



# Envisioning Rational Retreat

Investigating Solutions for Federal Managed  
Retreat from Sea Level Rise



PREPARED BY  
Molly Brind'Amour

PREPARED FOR  
Future of Land and  
Housing Program

# TABLE OF CONTENTS

<b>TABLE OF CONTENTS</b>	<b>2</b>
<b>EXECUTIVE SUMMARY</b>	<b>3</b>
<b>DISCLAIMER</b>	<b>3</b>
<b>ACKNOWLEDGEMENTS</b>	<b>4</b>
Client: Future of Land and Housing at New America	4
<b>BACKGROUND</b>	<b>4</b>
Cost to Society	6
<b>LITERATURE REVIEW</b>	<b>9</b>
<b>EXISTING EVIDENCE</b>	<b>11</b>
The Psychology of Relocation	11
Gaps in the Literature	12
Analyzing Effectiveness of Retreat Strategies	13
<b>ALTERNATIVES</b>	<b>16</b>
<b>CRITERIA</b>	<b>19</b>
<b>FINDINGS</b>	<b>21</b>
Assumptions:	21
ALTERNATIVE 1: INCREASING FLOOD INSURANCE RATES	22
ALTERNATIVE 2: EXPANDING FEMA HOME BUYOUTS	24
ALTERNATIVE 3: INTRODUCING NATIONWIDE SETBACK LAWS	26
<b>RECOMMENDATION</b>	<b>27</b>
<b>IMPLEMENTATION</b>	<b>28</b>
<b>CONCLUSION</b>	<b>30</b>
<b>WORKS CITED</b>	<b>31</b>
<b>APPENDIX</b>	<b>43</b>
Appendix A: Outcome Matrix	43
Appendix B: Cost-Effectiveness Calculations	44
Appendix C: Equity Matrixes	47
Appendix D: Feasibility Matrixes	51

## EXECUTIVE SUMMARY

As rising sea levels threaten coastal communities across the world, it is becoming increasingly imperative that communities plan to relocate people and property from areas that will no longer be fit for habitation. In order to do this successfully, the U.S. must develop a federal policy that begins the process of managed retreat from areas soon to be subject to sea level rise. I outline three alternatives for beginning federal managed retreat in the United States:

1. Increasing national flood insurance rates for areas at risk of sea level rise
2. Expanding federal buyouts of at-risk properties
3. Establishing nationwide setback zoning that prohibits development or expansion within the most at-risk zones for sea level rise

After considering cost-effectiveness, economic equity, and administrative & political feasibility, my ultimate recommendation is that the U.S. government pursues a nationwide setback zone in areas expected to be inundated with sea level rise by 2100.

## DISCLAIMER

The author conducted this study as part of the program of professional education at the Frank Batten School of Leadership and Public Policy, University of Virginia. This paper is submitted in partial fulfillment of the course requirements for the Master of Public Policy degree. The judgments and conclusions are solely those of the author, and are not necessarily endorsed by the Batten School, by the University of Virginia, New America Future of Land and Housing Program, or by any other agency.

## ACKNOWLEDGEMENTS

I would first like to thank Yuliya Panfil at New America for all the guidance, communication, and inspiration for this project. Profs. Wyckoff and Tello-Trillo at Batten were instrumental in guiding me through the writing process, and Prof. Beatley and his Coastal Resilience class always brought me fresh perspectives and ideas. I couldn't do this without support from my friends and family — I'm particularly grateful to Jane Ann and Andrea for the late-night commiseration, Erin and Emily for their encouragement via Whatsapp, and Jon for making me laugh even on the worst work days.

## Client: Future of Land and Housing at New America

This project is prepared for the The Future of Land and Housing program at the think tank New America, which provides research and writing aiming towards the resolution of housing, land and property rights challenges (*Future of Land and Housing*, n.d.). The program and its staff have released a number of written products relating to the practicalities and necessity of managed retreat, both through opinion and research pieces. While the Future of Land and Housing program is not the agent that would be enacting federal managed retreat policy in the U.S., they serve as one of a limited number of entities that's doing meaningful, public-facing work into the realities of managed retreat in the U.S. This policy analysis will provide further insight for the Future of Land and Housing program to use for their continued writing and research.

## BACKGROUND

America, and the world at large, is facing a grave and terrifying problem: seas are rising due to climate change, and we aren't sufficiently prepared to protect people and property from the damages rising tides will wreak. Sea level rise is now accelerating faster than it has historically, with a current rate of about one inch of sea level rise each year (SeaLevelRise.org, n.d.). The **long-term consequences** are shocking: in America alone, 13 million people are expected to be displaced from their homes by 2100 due to sea level rise (Science Daily, 2020). What's more, there is \$1.4 trillion in real estate located within 700 feet of a coast (A. R. Siders, 2019).

The term **managed retreat** refers to the process of using coastal management tools to move development away from potential hazards, like eroding coastlines (W. J. Neal et al., 2005). In the context of this problem, managed retreat means finding ways to relocate Americans away from low-lying areas that will be frequently subjected to sunny-day flooding as sea levels rise. Without managed retreat, homes may simply be abandoned when tragedy strikes, as in Hurricane Katrina, leading to losses in property tax rates, visible blights on the community, and economic losses for former owners (A. R. Siders, 2019). The loss of human life due to sea level rise is distressing, too. Even after excluding lives lost due to tropical cyclone activity, sea level rise *alone* is expected to contribute to between 84 and 277 additional deaths in the United States by 2100. As the study author indicates, adaptation, including retreat, would decrease these numbers (Adachi, 2015).

When it comes to sea level rise, Florida, North Carolina, Boston and New Orleans are expected to be particularly affected (Science Daily, 2020). Due to tectonic plate activity, the

Gulf and East Coast are expected to experience more acute sea level rise than the West Coast (SeaLevelRise.org, n.d.). Because of the geographic differences in threat from sea level rise, lack of federal policy on managed retreat will be especially problematic for certain **subpopulations**. U.S. coastal counties are 48% nonwhite, indicating the importance of creating adaptation plans that address the “deeply racialized history” of coastal communities (Hardy et al., 2017). What’s more, current home buyout programs (which can be a form of retreat) correlate strongly with higher racial diversity and lower home value, while shoreline armoring (a form of remaining in place) has been chosen in less diverse areas with higher home values (Allen, n.d.).

Currently, there are no federal policies in place for pre-disaster managed retreat. Although FEMA funds a small number of voluntary buyouts, these only occur after a disaster, with no plan for pre-emptive buyouts (Panfil, 2020). One reason why federal managed retreat hasn’t been implemented yet is because it is still a “taboo subject” for politicians of both parties; it forces people to consider that trillions of dollars of property may be located in areas that will soon be uninhabitable (Teirstein, 2021). Furthermore, strict protections of property rights and high levels of coastal development have made managed retreat a difficult subject to broach (A. R. Siders, 2019). However, the absence of precedent shouldn’t be seen as a limiting factor. As I’ll discuss in my literature review, retreat from rising tides is becoming increasingly popular in other coastal regions, and the absence of discussion and planning for managed retreat in the U.S. only underscores the importance of such a policy.

Although managed retreat can occur at the local level, the consequence of not developing comprehensive federal guidelines is that states, cities and counties could end up managing retreat ineffectively due to lack of funds and information, or choosing not to retreat at all, costing more money and lives down the line. Of course, managed retreat would be impossible without **government intervention**, given that many people do not have the knowledge, resources or support to voluntarily relocate. A representative survey of Panama City, Florida found that “people with college degrees do not want to relocate voluntarily,” with survey respondents listing high relocation costs and social ties as reasons they might choose not to move (Song & Peng, 2017). Therefore, developing managed retreat at the federal level seems the best possible way to ensure it actually occurs.

Managed retreat policy, for the purposes of this problem statement, falls under the federal **government’s jurisdiction**. Yes, the retreat of individual communities will likely also involve a lot of city and state governance. But federal-level policy guidance is necessary in order to help provide some standardization in protocol, and using federal policy levers rather than local levers allows access to unique types of retreat incentivization, like

adjustment of federal flood insurance premiums. Furthermore, it's fair to say that the U.S. federal government has an obligation to use its resources and expertise in order to prevent serious tragedy from occurring, which is almost certain if managed retreat is conducted improperly.

Currently, 40% of Americans live in coastal counties (US Department of Commerce, n.d.), which should be setting off alarm bells, given the dire sea level rise projections expected in the future. Despite the number of Americans (and key American cities for economy and culture) located near a floodplain, the United States has not established any federal policy on whether and how communities should conduct managed retreat. Without incentivization, or at least guidance, the retreat that communities will conduct is likely to be inequitable, expensive, dangerous, or nonexistent.

But failing to conduct a managed retreat is not an option. In climate change adaptation literature, authors are in agreement that certain communities will eventually become uninhabitable or “too vulnerable” due to rising sea levels (Braamskamp & Penning-Rowsell, 2018; Dannenberg et al., 2019; Mach et al., 2019; A. Siders, 2013), leaving managed retreat as an essential adaptation strategy (Carey, 2020; Lawrence et al., 2020; A. Siders et al., 2021). Thus, we must determine how to best guide managed retreat on a federal level. Failure to do so will result in enormous costs.

**Problem Statement:** *With sea levels projected to rise at least 20 inches by 2100 (New Study Warns That Sea Levels Will Rise Faster than Expected, 2021), estimates suggest that coastal flooding will cause \$14.2 trillion in property loss and damage by the end of the century (Regan, 2020). Because federal policymakers lack a consensus on how to best conduct “managed retreat” for coastal property projected to become uninhabitable, American coastal communities are at risk of extreme physical and economic destruction.*

## Cost to Society

For the purpose of this report, the costs of failing to create federal policy for managed retreat in America will be encapsulated by the cost of sea level rise in America, assuming no managed retreat is taken. There are other measures that will likely be taken to address the threat of rising sea levels, like building sea walls and hardening shorelines. However, mitigation measures like beach nourishment won't always be feasible, and shoreline hardening options can actually exacerbate shoreline erosion (W. Neal et al., 2017). Another factor to consider is the **time horizon** of analysis. The year 2100 will be used for the sake of convenience in this short report, but it's important to note that costs would continue to accrue past that year, providing that no policy is put in place to make managed retreat

efficient. Finally, the costs discussed in this memo will attempt to **exclude natural disaster events**, such as hurricanes, because managed retreat is intended as a long-term solution to overall higher sea levels, not particular disaster events.

The **direct costs** of rising sea levels will include the property damage and loss of life associated with sea level rise flooding. Human costs are estimated by Yosuke Adachi in “Human Lives at Risk because of Eustatic Sea Level Rise and Extreme Coastal Flooding in the Twenty-First Century.” Adachi estimates between **84 and 277 deaths** in the U.S. by the year 2100 exclusively due to “extra coastal flooding”(Adachi, 2015). Using the EPA’s current value of statistical life calculation (US EPA, 2014), that amounts to a window of roughly **\$621.6 million to roughly \$2.1 billion** in lost lives. It’s important to note that this calculation does not account for the future cost accounting that will need to be conducted to compare the cost of lives lost sooner to those lost later. While the property component is difficult to measure, one older report estimates a range between **\$20 billion and \$150 billion** by 2100, accounting for 50 cm of global sea level rise (Neumann & Yohe, 2000). However, recent NOAA global sea level projections indicate the possibility of 6.6 feet (or 201 cm) of global sea level rise by 2100 (Lubchenco & Dietrick, 2012), which would indicate that these costs could be much higher.

Unfortunately, low-income residents are likely to be some of the most **vulnerable groups** if managed retreat isn’t conducted. One study found that “by 2050, most coastal states are estimated to have at least some affordable housing units exposed to flood risk events at least four times per year,” with some cities like Crisfield, Maryland and Revere, Massachusetts seeing over 90% of their affordable housing stock exposed (*Amid a Worsening Climate Crisis, How Can Coastal Cities Protect Affordable Housing?*, 2021). This indicates that the costs of failing to manage retreat won’t be equally borne by all coastal residents.

