

The mid-rise walkup case study described here is a multi-story unreinforced masonry structure with masonry rubble foundation. Because the structure is so large and in such close proximity to the neighboring building, it is unsuitable for elevation.

Retrofit strategies that will result in full NFIP reduction in flood insurance premiums require filling the basement to the lowest adjacent grade and wet floodproofing below the DFE, leading to the loss of two units, additional first level floor construction and the reconfiguration of the entry vestibule. The loss of 20 percent of the building's units exemplifies the implications and limitations of existing federal regulations when applied to urban typologies. This strategy also requires structural reinforcement to allow filling the basement, adding a new floor to the existing first level, relocating

the critical systems to a new mechanical room, and building an addition on the roof, where a portion of the lost residential square footage can be replaced. It also requires a fire-rated separation at the new mechanical room.

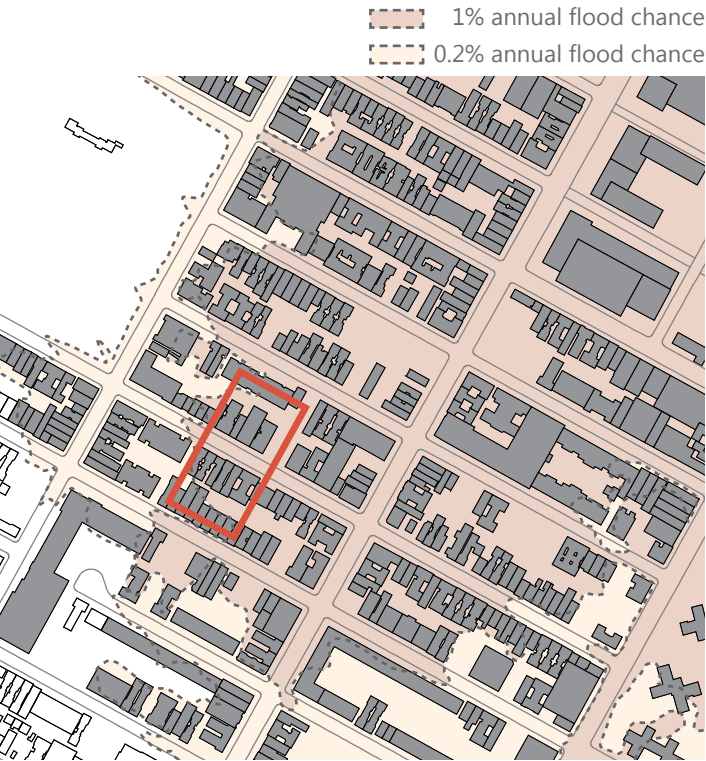
Alternative adaptation strategies, currently not recognized by NFIP, include leaving existing residential uses in the basement and first floor, wet floodproofing below the DFE, and enclosing the critical systems within a floodproof enclosure.

Partial adaptation is limited to elevating or dry floodproofing the critical systems in place.

All floodproofing solutions require assessment of the building's structural integrity and a thorough consideration of the implications for neighboring buildings.

