[vimeo 117303273 w=640 h=360]

The Big U - BIG Teams Vision for Rebuild by Design from BIG on Vimeo.

Designing for Flood Risk focuses on preparing buildings to withstand the threat of coastal **flooding**, while ensuring that they support everyday livability and quality of life. The devastation wrought in waterfront communities from recent Hurricanes and storm surge has brought a new level of urgency to this work. Flood tolerance is the capacity to remain undamaged and functional when flooded, which requires adapting the built environment to floods.

For a diagram of the **Sea Level Rise impact to your community** see maps below prepared by **Union of Concerned Scientists:** (all of maps referenced here are continuously being updated as new data comes in)

https://ucsusa.maps.arcgis.com/apps/MapSeries/index.html?appid=cf07ebe0a4c9439ab2e7e346656cb239

The USA National Oceanic and Atmospheric Administration:

https://coast.noaa.gov/slr/

or climatecentral.org:

https://choices.climatecentral.org/#12/40.7116/-74.0010?compare=temperatures&carbon-end-yr=2100&scenario-a=warming-4&scenario-b=warming-2

How can we ensure that buildings meet higher flood protection standards while preserving the vitality of our neighborhoods?

BASE FLOOD ELEVATION (BFE) the computed elevation in feet to which floodwater is anticipated to rise during the base flood, is the regulatory requirement for the elevation or floodproofing of structures. A building's flood insurance premium is determined by the relationship between the BFE and a structure's elevation.

"In the coastal velocity zone ("V zone"), where hurricane storm surge is the risk and wave action is the driving force, you need an open foundation on pilings, which allows

waves to pass below the home’s occupied space. Waves pack an enormous punch—because water is so much more massive than air, a 2-foot or 3-foot wave is far more destructive than the hurricane winds that are pushing it. That’s why a 30-foot surge with high battering waves, like Hurricane Katrina brought in 2005, is able to scrape shorelines clean of buildings" Ted Cushman, Building mag.

We need to develop a flood-tolerant lifestyle based on flood adaptation at the property level:

Parday House near Wargrave: **a completed home is raised up on a steel frame, above ground level**

- allows the site to flood, protecting from potential damage
- flood water flows freely underneath the building- development does not adversely impact the flood plain as a whole and excess water isn't pushed elsewhere

Beach House Landscape by Dirtwork NJ

Learning lessons from Hurricane Sandy in 2012,

- critical wet-flood proofing measures were incorporated in the design to mitigate heavy flooding, property damage and disruption of vital services
- The flood resilient landscape is built outside the sea wall to prevent soil erosion and to stabilize the natural shoreline
- Native plants, establishing a dense network of root systems, surround the site to help the fragile dunes and create a sustainable, flexible approach to long-term maintenance
- Bioswales are strategically planted to help prevent overwash from flowing directly back to the sea
- They also trap stormwater runoff until it can be safely drained into the soil. Wood decking can temporarily capture runoff and maximize groundwater recharge, a defense against coastal subsidence

- Rising 14 feet above sea level, the residence is accessed through a flood vent that allows for the equalization of pressure from unexpected and rapid surges and flooding

