Evaluating your FPM building design and construction requirements in a post-disaster environment

Cleveland, Ohio

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May 22, 2019

CDM Smith

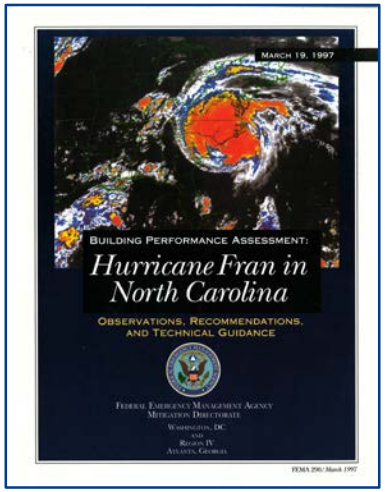
WATER + ENVIRONMENT + TRANSPORTATION + ENERGY + FACILITIES

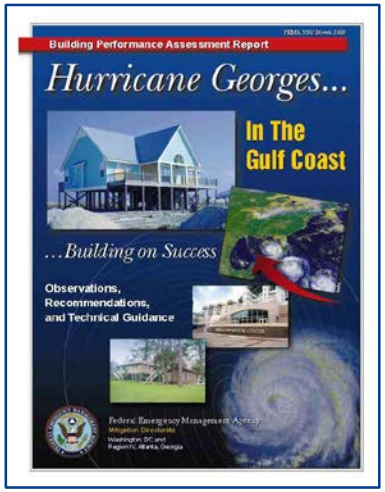
FLOOD FEST 2019: The Mitigation & Resilience Tour

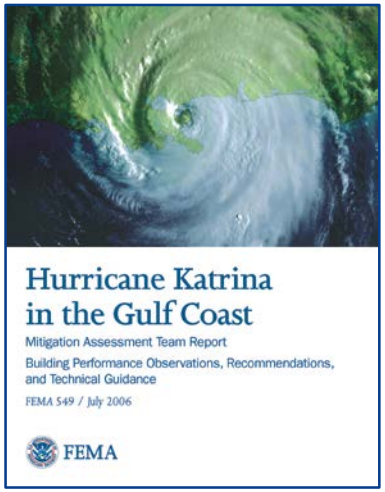
Concurrent Session Abstract

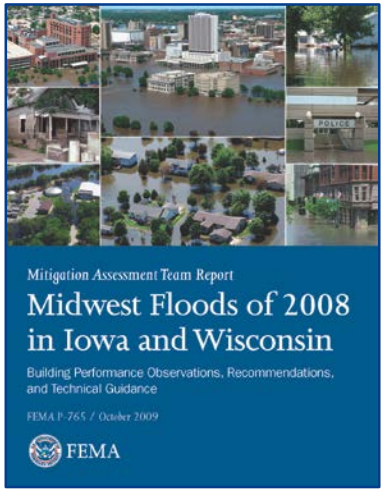
- Our goal is to share lesson learned that can **help communities leverage resources and data** for a variety of purposes (FEMA preliminary damage assessment, building safety evaluation, substantial damage, building performance assessment, etc.) especially **evaluating floodplain management building design and construction requirements**.
- This presentation will
  - focus on **experience and lessons** learned from past FEMA MAT deployments (emphasis on 2017 and 2018)
  - Identify **actions** communities can take in a pre and post disaster environment to effectively evaluate their floodplain management building design and construction requirements
  - share a variety of **flood damage observations** from recent hurricanes, as well as data the teams leveraged throughout the process to facilitate their building assessments
  - **highlight mobile GIS applications and other technology** used to help collaborate and coordinate

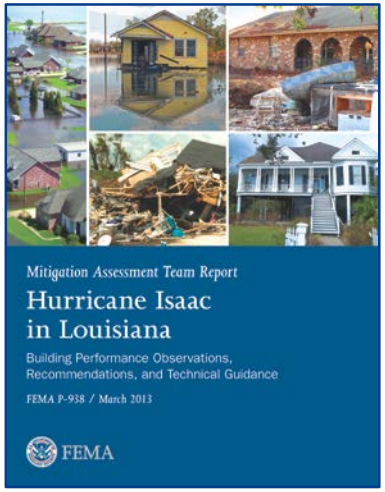
FEMA Mitigation Assessment Team Reports

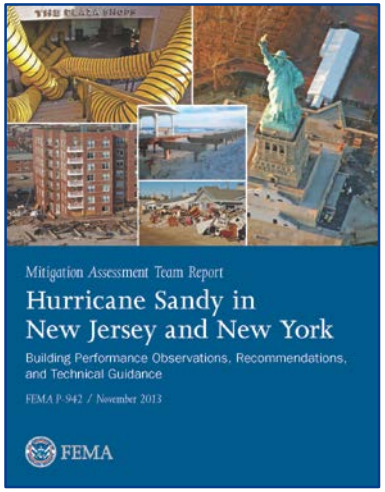


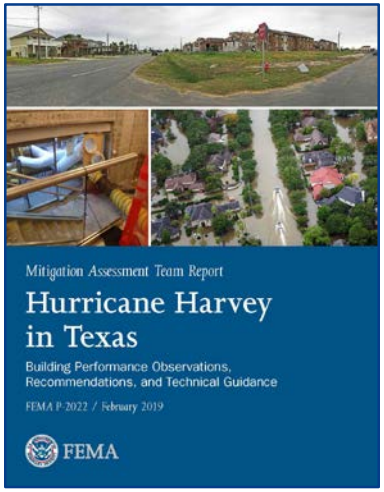












Guess the event/location?

FEMA P-757 Hurricane Ike MAT Report
Figure 3-22. Linear scour features tend to align with canals and roads as storm surge returns to the Gulf. Houses such as this one were fortunate not to be undermined and lost during Ike, as many homes undoubtedly were (Bolivar Peninsula, TX).

