Maryland Flood Proofing Workshop

August 2018

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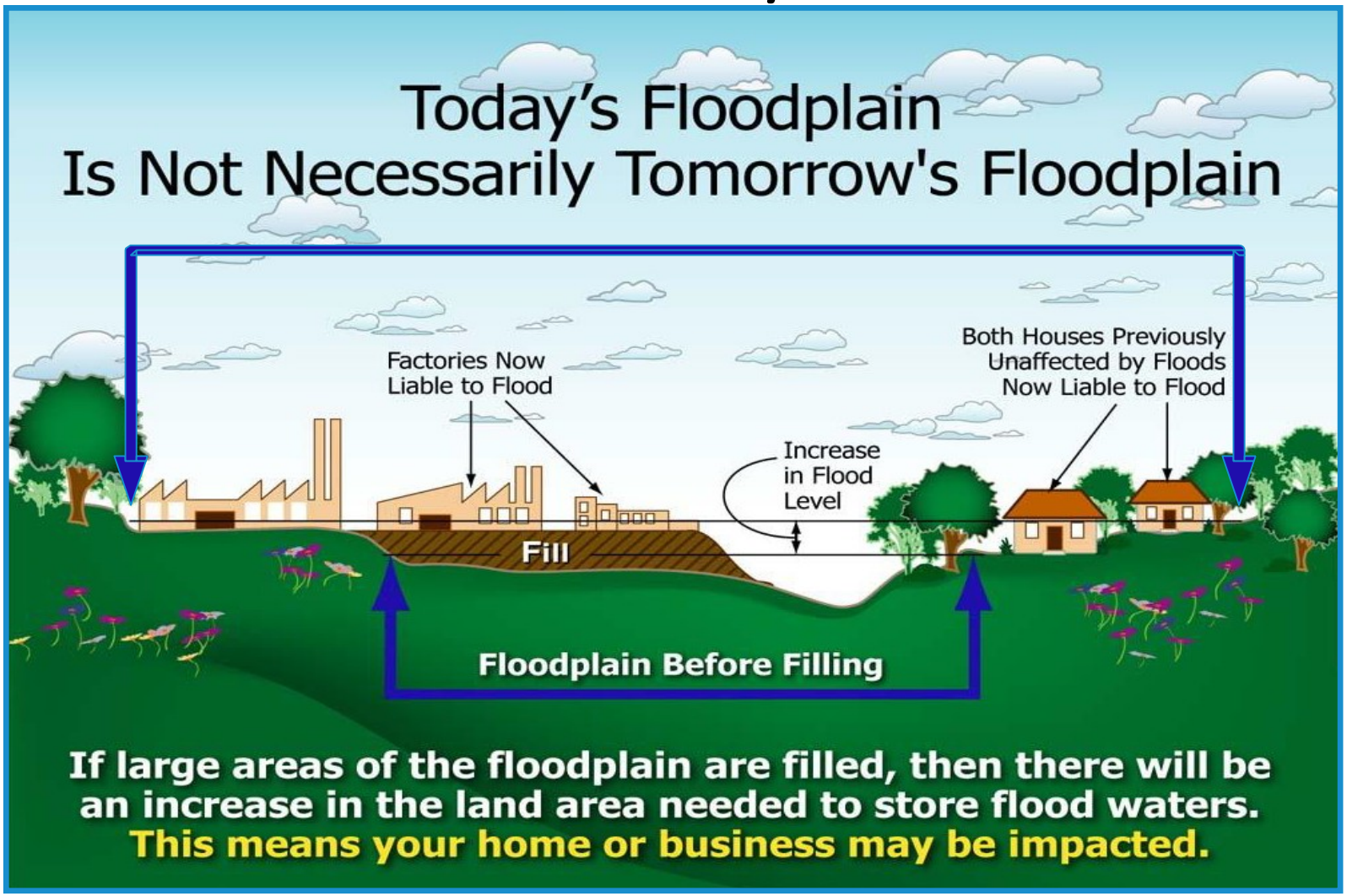
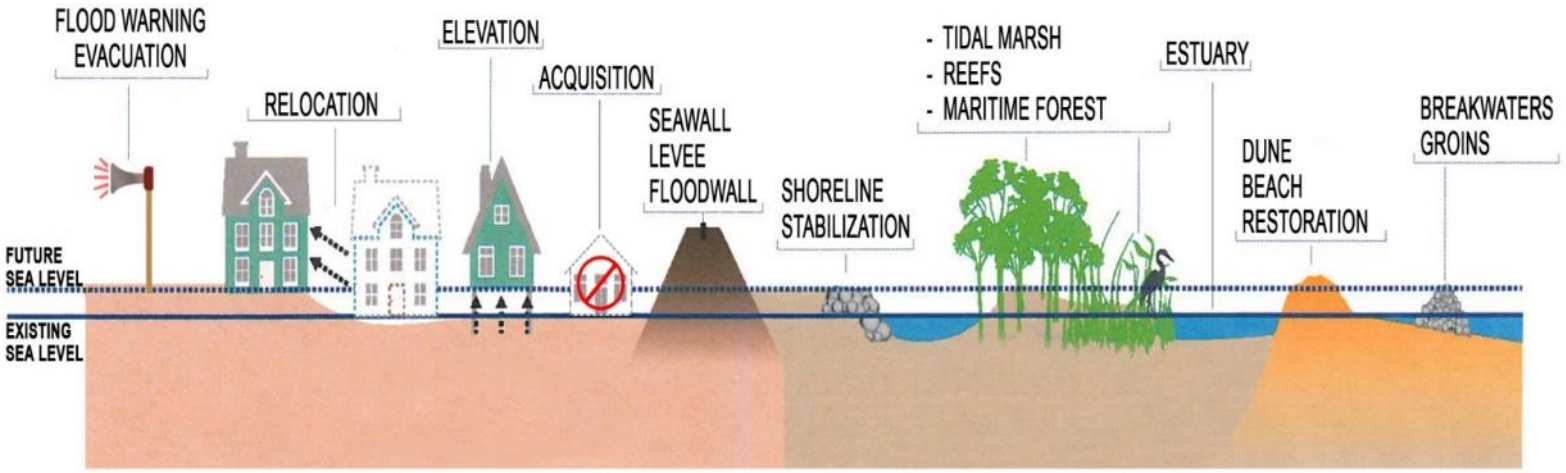
USACE-Huntington District

