RESILIENCY + PRESERVATION

ADAPTING TO SEA LEVEL RISE

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Case Study: South Beach, Miami Beach
Multi-Family Residential

Prepared and presented by The University of Miami's Center for Urban & Community Design at the School of Architecture in collaboration with the Department of Civil, Architectural, & Environmental Engineering and the City of Miami's Historic Resources Division

SOUTHEAST FLORIDA VULNERABILITIES - PAST & PRESENT

Hurricane Andrew struck Dade County on August 24th, 1992, as a Category 5 hurricane. The devastating storm triggered roughly $25 billion in damage. Among the estimated 49,000 destroyed and 108,000 damaged homes (National Weather Service, 2012) were many treasured historic buildings. The extensive structural damage from Hurricane Andrew gave rise to improved building codes and practices in South Florida. Some of the important changes included wind provisions from a national standard, impact resistant glazing requirements, and positive ties at all connections to resist uplift forces. Today, the Florida Building Code is considered amongst the best in the nation.

Given Southeast Florida's geographical location, the region remains at risk to hurricanes and flooding events. In light of a warmer and expanding ocean, the region is even more vulnerable, as identified by the United Nation's Intergovernmental Panel on Climate Change (IPCC), the US Army Corp of Engineers (USACE) and the Southeast Florida Regional Compact (SEFRC).

More intense and frequent weather events are expected over time, as are the rise of sea levels, sunny-day flooding (daylight flooding), storm surges, and the increase of subsurface hydrostatic pressure (IPCC, 2007). Snap-shots of the future are readily available in low-lying barrier islands and inland areas, where swamps were previously located.

Weather patterns are shifting, and with them the risks faced by developments far and wide, especially in Southeast Florida, including Miami Dade County, given its coastal and riverfront settings; coincidently, many are home to historic neighborhoods and buildings, that in turn anchor its rich cultural legacy and identity.

Developing resilience guidelines can help historic property owners and infill developers adjust to changing paradigms ensuring both responsible adaptation and sensible future growth. Each intervention by a property owner represents an opportunity to reduce disaster-related risks, increase community resilience, enhance livability and walkability, and protect natural and historic resources. This pamphlet is part of a series aimed at property owners in neighborhoods throughout Miami Dade County.

Resiliency and sustainability are two closely associated terms. Both indicate a community's capacity to "tolerate—and overcome—damage, diminished productivity, and reduced quality of life from an extreme event without significant outside assistance." (Mileti, 1999)
Adaptation refers to "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderately harm or exploits beneficial opportunities." (Institute for Sustainable Communities, 2012)
Mitigation refers to limiting the scale and rate of long-term climate change. By contrast, adaptation focuses on managing impacts of a changing climate. (Institute for Sustainable Communities, 2012)

KEY CHARACTERISTICS
Miami Beach Zoning + Average Flood Risk

ZONING:

South Beach hosts a variety of zoning typologies that range from RS-1 (single family housing) to CD-3 (high intensity comerical). The primary focus of this pamphlet will be multi-family residential. (RM-1, 2, 3)

FLOOD RISK:

FEMA Flood zone: AE

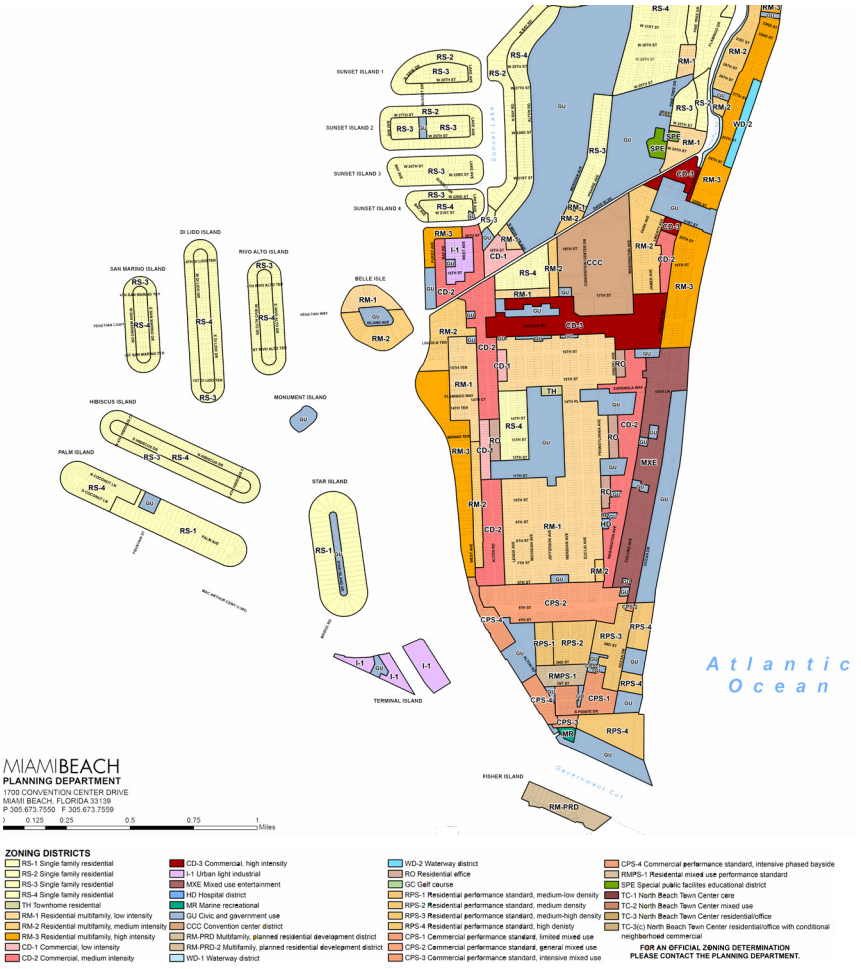
Avg. Elevation at Grade: +5 ft (USGS, NAVD 88)

