

The Business Case for the City of Miami Beach Stormwater Resilience Program

ICF led an interdisciplinary team in this pilot study to understand the business case for stormwater resilience investments in Miami Beach. The study considered the effect of sea level rise and infrastructure investments on factors such as flood damages, property values, insurance premiums, tax revenues, business disruptions, and more.



The goal of this study was to understand and communicate the business case for stormwater resilience investments in Miami Beach through robust data analysis and state-of-the-art modeling.

Citywide investments of at least
\$2 billion
for road elevation and storm protection would be cost-beneficial

4.9 to 14.1%
increase in residential property value per foot of nearby road elevation

8.5 to 11.5%
increase in residential property value per foot of parcel elevation

Benefits exceed costs

for public resilience investments analyzed

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Key Findings

- Benefits of the City's targeted investments in stormwater and infrastructure improvements significantly outweigh their costs, and provide substantial benefits to the residents, businesses, visitors, and government of Miami Beach.
- Miami Beach faces serious economic risks from climate change.
- However, the City's stormwater resiliency program can reduce those risks—this study found that the **economic benefits of adapting far outweigh the costs**.
- Citywide, public or private investments of at least \$1 billion over the next 30 years would be cost-beneficial to prevent surge-related flood damages.
- In addition, road elevation could conservatively increase total residential property values citywide by over \$1 billion in assessed value. This would result in \$6.6 million in annual revenues that can be used to fund city services.
- For the proposed investments studied for the First Street neighborhood, a combination of road elevation plus additional drainage and pump capacity will reduce flooding for roads and private property, and will increase property value.
- Individual adaptation is a vital component of Miami Beach's overall resilience, and homeowners have several options to reduce their flood risk.

Benefits from the proposed investments in First Street (compared to no action) include:

- Reduced flood risk to properties (up to a one-foot reduction during 10-year rain event)
- Increased property values (\$10,740,000 in residential assessed value)
- Avoided flood losses (up to \$204,000 per event)
- Avoided road closures
- Avoided business disruptions
- Lower expected flood insurance premiums (7%)

Individual adaptation is a critical component of Miami Beach's overall resilience.

- The City's improvements reduce the flood risk to individual properties.
- However, the City's investments will not remove all flood risk and there is a range of cost beneficial options that property owners can take.
- City investments in the right-of-way increase property values by 4.9 to 14.1% for each foot of additional road elevation. Lower elevation roads and properties see the greatest increase from elevation.
- This study analyzed the costs and benefits for three adaptation options for a hypothetical home and found that:
 - If reconstructing a home, building the house higher than the original elevation would result in a 3.6% increase in property value for each foot of increase. The benefits of elevating the home during construction outweigh the marginal increase in the cost of construction.
 - Dry flood proofing can be a cost-effective strategy for existing houses.
 - For the hypothetical home examined, which was pre-FIRM and a primary residence, the cost substantially outweighed the benefit for raising the home to reduce flooding (excluding other modifications to the property or building that may otherwise increase its value).
 - This study developed a methodology that can be applied to other residences, but the results should not be considered a definitive statement on the costs and benefits of home raising. There are several factors beyond those explored here why home raising may make sense, financially, societally, or otherwise. The actual costs and benefits of raising homes in Miami Beach may differ significantly from the hypothetical case due to factors including cultural or historic value, and differing insurance, building footprint, building construction, or finished floor elevation characteristics.
- If insurance rates increase, individual property adaptation becomes even more cost-effective.

This study developed a unique formula for Miami Beach to determine the economic benefit of adaptation and the City's stormwater resilience improvements. **The benefits of stormwater resilience investments are likely to be greater in reality than what were estimated in this study, due to the conservative assumptions used in the study.**

The Approach

The business case was evaluated at three scales: an individual home, a neighborhood, and Citywide. The analysis integrated three types of state-of-the-art models.

