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THESIS

**STRATEGIC RETREAT IN AN AGE
OF CLIMATE CHANGE**

by

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March 2022

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STRATEGIC RETREAT IN AN AGE OF CLIMATE CHANGE

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ABSTRACT

According to FEMA and NOAA, flooding is the most frequent and costly natural disaster in the United States. The National Flood Insurance Program, designed to alleviate some of the costs of this hazard, is financially insolvent and fiscally unsustainable. Through its Hazard Mitigation Assistance program, FEMA buys out homes, but the process is voluntary and slow, and demand far exceeds funds available. Consequently, the number of Repetitive Loss and Severe Repetitive Loss properties increases each year. The thesis explores why and how FEMA should pursue strategic retreat from high-risk areas. Disaster costs continue to rise as extreme weather events increase in frequency and intensity. Sea-level rise endangers coastal regions, and more homes may be susceptible to systemic and regular flooding than official estimates show. To resist by building ever larger flood walls and barriers may be unrealistic, and retreat as an adaptation technique may be preferable. Expensive as strategic retreat may be, loss-avoidance studies indicate that besides reducing pain and suffering, these measures pay for themselves. Strategic retreat may also result in climate refugees who are not prepared to deal with rapidly changing conditions. An adaptation framework recommends deterrents and incentives available to policymakers and practitioners to pursue strategic retreat in a planned, comprehensive, and equitable manner.

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TABLE OF CONTENTS

I.	INTRODUCTION.....	1
A.	RESEARCH QUESTION	3
B.	LITERATURE REVIEW	3
1.	Strategic Retreat	4
2.	Eminent Domain	11
3.	Equity and Social Justice.....	12
C.	RESEARCH DESIGN	15
D.	OVERVIEW OF CHAPTERS.....	17
II.	HAZARD MITIGATION	19
A.	RISING FLOOD RISK IN THE UNITED STATES	19
B.	FEMA’S HAZARD MITIGATION ASSISTANCE (HMA) PROGRAMS	21
C.	LIMITATIONS OF THE CURRENT HMA PROGRAMS	24
1.	A Voluntary Program.....	25
2.	Rising Demand for Home Buyouts.....	28
3.	The Repetitive Loss and Severe Repetitive Loss Problem	34
4.	How Climate Change Worsens the Situation	37
D.	CONCLUSION	44
III.	MITIGATION SYSTEMS THAT NO LONGER WORK	47
A.	NFIP AND HOME ACQUISITIONS	49
B.	FEMA’S FLOOD MAPS.....	57
C.	FLOODPLAIN MANAGEMENT.....	64
D.	BUILDING CODES.....	68
E.	CONCLUSION	76
IV.	CONSIDERATIONS OF STRATEGIC RETREAT.....	77
A.	BENEFITS OF WORKING WITH NATURE	77
B.	EMINENT DOMAIN AND OTHER BUYOUT MECHANISMS	81
C.	HOW RISK INFORMS STRATEGIC RETREAT.....	92
D.	CONCLUSION	102
V.	POTENTIAL IMPACTS OF STRATEGIC RETREAT	105
A.	TAX REVENUES	105
B.	SOCIAL JUSTICE AND EQUITY	112
C.	HAZARD MITIGATION LOSSES AVOIDED	120

D.	RELOCATION, AND CLIMATE REFUGEES.....	123
E.	CONCLUSION	130
VI.	STRATEGIC RETREAT EXPANDED AND EXPLORED	133
A.	A STRATEGIC RETREAT FRAMEWORK.....	133
B.	CONCLUSION	150
	APPENDIX A. NATIONAL REPETITIVE LOSS PROPERTIES TRENDS.....	161
	APPENDIX B. NATIONAL SEVERE REPETITIVE LOSS PROPERTIES TRENDS	163
	LIST OF REFERENCES.....	165
	INITIAL DISTRIBUTION LIST	201

LIST OF FIGURES

Figure 1.	Cost of Flood Disasters in the United States since 1980 in Inflation-adjusted Dollars	20
Figure 2.	EMA Hazard Mitigation Grant Program (HMGP) Dashboard.....	23
Figure 3.	Natural Hazard Mitigation Saves: 2019 Interim Report	24
Figure 4.	EMA HMA Property Buyouts Step-by-Step	32
Figure 5.	Frequency of U.S. Billion-dollar Disaster Events (1980–2019), (CPI-adjusted).....	39
Figure 6.	U.S. Billion-Dollar Disaster Events, 1980–2021	41
Figure 7.	National Flood Insurance Program Balance Sheet	50
Figure 8.	Age of Effective Date for FEMA Flood Maps	59
Figure 9.	First National Flood Risk Assessment 2020, Differences in the Number of Properties at Substantial Flood Risk compared to FEMA.....	61
Figure 10.	First National Flood Risk Assessment 2020, Changes in the Proportion of Properties at Substantial Flood Risk 2020–2050	63
Figure 11.	Harris County Flood District, Damaged Structures in Flood Zones vs. Buyouts.....	67
Figure 12.	The Building Code Adoption Portal, an Interactive Map that Tracks Five Hazards	70
Figure 13.	Houston and Harris County have Adopted the Latest Codes, but Texas has no Mandatory Statewide Building or Residential Code.....	71
Figure 14.	Statewide Code Adoption Status	73
Figure 15.	USACE Schematic Proposal of Floodwalls and Storm Surge Barriers in Miami-Dade County.	91
Figure 16.	U.S. Infrastructure at Risk of Becoming Inoperable Due to Flooding.	93
Figure 17.	Overall Risk by County	96
Figure 18.	Overall Risk Changes 2021–2051 by County.....	97

Figure 19.	FEMA, National Risk Index for Natural Hazards	99
Figure 20.	FEMA, National Risk Index for Natural Hazards with Coastal Flooding Risk (left) and Hurricane Risk (right) Layers Isolated	99
Figure 21.	The Extent of Hurricanes Floyd and Matthew Flood and Relocation Site.	118
Figure 22.	Hurricane Matthew, North Carolina, Map Showing Flood-prone Properties Acquired Using FEMA HMA Grant Funds.....	121
Figure 23.	Newtok, Alaska, Shoreline Erosion 1954–2027	126
Figure 24.	NOAA’s Sea Level Rise Viewer Depicting Six Feet of SLR in the NYC Region.....	129

LIST OF TABLES

Table 1.	FEMA’s FMA Program Funding Available vs. Received.....	28
Table 2.	FEMA Approval Times for Home Buyouts.....	30
Table 3.	Average Time for FEMA to Process Home Buyout Applications	31
Table 4.	Time Frame from Disaster Declaration Date to Approval.....	31
Table 5.	FEMA’s FMA Program and its Impact on RL and SRL Properties.....	35
Table 6.	Top Three Repetitive Loss Property States	36
Table 7.	Top Three Severe Repetitive Loss Property States.....	36
Table 8.	A Resilience Adaptation Framework for Strategic Retreat, 2021	134
Table 9.	National Repetitive Loss Property Trends, 2015–2019.....	161
Table 10.	National Severe Repetitive Loss Property Trends, 2015–2019	163

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LIST OF ACRONYMS AND ABBREVIATIONS

ASCE	American Society of Civil Engineers
ASFPM	American Society of Floodplain Managers
BCA	Benefit Cost Analysis
BCEGS	Building Code Effectiveness Grading Schedule
BCR	Benefit Cost Ratio
BRIC	Building Resilient Infrastructure and Communities
CAP-SSSE	Community Assistance Program – State Support Services Element
CRS	Community Rating System
DEP	Department of Environmental Protection
DHS	Department of Homeland Security
DRF	Disaster Relief Fund
EHP	Environmental and Historic Preservation
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIRM	Federal Insurance Rate Map
FMA	Flood Mitigation Assistance
FPM	Flood Plain Management
GIS	Geographic Information Systems
HCFCDD	Harris County Flood Control District
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HUD	US Department of Housing and Urban Development
IBHS	Insurance Institute for Business and Home Safety
ICC	International Code Council
IHP	Individuals and Household Program
IPCC	Intergovernmental Panel on Climate Change
MitFLG	Mitigation Framework Leadership Group
NASA	National Aeronautics and Space Administration
NFIP	National Flood Insurance Program
NIBS	National Institute of Building Sciences

NMIS	National Mitigation Investment Strategy
NOAA	National Oceanic and Atmospheric Agency
NRDC	Natural Resources Defense Council
PDM	Pre Disaster Mitigation
RL	Repetitive Loss
ROI	Return on Investment
RPA	Regional Planning Association
SFHA	Special Flood Hazard Area
SLR	Sea Level Rise
SRL	Severe Repetitive Loss
SRPA	Severe Repetitive Property Acquisition
WUI	Wildland Urban Interface

EXECUTIVE SUMMARY

Floods are among the most common and costly natural disasters in the United States.¹ More than 50 years ago, the federal government created the National Flood Insurance Program (NFIP) to insure flood losses and encourage sound floodplain management practices.² To promote participation in the NFIP, the government initially offered relatively inexpensive insurance. Many NFIP insured properties continue to drain the fund as they repeatedly flood, and their premiums are not commensurate with risk.³ Ever larger disasters result in the NFIP operating in deficit.⁴ Congressional efforts to put the NFIP on actuarially sound footing have mostly failed, and the program falls short of securing communities against floods.⁵ Indeed, in some ways, the NFIP may make things worse. Subsidized flood insurance offered by the NFIP encourages rebuilding in the same flood-prone areas after a disaster perpetuating the disaster cycle.⁶

In contrast, the Federal Emergency Management Agency (FEMA), through its Hazard Mitigation Assistance (HMA) program, offers homeowners the ability to sell their flooded or at-risk properties at pre-disaster appraised values.⁷ Local governments demolish the acquired home, and the land is deed-restricted in perpetuity as open space. By

¹ Statista, “U.S. Most Costly Natural Disasters 2020,” Statista, accessed April 25, 2021, <https://www.statista.com/statistics/744015/most-expensive-natural-disasters-usa/>.

² National Association of Insurance Commissioners, “Flood Insurance/National Flood Insurance Program (NFIP),” National Association of Insurance Commissioners, August 25, 2021, https://content.naic.org/cipr_topics/topic_flood_insurance_national_flood_insurance_program_nfip.htm.

³ Ike Brannon and Ari Blask, *Reforming the National Flood Insurance Program: Toward Private Flood Insurance*, Policy Analysis No. 817 (Washington, DC: CATO Institute, 2017), <https://www.cato.org/policy-analysis/reforming-national-flood-insurance-program-toward-private-flood-insurance>.

⁴ Diane P. Horn and Baird Webel, *Introduction to the National Flood Insurance Program (NFIP)*, CRS Report No. R44593 (Washington, DC: Congressional Research Service, 2021), <https://sgp.fas.org/crs/homesecc/R44593.pdf>.

⁵ Laura Lightbody, “Congress Again Defers on Reforming Flood Insurance Program,” Pew Charitable Trusts, January 9, 2019, <https://pew.org/2C9C8mM>.

⁶ Kevin T. Starbuck, “Moral Hazard: How the National Flood Insurance Program Is Limiting Risk Reduction” (master’s thesis, Naval Postgraduate School, 2016), <http://hdl.handle.net/10945/51620>.

⁷ Federal Emergency Management Agency, *Hazard Mitigation Assistance Guidance* (Washington, DC: Department of Homeland Security, 2015), https://www.fema.gov/sites/default/files/2020-04/HMA_Guidance_FY15.pdf.

eliminating the risk forever, HMA reduces future disaster costs. In this context, the HMA represents a workable approach to managing flood-prone areas in the United States.⁸ Yet climate change that drives higher temperatures and precipitation may imperil the efficacy of the current HMA program. Specifically, the HMA is voluntary, meaning homeowners can rebuild even in highly flood-prone areas. As climate change accelerates the intensity and frequency of disasters, the nation must prepare for changing conditions and rising costs.⁹ FEMA has bought out about 44,000 homes in the 30 years HMA has existed.¹⁰ At this rate, FEMA will have bought out about 130,000 homes by century's end. Some models predict that a three-foot rise in seas by the year 2100 will flood 4.2 million homes, and a six-foot increase will flood 13.1 million homes.¹¹

Evidence suggests that traditional methods of mitigating at-risk properties may not be adequate, and more urgent solutions may be necessary.¹² FEMA must consider pursuing strategic retreat from extreme high-risk areas of the United States. Strategic retreat may be the first step in realizing that the current approach of individual home buyouts is limited, does not change the risk profile of communities, and will not keep up in the future. At current funding levels, the HMA program is typically oversubscribed 2.5 to 3 times annually.¹³ This thesis examines why and how FEMA should pursue strategic retreat from high-risk areas in the United States.

⁸ Multi-Hazard Mitigation Council, *Natural Hazard Mitigation Saves: 2019 Report* (Washington, DC: National Institute of Building Sciences, 2019), <https://www.nibs.org/page/mitigationsaves>.

⁹ United Nations, "IPCC Report: 'Code Red' for Human Driven Global Heating, Warns UN Chief," UN News, August 9, 2021, <https://news.un.org/en/story/2021/08/1097362>.

¹⁰ "FEMA Bought 44,000 Flood-Prone Homes and May Have to Buy Millions More," Claims Journal, October 11, 2019, <https://www.claimsjournal.com/news/national/2019/10/11/293531.htm>.

¹¹ Mathew E. Hauer et al., "Millions Projected to Be at Risk from Sea-Level Rise in the Continental United States," *Nature Climate Change* 6, no. 7 (July 2016): 691–95, <https://doi.org/10.1038/nclimate2961>.

¹² Margie Kelly and 2019, "Report: FEMA Post-Flood Home Buyouts Take 5+ Years to Complete After Waters Recede," Natural Resources Defense Council (NRDC), September 12, 2019, <https://www.nrdc.org/media/2019/190912>.

¹³ Federal Emergency Management Agency, "Flood Mitigation Assistance FY2019 Subapplication Status," Flood Mitigation Assistance (FMA) Grant, November 9, 2021, <https://www.fema.gov/grants/mitigation/floods/flood-mitigation-assistance-fy2019-subapplication-status>.

Strategic retreat is a controversial but transformative tool. Typically, state, and local municipalities govern land use planning and zoning matters. However, the federal government is inextricably bound with local land use by offering subsidized flood insurance, establishing minimum floodplain management standards, and providing disaster relief. Given climate change, rising seas, and extreme weather events of greater intensity and frequency, not only is strategic retreat necessary and urgent, but it may fundamentally alter the way the United States deals with nature, manages risk, and achieves resilience.¹⁴

In the past few years, the resiliency debate has evolved. Planners refer to a taxonomy of resilience called the “Five Rs,” which provides a framework for evaluating the most appropriate combination of approaches to manage risk.¹⁵ **Rebuild** allows reinforcing existing structures through elevations and developing policies that require sturdier construction techniques in flood zones. Physical barriers like floodwalls enable **Resist** but can work only in limited circumstances. **Restore** uses nature-based solutions such as restoration of wetlands or living shorelines to better protect from storm surge and attenuate wave action. **Retain** allows water retention by controlling where the water goes through bio-swales and green roofs with their capacity to absorb water during a flood. Lastly, **Retreat** relocates people and structures out of harm’s way. No single strategy is adequate to address the challenge posed by climate change, and the approach to resilience must be a combination of techniques.

Resistance by investing in ever-larger flood barriers may not always be the best approach, and retreat may be the only realistic alternative due to increasing threats posed by rising seas.¹⁶ To some extent, retreat already happens in response to a natural disaster that forces people to move. Most coastal property in the United States is privately owned, and a voluntary buyout program inherently has limitations as FEMA cannot force a

¹⁴ David Dokken, “Summary for Policymakers,” in *Climate Change 2014: Impacts, Adaptation, and Vulnerability*, ed. Christopher B. Field et al. (New York: Cambridge University Press, 2014), 1–34, https://www.ipcc.ch/site/assets/uploads/2018/02/ar5_wgII_spm_en.pdf.

¹⁵ Robert Freudenberg et al., *Buy-in for Buyouts: The Case for Managed Retreat from Flood Zones* (Cambridge, MA: Lincoln Institute for Land Policy, 2016).

¹⁶ Thomas Frank, “Army Corps: After \$14B Upgrade, New Orleans Levees Are Sinking,” *Climate Wire*, April 11, 2019, <https://www.eenews.net/stories/1060153275>.

homeowner to sell or relocate. Using eminent domain authority for strategic retreat poses significant challenges and public opposition.¹⁷

Even in the best circumstances, mustering the political will and resources to move people without a significant disaster voluntarily may be challenging to achieve.¹⁸ Social fragmentation, marginalization, erosion of cultural identity, and economic anxiety due to uncertainty and loss of livelihood all reasonably may inhibit strategic retreat. Without a strategic vision and a framework, unmanaged, ad hoc retreat often misses opportunities to contribute to societal goals and leads to inequities in who moves and does not. Also, a focus purely on physical relocation misses the more extensive discussion on social factors such as loss of community and heritage, predominantly the loss minority and disadvantaged communities may experience. Strategic retreat must be carried out equitably and not disadvantage one demographic over another.¹⁹

The most significant barrier to strategic retreat may be the lack of a systematic framework and the set of related questions it raises. Among them: Under which circumstances does one pursue strategic retreat? Are there situations where community relocation rather than an individual home buyout would be warranted?²⁰ How do communities deal with declining or disappearing property tax revenues?²¹ How do governments ensure that any strategic retreat program does not disproportionately impact communities of color and lower-income populations and the program is fair and

¹⁷ Kirk E. Harris, “Because We Can Doesn’t Mean We Should and If We Do: Urban Communities, Social and Economic Justice, and Local Economic-Development-Driven Eminent Domain Practices,” *Economic Development Quarterly* 29, no. 3 (2015): 245–61, <https://doi.org/10.1177/0891242415575423>.

¹⁸ Anthony Oliver-Smith and Alex de Sherbinin, “Resettlement in the Twenty-First Century,” *Forced Migration Review*, no. 45 (2014): 23–25, <https://www.fmreview.org/sites/fmr/files/FMRdownloads/en/crisis.pdf>.

¹⁹ Mindy Thompson Fullilove, *Eminent Domain & African Americans: What Is the Price of the Commons?* (Arlington, VA: Institute for Justice, 2015), <https://ij.org/report/eminent-domain-african-americans/>.

²⁰ Newtok Village Council, *Newtok to Mertarvik Relocation* (Newtok, AK: Newtok Village Council, 2017), <https://www.congress.gov/116/meeting/house/108887/witnesses/HHRG-116-II24-Wstate-JordanJ-20190212-SD001.pdf>.

²¹ Helen J.P. Wiley, “Must Floodplain Buyouts Decrease Tax Revenue?,” *Risk Communication and Decision-Making Lab Notes* (blog), July 5, 2018, https://riskcenter.wharton.upenn.edu/lab-notes/buyouts_tax/.

equitable?²² Lastly, how does the U.S. deal with climate refugees, both internal and external, and what challenges does it pose to Homeland Security?²³

The thesis makes policy and implementation recommendations for strategic retreat from extreme high-risk coastal areas of the United States.²⁴ Voluntary buyouts are too slow, and hazard mitigation plans are not comprehensive enough.²⁵ This thesis offers an adaptation framework with deterrents and incentives available to policymakers and practitioners to achieve long-term resilience. Rising disaster costs, an unsustainable NFIP, properties that repeatedly flood, and a home buyout demand several orders of magnitude larger than FEMA can currently deliver should compel the United States to start preparing for strategic retreat *now*. The thesis attempts to make this case.

²² U.S. Commission on Civil Rights, *The Civil Rights Implications of Eminent Domain Abuse* (Washington, DC: U.S. Commission on Civil Rights, 2014), https://www.usccr.gov/files/pubs/docs/FINAL_FY14_Eminent-Domain-Report.pdf. U.S. Commission on Civil Rights.

²³ Bob Marshall, “The People of Isle de Jean Charles Aren’t the Country’s First Climate Refugees,” *The Lens*, December 6, 2016, <http://thelensnola.org/2016/12/06/the-people-of-isle-de-jean-charles-arent-the-countrys-first-climate-refugees/>.

²⁴ Department of Homeland Security, “Learn More,” National Risk Index, accessed November 6, 2021, <https://hazards.fema.gov/nri/learn-more>. Robynne Boyd and 2019 Robynne Boyd, “The People of the Isle de Jean Charles Are Louisiana’s First Climate Refugees—but They Won’t Be the Last,” NRDC Dispatch, September 23, 2019, <https://www.nrdc.org/stories/people-isle-jean-charles-are-louisianas-first-climate-refugees-they-wont-be-last>.

²⁵ Matthew Malecha et al., *Plan Integration for Resilience Scorecard Guidebook: Spatially Evaluating Networks of Plans to Reduce Hazard Vulnerability - Version 2.0* (College Station, TX: Institute for Sustainable Communities, College of Architecture, Texas A&M University, 2019), <http://mitigationguide.org/wp-content/uploads/2018/03/Guidebook-2020.05-v5.pdf>.

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I also dedicate this thesis to Samantha, Izaak, and Madison. The decisions we make the next few years will determine the world we leave behind for them.

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*“Now seas and Earth were in confusion, lost;
A world of waters, and without a coast.”*

— Ovid, *Metamorphoses*

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I. INTRODUCTION

One of the nation’s defenses against floods, the National Flood Insurance Program, consistently fails to protect communities before and after disasters. Given that floods are the most common natural disaster in the United States—they are also among the costliest.¹ Flood insurance programs have failed nationally to avert financial disasters from flooding. More than 50 years ago, the federal government created the National Flood Insurance Program (NFIP) to insure flood losses and encourage sound floodplain management practices.² Nearly 22,500 communities and slightly over five million policyholders belong to the NFIP.³ Yet, the NFIP currently operates in a deficit as revenues fail to cover expenditures.⁴ To promote participation in the NFIP, the government initially offered inexpensive insurance. Many NFIP insured properties continue to drain the fund as they repeatedly flood, and their premiums are not commensurate with risk.⁵ Congressional efforts to put the NFIP on actuarially sound footing have mostly failed over the years.⁶ Thus, the NFIP falls short of securing communities against floods.

Indeed, in some ways, the NFIP may make things worse. Subsidized flood insurance offered by the NFIP encourages rebuilding in the same flood-prone areas after a disaster. Furthermore, the NFIP promotes new developments in coastal and riverine

¹ “Floods,” Department of Homeland Security, accessed April 25, 2021, <https://www.ready.gov/floods>; “U.S. Most Costly Natural Disasters 2020,” Statista, accessed April 25, 2021, <https://www.statista.com/statistics/744015/most-expensive-natural-disasters-usa/>.

² “Flood Insurance/National Flood Insurance Program (NFIP),” National Association of Insurance Commissioners, October 1, 2020, https://content.naic.org/cipr_topics/topic_flood_insurance_national_flood_insurance_program_nfip.htm.

³ Federal Insurance and Mitigation Administration, “National Flood Insurance Program Financial Statements,” *The Watermark* 11, no. 3rd Quarter (2020): 2, <https://www.fema.gov/flood-insurance/work-with-nfip/watermark-financial-statements>.

⁴ Diane P. Horn and Baird Webel, *Introduction to the National Flood Insurance Program (NFIP)*, CRS Report No. R44593 (Washington, DC: Congressional Research Service, 2021), <https://sgp.fas.org/crs/homesec/R44593.pdf>.

⁵ Ike Brannon and Ari Blask, *Reforming the National Flood Insurance Program: Toward Private Flood Insurance*, Policy Analysis No. 817 (Washington, DC: CATO Institute, 2017), <https://www.cato.org/policy-analysis/reforming-national-flood-insurance-program-toward-private-flood-insurance>.

⁶ Laura Lightbody, “Congress Again Defers on Reforming Flood Insurance Program,” Pew Charitable Trusts, January 9, 2019, <https://pew.org/2C9C8mM>.

regions—that also happen to be high risk. For these reasons, building and land-use policies exacerbate flooding damage.⁷ Therefore, the NFIP perpetuates the disaster cycle.

In contrast, the Federal Emergency Management Agency (FEMA), through its Hazard Mitigation Assistance (HMA) program, offers homeowners the ability to sell their flooded or at-risk properties at pre-disaster appraised values. The community then demolishes the home, and the land is deed-restricted in perpetuity as open space. By eliminating the risk forever and lessening the drain on the NFIP, the HMA reduces future disaster costs. In this context, the HMA represents a workable approach to managing flood-prone areas in the United States.⁸

Yet climate change that drives higher temperatures and precipitation may imperil the efficacy of the current HMA program, particularly on the coasts. Specifically, the HMA is voluntary, meaning that homeowners can rebuild even in highly flood-prone areas because FEMA has few enforcement mechanisms. Although coastal areas account for less than 10 percent land area of the contiguous United States, according to 2014 estimates, coastal counties house 40 percent of the U.S. population.⁹ Furthermore, the coasts are about five times more densely packed than inland areas of the United States. Thus, hurricanes affect far more people, buildings, and infrastructure than disasters elsewhere.¹⁰ As climate change accelerates the intensity and frequency of disasters, the nation must prepare for changing conditions—and rising costs.¹¹ Given the disproportionate impacts of flooding in coastal regions, the HMA program may call for greater enforcement mechanisms to curb increased costs.

⁷ Kevin T. Starbuck, “Moral Hazard: How the National Flood Insurance Program Is Limiting Risk Reduction” (master’s thesis, Naval Postgraduate School, 2016), <http://hdl.handle.net/10945/51620>.

⁸ First Street Foundation, “Find Your Home’s Flood Risk,” Flood Factor, accessed March 28, 2021, <https://floodfactor.com/>.

⁹ National Ocean Service, “What Percentage of the American Population Lives near the Coast?,” Ocean Facts, February 26, 2021, <https://oceanservice.noaa.gov/facts/population.html>.

¹⁰ Coastal length and population figures include the Great Lakes.

¹¹ Rawle King, “1 in 4 High-Risk Areas Have at Least a 1 in 4 Chance of Flooding during a 30-Year Mortgage” (Washington, DC: Pew Charitable Trusts, October 2016), https://www.pewtrusts.org/~media/assets/2016/10/repeatedly_flooded_properties_cost_billions.pdf?la=en.

According to Kulp and Strauss, a 2019 report projects that globally, the number of people forced to move because of sea-level rise may be in the hundreds of millions and possibly 300 million by 2050, essentially tripling the number of people worldwide vulnerable to sea-level rise and flooding.¹² The evidence suggests that traditional methods of mitigating at-risk properties may not be adequate, and more urgent solutions may be necessary. FEMA must rethink its HMA programs and examine whether acquisitions through eminent domain rather than voluntary participation and other adaptation techniques may be warranted. In other words, FEMA must consider pursuing strategic retreat from extreme high-risk areas of the United States. Strategic retreat may be the first step in realizing the limitations of individual home buyouts and its inevitable failure to keep pace with future flooding.

A. RESEARCH QUESTION

Why and how should FEMA pursue strategic retreat from high-risk areas in the United States?

B. LITERATURE REVIEW

Strategic retreat inspires controversy in several ways. Typically, state, and local municipalities govern land use planning and zoning matters.¹³ However, the federal government is inextricably bound to local land use as it offers subsidized flood insurance, establishes minimum floodplain management standards, and provides disaster relief. Hence, land use is a national concern.¹⁴ This literature review discusses the debate around strategic retreat and two related topics that inform it: eminent domain as an adaptation tool that enables retreat and social equity issues that arise because of strategic retreat.

¹² Scott A. Kulp and Benjamin H. Strauss, “New Elevation Data Triple Estimates of Global Vulnerability to Sea-Level Rise and Coastal Flooding,” *Nature Communications* 10, no. 1 (2019): 1–12, <https://doi.org/10.1038/s41467-019-12808-z>.

¹³ “Land Use,” Environmental Law Institute, March 19, 2012, <https://www.eli.org/keywords/land-use>.

¹⁴ Joel Scata and 2017 Joel Scata, “FEMA Turning Blind Eye to NFIP’s Influence on Land Use (1),” *Natural Resources Defense Council* (blog), June 7, 2017, <https://www.nrdc.org/experts/fema-turning-blind-eye-nfips-influence-land-use-1>.

1. Strategic Retreat

In a study published by the Academy of Sciences, the author asserts that not only is strategic (or, as he terms it, managed) retreat necessary and urgent, but it may fundamentally alter the way the United States deals with nature and manages risk.¹⁵ Unfortunately, the word “retreat” has negative connotations and suggests defeat in a military sense. But such retreat may represent a process of regrouping to move to a safer place.¹⁶ The certainty of climate change and its impact on some localities—with coastal areas among the most vulnerable—serve as a starting point for most studies. Authors Siders, Hino, and Mach, in a recent article, argue, “faced with global warming, rising sea levels, and the climate-related extremes they intensify, the question is no longer whether some communities will retreat—moving people and assets out of harm’s way—but why, where, when, and how they will retreat.”¹⁷

An increasing amount of literature addresses strategic retreat or, as it is sometimes referred to, “managed retreat.” The terms “planned relocation” or “preventative resettlement” sometimes mean the same thing.¹⁸ Some scholars distinguish the phrase “managed retreat” and “strategic retreat,” with the former suggesting permanent evacuation of people, residences, and businesses out of areas likely to flood. The scholar A.R. Siders defines managed retreat as “the purposeful, coordinated movement of people and assets

¹⁵ John Carey, “Core Concept: Managed Retreat Increasingly Seen as Necessary in Response to Climate Change’s Fury,” *Proceedings of the National Academy of Sciences* 117, no. 24 (2020): 13182–85, <https://doi.org/10.1073/pnas.2008198117>.

¹⁶ Mark Nevitt, “Climate Adaptation Strategies: How Do We ‘Manage’ Managed Retreat?,” Kleinman Center for Energy Policy, August 25, 2020, <https://kleinmanenergy.upenn.edu/research/publications/climate-adaptation-strategies-how-do-we-manage-managed-retreat/>.

¹⁷ A.R. Siders, Miyuki Hino, and Katharine Mach, “The Case for Strategic and Managed Climate Retreat,” *Science* 365 (August 23, 2019): 761, <https://doi.org/10.1126/science.aax8346>.

¹⁸ Jane McAdam and Elizabeth Ferris, “Planned Relocations in the Context of Climate Change: Unpacking the Legal and Conceptual Issues,” *Cambridge Journal of International and Comparative Law* 4, no. 1 (2015): 4, <https://doi.org/10.7574/cjicl.04.01.137>.

out of harm's way.”¹⁹ The latter refers to a gradual abandonment.²⁰ This thesis treats both phrases interchangeably, but “strategic retreat” is preferred as it also implies integration with long-term planning and coordination across jurisdictions rather than “managed retreat,” which simply suggests how one manages the process.

Opinions vary as to the role of human beings in creating and responding to floods. Climate change and sea-level rise would be less of an issue, but it is nationally and globally critical because it intersects with and influences human activity and development. The U.N. secretary-general, in 2018, described climate change as “the defining issue of our time” and “a direct existential threat.”²¹ In a ground-breaking 1945 publication, *Human Adjustments to Floods*, Gilbert White, considered by many as the father of floodplain management, writes that “floods are acts of God, but flood losses are largely acts of man.”²² White's approach highlights a disciplinary divide between engineers who seek to control nature and geographers, like himself, who advocate adaptation.

In contemporary times, A.R. Siders of the University of Delaware defines strategic (or managed) retreat as “the purposeful, coordinated movement of people and assets out of harm's way” and recognizes it as a controversial but transformative tool.²³ Numerous obstacles prevent retreat, yet some communities, like Maui, Hawaii, have overcome these barriers to accomplish retreat on a small scale.²⁴ Based on scientific research, Hawaii is

¹⁹ A.R. Siders, “Managed Retreat in the United States,” *One Earth* 1, no. 2 (October 2019): 1, <https://doi.org/10.1016/j.oneear.2019.09.008>.

²⁰ Molly Mitchell et al., *Recurrent Flooding Study for Tidewater Virginia* (Gloucester Point, VA: Center for Coastal Resources Management, 2013), 28, http://ccrm.vims.edu/recurrent_flooding/Recurrent_Flooding_Study_web.pdf.

²¹ António Guterres, “Secretary-General's Remarks on Climate Change [as Delivered],” United Nations Secretary-General, September 10, 2018, <https://www.un.org/sg/en/content/sg/statement/2018-09-10/secretary-generals-remarks-climate-change-delivered>.

²² Gilbert Fowler White, *Human Adjustment to Floods: A Geographical Approach to the Flood Problem in the United States*, Research Paper No. 29 (Chicago: University of Chicago, 1945), 2, https://biotech.law.lsu.edu/climate/docs/Human_Adj_Floods_White.pdf.

²³ A. R. Siders, “Managed Retreat in the United States,” *One Earth* 1, no. 2 (2019): 1, <https://doi.org/10.1016/j.oneear.2019.09.008>.

²⁴ Douglas Codiga and Kylie Wager, *Sea-Level Rise and Coastal Land Use in Hawai'i: A Policy Tool Kit for State and Local Governments* (Honolulu: Center for Island Climate Adaptation and Policy, 2011), 27, <https://research.fit.edu/media/site-specific/researchfitedu/coast-climate-adaptation-library/united-states/west-coast-amp-hawaix27i/hawaix27i/University-of-Hawai'i.-SLR--Costal-Land-Use-Policy-Tool-Kit.pdf>.

planning on a sea-level rise of one foot by 2050 and 3 feet by the end of the century.²⁵ The Hawaii Coastal Zone Management Act gives local officials the tools to limit rebuilding and construction in coastal areas and enforce setbacks and conservation easements.²⁶ Land use policy can be a strong motivator in regulating floodplains, managing floods, and limiting construction in high-risk areas to achieve long-term resilience.

Whereas the terms “rebuild” and “resist” indicate some level of *control* by humans over nature, the terms “restore, retain, and retreat,” sometimes grouped under the term *adaptation*, have gained wider acceptance lately. The 2007 Intergovernmental Panel on Climate Change (IPCC) Report on Climate Change defines adaptation as “an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.”²⁷ Adaptation can refer to strategies that prepare for and cope with the effects of climate change and often begins with identifying context-specific goals communities have. Often these goals conflict with one another, such as promoting economic activity in coastal areas yet limiting development in coastal zones and floodplains. These conflicting activities require better alignment of risk and insurance and comprehensive plans that combine emergency plans with mitigation plans and engage communities to establish priorities.

In the past few years, the adaptation and resiliency debate has evolved. Planners refer to a taxonomy of resilience called the “Five Rs,” which provides a framework for evaluating the most appropriate combination of approaches to manage risk.²⁸ Rebuild allows reinforcing existing structures through elevations and developing policies that require sturdier construction techniques in flood zones. Physical barriers like floodwalls

²⁵ Charles H. Fletcher, “Sea Level by the End of the 21st Century: A Review,” *Shore & Beach* 77, no. 4 (Fall 2009): 4, http://www.soest.hawaii.edu/coasts/publications/fletcher2009_sealevelreview.pdf.

²⁶ State of Hawaii, Office of Planning and Sustainable Development, “State CZM Program,” State of Hawai’i Office of Planning and Sustainable Development, accessed December 20, 2021, <https://planning.hawaii.gov/czm/>.

²⁷ Intergovernmental Panel on Climate Change, “G. Definitions of Key Terms - AR4 WGII Foreword, Preface, and Introduction,” *Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability*, accessed January 2, 2022, https://archive.ipcc.ch/publications_and_data/ar4/wg2/en/frontmattersg.html.

²⁸ Robert Freudenberg et al., *Buy-in for Buyouts: The Case for Managed Retreat from Flood Zones* (Cambridge, MA: Lincoln Institute for Land Policy, 2016), 10–11.

enable Resist but can work only in limited circumstances. Restore uses nature-based solutions such as restoration of wetlands or living shorelines to better protect from storm surges and attenuate wave action. Retain allows water retention by controlling where the water goes through bio-swailes and green roofs with their capacity to absorb water during a flood. Lastly, retreat relocates people and structures out of harm's way. The Lincoln Institute of Land Policy and the Regional Planning Association concedes that "each category is by no means effective by itself."²⁹ The framework offers a combination of strategies to manage risk.

Projections of the number of people whom rising seas may affect have intensified the debate among those who advocate a position of *resisting*—building better defenses to keep nature at bay, that is, control—and those who support *retreating* as an adaptation strategy. In the former camp, the Dutch—long accustomed to regular flooding as over a third of their country lies below sea level—have invested heavily in a system of ambitious mechanically operated gates and sea walls to keep the water at bay.³⁰ Therefore, resisting has a place in resilience.

However, the Netherlands is a small country that can afford to undertake enormous engineering projects and implement ambitious land use management practices. The area of the Netherlands is about 16,000 square miles. The United States, by contrast, is 3.8 million square miles.³¹ The Netherlands coast is about 280 miles long. By comparison, NOAA officially estimates the length of the U.S. coast at nearly 95,500 miles.³² The Dutch spend about \$1.3 billion each year on flood defense and water management.³³ If the United States

²⁹ Freudenberg et al., 12.

³⁰ "The Delta Works," Deltawerken, accessed May 16, 2021, <http://www.deltawerken.com/deltaworks/23.html>.

³¹ "Countries Compared by Geography > Land Area > Square Miles," NationMaster, accessed November 7, 2021, <http://www.nationmaster.com/country-info/stats/Geography/Land-area/Square-miles>.

³² "How Long Is the U.S. Shoreline?," Ocean Facts, February 26, 2021, <https://oceanservice.noaa.gov/facts/shorelength.html>.

³³ Alcoforado Fag and Alcoforado Fag, "Flood Control and Its Management," *Journal of Atmospheric & Earth Science* 2, no. 1 (2018): 10, https://www.heraldopenaccess.us/article_pdf/15/flood-control-and-its-management.pdf.

sought to build similar projects, the costs would exceed \$30 billion annually—or about seven to eight times the current annual budget of the U.S. Army Corps of Engineers.³⁴

Over the years, the Corps has proposed and built massive levees, floodwalls, and coastal barriers to resist rising seas all over the United States. However, the Corps is often faulted for embarking on large infrastructure projects that do not work. For example, the courts found the Corps partially to blame for worsening the impacts of Hurricane Katrina. Channeling the natural course of the Mississippi River and blocking the flow of silt resulted in the loss of a third of wetlands and natural barrier islands that protected New Orleans.³⁵ In this way, resist seems to have drawbacks as an adaptation strategy.

Additionally, a congressional hearing determined levees that were the last line of defense to protect New Orleans were “fatally flawed in design, construction, or maintenance.”³⁶ Additionally, a media report questions whether the \$14 billion upgrades to the levees undertaken by the Corps after Hurricane Katrina are sinking.³⁷ According to a 2019 *Federal Register* notice, “Engineering analysis indicates the HSDRRS (Greater New Orleans Hurricane and Storm Damage Risk Reduction System) will no longer provide 1% level of risk reduction as early as 2023.”³⁸ Based on the above findings, a combination of sea-level rise and subsidence will render the defenses useless very soon. Resistance by investing in ever-larger flood barriers may not be viable.

The alignment of conflicting goals makes strategic retreat a powerful adaptation technique available to planners and regulators. To some extent, retreat already happens in

³⁴ Anna E. Normand and Nicole T. Carter, *U.S. Army Corps of Engineers: Annual Appropriations Process and Issues for Congress*, CRS Report No. R46320 (Washington, DC: Congressional Research Service, 2020).

³⁵ Findings of Fact and Conclusions of Law, *Robinson v. United States*, 471 F. Supp. 2d 684 (E.D. La. 2007), <http://cdnassets.hw.net/14/d9/6cb8d9e04077a52ac5f767a59d08/in-re-katrina-canal-breaches.pdf>

³⁶ *Hurricane Katrina: Who's in Charge of the New Orleans Levees?: Hearing before the Committee on Homeland Security and Governmental Affairs*, Senate, 109th Cong., 1st sess. (2005), <https://www.govinfo.gov/content/pkg/CHRG-109shrg26746/html/CHRG-109shrg26746.htm>.

³⁷ Thomas Frank, “Army Corps: After \$14B Upgrade, New Orleans Levees Are Sinking,” *Climate Wire*, April 11, 2019, <https://www.eenews.net/stories/1060153275>.

³⁸ “Lake Pontchartrain and Vicinity General Re-Evaluation Report,” US Army Corps of Engineers New Orleans District, accessed June 23, 2021, <https://www.mvn.usace.army.mil/About/Projects/BBA-2018/studies/LPV-GRR/>.

response to a natural disaster that forces people to move. Without a strategic vision and a framework, unmanaged, ad hoc retreat often misses opportunities to contribute to societal goals and leads to inequities in who moves or who stays. Also, an exclusive focus on physical relocation misses the more extensive discussion on such social factors as loss of community and heritage—predominantly the loss suffered by minority and disadvantaged communities.

Such theorists as Scott et al. contend that retreat is the only realistic alternative due to increasing threats posed by rising seas. Citing examples that range from Europe to Australia to the United States, the authors warn that “a business-as-usual approach will further entrench unsustainable path dependencies, such as building on flood plains or within fire-prone areas, which will prove more costly to protect or adapt in the future.”³⁹ This inevitability argument resembles the position of Mach et al. that intensifying climate change makes retreat from some areas unavoidable.⁴⁰ Similarly, in a 2020 paper, Robinson et al. claim that cities like New Orleans and Miami have heightened vulnerability in the eastern United States, with their high population, shallower coasts, and greater densities.⁴¹ For example, Hauer, Evans, and Mishra assert that a 0.9-meter (approximately three feet) rise in seas by the year 2100 will threaten 4.2 million people in the United States with inundation. A six-foot increase by 2100 will flood 13.1 million.⁴² Proponents of adaptation, such as Lawrence et al., maintain that “retreat will become an increasingly crucial and unavoidable adaptation response in low-lying coastal and river floodplains due

³⁹ Mark Scott et al., “Climate Disruption and Planning: Resistance or Retreat?,” *Planning Theory & Practice* 21, no. 1 (2020): 127, <https://doi.org/10.1080/14649357.2020.1704130>.

⁴⁰ Katharine J. Mach et al., “Managed Retreat through Voluntary Buyouts of Flood-Prone Properties,” *Science Advances* 5, no. 10 (2019): 1–9, <https://doi.org/10.1126/sciadv.aax8995>.

⁴¹ Caleb Robinson, Bistra Dilkina, and Juan Moreno-Cruz, “Modeling Migration Patterns in the USA under Sea Level Rise,” *PLOS One* 15, no. 1 (2020): e0227436, <https://doi.org/10.1371/journal.pone.0227436>.

⁴² Mathew E. Hauer et al., “Millions Projected to Be at Risk from Sea-Level Rise in the Continental United States,” *Nature Climate Change* 6, no. 7 (July 2016): 691, <https://doi.org/10.1038/nclimate2961>.

to sea-level rise and flooding from more intense rainfall.”⁴³ The dense populations on the coast vulnerable to sea level rise may provoke strategic retreat.

Amid such predictions, in a 2014 article, Oliver-Smith and de Sherbinin reason that involuntary resettlement offers the best solution, although they caution this approach carries risk.⁴⁴ Although relocation represents vital protection for vulnerable communities, the authors conclude that resettlement because of large infrastructure projects has been poor. They blame resettlement risks on two broad issues: the lack of a legal and regulatory framework; the complex interaction of socio-economic factors that vary and are unpredictable:

Post-disaster resettled populations often abandon the new settlements and return to previous home sites for a wide variety of environmental, economic, social and psychological motives. Part of the blame for these failures has been due to failures in design, construction, implementation, and delivery of the resettlement project itself, and these problems generally derive from a lack of consultation with, and participation by, the affected people. This lack is generally due to a disparagement of local knowledge and culture on the part of policymakers and planners.⁴⁵

The authors posit that any resettlement solution must be durable to ensure successful outcomes.

Japan reconstructed 145,000 homes on higher ground in an example of a large-scale strategic retreat after the 2011 tsunami, albeit in response to a disaster rather than climate change. Either way, it is the most extensive and among the more successful relocation programs ever administered. Pinter et al. advise, “Recovery from the 2011 tsunami also involved a paradigm shift in non-structural land-use management, preventing residential

⁴³ Judy Lawrence et al., “Implementing Pre-Emptive Managed Retreat: Constraints and Novel Insights,” *Current Climate Change Reports* 6, no. 3 (September 2020): 77, <https://doi.org/10.1007/s40641-020-00161-z>.

⁴⁴ Anthony Oliver-Smith and Alex de Sherbinin, “Resettlement in the Twenty-First Century,” *Forced Migration Review*, no. 45 (2014): 23, <https://www.fmreview.org/sites/fmr/files/FMRdownloads/en/crisis.pdf>.

⁴⁵ Oliver-Smith and de Sherbinin, 23.

reconstruction on high-hazard land in the affected area.”⁴⁶ They also acknowledge that the response due to its scale and involuntary participation is starkly different from those feasible in the United States.

2. Eminent Domain

Purchasing properties through eminent domain carries risk and opposition. Literature on both sides argues the inevitability and the impossibility of carrying out such a process. Harris, for example, contends that disadvantaged populations bear the biggest brunt of eminent domain without realizing its benefits.⁴⁷ Before addressing the legal arguments for and against acquiring property through eminent domain, Harris claims that the federal government must consider two issues. First, if voluntary buyouts are too slow and too limited for long-term resiliency, are other mechanisms available to move people out of high-risk areas? Second, how does the United States determine regions of extremely high risk suitable for strategic retreat?⁴⁸ Both questions have a fair amount of literature devoted to them. Peterson et al. address the first question:

We find that state and local governments are using a range of traditional and innovative financial mechanisms, including municipal/green bonds, revolving loan funds, local option sales taxes, and stormwater utility fees, as viable tools for funding buyouts. These tools may promote more autonomy from federal government mitigation programs, and ultimately, faster buyout processes.⁴⁹

FEMA recently released its National Risk Index (NRI) identifying highest-risk areas in the United States.⁵⁰ The index covers 18 natural hazards and includes data about

⁴⁶ Nicholas Pinter et al., “Large-Scale Managed Retreat and Structural Protection following the 2011 Japan Tsunami,” *Natural Hazards* 96, no. 3 (April 2019): 1435, <http://dx.doi.org/10.1007/s11069-019-03602-7>.

⁴⁷ Kirk E. Harris, “Because We Can Doesn’t Mean We Should and If We Do: Urban Communities, Social and Economic Justice, and Local Economic-Development-Driven Eminent Domain Practices,” *Economic Development Quarterly* 29, no. 3 (2015): 245–61, <https://doi.org/10.1177/0891242415575423>.

⁴⁸ Harris.

⁴⁹ Kelsey Peterson et al., “A Review of Funding Mechanisms for US Floodplain Buyouts,” *Sustainability* 12, no. 23 (January 2020): 1, <https://doi.org/10.3390/su122310112>.

⁵⁰ “National Risk Index for Natural Hazards,” Federal Emergency Management Agency, January 8, 2021, <https://www.fema.gov/flood-maps/products-tools/national-risk-index>.

expected annual losses, social vulnerabilities, environmental factors, and community resilience. It offers a comprehensive view of the nation's most vulnerable areas and provides a resource for areas suitable for retreat. According to the IPCC, in areas that undertake strategic retreat through eminent domain, the change could be transformational for society, the economy, and ecology.⁵¹ As most property along the coastal United States is privately owned, using eminent domain authority for strategic retreat poses significant challenges. Georgetown Law School maintains a crosscutting legal framework and overarching legal jurisdiction for managed retreat.⁵² Such a framework does not guarantee that the federal government's exercise of eminent domain authority will not meet opposition.

