Littoral Limits: Flood Insurance and the Quantification of Risk in the United States, 1914-2018

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Abstract

Littoral Limits has three related concerns: how flood risk came to be quantified, how such information was used and contested once quantified, and how this information has shaped our relationships with the natural world. These three concerns come together under the unifying theme of limits: the practice of quantifying and making policy on the basis of floodplain boundaries has entailed the determination and contestation of limits to which land is favored for diverse uses, and which land might best be regulated to limit flood hazard exposure. This project is carried out in large part via a case study of the National Flood Insurance Program, a federal program that has driven flood risk knowledge production and floodplain land use policy in the United States since its creation in 1968.

The mid-twentieth century, when federal involvement in flood insurance was debated and eventually enacted, was a time of overt tension between two approaches to flood-prone lands. One of these approaches, *floodplain management,* prioritized managing human inhabitation and usage of flood-prone lands in order to limit exposure to hazard. The other approach, *flood control*, emphasized building structures that restrict or divert floodwaters in order to make flood-prone areas safer for inhabitation. In other words, floodplain management involved determining natural limits and using them to constrain land use, while flood control involved pushing the limits of acceptable land use deeper into flood-prone terrain. Proponents of both approaches were involved in the flood insurance debate, with expert theorists more in favor of floodplain management, and politicians and other interests more divided between approaches. This dissertation concludes that while the NFIP has indeed made some tangible contributions to the adoption of floodplain management practices in the United States, its most significant influence has been to help maintain extant development and inhabitation practices in flood-prone areas,

even in the face of natural limits that are shifting due to climate change as well as land use change. This is not due to the triumph of one of the two approaches mentioned above, so much as it is due to a third, implied but rarely enunciated, approach at work: flood insurance as a taxpayer-subsidized way of protecting development that falls within harm's way.

This case study of flood insurance provides insights into the deeply ingrained drive to derive profit from the development of the natural world, using sources including archival records, Congressional hearings, newspapers, gray literature, and published scientific articles. For different groups that take an interest in flood-prone land, economic development means different things. For propertied interests, it means the ability to maximize the financial worth of their properties. For managerially-minded academics and experts, it often means minimizing governmental hazard exposure, thereby minimizing human impacts and taxpayer burden. The history of the NFIP reveals that, in conjunction with other federal programs, the scales have tipped ever more heavily toward the promotion and stabilization of real estate as an investment vehicle, for both middle-class and wealthy homeowners and large-scale developers. This is a status quo that is becoming increasingly unstable and untenable as hurricanes and the specter of climate change and sea level rise call into question the economic and engineering logics of stationarity on which federal flood insurance and flood control have been based.

This project makes several historiographical contributions. It contributes to environmental history via its examination of the quantification of the natural world in a different way than environmental histories of production and extraction. It contributes to U.S. political history by highlighting the enduring relevance of an often-overlooked Great Society program. Finally, it contributes to the history of disaster by demonstrating how hazard mapping can be perceived to be a catastrophic event.

Acknowledgements

The sole authorship of most works of history obscures the extent to which historical scholarship is a communal, rather than a solitary, pursuit. In the completion of this dissertation, I have many people to thank, beginning with Greg Cushman. As my advisor, he has supported me through thick and thin, continuously pushing me to expand my thinking and not to be content with the superficial story. I can trace my growth as a scholar through the way I engaged with his feedback to my work. As a first-year doctoral student, I was stunned and intimidated by the amount of red ink on my returned term paper, barely even wanting to look at it when I first saw it. But as my graduate school career draws to a close, I realize that I have come to eagerly anticipate every returned draft, aware that the opportunity to receive such thoughtful and erudite feedback is not one that presents itself with regularity.

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I will long remember our sandbagging together during the flood that planted the initial seed for this dissertation project. Joe and Griselda Witkowski have been steadfast, enthusiastic supporters. Chepina's love and support have been what enabled me to push through the tough times and complete a doctoral dissertation. I am consistently amazed by her ability to be a full-time professor and a full-time mother to our daughter Jacqueline. To them I dedicate this work.