Stormwater Model

This study used an integrated 2-dimensional surface and groundwater modeling software (ICPR4, the Interconnected Pond Rounding model version 4). The model combines rain, tides, and groundwater. It captures how flooding is reduced through stormwater pipes, pumps, and elevation.

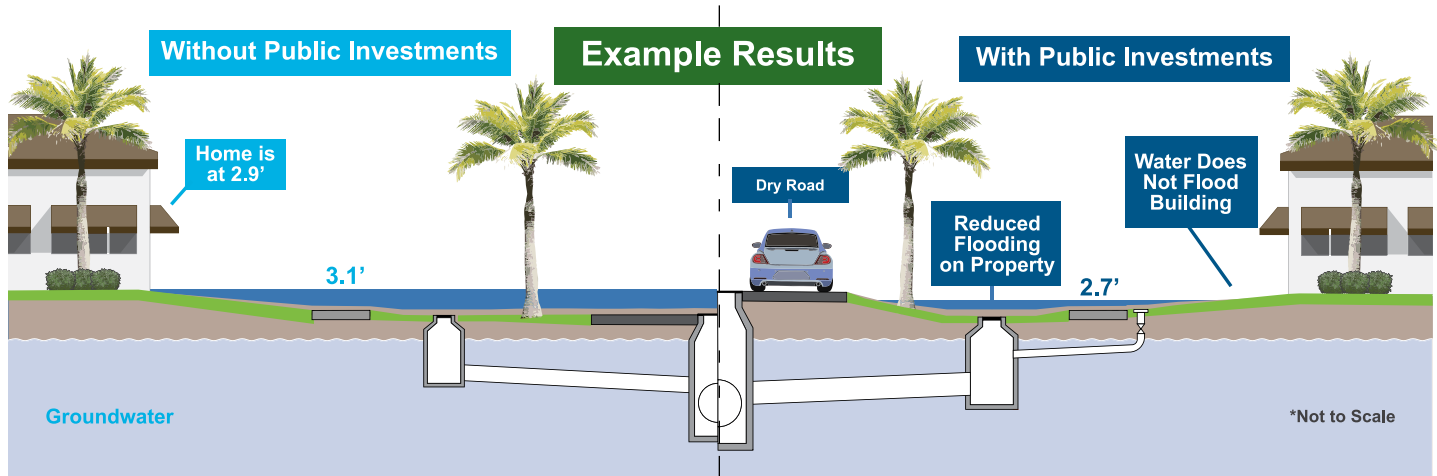
The team used the model to estimate flood depths for four example flooding events, including King Tide, 5-year and 10-year rain events, and a 25-year moderate hurricane (including rain and storm surge). Sea level rise was incorporated to examine how flood risk worsens with one foot of sea level rise, and how infrastructure investments make a difference.

For the First Street neighborhood, the model showed that investments including stormwater pipes, pumps, and elevating the road reduce the level of water enough to eliminate flooding to buildings during the five- and ten-year rainstorm events. The model showed more than a one-foot decrease in flooding in some areas.

3.6%
increase in home value
per foot of elevation
for single-family
homes in Miami Beach



This study evaluated costs and benefits of adaptation options for a hypothetical home.



The stormwater modeling showed that the public investments reduce flooding on roads and private property. Example results are shown here for the median property in the First Street neighborhood.

Catastrophic Risk Model

This study used the AIR Tropical Cyclone model to estimate expected losses from storm surge with and without sea level rise, and to estimate the effects of public and private flood mitigation measures on insurance premiums. The modeling shows that a sea level rise of approximately one foot (compared to 2013 levels) will produce approximately a doubling in the losses from small to moderate hurricanes and a 25 to 30% increase in damage from severe hurricanes (e.g., a direct hit from a major hurricane).