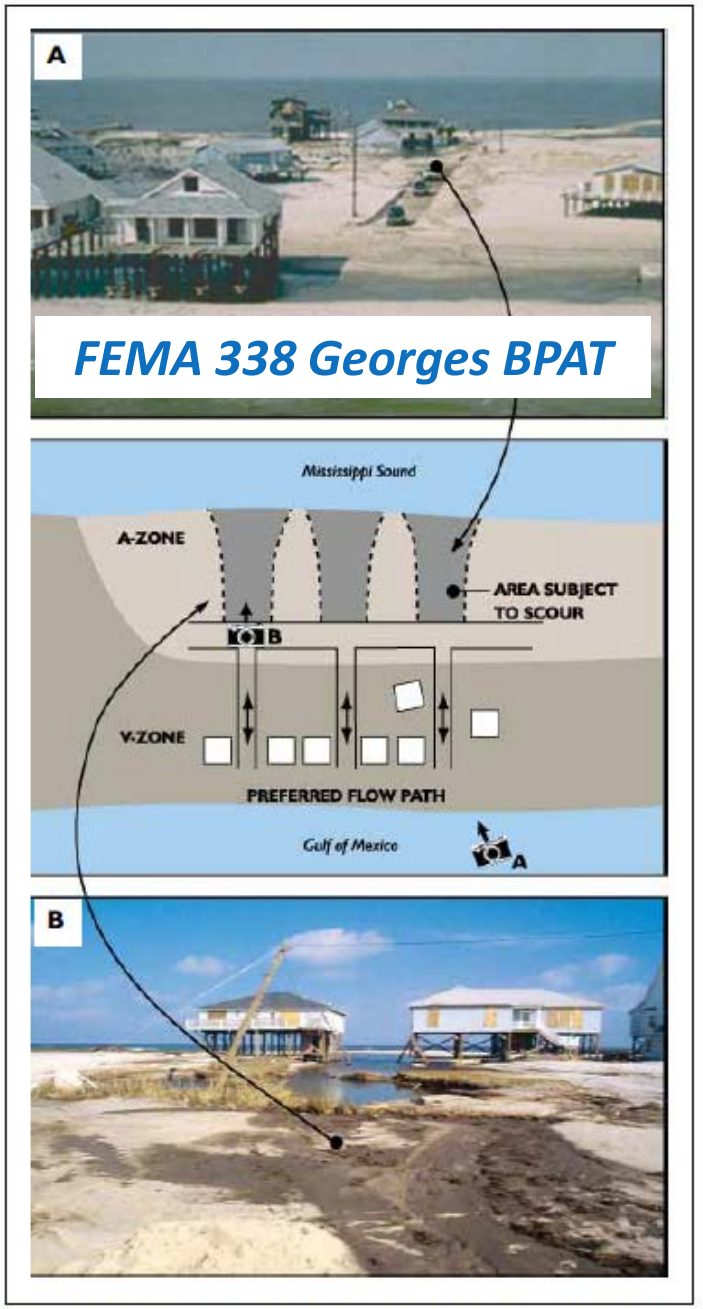
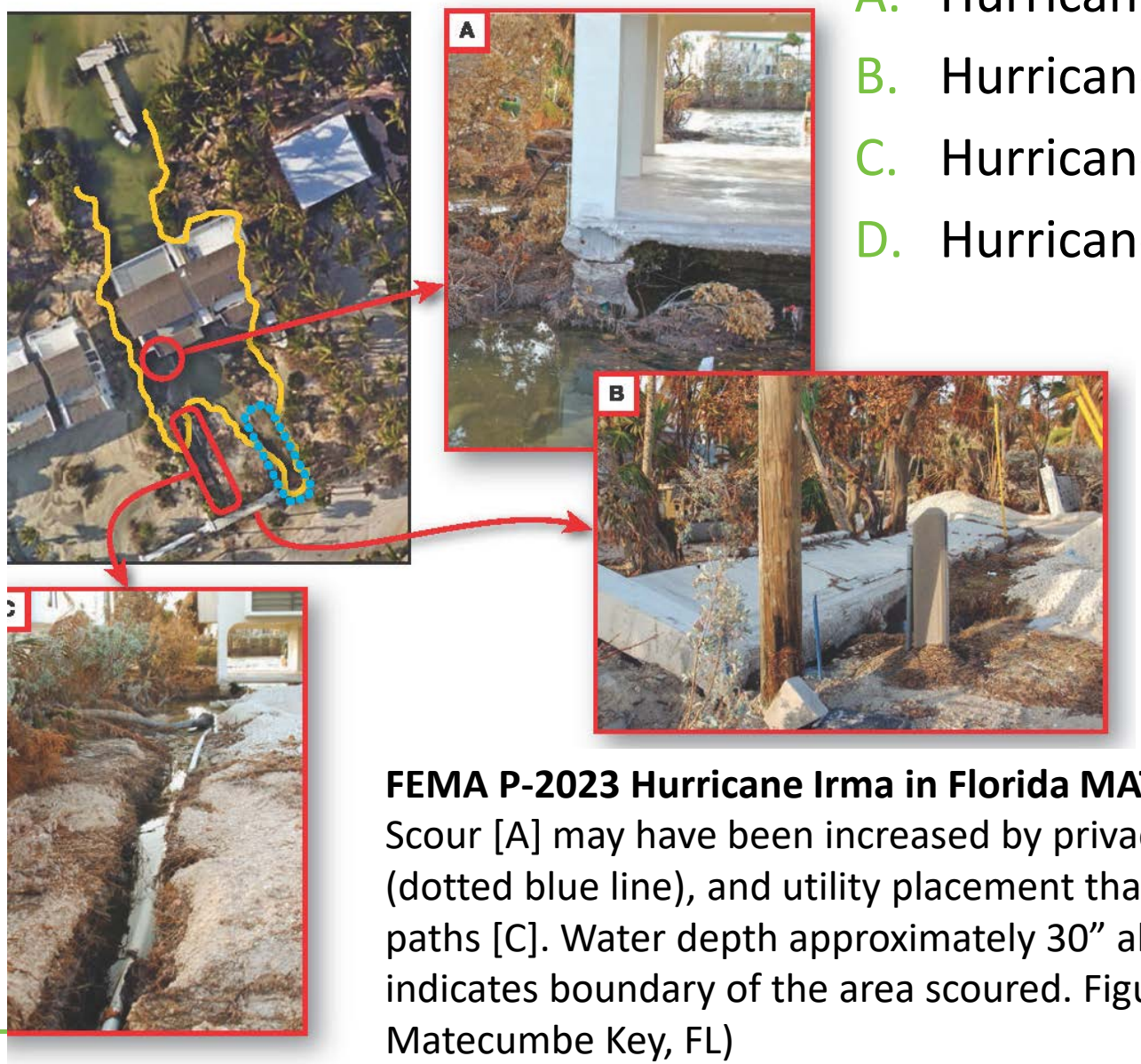


FIGURE 4-9 Side streets perpendicular to the shoreline, combined with a break in the existing scattered dunes and vegetation where the side streets meet the main east-west road, provided a preferred path for storm surge and retreat flow across the island.