KEY CHARACTERISTICS

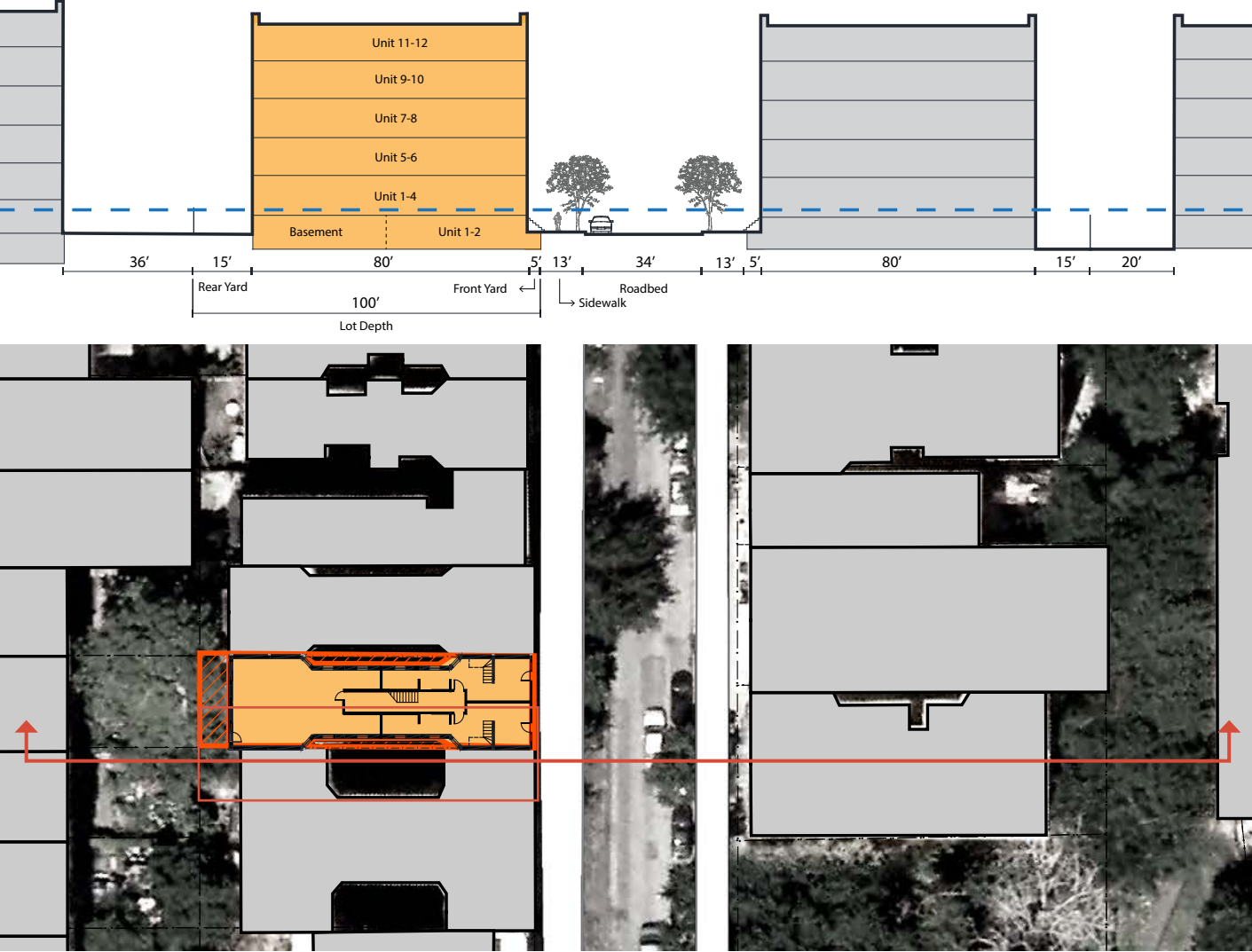
FLOOD RISK	
Flood Zone/BFE	AE +11'
Grade Elevation	+2' at sidewalk and property
Design Flood Elevation (DFE)	+12' (10' above sidewalk grade)
Lowest Occupiable Floor	- 2' (4' below sidewalk grade)
Cellar Elevation	- 2' (4' below sidewalk grade)
Critical Systems Location	Basement
TYPOLOGY	
Lot Size	25' x 100'
Building Size	25' x 80'
Yards	5' front; 15' rear
Construction Type	Masonry with wood joists
Foundation Type	Rubble
Year Built	1900
Stories	5 + basement
Residential Floor Area	11,000 s.f.
Residential Units	10 single story, 2 duplex
Elevator	N/A
SITE CONDITIONS	
Sidewalk Width	13'
Roadbed Width	34'
Zoning District	R8B, Residential