3. Equity and Social Justice

Even in the best circumstances, mustering the political will and resources to move people without a significant disaster voluntarily may be challenging. Social fragmentation, marginalization, erosion of cultural identity, and economic anxiety due to uncertainty and loss of livelihood all reasonably may inhibit strategic retreat.⁵³ For these reasons, voluntary relocation proves difficult and a barrier to strategic retreat.

Programs and policies that pursue strategic retreat and purchase properties through eminent domain must also consider equity and social justice questions. That is, are people from different socio-economic backgrounds treated fairly? In a 2020 article, Elliott et al. note that federal buyout programs “disproportionately targets whiter counties and neighborhoods, especially in more urbanized areas where the program now concentrates.”⁵⁴ Citing examples from New York, New Jersey, and Houston that when

⁵¹ David Dokken, *Summary for Policymakers, Climate Change 2014: Impacts, Adaptation, and Vulnerability* (Cambridge: Intergovernmental Panel on Climate Change, 2014), https://www.ipcc.ch/site/assets/uploads/2018/02/ar5_wgII_spm_en.pdf.

⁵² “Managed Retreat Toolkit: Overview of the Legal Framework,” Managed Retreat Toolkit, accessed June 22, 2021, <https://www.georgetownclimate.org/adaptation/toolkits/managed-retreat-toolkit/overview-of-the-legal-framework.html>.

⁵³ Oliver-Smith and de Sherbinin, “Resettlement in the Twenty-First Century.”

⁵⁴ James R. Elliott, Phylcia Lee Brown, and Kevin Loughran, “Racial Inequities in the Federal Buyout of Flood-Prone Homes: A Nationwide Assessment of Environmental Adaptation,” *Socius* 6 (2020): 2, <https://doi.org/10.1177/2378023120905439>.

buyouts occur, they are not always a rational benefit-cost driven process but “inherently a racialized process because residential properties, the ultimate target of the program, are socialized assets, embedded in neighborhoods that have long been segregated and unequally served by government programs.”⁵⁵ The authors’ claims, if true, point to some uncomfortable realities with FEMA’s programs. In a report published in November 2020, FEMA’s National Advisory Council (NAC), an advisory body formed after Hurricane Katrina, unequivocally states that disaster aid exacerbates inequities by short-changing poorer and minority communities. NAC found that FEMA provides “an additional boost to wealthy homeowners and others with less need, while lower-income individuals and others sink further into poverty after disasters.”⁵⁶ Strategic retreat if implemented, must ensure that government programs don’t perpetuate inequities.

High-risk areas may disproportionately represent lower socio-economic classes and people of color. Bakkensen and Ma claim that it is hardly surprising that “low-income and minority residents are more likely to move into high-risk flood zones.”⁵⁷ As homes located just inside a high-risk flood zone are likely to be discounted by 6.3 percent, they are more attractive to low-income and minority residents.⁵⁸ Further, when it comes to relocation, Loughran and Elliott hold that environmental mobility “reflects and thus seems to depend on racialization processes of neighborhood attainment, thereby challenging a purely technocratic framing of current buyout policies and illuminating the racialized nature of environmental mobility more generally.”⁵⁹ Poorer communities face more flooding risks because they are more likely to be in flood-prone areas, and thus more likely to be the beneficiaries of federal programs

⁵⁵ Elliott, Brown, and Loughran, 2.

⁵⁶ National Advisory Council, *National Advisory Council: Report to the FEMA Administrator* (Washington, DC: National Advisory Council, 2020), 6, https://www.fema.gov/sites/default/files/documents/fema_nac-report_11-2020.pdf.

⁵⁷ Laura A. Bakkensen and Lala Ma, “Sorting Over Flood Risk and Implications for Policy Reform,” *Journal of Environmental Economics and Management* 104 (November 2020): 3, <https://doi.org/10.1016/j.jeem.2020.102362>.

⁵⁸ Bakkensen and Ma, 3.

⁵⁹ Kevin Loughran and James R. Elliott, “Residential Buyouts as Environmental Mobility: Examining Where Homeowners Move to Illuminate Social Inequities in Climate Adaptation,” *Population and Environment* 41, no. 1 (September 2019): 52, <https://doi.org/10.1007/s11111-019-00324-7>.

In an executive order signed January 20, 2021, President Biden ordered the federal government to “pursue a comprehensive approach to advancing equity for all, including people of color and others who have been historically underserved, marginalized, and adversely affected by persistent poverty and inequality.”⁶⁰ The order includes provisions for agencies to remove potential barriers underserved communities may face in accessing federal programs. It proposes allocating resources to increase funding to underserved communities.

Indeed, social justice and equity concerns have recently gained prominence in the public discourse. In a book published in 2020, Guy and McCandless claim that “equity is the fourth pillar of public administration alongside efficiency, economy, and effectiveness.”⁶¹ Despite the evolving definition of the term—from a philosophical concept to a constitutional matter, to finally an administrative issue—it profoundly affects people’s lives. The core concept suggests that access to public services should be fair in process, quality, and outcome and serve the entire population, not just a favored few.

Although equity and equality may be similar, they are not synonymous since equity requires greater nuance than simply distributing goods equally among all. The Annie E. Casey Foundation explains the two interrelated concepts thus: “Equity involves trying to understand and give people what they need to enjoy full, healthy lives. Equality, in contrast, aims to ensure that everyone gets the same things to enjoy full, healthy lives.”⁶² According to the foundation, disadvantaged and traditionally marginalized communities need to level the playing field. Elaborating on the theme of equity, McCandless and Guy define social justice as systems and not just individuals who remedy historic inequities to benefit the least advantaged in society. The authors state public administration is “the vehicle for

⁶⁰ Joseph R. Biden, Jr., “Executive Order on Advancing Racial Equity and Support for Underserved Communities through the Federal Government,” White House, January 21, 2021, <https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/20/executive-order-advancing-racial-equity-and-support-for-underserved-communities-through-the-federal-government/>.

⁶¹ Mary Guy and Sean McCandless, *Achieving Social Equity* (Irvine, CA: Melvin & Leigh, Publishers, 2020), 4.

⁶² “Equity vs. Equality and Other Racial Justice Definitions,” *Casey Connects* (blog), April 14, 2021, <https://www.aecf.org/blog/racial-justice-definitions/>.

ensuring both social justice and social equity,” strategic retreat must be carried out equitably and not disadvantage one demographic over another.⁶³

C. RESEARCH DESIGN

Strategic retreat from high-risk areas is a suitable topic to study.⁶⁴ The critical elements of the present research are how one can undertake retreat; the criteria under which the U.S. government carries it out and the implications of such implementation. The thesis looks at the successes and the shortcomings of FEMA’s HMA program and the NFIP. It relies on data collected over 30 and 50 years of the programs. Most data used in this thesis is publicly available at OpenFEMA, a public resource for FEMA’s program data.⁶⁵ A close analysis of this data reveals homeownership trends, hazard mitigation, NFIP affordability, and equity. The thesis is also prescriptive as it makes policy and implementation recommendations for strategic retreat from extreme high-risk coastal areas of the United States.

As flooding is the costliest and most prevalent natural disaster, I have limited my study area to the risks posed by more significant precipitation due to climate change. This risk generally manifests in three forms. First, rising temperatures in the sea and sea-level rise pose an immediate threat to coastal communities in the form of hurricanes, storm surges, and erosion. Second, atmospheric rivers or “rivers in the sky” hold more significant moisture, resulting in torrential rain and causing inland flooding. Third, riverine floods, which could be a combination of rapid snowmelt and over-development, may reduce land permeability.

Sometimes, as was the case of Hurricane Harvey in Houston, all three factors come together. In a comprehensive post-Harvey study conducted by the Delft University of Technology, the researchers conclude, “flooding is a problem that has multiple (often local)

⁶³ Guy and McCandless, *Achieving Social Equity*, 3.

⁶⁴ The thesis is limited to studying floods and retreat from coastal areas. It is also limited to studying buyouts or relocation of residential structures. The thesis does not address problems with the NFIP. Lastly, the thesis does not address retreat from wildland urban interfaces.

⁶⁵ “OpenFEMA,” Federal Emergency Management Agency, December 8, 2021, <https://www.fema.gov/about/reports-and-data/openfema>.

drivers of both physical and social origin.”⁶⁶ Although my thesis does not employ the case-study method per se, Harvey and Houston offer a microcosm of many inherent problems: unregulated development, poor floodplain management, and zoning, weak building code adoption and enforcement, outdated flood maps, multiple floods and hurricanes, a large number of repetitive losses and severe repetitive losses of properties, demand for buyouts that far outstrips supply, barrier islands as ideal areas of retreat, disruption to the port of Houston, and oil and gas refineries that have national impact. These factors collectively make a compelling case for strategic retreat from some extreme high-risk areas of the United States.

The most significant barrier to strategic retreat may be the lack of a systematic framework for managing it. Under which circumstances does one use it? Are there methods besides purchase or eminent domain that governments should pursue initially? Are there situations where community relocation rather than an individual home buyout would be warranted? How do communities deal with declining or disappearing property tax revenues? Lastly, how does FEMA ensure that any strategic retreat program does not disproportionately impact communities of color and lower-income populations? In other words, what mechanisms are put in place to carry out a strategic retreat program fairly and equitably?

I have not interviewed or surveyed anyone for this thesis. The thesis relies solely on existing FEMA data, most of which is publicly available. I have relied on some data that is not published publicly, ensuring that there is *no* personal identifiable information (PII) in any of it. This data includes FEMA’s response and recovery programs, risk-map and planning programs, HMA, and NFIP. The Naval Postgraduate School’s Institutional Review Board has reviewed this material and approach and approved its use. ***The analysis and conclusions drawn from the data and opinions throughout the thesis are my own and not the official position of the U.S. federal government.***

⁶⁶ Antonia Sebastian et al., “Hurricane Harvey Report: A Fact-Finding Effort in the Direct Aftermath of Hurricane Harvey in the Greater Houston Region,” 2017, 93, <https://repository.tudelft.nl/islandora/object/uuid%3A54c24519-c366-4f2f-a3b9-0807db26f69c>.

D. OVERVIEW OF CHAPTERS

Chapter I lays out the research questions and introduces the problem statement. The U.S. federal government, primarily through FEMA, buys out homes at risk from flooding. The chapter lays out a case for strategic retreat from high-risk areas of the United States, different adaptation strategies that may be available, and why a retreat program must consider issues of equity and fairness.

Chapter II discusses flood risk in the United States and available means to minimize their impacts. The chapter argues that FEMA's buyout programs currently take too long, and demand far exceeds grants available. The program's voluntary nature and climate change pose risks several orders of magnitude larger than FEMA's processes can currently handle.

Chapter III takes the example of Hurricane Harvey and its impact on Houston and Harris County, Texas. The chapter examines the intersection of four factors: the NFIP, flood mapping, floodplain management, and building codes, and how their collective shortcoming led to catastrophe. The chapter does not offer solutions but attempts to understand better the problem and how multiple factors act in unison to create "the perfect storm."

Chapter IV lays out the case for and against strategic retreat. This chapter picks up arguments laid out in chapters II and III regarding the problem's urgency. The chapter details the debate between advocates of *resist* who want to build ever-larger flood walls and barriers to protect against rising seas and floodwaters and proponents of *retreat* who advocate not building back in highly vulnerable and high-risk areas. The chapter discusses buyouts through eminent domain and other buyout mechanisms employed in the past in the United States. The chapter closes with how a better understanding of risks and vulnerability may inform decisions to retreat strategically.

Chapter V considers the consequences of strategic retreat and what means may be available to minimize these impacts. Communities that lose homes stand to suffer lost tax revenues. Strategic retreat also risks losing the "fabric" of a community. It raises questions of how mitigation programs consider social justice and equity issues and not

disproportionately disadvantage lower-income, rural, and socially vulnerable communities. Although the costs of strategic retreat may be high, loss avoidance studies show that even single disasters pay for the upfront investment in mitigation. The chapter closes by examining the impact of strategic retreat on mass migration and climate refugees.

Chapter VI lays out a framework for strategic retreat and provides a classification rubric for different adaptation strategies, deterrents, and incentives available to policymakers and practitioners. The chapter and the thesis conclude by advocating why adaptation strategies must look beyond benefit-cost analyses and consider strategic retreat's human and societal aspects.

II. HAZARD MITIGATION

FEMA’s HMA grant programs, as they currently exist, have limitations. Buyout programs are voluntary, meaning homeowners can change their minds up to closing. The grant dollars flow from the federal government to the state, the local government, and the homeowner. Each step adds time to the process, and a single home buyout may commonly take as long as five years—an inordinately long time when the next flood may be imminent. The chapter looks at the mechanisms of home buyouts and determines whether FEMA may gain any efficiencies. Lastly, the chapter examines the issue of how demand for home buyouts, and mitigation in general, far exceeds grant monies available. The HMA program, despite past effectiveness, may not be equipped to deal with challenges posed by accelerating climate change that floods far more homes even with modest rises in sea levels this century.

A. RISING FLOOD RISK IN THE UNITED STATES

Floods dominate natural disasters and cause the most damage in the United States. As early as 2010, FEMA and NOAA concluded that “flooding is the most frequent severe weather threat and the costliest natural disaster facing the nation. Ninety percent of all natural disasters in the U.S. involve flooding.”⁶⁷ According to 2018 research by the Pew Charitable Trust, 73 percent of all presidentially declared disasters have been flood-related in the past twenty years.⁶⁸ The Congressional Research Service in 2020 reinforced the point, stating, “as much as 90 percent of the damage related to all-natural disasters (excluding droughts) is caused by floods, and associated debris flows” as depicted in

⁶⁷ “FloodingHistoryandCausesFS.Pdf,” 1, accessed March 14, 2022, <https://www.fbiic.gov/public/2010/mar/FloodingHistoryandCausesFS.PDF>.

⁶⁸ Laura Lightbody and Forbes Tompkins, “Where It Rains, It Floods: Nationwide Disasters Underscore Need for Flood Policy Overhaul,” Pew Charitable Trusts, January 25, 2018, <https://www.pewtrusts.org/en/research-and-analysis/articles/2018/01/25/where-it-rains-it-floods>.

Figure 1, and is the cause of the highest number of major disaster declarations by the president.⁶⁹

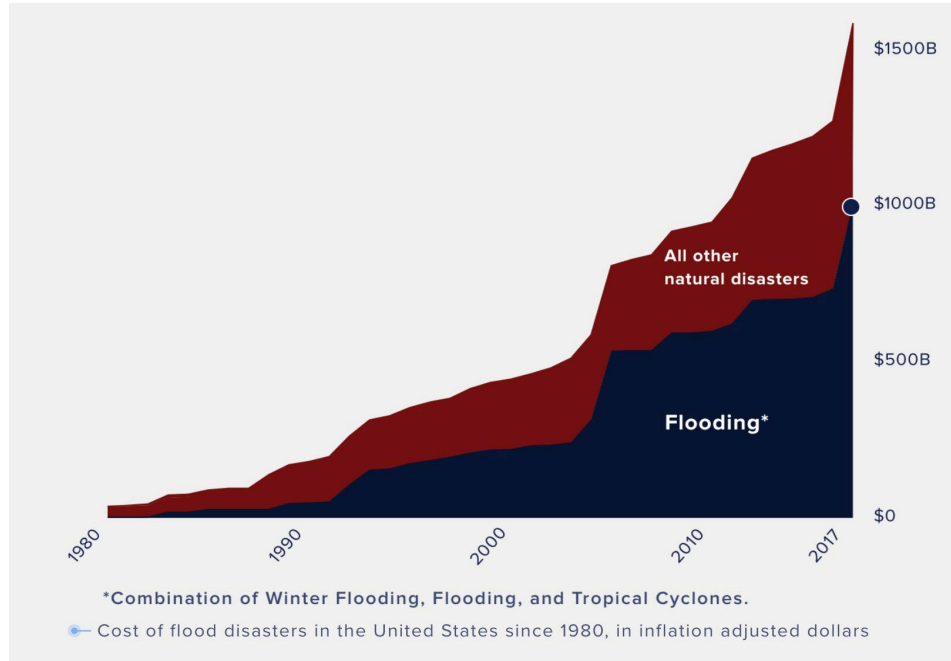


Figure 1. Cost of Flood Disasters in the United States since 1980 in Inflation-adjusted Dollars⁷⁰

Globally, MunichRe, a reinsurer, estimates that since 1980, flooding has accounted for 40 percent of all loss-related natural catastrophes and totals more than \$1 trillion. Only 12 percent of these losses are insured.⁷¹ Research published in January 2021 by the National Academy of Sciences finds that around a third of the \$200 billion in flood-related damages

⁶⁹ Diane P. Horn, *National Flood Insurance Program: Selected Issues and Legislation in the 115th Congress*, CRS Report No. R45099 (Washington, DC: Congressional Research Service, 2018), <https://fas.org/sgp/crs/homsec/R45099.pdf>. National Disaster Education Coalition, “Floods and Flash Flooding - Get the Facts,” New Jersey Office of Emergency Management Flood Information, accessed October 12, 2020, <https://www.state.nj.us/emergency/flood/flood.html>.

⁷⁰ Source: Matthew Eby and Colleen Ensor, “Understanding FEMA Flood Maps and Limitations,” First Street Foundation, March 21, 2019, <https://firststreet.org/flood-lab/research/understanding-fema-flood-maps-and-limitations/>.

⁷¹ “Risks from Floods, Storm Surges and Flash Floods: Underestimated Natural Hazards,” Munich Re, accessed October 31, 2021, <https://www.munichre.com/en/risks/natural-disasters-losses-are-trending-upwards/floods-and-flash-floods-underestimated-natural-hazards.html>.

over the past 30 years is due to climate change’s effect on precipitation.⁷² Further, the National Bureau of Economic Research believes that by 2100, climate change could cost the United States 10.5 percent of its gross domestic product (GDP), primarily due to extreme weather events.⁷³ As prevalent, extensive, and expensive floods currently are, the situation with climate change is liable to get much worse.

B. FEMA’S HAZARD MITIGATION ASSISTANCE (HMA) PROGRAMS

Natural disasters are unpredictable. In the last three decades, they have also been increasing in frequency and intensity.⁷⁴ Building resilience in the face of these disasters is a challenge. To alleviate the federal costs of disasters, Congress amended the Disaster Relief Act of 1974 in 1988 (PL 100-707). Renamed the Robert T. Stafford Disaster Relief and Emergency Assistance Act (commonly called the Stafford Act), it provides federal assistance—in the form of grants—to mitigate the impacts of future disasters. Hazard Mitigation offers communities the technical guidance, the tools for sound building construction and infrastructure protection, floodplain management standards, and of course, money to reduce risk. According to FEMA, “hazard mitigation is any sustainable action that reduces or eliminates long-term risk to people and property from future disasters.”⁷⁵ FEMA continues to explain that as mitigation breaks the sequence of damage and re-construction, it offers lasting and permanent solutions to reduce the future impact of disasters.⁷⁶ In these ways, the Stafford Act provides immediate relief from disasters but also ensures that reconstruction occurs in a resilient manner.

⁷² Frances V. Davenport, Marshall Burke, and Noah S. Diffenbaugh, “Contribution of Historical Precipitation Change to US Flood Damages,” *Proceedings of the National Academy of Sciences* 118, no. 4 (January 26, 2021): 1, <https://doi.org/10.1073/pnas.2017524118>.

⁷³ Matthew E. Kahn et al., *Long-Term Macroeconomic Effects of Climate Change: A Cross-Country Analysis* (Cambridge, MA: National Bureau of Economic Research, 2019), https://www.nber.org/system/files/working_papers/w26167/w26167.pdf.

⁷⁴ Adam B. Smith, “U.S. Billion-Dollar Weather and Climate Disasters, 1980 - Present (NCEI Accession 0209268)” (NOAA National Centers for Environmental Information, 2020), <https://doi.org/10.25921/STKW-7W73>.

⁷⁵ “Hazard Mitigation Assistance Grants | FEMA.Gov,” accessed March 11, 2022, <https://www.fema.gov/grants/mitigation>.

⁷⁶ “Hazard Mitigation Assistance Grants,” FEMA Grants, December 2, 2020, <https://www.fema.gov/grants/mitigation>.

FEMA’s Hazard Mitigation Assistance programs have funded more than \$15 billion worth of mitigation projects over the last 30 years.⁷⁷ These programs have successfully mitigated at-risk structures in this period, thereby minimizing, or eliminating recurring disaster losses, reducing suffering, damage to property, and loss of life. HMA comprises of the Hazard Mitigation Grant Program (HMGP), the Post-Fire HMGP; the Flood Mitigation Assistance (FMA) program; the Pre-disaster Mitigation (PDM) program, which was sunset in 2019; and the newest, Building Resilient Infrastructure and Communities (BRIC) program established in 2020. These grant programs have slightly different purposes, but they all accomplish long-term risk reduction and enable communities to be more resilient. Post-Fire HMGP and HMGP, the largest grant program, are available after a disaster declaration and are state-administered programs. The others are non-disaster grants, and FEMA administers these annually appropriated grants.

Although the amount of money available varies based on disaster activity, the Hazard Mitigation Assistance Division of FEMA awards about \$1.5 billion in grants each year across all five programs.⁷⁸ Despite increased funding for mitigation, especially as disasters get more extensive and frequent, the total spending for FEMA’s largest HMA program, HMGP, represents just 15 percent of total disaster costs.⁷⁹ As HMA programs generally require a 25 percent non-federal cost share, communities struggle to perform mitigation promptly.⁸⁰

The Hazard Mitigation Grant program, a multi-hazard grant program, has funded various risk reduction activities over the last thirty years. Figure 2 shows that home elevations, acquisitions, and mitigation reconstruction, account for a third of the money spent. The

⁷⁷ “Hazard Mitigation Assistance Projects - V2,” OpenFEMA Dataset, December 21, 2021, <https://www.fema.gov/openfema-data-page/hazard-mitigation-assistance-projects-v2>.

⁷⁸ Federal Emergency Management Agency, “Hazard Mitigation Assistance,” FEMA Reports & Data, September 2, 2021, <https://www.fema.gov/data-visualizations/hazard-mitigation-assistance-obligations>.

⁷⁹ About a dozen states who have an enhanced mitigation plan, qualify for 20 percent HMGP funding.

⁸⁰ Helen J.P. Wiley and Carolyn Kousky, “Speeding Up Post-Disaster Housing Buyouts,” *Solutions*, Fall 2020, 63, <https://riskcenter.wharton.upenn.edu/wp-content/uploads/2021/01/WILEY-Buyouts-Solutions.pdf>.

proportion of flood reduction projects in PDM is similar, and of course, the FMA program is dedicated solely to mitigating flood hazards.

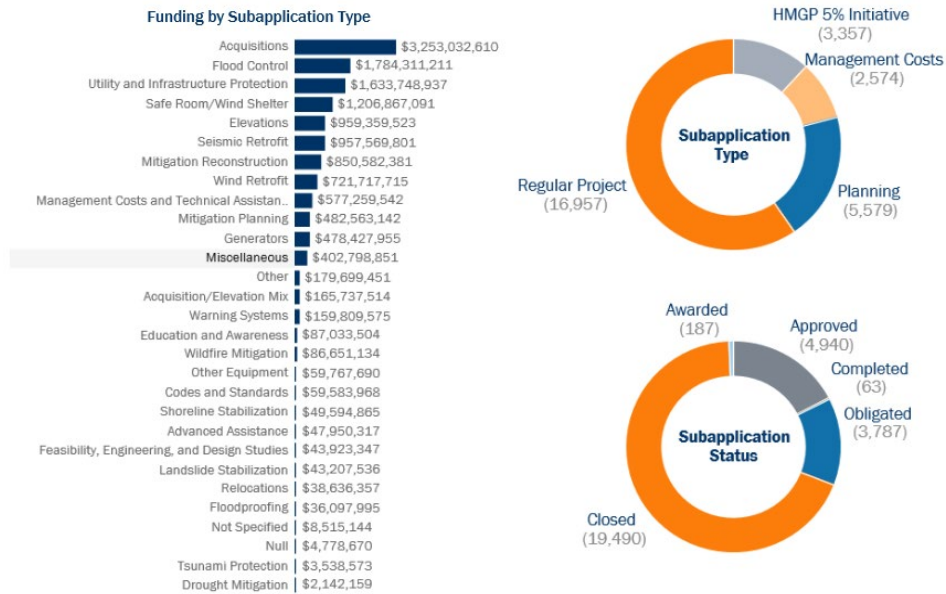


Figure 2. EMA Hazard Mitigation Grant Program (HMGP) Dashboard⁸¹

According to Columbia University’s Center for Climate Change Law, “Acquisition is a general term that covers a variety of programs in which the government purchases land. Buyout programs are a specific type of acquisition program in which the government uses public funds to purchase the title of privately held lands, demolishes existing structures on the land, and maintains the land in an undeveloped state for public use in perpetuity.”⁸² Both terms— “acquisition” and “buyout”—are used synonymously throughout this thesis.

The National Institute of Building Sciences (NIBS), in 2019, updated a decade-old study of the costs and associated benefits of hazard mitigation. Commissioned by the U.S.

⁸¹ Source: This dashboard which is updated every 24-hours, resides behind FEMA’s firewall, and is not publicly available. The author would like to acknowledge and thank FEMA specialist, Ms. Amanda Dampz, for the dashboard.

⁸² Anne Siders, *Managed Coastal Retreat: A Legal Handbook on Shifting Development Away from Vulnerable Areas* (New York: Columbia Center for Climate Change Law Columbia Law School, 2013), 109, <http://www.ssrn.com/abstract=2349461>.

Department of Housing and Urban Development (HUD), it represented “the most exhaustive benefit-cost analysis of natural hazard mitigation, from adopting up-to-date building codes and exceeding codes to addressing the retrofit of existing buildings and utility and transportation infrastructure.”⁸³ It concluded that investing in hazard mitigation yielded on the aggregate for all federal grants an overall benefit-cost ratio of 6:1, as seen in the top right value (Figure 3).

	ADOPT CODE	ABOVE CODE	BUILDING RETROFIT	LIFELINE RETROFIT	FEDERAL GRANTS
Overall Benefit-Cost Ratio	11:1	4:1	4:1	4:1	6:1
Cost (\$ billion)	\$1_{year}	\$4_{year}	\$520	\$0.6	\$27
Benefit (\$ billion)	\$13_{year}	\$16_{year}	\$2200	\$2.5	\$160
Riverine Flood	6:1	5:1	6:1	8:1	7:1
Hurricane Surge	not applicable	7:1	not applicable	not applicable	not applicable
Wind	10:1	5:1	6:1	7:1	5:1
Earthquake	12:1	4:1	13:1	3:1	3:1
Wildland-Urban Interface Fire	not applicable	4:1	2:1	not applicable	3:1

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Figure 3. Natural Hazard Mitigation Saves: 2019 Interim Report⁸⁴

In other words, every dollar invested in mitigation yields a return of six dollars, and in some cases, could be much higher. Specific mitigation measures, such as adopting the latest disaster-resistant building codes or seismically retrofitting existing buildings in earthquake zones have an even greater return of 11:1 and 13:1, respectively. This report updated the earlier ROI of 4:1, demonstrating not only that the return is higher than once thought, as disaster costs increase, the payback on mitigation investments also increases.

C. LIMITATIONS OF THE CURRENT HMA PROGRAMS

Despite these apparent successes, the HMA program has drawbacks. Besides the lengthy timeframe buyouts take, structural problems exist with systems currently in place

⁸³ “Natural Hazard Mitigation Saves: 2019 Report | National Institute of Building Sciences,” accessed March 11, 2022, <https://www.nibs.org/reports/natural-hazard-mitigation-saves-2019-report>.

⁸⁴ Source: Multi-Hazard Mitigation Council, *Natural Hazard Mitigation Saves: 2019 Report* (Washington, DC: National Institute of Building Sciences, 2019), 2, <https://www.nibs.org/page/mitigationsaves>.

that may have worked at one time but are no longer effective in either communicating or mitigating risk. First, this voluntary program grants money to states and not individuals. The voluntary nature of the program adds time to the process. The demand for grants is far greater than money available each year, and the number of properties that repeatedly flood continues rising. Climate change exacerbates the situation and amplifies the limitations of the current HMA programs.

1. A Voluntary Program

According to research conducted by the National Weather Service, the 1993 Mississippi flood was the costliest U.S. riverine flood in recent times, causing close to \$15 billion in damages, 50 deaths, and inundating more than 20 million acres in nine states.⁸⁵ Authorities evacuated approximately 54,000 people, while 50,000 homes were destroyed or damaged.⁸⁶ The floods severely damaged 75 towns; some were never rebuilt.⁸⁷ The Flood Mitigation Assistance (FMA) program created by Congress in 1994 aimed to specifically address flood hazard and was only available to communities that participated in the NFIP. Flood related mitigation projects include home elevations, flood-proofing utilities, and relocation. In 2019 and 2020, \$160 million in flood mitigation grants were available each year.

Since 1994—after the Mississippi River floods and the creation of the FMA program—communities have looked to federal grant programs and other funding sources to help disaster survivors.⁸⁸ Home buyouts have been one of the most widespread and effective ways for communities to reduce flooding risk, and according to FEMA, “Buyout projects have become a well-received mitigation measure to permanently remove people

⁸⁵ “The Great Flood of 1993,” NWS Forecast Office Quad Cities, IA/IL, accessed August 29, 2021, https://www.weather.gov/dvn/071993_greatflood.

⁸⁶ The earlier 1927 Mississippi River flood was even more destructive — then more than 700,000 people were rendered homeless.

⁸⁷ “The Great Flood of 1993,” Central Midwest Water Science Center, Fact Sheet, August 22, 2018, <https://www.usgs.gov/centers/cm-water/science/great-flood-1993>.

⁸⁸ The Flood Insurance Reform Act (FIRA) of 2004, created two additional flood mitigation grant programs – the Repetitive Flood Claim (RFC) program, and the Severe Repetitive Loss (SRL) program. The Biggert-Waters Flood Insurance Reform Act of 2012 merged these two programs with the Flood Mitigation Assistance (FMA) program.

out of harm’s way.”⁸⁹ FEMA acquires homes that have flooded or are at risk of flooding at pre-disaster appraised values and demolishes them. FEMA and HUD are the two largest entities providing grants for buyouts among federal agencies. A few state and local-funded programs exist but are much smaller.⁹⁰ As they permanently remove flood-prone structures from harm’s way, such acquisitions are one of the most effective mitigation measures. Converting the acquired property to open space and deed-restricting it in perpetuity prevents future construction. The deed on the acquired land allows limited recreational uses such as parks, walking paths, and bicycle trails. All HMA programs rely on voluntary participation. In the last 30 years FEMA has bought out close to 44,000 homes throughout the United States.⁹¹

FMA is currently the most effective grant program to mitigate flood risk as hazard mitigation projects under FMA—elevations or acquisitions, despite their lower local match—yield high benefit-cost ratios. According to FEMA’s HMA program digest, most of FEMA’s grant programs have a 75:25 federal and local cost-share, giving the state and local governments a vested interest in the buyout as well. FMA may contribute up to 90 percent or 100 percent federal cost share for repetitive loss (RL) and severe repetitive loss (SRL) properties.⁹² Both categories of properties have legal definitions as it changes the cost share of mitigation. The NFIP defines an RL property as a structure that has “incurred flood-related damage on 2 occasions, in which the cost of repair, on the average, equaled or exceeded 25 percent of the value of the structure at the time of each such flood event.”⁹³ An SRL property is defined as one that has incurred flood-related damage for which “four or more separate claim payments have been made under a Standard Flood Insurance Policy issued pursuant to this title, with the amount of each such claim exceeding \$5,000, and

⁸⁹ “Home Buyout Is the Best Option | FEMA.Gov,” accessed March 14, 2022, <https://www.fema.gov/case-study/home-buyout-best-option>.

⁹⁰ Peterson et al., “A Review of Funding Mechanisms.”

⁹¹ “FEMA Bought 44,000 Flood-Prone Homes and May Have to Buy Millions More,” *Claims Journal*, October 11, 2019, <https://www.claimsjournal.com/news/national/2019/10/11/293531.htm>.

⁹² “Hazard Mitigation Assistance Program Digest,” 2015, 34.

⁹³ “USCODE-2009-Title42-Chap50-SubchapIV-Sec4121.Pdf,” 4821, accessed March 11, 2022, <https://www.govinfo.gov/content/pkg/USCODE-2009-title42/pdf/USCODE-2009-title42-chap50-subchapIV-sec4121.pdf>.

with the cumulative amount of such claims payments exceeding \$20,000”⁹⁴ RL and SRL properties pose exceptional challenges to the NFIP and why buying them out at increased or no cost share may be appealing.

A large part of the insolvency of the NFIP is due to the financial burden caused by RL and SRL properties. According to a 2019 CRS Report that studied issues with the NFIP, these properties, though small as compared to the total 5 million policy holders, constitute the highest number of claims.⁹⁵ The Pew Charitable Trust who has studied NFIP extensively, has determined that RL and SRL policyholders “face no limits on the number of claims they can submit or on a value of payments they may receive.”⁹⁶ The Pew Trust also found that “Historically, repeatedly flooded properties have accounted for **just 1 percent of properties with National Flood Insurance Program policies** but **about 25–30 percent of flood claims. claims.**”⁹⁷ The data demonstrates the disproportionate burden of RL and SL on the NFIP program.

Buying out these properties at 90 percent or 100 percent pre-disaster appraised value of the home makes more sense than paying multiple repetitive claims from an actuarial perspective. According to data compiled by the author utilizing Open FEMA datasets, since 2013 FEMA has made \$89 million to \$199 million in grants available each year under its FMA program.⁹⁸ Further analysis of the FMA program reveals that the program receives applications two and a half to three times the money available each year. As Table 1 shows, in 2013, against the \$120 million in grants available, FEMA received applications totaling \$305 million.⁹⁹ Each year, this trend can be seen, including 2016,

⁹⁴ “National Flood Insurance Program Terminology Index,” Flood Insurance, June 1, 2021, <https://www.fema.gov/flood-insurance/terminology-index>.

⁹⁵ “The National Flood Insurance Program: Selected Issues and Legislation in the 116th Congress,” 37, accessed March 14, 2022, <https://www.everycrsreport.com/reports/R46095.html>.

⁹⁶ Pew Charitable Trusts, “Repeatedly Flooded Properties Cost Billions,” 1.

⁹⁷ Pew Charitable Trusts, 2 Emphasis in original.

⁹⁸ “Hazard Mitigation Assistance | FEMA.Gov,” accessed March 18, 2022, <https://www.fema.gov/data-visualizations/hazard-mitigation-assistance-obligations>.

⁹⁹ Author’s independent analysis of publicly available data at “OpenFEMA Data Sets | FEMA.Gov,” accessed March 14, 2022, <https://www.fema.gov/about/openfema/data-sets>.

where against the \$199 million available, FEMA received applications totaling \$372 million.

Table 1. FEMA’s FMA Program Funding Available vs. Received.¹⁰⁰

Program	Program FY	Competitive Funds Available (Millions)	Competitive Applications (Millions)	Number of Applications Received
FMA	2016	\$199	\$372	211
FMA	2015	\$150	\$307	228
FMA	2014	\$89	\$232	216
FMA	2013	\$120	\$305	257

Historically, mitigation needs far outweigh mitigation funding. For the first year of its BRIC program, in 2020, FEMA received projects totaling \$3.6 billion against the \$0.5 billion available.¹⁰¹ For the FMA program in 2020, against the \$200M available, FEMA received applications totaling \$477M.¹⁰² FEMA typically receives applications 2.5 to 3 times the funding available each year. For 2020, FEMA received projects totaling seven times as much, underscoring the significant national demand for mitigation.

2. Rising Demand for Home Buyouts

The shortage of funds to buy out homes is not the only challenge facing extreme-risk properties; the speed of home buyouts is of concern as well. The American Society of Floodplain Managers (ASFPM), in its January 2020 News and Views, cited research from

¹⁰⁰ Adapted from: Federal Emergency Management Agency, “Flood Mitigation Assistance FY2019 Subapplication Status,” Flood Mitigation Assistance (FMA) Grant, November 9, 2021, <https://www.fema.gov/grants/mitigation/floods/flood-mitigation-assistance-fy2019-subapplication-status>. Information for each year is publicly available, compilation and comparison performed by the author.

¹⁰¹ “Building Resilient Infrastructure and Communities FY 2020 Subapplication Status,” FEMA Grants, December 13, 2021, <https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities/fy2020-subapplication-status>.

¹⁰² “Flood Mitigation Assistance FY 2020 Subapplication Status,” FEMA Grants, July 2, 2021, <https://www.fema.gov/grants/mitigation/floods/fy2020-subapplication-status>.

the Natural Resources Defense Council (NRDC) revealing that buyouts take five years on average to complete.¹⁰³ The ASFPM article continues,

The reasons for the long period seem to be mostly due to lengthy procedures and the period it takes some FEMA regions to review and approve the buyout application after the state has already reviewed it for compliance. Not that all the blame lies with FEMA since states and local communities also have a role in the buyouts. At any rate, the process must be streamlined if buyouts are to be as useful as they could be.¹⁰⁴

To confirm the veracity of the five-year claim, FEMA independently analyzed the assertions.¹⁰⁵ Nearly 93 percent of acquisition projects that FEMA receives are approved within three years. Eighty percent are approved in *less than two years* (Table 2). Regional variations emerge, with FEMA Region 1 (Northeast U.S.) taking the longest to submit applications but the quickest to approve them. Region 4 (Southeast U.S.), presumably with the volume of work, and Region 10 (Northwest U.S.) with lengthier environmental reviews, takes the longest to approve them.

¹⁰³ Ricardo S. Pineda and ASFPM Chair, “Promoting Resiliency of Our Nation’s Water Resources Infrastructure,” *News & Views: An Association of State Floodplain Managers Newsletter*, January 2020, https://asfpm-library.s3-us-west-2.amazonaws.com/NewsViews/News_Views_Jan2020.pdf.

¹⁰⁴ Margie Kelly and 2019, “Report: FEMA Post-Flood Home Buyouts Take 5+ Years to Complete After Waters Recede,” Natural Resources Defense Council (NRDC), September 12, 2019, <https://www.nrdc.org/media/2019/190912>.

¹⁰⁵ Shannon Reiss and Steve Martin, “Florida’s Post-Disaster Toolkit for Floodplain Administrators,” *News & Views: An Association of State Floodplain Managers Newsletter* 33, no. 2 (March 2020): 1–4, https://asfpm-library.s3-us-west-2.amazonaws.com/NewsViews/News_Views_March_2020.pdf. A portion of this paper was previously published as a brief op-ed by the author in response to the ASFPM article.

Table 2. FEMA Approval Times for Home Buyouts¹⁰⁶

Region	Average of Number of Months from Date Declared to Date Submitted	Average of Number of Months from Date Submitted to Date Approved	Average Number of Months from Declaration Date to Approve
1	23.0	0.2	23.2
2	19.7	1.6	21.3
3	14.1	3.9	18.0
4	14.0	5.9	19.8
5	15.1	5.1	20.3
6	17.7	3.6	21.4
7	11.8	2.0	13.8
8	14.2	4.6	18.8
9	11.2	3.2	14.3
10	19.3	5.1	24.5
Grand Total	15.5	4.0	19.5

FEMA analyzed 2,065 completed acquisition projects.¹⁰⁷ The total time to complete a buyout is long and FEMA’s analysis indicates that states take on average 15.5 months to submit an acquisition project (Table 3). FEMA, on the other hand takes four, and this includes time for all eligibility, benefit-cost analysis, and environmental reviews.¹⁰⁸

¹⁰⁶ The author would like to acknowledge and thank FEMA specialist, Mr. Jody Springer for the analysis in Tables 2 & 3.

¹⁰⁷ Source: Federal Emergency Management Agency, “Hazard Mitigation Assistance Projects - V2.”

¹⁰⁸ Author’s independent analysis of publicly available data at “OpenFEMA Data Sets | FEMA.Gov.”

Table 3. Average Time for FEMA to Process Home Buyout Applications¹⁰⁹

Table 4. Time Frame from Disaster Declaration Date to Approval	Number of Projects	Percent of Projects
1 to 12 Months	573	28%
13 to 24 Months	1025	50%
25 to 36 Months	331	16%
Greater than 37 Months	136	7%
Total Project Count	2065**	100%

**A project typically consists of multiple individual properties.

The 19.5 months it takes to complete a buyout may still be inordinately long for a homeowner displaced from her home, but not all faults may be FEMA’s.

Acquisition projects, by nature, are complex. FEMA’s home buyout program is voluntary and involves various stakeholders—the most essential being disaster survivors and property owners who must make critical life-altering decisions. Common sense dictates that two years for a homeowner whose life has been upended by a disaster is too long. Even though the five-year timeframe may be misleading, many steps and parties are involved in a home buyout, as Figure 4 depicts:

¹⁰⁹ Author’s independent research previously published as “FEMA Hazard Mitigation Assistance: Buyouts – opportunities and challenges” in ASFP News & Views, vol. 33, no. 2, March 2020.

FEMA's Hazard Mitigation Assistance Grant Programs Property Buyouts: Step-by-Step

FEMA
April 2020

After a presidentially declared disaster, local officials may request money from the state to purchase properties that have either flooded or been determined substantially damaged by the local floodplain manager. Since 1989, FEMA has acquired more than 43,000 flood-prone properties.

The buyout acquisition cycle is about 18 to 24 months. **On average, it takes FEMA approximately 4 months to approve the acquisition project once the state requests funding.**

This is a long-term effort, requiring multiple decisions at each step.

For more information about property buyouts under FEMA's Hazard Mitigation Assistance Grant Programs (HMGP, BRIC, and FMA), visit www.fema.gov/hazard-mitigation-assistance or contact your local or state emergency management officials. All HMA programs are voluntary programs.

HMA Program Cost Sharing Requirements (Federal/Non-Federal Share)

Hazard Mitigation Grant Program: 75/25
Pre-Disaster Mitigation: 75/25
Flood Mitigation Assistance: 75/25
FMA repetitive loss: 90/10
FMA severe repetitive loss: 100/0

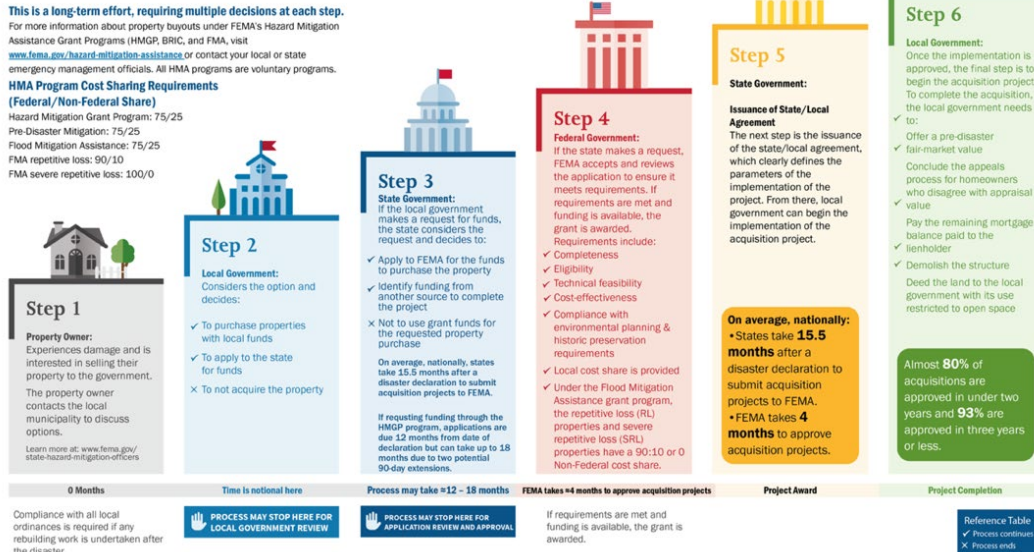


Figure 4. FEMA HMA Property Buyouts Step-by-Step¹¹⁰

FEMA's buyout programs also have structural limitations. By their nature, all HMA programs, including the FMA, are designed to deal with the state.¹¹¹ A homeowner interested in a buyout cannot approach FEMA directly. She must go through her local community, which must sponsor her. As funding is limited and highly competitive, the local district generally sets up its evaluation criteria and a competitive process to select the properties with the best chance of winning a successful grant. This step adds time. In turn, the state goes through a similar selection process before submitting grants to FEMA for consideration—and these requests typically reflect the state's funding priorities.

Meanwhile, the homeowner is facing her dilemma about repairing their home after a disaster. Through its Individual and Household Program (IHP), FEMA makes money available to homeowners immediately after a disaster to carry out temporary repairs to

¹¹⁰ Source: FEMA Infographic, power-point slide training material, April 2020, not published.

¹¹¹ Technically, State, Territory or Tribe, but the proportion of grants awarded to Territories and Tribes is small.

continue living in the damaged home.¹¹² Moreover, as homeowner insurance and flood insurance claim payouts are generally available within 60 to 90 days of a disaster, most homeowners are less motivated to relocate once they have repaired their homes and their lives have somewhat resumed a semblance of normalcy.

If, after all, a homeowner still wants to sell and wins approval, a few additional steps become necessary. FEMA conducts an appraisal to determine the pre-disaster value of the home and makes an offer. If a homeowner does not accept the offer and terms, FEMA performs a second, and if necessary, a third appraisal. Surveys at times are required, and title work and deed restrictions take additional time. FEMA also requires that the state submits a benefit-cost analysis to demonstrate that the grant is cost-effective to the federal government.¹¹³ Independently, FEMA conducts environmental and historic preservation reviews to verify that the structure is not a historical structure or part of a historic district. As this program is voluntary, the homeowner can change her mind at any time and withdraw from the process. This development may delay things further for other homeowners. Because a project rarely consists of a single property, the local community and state then scramble to find an alternate homeowner and submit a scope modification to FEMA to re-evaluate the project.

In the end, the home must be demolished, utilities capped as necessary, and the property converted to open space. If demolition of the structure reveals any hazardous materials, FEMA allows additional costs and time to be added. FEMA will close out the grant once the grant recipient completes all close-out requirements and reconciles all finances. Local communities face the loss of property taxes and potential blight if buyouts occur in a piece-meal and checker-board manner. The state, in turn, as a condition of the

¹¹² Federal Emergency Management Agency, “Assistance to Individuals and Households” (Washington, DC: Federal Emergency Management Agency, May 2011), https://www.fema.gov/pdf/media/factsheets/2011/dad_asst_indv_households.pdf.

¹¹³ In order to reduce complexity, FEMA has introduced efficiencies such as ‘pre-calculated’ benefits where within the SFHA, home elevations under \$175,000 and home buyouts under \$276,000 (adjusted for locality factors), are automatically deemed cost-effective.

grant, must certify every three years that open-space is maintained.¹¹⁴ Only a limited number of allowable uses—for example, recreation—are permitted. If not, corrective action is required.¹¹⁵ All these steps, most of them performed sequentially, and by multiple parties adds to the complexity and the time it takes to buyout a single home.

The current approach of individual home buyouts also creates what is known as checker-boarding that changes the nature of the community as some homes are acquired and others are not. Although every property bought out eliminates risk, individualized home buyouts do not change the risk profile of a community. Checker-boarding hurts many areas as random vacant lots are too small to convert into parks for recreational use. A community thereby suffers from lost property tax revenue, and the degradation of the social fabric of a community compromise what urban planners define as a “sense of place.”¹¹⁶ Strategic retreat gives the United States the ability to manage extreme high-risk areas better and change a community’s risk profile.

3. The Repetitive Loss and Severe Repetitive Loss Problem

Despite best efforts to buy out extreme risk properties through its FMA and its other HMA programs, FEMA does not make a dent in the national count of RL and SRL properties as Table 4 shows.