Flood Risk Adaptive Measures

THE CHANGING FLOODPLAIN
Man-Made Dynamics



FLOOD RESILIENCY



Comprehensive/Holistic
approach to resisting catastrophic loss

FLOOD RISK ANALYSIS

Flood Risk = *f* [Hazard x Probability of Flooding x Consequences]

HAZARD is a water surface elevation for a specific flood/inundation event.

PROBABILITY of Flooding is the frequency of flooding or how often does flooding occur in a particular location. Reduce the frequency of flooding and risk is reduced.

CONSEQUENCES are the potential damages and life loss associated with flooding. The structures (critical, residential, commercial, public, and industrial), land use (agricultural, urban, public) , and infrastructure (highways, roads, rail, utilities) make up the potentially damageable assets. Reduce the consequences of flooding and risk is reduced.

Note: *If critical facilities become inoperable during a flood event, the area of impact extends beyond the area of flooding (i.e. hospitals, fire and rescue, energy, communications, water and wastewater, etc.).*

FLOOD RISK CONSEQUENCES

- Life Loss
- Health, Safety & Welfare
- Damage to Property
- Business Losses
- Emergency Response Costs
- Recovery Costs
- Community Cohesion
- Compounded Disasters
  - Fire
  - Hazardous Material
  - Critical Facilities (Power, Potable Water Sewer, Communication)

FLOOD RISK MANAGEMENT

STRUCTURAL - reduce probability:

- Control / Change Hydrology
  - Dams - Fed, State & Local
  - Levees / Floodwalls - Local
  - Diversions - Local
  - Channels – Local
- Scale - LARGE

NONSTRUCTURAL - reduce consequences:

- Adapt to floodplain
  - Flood Risk Adaptive Measures
  - Property - Local/Private
  - Behavior – Local/Private
  - Planning/Preparedness – All
  - Restore Floodplain – All
- Scale – small

Or, put another way……

Flood Risk Adaptive Measures allow for people and structures that are exposed and vulnerable to flood risk to adapt to flooding and to those risks associated with flooding without changing the characteristics of the flood ……no increased stages, velocities, or duration of flooding.

FLOOD RISK ADAPTIVE MEASURES

PHYSICAL

- Acquisition (buyout / demolition)
- Basement Fill
- Elevation
- Relocation (Individual Structures / Multiple Structures)
- Dry Flood Proofing
- Wet Flood Proofing
- Barriers – Berms Walls (Temporary / Permanent)

NONPHYSICAL

- Education / Communication
- Flood Emergency Preparedness & Warning
- Other - *National Flood Insurance Program (NFIP); Floodplain Management; Land Use Regulation (Zoning); Building Codes*

NATURE BASED

- Low Impact Development / Green Infrastructure / Floodplain Restoration

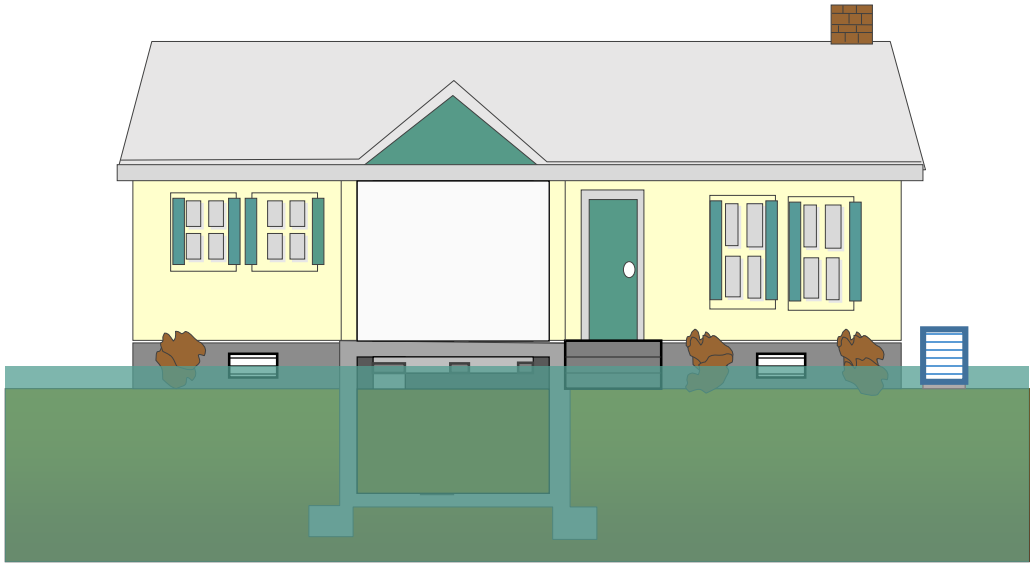
FLOOD RISK ADAPTIVE MEASURES

Acquisition

Acquire & Demolish

Opportunities & Challenges

FLOOD RISK ADAPTIVE MEASURES
Basement Evacuate/Fill (the basics)



- **Evacuate Basement**
  - Relocate Storage/Other (Above DFE)
  - Elevate Mechanical/Electrical Equipment (Above DFE)
  - Remove Finishes & Demo Floor Slab
- **Fill Basement** (Level w/Exterior Grade & Suitable fill)
- **Install Flood Louvers/Vents/Openings**

FLOOD RISK ADAPTIVE MEASURES

Elevation



Residential Structure – Grundy, VA

…is one of the most common and effective methods used to prevent flooding of living space…

…recommend design and construction by reputable/qualified professionals and contractors…

…Not permitted in regulatory floodway…**Not** recommended areas of high velocity

…Acceptable in A Zones.

