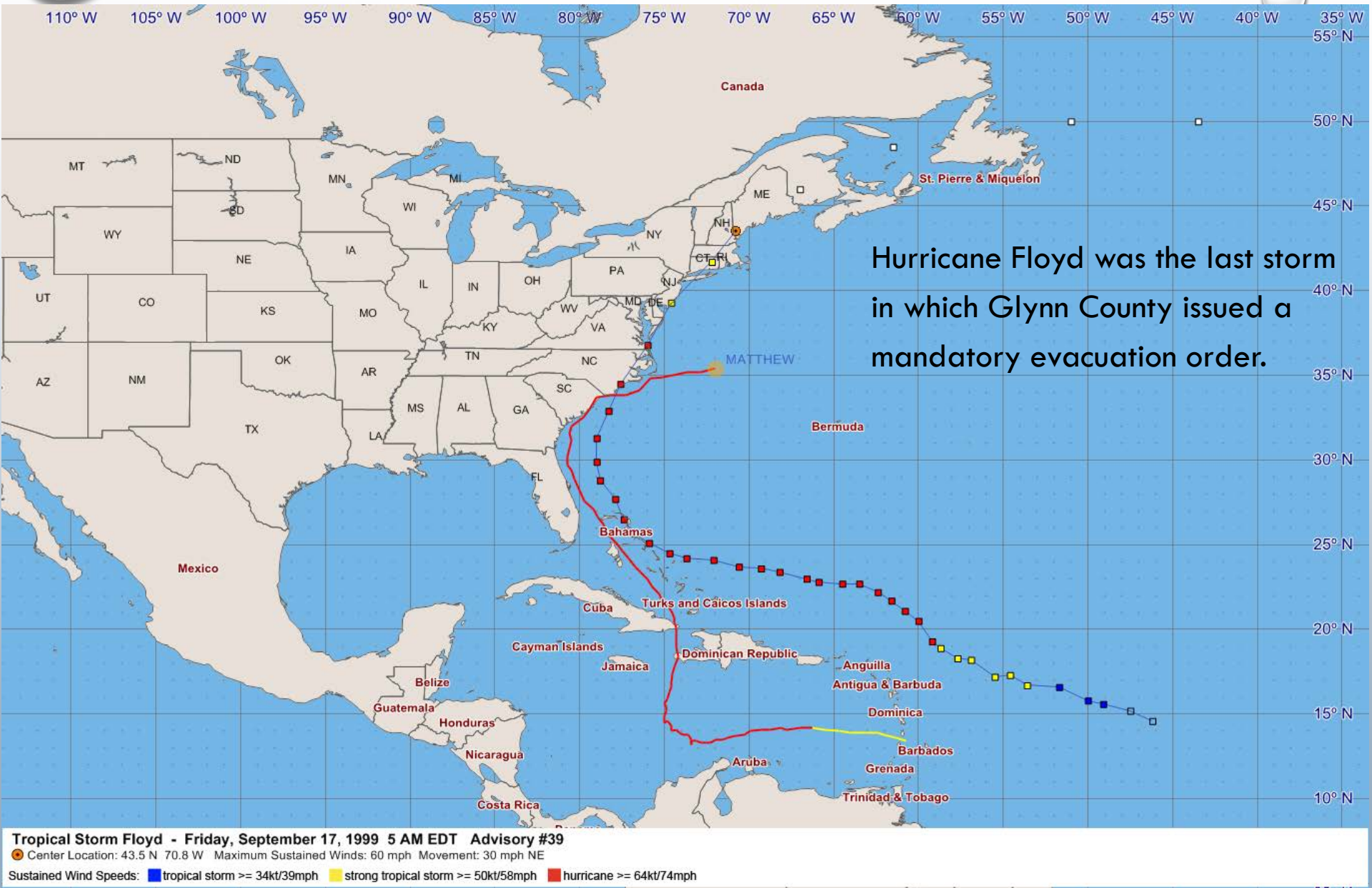
  Preparation – How Glynn County GIS (GCGIS) prepared for hurricane season.

  Response During the Storm – GCGIS Response during Hurricane Matthew

  Response After the Storm - GCGIS Response after Hurricane Matthew

  Lessons Learned - How to succeed in the future!

HURRICANE MATTHEW (2016) / HURRICANE FLOYD (1999) TRACKS



Hurricane Floyd was the last storm in which Glynn County issued a mandatory evacuation order.

Preparation

GIS preparation

- Identify essential personnel.
  - Based on the role in the GIS department and Emergency Management Agency (EMA).
- Identify locations where essential personnel are needed.
  - 2 locations Emergency Operations Center and back up Emergency Operations Center.
  - Also make note of the locations of staff who will be evacuating and establish procedures for reentry.
- Identify equipment would be needed for those staying.
  - Laptops, hard drives, printers, paper, office supplies, GPS devices, batteries, flashlights, radios, first aid… etc.
- Back up of the GIS database to two external hard drives. One hard drive will go to each location.
  - This is in case of loss of network/internet connection.
  - Back up of standard maps the GIS Department produces i.e. base maps, road maps, fire, police, and ems maps.
- Software licenses are checked out from the license managers. i.e. ArcMap, and Trimble office
  - Again in case of loss of connection with our license manager on the server.