Avg. Base Flood Elevation: +8 ft (FEMA, NGVD 29)

Avg. Design Flood Elevation: +11 ft (FEMA, NGVD 29)

Avg. Depth to Water Table: -2 ft (FGS FAVA II, MSL)

Projected Sea Level Rise is of great concern. One (1) foot would envelop substantial amounts of shoreline. At two (2) feet, many streets would be impossible to traverse At three (3) feet, the flooding would trespass beyond the streets and into structures.



Source:
"Miami Dade County Elevation Map." USGS Topographic Survey Map. http://www.peakbagger.com/peak.aspx?pid=7934.

FLOOD ZONE TYPES:

Zones with Letters "A" and "V" have a 1-4% chance of flooding during a 30-year mortgage.

Zones with "X", "B", or "C" are considered moderate to low risk of flooding during a 30-year mortgage, but cannot be completely taken out of the risk zone

Current Conditions

+2FT Sea Level Rise

+3FT Sea Level Rise

IMPORTANT CONCEPTS & LANGUAGE
Glossary of Resiliency Terms

BASE FLOOD ELEVATION (BFE)
The computed elevation in feet to which floodwater is anticipated to rise during the 1% annual chance storm shown on the FIRMs issued by FEMA. A building's flood insurance premium is determined by the relationship between the BFE and the level of the lowest habitable floor of a structure.

DESIGN FLOOD ELEVATION (DFE)
Defined by the Florida Building Code as the elevation to which the lowest habitable floor must meet or exceed which is the higher of:

1. The BFE at the depth of peak elevation of flooding including wave crest height in the 100-year Floodplain
2. The elevation of the design flood associated with the area designated on a flood hazard map or adopted by the community, or otherwise legally designated.

FLOOD INSURANCE RATE MAPS (FIRMS)
The official flood map, on which FEMA has delineated the 1% Annual Chance Floodplain or Special Flood Hazard Area (SFHA), 0.2% annual floodplain, Base Flood Elevations (BFEs) and flood-ways.

100-YEAR FLOODPLAIN
The area that has a 1% chance of flooding in any given year. It is indicated on FEMA's FIRMs and is also referred to as the "Special Flood Hazard Areas".

LOWEST HABITABLE FLOOR
According to the Florida Building Code, the floor of the lowest enclosed area, including basement, but excluding any unfinished flood-resistant enclosure that is usable solely for vehicle parking, building access, or limited storage.

LOWEST ADJACENT GRADE
Elevation of the lowest natural or re-graded ground surface, or structural fill, abutting the walls of a building.

For more information, visit:
"FEMA Flood Insurance Study Miami-Dade County" No. 12086CV000A, September 11, 2009.
Section R322: Flood-Resistant Construction." Florida Building Code: Residential (2014).
"Coastal Climate Resiliency: Retrofitting Buildings for Flood Risk ". New York City Department of Planning (October, 2014).
"The National Flood Insurance Program." The National Flood Insurance Program | FEMA.gov, www.fema.gov/national-flood-insurance-program.

NFIP
National Flood Insurance Program (NFIP) Federal program that makes flood insurance available to municipalities that enact and enforce floodplain management regulations that meet or exceed the criteria established by FEMA.

NATIONAL FLOOD INSURANCE PROGRAM

Source:
Coastal Climate Resiliency: Retrofitting Buildings for Flood Risk. New York City Department of Planning (October, 2014).

DRY FLOODPROOFING
Involves making a building, or an area within a building, substantially impermeable to the passage of water up to the DFE. Structural components having the capacity to resist specified loads and walls able to resist the penetration of flood water are used below the DFE. Under the NFIP standard, only non-residential buildings can use dry floodproofing.

WET FLOODPROOFING
Allows floodwaters to enter and exit parts of the building below the DFE in order to equalize hydrostatic pressure. This technique relies on the use of flood damage-resistant materials. Parts of the building below the DFE are only to be used for parking, storage, building access or crawl space.

ELEVATE CRITICAL SYSTEMS
Involves elevating electrical & mechanical systems to the BFE or higher.

REINFORCE STRUCTURE
May involve repair, rehabilitation, renovation, or reconstruction of the superstructure and the foundation.

BACKFLOW VALVES & SUMP PUMPS
Backflow valves inhibit flooding from backed-up sewers & sump pumps inhibit flooding from groundwater.

FLOOD VENTS & BREAKWALLS
Both wetproofing methods allow flood water to enter & exit crawlspace or structural enclosures below the BFE.

ELEVATE: FILL & RAISE SITE
Requires raising the existing structure to a new grade & filling in the area beneath with soil, gravel, or crushed stone. This will increase ground elevations or change soil properties.

