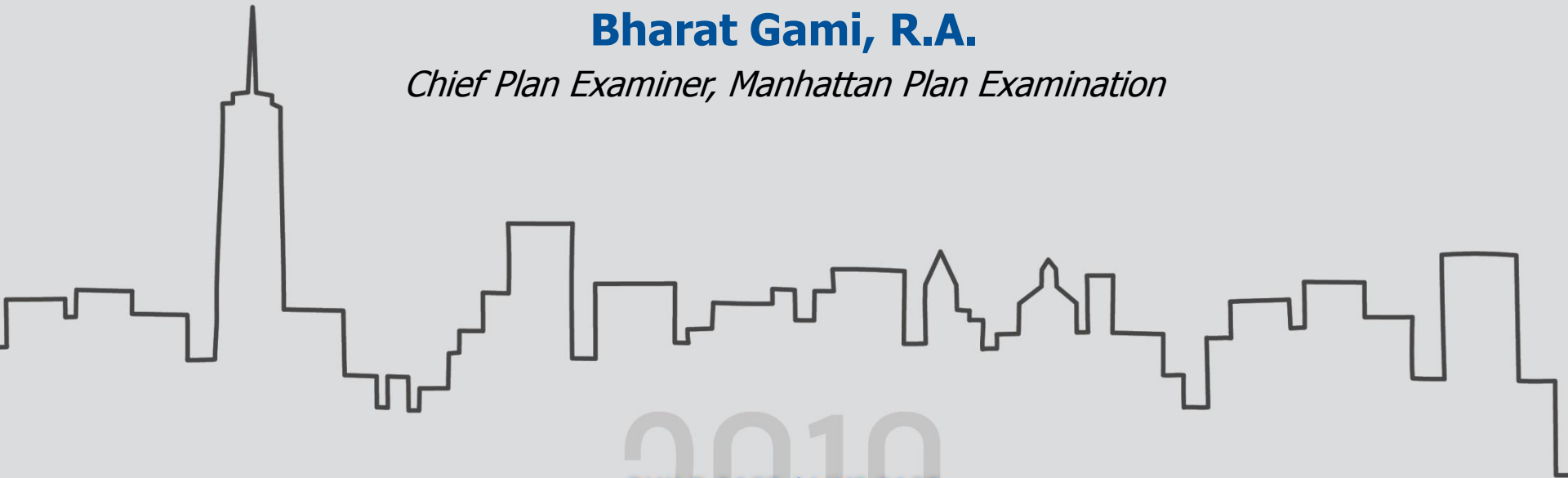


LEARNING FROM DAMAGE ASSESSMENT POST HURRICANE MARIA

presented by

Bharat Gami, R.A.

Chief Plan Examiner, Manhattan Plan Examination



2010
BUILD SAFE / LIVE SAFE
CONFERENCE

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COURSE DESCRIPTION

- This course will discuss **lessons learned** from the **post disaster damage assessment of essential facilities as well as residential structures** in Hurricane ravaged areas of Puerto Rico.
- It will consist of **four interrelated themes**: disaster preparedness, damage assessment, data analytics and lessons learned.
- The course will highlight the **role of regulatory agencies** such as NYC DOB in conducting damage assessment, application of **ATC-45 protocol using mobile apps**, real time data sharing and analytics as well as **effective use of GIS mapping**.

LEARNING OBJECTIVES

At the end of the this course, participants will be able to:

1. Participants will discuss what is involved in **disaster preparedness** by exploring ATC-45 protocol for damage assessment, baseline data collection in digital format, team dynamics and situational awareness of the disaster zone.
2. Participants will review important considerations during **damage assessment** such as needs assessment using aerial/wind shield surveys, logistics, data collection/verification, communications and personal safety.
3. Participants will examine important elements of the **data analytics** phase by exploring reporting requirements, briefings, data sharing with the Office of Emergency Management and other stakeholders.
4. Participants will study **lessons learned** in order to prepare for and better manage disasters of similar magnitude by identifying what worked and what did not go according to plan.

AGENDA

- Background Information – San Juan, Puerto Rico
- Impact of Hurricanes on Puerto Rico
- Role of Regulatory Agencies
 - Disaster Preparedness
 - Damage Assessment
 - Data Analytics
 - Lessons Learned
- Q & A

BACKGROUND INFORMATION

SAN JUAN, PUERTO RICO

San Juan, the capital of Puerto Rico has approximately 395,000 people.

Total population of Puerto Rico is approximately 3.7 Million people.



BACKGROUND INFORMATION

SAN JUAN, PUERTO RICO

- Founded in 1519 by Ponce de Leon
- Oldest continuously inhabited city in USA
- Listed on the *National Register of Historic Places* since 1972
- *On UNESCO's World Heritage List* since 1983