Preparation

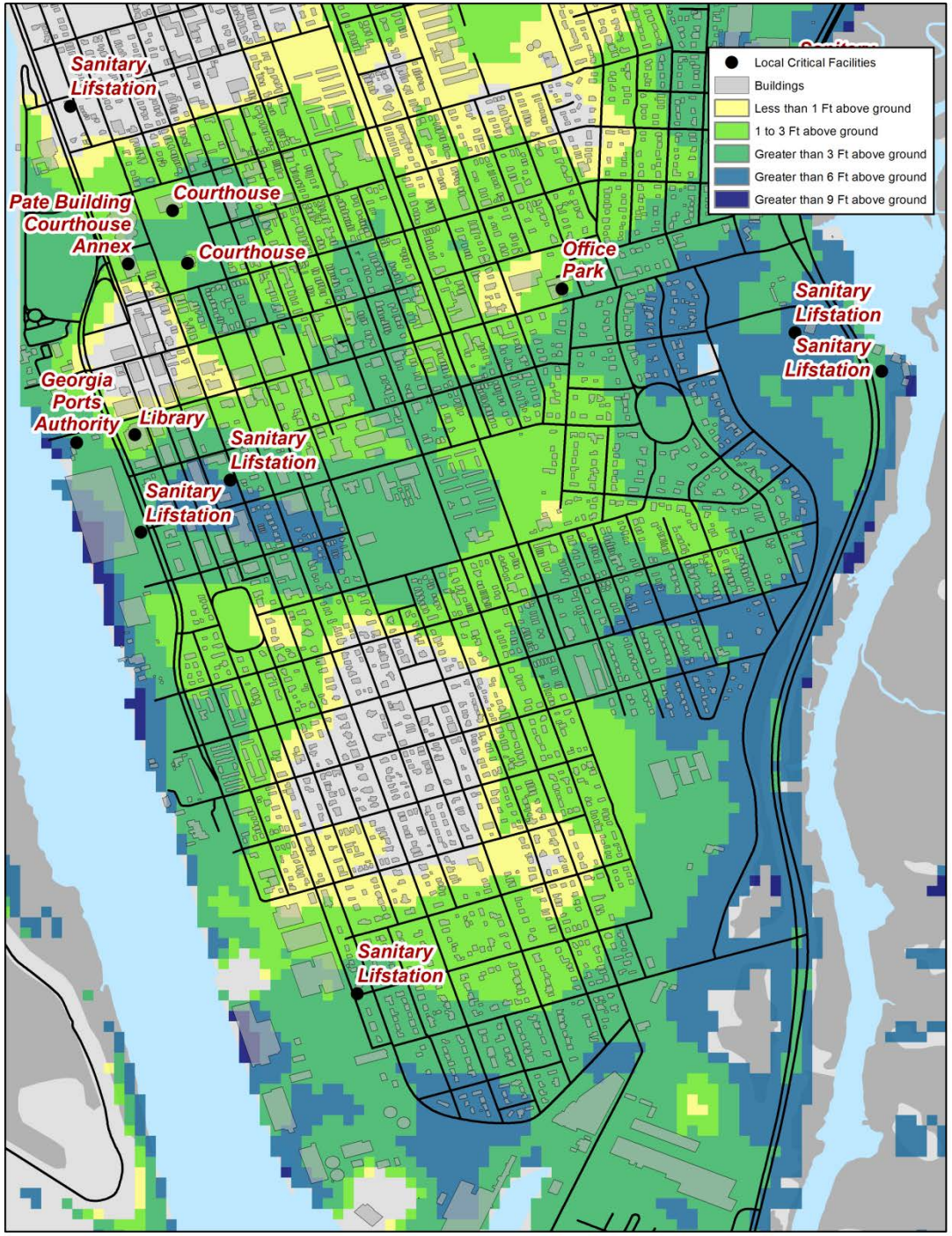
Collaboration with NWS and NHC

- Glynn County works closely with National Weather Service (NWS) and National Hurricane Center (NHC) in preparation for hurricane season.
  - Mock hurricane tabletop exercises with Glynn County EMA, NWS JAX, and GEMA annually.
- NWS JAX provided advisories every 6 hours leading up to the storm.
  - Software used HURREVAC - administered by FEMA, the USACE, and the NOAA National Hurricane Center.
- GCGIS utilized inundation data to determine where to relocate county assets and to determine an evacuation decision, mandatory, voluntary, or none.
  - Software HURREVAC, ArcGIS for desktop 10.3.1, NHC GeoTIFF (inundation raster)

During the Storm

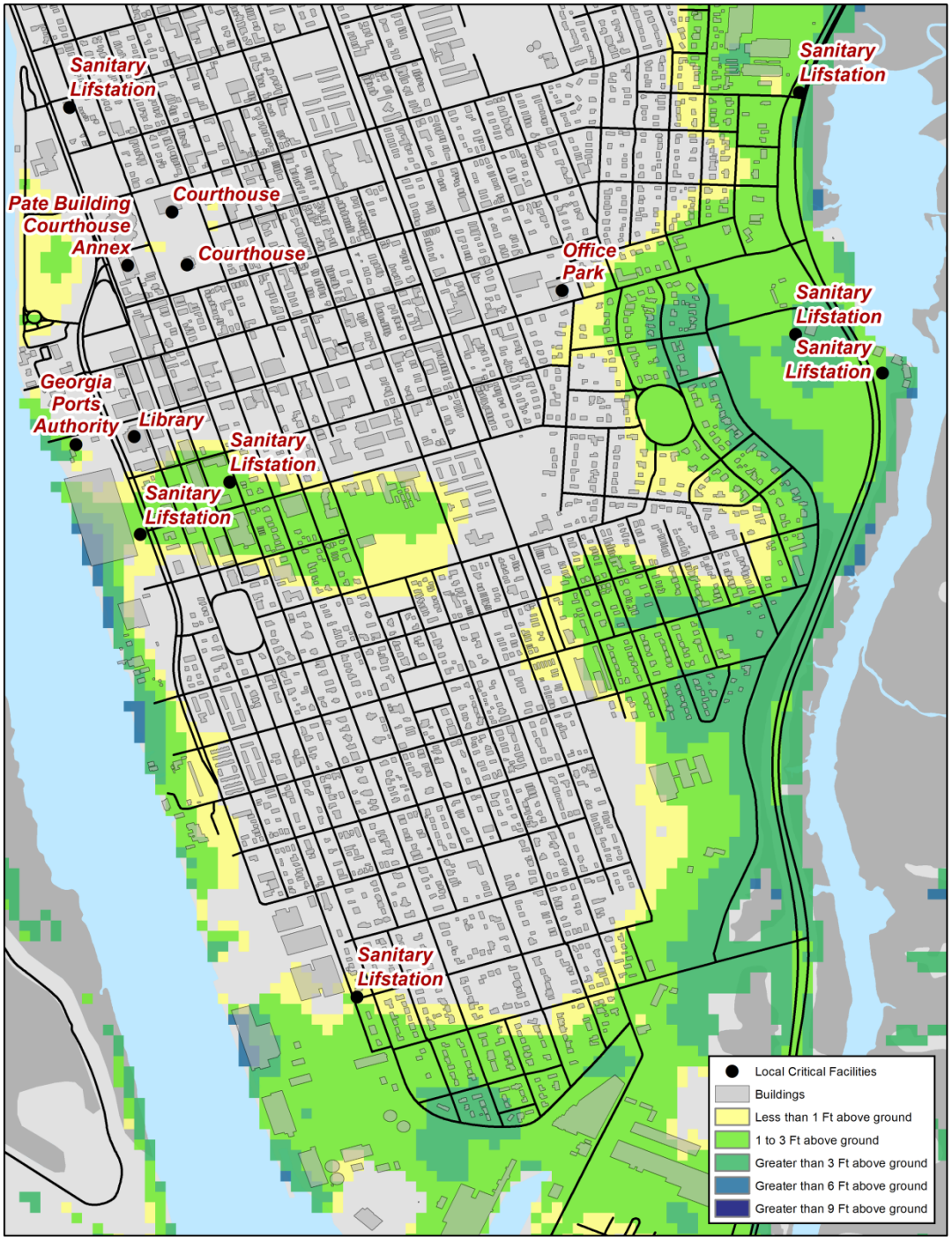
Map Production

- Hurricane storm surge inundation
  - For: Glynn County officials
  - Purpose: To allow Glynn County Officials to determine the need to evacuate critical facilities such as the detention center. To identify areas of flooding where county assets and equipment may need to be moved. To identify which, if any, county facilities may receive flooding and plan strategies to allow access back into these locations after the storm.
  - Data: Glynn county GIS maintained layers and GeoTIFF data from NHC.
  - Software: ArcGIS for Desktop 10.3.1