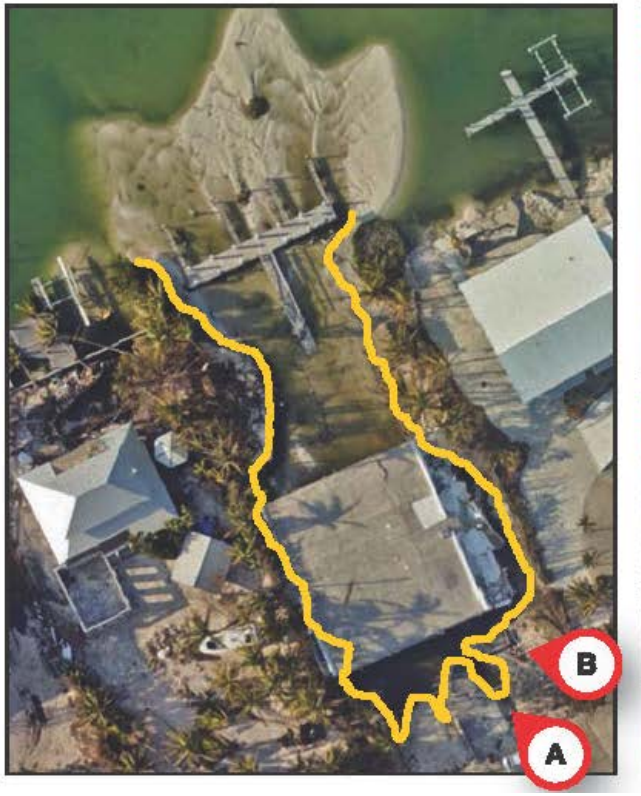
Guess the event/location?

A. Hurricane Irma, Florida
B. Hurricane Michael, Florida
C. Hurricane Ike, Texas
D. Hurricane Harvey, Texas



FEMA P-2023 Hurricane Irma in Florida MAT Report
Scour [A] may have been increased by privacy walls [B], driveways (dotted blue line), and utility placement that led to preferred flow paths [C]. Water depth approximately 30” above slab. Yellow line indicates boundary of the area scoured. Figure 3-14 (Lower Matecumbe Key, FL)

Guess the event/location?



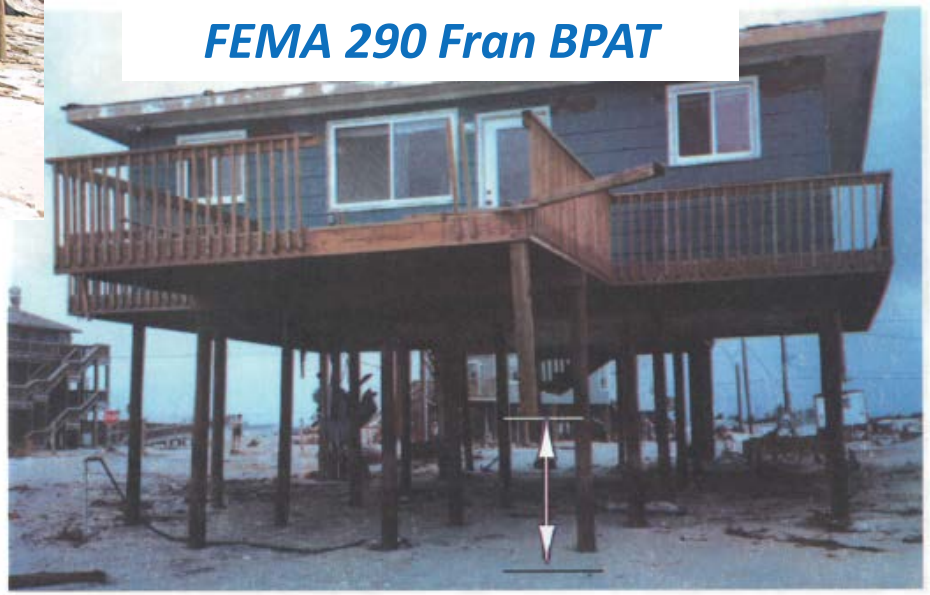
FEMA P-2023 Hurricane Irma in Florida MAT Report
Yellow line indicates boundary of the area scoured. The MAT did not determine whether scour contributed to the collapse. Figure 3-17 (Lower Matecumbe Key, FL)

Guess the event/location?

A. Hurricane Irma, Florida
B. Hurricane Matthew, Florida
C. Hurricane Sandy, New Jersey
D. Hurricane Florence, North Carolina

Hurricane Florence, North Carolina
Shallow deck supports into frontal dune.

FEMA 290 Fran BPAT



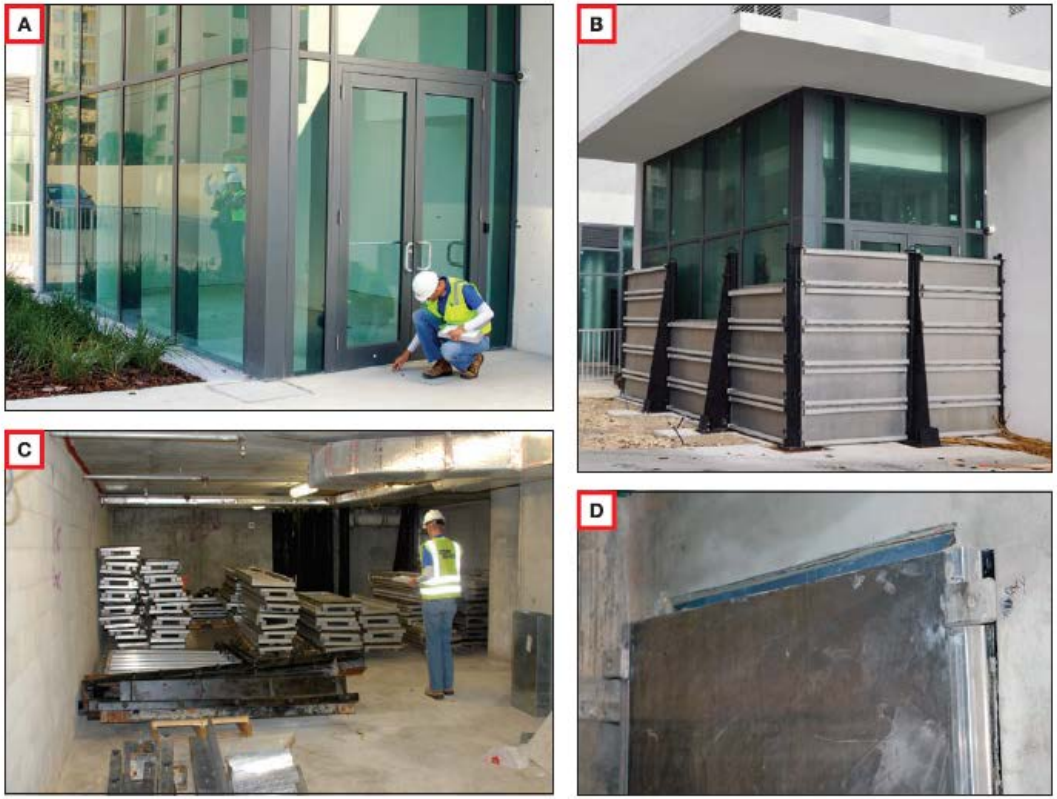
Embedment of deck supports into frontal dune was often shallow. After erosion of the dune, the bottom of the support for this deck was left several feet above grade.