BACKGROUND INFORMATION

VIEJO, SAN JUAN

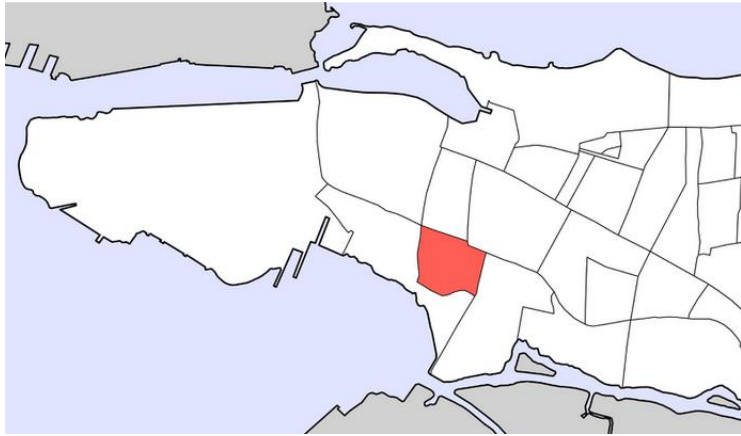


BACKGROUND INFORMATION

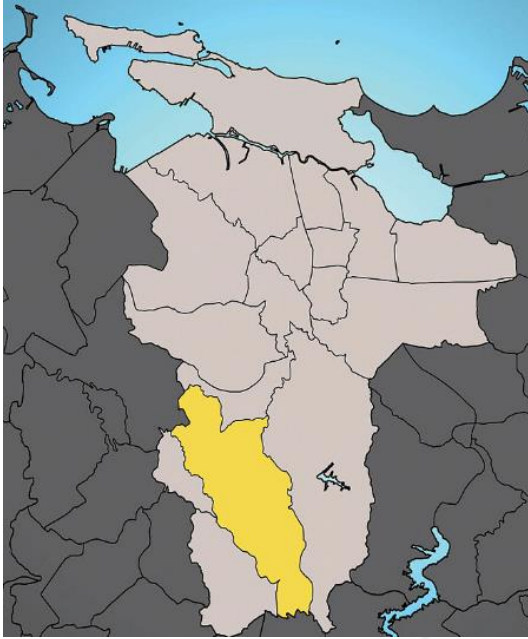
SANTURCE



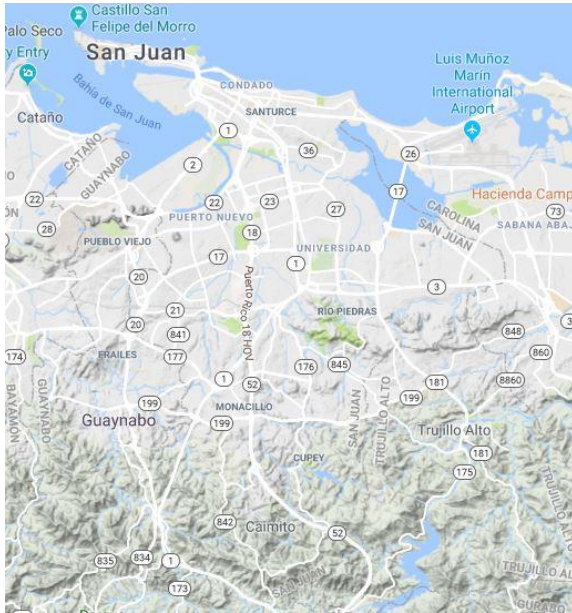
DAMAGE ASSESSMENT IN PR BARRIOS – TRAS TALLERES



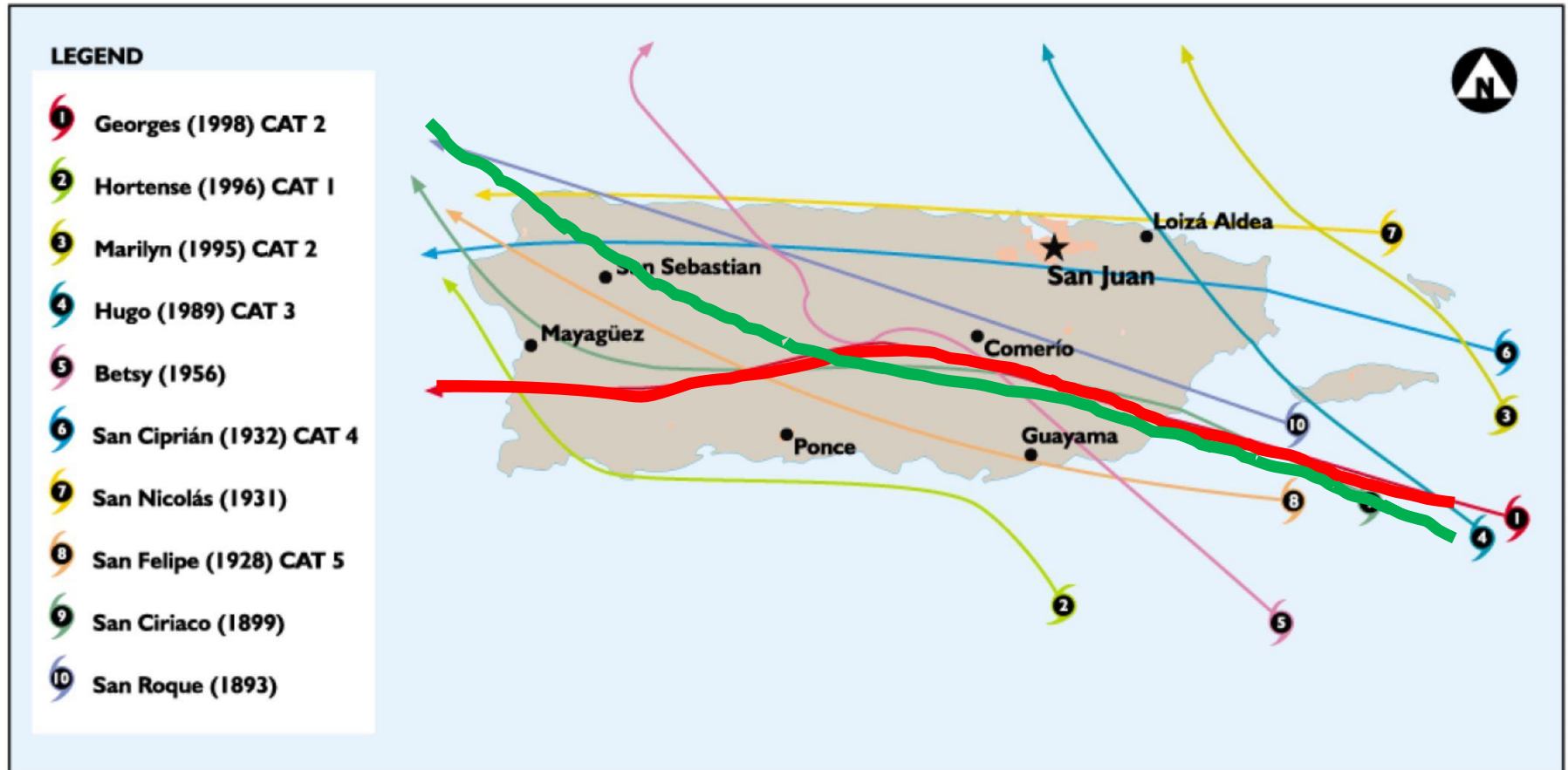
DAMAGE ASSESSMENT IN PR BARRIOS – CAIMITO BAJO