FLOOD RISK ADAPTIVE MEASURES

Elevation

Huntington, VA - Assessment

Existing

Proposed

FLOOD RISK ADAPTIVE MEASURES

Elevation Utilizing Piers / Posts / Columns

FLOOD RISK ADAPTIVE MEASURES
Relocation

Lighthouse - Cape Hatteras, NC

Masonry Structure

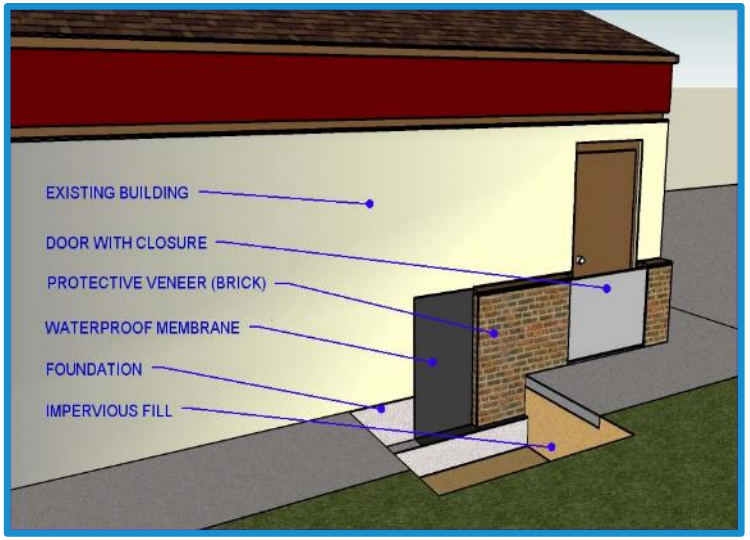
Grundy, VA

FLOOD RISK ADAPTIVE MEASURES

Dry Flood Proofing

Dry Flood Proofing (Temporary)

- Flood depths 3 feet or less
- Structurally sound buildings
- New design & construction
- Retrofitting existing structures
- No basement or crawl space



Basic Dry Flood Proofing Detail

Kermit, WV (Pizza Hut)

BARRIERS - CLOSURE DEVICES

Inserts

Stop Logs

Waterproof Door

Panel System

Swing Gate (Driveway)

Wall Swing Gate

FLOOD RISK ADAPTIVE MEASURES
Dry Flood Proofing

Etna Borough, PA Municipal Bldg.

- Critical Facility (EOC)
- Temp Closures – Access/Egress?
- Installation requires equipment & manpower

FLOOD RISK ADAPTIVE MEASURES
Wet Flood Proofing

City of Sacramento Fire Station 43 (Natomas, CA)

Church (Grundy, VA)

Town Hall (Prestonsburg, KY)

FLOOD RISK ADAPTIVE MEASURES
Barriers - Walls / Berms (USACE – Structural)

Masonry Wall (residential Grundy, VA)

Concrete Wall (commercial)

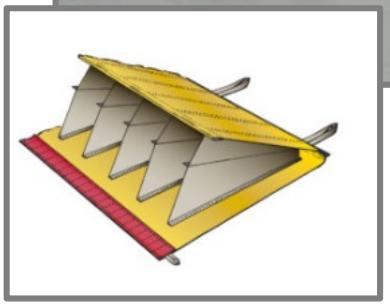
Earthen Berm

Masonry Wall (non-residential Crum, WV)

FLOOD RISK ADAPTIVE MEASURES

Barriers - Walls / Berms Temporary Perimeter Systems

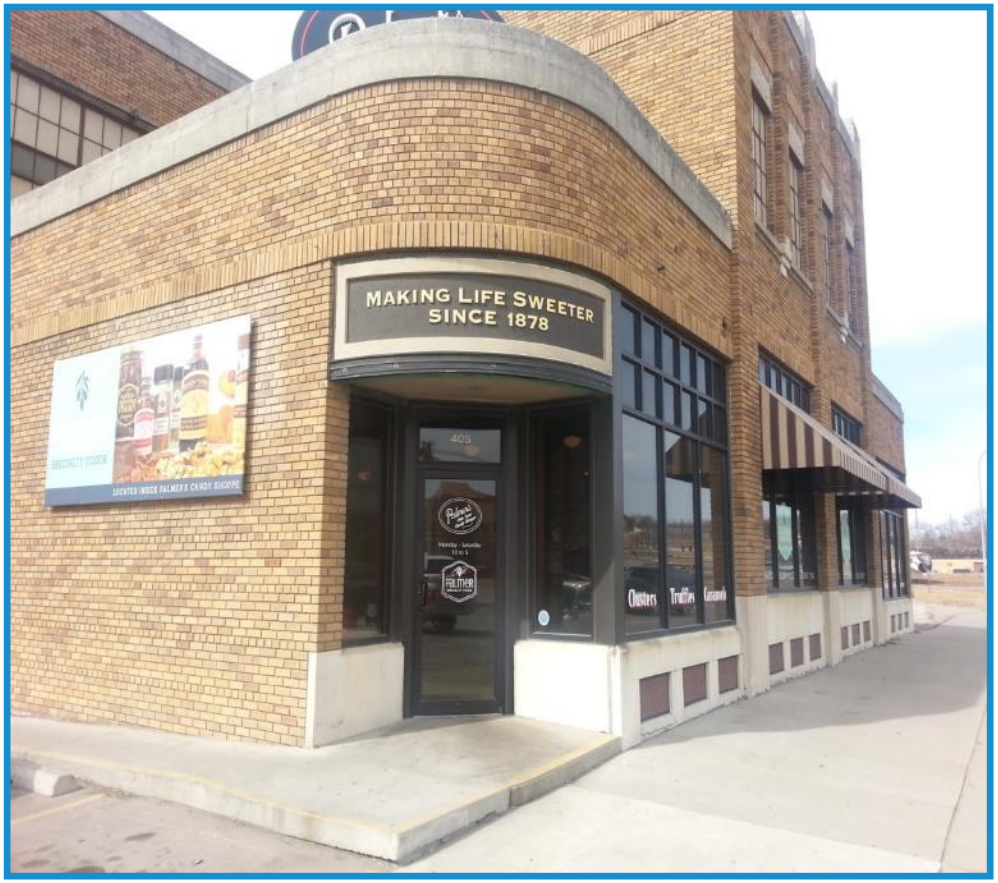
PANELS (FOLDING)