Guess the event/location?

Figure 2-40 *Engineered flood shield installed over opening to large dry floodproofed commercial building.*

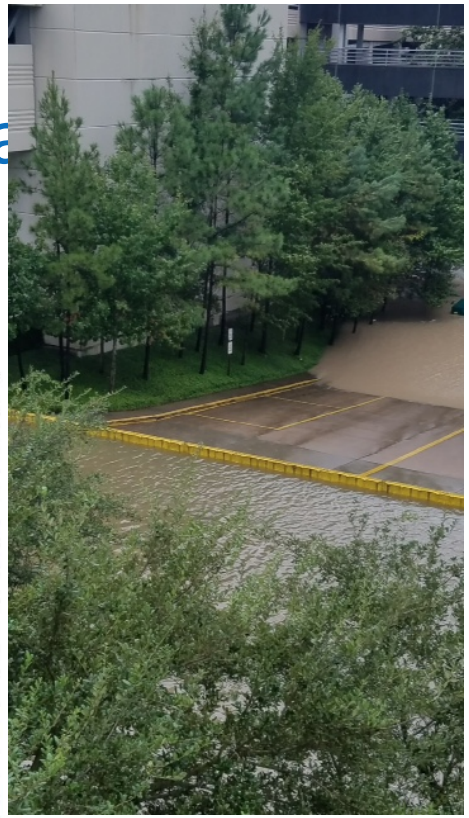
> *"Dry floodproofing often requires extensive human intervention."*

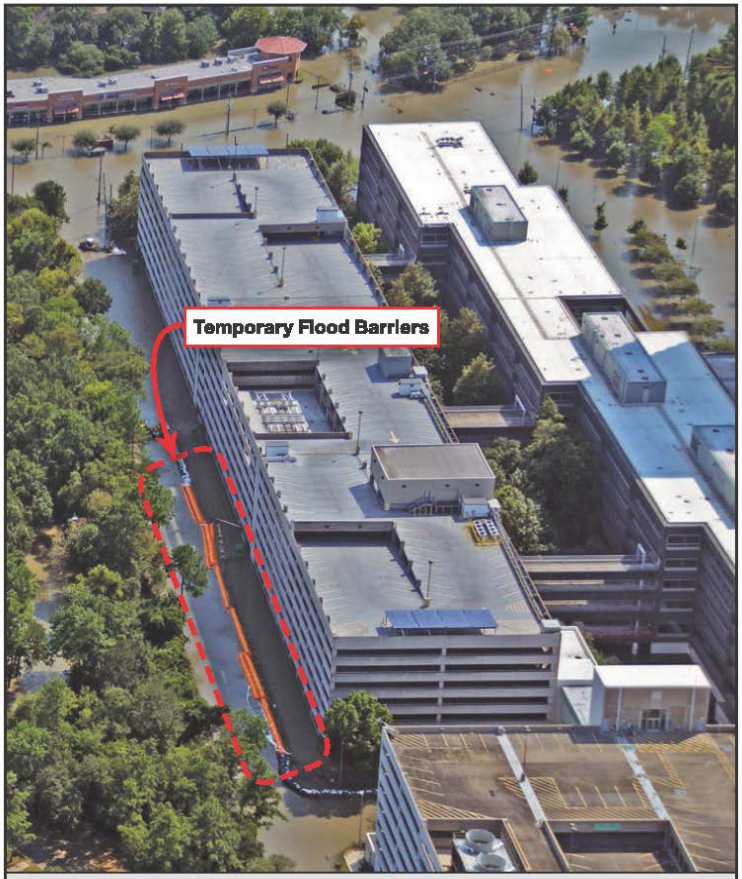
FEMA P-2023 Hurricane Irma in Florida MAT Report Figure 3-31: A high-rise residential building under construction was successfully protected by a dry floodproofing method that used flood panels and doors; the floodproofing was installed by the building contractor (Miami, FL)



The doors without [A] and with [B] the floodproofing system deployed. [C] shows the panel and post storage room. [D] shows a gap at the top of a doorway flood shield.
System took 10 workers 2 full days to install.

"In one case, a contractor failed to properly install the complete floodproofing system, allowing floodwater to enter the building through the unprotected area."





Orange temporary flood barriers are visible along the east side of the complex, but are submerged along the southeast corner of the parking garage where the grade elevation is lower.

Water from the parking garage filled the loading dock from the left; orange temporary flood barriers are shown floating in the floodwater at right.

FEMA P-2022 Hurricane Harvey in Texas MAT Report

Figure 3-68 through 3-71

The passive floodgate was not overtopped.

Floodwater entered via the parking garage and by overloading an

A. unreinforced masonry wall used to infill a below-grade
B. wall penetration to an unused utility vault.
C. Understanding the potential source of flooding
D. is critical.

Guess the event/location?