ADVISORY 35

OCTOBER 7, 6:30 AM



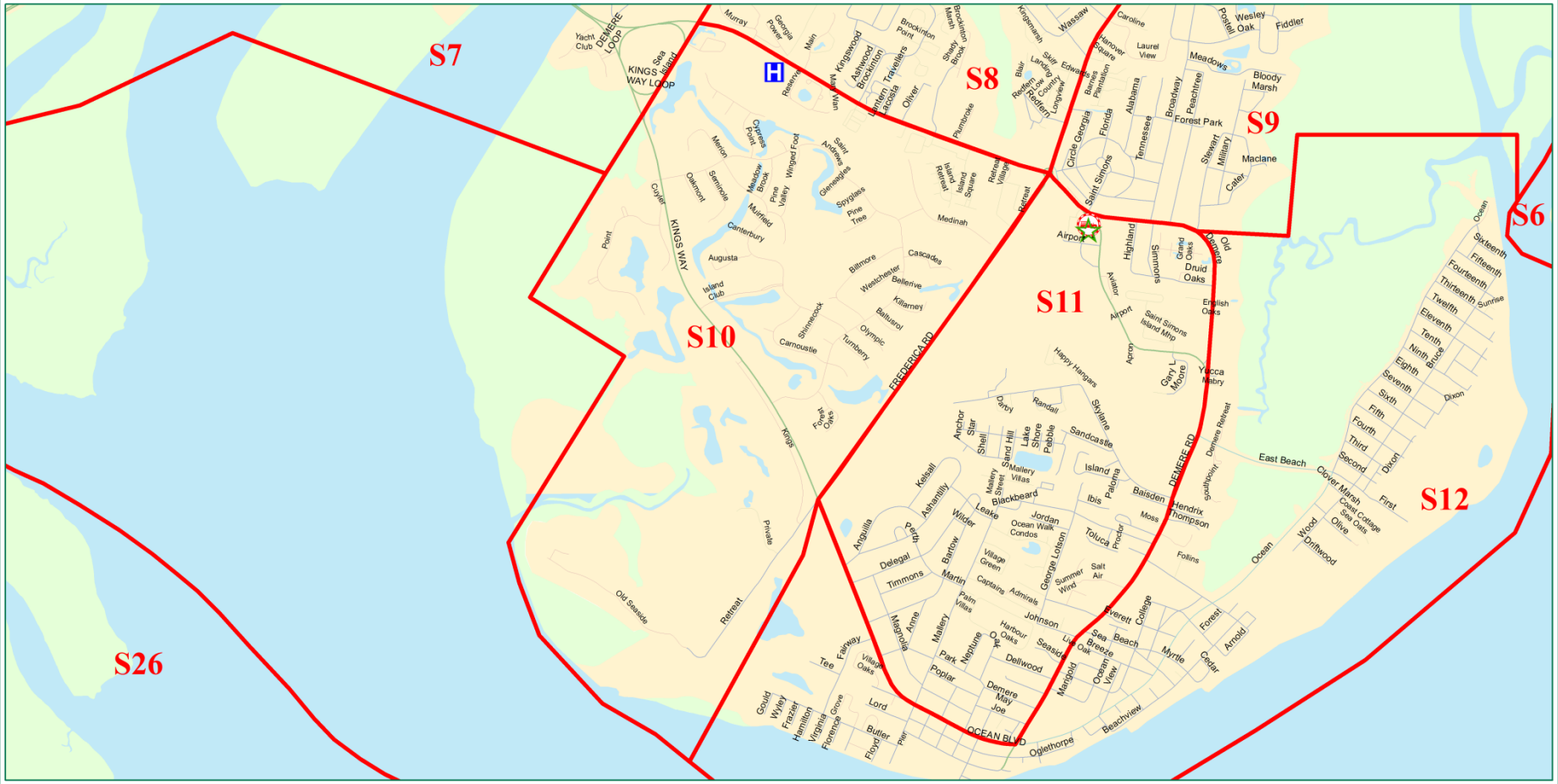
ADVISORY 38

OCTOBER 7, 4:30 PM

During the Storm

Map production cont.

- Emergency Operating Sectors
  - For: Glynn County Police
  - Purpose: small 8.5x11 maps showing emergency operating sectors to be handed out to emergency personnel to show areas to patrol.
  - Data: Glynn County GIS maintained layers.
  - Software: ArcGIS for Desktop 10.3.1
- Glynn County Roads Map
  - For: National Guard
  - Purpose: To show Glynn County roads for the National Guard to navigate and clear roads of down trees and open access into subdivisions.
  - Data: Glynn County GIS maintained layers
  - Software: ArcGIS for Desktop 10.3.1



Legend

- Medical Care Facilities
- Fire Station
- Police Station
- OP Sectors
- Glynn Boundary

N
W E
S

Glynn County Operating Sectors

Sector: S10

1 inch = 0.3 miles

0 0.175 0.35 0.7 Miles

www.glynncounty.org

April 4, 2017

Glynn County GIS Department
Phone: 912-554-7418
Email: GIS@glynncounty-ga.gov

Author:

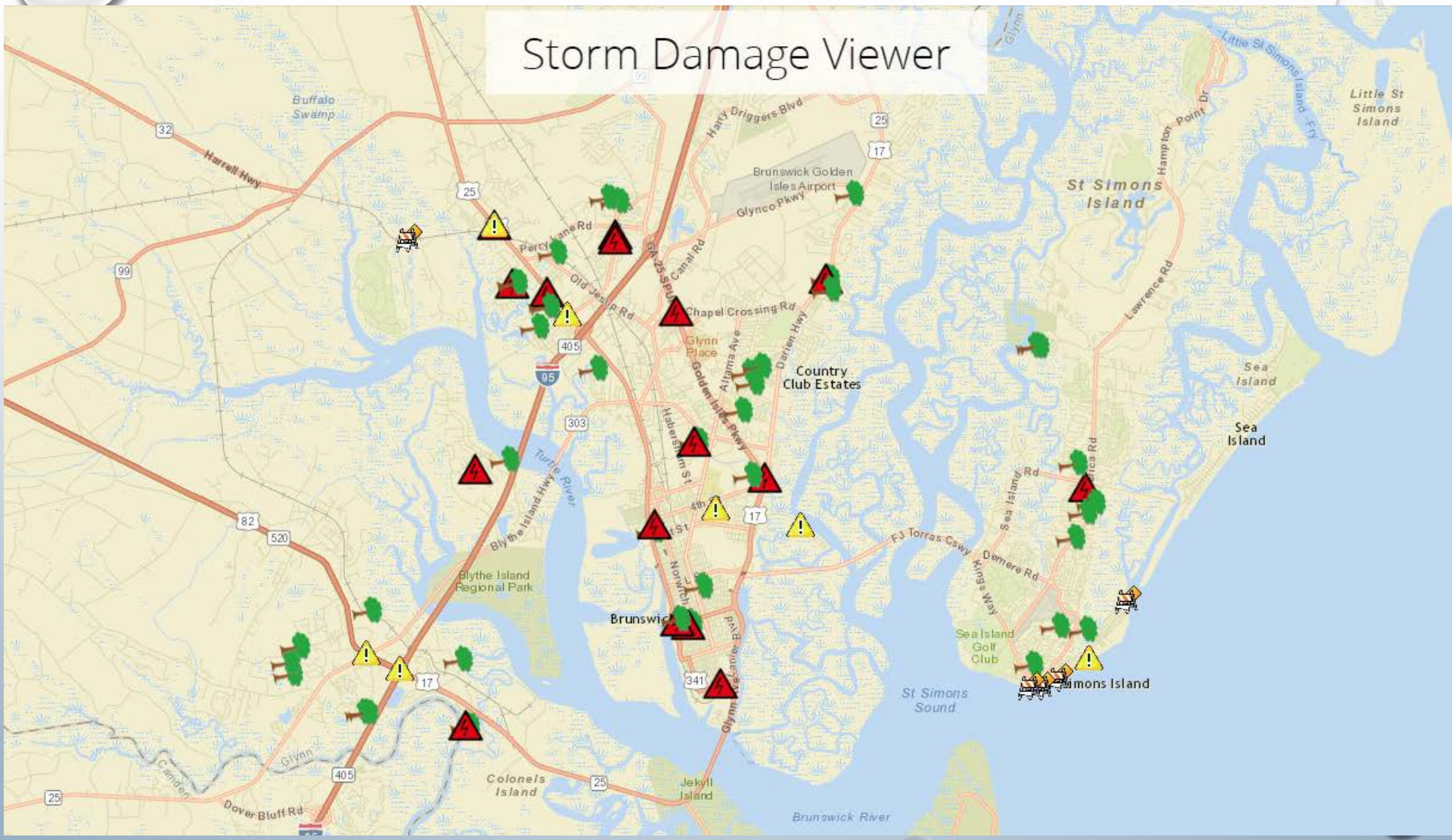
Document Name: OpSectorMapBook11_X_17_Landscape

During the Storm

Website updates

- **Glynn County Storm Damage Viewer**
  - For: Glynn County officials and general public
  - Purpose: GCGIS created an ArcGIS online map application to track road closures, down trees, down power lines, flooding, and other areas of concern during Hurricane Matthew.
  - Data: ArcGIS Online Basemap, storm damage layers created for this viewer.
    - Points - down trees, down power lines, closed roads, other areas of concern
    - Area – flooding
    - Hurricanes active from ArcGIS Online– hurricane tracks and positions provided by ESRI disaster response, NOAA National Hurricane Center (NHC) and Joint Typhoon Warning Center (JWTC)
    - Software: ArcGIS for Desktop and ArcGIS Online

Storm Damage Viewer



During the Storm

Collaboration with NWS and NHC

- Glynn County Emergency Operations Center (EOC) received weather advisory briefings during the storm event from NWS meteorologist Ben Nelson on location and meteorologist Al Sandrik remote (JAX) on storm intensity, location, and tracks every 3 hours during the storm event. These briefings allowed Glynn county officials to monitor storm activity and possible scenarios for storm impact to make decisions regarding county assets, personnel, reentry, and damage assessment.
  - Software: HURREVAC
- During the storm event after each advisory the NHC provided a potential storm surge inundation GeoTIFF for download and use in GIS software. GCGIS overlaid the GeoTIFF datasets in local County maps to allow county officials to make decisions about County facilities, asset locations, and potential areas of impact.
  - Software: ArcGIS for Desktop 10.3.1
  - Data: Glynn County GIS maintained layers and NHC storm surge GeoTIFF