The largest **opportunity cost** associated with sea level rise flooding is the GDP decrease associated with sea level rise flooding. One paper, accounting for factors like individual migration decisions and economic adaptation, indicates a decrease in U.S. real GDP per capita due to sea level rise to be about .1% from 2020 to 2100 (Desmet et al., 2018).

With 2020 GDP per capita set at \$65,593.444 (*GDP per Capita (Current US\$) - United States | Data*, n.d.), a .1% decrease would bring per capita GDP in 2100 to \$65,527.851, barring any other changes outside the scope of the paper. With a U.S. population of 331,449,281 in 2020 (*United States of America*, n.d.), such a per capita decrease would amount to about **\$21.7 billion**, total.



Further study into the paper's calculation methods and developing an equation to accurately capture the total GDP loss over the time window, along with projected population changes would provide a more nuanced picture of externality costs. The current figure is intended to serve as a benchmark to indicate the gravity of the situation and the importance of acting to create nationwide managed retreat policy.

I believe that the last estimate also captures the **opportunity cost** of rising sea levels, because it accounts for the opportunities for economic growth that will be foregone if the U.S. chooses not to adapt to rising sea levels. A classic opportunity cost is the time and labor spent to fortify coastal infrastructure within a flood zone, labor which could have been spent on other important projects like improving transit or relieving student debt. If managed retreat was conducted completely and quickly, there would be no need to fortify areas in flood zones. But in the absence of managed retreat, in order to protect coastal communities, it is expected that the U.S. would need about **\$400 billion** in order to build sea walls to protect coastal communities by 2040, which would also be about the price of building the entire interstate highway system (Morrison, 2019). It's important to note that the costs of sea walls by the year 2100, our benchmark year, could likely be much more, given that these would need to be repaired or replaced given the even higher rise of tides.

It's also important to note that adaptation factors like these aren't accounted for in estimates like Desmet et. al's, which could mean that GDP decreases aren't as severe, if flood walls are able to protect certain investments. This may also mean some short-term prevention of loss of life, and perhaps lower human costs than those articulated earlier, at least in the 100-year time horizon. However, because sea level rise shows no sign of stopping, it's very possible that even these flood walls will no longer be viable in the long term, leading to eventual GDP decreases as areas are forced to be abandoned. Also, when fortifications like sea walls start to fail, if we haven't conducted managed retreat, then it seems like the human and property costs "saved" by the sea wall are merely delayed.

What's more, the \$400 billion in sea wall costs is still expected to be a "deliberate underestimate," because it doesn't account for measures like stormwater system improvement or home buyouts (Morrison, 2019). Although this may be considered an externality cost, I conceive it as an opportunity cost, given that it robs us of the opportunity to invest that capital in long-term investments that won't be destroyed.



Type of Cost	Cost Estimate/Range
Direct Costs	\$20.6 billion - \$152.1 billion
Opportunity Costs	\$421 billion
<b>Total Approx. Cost to Society</b>	<b>\$441.6 billion - \$573.1 billion</b>

Based on these very rough costs, we see an approximate cost to society of failing to federally plan for managed retreat of at least \$441.6 billion by the year 2100. As I've noted in this review, this is likely a somewhat conservative and still rough estimate, and further research should yield more exact numbers on the true cost of this problem.

## LITERATURE REVIEW

While about 1.3 million people have been relocated globally in the last 30 years as “managed retreat” from “geological hazards,” much of this has not been planned (Lawrence et al., 2020). However, one possible **comparison** could be the case of the Republic of Kiribati, which has purchased land for relocation and is creating workforce training programs, since its territory is expected to become submerged (Science Daily, 2021). Meanwhile, England’s small-scale “roll-back” relocation policy has been used to relocate individual single houses from rapidly eroding areas, with varying compensation schemes (Thaler, 2021). The concept of spending large amounts of money and time to relocate communities before a disaster is in view generally seems difficult, which is one reason why few examples of large-scale, pre-emptive managed retreat exist.

The concept of managed retreat is still relatively unfamiliar to many constituents. A Google Trends snapshot of the phrase as a search term indicates that there were many periods in the last five years when there simply wasn’t enough data to calculate the term’s popularity (*Managed Retreat*, n.d.). Managed retreat is becoming increasingly **politically salient**, with the topic coming up at CNN’s 2019 Climate Town Hall. In response, candidate Bernie Sanders admitted “I don’t think it makes a lot of sense to rebuild that house so it is knocked down again in the next storm.” Then-candidate Joe Biden, meanwhile, danced around it: “We have to be in a position where we build back, we don’t build back to normal, we build back to what is necessary” (Simon, n.d.). Even if managed retreat hasn’t quite penetrated the cultural lexicon yet, coastal cities are choosing to invest in infrastructure to shield against rising tides (Love, n.d.), indicating, at least, that Americans are beginning to recognize the importance of taking action now to protect against future damage.

There are a few pieces of scholarship that provide us guidance on what types of strategies might be **legally feasible** for implementing managed retreat. For one, we can note the Army Corps of Engineers' 2015 clarification of its flood mitigation policy, which made flood mitigation funding contingent on "municipalities' agreement to use eminent domain to relocate households if necessary" (Cheng, 2021). Using eminent domain to make household relocation compulsory would require three things in order to be legal: that homeowners are forced to leave, that the land will now be used for a better "public use," and crucially, that "just compensation" of fair market value is offered to the homeowner (Cheng, 2021).

Even less straightforward methods of managed retreat must still follow the principles of eminent domain. Certain restrictions and exactions that could be used for managed retreat, like making a property owner grant a conservation easement, will need to do three things. They must serve the public, provide a public benefit proportional to the private burden, and (in the case of an exaction) not "condition a permit on the performance of some unrelated task" (A. Siders, 2013). Even a regulation can test the limits of eminent domain, with legal precedent from *Lucas v. South Carolina Council* allowing landowners to receive government compensation for regulations that completely remove the property's economic value (A. Siders, 2013).

The **financial cost** of conducting managed retreat continues to complicate matters, even if legal challenges are worked around. Conducting managed retreat by relocating even just one tenth of the buildings located within 700 feet of the U.S. coast would cost \$140 billion (A. R. Siders, 2019). If the financial responsibility were levied unto states and communities to relocate themselves according to federal guidelines, it is almost certain that liquidity-constrained cities and states would refuse to subsidize relocation of at-risk communities. If the entire managed retreat process was financed by the federal government, meanwhile, there would likely be extreme amounts of pushback from "unaffected" constituents in land-locked states, who may view coastal residents as selfish risk-takers, undeserving of precious, limited tax dollars. The relocation process would undoubtedly plunge the U.S. further into debt, but the costs of not retreating and allowing current coastal communities to be battered by sea level rise would be far, far worse.

The main challenge in making federal managed retreat a priority for funding is the forward-looking nature of the problem. Many citizens will be reluctant to see their tax dollars go toward relocating people away from a disaster that hasn't yet struck, especially when issues like malnutrition and healthcare gaps seem much more visible and pressing. Many people who may be expected to help pay for managed retreat programs will not live

long enough to see these programs to completion, or to see the sea level rise that managed retreat aims to protect against.

Unfortunately, managed retreat is not a solution that will become **obsolete** any time soon. While temporary mitigation measures like sea walls and floating cities may come into vogue in the coming years, they only serve to delay (or in the case of sea walls, accelerate) the inevitable need to retreat away from areas that will be erased by the ocean. The question is not whether retreat will occur in the coming years, but whether that retreat will be managed or hasty.

## EXISTING EVIDENCE

### The Psychology of Relocation

Up to 340 million people could be displaced by 2050 due to sea level rise and flooding, given high emissions, indicating the scale and timeline at which global managed retreat will need to occur in order to avoid sudden crises (Ajibade et al., 2020). Complicating matters, however, is the prevailing notion that managed retreat is politically repulsive (Carey, 2020), considered a form of “unacceptable defeat” by some (Braamskamp & Penning-Rowsell, 2018).

One study indicated the existence of so-called “unaware individualists,” people at risk of flooding who experience “**optimism bias**” and underestimate their flooding risk, opposing the relocation of their houses (Dachary-Bernard et al., 2019). Other psychological and personal barriers to retreat include job prospects, place attachment/cultural ties, and simply enjoying the views and recreation of living near the water (A. R. Siders, 2019). Siders notes psychological incongruities like cognitive biases that discount previous flood experience due to place attachment, a “status quo bias” against pursuing any new action, and her conception of “nostalgia bias,” where people resist managed retreat in the hopes that they will somehow return to a world where such retreat isn’t necessary (A. R. Siders, 2019).

Any managed retreat strategy that depends on individuals surmounting such challenges will need to employ **psychological strategies** that encourage people to stop discounting the future so severely. Several interventions that can encourage people to do so include providing concrete and vivid realizations of one’s future self, reinforcing similarity between current and future selves, and highlighting positive traits of the future self (Molouki, 2016). Lynch and Gauberman’s review of time in decision-making notes that pre-commitment

devices, where humans impose penalties on themselves that make it harder to deviate in the future, can be functional tools (Lynch & Zauberman, 2006). They also note that “from a public policy perspective...internal self-control and externally induced self-control are substitutable,” indicating that people will reduce the self control they use when provided with a sufficient extrinsic motivator (Lynch & Zauberman, 2006). Psychological concepts like these could be used in managed retreat strategies: for example, buyout contracts of at-risk properties could be drawn up to not execute until, say, 10 years into the future, allowing residents to make a wise choice now that they will be unable to deviate from later.

Despite objections to the idea of relocation, successful managed retreat policy will require a certain degree of **community buy-in**. Consensus has been built around the importance of engaging members of the public in the decision making process for managed retreat (Alexander et al., 2012). Managed retreat literature also makes frequent references to the importance of equity and distributive justice (A. Siders et al., 2021), which is especially essential given the deeply disruptive effects managed retreat can have on health, economies and culture (Dannenbergh et al., 2019). With the U.S. currently lacking any meaningful federal policy guidance for conducting managed retreat, strategies that help incentivize and encourage (pre-emptive) managed retreat will be invaluable to study.

## Gaps in the Literature

Building a body of literature to analyze potential ways the U.S. could successfully implement federal managed retreat policy is difficult, mainly because **managed retreat is largely still without precedent**. One of the key research gaps in the field of managed retreat studies is that the field is small and often focused outside of the United States (Dundon & Abkowitz, 2021). In fact, research into voluntary managed retreat for coastal flood risk adaptation has been considered “almost non-existent” (Braamskamp & Penning-Rowsell, 2018). Furthermore, because the U.S. has no managed retreat policy in place, little evidence exists that can identify previously effective strategies for implementing managed retreat in America. Retreat in America is “ad hoc” “piecemeal” and occurs “only after (an expensive) disaster strikes”, with continued expectations that public services will operate as usual even when facing great climate risks (Dundon & Abkowitz, 2021).

But this knowledge gap isn't just limited to America -- research indicates that managed retreat take-up rates are low in England because of a “lack of formal national guidance” (Cooper, 2003). The literature suggests that a similar lack of national managed retreat policy guidance also plagues countries like New Zealand and Australia (Hanna et al., 2018; Rogers et al., 2014).

Studies that purport to analyze the success of managed retreat strategies may tend to refer to a more specific coastal management concept of managed retreat, analyzing the environmental effects of strategies like physically removing coastal protection structures or opening floodgates (Cooper, 2003; Rogers et al., 2014). While “micro-strategies” like these may become environmental components of U.S. managed retreat policy, they don’t speak to the larger issues of the physical relocation of people and buildings that will be the crux of future managed retreat strategy.