¹¹⁴ Property Acquisition and Relocation for Open Space, *U.S. Code* 44 (2010) § 80 et seq., accessed December 23, 2021, <https://www.govinfo.gov/content/pkg/CFR-2010-title44-vol1/pdf/CFR-2010-title44-vol1-part80.pdf>.

¹¹⁵ Property Acquisition and Relocation for Open Space §§ 80.19 (a).

¹¹⁶ Ming Hu and Roger Chen, “A Framework for Understanding Sense of Place in an Urban Design Context,” *Urban Science* 2, no. 2 (June 2018): 1–19, <https://doi.org/10.3390/urbansci2020034>.

Table 5. FEMA’s FMA Program and its Impact on RL and SRL Properties¹¹⁷

Fiscal Year	Properties Submitted	Properties in selected FMA Traditional apps	SRL/RL properties in selected FMA Traditional apps	Total Number of listed SRL properties	Total number of listed RL properties
2019	1,476	1,049	853	28,096	181,009
2018	1,049	552	670	26,292	178,882
2017	1,365	719	516	24,872	163,059*
2016	1,565	832	567	22,552	158,058
2015	1,443	678	565	22,312	156,326
2014	1,197	376	300	22,475	156,359
2013	1,746	603	467	22,364	148,300

* Property count in Houston and Harris County may not be accurate due to Hurricane Harvey. Many insured homes suffered multiple losses but are not mapped in the SFHA and hence technically not included in the RL and SRL tally.

Using 2013 as a baseline, the national count of RL and SRL properties was 22,364 and 148,300, respectively. Despite buying out a little more than 500 such properties on average, each year, for the past seven years, the national count of RL and SRL properties currently stands at 28,096 and 181,009, respectively. The number is going up!

Nationally even within RL and SRL properties, there is a great deal of unevenness. Not surprisingly, Texas, Louisiana, and New Jersey occupy the top three spots (Tables 5 and 6).

¹¹⁷ Source: Author’s analysis. Data resides behind FEMA’s firewall and not publicly available. The author would like to acknowledge and thank FEMA specialist Mr. Brandon Sweeza for the analysis in Tables 4, 5 & 6.

Table 6. Top Three Repetitive Loss Property States¹¹⁸

	FMA RL (Insured, Unmitigated)					
State	5-Year Trend	FY15	FY16	FY17	FY18	FY19
TX	Up	2,143	2,612	3,318	8,933	8,299
LA	Up	5,824	5,563	6,223	6,105	5,827
NJ	Dn	1,719	1,577	1,413	1,342	1,238

Table 7. Top Three Severe Repetitive Loss Property States¹¹⁹

	FMA SRL (Validated, Insured, Unmitigated)					
State	5-Year Trend	FY15	FY16	FY17	FY18	FY19
TX	Up	1,477	1,631	1,868	2,991	2,827
LA	Dn	2,492	2,337	2,333	2,294	2,105
NJ	Dn	1,908	1,748	1,535	1,401	1,323

For example, Texas saw a significant spike in RL and SRL properties after Hurricane Harvey in 2017.¹²⁰ All three states aggressively pursue home buyout strategies. Among them, New Jersey is the only state that has seen its share of RL and SRL properties go down. Texas and Louisiana have primarily remained unchanged or seen these problematic properties go up in number.¹²¹

¹¹⁸ Source: Author’s analysis. Data not publicly available.

¹¹⁹ Source: Author’s analysis. Data not publicly available. NJ is an anomaly. Although a coastal state, its highest concentration of RL and SRL properties is in the Passaic and Raritan River Valleys due to a high proportion of older homes and older floodplain management standards.

¹²⁰ Author’s analysis. Data not publicly available. RL and SRL counts fluctuate regularly as properties drop in and out of RL and SRL due to substantial damage, change in coverage, or mitigation. It should also be remembered a property may flood repeatedly and not meet the legal definition of a RL or SRL property.

¹²¹ Appendices A & B, contain the complete list of RL and SRL properties nationally.

The Yale Environment 360 journal recognizes that FEMA will remain a primary funding source for home buyouts.

Over the past 30 years, FEMA has supported buyouts of more than 43,000 properties. At that pace, FEMA’s current programs would support about 130,000 more buyouts over the next 90 years. But that’s a drop in the bucket compared to the projected 13.1 million Americans who could see their homes inundated by six feet of sea level rise in coastal areas by the end of the century. And millions more along the nation’s rivers and inland floodplains may need to move out of increasingly flood-prone areas as extreme precipitation events increase.¹²²

According to scientists, millions more—about 41 million, or nearly three times FEMA’s current estimate—may be at risk from flooding.¹²³

4. How Climate Change Worsens the Situation

That sea levels globally are rising is an indisputable fact.¹²⁴ On average, seas have risen by eight inches since 1900, of which three inches have occurred since 1993, indicating accelerating rates in 25 Atlantic and Gulf Coast cities.¹²⁵ According to the World Meteorological Organization (WMO), weather, climate, or water hazard-related disasters occurred every day on average over the past 50 years and “the number of disasters has increased by a factor of five over the 50-year period, driven by climate change, more extreme weather and improved reporting.”¹²⁶ In a comprehensive study published in 2021,

¹²² Rob Moore, “As Climate Risks Worsen, U.S. Flood Buyouts Fail to Meet the Need,” *Yale Environment 360*, January 23, 2020, <https://e360.yale.edu/features/as-climate-risks-worsen-u.s.-flood-buyouts-fail-to-meet-the-need>.

¹²³ Oliver E. J. Wing et al., “Estimates of Present and Future Flood Risk in the Conterminous United States,” *Environmental Research Letters* 13, no. 3 (2018): 1, <https://doi.org/10.1088/1748-9326/aaac65>.

¹²⁴ Michael Oppenheimer and Bruce C. Glavovic, “Chapter 4: Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities — Special Report on the Ocean and Cryosphere in a Changing Climate,” in *The Ocean and Cryosphere in a Changing Climate: A Special Report of the Intergovernmental Panel on Climate Change*, ed. Hans-Otto Pörtner et al. (Geneva: Intergovernmental Panel on Climate Change, 2019), 321–445, <https://www.ipcc.ch/srocc/chapter/chapter-4-sea-level-rise-and-implications-for-low-lying-islands-coasts-and-communities/>.

¹²⁵ US Global Change Research Program, “Sea Level Rise,” USGCRP Indicators, accessed October 7, 2021, <https://www.globalchange.gov/browse/indicators/global-sea-level-rise>.

¹²⁶ James Douris and Geunhye Kim, *WMO Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970–2019)*, WMO-No. 1267 (Geneva: World Meteorological Organization, 2021), 16, https://library.wmo.int/index.php?lvl=notice_display&id=21930#.YcbA8GjMI2w.

WMO reported that global climate and water hazards accounted for 50 percent of all disasters, and economic losses have increased sevenfold from the 1970s to the 2010s. A new mapping tool from the World Resource Institute, *Aqueduct Floods*, found that by 2030, 15 million people and \$177 billion will be impacted annually due to flooding. An additional 132 million people and \$535 billion will be affected annually due to riverine flooding.¹²⁷ The 2017 hurricane season, which saw Harvey, Irma, and Maria, accounted for 35 percent of total economic losses of the top ten disasters worldwide.¹²⁸ What remains open to debate is how much and whether people will experience the impacts of rising seas evenly.

If 2017 was a bad year for disasters, 2019 was worse. According to NOAA, in 2019 the United States experienced 14 separate billion-dollar disasters.¹²⁹ NOAA continues, **“2021 is the seventh consecutive year (2015-2021) in which 10 or more billion-dollar weather and climate disaster events have impacted the United States.”**¹³⁰ Over a slightly longer timeframe, measured since 1980, as the graph on the left of Figure 5 depicts, the number of billion-dollar disasters is steadily rising. Instead of frequency of events, if one plots the costs of the same disaster events over the same timeframe (1980–2019), the graph on the right is even more dramatic, showing a steep increase in costs even after adjusting for inflation.

¹²⁷ “RELEASE: New Data Shows Millions of People, Trillions in Property at Risk from Flooding — But Infrastructure Investments Now Can Significantly Lower Flood Risk,” World Resources Institute, April 23, 2020, <https://www.wri.org/news/release-new-data-shows-millions-people-trillions-property-risk-flooding-infrastructure>.

¹²⁸ World Meteorological Organization, “Weather-Related Disasters Increase over Past 50 Years, Causing More Damage but Fewer Deaths,” August 31, 2021, <https://public.wmo.int/en/media/press-release/weather-related-disasters-increase-over-past-50-years-causing-more-damage-fewer>.

¹²⁹ Adam B. Smith, “U.S. Billion-Dollar Weather and Climate Disasters, 1980 - Present (NCEI Accession 0209268)” (NOAA National Centers for Environmental Information, 2020), <https://doi.org/10.25921/STKW-7W73>.

¹³⁰ Adam B. Smith, “U.S. Billion-Dollar Weather and Climate Disasters, 1980 - Present (NCEI Accession 0209268)” (NOAA National Centers for Environmental Information, 2020), <https://doi.org/10.25921/STKW-7W73> Emphasis in the original.

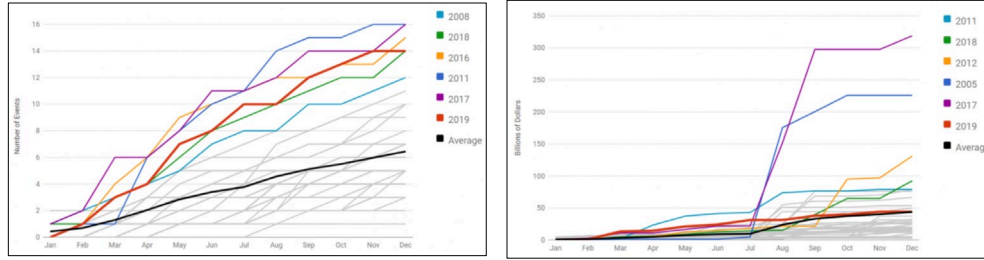


Figure 5. Frequency of U.S. Billion-dollar Disaster Events (1980–2019), (CPI-adjusted)¹³¹

NOAA predicts that by the year 2100, even under its low estimate scenarios, sea levels could rise by a foot as measured from the year 2000. In its extreme projections, the rise could be over eight feet.¹³² In the mid-20th century, fewer than 20 percent of the counties in the United States experienced a disaster. Today, half do. From 1920 through 1980, 50 U.S. counties had a major disaster each year. Since 1980, the number has tripled, with an apparent acceleration since 2000.¹³³

Observable effects on the environment due to global climate change are evident everywhere, with shrinking glaciers, loss of sea ice, acceleration of rising seas, and more intense heat waves resulting in severe prolonged drought and intense wildfires. The U.S. Global Change Research Program Climate Science Special Report of 2017 summarizes **“global average sea level has risen by about 7–8 inches since 1900, with almost half (about 3 inches) of that rise occurring since 1993.”**¹³⁴ According to NOAA’s Climate Service, sea levels are expected to increase by several inches in the next 15 years—one to

¹³¹ Source: Adam B. Smith, “2010–2019: A Landmark Decade of U.S. Billion-Dollar Weather and Climate Disasters,” *Beyond the Data* (blog), October 3, 2021, <https://www.climate.gov/news-features/blogs/beyond-data/2010-2019-landmark-decade-us-billion-dollar-weather-and-climate>.

¹³² William V. Sweet et al., *Global and Regional Sea Level Rise Scenarios for the United States*, NOAA Technical Report NOS CO-OPS 083 (Silver Spring, MD: National Oceanic and Atmospheric Administration, 2017), https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf.

¹³³ Leah Platt Boustan et al., *The Effect of Natural Disasters on Economic Activity in US Counties: A Century of Data* (Cambridge, MA: National Bureau of Economic Research, 2017), https://www.nber.org/system/files/working_papers/w23410/w23410.pdf.

¹³⁴ USGCRP, “Climate Science Special Report” (U.S. Global Change Research Program, Washington, DC), accessed March 14, 2022, <https://science2017.globalchange.gov/chapter/executive-summary/> Emphasis in the original.

four feet by 2100. Some scenarios do not rule out as much as eight feet by 2100.¹³⁵ This rise will be higher than the global average along the East and Gulf coasts.¹³⁶

Accelerating climate change means FEMA cannot acquire properties at the same rate and in the same manner as in the past. The problems confronting the United States are several orders of magnitude larger, and by the century's end, they may be worse. These problems require bolder solutions. Climate refugees from other nations fleeing food and water scarcity, severe drought, extreme heat, or regular floods make this an urgent homeland security issue. However, climate refugees are not strictly a cross-border problem.

Natural disasters, both in their intensity and frequency, are accelerating. The National Oceanic and Atmospheric Administration (NOAA) maintains a billion-dollar disaster database, a repository dating to 1980. The database (Figure 6) demonstrates that not only are these enormous natural disasters increasing the “first nine months of 2020 ties the annual record of 16 events that occurred in 2011 and 2017. The year 2020 is the sixth consecutive year (2015–2020) in which ten or more billion-dollar weather and climate disaster events have impacted the United States.”¹³⁷

¹³⁵ John A. Church and Neil J. White, “Sea-Level Rise from the Late 19th to the Early 21st Century,” *Surveys in Geophysics* 32, no. 4–5 (September 2011): 585–602, <https://doi.org/10.1007/s10712-011-9119-1>.

¹³⁶ US Global Change Research Program, *Climate Science Special Report* (Washington, DC: U.S. Global Change Research Program, 2017), 10, <https://science2017.globalchange.gov/chapter/executive-summary/>.

¹³⁷ NOAA National Centers for Environmental Information, “U.S. Billion-Dollar Weather and Climate Disasters, 1980 - Present (NCEI Accession 0209268),” NOAA National Centers for Environmental Information, October 23, 2021, <https://accession.nodc.noaa.gov/0209268>.

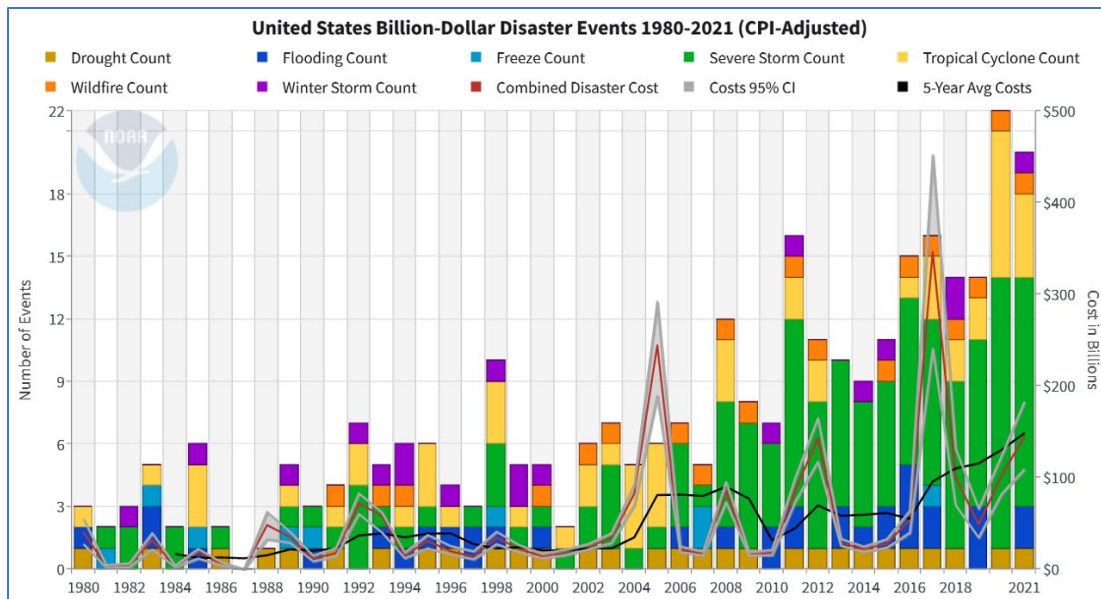


Figure 6. U.S. Billion-Dollar Disaster Events, 1980–2021¹³⁸

Various reasons account for the increasing frequency of these large disasters. Not only is the population going up in many parts of our nation, but development in areas previously not as densely inhabited is at higher risk of damage. Such vulnerable areas as coasts and inland river floodplains already house much of the nation’s population.¹³⁹ Adopting and enforcing current disaster-resistant building codes help, but they cannot prevent losses completely. The National Mitigation Investment Strategy, released by the Mitigation Framework Leadership Group (MitFLG), concluded that adopting and enforcing current disaster-resistant building codes help reduce disaster losses.¹⁴⁰ However, according to data developed by FEMA’s building science branch in 2019, “developing, approving, incorporating, inspecting, and enforcing building codes varies widely across the country, and only 32 percent of disaster-prone jurisdictions have adopted disaster-resistant

¹³⁸ Source: NOAA National Centers for Environmental Information.

¹³⁹ Shiva Polefka, *Moving Out of Harm’s Way* (Washington, DC: Center for American Progress, 2013), <https://www.americanprogress.org/issues/green/reports/2013/12/12/81046/moving-out-of-harms-way/>.

¹⁴⁰ “National Mitigation Investment Strategy,” n.d., 20.

building codes.”¹⁴¹ Even though it is proven that latest building codes can mitigate against losses, states and communities are slow in adopting and enforcing them.

The 2017 Hurricane season alone is estimated to have generated more than \$206 billion in damages.¹⁴² As of 2019, FEMA had approved 4,802 applications for funeral assistance in Florida, Texas, and Puerto Rico due to Hurricanes Harvey, Irma, and Maria.¹⁴³ Hurricane Harvey accounted for \$125 billion, second only to Hurricane Katrina in cost and devastation.¹⁴⁴ Hurricane Maria, also in 2017, caused widespread destruction in Puerto Rico and the Virgin Islands. In Puerto Rico, the hurricane caused rainfall of up to 20 inches in 48 hours, caused widespread flooding and mudslides across the island, and resulted in damages totaling \$90 billion.¹⁴⁵

Climate change affects the scale, intensity, and frequency of natural hazards. According to the Fourth National Climate Assessment, today’s decisions will determine future risks from climate change.

Climate change creates new risks and exacerbates existing vulnerabilities in communities across the United States, presenting growing challenges to human health and safety, quality of life, and the rate of economic growth.¹⁴⁶

¹⁴¹ Mitigation Framework Leadership Group, *National Mitigation Investment Strategy* (Washington, DC: Department of Homeland Security, 2019), 16–17, https://www.fema.gov/sites/default/files/2020-10/fema_national-mitigation-investment-strategy.pdf.

¹⁴² Jeff Masters, “2017 U.S. Hurricane Damage Estimate of \$206.6 Billion: Highest on Record,” *Weather Underground Category 6* (blog), November 28, 2017, <https://www.wunderground.com/cat6/2017-us-hurricane-damages-206-billion-highest-record>.

¹⁴³ Chris P. Currie, *Disaster Response: Federal Assistance and Selected States and Territory Efforts to Identify Deaths from 2017 Hurricanes*, GAO-19-486 (Washington, DC: Government Accountability Office), accessed January 15, 2022, <https://www.gao.gov/products/gao-19-486>.

¹⁴⁴ NOAA Office for Coastal Management, “Hurricane Costs,” Office for Coastal Management Fast Facts, accessed August 28, 2021, <https://coast.noaa.gov/states/fast-facts/hurricane-costs.html>.

¹⁴⁵ Michon Scott, “Hurricane Maria’s Devastation of Puerto Rico,” *Understanding Climate*, October 19, 2021, <https://www.climate.gov/news-features/understanding-climate/hurricane-marias-devastation-puerto-rico>.

¹⁴⁶ US Global Change Research Program, *Fourth National Climate Assessment: Volume II, Impacts, Risks, and Adaptation in the United States* (Washington, DC: US Global Change Research Program, 2018), 25, <https://nca2018.globalchange.gov>.

The report continues that unless governments take sustained mitigation and adaptation measures, “climate change is expected to cause growing losses to American infrastructure and property and impede the rate of economic growth over this century.”¹⁴⁷

In August 2021, the IPCC published its Sixth Assessment Report, *Climate Change 2021: The Physical Science Basis*.¹⁴⁸ The report prepared by 234 scientists from 66 countries over several years highlights blames human action for the unprecedented rate of climate change for at least the last 2,000 years. Some trends, such as rising seas, may be irreversible for centuries or millennia. The United Nations warns that “global mean sea level has risen faster since 1900, than over any preceding century **in at least the last 3,000 years.**”¹⁴⁹ A 1.5 degree centigrade warming over the next 20 years will mean increased precipitation (and greater drought) and limiting global warming to just 1.5 degrees will require rapid “transformational change” and aggressive reductions in carbon dioxide emissions, to about half by 2030 and net-zero by 2050.¹⁵⁰ Even so, achieving net-zero in the next 30 years would mean that by 2100, sea levels would rise to 2.5 feet relative to 1986–2005 with catastrophic consequences.¹⁵¹

The IPCC report is unequivocal that humans have warmed the atmosphere, oceans, and land. Under all emission scenarios, global surface temperatures will continue to rise at least until mid-century and “continued global warming is projected to further intensify the global water cycle, including its variability, global monsoon precipitation and the severity

¹⁴⁷ US Global Change Research Program, 25.

¹⁴⁸ International Panel on Climate Change, *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (Geneva: International Panel on Climate Change, 2021), https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Full_Report.pdf.

¹⁴⁹ “IPCC Report: ‘Code Red’ for Human Driven Global Heating, Warns UN Chief,” UN News, August 9, 2021, <https://news.un.org/en/story/2021/08/1097362> Emphasis in original.

¹⁵⁰ Kelly Levin, David Waskow, and Rhys Gerholdt, “5 Big Findings from the IPCC’s 2021 Climate Report,” World Resources Institute Insights, August 9, 2021, <https://www.wri.org/insights/ipcc-climate-report>.

¹⁵¹ Bruce Lieberman, “1.5 or 2 Degrees Celsius of Additional Global Warming: Does It Make a Difference?,” Yale Climate Connections, August 4, 2021, <http://yaleclimateconnections.org/2021/08/1-5-or-2-degrees-celsius-of-additional-global-warming-does-it-make-a-difference/>.

of wet and dry events.”¹⁵² Warming increases precipitation in higher latitudes and causes subtropics to be drier. Coastal areas will see continuing sea-level rise through the rest of the century leading to more frequent and severe coastal flooding and coastal erosion. The frequency and intensity of hurricanes will continue rising. The United Nations summarizes, “sea-level events that previously occurred once every 100 years could occur every year by the end of the century. The report makes clear that while natural drivers will modulate human-caused changes, especially at regional levels and in the near term, they will have little effect on long-term global warming.”¹⁵³

D. CONCLUSION

The HMA program, despite past effectiveness, may not be equipped to deal with challenges posed by accelerating climate change that floods far more homes even with modest rises in sea levels this century. There exist structural limitations to FEMA’s HMA programs. Funds for buyouts are limited. Adoption and enforcement of disaster-resistant building codes nationally is spotty. Provisions of sound land-use policies and floodplain management practices are weak. Lastly, subsidized flood insurance perpetuates high-risk behavior and offers few incentives to a homeowner to relocate despite repeated floods. The flooding problem is liable to get several orders of magnitude worse and FEMA’s home buyout programs are not equipped to handle an exponential increase of flood-prone properties this century.

In short, things are bad, likely to get worse, and humankind cannot do much to stop climate change, global warming, and rising seas. Such slow-onset disasters as sea-level rise afford some time to prepare and react. On the other hand, a lack of a catastrophic disaster event does not propel people to action. Absent a disaster, asking people to voluntarily relocate or Congress to appropriate funding is difficult. Factors that may motivate people to move freely—for example, greater awareness of rising flood risk—are possible but difficult. The realization that their home may flood again and yet again may be a motivator,

¹⁵² “IPCC_AR6_WGI_Headline_Statements.Pdf,” 1, accessed March 11, 2022, https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Headline_Statements.pdf.

¹⁵³ “IPCC Report: ‘Code Red’ for Human Driven Global Heating, Warns UN Chief,” UN News, August 9, 2021, <https://news.un.org/en/story/2021/08/1097362>.

but absent flood insurance premiums that reflect actual risk, people may be more apt to stay put and not move.

Historically, people have always lived close to the water, and absent external forces will continue doing so. Individual home buyouts are good, but the voluntary nature of the program means not only does the process take long, but any “hold-outs”—people who will not move, no matter what—keep land from being repurposed and defeats a comprehensive strategic retreat program from the location. These arguments lead to the primary question posed by this thesis: How and why should FEMA pursue strategic retreat from high-risk areas in the United States?

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III. MITIGATION SYSTEMS THAT NO LONGER WORK

This chapter explores why U.S. mitigation measures are no longer effective. One explanation is that these systems were never meant to be permanent solutions. Take NFIP, for example. The federal government offered subsidized flood insurance as private insurers were reluctant to provide flood insurance. FEMA, who administers the NFIP, hoped that NFIP minimum standards and better ordinances would make communities less susceptible to flooding and force homeowners to understand their risk better.¹⁵⁴ In practice, neither greater risk awareness nor greater risk aversion has occurred 50 years later.

Another plausible explanation is that these systems made sense for their times, but they no longer do in an age of climate change. People do not experience the impacts of climate change with the same severity everywhere. Coastal areas and areas in the wildland urban interface (WUI) are at far greater risk than other parts of the United States. In some places, specific mitigation systems are still highly effective. Since 1992, after Hurricane Andrew, Florida has adopted an up-to-date statewide building code and is among the best in the nation.¹⁵⁵ However, Florida fares poorly regarding its high RL and SRL properties counts. Occasionally one encounters places and events where all systems appear to fail almost simultaneously. One such recent incident is Hurricane Harvey in 2017 that hit the Texas coast and Houston.

The larger Houston metro area and Harris County are symptomatic of what has gone wrong and what these failures portend for the nation. They represent a microcosm of a series of poor decisions not just at the local level but at the state and federal levels. As a large and growing coastal metropolis, the case of Houston during and after Hurricane Harvey can offer some clues to solving some of the issues besetting mitigation nationally.

¹⁵⁴ Federal Emergency Management Agency, *National Flood Insurance Program (NFIP) Floodplain Management Requirements: A Study Guide and Desk Reference for Local Officials* (Washington, DC: Department of Homeland Security, 2005), 195, https://www.fema.gov/sites/default/files/documents/fema-480_floodplain-management-study-guide_local-officials.pdf.

¹⁵⁵ Insurance Services Office, *National Building Code Assessment Report: Building Code Effectiveness Grading Schedule* (Jersey City, NJ: Insurance Services Office, 2019), https://www.isomitigation.com/siteassets/downloads/iso-bcegs-state-report_web.pdf.

The NFIP is insolvent, and this affects home buyouts. FEMA’s flood maps have limitations in conveying flood risk and setting insurance rates. Floodplain management at the national and local levels is severely underfunded, and many communities have a poor inspection and equally lax enforcement mechanisms. Where local floodplain ordinances can regulate land use, building codes can protect lives and properties against disaster losses. However, many parts of the country have extremely poor or no building codes. These systems collectively can offer better risk reduction, but with accelerating climate change and more severe and frequent disasters, even these measures may not be enough as even the best building codes and zoning cannot offer absolute protection.

Besides risks to its residents and their homes the Port of Houston ranks first in the United States for goods shipped and received and supports 1.35 million jobs in Texas and 3.2 million jobs nationwide.¹⁵⁶ Houston is also a critical oil and gas hub employing a third of the nation’s extraction jobs.¹⁵⁷ Hurricane Harvey resulted in the excavation of nearly 10 percent of off-shore oil rigs in the Gulf.¹⁵⁸ An ambitious plan is to protect about 70 miles of the Texas coast and the Houston shipping channel. Dubbed the “Ike-Dike” since the idea was floated after Hurricane Ike in 2008, it would be the world’s largest flood barrier if built. The price tag: \$29 billion. The U.S. Army Corps of Engineers submitted the first phase of its study to Congress in 2021.¹⁵⁹ In the opinion of the Texas General Land Office, “the revised draft proposal identified in the final report would be built over a period of 12 to 20 years, depending on congressional authorization and partnerships.”¹⁶⁰

¹⁵⁶ Chris Virk-Brown, “Port of Houston #1 Port in U.S.,” *Port Houston* (blog), November 23, 2020, <https://porthouston.com/port-of-houston-the-number-one-port-in-us/>.

¹⁵⁷ “The Energy Industry in Houston,” Greater Houston Partnership, accessed August 28, 2021, <https://www.houston.org/why-houston/industries/energy>.

¹⁵⁸ Rachael Dottle, Ritchie King, and Ella Koeze, “Hurricane Harvey’s Impact — and How It Compares to Other Storms,” *FiveThirtyEight* (blog), September 2, 2017, <https://fivethirtyeight.com/features/hurricane-harveys-impact-and-how-it-compares-to-other-storms/>.

¹⁵⁹ Texas A&M University at Galveston, “Ike Dike: A Coastal Barrier Protection the Houston/Galveston Region from Hurricane Storm Surge,” Ike Dike Home, November 11, 2021, <https://www.tamug.edu/ikedike/>.

¹⁶⁰ Texas General Land Office, “Frequently Asked Questions,” Coastal Texas Study, accessed January 11, 2022, <https://coastalstudy.texas.gov/draft-proposal/faq/index.html>.

Even if funding is cobbled together, whether a large growing metropolis such as Houston can afford to wait that long is a different story.

A. NFIP AND HOME ACQUISITIONS

Given the severity and unpredictability of flooding and to offset the losses caused by regular floods, the federal government created the NFIP in 1968.¹⁶¹ FEMA explains that “through the NFIP, property owners in participating communities may purchase coverage against food losses. By employing wise floodplain management, a participating community can reduce risk and protect its citizens and the community against much of the devastating financial losses resulting from foods.”¹⁶² A GAO report on comprehensive reform of the NFIP reported that “private insurance companies could not profitably provide flood coverage at a price that consumers could afford, primarily because of the catastrophic nature of flooding and the difficulty of determining accurate rates.”¹⁶³ As floods effect poorer people disproportionately, Congress subsidized insurance cost to make premiums more affordable. In return Congress asked for sound flood plain management. The American Academy of Actuaries reporting on the value of the NFIP affirmed,

The NFIP is much more than an insurance program. It disseminates important flood exposure information through maps, works with communities to develop land use management strategies, influences building code standards, protects lending institutions against mortgage defaults due to uninsured losses, and reduces the need for post-event disaster aid, among other things. It is important to consider these other activities when evaluating the public benefit of the program.¹⁶⁴

According to FEMA’s NFIP quarterly financial report, *The Watermark*, as of June 2020, a little more than 5 million policies in effect are spread out over 22,493 communities

¹⁶¹ Typically, homeowners’ insurance does not cover flood losses and hence the necessity for a separate flood insurance program.

¹⁶² “F084_atq_11aug11.Pdf,” 11, accessed March 11, 2022, https://www.fema.gov/sites/default/files/2020-05/f084_atq_11aug11.pdf.

¹⁶³ “Gao-17-425.Pdf,” 8, accessed March 11, 2022, <https://www.gao.gov/assets/gao-17-425.pdf>.

¹⁶⁴ Kay Cleary et al., “American Academy of Actuaries,” n.d., 7.

that participate in the NFIP.¹⁶⁵ Although some \$1.3 trillion insurance coverage is in place, the NFIP has only \$16 billion capacity to pay claims and an additional borrowing authority from the U.S. Treasury for up to \$9.9 billion. It also has an outstanding debt of \$20.5 billion, even though the Treasury forgave \$17 billion in debt after Hurricane Sandy.¹⁶⁶ FEMA argued, with some validity, that the NFIP was never designed to address catastrophic events. The program was solvent until Hurricane Katrina in 2005, but it has never recovered. Losses incurred in 2012 after Hurricane Sandy and again after the 2017 Hurricane season worsened the situation (Figure 7).

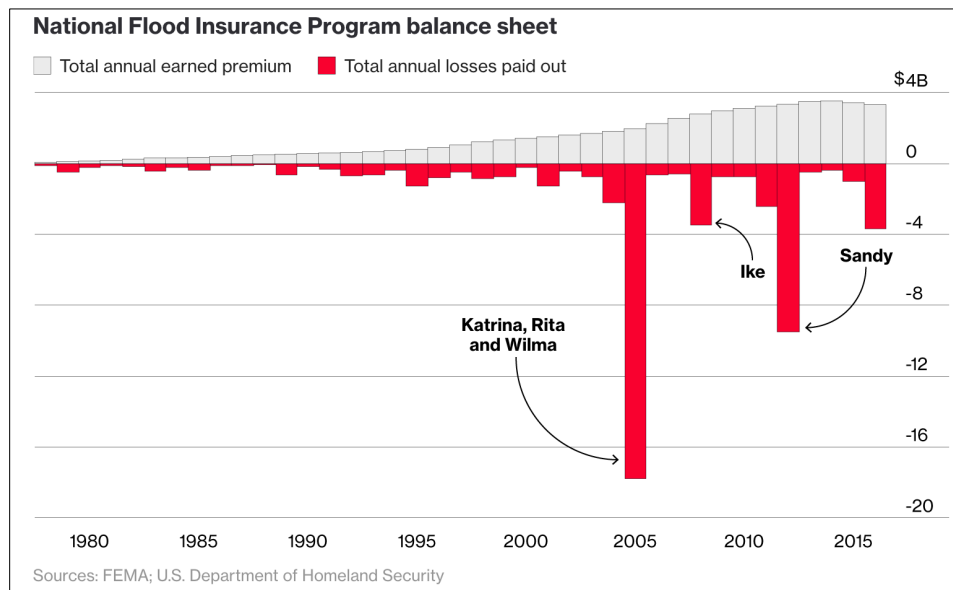


Figure 7. National Flood Insurance Program Balance Sheet¹⁶⁷

¹⁶⁵ Federal Insurance and Mitigation Administration, “National Flood Insurance Program Financial Statements,” 2.

¹⁶⁶ Federal Insurance and Mitigation Administration, “National Flood Insurance Program Financial Statements.”

¹⁶⁷ Source: Michael Keller et al., “Outdated and Unreliable: FEMA’s Faulty Flood Maps Put Homeowners at Risk,” Bloomberg, October 6, 2017, <https://www.bloomberg.com/graphics/2017-fema-faulty-flood-maps/>.

At the time of this writing, FEMA is in the process of updating its flood insurance rate-setting methodology.¹⁶⁸ Instead of relying entirely on FIRMs, Risk Rating 2.0 (RR2.0) compiles data from three catastrophic commercial models that consider specific features such as “flood frequency, multiple flood types—river overflow, storm surge, coastal erosion and heavy rainfall—and distance to a water source along with property characteristics such as elevation and the cost to rebuild.”¹⁶⁹ As the new methodology only took effect starting in October 2021, it is too early to tell what impact it will have on the NFIP, distributing risk, or home buyouts.¹⁷⁰

Risk Rating 2.0 is the most recent significant attempt to bring NFIP premiums to actuarially sound rates and signal waterfront property owners’ risk from extreme weather fueled by climate change. The rollout has already triggered a contentious debate, drawing battle lines. RR2.0 undoubtedly does a better job of assessing flood risk as it considers factors specific to a property, such as its lowest floor elevation, distance from the source of the flooding, and type of construction. Rather than a flat risk for an entire floodplain, the new system estimates risk facing each home considering its specific siting, proximity, and replacement cost. In better reflecting the actual risk of insuring a home, RR2.0 eliminates inequities by homeowners inland subsidizing those living in waterfront properties, which also tend to be valued higher. As expected, the highest rate increases are in states like Florida and affluent communities with higher value homes close to the water.

The last comprehensive effort by Congress to put the NFIP on sound financial footing was in 2012 with the passing of the Biggert-Waters Flood Insurance Reform Act.

¹⁶⁸ Federal Emergency Management Agency, *National Flood Insurance Program: Risk Rating 2.0 Methodology and Data Sources* (Washington, DC: Federal Emergency Management Agency, 2021), https://www.fema.gov/sites/default/files/documents/fema_risk-rating-2.0-methodology-data-sources_4-21.pdf.

¹⁶⁹ “Risk Rating 2.0: Equity in Action | FEMA.Gov,” accessed March 11, 2022, <https://www.fema.gov/flood-insurance/risk-rating>.

¹⁷⁰ Diane P Horn, *National Flood Insurance Program: The Current Rating Structure and Risk Rating 2.0*, CRS Report No. R45999 (Washington, DC: Congressional Research Service, 2021), <https://sgp.fas.org/crs/homesec/R45999.pdf>.

(BW-12).¹⁷¹ The Act directed FEMA to remove the discounts for some policyholders and provide insurance rates that more accurately reflected flood losses. Because of concerns about rising premiums from constituents in multiple communities, Congress passed the Homeowner Flood Insurance Affordability Act of 2014 (HFIAA).¹⁷² The 2014 act rolled back many of the changes implemented under BW-12.

Similarly, within a few weeks of the rollout of RR2.0, several senators wrote to FEMA opposing the rate hikes and urging FEMA to delay implementation.¹⁷³ Where a few policyholders would indeed see their rates go up, FEMA pointed out that about a quarter of policyholders would see their premiums go down.¹⁷⁴ This debate highlights the difficulty of rolling back deeply discounted “grandfathered” insurance premiums and becomes more relevant as climate change worsens. How long and how much should the public subsidize high-risk behavior?

Hurricane Harvey revealed some issues with insurance coverage (or lack thereof) as Houston has experienced recurrent floods in recent times. Harvey was a Category 4 storm that hit Texas on August 25, 2017, flooding 204,000 homes and causing 68 deaths. Total damage by Hurricane Harvey was estimated at \$125 billion, making it the second-costliest natural disaster in the U.S. (after Hurricane Katrina).¹⁷⁵ Some parts of Houston received more than 50 inches of rain in four days.¹⁷⁶ Harvey was the third “100-year” rain

¹⁷¹ Moving Ahead for Progress in the 21st Century Act” or the “MAP-21, Public Law 112-141, *U.S. Statutes at Large*, 405 (2012), <https://www.govinfo.gov/content/pkg/PLAW-112publ141/pdf/PLAW-112publ141.pdf>.

¹⁷² Flood Insurance Affordability Act of 2014, Public Law 113-89, *U.S. Statutes at Large* 1020 (2014), <https://www.congress.gov/bill/113th-congress/house-bill/3370>.

¹⁷³ John Kennedy Staff, “Kennedy, Cassidy, Menendez Oppose FEMA Plan to Hike Louisianians’ Flood Insurance Costs,” John Kennedy U.S. Senator for Louisiana, September 22, 2021, <https://www.kennedy.senate.gov/public/2021/9/kennedy-cassidy-menendez-oppose-fema-plan-to-hike-louisianians-flood-insurance-costs>.

¹⁷⁴ Federal Emergency Management Agency, “Risk Rating 2.0 Is Equity in Action” (Washington, DC: Federal Emergency Management Agency, April 2021), https://www.fema.gov/sites/default/files/documents/fema_rr-2.0-equity-action_0.pdf.

¹⁷⁵ John D. Murphy, *August/September 2017 Hurricane Harvey* (Silver Spring, MD: National Weather Service, 2018), <https://www.weather.gov/media/publications/assessments/harvey6-18.pdf>.

¹⁷⁶ “Hurricane Harvey Aftermath: What Happened and What’s Next,” CNN, accessed October 30, 2020, <https://www.cnn.com/specials/us/hurricane-harvey>.

event to hit Southeast Texas in three years.¹⁷⁷ Metrological scientists have described Hurricane Harvey as a 1 in 500-year or 1,000-year event, and some parts of southeast Texas experiencing water levels characteristic of a 1 in the 500,000-year event.¹⁷⁸ Researchers at MIT and Princeton have determined that “historical 100-year flood level would occur annually in New England and mid-Atlantic regions and every 1–30 years in southeast Atlantic and Gulf of Mexico regions in the late 21st century.”¹⁷⁹

Houston—now the nation’s fourth largest—has been booming. More development results in less pervious surface area and a diminished ability of the ground to absorb excess precipitation. Without strong floodplain management, that is the case in Houston. The Kinder Institute for Urban Research at Rice University found that since 2000, the population in Harris County has grown by about 40 percent.¹⁸⁰ By 2050, the population in the Houston metro area is expected to approach 10 million.¹⁸¹ Greater development will further stress the natural condition of the land but place higher number of people at risk.

Congress has mandated and the federal government requires flood insurance for all federally backed mortgages in the Special Flood Hazard Area (SFHA).¹⁸² However, many uninsured flooded homes in Houston were not mapped in the flood hazard area and were not required to have flood insurance. According to a 2017 report, nearly 70 percent of the

¹⁷⁷ Halloween floods followed the 2015 Memorial Day floods the same year. The Tax Day floods of 2016 were the worst since Allison in 2001. And then came Hurricane Harvey in 2017.

¹⁷⁸ Tia Ghose, “Hurricane Harvey Caused 500,000-Year Floods in Some Areas,” *livescience.com*, September 11, 2017, <https://www.livescience.com/60378-hurricane-harvey-once-in-500000-year-flood.html>.

¹⁷⁹ Reza Marsooli et al., “Climate Change Exacerbates Hurricane Flood Hazards along US Atlantic and Gulf Coasts in Spatially Varying Patterns,” *Nature Communications* 10, no. 1 (2019): 1, <https://doi.org/10.1038/s41467-019-11755-z>.

¹⁸⁰ “After 20 Years, the Center of Harris County’s Population Has Moved Outside the Loop,” The Kinder Institute for Urban Research, accessed March 15, 2022, <https://kinder.rice.edu/urbanedge/2022/01/13/harris-county-population-suburbs-census>.

¹⁸¹ Texas Water Development Board, “Population Projections: 2000 - 2060: Houston, Harris County and the State of Texas,” Houston Planning & Development, January 2006, https://www.houstontx.gov/planning/Demographics/demograph_docs/PopProjections.htm.

¹⁸² “For Real Estate, Lending & Insurance Professionals | FEMA.Gov,” accessed March 15, 2022, <https://www.fema.gov/flood-maps/products-tools/know-your-risk/realtor-insurance-lenders>.

damage from Hurricane Harvey was uninsured.¹⁸³ Some homeowners did not voluntarily purchase flood insurance in the misplaced belief that flooding would not affect them as they had never flooded before. Research has also shown that 25 percent to 42 percent of homeowners are less likely to hold flood insurance when expectations of government bailouts after a disaster are high.¹⁸⁴ Lack of risk awareness may also explain why only 30 percent of U.S. homeowners who live in the SFHA have flood insurance.¹⁸⁵ A sound and sustainable NFIP is a primary component of communities achieving resiliency. Higher levels of NFIP coverage becomes harder due to the factors identified above.

Indeed, reducing the total count of SRL properties played a significant role in Houston's post-Harvey buyout strategy. Harris County's Project Recovery has identified 869 properties classified by the NFIP as SRL, and due to multiple flooding events, NFIP has paid 5,364 claims for these properties totaling over \$400 million.¹⁸⁶ They are the most significant totals of any area in the United States. According to the Natural Resources Defense Council (NRDC) research, a single home in the Trinity Gardens has 29 claims, and at least 446 homes have flooded ten or more times.¹⁸⁷ Once one adds RL properties to the SRL number, the count is closer to 2,800 properties. These are just NFIP-insured properties. According to Harris County Flood District, a total of 154,170 homes in Harris

¹⁸³ Tom Larsen, "Hurricane Harvey: Identifying the Insurance Gap," CoreLogic®, September 9, 2017, <https://www.corelogic.com/intelligence/hurricane-harvey-identifying-the-insurance-gap/>.

¹⁸⁴ Craig E. Landry, Dylan Turner, and Daniel Petrolia, "Flood Insurance Market Penetration and Expectations of Disaster Assistance," *Environmental & Resource Economics* 79, no. 2 (2021): 357–86, <https://doi.org/10.1007/s10640-021-00565-x>.

¹⁸⁵ Carolyn Kousky et al., *The Emerging Private Residential Flood Insurance Market in the United States* (Philadelphia: Wharton Risk Management and Decision Processes Center, 2018), <https://riskcenter.wharton.upenn.edu/wp-content/uploads/2018/07/Emerging-Flood-Insurance-Market-Report.pdf>.

¹⁸⁶ "Post Disaster Relocation and Buyout Program," Project Recovery, accessed August 28, 2021, <https://harrisrecovery.org/post-disaster-relocation-and-buyout-program/>.

¹⁸⁷ Lucas Eastman and 2016 Rob Moore, "Flood, Rebuild, Repeat: The Need for Flood Insurance Reforms," Expert Blog, August 11, 2016, <https://www.nrdc.org/experts/rob-moore/flood-rebuild-repeat-need-flood-insurance-reforms>.

County flooded due to Hurricane Harvey, and 64 percent were uninsured.¹⁸⁸ Given the recurrent flooding, the demand for buyouts in Houston and Harris County is high.

Mrs. G, a Houston resident, is a homeowner whose house had flooded multiple times, including during Hurricane Harvey.¹⁸⁹ She had NFIP insurance and knew how the system worked as she had flooded previously. FEMA would offer her some monetary relief and temporary housing immediately after a disaster. Within 30–60 days, she would get her NFIP and homeowners’ insurance claim checks if all went well. She would spend the next four to six months making repairs to her home and settling back in, only to be flooded again a year or two later. She was interested in FEMA’s home buyout program but was also wary that of demand, and a lengthy process up to two years, as discussed in Chapter II. Mrs. G posed a straightforward question to FEMA: instead of making multiple payments repeatedly, why wouldn’t FEMA just buy her out immediately? Mrs. G represents the ideal mitigation candidate: she wishes to participate voluntarily, her home fits the definition of an RL property, it is in a high-risk area, and flood insurance premiums, although low, are steadily going up. Finally, she is tired of three major floods in as many years. She wants out.

To address some of the structural challenges with the FMA program and respond to Mrs. G’s question, FEMA explored a new HMA grant, the Severe Risk Property Acquisition (SRPA) program.¹⁹⁰ The program’s primary objective was to offer expedited buyouts of NFIP insured RL and SRL structures hit by Hurricane Harvey in the Houston and Harris County area. Like all HMA programs, the program would rely on voluntary participation by the homeowner. As a pilot program, this initiative proposed to Congress requested a one-time supplemental appropriation. FEMA estimated that \$600M-\$800M

¹⁸⁸ Jeff Lindner and Steve Fitzgerald, “Immediate Report – Final Hurricane Harvey - Storm and Flood Information” (memorandum, Houston, TX: Harris County Flood Control District, 2018), 13, <https://www.hcfcfd.org/Portals/62/Harvey/immediate-flood-report-final-hurricane-harvey-2017.pdf>.

¹⁸⁹ Mrs. G is a real individual who FEMA assisted after Hurricane Harvey. Her name is withheld for privacy reasons.

¹⁹⁰ Federal Emergency Management Agency, “Agency Information Collection Activities: Proposed Collection; Comment Request; Property Acquisition and Relocation for Open Space,” *Federal Register* 84, no. 154 (August 9, 2019): 39356–59, <https://www.federalregister.gov/documents/2019/08/09/2019-17102/agency-information-collection-activities-proposed-collection-comment-request-property-acquisition>.

would not address all damaged homes in Harris County but address approximately 2,800 RL and SRL structures of the 154,170 that flooded.

Although the program would directly fund the homeowner, FEMA determined that it did not want to be in the land ownership business. It would still need to partner with the local and state governments to demolish the home, own title to the land, and maintain it as open space in perpetuity. SRPA would allow FEMA to enter into a direct agreement with a property owner voluntarily to acquire their structure while allowing the property owner to keep the land or the community to purchase the land and deed restrict it. For its part, FEMA would streamline the acquisition process to buyout as quickly as 45 days.