Property Value Model

This study used a hedonic pricing model to determine the effects of public and private investments on home values. Hedonic modeling is a statistical analysis technique used to isolate how much people are willing to pay for a particular characteristic related to a home purchase—in this case the parcel elevation and the

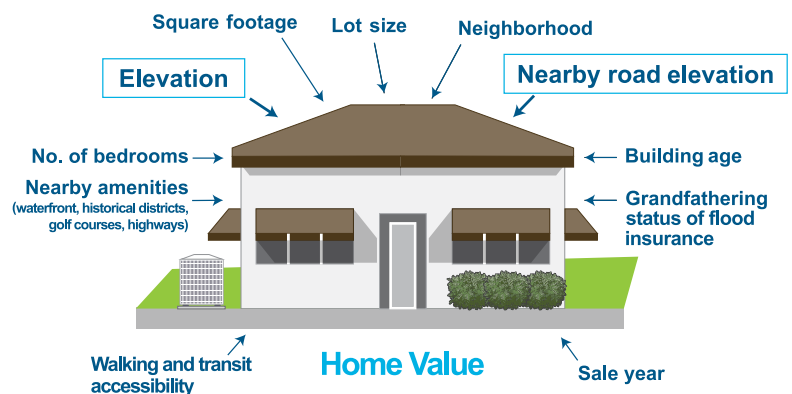
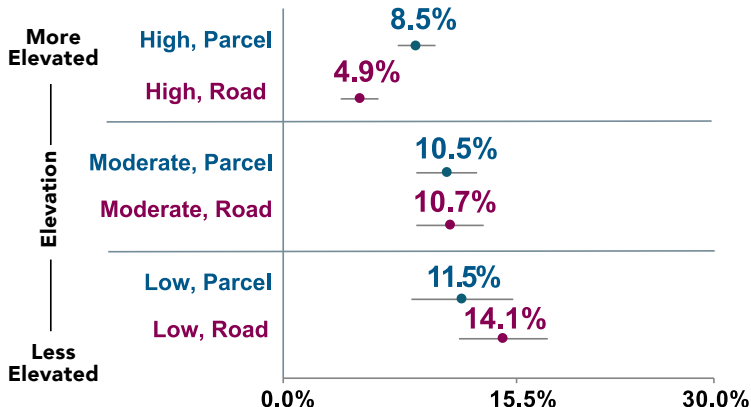
elevation of nearby roadways. The study developed models for all homes, condos only, and standalone homes only, based on actual home sales prices in Miami Beach from 2005 through January 2019. The analysis was independently peer-reviewed.

Both factors tested in this study—parcel elevation and road elevation—positively affect property values in Miami Beach.

- Home prices are higher for parcels at higher average elevations with a 8.5 to 11.5% increase per foot of elevation.
- Home prices are higher for parcels with more elevated surrounding roads with a 4.9 to 14.1% increase per foot of roadway elevation.
- Parcel and road elevation increases have greater price effects when the initial elevation is lower.

All Homes

% price change per 1 foot increase in elevation



Buyers on Miami Beach are willing to pay more for the two characteristics isolated in this study: the elevation of a property and the nearby road.

What do these investments mean to you?

