



Hurricane Sandy: Initial Lessons for Buildings

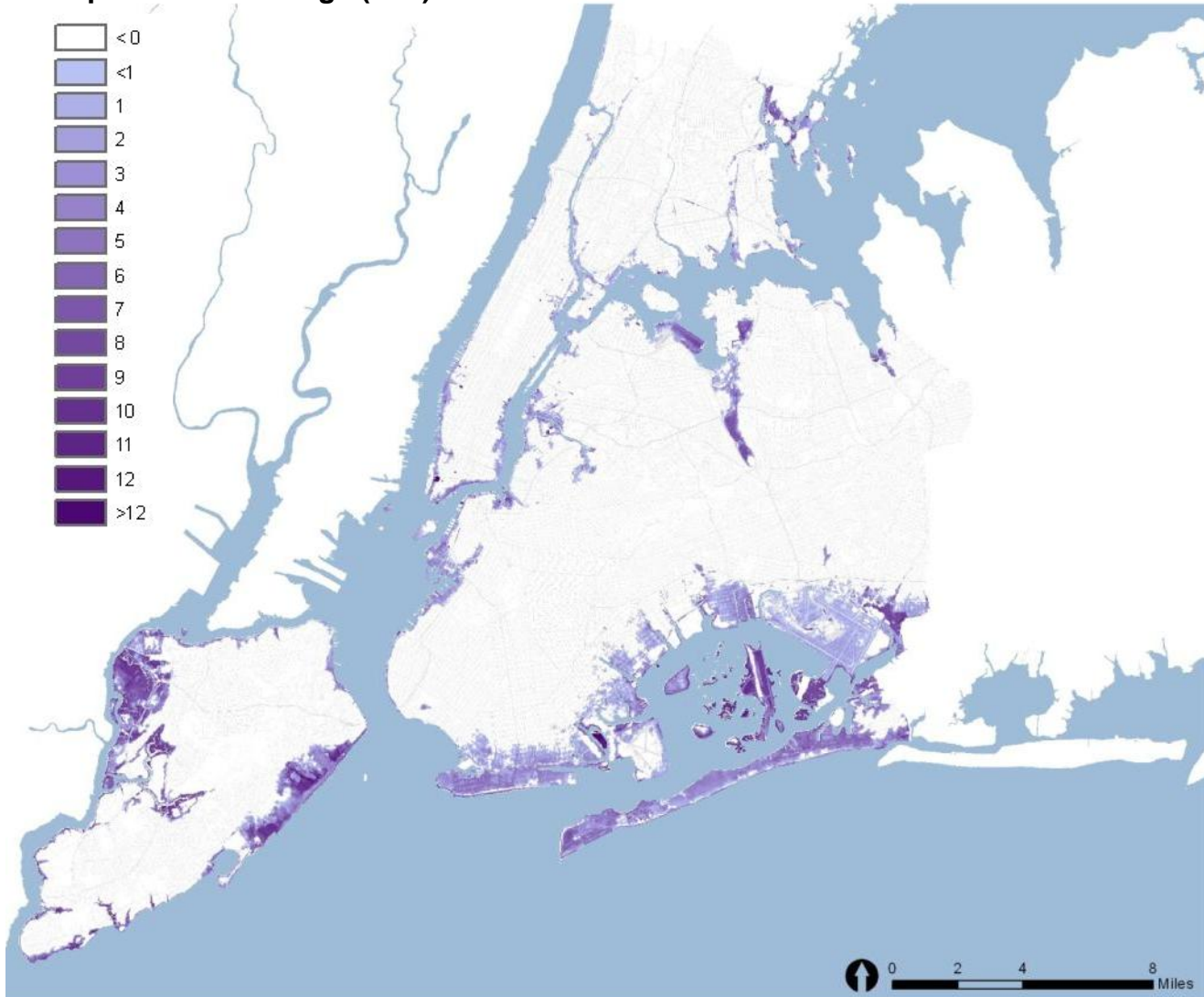
December 17, 2012

NYCPLANNING
DEPARTMENT OF CITY PLANNING CITY OF NEW YORK

Overview – Damage from Hurricane Sandy

Storm presented two main types of flood hazards – stillwater flooding and wave action