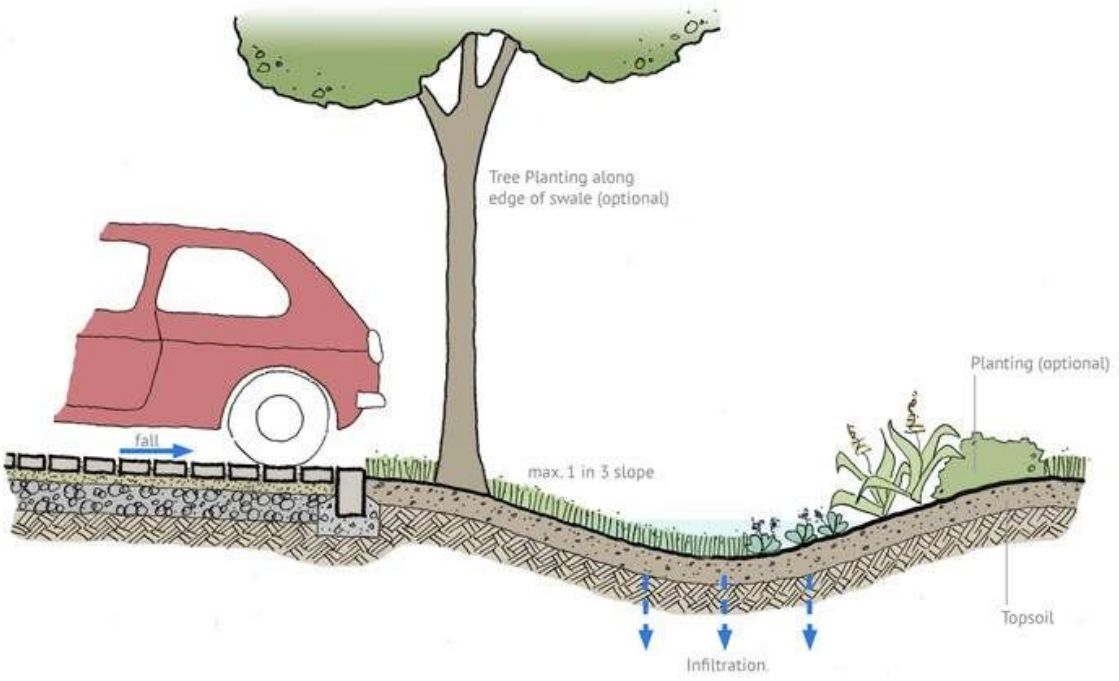

Water is collected in case of infrastructure failure though a low sloped roof that drains towards a cistern located in the rear of the home.
Solar Panels, which line the roof, supply power at any time and they are ready in the midst of a regional power outage.
Warmth is trapped in the home by insulating the roof and floors with R-50 spray foam insulation (Grey floor box indicates spray foam insulation areas).
Usual Sand bagging efforts are reduced dramatically by the small footprint.
Safe boat access directly off of the sun deck allows for the delivery of fresh supplies and permits an easy emergency rescue entrance.
F9Productions.com

RIBA competition entry above: flood solution

Permeable paving use in mitigating flash flooding caused by heavy rainfall:

- permeable paving can drain into swales and retention ponds
- reduces the risk of flash flooding by slowing down the flow of rainwater to help to discharge it back to the ground at a reduced flow rate

Drainage swales to prevent and ease flash flooding from heavy rainfall:



Swales can be part of an area's natural landscaping, or they can be created to help ensure proper **drainage**, minimize runoff or capture storm water. In simple terms, they are generally shallow ditches that have gently sloping sides.

- swales are a cost effective and more natural solution to traditional drainage construction
- provide an opportunity to introduce more native species to a site
- the swales can be seeded with a mix containing species suitable for seasonally wet soils

Green corridors/temporary holding ponds for flood waters:

Water Boulevards, a concept developed in England, creates a network of green corridors to manage and passively reduce flooding, integrating Green Infrastructure and Water Sensitive Urban Design into City streets. It can be applied as a **network of green**

corridors to any city at risk of flooding. Water Boulevards is a project by Baharash Architecture.

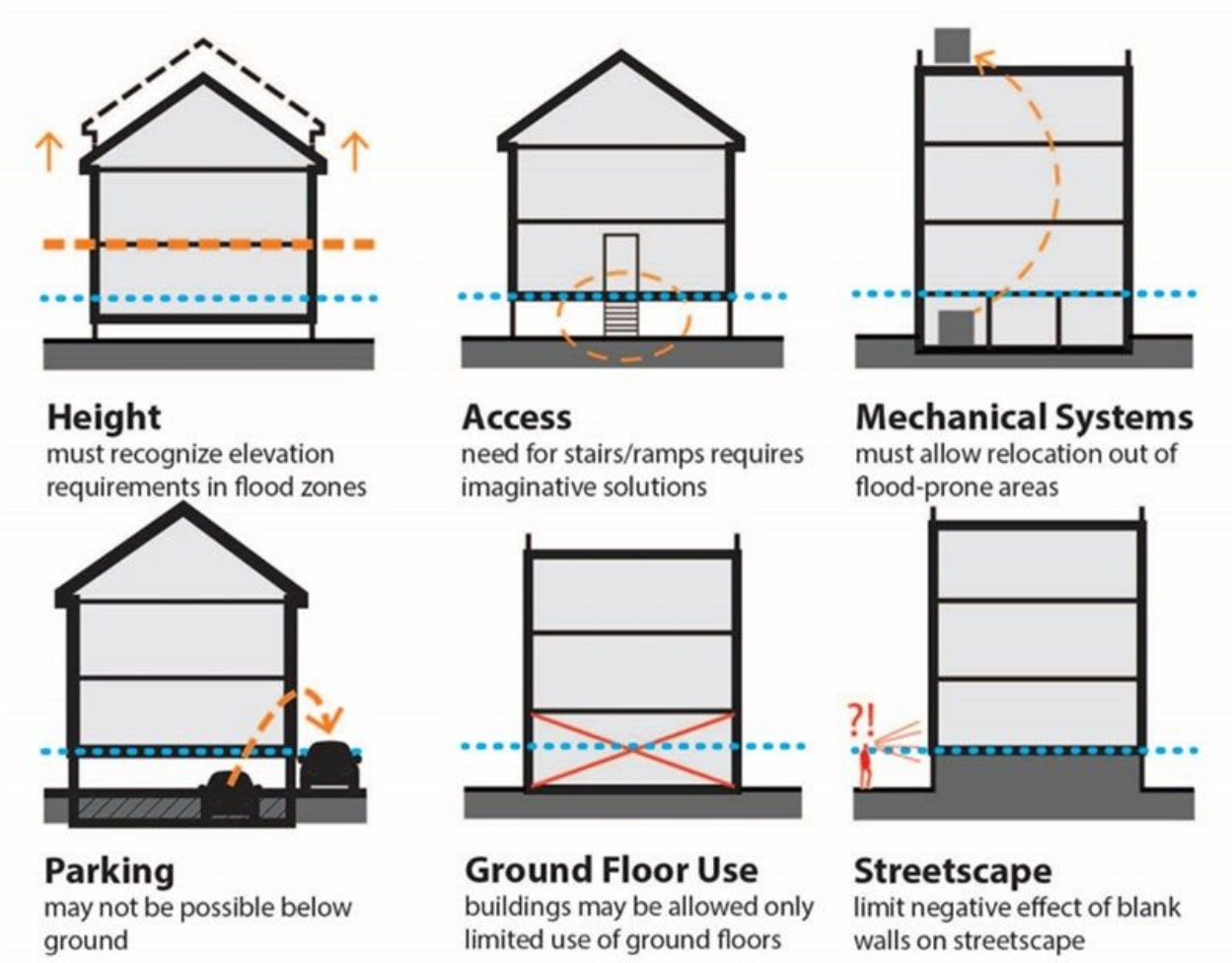
[vimeo 120477342 w=640 h=360]