PANELS (SELF RISING)

BLADDER

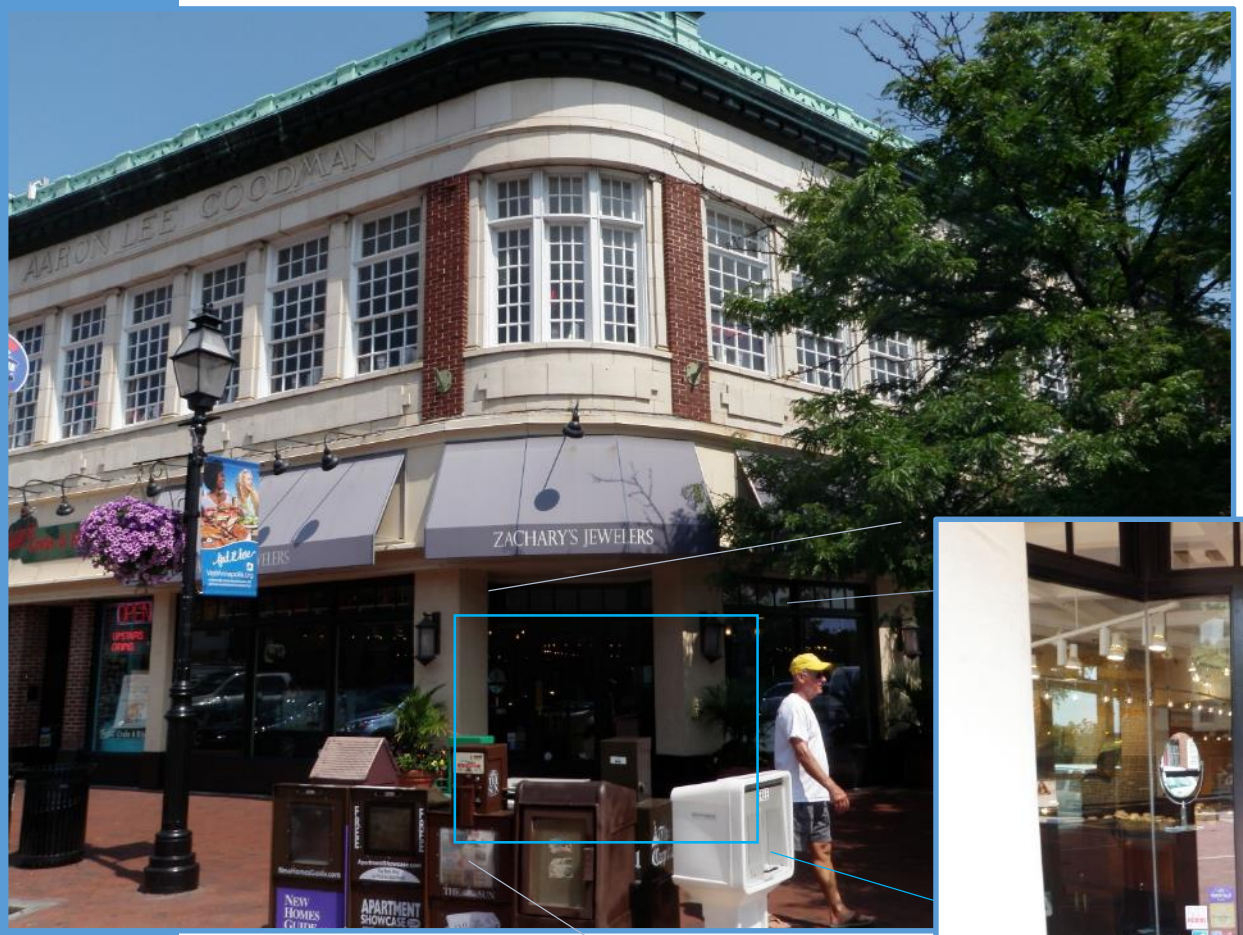
FLOOD RISK ADAPTIVE MEASURES



Elevation / Wet Flood Proofing (Historic Structure)

FLOOD RISK ADAPTIVE MEASURES

Elevation & Wet Flood Proofing (Historic Structure)