DAMAGE ASSESSMENT IN PR EL MINAO



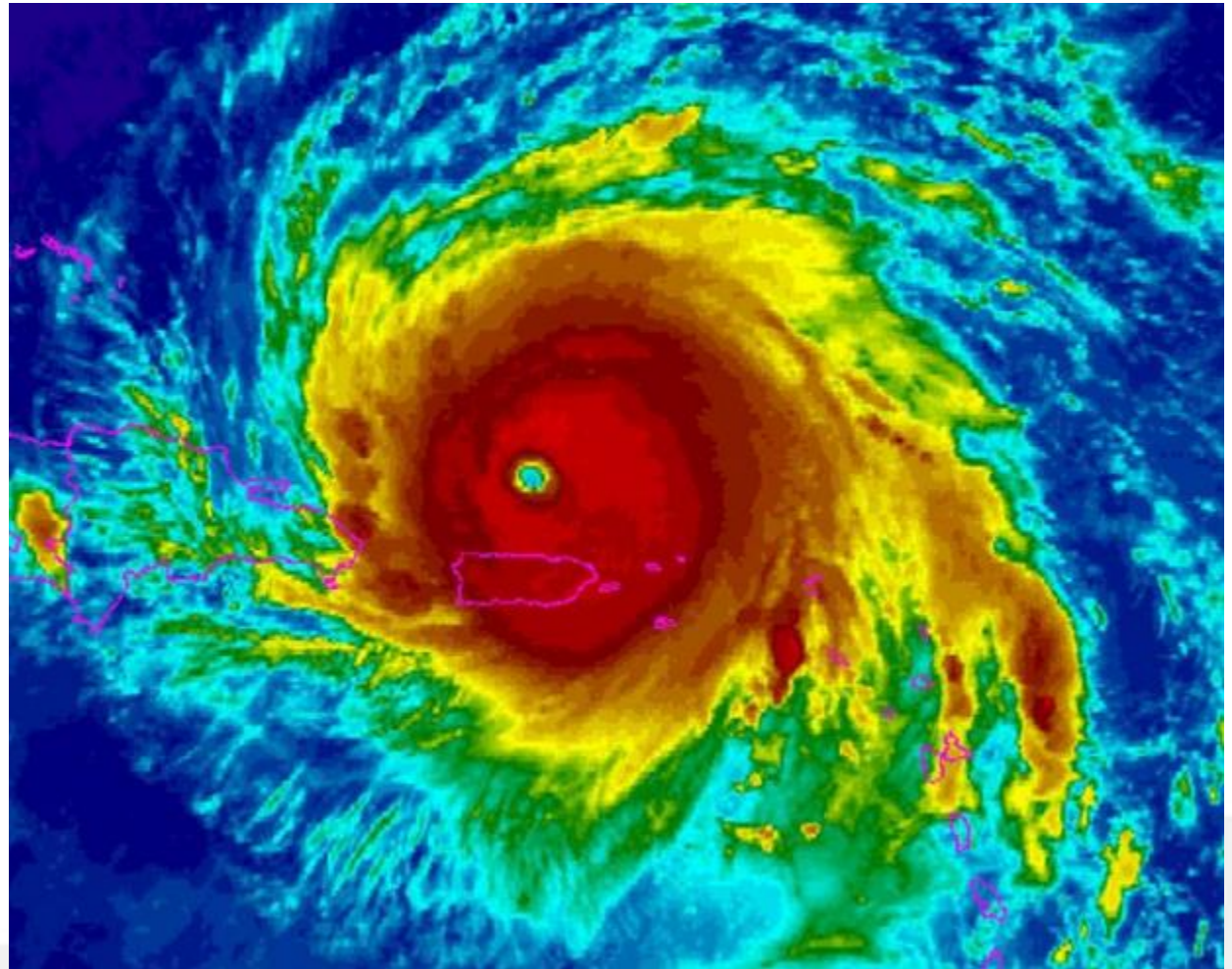
HURRICANE IMPACT



HURRICANE IMPACT

IRMA

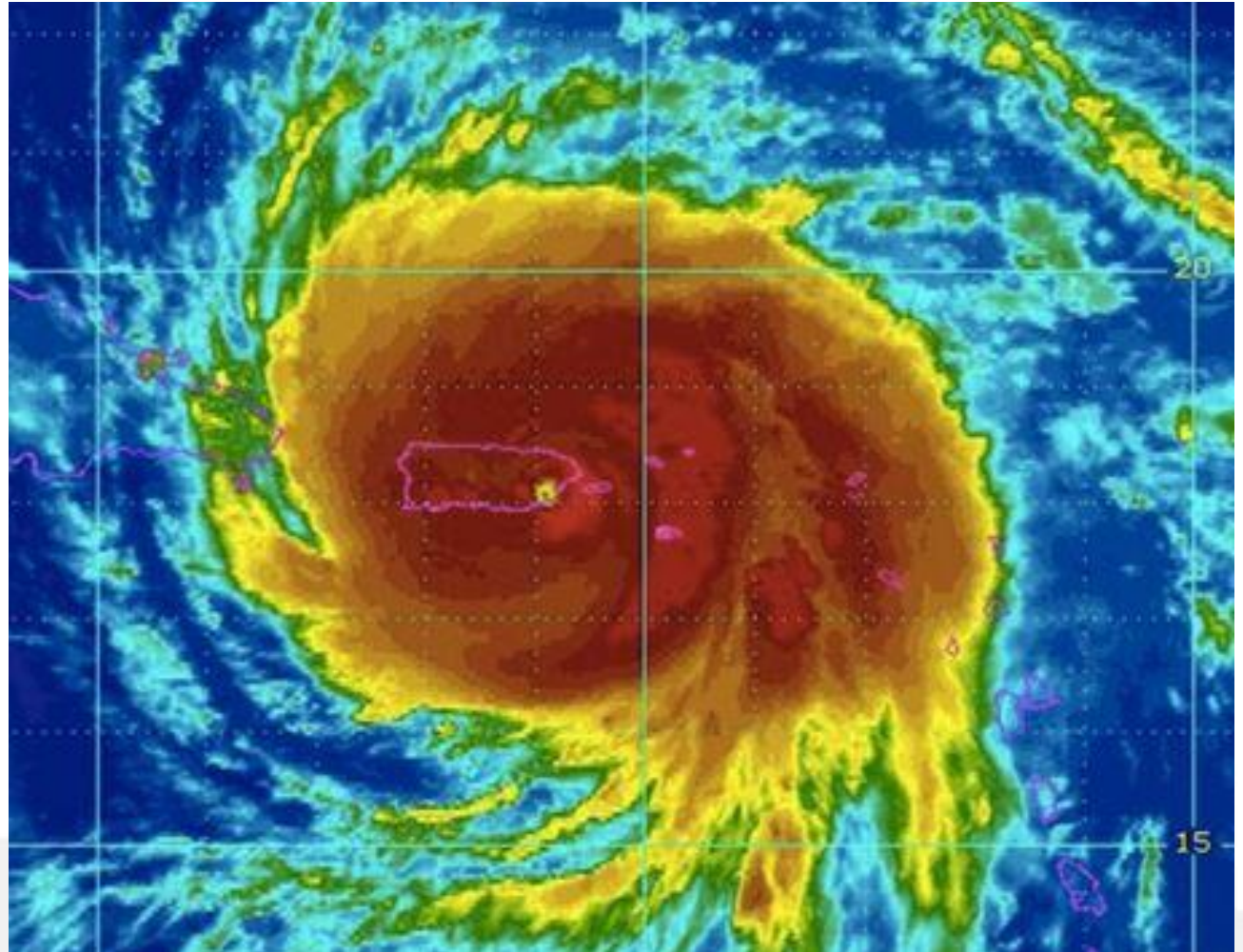
- Category 5 Hurricane
- 50 miles north of San Juan
 - September 07, 2017
- 66% of the territory lost power



HURRICANE IMPACT

MARIA

- Category 4 Hurricane
- Pummeled the Island on September 20, 2017
 - With 155-mph winds, making it the third-strongest storm to make landfall in the U.S.
- 95% of the territory lost power