Water Boulevards from Baharash on Vimeo.

Parks as water holding areas:

Parks can be designed to double as a water holding area during a flood event. Parks, designed like this one in Copenhagen, allow recreational areas like skate parks to become temporary holding ponds for flood waters:

Mechanical and electrical equipment protection during flood events:

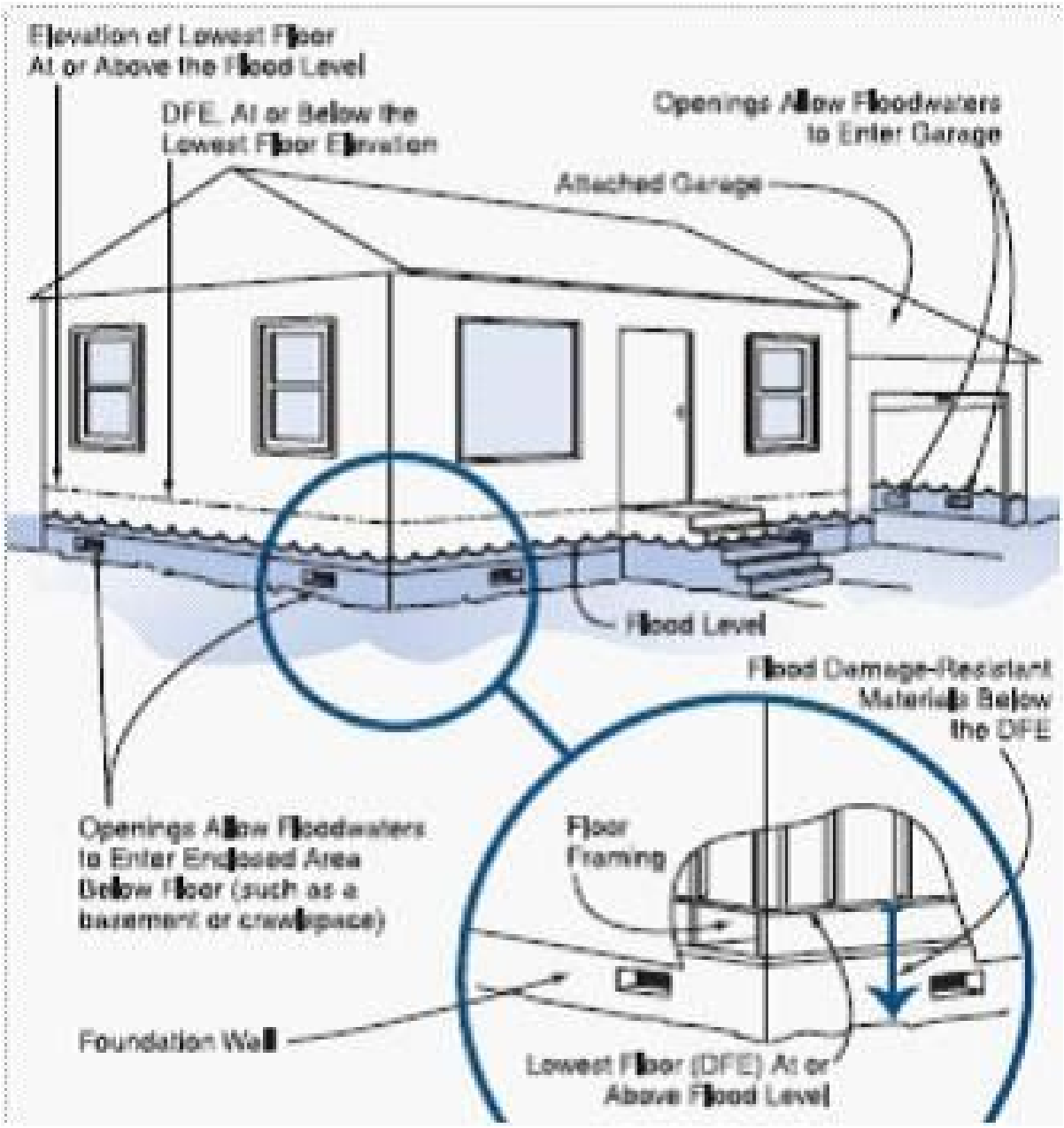


- Mechanical and electrical equipment such as HVAC, boilers, and water heaters should also be relocated above BFE whenever possible. It is important not only to protect the equipment from flood damage, but also to prevent gas and oil from mixing with flood water contributing to other environmental risks.
- In flood prone areas the main lines should be run through the ceiling or upper wall then down to switches and outlets set at mid-wall height. Any wiring installed below the BFE must be water-resistant