Depth of Storm Surge (feet)



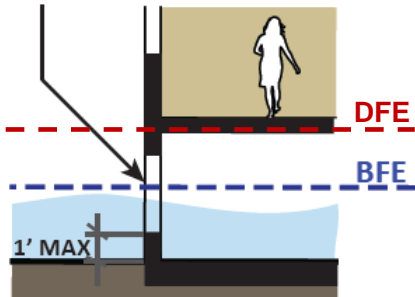
- Atlantic Coast shorelines (e.g., SI South Shore, Rockaways) faced storm surge plus wave action
 - Damage from flooding and impact of wave action
 - Severe structural damage concentrated in areas directly facing shoreline
- Upper Harbor and other areas to the north generally experienced inundation only
 - Damage primarily to building systems and contents

Floodproofing Requirements for Buildings

Local codes must comply with FEMA standards in order to maintain eligibility for National Flood Insurance Program

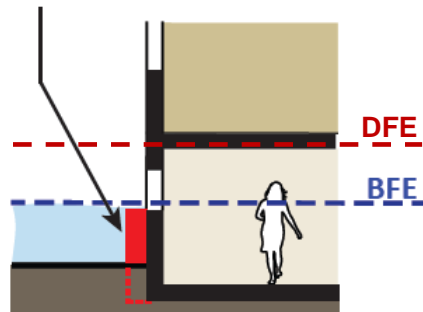
WET FLOODPROOFING

1 INCH OF NET OPEN
AREA PER 1 SQ. FT.
OF ENCLOSED AREA



DRY FLOODPROOFING

FLOOD SHIELDS
PREVENT WATER
FROM ENTERING



Wholly residential buildings
cannot use dry floodproofing

NYC Building Code contains floodproofing requirements

- In Appendix G of NYC Building Code
- Code references FEMA Flood Insurance Rate Maps (FIRMs), first issued for NYC in 1983, which identify:
 - Geography within which requirements apply – 100-year flood zone
 - Elevation to which buildings must be raised or floodproofed - **Base Flood Elevation (BFE)**
- Some buildings may be elevated to a higher elevation – **Design Flood Elevation (DFE)**
- Requirements apply to new construction or to improvements that exceed 50% of market value of building

Two main techniques of floodproofing exist –
applicable to different building types

Importance of Codes to Coastal Resilience

Code requirements are an effective tool for preventing severe damage to buildings

Year Built	Inundation area	Destroyed by Storm	Red tags	Yellow Tags
Before 1983	84%	98 %	94%	67%
1983-2001	9%	< 1%	4%	23%
2002 or later	5%	< 1%	1%	9%
No Data	2%	2%	1%	1%

Land Use	% of Total Destroyed by Storm	% of Total Red Tags
One & Two Family	88%	90%
Multi-Family Walk Up	1%	4%
Mixed Residential & Commercial	6%	1%
Commercial & Office	2%	1%
Public Facility & Institution	< 1%	1%
Vacant	1%	1%
Open Space & Recreation	1%	1%
Industrial & Manufacturing	< 1%	1%
Multi-Family Elevator	< 1%	< 1%
Transportation & Utility	< 1%	< 1%
Parking	< 1%	< 1%

Most buildings in the coastal area predate floodproofing requirements

- **84%** of buildings in inundation area were built before 1983, when first FEMA Flood Insurance Rate Maps (FIRMs) were issued