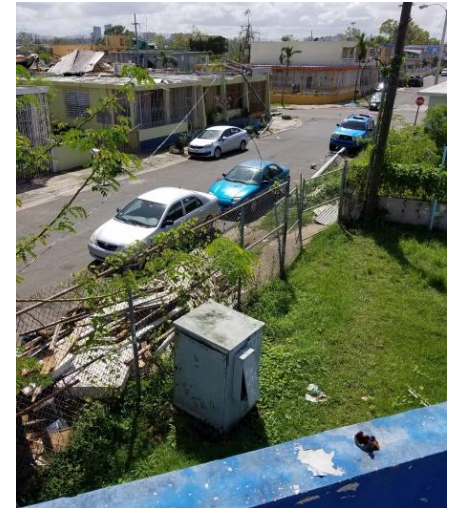
HURRICANE IMPACT

WIND-BORNE DEBRIS



HURRICANE IMPACT

WIND-BORNE DEBRIS



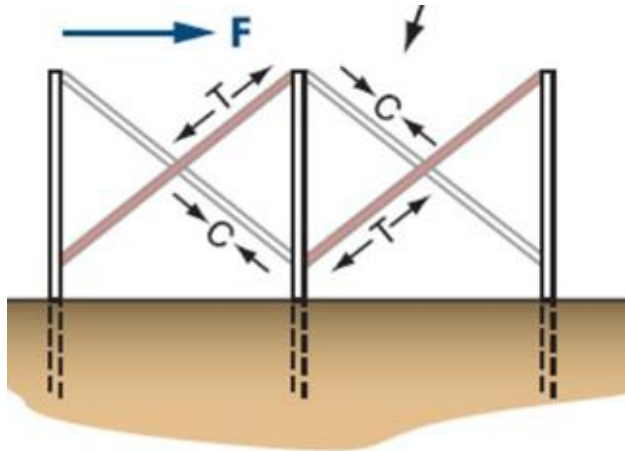
HURRICANE IMPACT

DOWNED TREES & UTILITY POLES

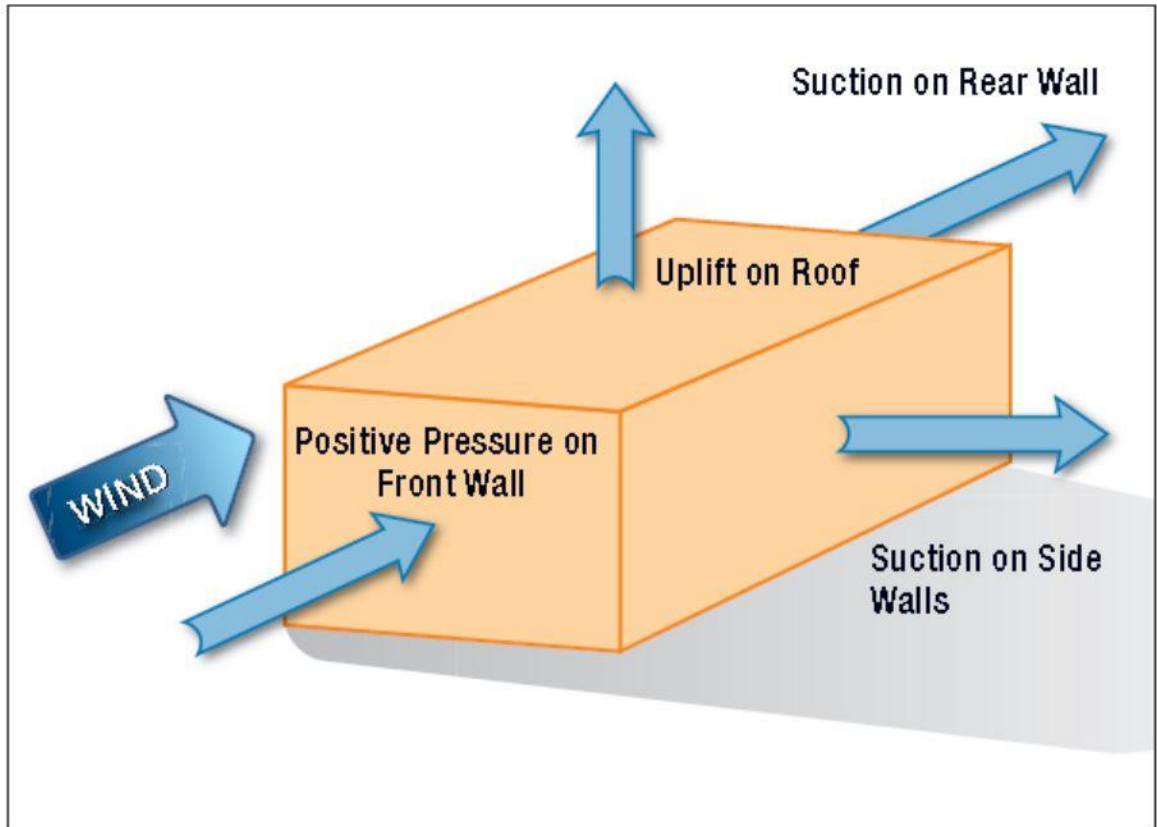


HURRICANE IMPACT

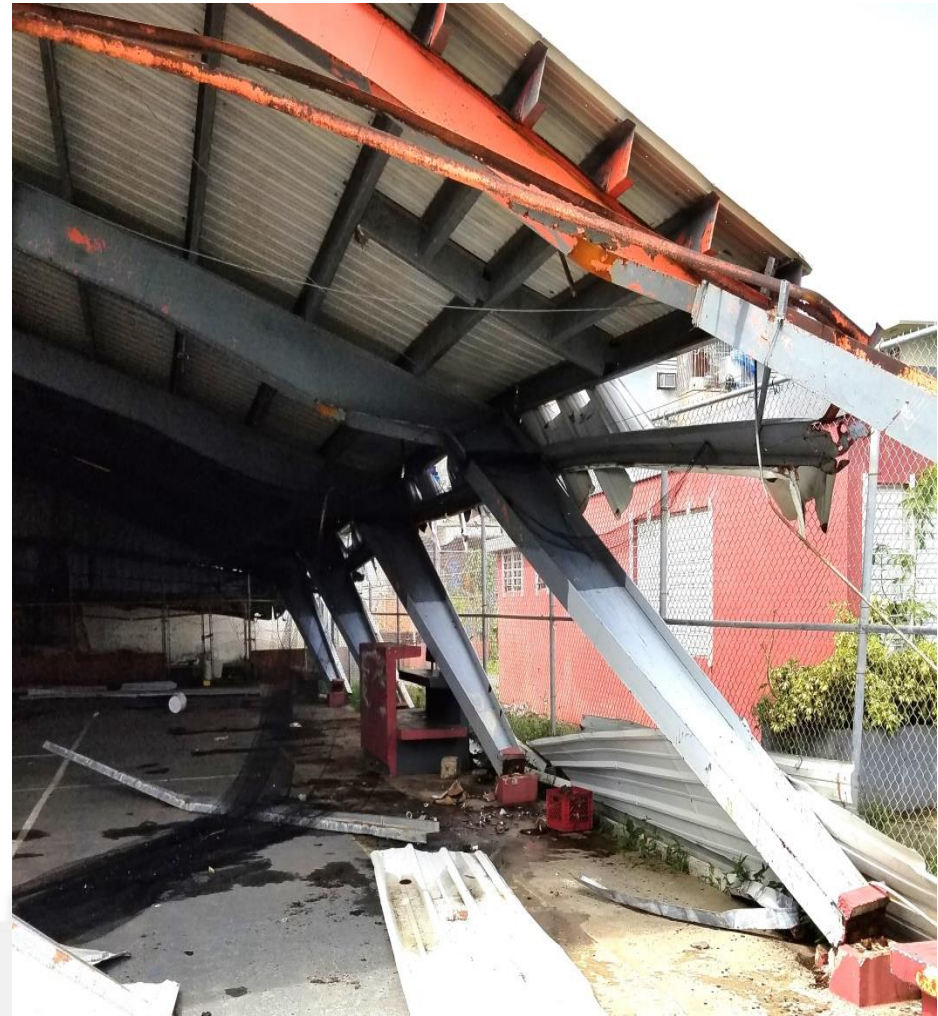
WIND ON STRUCTURES



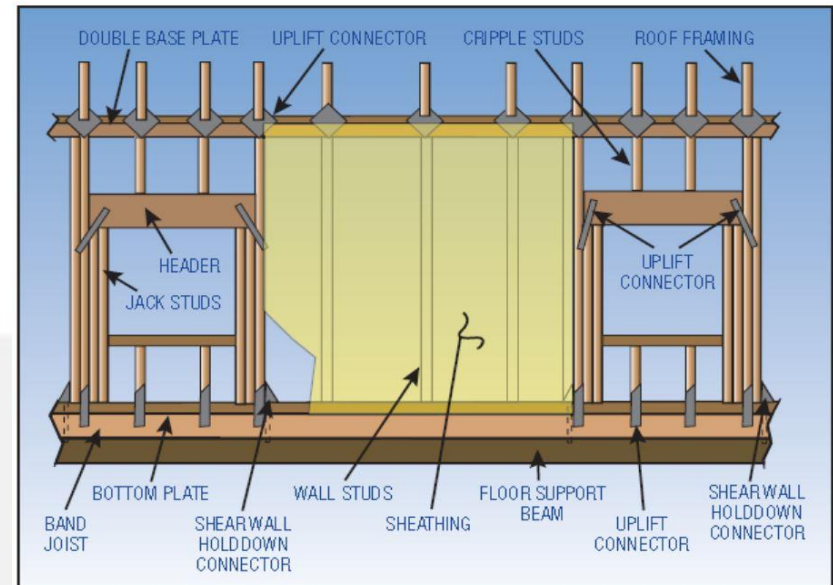
Braces loaded in tension (T) resist lateral force (F). Braces loaded in compression (C) are not effective.



HURRICANE IMPACT BASKETBALL COURTS



HURRICANE IMPACT COMPOSITE STRUCTURES



ROLE OF REGULATORY AGENCIES

- Under Emergency Management Assistance Compact (EMAC) any state or union territory can request aid once a state of emergency has been declared.
- EMAC facilitates efficient and effective sharing of resources between member states during times of disaster or emergency.
- NYC DOB responded to two separate requests. The first request was to help the City of San Juan with assessment of damage to essential facilities. The second request was to help the State of Puerto Rico with damage assessment of facilities through out the State.

ROLE OF REGULATORY AGENCIES



NEW YORK CITY DEPARTMENT OF BUILDINGS POST DISASTER STRUCTURAL RAPID ASSESSMENT FORM



BIN: _____ BLOCK: _____ LOT: _____ # Bldg, Lot: _____		OVERALL RATING: (Check One: Green, Yellow or Red)	
Building Address: _____ A.K.A. _____		<input type="checkbox"/> INSPECTED (Green)	<input type="checkbox"/> Exterior only <input type="checkbox"/> Exterior and Interior
		<input type="checkbox"/> RESTRICTED USE (Yellow)	
Basement: <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown No. Stories: _____		<input type="checkbox"/> UNSAFE (Red)	<input type="checkbox"/> DESTROYED (Grey)