SRPA never got off the ground, and FEMA withdrew it.¹⁹¹ The state was not thrilled about FEMA going to the homeowner directly by-passing them and the local community. The state and the local community were unenthused about retaining land ownership. They did not have a say in the buyout but would maintain the land as open space in perpetuity. FEMA also struggled with the 45-day target it had set, not fully knowing to what extent it would be able to expedite EHP reviews. Lastly, Congress did not appropriate the additional money needed for the pilot program.

SRPA, if implemented, would greatly expedite home-buyouts. Although \$800 million may be a lot of money, it pales compared to the multiple NFIP claim payouts and response and recovery costs after a disaster. At the time of this writing, HR 3684, The Infrastructure Investment and Jobs Act of August 2021 includes \$3.5 billion for Flood Mitigation Assistance, but whether this bill becomes law remains to be seen.¹⁹² It is only a matter of time before another flood hits Houston, and lessons learned from Harvey should not be lost. A SRPA pilot could act as a testbed to explore other ideas and establish a blueprint for future action in other vulnerable parts of the nation.

Homeowners tired of multiple floods were ready to sell and move after Hurricane Harvey, often agreeing to sell below market value to avoid the hassle and instant cash

¹⁹¹ Federal Emergency Management Agency.

¹⁹² Infrastructure Investment and Jobs Act, Public Law 117–70, *U.S. Statutes at Large* (2021), <https://www.congress.gov/bill/117th-congress/house-bill/3684/text>.

offered by a developer. Of the 45,000 homes in Harris County sold six months after Hurricane Harvey, at least 12,000 had at least a foot of flood damage.¹⁹³ Just an inch of water in a house can cause more than \$25,000 damage.¹⁹⁴ Higher flood levels may result in a place deemed by authorities substantially damaged and uninhabitable. Individuals looking to “flip” a home were some of the buyouts. The vast majority were sizeable private equity and investment firms looking to package land parcels and build medium or high-density, mixed-use properties.¹⁹⁵ Absentee buyers and investors in Houston and surrounding counties rose nearly 12 percent in a year, with some areas—for example, adjacent Galveston County—experiencing 36-percent purchases by absentee buyers.¹⁹⁶ As long as the federal government continues subsidizing flood insurance, the investors know their assets are protected even when the next flood occurs. The resultant outcome of speculative property development is higher density, perhaps with better building codes, but in some of the country’s riskiest floodplains.

Mrs. G sold her property to a developer. She could not wait two years.

B. FEMA’S FLOOD MAPS

The NFIP’s goals have always been broader than just insurance. Besides providing flood insurance, encouraging sound floodplain management principles, identifying, and mapping risk are critical components of the program. Flood maps also serve to communicate flood risk to the public and serve as the basis for establishing flood insurance premiums. The nation’s flood maps, which ought to guide and regulate development in the floodplains, are non-existent or outdated. FEMA develops flood insurance rate maps

¹⁹³ “In Houston’s Flooded Neighborhoods, Real Estate Investors See an Opportunity,” *Houston Chronicle*, May 10, 2018, <https://www.houstonchronicle.com/news/houston-texas/houston/article/houston-harvey-flood-homes-real-estate-investor-12901718.php>.

¹⁹⁴ “Why Buy Flood Insurance?,” National Flood Insurance Program, accessed November 1, 2020, <https://www.floodsmart.gov/why/why-buy-flood-insurance>.

¹⁹⁵ David Hunn and Matt Dempsey, “In Houston’s Flooded Neighborhoods, Real Estate Investors See an Opportunity,” *Houston Chronicle*, May 10, 2018, <https://www.houstonchronicle.com/news/houston-texas/houston/article/houston-harvey-flood-homes-real-estate-investor-12901718.php>.

¹⁹⁶ Andrew LePage, “Absentee Buyer Activity Spikes After Hurricane Harvey,” *CoreLogic®*, November 29, 2018, <https://www.corelogic.com/intelligence/absentee-buyer-activity-spikes-after-hurricane-harvey/>.

(FIRMs) that determines a community’s flood risk. A report by the American Society for Floodplain Managers (ASFPM) in 2020 concluded that “there are approximately 3.5 million miles of streams and rivers, and 95,471 miles of coastlines in the nation. Currently, only 1.14 million stream miles and 45,128 shoreline miles have flood maps. By this metric, only about 1/3 of the nation has been mapped.”¹⁹⁷

The report summarized that roughly 15 percent of the 22,000 communities that participate in the NFIP have maps that are 15 years old, and of those, many are more than 40 years old (Figure 8). According to ASFPM, the federal government should spend as much as \$11.77 billion to update flood maps.¹⁹⁸ FEMA’s flood-mapping budget is about \$263 million a year. In 2021, the congressional budget justification decreased the flood mapping budget by \$163 million.¹⁹⁹

¹⁹⁷ Association of State Floodplain Managers, *Flood Mapping for the Nation: A Cost Analysis for Completing and Maintaining the Nation’s NFIP Flood Map Inventory* (Madison, WI: Association of State Floodplain Managers, Inc., 2020), 19, https://asfpm-library.s3-us-west-2.amazonaws.com/FSC/MapNation/ASFPM_MaptheNation_Report_2020.pdf.

¹⁹⁸ Association of State Floodplain Managers, 17.

¹⁹⁹ Department of Homeland Security, *Federal Emergency Management Agency: Budget Overview Fiscal Year 2021 Congressional Submission* (Washington, DC: Department of Homeland Security, 2021), 200, https://www.dhs.gov/sites/default/files/publications/federal_emergency_management_agency.pdf.

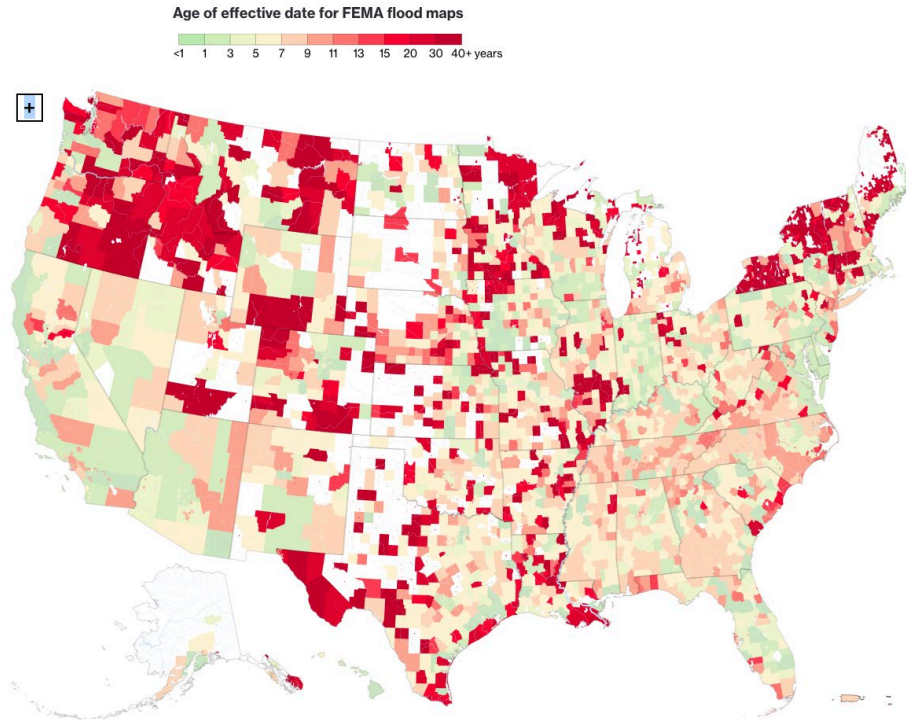


Figure 8. Age of Effective Date for FEMA Flood Maps²⁰⁰

As building and land development increases, land permeability diminishes and is more susceptible to flooding. Map updates are meant to reflect these changes. FEMA’s maps examine historical flooding as a predictor of current flood risk but do not include future projections. However, history alone cannot serve an infallible guide to the future. Threats change over time increasing with rising seas, coastal development, and climate change putting an increasing number of U.S. homes, cities, and infrastructure at risk.

An Office of Inspector General report also in 2017 found 58 percent of all FEMA flood maps are considered inaccurate or out-of-date.²⁰¹ The consequences of non-existent or outdated flood maps are readily visible. A 2017 report by the Congressional Budget Office found that maps outdated by five years existed in 83 of the country’s highest risk

²⁰⁰ Source: Keller et al., “Outdated and Unreliable.”

²⁰¹ Department of Homeland Security, Inspector General, *FEMA Needs to Improve Management of Its Flood Mapping Programs*, OIG-17-110 (Washington, DC: Department of Homeland Security, 2017), <https://www.oig.dhs.gov/sites/default/files/assets/2017/OIG-17-110-Sep17.pdf>.

counties and 42 counties maps were ten years old.²⁰² According to Baker Institute at Houston's Rice University, as much as half the flood damage in Harris County occurred outside the mapped SFHA.²⁰³

A rigorous flood mapping program establishes the basis for community floodplain management regulations. New construction in a mapped community must comply with current disaster-resistant building codes. The NFIP defines these codes as minimum standards and argues that structures in NFIP participating communities are more resilient to future disasters. "Buildings in the floodplain that meet the NFIP standards suffer 80% less flood damage than buildings constructed before the requirements went into effect."²⁰⁴ But as noted earlier, many homeowners underestimate their flood risk, leaving them vulnerable, underinsured, or worse, uninsured.

Based on 2000 census data, research conducted by FEMA found slightly more than 3 percent of the U.S. population, or about 8.6 million people in the conterminous United States, live in SFHA as defined by FEMA.²⁰⁵ According to a study published in 2018, this number may be closer to 41 million.²⁰⁶ The 41 million sum increases to more than 60 million for those that live in both the 1-percent and the 0.2-percent annual chance floodplain (the 100-year and the 500-year floodplain). Even more alarmingly, using medium population and development growth projections, the number of people at risk in

²⁰² Congressional Budget Office, "Age of Flood Maps in Selected Counties That Account for Most of the Expected Claims in the National Flood Insurance Program: Supplemental Material for 'The National Flood Insurance Program: Financial Soundness and Affordability'" (Washington, DC: Congressional Budget Office, November 2017), <https://www.cbo.gov/system/files?file=115th-congress-2017-2018/reports/53028-supplementalmaterial.pdf>.

²⁰³ Jim Blackburn, *Living with Houston Flooding* (Houston: James A. Baker III Institute for Public Policy of Rice University, 2017).

²⁰⁴ Federal Emergency Management Agency, *Floodplain Management and the Endangered Species Act: Checklist for Programmatic Compliance* (Bothell, WA: Federal Emergency Management Agency, Region 10, 2010), 1, https://www.fema.gov/pdf/about/regions/regionx/Biological_Opinion_Checklist8_12_10.pdf.

²⁰⁵ Mark Crowell et al., "An Estimate of the US Population Living in 100-Year Coastal Flood Hazard Areas," *Journal of Coastal Research - J COASTAL RES* 26 (March 1, 2010), <https://doi.org/10.2112/JCOASTRES-D-09-00076.1>.

²⁰⁶ Wing et al., "Estimates of Present and Future Flood Risk," 1.

the 500-year floodplain increases by 41 percent.²⁰⁷ Better models, more accurate forecasting, and taking future risk into account, shows that the U.S. government has severely underestimated flood risk.

Recognizing the limitations of FEMA’s mapping program, the non-profit First Street Foundation has created a flood tool to let homeowners determine their own flood risk. Figure 9 shows darker blues areas where people are unaware of or underestimate their risk at the property level. According to First Street, “46 million properties across the country at substantial risk, of which 5.9 million properties and property owners are currently unaware of or underestimating the risk they face because they are not identified as being within the SFHA zone.”²⁰⁸

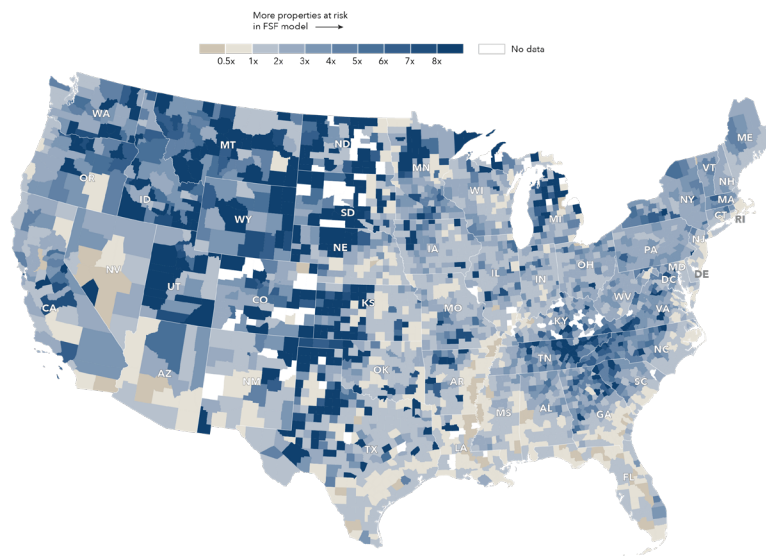


Figure 9. First National Flood Risk Assessment 2020, Differences in the Number of Properties at Substantial Flood Risk compared to FEMA²⁰⁹

²⁰⁷ Wing et al., 6.

²⁰⁸ “Highlights from ‘The First National Flood Risk Assessment,’” First Street Foundation, June 29, 2020, <https://firststreet.org/research-lab/published-research/2020-national-flood-risk-assessment-highlights/>.

²⁰⁹ Source: First Street Foundation, *The 3rd National Risk Assessment: Infrastructure on the Brink* (Brooklyn, NY: First Street Foundation, 2021), 9, <https://assets.firststreet.org/uploads/2021/09/The-3rd-National-Risk-Assessment-Infrastructure-on-the-Brink.pdf>.

Millions of people could be exposed to the hidden threat that will only grow as climate change worsens. At the Government Accounting Office’s request, a study commissioned by FEMA in 2017 evaluated how population growth and climate change might alter flood risk in the United States through 2100. The study estimated “median increase in the area of the 100-year floodplain in riverine environments of 45 percent nationwide and 55 percent in coastal areas, but with large regional variation. On average, roughly 30 percent of this increase is attributable to population growth and 70 percent to climate change.”²¹⁰

The First Street Foundation modeled the impact of climate change and sea-level rise in the United States. It found that the current estimate of 14.6 million properties at high risk of flooding increases to 23.5 million over the next 30 years, as shown in Figure 10.²¹¹ Of these, 3.6 million are classified as facing almost a 99-percent chance of flooding over the next thirty years. Predictably, the highest increases, in some cases more than 250 percent, are along the Gulf Coast and the Atlantic seaboard. States such as Louisiana with 21 percent and Florida with 20 percent already have the most significant proportion of properties currently with substantial flood risk. Louisiana by 2050 faces a 69-percent proportional rise of properties at risk.

²¹⁰ Carolyn Kousky, *Financing Flood Losses: A Discussion of the National Flood Insurance Program* (Washington, DC: Resources for the Future, 2017), 4.

²¹¹ First Street Foundation, *The First National Flood Risk Assessment: Defining America’s Growing Risk* (Brooklyn, NY: First Street Foundation, 2020), 12, https://assets.firststreet.org/uploads/2020/06/first_street_foundation__first_national_flood_risk_assessment.pdf.

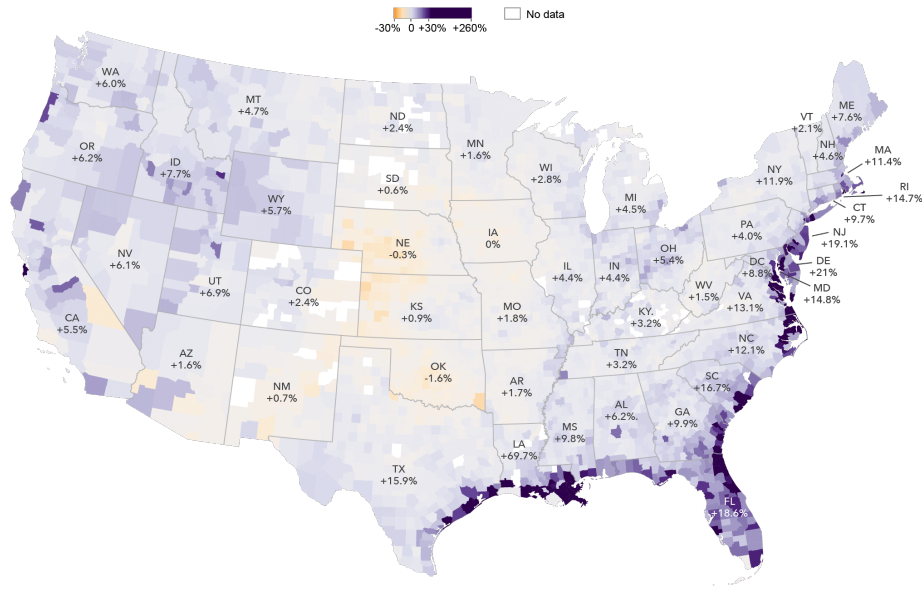


Figure 10. First National Flood Risk Assessment 2020, Changes in the Proportion of Properties at Substantial Flood Risk 2020–2050²¹²

One of the factors contributing to Houston’s problem is the lack of updated maps. According to Houston Public Works, the current 100-year rainfall amount used for mapping is about 13 inches in 24 hours and 19 inches in 24 hours indicate a 500-year event. These amounts have been exceeded many times just in the past decade. Current maps underrepresent the real and present risk of flooding. Houston Public Works continues that approximately 25 percent of all flood claims occur outside the Special Flood Hazard Areas depicted on FEMA maps.²¹³

First Street Foundation’s future projections indicate that Houston is fourth on the list of the highest number of properties at flood risk by 2050, as calculated in the SFHA or 100-year (1 percent annual) risk. At the 500-year (0.2 percent annual) risk, Houston by the year 2050 ranks first, with a full third of its properties at risk.²¹⁴ More than 17 percent of individual properties in Houston are at risk of flooding over the next 30 years, of which 57

²¹² Source: First Street Foundation, 11.

²¹³ “Flood Hazard,” Houston Public Works, accessed August 27, 2021, <https://www.publicworks.houstontx.gov/flood-hazard>.

²¹⁴ First Street Foundation, *The First National Flood Risk Assessment*, 15.

percent are at major to extreme danger.²¹⁵ These projections may not include the other characteristic of Houston – proximity to the Gulf of Mexico and the impact of storm surge.

A GAO report, released in October 2021 states that FEMA’s flood hazard maps do not reflect the best available science and “has been operating under an out-of-date plan that does not reflect new goals, objectives, activities, performance measures, and associated timeframes.”²¹⁶ GAO recommends that FEMA update its Risk MAP program to reflect current and *future* flood hazards.²¹⁷

C. FLOODPLAIN MANAGEMENT

NFIP requires structures in the Special Flood Hazard Area (SFHA), i.e., facilities subject to a 1-percent chance of annual flooding and purchased through a federally backed mortgage (most homes in the United States), to carry flood insurance for the duration of the mortgage. Generally, an average homeowner mortgage is at least 30 years. However, cities routinely flout NFIP regulations. A recent report showed nearly a quarter-million policies in violation, costing the federal government \$1 billion in flood claims in the past decade.²¹⁸ Local communities responsible to monitor and enforce regulations know that FEMA rarely puts NFIP participating communities on probation. Suspension is even rarer. Communities that had compliance issues identified remained non-compliant even two years later.²¹⁹ FEMA annually funds the Community Assistance Program – State Support Services Element (CAP-SSSE), which according to FEMA “helps states proactively identify, prevent and resolve floodplain management issues in participating communities

²¹⁵ First Street Foundation, 139.

²¹⁶ “Gao-22-104079.Pdf,” 2, accessed March 11, 2022, <https://www.gao.gov/assets/gao-22-104079.pdf>.

²¹⁷ Emphasis mine.

²¹⁸ Christopher Flavelle and John Schwartz, “Cities Are Flouting Flood Rules. the Cost: \$1 Billion.,” *New York Times*, April 9, 2020, <https://www.nytimes.com/2020/04/09/climate/fema-flood-insurance.html>.

²¹⁹ Jacquelyn Monday et al., *An Evaluation of Compliance with the National Flood Insurance Program Part A: Achieving Community Compliance* (Washington, DC: American Institute for Research, 2006), 49, https://www.fema.gov/sites/default/files/2020-07/fema_nfip_eval_community_compliance_a.pdf.

before a flood event even occurs.”²²⁰ For 2020, the total amount available for all states and territories was a meager \$10.4 million.²²¹ This money spread out over 22,493 NFIP participating communities does not go far.

A large part of the floodplain management woes in Harris County is Houston’s unbridled, rapid growth. The paving of many areas has resulted in the White Oak Bayou, one of the county’s watersheds, losing 71 percent of its original wetlands between 1992 and 2010.²²² Since 1980, rainfall in the Bray’s Bayou watershed in Houston has increased by 26 percent, but runoff has risen by 204 percent.²²³ Houston is not atypical of other large coastal metropolitan cities. Rapid growth has meant enormous impervious surfaces, which means precipitation or storm surge resulting in runoffs and flash floods rather than the soil slowly absorbing water. Houston also has relatively flat terrain, and its proximity to the coast and sub-tropical climate provide optimal conditions for rainfall that the city’s infrastructure and bayous cannot handle. Once the stormwater networks are overwhelmed, the city’s streets become secondary drainage facilities.

The other issue with floodplain management is that the Harris County Flood Control District (HCFDC) does not have sole jurisdiction in flood-related matters. That authority resides with 34 floodplain administrators reporting to separate city elected officials, each with its design criteria.²²⁴ This complex governance is superimposed on 22 watersheds, and each drain into its waterways in the fourth most populated county in the

²²⁰ “Community Assistance Program – State Support Services Element | FEMA.gov,” accessed March 11, 2022, <https://www.fema.gov/ko/floodplain-management/financial-help/community-assistance-program-state-support-services-element>.

²²¹ Department of Homeland Security, *The Department of Homeland Security (DHS): Notice of Funding Opportunity (NOFO) FY 20 Community Assistance Program-State Support Services Element* (Washington, DC: Department of Homeland Security, 2020), 4, https://www.fema.gov/sites/default/files/2020-07/fema_CAP-SSSE_FY2020-NOFO.pdf.

²²² John S. Jacob et al., *Houston-Area Freshwater Wetland Loss, 1992-2010*, TAMU-SG-14-303 (Houston: Texas A&M University System, 2015), 9, <http://tcwp.tamu.edu/files/2015/06/WetlandLossPub.pdf>.

²²³ “Another Flood: Politicians Dither While Houstonians, yet Again, Wade Through a Deluge,” *Houston Chronicle*, January 18, 2017, sec. Editorials, <https://www.houstonchronicle.com/opinion/editorials/article/Another-flood-10867145.php>.

²²⁴ “Floodplain Administrators Shared Responsibilities,” Floodplain Administrators, accessed August 27, 2021, <https://www.hcfcd.org/Community/Contact-Us/Floodplain-Administrators>.

United States. If 22 seems a lot, it is—a comparable large coastal city like Los Angeles has six.²²⁵ HCFDC candidly describes each watershed as having “its own independent flooding issues.”²²⁶ Its challenges are unique, and Houston cannot apply unitary solutions such as more buyouts or robust flood control measures uniformly across the city.

At the time of Hurricane Harvey, the Houston Chronicle reported that Harris County had 9,700 Repetitive Loss and 1,965 Severe Repetitive Loss properties.²²⁷ However, the total number of RL and SRL properties is most certainly an undercount as many flood-prone buildings in Houston and Harris County are not mapped in the SFHA and have no requirement to purchase flood insurance. Among cities with at least half a million inhabitants, Houston leads the pack on FEMA-funded buyouts.²²⁸ According to researchers at Rice University, around 4,000 Houston residents applied to the buyout program after Harvey. Texas accepted about 1,000 applications.²²⁹ At this rate, it would take more than three decades to acquire the 36,000 or so homes damaged by Hurricane Harvey in flood zones (Figure 11).²³⁰

²²⁵ Los Angeles Sediment Management, “What Is a Watershed” (Los Angeles: Los Angeles Sediment Management), 1, accessed August 27, 2021, <https://www.dpw.lacounty.gov/lacfd/sediment/dcon/FactSheet7watershed.pdf>.

²²⁶ “A Web of Watersheds and Sub-Watersheds,” Harris County Watersheds, accessed August 27, 2021, <https://www.hcfdc.org/About/Flooding-and-Floodplains/Drainage-Network/Harris-Countys-Watersheds>.

²²⁷ Dylan Baddour, “Deep in Debt, Flood Insurance Program Expected to Boost Rates,” *Houston Chronicle*, March 17, 2017, <https://www.houstonchronicle.com/business/article/Flood-insurance-program-deep-in-debt-costs-will-11009266.php>.

²²⁸ Stephen Paulsen, “Flood the Markey: What to Do with Houston’s Perpetually Flooded Homes,” *Grist*, August 27, 2019, <https://grist.org/Array/buyouts-can-save-houston-hurricane-harvey-flood-soaked-homeowners/>.

²²⁹ Blackburn, *Living with Houston Flooding*.

²³⁰ Lisa Song et al., “Buyouts Won’t Be the Answer for Many Frequent Flooding Victims,” *ProPublica*, November 1, 2017, <https://features.propublica.org/houston-buyouts/hurricane-harvey-home-buyouts-harris-county/>.

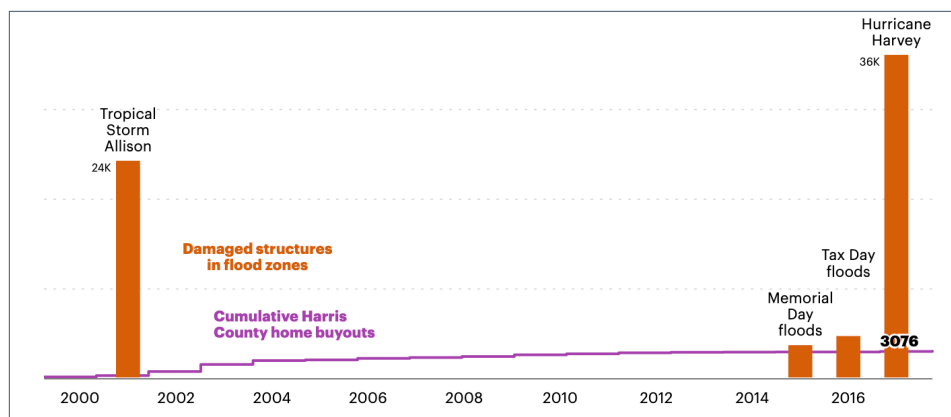


Figure 11. Harris County Flood District, Damaged Structures in Flood Zones vs. Buyouts²³¹

The NFIP and FEMA’s Floodplain Management offer some incentives for communities to voluntarily undertake risk reduction measures over and beyond NFIP minimum standards through the Community Rating System (CRS) created in 1990.²³² As communities undertake actions that reduce risk, they get a 5-percent reduction on its NFIP premiums with a maximum potential of a 45-percent discount.²³³ The most significant premium discounts elevate a property above the Base Flood Elevation (BFE). Of the 1,258 Texas communities that belong to the NFIP, a mere 69, or 5 percent, participate in the CRS.²³⁴ Harris County and Houston belong to the CRS and receive at least 15 percent savings on their already low NFIP insurance premiums.

Flood insurance, which requires communities to adopt minimum planning and building standards in floodplains, is a form of mitigation. Although necessary, this type of mitigation has often been ineffective in reducing damage. While CRS has encouraged some

²³¹ Source: Song et al.

²³² “Community Rating System | FEMA.Gov,” accessed March 15, 2022, <https://www.fema.gov/fact-sheet/community-rating-system>.

²³³ Federal Insurance and Mitigation Administration, “Community Rating System Fact Sheet” (Washington, DC: Department of Homeland Security, 2020), https://waterresources.saccounty.net/stormready/Documents/Progress%20Reports/2020/NFIP_CRS_Fact_Sheet_2020.pdf.

²³⁴ Community Rating System, “Texas: Top 50 National Flood Insurance Program (NFIP) Policy Count Communities* and Community Rating System (CRS) Participation” (Washington, DC: Community Rating System, 2021), https://crsresources.org/files/100/maps/states/texas_crs_map_october_2021.pdf.

risk reduction in the way people build structures, an individual property’s risk profile often does not determine its insurance premium. Instead, the federal government sets premiums artificially low, creating what insurance professionals call a “moral hazard” when insurance makes people take more significant risks than they would without insurance. Artificially low flood insurance rates have subsidized real estate development in flood-prone areas where development should be discouraged.²³⁵ Thus, the NFIP instead of reducing risk has the unintended consequence of encouraging risky behavior.

In a recent development, FEMA has just requested public comment on floodplain management standards that communities should adopt that would help them “become safer, stronger, and more resilient.”²³⁶ Commonly referred to as NFIP minimum standards, adopting these standards are a prerequisite to participate in the NFIP and a vital tool governing building and reconstruction in the SFHA. These standards aim to protect the natural and beneficial functions of the nation’s floodplains and reduce flooding.

NFIP compliant structures have resulted in \$2.4 billion per year in reduced flood losses, saving the nation more than \$100 billion over the last 40 years.²³⁷ As FEMA has not revised these standards since first introduced in 1975, FEMA’s information collection presents a vital opportunity to propose significant changes for floodplain management. The notice explicitly acknowledges that climate change exacerbates the risk of flooding to homeowners. Specifically, it asks whether NFIP minimum standards consider future risk and sea-level rise.

D. BUILDING CODES

Multiple reasons explain the increasing frequency of these large disasters. Not only is the population increasing in many parts of our nation, but development also in areas

²³⁵ Thomas A. Birkland, *Lessons of Disaster: Policy Change after Catastrophic Events* (Washington, DC: Georgetown University Press, 2006), loc. 1288-1293, Kindle.

²³⁶ “Public Comment Period on the National Flood Insurance Program’s Minimum Floodplain Management Standards | FEMA.Gov,” accessed March 11, 2022, <https://www.fema.gov/event/public-comment-period-national-flood-insurance-programs-minimum-floodplain-management>.

²³⁷ “Individuals - Floodplain Management Resources,” FEMA Floodplain Management, July 15, 2021, <https://www.fema.gov/floodplain-management/manage-risk/individuals>.

previously not as densely inhabited is at higher risk of damage. Vulnerable areas such as coasts and inland river floodplains already house much of the nation's population.²³⁸ Adopting and enforcing current disaster-resistant building codes help, but they cannot prevent losses completely. Yet, FEMA's building code adoption tracking project found that only about 36 percent of disaster-prone jurisdictions have adopted disaster-resistant building codes.²³⁹

This abysmal adoption rate is disheartening, especially as seen in Figure 12. Code and above code adoptions for riverine flooding and hurricane surge have an ROI as high as 1:5 and 1:7. Building Codes Saves, a recent FEMA study, determined that modern building codes significantly reduce property losses from natural disasters. The average cost for modern code requirements for a \$300,000 single-family home is about \$4,500, or about 1.5 percent of the home's total cost. This investment over a 30-year mortgage could result in losses avoided of \$48,000.²⁴⁰

Through its national Building Code Adoption Tracking (BCAT), FEMA tracks building code adoption for approximately 22,000 jurisdictions. The interactive GIS portal tracks five hazards, flood, seismic, tornado, hurricane, and other damaging winds. The International Code Council governs the adoption of building codes.²⁴¹ International building codes are adopted every three years, the latest in effect being 2018. FEMA also tracks whether local amendments have weakened the model code. As shown in Figure 12, Texas has no statewide building code. The 2003 International Building Code (IBC) is mandatory for municipalities only. Some municipalities have adopted the 2000 International Residential Code (IRC), but they have broad discretion to amend it, as with Harris County (Figure 13).

²³⁸ Polefka, *Moving Out of Harm's Way*.

²³⁹ "Nationwide Building Code Adoption Tracking | FEMA.Gov," accessed March 15, 2022, <https://www.fema.gov/emergency-managers/risk-management/building-science/bcat>.

²⁴⁰ Compass PTS JV, *Building Codes Save: A Nationwide Study* (Washington, DC: Department of Homeland Security, 2020), <https://www.fema.gov/emergency-managers/risk-management/building-science/building-codes-save-study>.

²⁴¹ "The International Codes," ICC, December 13, 2016, <https://www.iccsafe.org/products-and-services/i-codes/the-i-codes/>.

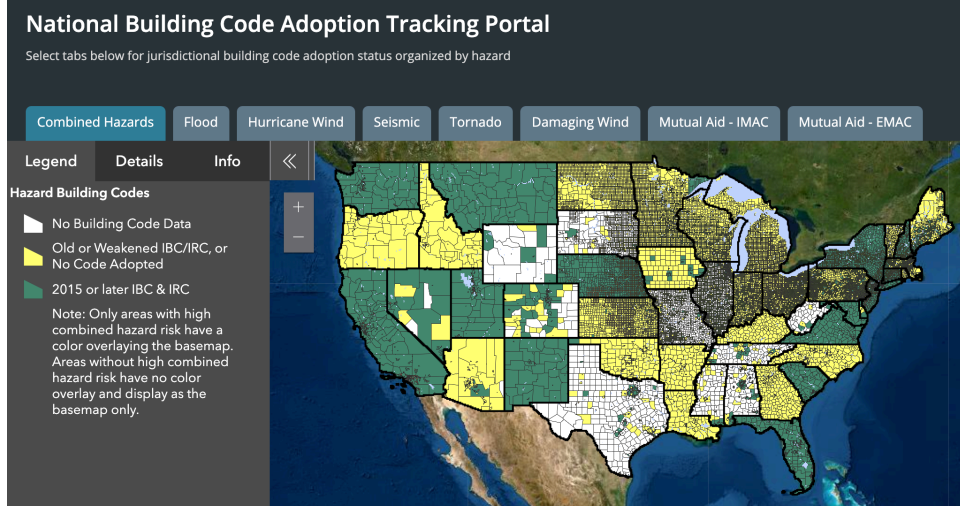
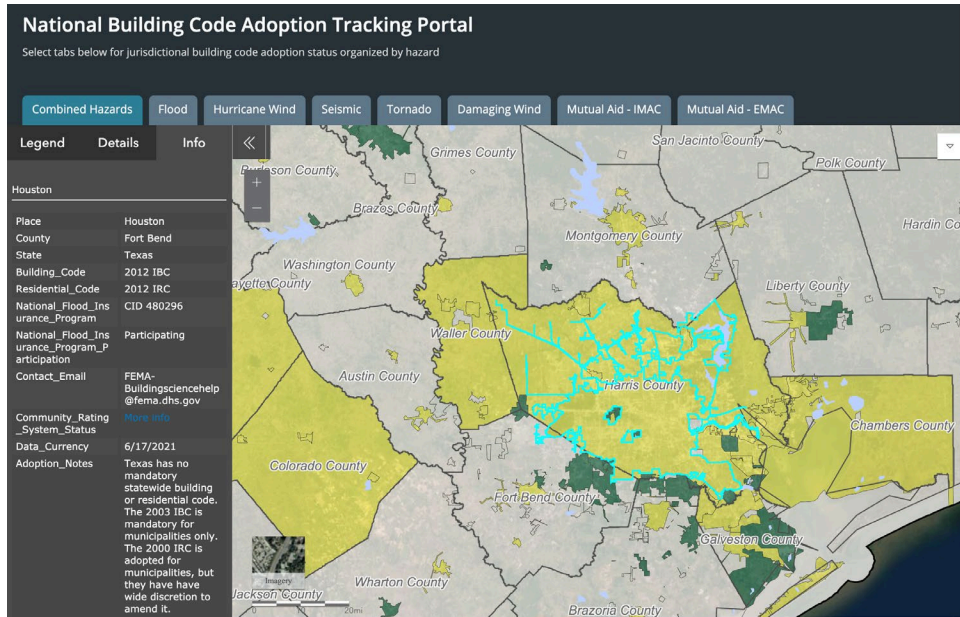


Figure 12. The Building Code Adoption Portal, an Interactive Map that Tracks Five Hazards²⁴²



²⁴² Source: Federal Emergency Management Agency, “National Building Code Adoption Tracking Portal,” The National Risk Index, accessed June 22, 2021, <https://hazards.geoplatform.gov/portal/apps/MapSeries/index.html?appid=ddf915a24fb24dc8863eed96bc3345f8>.

Figure 13. Houston and Harris County have Adopted the Latest Codes, but Texas has no Mandatory Statewide Building or Residential Code²⁴³

IBHS, the Insurance Institute for Business and Home Safety, rated hurricane-prone Atlantic and Gulf states on their 2018 residential code enforcement.²⁴⁴ Florida received a high score of 95, improving over its 2015 score by a point. In contrast, Texas had a score of 34, losing two points from its 2015 score. The report recommended, “the extensive damage and loss of life that resulted from Hurricane Harvey—one of the costliest hurricanes on record, inflicting nearly \$200 billion in damage to Houston and surrounding areas—necessitates stringent control of future land development and residential building construction, especially in flood-prone areas.”²⁴⁵

Although far from being universally accepted, states are beginning to realize that adopting and enforcing the latest disaster-resistant building codes is one of the best risk-reduction measures it can undertake, and some localities—for example, Florida and California—also have adopted supplemental codes to meet local requirements for all-hazard protection.²⁴⁶ FEMA has signaled the importance of building codes by funding in Puerto Rico an extensive code adoption and enforcement project with a federal cost-share of \$89 million.²⁴⁷ When Hurricane Maria struck Puerto Rico in 2017, the territory only had 2009 ICC codes in effect. An estimated 1,138,843 residential structures were damaged or destroyed, and total response and reconstruction cost estimated at \$139 billion presented

²⁴³ Source: Federal Emergency Management Agency.

²⁴⁴ Insurance Institute for Business & Home Safety, *Rating the States: 2018* (Richburg, SC: Insurance Institute for Business & Home Safety, 2018), https://ibhs.org/wp-content/uploads/wpmembers/files/Rating-the-States-2018_IBHS.pdf.

²⁴⁵ Insurance Institute for Business & Home Safety, 21.

²⁴⁶ American Society of Civil Engineers, *Minimum Design Loads for Buildings and Other Structures*, 7th ed. (Reston, VA: American Society of Civil Engineers, 2013), <https://doi.org/10.1061/9780784412916>.

²⁴⁷ “New Building Codes Support Puerto Rico in Building Back Stronger,” Federal Emergency Management Agency, January 2, 2019, <https://www.fema.gov/press-release/20210318/new-building-codes-support-puerto-rico-building-back-stronger>.

the island with the unique opportunity to build back stronger.²⁴⁸ With FEMA HMGP funding, Puerto Rico adopted the 2018 code and undertook an ambitious code enforcement project with a 20-fold increase in building inspectors and permitting officials.

In 2020, the first year of the BRIC program, the Sonoma County in California, which has a statewide building code, won competitive grants. FEMA awarded \$37 million to a project that reduces the risk of catastrophic wildfire losses in the Wildland Urban Interface by reducing vegetation and creating buffers around structures to decrease fire spread and intensity. Besides the statewide and local building code adoption and enforcement, an essential factor in the selection was Sonoma’s demonstration that the project used nature-based solutions and increased environmental benefits, including forest health and water quality.²⁴⁹

The 2021 BRIC NOFO allocates as many as 20 points out of 100 for states that have adopted the latest (2021) or one prior (2018) ICC building code. If a state has the 2015 code in effect, it is eligible for 10 points. Any code before 2015 or no codes garners no points.²⁵⁰ As Figure 14 shows, only about a dozen states and territories depicted in red are eligible for 20 points, and about another dozen for 10 points. However, most of the states have no statewide building code.

²⁴⁸ John Ingargiola, José Valenzuela, and Michael Rimoldi, “Innovative Solutions for Post-Disaster Code Enforcement – Development of Sustainable Permitting, Inspections and Building Code Programs” (Building Innovations 2019, National Institute of Building Sciences, January 8, 2019), <https://portal.nibs.org/files/wl/?id=dNBZl5D4UdBGovm2XTvb3mnVI5zZ1uE8>.

²⁴⁹ Federal Emergency Management Agency, “Fiscal Year 2020 Building Resilient Infrastructure and Communities (BRIC) Competitive Project Selections,” FEMA Grants, November 8, 2021, <https://www.fema.gov/fact-sheet/fiscal-year-2020-building-resilient-infrastructure-and-communities-bric-competitive>.

²⁵⁰ Department of Homeland Security, *The Department of Homeland Security (DHS) Notice of Funding Opportunity (NOFO) Fiscal Year 2021 Building Resilient Infrastructure and Communities* (Washington, DC: Department of Homeland Security, 2021), 27, https://www.fema.gov/sites/default/files/documents/fema_nof-fiscal-year-2021-building-resilient-infrastructure.pdf.

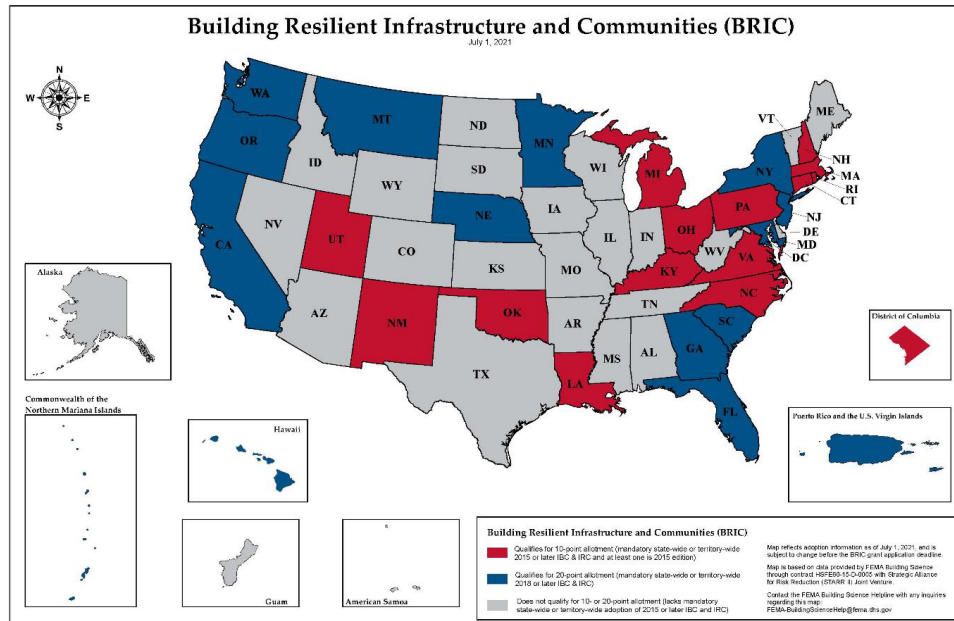


Figure 14. Statewide Code Adoption Status²⁵¹

These few points can differentiate between a successful project that is selected and one that is not in a highly competitive program. The \$500 million 2020 BRIC program attracted projects from around the country totaling \$3.6 billion.²⁵² Some states are beginning to pay attention. Colorado, for example, has no statewide building code.²⁵³ Despite local opposition, a state lawmaker, Chris Hansen, recently opined that for the state to stay competitive and complement its investments in mitigation and suppression, Colorado must seriously consider adopting the latest codes and enhancing enforcement.

²⁵¹ Source: Unpublished FEMA graphic representation based on International Code Council (ICC) data. International Code Council, “FEMA’s Building Resilient Infrastructure and Communities (BRIC) Program: Adoption of the International Building Code (IBC) and International Residential Code (IRC) by State” (Washington, DC: International Code Council, September 2020), <https://www.iccsafe.org/wp-content/uploads/Code-Adoption-for-FEMAs-BRIC-Program-FY20.pdf>.

²⁵² Federal Emergency Management Agency, “Building Resilient Infrastructure and Communities FY 2020 Subapplication Status.”

²⁵³ “Building Codes by State,” Insurance Institute for Business & Home Safety, January 20, 2019, <https://ibhs.org/public-policy/building-codes-by-state/>.

Hansen argued, “if we’re going to spend a lot of additional state resources, I think it’s perfectly reasonable then to require some minimum codes.”²⁵⁴

Since 2015 International Building Codes (I-Codes) require that states build at least 1-foot higher (unless local codes require more), but codes alone are insufficient. FEMA, since 2013, has required the use of ASCE-24, a standard that requires one foot or two feet of freeboard, depending on the type of facility, if using HMA grants.²⁵⁵ Freeboard can provide that buffer if flood elevations change due to future development that constricts water flow or increases runoff. It can also offer a safety factor due to surveying mistakes, incorrect benchmarks, or errors in interpreting flood profiles. Freeboard can also protect from future climate change due to sea-level rise, resulting in higher flood elevations. The benefits in every instance far outweigh the incremental cost to elevate a structure the one or two additional feet. For example, a mere 2-feet of freeboard above the BFE for a residential facility in a flood V-Zone resulted in benefits about 17 times higher than the corresponding cost.²⁵⁶ For this reason, independent experts have urged FEMA to promote the adoption of freeboard in its training and technical publications.²⁵⁷ Yet, a 2019 study found that 38 percent of communities participating in the NFIP have no freeboard provisions in their adopted building codes.²⁵⁸ As with code adoption and enforcement, to get communities to adopt higher-standards, even with small up-front costs is difficult.

²⁵⁴ Jesse Paul, “Colorado Doesn’t Have a Statewide Building Code. Would Enacting One Help Protect Homes against Wildfire?,” *Colorado Sun*, October 22, 2021, <https://coloradosun.com/2021/10/22/colorado-statewide-building-code-proposal/>.

²⁵⁵ Kathy Baumgaertner et al., *Guidance of Applying ASCE 24 Engineering Standards to HMA Flood Retrofitting and Reconstruction Projects* (Washington, DC: Department of Homeland Security, 2013), https://www.fema.gov/sites/default/files/documents/fema_asce-24-hma-guidance.pdf.

²⁵⁶ Multi-Hazard Mitigation Council, *Natural Hazard Mitigation Saves: 2019 Report*, 19.

²⁵⁷ Nina Aggarwal, *Evaluation of the National Flood Insurance Program: Recommendations from the Individual Reports* (Washington, DC: American Institutes for Research, 2006), 33, https://www.fema.gov/sites/default/files/2020-07/fema_nfip_eval-recommendations.pdf.

²⁵⁸ Multi-Hazard Mitigation Council, *Natural Hazard Mitigation Saves: 2019 Report*, 141.

Also, in 2015, then-President Obama introduced the Federal Flood Risk Management Standard (FFRMS) by Executive Order 13690.²⁵⁹ The order aimed to “improve the resilience of communities and federal assets against the impacts of flooding.”²⁶⁰ The standard applied to all federal facilities and any construction or repair using federal funds. The order gave agencies three options to implement where they could use the best available science, build in additional free-board in their designs, or build to at least the 500-year flood plain. Although some discretion was available to individual agencies in implementing the order, the step was a considerable advance in addressing the rising risk of flooding and considering the future threat posed by climate change and rising seas.²⁶¹

In August 2017, President Trump, with the issuance of Executive Order 13807, revoked the FFRMS.²⁶² Ironically, the standard that would have offered greater protection from flooding was rescinded by President Trump two weeks before Hurricane Harvey hit Texas. In May 2021, President Biden, by Executive Order 14030, reinstated the FFRMS.²⁶³ The standard is a commonsense approach that safeguards federal investment against future risk and climate change from our most common natural disaster. In August 2021, FEMA issued interim guidelines for the partial implementation of the FFRMS for its

²⁵⁹ Barack Obama, “Executive Order – Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input,” The White House, January 30, 2015, <https://obamawhitehouse.archives.gov/the-press-office/2015/01/30/executive-order-establishing-federal-flood-risk-management-standard-and->.