Two approaches to floodproofing buildings: Wet and Dry:

Wet floodproofing:

- allows buildings in the flood zone to be designed to allow floodwaters to enter and leave the structure without the use of any mechanical equipment.
- Spaces that are below grade on all sides are prohibited, and the lowest occupiable floor is required to be elevated above the BFE
- To prevent the collapse of building walls, a wet-floodproofed building allows for the equalization of hydrostatic forces on both sides of the wall during a flood event. This is achieved with openings at the ground level called flood vents see Orla Studios Guide to Flood Vents
- All emergency exit stairwells and corridors shall be wet floodproofed and designed with hydrostatic openings (flood vents) to maintain the operation of the exit door. Emergency exits must open at grade. Evacuation points from elevated floors are not acceptable as emergency exits.



Dry floodproofing:

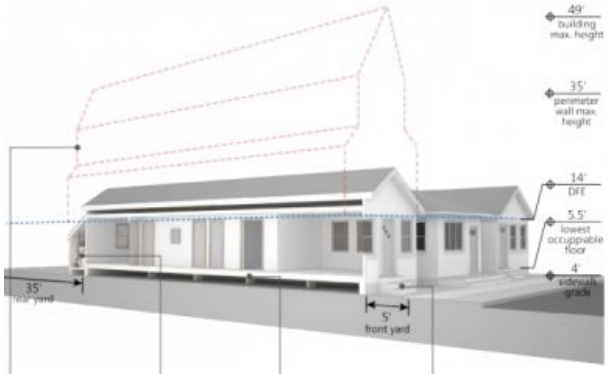
- Dry floodproofing makes a structure watertight up to at least the level of the BFE through the implementation of sealants, flood shields, aquarium glass and strengthening structural components to resist hydrostatic forces from floodwaters, and protecting utilities from flood damage
- Unlike wet floodproofing, the first floor of a dry-floodproofed structure can be at an elevation below grade or below the base flood elevation.

- Through **dry floodproofing, building access can be maintained at grade with no apparent differences from a non-floodproofed condition**
- Any of these conditions will generally entail higher construction costs. **Dry floodproofing can present safety hazards during a flood event by blocking egress, so it is not allowed in entirely residential buildings**

EXISTING CONDITIONS

FLOOD ELEVATION

14' DFE = BFE + freeboard
= 8.5' above lowest occupiable floor
= 10' above lowest property grade



ZONING ENVELOPE

The allowable building height is measured from the DFE.

The existing building has non-compliant front and side yards, and does not provide required parking. These non-compliances must be considered when retrofitting.

The floor area is not maximized. 200 square feet can be added pursuant to underlying floor area ratio and within the adjusted bulk envelope.

CRITICAL SYSTEMS

All systems are located in a rear enclosure below the DFE.

STRUCTURAL SYSTEMS

Single story wood frame combustible construction type on shallow unreinforced masonry foundation. The wood structure is not sufficiently tied to the foundation.

ACCESS

Building access is provided at the front and rear entrances 1.5' above the sidewalk grade.

ILLUSTRATIVE RETROFIT STRATEGY

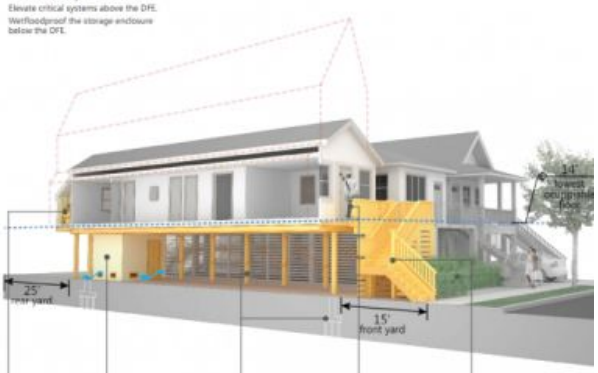
BUNGALOW

ELEVATE & WET FLOODPROOF

Elevate the existing structure on a new foundation system to bring the lowest occupiable floor above the DFE. To accommodate access to the elevated structure, shift the existing building footprint back from the front property line into the rear yard.

Elevate critical systems above the DFE.

Wetfloodproof the storage enclosure below the DFE.



CRITICAL SYSTEMS

Elevate systems above the DFE within a fireproofed and vented accessory structure at the rear.

USE

There is no loss of usable space because the existing home is elevated in place.

If loss of usable space occurs by relocation of access or critical systems within habitable space, that loss of usable floor area can be recaptured as an addition within the permitted bulk envelope. The existing non-compliant yards remain.

The wet floodproofed area below the structure may only be used for vehicular parking, crawl space, storage or access.

STRUCTURAL SYSTEMS

Elevate the structure on columns with a spread footing foundation system. Piles may be required depending on soil conditions or by the flood hazard area designation.

Elevate the accessory structure containing the critical systems on structural columns.

Insulate and fireproof underside of lowest floor to enclose building envelope.