Newer buildings constructed to code requirements fared better in the storm

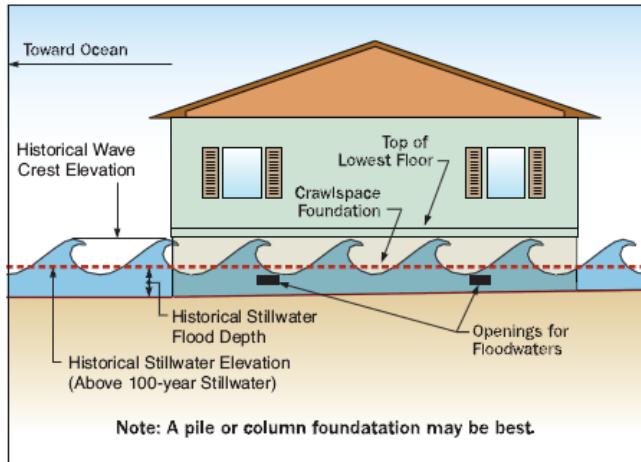
- **98%** of buildings destroyed by the storm were built before 1983
- **94%** of red-tagged buildings were built before 1983

Severe damage was concentrated in 1- and 2-family homes

- **88%** of destroyed buildings and **90%** of red-tagged buildings were 1- or 2-family homes
- A large majority of red-tagged buildings were in Staten Island and Queens

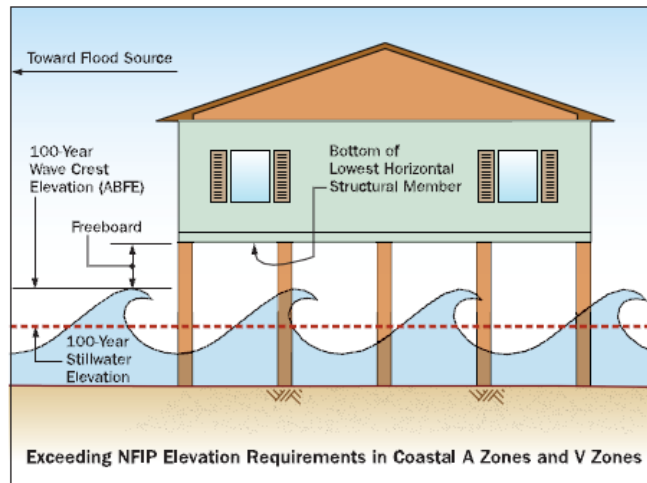
Floodproofing Requirements for Buildings

Different floodproofing standards apply in areas where stillwater flooding is expected (A-zone) and where wave action is expected (V-zone)



A-zone

- Elevate lowest floor above BFE
- Enclosure below the BFE must be wet flood proofed
- Enclosed space below the BFE shall be used solely for parking, storage and building access
- Utilities must be elevated above the BFE or designed to prevent water from entering and accumulating
- Commercial or mixed-use buildings can opt to dry floodproof non-residential spaces below the BFE