Structural System: (Check one) <input type="checkbox"/> Steel frame <input type="checkbox"/> Wood frame <input type="checkbox"/> Concrete <input type="checkbox"/> Bearing masonry <input type="checkbox"/> Attached <input type="checkbox"/> Other Describe: _____		Detailed Evaluation required (check one) <input type="checkbox"/> Structural <input type="checkbox"/> Geotechnical <input type="checkbox"/> Other: _____ Comment: _____	

Instructions: Review structure for the conditions listed below. A "yes" answer to 1, 2, 3, or 5 is grounds for posting entire structure UNSAFE. If more review is needed, post RESTRICTED USE. A "yes" answer to 4 requires posting AREA UNSAFE and/or barricading around the hazard. More review triggers detailed inspection. DESTROYED requires immediate communication to utilities for shut off.

- Primary goal is to assure that structures are safe for reentry after a disaster.
- Damage assessment begins once search and rescue is complete.

ROLE OF REGULATORY AGENCIES

NYC DEPARTMENT OF BUILDINGS



14 DOB employees were dispatched in early October 2017 to perform damage assessment of essential facilities such as government buildings, schools, police precincts and hospitals as well as residences.

- Team 1 was deployed from 9/24-10/6 and had 2 employees.
- Team 2 was deployed from 10/6-10/22 and had 12 employees

ROLE OF REGULATORY AGENCIES

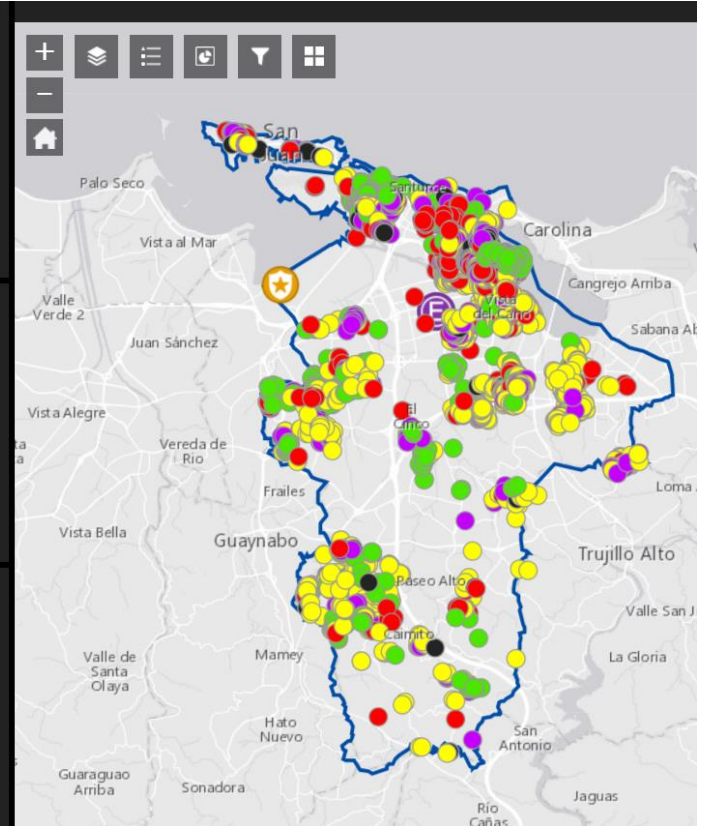
NYC DEPARTMENT OF BUILDINGS

The DOB team adapted to daily objectives/situation, players, new assignments, and multiple missions. They achieved a balance between practicality, risk, constraints, resiliency, effectiveness and efficiency.