ELEVATE: RAISE BUILDING
Elevating the lowest habitable floor of a building above the DFE and floodproofing any structure below the DFE.

ELEVATE: ABANDON LOWEST FLOOR & WET FLOODPROOF
Involves wetproofing and abandoning any habitable floors below the DFE. Involves wetproofing and abandoning any habitable floors below the DFE. In some jurisdictions across the country, Floor Area Ratios (FAR) on a site are being adjusted in light of this adaptation option. In others, where the threat of flooding may be more eminent or severe, Transfer of Development Rights (TDR) mechanisms are being introduce to lighten the burden on property owners.

NGVD 29
The National Geodetic Vertical Datum of 1929 is the datum, or established starting point, for surveyors and engineers to measure ground and flood elevations for most of the 20th century. It was presumed to reflect the average national sea level, though it later became evident that no such average exists. *Note: The new FEMA maps are in NAVD 88; as such, the NGVD 29 is being phased out.

NAVD 88
The North American Vertical Datum of 1988 is the datum, or established starting point, for surveyors and engineers to measure ground and flood elevations that corrects many of the problems of the NGVD 29 by accounting for gravitational forces in different areas. It is the standard vertical orthometric datum used in most recent surveys and flood maps.

MIAMI BEACH & ART DECO

Art Deco made its debut at the "1925 Paris Exposition des Arts Decoratifs et Industriels Modernes." It offered a reconciliation between the decorative arts and the advancements in technology and industry. The style took inspiration from both past and future, utilizing ancient Egyptian and Mayan cultural motifs as well as modern industrial symbols. Art Deco buildings were typically angular and clean, with rectangular, blocky, stepped-back facades, and symmetrical or asymetrical massing. There was a strong emphasis on vertical orientation and doorways and entrances were often surrounded by elaborate ornamentation. Decorative elements included geometric patterns, symbols, abstracted natural forms, patterned terrazzo, glass block, and etched glass. Miami Beach gave rise to a unique form of Art Deco, which employed nautical themes as well as tropical floral and fauna motifs. Ocean liners, palm trees, flamingos, pelicans, astrological symbols and numerous related elements graced the exteriors and interiors of the new local architecture.

ALL ARCHITECTURAL STYLES WITHIN DISTRICT:

VERNACULAR STYLE	1900-1930'S
BUNGALOW STYLE	1910'S-1930'S
MEDITERRANEAN REVIVAL	MID 1910'S - EARLY 1930'S
MED-DECO	LATE 1920'S - MID 1930'S
ART DECO	LATE 1920'S - 1930'S
STREAMLINE MODERNE	1930'S - 1940'S
CLASSICAL REVIVAL ART DECO	1930'S - EARLY 1940'S
POST WAR DECO	POST WWII - 1960'S
POST WAR MODERN	POST WWII - 1965
ECLECTIC	1920'S - 1950'S
GARDEN STYLE	LATE 1940'S - MID 1960'S

STREAMLINE MODERNE

The Moderne style kept many features of its predecessor style Art Deco, including smooth and articulated stucco, architectural glass block, keystone and a variety of metals used for detailing. It evolved, however, under the growing influence of industrial design and transportation, into a more "streamlined" appearance, reflecting the character of automobiles, airplanes, trains and even home appliances. This resulted in powerful horizontally designed compositions, accentuated by striking vertical features and punctuated by technological iconography. Elements like continuous "eyebrows", racing stripe banding, radio tower spires, ship-like portholes, and deck railings similar to those found on grand ocean liners, were among the new features put forth by this style. Nautical themes, which originated in Miami Beach, were prominent and "eyebrows," intended to temper sunlight, and other details swept neatly around facades. Surfaces became smoother, planer, and more visually aerodynamic; and smooth, rounded edges were favored over sharp ones, particularly on corner buidlings. Banks of windows allowed for cross ventilation and natural daylighting of interior spaces.

South Beach Historic Districts

DEPRESSION MODERNE

Depression Moderne was an even more stripped down form of Art Deco that was commonly used for civic buildings. As a result, the Art Deco architecture of Miami Beach was, from the beginning, a local adaptation which typically combined Streamline massing with Art Deco applied details.

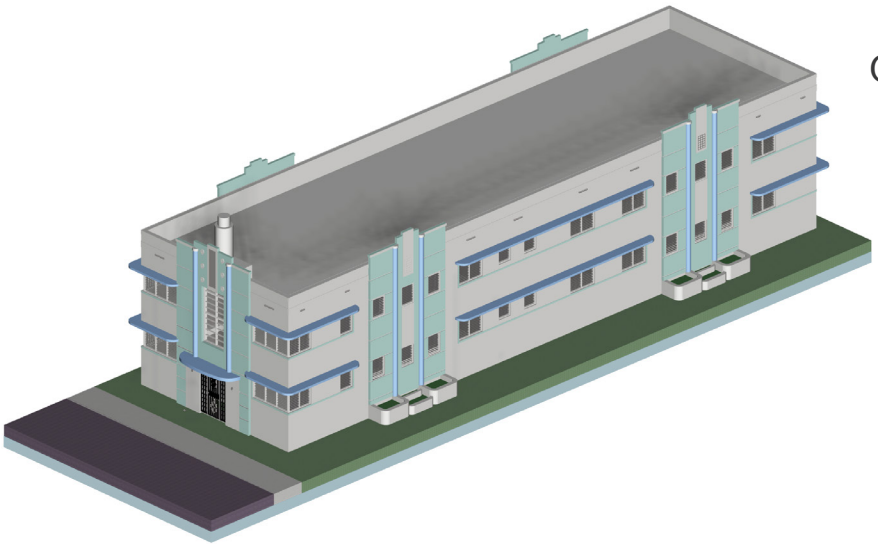
Image from Plan NoBE https://www.miamibeachfl.gov/wp-content/uploads/2018/07/PlanNoBe_Adopted101916_sm.pdf