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Chapter One

Introduction

In 2008, for the second time in fifteen years, Iowa City, Iowa, was hit by massive flooding. As it had also done in 1993, the Iowa River swelled well beyond its banks, inundating city neighborhoods and portions of the University of Iowa. In nearby Cedar Rapids, the neighboring Cedar River swamped the city's supposedly impregnable City Hall, perched high on an island in the middle of the river. According to federally endorsed standards, both the 1993 and 2008 floods were calculated to be 500-year floods, a term that raises a handful of questions.[1] Was this city simply unlucky to experience two floods in such rapid succession? Was something off about the way that flood magnitudes were calculated? Perhaps something about the baseline conditions had changed?

With these questions among its starting points, I embarked on this dissertation, intending to examine the ways that flood risk has been quantified, particularly by experts and bureaucrats in the United States. From the outset, the National Flood Insurance Program (NFIP) seemed a natural focal point. This federally run program has provided many Americans with their primary point of interface with flood recurrence analysis in the half-century since its enactment. It has done this most tangibly through the requirement that borrowers of federally backed mortgages for flood-prone properties carry flood insurance. Even for people who do not fall into this category, it has affected development patterns in flood-prone areas, and it has helped to cement the use of recurrence interval as a way of talking about and quantifying floods—the term 'hundred-year flood' especially. As it has evolved, this project has become not just a history of

[1] Robert Holmes and Heidi Koontz, "Two 500-Year Floods Within 15 Years—What Are The Odds," Press Release, U. S. Geological Survey, June 20, 2008.

probabilistic study of flood recurrence, or an institutional history of the NFIP. Both of these are now components of a project that examines expert understandings of how to apply statistical analysis to mediate the relationship between humans and the natural world, the political ideologies and interest groups behind the enactment and development of the NFIP, and who the program best serves and fails to serve. Delving more deeply into the questions presented in the previous paragraph, this turns out to be a story of not only statistical methods, but also of the ways that Americans have understood property, environmental risk, and the limits of the natural world.

A small handful of historians have paid more than passing attention to the NFIP. The most widely-known treatment is probably that given by environmental historian Ted Steinberg in his book *Acts of God*.[2] As part of a broader argument that 'natural' disasters are exacerbated by human agency, Steinberg highlights the ways that the NFIP has served development interests at the cost of property owners and taxpayers. In a co-authored article, historian Scott Knowles and business professor Howard Kunreuther place the NFIP in the context of the exploding coastal population of the past half-century, and posit that its hard times in the years since Katrina suggest a breakdown of the consensus that disaster relief should be a federal spending priority.[3] A recent dissertation by Nancy Germano takes particular interest in the NFIP's relationship with the often-competing imperatives of environmentalism and property rights, with a particular focus on the Midwestern states of Ohio, Indiana, and Michigan.[4] My perspective has been inspired in part by Steinberg's take on the NFIP, and in some ways I pick up where he leaves off, examining

[2] Ted Steinberg, *Acts of God: The Unnatural History of Natural Disaster in America* (New York: Oxford University Press, 2000).
[3] Scott Knowles and Howard Kunreuther, "Troubled Waters: The National Flood Insurance Program in Historical Perspective," *Journal of Policy History* 26, no. 3 (2014): 327-353.
[4] Nancy Germano, *The Urban Midwest's "Dangerous Friends": At the Confluence of Flooding Rivers, An Environmental Movement, and a National Insurance Program* (Ph.D. dissertation, Indiana University, 2017).

more closely the political debates that have brought the NFIP to its current state, weighted strongly in favor of development interests. My interest in the processes of flood risk quantification and mapping that are so central to the program's operation is something left mostly untouched by these other historians of the NFIP.

The NFIP is deeply rooted in the idea of floodplain management, an approach to flood hazards that can be traced to a network of experts that coalesced in the middle of the twentieth century, informally led by the geographer Gilbert White. In short, the tenets of *floodplain management* prioritize managing human inhabitation and usage of flood-prone lands in order to limit exposure to hazard, as opposed to the approach of *flood control*, which emphasizes building structures that restrict or divert floodwaters in order to make flood-prone areas safer for inhabitation. Yet while the NFIP has indeed made some tangible contributions to the adoption of floodplain management practices in the United States, its most significant influence has been diametrically opposed to the hopes of its most prominent theoretical forebears. It has become commonplace in recent years to suggest that the NFIP is a failed governmental program because it has not kept flooding damages from continuing to increase, and it has fallen into fiscal insolvency to boot. But the legislative enactment of the NFIP was not based only on the support of floodplain management advocates. It also needed the support of politicians whose interest in floodplain management was often transactional, at best. A program with the explicit purpose of making insurance available at below-market prices for flood-prone properties via federal subsidies would have been a political non-starter. But the cloak of the promise of floodplain management bestowed upon the NFIP by its designers, and continually renewed through ongoing regulatory programs and periodic legislative efforts, has had the overall effect of giving the program political cover, even as it has developed into an acquiescent handmaiden for the

ongoing subsidization of development of flood-prone areas in the United States. The NFIP may never have passed into law without a grounding in expert-led floodplain management, but a range of competing interests would make sure that it never went too far in impeding the needs of private investment and economic development.