Their core capabilities were a result of two DOB initiatives:

- Annual Post disaster emergency response training at Fort Totten, Queens
- Expertise in using mobile applications supported by GIS mapping



[illegible]

ROLE OF REGULATORY AGENCIES

MULTIPLE MISSION



- At the request of NYCEM, we worked on multiple missions
 - We traveled to Corozal to inspect damage due to wind and rain
 - We inspected San Juan barrios and sub-barrios.
 - We inspected damaged roofs – Blue tarp program
 - We located abandoned buildings
- At the request of US Army Corps of Engineers inspected 205 Police Precincts throughout Puerto Rico.
- At the request of Federal Emergency Management Agency-FEMA- We inspected 1876 structures in San Juan. These structures were identified by FEMA based on aerial imagery captured on 9/24/2017.

ROLE OF REGULATORY AGENCIES IN THE EYE OF THE HURRICANE - COROZAL



HURRICANE IMPACT

LAND SLIDES NEAR COROZAL



DISASTER PREPAREDNESS TRAINING AND READINESS



- Best practices for responding to large scale disasters
 - Delegation of resources, mustering staff, identifying and triaging affected structures and coordinating inter-agency efforts.
- Best in class example of urban disaster response.
- Each year, 500 city and outside responders attend damage assessment training at Fire department Training Center at Fort Totten, Queens.

DISASTER PREPAREDNESS BASELINE DATA COLLECTION



- Initially DOB team did not have building foot prints. DOB's GIS team in NYC was able to generate base maps using all available data.
- They developed GIS layers for aerial Imagery captured by NOAA on 9/24, San Juan Police Stations base map, and building foot prints.
 - DOB GIS connected with 11 separate agencies in NY, DC, PR through secure GIS portal structured around NIMS protocols.

DISASTER PREPAREDNESS

TEAM COMPOSITION



Large vs. Small

- Geographical familiarity
- Language proficiency
- Team spirit

Logistics

- Go Bag
- Emergency supplies
- Communications
- Medical needs
- Personal safety

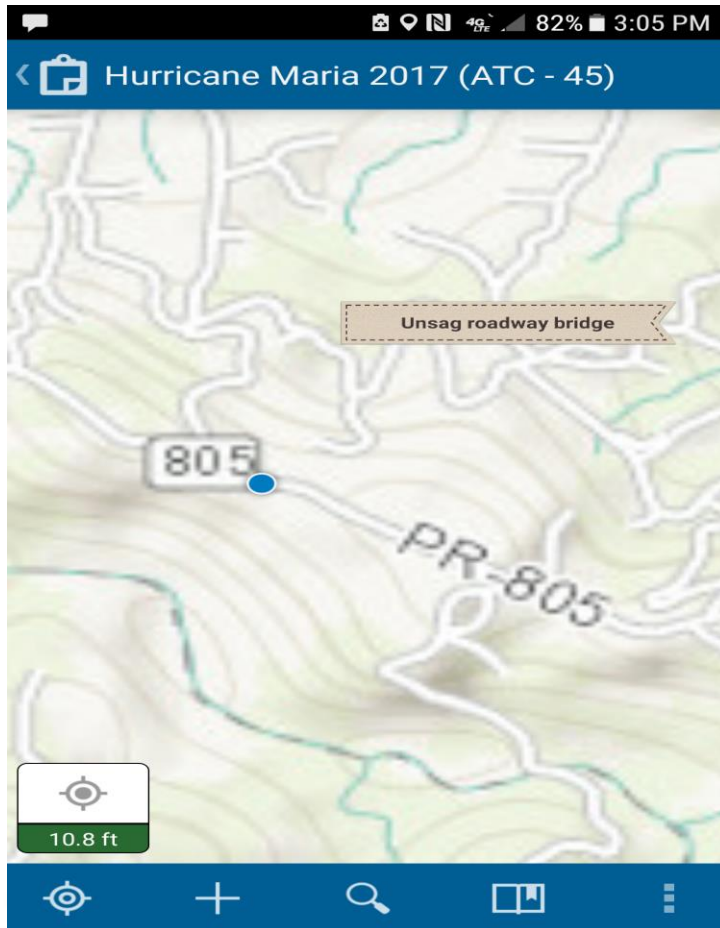
DAMAGE ASSESSMENT

NEEDS ASSESSMENT



- Aerial surveys: Analysis of aerial images to assess damage.
- Windshield surveys: General assessment from a vehicle to identify geographical areas that need rapid damage assessment.
- Rapid damage assessment: Using ATC-45 protocol
- Detailed damage assessment: using ATC-45 protocol for closer assessment of difficult and essential facilities

DAMAGE ASSESSMENT ROUTES AND MAPS



- Initially DOB inspectors received routes as general locations called **sub-barrios**. DOB GIS team working with other GIS teams nationwide was able to generate more accurate location maps and building foot prints to assist the inspectors.
- Wireless communications was a challenge but DOB team was able to use a feature in Collector for ArcGIS that allowed downloading of maps for **off-line** use.