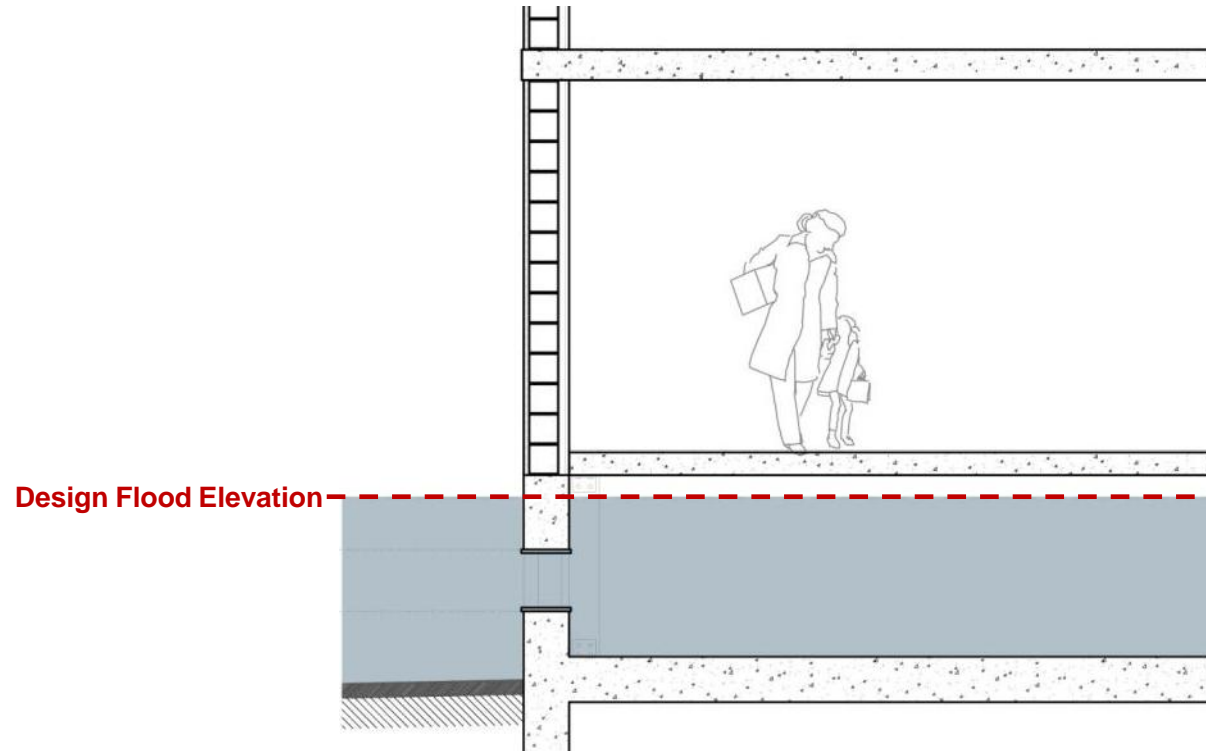


V-zone (high-velocity wave action zone)

- Building elevated above BFE on piles or columns above open foundation – no enclosure below the BFE (breakaway walls only)
- Offers less resistance to waves passing beneath building