## Analyzing Effectiveness of Retreat Strategies

A more useful overview of the sorts of strategies whose effectiveness will be worth studying can be found in Columbia Law School’s Managed Coastal Retreat handbook. The document provides a useful chart that outlines some of the tools that could be used as “coastal management,” ranging from flood insurance reforms to downzoning, building moratoria, buyouts and tax incentives (A. Siders, 2013).

### Buyout Programs

Perhaps the managed retreat study with the greatest amount of U.S.-based evidence is the option of voluntary home buyouts for threatened areas. Mach et. al’s study of voluntary FEMA home buyouts found that most bought-out properties were single family properties, and those that served as primary residences, with the amount of flood property damage, population and population density serving as the most important county-level factors in determining which counties would receive buyouts (Mach et al., 2019). The data also indicates that counties with buyouts saw “bought-out properties located in relatively poorer, less densely populated areas, also with relatively lower education levels, lower English language proficiency, and greater racial diversity”(Mach et al., 2019).

While high financial incentives have been found to encourage participation in buyouts, they didn’t necessarily succeed in removing the financial burden of relocation (Binder & Greer, 2016). Other factors associated with buyout program participation include trust in program authorities, perception of program community engagement, and community disaster history (Binder et al., 2015). Those who choose to sell in a home buyout program have been shown to view the buyout process as **less voluntary** than those who chose not to (Vries & Fraser, 2012). This evidence suggests the relative success of buyouts at relocating individuals, while also providing cautionary frameworks to suggest the importance of factors like fully compensating buyers, engaging with the community, and building trust.

In their design analysis of effective buyout programs, Thistlethwaite, Henstra and Ziolecki find that timing buyouts pre-flood can allow for better stakeholder engagement and thus better uptake. They also note that while voluntary buyouts are more socially and politically feasible, they are less effective and efficient than mandatory buyouts, given that governments need to still defend the holdouts (Thistlethwaite et al., 2020). They also note the importance of providing transparency on buyout eligibility criteria, and point towards the importance of offering compensation that can actually allow the resident to continue their quality of life in a safer area (Thistlethwaite et al., 2020).

### Community-wide Relocation

Acquiring new land to serve as a new community for those fleeing sea level rise is one compelling option for incentivizing managed retreat. This could be implemented in conjunction with buyouts, as an alternative to expecting community members to seek new locations of residence after the buyout. Valmeyer, Illinois attempted such a relocation to relative success, with the school system running continuously and about two thirds of the original residents choosing to continue on to the new community (Carey, 2020). However, other resettlement attempts in Isle de Jean Charles and Pecan Acres, Louisiana were met with resistance either from community members or those living in the new relocation community (Carey, 2020). While some argue that implementing a smaller, targeted relocation is best for minimizing costs, others find that this can damage community cohesion in comparison to “whole community relocation” (Gharbaoui & Blocher, 2016). However, two whole-community relocation attempts in Fiji were met with failures like insufficient risk reduction and host community tensions (Gharbaoui & Blocher, 2016).

Daniel Peltz’s analysis of anticipatory and reactive relocations found that **longer planning timeframes**, increased community participation, and smaller relocation populations are factors with great importance in a relocation’s success or perceived success (Peltz, 2015). However, Peltz also noted that even relocations that are well-planned, well-financed and well-executed could not necessarily be guaranteed to be perceived as a success by those involved (Peltz, 2015). Crucially, the literature lacks a historical analogue with a sample size large enough to be relevant to the case of the United States and all its coastal residents.

### Zoning Adjustments

The use of land use laws and regulations to disincentivize development in at-risk zones can have the effect of **moving future development inland**. In their review of legal and regulatory strategies for retreat, Reiblich et al suggest using “no-build areas” via rolling easements or zoning restrictions to restrict people from building in coastal areas, as well as

using redevelopment restrictions to local zoning ordinances to make it “difficult or impossible to build in dangerous areas” (Reiblich et al., 2017). However, the authors also note that redevelopment restrictions can be too slow, and that rolling easements can be controversial or legally dicey (Reiblich et al., 2017).

Both Kauaʻi and Rhode Island have created restrictions that either prevent new buildings from getting too close to the future shoreline, or allow new structures to be removed if the sea encroaches too close (Carey, 2020). Norfolk, Virginia, has also adopted incentives for developers to build further from flood-prone areas (Wrathall et al., 2019). However, teasing out the causal effects of zoning restrictions on developers’ building choices, and subsequently the choice of residents to relocate, will be difficult given the newness of the concept of zoning for managed retreat.

Zoning measures and restrictions may also face the criticism of being too narrow, if they fail to restrict current development the way they restrict future development. However, they have the advantage of being extremely forward-looking. Setbacks, for example, that prevent a property owner from building or expanding too close to the shore, help avoid the costs of frequent repairs (A. Siders, 2013). These more forward-looking, preventative measures could be used in conjunction with active managed retreat strategies, such as flood insurance rate adjustment, to help pull residents away from the coast.

It’s also important to note that zoning restrictions like **rolling easements** can affect even current construction. In the example of Texas’ Open Beaches Act, the Texas government can “prohibit or remove” obstructions like sea walls, housing, structures and coastal armoring that “end up seaward of the mean vegetation line due to beach erosion” (A. Siders, 2013). Thus, as Texas’s beaches erode further, more and more structures will be legally “removable,” due to the “rolling” nature of easement. Zoning measures that account for increased erosion and rising tides will allow for more immediate action to be taken in relocation or removal of at-risk structures, rather than waiting for new development.

### Insurance Adjustments

Altering national flood insurance premiums is another potential lever to pull in the fight to begin the process of managed retreat. Current insurance schemes are noted to “incentivize remaining in dangerous coastal areas,” with the National Flood Insurance Program lacking the funds to cover its treasury obligations (Parry et al., 2020). By restructuring insurance premiums to cover projected sea level rise damages, insurance premiums will increase, serving to disincentivize residents from staying in hazardous coastal areas, communicate the severity of future flooding, and provide sufficient funding for the inevitable damages



that will occur in these areas. With “repetitive loss properties” costing over \$12.1 billion in taxpayer dollars from flood insurance payouts just since 2012, adjusted rates could go a long way in incentivizing residents to actually relocate (Panfil, 2020).

It would also serve as a way of closing the information asymmetry and ensuring residents are actually aware of the true risk of inhabiting their property. We know that residents are wary about property decisions when confronted with realities of flood risk: one survey of Colorado floodplain homeowners revealed that 69% would have changed their offer if they had known about the property flood risk and insurance prices (Hino & Burke, n.d.). Furthermore, although information on insurance effects is limited, we can consult California’s property tax program as something of a proxy. Residents were 10 to 16 percent less likely to move for each \$1,000 increase in property taxes associated with the new property. If we assume these effects work in reverse, and work with adjustment of flood insurance premiums, we may find that a \$500 yearly increase in flood insurance (about a 28% increase given average NFIP prices of \$1800 each year) (Reynolds, 2021), we may find that 5% of residents in eligible areas may choose to move inland.

However, literature shows that increased flood insurance premiums for managed retreat must have measures that ensure they don’t overburden vulnerable groups (Panfil, 2020; Verchick & Johnson, 2014). Blanket rate increases regardless of income and home value may lead to inability and/or refusal to pay premiums, rather than relocation.

Naturally, many of the pieces of evidence pointing towards the effectiveness of various managed retreat strategies will seem somewhat distant from the current context, given the novelty of the topic area. However, even opinion studies and geographically distant case studies can provide essential and generalizable evidence for such a new, unexplored problem. The effectiveness of these policies will be less certain than policies addressing older problems, but they are well worth continued study.

## ALTERNATIVES

There are two key market failures at play in the lack of managed retreat legislation: an information asymmetry that prevents property owners from fully evaluating their flood risk, and the presence of externalities where property owners' choice to live on the coast exerts negative externalities on fellow citizens, whose tax dollars subsidize the others' choice to live in high-risk flood zones. These alternatives specifically target those market failures. For the purpose of this analysis, I use flooding as a metric for sea level rise. Although these areas are not exactly the same, they serve as reasonable points of comparison to approximate the area that will be damaged by nuisance flooding in the future as a result of sea level rise.

### **Alternative 1: Adjusting Flood Insurance Rates**

This alternative would entail raising current premiums paid for coastal properties to better reflect the costs associated with protecting, rebuilding and reinforcing the homes. The current National Flood Insurance Program is insolvent, with its revenue insufficient to cover all the claims it will receive for flood and storm damage (Stewart, 2021). As of October, NFIP introduced a new program to base premiums on a better, more comprehensive analysis of property risk, which is expected to decrease premiums for 23 percent of policyholders and provide small premium increases (of \$10 or less per month) for 66 percent of policyholders (Stewart, 2021). This could be a beneficial first step, but attempts to accurately adjust flood insurance premiums are currently hampered by a NFIP rule forbidding premium increases of more than 18 percent per year (Stewart, 2021).

A more robust upward adjustment of premiums through eliminating the 18 percent rule would likely serve to encourage relocation inland, forcing homeowners to internalize the externalities their properties create. This alternative would also adjust for the most recent sea-level rise predictions, rather than relying on conservative estimates. Another modification, considered by FEMA in 2021, would be to use flooding metrics other than the 100-year flood projection, since floods are frequently occurring outside the boundaries of these areas (Scata, 2021). Finally, by redirecting flood insurance and disaster payouts toward relocation, rather than rebuilding, more families would eventually leave the flood zone.<sup>1</sup> With the combined increase in premiums from these adjustments, homeowners would find it cheaper to buy a better house in a safer location, rather than paying a large chunk of their paychecks toward insurance. Although this would be very politically unfeasible, it does seem relevant to note that it likely would not be an extremely regressive

---

<sup>1</sup> FEMA has specifically expressed potential interest in helping families move out of repeatedly-flooded homes, as opposed to rebuilding (Scata, 2021)

program, since many lower-income people rent, rather than owning homes. However, the possibility that landlords would increase rents in response to this rule remains a possibility, and could contribute to gentrification.

### **Alternative 2: Expanding Federal Home Buyouts of At-Risk Homes**

This alternative would establish a pre-emptive, voluntary home buyout program where the federal government would provide market-value compensation for homes at risk of severe flooding. This would help incentivize managed retreat by making it financially feasible for homeowners to relocate away from flood zones. In addition, it would prevent new homeowners from moving into the at-risk areas, unlike alternative 1. FEMA information indicates that “voluntary buyouts in the 30 top repetitive loss communities cost \$1 for every \$2 saved in future insurance claims,” (A. Siders, 2013) indicating that this solution would be financially feasible for the federal government. The program could be targeted to “repetitive loss communities,” and areas that are projected to see severe property loss in the next 100 years, allowing those property owners the funds to move elsewhere. The government could then develop the land for eco-friendly uses that buffer tides, like mangroves or living shorelines, or choose to rent out the homes on a temporary basis, allowing tenants to stay for shorter-term lease that allow them mobility to higher ground when needed. One limitation of this solution is that it would fail to offer an economic penalty for staying in the flood zone, allowing rich homeowners to continue to inhabit unsafe areas if they so choose.

### **Alternative 3: Establishing Federal Setback Zoning Guidance**

This alternative would establish a federal-level zoning law that forbids the building or expansion of a structure if the structure is not sufficiently set back from current and future tidelines. In this case, that ordinance would use a long timeline to establish the tideline and prevent building or expanding if the structure would not remain sufficiently set back from the projected high tide line in 100 years. For example, a zoning restriction should mandate that a structure must be 50 feet from the high tide line, and that structure would need to be 50 feet away from the projected 2122 high tide line. This would discourage developers and owners from building or expanding near sea level, and encourage them to pursue opportunities inland. New development hasn't stopped in coastal areas – of the homes built approximately from 2010-2016/2017, there were about 3,500 new homes in the 10 year flood zone risk (*Ocean at the Door*, n.d.). Thus, this policy would serve to redirect development and new housing construction to safer inland areas, as well as beginning the process of disinvesting in coastal areas. Once residents realize that all new development

will be occurring elsewhere, they will be less likely to choose to remain in low-lying areas within and near the setback.