²⁶⁰ “Eo-13690-Flood-Risk-Mgmt-2015-01.Pdf,” 6425, accessed March 15, 2022, <https://www.energy.gov/sites/default/files/2021-06/eo-13690-flood-risk-mgmt-2015-01.pdf>.

²⁶¹ Association of State Floodplain Managers, *Guidelines for Implementing Executive Order 11988, Floodplain Management, and Executive Order 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input* (Association of State Floodplain Managers, 2015), 7–8, https://asfpm-library.s3-us-west-2.amazonaws.com/General/Implementing_Guidelines_for_EO11988_13690_08_Oct15_508.pdf.

²⁶² Donald J. Trump, “Executive Order 13807: Establishing Discipline and Accountability in the Environmental Review and Permitting Process for Infrastructure Projects,” *Federal Register* 82, no. 163 (August 15, 2017): 40463–69, <https://www.govinfo.gov/content/pkg/FR-2017-08-24/pdf/2017-18134.pdf>.

²⁶³ Joseph R. Biden, Jr., “Executive Order on Climate-Related Financial Risk,” The White House, May 20, 2021, <https://www.whitehouse.gov/briefing-room/presidential-actions/2021/05/20/executive-order-on-climate-related-financial-risk/>.

HMA grant programs.²⁶⁴ Unfortunately, the nation lost about four years in achieving higher resiliency. This episode also highlights how politically fraught the topic of climate change and increased flooding is with little assurance that the standard will survive future administrations.

E. CONCLUSION

The problems encountered by a large and growing metropolis like Houston are not unique. As examined in this chapter, besides a large proportion of housing stock subject to repetitive flood losses, Houston is strategically important for other reasons such as its port and its centrality in the nation's oil and gas industry. Tempting as it may be to envision large barriers that can resist the rising seas, such schemes are exorbitantly expensive and take a long time to design, permit, bid and build. Projects such as the "Ike-Dike" even if funded, raise two questions: a.) given the accelerating frequency and severity of hurricanes due to climate change, can we wait this long? b.) at what point is it no longer practical to resist, and does the conversation need to shift to retreat?

Where the four systems discussed in this chapter are significant factors contributing to the problem, it is worth asking, if Houston systematically addressed these, would it have solved the problem of storm surge, coastal flooding, and repetitive losses? Indeed, any of these factors, actuarially sound flood insurance policies, better maps, good floodplain management, and the latest building codes, will help mitigate future catastrophe. If meteorological predictions about the frequency of extreme precipitation events are correct, all our mitigation measures, rigorously applied, will not be enough to deal with climate change. They may only delay the inevitable, and the United States may need to consider strategic retreat as a serious option.

²⁶⁴ Federal Emergency Management Agency, "Partial Implementation of the Federal Flood Risk Management Standard for Hazard Mitigation Assistance Programs (Interim)" (Washington, DC: Federal Emergency Management Agency, 2021), https://www.fema.gov/sites/default/files/documents/fema_policy-fp-206-21-0003-partial-mplementation-ffrms-hma-programs-interim.pdf.

IV. CONSIDERATIONS OF STRATEGIC RETREAT

Some of them over half a century old, systems in place are inadequate to handle current and projected scenarios of a warming world and rising seas. This chapter examines the arguments for and against strategic retreat as a strategy for managing the impacts of climate change. The most significant barrier to strategic retreat may be the lack of a systematic framework. Under which circumstances should the U.S. government pursue strategic retreat? How do communities deal with declining or disappearing property tax revenues? Lastly, how does any buyout program ensure that any strategic retreat program does not disproportionately affect communities of color and lower-income populations? In other words, which mechanisms can governments establish to carry out a strategic retreat program fairly and equitably?

This chapter considers some of the criteria for communities planning strategic retreat. It outlines some instruments available to communities and some potential pitfalls to avoid. Lastly, the chapter analyzes criteria for areas that may be candidates for retreat. Risk-informed decision-making dictates that areas with the greatest vulnerability would be the most suitable for strategic retreat, making a common and shared understanding of high-risk areas necessary. However, risk is rarely static, involves residual risk, and rapidly changing climate conditions includes many future uncertainties in decisions of strategic retreat.

A. BENEFITS OF WORKING WITH NATURE

Given future climate change risks, an emerging school of thought suggests specific measures to curb risks. According to authors Kulp and Strauss, a 2019 report projects that the number of people forced to move because of sea-level rise may be in the hundreds of millions and possibly 300 million by 2050, essentially tripling the number of people globally vulnerable to sea-level rise and global flooding.²⁶⁵ The evidence suggests that traditional methods of mitigating at-risk properties may not be adequate, and different

²⁶⁵ Kulp and Strauss, “New Elevation Data Triple Estimates.”

solutions may be necessary. These dire predictions have also intensified the debate among those who advocate a position of *resisting*—building better defenses to keep nature at bay—and those who support *retreating*.

The Dutch—long accustomed to regular flooding as more than a third of their country lies below sea level—have invested heavily in a system of ambitious mechanically operated gates and sea walls to keep the water at bay.²⁶⁶ Indeed, such “gray” infrastructure projects may be appropriate in some areas. The decades-long Delta Works project culminated in 1997 with a massive storm surge barrier protecting the city and port of Rotterdam from flooding. Extreme flooding in the 1990s due to climate change and sea-level rise led to mass evacuations, and water managers in the Netherlands saw the limitations of gray engineering.²⁶⁷

One of the drawbacks of draining the land is that peat and clay soils contract. Land subsidence makes it susceptible to even more flooding, perpetuating the vicious cycle. Taking a step back from building more walls and dikes, in 2007 the Dutch undertook a massive Room for the River program.²⁶⁸ The fundamental concept of this program was the idea that instead of keeping water out and fighting nature, it may be more appropriate to work with nature and accommodate periodic flooding. Removing several dikes and obstructions and widening and broadening several flood channels and floodplains helped the program.²⁶⁹ The Dutch largely went unscathed and suffered no fatalities from the deadly floods in 2021, killing 220 in Germany and Belgium. Experts attributed the Dutch success to employing nature to divert water to traditional floodplains and letting them periodically flood instead of building larger defenses.²⁷⁰

²⁶⁶ Deltawerken, “The Delta Works.”

²⁶⁷ K. Jan Oosthoek, “Dutch River Defences in Historical Perspective,” *Environmental History Resources*, January 21, 2006, <https://www.eh-resources.org/dutch-river-defences-in-historical-perspective/>.

²⁶⁸ “Room for the River Programme,” *Integrated Water Management*, April 15, 2019, <https://www.dutchwatersector.com/news/room-for-the-river-programme>.

²⁶⁹ Chris Lovenko, “Dutch Masters: The Netherlands Exports Flood-Control Expertise,” *Earth: The Science behind the Headlines*, August 31, 2018, <https://www.earthmagazine.org/article/dutch-masters-netherlands-exports-flood-control-expertise>.

²⁷⁰ Thomas Erdbrink, “To Avoid River Flooding, Go with the Flow, the Dutch Say,” *New York Times*, September 7, 2021, <https://www.nytimes.com/2021/09/07/world/europe/dutch-rivers-flood-control.html>.

The idea of working with nature rather than in opposition to it has been gaining currency in the last decade with the promotion of green infrastructure. In 2014 the United Nations, in partnership with The Nature Conservancy and others, published its *Green Infrastructure Guide for Water Management*.²⁷¹ In 2019, the U.S. Army Corps of Engineers published its *Engineering with Nature Atlas*.²⁷² The Environmental Protection Agency actively promotes green infrastructure benefits.²⁷³ FEMA encourages local communities to employ nature-based solutions.²⁷⁴

In brief, such gray infrastructure as seawalls and hard barriers to block waves and storm surges have severe limitations. They are expensive to build and maintain, and these structures have the unintended consequences of magnifying waves rather than dampening them and causing long-term environmental problems. In the case of New Orleans, the Army Corps of Engineers admitted that it had not adequately accounted for land subsidence and sea-level rise.²⁷⁵ Such elements as oyster beds, wetlands, sand bars, reefs, dunes, and other natural barriers would more effectively counter storm surges and the devastating impact of hurricanes.²⁷⁶

In contrast to gray infrastructure, green infrastructure uses natural processes or artificial systems that mimic nature. The incorporation of green infrastructure serves to improve the overall quality of the environment and at the same time offer other social and

²⁷¹ Maija Bertul et al., *Green Infrastructure Guide for Water Management* (Nairobi, Kenya: United Nations Environment Programme, 2014), <https://wedocs.unep.org/bitstream/handle/20.500.11822/9291/-Green%20infrastructure%3a%20guide%20for%20water%20management%20%20-2014unep-dhigroup-green-infrastructure-guide-en.pdf?sequence=3&isAllowed=y>.

²⁷² “What Is Engineering with Nature?,” *Engineering with Nature*, accessed September 7, 2021, <https://ewn.ercd.dren.mil/>.

²⁷³ “Green Infrastructure,” Environmental Protection Agency, November 4, 2021, <https://www.epa.gov/green-infrastructure>.

²⁷⁴ Federal Emergency Management Agency, *Building Community Resilience with Nature-Based Solutions: A Guide for Local Communities* (Washington, DC: Federal Emergency Management Agency, 2021), https://www.fema.gov/sites/default/files/documents/fema_riskmap-nature-based-solutions-guide_2021.pdf.

²⁷⁵ Thomas Frank, “After a \$14-Billion Upgrade, New Orleans’ Levees Are Sinking,” *Scientific American*, April 11, 2019, <https://www.scientificamerican.com/article/after-a-14-billion-upgrade-new-orleans-levees-are-sinking/>.

²⁷⁶ “Living Shorelines Project Map,” NOAA Habitat Blueprint, accessed September 7, 2021, <https://www.habitatblueprint.noaa.gov/living-shorelines/project-map/>.

ecological benefits. Two critical concepts behind green infrastructure are their interconnectivity and their multifunctionality. In other words, using natural elements, trees, plants, wetlands, etc., along the bank of a river helps stabilize the bank, is self-sustaining, and provides a natural habitat to fish and wildlife. Raingardens, green roofs, permeable pavements, and other green technologies offer multiple benefits. On a larger scale, mangroves, due to their tangled root systems, are shown to protect coastlines from erosion, filter pollutants, and serve as valuable nurseries for fish.²⁷⁷ Loss of mangrove forests due to coastal development has led to increased coastal flooding and storm surge.²⁷⁸ Recognizing the value of mangroves to reverse trends, such countries as Vietnam, the Philippines, and Guyana have restored about a quarter-million acres of mangroves in the past decade.²⁷⁹

A 2015 paper published in the *International Journal of Water Governance* highlights how deltas worldwide were using green infrastructure or nature-based solutions to deal with flooding.²⁸⁰ The authors report a significant shift in the lexicon where the profession used terms like flood defense only a few decades ago rather than flood risk management. This difference in thinking and vocabulary is a meaningful change as the emphasis has shifted from such “hard” engineering defense as dikes to softer “nature-based solutions.”²⁸¹ The shift from “flood defense” to “flood risk” also leads to the realization that there is always a residual risk and that fail-free defense is impossible. Adaptive strategies for flood risk management are “based on the recognition that risks cannot be

²⁷⁷ “Importance of Mangroves,” Florida Museum, October 3, 2018, <https://www.floridamuseum.ufl.edu/southflorida/habitats/mangroves/importance-mangroves/>.

²⁷⁸ Pelayo Menéndez et al., “The Global Flood Protection Benefits of Mangroves,” *Scientific Reports* 10, no. 1 (2020): 1–11, <https://doi.org/10.1038/s41598-020-61136-6>.

²⁷⁹ Channing Sargent, “Mangroves and the Cost of Flooding,” *One Earth*, November 10, 2021, <https://www.oneearth.org/mangroves-and-the-cost-of-flooding>.

²⁸⁰ Anna Wesselink et al., “Trends in Flood Risk Management in Deltas around the World: Are We Going ‘Soft’?,” *International Journal of Water Governance* 3, no. 4 (December 2015): 25–46, <https://journals.open.tudelft.nl/ijwg/article/view/5858>.

²⁸¹ “Nature-Based Solutions,” Commission on Ecosystem Management, September 27, 2016, <https://www.iucn.org/commissions/commission-ecosystem-management/our-work/nature-based-solutions>.

removed entirely but only partially and often at the expense of other societal goals.”²⁸² FEMA has also shifted to a flood risk management posture rather than a flood control position.²⁸³

A better understanding of risk and greater acknowledgement of residual risk has also led to the realization that it may be more prudent for the earth to flood periodically rather than seek to control floods. This has also led to a greater adoption and acceptance of nature-based solutions. In a 2020 paper, Robinson et al. claim that cities like New Orleans and Miami have heightened vulnerability in the eastern United States, with their high population, shallower coasts, and densities.²⁸⁴ Retreat from high-risk regions may be the only realistic solution.

B. EMINENT DOMAIN AND OTHER BUYOUT MECHANISMS

New issues arise if communities are to accomplish strategic retreat through mandatory purchase or eminent domain. According to the IPCC, areas that undertake strategic retreat through eminent domain, the change could be transformational for society, the economy, and ecology.²⁸⁵ As most property along the coastal United States is privately owned, using eminent domain authority for strategic retreat poses significant challenges. Buyout is the commonest adaptation mechanism to achieve strategic retreat. However, as this thesis has already shown, voluntary programs take a long time, and “checker-boarding” may not change the risk profile of a community. Buyouts through eminent domain pose their own set of challenges. The topic of eminent domain concerns the proper relationship between the individual and the state. Eminent domain (or the takings) clause of the U.S. Constitution, through the Fifth Amendment, provides this condition: “Nor shall private property be taken for public use without just compensation.”²⁸⁶ A guarantee of just

²⁸² Paul Sayers et al., “Flood Risk Management: A Strategic Approach” (Paris: UNESCO, 2012), 9, <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.703.5911&rep=rep1&type=pdf>.

²⁸³ Sayers et al., “Flood Risk Management.”

²⁸⁴ Robinson, Dilkina, and Moreno-Cruz, “Modeling Migration Patterns in the USA,” 11.

²⁸⁵ Dokken, “Summary for Policymakers.”

²⁸⁶ U.S. Const. amend. V.

compensation must follow when the government deprives a private owner of possession of his assets. “Just compensation” at a minimum means fair market value, and unless it is for public use, confiscating property should be prohibited. Buyouts of hazardous properties requires a process that awards some compensation to property holders, complicating the strategic retreat process.

Purchasing properties through eminent domain carries risk and opposition. Literature on both sides argues the inevitability and the impossibility of carrying out such a process. Harris, for example, contends that disadvantaged populations bear the biggest brunt of eminent domain without realizing its benefits.²⁸⁷ The U.S. government is no stranger to eminent domain, advocating that it may be necessary at times in the interest of the larger public good with the proviso that the government justly compensates the owner. The Department of Justice has opined, “whenever the United States acquires a property through eminent domain, it has a constitutional responsibility to justly compensate the property owner for the fair market value of the property.”²⁸⁸ Traditionally, eminent domain has been used to build transportation and other infrastructures—water supply or electric easements or maintain navigable waterways. Eminent domain has been used by the federal government to build transportation and infrastructure and even to establish parks for areas of historical interest such as Gettysburg as far back as 1896 when the government preserved the battlefield from development.²⁸⁹ In this way eminent domain has been used by the government for public use and the larger public good.

The definitions of “public good” and “public use” are broad. The Supreme Court has upheld that eminent domain acquisition of land and property need not just be for government or public use.²⁹⁰ In 2005, the Court ruled in favor of the City of New London,

²⁸⁷ Harris, “Because We Can Doesn’t Mean We Should.”

²⁸⁸ “History of the Federal Use of Eminent Domain,” Environment and Natural Resources Division, May 15, 2015, <https://www.justice.gov/enrd/history-federal-use-eminent-domain>.

²⁸⁹ *United States v. Gettysburg Elec. Ry. Co.*, 160 U.S. 668 (1896).

²⁹⁰ “*Kelo v. City of New London* [Summary],” Philadelphia Bar Association, June 23, 2005, <https://www.philadelphiabar.org/page/SupCourtDecKelovCityNewLondon?appNum=2>.

Connecticut, where private homes were acquired and turned over to a private developer.²⁹¹ The courts argued that the properties were vital for the economic revitalization of the city's waterfront. In this instance, the courts defined public good as bringing jobs to the area to benefit the public.²⁹² The case of New London highlighted another crucial distinction: cities are not necessarily bound by federal definitions as cities are functions of the state and local government, with sovereign rights and their eminent domain powers. The Court ruled in favor of affording states broad latitude in determining what public needs justified the use of the eminent domain, stating, "the court must look to the entire Plan's importance and the City's overall interest in the economic benefits derived from the development."²⁹³ The case also recognized that the needs of society varies significantly and emphasized state legislatures' and state courts' roles in determining local public needs.²⁹⁴ The Court's decision was a split one, and the decision was controversial, as most eminent domain cases are.²⁹⁵ Therefore, "public use" and "public good" can be a much contested issue that affects how governments can enforce eminent domain in strategic retreat.

To provide some uniform standards, the federal government in 1970 passed the Uniform Relocation Assistance and Real Property Acquisition Act (URA). The act aimed to ensure fair treatment of peoples displaced and sought "to provide uniform, fair and equitable treatment of persons whose real property is acquired or who are displaced in connection with federally funded projects."²⁹⁶ The U.S. Department of Housing and Urban Development spells out its rights, duties, and obligations when a property is acquired and

²⁹¹ John Rappa, "Kelo v. City of New London," OLR Research Report, July 26, 2005, <https://www.cga.ct.gov/2005/rpt/2005-r-0560.htm>.

²⁹² "The Government's Power of Eminent Domain to Condemn Private Property," Lawshelf Educational Media, accessed October 22, 2021, <https://lawshelf.com/shortvideoscontentview/the-governments-power-of-eminent-domain-to-condemn-private-property/>.

²⁹³ Todd Berman, "Kelo v. City of New London," *Case Briefs* (blog), accessed October 22, 2021, <https://www.casebriefs.com/blog/law/property/property-law-keyed-to-dukeminier/eminent-domain-and-the-problem-of-regulatory-takings/kelo-v-city-of-new-london/>.

²⁹⁴ *Kelo v. New London*, 268 Conn. 1, 843 A. 2d 500 (2005).

²⁹⁵ Trevor Burrus and Sam Spiegelman, "Will the Supreme Court Overturn the Infamous Takings Decision of Kelo v. City of New London?," *Cato at Liberty* (blog), April 16, 2021, <https://www.cato.org/blog/will-supreme-court-overturn-infamous-takings-decision-ke-lo-v-city-new-london>.

²⁹⁶ "Real Estate Acquisition and Relocation Overview in HUD Programs," HUD Exchange, accessed October 22, 2021, <https://www.hudexchange.info/programs/relocation/overview>.

clearly distinguishes voluntary and involuntary acquisition (or condemnation).²⁹⁷ HUD works closely with the Federal Highway Administration (FHWA), designated as the lead federal agency for the URA.²⁹⁸ FHWA cautions that “condemnation is usually not used until all attempts to reach a mutually satisfactory agreement through negotiations have failed.”²⁹⁹

The use of an eminent domain is generally considered too blunt an instrument to acquire residential properties and forcibly evict people from their homes. Condemning properties risk unfair treatment of populations of color and the poor.³⁰⁰ That the government may unfairly target some people was the conclusion of a briefing before the Civil Rights Commission in Washington, D.C., in 2014. The commission summarized that the term “urban renewal” often meant “Negro removal,” and too often, areas were declared “blighted” and hence in need of redevelopment.³⁰¹ In the name of progress, owners seldom received just compensation as may have occurred in the 1940s in Southside Chicago and 2008 in Montgomery, Alabama.³⁰² According to a 2007 Institute for Justice study between 1949 and 1973, “2,532 projects in 992 cities displaced a million people, two-thirds African American.”³⁰³ The report goes on to state that blacks were “five times more likely to be displaced than they should have been given their numbers in the population.”³⁰⁴ Eminent

²⁹⁷ Department of Housing and Urban Development, *Tenant Assistance, Relocation and Real Property Acquisition*, CPD Handbook 1378.0 (Washington, DC: Department of Housing and Urban Development, 2019), 5–2, 5–5, https://www.hud.gov/program_offices/administration/hudclips/handbooks/cpd/13780.

²⁹⁸ Federal Highway Administration, “Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Uniform Act),” Office of Planning, Environment, & Realty (HEP), February 27, 2020, https://www.fhwa.dot.gov/real_estate/uniform_act/.

²⁹⁹ Federal Highway Administration, *Acquisition: Acquiring Real Property for Federal and Federal-Aid Programs and Projects*, FHWA-HEP-19-010 (Washington, DC: Department of Transportation, 2018), 4, https://www.fhwa.dot.gov/real_estate/uniform_act/acquisition/real_property.cfm.

³⁰⁰ U.S. Commission on Civil Rights, *The Civil Rights Implications of Eminent Domain Abuse* (Washington, DC: U.S. Commission on Civil Rights, 2014), 51, https://www.usccr.gov/files/pubs/docs/FINAL_FY14_Eminent-Domain-Report.pdf.

³⁰¹ U.S. Commission on Civil Rights, 43.

³⁰² U.S. Commission on Civil Rights, iii.

³⁰³ U.S. Commission on Civil Rights, 7.

³⁰⁴ Mindy Thompson Fullilove, *Eminent Domain & African Americans: What Is the Price of the Commons?* (Arlington, VA: Institute for Justice, 2015), 2, <https://ij.org/report/eminent-domain-african-americans/>.

domain has great potential to be misused and if economic development is an argument advanced by governments, the question is who does economic development benefit and who does it disadvantage?

The federal government often has used the “public good” argument and purchased properties to build roads and bridges. Whether governments can use the same idea to buy properties for strategic retreat is a different matter. If communities pursue strategic retreat as a tactic for urban renewal schemes or removal of urban blight, the outcome would be poor, especially as it could lead to greater inequities. Courts have argued that the federal government can use its eminent domain authorities for environmental conservation purposes.³⁰⁵ Establishing parks, protecting forests, preserving historically valuable sites, protecting environmentally sensitive areas, and “setting aside open space for future generations qualifies as public use.”³⁰⁶ Use by the larger public with equitable and fair access, in these cases, equates to the public good.

Ensuring public safety is a key element of government. If protecting its people from climate change, such as rising seas, is a consideration government may be justified in implementing strategic retreat and in some instances using its powers of eminent domain to do so. In 2012, authors Kim and Karp set forth a series of arguments for managing strategic retreat options based on regulatory and market-based options in the state of Connecticut.³⁰⁷ The authors recognize that the challenges facing Connecticut and other similar coastal states are at least two-fold: to reduce risk to people, property, and critical ecosystems and to effectively manage or prevent new development in high-risk areas.³⁰⁸

³⁰⁵ Maye C. Emlein, “Rising to the Challenge: Managed Retreat and the Taking Clause in Maine’s Climate Change Era,” *Maine Law Review* 73, no. 1 (2021): 169–214, <https://digitalcommons.maine.gov/mlr/vol73/iss1/6>.

³⁰⁶ Department of Justice, “History of the Federal Use of Eminent Domain.”

³⁰⁷ Hyo Kim and Caroline A. Karp, “When Retreat Is the Better Part of Valor: A Legal Analysis of Strategies to Motivate Retreat from the Shore,” *Sea Grant Law and Policy Journal* 5, no. 1 (2012): 169–209, <https://nsglc.olemiss.edu/sglpj/vol5No1/Kim.pdf>.

³⁰⁸ Kim and Karp, 172.

According to Kim and Karp, federal, state, and local governments have the legal authority to address climate-related impacts on the coast if there is a threat to human security.³⁰⁹

The constitution grants the federal government the ability to act preemptively to protect its citizenry and assets to “insure domestic tranquility, provide for the common defense, promote general welfare.”³¹⁰ Article 1, Section 8 assigns Congress the authority to regulate commerce, and the reference includes the power to regulate navigable waters.³¹¹ The Rivers and Harbors Act regulates watershed development and provides flood protection.³¹² The government already exercises its authority in matters small and large to regulate waterways, coastal development, and protect its citizens. That it may do so to protect against future climate risk is justifiable.

The federal government has wide powers that affect land-use and development, especially along its coasts. A 2021 CRS report on U.S. climate change policy examines dozens of legislative proposals and executive orders on adapting and mitigating the impacts of climate change at the federal level.³¹³ Among them are FEMA through NEPA enforcement; the White House Council on Environmental Quality (CEQ); EPA’s Climate-Ready Estuaries and Water Utilities Initiative; and the DHS, which has primary responsibility for the nation’s vulnerability climate-related risk. These all indicate that the federal government has broad legal authority when dealing with coastal adaptation and preparing for and dealing with the consequences of climate change.³¹⁴ Even the U.S. Fish and Wildlife Service, through the Coastal Barrier Resources Act (CBRA) of 1982 (and subsequent amendments), “encourages the conservation of hurricane-prone, biologically

³⁰⁹ Kim and Karp, 188.

³¹⁰ U.S. Constitution: Preamble, accessed December 3, 2021, <https://www.uscourts.gov/about-federal-courts/educational-resources/about-educational-outreach/activity-resources/us>.

³¹¹ “Navigation and Navigable Waters,” *U.S. Code* 33, accessed December 29, 2021, <https://www.govinfo.gov/content/pkg/USCODE-2018-title33/html/USCODE-2018-title33.htm>

³¹² The Rivers and Harbors Act, *U.S. Code* 33 (2010) 401 et seq., <https://www.govinfo.gov/content/pkg/USCODE-2010-title33/pdf/USCODE-2010-title33-chap9-subchapI.pdf>

³¹³ Kate C. Shouse, *U.S. Climate Change Policy*, CRS Report No. R46947 (Washington, DC: Congressional Research Service, 2021), <https://crsreports.congress.gov/product/pdf/R/R46947>.

³¹⁴ Shouse, 33–42 Appendices list Legislative and Executive Actions dealing with climate change at the federal level.

rich coastal barriers by restricting federal expenditures that encourage development.”³¹⁵ These measures, many decades old, have shaped and limited development along the nation’s coasts and floodplains. There is some urgency to the issue that the federal government assumes leadership in guiding the nation’s climate policy in an age of climate change.

States and local governments likewise play a role in guiding coastal development. Through the Tenth Amendment, states have the extensive legal authority to protect their citizens’ public health, safety, and welfare.³¹⁶ Several coastal states also have broad common law authority to protect their citizens’ access to water, lands, and natural resources through the public trust doctrine.³¹⁷ Most states also have Coastal Management Acts that guide development along the shorelines. The state uses this authority to perform beach nourishment and rebuild lost shorelines; according to a unanimous Florida court 2010 decision, such activity does not constitute an invasion of property rights.³¹⁸ Ultimately, cities and towns retain primary responsibility for land use. However, in Connecticut and other coastal states, land-use decisions in coastal and riparian floodplains are cooperative.

Kim and Karp recognize that lacking a consistent national policy regarding the sea-level rise and climate change, states and locals are often left with the following choices: (1) do nothing, (2) protect high-risk areas through armoring, (3) provide incentives to retreat, or (4) prohibit redevelopment. The laissez-faire option usually defaults to coercive regulatory efforts. They are seldom widespread and may be increasingly expensive and untenable with rising sea levels and climate change. According to a New York state task force on sea-level rise, the NFIP, by offering relatively inexpensive insurance and poor enforcement of floodplain management standards in NFIP participating communities,

³¹⁵ “CBRA Legislation and Testimony,” Coastal Barrier Resources System, July 2, 2021, <https://www.fws.gov/cbra/Legislation.html>.

³¹⁶ U.S. Constitution, Amendment X. Rights Reserved to the States and to the People,” <https://www.law.cornell.edu/constitution-conan/amendment-10>.

³¹⁷ “History and Legal Precedents,” NJ Public Access Rights, January 13, 2021, <https://www.nj.gov/dep/cmp/access/njparightslegal.htm>.

³¹⁸ *Stop the Beach Renourishment, Inc. v. Florida Department of Environmental Protection et al.*, U.S. slip opinion 08-1151 46 (2010). <https://www.supremecourt.gov/opinions/09pdf/08-1151.pdf>

continues to “distort market-forces and favor coastal development,”³¹⁹ a topic explored earlier in the thesis with the perverse incentives and moral hazards the NFIP presents.

State and local governments cite public health risks because of failed or exposed septic systems or biological or chemical contamination and act preemptively. They can condemn property and prevent rebuilding or further development along with high-risk coastal areas, but as noted earlier, such options are rarely popular. Another approach may be to let regulatory and market-based strategies dictate individual choices. Market strategies could include full disclosure of flood, inundation, and storm damage at point-of-sale. Fully one third of states have no legal requirement to disclose flood damage at the sale of a house nor notify a home buyer of flood risk.³²⁰ Regulatory mechanisms such as mandatory setbacks, mandatory insurance, and risk-based special tax assessments may inhibit further development. An aggressive communication strategy about climate change and future risks from rising seas would also aid people in making informed decisions.

As threats increase over the coming decades, governments are likely to provide deterrents to rebuild coastal areas and offer incentives to retreat. To purchase high-risk properties through eminent domain and in the public interest is a legal option that may be politically difficult to pursue. Governments can motivate strategic retreat through market-based and communication techniques, but they can also regulate and limit development in coastal areas. If condemnation and purchase through eminent domain are politically untenable, the state could condemn property and take the title in the public interest to protect public health and safety. In turn, they could lease the property back to the current homeowners until such a time that it is uninhabitable due to catastrophic damages or

³¹⁹ New York State Sea Level Rise Task Force, *New York State Sea Level Rise Task Force: Report to the Legislature* (New York: New York State Sea Level Rise Task Force, 2010), 43, <https://research.fit.edu/media/site-specific/researchfitedu/coast-climate-adaptation-library/united-states/east-coast/new-york/NYSSLRT.--2010.--New-York-State-SLR-Report.pdf>.

³²⁰ Steve Bohnstedt and Quincy Herald Whig, “How States Stack Up on Flood Disclosure,” Natural Resources Defense Council, accessed November 6, 2021, <https://www.nrdc.org/flood-disclosure-map>.

changes in the shoreline. Such a scheme has been implemented successfully in coastal Maine.³²¹

Buyouts and the use of eminent domain may be the only realistic solution in high risk, coastal communities, subject to repeated threats. In high-risk areas of the United States, from the Florida Keys to the Jersey shore, the Corps has made all buyouts mandatory.³²² In 2015, the U.S. Army Corps of Engineers concluded that it could not simply rely on voluntary acquisitions in its programs. The Corps Planning Bulletin 2016–01 clearly states,

A 100-percent voluntary participation plan for acquisition, relocation, permanent evacuation is not considered a complete plan and is not acceptable for USACE participation. All future acquisition, relocation, and permanent evacuation recommendations for USACE participation must include the option to use eminent domain, where warranted.³²³

But local officials may not have the political will to enforce mandatory buyouts. Elected officials in most places have balked at the notion of forcibly evicting residents.³²⁴ The City of Nashville, TN, which initially agreed to the Corps conditions of buyout, is finding it hard to meet its commitment to acquire properties through eminent domain.³²⁵ Currently, Nashville is running the program voluntarily, but with the caveat that if a homeowner declines, there is no guarantee there would be funding available in the future.

³²¹ Barbara A. Vestal et al., *Anticipatory Planning for Sea-Level Rise Along the Coast of Maine*, EPA-230-R-95-900 (Washington, DC: Environmental Protection Agency, 1995), http://papers.risingsea.net/federal_reports/maine_0.pdf.

³²² Wetlands Watch, “US Army Corps of Engineering Money Comes with a Condemnation Kicker,” *Director’s Blog* (blog), March 22, 2020, <https://wetlandswatch.org/directors-blog/2020/3/16/us-army-corps-of-engineering-money-comes-with-a-condemnation-kicker>.

³²³ US Army Corps of Engineers, “Clarification of Existing Policy for USACE Participation in Nonstructural Flood Risk Management and Coastal Storm Damage Reduction Measures,” *USACE Planning Bulletin*, no. PB 2016-01 (December 22, 2015): 2, https://planning.erdc.dren.mil/toolbox/library/pb/PB2016_01.pdf.

³²⁴ Christopher Flavelle, “Trump Administration Presses Cities to Evict Homeowners from Flood Zones,” *New York Times*, March 11, 2020, <https://www.nytimes.com/2020/03/11/climate/government-land- eviction-floods.html>.

³²⁵ Mike Reicher, “Nashville Makes Push to Buy Flooded Homes and Replace with Open Space,” *The Tennessean*, September 9, 2017, <https://www.tennessean.com/story/news/2017/09/08/nashville-makes-push-buy-flooded-homes-and-replace-open-space/645566001/>.

After the 2017 hurricanes—which included major storms Harvey, Irma, and Maria—in 2018, Congress asked the Corps to study flood control measures in 30 cities throughout the United States.³²⁶ In Miami, to build its flood walls and barriers (Figure 15), the Corps may buy out more than 350 properties, including several multi-unit condos through eminent domain. In addition, the Corps would need to elevate 10,000 homes and floodproof an additional 7,000.³²⁷ This ambitious project requires voluntary and mandatory participation from several entities, private and public, to succeed. The U.S. Army Corp needs some guarantees that it can be assured of property buyouts, using eminent domain if and where necessary, before it can undertake design and permitting this large project.

³²⁶ US Army Corps of Engineers, “BiPartisan Budget Act of 2018 (Public Law 115-123): Long-Term Disaster Recovery Investment Plan (LDRIP)” (Washington, DC: US Army Corps of Engineers, November 5, 2019), <https://usace.contentdm.oclc.org/utis/getfile/collection/p16021coll5/id/35498>.

³²⁷ Alex Harris, “Feds Consider a Plan to Protect Miami-Dade from Storm Surge: 10-Foot Walls by the Coast,” *Miami Herald*, February 7, 2020, <https://www.miamiherald.com/news/business/real-estate-news/article239967808.html>.

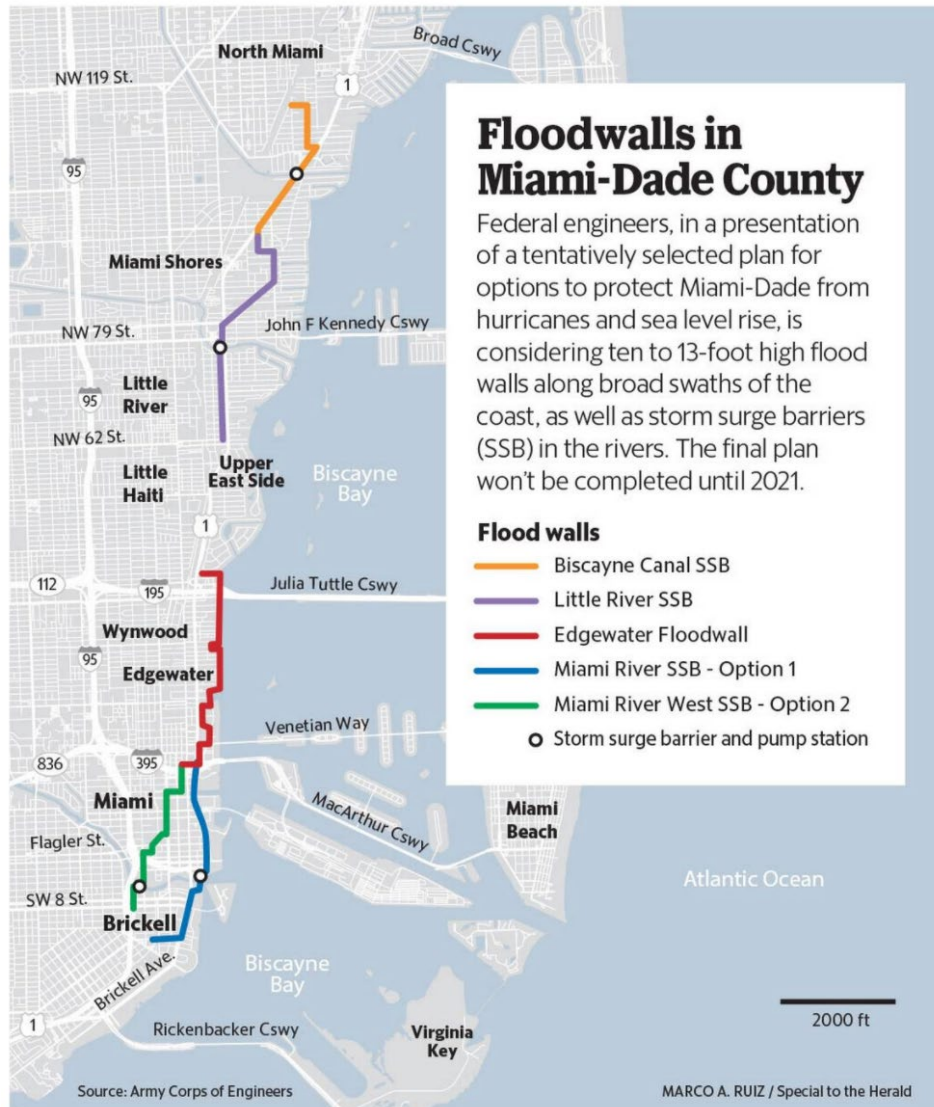


Figure 15. USACE Schematic Proposal of Floodwalls and Storm Surge Barriers in Miami-Dade County.³²⁸

The Corps explained that without eminent domain, it could not assure lawmakers that buyouts funded by Congress would happen, stating,

In order to have a complete plan, *the ability to use eminent domain must be retained and a condition of an implementable project*. A 100-percent voluntary participation plan for acquisition, relocation, permanent evacuation is not considered a complete plan and is not acceptable for

³²⁸ Source: Harris.

USACE participation. All future acquisition, relocation, and permanent evacuation recommendations for USACE participation must include the option to use eminent domain, where warranted.³²⁹

To be sure, the Corps also acknowledged that it “should require eminent domain only for homes whose flood risk was so severe that their inhabitants were in physical danger.”³³⁰

Eminent domain may be an instrument of last resort. Other policy deterrents and incentives may be available to regulators to discourage development and prevent rebuilding in high-risk areas post-disaster. Unless land loss is so extreme and the risk so extraordinary that the only responsible thing may be to force people to retreat, eminent domain may be only one of several options governments should consider. No option dealing with moving people from their homes and sometimes their ancestral lands is easy. Before a community decides to retreat, they need a shared understanding of what constitutes areas of high risk in the United States.

C. HOW RISK INFORMS STRATEGIC RETREAT

First, if voluntary buyouts are too slow and not comprehensive enough for long-term resiliency, are other mechanisms available to move people out of high-risk areas? Second, how does the United States determine regions of extreme high risk suitable for strategic retreat? Although the primary focus of this thesis is residential structures and home buyouts, the threats posed to infrastructure from climate change are equally significant. Each year, the American Society of Civil Engineers (ASCE) releases an Infrastructure Report Card for the nation’s ports, bridges, roads, and other infrastructure. The United States consistently gets a failing grade.³³¹

According to an October 2021 report, *Infrastructure on the Brink*, published by the First Street Foundation, roughly 25 percent of U.S. infrastructure, as depicted in the map

³²⁹ US Army Corps of Engineers, “Clarification of Existing Policy,” 2. Emphasis by author.

³³⁰ Flavelle, “Trump Administration Presses Cities to Evict Homeowners from Flood Zones.”

³³¹ “Making the Grade,” ASCE’s 2021 Infrastructure Report Card, October 27, 2016, <https://infrastructurereportcard.org/making-the-grade/>.

below (Figure 16), is at risk of becoming inoperable due to flood risk. Predictably, the risk is highest along the coasts—but is not limited to the coasts alone.

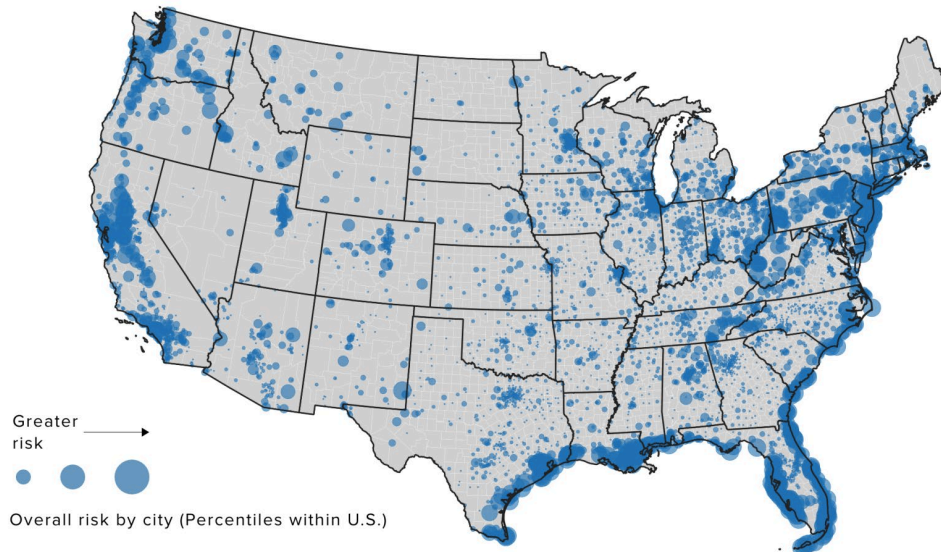


Figure 16. U.S. Infrastructure at Risk of Becoming Inoperable Due to Flooding.³³²

The foundation determined that 36,000 facilities, nearly a quarter of all critical infrastructure is at risk of becoming inoperable due to flooding. This is in addition to nearly a quarter of all roads that would be rendered unpassable besides the 14 percent of homes that would be flooded. For years, experts have argued that the 100-year (or 1 percent annual) flood standard used to protect a single-family home cannot be the same for a critical infrastructure facility.³³³ The American Society of Floodplain Managers (ASFPM) agrees: “We’ve all seen the trends over the last several decades, where average annual flood losses have increased fourfold from \$4 billion annually in the 1980s to nearly \$17 billion annually by 2018. Extreme flooding events from over the last three years have only accelerated that

³³² Source: First Street Foundation, *The 3rd National Risk Assessment*, 12.

³³³ Bruce Julian, “NRCS Perspectives on the 100-Year Flood Standard,” in *Reducing Flood Losses: Is the 1% Chance (100-Year) Flood Standard Sufficient* (Washington, DC: National Academies Keck Center, 2004), 71, https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/16/nrcs143_009401.pdf.

trend.”³³⁴ The fourth National Climate Assessment (NCA) warns that without adaptation, the nation’s infrastructure will continue to degrade for the rest of this century.³³⁵ Cascading effects will “threaten our economy, national security, essential services, and health and well-being.”³³⁶ The failure to anticipate the interconnected impacts of climate change could increase risks across critical sectors.

FEMA’s HMA programs have not typically funded many infrastructure projects (Figure 2). In 2018, FEMA introduced a new hazard mitigation grant program, Building Resilient Infrastructure and Communities (BRIC).³³⁷ The Flood Mitigation Assistance (FMA), with its lower-cost share, remains the best program for home buyouts, but for infrastructure, BRIC may be a better vehicle. As its name suggests, the grant’s primary purpose is to address infrastructure. In passing the law, Congress rightfully recognized that setting aside some money—6 percent—from the disaster relief fund each year and pooled for states, tribes, and territories to compete was one way to address the gap in infrastructure spending. With \$0.5 billion in 2020 and \$1 billion in 2021 appropriated for the program, BRIC does not fill the budget gap to address the nation’s infrastructure needs, but it’s a start.

Although home buyouts are a critical component in initiating strategic retreat, other factors can be weighed. Any proposal that envisions relocating a community must also deal with relocating associated roads, utilities, and support services.³³⁸ Besides dealing with multiple jurisdictions and ownership, according to researchers at the Innovation Network for Communities, costs to relocate infrastructure can be the biggest obstacle to states and

³³⁴ Association of State Floodplain Managers, “Flooding Could Shut Down 25% of Critical Infrastructure, Says Report,” *The Insider*, November 2021, 8, <https://asfpm-library.s3.us-west-2.amazonaws.com/Insider/Insider+-+Nov+2021.pdf>.

³³⁵ US Global Change Research Program, *Fourth National Climate Assessment: Summary of Findings* (Washington, DC: US Global Change Research Program, 2018), 7, https://nca2018.globalchange.gov/downloads/NCA4_Ch01_Summary-Findings.pdf.

³³⁶ US Global Change Research Program, *Fourth National Climate Assessment*, 30.

³³⁷ “Building Resilient Infrastructure and Communities,” FEMA Grants, December 13, 2021, <https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities>.

³³⁸ Georgetown Climate Center, “Managed Retreat Toolkit: Infrastructure - Georgetown Climate Center,” Managed Retreat Toolkit, accessed January 28, 2022, <https://www.georgetownclimate.org/adaptation/toolkits/managed-retreat-toolkit/infrastructure.html?chapter>.

cities.³³⁹ Abandoning infrastructure—in other words failing to provide utilities or maintaining roads for those who refuse to move—may be legally questionable.³⁴⁰ Repairing and upgrading degraded and failing infrastructure in high-risk areas may be unwise as it may not withstand the next storm. Rebuilding it after a disaster in areas of high risk may be even more injudicious, especially as costs associated with even the basic maintenance and upkeep of failing infrastructure are incredibly high.³⁴¹ Considerations of whether to rebuild infrastructure, abandoning it, or relocating it, may be the biggest driver in strategic retreat decisions.

The First Street Foundation in October 2021 released its Third National Risk Assessment.³⁴² According to the study, the highest concentration of community risk (predictably) exists in coastal states like Louisiana and Florida. Six of the top 20 most at-risk counties are in Louisiana including the most at-risk county in the country, Cameron Parish. New Orleans, Miami and Tampa exhibit significant flood risks and half of Houston’s critical infrastructure is vulnerable to flooding. Figure 17, shows the risk by county, with the darker blue shades exhibiting higher risks. The map is an aggregate of risks across the categories of at-risk roads, infrastructure, social infrastructure, commercial and residential structures.

³³⁹ Peter Platrik and John Cleveland, *Can It Happen Here? Improving the Prospect for Managed Retreat by Us Cities* (Tamworth, NH: Innovation Network for Communities, 2019), 35, <https://adaptation.ei.columbia.edu/sites/default/files/content/Managed-Retreat-Report-March-2019.pdf>.

³⁴⁰ Platrik and Cleveland, 35.

³⁴¹ Platrik and Cleveland, 10.

³⁴² First Street Foundation, *The 3rd National Risk Assessment*.

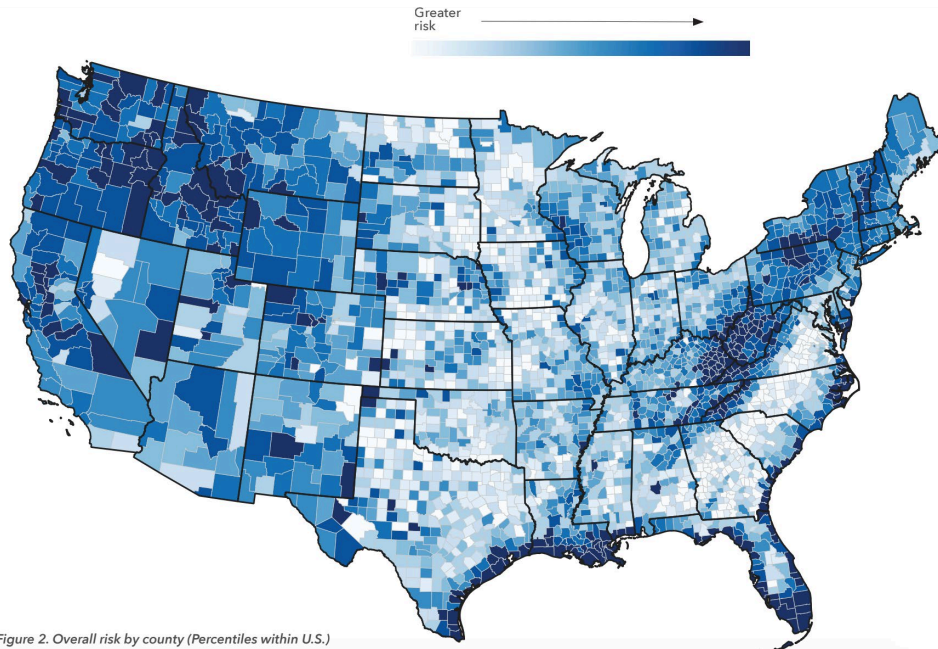


Figure 17. Overall Risk by County³⁴³

³⁴³ Source: First Street Foundation, 9.