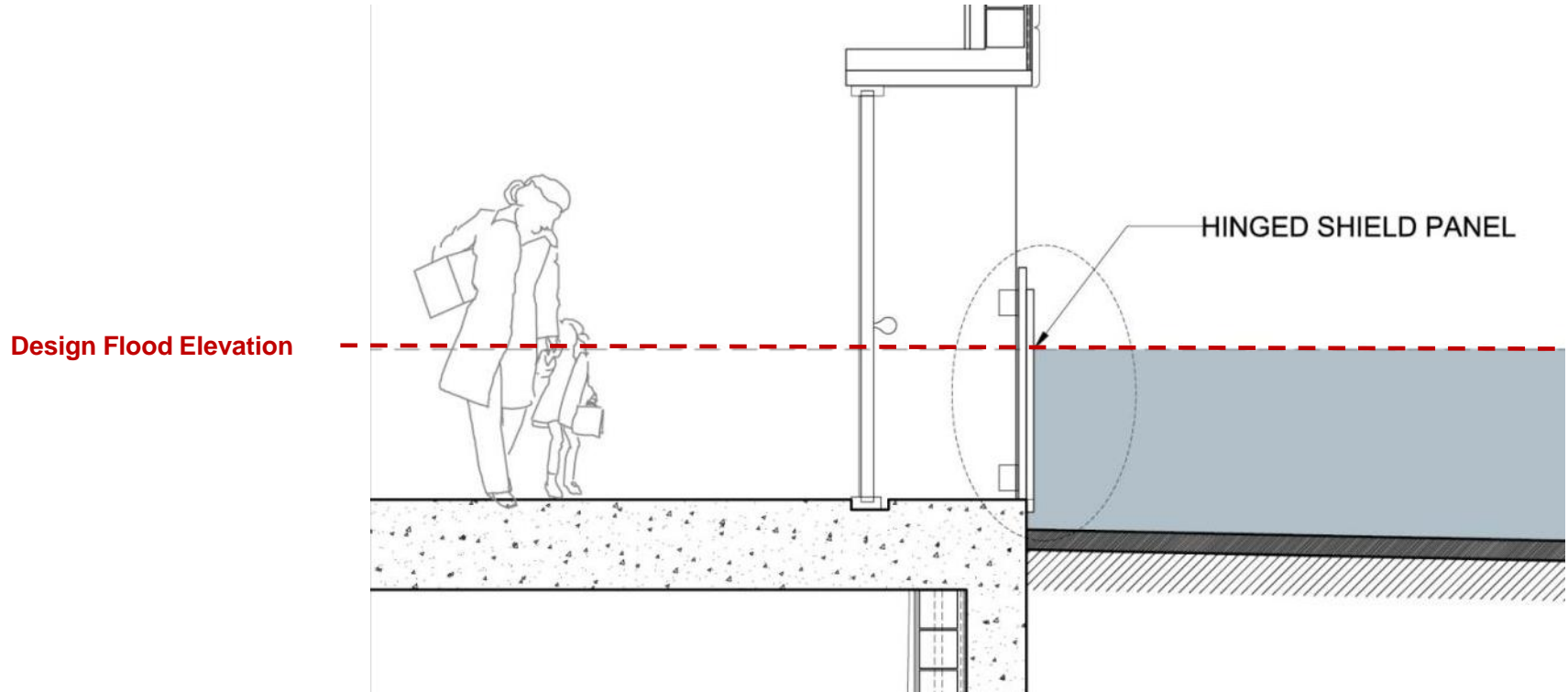
Floodproofing Techniques: Example

Elevation of lowest floor containing habitable space



Floodproofing Techniques: Example

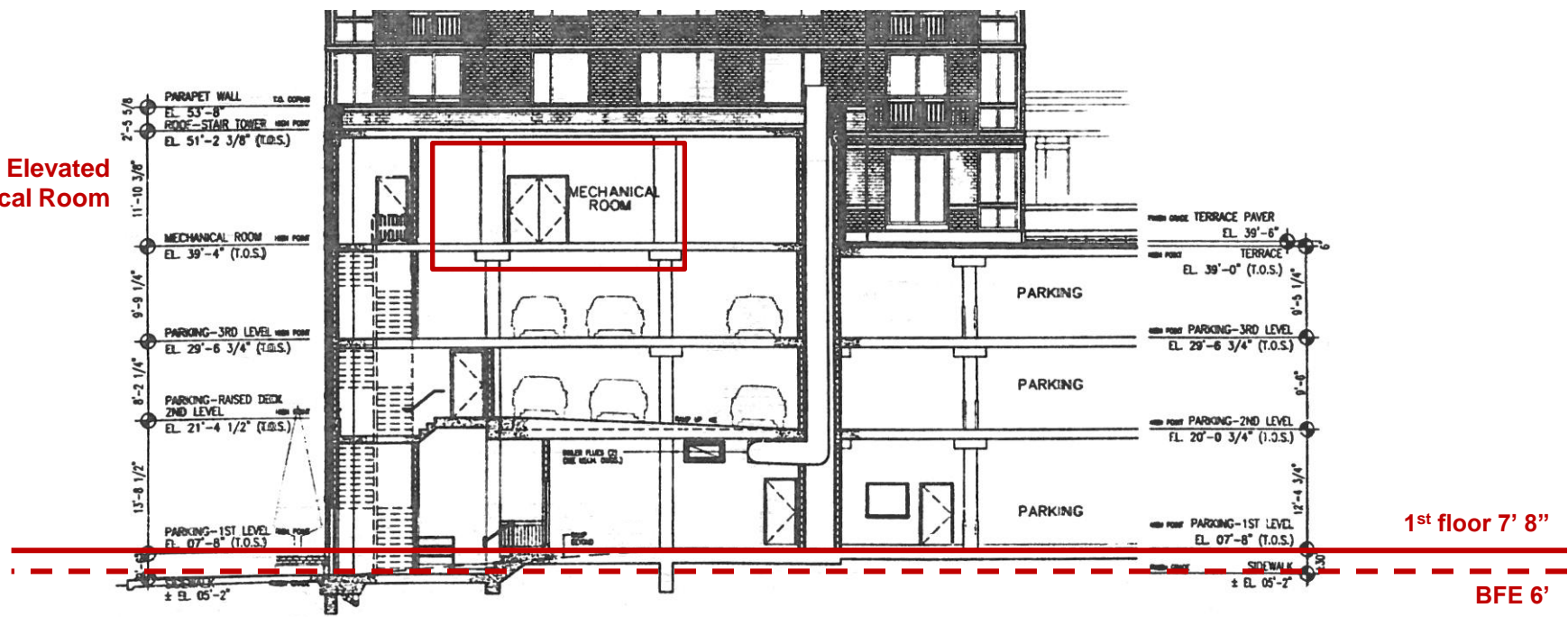
Flood shields (non-residential spaces only)