ACCESS

The building entrance is relocated to 10' above grade. The stairs may be located underneath or adjacent to the structure depending on available yard space and clearance underneath the structure. Here the building is shifted towards the rear property line to accommodate the stair run and porch depth.

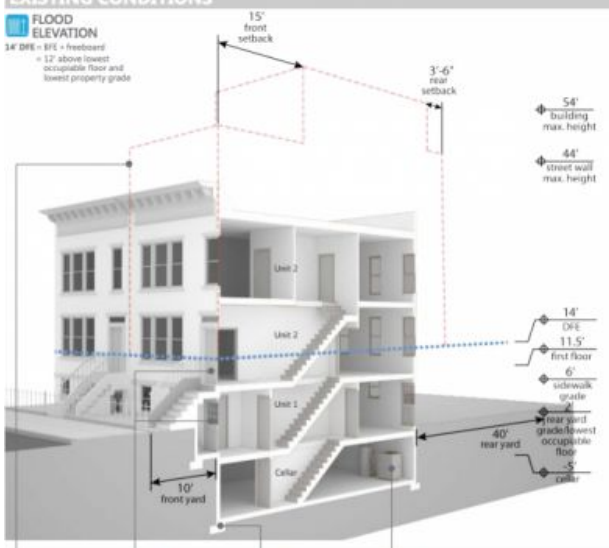
STREETSCAPE

As per the Zoning Resolution, homes elevated over 5' above the sidewalk grade require one streetscape mitigation, and over 9' require two. These enhancements can be selected from a list of options specified in the Zoning Resolution, such as: plantings, covered and uncovered porches, stairs with 90-degree turns, or elevated front yards.

EXISTING CONDITIONS

FLOOD ELEVATION

14' DFE = BFE + freeboard
= 12' above lowest occupiable floor and lowest property grade



ZONING ENVELOPE

The allowable building height is measured from the DFE.

The floor area is overbuilt, which is an existing non-compliance. Zoning allows the relocation of existing non-compliant floor area to above the DFE within the adjusted bulk envelope.

ACCESS

Building access is provided at two front entrances, one located 5' above sidewalk grade and the second located 4' below sidewalk grade.

The building access at the rear yard is provided at rear grade, 4' below the sidewalk grade.

STRUCTURAL SYSTEMS

Three-story combustible construction with unreinforced masonry bearing party-walls and wood joist on a rubble foundation.

CRITICAL SYSTEMS

All systems are located in the cellar.

ILLUSTRATIVE RETROFIT STRATEGY

ATTACHED

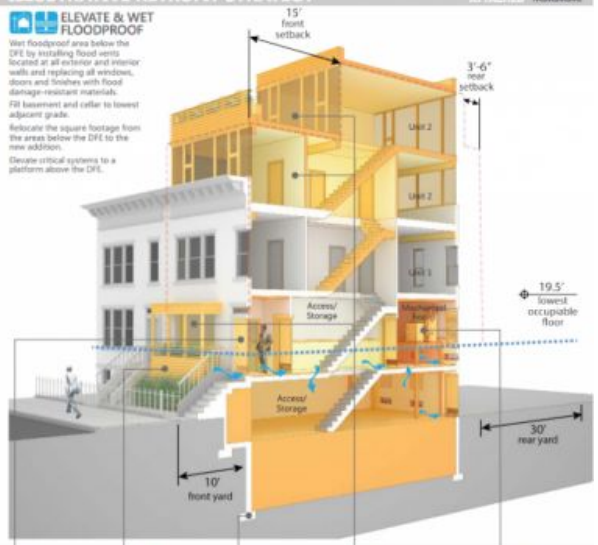
ELEVATE & WET FLOODPROOF

Wet floodproof area below the DFE by installing flood vents located at all exterior and interior walls and replacing all windows, doors and finishes with flood damage-resistant materials.

Fill basement and cellar to lowest adjacent grade.

Relocate the square footage from the areas below the DFE to the new addition.

Elevate critical systems to a platform above the DFE.



ACCESS

All doors below the DFE are required to be wet floodproofed by installation of flood vents.

Modify the height of the front and rear building entries at the adjusted lowest level.

Existing entrance at the front stairs to remain. Interior layout of this entrance reconfigured to accommodate the new vestibule and front porch.

STREETSCAPE

Add plantings and porch to fulfill the zoning streetscape mitigation requirements.

Replace windows at streetwall elevation below the DFE with flood damage-resistant materials and install planters in front of the facade.

STRUCTURAL SYSTEMS

Remove existing floor plate and slab, and fill the cellar and basement to lowest adjacent grade. Add reinforcement to the foundation walls. If the adjacent properties are not infilling their shared party wall areas, reinforce the foundation walls to account for new load.

New addition at roof and platform for critical systems require additional structural support.

USE

Relocate uses from the basement level and first level to the two story addition.

Convert first level to porch, storage, access and mechanical room.

The building remains 2-family. Relocate the garden level unit to the second story and the duplex unit to the new third and fourth stories.

New entry vestibule to allow for reconfigured circulation.