The identification of limits or boundaries are central to the practice of floodplain management and the operation of the NFIP. The boundary that is most important to the NFIP is the aforementioned hundred-year floodplain: This term, which is more accurately referred to as the one-percent floodplain, refers to any land that has been determined to have at least a one percent chance of being flooded in a year. For the NFIP, it is important because it is the boundary inside which flood insurance is widely required. The hundred-year floodplain is determined via formulas that rely on historic flood data coupled with watershed information. While hundred-year floodplain information is determined via computations, there was no incontrovertible reason that the hundred-year floodplain itself was the standard on which the NFIP should operate. Rather, this standard was chosen by seminar of experts similar to the science advisory panels examined by historian Sheila Jasanoff in her book *The Fifth Branch*. As Jasnanoff demonstrates, the decisions reached by advisory panels are far more subjective than might commonly be believed, and this is true about the hundred-year floodplain as well. The hundred-year floodplain bears some strong similarities to another formulation of natural limits, the construct of "maximum sustainable yield" used in fisheries science. Maximum sustainable yield (MSY) is the topic of historian Carmel Finley's book *All the Fish in the Sea*, and her treatment of MSY helps to inform my approach to the hundred-year floodplain. As Finley has found that the idea of MSY created undue optimism about available fishery resources, I am interested in the ways that the delineation of the hundred-year floodplain and the practice of

floodplain management created overly optimistic expectations about the potential for reducing flood damages.[5]

This case study of flood insurance provides insights into the deeply ingrained drive to derive profit from the development of the natural world. Economic development is a goal widely shared in capitalist societies, and a long-standing objective of the United States government. But this has been a contested objective. For different groups that take an interest in flood-prone land, it means different things. For propertied interests, it means the ability to maximize the financial worth of their properties—even if this means building housing stock that may eventually flood. For managerially-minded academics and experts, it often means minimizing governmental hazard exposure, thereby minimizing taxpayer burden. The history of the NFIP, in conjunction with other federal programs, reveals that the scales have tipped ever more heavily toward the promotion and stabilization of real estate as an investment vehicle, both by individual homeowners and large-scale developers. As a commodity, flood-prone land has undergone a transformation. At one time, its value was derived primarily from access to waterways for commercial and industrial purposes, and limited by its seeming unsuitability for other uses that did not benefit from waterway access. Though waterway access remains an important driver of coastal and riparian land valuation, it has increasingly been joined by recreational and aesthetic considerations, while land once thought unsuited to residential and commercial development is increasingly utilized. While other federal programs have aimed to decrease the flood hazard exposure of such lands, the NFIP has become a backstop for when flood protections are absent or fail, helping to ensure that these lands continue to produce or retain wealth for their owners.

[5] Sheila Jasanoff, *The Fifth Branch: Science Advisors as Policymakers* (Cambridge, Massachusetts: Harvard University Press, 1990); Carmel Finley, *All the Fish in the Sea: Maximum Sustainable Yield and the Failure of Fisheries Management* (Chicago: University of Chicago Press, 2011).

Formal insurance is a relatively new method of coping with a hazard that has stalked the human consciousness from the origins of settled life. In the Western intellectual lineage, floods loom large as natural phenomena that reflect the will of the divine. In the Biblical narrative, when the wickedness of the world had become so great that God decided he needed to wipe the slate clean and start anew, his chosen instrument of destruction and renewal was a flood.[6] In the early modern period, theologians often understood the Biblical flood as part of an ongoing degradation of the world after the Fall of Adam, and saw contemporary floods as further divine retribution for sins. As scholars began to study geological history, the Biblical flood also gained scientific importance. Early geologists saw it as the dividing point between two different geological eras, the antediluvium and the postdiluvium. This geological paradigm of diluvialism eventually evolved into a related paradigm, catastrophism, which treated a wider array of natural events as geological markers, before mostly yielding in the nineteenth century to uniformitarianism, an approach that emphasizes gradual evolution rather than dramatic change forced by catastrophic events. As the historian Michael Kempe has observed, by the eighteenth century, views of the Biblical flood (and other floods) were shifting, from an emphasis on the destructiveness of floods to increasing consideration of the renewal they offered.[7]

Kempe argues that by the eighteenth century, floods were increasingly seen as parts of the natural order, even potentially beneficial ones, and less as instruments of God's wrath.[8] Though this should not be taken to suggest that people ever abandoned their fear of the danger

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[6] Gen. 6-9.