Floodproofing Techniques: Example

Elevation of mechanical space

Elevated
Mechanical Room



Recent Construction: Examples

Newer buildings constructed to code requirements fared better during the storm



The Edge, Williamsburg, Brooklyn

Recent Construction: Examples

Newer buildings constructed to code requirements fared better during the storm

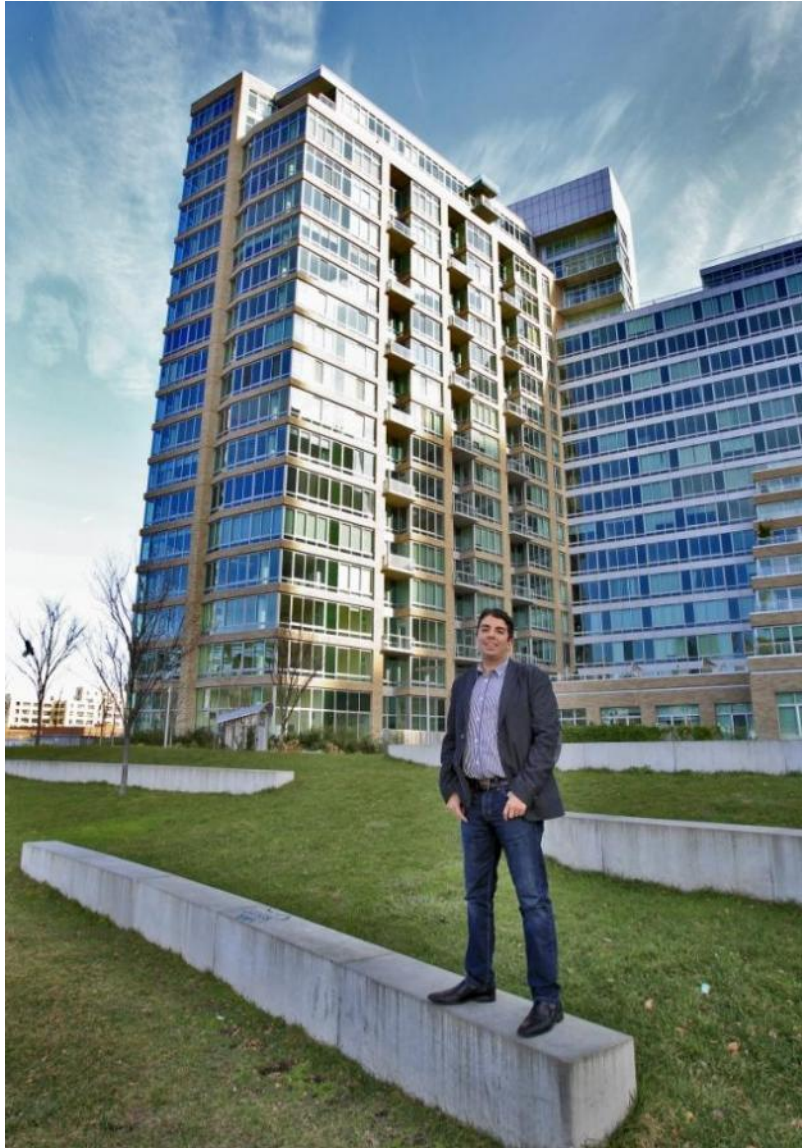