OUR MISSION
TO PROVIDE THE BEST POSSIBLE LAW ENFORCEMENT AND QUALITY OF LIFE SERVICES TO OUR COMMUNITY.
EXIT
Major Hurricane Matthew Briefing
Noon Situation Overview
WARNING!
...Matthew on A Paralleling Storm Track...
...Continued Storm Surge/Wave threat...
Storm surge flooding, beach erosion and infrastructure damage is possible for coastal areas today into tonight.
Major Hurricane winds will remain well offshore east of the center with strong tropical storm force to hurricane force sustained winds impinging on our coast. Northeasterly winds are still pushing water towards our beaches. Worst Case Storm tide flooding possibilities...
6 to 9 feet Above Ground Level (AGL) is still possible along the oceanfront.
4 to 7 feet AGL rivers, estuaries and the Intra-coastal Waterway near the ocean.
3 to 6 feet AGL in areas away from the ocean.
Breakers of 10 to 15 feet will batter beaches. With major to severe beach erosion possible.
Waves will break through weak points in the dunes with water washing inland.
Some damage to coastal Infrastructure is possible, including damage to roads and vulnerable structures.
8 to 12 inch rainfall in coastal counties could cause flash flooding in coastal areas.
The storm poses an imminent threat of tropical storm and/or hurricane conditions to SOME PORTION of the Warning area. Heed the advice of Local Officials. Be careful about rumors, erroneous social media posts and unwarranted speculation.
@NWSJacksonville
Weather.gov/JAX
US National Weather Service Jacksonville
spillman
Call Nature Location City Zone Status
104 Accident PD 3700 CYPRESS MILL RD; THE COV B25 BP1A
101 Suspicious 1018 ALBANY ST B20 BP104 ARRV
100 Suspicious INTERSTATE 95 & NEW JESUP H B20 GP6 ARRV
99 Citizen Assist 157 PUBLIC SAFETY BLVD B25 GP10 ARRV
95 Burglary 115 FAIRMAN AV; FAIRWAY OAK B25 GP5 ARRV
Unit Status Time Call# Zone Agen Location Description
100 ONDT 4.6H GP GCP (MDC)
104 81 7.1H GP GCP ARCO PRE
110 8 3.5H GP GCP
113 AVAIL 3.6H GP GCP
118 AVAIL 46.0m GP GCP
119 AVAIL 3.6H GP GCP
120 81 16.1m GP GCP
121 AVAIL 3.6H GP GCP OAK GROV
91.3 Fm
weather

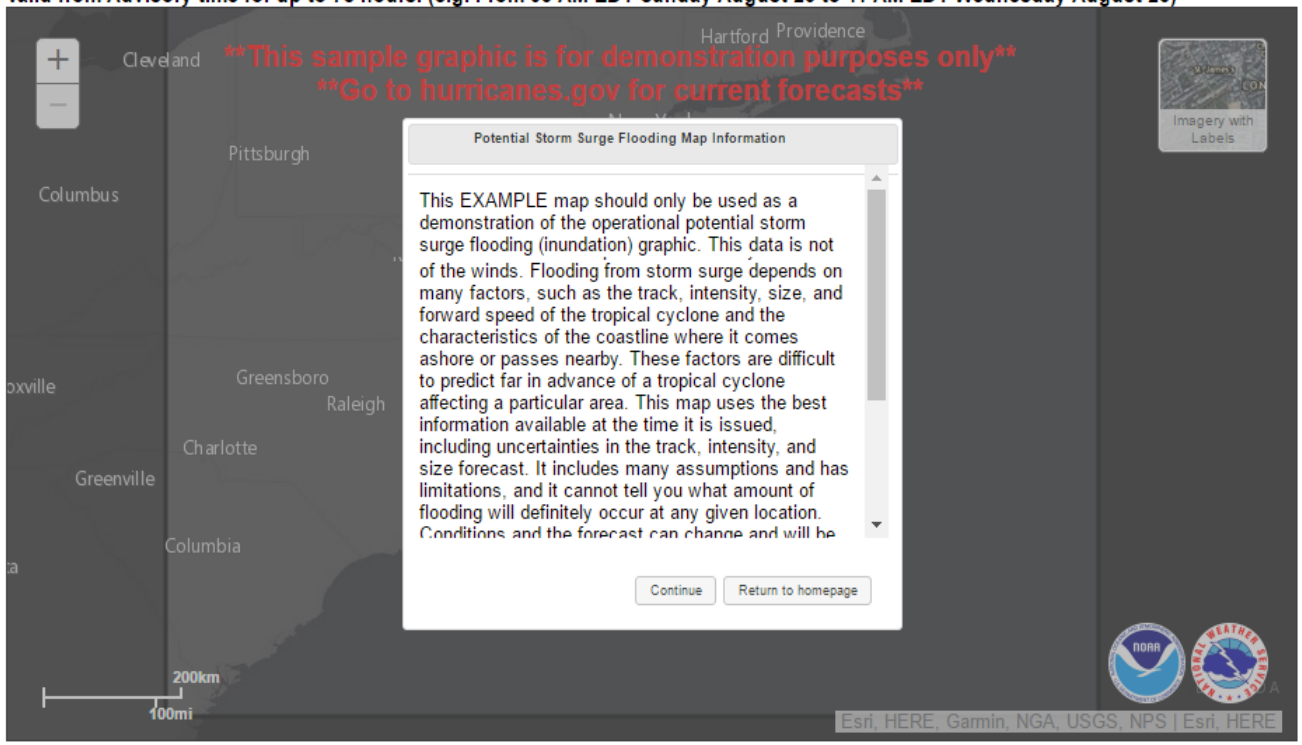
NATIONAL HURRICANE CENTER

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Potential Storm Surge Flooding Map (Inundation): Interactive Example

Click here to return to the inundation graphic documentation

NHC Potential Storm Surge Flooding Map: Interactive Example
Hurricane TEST (2009) Advisory 24
Valid from Advisory time for up to 78 hours. (e.g. From 05 AM EDT Sunday August 23 to 11 AM EDT Wednesday August 26)



Potential Storm Surge Flooding*

- Intertidal Zone/Estuarine Wetland
- Greater than 1 foot above ground
- Greater than 3 feet above ground

Map Layer Options:

Inundation Layer Only | Inundation with Intertidal Layer

Map Opacity Slider

Download GIS data

NATIONAL WEATHER SERVICE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

ABOUT

P-Surge 2.5: Probabilistic Hurricane Storm Surge (with tide)

MD

Click Map to Zoom

Archive data HERE

Storm and Year

Matthew2016

Advisory

38

Type

10% Exceedance Ht.