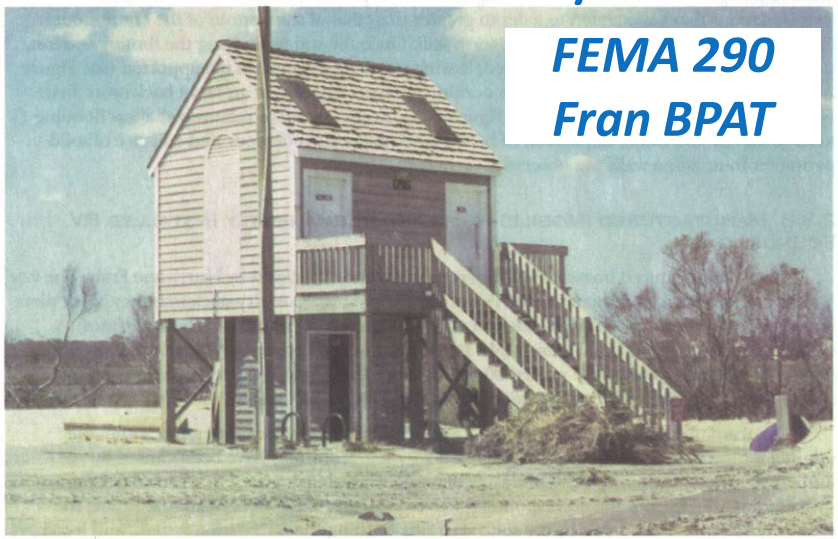


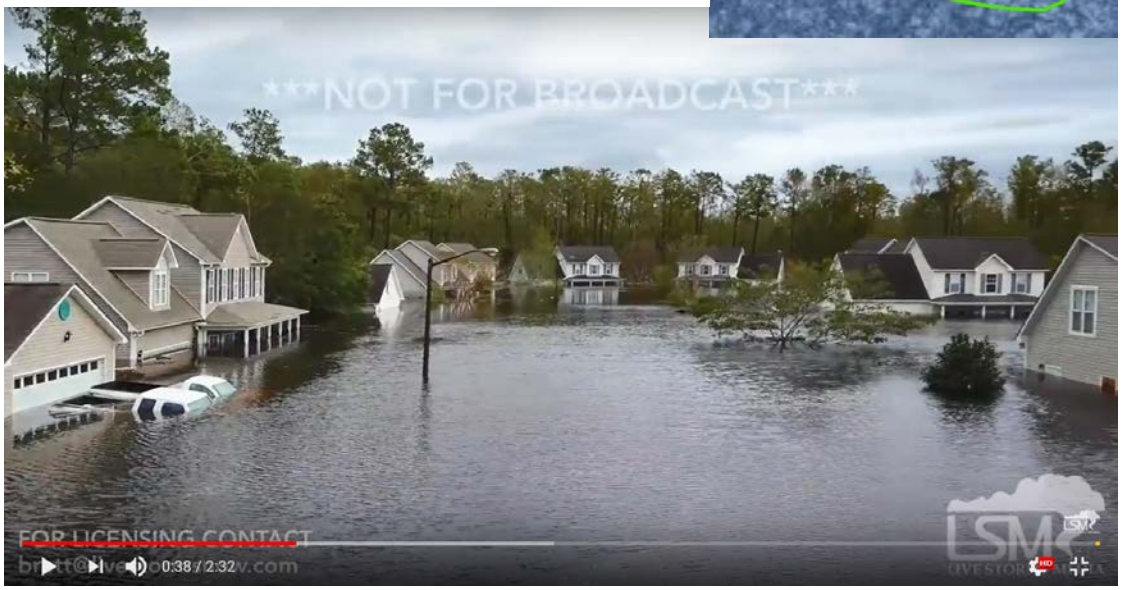
Figure 2-21 Survival of this properly elevated NC State Park public restroom demonstrates the State's commitment to proper construction in coastal areas.

FEMA P-2023 Hurricane Irma in Florida MAT Report

Figures 3-41 & 42: Restroom in Long Key State Park that sustained structural flood damage. Elevated restroom with ground-level enclosure at Bahia Honda State Park, flood depth in enclosure was 5 feet. (Monroe County)

Guess the event/location?

Hurricane Florence, North Carolina
Town Creek, NC houses in and out of SFHA flooded



Source: https://youtu.be/lVWHtR8OnSw

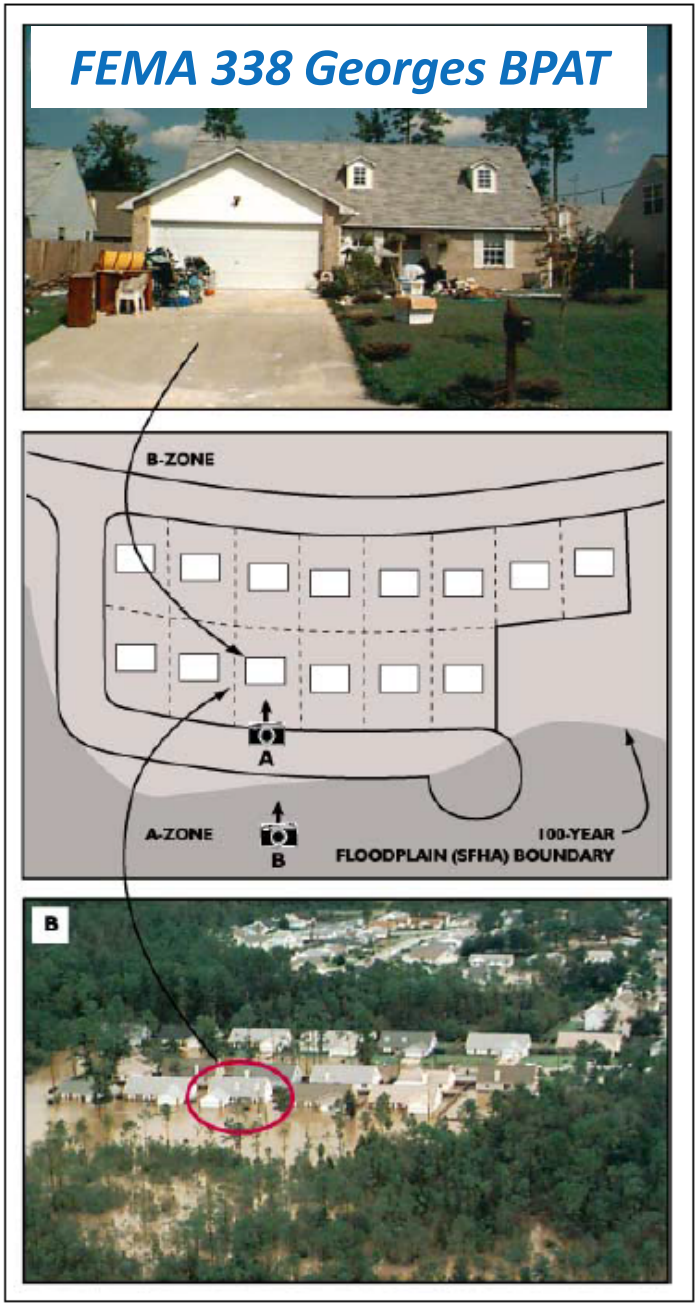


FIGURE 5-3 The home pictured above is one of approximately 10 homes in this subdivision which experienced flood depths of 2 to 3 feet when the water levels exceeded the BFE and extended beyond the limits of the SFHA.