Because the legality of federal-level zoning restrictions is ambiguous, this alternative could also be manifested through withdrawal or decrease of federal (disaster?) funds for communities that refuse to adopt such zoning. However, it's possible that eminent domain will provide enough precedent to allow restrictive zoning like this at the federal level. Maine's Coastal Sand Dune Rules provide an example of zoning that prohibits permitting of projects expected to be damaged by sea level rise within the next 100 years (Wetlands Watch, n.d.). Besides questions of legality, one limitation of this alternative is that it would likely be severely opposed by coastal communities whose economy is driven by tourism. These communities would need to find new ways to remain economically afloat if new development in their beach areas is prohibited.

## CRITERIA

The **policy goal** here is to increase the number of Americans relocated from risky coastal areas to inland regions that will not be at risk of sea level rise flooding in the next 100 years. Thus, three criteria will be used in order to analyze the validity of alternatives: cost-effectiveness, equity, and political & administrative feasibility, based on some of the priorities of New America's Future of Land and Housing program.

### Criterion 1: Cost-Effectiveness

This criterion refers to the monetary expense, measured in U.S. dollars, of implementing one unit of my outcome. In this case, that will be the U.S. federal government's monetary cost of relocating one American from an area located approximately within FEMA's Special Flood Hazard Area (SFHA). My scale, located in Appendix B, ranks cost-effectiveness from "low" to "high." Although the SFHA refers specifically to 100-year flood events, rather than sea level rise, it serves as a useful benchmark in approximating the areas that are also at risk of sea level rise. In order to find this metric, I will divide the cost of each project by the projected number of residents it will relocate into inland areas each year. Although "households" may be an equally valuable metric to help measure property saved, I've selected individuals as my outcome unit to underscore the importance of getting as many people away from coastal hazard zones as possible.

Flood insurance rate adjustments, voluntary home buyouts, and setback laws are already in action in America to varying degrees. Because my alternatives would involve expanding/nationalizing/improving these programs, I attempt to extrapolate assumptions about effectiveness and number of people relocated based on existing program data and academic research. Because there is so little research on managed retreat and effectiveness of relocation strategies, these calculations should not be used as a definitive guide to program cost-effectiveness; rather, they should be seen as rough, back-of-the-envelope estimates to aid in alternative comparisons. The formula used for calculations is as follows:

$$\frac{\text{Comprehensive program cost}}{\text{Number of people relocated from flood zones/year}} === \text{Cost Effectiveness (per person)}$$

### Criterion 2: Economic Equity

This criterion refers to how fairly the alternative divides the costs and benefits of the program among different socioeconomic groups. An equitable alternative will not disproportionately burden poorer residents, and not disproportionately advantage wealthier residents. Equity is an essential criterion in any relocation program, especially given that historic attempts to relocate people in America have involved unjust treatment of racial minorities. In coastal areas, equity is especially relevant, because lower-income people are less likely to be able to protect their homes against sea level rise, while wealthier residents have the money and political capital to win mitigation measures that protect their homes. When comparing demographics of the 100-year floodplain to national averages, we find that rates were about the same, approximately 15% from 2011-2015 (*Population in the U.S. Floodplains*, 2017). However, this floodplain isn't exclusively coastal, so it may obscure some of the income discrepancies of areas that will be acutely affected by sea level rise. We know that wealthy households are increasingly moving to coastal cities, while more modest households move to the rust belt, indicating income sorting and emphasizing the importance of considering economic equity when considering sea level rise management strategies (Leefeldt, 2018).

In order to properly analyze the economic equity of each alternative, I've developed a questionnaire (Appendix C) to determine how the costs, benefits and economic realities of each alternative will affect lower and higher income residents. This questionnaire

addresses equity on a point scale from 0-10 that translates to “low” “medium-low” “medium” “medium-high” and “high” metrics of equity.

### Criterion 3: Political & Administrative Feasibility

This criterion refers to the likelihood of the alternative being implemented in practice, based on both its likely political palatability and its administrative burden. Feasibility will be measured as high, medium-high, medium, medium-low and low, based on how likely it is to be supported from genesis to implementation. This uses a matrix that uses an 8 point scale to analyze the precedent and potential support for each policy. An alternative that is high in political and administrative feasibility will have a clear, uncontested path to becoming law, and a low degree of implementation complexity, making it realistic to execute. Considering political and administrative feasibility is essential, because these factors determine whether a program can actually be executed given the current political landscape. Recommending a program with no feasibility would be irrelevant to discussions of what realistic federal managed retreat could look like. Political feasibility can be measured by researching individual Congressional and public stances on managed retreat solutions, as well as past precedent. Administrative feasibility can be measured by detailing the complexity of the institutions required for successful functioning of the alternative. For example, in order to create nationwide setback zoning laws, a new entity may need to be created to oversee the expansion, given that the U.S. does not functionally conduct zoning at the national level.

I have created the matrix in Appendix D to help quantify these considerations and provide a framework for analyzing and comparing alternatives. This matrix is comprehensive of both political and administrative feasibility, and involves quantifiable and clear yes/no questions.

## FINDINGS

In this document, I will analyze my three alternatives for conducting managed retreat: increasing National Flood Insurance Program premiums to better reflect true risk, expanding FEMA voluntary buyouts of properties deemed to be hazardous, and establishing a nationwide setback limitation that prohibits new development or expansion too close to the shoreline. The three criteria I will use in my analysis will be cost-effectiveness, or the cost to the federal government of relocating one person away from the flood zone; equity, or the degree to which the program fairly balances costs and benefits based on the wealth of residents; and feasibility, which refers to how politically and administratively palatable and possible an alternative would be.

### Assumptions:

The first big assumption I will make is that flooding is an acceptable stand-in for sea-level rise. Because future sea level rise has not happened yet, it's important to key into a current indicator that can predict future risk. Thus, I will refer to flood risk zones, rather than specifying "future sea level rise zones," as these are somewhat interchangeable, barring freshwater flooding.<sup>2</sup> I will also assume that economic equity and inequity can capture some racial equity and inequity. Although my equity criteria is simplified to economic equity for ease of analysis, the economic measures I refer to (like income and home-ownership) are strongly correlated with race. Forty six percent of young white families own their home, compared to 17% of young black families (Bhutta et al., 2020). Furthermore, the net worth of a black family is just one tenth of that of a white family (McIntosh et al., 2020). Further investigation into racial components of managed retreat strategies is certainly warranted. Another nuanced equity dimension to note is that I find it inequitable both if lower-income families are disproportionately incentivized to leave their coastal home and if they are disproportionately incentivized to stay. An ideal, equitable strategy will put high and low income residents in similar positions regarding leaving or staying. Relevant calculations, sources and tables for these findings can be found in the Appendix.

---

<sup>2</sup> In my feasibility metric, you will note that I've gathered precedent data specifically from coastal states because they are most threatened by sea level rise, though anti-flood measures may help inland states with freshwater flooding issues.



## ALTERNATIVE 1: INCREASING FLOOD INSURANCE RATES

### Cost-Effectiveness:

With a cost of just \$.01 per person relocated each year, increasing flood insurance rates ranks high for cost-effectiveness. This alternative would be extremely inexpensive, given that it would only involve increasing the rates of a program already in existence. I account for the cost of one communications specialist, in addition to the staff NFIP already employs, to help communicate the changing premiums people would pay. In order to calculate the effect of increased premiums on residential mobility, I used tax increases as a proxy for flood insurance rate increases, given that in both situations, the resident's price burden changes, but their benefits do not. Once I calculated the mobility based on an average rate increase, I multiplied this by the number of NFIP households in order to get an idea of how many people would move as a result of this policy. Although it's possible that these people would move to cheaper properties still within flood zones, it seems more likely that they would elect to move away from areas that would involve NFIP coverage, so that is what I assume. Following these calculations, we find that the federal government could cause one person to move from a flood hazard zone for just ten cents.

### Equity:

Increasing flood insurance rates ranks medium-low for equity. With a score of 2 on our matrix, rate changes have a number of factors that disproportionately impact lower income residents. For one, premium increases will come entirely from citizens, with the government receiving all of the benefits of the alternative and very few of the costs. Residents will see higher costs if they choose to stay. However, it is possible to design this policy in a progressive way that places cost burdens on those who are best able to bear it. FEMA has reportedly proposed a "means-tested affordability program" to help low-income residents afford mandatory insurance; what's more, the recent NFIP overhaul for more accurate rates actually aimed to ensure that lower-income homeowners were not subsidizing higher-income homeowners (Olick, 2021).

However, any increase in premiums will naturally be more easily borne by higher-income residents. Furthermore, property owners facing higher insurance costs may choose to pass that cost on to tenants in the form of rent increases, and renters tend to be lower-income than property owners. These higher costs will likely lead to slight decreases in home prices, as those areas become less desirable, but the burden of insurance will likely keep low-income families from buying or staying in these areas. Finally, the most recent round of NFIP price adjustments has already drawn ire as concerning in terms of equity, with South

Louisiana residents complaining that they are already financially stretched by the cost of insurance and fearing that insurance rate price hikes are pricing people out of living in the area (Jones, n.d.). Thus, equity for this option is medium-low.

#### Feasibility:

Increasing rates for the National Flood Insurance Program scores a 6 on our administrative and political feasibility matrix, ranking medium-high. In its favor, we know that altering NFIP rates would not require the establishment of any new programs or departments, nor would it require substantial staffing increases. It's also indicative of good feasibility that all coastal states already contain communities that participate in NFIP (*Community Status Book* | *FEMA.Gov*, n.d.).

Congressional indicators for feasibility look negative, given that a number of Republican senators from Gulf states introduced the NFIP Risk Rating 2.0 Act of 2021 last fall, aiming to halt the expected increase in flood insurance premiums of the most recent NFIP reform (*Senators From Gulf Coast States Seeking to Delay New Flood Insurance Rating System*, 2021). In addition, because increasing premiums to reflect true risk would cause premiums to increase by more than 18% a year, Congressional approval would likely be required. Rate increases are capped at 18% each year by statute (*FEMA Offers More Equitable Flood Insurance Rates Beginning Oct. 1* | *FEMA.Gov*, n.d.). Finally, although this alternative might not be popular in coastal states, it's unlikely that there would be any genuine precedent for court challenges. And while the public might be opposed to fronting higher premium costs, this alternative wouldn't cost much in taxpayer dollars. Thus, this option ranks medium-high for feasibility.

## ALTERNATIVE 2: EXPANDING FEMA HOME BUYOUTS

#### Cost-Effectiveness:

With a cost of \$123,245.21 per person, expanding FEMA home buyouts ranks low for cost-effectiveness. This alternative involves extreme expense for the federal government. To begin, the federal government must pay 75% of the actual buyout price (with the rest supplied by the state), and even if only 10,000 homes are bought out each year, the government would need to spend \$3 billion on the homes alone. Beyond that, the government would also need to pay yearly maintenance costs in order to keep these newly federal properties in decent shape (and even more if the properties are to be turned into any functional or recreational space), as well as staffing costs for the army of appraisers

that will help assess and run the buyout process, and about \$180 billion in demolition costs each year.

As far as effectiveness goes, we can assume approximately 40% takeup rate for a buyout program, amounting to about 10,000 homes a year, if 25,000 homes were offered buyouts. Still, this amounts to over \$3 trillion in costs to move about 26,000 people: an abysmally low score for cost-effectiveness.

### Equity:

Expanding FEMA home buyouts ranks high in terms of equity, with a score of 8 on the equity matrix. In its favor, there are no immediate costs to the resident, and the federal and state governments bear all costs. Thus, costs can't be passed on to renters, and those who choose to stay won't see higher costs, as in the case with flood insurance.

