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 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)
- 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
**EXISTING CONDITIONS**

**FLOOD ELEVATION**
12’ DFE = BFE + freeboard
= 14’ above lowest occupable floor
= 10’ above lowest property grade

**REAR SETBACK**
30’ rear setback

**FRONT SETBACK**
10’ front setback

15’

**15’ front setback**

**85’ setback max. height**

**75’ streetwall max. height**

**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**

**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.

**USE**
Basement level becomes crawl space and storage, if clearance permits. Relocate the square footage from areas below the DFE to new addition at the roof. Elevate critical systems above the DFE.

**ILLUSTRATIVE RETROFIT STRATEGY**

**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.

**STREETSCAPE**
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.

**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.

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

**CRITICAL 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.

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

**USE**
Basement level becomes crawl space and storage, if clearance permits. Relocate basement level duplex unit to new addition at the roof. Elevate critical systems above the DFE.

**STREETSCAPE**
Replace windows at the streetwall elevation below the DFE with flood damage-resistant materials and install planters in front of building facade.
**RETROFIT FLOOR PLAN**

### CHANGE OF USE

**EXISTING**

- Basement Level
- Level One

**PROPOSED**

- Basement Level
- Level One

**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 meet insurance or code requirements related to the equipment's requirements; and to maintain 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 meet insurance or code requirements related to the equipment's requirements; and to maintain manufacturers.

**ACCESS & STREETSCAPE**

**RETROFIT FLOOR PLAN ALTERNATIVE STRATEGIES**

- **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.

### MID-RISE WALK-UP

**ACCESS & STREETSCAPE**

- Elevate critical systems above the DFE.
- Wet floodproof partial basement level at mechanical room.
- 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.

**RENOVATION**

- 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.