[7] Discussion of the Biblical flood and its relation to geological paradigms draws on Kempe, "Noah's Flood: The Genesis Story and Natural Disasters in Early Modern Times," *Environment and History* 9, no. 2 (May 2003): 151-171. For further reading, see the work of Martin Rudwick, such as *George Cuvier, Fossil Bones, and Geological Catastrophes: New Translations and Interpretations of the Primary Texts* (Chicago: University of Chicago Press, 1997).

[8] See also also René Favier and Anne-Marie Granet-Abisset, "Society and Natural Risks in France, 1500-2000: Changing Historial Perspectives," in *Natural Disasters, Cultural Responses: Case Studies Toward a Global Environmental History*, eds. Christof Mauch and Christian Pfister (Lanham, Maryland: Lexington Books, 2009): 103-136.

and destructiveness of raging waters, a similar mindset can be found in the United States of the nineteenth century. As historian Jared Taber has written about the ways that Hartford, Connecticut, related to floods in the nineteenth century, they "posed an infrastructural challenge rather than an existential one." For many years, residents of Hartford came to terms with the recurrence of floods primarily by adapting to their cycles. The eventual growth of structural flood protections in Hartford was driven not so much by existential fears, as by the demands of growing industrial production that could not easily accommodate flood-related pauses.[9]

While the mindset Taber identifies in Hartford represents one approach to flood hazards in the nineteenth century, this mindset was not hegemonic. Some riverine cities, most notably New Orleans, had been adapting to the threat of floods by building levees—the most commonly employed form of structural flood control into the twentieth century—since the eighteenth century.[10] Levees, which are embankments built along rivers to keep waters from escaping the river channel, were sometimes financed privately and sometimes publicly. In some cases, riparian landowners were required by law to build levees. Approaches to flooding varied regionally, but the idea of flood control—holding back floodwaters through the use of physical structures—especially took hold in New Orleans and along the Mississippi River. In the early years of the republic, the federal government took little active interest in flooding or flood control, but that started to change in the 1850s with a pair of federally funded surveys of the Mississippi River that emphasized flood control.[11] A generation later, federal involvement went

[9] Jared Taber, *Thinking Like a Floodplain: Water, Work, and Time in the Connecticut River Valley, 1790-1870* (Ph.D. dissertation, University of Kansas, 2016). Quote is from page 283.
[10] On New Orleans and its levees, see Craig Colten, *An Unnatural Metropolis: Wresting New Orleans from Nature* (Baton Rouge: Louisiana State University Press, 2005); and also Jeffrey Alan Owens, *Holding Back the Waters: Land Development and the Origins of Levees on the Mississippi* (Ph.D. dissertation, Louisiana State University, 1999).
[11] See Cynthia Poe, *Reconstructing the Levees: The Politics of Flooding in Nineteenth Century Louisiana* (Ph.D. dissertation, University of Wisconsin-Madison, 2006); and George S. Pabis, "Delaying the Deluge: The Engineering

from analysis to implementation, with the creation of the Mississippi River Commission. This body, consisting of a balance of civilians and representatives of federal agencies including the U.S. Army Corps of Engineers, was charged with making recommendations about future navigational and flood control improvements to be built along the Mississippi. Due mainly to narrow political interests, the MRC ended up promoting a policy of 'levees-only,' that levees should be the only form of flood control used along the Mississippi.[12]

Aside from their political benefits, levees also had the benefit that they could be justified as navigational improvements. Through the nineteenth and early twentieth centuries, the federal government remained little involved in flood control explicitly identified as such, but it was deeply involved in projects framed as aiding commerce and transportation, a category that included navigational improvements. This was part of a much broader tendency through the nineteenth century for federal policy, as it related to the natural world, to prioritize settlement, improvement, and economic exploitation—priorities that began to be re-evaluated by the conservationists of the late nineteenth and early twentieth centuries.[13] Navigational improvement clearly matched those priorities, and for those seeking federal funding for flood control infrastructure, the best approach usually involved promoting its benefits for purposes like navigation. At least through the early twentieth century, Congress continued to distinguish between navigational improvements that aided common weal and the country as a whole and was

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Debate over Flood Control on the Lower Mississippi River, 1846-1861," *The Journal of Southern History* 64, no. 3 (August 1998): 421-454.