Images sourced from Google Photos

FLOODING SCENARIOS
Future Impact of Sea Level Rise

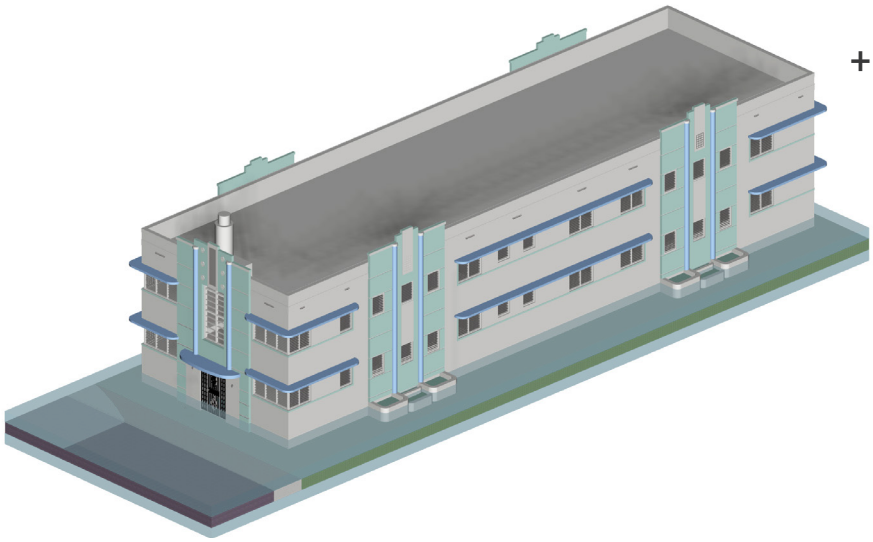
South Beach, Miami Beach

Present



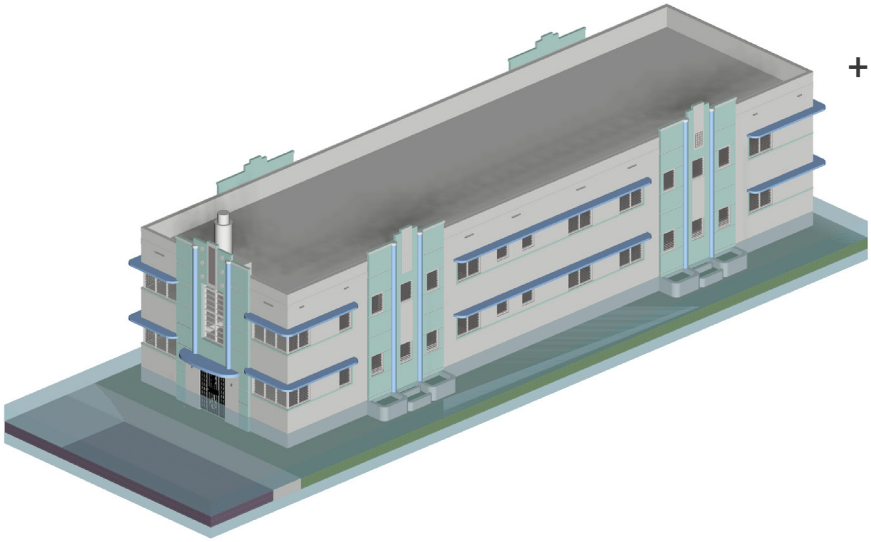
Current Conditions

- DFE: +11 FT
- BFE: +8 FT
  W/ DAYLIGHT FLOODING
- Sea Level 2019
- Ground Water: -2 FT ~



+ 2 FT SEA LEVEL RISE

- DFE: +13 FT
- BFE: +10 FT
- Sea Level Rise = +2 FT
- Sea Level 2019
- Ground Water: 0 FT ~



+ 3 FT SEA LEVEL RISE

- DFE: +14 FT
- BFE: +11 FT
- Sea Level Rise = +3 FT
- Sea Level 2019
- Ground Water: +1 FT ~

Future

*Storm surge and flooding may vary

Architect: Lawrence Murray Dixon
Pennsylvania Ave. & 12th Street

MITIGATE: Reduce Your Carbon Footprint

PREPARE: Do Your Research and Identify Flood Risks

DEFEND: Short-Term Flood Protection

ADAPT: Long-Term Flood Protection

RELOCATE/REBUILD: For When Adaptations Aren't Possible

Image adapted from Miami Dade County Sea Level Rise Strategy https://miami-dade-county-sea-level-rise-strategy-draft-mdc.hub.arcgis.com/

MITIGATE
How Can I Make My Residence More Sustainable?