Although it's possible that the empty lots created by buyout programs could increase or decrease nearby property values (BenDor et al., 2020), it seems more likely that real estate values for houses in this area will decrease once the area reaches a critical level of buyouts. It's unlikely that this would cause low-income families to want to stay in these areas, though, because the buyout would likely still be more compelling.

Finally, it's important to address the equity concerns that have already arisen in past voluntary buyout situations. Areas implementing buyouts tend to be wealthier, while the neighborhoods where buyouts actually occur tend to be relatively lower income and more "socially vulnerable"; furthermore, neighborhoods with less political connections/coordination may be less likely to convince local governments to administer buyout programs (Kraan et al., 2021). Given that the current buyout program still requires local cost contributions, this is another valid equity component that prevents this option from ranking "high" in equity. .

### Feasibility:

The option of expanding FEMA's buyout program for more coastal properties scores a 6 on our political and administrative feasibility matrix, which makes it "medium-high" in feasibility. Because FEMA already has a hazard buyout program that conducts property buyouts in conjunction with local communities, there would be no need for the establishment of a new department. However, enabling buyouts on this much larger scale would certainly require expansion of staffing, with at least 100 more employees required to

advertise the program, liaise with local communities, assess buyout applications, and design and manage stewardship of the new property acquisitions.

Already, most coastal states have already hosted FEMA hazard buyouts, though five states have not yet had properties bought out (*Hazard Mitigation Grant Program - Property Acquisitions* | *FEMA.Gov*, 2020). Public opinion is difficult to determine, likely because the current federal buyout program is so small that there hasn't been much precedent for a national survey, but it's likely that the high cost of buyouts will impose a tax burden that could be difficult to swallow for inland Americans. Although members of Congress have not advocated for this specific policy option, bipartisan Congressional advocacy for expediting FEMA buyouts in 2018's Promoting Flood Risk Mitigation Act (H.R. 5846) serves as an appropriate proxy to indicate Congressional support for increasing the impact of the FEMA buyout program (Moore, 2018). Finally, it's possible that state and local governments would challenge expansion of this program, because states are expected to pay 25% of the buyout project costs (*\$6.5 Million Approved to Acquire 31 Flood-Prone Properties in Pender County* | *FEMA.Gov*, n.d.). Thus, this option ranks medium-high in feasibility.

### ALTERNATIVE 3: INTRODUCING NATIONWIDE SETBACK LAWS

#### Cost-Effectiveness:

With a cost of \$874 per person, introducing nationwide setback laws ranks high for cost-effectiveness, though it isn't quite as cheap on the government as increasing flood insurance premiums. Implementing this alternative would require reasonably large yearly expenditures on employees, because planners and compliance officers would be needed in order to design, enforce and administer a new nationwide zoning regulation. However, this alternative would likely require lower employee costs over time, despite raises, as the planning exits the troubleshooting period and begins to be effectively standardized and understood across the nation. Given current rates of rapid coastal development, setback zoning laws that prevent some of this development could keep about 3,033 people from moving to new construction in the 10-year flood zone (even more at-risk than the 100-year floodplain). Thus, this is a very cost-effective solution.

#### Equity:

Introducing nationwide setback zoning ranks medium-high in terms of equity, with a score of 7. While direct costs are just staffing, the long-term costs inherent to this alternative are inherently progressive. Because setback laws relate to future expansion and development,

their effects will be directed toward wealthier residents: property developers and builders, as well as those who can afford to expand their homes.

However, setback laws are likely to lead to increases in housing prices. Because they limit the future growth of coastal property, thus making the stock of coastal housing and commercial structures finite, the values of these pre-existing properties are likely to increase. In the long term, though, given time for developers to start building more properties in inland areas, the increase in housing supply is likely to eventually make it more affordable to live inland. There seem to be no current equity concerns with setback zoning that exists today; in fact, setbacks are lauded for preserving community cohesion by allowing people to reside on their properties for longer (*Managed Retreat Toolkit » Setbacks and Buffers* - Georgetown Climate Center, n.d.). Finally, this alternative won't contribute to keeping or incentivizing low-income families into hazardous areas. The setback would function as a safety mechanism that ensures nobody ends up too close to threatening sea levels. Thus, this option ranks medium-high for equity.

#### Feasibility:

Creating a nationwide ocean setback zone ranks medium for political and administrative feasibility, with a score of 5 points.. For one, because the United States does not zone on a national level, creating nationwide zoning restrictions would likely require the establishment of a new federal program. It's possible such a program could be hosted under the Coastal Zone Management Program, which provides guidelines for healthy coastal management for states. However, because participation in this program is voluntary, and Alaska chooses not to participate (Randall & deBoer, 2012), it's likely that creating a federally binding zoning restriction would need to be administered by a different program. This alternative would thus also require the expense of new program staff to work on program design, state and city relations, and ensuring compliance over a vast geographical area.

Factors adding to this alternative's political feasibility include the fact that at least 50% of coastal states have at least some setback laws, though notable exceptions like Alaska, Georgia and Massachusetts have no state setback laws (*Evaluation of Erosion Hazards*, 2000). There have been no publicly available polls or Congressional comments on an alternative like this, so public opinion does not factor strongly into the feasibility of this alternative. However, feasibility is impacted by the fact that establishing nationwide setback laws would certainly require Congressional action. Although it's possible that eminent domain could be used to justify the government "taking" of coastal land, it's very likely that

state and local governments would take issue with federal management of a policy area usually left to them. Federal courts can be used to challenge executive orders wherein a president acts outside the scope of their office (*Executive Orders*, n.d.), so this legislation would be even more likely to be challenged if it was enacted without Congressional approval. Here, then, I find that this alternative ranks medium for political and administrative feasibility.

## RECOMMENDATION

With a score of 12 on our outcomes matrix, alternative 3 (introducing national setback laws) is the recommended alternative for establishing federal managed retreat policy. This option is particularly remarkable for its cost-effectiveness. Because staffing is the most significant government cost of this policy, yearly costs stay relatively low, and are likely to decrease further once the zoning is designed and planners are no longer frequently needed. Furthermore, effectiveness is high, as it prevents future coastal development as well as expansion of current properties, thus also serving as a disinvestment method. Equity, too, is relatively high, as this option weighs its costs most heavily upon those who choose to build or expand in coastal areas, a group which tends to be wealthier than those merely living there. Furthermore, this option levies no direct cost on the homeowner or resident, making it far more equitable than insurance increases. However, because nationwide zoning is unprecedented in the U.S., the feasibility of this alternative is not quite as high as the feasibility of other options. Creating new zoning that restricts coastal development will be a daunting task, but one that would free cities and communities from having to individually adjust their own zoning regulations. Uniform, federally enforced setback laws would communicate clearly the risks of living close to sea level, ensuring that communities and cities make smart development decisions, rather than being tempted by the short-term economic promise of coastal development.

## IMPLEMENTATION

While establishing nationwide setback zoning may seem daunting, the implementation of this strategy will be relatively frontloaded. First, urban planners will be needed to help develop the exact specifications of the law. They will need to determine the mandatory setback distance from coastline, the exact sea level projections and time horizons to use, and the definition of “expansions” and “permanent structures,” so as to avoid any possible miscommunication. Once the zoning is drafted as a bill, it will need to pass both Houses and be signed by the President before it can begin to be implemented. This will require strong communications campaigning to build public support – framing the legislation as a protective, proactive solution to local sea level problems will go a long way in building public opinion. Although it’s beyond the scope of this paper, an effective implementation strategy could include folding this zoning regulation into a bill that provides other managed retreat incentives, like stipends for moving from flood zones and tax incentives for housing built in inland areas. This way, the restrictions of the setback zoning would be countered with tangible incentives for those wanting to leave the coast, doubling the program’s effect.

Once the program is law, enforcement will need to be reliable in order for setback zoning to have any meaningful effect. Compliance officers will be required in order to conduct spot visits to communities and conduct audits, ensuring no development is occurring in forbidden zones. It will be essential for these officers to build strong relationships with local governments, so as to stay informed of any potential risks or violations. As time passes, this policy will become more normalized, with communities becoming accustomed to the redirection of development inland. Thus, once the policy is publicly recognized and accepted, given its high penalties for violation, there’s likely to be very low need for enforcement as time goes by.

### **Risks & Risk Management:**

The first implementation risk is the risk of local and state objection. The U.S. has no nationwide spatial use plans, and states have generally delegated land use powers to local governments (*The Governance of Land Use*, 2017). Thus, states and local governments could argue that their sovereignty was infringed upon through the creation of setback zoning. This could provide a court precedent for challenging the constitutionality of this law, as in *Lucas v. South Carolina Council* where regulations damaged a property’s economic value (A. Siders, 2013). However, eminent domain could justify the “taking” of this land, or its value. Even if the property is effectively “taken” with this prohibition on development, protection



from sea level rise would qualify as a valid “public use,” and some form of “just compensation” could be provided to owners of restricted property, thus satisfying the conditions for lawful use of eminent domain (Cheng, 2021). “Just compensation” need not be daunting; the property’s future damages due to sea level rise would be taken into account in order to show that high compensation is not necessary.

The second, and most important, implementation risk to this policy is the risk of developer noncompliance. Widespread noncompliance, manifested as complete ignorance and continued development within the setback zones represents a **worst case scenario**. The entities best prepared to notice new expansions and development in coastal hazard areas are local governments, and if new development promises economic gains to these governments, they may choose to turn a blind eye. Because this policy would be housed federally, it could be very difficult for the federal government to notice and catch violations, particularly lower-level violations, like individual property expansions. One solution to this challenge would be clear and strict penalties for noncompliance, with occasional community visits and audits by compliance officers. Those found to be in violation of the zoning law could be forced to completely relocate the portion of the development located in the setback, as is the case with local setback zoning, amounting to an extremely expensive penalty (Van Vactor, n.d.)

### **Diverging Perspectives**

There are three key stakeholder groups for this policy, excluding the federal government: developers, residents and local government. Residents are likely going to be the simplest group to deal with. Although there are certain subsets of residents who will be directly affected, like those who wish to expand upon their properties, most residents are likely not planning this kind of change. Some residents living within the setback, however, may be opposed to the idea that there will no longer be any new gyms, grocery stores or restaurants in their communities. However, this is something of a necessary lesson: it’s irresponsible to build a long-term structure in an area that is not projected to be above water in the long term. Developers will be more difficult to deal with, given the vast profits that can be made on the water. NOAA estimates that \$143 billion in GDP comes from ocean-based tourism and recreation each year (*Tourism and Recreation*, n.d.). Successful implementation of this alternative will require a very effective communications strategy that lays out long-term costs to building on the water, showing prospective developers how they can actually save money by choosing to build inland. This frames the policy in a

familiar, profit-oriented setting, and provides long-term perspective to company decisions that may be made on a short-term basis.

Finally, it stands to reason that local governments, whether city, town or county, may object to sweeping new zoning changes that stand in the way of local authority. They may be hesitant to say goodbye to plans for future development within the flood zone. However, it's also important to note that many of these governments have likely been struggling with their own attempts at conducting managed retreat. In Pacifica, California, community members demanded (and succeeded) in getting managed retreat written out of community plans (Bromhead, 2022). It's very possible that local governments will welcome federal policy that eases the burden on local politicians and planners, and saves them from the political challenge of attempting to muster support for individual retreat plans.

## CONCLUSION

It may not be simple to create a new federal zoning policy from scratch, but by nature, any policy that conducts nationwide managed retreat effectively will not be simple. Creating setback zoning will not only prevent future development in hazardous coastal areas, but it will also send a clear message to current coastal residents that the time for retreat is coming. While policies that directly relocate residents to inland areas may one day have their place, for now, preventing future development is key to ensuring that relocation is rational and well-prepared. Setback zoning will serve as a proactive way to protect people and property where ocean meets land, and usher in a new era of strong, safe development in harmony with the sea.