[12] For more on the Mississippi River Commission, see Matthew Todd Pearcy, *A History of the Mississippi River Commission, 1879-1928: From Levees-only to a Comprehensive Program of Flood Control for the Lower Mississippi Valley* (Ph.D. dissertation, University of North Texas, 1996).

[13] Numerous environmental historians have examined various facets of the federal prioritization of settlement, development, and economic exploitation. For a treatment of federal policy relating to the environment as a whole, see Richard Andrews, *Managing the Environment, Managing Ourselves: A History of American Environmental Policy* (New Haven, Connecticut: Yale University Press, 1999). On late nineteenth and early twentieth century conservation, the classic treatment remains Samuel Hays, *Conservation and the Gospel of Efficiency: The Progressive Conservation Movement, 1890-1920* (Cambridge, Mass.: Harvard University Press, 1959).

much less enthusiastic about flood control projects that were thought to primarily benefit individual property owners.

The first major federal legislation explicitly authorizing flood control was the Flood Control Act of 1917, which provided for flood control appropriations for levees specifically along the Mississippi River. Linking flood control and navigation, Congress was moved to consider flooding a public problem in need of legislative intervention because several recent major floods had affected navigation on the nation's central inland waterway.[14] Further legislation passed in 1928—in the wake of some of the country's most calamitous river flooding, on the Mississippi River and in New England in 1927—authorized federal flood control spending not only there, but throughout the country, and it provided for a wider range of flood control structures than levees. The greatest shift of all came in 1936, when legislation dramatically expanded the range of flood control projects that could receive federal funding, and committed the federal government to paying for them. The Flood Control Act of 1936 broadly authorized flood control projects whenever the projected benefits, to whomever they accrued, exceeded the costs.[15] The 1936 legislation also lifted requirements for benefiting localities to share the costs of flood control measures, requirements that were only rarely overlooked before then. Thus, by 1936, the federal government had fully committed to flood control.[16]

The flood control structures authorized by the Flood Control Act of 1936 and previous pieces of legislation depended heavily on the expertise of a single discipline: engineering. Further, an engineering mindset predominated in this sector of environmental management and

[14] Historian Matthew Pearcy argues that river navigation had become a pressing issue by the mid-1910s because of the poor performance of the nation's rail system and increasing demands on American industry created by World War I-related trade. See Pearcy, "A History of the Ransdell-Humphreys Flood Control Act of 1917," *Louisiana History* 41, no. 2 (Spring 2000): 133-159.
[15] U.S. Public Law 738. 74th Cong., 2d sess., June 22, 1936.
[16] This paragraph and the previous one draw on my MA thesis. See Brian Rumsey, "Flood Control Policy Through the New Deal," chapter 2 in *Beyond Bigger and Better: Gilbert White and America's New Approach to Floodplain Management* (M.A. thesis, Mississippi State University, 2010), 8-30.

planning. Politicans approached the issue of flooding pre-disposed to think in terms of how to justify and fund structures that would restrain floodwaters. Yet even in the 1930s, and especially after World War II, experts played increasingly diverse roles in issues of disaster-related planning and management. While engineers continued to be centrally involved in issues relating to flooding, they were increasingly joined by geographers asking questions about the relationship between humans and the natural world. Though geography has its own disciplinary boundaries, it has long been a field comfortable with interdisciplinary work, drawing on the insights of fields ranging from demography to the natural sciences. The influence of new types of experts on questions of flooding helped to drive a gradual shift toward a managerial mindset, rather than one informed primarily by the engineering approach.[17]