What Homeowners can do:

Conserve water and energy

Carpool, bike, or use public transportation whenever possible

Compost food scraps

Advocate for proactive changes to the whole building

Recycle and advocate for recycling at the building level

Eliminate excess junk mail

Eat less meat

Use energy efficient LED light bulbs instead of incandescent

Educate yourself and others

Make your voice heard

What Building Owners can do:

Solar energy

Green Roofs

Insulated window replacement

Energy efficient mechanical systems

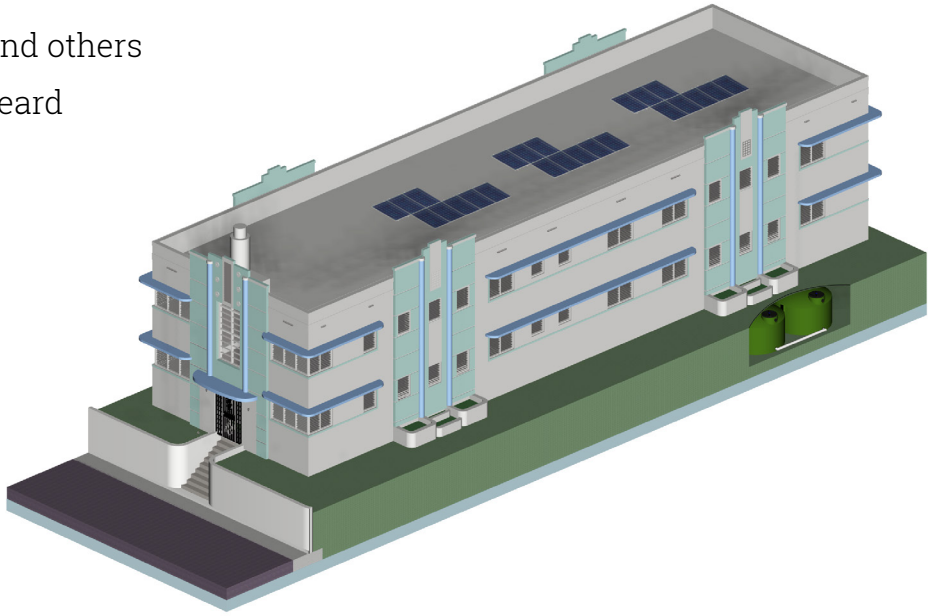
Create rain gardens and water basins to help with flooding

Recycling initiatives

Strategic partnerships (i.e. CityBike)

Rooftop additions

Shading elements (louvers + overhangs)



Some Landscape Options to Consider:

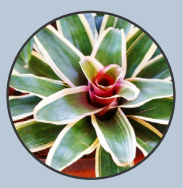
Replace Asphalt in front of lawns with Permeable Pavers

Use Mulch to retain moisture in plant boxes

Replace lawn with gravel , crushed shells or rocks

Pitch Yard to Drain Water into Rain Gardens

Consider Bioswales or Drainage Canals to Help Absorb Flood Water



Grow Drought-Resistant Bromeliads or Succulents to Reduce Water for Irrigation and/or Grow Bog and Moisture-Loving Plants to Reduce Garden Floods

IDENTIFY MY FLOOD RISK

Take a look at the FEMA FIRMs to determine your building's flood risk. Base Flood Elevations (BFE) are determined from detailed hydraulic analyses and mandatory flood insurance is required for property owners.

FEMA Flood Zone: AE
Avg. Elevation at Grade: +5 ft (USGS, NAVD 88)
Avg. Base Flood Elevation: +8 ft (FEMA, NGVD 29)
Avg. Design Flood Elevation: +11 ft (FEMA, NGVD 29)
Avg. Depth to Water Table: -2 ft (FGS FAVA II, MSL)

IDENTIFY MY FLOOD ELEVATION

Before determining what flood-proofing measures must be taken, you must first understand where your building is in relation to FEMA's flood elevation requirements and the existing grade. This means locating the lowest habitable floor and the Base Flood Elevation (BFE) for your building. The DFE is the elevation to which the lowest habitable floor must meet or exceed.

The best way to guarantee an accurate flood level for your building is to obtain an Elevation Certificate from a professional engineer, architect, or land surveyor.

REVIEW RELEVANT REGULATIONS

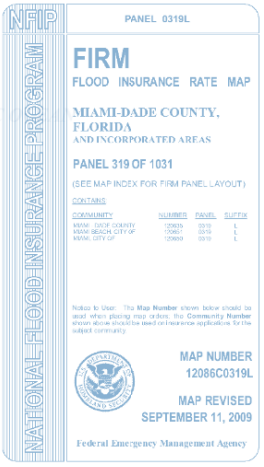
Knowing the regulations at the federal, state, and local level will inform your approach to retrofitting. Flood retrofitting design and construction is regulated by FEMA's FIRMs, the Florida Building Code, Miami21's zoning codes, and other local laws. FEMA also administers the NFIP, or National Flood Insurance Program. In order for property owners in the city to receive insurance as part of the NFIP, cities must adopt these federal standards into their building codes, as Miami Beach as done.

For more information about NFIP visit www.floodsmart.gov.