ANNAPOLIS, MARYLAND HISTORIC DISTRICT – NONSTRUCTURAL ASSESSMENT SAMPLING

Structure Information / Data

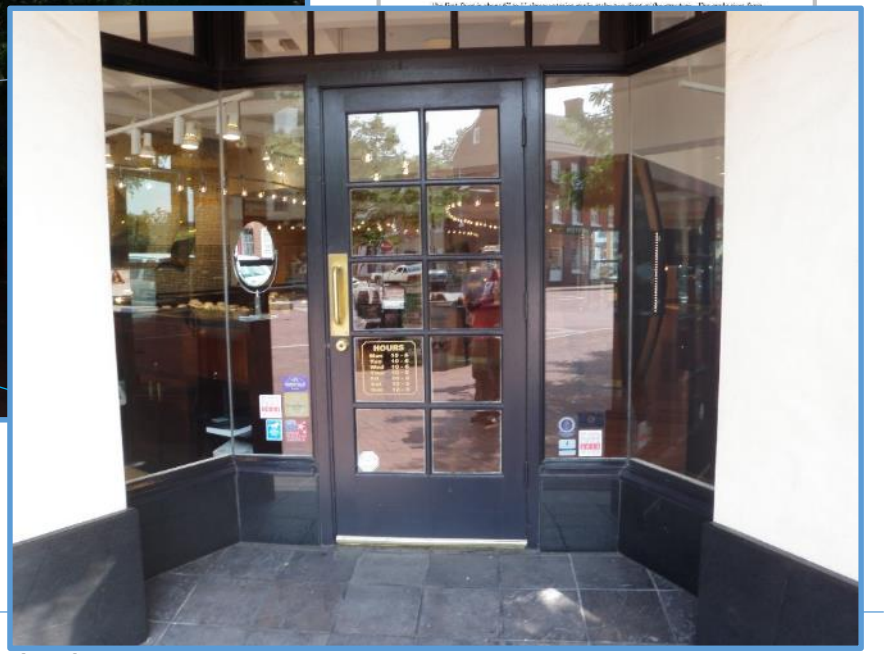
Structure/Flood Elevations Table

Structure Photographs

South Elevation

East Elevation

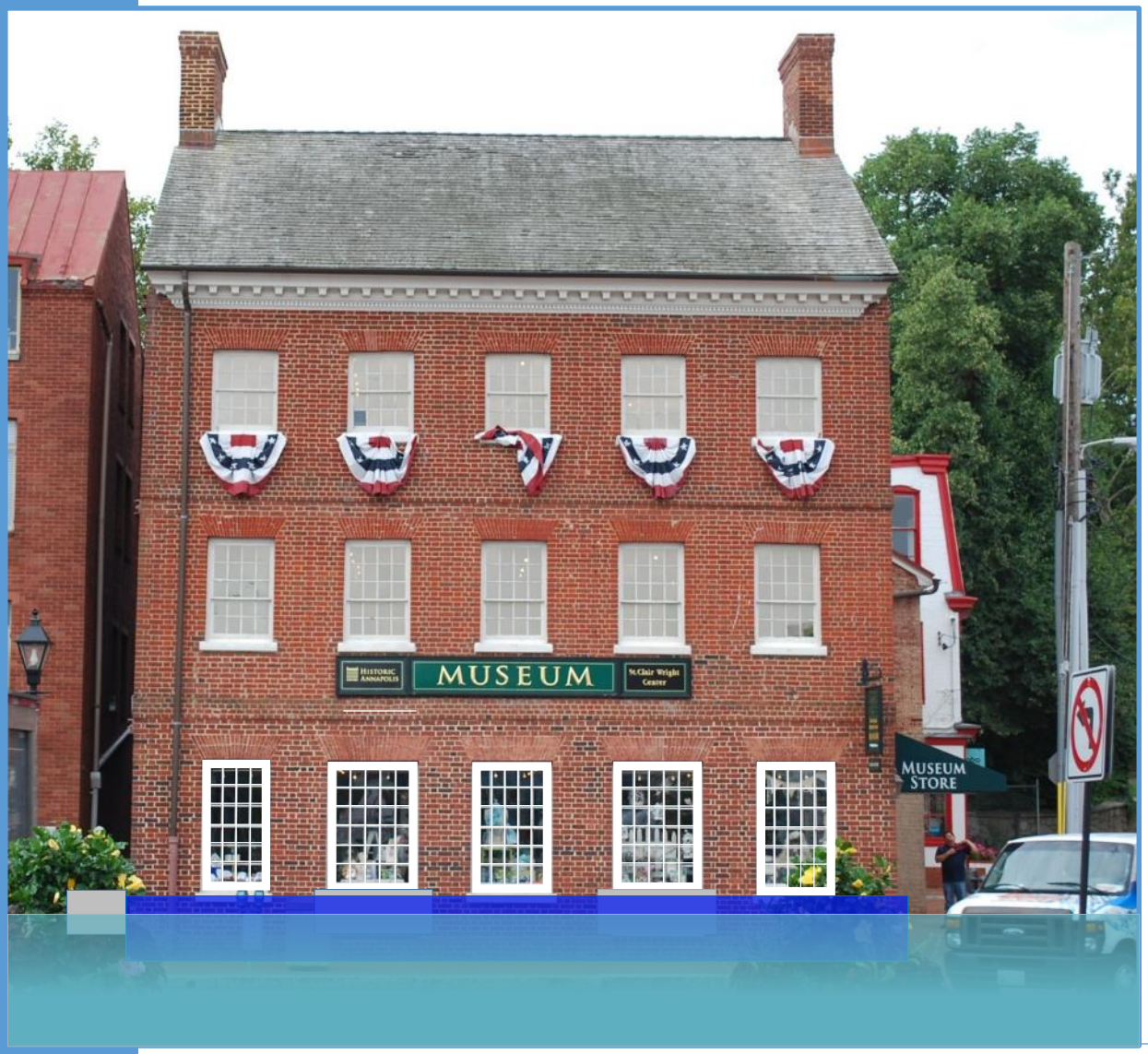
Site Visit (Observations/Field Notes)