Datum

Above Ground

Time Grouping

Cumulative

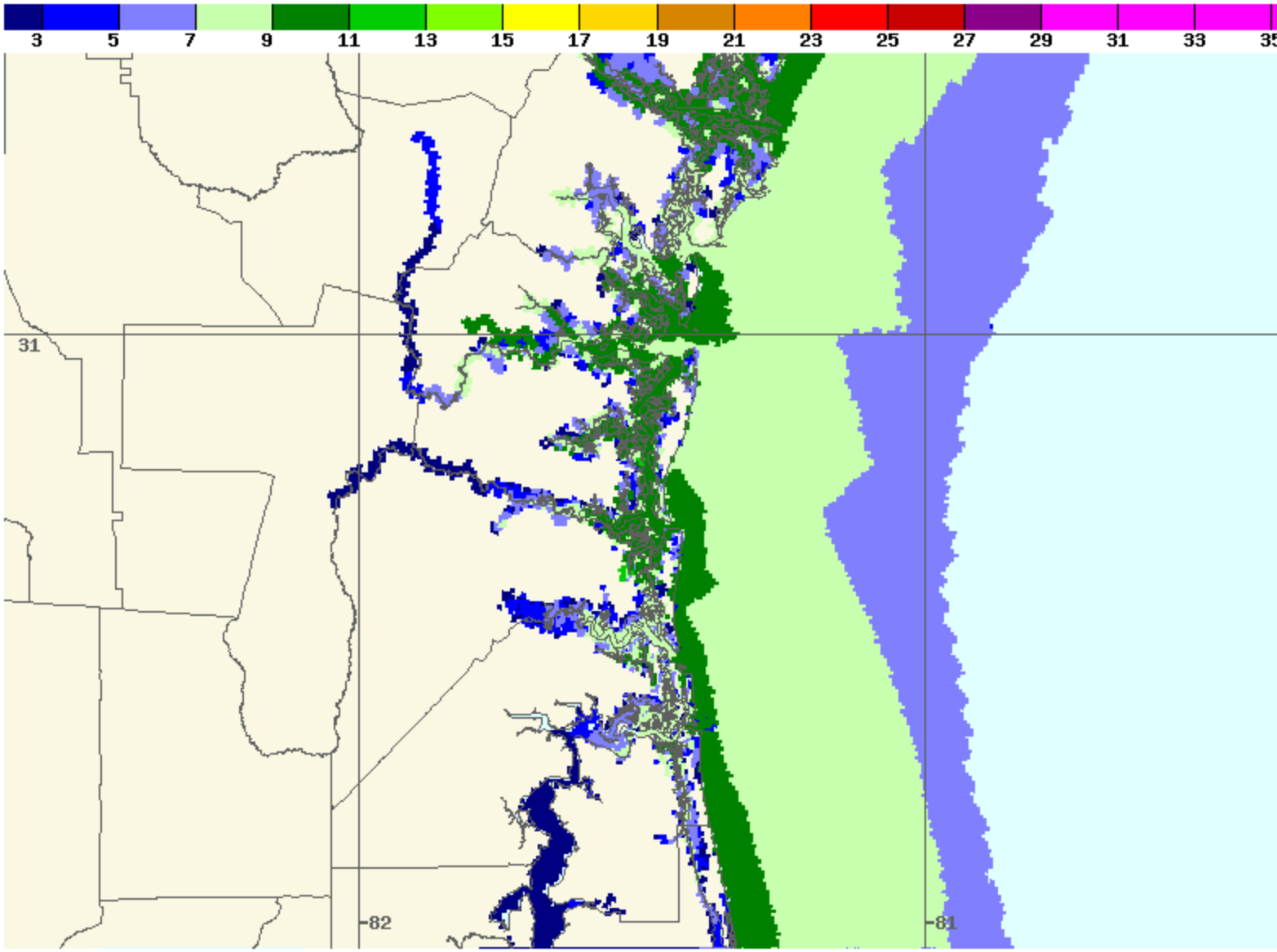
Start | Stop

Frame: 13

Download Data

SHP GRIB II

P-Surge 1.0

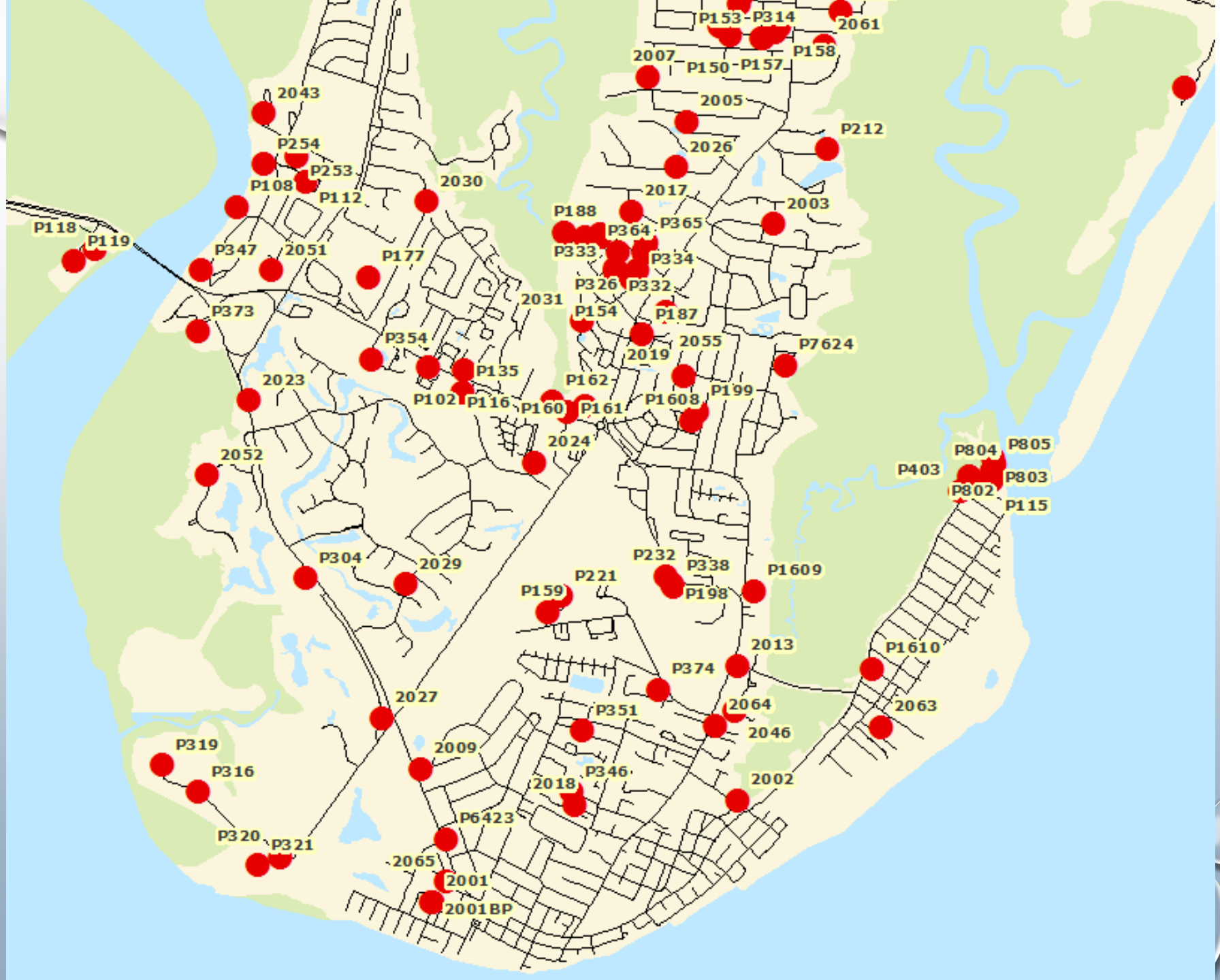


Hurricane Matthew(2016) Advisory 38: Storm surge (with tide) heights in feet above ground level with a 1 in 10 chance of being exceeded

After the Storm

Brunswick Glynn Joint Water and Sewer Commission (JWSC)

- JWSC determined that at 7:00 PM on Sunday October, 9th (more than 40 hours after the hurricane had passed) that more than 80% of the sewer system was non-operational on St. Simons Island and it was unsafe for residents to return.
- GCGIS used a projector and ArcGIS Desktop (inside the EOC) to map the water and sewer utilities as they became operational.
- Existing utility data was presented in a way that all agencies and elected officials could make timely decisions to ensure citizen safety.


P153
P314
2061
P158
2007
P150
P157
2005
P212
2026
2043
P254
P253
P108
P112
2030
2017
2003
P188
P364
P365
P118
P119
P347
2051
P177
P333
P334
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2031
P373
P154
P187
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2019
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P7624
P135
P162
2023
P102
P116
P160
P161
P1608
P199
2024
2052
P804
P805
P403
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P802
P115
P304
2029
P232
P338
P1609
P221
P159
P198
2013
P1610
P374
2027
P351
2064
2063
2046
P319
2009
P316
P346
2018
2002
P6423
P320
P321
2065
2001
2001BP