ASSESS MY BUILDING & SPEAK WITH PROFESSIONALS

Understanding how your building is currently functioning is critical in designing an appropriate mitigation strategy for your home. This includes identifying what kind of foundation and structural system you have, where your critical systems (such as mechanical and electrical equipment) are located, and how well these elements are working.

https://www.fema.gov/flood-maps - Panels 317, 319, 336, & 338



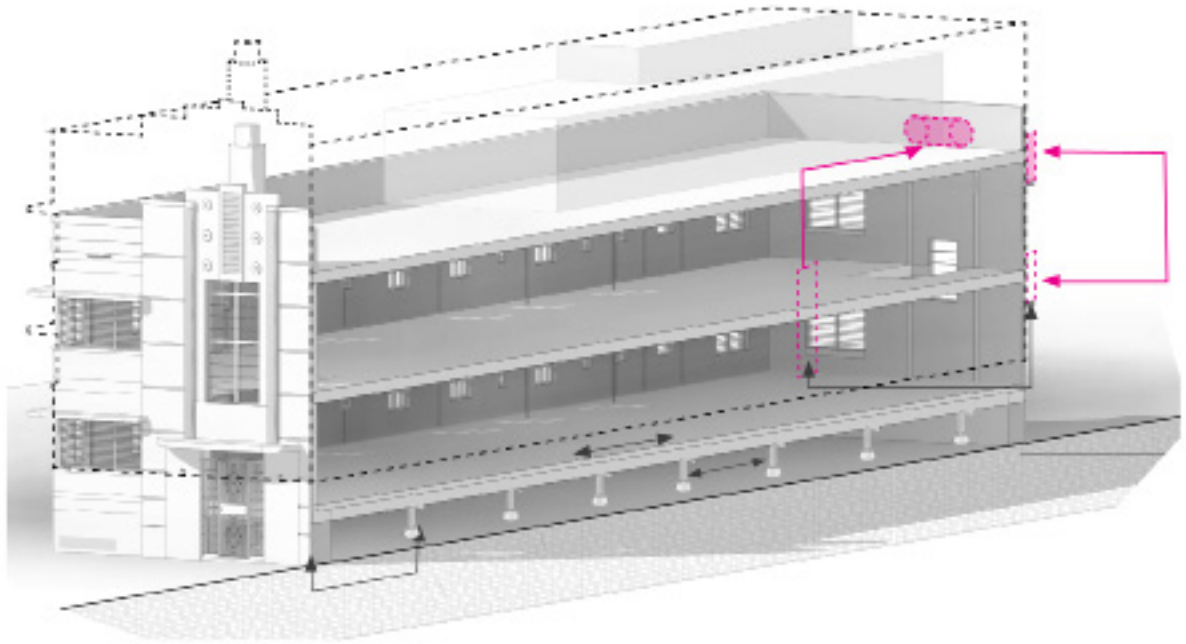
https://map1.msc.fema.gov/firm?id=12086C0317L

DEFEND

What Can I Be Doing in the Short-Term? (Dry-Proofing)

DRY FLOODPROOFING

Involves making a building, or an area within a building, substantially impermeable to the passage of water up to the BFE.



- Install Backflow Valves and Sump Pumps (If Needed)
- Install Flood Vents for ground floor levels with Continuous Foundation or Break-Away Panels for Pier Foundation
- Reinforce Foundation Stem Wall & Piers
- Wet Floodproof ground floor levels
- Elevate Critical Systems (such as AC Units or Electrical Panels) Above the BFE or Higher
- Dry Floodproof the Current Lowest Level that is Below the BFE

Flood Force Types

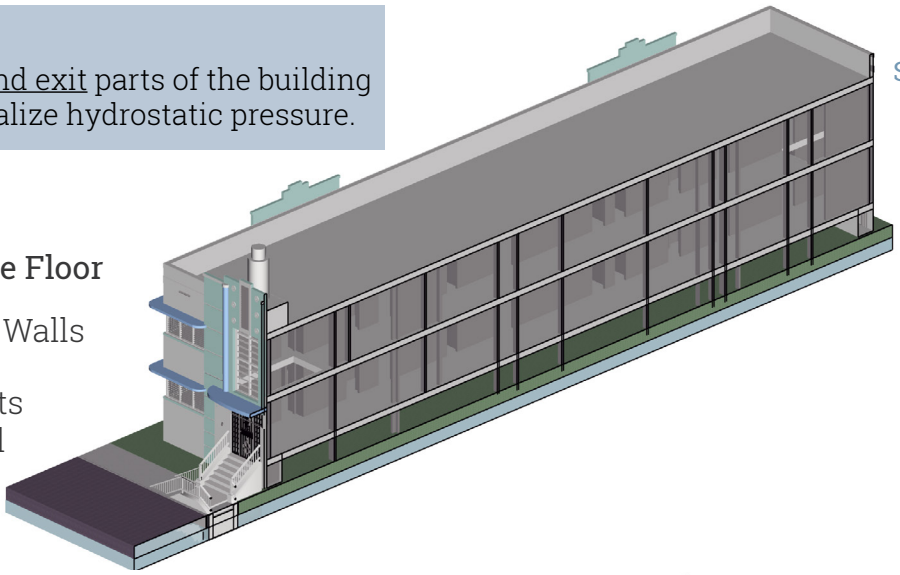
Hydrostatic Flood Force: The force of water at rest exerted on a submerged object; include saturated soil pressure on any portion of the building that is below grade

Hydrodynamic Force: The force exerted in vertical surfaces exposed to moving floodwaters; based on the expected velocity floodwaters with the depths of the DFE

What Can I Be Doing in the Long Term? (Wet-Proofing)

WET FLOODPROOFING

Allows floodwaters to enter and exit parts of the building below the DFE in order to equalize hydrostatic pressure.