## WORKS CITED

*\$6.5 Million Approved to Acquire 31 Flood-Prone Properties in Pender County* | FEMA.gov. (n.d.).

Retrieved March 4, 2022, from

<https://www.fema.gov/press-release/20210526/65-million-approved-acquire-31-flood-prone-properties-pender-county>

Adachi, Y. (2015). Human Lives at Risk because of Eustatic Sea Level Rise and Extreme Coastal Flooding in the Twenty-First Century. *Weather, Climate, and Society*, 7(2), 118–132. <https://doi.org/10.1175/WCAS-D-13-00063.1>

Ajibade, I., Sullivan, M., & Haeffner, M. (2020). Why climate migration is not managed retreat: Six justifications. *Global Environmental Change*, 65, 102187. <https://doi.org/10.1016/j.gloenvcha.2020.102187>

Alexander, K. S., Ryan, A., & Measham, T. G. (2012). Managed retreat of coastal communities: Understanding responses to projected sea level rise. *Journal of Environmental Planning and Management*, 55(4), 409–433. <https://doi.org/10.1080/09640568.2011.604193>

Allen, M. (n.d.). *Protection for the Rich, Retreat for the Poor*. Hakai Magazine. Retrieved October 12, 2021, from <https://www.hakaimagazine.com/news/protection-for-the-rich-retreat-for-the-poor/>

*Amid a Worsening Climate Crisis, How Can Coastal Cities Protect Affordable Housing?* (2021, May 5). Housing Matters.

<https://housingmatters.urban.org/research-summary/amid-worsening-climate-crisis-how-can-coastal-cities-protect-affordable-housing>

Ando, A. W., & Reeser, C. (2022). Homeowner Willingness to Pay for a Pre-Flood Agreement for a Post-Flood Buyout Running title: WTP for Post-Flood Buyout Commitment. *Land Economics*, 052721. <https://doi.org/10.3368/le.98.4.052721-0056>

BenDor, T. K., Salvesen, D., Kamrath, C., & Ganser, B. (2020). Floodplain Buyouts and Municipal Finance. *Natural Hazards Review*, 21(3), 04020020. [https://doi.org/10.1061/\(ASCE\)NH.1527-6996.0000380](https://doi.org/10.1061/(ASCE)NH.1527-6996.0000380)

Bhutta, N., Chang, A. C., Dettling, L. J., & Hewitt, J. W. H. with assistance from J. (2020). *Disparities in Wealth by Race and Ethnicity in the 2019 Survey of Consumer Finances*. <https://www.federalreserve.gov/econres/notes/feds-notes/disparities-in-wealth-by-race-and-ethnicity-in-the-2019-survey-of-consumer-finances-20200928.htm>

Bieretz, B., & Schilling, J. (n.d.). *Pay for Success and Blighted Properties*.

Binder, S. B., Baker, C. K., & Barile, J. P. (2015). Rebuild or Relocate? Resilience and Postdisaster Decision-Making After Hurricane Sandy. *American Journal of Community Psychology*, 56(1), 180–196. <https://doi.org/10.1007/s10464-015-9727-x>

Binder, S. B., & Greer, A. (2016). The Devil Is in the Details: Linking Home Buyout Policy, Practice, and Experience After Hurricane Sandy. *Politics and Governance*, 4(4), 97–106.

Braamskamp, A., & Penning-Rowsell, E. C. (2018). Managed Retreat: A Rare and Paradoxical Success, but Yielding a Dismal Prognosis. *Environmental Management and Sustainable Development*, 7(2), 108. <https://doi.org/10.5296/emsd.v7i2.12851>

Bromhead, H. (2022, April 4). "Managed Retreat" Is a Terrible Way to Talk About Responding to Climate Change. *Slate*.

<https://slate.com/technology/2022/04/managed-retreat-climate-change-language.html>

Carey, J. (2020). Core Concept: Managed retreat increasingly seen as necessary in response to climate change's fury. *Proceedings of the National Academy of Sciences*, 117(24), 13182–13185. <https://doi.org/10.1073/pnas.2008198117>

Cheng, F. (2021, November 17). *Is Compulsory Managed Retreat Our Future? Examining the U.S. Army Corps of Engineers' Eminent Domain Policy*. New America.  
<http://newamerica.org/future-land-housing/briefs/is-compulsory-managed-retreat-our-future/>

*Communications Specialist Salary* | *PayScale*. (n.d.). Retrieved March 4, 2022, from [https://www.payscale.com/research/US/Job=Communications\\_Specialist/Salary](https://www.payscale.com/research/US/Job=Communications_Specialist/Salary)

*Community Status Book* | *FEMA.gov*. (n.d.). Retrieved March 4, 2022, from <https://www.fema.gov/flood-insurance/work-with-nfip/community-status-book>

*Compliance Officer Salary* | *PayScale*. (n.d.). Retrieved March 4, 2022, from [https://www.payscale.com/research/US/Job=Compliance\\_Officer/Salary](https://www.payscale.com/research/US/Job=Compliance_Officer/Salary)

Cooper, N. J. (2003). The use of 'managed retreat' in coastal engineering. *Proceedings of the Institution of Civil Engineers - Engineering Sustainability*, 156(2), 101–110.  
<https://doi.org/10.1680/ensu.2003.156.2.101>

Dachary-Bernard, J., Rey-Valette, H., & Rulleau, et B. (2019). Preferences among coastal and inland residents relating to managed retreat: Influence of risk perception in

- acceptability of relocation strategies. *Journal of Environmental Management*, 232, 772–780. <https://doi.org/10.1016/j.jenvman.2018.11.104>
- Dannenbergh, A. L., Frumkin, H., Hess, J. J., & Ebi, K. L. (2019). Managed retreat as a strategy for climate change adaptation in small communities: Public health implications. *Climatic Change*, 153(1), 1–14. <https://doi.org/10.1007/s10584-019-02382-0>
- Desmet, K., Kopp, R. E., Kulp, S. A., Nagy, D. K., Oppenheimer, M., Rossi-Hansberg, E., & Strauss, B. H. (2018). *Evaluating the Economic Cost of Coastal Flooding* (No. 24918; NBER Working Paper Series). National Bureau of Economic Research. [https://www.nber.org/system/files/working\\_papers/w24918/w24918.pdf](https://www.nber.org/system/files/working_papers/w24918/w24918.pdf)
- Dundon, L. A., & Abkowitz, M. (2021). Climate-induced managed retreat in the U.S.: A review of current research. *Climate Risk Management*, 33, 100337. <https://doi.org/10.1016/j.crm.2021.100337>
- Evaluation of Erosion Hazards*. (2000). The Heinz Center.
- Executive Orders*. (n.d.). The Heritage Foundation. Retrieved March 4, 2022, from <https://www.heritage.org/political-process/heritage-explains/executive-orders>
- FEMA Offers More Equitable Flood Insurance Rates Beginning Oct. 1* | *FEMA.gov*. (n.d.). Retrieved March 3, 2022, from <https://www.fema.gov/press-release/20210924/fema-offers-more-equitable-flood-insurance-rates-beginning-oct-1>
- Ferreira, F., Gyourko, J., & Tracy, J. (2012). *Housing Busts and Household Mobility: An Update*.
- Frimpong, E., Howard, G., & Kruse, J. (n.d.). *Homeowner Preference for Household-level Flood Mitigation in US: Analysis of a Discrete Choice Experiment*.

Fry, R. (2019, October 1). The number of people in the average U.S. household is going up for the first time in over 160 years. *Pew Research Center*.  
<https://www.pewresearch.org/fact-tank/2019/10/01/the-number-of-people-in-the-average-u-s-household-is-going-up-for-the-first-time-in-over-160-years/>

*Future of Land and Housing*. (n.d.). New America. Retrieved December 10, 2021, from <http://newamerica.org/future-land-housing/>

*GDP per capita (current US\$)—United States | Data*. (n.d.). World Bank. Retrieved April 7, 2022, from <https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=US>

Gharbaoui, D., & Blocher, J. (2016). The Reason Land Matters: Relocation as Adaptation to Climate Change in Fiji Islands. In A. Milan, B. Schraven, K. Warner, & N. Cascone (Eds.), *Migration, Risk Management and Climate Change: Evidence and Policy Responses* (pp. 149–173). Springer International Publishing.  
[https://doi.org/10.1007/978-3-319-42922-9\\_8](https://doi.org/10.1007/978-3-319-42922-9_8)

Hanna, C. J., White, I., & Glavovic, B. (2018). *Managed retreat governance: Insights from Matatā, New Zealand*. [Report]. University of Waikato, New Zealand.  
<https://researchcommons.waikato.ac.nz/handle/10289/14523>

Hardy, R. D., Milligan, R. A., & Heynen, N. (2017). Racial coastal formation: The environmental injustice of colorblind adaptation planning for sea-level rise. *Geoforum*, 87, 62–72. <https://doi.org/10.1016/j.geoforum.2017.10.005>

*Hazard Mitigation Grant Program—Property Acquisitions | FEMA.gov*. (2020, July 22).  
<https://www.fema.gov/openfema-data-page/hazard-mitigation-grant-program-property-acquisitions-0>



Hino, M., & Burke, M. (n.d.). *The effect of information about climate risk on property values.*

PNAS. Retrieved March 4, 2022, from

<https://www.pnas.org/doi/abs/10.1073/pnas.2003374118>

Jones, D. (n.d.). *'We can't afford anything else': St. Charles Parish leaders, FEMA reps hold town hall as flood insurance rates skyrocket.* <https://www.fox8live.com>. Retrieved March 4, 2022, from

<https://www.fox8live.com/2022/03/04/we-cant-afford-anything-else-st-charles-parish-leaders-fema-reps-hold-town-hall-flood-insurance-rates-skyrocket/>

Kraan, C. M., Hino, M., Niemann, J., Siders, A. R., & Mach, K. J. (2021). Promoting equity in retreat through voluntary property buyout programs. *Journal of Environmental Studies and Sciences*, 11(3), 481–492. <https://doi.org/10.1007/s13412-021-00688-z>

Lasky, J. (2019, August 2). *Looking for a Beach House? It'll Cost You—The New York Times.*

<https://www.nytimes.com/2019/08/02/realestate/buying-a-beach-house-is-expensive.html>

Lawrence, J., Boston, J., Bell, R., Olufson, S., Kool, R., Hardcastle, M., & Stroombergen, A.

(2020). Implementing Pre-Emptive Managed Retreat: Constraints and Novel Insights. *Current Climate Change Reports*, 6(3), 66–80.

<https://doi.org/10.1007/s40641-020-00161-z>

*Learn how much it costs to Demolish a House.* (n.d.). Retrieved March 4, 2022, from

<https://www.homeadvisor.com/cost/landscape/house-demolition/>

Leefeldt, E. (2018, August 21). *America's rich are moving to the coasts as the poor go inland.*

CBS News.

<https://www.cbsnews.com/news/american-migration-rich-move-to-coasts-poor-to-the-heartland/>

Love, S. (n.d.). *This Is What the U.S. Could Look Like When Our Coasts Are Under Water*. Vice.

Retrieved October 12, 2021, from

<https://www.vice.com/en/article/8xzznk/this-is-what-america-could-look-like-when-our-coasts-are-under-water>

Lubchenco, D. J., & Dietrick, D. R. (2012). *Global Sea Level Rise Scenarios for the United States National Climate Assessment* (p. 33) [NOAA Technical Report OAR CPO-1]. National Oceanic and Atmospheric Administration.

Lynch, J. G., & Zauberman, G. (2006). When do you Want It? Time, Decisions, and Public Policy. *Journal of Public Policy & Marketing*, 25(1), 67–78.

<https://doi.org/10.1509/jppm.25.1.67>

Mach, K. J., Kraan, C. M., Hino, M., Siders, A. R., Johnston, E. M., & Field, C. B. (2019).