Extrapolating risk over the next 30 years, 2021–2051, the areas where climate-related impacts are going down are relatively few, as depicted in beige in Figure 18.

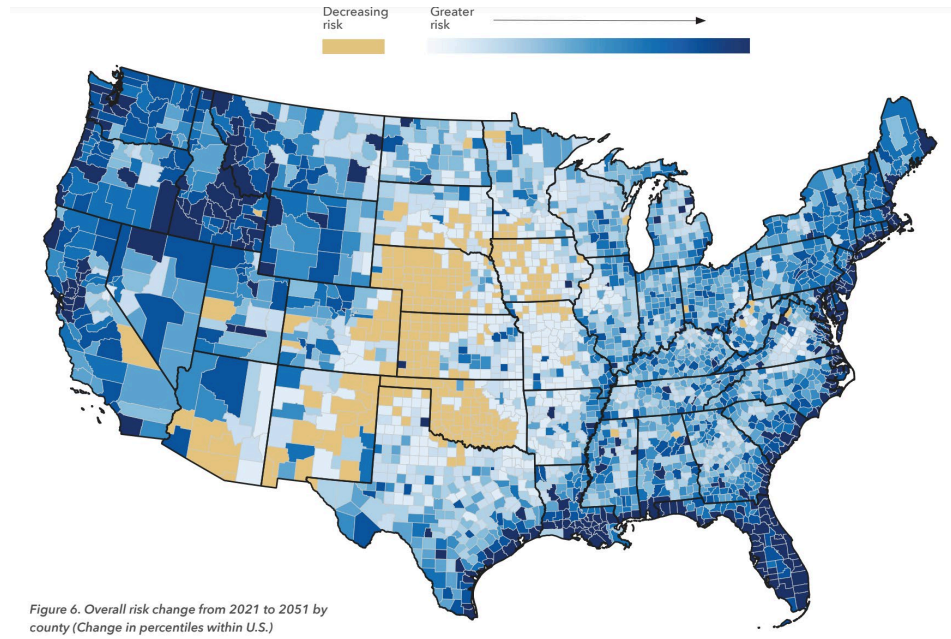


Figure 18. Overall Risk Changes 2021–2051 by County³⁴⁴

Coastal areas, especially along the Gulf and the Atlantic seaboard, show increasing risk. According to the report, rising sea levels, surges, and stronger coastal storm intensities almost entirely drive risks along the coasts. The northwest sees more significant flooding due to higher precipitation, storm runoff, and snowmelt feeding into rivers. The 20 counties at the highest risk with the most change all lie in coastal areas with the top five in Virginia, Louisiana, and Texas, with Norfolk, VA, exhibiting a 22-percent rise in risk over the next 30 years. More than half of Norfolk’s residential properties are at risk. The assessment summarizes that the impacts in some areas of the nation will be devastating with places like Orleans Parish in Louisiana, where nearly 99 percent of roads will be unpassable.

The authors caution that homeowners may be complacent about their risk if their homes do not flood. However, the indirect effects of living in flooded communities may

³⁴⁴ Source: First Street Foundation, 15.

be even more devastating. First Street Foundation cautions: “In fact, road closures, school closures, utility issues, and lack of access to emergency services and hospitals can arguably have more dire consequences than the economic losses that come with floodwaters entering a home.”³⁴⁵ Thus, infrastructure risk becomes relevant post-disaster.

FEMA recently released its National Risk Index (NRI).³⁴⁶ The index covers 18 natural hazards and “visualizes natural hazard risk metrics and includes data about expected annual losses from natural hazards, social vulnerability and community resilience.”³⁴⁷ It offers a comprehensive view of the nation’s most vulnerable areas and provides a resource for areas suitable for retreat. As FEMA’s risk index covers different hazards, including volcanoes, tsunamis, earthquakes, and tornadoes, the risk profile for the country is significantly different than one for floods, hurricanes, and storm surges alone, as seen in Figure 19.

³⁴⁵ First Street Foundation, 17.

³⁴⁶ Federal Emergency Management Agency, “National Risk Index for Natural Hazards.”

³⁴⁷ “National Risk Index for Natural Hazards | FEMA.Gov,” accessed March 11, 2022, <https://www.fema.gov/flood-maps/products-tools/national-risk-index>.

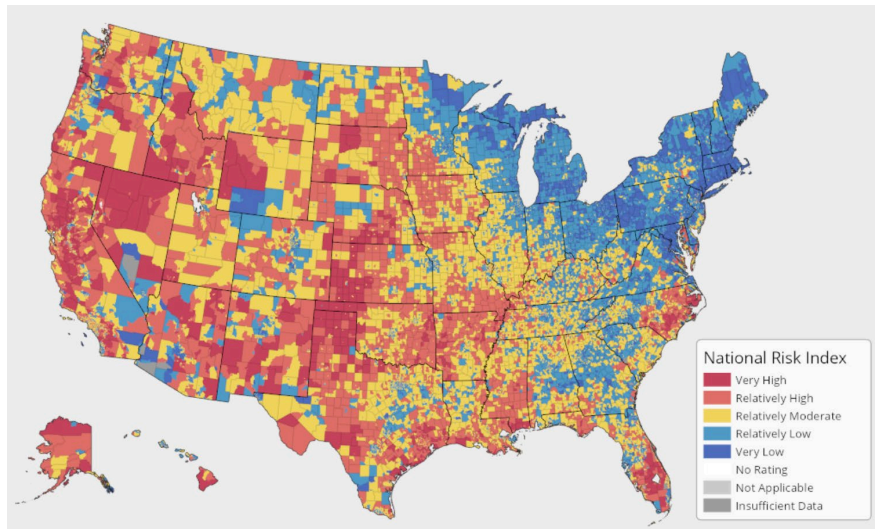


Figure 19. FEMA, National Risk Index for Natural Hazards³⁴⁸

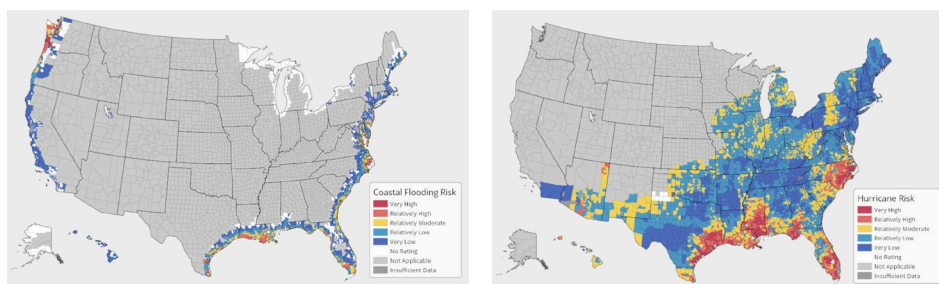


Figure 20. FEMA, National Risk Index for Natural Hazards with Coastal Flooding Risk (left) and Hurricane Risk (right) Layers Isolated³⁴⁹

The NRI also has limited data for climate change and its projected impacts, natural hazards forecasts, or dependencies between interrelated hazard types such as coastal flooding and hurricanes.³⁵⁰ This limitation makes the NRI less useful as a tool in planning for future risk and climate change. When one keeps in mind that flooding risk and risks

³⁴⁸ Source: Department of Homeland Security, “Learn More,” National Risk Index, accessed November 6, 2021, <https://hazards.fema.gov/nri/learn-more>.

³⁴⁹ Adapted from: Federal Emergency Management Agency, “National Risk Index: Interactive Mapping and Data-Based Interface,” National Risk Index, accessed January 23, 2022, <https://hazards.fema.gov/nri/map#>.

³⁵⁰ “Frequently Asked Questions,” National Risk Index, accessed November 6, 2021, <https://hazards.fema.gov/nri/frequently-asked-questions#how-were-natural-hazards-selected-for-the-nri>.

from rising seas and the threat posed to the coasts are among the most prevalent and costliest disasters, the risk maps are significantly different, as seen in Figure 20 above.

FEMA's index accounts for regional variations, and risks are calculated based on a combination of factors. These factors include how often a disaster strikes a particular area, how much property may be damaged, how vulnerable the population is socially, and how resilient it is in terms of its ability to bounce back after a disaster. The formula that calculates risk also may lead to some distorted results: Oklahoma, for example, may be twice as likely to get tornadoes than New York. But, as there are 20 times more people in New York than Oklahoma and 20 times the property value is at risk, New York is ranked higher than Oklahoma for tornado risk. The index finds Los Angeles County as the community with the highest aggregate risk in the nation. Due to the combination of high risk, higher population densities, and property values, parts of New York and Miami make the top-ten riskiest areas in the United States.³⁵¹

People's awareness of risk and, to some extent, their preparedness also factors into the index. Risk perception, and the often-misguided belief that a disaster has struck once before but will not strike again, may explain people's underestimation of flood risk. It may also account for why nationally, only about 5 million people own policies when by FEMA's estimate, the number of people who live in the Special Flood Hazard Area (SFHA) is much higher. Recent research has found that the number of Americans living in the SFHA may be closer to 41 million.³⁵² And this figure does not include how climate change with rising seas and more significant precipitation will worsen the conditions.

Other tools beside the FEMA tool help communities to make better risk-informed decisions. The United Nations Office for Disaster Risk Reduction (UNDRR) has created a Quick Risk Estimation (QRE) tool to identify current and future risks and threats to human and physical assets. The tool considers multiple hazards, including biological and infectious diseases and not just natural climatic hazards and climate change. As the tool

³⁵¹ Ron Brackett, "FEMA Tool Calculates Risk for Every County in the Nation; Los Angeles Is at the Top," The Weather Channel, January 6, 2021, <https://weather.com/news/news/2021-01-04-fema-national-risk-index-riskiest-counties-in-the-us-los-angeles-new-york>.

³⁵² Wing et al., "Estimates of Present and Future Flood Risk."

makes clear, its goal “is not a full-scale risk assessment, rather a multi-stakeholder engagement process to establish a common understanding.”³⁵³ Not necessarily a risk analysis tool, the Georgetown University Climate Center maintains a resource site for managed retreat.³⁵⁴ Besides acquisition tools, the center also provides legal and regulatory opinions on retreat-related topics. These tools serve different needs from legal frameworks, and financing tools to planning guides, but all offer means to manage the retreat process smoothly.

To better serve community resilience, relocation and retreat options, organizations have created tools that guide community leaders through a step-by-step process to navigate the complex strategic retreat process. In partnership with FEMA, the EPA has created a Regional Resilience Toolkit walking users through a five-step, Engage-Assess-Act-Fund-Measure process to build large-scale resilience to natural disasters.³⁵⁵ The goal of the toolkit, according to EPA, is to bring stakeholders together to integrate such planning processes as mitigation and climate adaptation into a joint action plan.

In October 2020, the National Institute of Standards and Technology released a playbook titled “Community Resiliency Planning Guide for Buildings and Infrastructure Systems.”³⁵⁶ The guide highlights the importance of the benefits of a community-scale view of resilience and emphasizes the value of connecting social and economic goals to the built environment. Building on a scorecard developed by Texas A&M University in 2019, the playbook recognizes that communities with few resources cannot keep up with multiple plans as they are often inconsistent and lack integration. It is what Texas A&M describes as “a ‘plethora of plans problem’—cities are often swimming in plans. Even

³⁵³ “Quick Risk Estimation (QRE) Tool,” Making Cities Resilient, accessed December 7, 2021, <https://mcr2030.undrr.org/quick-risk-estimation-tool>.

³⁵⁴ “Managed Retreat Toolkit: Introduction,” Managed Retreat Toolkit, accessed March 28, 2021, <https://www.georgetownclimate.org/adaptation/toolkits/managed-retreat-toolkit/introduction.html>.

³⁵⁵ Dana Brechwald et al., *Regional Resilience Toolkit: 5 Steps to Build Large-Scale Resilience to Natural Disasters* (Washington, DC: Environmental Protection Agency, 2019), https://www.epa.gov/sites/default/files/2019-07/documents/regional_resilience_toolkit.pdf.

³⁵⁶ National Institute of Standards and Technology, *Community Resilience Planning Guide for Buildings and Infrastructure Systems: A Playbook*, NIST SP 1190GB-16 (Gaithersburg, MD: National Institute of Standards and Technology, 2020), <https://doi.org/10.6028/NIST.SP.1190GB-16>.

small communities can have four or more plans guiding their development and management at any given time.”³⁵⁷ A collaborative planning process may result in greater consistency, reducing vulnerability and higher resilience.

With a global focus and an emphasis on urban areas, Notre Dame University maintains a Global Adaptation Initiative website (ND-GAIN).³⁵⁸ The initiative aims to help private and public sector entities prioritize climate adaptation actions, lower risk, and enhance readiness as 40 percent of the U.S. population lives in highly populated coastal areas. How one addresses these risks, particularly coastal cities, will be critical in the next few decades. One of the initiative’s practical tools is the Urban Adaptation Assessment UAA. It is a detailed analysis of 270 cities in every state and Puerto Rico as measured by their vulnerability and preparedness across multiple hazards such as heat, cold, drought, and sea-level rise by the year 2040. For these cities, the tool provides neighborhood-level assessment.

D. CONCLUSION

In managing the process of strategic retreat, communities need to consider several factors. The shift in the conversation from controlling nature to living with nature accompanies engineering practices that shift from gray infrastructure to green infrastructure and nature-based solutions. The shift from controlling floods to managing floods also implies that no risk reduction measure that is absolute, there is always residual risk, and that it may make sense to occasionally accommodate floods. Once a community determines that it may be futile to resist by building ever larger barriers, and that strategic retreat may be the only realistic solution, other decision points follow. None of these decisions are easy, as they deal with relocation or rebuilding of expensive infrastructure,

³⁵⁷ Matthew Malecha et al., *Plan Integration for Resilience Scorecard Guidebook: Spatially Evaluating Networks of Plans to Reduce Hazard Vulnerability - Version 2.0* (College Station, TX: Institute for Sustainable Communities, College of Architecture, Texas A&M University, 2019), vii, <http://mitigationguide.org/wp-content/uploads/2018/03/Guidebook-2020.05-v5.pdf>.

³⁵⁸ “Urban Adaptation Assessment,” Notre Dame Global Adaptation Initiative, March 4, 2019, <https://gain.nd.edu/our-work/urban-adaptation/>.

and human elements that touch upon fundamental factors of a potential loss of home, place and belonging.

To buyout properties through eminent domain poses challenges such as who defines the larger public good and leads to questions of equity with who gets to stay and who must leave. On the other hand, left entirely to voluntary participation may also lead to unsatisfactory outcomes as the ones who can afford to stay, do, and society continues paying for public services and residual risk. To make better risk-based decisions will require risk assessment. Several risk-assessment tools exist: none of them perfect. Nonetheless, they are essential as they give communities and homeowners a common vocabulary to discuss risk factors and raise risk awareness. They are also important in conveying the reality that risk is not static, but constantly changes and evolves. The rate of change may also be accelerating. Risk indices help communities set priorities and create comprehensive plans that guide rebuilding after disasters and steer development away from high-risk areas. Heightened awareness and an impetus to act may be the tools' most valuable assets and help bring communities together to engage in conversations and determine their destinies. Most scenarios carry residual risk and whether to stay, move, and when are primarily personal decisions. At some point, these decisions become societal ones.

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V. POTENTIAL IMPACTS OF STRATEGIC RETREAT

Strategic retreat poses its own set of challenges to communities and individuals. Decisions to move out of developed areas have fiscal and other consequences, and this chapter weighs the impacts of these decisions on local municipalities. These decisions could also lead to inequities and social and environmental justice concerns if not carried out correctly. On the other hand, keeping these concerns in mind can also lead to successful community relocations. Costly as large-scale buyouts, relocation, and strategic retreat is, loss avoidance studies show that the upfront investment pays for itself even after a single subsequent disaster. Lastly, strategic retreat also leads to mass relocation and climate refugees that lawmakers need to prepare for.

A. TAX REVENUES

Local communities generally do not favor buyouts because it erodes their tax base. Residential taxes disappear and as the population dwindles, so do the small businesses that are sustained by them, further eroding tax revenues. Buyout programs allow limited recreational and open space uses. However, even the most ambitious parks and trails are not substitutes for lost taxes that create thriving communities and a sense of place.

In a 2018 publication, Wharton's Risk Management and Decision Processes Center tracked whether floodplain buyouts must result in a decrease in tax revenues.³⁵⁹ Undoubtedly, in states like New Jersey, which relies heavily on property taxes for their general income, the impact of buyouts would be significant.³⁶⁰ In contrast, Louisiana predominantly relies on sales taxes for its revenue. The effect of any loss of property taxes would be small, making buyouts easier, at least from a fiscal standpoint.³⁶¹ Helen Wiley

³⁵⁹ Helen J.P. Wiley, "Must Floodplain Buyouts Decrease Tax Revenue?," *Risk Communication and Decision-Making Lab Notes* (blog), July 5, 2018, https://riskcenter.wharton.upenn.edu/lab-notes/buyouts_tax/.

³⁶⁰ Jared Walczak, "How High Are Property Taxes in Your State?," Tax Foundation, August 13, 2015, <https://taxfoundation.org/how-high-are-property-taxes-your-state/>.

³⁶¹ Jared Walczak and Scott Drenkard, "State and Local Sales Tax Rates in 2017," Tax Foundation, January 31, 2017, <https://taxfoundation.org/state-and-local-sales-tax-rates-in-2017/>.

from Wharton recommends strategies states and local governments can undertake to minimize potential losses and, in some cases, increase revenues. These strategies include incentives to relocate in the same municipality, provide housing for the displaced, maximize recreational benefits of acquired properties to improve property values and integrate mitigation plans with long-term land-use goals.³⁶² In other words, potential loss of tax revenues may be offset by other means and may not even be as large an impact in some states as initially assumed.

The Environmental Law Institute and the University of North Carolina's Institute for the Environment in 2017 published an action guide examining approaches and best practices for floodplain buyouts. Through a series of 13 detailed case studies in four states, the guide helps communities understand the ecological and social value of acquired flood-prone properties.³⁶³ The guide also provides a gradient of restoration in order of intensity, from non-intervention to restoring ecosystems to their pre-development days. It may include such things as wetland or wildlife habitat reestablishment.³⁶⁴

Tax incentives (or disincentives) may not effectively retain a displaced population within a municipality. A 2013 study by Columbia University's Center for Climate Change Law found that buyout programs receive the highest local support when redevelopment areas are identified before a disaster. Such areas, if nearby, also minimize tax revenue loss when considered part of long-term land-use planning.³⁶⁵ Smaller municipalities often struggle to develop long-term plans because short-term concerns prioritize budget allocation. Communities can mitigate the lack of advanced planning by engaging the public at community events, emphasizing local priorities, the value of not living in high-risk areas,

³⁶² Wiley, "Must Floodplain Buyouts Decrease Tax Revenue?"

³⁶³ "Climate Change: Adaptation, Mitigation, and Resilience," Climate & Energy Program, accessed November 22, 2021, <https://www.eli.org/climate-energy/strengthen-capacity-adapt-climate-change>.

³⁶⁴ Environmental Law Institute and UNC Institute for the Environment and the Environmental Law Institute, *Floodplain Buyouts: An Action Guide for Local Governments on How to Maximize Community Benefits, Habitat Connectivity, and Resilience* (Washington, DC: Environmental Law Institute, 2017), 32, <https://www.eli.org/sites/default/files/eli-pubs/actionguide-web.pdf>.

³⁶⁵ Siders, *Managed Coastal Retreat*.

and providing housing options in safer regions that are readily available. According to Wiley,

By engaging in these types of discussions and planning pre-disaster, municipalities will be better able to assess where buyouts are feasible and plan future housing developments and recreational areas in ways that enhance communities and increase tax revenues when funding sources are available.³⁶⁶

Although New Jersey is a state with the highest property taxes in the nation, in the aftermath of Hurricane Sandy, the state announced its Blue Acres home buyout program, an offshoot of the state’s Department of Environmental Protection (DEP), Green Acres program.³⁶⁷ Although the program had been in existence since 1990, Sandy was the first big project undertaken under Blue Acres. Rather than leave buyouts to local communities the state committed \$300 million of Sandy disaster recovery funds to buy out about 1,000 homes and an additional 300 RL and SRL properties. In its Blue Acres program objectives, the state explicitly stated that it wanted to prioritize “clusters of homes, or whole neighborhoods.”³⁶⁸ The state emphasized that the program was strictly voluntary, and they would not use eminent domain to acquire properties. New Jersey made it attractive for homeowners, offering “pre-storm value” for their homes, covering most expenses, and waiving real estate transfer taxes.³⁶⁹ The state sought to ensure that its home buyout program was a success and to remove any potential obstacles homeowners may face.

Based on the success of the Hurricane Sandy buyouts, in late 2021, New Jersey was considering expanding Blue Acres to cover flooding from Hurricane Ida. To be sure, the commissioner of New Jersey’s DEP was quick to point out that unless there was new statutory authorization for purchase through eminent domain, “there was no mechanism

³⁶⁶ Wiley, “Must Floodplain Buyouts Decrease Tax Revenue?”

³⁶⁷ “Blue Acres Floodplain Acquisitions,” New Jersey Department of Environmental Protection, September 14, 2021, https://www.nj.gov/dep/greenacres/blue_flood_ac.html.

³⁶⁸ New Jersey Department of Community Affairs, “Blue Acres Buyout Program,” ReNewJerseyStronger, accessed October 31, 2021, <https://www.renewjerseystronger.org/homeowners/blue-acres-buyout-program/>.

³⁶⁹ Green Acres Program, “Frequently Asked Questions: New Jersey Department of Environmental Protection Superstorm Sandy Blue Acres Buyout Program” (Trenton, NJ: New Jersey Department of Environmental Protection, September 16, 2015), <https://www.nj.gov/dep/greenacres/pdf/faqs-blueacres.pdf>.

for doing that.”³⁷⁰ However, the project manager, Jay Smith, in charge of the U.S. Army Corps of Engineers’ massive \$16 billion Back Bays project to build barriers at five sites in New Jersey, seemed to think some eminent domain would be inevitable. Mr. Smith said, “It has to do with mandatory versus voluntary buyouts and the use of the eminent domain to do that, which may not be a popular topic, but that is something that we need to sweat with the state and our partners going forward.”³⁷¹ Under a NJ-PACT program (Protecting Against Climate Threats), the state considered new land-use rules for anyone considering building in floodplains.³⁷²

Beyond the 1,000 homes the Blue Acres program has acquired, it also accomplished something not done before in other home buyout programs. In conjunction with HUD’s CDBG program, Blue Acres assisted not simply homeowners, but renters affected by buyouts of their rental properties.³⁷³ The program added a dedicated team to address tenants, and Blue Acres successfully distributed \$1.2 million in assistance to 51 renters.³⁷⁴ After Tropical Storm Lee and Hurricanes Irene and Sandy, three states using funds from HUD and FEMA ran their home buyout and managed retreat programs. Three particularly hard-hit communities of Oakwood Beach, New York; Wayne, New Jersey; and Milford, Connecticut, were identified for managed retreat.³⁷⁵ New York ran its home repair and acquisition program through NY Rising.³⁷⁶ For an enhanced buyout program, the city identified two particularly hard-hit communities—Oakwood Beach and Ocean Breeze on

³⁷⁰ Jon Hurdle, “In Wake of Ida, DEP Looks to Buy More Flood-Prone Properties,” NJ Spotlight News, September 22, 2021, <https://www.njspotlight.com/2021/09/nj-dep-blue-acres-flood-climate-change-buy-property/>.

³⁷¹ Hurdle.

³⁷² “NJ PACT - Resilient Environments and Landscapes,” NJ PACT: Protecting against Climate Threats, accessed October 31, 2021, <https://www.nj.gov/dep/njpact/real.html>.

³⁷³ FEMA’s HMA programs do not cover tenants, only landowners.

³⁷⁴ “New Jersey Blue Acres Buyout Program,” ULI Developing Urban Resilience, accessed October 31, 2021, <https://developingresilience.uli.org/case/new-jersey-blue-acres-buyout-program/>.

³⁷⁵ Robert Freudenberg et al., “Buy-In for Buyouts: Three Flood-Prone Communities Opt for Managed Retreat,” *Landlines*, July 2016, 26–35, <https://www.lincolnst.edu/sites/default/files/pubfiles/buy-in-for-buyouts-0716ll.pdf>.

³⁷⁶ “Buyout & Acquisition Programs,” Governor’s Office of Storm Recovery (GOSR), accessed November 22, 2021, <https://stormrecovery.ny.gov/housing/buyout-acquisition-programs>.

Staten Island.³⁷⁷ Still, running voluntarily and offering pre-storm appraised values, the program returned the land to nature with striking results as Staten Island’s shoreline and wildlife have rebounded.³⁷⁸

Among the best symbiotic relationships are those formed among local communities that acquire properties and in turn deed over the land to (or establish permanent conservation easements with) a land-trust agency, “a voluntary, legal agreement between a landowner and a land trust or government agency that permanently limits uses of the land to protect its conservation values.”³⁷⁹ The community eliminates risk permanently and is no longer responsible for maintaining the vacant property. As FEMA requires that local communities recertify that acquired property is preserved as open space every three years, monitoring and maintenance places additional administration burden on the local government.³⁸⁰ As the mission of most land trust agencies is the conservation of land, they also benefit. FEMA requires that communities only transfer land to another public entity or a land-trust agency to prevent redevelopment.³⁸¹

In Brookhaven, New York, the Trust for Public Land, and the Nature Conservancy purchased 106 vacant lots comprising 22 acres to let them revert to wetlands.³⁸² Converting land back to nature is significant for not only taking the residents of these extreme flood-prone properties out of harm’s way but as wetlands that act as a natural

³⁷⁷ “Governor’s Office of Storm Recovery Expands Enhanced Buyout Program,” Governor’s Office of Storm Recovery (GOSR), April 7, 2014, <https://stormrecovery.ny.gov/news-announcements/governor%E2%80%99s-office-storm-recovery-expands-enhanced-buyout-program>.

³⁷⁸ Nathan Kensinger, “Four Years after Sandy, Staten Island’s Shoreline Is Transformed,” Curbed NY, October 27, 2016, <https://ny.curbed.com/2016/10/27/13431288/hurricane-sandy-staten-island-wetlands-climate-change>.

³⁷⁹ “Conservation Options,” Land Trust Alliance, December 23, 2014, <https://www.landtrustalliance.org/what-you-can-do/conserves-your-land/conservation-options>.

³⁸⁰ Federal Emergency Management Agency, *Hazard Mitigation Assistance Guidance* (Washington, DC: Department of Homeland Security, 2015), https://www.fema.gov/sites/default/files/2020-04/HMA_Guidance_FY15.pdf.

³⁸¹ Federal Emergency Management Agency, *Hazard Mitigation Assistance Guidance Addendum* (Washington, DC: Department of Homeland Security, 2015), 16, https://www.fema.gov/sites/default/files/2020-07/fy15_hma_addendum.pdf.

³⁸² Liz Galst, “Brookhaven Town, The Nature Conservancy Acquire 106 Coastal Parcels to Prevent Flooding in Mastic Beach,” Nature Conservancy, April 20, 2020, <https://www.nature.org/en-us/newsroom/ny-mastic-beach-brookhaven-coastal-parcels/>.

barrier help to mitigate the impacts of storm surges and ocean waves. The wetlands offer the additional benefit of providing habitats to aquatic species and migratory birds. Brookhaven is by no means the only conservation partnership with a land trust agency.

Other Land Trust organizations—for example, Wetlands Watch, based in Norfolk, Virginia—focus on sea-level rise that threatens 50 percent to 80 percent of tidal wetlands.³⁸³ To mitigate this threat, Wetlands Watch collaborated with the city of Chesapeake and another land trust organization on a pilot project to offer municipalities a guide to transfer acquired properties to land trusts dedicated to the conservation of open space.³⁸⁴ Although FEMA’s requirements for post-acquisition land use and land trusts missions are aligned, to transfer these properties in a way that complies with FEMA’s “byzantine regulatory framework” can be tricky.³⁸⁵ Since 2007, the city has purchased 38 parcels using FEMA money and in 2020 identified six more, the second-highest cumulatively, of any community in the state. Chesapeake can boast of its success, but a mere 44 properties bought out over 13 years confirms the sluggish pace of buyouts.

Gloucester, VA, near Chesapeake, has seen the consequences of not pursuing a comprehensive buyout program. Since Hurricane Isabel in 2003, Gloucester had been buying out flood-prone homes and, by 2014, had acquired 33.³⁸⁶ But then there was a change in the city’s elected officials, who were not keen on maintaining open land and the potential loss of property taxes. According to the Chesapeake Bay Journal, “Gloucester’s acquisition program was also undercut early on by developers who gobbled up waterfront properties at better prices than FEMA was offering.”³⁸⁷ The Gloucester city government lists several protective measures, but home buyouts are not one of them.³⁸⁸

³⁸³ “Wetlands Watch,” Wetlands Watch, accessed November 22, 2021, <https://wetlandswatch.org>.

³⁸⁴ “Managed Retreat Planning,” Wetlands Watch, accessed December 22, 2021, <https://wetlandswatch.org/managed-retreat>.

³⁸⁵ Tamara Dietrich, “Virginia City Seeks Conservation Solution for Flood-Prone Properties,” *Bay Journal*, September 2, 2020, https://www.bayjournal.com/news/climate_change/virginia-city-seeks-conservation-solution-for-flood-prone-properties/article_bc5a701a-ec62-11ea-8c53-ebba58aa49dd.html.

³⁸⁶ Dietrich.

³⁸⁷ Dietrich.

³⁸⁸ “Protective Measures,” Gloucester Flood Information, accessed November 22, 2021, <https://www.gloucesterva.info/517/Protective-Measures>.

The pilot program’s success in Chesapeake and Brookhaven is due primarily to partnerships with land trust agencies. It offers one more mechanism to ease the potential loss of property tax revenue and eliminate the administrative burden of maintaining open space in perpetuity and certifications every three years. The head of policy at Wetlands Watch is optimistic that Chesapeake could “revolutionize how communities approach adaptation, taking some of the political charge out of managed retreat.”³⁸⁹ The combination of strategic retreat and land conservation could be a win-win scenario.

In October 2021, the State of Virginia announced its first Community Flood Preparedness Fund grant award winners.³⁹⁰ Established in 2020, the grant’s \$7.8 million funds arose from the Commonwealth’s decision to participate in a Regional Greenhouse Gas Initiative, a regional cap-and-trade program.³⁹¹ Identifying the need for consistent funding, Virginia’s aim with this program is “to plan for, mitigate, and build resilience to the climate change impacts being felt today.”³⁹² The fund’s goal is to assist communities prepare where flooding is a recurring problem.³⁹³ The grant prioritizes projects aligned with local, state, and federal floodplain management standards, the Virginia Coastal Resilience Master Plan and that use nature-based solutions.³⁹⁴ At least 25 percent of funding each year is targeted for projects in low-income geographic areas and serving vulnerable and underserved communities.³⁹⁵

³⁸⁹ Marina Schauffler, “Enhancing Natural Protections against Rising Waters,” *Saving Land Magazine*, Winter 2019, <https://www.landtrustalliance.org/news/enhancing-natural-protections-against-rising-waters>.

³⁹⁰ “Community Flood Preparedness Fund Grants and Loans,” Dam Safety and Floodplains, accessed November 30, 2021, <https://www.dcr.virginia.gov/dam-safety-and-floodplains/dsfpm-cfpf-awards>.

³⁹¹ “Elements of RGGI,” Regional Greenhouse Gas Initiative: An Initiative of Eastern States of the US, accessed November 30, 2021, <https://www.rggi.org/program-overview-and-design/elements>.

³⁹² “Virginia Needs the Community Flood Preparedness Fund,” accessed March 15, 2022, <https://www.cbf.org/blogs/save-the-bay/2022/02/virginia-needs-the-community-flood-preparedness-fund.html>.

³⁹³ Virginia Community Flood Preparedness Fund; Loan and Grant Program., *Code of Virginia* 10 (2021) §10.1-603.25, <https://law.lis.virginia.gov/vacode/title10.1/chapter6/section10.1-603.25/>.

³⁹⁴ “Coastal Adaptation & Resilience Master Plan,” Secretary of Natural Resources, accessed November 30, 2021, <https://www.naturalresources.virginia.gov/initiatives/resilience/masterplan/>.

³⁹⁵ Virginia Department of Conservation and Recreation, “Community Flood Preparedness Fund Grants and Loans.”

B. SOCIAL JUSTICE AND EQUITY

While pursuing strategic retreat, one of the critical questions is whether people from different socio-economic backgrounds are treated fairly. In a 2020 article, Elliott et al. note, “Statistical analyses indicate that [the] net of local flood damage, population, and incomes, the program disproportionately targets whiter counties and neighborhoods, especially in more urbanized areas where the program now concentrates.”³⁹⁶ When buyouts occur within these counties, the process is not always a rational benefit–cost-driven process. Citing examples from New York and New Jersey after Hurricane Sandy and Houston after Hurricane Harvey, they contend that the process “is also inherently a racialized process because residential properties, the ultimate target of the program, are socialized assets, embedded in neighborhoods that have long been segregated and unequally served by government programs.”³⁹⁷ The authors’ claims, if true, point to some uncomfortable realities with FEMA’s HMA program that need to be examined and, if necessary, reformed.

High-risk areas may disproportionately represent lower socio-economic classes and people of color. Bakkensen and Ma claim that it is hardly surprising that “low income and minority residents are more likely to move into high-risk flood zones.”³⁹⁸ As homes located just inside a high-risk flood zone are likely to be discounted by 6.3 percent, they are more attractive to low-income and minority residents. Further, when it comes to relocation, Loughran and Elliott hold that “environmental mobility reflects and thus seems to depend on racialization processes of neighborhood attainment, thereby challenging a purely technocratic framing of current buyout policies and illuminating the racialized nature of environmental mobility more generally.”³⁹⁹ Any implementation of strategic retreat must ensure that it does not discriminate against low-income and communities of color.

³⁹⁶ Elliott, Brown, and Loughran, “Racial Inequities in the Federal Buyout of Flood-Prone Homes,” 2.

³⁹⁷ Elliott, Brown, and Loughran, 2.

³⁹⁸ Laura A. Bakkensen and Lala Ma, “Sorting Over Flood Risk and Implications for Policy Reform,” *Journal of Environmental Economics and Management* 104 (November 2020): 3, <https://doi.org/10.1016/j.jeem.2020.102362>.

³⁹⁹ Loughran and Elliott, “Residential Buyouts as Environmental Mobility,” 52.

Research in current practices in flood risk management under sea-level rise exhibit bifurcating trends. On the one hand, one group supports the resistance of wealthier, denser urban areas by building bigger and better defenses. On the other hand, people from poorer and more rural areas will likely retreat.⁴⁰⁰ By contrast, analyzing FEMA data, in an article published in 2019, authors Mach et al. found that for government-funded buyouts, more prosperous, more densely populated areas are more likely to implement voluntary buyouts.⁴⁰¹ The authors draw the uncomfortable conclusion that

if poor and rural coastal areas are forced to retreat under additional sea-level rise, as predicted in economic analyses, then our finding that greater government intervention has, to date, occurred in richer and more densely populated areas suggests that, without adjustments, future retreat in poorer and more rural communities may be less likely to be supported and managed by government. These populations could therefore be at increased risk of becoming trapped in areas of high flood risk.⁴⁰²

FEMA, a significant source of federal home buyouts, runs its acquisition program entirely voluntarily.⁴⁰³ As climate change intensifies, retreat from some areas may be unavoidable. As buyouts accelerate, communities must be sensitive to equity and social justice considerations.

FEMA’s HMA program’s primary purpose is “for mitigation measures that reduce or eliminate long-term risk to people and property from future disasters.”⁴⁰⁴ Those projects that protect the most property and save the most lives have an advantage over ones that do not. The HMA program has maintained it is “need-blind,” and that other federal programs

⁴⁰⁰ Jochen Hinkel et al., “The Ability of Societies to Adapt to Twenty-First-Century Sea-Level Rise,” *Nature Climate Change* 8, no. 7 (2018): 570–78, <https://doi.org/10.1038/s41558-018-0176-z>.

⁴⁰¹ Mach et al., “Managed Retreat through Voluntary Buyouts.”

⁴⁰² Mach et al., 6.

⁴⁰³ Federal Emergency Management Agency, *Hazard Mitigation Assistance Guidance*, 28.

⁴⁰⁴ Federal Emergency Management Agency, “Hazard Mitigation Assistance” (Washington, DC: Department of Homeland Security, 2021), 2, https://www.fema.gov/sites/default/files/documents/fema_hma-trifold_2021.pdf.

such as the HUDs Community Development Grant Program (CDBG) address rehabilitation of low- and middle-income communities to prevent or eliminate slums or blight.⁴⁰⁵

A recent study found that of 40,000 FEMA buyouts, nearly 85 percent were in neighborhoods that were white and non-Hispanic.⁴⁰⁶ As disaster costs rise, authors Howell and Elliott worry about social inequalities. A detailed analysis of every county in the United States that has received disaster aid and a random sampling of 3,400 homes shows “holding disaster costs constant, the more Federal Emergency Management Agency money a county receives, the more whites’ wealth tends to grow, and the more blacks’ wealth tends to decline.”⁴⁰⁷ In other words, the way FEMA currently administers disaster aid, the rich get richer, and the poor get poorer.

Lastly, FEMA’s HMA programs use the definition of small and impoverished communities outlined in Title 44 of the Code of Federal Regulations. It requires a community to consist of less than 3,000 residents, is in a rural area, not within the corporate boundary of a larger city and its per capita income is less than 80 percent of the national average.⁴⁰⁸ For a community to meet all criteria to qualify, means only very few do, and fewer have the wherewithal to apply. Small, impoverished communities who may be eligible for a lower (or in some cases, no) cost-share lose out. In a recent congressional hearing, Ms. Chauncia Willis, of the Institute for Diversity and Inclusion in Emergency Management, made the recommendation to modify the definition of small, impoverished communities by raising it from 3,000 people to 25,000 or 50,000 people. She suggested that congress change the Benefit-Cost Analysis FEMA requires labeling it “inherently

⁴⁰⁵ Department of Housing and Urban Development, “Meeting a National Objective,” in *Guide to National Objectives & Eligible Activities for Entitlement Communities* (Washington, DC: Department of Housing and Urban Development, 2014), 3–1, https://files.hudexchange.info/resources/documents/CDBG_Guide_National_Objectives_Eligible_Activities.pdf.

⁴⁰⁶ Rebecca Hersher and Robert Benincasa, “How Federal Disaster Money Favors the Rich,” NPR All Things Considered, March 5, 2019, <https://www.npr.org/2019/03/05/688786177/how-federal-disaster-money-favors-the-rich>.

⁴⁰⁷ Junia Howell and James R. Elliott, “As Disaster Costs Rise, So Does Inequality,” *Socius* 4 (2018): 1, <https://doi.org/10.1177/2378023118816795>.

⁴⁰⁸ “Mitigation Planning Definitions” 44 CFR § 201.2, <https://www.law.cornell.edu/cfr/text/44/201.2>.

inequitable and biased toward homeowners.”⁴⁰⁹ She also advocated the elimination of the 75/25 percent cost share for small and impoverished communities.⁴¹⁰

In the Executive Order on Advancing Racial Equity, President Biden ordered that the federal government should “pursue a comprehensive approach to advancing equity for all, including people of color and others who have been historically underserved, marginalized, and adversely affected by persistent poverty and inequality.”⁴¹¹ States and locals often accuse FEMA’s programs of being too complex for all communities to access successfully. A GAO study published in 2021 found, “10 of the 12 jurisdictions said grant application processes were complex and lengthy.”⁴¹² Technical capability was also cited as a concern by eight jurisdictions. The order includes provisions for agencies to remove potential barriers underserved communities may face in accessing federal programs. It proposes allocating resources to increase funding to underserved communities.⁴¹³

Indeed, social justice and equity concerns have garnered attention recently. In a book published in 2020, Guy and McCandless claim that “equity is the fourth pillar of public administration alongside efficiency, economy, and effectiveness.”⁴¹⁴ Despite the evolving definition of the term—from a philosophical concept to a constitutional matter, to finally an administrative issue—it profoundly affects people’s lives. For instance, a GAO report determined that post-disaster housing assistance across ten federal grants primarily benefited homeowners rather than renters.⁴¹⁵ The core concept suggests that

⁴⁰⁹ Chauncia Willis, “Ensuring Equity in FEMA’s Disaster Preparedness, Response, and Recovery,” October 27, 2021, 8, <https://homeland.house.gov/imo/media/doc/2021-10-27-HRG-Testimony-Willis.pdf>.

⁴¹⁰ Willis, “Ensuring Equity in FEMA’s Disaster Preparedness, Response, and Recovery.”

⁴¹¹ Joseph R. Biden, Jr., “Executive Order 13985: Advancing Racial Equity and Support for Underserved Communities through the Federal Government,” *Federal Register* 86, no. 14 (January 25, 2021): 7003, <https://www.govinfo.gov/content/pkg/FR-2021-01-25/pdf/2021-01753.pdf>.

⁴¹² Chris Currie, *Disaster Resilience: FEMA Should Take Additional Steps to Streamline Hazard Mitigation Grants and Assess Program Effects*, GAO-21-140 (Washington, DC: Government Accountability Office, 2021), highlights, <https://www.gao.gov/products/gao-21-140>.

⁴¹³ Biden, Jr., “Executive Order 13985,” 7010.

⁴¹⁴ Guy and McCandless, *Achieving Social Equity*, 4.

⁴¹⁵ Mathew J. Scire, *Disaster Assistance: Federal Assistance for Permanent Housing Primarily Benefited Homeowners; Opportunities Exist to Better Target Rental Housing Needs*, GAO-10-17 (Washington, DC: Government Accountability Office, 2010), 9, <https://www.gao.gov/assets/gao-10-17.pdf>.

access to public services should be fair in process, quality, and outcome and serve the entire population, not just a favored few. Although equity and equality may be similar, they are not synonymous since equity requires greater nuance than simply distributing goods equally among all.

Disadvantaged and traditionally marginalized communities need leveling of the playing field. Elaborating on the theme of equity, McCandless and Guy define social justice as systems and not just individuals who remedy historic inequities to benefit the least advantaged in society. The state public administration is “the vehicle for ensuring both social justice and social equity.”⁴¹⁶ If public administration were the vehicle for federal policies and programs, then “pulling the right levers” or strategic retreat must be carried out equitably and not disadvantage one demographic over another.

Climate variability poses varying risks to different regions and sectors and how different people cope with their impact based on their socio-economic conditions. Not surprisingly, risks are highest for low-income communities, communities of color, children, and the elderly. According the Fourth Climate Assessment Report, “Climate change creates new risks and exacerbates existing vulnerabilities in communities across the United States, presenting growing challenges to human health and safety, quality of life, and the rate of economic growth.”⁴¹⁷

The example of a small town called Princeville, NC is instructive to understand some of the challenges small, impoverished, and disadvantaged communities face in mitigating future disasters. Incorporated by a community of African Americans in 1855, not unlike other poor communities across the nation, Princeville was built in a high-risk floodplain.⁴¹⁸ The town has experienced significant and repetitive floods for decades. It sits adjacent to the Tar River, which flooded seven times between 1800 and 1958.⁴¹⁹

⁴¹⁶ Guy and McCandless, *Achieving Social Equity*, 3.

⁴¹⁷ US Global Change Research Program, *Fourth National Climate Assessment*.

⁴¹⁸ “Town of Princeville, NC - History,” Town of Princeville, accessed January 28, 2022, <https://www.townofprinceville.com/town-of-princeville-nc-history.html>.

⁴¹⁹ “Town of Princeville NC - Our History,” Town of Princeville, accessed October 27, 2021, <https://www.townofprinceville.com/town-of-princeville-nc-history.html>.

Although in 1965, the U.S. Army Corps of Engineers built a dike to prevent future floods, it failed in 1999 due to Hurricane Floyd. Parts of the town flooded up to 20 feet, and it took ten days for the waters to recede.⁴²⁰ More recently, in 2016, Hurricanes Matthew flooded the town again, destroying 450 homes and flooding 80 percent of the town's 2,200 people.⁴²¹

Where it would be feasible to perform individual home buyouts over the years, the situation in Princeville warranted strategic retreat and relocation. The Coastal Resilience Center, a DHS Center of Excellence, housed at the University of North Carolina, and other partners convened a five-day visioning workshop to imagine a future Princeville. The work published in a report developed three scenarios for a 53-acre tract, depicted in the blue outline in Figure 21.⁴²²

⁴²⁰ US Army Corps of Engineers, *Princeville, North Carolina Flood Risk Management Integrated Feasibility Report and Environmental Assessment*, Draft Report (Wilmington, NC: US Army Corps of Engineers, Wilmington District, 2014), 10, 46, <https://cms6.revize.com/revize/uppercoastalplain/Princeville%20Levee%20Integrated%20Report%20FINAL%20Draft%20-%2003%2012%2014.pdf>.

⁴²¹ "Hurricane Matthew Recovery - Princeville," Hurricane Matthew Recovery – Engagement, accessed October 29, 2021, <https://coastalresiliencecenter.unc.edu/crc-projects/hurricane-matthew-recovery/hurricane-matthew-recovery-engagement/hurricane-matthew-recovery-princeville/>.

⁴²² Coastal Resilience Center, *2018 Recovery Plan: Princeville Recovery Plan* (Chapel Hill, NC: University of North Carolina at Chapel Hill, 2018), <https://coastalresiliencecenter.unc.edu/wp-content/uploads/sites/845/2018/12/Princeville-Recovery-Plan.pdf>.