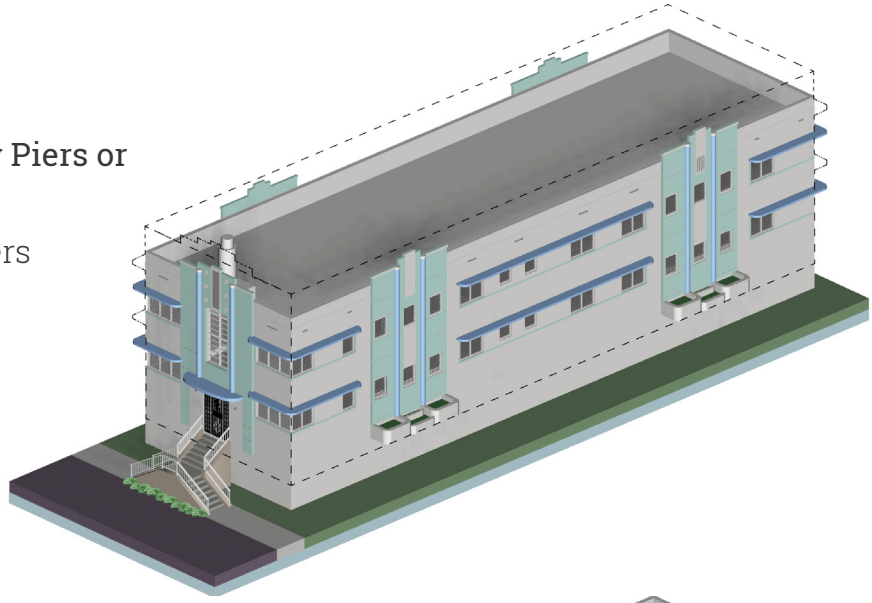
Short-term

Raise First Floor to DFE or Repurpose Lowest Habitable Floor

Wet Floodproof Foundation Walls

Add Openings or Flood Vents Along New Foundation Wall

Structural Reinforcement



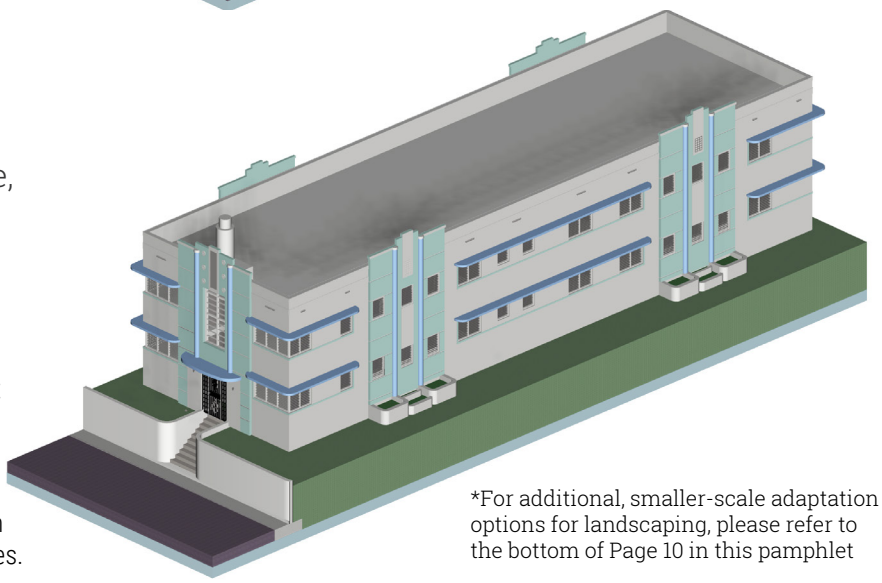
Elevate Building on Masonry Piers or Extend Foundation

Wet Flood-proof Masonry Piers

Add Break-walls for Privacy, Landscaping, or Looks

Structural Reinforcement

FAR Apdaptation



Fill and Elevate Entire Lot

If Maintaining a Crawlspace, Install Flood Vents

Structural Reinforcement

Long-term

* Where these retrofits are not possible, see next page for options

* Any adaptation to the structure should be discussed and performed by a licensed professional. These illustrations hope to inform homeowners of possible options for their homes.

*For additional, smaller-scale adaptation options for landscaping, please refer to the bottom of Page 10 in this pamphlet

RELOCATE OR REBUILD

What if Adaptation is Not Cost Effective For Me?

Cost will always be an integral factor when thinking about adapting and retrofitting your home. In addition to construction costs and design fees, owners may face an additional loss of usable square footage when abandoning the first floor or moving mechanical equipment. In some cases, the cost of defending and adapting a building may exceed the value of the property, even with the insurance credits such retrofits could provide. In these cases, homeowners may choose to either:

1. **Relocate:**
   Sell the property as is and find a new lot at a higher elevation or one that has already been retrofitted.
2. **Rebuild:**
   Demolish the building and rebuild a new flood-compliant home or redevelop the property entirely.