Managed retreat through voluntary buyouts of flood-prone properties. *Science Advances*, 5(10), eaax8995. <https://doi.org/10.1126/sciadv.aax8995>

*Managed retreat*. (n.d.). Google Trends. Retrieved October 11, 2021, from

<https://trends.google.com/trends/explore?date=all&geo=US&q=managed%20retreat>

*Managed Retreat Toolkit » Setbacks and Buffers—Georgetown Climate Center*. (n.d.).

Georgetownclimatecenter.Org. Retrieved March 4, 2022, from

<https://www.georgetownclimate.org/adaptation/toolkits/managed-retreat-toolkit/setbacks-and-buffers.html>

McIntosh, K., Moss, E., Nunn, R., & Shambaugh, J. (2020, February 27). Examining the

Black-white wealth gap. *Brookings*.

<https://www.brookings.edu/blog/up-front/2020/02/27/examining-the-black-white-wealth-gap/>

Molouki, S. (2016, September 22). Increasing the Pull of the Future Self. *The Decision Lab*.

<https://thedecisionlab.com/insights/finance/increasing-pull-future-self/>

Moore, R. (2018, June 26). *Congress Wants to Know Why FEMA Buyouts Take So Long*. NRDC.

<https://www.nrdc.org/experts/rob-moore/congress-wants-know-why-fema-buyouts-take-long>

Morrison, J. (2019, August 5). *Who Will Pay for the Huge Costs of Holding Back Rising Seas?* Yale E360.

<https://e360.yale.edu/features/who-will-pay-for-the-huge-costs-of-holding-back-rising-seas>

*National Flood Insurance Program Fact Sheet*. (n.d.).

Neal, W., Bush, D., & Pilkey, O. (2017). Managed Retreat. In *Encyclopedia of Coastal Science* (pp. 1–7). [https://doi.org/10.1007/978-3-319-48657-4\\_201-2](https://doi.org/10.1007/978-3-319-48657-4_201-2)

Neal, W. J., Bush, D. M., & Pilkey, O. H. (2005). Managed Retreat. In M. L. Schwartz (Ed.), *Encyclopedia of Coastal Science* (pp. 602–606). Springer Netherlands. [https://doi.org/10.1007/1-4020-3880-1\\_201](https://doi.org/10.1007/1-4020-3880-1_201)

Neumann, J. E., & Yohe, G. (2000). *Sea-level Rise and Global Climate Change*. Pew Center on Global Climate Change.

*New study warns that sea levels will rise faster than expected*. (2021, February 2). Mongabay Environmental News.

<https://news.mongabay.com/2021/02/new-study-warns-that-sea-levels-will-rise-faster-than-expected/>

*Ocean at the Door: New Homes and the Rising Sea.* (n.d.). Retrieved March 4, 2022, from

<https://www.climatecentral.org/news/ocean-at-the-door-new-homes-in-harms-way-zillow-analysis-21953>

Olick, D. (2021, August 17). *FEMA overhauls the National Flood Insurance Program for climate change.* CNBC.

<https://www.cnn.com/2021/08/17/fema-overhauls-national-flood-insurance-program-for-climate-change.html>

Panfil, Y. (2020, July 14). *The Case for Managed Retreat.* Politico.

<https://www.politico.com/news/agenda/2020/07/14/climate-change-managed-retreat-341753>

Parry, C., Snow, M. H., & Franklin, R. (2020). *Planning for Managed Retreat:* William and Mary Law School.

Peltz, D. (2015). *Planned Relocations in the Context of Natural Disasters and Climate Change: A Review of the Literature* (p. 35). Brookings-LSE.

*Population in the U.S. Floodplains.* (2017). NYU Furman Center.

[https://furmancenter.org/files/Floodplain\\_PopulationBrief\\_12DEC2017.pdf](https://furmancenter.org/files/Floodplain_PopulationBrief_12DEC2017.pdf)

Randall, M., & deBoer, H. (2012, February 2). *COASTLINE CONSTRUCTION RESTRICTIONS.*

<https://www.cga.ct.gov/2012/rpt/2012-R-0046.htm>

*Real Estate Appraiser salary in Virginia.* (n.d.). Retrieved March 4, 2022, from

<https://www.indeed.com/career/real-estate-appraiser/salaries/VA>

Regan, H. (2020, July 30). *Flooding from sea level rise could cost our planet \$14.2 trillion, study says*. CNN.

<https://www.cnn.com/2020/07/30/weather/coastal-flooding-sea-level-rise-study-intl-hnk/index.html>

Reiblich, J., Wedding, L. M., & Hartge, E. H. (2017). Enabling and Limiting Conditions of Coastal Adaptation: Local Governments, Land Uses, and Legal Challenges. *Ocean and Coastal Law Journal*, 22(2), 156–194.

Reynolds, P. (2021, October 1). *Flood Insurance Rates Just Went Up for Millions of Homeowners*. Money. <https://money.com/flood-insurance-cost-2021/>

Rogers, K., Saintilan, N., & Copeland, C. (2014). Managed Retreat of Saline Coastal Wetlands: Challenges and Opportunities Identified from the Hunter River Estuary, Australia. *Estuaries and Coasts*, 37(1), 67–78. <https://doi.org/10.1007/s12237-013-9664-6>

Scata, J. (2021, October 14). *FEMA Moves to Reform Flood Insurance Program*. NRDC. <https://www.nrdc.org/experts/joel-scata/fema-moves-reform-flood-insurance-program>

Science Daily. (2020, January 22). *Sea level rise could reshape the United States, trigger migration inland: AI shows climate change-driven sea-level rise could trigger mass migration to cities inland*. ScienceDaily.

<https://www.sciencedaily.com/releases/2020/01/200122150021.htm>

Science Daily. (2021, June 18). *Managed retreat: A must in the war against climate change: New research finds that moving off the coast and away from floods can expand options*.

ScienceDaily. <https://www.sciencedaily.com/releases/2021/06/210618091642.htm>

- SeaLevelRise.org. (n.d.). *Sea Level Rise Forecast*. Sea Level Rise. Retrieved October 11, 2021, from <https://sealevelrise.org/forecast/>
- Senators From Gulf Coast States Seeking to Delay New Flood Insurance Rating System*. (2021, September 29). Insurance Journal. <https://www.insurancejournal.com/news/southcentral/2021/09/29/634199.htm>
- Siders, A. (2013). Managed Coastal Retreat: A Legal Handbook on Shifting Development Away from Vulnerable Areas. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.2349461>
- Siders, A., Ajibade, I., & Casagrande, D. (2021). Transformative potential of managed retreat as climate adaptation. *Current Opinion in Environmental Sustainability*, 50, 272–280. <https://doi.org/10.1016/j.cosust.2021.06.007>
- Siders, A. R. (2019). Managed Retreat in the United States. *One Earth*, 1(2), 216–225. <https://doi.org/10.1016/j.oneear.2019.09.008>
- Simon, M. (n.d.). Retreat? Pish. Democrats Dare Not Speak Climate Change's 'R' Word. *Wired*. Retrieved October 11, 2021, from <https://www.wired.com/story/democrats-climate-change-retreat/>
- Song, J., & Peng, B. (2017). Should We Leave? Attitudes towards Relocation in Response to Sea Level Rise. *Water*, 9(12), 941. <https://doi.org/10.3390/w9120941>
- Stewart, D. (2021, September 30). *Coastal Risk is Rising: How Will We Respond?* New America. <http://newamerica.org/future-land-housing/reports/coastal-risk-is-rising-how-will-we-respond/>
- Teirstein, Z. (2021, April 8). *Retreat from coastlines? Politicians don't want to talk about it*.

Grist.

<https://grist.org/climate/retreat-from-coastlines-politicians-dont-want-to-talk-about-it/>

Thaler, T. (2021). Just retreat—how different countries deal with it: Examples from Austria and England. *Journal of Environmental Studies and Sciences*, 11(3), 412–419.

<https://doi.org/10.1007/s13412-021-00694-1>

*The Governance of Land Use*. (2017). OECD.

<https://www.oecd.org/regional/regional-policy/land-use-United-States.pdf>

Thistlethwaite, J., Henstra, D., & Ziolecki, A. (2020). *Managed Retreat from High-risk Flood Areas: Design Considerations for Effective Property Buyout Programs*. 158, 12.

*Tourism and Recreation*. (n.d.). NOAA Office for Coastal Management. Retrieved April 8, 2022, from <https://coast.noaa.gov/states/fast-facts/tourism-and-recreation.html>

*United States of America*. (n.d.). Data Commons Place Explorer. Retrieved April 7, 2022, from [https://datacommons.org/place/country/USA?utm\\_medium=explore&mprop=count&popt=Person&hl=en](https://datacommons.org/place/country/USA?utm_medium=explore&mprop=count&popt=Person&hl=en)

*Urban Planner Salary | PayScale*. (n.d.). Retrieved March 4, 2022, from [https://www.payscale.com/research/US/Job=Urban\\_Planner/Salary](https://www.payscale.com/research/US/Job=Urban_Planner/Salary)

US Department of Commerce, N. O. and A. A. (n.d.). *What percentage of the American population lives near the coast?* Retrieved October 11, 2021, from <https://oceanservice.noaa.gov/facts/population.html>

US EPA, O. (2014, April 20). *Mortality Risk Valuation* [Overviews and Factsheets]. <https://www.epa.gov/environmental-economics/mortality-risk-valuation>

Van Vactor, W. (n.d.). *Do I Need to Worry About Existing House Violating Setback Requirements?*

Www.Nolo.Com. Retrieved April 8, 2022, from

<https://www.nolo.com/legal-encyclopedia/do-i-need-worry-about-existing-house-violating-setback-requirements.html>

Verchick, R. R. M., & Johnson, L. R. (2014). When Retreat is the Best Option: Flood Insurance after Biggert-Waters and Other Climate Change Puzzles. *SSRN Electronic Journal*.

<https://doi.org/10.2139/ssrn.2418089>

Vries, D. H. D., & Fraser, J. C. (2012). *Citizenship rights and voluntary decision making in post-disaster U.S. floodplain buyout mitigation programs*.

Wetlands Watch. (n.d.). *Wetlands Watch Pilot Project: Legislatively Created Rolling Easements*.

<https://wetlandswatch.org/s/Wetlands-Watch-Pilot-Project-Legislative-Rolling-Easements-Language-knny.pdf>

Wrathall, D. J., Mueller, V., Clark, P. U., Bell, A., Oppenheimer, M., Hauer, M., Kulp, S., Gilmore, E., Adams, H., Kopp, R., Abel, K., Call, M., Chen, J., deSherbinin, A., Fussell, E., Hay, C., Jones, B., Magliocca, N., Marino, E., ... Warner, K. (2019). Meeting the looming policy challenge of sea-level change and human migration. *Nature Climate Change*, 9(12), 898–901. <https://doi.org/10.1038/s41558-019-0640-4>

## APPENDIX

### Appendix A: Outcome Matrix



1 = low 2 = medium-low 3 = medium 4 = medium-high 5 = high	<b>Alternatives:</b>		
<b>Criteria:</b>	<b>Adjust Insurance</b>	<b>Increase Buyouts</b>	<b>Mandate Setbacks</b>
<b>Cost-Effectiveness:</b>	5	1	5
<b>Feasibility:</b>	4	4	3
<b>Equity:</b>	2	5	4
<b>Total:</b>	<b>11</b>	<b>10</b>	<b>12</b>

## Appendix B: Cost-Effectiveness Calculations

$$\frac{\text{Comprehensive program cost}}{\text{Number of residents relocated}} === \text{Cost Effectiveness (per person)}$$

<b>Cost-Effectiveness Level</b>	<b>Cost per Person Moved Inland (Yearly)</b>
High	\$100,000 +
Medium-High	\$50,000 - \$99,999
Medium	\$10,000 - \$49,999
Medium-Low	\$1,000 - \$9,999
Low	\$0 - \$999

**Please see the attached spreadsheet for cost formulas and calculations.  
Below are the sources for cost estimates:**

**Insurance increases:**

Communications specialist (\$54,787 per year) (*Communications Specialist Salary* | PayScale, n.d.)