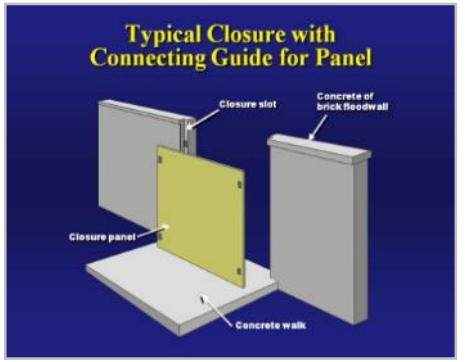
Annapolis, Maryland
Historic District

FLOOD RISK ADAPTIVE MEASURES

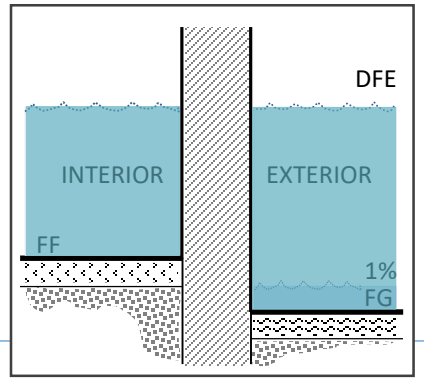
Historic Museum Annapolis, MD



Temporary Barrier



Closure/Shield



BUILDING SECTION (at Grade)

Not to Scale

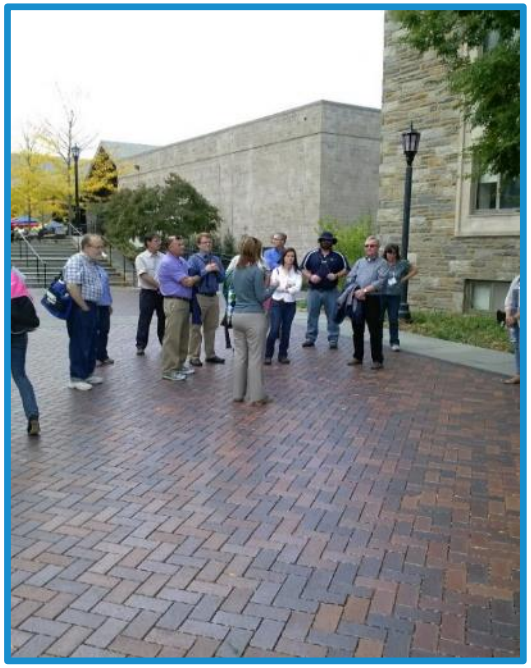
FLOOD RISK ADAPTIVE MEASURES

Nonphysical

- Awareness - Education / Outreach
- Regulations (codes, zoning, floodplain management)
- Warning / Evacuation
  - Who / How / When
- Preparedness Planning
  - Response / Recovery
  - Evacuation Routes
  - Evacuation Centers
  - Vertical Evacuation

FLOOD RISK ADAPTIVE MEASURES

Low Impact Development & Green Infrastructure



- **RAIN GARDEN**
- **PLANTER BOX**
- **GREEN SPACE**
- **POROUS PAVEMENT**
- **RAIN BARREL**

SHARED RESPONSIBILITY & SELF HELP

OBSERVATIONS

SHARED RESPONSIBILITY & SELF HELP

Elevated HVAC / WH (Interior)

Rain Barrel

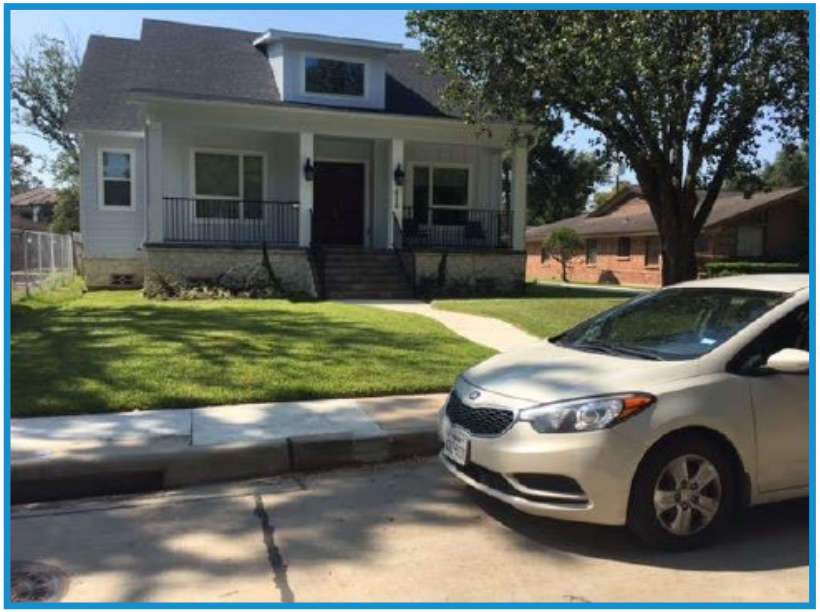
Elevated HVAC (Exterior)

GOOD

- Identify Risk
- Plan / Prepare
- Manipulate Landscape
- Acquire/fabricate barriers
- Install Flood Louvers/Vents/Openings
- Elevate Mechanical/Electrical Equipment
- Remove/Rehab Damageable finishes/Construction
- Sewer check valve(s) / Building drain check valve(s)
- Evacuate Basement (Equipment / Appliances / Storage)