Flood control involves a much different approach to flood-prone lands than floodplain management. The former represents an engineering approach to floods, while the latter involves much more of a managerial mindset. It would be anachronistic to say that the Hartfordites of Taber's analysis practiced floodplain management, because the term has twentieth-century origins, even though their approach to areas subject to flooding does evoke the idea in some ways. In contrast to flood control, which emphasizes minimizing flood threats so that people can use flood-prone land however they wish, floodplain management involves the encouragement of adaptations or limits to usage of flood-prone lands as a means to minimize potential losses or damages. Some tools in the floodplain management toolkit include zoning, floodproofing, and

[17] Many historians have taken an interest in the ways that relationships between experts, lay people, and governance have evolved during the twentieth century. In *The Disaster Experts: Mastering Risk in Modern America* (Philadelphia: University of Pennsylvania Press, 2011), Scott Knowles identifies an "All-Hazards Era" that started in the 1960s and focused on addressing the hazards inherent to any given area and corresponds with the floodplain management approach. Brian Balogh, in *Chain Reaction: Expert Debate and Public Participation in American Commercial Nuclear Power, 1945-1975* (New York: Cambridge University Press, 1991), differentiates between a time period centered on the Progressive Era, in which the administrative state was staffed by a new generation of disinterested experts, and the post-World War II era, which saw the emergence of a permanent linkage between self-interested federal agencies and experts who had a mutual need for each other.

abandonment of flood-prone areas. The idea of floodplain management started to spread especially after World War II, promoted by a number of experts, none more active than geographer Gilbert White, sometimes called the "Father of Floodplain Management." One of the tools of floodplain management that White promoted was flood insurance, which he saw as valuable because high insurance rates would discourage all but the most specifically suited users from building expensive buildings in flood prone areas, while uses that did not involve valuable construction, often more suited to floodplains, would not require as much high-priced insurance.[18]

In one sense, widespread implementation of flood control measures helped to sow the seeds for the idea of floodplain management. This is because without governmental intervention to make floodplains safer for inhabitation, these areas were less attractive for development, with the significant exception of development that benefited from proximity to waterways, and there was thus less need for management. The reasoning behind floodplain management was also strengthened by an increased societal expectation of federal relief in the wake of catastrophic events such as floods. Historians have often argued that the federal government did not become fully and systematically involved in natural disaster relief until the middle of the twentieth century.[19] Before then, this interpretation goes, federal disaster relief happened on an ad-hoc basis and was not usually expected by disaster victims. Scholars have especially pointed to the

[18] For more on how Gilbert White thought about flood insurance, see my MA thesis, Rumsey, *Beyond Bigger and Better*, especially chapter 2. White's biography is Robert Hinshaw, *Living with Nature's Extremes: The Life of Gilbert Fowler White* (Boulder, Colorado: Johnson Books, 2006).

[19] David Moss develops this position in "Courting Disaster? The Transformation of Federal Disaster Policy Since 1803," chapter 8 in Kenneth Froot, ed., *The Financing of Catastrophe Risk* (Chicago: University of Chicago Press, 1999), 307-362. Similar interpretations are offered in Peter May's *Recovering from Catastrophe: Federal Disaster Relief Policy and Politics* (Westport, Connecticut: Greenwood Press, 1985); Rutherford Platt's *Disasters and Democracy: The Politics of Extreme Natural Events* (Washington, D.C.: Island Press, 1999); Keith Bea's essay "The Formative Years, 1950-1970," in *Emergency Mangement: The American Experience, 1900*-2010, ed. Claire B. Rubin (Boca Raton, Florida: CRC Press, 2012), 83-114; and Patrick Roberts, *Disasters and the American State: How Politicians, Bureaucrats, and the Public Prepare for the Unexpected* (New York: Cambridge University Press, 2013).

Disaster Relief Act of 1950, which authorized a standing pool of money for disaster relief, as a turning point. Recent scholarship has called this interpretation into question, both by emphasizing the federal disaster relief programs that were already in place before 1950, and by taking a step back to argue that even if federal disaster relief prior to 1950 *appeared* to operate on an ad hoc basis, it was actually provided with regularity to those who could provide evidence of their status as blameless victims.[20] But even in light of these revisionist interpretations, the historical evidence demonstrates that both floodplain management advocates and politicians were responding to a perceived increase in societal expectations regarding governmental flood relief in the post-World War II era.[21]

The question of what constitutes a 'natural disaster' is more complex than first appearances might suggest. In common usage, the term often is used as a general descriptor for events with causal agents from the non-human world that lead to injuries or losses of life or property. Historians as well as scholars from other disciplines have taken notice of the human components of so-called 'natural' disasters. In *Acts of God*, Steinberg repeatedly demonstrates the ways that natural disasters are *not* merely unforeseeable and unavoidable acts of God, but are

[20] For the former revisionist approach, see Gareth Davies, "Pre-Modern Disaster Politics: Combating Catastrophe in the 1950s," *Publius: The Journal of Federalism* 47, no. 2 (Apr. 2017): 260-281. For the latter, see Michele Landis Dauber, *The Sympathetic State: Disaster Relief and the Origins of the American Welfare State* (Chicago: University of Chicago Press, 2012).