Photo: Anthony DelMundo for New York Daily News

The View, Long Island City, Queens

Recent Construction: Examples

Newer buildings constructed to code requirements fared better during the storm



Ikea, Red Hook, Brooklyn

Recent Construction: Examples

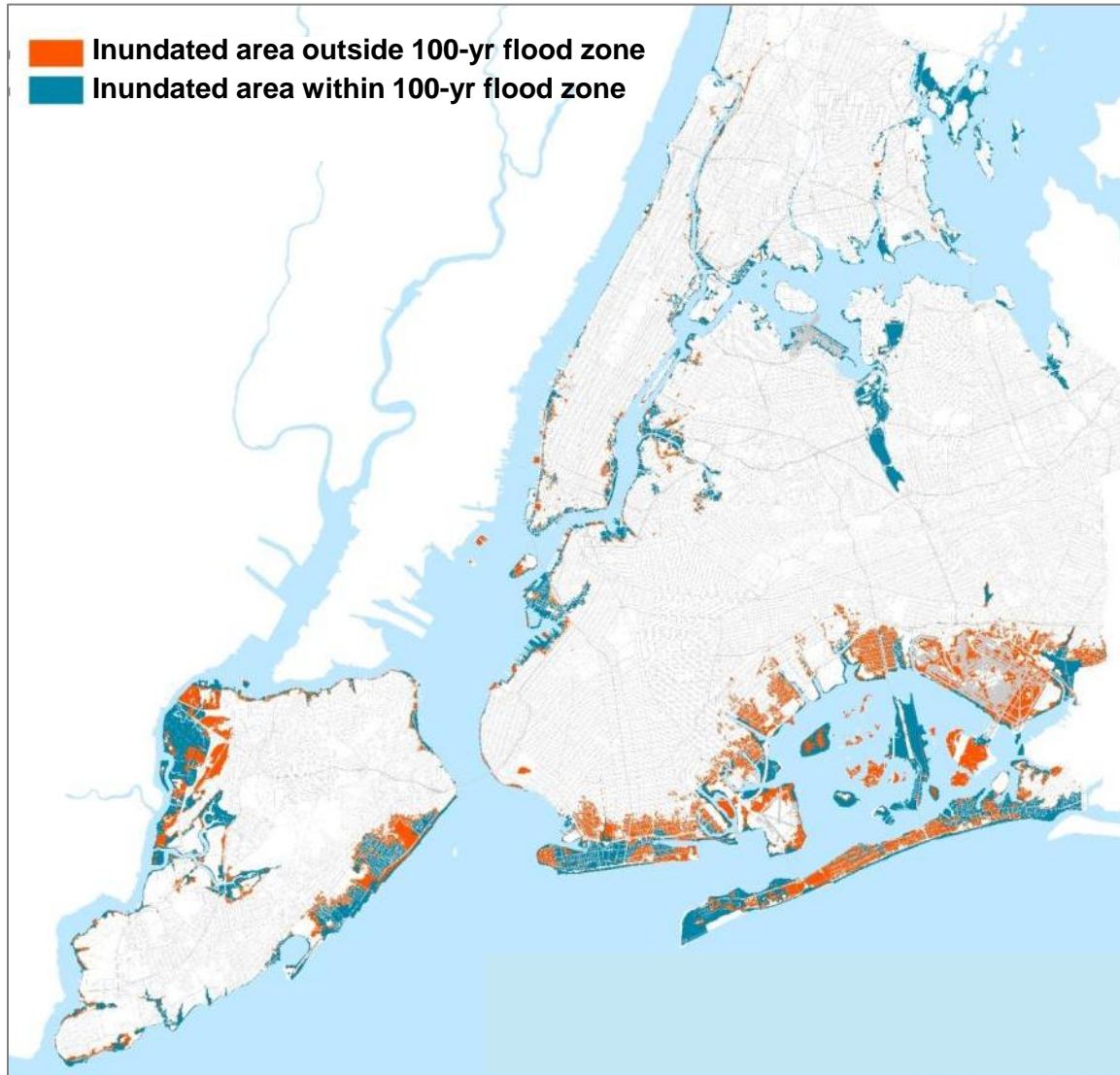
Newer buildings constructed to code requirements fared better during the storm