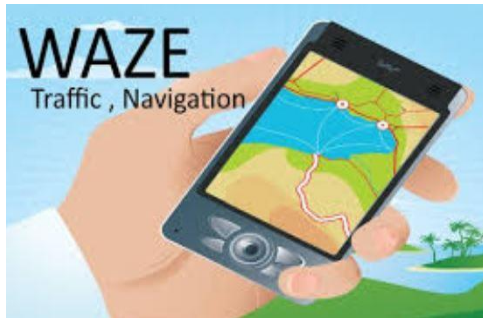
DAMAGE ASSESSMENT

DATA COLLECTION VS. VERIFICATION

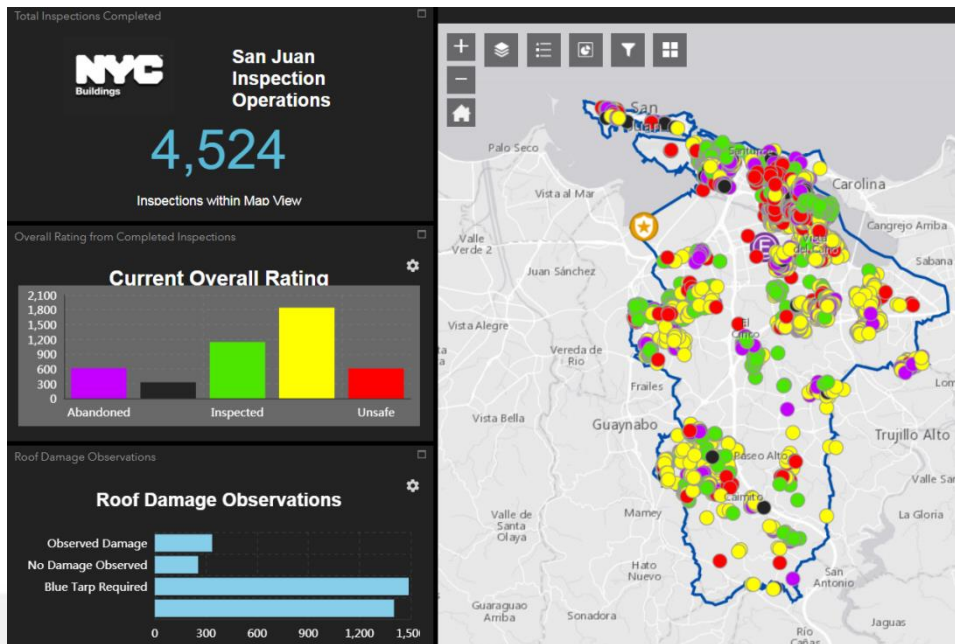


- Information was captured with a GPS enabled smartphone and uploaded to a web-based map and information dashboard for sharing with local officials.
- The Collector App available on smart phone was updated as needed to allow the team to locate buildings/structures, use checklists for damage assessment, and to connect their location in field to previously assembled data.

DAMAGE ASSESSMENT UPDATES AND COMMUNICATIONS



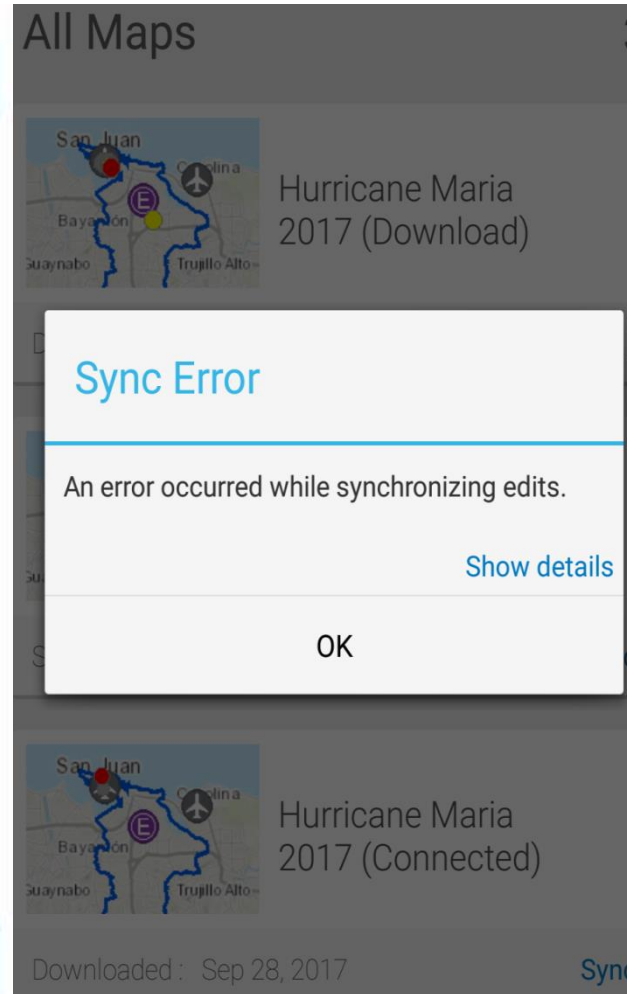
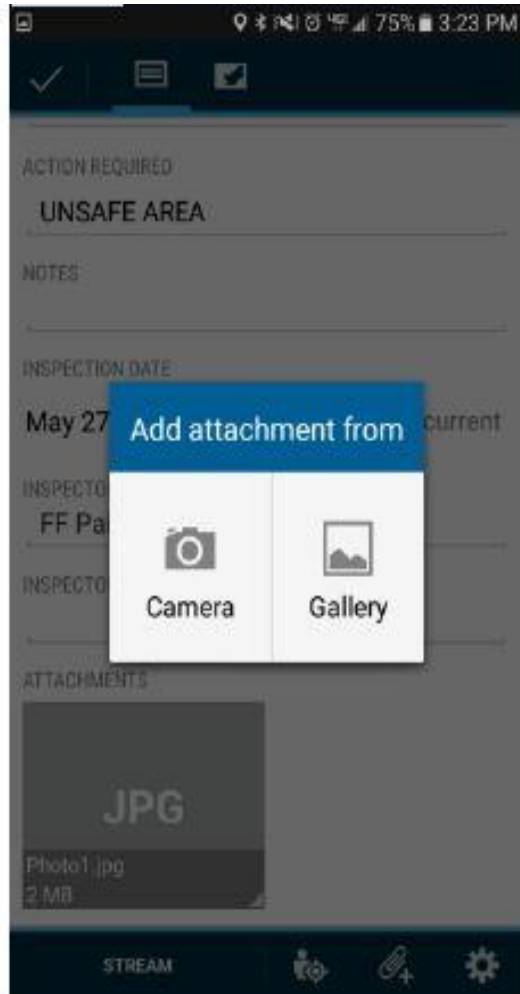
- Updates and communications



- Live feeds, traffic and incident information

DATA ANALYTICS

DATA MANAGEMENT



- Data uploads, organization and clean-up

DATA ANALYTICS

REPORTING REQUIREMENTS

	<u>4336</u>	<u>4339</u>	<u>Total</u>
REGISTRATIONS	8,188	391,562	399,750
AWARDS			
HA \$	\$534,738	\$55,513	\$590,251
ONA \$	\$495,105	\$14M	~14.6M
TOTAL			~15M
COUNT			
HA	2124	19,342	21,466
ONA	29	54,174	54,203
Total			75,669
INSPECTIONS			
Issued	1,720	155,216	156,936
Returned	948	86	1,034
SHELTERS			
Open			112
Residents			6,067
Pets			85
BLUE ROOF			