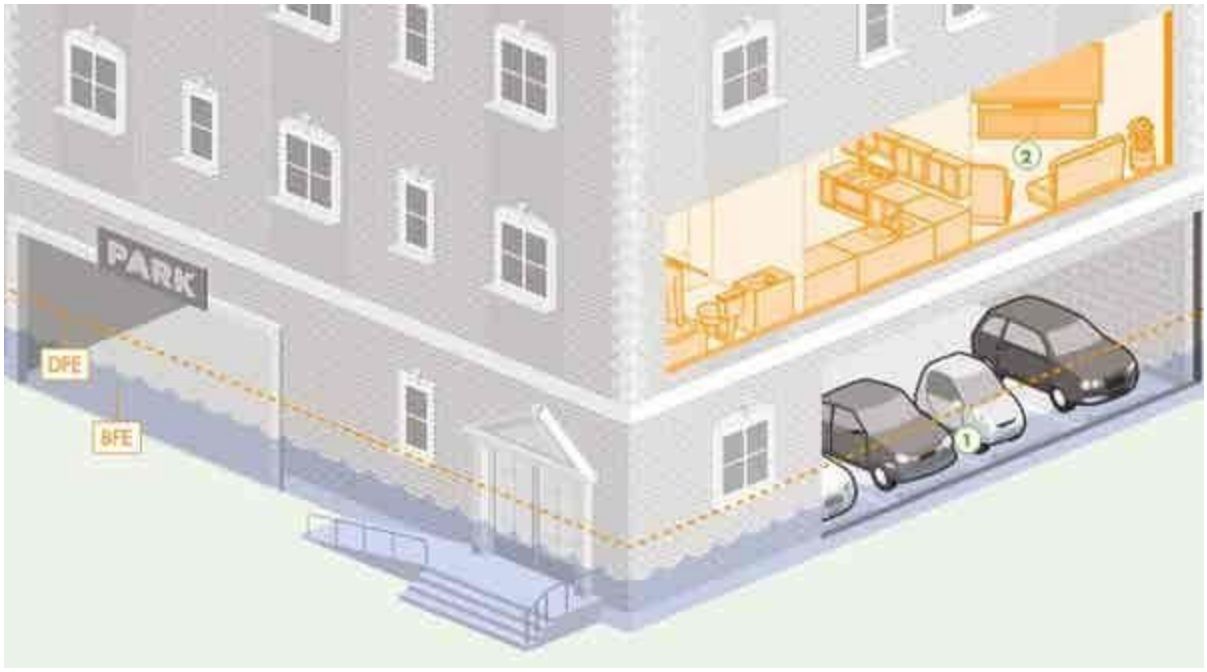
There is a total loss of 370 s.f. of floor area due to reconfigured unit and new interior access layout.

CRITICAL SYSTEMS

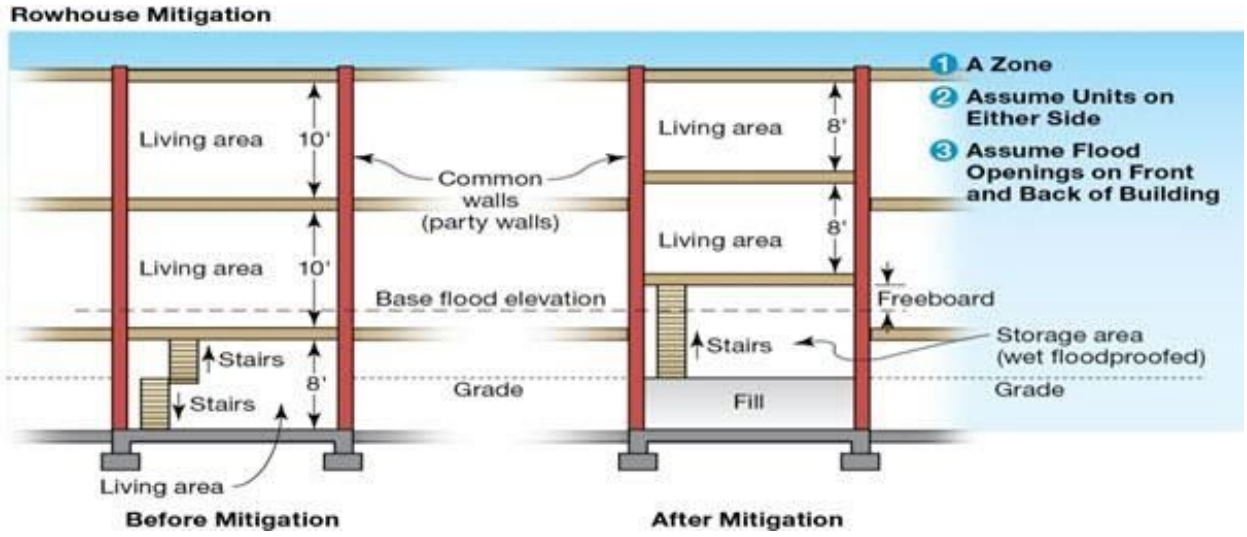
Elevate systems on a platform above the DFE within new fireproof and vented mechanical room.

Install sump pump with an emergency battery pack and discharge above the DFE.