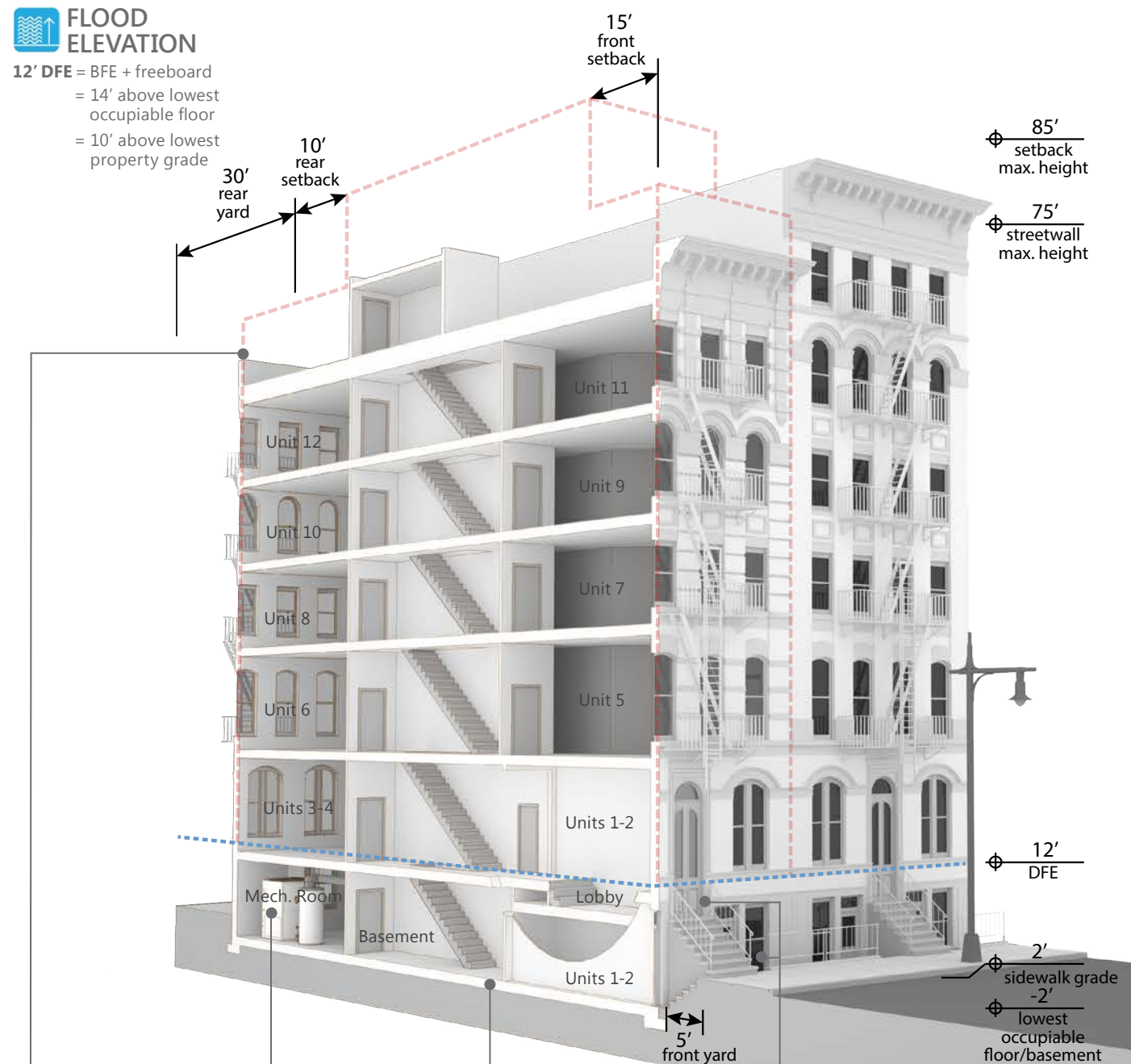
SITE & BUILDING CONDITIONS

SITE CONDITIONS
Sites with narrow lot size and shallow rear yard depth. Rear yards typically range from 0 to 6 feet below the sidewalk grade. No side yards are provided, and streets and sidewalks are typically of standard width.

BUILDING TYPOLOGY
Buildings are four to six-story unreinforced masonry bearing walls with wood joists and rubble foundation. Vertical circulation is provided by stairs and egress is provided by fire escapes. Critical systems are located in the basement/cellar. Entrances located above and below the sidewalk and property grade.



EXISTING CONDITIONS



ZONING ENVELOPE

The allowable building height is measured from the DFE.
 The building has a non-compliant rear yard.
 The building is built to the maximum allowable floor area. To comply with the Zoning standards, the floor area below the DFE can be relocated within the adjusted bulk envelope.

CRITICAL SYSTEMS

All systems are located in a mechanical room in the basement.

STRUCTURAL SYSTEMS

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

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 3' below the rear yard grade.