HURRICANE HARVEY AFTERMATH

Elevated with flood vents and no damage



Next door Slab on grade damage

SMART VENT
Foundation Flood Vents

ASSESSING THE SITUATION

- **Flood Characteristics**

  Flood depth, Flood velocity, Flood duration, Rate of rise, Debris/Ice flows, Wave action, Floodway, Other (?)…

- **Site Characteristics**

  Location, Soil type, Topography, Site size & geometry, Urban/Rural, Other (?)…

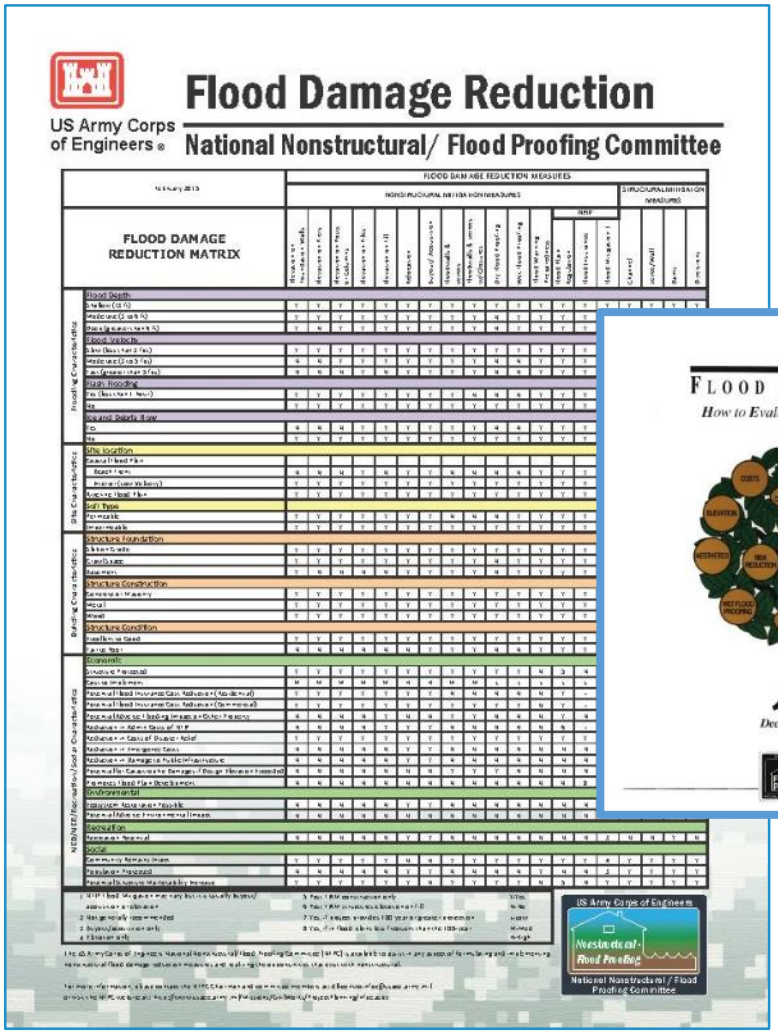
- **Building/Structure Characteristics**

  Type of construction, Foundation, Condition of the building, Building Occupancy, Lower levels (Basement), Historical Significance, Additions/Modifications, Other (?)…

- **Other Considerations**

  Building Codes, Zoning Ordinances and Local Restrictions, Other Agencies (Local / State / Federal), Aesthetics, Public Health/Safety/Welfare, Other (?)…