Arverne by the Sea, The Rockaways, Queens

FEMA Flood Maps and Inundation from the Storm

Flooding during Hurricane Sandy substantially exceeded both the boundaries and the flood heights of the current FEMA 100-year flood zone



Sandy inundation area extended beyond current FEMA-designated flood zone

- Roughly 1/4 of red-tagged buildings,
- Over 2/3 of the residential units, and
- More than 1/2 the buildings

in the inundation area were **outside the current FEMA 100-year flood zone**

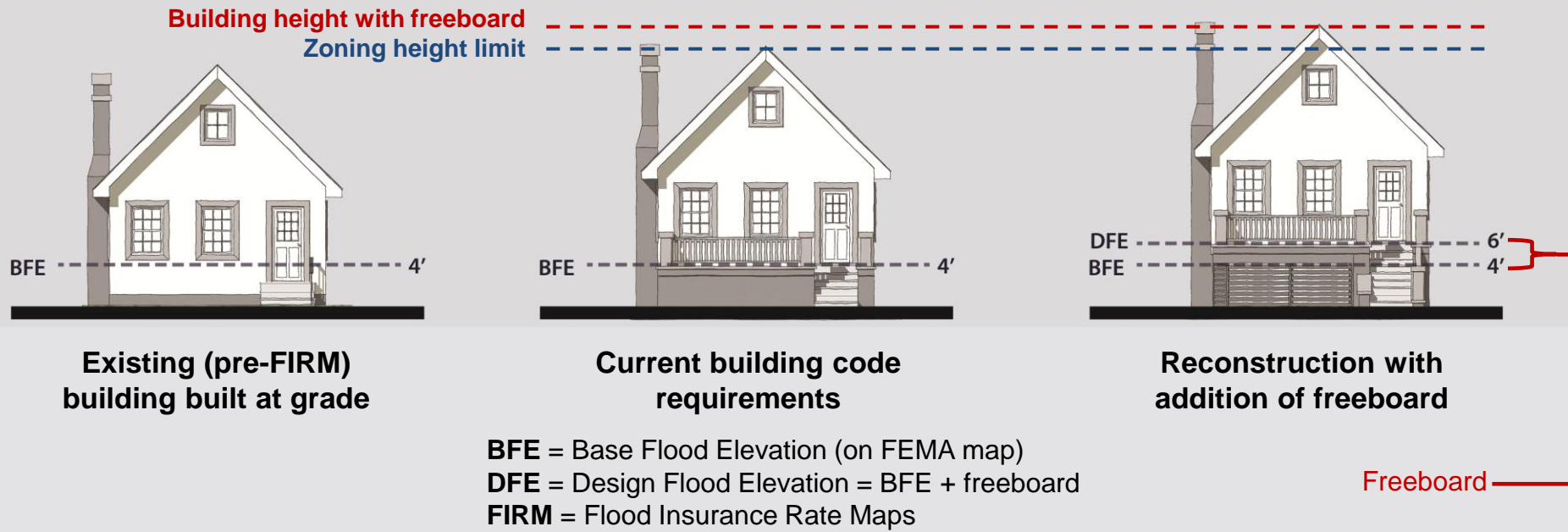
Need for Upgrades to Building Code, Zoning, and Flood Maps

Prior to the storm, PlaNYC identified the need for improvements to flood zone regulations



- FEMA update of **flood maps**, including designated Base Flood Elevations
- Upgrades to floodproofing requirements of Building Code (Appendix G) to require **freeboard**:
 - elevating buildings 1-2 feet further to provide an additional margin of safety
- Corresponding **amendments to Zoning Resolution** to accommodate floodproofing requirements including freeboard

Zoning Issues: Example



Limitations

- Zoning Resolution does not allow 1-2 feet of additional building height to accommodate freeboard
- For some buildings, this can prevent use of all of floor area, discourage flood protection

Shaping New York City's Future After Sandy





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