After the Storm

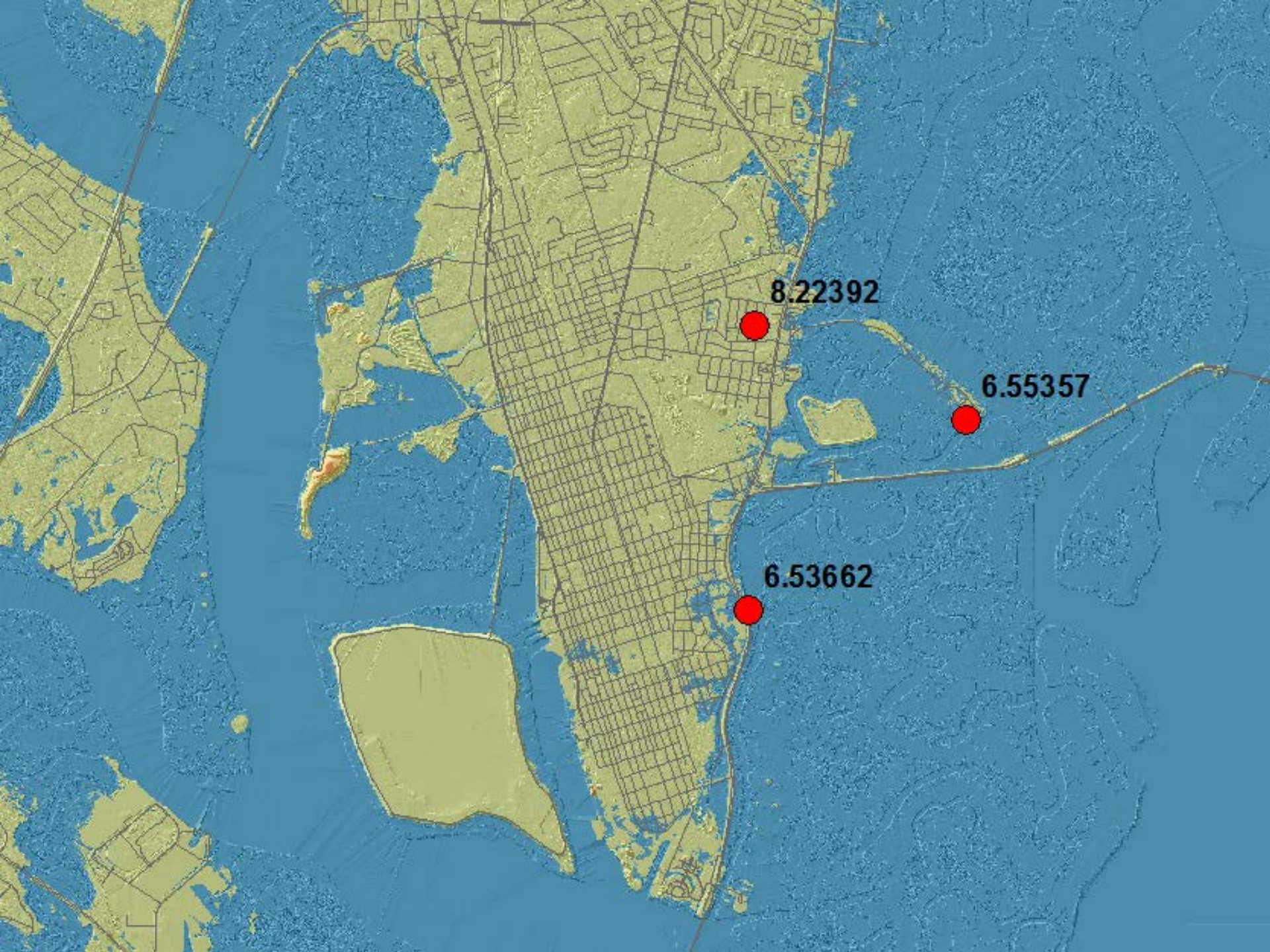
High water marks

- GCGIS collected high water marks from known flooded areas, particularly along the eastern part of the County and St. Simons Island. High water marks are marks on houses or debris lines on the ground left by the surge. These high water marks were collected with survey grade GPS in order document the elevation of the storm surge.
  - Equipment: Leica Viva GS 15 antenna and CS 15 controller
  - Software: Leica SmartWorx Viva, Leica Geo Office, ArcGIS for Desktop 10.3.1
  - Data: Glynn County GIS maintained layers, high water points collected by GCGIS

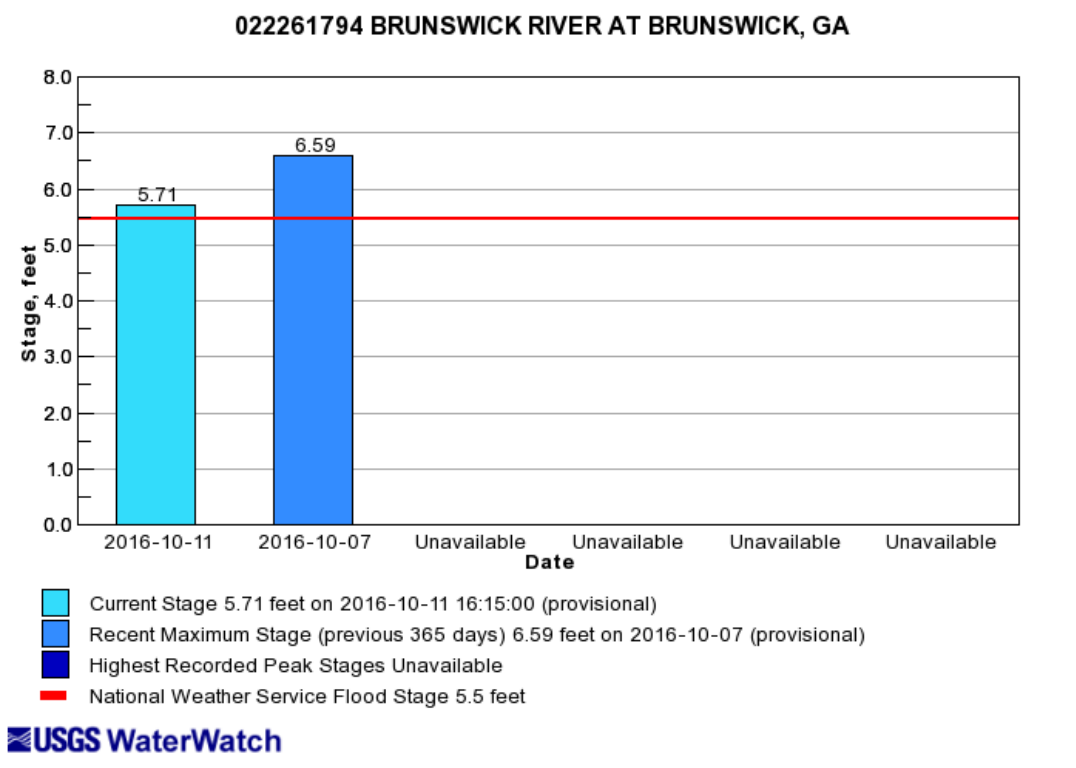
After the Storm

Validation of NHC forecast data

- GCGIS used the high water mark data to establish an overall storm surge elevation during Hurricane Matthew. The elevation of the high water marks were approximately 6.7ft. above mean sea level. Mean Sea Level for Glynn County is approx. 3-4 ft. in elevation.
- The predicted high tide for Saturday October 8th at 2:18am should have been 6.8ft.
- This would indicate a storm tide of approx. 11ft. or 3 ft. storm surge plus wave action.
- Using DEM data GCGIS was able to symbolize the storm surge inundation.
- Comparing the High Water Marks and DEM data with the potential storm surge inundation GeoTIFF from the NHC advisory just before the storm passed, it was determined that these predictions were a near match to actual storm surge levels.
    - Software: ArcGIS for desktop 10.3.1
    - Data: Glynn county GIS maintained layers, Glynn county 2008 LIDAR DEM, GCGIS collected high water marks, NHC potential storm surge inundation GeoTIFF