Effectiveness: Using property tax as a proxy, we can say, conservatively, that people are 10% more likely to move with a \$1,000 increase in flood insurance annually. This is based on a survey that analyzes California residents' willingness to stay in their homes when faced with a \$1,000 annual property tax increase upon moving: "the data confirm our earlier finding that both frictions give rise to reduced household mobility—10 percent to 16 percent less per \$1,000 using our preferred mobility measure MOVE1" (Ferreira et al., 2012).

We will assume these effects are similar in reverse for a \$1,000 increase in flood insurance premiums if residents choose to stay in their home.

The average NFIP insurance is \$1,800/year (Reynolds, 2021), so if premiums increased 28%, that's an additional \$504/year on average. That is approximately half of \$1,000, meaning that we can expect half of 10% increase in mobility (about 5%).

The number of households we're concerned about = 5.1 million (number of NFIP policies in place)(*National Flood Insurance Program Fact Sheet*, n.d.)<sup>3</sup> times the average household size of 2.6 people (Fry, 2019) times the mobility rate we just calculated of .05 = 663,000 people moved.

**Expanding buyouts:**

First, we need to start by calculating the average price of a coastal home. We know "more than 300,000 of today's coastal homes, with a collective market value of about \$117.5 billion today, are at risk of chronic inundation in 2045"(Lasky, 2019). With a little division, this tells us that that the average price of a chronically at-risk home is \$391,666.66, but we'll take it down to \$300,000 because we have a broader

---

<sup>3</sup> In this case, some homes may be at risk of river or lake flooding, rather than sea level rise flooding. Still, we'll consider relocation from any flood-risk area beneficial in our greater purpose here.

idea of what the floodplain is, and houses are likely cheaper further from the most immediate danger zone.

Next, we'll assume that 10,000 buyouts can be carried out each year, times the average home cost of \$300,000 times .75 (the amount of buyout paid by the federal government).

Land management costs = \$1,744 per property for maintenance on federally owned properties (Bieretz & Schilling, n.d.) times the 10,000 households who take the buyout (see below) = 3.5 billion each year

Staffing costs = We'll say 100 new appraisers at \$59,355/year (*Real Estate Appraiser Salary in Virginia*, n.d.) + \$10,000 benefits = \$69,355 times 100 appraisers = \$6.9355 million

Demolition costs = \$18,000 (*Learn How Much It Costs to Demolish a House.*, n.d.) per property times the 10,000 properties

Effectiveness:

First, we calculate willingness to accept buyout:

"We find nearly all respondents identified positive WTP to enroll in this program, with average WTP about \$600. Factors like flood risk and expectation of neighbors' responses significantly affect WTP. If the pre-flood agreement is available only if the homeowner has flood insurance, only 68% of homeowners were willing to accept the agreement." (Ando & Reeser, 2022)

"Regardless of the timing of the contracts (i.e., contracts offered before damage and after damage), buyout is the most selected option, being selected 50% of the time before damage and 53% of the time after damage." (Frimpong et al., n.d.)

Given these estimates, we'll assume conservative that 40% of those offered accept the buyout, so that if 25,000 homeowners were offered a buyout, we could be certain that 10,000 would accept.

We multiply 10,000 households by 2.6 people (Fry, 2019) again to get effectiveness

### **Nationwide setbacks:**

Cost:

For program design: Urban planner salary average = 58,483/year (*Urban Planner Salary* | *PayScale*, n.d.) + 10,000 in benefits = about \$68,483 each year times the number of urban planners needed (15)

We'll also need staff to enforce: Compliance officer salary average = \$71,235/year (*Compliance Officer Salary* | *PayScale*, n.d.) + 10,000 in benefits = 81,235 times the number of officers needed (20)

Effectiveness:

Of the homes built approximately 2010-2016/2017, there were about 3,500 new homes in the 10 year flood zone risk (*Ocean at the Door*, n.d.)

Conservatively, we'll assume a third of these may be within our ideal setback lines = 1166.666 homes x average household occupancy of 2.6 (Fry, 2019) = about 3,033 people/year

## **Appendix C: Equity Matrixes**

<b>Equity Level</b>	<b>Points</b>
High	8-10
Medium-High	6-7
Medium	4-5
Medium-Low	2-3

Low	0-1
-----	-----

Increasing Flood Insurance Rates: Equity	
Question	Point Value
Who are this alternative's costs largely borne by?	Government, or no costs (+1) Resident (0)
Is it possible that costs can be passed on to renters?	Yes (0) No (+1)
Are there ways to make cost applications progressive?	Yes, or no costs (+1) No (0)
Will this inherently create a cost burden on low-income residents who choose to stay?	Yes (0) No (+1)
Will this create a cost burden on low-income residents even if they choose to move?	Yes (0) No (+1)
Is this likely to make living in inland areas more affordable in the short term for those with low incomes?	Yes (+1) No (0)
Is this likely to make living in inland areas more affordable in the long term for those with low incomes?	Yes (+1) No (0)
Has this alternative had economic equity concerns in previous/current iterations?	No (+1) Yes, or no similar iterations (0)
Will this disproportionately incentivize low-income residents to stay in areas of coastal risk?	Yes (0) No (+1)
Is this likely to lead to climate gentrification of inland areas?	Yes (0) No (+1)
<b>Total:</b>	<b>3</b>

<b>Creating Setback Laws: Equity</b>	
<b>Question</b>	<b>Point Value</b>
Who are this alternative's costs largely borne by?	Government, or no costs (+1) Resident (0)
Is it possible that costs can be passed on to renters?	Yes (0) No (+1)
Are there ways to make cost applications progressive?	Yes, or no costs (+1) No (0)
Will this inherently create a cost burden on low-income residents who choose to stay?	Yes (0) No (+1)
Will this create a cost burden on low-income residents even if they choose to move?	Yes (0) No (+1)
Is this likely to make living in inland areas more affordable in the short term for those with low incomes?	Yes (+1) No (0)
Is this likely to make living in inland areas more affordable in the long term for those with low incomes?	Yes (+1) No (0)
Has this alternative had economic equity concerns in previous/current iterations?	No (+1) Yes, or no similar iterations (0)
Will this disproportionately incentivize low-income residents to stay in areas of coastal risk?	Yes (0) No (+1)
Is this likely to lead to climate gentrification of inland areas?	Yes (0) No (+1)
<b>Total:</b>	<b>7</b>

<b>Increasing Buyouts: Equity</b>	
<b>Question</b>	<b>Point Value</b>
Who are this alternative's costs largely borne by?	Government, or no costs (+1) Resident (0)
Is it possible that costs can be passed on to renters?	Yes (0) No (+1)
Are there ways to make cost applications progressive?	Yes, or no costs (+1) No (0)
Will this inherently create a cost burden on low-income residents who choose to stay?	Yes (0) No (+1)
Will this create a cost burden on low-income residents even if they choose to move?	Yes (0) No (+1)
Is this likely to make living in inland areas more affordable in the short term for those with low incomes?	Yes (+1) No (0)
Is this likely to make living in inland areas more affordable in the long term for those with low incomes?	Yes (+1) No (0)
Has this alternative had economic equity concerns in previous/current iterations?	No (+1) Yes, or no similar iterations (0)
Will this disproportionately incentivize low-income residents to stay in areas of coastal risk?	Yes (0) No (+1)
Is this likely to lead to climate gentrification of inland areas?	Yes (0) No (+1)
<b>Total:</b>	<b>8</b>

## Appendix D: Feasibility Matrixes

Increasing Flood Insurance Rates Feasibility	
Question:	Point Value:
Does this program require a new department or program, or can it involve the expansion of a pre-existing program?	New = 0 pt Pre-existing = 1 pt
Does this program require substantial new employee expenditures (50+ new employees) in order to be implemented?	Yes = 0 pt No = 1 pt
Does this program have legal precedent in US coastal states already?	Yes, in at least 50% of coastal states = 2 pt ( <i>Community Status Book   FEMA.Gov, n.d.</i> ) Yes, in less than 50% of coastal states = 1 pt No legal precedent in any coastal state = 0 pt
Is the program likely to inflict direct and immediate financial costs on Americans?	Yes = 0 pt No = 1 pt
Have any members of Congress publicly regarding this alternative?	Yes, favorable = 1 pt Oppositional, or none have mentioned it = 0 pt ( <i>Senators From Gulf Coast States Seeking to Delay New Flood Insurance Rating System, 2021</i> )
Is this alternative implementable through executive action or agency discretion?	Yes = 1 pt No, requires Congressional action = 0 pt ( <i>FEMA Offers More Equitable Flood Insurance Rates Beginning Oct. 1   FEMA.Gov, n.d.</i> )
Is there precedent for state or local level	State/local opposition/court challenges =



opposition and/or court challenges?	0 pt No precedent for challenge = 1 pt
Is the program likely to necessitate high operational costs each year?	Yes = 0 pt No = 1 pt
Total:	6

<b>Expanding Buyouts Feasibility</b>	
<b>Question:</b>	<b>Point Value:</b>
Does this program require a new department or program, or can it involve the expansion of a pre-existing program?	New = 0 pt Pre-existing = 1 pt
Does this program require substantial new employee expenditures (50+ new employees) in order to be implemented?	Yes = 0 pt No = 1 pt
Does this program have legal precedent in US coastal states already?	Yes, in at least 50% of coastal states = 2 pt ( <i>Hazard Mitigation Grant Program - Property Acquisitions   FEMA.Gov, 2020</i> ) Yes, in less than 50% of coastal states = 1 pt No legal precedent in any coastal state = 0 pt
Is the program likely to inflict direct and immediate financial costs on Americans?	Yes = 0 pt No = 1 pt
Have any members of Congress publicly regarding this alternative?	Yes, favorable = 1 pt (Moore, 2018, p. 201) Oppositional, or none have mentioned it = 0 pt
Is this alternative implementable through executive action or agency discretion?	Yes = 1 pt No, requires Congressional action = 0 pt
Is there precedent for state or local level	State/local opposition/court challenges =

opposition and/or court challenges?	0 pt No precedent for challenge = 1 pt
Is the program likely to necessitate high operational costs each year?	Yes = 0 pt No = 1 pt
Total:	6

Nationwide Setbacks Feasibility	
Question:	Point Value:
Does this program require a new department or program, or can it involve the expansion of a pre-existing program?	New = 0 pt (Randall & deBoer, 2012) Pre-existing = 1 pt
Does this program require substantial new employee expenditures (50+ new employees) in order to be implemented?	Yes = 0 pt No = 1 pt
Does this program have legal precedent in US coastal states already?	Yes, in at least 50% of coastal states = 2 pt ( <i>Evaluation of Erosion Hazards</i> , 2000) Yes, in less than 50% of coastal states = 1 pt No legal precedent in any coastal state = 0 pt
Is the program likely to inflict direct and immediate financial costs on Americans?	Yes = 0 pt No = 1 pt
Have any members of Congress publicly regarding this alternative?	Yes, favorable = 1 pt Oppositional, or none have mentioned it = 0 pt
Is this alternative implementable through executive action or agency discretion?	Yes = 1 pt No, requires Congressional action = 0 pt
Is there precedent for state or local level opposition and/or court challenges?	State/local opposition/court challenges = 0 pt No precedent for challenge = 1 pt

Is the program likely to necessitate high operational costs each year?	Yes = 0 pt No = 1 pt
Total:	5

Feasibility Level	Point Range
High	8-9
Medium-High	6-7
Medium	4-5
Medium-Low	2-3
Low	0-1