Photo 1: Calle Yamilla : collapsed basketball shed San Juan

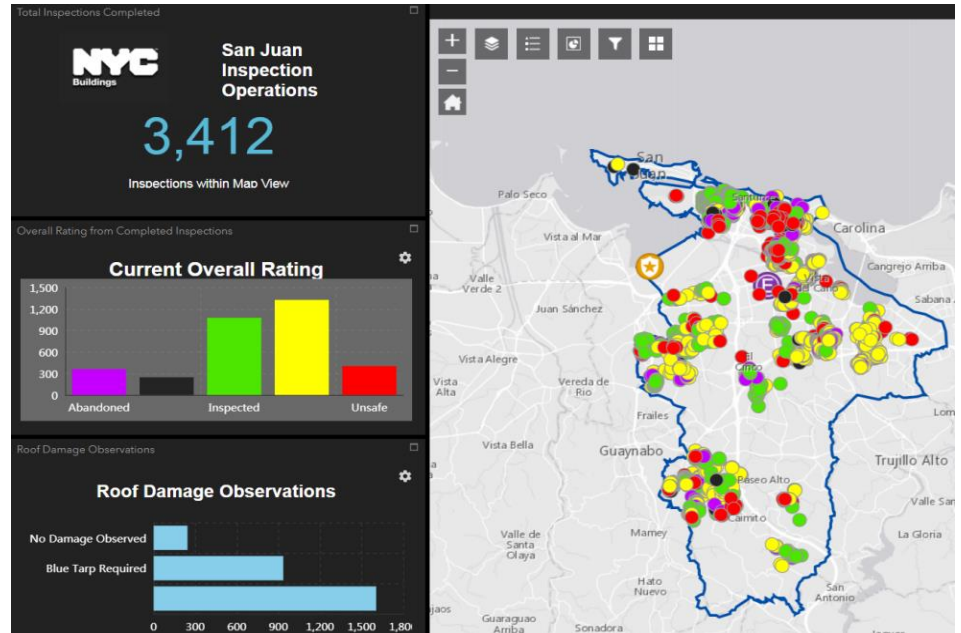
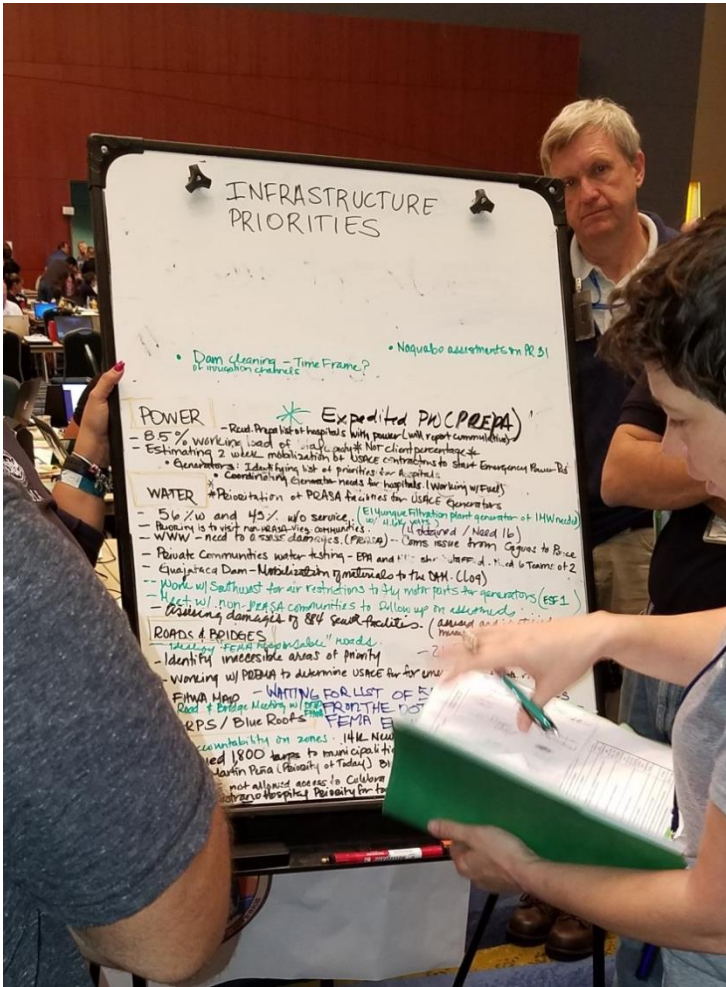
Date 10/01/17

PRELIMINARY STRUCTURAL STABILITY ADVISORY REPORT PREPARED FOR:

City of San Juan Building Department

Prepared by: Timothy D. Lynch PE. Chief Engineer Enforcement,

DATA ANALYTICS BRIEFINGS



- Briefings: receive and give, Dashboard with real time data
- Data sharing and GIS mapping

DATA ANALYTICS

IMAGES AND ANALYSIS



LESSONS LEARNED

BEST PRACTICES – WHAT **DID** WORK WELL


- Strategic investment in training and technology is paying huge dividends.
- Annual training at Fort Totten
- Proficiency in conducting emergency operations
- Experience in performing structural damage assessment
- Familiarity with mobile applications using GIS
- DOB GIS team's effort in putting together base maps and GIS layers using all available resources and inter agency coordination
- DOB's GIS team was able to provide real time data to inspectors in the field as well as local agencies for immediate use
- Image analysis of aerial images along with images captured in the field by DOB inspectors provided unique and accurate understanding of structural conditions

LESSONS LEARNED

BEST PRACTICES – WHAT **DID NOT** WORK WELL

- Fragmented GIS resources across a variety of government web sites.
- Lack of centralized notification regarding available GIS resources, aerial missions, live data feeds and individual agency data
- Lack of clarity with respect to roles and responsibilities of various agencies and personnel on ground.
- Redundancy and duplication of effort
- Poor cellular and internet service
- Equipment logistics
- Risky driving conditions
- Lack of electricity
- Constraints related to food, water and lodging


POST HURRICANE MARIA AWARENESS



ESTADO LIBRE ASOCIADO DE
PUERTO RICO
Oficina de Gerencia de Permisos

2016

PUERTO RICO BUILDING CODE



AMENDMENTS TO:

- 2009 INTERNATIONAL BUILDING CODE
- 2009 INTERNATIONAL RESIDENTIAL CODE
- 2009 INTERNATIONAL MECHANICAL CODE
- 2009 INTERNATIONAL PLUMBING CODE
- 2009 INTERNATIONAL FIRE CODE
- 2009 INTERNATIONAL FUEL AND GAS CODE
- 2009 INTERNATIONAL ENERGY CONSERVATION CODE
- 2009 INTERNATIONAL EXISTING BUILDING CODE
- 2009 INTERNATIONAL PRIVATE SEWAGE DISPOSAL CODE



- Disasters are becoming more frequent.
- A disaster can impact any one of us at any time.
- Preparedness and mutual aid are essential.

**This concludes the
American Institute of Architects
Continuing Education Systems Course.**

NYC Department of Buildings Contact for AIA:

Melanie Guzman
Melaguzman@buildings.nyc.gov
(212) 393-2163

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