TOOL	RESULTS	RELATIVE COST
	Install Back-flow Valves to Avoid Sewage Overflow and/or Sump Pumps for Groundwater Flooding	Lowest
	Install Flood Vents in Basement or Crawlspace to Allow Water In and Reduce Pressure	
	Elevate Critical Systems Above the BFE	
	Dry Flood-proof Habitable Areas Above the BFE and/or Areas 3 FT Above Adjacent Grade	
	Wet Flood-proof Crawlspace Areas or Structure Below the BFE	
	Elevate on Continuous Foundation Walls or Open Foundation	
	Elevate and Fill Lot	Highest
	Reinforce Building Superstructure and Foundation to Withstand Forces of Storm Events & Water	Varies

CROSS-SECTION OF SOUTH FLORIDA FROM THE OCEAN TO THE EVERGLADES

SOURCES & ADDITIONAL INFO:

Federal Emergency Management Agency (FEMA) - http://fema.gov
National Flood Insurance Program (NFIP) - http://floodsmart.gov
American Society of Civil Engineers (ASCE) - http://asce.org/climate-change
Florida Building Code - http://floridabuilding.org
Surging Seas - http://climatecentral.org

URBAN DESIGN CONSIDERATIONS

How Will Climate Change Affect My Neighborhood?

Adapting buildings to climate change should not come at the expense of a vibrant and inviting streetscape. Homeowners, city planners, and community groups should work together to develop standards for ramps, staircases, landscape, parking, and sidewalk-facing retaining walls to ensure that streets remain active, interesting, safe and comfortable for pedestrians and cars.

ACCESS

When moving access points and entrances up, it is important to design stairs and ramps that are inviting and safe, while enhancing connectivity.

HISTORIC PRESERVATION

When adapting historic architectural types, keep the front elevation true to the original character and materials of the building to the greatest extent possible.

STREETSCAPE

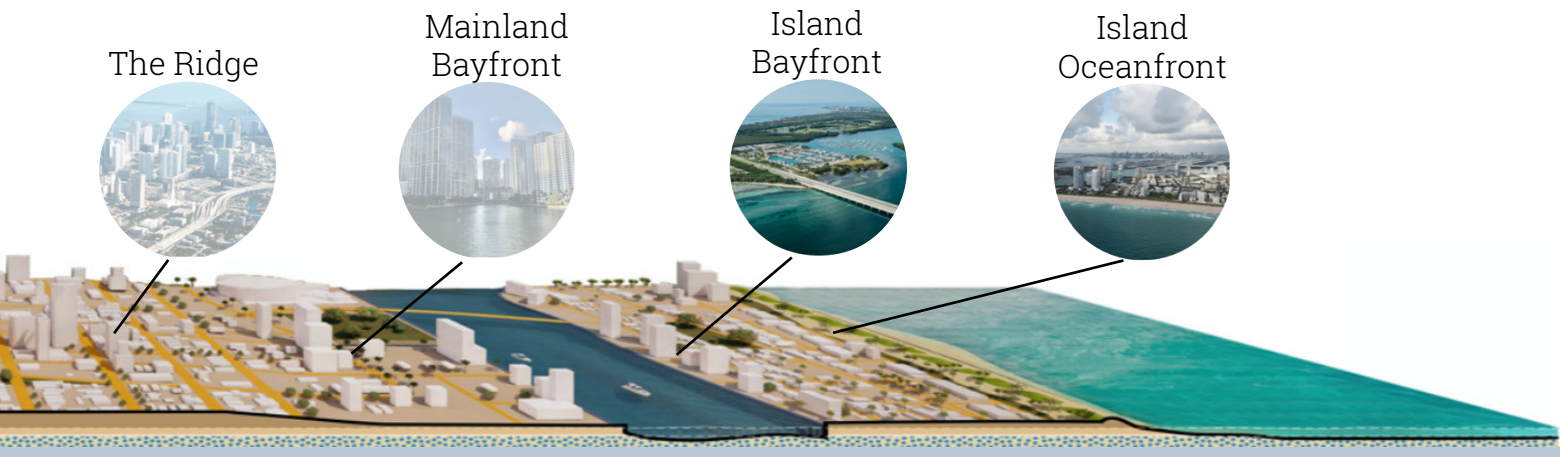
Elevating houses can disrupt connectivity. Screening, landscaping, & other design solutions can help ground buildings into their adapted surroundings.

MALADAPTATION

Involves a poor selection of adaptation measures, resulting in changes in the infrastructure systems that become less effective as time goes by until the systems become dysfunctional.

PARKING

Parking, garage entries, and curb cuts should be located strategically so as not to interrupt the pedestrian experience or aesthetic of the street.



National Oceanic & Atmospheric Administration Digital Coast - http://coast.noaa.gov/digitalcoast
U.S. Climate Resilience Toolkit - http://toolkit.climate.gov
Southeast Florida Climate Compact - http://southeastfloridaclimatecompact.org
Miami-Dade Green - http://miamidade.gov/green
100 Resilient Cities - resilientcitiesnetwork.org
Miami Beach Rising Above - www.mbrisingabove.com

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DADE HERITAGE TRUST

CHRISTINE RUPP, Director
Website: www.dadeheritagetrust.org

This pamphlet is one in a series of case studies throughout Miami-Dade County titled "Resiliency and Preservation." For more information or access to additional pamphlets and resources, see the link and QR code below.

https://linktr.ee/ResiliencyAndPreservation