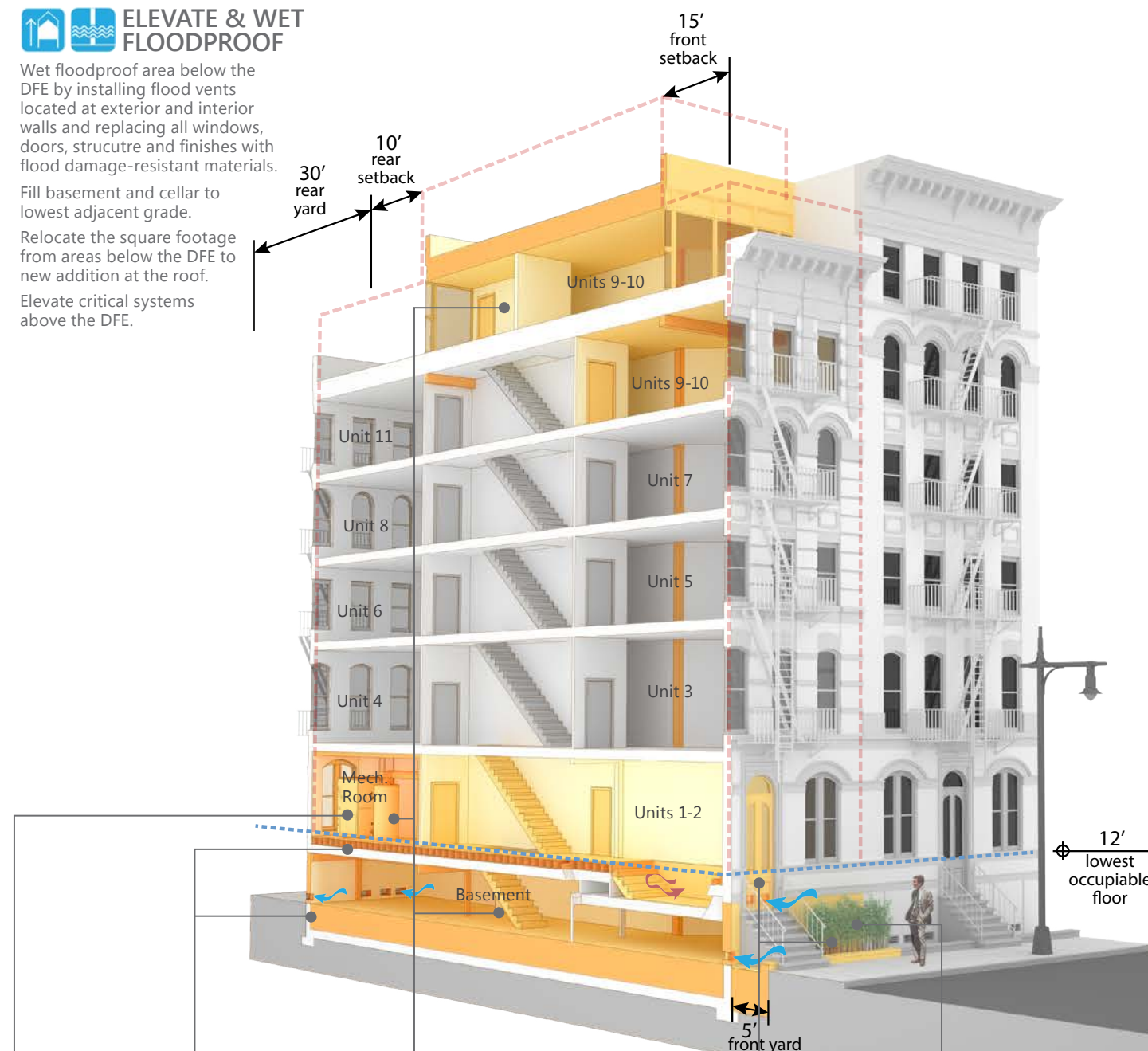
ILLUSTRATIVE RETROFIT STRATEGY

MID-RISE WALK-UP



ELEVATE & WET FLOODPROOF

Wet floodproof area below the DFE by installing flood vents located at exterior and interior walls and replacing all windows, doors, structure and finishes with flood damage-resistant materials.
 Fill basement and cellar to lowest adjacent grade.
 Relocate the square footage from areas below the DFE to new addition at the roof.
 Elevate critical systems above the DFE.