[21] These increasing expectations of flood relief can be linked to broader societal expectations of the federal government's role in aiding people during times of crisis. As explained by Lizabeth Cohen in her book *Making a New Deal: Industrial Workers in Chicago, 1919-1939* (New York: Cambridge University Press, 1990), the welfare capitalism of the 1920s had created expectations on the part of workers of a primitive social safety net, originally provided by corporate employers. After the downturn of the Great Depression, when many employers were no longer able to offer such benefits, or employees lost their benefits upon losing their jobs, workers increasingly turned to the federal government to offer a safety net. Cohen argues that these workers and their political expectations played an important role in shaping the New Deal welfare state. In his book *Rising Tide: The Great Mississippi Flood of 1927 and How It Changed America* (New York: Simon & Schuster, 1997), John Barry argues that specific expectations of flood relief grew after the Mississippi River floods of 1927, based on the precedent set by southern states' insistence that the federal government help pay for flood damages. In his book *The Thousand-Year Flood: The Ohio-Mississippi Disaster of 1937* (Chicago: University of Chicago Press, 2011), David Welky highlights the Ohio River flooding of 1937 as being just as calamitous as the Mississippi River floods of 1927, but sees it as a partially lost opportunity for further flood policy change such as a shift toward integrated planning.

the products of human agency.[22] City boosters have downplayed seismic risks, for example, leading to inadequate preparations for earthquakes. Or, the state has chosen not to invest in projects that would render citizens less vulnerable to natural calamity. Steinberg's title refers to his argument that in treating floods as uncontrollable doings of the Almighty, American society's rich and powerful can perpetuate the status quo, rather than making changes impacting their social status that could lessen the impacts of disasters. He even pinpoints the NFIP as an especially insidious example of this phenomenon. Steinberg also pays heed to the ways that race and catastrophe intersect, a question pondered even more deeply by scholars such as the sociologist Robert Bullard. Areas populated by racial minorities may have inferior structural protections from disasters, be identified as sacrifice zones when levees must be breached, or receive lesser levels of disaster relief than majority-white areas.[23] The Dust Bowl is often held in the national imagination as one of the worst natural disasters to ever befall the United States, but the environmental historian Donald Worster argues convincingly that its disastrous nature had far more to do with human misunderstandings of the Great Plains environment and an exploitativeness fueled by capitalism, than with the caprices of the natural world.[24] Even disregarding the elements of human complicity in 'natural' disasters, the idea of natural disaster has itself changed over time. For example, comets and eclipses, now understood in terms of planetary motion and as mere curiosities by the general populace, were once seen as catastrophic because of their perceived purpose as harbingers of divine wrath.[25]

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[22] Steinberg, *Acts of God.*
[23] Bullard has a large body of work on natural disasters and environmental justice, but see especially Bullard, "Equity, Unnatural Man-Made Disasters, and Race: Why Environmental Justice Matters," in Robert Wilkinson and William Freudenberg, eds., *Equity and the Environment (Research in Social Problems and Public Policy, Volume 15)* (Amsterdam: Elsevier, 2008), 41-85.
[24] Donald Worster, *Dust Bowl: The Southern Plains in the 1930s* (New York: Oxford University Press, 1979).
[25] Michael Kempe, "Noah's Flood: The Genesis Story and Natural Disasters in Early Modern Times," *Environment and History* 9, no. 2 (May 2003): 151-171.