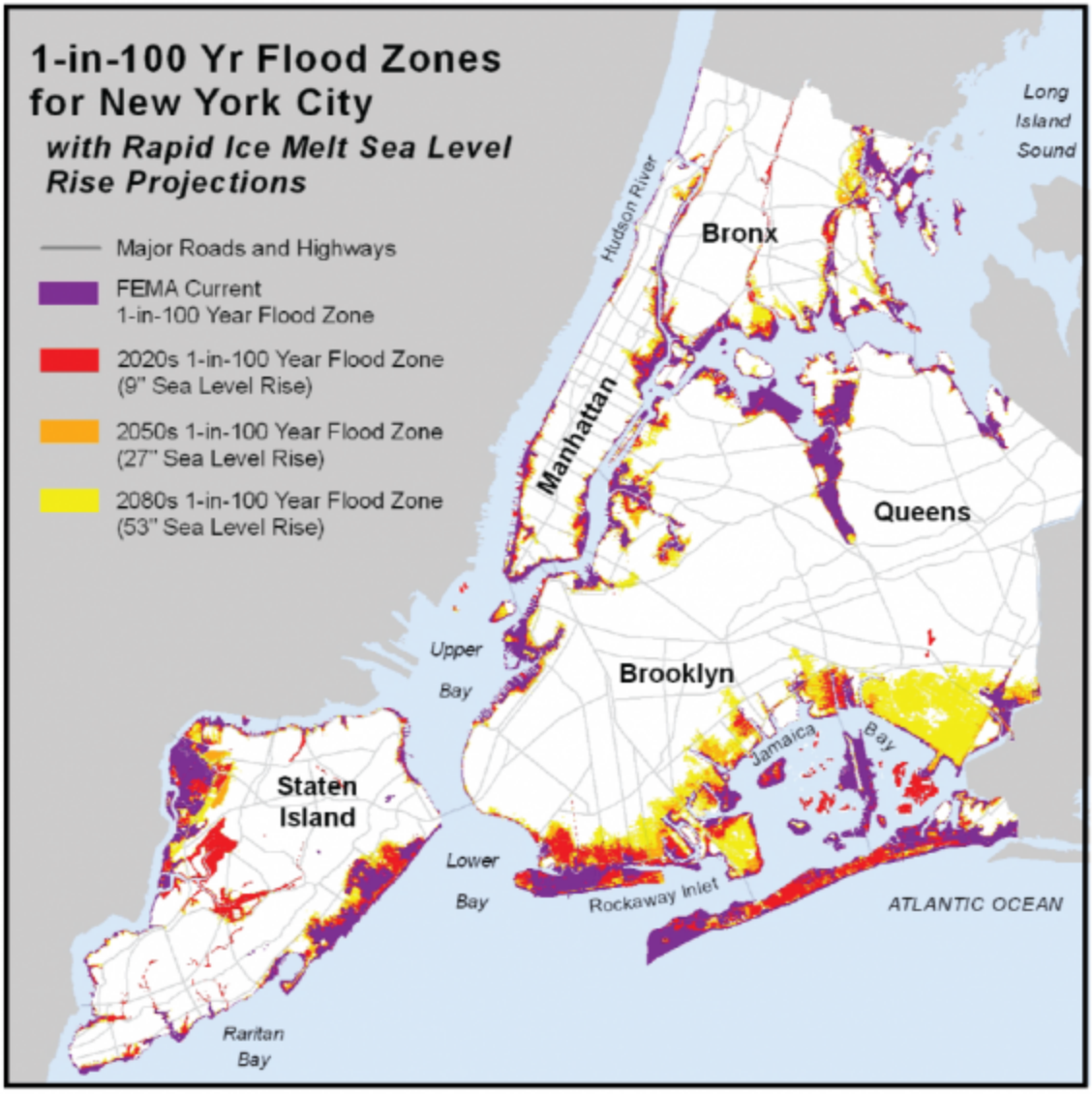
New building height requires installation of sprinkler system.



As a fairly common practice in New York City, new mixed-use buildings in A zones have **combined wet and dry floodproofed areas** at the ground floor. With this solution, portions of the building are sealed at the ground floor to keep floodwaters out, **while lobbies and entryways are designed to accommodate flooding**



New York City and Sea Level Rise



Flood and Hurricane proof skyscraper in NYC:

"In **American Copper Apartments**, (above) developers decided to fortify the two towers with features that would mitigate the effects of a hurricane, including **a flood resilient basement and lobby and a park that doubles as a bioswale.**

Mechanical equipment that would typically be found in the basement — such as generators, electrical switchgear, and pumps — **is on the second floor, above the flood line"** writes **Lauren Young of Science Friday,**