CRITICAL SYSTEMS

Elevate systems on a platform above the DFE within a fireproof and vented mechanical room.
 Isolation and/or vibration pads may be required.

STRUCTURAL SYSTEMS

Fill basement to lowest adjacent grade. Reinforce foundation walls as required in basement, where fill is added. If adjacent properties are not infilling their shared party wall areas, reinforce the foundation walls to account for new load.
 New addition at the roof and the platform for the critical systems require additional structural support.

USE

Basement level becomes crawl space and storage, if clearance permits.
 Relocate basement level duplex unit to new addition, reconfigure existing 5th floor single story unit as a duplex unit.
 Relocate critical systems to first story, reconfigure unit as required.
 Reconfigure entry vestibule to accommodate required size for wet floodproofing.
 Raise existing first floor level to the DFE by installing additional stairs and floor construction.
 Loss of 1,200 s.f. due to relocation and reconfigured units.

ACCESS

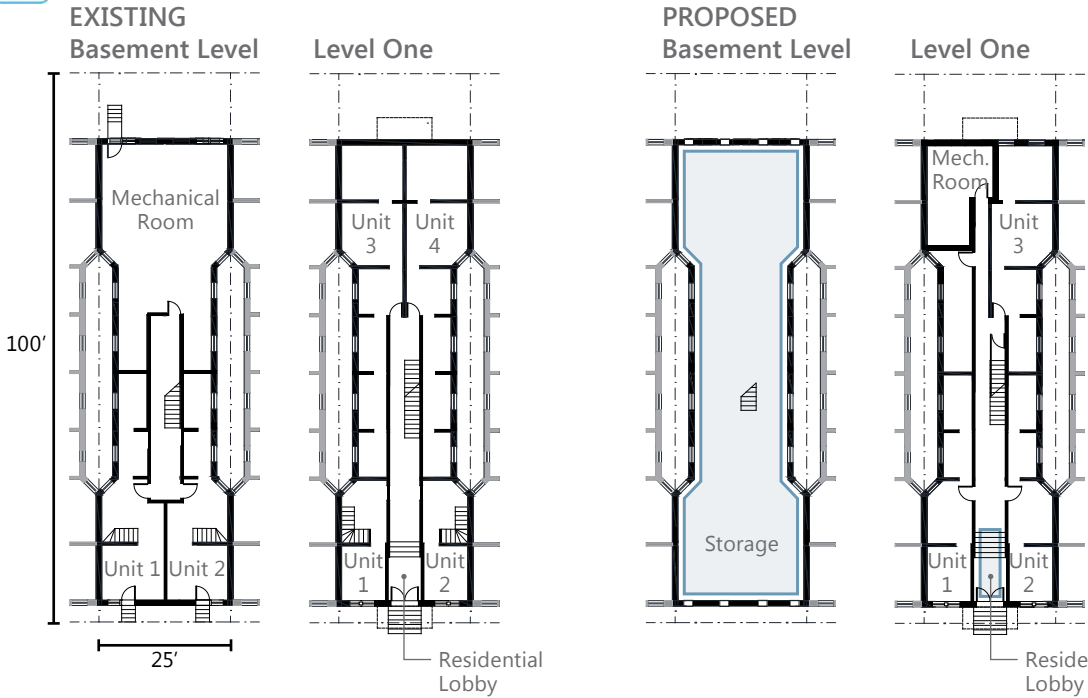
Remove the door below sidewalk grade and infill with flood damage-resistant building materials.
 Additional stairs at lobby to meet new first floor elevation.
 Add rear access above the DFE adjacent to the mechanical room.

STREETSCAPE

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



CHANGE OF USE



Basement Level
New storage and crawl space. Fill to lowest adjacent grade. Loss of mechanical room and occupiable space of two units.

Level One
Level one becomes the lowest occupiable floor.
New mechanical room within existing structure for elevated critical systems.
Loss of one rear unit to new mechanical room. Convert and reconfigure two front units from duplex to single-story.
Residential lobby remains; reconfigure per wet floodproofing requirements.

Level Six (New)
Relocate lost occupiable floor area from the basement level to the new addition.

ADAPTATION CONSIDERATIONS



CRITICAL SYSTEMS

It is important to consider the weight of the mechanical equipment on the building structure when elevating equipment to a higher floor. The additional load may require structural reinforcement of the space where the equipment is being relocated.