8.22392
6.55357
6.53662

After the Storm



- 2016-10-07 FRI 8:08 PM

1.7 FEET LOW TIDE

- 2016-10-08 SAT 2:18 AM

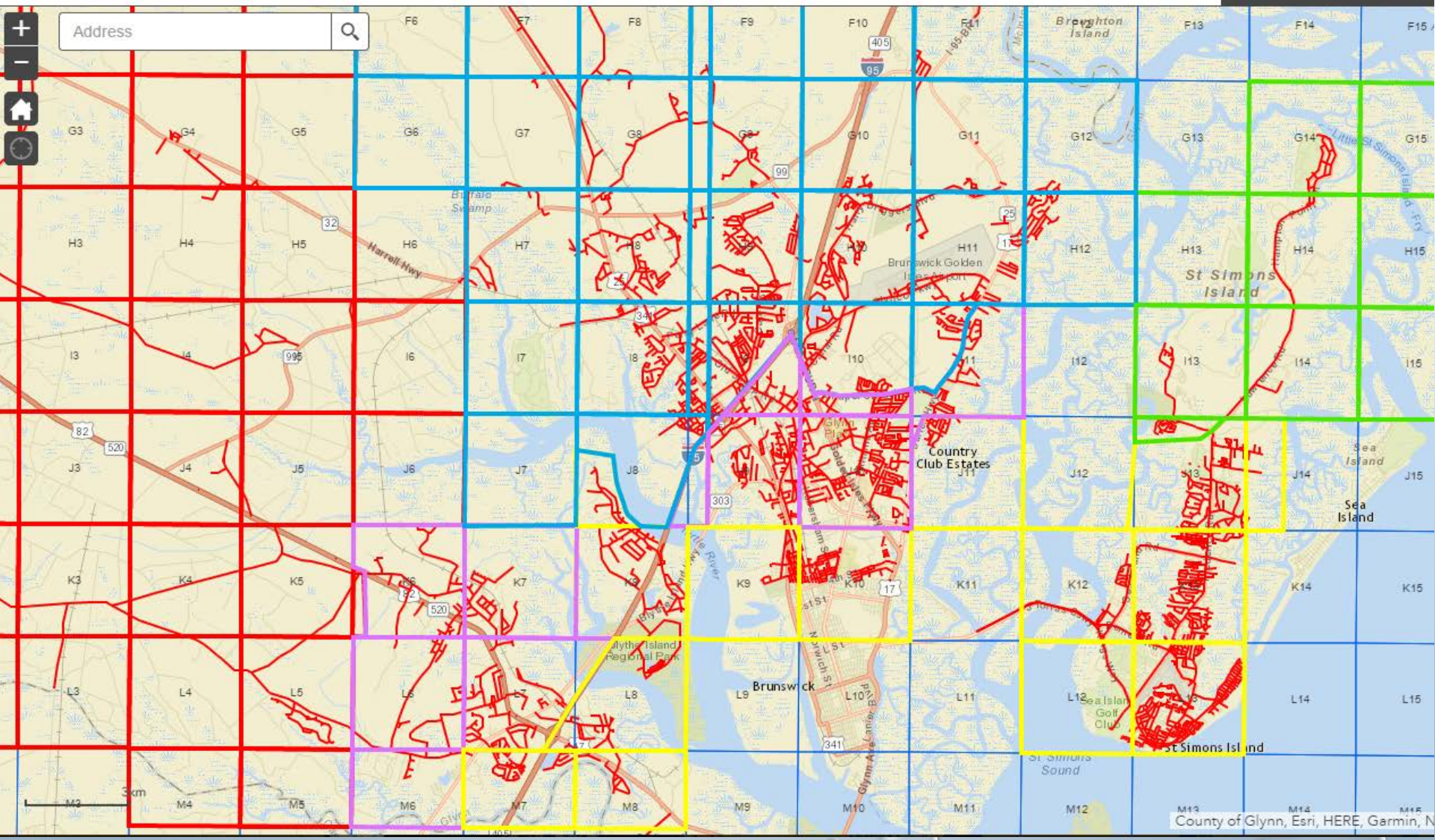
6.8 FEET HIGH TIDE

After the Storm

Debris removal

- GCGIS created debris removal area maps that had the dates the debris would be picked up in specific locations of the County.
  - Software: ArcGIS for Desktop 10.3.1
- Created a debris removal area viewer allowing residents to search their address and observe which debris removal area they reside in.
  - Software: ArcGIS for Desktop 10.3.1
  - ArcGIS Online App Builder

Hurricane Matthew Debris Does Not Work Well with Internet Explorer Hurricane Matthew Updates



After the Storm

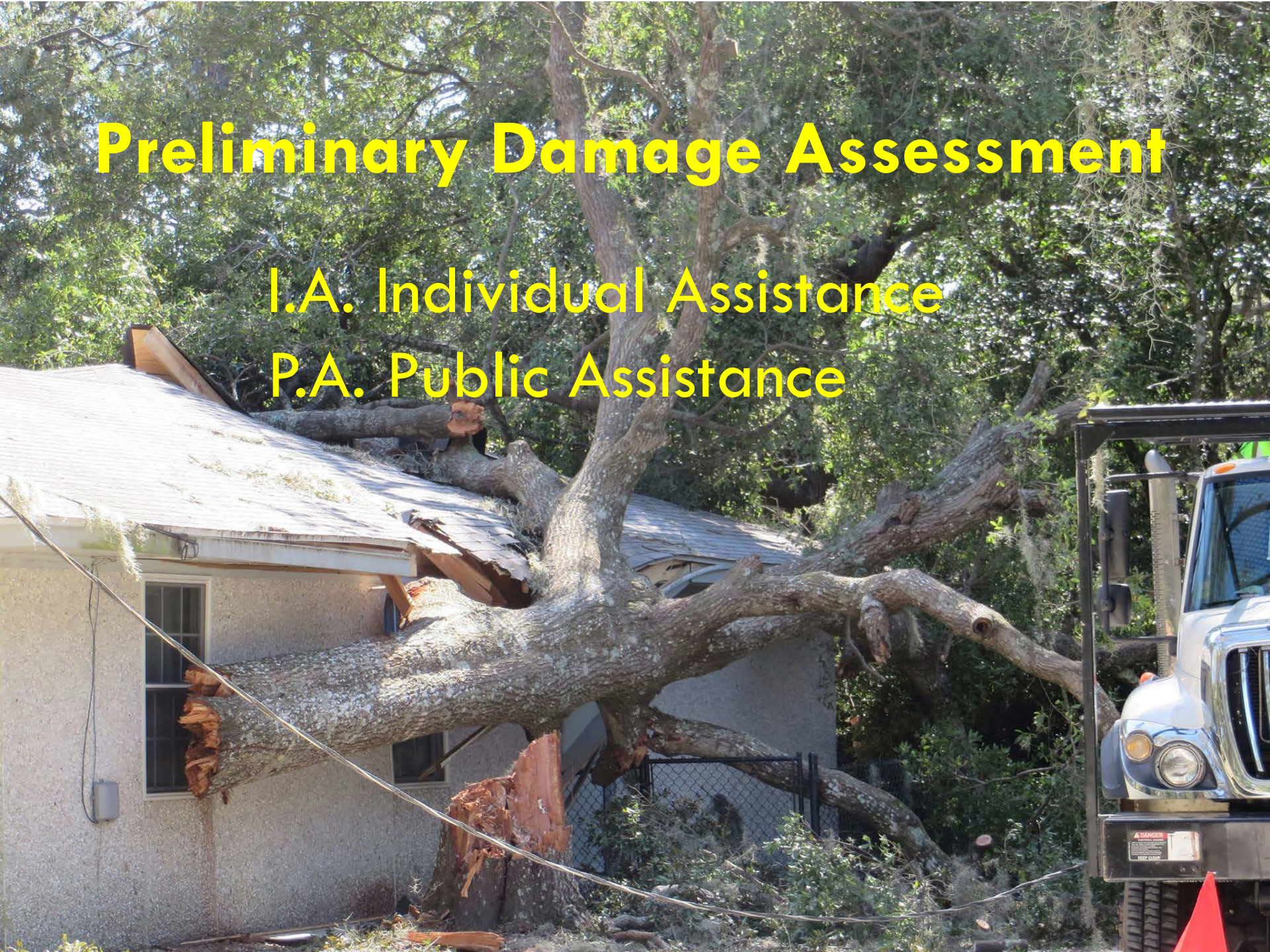
Preliminary Damage Assessment

- During the preliminary damage assessment, GCGIS, assisted in the data collection in the field.
  - FEMA field sheets
- Produced location maps of reported and expected heavily damaged areas to aid in the effort and expedite data collection.
- Maps created with points indicating homes that had damage and were included in the FEMA damage assessment.
- FEMA later used these maps to survey/sample damage assessment properties.
  - Software: ArcGIS for Desktop 10.3.1

Preliminary Damage Assessment

I.A. Individual Assistance

P.A. Public Assistance



What is FEMA looking for?