FLOOD DAMAGE REDUCTIO MATRIX

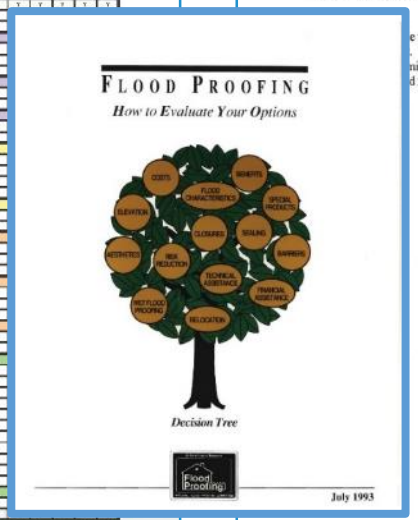


US Army Corps of Engineers

Flood Damage Reduction

National Nonstructural/ Flood Proofing Committee

FLOOD DAMAGE REDUCTION MATRIX

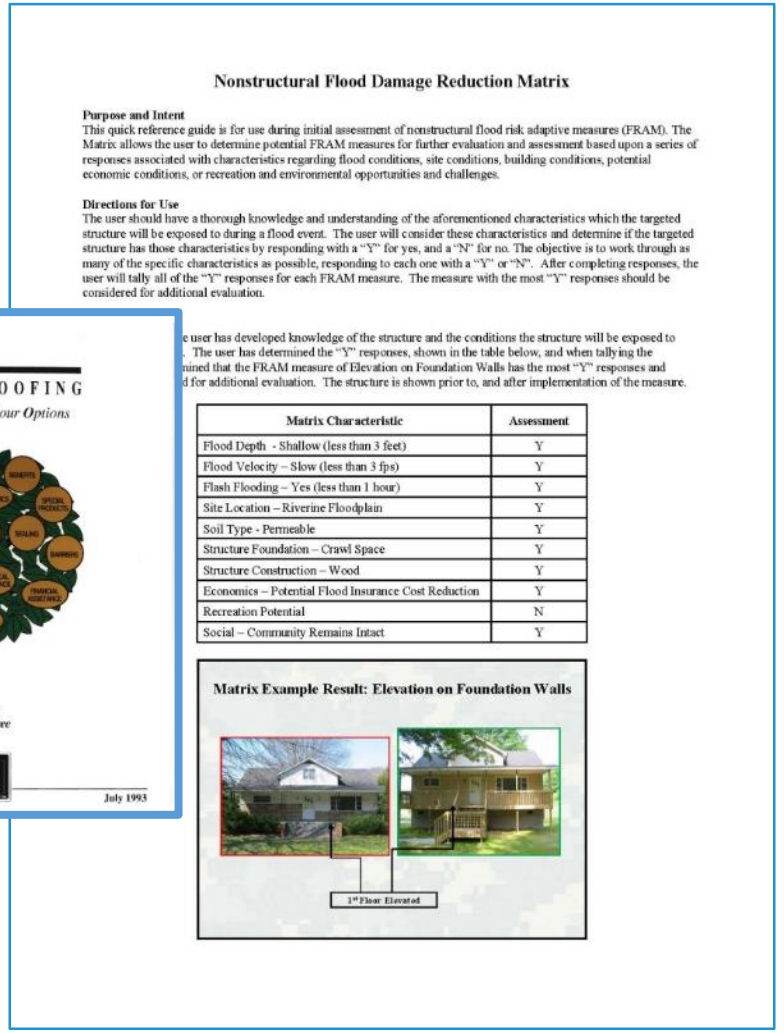


FLOOD PROOFING

How to Evaluate Your Options

Decision Tree

July 1993



Nonstructural Flood Damage Reduction Matrix

Purpose and Intent

This quick reference guide is for use during initial assessment of nonstructural flood risk adaptive measures (FRAM). The Matrix allows the user to determine potential FRAM measures for further evaluation and assessment based upon a series of responses associated with characteristics regarding flood conditions, site conditions, building conditions, potential economic conditions, or recreation and environmental opportunities and challenges.

Directions for Use

The user should have a thorough knowledge and understanding of the aforementioned characteristics which the targeted structure will be exposed to during a flood event. The user will consider these characteristics and determine if the targeted structure has those characteristics by responding with a "Y" for yes, and a "N" for no. The objective is to work through as many of the specific characteristics as possible, responding to each one with a "Y" or "N". After completing responses, the user will tally all of the "Y" responses for each FRAM measure. The measure with the most "Y" responses should be considered for additional evaluation.

e user has developed knowledge of the structure and the conditions the structure will be exposed to . The user has determined the "Y" responses, shown in the table below, and when tallying the mined that the FRAM measure of Elevation on Foundation Walls has the most "Y" responses and d for additional evaluation. The structure is shown prior to, and after implementation of the measure.

Matrix Characteristic	Assessment
Flood Depth - Shallow (less than 3 feet)	Y
Flood Velocity – Slow (less than 3 fps)	Y
Flash Flooding – Yes (less than 1 hour)	Y
Site Location – Riverine Floodplain	Y
Soil Type - Permeable	Y
Structure Foundation – Crawl Space	Y
Structure Construction – Wood	Y
Economics – Potential Flood Insurance Cost Reduction	Y
Recreation Potential	N
Social – Community Remains Intact	Y

Matrix Example Result: Elevation on Foundation Walls

FLOOD BARRIER TESTING & CERTIFICATION

http://nationalfloodbarrier.org/

- **Partnership:**
  - FM Approvals
  - Association of State Flood Plain Managers (ASFPM)
  - USACE National Nonstructural Committee (NNC)
- **Four categories (currently):**
  - Temporary Flood Barriers
  - Closure Devices
  - Backwater valves
  - Mitigation Pumps
- **Provides** an unbiased process of evaluating products in terms of resistance to water forces, material properties, and consistency of product manufacturing.

NATIONAL NONSTRUCTURAL COMMITTEE

http://www.usace.army.mil/Missions/CivilWorks/ProjectPlanning/nfpc.aspx

Chartered: 1985

NNC Members and Advisors

- Randall Behm, Chair, Omaha
- Steve O'Leary, Secretary, Huntington
- Kim Gavigan, Phoenix
- Lea Adams, Davis (HEC)
- Mary Weidel, Detroit (IWR)
- Brian Rast, Kansas City (IWR)

Technical Resources

- Nonstructural Techniques
- Publications
- Assessment Tools
- National Flood Barrier Testing & Certification Program
- Links to Associated Site

Google: **NFPC**

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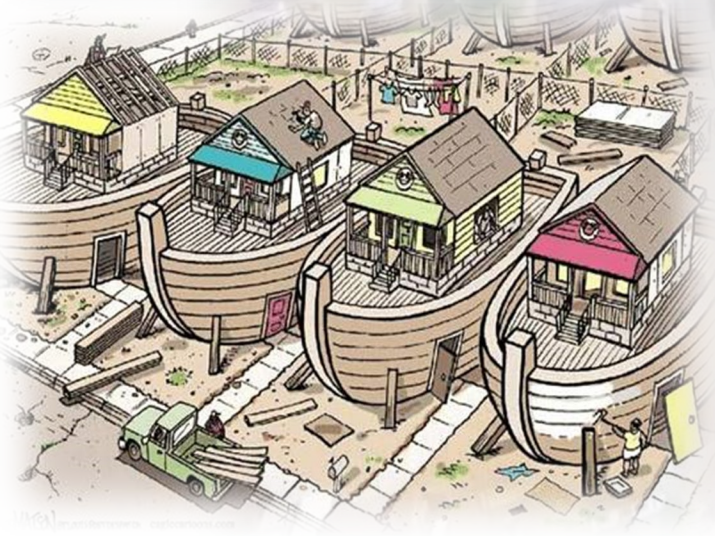

QUESTIONS?