Oil- or gas-fueled boilers, furnace and water heaters require adequate combustion air and venting of exhaust gases. Venting and fire-rated enclosure requirements may affect if and how equipment can be elevated.

Before relocating equipment, ample consideration must be given to minimum clearances required for equipment, conduits, piping and duct work in order to maintain the horizontal and vertical clearances as required by building code, the National Electric Code and as recommended by manufacturers. Designing for the minimum clearance is important to maintain air circulation; to meet insurance or code requirements related to the equipment's requirements; and to maintain distance from combustible building materials. The use of heat shields as specified by code may reduce clearance requirements. Failure to maintain clearances can result in safety issues, such as fire, and can void equipment warranties.



ACCESS & STREETScape



NON-SUBSTANTIAL DAMAGE/IMPROVEMENT STRATEGIES

Non-substantially improved buildings within the floodplain are not required to comply with Appendix G of the NYC Building Code. This allows for greater flexibility in adapting buildings for flood resiliency. The alternatives illustrated below lower the risk for buildings and provide practical pathways for adaptation. Under current NFIP regulations, these measures may not lower insurance premiums.

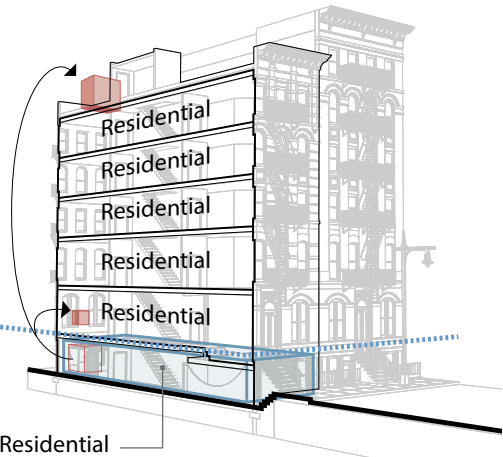
The blue icons below illustrate adaptive measures that receive full reduction of NFIP premiums. Icons in gray indicate strategies that improve building resilience, but receive no or partial reduction of NFIP premiums.

If the lowest occupiable floor is left below the DFE, life safety must be considered. Residents should always follow evacuation procedures.

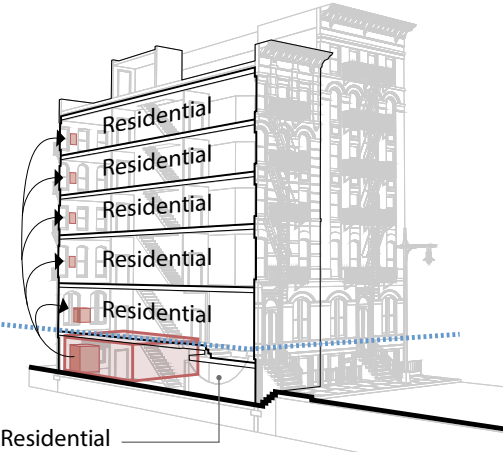
- Occupied Space
- Critical Systems
- Dry Floodproof
- Wet Floodproof
- Open Structure
- NFIP Premium Reduction

- Elevate critical systems above the DFE.
- Wet floodproof below the DFE. Install flood vents and replace all windows, doors and finishes with flood damage-resistant materials.
- All residential uses remain. Convert mechanical room to storage.
- Add structural support for relocated critical systems.
- Relocate critical systems to the roof within a fire-rated and vented enclosure. Raise electrical utilities above DFE at building rear.

No or partial reduction in NFIP premiums. The structure is not filled to the lowest adjacent grade. Wet floodproofing is not permitted at residential use. Lowest occupiable floor is below the DFE.



No or partial reduction in NFIP premiums. Critical systems remain located below the DFE and the structure is not filled to the lowest adjacent grade. Dry floodproofing is not permitted at residential use. Lowest occupiable floor is below the DFE.



- Dry floodproof partial basement level at mechanical room.
- Residential use at basement and level one remains below the DFE.
- Add reinforcement to party-walls, exterior walls and foundation slab at dry floodproof enclosure, and ensure changes do not impact neighboring property's structural integrity.
- Critical systems to remain in place within dry floodproofed mechanical room. Provide emergency shut off above the DFE. Install in-unit hot water systems at each residential unit.