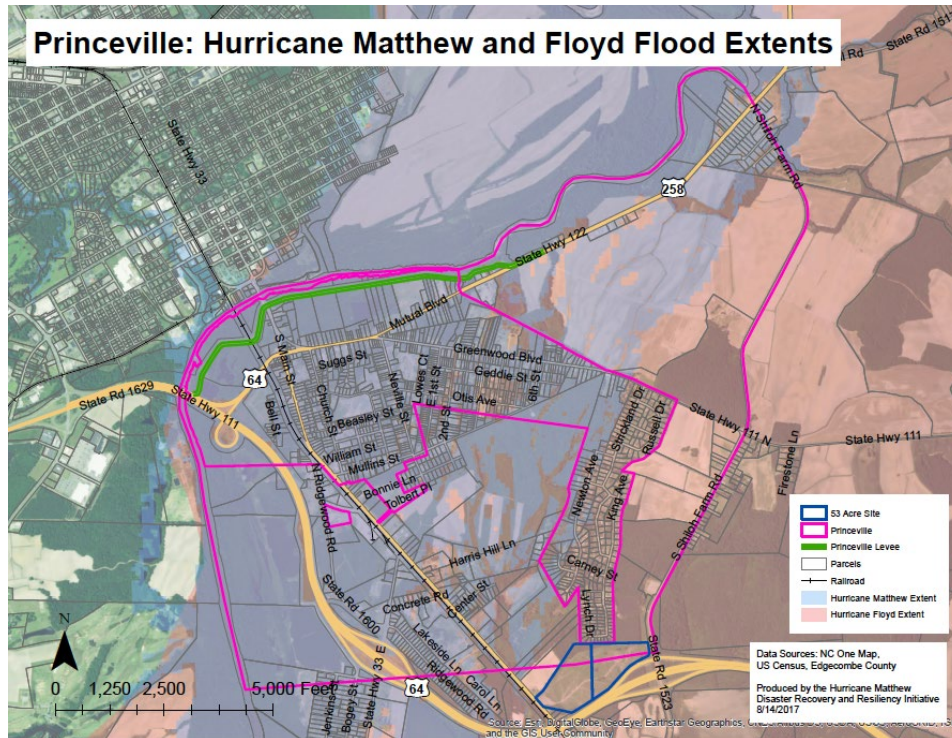


Figure 21. The Extent of Hurricanes Floyd and Matthew Flood and Relocation Site.⁴²³

The state would purchase the site to relocate the town outside the floodplain. It would include not just homes but infrastructure, public facilities, and community amenities, yet connected to the historic core of Princeville.

FEMA successfully selected Princeville for a grant under the first year of BRIC in 2020. A quarter of the town and all associated utilities will be relocated to the new parcel outside the Special Flood Hazard Area.⁴²⁴ The town coordinated project funding between FEMA and HUD to avoid gaps in funding. The proposed project creates more than five acres of green open space and uses nature-based solutions. The project is too large to be funded at once, but a master plan where funding comes from various sources, as they

⁴²³ Source: Coastal Resilience Center, *Princeville: Hurricane Matthew and Floyd Flood Extents* (Hurricane Matthew Disaster Recovery and Resiliency Initiative, August 14, 2017), 65, <https://coastalresiliencecenter.unc.edu/wp-content/uploads/sites/845/2018/09/Flood-Extent8x111.pdf>.

⁴²⁴ Federal Emergency Management Agency, “Fiscal Year 2020.”

become available, can be implemented in a phased manner.⁴²⁵ This project accomplishes two things. One, it mitigates risk by moving several residents out of harms' way at once. Second, undertaking strategic retreat allows the historical community to stay together and maintain cultural cohesion, which would not have been possible with individual buyouts.⁴²⁶

In funding projects like Princeville, FEMA is adapting to the times. In July this year, FEMA announced an initiative to advance equity “to drive response operations and deliver better services to marginalized and other vulnerable populations.”⁴²⁷ The 2021 BRIC Notice of Funding Opportunity expands the definition of disadvantaged communities and uses the term Economically Disadvantaged Rural Communities (as referenced in 42 USC § 5133(a)) and is used synonymously with Small Impoverished Communities. The broader definition includes “a combination of variables that may include, but are not limited to, the following: Low income, high and/or persistent poverty high unemployment and underemployment, racial and ethnic residential segregation, particularly where the segregation stems from discrimination by government entities, linguistic isolation, high housing cost burden and substandard housing.”⁴²⁸ These communities are eligible for a 90 percent instead of 75 percent federal share of grant funding.⁴²⁹

FEMA’s 2021 BRIC program also promotes President Biden’s Justice 40 initiative by prioritizing assistance that benefits disadvantaged communities as referenced in Executive Order 14008—Tackling the Climate Crisis at Home and Abroad—by prioritizing projects where “40 percent of the overall benefits flow to disadvantaged

⁴²⁵ Coastal Resilience Center, *2018 Recovery Plan: Princeville Recovery Plan*.

⁴²⁶ Federal Emergency Management Agency, “Fiscal Year 2020.”

⁴²⁷ “FEMA Announces Initial Initiatives to Advance Equity,” Federal Emergency Management Agency, July 21, 2021, <https://www.fema.gov/press-release/20210721/fema-announces-initial-initiatives-advance-equity>.

⁴²⁸ “Where Equity Fits into the BRIC/FMA Program Design and Community Resilience,” n.d., 51.

⁴²⁹ Department of Homeland Security, *The Department of Homeland Security (DHS) Notice of Funding Opportunity (NOFO) Fiscal Year 2021 Building Resilient Infrastructure and Communities*.

communities.”⁴³⁰ Buyouts from high-risk areas will continue to accelerate in an age of climate change. How governments manage the strategic retreat process and make the economic case will determine its success.

C. HAZARD MITIGATION LOSSES AVOIDED

From a policy perspective, the question is how the government can continue paying for buyouts as the appetite is large and ever-increasing. NOAA estimates that mitigation saves the American public \$3.4 billion every year, and in addition, the NFIP saves the nation approximately \$1.87 billion annually in avoided flood losses.⁴³¹ As strategic retreat from some high-risk areas of the United States becomes inevitable, it may be worthwhile considering not just the initial costs of the buyouts but avoided costs of response and recovery.

After significant events, FEMA conducts Loss Avoidance Studies (LAS), and it notes, “with significant investment being made in mitigation, demonstrating cost-effectiveness is crucial for continued support. The studies quantify the losses avoided (also known as damage prevented or benefits) due to the implementation of the projects.”⁴³² Each such study relies on the assumption that the same area will be hit in the future by another disaster. The money invested in mitigation demonstrates the losses avoided had no mitigation occurred in those areas. Some projects may demonstrate cost-effectiveness even after a single subsequent event. A higher number of disasters result in even greater savings.

For example, the eastern seaboard of North Carolina suffered devastating losses after Hurricane Fran in 1996 and Hurricane Floyd in 1999. Hurricane Matthew in 2016, killing 26 and damaging 100,000 structures state-wide.⁴³³ A mere two years later, roughly

⁴³⁰ Joseph R. Biden, Jr., “Executive Order on Tackling the Climate Crisis at Home and Abroad,” The White House, January 27, 2021, <https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/>.

⁴³¹ “Hazard Mitigation Value,” Office for Coastal Management Fast Facts, accessed October 23, 2021, <https://coast.noaa.gov/states/fast-facts/hazard-mitigation-value.html>.

⁴³² “Hazard Mitigation Assistance Loss Avoidance Study Summaries,” Hazard Mitigation Assistance Grants, accessed October 23, 2021, <https://www.fema.gov/ja/grants/mitigation/loss-avoidance-studies>.

⁴³³ Curtis Skinner, “North Carolina Estimates \$1.5B in Hurricane Damage to Buildings,” *Insurance Journal*, October 17, 2016, <https://www.insurancejournal.com/news/southeast/2016/10/17/429518.htm>.

the same area was impacted by Hurricane Florence. North Carolina Office of State Budget and Management estimated Floyd caused losses between \$7 billion and \$9.4 billion inflated to today’s dollars.⁴³⁴ FEMA estimated losses from Matthew at \$4.8 billion. Damages from Florence totaled \$17 billion—that is, they exceeded both Floyd and Matthew put together.⁴³⁵

After Hurricane Fran, FEMA funded 478 projects in North Carolina through its HMA program, funding elevations, acquisitions, relocations, and other flood control projects (Figure 22). The map depicts areas of inundation due to Hurricane Matthews juxtaposed over properties indicated by dots, the state had acquired prior to the disaster.

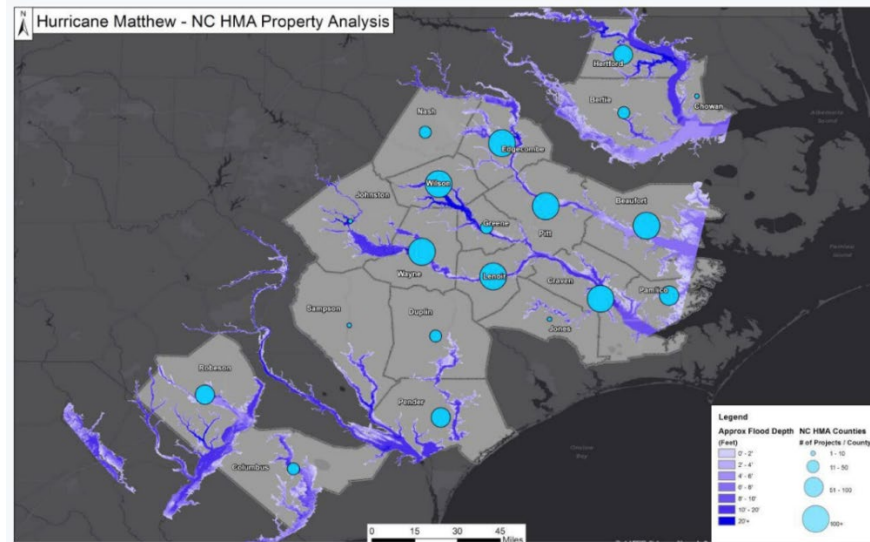


Figure 22. Hurricane Matthew, North Carolina, Map Showing Flood-prone Properties Acquired Using FEMA HMA Grant Funds⁴³⁶

⁴³⁴ Corey Davis, “Floyd’s Flooding Overwhelmed Eastern North Carolina,” *North Carolina Climate Blog* (blog), September 16, 2019, <https://climate.ncsu.edu/blog/2019/09/floyds-flooding-overwhelmed-eastern-north-carolina/>.

⁴³⁵ Ford Porter, “Updated Estimates Show Florence Caused \$17 Billion in Damage,” NC Governor Roy Cooper, October 31, 2018, <https://governor.nc.gov/news/updated-estimates-show-florence-caused-17-billion-damage>.

⁴³⁶ Source: Federal Emergency Management Agency, “Losses Avoided from Hurricane Matthew in North Carolina,” Case Study Library, July 23, 2021, <https://www.fema.gov/case-study/losses-avoided-hurricane-matthew-north-carolina>.

The City of Kinston in Lenoir County, not far from Princeville, affected by Hurricane Fran, was again hit by Hurricane Matthew. Lenoir county resulted in 3,291 homes damaged by the storm.⁴³⁷ Of the 6,000 structures the state has mitigated, 2,249 are in the Matthew flood-affected area. Utilizing an estimated range of flooding under two feet and over five feet, based on the location and type of building, the 2,249 structures that FEMA had previously mitigated at the cost of \$271,061,352 resulted in losses avoided of \$234,814,741.⁴³⁸ These mitigation measures equate to a return on investment of 0.87 for a single event. Not only did mitigation prevent loss and suffering, but the buyouts paid for themselves. The salient feature about buyouts, as opposed to such other mitigation measures as home elevations, is that buyouts eliminate risk forever. Even a single event can have a high positive return on investment. Countless future events that may be potentially more severe will result in even greater returns.

FEMA's study after Hurricane Harvey found that the agency has invested approximately \$555 million in Texas for the acquisition and elevation of 4,386 properties. Of this total, 1,618 properties are in the Hurricane Harvey inundation areas, and the state estimates its FEMA-funded project costs at \$205 million. This prior investment of \$205 million in the coastal regions of Texas for acquisition and elevation avoided losses of more than \$330 million, resulting in a return on investment of 1.61.⁴³⁹ As of October 2021, the state has bought out 669 properties. The state has also identified areas for acquisition through eminent domain.

One such area is the Aldine neighborhood in North Houston, which has suffered multiple floods, including Hurricane Harvey. One resident has flooded 23 of the 29 years she has lived there.⁴⁴⁰ Her home is one of 55 homes identified in the HCFCDD mandatory

⁴³⁷ ReBuild NC, *Hurricane Matthew Resilient Redevelopment Plan: Lenoir County* (Durham, NC: N.C. Office of Recovery & Resiliency, 2017), 3–2, https://files.nc.gov/rebuildnc/documents/matthew/rebuildnc_lenoir_plan_combined.pdf.

⁴³⁸ “Losses Avoided from Hurricane Matthew in North Carolina,” fig. Table 1.

⁴³⁹ “Losses Avoided from Hurricane Harvey in Texas,” Case Study Library, February 11, 2021, <https://www.fema.gov/case-study/losses-avoided-hurricane-harvey-texas>.

⁴⁴⁰ Anita D. Brown, “Aldine Residents Take Buyouts from Flood Control District,” *Chron*, May 17, 2006, <https://www.chron.com/neighborhood/cyfair-news/article/Aldine-residents-take-buyouts-from-flood-control-1575686.php>.

buyout program. In addition to the pre-disaster appraised value of the house, the county also offered moving costs and helped identify comparable homes in the vicinity outside the floodplain. The program in Aldine would resemble many other similar ones nationwide except for one fact: Project Recovery makes clear that “the post-disaster recovery and buyout program is a mandatory buyout program.”⁴⁴¹ With purchase through eminent domain if necessary, Harris County reiterates that the “future flood resilience and the safety of our residents and first responders depend upon returning repetitively flooding areas to green space.”⁴⁴² The alternative is climate refugees forced to relocate when they have no other choice.

D. RELOCATION, AND CLIMATE REFUGEES

The most severe impact of strategic retreat is populations displaced from their homes, either due to forced or voluntary relocation caused by climate. Climate migration is “the preemptive movement of people and property away from areas experiencing severe impacts.”⁴⁴³ As climate-induced migration is an emerging field, a solitary definition does not exist, but the migration could be the cause of a solitary “sudden-onset” event such as a hurricane or sustained “slow-onset” long-term environmental degradation due to climate change. It results in loss of physical territory or the uninhabitability of land in all cases.⁴⁴⁴

The inhabitants of Isle de Jean Charles, located on a narrow island in the bayous of South Terrebonne Parish, probably holds the unfortunate distinction of being the first climate refugees in Louisiana and possibly the United States.⁴⁴⁵ The Biloxi Chitimacha

⁴⁴¹ “Buyout Program Deadline Extended,” Project Recovery Harvey, January 13, 2021, <https://aldinedistrict.org/2021/01/buyout-program-deadline-extended/>.

⁴⁴² Project Recovery, “Post Disaster Relocation and Buyout Program.”

⁴⁴³ Alfredo Gómez, *Climate Change: A Climate Migration Pilot Program Could Enhance the Nation’s Resilience and Reduce Federal Fiscal Exposure*, GAO-20-488 (Washington, DC: Government Accountability Office, 2020), <https://www.gao.gov/assets/gao-20-488.pdf>.

⁴⁴⁴ Walter Kälin and Nina Schrepfer, *Protecting People Crossing Borders in the Context of Climate Change Normative Gaps and Possible Approaches* (Geneva: UN High Commissioner for Refugees, 2012), <https://www.unhcr.org/4f33f1729.pdf>.

⁴⁴⁵ Robynne Boyd and 2019 Robynne Boyd, “The People of the Isle de Jean Charles Are Louisiana’s First Climate Refugees—but They Won’t Be the Last,” NRDC Dispatch, September 23, 2019, <https://www.nrdc.org/stories/people-isle-jean-charles-are-louisianas-first-climate-refugees-they-wont-be-last>.

Choctaw tribe settled in the Isle in the early 1800s. A combination of frequent hurricanes, rising seas, storm surge, and coastal erosion since 1955 has resulted in the Isle retaining a mere 2 percent of its land. An island that once consisted of 22,000 acres is now just 320 acres.⁴⁴⁶ Places like Isle de Jean Charles may be swallowed by the gulf waters and simply cease to exist.

The 2005 hurricanes Katrina and Rita resulted in the loss of 2,000 square miles of deltaic wetlands, and the Louisiana coast has yet to recover over 15 years later. A football field of wetlands vanishes into the Gulf approximately every hour and a half.⁴⁴⁷ Coastal erosion is a natural phenomenon, and although more severe and more frequent hurricanes accelerate the process, they are not the only contributor. Global warming and associated sea-level rise are causing impacts globally, and the situation in some places like Isle de Jean Charles is dire.

In 2018, in response to a competition announced by HUD, Louisiana was one of twelve successful entrants to win the National Disaster Resilience Competition.⁴⁴⁸ Of the two projects the state submitted, one was for strategic retreat and relocation of the inhabitants of Isle de Jean Charles. The state dedicated \$48.3 million for relocation, but it did make it clear that participation in the resettlement program was voluntary.⁴⁴⁹ With the award monies, the state has started the purchase of a 515-acre tract of land on higher ground 40 miles north for \$11.7 million. The state emphasized that they sought to preserve the unique culture, history, and diversity of the community in New Isle. Despite the lack of condemnation or forced relocation, the state made it attractive for residents to resettle to

⁴⁴⁶ Kristoffer Tigue et al., “To Flee, or to Stay Until the End and Be Swallowed by the Sea,” *Inside Climate News* (blog), July 18, 2021, <https://insideclimatenews.org/news/18072021/to-flee-or-to-stay-until-the-end-and-be-swallowed-by-the-sea/>.

⁴⁴⁷ “Coastal Land Loss in the Mississippi River Delta,” Restore the Mississippi River Delta, accessed September 7, 2021, <http://mississippiriverdelta.org/our-coastal-crisis/land-loss/>.

⁴⁴⁸ Department of Housing and Urban Development, *National Disaster Resilience Competition: Grantee Profiles* (Washington, DC: Department of Housing and Urban Development, 2016), <https://www.hud.gov/sites/documents/NDRCGRANTPROF.PDF>.

⁴⁴⁹ “How to Apply,” Isle de Jean Charles Resettlement, April 18, 2019, <https://isledejeancharles.la.gov/how-to-apply>.

the new site by offering them a “forgivable mortgage.”⁴⁵⁰ Residents would have to maintain the property as their primary residence for five years, carry insurance, and at the end of the five years, they would own the property.

The example of Isle de Jean Charles offers two painful lessons. First, despite clearly identified upfront funding, largely from a single source, the certainty of the land disappearing into the sea, an attractive voluntary relocation package from the state, and an intent to keep the community together, strategic retreat takes time. To buy land and build infrastructure, schools, homes, and public amenities in the new place is a lengthy process. Second, how does the government ensure that abandoned land is returned to nature and remains that way? FEMA’s requires acquired property to be deed-restricted in perpetuity as open space, but other programs may not have such restrictions. The condition placed on residents relocating was they would not be able to improve their ancestral lands, and the site would be allowed to return to nature.

The situation gets a little murky with landowners who have not taken up the offer to relocate. A vast majority of land in Terrebonne parish is owned by private oil and gas companies, dating back to the early 20th century. According to the State’s Office of Community Development, who is managing the process, “We do not have the authority to tell individual landowners who are receiving no money or considerations from us what they can and can’t do with their property.”⁴⁵¹ Many of these private lands in the parish, including Isle de Jean Charles, are converted into a “sportsman’s paradise.”⁴⁵² The traditional chief of the tribe since 2007 is upset and accuses Louisiana: “The State hijacked our resettlement,” and that it is “profoundly unsettling.”⁴⁵³ He claims that the state would

⁴⁵⁰ “Resettlement Plan,” Isle de Jean Charles Resettlement, February 24, 2017, <https://isledejeancharles.la.gov/resettlement-plan>.

⁴⁵¹ Nathan Jesse, “Tribal Leaders Raise ‘Serious Concerns’ About Plans to Turn Their Shrinking Louisiana Island Home Into a ‘Sportsman’s Paradise,’” *DeSmog*, July 23, 2021, <https://www.desmog.com/2021/07/23/isle-de-jean-charles-tribe-louisiana-sportsmans-paradise/>.

⁴⁵² Dalia Faheid and Katie Livingstone, “To Flee, or to Stay Until the End and Be Swallowed by the Sea,” *Inside Climate News* (blog), July 18, 2021, <https://insideclimatenews.org/news/18072021/to-flee-or-to-stay-until-the-end-and-be-swallowed-by-the-sea/>.

⁴⁵³ Albert Naquin, “IDJC BCC Chief Naquin Statement,” July 15, 2021, <https://www.desmog.com/wp-content/uploads/2021/07/IDJC-BCC-Chief-Naquin-Statement.pdf>.

provide them no services if they stayed. He only recently learned that the state is repurposing and re-developing their ancestral home. In the case of Indian Tribal Nations, Chief Naquin also raises the questions of colonization of their land and equity issues.

Thousands of miles away, the residents of the small village of Newtok, Alaska, have been facing their distinct challenges with climate change and confronting relocation. Newtok is losing 70 feet of coastline each year due to sea ice loss and erosion caused by waves and storm surges (Figure 23).

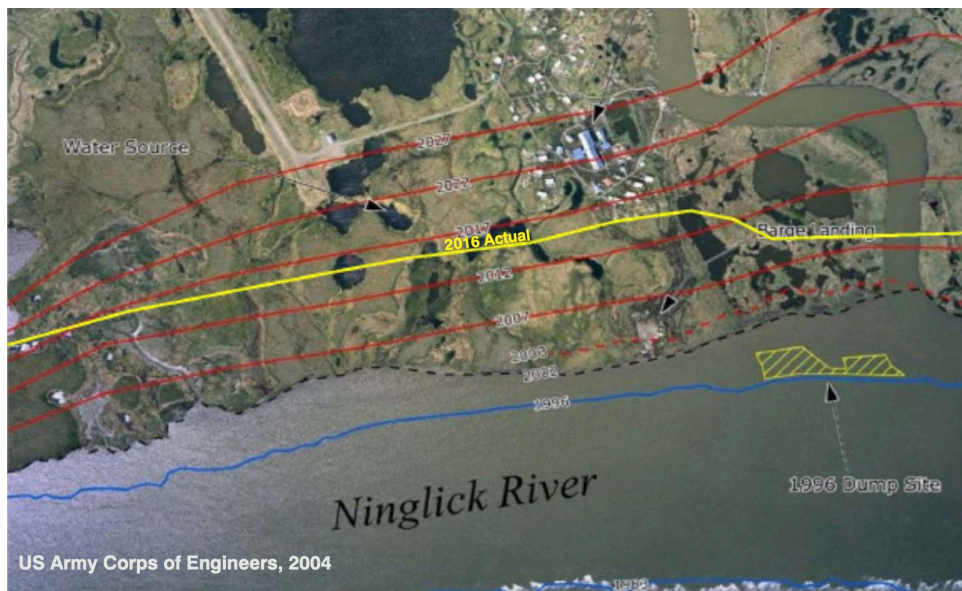


Figure 23. Newtok, Alaska, Shoreline Erosion 1954–2027⁴⁵⁴

The permafrost in Newtok is no longer permanent, and the thick ice that buttressed the village no longer protects against violent storm surges. The decades-long relocation process has been beset with difficulties and has not gone smoothly. Congress had created the Denali Commission, an independent federal agency, in 1998 to coordinate federal,

⁴⁵⁴ Source: Newtok Village Council, *Newtok to Mertarvik Relocation* (Newtok, AK: Newtok Village Council, 2017), <https://www.congress.gov/116/meeting/house/108887/witnesses/HHRG-116-II24-Wstate-JordanJ-20190212-SD001.pdf>.

state, and local relocation efforts.⁴⁵⁵ In 2003, GAO identified that of the 200 Native Alaskan villages affected by floods and coastal erosion, 31 faced imminent danger.⁴⁵⁶ Twelve of these have decided to relocate entirely or in part. In its 2009 update, the GAO stated that limited progress had been made in this regard, and despite the existence of the Denali commission, citing the lack of a single, comprehensive federal program as one of the reasons.

Moving an entire community, even one as small as Newtok consisting of fewer than 400 people, takes a lot of planning and coordination—and a lot of time and money, which the village does not have. The cost estimate in 2006 for the relocation was \$130 million, or about \$380,000 per person. Efforts to move have been ongoing for over twenty years. Back in 1995, the village decided to move to higher ground. Six major disaster declarations between 2002 and 2017 devastated the village. A GAO report in 2003 concluded that the government must relocate Newtok and in 2006 a technical assistance report by the U.S. Army Corps concurred.⁴⁵⁷ Among GAO’s recommendations was to waive the non-federal cost share for grants, not perform a benefit-cost analysis as is typically done for federal assistance and allow for the bundling of federal funds.

The last item may seem obvious as significant multi-year, multi-agency relocation efforts require a coordinated response and that federal, state, and local agencies act in concert. However, federal rules prohibit the commingling of funds unless there is an audit trail.⁴⁵⁸ On top of this accounting requirement, if the federal government superimposes specific grant conditions from each agency in terms of monitoring and reporting, time

⁴⁵⁵ Anu K. Mittal, *Alaska Native Villages: Limited Progress Has Been Made on Relocating Villages Threatened by Flooding and Erosion*, GAO-09-551 (Washington, DC: Government Accountability Office), accessed December 1, 2021, <https://www.gao.gov/products/gao-09-551>.

⁴⁵⁶ Anu Mitta, *Alaska Native Villages: Most Are Affected by Flooding and Erosion, but Few Qualify for Federal Assistance*, GAO-04-142 (Washington, DC: Government Accountability Office, 2003), <https://www.gao.gov/assets/gao-04-142.pdf>.

⁴⁵⁷ US Army Corps of Engineers, Alaska District, *Alaska Village Erosion Technical Assistance Program: An Examination of Erosion Issues in the Communities of Bethel, Dillingham, Kaktovik, Kivalina, Newtok, Shishmaref, and Unalakleet* (Anchorage, AL: US Army Corps of Engineers, Alaska District, 2006), http://66.160.145.48/coms/cli/AVETA_Report.pdf.

⁴⁵⁸ “Standards for Financial Management Systems,” 2015 DOJ Grants Financial Guide, accessed October 29, 2021, https://www.ojp.gov/sites/g/files/xyckuh241/files/archives/financial_guides/financialguide15/PreawardRequirements/chapter2.3c.htm.

limits by when a community spends the money, environmental, legal, and other requirements, the situation is a complicated morass of competing laws and rules. Absent a single agency in charge of relocations, governments will need to eliminate bureaucratic hurdles as Alaska and the nation confronts issues of strategic retreat.

In response to some of the concerns raised in the GAO report, in 2006, Alaska formed a planning group to initiate a move for Newtok.⁴⁵⁹ The tribe has occupied these lands for over 2,000 years and needed to maintain their identity and sense of community. Therefore, village elders rejected the offer to elevate individual homes or buyouts. The village decided to move upriver nine miles (and 35 feet higher) to Mertarvik. The state completed construction of basic infrastructure in 2014, and in 2017 the town held its official “ribbon-cutting” when about a third of the town’s population, about 130 people had relocated.⁴⁶⁰ Alaska contributed \$10.8 million to the effort, and the Bureau of Indian Affairs, Denali Commission, FEMA, and HUD all contributed under \$5 million each. About \$130 million more is needed.⁴⁶¹

If Alaska and Louisiana are both remote and rural, with sparse populations and imminent climate catastrophe, the New York metropolitan area faces different challenges. It is urban, dense, and barring a disaster, does not face the immediate challenges Newtok and Isle de Jean Charles do. In the aftermath of Hurricane Sandy, in 2013, congress passed an emergency disaster relief appropriation totaling \$50.2 billion.⁴⁶² To spend these sums on a single storm is unimaginable in places like Alaska and Louisiana. The New York Academy of Sciences, in 2013 advocated six adaptation strategies ranging from better building codes to green infrastructure to “large protective engineering works such as storm

⁴⁵⁹ “Newtok Planning Group, Planning & Land Management, Division of Community and Regional Affairs,” Division of Community and Regional Affairs, June 10, 2021, <https://www.commerce.alaska.gov/web/dkra/PlanningLandManagement/NewtokPlanningGroup.aspx>.

⁴⁶⁰ Relocate Newtok, “Mertarvik,” Relocate Newtok, May 9, 2017, <https://relocatenewtok.org/mertarvik/>.

⁴⁶¹ Federal Emergency Management Agency, *Hazard Mitigation Assistance: Mitigation Action Portfolio* (Washington, DC: Department of Homeland Security, 2021), https://www.fema.gov/sites/default/files/documents/feam_fy21-bric-mitigation-action-portfolio.pdf.

⁴⁶² Disaster Relief Appropriations, Public Law 113–2, *U.S. Statutes at Large*, 4 (2013), <https://www.govinfo.gov/content/pkg/BILLS-113hr152enr/pdf/BILLS-113hr152enr.pdf>.

surge barriers.”⁴⁶³ Crucially, the Academy argued for a hybrid approach combining critical infrastructure and resiliency measures. Availability of finance and high benefit-cost ratios place strategic retreat off the table, and to resist appears to be a viable option. However, there is no unanimity on the region’s approach against rising seas. Sea level rise at New York City’s Battery by 2050 ranges from a low of 0.6 feet to a high of 1.8 feet and by 2100 from 1.9 feet to 6.3 feet.⁴⁶⁴ As the NOAA map (Figure 24) depicts in areas in blue, sea-level rise could have devastating consequences for the region.

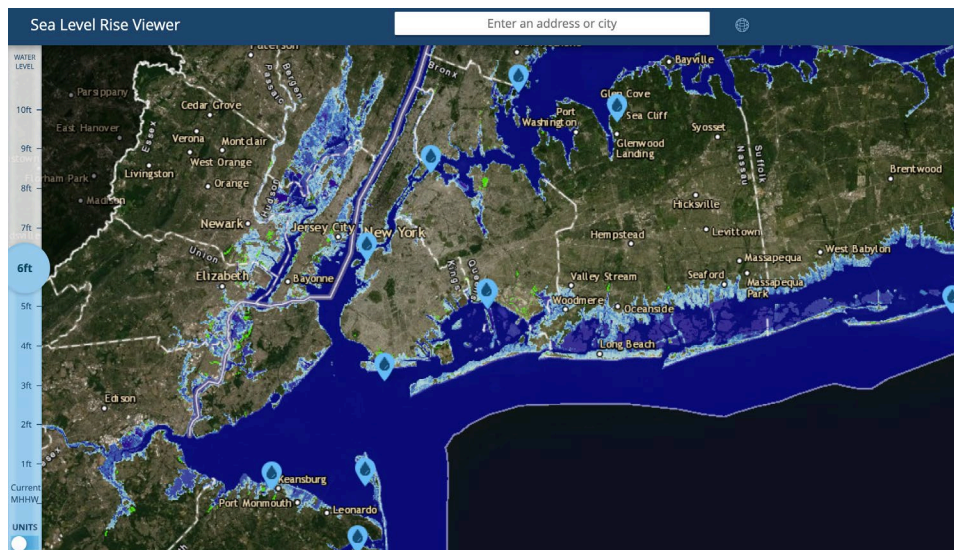


Figure 24. NOAA’s Sea Level Rise Viewer Depicting Six Feet of SLR in the NYC Region.⁴⁶⁵

The U.S. Army Corps of Engineers’ cost estimates for a five-mile retractable barrier between Long Island’s Rockaways to Sandy Hook, New Jersey, ranges from \$62 billion to \$119 billion. In August 2020, the Corps suspended the project nearly four years after the

⁴⁶³ Jeroen C. J. H. Aerts et al., “Cost Estimates for Flood Resilience and Protection Strategies in New York City,” *Annals of the New York Academy of Sciences* 1294 (August 2013): 1–104, <https://doi.org/10.1111/nyas.12200>.

⁴⁶⁴ Ben Strauss, Claudia Tebaldi, and Scott Fulp, *New York and the Surging Sea: A Vulnerability Assessment with Projections for Sea Level Rise and Coastal Flood Risk* (Princeton, NJ: Climate Central, 2014), <https://sealevel.climatecentral.org/uploads/ssrf/NY-Report.pdf>.

⁴⁶⁵ Source: NOAA Office for Coastal Management, “Sea Level Rise Viewer,” Digital Coast, accessed January 3, 2022, <https://coast.noaa.gov/digitalcoast/tools/slr.html>.

\$19 million study began but did not offer reasons for doing so.⁴⁶⁶ Environmental groups cited significant concerns with the Corps' proposals, including long-term environmental impacts.⁴⁶⁷ Not unlike the 'Ike Dike' or the Miami floodwall, there are no clear answers, and if strategic retreat is hard to solve, so are strategies to resist.⁴⁶⁸

Even moving a few hundred people requires a different set of skills and tools as seen in Louisiana and Alaska. The cost to relocate residents of Alaskan villages has been as high as \$1 million per person, or nearly triple the initial estimate.⁴⁶⁹ The political will to relocate even a tiny village of 100 people at the cost of \$100 million may be lacking. As some scholars have predicted, the consequence of non-action may be decline and forced abandonment.⁴⁷⁰ Rather than abandonment, strategic retreat may be the preferable alternative. That the government does so in a fair and equitable manner will add to the complexity and challenges.

E. CONCLUSION

The topic of strategic retreat is not an easy one. Solving the physical components of retreat, such as buyouts and relocation, maybe solvable if enough resources are dedicated to them. As examined in this chapter, communities may offset the loss of tax revenue from residential development through other means. Municipalities may recuperate upfront retreat costs through savings generated even from a single disaster. Loss avoidance studies show that mitigation measures pay for themselves. Besides, strategic retreat may be the only option available in some localities at risk of disappearing with rising seas.

⁴⁶⁶ Henry Goldman, "U.S. Army Corps Suspends Key Study of NYC Storm Protections," Bloomberg, February 25, 2020, <https://outline.com/HVJg7C>.

⁴⁶⁷ Riverkeeper, "Storm Surge Barriers for NY Harbor: Army Corps Alternatives Threaten the Very Life of the Hudson River," *Ecology* (blog), July 5, 2018, <https://www.riverkeeper.org/blogs/ecology/storm-surge-barriers-for-ny-harbor-threaten-life-of-the-hudson-river/>.

⁴⁶⁸ Strategic retreat from areas of wildfire, extreme heat, and severe drought may be as urgent as the retreat from floods and the coastal regions but is beyond the scope of this thesis.

⁴⁶⁹ Henry P. Huntington, Eban Goodstein, and Eugénie Euskirchen, "Towards a Tipping Point in Responding to Change: Rising Costs, Fewer Options for Arctic and Global Societies," *Ambio* 41, no. 1 (February 2012): 68, <https://doi.org/10.1007/s13280-011-0226-5>.

⁴⁷⁰ Robert J. Nicholls et al., "Sea-Level Rise and Its Possible Impacts given a 'beyond 4°C World' in the Twenty-First Century," *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 369, no. 1934 (January 13, 2011): 175, <https://doi.org/10.1098/rsta.2010.0291>.

What is harder to solve is the human aspect of strategic retreat. It involves people with an attachment to the land, their community, and sometimes their source of livelihood that depends on the land and adjacent water. Making sure that communities are engaged through the retreat process and have a say in their destinies is critical to the success of any strategic retreat. Government provided housing to relocate may result in the municipality not losing tax revenue, but crucially also ensure that people don't simply move to equally high-risk areas. That any strategic retreat program not unfairly discriminates against minorities, or the poor is critical for widespread acceptance by the community.

These efforts suggest that comprehensive, multi-year, multi-phase comprehensive plans that combine mitigation plans and climate adaptation plans are vital, as is the coordination of funding in a way that does not duplicate effort or leaves gaps in the retreat process. Successful strategies must include not just what happens to the people and land retreated from, but where people relocate to. And these plans will also include what happens to the land left behind, what incentives and deterrents regulators can offer to prevent rebuilding in high-risk areas and how best the land can be reimagined for public access, nature conservation, and the larger common good.

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VI. STRATEGIC RETREAT EXPANDED AND EXPLORED

The shift in conversation from individual home buyouts to large-scale relocation and strategic retreat has started happening in the United States, albeit in limited ways. This chapter establishes a framework for strategic retreat. The topic is complex and relatively new, and retreat options are presented within a larger resilience adaptation framework. Policymakers have mechanisms that can act as inhibitors or incentives that can guide development and reconstruction away from high-risk areas.

A. A STRATEGIC RETREAT FRAMEWORK

To manage strategic retreat, the Regional Plan Association (RPA) and Lincoln Institute of Land Policy have come up with a taxonomy of resilience called the “Five Rs,” which provides a framework for evaluating the most appropriate combination of approaches to manage risk.⁴⁷¹ **Rebuild** allows reinforcing existing structures through elevations and developing policies that require sturdier construction techniques in flood zones. Such physical barriers as floodwalls and barriers enable **Resist** but can work only in limited circumstances. **Restore** uses nature-based solutions such as restoration of wetlands or living shorelines to better protect from storm surges and attenuate wave action. **Retain** allows water retention by controlling where the water goes through bio-swales and green roofs with their capacity to absorb water during a flood. Lastly, **retreat** relocates people and structures out of harm’s way. The RPA cautions that no single strategy is adequate to address the challenge posed by climate change, and the approach to resilience must be a combination of techniques. One thing RPA and the Lincoln Institute are sure about is that “managing the growing risk posed by floods will be very costly— but not as costly as the price of inaction.”⁴⁷²

Any strategic retreat framework may need to include 1. Understanding the risks, including future risks; 2. Understanding threats from different hazards; 3. Realizing that

⁴⁷¹ Freudenberg et al., *Buy-in for Buyouts*, 13–14.

⁴⁷² Freudenberg et al., 12.

risks are not uniformly distributed across the United States; 4. Accepting that risk is not static and changes with time and accelerates; 5. Hazard mitigation strategies may need to include a range of responses, from resist to retreat and recognizing the interdependence of infrastructure. In other words, it is not simply enough to relocate or rebuild people’s homes, but roads, sewers, schools, hospitals, and other infrastructure may need to be relocated and strengthened as well. Table 8 lists some of the approaches that constitute a Strategic Retreat Framework.

Table 8. A Resilience Adaptation Framework for Strategic Retreat, 2021

RESILIENCE ADAPTATION FRAMEWORK			
	REBUILD	RESTORE	RETAIN
MITIGATION / RISK REDUCTION:			
Bldg Codes, Land-Use Planning		Restore wetlands	Retention/Detention
Home Elevation		Living Shorelines	Bioswales
Wet or Dry Floodproofing		Dunes and Barrier Reefs	Roof Gardens
Green or Gray Infrastructure		Restore mangroves	Other green infrastructure
	RESIST	RETREAT	
		MANAGED RETREAT	STRATEGIC RETREAT
Sea Walls / Barriers		Mandatory or Voluntary	Voluntary Buyout
Operable Gates		Planned Relocation	Phased Relocation
Levees / Dams		Federal / State / Local	Federal / State / Local
Other physical barriers			
ENABLING TOOLS FOR RETREAT			
	DETERRENTS	INCENTIVES	
POLICY-DRIVEN	Higher Insurance Premiums	Land Trust Partnerships	
	Minimal to No Emergency Response	Alleviate Administration Burden	
	Limits to Recovery Funds	Provide non-financial Tech Assistance	
	Communicate Risk information	Streamline review & approvals	
	Communication of climate change	Reduce Cost-effectiveness burden	
		Promote measuring success	
MARKET-DRIVEN		Planning across multiple jurisdictions	
		Facilitate coalitions	
		Code Adoption & Enforcement	
		Planning and Zoning	
		Floodplain Management	
		Open Space & Recreational Uses permitted	
		Pre-disaster Estimated Value for buy-outs	
		Relocation with mortgage pay-down	
		Cap-and-Trade	
		Living Wills	
	Rolling Easements		
	Encourage Public-Private Partnerships		
	Strengthen CRS		

10/Dec-10-2021

The adaptation framework, of which strategic retreat is one component, outlines some of the strategies available. None should be considered in isolation, and indeed the “correct” response to making a community more resilient may be a combination of approaches. Additionally, what approach may be suitable in one location may not be suitable in another. Also, based on changing times, the approach may need to change. For example, FEMA’s HMA program traditionally only provided hazard mitigation grants. The 2021 Infrastructure Bill included provisions for FEMA to administer a \$500 million revolving loan program for performing mitigation activities.⁴⁷³

The framework is not a comprehensive list but summarizes and classifies some approaches to adaptation. Besides pros and cons, each method lists some enhancements necessary within the next few years as the urgency to implement strategic retreat increases. As risk is dynamic, the strategies must be nimble enough to change and evolve, and no single approach will always be valid for all locations. The critical point is that adaptation strategies need not be either/or decisions.

States and local communities have typically dismissed strategic retreat for the many social and political risks this option presents. Unless lawmakers carefully consider concerns in close consultation with the community, retreat will fail even though it is a strategy that most effectively addresses risk by eliminating it. Residents who move to safer grounds can maintain their prior social connections. Strategic retreat can also act in concert with other adaptation strategies where communities can use acquired land to build defensive buffers, for example, or restore wetlands. The trickiest aspect of strategic retreat involves populations forced to retreat due to coastal erosion, floods, wildfire, extreme heat, and drought. These climate refugees pose cross-border challenges, but internal migration exists within the United States in vastly different geographies.

A combination of sticks and carrots may be appropriate to successfully realize any strategic retreat program. The biggest stick is buyout through eminent domain or forced

⁴⁷³ STORM Act, Public Law 116-284, *U.S. Statutes at Large* 134 (2021): 4869-4877, <https://www.congress.gov/bill/116th-congress/senate-bill/3418/text>

relocation, and as examined in Chapter IV, a controversial approach. Forcibly acquiring private property through eminent domain is not a popular measure in the best of circumstances. Carrots may consist of greater financial incentives to homeowners to leave and relocate to safer places. Between these two extremes, other hybrid mechanisms may be worth exploring: progressively raise NFIP premiums, higher property taxes, limiting post-disaster FEMA's Individual Assistance, higher deductibles on FEMA's Public Assistance program, and limits to Urban Search and Rescue. The last already occurs in some forms: a state may not rescue people who deliberately ignore mandatory evacuation orders. Louisiana, for example, warns its residents, "During a hurricane, a person failing to comply with evacuation orders may not be rescued or provided other lifesaving assistance."⁴⁷⁴ In some states, people refusing mandatory evacuation orders face misdemeanor charges.⁴⁷⁵

Authors Oliver-Smith and de Sherbinin argue that involuntary resettlement, as opposed to voluntary buyouts, offers the best solution to strategic retreat. However, they caution this approach carries risk.⁴⁷⁶ While relocation represents vital protection for vulnerable communities, according to Oliver-Smith and de Sherbinin, "the track record of resettlement associated with large infrastructure and development projects has been poor."⁴⁷⁷ They blame resettlement risks on two broad issues. One is the lack of a legal and regulatory framework. The other is a complex interaction of socio-economic factors that vary and are unpredictable.⁴⁷⁸ The authors rightfully argue that any resettlement solution must be durable to ensure successful outcomes as "resettlement is a complex social process; at its best, it should support and nourish the coping and adaptation processes that enable a

⁴⁷⁴ Louisiana State Legislature, "Interjurisdictional Homeland Security and Emergency Preparedness Agency: §730.3. Evacuations and Curfews," RS 29:730.3, June 16, 2008, <http://www.legis.la.gov/Legis/Law.aspx?d=630905>.

⁴⁷⁵ "Forced Evacuation," ABA Legal Fact Check, September 8, 2017, <https://abalegalfactcheck.com/articles/forced-evac.html>.

⁴⁷⁶ Oliver-Smith and de Sherbinin, "Resettlement in the Twenty-First Century," 24.

⁴⁷⁷ Oliver-Smith and de Sherbinin, 23.

⁴⁷⁸ Oliver-Smith and de Sherbinin, 23.

population to regain the functionality and coherence of a viable community, resilient enough to deal with social and environmental stressors.”⁴⁷⁹

As the framework indicates, there isn’t a solitary approach to adaptation, and depending on the situation, one or a combination of techniques may be appropriate. Some of the concepts listed in the table are summarized below:

Strategic or Managed Retreat:

- Mandatory or voluntary buyouts: Residential home buyouts may occur voluntarily or by mandatory purchase through eminent domain. The former approach is traditionally how buyouts have happened, and FEMA runs its program voluntarily. As properties are deed-restricted in perpetuity as open space, the risk is eliminated forever. The downside of voluntary buyouts is that they take long, and in the case of “checker-boarding,” it does not change a community’s risk profile and can lead to urban blight. The latter approach is perilous, but it may be the only viable option in some situations of extreme high risk. Before resorting to mandatory buyouts, governments can offer deterrents and incentives to homeowners, explored in greater detail below.
- Planned and phased relocation: If the relocation of a community is planned, it may be carried out in a phased manner over several years. Either way, the government has the option of buyout without an obligation to relocate a population to a safer site, although the latter option offers some advantages. A phased relocation could include the ability of local municipalities to maintain their tax base and, for its relocated population, the ability to maintain a sense of community. As housing stock may be limited in a community, housing availability can be a significant incentive for relocation.

⁴⁷⁹ Oliver-Smith and de Sherbinin, 25.

- Federal/state/local Programs: All three programs exist; however, federal grants primarily through FEMA and HUD are the primary funding source. The availability of funds generally limits the scale of buyouts. State and local governments buyouts may be quicker than federal processes. Authors Peterson et al. have identified 34 separate buyout funding programs, including the five funded by FEMA and HUD.⁴⁸⁰ Besides these, states can raise funds through traditional methods such as municipal bonds, revolving loans, and utility fees. Strategic retreat in Louisiana, Alaska, and North Carolina are funded almost entirely by the federal government. Retreat needs to ensure programs are carried out fairly and equitably and do not disadvantage poor and colored communities.

Besides these approaches, the framework identifies enabling tools. The matrix distinguishes between deterrents and incentives, and actions are examined against whether these measures are policy-based or directed by market forces. Of course, these categories are not iron-clad. For instance, flood insurance is a policy decision dictated by congress as it is a market one in terms of insurance affordability.

Policy-Driven Deterrents:

- Charge higher insurance premiums: Charging actuarially sound flood insurance rates are possibly the single most effective measure for prompting people to make risk-based decisions about where they live. However, reforming the NFIP is politically perilous, and past attempts have mostly failed. Critics have further argued that publicly subsidized flood insurance poses a “moral hazard” and encourages rather than deters development in the floodplain.⁴⁸¹ Any future reform program must tackle the issue of affordability and equity.⁴⁸²

⁴⁸⁰ Peterson et al., “A Review of Funding Mechanisms,” 6.

⁴⁸¹ Starbuck, “Moral Hazard.”

⁴⁸² National Academy of Science, “Affordability of National Flood Insurance Program Premiums — Report 1” (Washington, DC: National Academies Press, March 2015), <https://www.nap.edu/resource/21709/Affordability-of-NFIP-final.pdf>.

- Provide minimal emergency response: Limits may be placed on the amount of emergency response assistance offered to people who choose to live in high-risk areas. The State of California, for example, has laws charging people with misdemeanors, fines, and imprisonment if they refuse to follow mandatory evacuation orders.⁴⁸³ From a practical perspective, it is hard to see first responders refusing aid to those in need of assistance.
- Limit recovery funds: With disaster costs continually going up and recovery funds through FEMA’s Public Assistance and Individual Assistance programs, limits should be placed on communities who do not actively prepare and mitigate against future disasters. One such provision required by the Disaster Recovery Reform Act (DRRA) of 2018 requires FEMA to revisit the formula through which it determines which federal disasters qualify for public assistance by making communities invest in mitigation prior to a disaster.⁴⁸⁴
- Communicate risk information: A 100-year flood is probably one of the most misunderstood terms in preparedness as most individuals think it indicates a flood that occurs once every 100 years. It means a 1 in 100 or 1-percent probability of occurring any given year. For most homes with a 30-year mortgage, statistically, this translates to a 26 percent, or one in four chance of flooding during a typical home mortgage.⁴⁸⁵ Additionally, 25

⁴⁸³ Andrew Grundman, *Legal Guidelines for Controlling Movement of People and Property During an Emergency* (Sacramento, CA: Governor’s Office of Emergency Services, 1999), 89, [https://www.caloes.ca.gov/PlanningPreparednessSite/Documents/Legal%20Guidelines%20for%20Controlling%20Movement%20People%20Property%20\(FEAT%20doc\).pdf](https://www.caloes.ca.gov/PlanningPreparednessSite/Documents/Legal%20Guidelines%20for%20Controlling%20Movement%20People%20Property%20(FEAT%20doc).pdf).