Guess the event/location?

FIGURE 4-5 House along the Fish River, elevated through FEMA's HMGP that suffered minimal flood damage.

FEMA P-2023 Hurricane Irma in Florida MAT Report

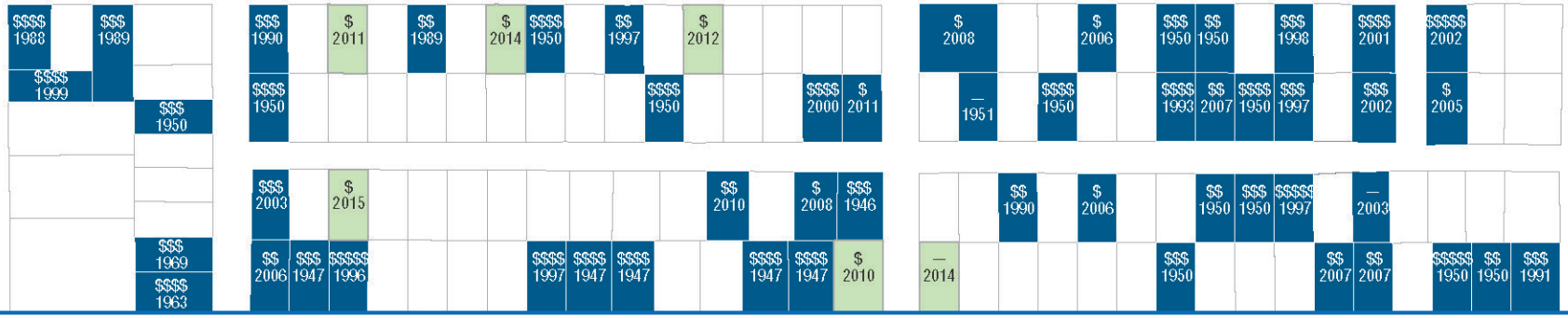
Figure 3-5 and Figure 3-6 show damage to adjacent
elevated and non-elevated homes on the Atlantic Ocean shoreline of Big Pine Key.

Guess the event/location?

Figures 3-7 and 3-8 Elevated house built in 2002 (HWM, shown as the dotted red line) had much less damage than surrounding older slab-on-grade houses. Slab-on-grade house (located across the street from the elevated residence) has large debris pile [Zone AE]

FEMA P-2022 Hurricane Harvey in Texas MAT Report

Figure 3-17 Non-flood damage-resistant materials removed from the crawlspace of the adjacent elevated Harris County building built in 2014 [Zone AE]



RESULTS

	CLAIM AMOUNTS		FOUNDATION TYPE		YEAR BUILT			
	Quantity	Percent	Crawlspace	Slab	Pre-1982[1]	Post-1982	1982-2000	Post-2000[2]
0	16	10%	13	3	0	16	1	15
$	31	20%	18	13	0	31	1	30
$$	24	15%	6	18	7	17	4	13
$$$	27	17%	1	26	19	8	5	3
$$$$	40	26%	0	40	27	13	11	2
$$$$$	19	12%	0	19	9	10	9	1
Total	**157**	**100%**	**38**	**119**	**62**	**95**	**31**	**64**

1 Initial FIRM is dated 1981; structures built 1982 and later would comply with NFIP requirements per the initial FIRM.
2 Updated FIRM for the area studied is dated 1999; structures constructed 2000 and later would comply with updated zone information shown on the 1999 or latest effective FIRM.

Crawlspace
Slab
No NFIP policy
Year built

Insurance Claims (data as of June 2018):
— Closed w/o payment
$ 1–10,000
$$ 10,000–50,000
$$$ 50,000–125,000
$$$$ 125,000–225,000
$$$$$ 225,000+

	Quantity	Percent	Crawlspace	Slab	Pre-1982[1]	Post-1982	1982-2000	Post-2000[2]
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Figure 3-23: Distribution of residences analyzed in the representative residential area, as of June 2018

RESULTS

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- Claims 71 of 157 < $50,000
- Foundation
  - 37 or 38 crawlspace < $50,000 (34 of 119 slab)
- Post-FIRM
  - 72 of 95 < $50,000
  - Post 2000 - 58 of 64 < $50,000

Mexico Beach, FL

Mexico Beach, FL

Through early 2019, 180 Closed NFIP Claims

77 Zone AE Polices, Average Claim $ 123,200

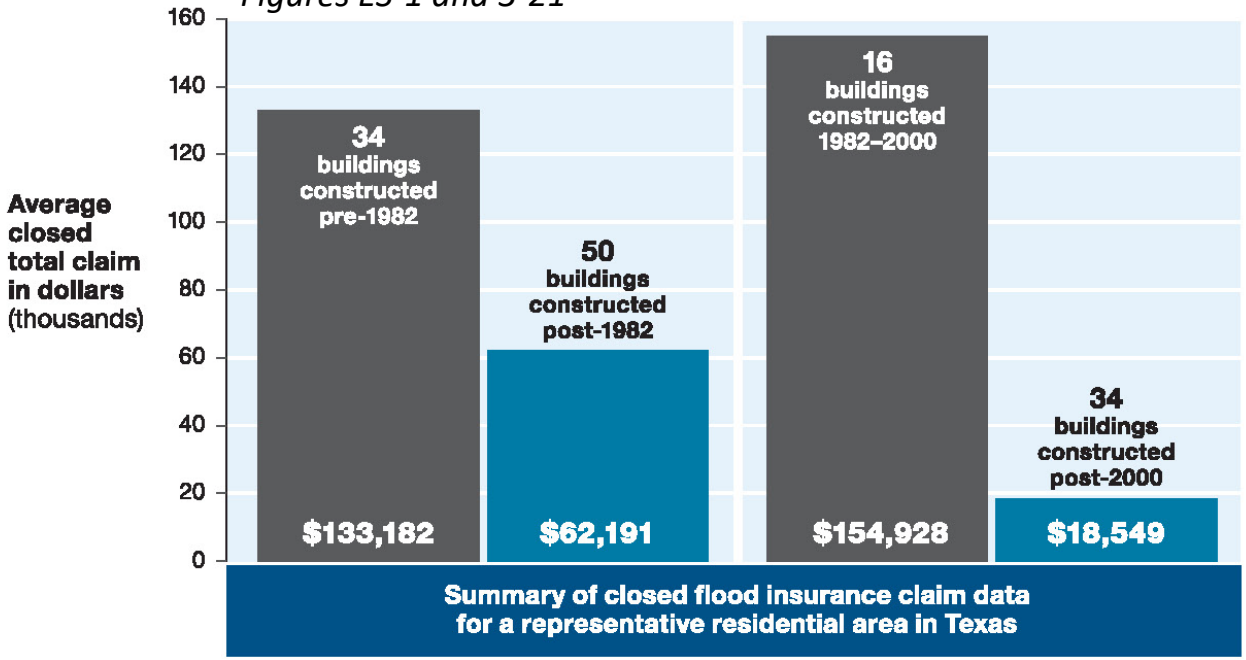
133 Outside SFHA Policies, Average Claims $146,400