Individual Property

- Reduce the risk of flood damage
- Increase home value
- Lower insurance rates

Neighborhood

- Fewer flood events
- Higher property values
- More desirable

Miami Beach

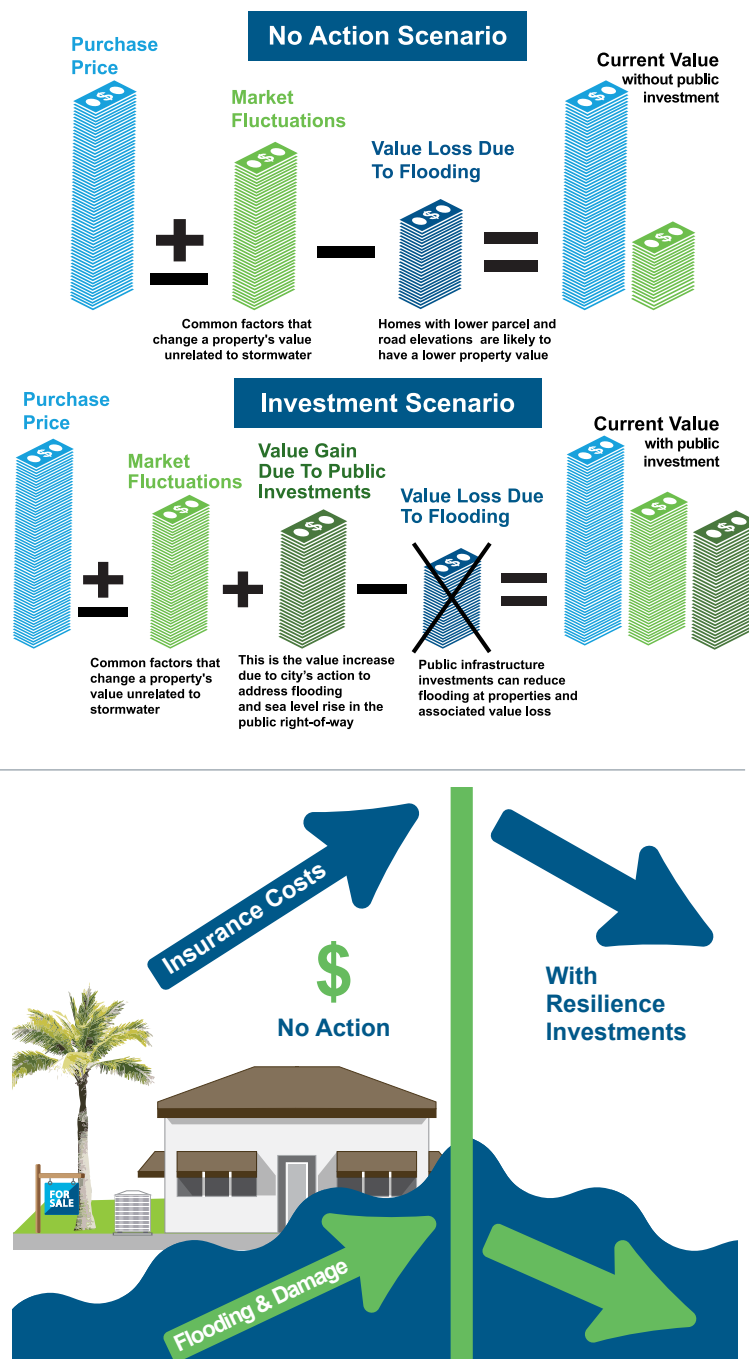
- Stronger property value base
- Safer roads and faster recovery
- Healthier quality of life

Flood Risk and Investment Effects on Property Values

The City's public infrastructure investments not only reduce the potential value loss of a home due to flooding, but also provide additional value gain due to the infrastructure investments themselves. The public infrastructure investments directly impact the value of homes on Miami Beach in a positive way. This value increase would be in addition to any value increases due to individual homeowner adaptations.

Insurance Impacts

- Currently, flood insurance premiums are established by the federal government (Federal Emergency Management Agency, FEMA), are subsidized, and do not reflect the actual cost of risk.
- Insurance rates are expected to increase as FEMA sets rates that are closer to the cost associated with actual flood risk.
- Insurers, like FEMA, work with firms like AIR to understand their expected Average Annual Losses (AAL), which is the long-term average loss expected from storm damage, and set rates accordingly.
- AIR modeling shows that with one foot of sea level rise (above 2013 sea levels), the average annual losses from flooding will increase 96%. Without adaptation this could mean a near doubling in flood insurance costs by the middle of the century.
- In the First Street neighborhood, public and private investments that can be undertaken within the next few years would decrease AAL (and potentially insurance rates) by 7% and 17%, respectively.



This study was conducted by an interdisciplinary team that included:



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