⁴⁸⁴ Federal Emergency Management Agency, “Cost of Assistance Estimates in the Disaster Declaration Process for the Public Assistance Program,” *Federal Register* 85, no. 240 (December 14, 2020): 80719–45, <https://www.federalregister.gov/documents/2020/12/14/2020-27094/cost-of-assistance-estimates-in-the-disaster-declaration-process-for-the-public-assistance-program>.

⁴⁸⁵ This number is derived using probability theory. First, we calculate the probability of there not being a flood over a 30-year period. Since for each year, there is a 99 percent chance of there not being a flood, the chance that there is no flood over 30 years is 74 percent (or $.99^{30}$). The probability of a house in a 100-year floodplain being inundated at least once, then, is just the complement, so 26 percent. Maggie Koerth, “It’s Time to Ditch the Concept of ‘100-Year Floods,’” *FiveThirtyEight* (blog), August 30, 2017, <https://fivethirtyeight.com/features/its-time-to-ditch-the-concept-of-100-year-floods/>.

percent of flood losses are outside a high-risk area, and people may be at greater risk of flooding than their flood maps show.⁴⁸⁶

- Communicate climate change: The scientific consensus that climate change is “wide-spread, rapid and intensifying,” is caused by humans and may be irreversible unless collectively all nations cut emissions by 2050 is virtually unanimous.⁴⁸⁷ This communication must be communicated unequivocally and directly to the public and should include a sober assessment of impacts and consequences.

Policy-Driven Incentives:

- Enable land trust partnerships: Currently, there exist two significant inhibitors to states and locals pursuing home buyouts. One is the potential loss of property tax revenue; the other is the burden of maintaining a property in perpetuity as open space. As land-trust agencies often aim to promote and conserve available land, partnership with land-trust agencies offers a mutually beneficial relationship for both entities.⁴⁸⁸
- Ease administrative burden: Property acquired under any home buyout program must report every three years that the property has been maintained as open space, and only permitted recreational uses occur on the land. Third parties can alleviate this administrative burden, for example, land-trust agencies cited above, in providing the monitoring and reporting service. The federal government can also play an essential role in reducing the administrative burden associated with buyouts, relocations, and strategic retreat.

⁴⁸⁶ National Association of Insurance Commissioners, “Flood Insurance Basics” (Washington, DC: National Association of Insurance Commissioners), accessed December 6, 2021, https://www.naic.org/documents/cnte_c_trans_read_wg_related_flood_insurance_basics_v4.pdf.

⁴⁸⁷ Intergovernmental Panel on Climate Change, “Climate Change Widespread, Rapid, and Intensifying – IPCC,” *IPCC Newsroom* (blog), August 9, 2021, <https://www.ipcc.ch/2021/08/09/ar6-wg1-20210809-pr/>.

⁴⁸⁸ “Land Trust Alliance,” Land Trust Alliance, accessed January 16, 2022, <https://www.landtrustalliance.org/>.

- Provide non-financial technical assistance: Despite one of FEMA’s strategic goals to reduce complexity in its programs, a survey conducted by FEMA found that most recipients and sub-recipients of grants found FEMA’s programs “too complex” “lack flexibility.”⁴⁸⁹ An overwhelming number of public comments had to do with technical assistance. This need was more acutely felt in impoverished, disadvantaged, and rural communities with low-capacity and lacking a dedicated and trained staff to apply for grants.⁴⁹⁰ FEMA’s 2020 BRIC application made non-financial technical assistance to ten small, impoverished, socially vulnerable, or tribal communities (expanded to 20 in 2021) to “level the field.”⁴⁹¹
- Streamline review and approvals: Nearly 40 percent of stakeholders submitting input to FEMA’s BRIC program noted the need to streamline the grants application process, especially for “smaller, non-resourced communities.”⁴⁹² As projects get more complex and more infrastructure mitigation projects are funded, the need to streamline the process will grow more urgent. Strategic retreat requires coordination across many players and funding sources with specific requirements, which may be phased over multiple years. The federal government can play an essential role in enabling and easing the buyout, retreat, and relocation process.
- Reduce cost-effectiveness burden: The federal government requires that all projects utilizing federal funds be cost-effective. The Office of Management and Budget sets the rules and monitors all projects’ positive benefit-cost ratio. Unfortunately, for most recipients, to perform a Benefit-Cost Analysis

⁴⁸⁹ Federal Emergency Management Agency, *Summary of Stakeholder Feedback: Building Resilient Infrastructure and Communities (BRIC)* (Washington, DC: Federal Emergency Management Agency, 2020), 21, https://www.fema.gov/sites/default/files/2020-06/fema_bric-summary-of-stakeholder-feedback-report.pdf.

⁴⁹⁰ Federal Emergency Management Agency, 51.

⁴⁹¹ Federal Emergency Management Agency, “BRIC Direct Technical Assistance” (Washington, DC: Federal Emergency Management Agency, August 2021), https://www.fema.gov/sites/default/files/documents/fema_fy21-bric-direct-technical-assistance-psm.pdf.

⁴⁹² Federal Emergency Management Agency, *Summary of Stakeholder Feedback*, 22.

is beyond their capacity, most asking for additional flexibilities and the use of their methodologies.⁴⁹³ The federal government can ease this burden by taking a program, rather than an individual project, view of cost-effectiveness, promoting more significant pre-calculated benefits, and establishing thresholds under which BCAs would not be required. In a program view, an entire group of projects in a particular location could be deemed cost-effective. Reducing this burden would also help promote equities dealing with strategic retreat, as a community, rather than individual home values would be considered.

- Promote success: Communities lack the tools to promote the effectiveness of mitigation and buyouts through best-practice stories. Federal, state, and local governments can encourage successes using financial figures, and levels of human loss and suffering avoided due to mitigation measures taken and retreating out of harm's way.⁴⁹⁴
- Integrate plans: As strategic retreat gains importance, planning across municipal boundaries and at the regional level will be necessary to integrate hazard mitigation plans with local comprehensive programs.⁴⁹⁵ Harris County in Texas is one example of a successful multijurisdictional plan. More than 30 cities and non-profits have collaborated to create a single plan that enhances resilience and reduces long-term vulnerability.⁴⁹⁶
- Facilitate coalitions: Such an undertaking as a strategic retreat involves many federal, state, and local actors. Retreat may also require a multi-year phased approach. Even at the national level, active collaboration is required

⁴⁹³ Federal Emergency Management Agency, 25.

⁴⁹⁴ "Mitigation Best Practices," Hazard Mitigation Planning, September 9, 2021, <https://www.fema.gov/emergency-managers/risk/hazard-mitigation-planning/best-practices>.

⁴⁹⁵ Charles Powell, "Integrating Hazard Mitigation into the Local Comprehensive Plan" (Washington, DC: Federal Emergency Management Agency, July 2020), 2.

⁴⁹⁶ "Collaborative Community Resilience: Multi-Jurisdictional Hazard Mitigation Planning," Case Study Library, February 11, 2021, <https://www.fema.gov/case-study/collaborative-community-resilience-multi-jurisdictional-hazard-mitigation-planning>.

among multiple agencies, a role MitFLG fulfills.⁴⁹⁷ Governments can incentivize mitigation, buyout, and strategic retreat processes by facilitating alliances and coalitions. FEMA has also convened an External Stakeholders Workgroup consisting of three states, three local, and three tribal representatives who collaborate on urgent and emerging issues and foster dialogue among varied constituents.⁴⁹⁸

- Adopt and enforce codes: Adopting the latest disaster-resistant building codes and their enforcement can be one of the most effective measures communities can take for greater resilience.⁴⁹⁹ Preventing reconstruction of substantially damaged structures and ensuring rebuilding occurs to the latest codes and standards can be essential in preventing future losses. FEMA’s guidance on the topic states, “Rebuilding a substantially damaged structure in a floodplain requires a permit for the property to be brought into compliance with local floodplain management regulations. Options may include floodproofing a non-residential structure, relocating the structure outside the floodplain, elevating the building to a height determined by local officials, or demolishing the home.”⁵⁰⁰
- Guide planning and zoning: Local planning and zoning can aid in not only preventing rebuilding in floodways and high-risk floodplains using techniques such as setbacks and easements may ease the eventual path to strategic retreat.⁵⁰¹ Also, imposing limits on types of use and construction

⁴⁹⁷ “Mitigation Framework Leadership Group (MitFLG),” National Mitigation Framework, March 22, 2021, <https://www.fema.gov/emergency-managers/national-preparedness/frameworks/mitigation/mitflg>.

⁴⁹⁸ “Hazard Mitigation Assistance External Stakeholder Working Group,” About Hazard Mitigation Assistance, June 25, 2021, <https://www.fema.gov/grants/mitigation/external-stakeholder-working-group>.

⁴⁹⁹ Compass PTS JV, *Building Codes Save: A Nationwide Study*.

⁵⁰⁰ “Substantial Damage Determination,” Federal Emergency Management Agency, October 6, 2021, <https://www.fema.gov/fact-sheet/substantial-damage-determinations>.

⁵⁰¹ Federal Emergency Management Agency, *National Flood Insurance Program (NFIP) Floodplain Management Requirements: A Study Guide and Desk Reference for Local Officials*, 208.

based on flood zones can play an essential role in promoting appropriate development in proper places.⁵⁰²

- Enforce floodplain management standards: In October 2021, FEMA started accepting public comments on revising NFIP minimum standards. These standards have not been updated for more than 20 years, and newer ones can be a considerable incentive. According to FEMA, “Structures built to NFIP standards experience 65 percent less damage than structures not built to these standards and have resulted in \$2.4 billion per year in reduced flood losses, saving the nation more than \$100 billion over the last 40 years.”⁵⁰³

Market-Based Deterrents:

- Deed-restrict properties in perpetuity: By deed restricting a property in perpetuity as open space and permitting limited recreational uses, rebuilding in high-risk areas can act as a deterrent. Section § 80.19 Land use and oversight of Section 44 of the Code of Federal Regulations (CFR) clearly states, “The property shall be dedicated and maintained in perpetuity as open space for the conservation of natural floodplain functions.”⁵⁰⁴ Limited uses may include: “Parks for outdoor recreational activities; wetlands management; nature reserves; cultivation; grazing; camping (except where adequate warning time is not available to allow evacuation); unimproved, unpaved parking lots; buffer zones; and other uses FEMA determines compatible with this part.”⁵⁰⁵
- Place limits on reconstruction after a disaster: Substantially Damaged structures are those structures that have suffered at least a 50 percent loss to

⁵⁰² Federal Emergency Management Agency, “Design and Construction in Coastal A Zones” (Washington, DC: Federal Emergency Management Agency, December 2005), 3, https://www.fema.gov/pdf/rebuild/mat/coastal_a_zones.pdf.

⁵⁰³ Federal Emergency Management Agency, “Individuals - Floodplain Management Resources.”

⁵⁰⁴ Property Acquisition and Relocation for Open Space, *U.S. Code* 44 (2010) 80 et seq. <https://www.govinfo.gov/content/pkg/CFR-2010-title44-vol1/pdf/CFR-2010-title44-vol1-part80.pdf>.

⁵⁰⁵ Property Acquisition and Relocation for Open Space.

the replacement value of a structure.⁵⁰⁶ The federal, state and local governments can ensure that rebuilding occurs to the latest adopted codes and standards by enforcing limits on reconstructing these structures after a disaster. Governments can also prohibit rebuilding in floodways.

- Limit redevelopment in coastal areas: Several laws, for example, the Coastal Barrier Resources Act (CBRA), already prohibit rebuilding in some areas after a disaster.⁵⁰⁷ State and local governments have additional public safety tools to prevent rebuilding in high-risk areas. A 2020 study by RAND found that shifting greater responsibility from FEMA to states and locals would encourage more resilient planning and better building practices and encourage them to transfer some of the risks to the insurance market.⁵⁰⁸
- Promote losses avoided stories: Outlining failures, including opportunity costs and loss of revenue that may have occurred, absent of mitigation, can act as a market-driven deterrent.⁵⁰⁹
- Eliminate insurance subsidies: Actuarially sound, market-dictated insurance premiums could be the single most significant deterrent to rebuilding in high-risk areas. The American Academy of Actuaries in 2019 opined, “Actuarial principles can provide important guidance to the NFIP

⁵⁰⁶ “Fact Sheet: ‘Substantial Damage’ – What Does It Mean?,” Federal Emergency Management Agency, December 2, 2019, <https://www.fema.gov/press-release/20210318/fact-sheet-substantial-damage-what-does-it-mean>.

⁵⁰⁷ Coastal Barrier Resources Act, Public Law 97–348, *U.S. Statutes at Large*, 1653 (1982), <https://www.congress.gov/97/statute/STATUTE-96/STATUTE-96-Pg1653.pdf>.

⁵⁰⁸ Lloyd Dixon, Jason Thomas Barnosky, and Noreen Clancy, *Insuring Public Buildings, Contents, Vehicles, and Equipment against Disasters: Current Practices of State and Local Government and Options for Closing the Insurance Gap* (Santa Monica, CA: RAND Corporation, 2020), https://www.rand.org/pubs/research_reports/RRA332-1.html.

⁵⁰⁹ Federal Emergency Management Agency, “Hazard Mitigation Assistance Loss Avoidance Study Summaries.”

in establishing rates that yield sufficient revenue to cover program claims in a way that reflects each policy's risk."⁵¹⁰

Market-Based Incentives:

- Encourage open space and recreational uses: Once a property is acquired, FEMA's HMA grants deed-restrict that property from future development in perpetuity. However, such limited recreational uses as parks, hiking, and bicycle trails are permitted, often offering towns and communities attractive natural features in their community, as multiple successful case studies at various scales show.⁵¹¹
- Offering pre-disaster estimated value for buyouts: Offer pre-disaster appraised value for the property or the lot as an incentive for people to sell after a disaster. This benefit can be reinforced in buyout programs post-disaster. This strategy cannot work absent a disaster, and other incentives to retreat may need to be offered.
- Offer relocation with mortgage pay-down: One strategy used in the past, as we will examine later in the chapter in Isle de Jean Charles, is that the government can relocate people to a newly designed and built area in a safer place. In return, the new house mortgage can be paid down and property deeded over, say after five years. Readily available housing can be a massive incentive for people to relocate and ensures that people will continue living in the newly built places and maintain a sense of community.
- Use Cap-and-Trade mechanisms to fund retreat: The State of Virginia is among several states where the Governor plans to use 45 percent of the revenue collected from a regional cap-and-trade program pay to mitigate properties subject to recurrent flooding sea-level rise. The Regional

⁵¹⁰ American Academy of Actuaries, *The National Flood Insurance Program: Challenges and Solutions* (Washington, DC: American Academy of Actuaries, 2019), 7, <https://www.actuary.org/sites/default/files/2019-09/flood9.19.pdf>.

⁵¹¹ "Floodplain Buyout Case Studies," ELI's Sustainable Use of Land Program, accessed December 13, 2021, <https://www.eli.org/sustainable-use-land/floodplain-buyout-case-studies>.

Greenhouse Gas Initiative (RGGI) has since 2009 reduced carbon emissions in the participating states by half while funding resiliency activities in local communities.⁵¹²

- Encourage living wills: Living wills or life estates can be mechanisms by which a land trust or a local government can take possession of a property or land and turn it back to the owner for use and occupancy until they die. Simultaneously, future generations do not continue living in high-risk areas, or land is not sold to private developers. Florida Forever is a successful program that has acquired 2.5 million acres of land for conservation.⁵¹³
- Create rolling easements: Setbacks and buffers can work to limit or prevent building or rebuilding on a property edge abutting water or wetlands. These setbacks and buffers can vary by location, the severity of anticipated sea-level rise, and local factors such as the size of individual lots. Another mechanism may be rolling easements where the setback line is not static and can move landward as water advances. Such easements can also facilitate migrating natural features like dunes or tidal wetlands. For example, the State of North Carolina, in its Coastal Area Management Act (CAMA) Handbook, specifies setbacks from erosion lines and “extends inland from the first line of stable natural vegetation.”⁵¹⁴ The EPA provides an excellent resource on rolling easements with numerous examples from

⁵¹² Regional Greenhouse Gas Initiative, “The Regional Greenhouse Gas Initiative: An Initiative of Eastern States of the US” (New York: Regional Greenhouse Gas Initiative, Inc., September 2021), https://www.rggi.org/sites/default/files/Uploads/Fact%20Sheets/RGGI_101_Factsheet.pdf.

⁵¹³ “Acquisition and Restoration Council (ARC),” Florida Department of Environmental Protection, December 15, 2021, <https://floridadep.gov/lands/environmental-services/content/acquisition-and-restoration-council-arc>.

⁵¹⁴ North Carolina Department of Environment and Natural Resources, *CAMA Handbook for Development in Coastal North Carolina* (Raleigh, NC: North Carolina Department of Environment and Natural Resources), 13, accessed December 14, 2021, <https://www.oibgov.com/files/documents/CAMAHandbookforDevelopment1313114527012816AM.pdf>.

around the country.⁵¹⁵ At some point, building on a parcel may become commercially unviable, and rolling easements can provide a combination of incentives and deterrents to when and where to make.

- Encourage public-private partnerships: We have previously examined the role of land trust partnerships and non-governmental organizations (NGOs) in the acquisition, relocation, and retreat process. An equally valuable partner can be private, for-profit entities through public-private partnerships (P3s). There is increasing awareness of climate change and natural disasters in the private sector. P3s are not uncommon in infrastructure or transportation facilities where a private entity can generate a revenue stream through initial investment and long-term operations. Such arrangements need to be further explored for strategic retreat. The United Nations Office for Disaster Risk Reduction, in collaboration with the global accounting firm Price Waterhouse Coopers, has created its R!se Initiative. It has a goal “to reduce disaster risks and build more resilient communities and a more sustainable global economy.”⁵¹⁶ In identifying eight streams of activities, the initiative aims to address more resilient cities, support the private sector in developing improved disaster risk management capabilities, and responsible investing.
- Strengthen the Community Rating System (CRS): Although a voluntary program offered through the NFIP, CRS offers participating communities up to a 45 percent discount on its premiums in return for measures a community takes over and above NFIP minimum standards.⁵¹⁷ The greater

⁵¹⁵ James G. Titus, *Rolling Easements* (Washington, DC: Environmental Protection Agency, Climate Ready Estuaries, 2011), <https://www.epa.gov/sites/default/files/documents/rollingeasementsprimer.pdf>.

⁵¹⁶ United Nations Office for Disaster Risk Reduction, *R!SE Disaster Risk-Sensitive Investments* (Geneva: United Nations Office for Disaster Risk Reduction, 2014), https://www.unisdr.org/files/37589_rseprogramsummary.pdf.

⁵¹⁷ Federal Emergency Management Agency, *National Flood Insurance Program: Community Rating System: A Local Official's Guide to Saving Lives Preventing Property Damage Reducing the Cost of Flood Insurance*, FEMA B-57 (Washington, DC: Federal Emergency Management Agency, 2015), https://cfcog.org/wp-content/uploads/2016/09/2015_NFIP_Small_Brochure.pdf.

the risk reduction measures, such as incorporating freeboard, the more resilient a community is to future risk. Besides the direct economic impact of lower insurance premiums, the CRS can also signal to investors the seriousness of society taking a future threat and steps it is willing to take now to mitigate against climate change and sea-level rise. Of the approximately 22,000 communities that belong to the NFIP, about 1,500 participate in the CRS program.⁵¹⁸ CRS is an important program and should be promoted and strengthened as it gives participating communities the voluntary mechanism to make risk-informed decisions for their communities.

Resilient Communities:

The framework aims to provide communities the tools to make long-term and informed decisions about their future to create more resilient places. Part of resiliency is the realization that at some point, it does not make fiscal or social sense to keep rebuilding more robust defenses or elevating buildings in high-risk areas. At some point, the best approach may be strategic retreat—however, the decision to retreat need not be binary. There are various approaches available, and rather than rely on de facto methods such as voluntary individual home buyouts, it may be worthwhile considering the suite of options identified in the framework. Even though voluntary home buyouts have worked in the past – albeit slowly – past performance is no guarantee for future success, especially in rapidly changing times.

Part of the adaptation strategy for communities is to rethink the purpose and timeline of strategic retreat and any buyout programs that may be part of the larger vision and plan. These programs at all levels and irrespective of funding source need to be examined as long-term adaptations to flood risk and not just short-term post-disaster recovery tools. Currently, funding for buyouts occurs after a disaster and FEMA’s biggest HMA program is the post-disaster HMGP. Absent a disaster, it is hard to motivate people

⁵¹⁸ Federal Emergency Management Agency, “Community Rating System Eligible Communities” (Washington, DC: Federal Emergency Management Agency, October 1, 2021), https://www.fema.gov/sites/default/files/documents/fema_october-2021-crs-eligible-communities.pdf.

to move and more challenging to fund strategic retreat. Disasters may offer opportunities such as greater funding, a unity of effort across agencies and stakeholders, and a sense of urgency. However, disasters are probably the worst time to undertake strategic relocation from a human perspective when lives are disrupted. After a disaster, there is a risk of picking the most expedient approach and such a tactic should be resisted. The extra time, money, and effort to attain greater resiliency is a worthier goal.

The best approach may be to plan for and undertake strategic retreat when there aren't disasters, actions are not reactive, and there isn't an emergency response to contend with. To shift the conversation from post- to pre-disaster funding is sound policy. Not only does mitigation pay for itself, but communities can avoid rash and impetuous decisions. With increased funding for FMA and BRIC as part of President Biden's infrastructure bill, greater sums of money are available for pre-disaster FMA and BRIC programs and to deal with climate change.⁵¹⁹ It is a step toward greater resiliency. However, in the near-term federal disaster funding will remain the most significant infusion of funds to implement strategic retreat. With the impetus to relocate after a disaster, strategic retreat can succeed even if carried out incrementally.

B. CONCLUSION

Rising disaster costs, an unsustainable NFIP, and demand several orders of magnitude larger than FEMA can currently deliver should compel the United States to start preparing for strategic retreat now. As seen in the few examples explored in this thesis, reasons prompting strategic retreat are varied and occur at different rates in different places. In some cases, as in Newtok and Isle de Jean Charles, retreat may be unavoidable; it may be a matter of choice in places like Princeville. What lessons do these examples offer for the many thousands, and perhaps millions, who may have no choice but to retreat soon? Each of the projects reviewed reflects an enormous investment of taxpayer dollars. They also represent a personal investment to relocate to a new area and a potential loss of place,

⁵¹⁹ "Infrastructure Deal Provides FEMA Billions for Community Mitigation Investments," Federal Emergency Management Agency, November 15, 2021, <https://www.fema.gov/press-release/20211115/infrastructure-deal-provides-fema-billions-community-mitigation-investments>.

history, and heritage that is harder to quantify. Besides sporadic financial investment, generally after a disaster, there doesn't currently exist a clear legal framework, a single entity, or a federal agency coordinating strategic retreat. The patchwork of funding sources and their timing adds to the complexity of the effort.

Why is it necessary for the federal government to be involved in home buyouts in the first place? Or broadly, even in retreat and relocation activities? There is the matter of alleviating human loss and suffering. But, from a financial perspective, if one is running a business, in this case, the NFIP, it makes sense to get rid of the worst performers. That is why for RL and SRL properties, FEMA's HMA program offers buyouts at 90 percent and 100 percent costs at pre-disaster appraised values. It makes financial sense. Moreover, FEMA spends far greater amounts on disaster relief, often in the same areas with the most critical and recurring risk. Search & rescue, evacuation, temporary relocation, food and shelter, and repair costs have steadily increased. GAO estimates that since 2005 disaster costs have exceeded \$450 billion.⁵²⁰ A 2019 CRS report concluded that "over the last six years, the DRF has required sustained high levels of appropriations, including three of its six highest total appropriations ever by fiscal year, even adjusting for inflation, and back-to-back largest annual appropriations in FY2018 and FY2019."⁵²¹ These are all costs with little return. In contrast, loss avoidance studies show that sometimes as little as a single event is enough to pay for the initial investment in mitigation.

FEMA may have limited options to restrict growth and redevelopment in high-risk areas. One mechanism is to charge insurance premiums commensurate with risk. However, raising flood insurance rates is politically unappealing. Another option is to deny disaster assistance to those who refuse to relocate, but this approach, too, carries political risk. If the federal government were to implement a program of strategic retreat through mandatory purchase by eminent domain, significant practical considerations would follow: What happens to the tax base of communities vacated; how is such a program carried out

⁵²⁰ Chris Currie, *Disaster Recovery: Recent Disasters Highlight Progress and Challenges*, GAO-20-183T (Washington, DC: Government Accountability Office, 2019), 1–2, <https://www.gao.gov/assets/gao-20-183t.pdf>.

⁵²¹ William L. Painter, *The Disaster Relief Fund: Overview and Issues*, CRS Report No. R45484 (Washington, DC: Congressional Research Service, 2020), 19, <https://sgp.fas.org/crs/homesecc/R45484.pdf>.

equitably; and, lastly, in which situations would relocation of a community, instead of individual home buyouts, be appropriate?

At present, FEMA's buyout program is voluntary, giving the homeowner all the time from initiation until closing (which could be two to five years later) to back out. Purchase through eminent domain is never a popular option, especially as states and locals could accuse the federal government of overreach and 'taking.' But are there certain conditions where this approach is necessary and justified, say in coastal barrier islands or a wildland-urban interface close to a densely populated area? The next few years will be pivotal in determining whether FEMA can continue to run a buyout program entirely voluntarily. And, if FEMA can continue to pay to reconstruct homes and infrastructure repeatedly after a disaster in the same areas. Even in the best circumstance, mustering the political will and resources to move people without a significant disaster voluntarily may be difficult. Social fragmentation, marginalization, erosion of cultural identity, and economic anxiety due to uncertainty and loss of livelihood may reasonably inhibit strategic retreat.⁵²² Strategic retreat from some extreme high-risk areas of the United States after a disaster may be inevitable and make the decision easier.

The adaptation framework advocates a combination of approaches. The right solution for a particular place and time may be a hybrid approach with the right mix of incentives for people to retreat and deterrents from rebuilding in high-risk areas. Comprehensive planning with phased incremental approaches to retreat may be the most appealing approach to avoid significant societal disruptions. Losing one's home and everything a community signifies in terms of social, cultural, and economic values can be traumatic for most. States must align their recovery and mitigation plans to consider the pervasive threats brought on by climate change, adjust their long-term goals and set realistic time frames.

Some states, such as Louisiana and New York, already do this. Rather than simply rely on post-disaster funding, the state has identified a list of willing RL and SRL homeowners ready for buyout. Louisiana regularly resubmits projects in subsequent years

⁵²² Oliver-Smith and de Sherbinin, "Resettlement in the Twenty-First Century."

if unsuccessful in any given year. In New York, 184 of the community's 185 residents had applied for relocation. By 2015, the State's NY Rising buyout program had accepted 180.⁵²³ Other success stories, such as ones in Brookhaven, New York, rely on active community engagement and participation. The most significant part of managing strategic retreat in Oakwood, Staten Island, was working with locals through community-led organizations who established trust with residents. These organizations guided homeowners to navigate difficult personal choices and helped them relocate from vulnerable coastal areas.⁵²⁴ Successful relocation programs result from considering the long-term interests of buyout participants. Vital is that a state's long-term adaptation plans are in place before a disaster occurs and does not rely simply on disaster funding for strategic retreat.

The federal government needs to continue providing incentives for people to eliminate or minimize risk, as local communities and individuals generally do not have the means to undertake these actions independently. Through the right combination of carrots such as grant money and sticks such as penalties for development in high-risk areas, the federal government can guide the nation towards greater resiliency. The local match often acts as an inhibiting factor in considering large-scale buyouts or strategic retreat. A state may choose to share its non-federal share with the local community in any manner they choose. As Louisiana experiences chronic flooding, the state offers primary homeowners the entire match amount in all its 51 parishes' home buyouts. Funded through its Restore LA program and the Louisiana Watershed Initiative, the programs take away the financial burden homeowners may feel in financing any portion of the buyout.⁵²⁵

Post-acquisition, partnerships with land trusts can be a powerful tool to reduce the administrative burden of maintaining the land in perpetuity as open space. The mission of

⁵²³ Katie Spidalier, Isabelle Smith, and Jessica Granni, *Managing the Retreat from Rising Seas: Lessons and Tools from 17 Case Studies* (Washington, DC: Georgetown Climate Center, n.d.), 119, https://www.georgetownclimate.org/files/MRT/GCC_20_FULL-3web.pdf.

⁵²⁴ Katie Spidalier, Isabelle Smith, and Jessica Granni, *Managing the Retreat from Rising Seas: Staten Island, New York: Oakwood Beach Buyout Committee and Program* (Washington, DC: Georgetown Climate Center, 2020), 1, https://www.georgetownclimate.org/files/MRT/GCC_20_Oakwood-4web.pdf.

⁵²⁵ "Statewide Buyout Program," Louisiana Watershed Initiative, accessed November 23, 2021, <https://watershed.la.gov/buyouts>.

land trust entities frequently aligns with the aims of a strategic retreat program. To preserve the environmental value of water and land are mutual benefits of such partnerships. There is greater realization and awareness that ecosystem services, things that possess intrinsic value, such as clean air and water, are not readily bought and sold in the marketplace. Consequently, communities often overlook their worth. The National Ecosystem Services partnership has published a guidebook to integrate ecosystem services into federal resource management.⁵²⁶ As strategic retreat increases in practice, there is value to losses avoided from repetitive destruction and rebuilding. However, the overlooked value of realized ecosystem services—the importance of restoring flood-prone land to nature—should not be ignored.

Unlike individual home buyouts, where the engagement with sellers generally ends with closing, strategic retreat is different. The program's success relies on remaining engaged with the community and helping them choose whether to stay within the municipality, relocate as a community, or individually relocate elsewhere. Often the interests of the participant in the buyout program and the city are aligned as there is a mutual benefit in maintaining social stability and retaining the local tax base. However, financial incentives alone are often not enough to motivate a homeowner to relocate when residents fear a loss of community. Social motivators, such as the availability of housing in a safer area but within the same municipality where communities can relocate together, can increase the success of strategic retreat, and foster long-term stability for participants. The complexity of the buyout process and the length of time the process can take require close collaboration between federal, state, and local governments and the homeowner. A standardized procedure that allows for coordination across boundaries and alignment across different programs yet maintains local implementation flexibilities is crucial to success. A predictable process devoid of bureaucratic complexity is possibly the single most significant factor determining the success of strategic retreat programs.

⁵²⁶ Lydia Olander, James Boyd, and Emily Schieffer, "Integrating Ecosystem Services into Federal Resource Management," National Ecosystem Services Partnership, accessed November 23, 2021, <https://nespguidebook.com/introduction/integrating-ecosystem-services-into-federal-resource-management-a-guidebook/>.

Even if carried out incrementally, strategic retreat must consider the problem of how to proactively deal with the nation's RL and SRL problem that grows each year. States can play an essential role by updating their hazard mitigation plans to reflect the current inventory of these properties. Instead of relying on expediency or political pressures, a systematic strategic retreat can prioritize RL and SRL property buyouts. However, strategic retreat cannot simply buy out the highest value properties and leave vulnerable populations behind. Strategic retreat also cannot target lower-income populations, communities of color, and otherwise disadvantaged people. As strategic retreat often involves multiple entities and various funding sources, implementing it will become even more challenging at the local level. It will require that the federal government offer direct technical assistance to small and impoverished communities to win grants. Where not a guarantor of success, such aid can help foster greater equity and level the playing field.

Retreat from coastal and riverine areas have differences, as does withdrawal from wildland-urban interfaces. But these differences pale when compared to diverse populations from varied cultural and socio-economic backgrounds forced to deal with retreat. The more pressing question is whether governments can quickly scale up lessons learnt from relocating smaller communities by multiple orders of magnitude. Even a relatively substantial undertaking of buyouts prompted by Hurricanes Sandy and Harvey meant the displacement of a few thousand homes. By 2100 it is estimated that internal climate refugees in the United States may be as high as 13.1 million, assuming a six-foot sea level rise.⁵²⁷ The impact represents trillions of dollars of investment in infrastructure and homes to make a large-scale retreat from places like New York, Miami, or New Orleans practically unthinkable. However, this investment, even if partially implemented, may well represent lives saved and losses avoided several magnitudes larger.

Should the United States consider strategic retreat purely in economic terms of losses avoided and positive benefit-cost ratios? Besides the financial considerations, strategic retreat must start with equity, social justice, and accruing ecosystem benefits.

⁵²⁷ Linda Poon, "Where America's Climate Migrants Will Go as Sea Level Rises," Bloomberg CityLab, February 3, 2020, <https://www.bloomberg.com/news/articles/2020-02-03/mapping-migration-in-the-face-of-climate-change>.

Based on recent examples of retreat, it is evident that both financial and non-financial criteria are critical to implementing a successful program. Ignoring one or the other can lead to polarization, gentrification, and unsatisfactory outcomes. There may be instances where it may be cheaper and easier to simply buy out individual homeowners and give them money to relocate wherever they wish. However, there is a possibility that people will simply relocate to other equally high-risk areas. Such an approach would also result in the community losing the intangible benefits of maintaining their cultural fabric, way of life, and in some instances, their source of livelihood. That would make society poorer. Communities must carry out retreat in a way that ensures equitable outcomes, promotes social and cultural bonds, protects the environment, and enhances resilience.

A 2002 publication by the John Heinz Center for Science, Economics and the Environment summarized that the human element above all other costs should be paramount when tackling community resilience. Coasts are increasingly populated, putting an ever more significant number of people at risk. Science has not found effective methods to reduce hazards – only better ways to mitigate them by building safer buildings and more robust infrastructure. These practices ultimately determine a community’s resilience.

A vital part of effective disaster planning—whether for mitigation, preparation, response, or recovery—is an understanding of the people and institutions that make up each community, including their strengths and their weaknesses, as a basis for developing policies, programs, and practices to protect them. In the end, it is human decisions related to such matters as land use planning and community priorities that will build stronger, safer, and better communities.⁵²⁸

Ultimately, it is an individual’s responsibility to choose personal safety and reduce damage to their personal property. However, the government’s responsibility is to put policies and mechanisms in place to make such decisions easier and reduce suffering and loss of citizens’ lives. Despite the considerable financial incentive through grants offered by the

⁵²⁸ G. William Miller et al., *Human Links to Coastal Disasters* (Washington, DC: The H. John Heinz III Center for Science, Economics and the Environment, 2002), 12–13, <https://research.fit.edu/media/site-specific/researchfitedu/coast-climate-adaptation-library/united-states/national/us---heinz-center-amp-nwf-reports/Heinz-Ctr.-2002.-US-Human-Links-to-Coastal-Disasters.pdf>.

federal government, mitigation can take time, and why added urgency to act now is warranted.

Why is strategic retreat important to Homeland Security? This thesis has argued FEMA's approach to home buyout is too timid. Buying piecemeal homes creates checkerboarding and does not, in any meaningful way, change the risk profile of a community. Often, dozens of houses are not acquired next to a vacant lot. It is only a matter of time before the next disaster will damage these homes again. Or, as seen in the case of Houston will potentially be re-developed by an investor and gentrified. If one thinks the approach to buyouts by the federal government is timid, a clear path to strategic retreat is practically non-existent. There isn't a single agency in charge of a systematic effort to relocate a high-risk community. A complicated topic is governed by competing laws, jurisdictions, and a patchwork of inadequate and piecemeal funding, with the outcome often being "too little, too late."

This thesis has only examined strategic retreat from rising seas and floods. Long-term visioning of the acquired land is essential. Returning the land to nature with allowable public recreational uses is best, especially in conjunction with broader regional plans. If local governments do not repurpose the land imaginatively, the result could be blighted properties, an eyesore, and long-term maintenance nightmares for the municipality. A poor land-use plan could have the detrimental impact of eroding trust and confidence in the local government. Fortunately, there are excellent examples to emulate. The City of Fargo, North Dakota, since 1997, has acquired over 200 flood-prone properties along the Red River, converted them into parks, and connected them to over 150 miles of regional scenic paths and trails.⁵²⁹ Also, this thesis has focused on areas of retreat. Less attention is devoted to receiving areas. There are few such examples with enough historical context to draw broad policy and implementation lessons.

The consequences of climate change are at a complex intersection of the built environment, population densities, land-use patterns, socio-economic decisions, cultural

⁵²⁹ "Parks & Facilities," Fargo Parks District, accessed November 23, 2021, <https://www.fargoparks.com/parks-and-facilities>.

norms, and dozens of other factors determining where the human species has chosen to live for centuries. Human activity influences climate change, but it is myopic to decide on future action on a mathematical equation of loss to property and life. Benefit-cost ratios alone cannot dictate mitigation measures. The human costs are actual, far-reaching, beyond benefit-cost ratios, and frequently extend beyond the geographic area impacted by a disaster. People and places will not feel the impact of climate change uniformly everywhere nor simultaneously.

There are problems with FEMA's approach to home buyouts that focus on risk-reduction. An unintended consequence of this focus is that HMA treats populations inequitably. Simply addressing the monetary value of structures and higher benefit-cost ratios leads to the outcome that bigger, more affluent homes get elevated or acquired before smaller, poorer homes in flood-prone areas. A recent investigative report found that even if federal grants are "designed to avoid picking winners and losers, it ends up doing so anyway, favoring wealthier neighborhoods."⁵³⁰ The HMA program also does not mitigate rental structures, thereby disadvantaging more impoverished populations.⁵³¹ FEMA's programs affect the poor and minorities in a disproportionate manner.

It will take vigilance from regulators to ensure that the wealthy and able don't continue living in high-risk areas and the public continues footing the bill. Nor should strategic retreat force minorities, tribal nations, and native villages to relocate and struggle to maintain their sense of community and identity. Coastlines are sites of high value throughout the world due to their intense use for habitation, recreation, and conservation. They often end up being contested territories. Where inequities exist within the U.S., the situation around the globe is much worse as climate change does not discriminate among nations and rising seas are oblivious to political boundaries.

The United States is a wealthy country and well-equipped to prepare for and mitigate against climate change and rising seas. Climatic changes will affect places in the

⁵³⁰ Hersher and Benincasa, "How Federal Disaster Money Favors the Rich."

⁵³¹ Federal Emergency Management Agency, "Homeowner's Guide to the Hazard Mitigation Grant Program" (Washington, DC: Federal Emergency Management Agency, 2016), 2, https://www.fema.gov/sites/default/files/documents/fema_homeowners_guide_hazard_mitigation_grant_program_11-04-16.pdf.

world that are far less able to cope with their impacts. Recovery from disasters in many parts of the world will take longer. Worse, many countries cannot afford to rebuild in a resilient manner, safeguard against future losses and provide for the safety of their citizens. Many Pacific and the Indian Ocean islands are at risk of disappearing, and for whom the threat may already be here.⁵³² Many South Asian nations face the calamity of large portions of their population left homeless due to rising seas, drought, and desertification and staring at a hopeless future. This dystopian view is not one in the distant future. These changes are upon us and getting worse each successive year.

A hopeful vision can temper this bleak future. One cannot control climate change, but collective resolve among nations can slow its acceleration. In rare glimpses of optimism, there is a boom in renewable energy sources and indications that global emissions may be plateauing.⁵³³ Even though extreme weather events are becoming more common, better forecasting, warning systems, and resilient structures result in fewer deaths.⁵³⁴ The world is getting better at adapting. Sound policies can lead to timelier risk mapping and enhanced risk awareness. They may also lead to more robust building codes and better land-use and floodplain management. Optimistically, someday, these policies may also result in fiscally responsible flood insurance.

Finally, it may lead to a realization that mitigation measures that may have worked a mere half-century ago cannot keep up. Scaling up these efforts will help but will not solve the problem. Voluntary buyouts may simply be one among a suite of options identified in the adaptation framework that high-risk localities must consider. Mechanisms such as strategic retreat, not actively pursued up to now, may need to be the start of conversations regarding resilient communities rather than an option of last resort. Programs must consider social justice, and equity issues as the United States moves beyond individual home

⁵³² Hussain Rasheed Hassan and Valerie Cliff, “For Small Island Nations, Climate Change Is Not a Threat. It’s Already Here,” World Economic Forum, September 24, 2019, <https://www.weforum.org/agenda/2019/09/island-nations-maldives-climate-change/>.

⁵³³ James Temple, “The Rare Spots of Good News on Climate Change,” *MIT Technology Review*, December 23, 2021, <https://www.technologyreview.com/2021/12/23/1042973/climate-change-action-progress-clean-energy/>.

⁵³⁴ Hannah Ritchie and Max Roser, “Natural Disasters,” *Our World in Data*, June 3, 2014, <https://ourworldindata.org/natural-disasters>.

buyouts to relocation to strategic retreat. Regardless of the community's specific approach, time is upon us. The world is already in an age of climate change that threatens to get exponentially worse.

APPENDIX A. NATIONAL REPETITIVE LOSS PROPERTIES TRENDS

Nationally, the trend of properties categorized by the NFIP as Repetitive Loss Properties is on the rise. As the table below depicts, although there is variation among individual states, cumulatively the trends are upward, and in some cases such as Texas, significantly higher. As these high-risk properties account for some of the largest losses to the NFIP, and the greatest suffering, FEMA prioritizes buying out such properties each year through its HMA program. However, buyouts are not keeping up with new repetitive loss properties added to the rolls each year as seen in the 5-year comparison below.

Table 9. National Repetitive Loss Property Trends, 2015–2019⁵³⁵

	FMA RL (Insured, Unmitigated)					
State	Trend	FY15	FY16	FY17	FY18	FY19
TX	Up	2,143	2,612	3,318	8,933	8,299
LA	Up	5,824	5,563	6,223	6,105	5,827
NJ	Dn	1,719	1,577	1,413	1,342	1,238
NY	Dn	1,188	1,122	1,070	1,044	1,031
NC	Up	312	308	439	407	859
FL	Up	842	784	1,015	1,603	1,673
PA	Dn	656	620	503	469	465
VA	Dn	333	322	333	303	314
MA	Up	68	83	75	74	121
AL	Dn	377	356	342	348	325
MO	Up	239	216	276	343	296
MS	Up	308	288	277	297	312
IL	Dn	180	162	143	137	132
CT	Dn	258	233	227	212	185
CA	Dn	159	152	161	153	150
SC	Up	14	42	169	215	297
KY	Up	128	152	135	131	164
OH	Dn	92	96	83	79	83
IN	Up	89	94	86	84	127

⁵³⁵ Source: Author’s analysis. Data resides behind FEMA’s firewall and not publicly available. The author would like to acknowledge and thank FEMA specialist Mr. Brandon Sweeza for the analysis.

	FMA RL (Insured, Unmitigated)					
State	Trend	FY15	FY16	FY17	FY18	FY19
WV	Dn	80	76	85	78	74
GA	Up	107	101	119	169	163
WA	Dn	136	129	110	105	88
OK	Up	61	83	80	82	72
AR	Up	68	64	73	100	89
TN	Dn	55	50	47	46	46
IA	Up	39	34	53	49	49
MD	Up	38	38	35	37	44
DE	Dn	13	12	13	12	12
RI	Dn	26	26	23	21	20
PR	Up	6	5	3	5	8
MI	Up	16	14	11	14	30
ME	Up	5	5	4	6	7
OR	Dn	33	31	34	34	30
KS	Up	16	16	22	20	23
HI	Up	1	1	2	2	5
NH	Up	13	13	10	15	19
MN	Dn	14	11	12	11	10
WI	Up	9	5	6	10	12
NE	Dn	2	3	3	2	1
VI	Dn	3	1	1	1	1
NV	Up	2	2	2	2	3
CO	-	1	1	1	1	1
NM	-	1	1	2	1	1
ND	Dn	5	5	3	3	3
AK	-	1	2	2	2	1
DC	-	0	0	0	0	0
SD	Dn	2	2	0	0	0
VT	Dn	6	6	5	5	5
AZ	Dn	6	5	2	2	1
MT	Dn	3	2	2	2	1
ID	-	0	0	0	0	0
UT	-	0	0	0	0	0
WY	-	0	0	0	0	0
US Total	Up	15,697	15,526	17,053	23,116	22,717

APPENDIX B. NATIONAL SEVERE REPETITIVE LOSS PROPERTIES TRENDS

Nationally, the trend of properties categorized by the NFIP as Severe Repetitive Loss Properties is on the rise. As the table below depicts, although there is variation among individual states, cumulatively the trends are upward, and in some cases such as Texas, significantly higher. As these high-risk properties account for some of the largest losses to the NFIP, and greatest suffering, FEMA prioritizes buying out such properties each year through its HMA program. However, buyouts are not keeping up with new severe repetitive loss properties added to the rolls each year as seen in the 5-year comparison below.

Table 10. National Severe Repetitive Loss Property Trends, 2015–2019⁵³⁶

	FMA SRL (Validated, Insured, Unmitigated)					
State	Trend2	FY15	FY16	FY17	FY18	FY19
TX	Up	1477	1631	1868	2991	2827
LA	Dn	2492	2337	2333	2294	2105
NJ	Dn	1908	1748	1535	1401	1323
NY	Dn	1060	1018	950	935	939
NC	Dn	403	401	459	438	771
FL	Up	650	627	638	750	742
PA	Dn	545	519	461	443	449
VA	Dn	405	407	431	392	398
MA	Up	256	271	262	259	321
AL	Dn	307	295	287	303	297
MO	Dn	220	209	197	234	213
MS	Dn	213	203	197	188	187
IL	Up	174	174	169	162	176
CT	Dn	210	198	186	178	175
CA	Up	163	165	181	183	174
SC	Up	31	47	106	156	172
KY	Up	141	162	139	131	149
OH	Up	108	113	98	99	110

⁵³⁶ Source: Author’s analysis. Data resides behind FEMA’s firewall and not publicly available. The author would like to acknowledge and thank FEMA specialist Mr. Brandon Sweeza for the analysis.

	FMA SRL (Validated, Insured, Unmitigated)					
State	Trend2	FY15	FY16	FY17	FY18	FY19
IN	Up	74	72	70	61	84
WV	Dn	70	62	63	60	65
GA	Up	50	46	55	64	62
WA	Dn	77	75	63	57	58
OK	Dn	51	60	62	57	54
AR	Up	37	33	40	45	50
TN	Dn	51	51	52	48	43
IA	Dn	48	43	37	34	42
MD	Dn	31	30	29	26	28
DE	-	23	19	26	22	23
RI	Dn	29	27	25	22	22
PR	Dn	30	21	12	18	20
MI	Up	11	11	11	13	18
ME	Up	8	8	9	9	13
OR	Dn	13	10	14	13	12
KS		8	9	10	10	12
HI	Up	9	10	11	11	12
NH	Dn	15	12	8	11	9
MN	Dn	11	10	9	9	9
WI	-	8	8	7	11	8
NE	-	5	5	6	4	5
VI	Dn	4	3	1	2	3
NV	Up	1	1	2	2	2
CO	-	2	2	1	2	2
NM	Up	1	1	2	2	2
ND	Up	0	0	0	1	1
AK	Up	0	1	1	1	1
DC	-	1	1	1	1	1
SD	-	1	1	1	1	1
VT	Dn	1	1	0	0	0
AZ	Dn	1	1	2	2	0
MT	-	0	0	0	0	0
ID	-	0	0	0	0	0
UT	-	0	0	0	0	0
WY	-	0	0	0	0	0
US Total	Up	11,434	11,159	11,127	12,156	12,190

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