Image Source - https://www.nytimes.com/interactive/2018/10/12/us/mexico-beach-fl-damage-map.html

Summary of 2017 & 2018 observations

- Elevation and Foundation Type Matter
- Mother Nature does not follow directions/read a FIRM
- Scour and Erosion
  - Irma MAT
- Dry Floodproofing Lessons Learned
  - Irma MAT
  - Harvey MAT

FEMA P-2022 Hurricane Harvey in Texas MAT Report
Figures ES-1 and 3-21



Tools & data to evaluate FPM requirements in a post-disaster environment

- Data
  - Parcel – year built, foundation type, building characteristics
  - Completed mitigation projects
  - Building permits and plans
  - NFHL and non-regulatory products
  - MT-1 and MT-2s aka LOMA, LOMR, CLOMR, etc.
  - Flood insurance Policy Holders
  - Repetitive Loss Properties
  - Elevation Certificates
  - Location of Public and Critical Facilities
  - Local Hazard Mitigation Plan/Strategy
  - Historical Imagery/Street View
- Monitoring
  - Press/social media
    - Crowdsourcing
    - Heatmaps
  - Damage assessments/Insurance claims
  - High water marks
  - Situation Reports
  - First Responders/Search and Rescue
  - Imagery/Civil Air Patrol Pictures

Tools & data to evaluate FPM requirements in a post-disaster environment

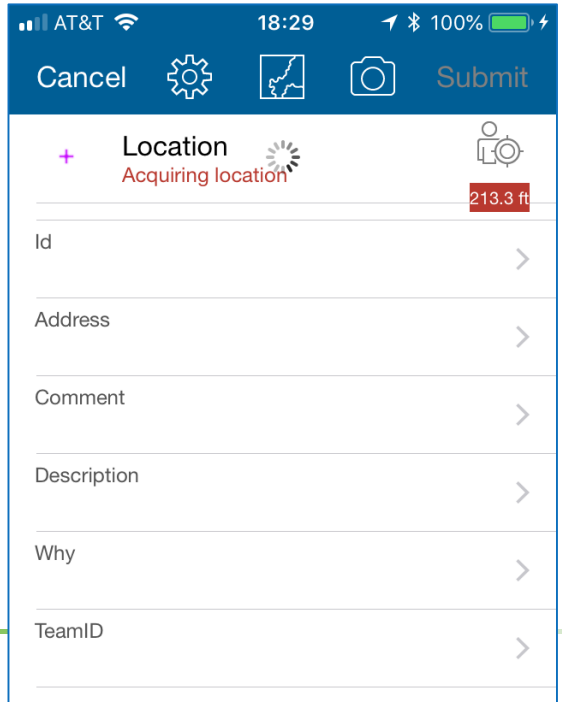
- Onslow County
  - 49 minute video, 12 miles
  - Mandatory Evacuation
  - Situational awareness
  - Legal restrictions
  - Processing
  - Coastal perspective
  - Efficient
  - Planned points of emphasis
  - Calibrate modeling
  - Document building performance

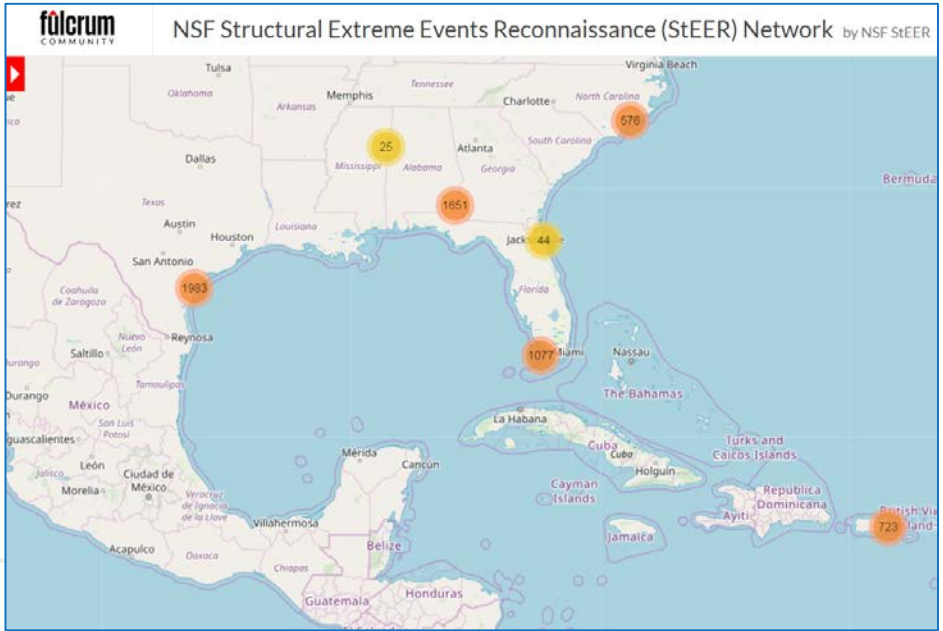
Tools & data to evaluate FPM requirements in a post-disaster environment

- Realtor Sites
  - Building characteristics – year built, size, materials, etc.
  - Exterior and interior pictures
  - Identified large break-away walls in this example