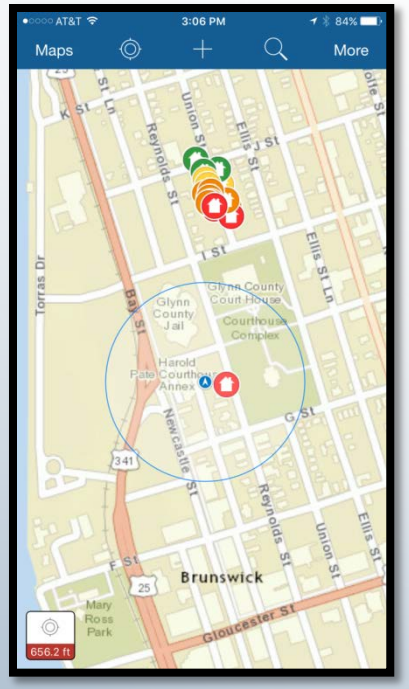
Extent of Damage

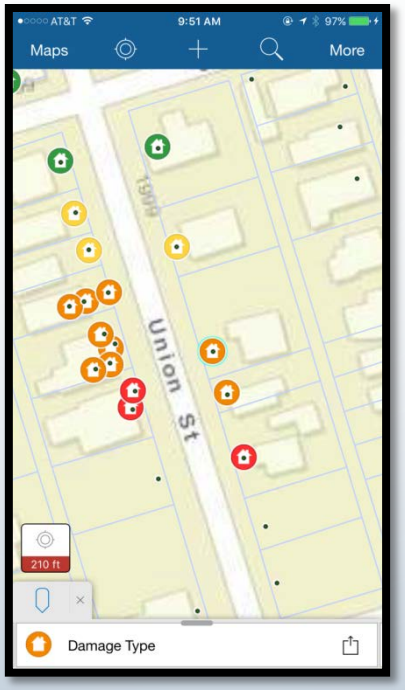
- Minor, Major, Destroyed
- Dwelling Type
- Low income
- Insured
- Primary Residence

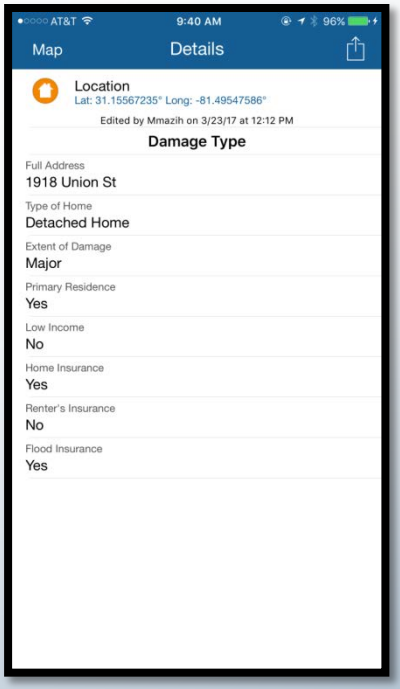

Know your
Assessment Areas
Identify areas prone
to flooding
Identify areas with
vulnerable
populations

After the Storm

ESRI's (ArcMap) Collector Application on I-Phone 7 Plus
Under Development

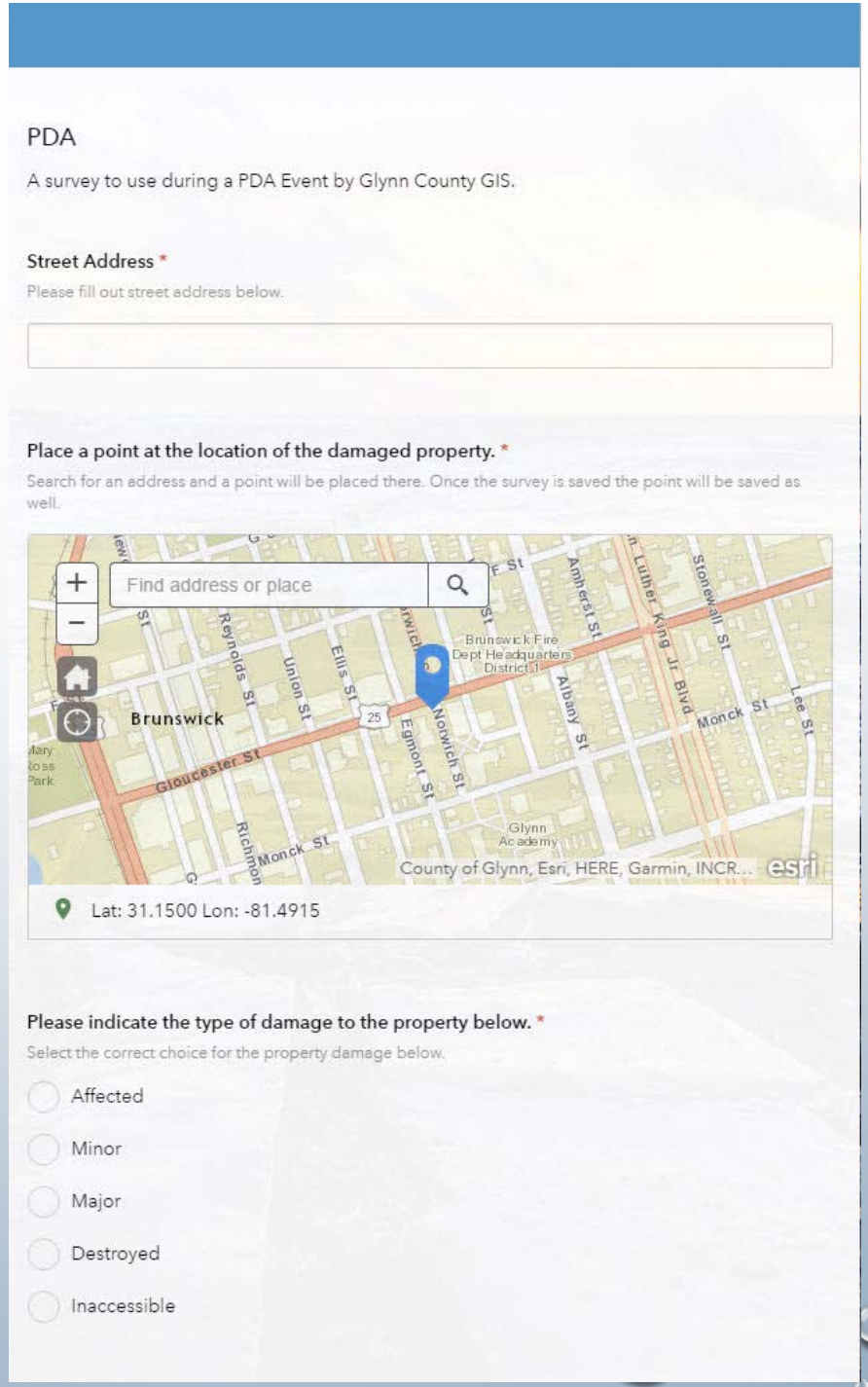






- SURVEY 123

NEW FROM ESRI



Lessons learned

Brunswick-Glynn Joint Water and Sewer Commission

It would have been beneficial for JWSC GIS personnel to be present at the EOC or a Water and Sewer Utilities Map Viewer would have been an asset during the event.

Storm Damage Viewer

The major problem that Glynn County GIS encountered was removing features from the map once the hazard had been addressed by an agency. It was difficult for Public Works and the 911 Center to determine which hazards had been mitigated in real time.

Preliminary Damage Assessment

It would have been helpful for Customer Service and 911 to have provided a list of addresses with damage not necessarily concerning the roadways. GCGIS may have used these addresses as a starting point for the PDA.

Lessons learned

Wireless Internet and Portable Database

Jetpack (Mobile Hotspot) and External Hard Drives with GIS Database included where extremely beneficial as our home office lost power.

Local Road Maps

GCGIS had difficulty providing road maps timely and efficiently to outside agencies.

(Our printer could only print up to 11” x 17” size)

Detailed road maps should have been created in advance or Chamber of Commerce brochure road maps stocked.

Lessons learned

Hurricane Damage Viewer:
http://glynn.maps.arcgis.com/apps/webappviewer/index.html?id=9abdff9ecb774c4f97515e08c871e212
Inundation Advisory/DEM Comparison Swipe Map:
http://glynn.maps.arcgis.com/apps/StorytellingSwipe/index.html?appid=5989132d74984970b0409f7d344f0b16
Debris Collection Viewer:
http://glynn.maps.arcgis.com/apps/webappviewer/index.html?id=56e09b3b059f4ecab9a31472aea54d98

Lessons learned

National Hurricane Center Potential Storm Surge Flooding:
http://www.nhc.noaa.gov/surge/inundation/interactive_example/
National Weather Service Probabilistic Hurricane Surge:
http://slosh.nws.noaa.gov/psurge2.0/index.php?S=Matthew2016&Adv=38&Ty=e10&Z=y23&D=agl&Ti=cum&Msg=13&Help=about

Contact Information

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