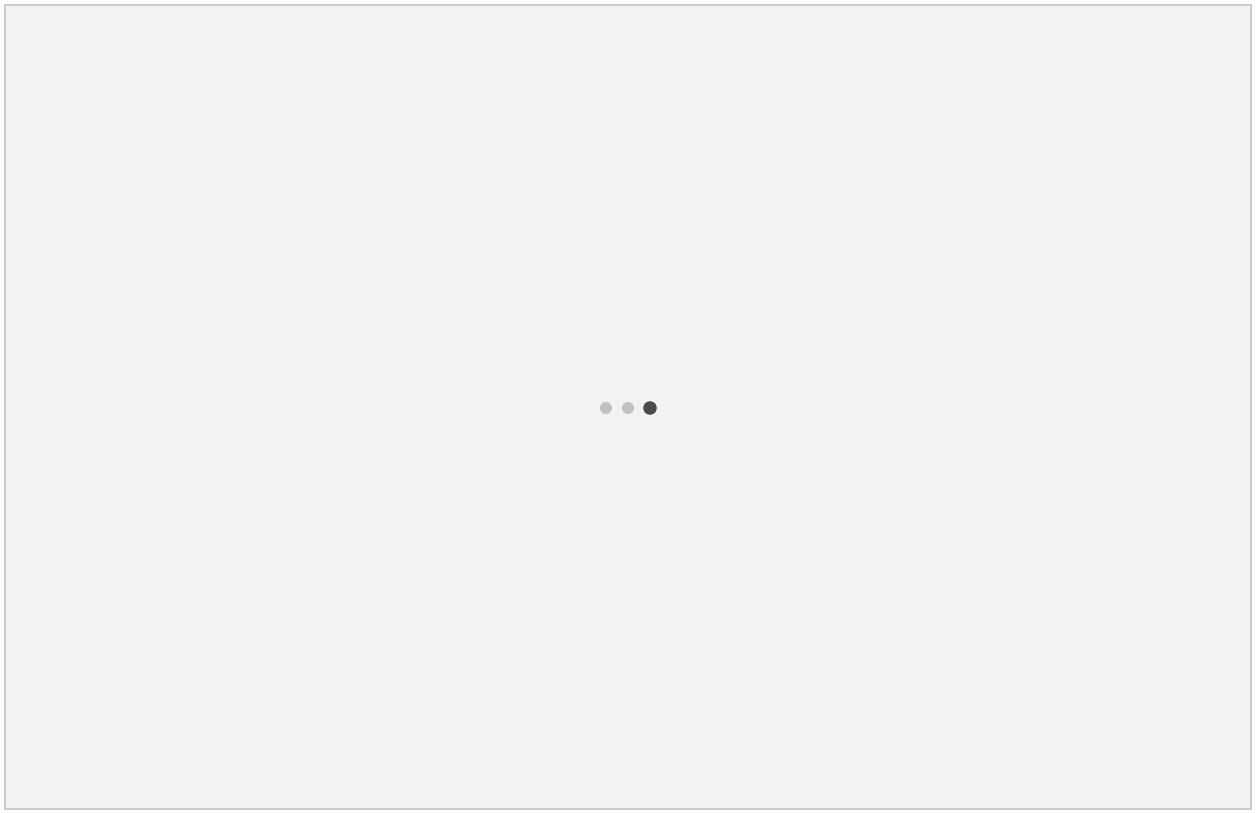
Nearly 2 million people were left without power during the Sandy storm in NYC, and some were living in buildings for no power for a week, **the developer of these apartments elected to put things like water pumps, elevators, lights, electrical charging outlets and people's refrigerators on emergency power generators.**

Full article about American Copper:
https://www.sciencefriday.com/articles/building-flood-proof-skyscraper-resilient-climate-change/

Helping neighborhood vibrancy when first floors need to be elevated above base flood plain:

- A **planting buffer with shrubs or trees,** combined with other façade treatments such as vertical articulation, can mitigate limited ground-floor activity
- Architectural elements like turns in an entry stair, **porches or decks for one and two family buildings can mitigate the distance between grade and the first occupied floor of a building**, introduce an additional horizontal visual feature

that gives the façade more of a pedestrian scale, and bring “eyes on the street” with a semi-private space closer to the sidewalk



- **Access elements such as stairs and ramps can be integrated into the landscaping** to make a more seamless transition from sidewalk to building. Grading should be designed that does not create drainage problems for adjacent properties

Coastal community planning and development codes need to be updated immediately:

- Planning and zoning could be modified allowing for additional flexibility to raise yards and building heights to resolve the difference between existing grade and BFE, making it possible to resolve the height differential between them

RESOURCES:

San Francisco has a Model for Grant Assistance for Flood Preparation:

The San Francisco Public Utilities Commission (SFPUC)'s Floodwater Grant Program ("Grant Program") helps property owners in San Francisco minimize the risk of property damage due to flooding. They encourage Residents to take advantage of the Grant Program which reimburses flood victims who want to install improvements like doorway seals, flood gates or plumbing upgrades to lessen or prevent future flood damage. More info here:

https://sfwater.org/index.aspx?page=681

New Jersey Excellent Guide to Resilient Building Design:

http://www.hobokennj.gov/docs/communitydev/Resilient-Buildings-Design-Guidelines

For Cities trying to protect Utilities and Wastewater plants, excellent guide from US Environmental Protection Agency:

https://www.epa.gov/sites/production/files/2015-08/documents/flood_resilience_guide.pdf

New York Cities Video about their flood resilience strategies:

[youtube https://www.youtube.com/watch?v=6QJYgm0fRHk]

[youtube https://www.youtube.com/watch?v=cFEJJFsDpvI&w=560&h=315]

Orla Huq

#flood #floodplanning #floodvent #resilientarchitecture #greendesign #sustainable #resilientbuildings #flooddesign #retentionponds #flooding #wetproofing #dryproofing