Tools & data to evaluate FPM requirements in a post-disaster environment

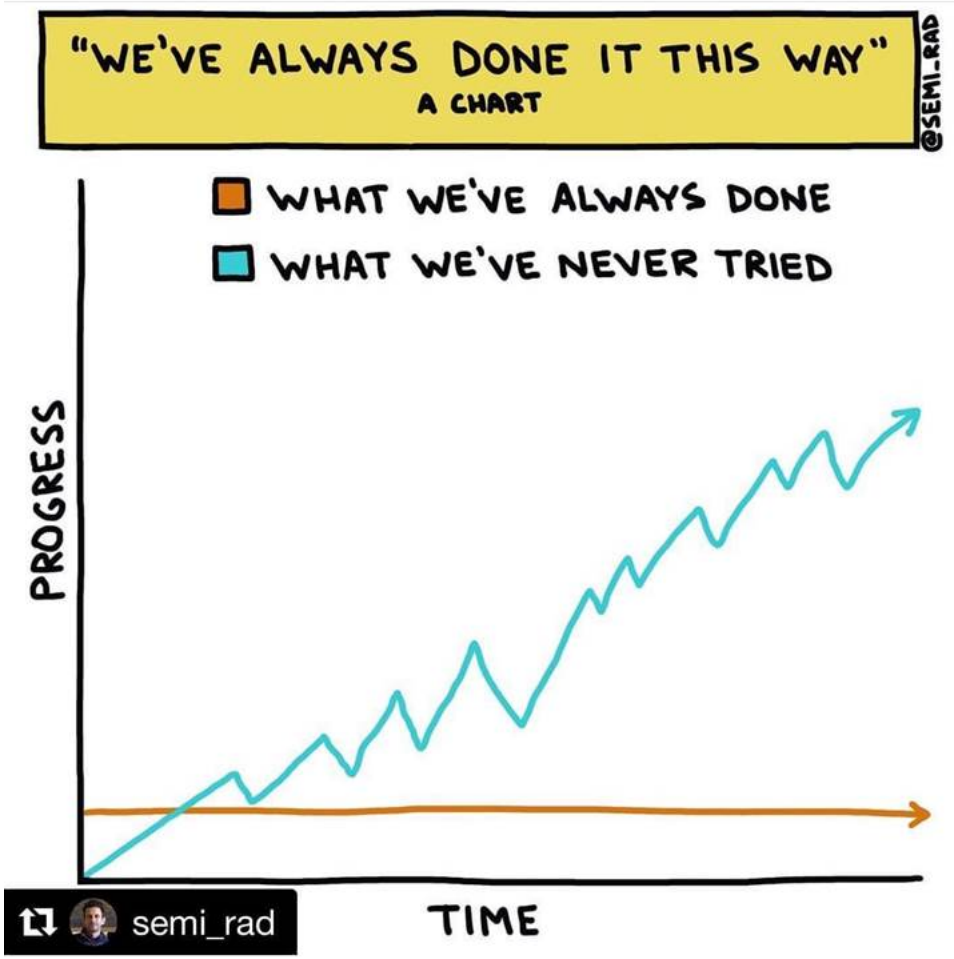
- Applications
  - ESRI Collector
  - Fulcrum
- Public/self reporting
  - Site elevations versus USGS HWM
- Collaboration
  - Teams Site
  - Slack Channel
- Data analytics
  - Information overload
  - Pre-established criteria/process
  - Event focused emphasis

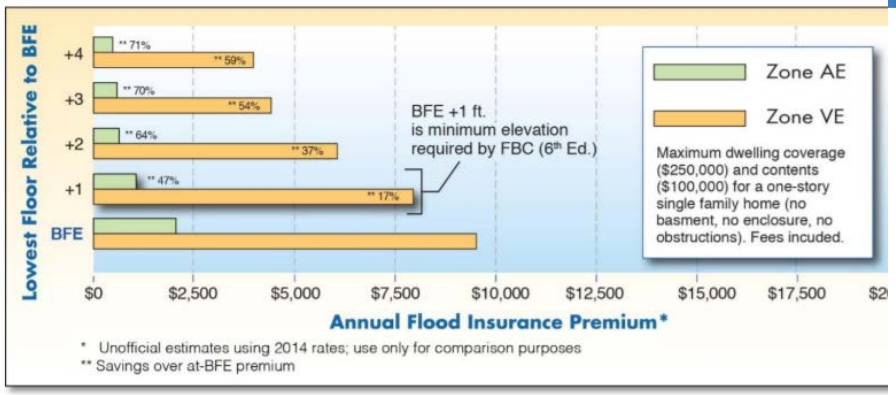




Why do all this

- Evaluate effectiveness of requirements and practices in your community
- Must consider magnitude/probability of the event
- Jurisdictions goals related to building performance
- Own it – local policy/decisions versus one-size fits all
- Routinely reevaluate
- Validate/calibrate model
- Performance based design





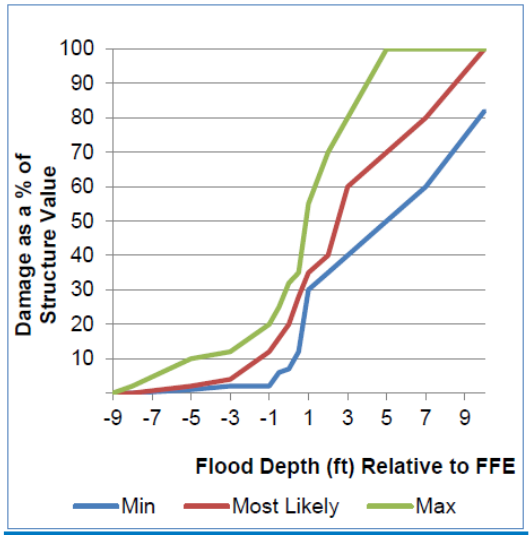


Figure 107. Prototype 7A: Building on Open Pile Foundation, Inundation Damage – Structure

Table 91. Prototype 7A: Building on Open Pile Foundation, Inundation Damage – Structure

Flood Depth	Min	Most Likely	Max
-9	0	0	0
-8	0	0	2
-5	1	2	10
-3	2	4	12
-1	2	12	20
-0.5	6	16	25
0	7	20	32
0.5	12	28	35
1	30	35	55
2	35	40	70
3	40	60	80
5	50	70	100
7	60	80	100
10	82	100	100

Questions

Evaluating your FPM building design and construction requirements in a post-disaster environment

Cleveland, Ohio

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May 22, 2019

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