Since the late twentieth century, historians have started to think much more seriously about natural disasters than they once did. The predominant view prior to this evolution in thinking was that disasters were nothing more than "deviations from the norm", "extreme and destructive forces that descended without warning on unlucky communities," in the words of environmental historian Christof Mauch.[26] More recently, historians have come to understand that rather than simply descending and then departing, natural disasters have done much to shape the contours of modern life. In his introduction to a collection of essays on natural disaster in history, Mauch writes that natural disasters are intimately connected to the process of modernization. They have helped drive technological developments, shaped governing priorities, and driven the creation of a cumulative body of knowledge.[27]

To combat high waters via flood control, manage flood-prone lands through floodplain management—or to simply steer clear of flood hazards—it is necessary to have an idea of which lands are more flood-prone and how much flooding can plausibly be expected. Through the nineteenth century, the dominant mode of understanding flood hazards involved historical documentation. Past floods served to inform people about what was possible in the future: an extremely practical and ancient use of historical record-keeping. This especially involved flood marks: markings placed on buildings or other landmarks identifying the high water marks of significant floods. This practice has never entirely passed from the scene, persisting today in flood monuments built for public memory and in technical floodplain analyses, but it carried particular weight prior to the mid-twentieth century before it became rivaled by probabilistic

[26] Christof Mauch, "Introduction," in *Natural Disasters, Cultural Responses: Case Studies Toward a Global Environmental History*, eds. Mauch and Christian Pfister (Lanham, Maryland: Lexington Books, 2009), 1-16.
[27] This is a theme found in several of the essays in *Natural Disasters, Cultural Responses* and is also central to Kevin Rozario's *The Culture of Calamity: Disaster and the Making of Modern America* (Chicago: University of Chicago Press, 2007). For a popular history that argues for the causality of a particular disaster in shaping American society, see Barry, *Rising Tide*.

assessments. Flood marks are found throughout the world, including in the United States, but have a particularly rich history in Europe, where marks have persisted for hundreds of years.[28] In parts of the United States settled in the mid-1800s and later, a dearth of historical records provided a special impetus for probabilistic assessment of flood risk, given the recognition that a few decades' worth of history would be unlikely to contain the largest flood possible for a given river or stream. Though flood risk analysis is heavily used today by the NFIP, many of its initial developers were actually interested in its applications for the construction of sewer systems. It was not until the early twentieth century that a small group of experts, mainly civil engineers, started to apply probability to flood recurrence. Over the next hundred years, probability would become an important tool used to define floods themselves. The "hundred-year flood," so central to the operation of the NFIP, is a probabilistic determination that is more accurately called the one-percent flood—the magnitude of flood at any riparian or coastal location with a one percent chance of occurring in any given year.

The quantification of flood recurrence intervals requires certain assumptions about the natural world. Though debates over the possibility of whether climates could change had already been breached prior to the turn of the twentieth century, students of flood risk mostly steered clear of this question, basing their work on the assumption that they need not account for either long-term climate variability or change.[29] In other words, they adhered to the assumption of

[28] On flood marks in Austria, see Christian Rohr, "Measuring the Frequency and Intensity of Floods of the Traun River (Upper Austria), 1441-1574," *Hydrological Sciences Journal* 51, no. 5 (2006): 834-847; and Rohr, "The Danube Floods and Their Human Response and Perception," *History of Meteorology* 2 (2005): 71-86. On flood marks in Slovakia, see Pavla Pekárová et. al., "Historic Flood Marks and Flood Frequency Analysis of the Danube River at Bratislava, Slovakia," *Journal of Hydrology and Hydromechanics* 61 (2013): 326-333.

[29] Geographers, geologists, and chemists discussed climate variability in various contexts by the early twentieth century, including notions that land use changes would lead to more favorable climatic conditions, questions about desertification in Africa, and the first inklings that atmospheric carbon dioxide could lead to global climate change. See James Rodger Fleming, *Historical Perspectives on Climate Change* (New York: Oxford University Press, 1998); and Philipp Lehmann, *Changing Climates: Deserts, Desiccation, and the Rise of Climate Engineering, 1870-1950* (Ph.D. dissertation, Harvard University, 2014).

stationarity. Recently, the assumption of stationarity has been called into question by various scientific disciplines, linked especially to anthropogenic global warming. On the ground, however, belief in stationarity still has a firm base of support—if not from experts, then from people exposed to flood hazards. Though they may recognize in the abstract that climate change will mean changes for flood risks, in practice, the idea of changing flood risk assessments is fraught with controversy. One of the most difficult things about coming to terms with nonstationarity is what it means for conceptions of property ownership and rights. At their most dramatic, natural forces can create or destroy land, sometimes in an instant.[30] But changing risk assessments can be destructive in their own way, dramatically changing the financial value attached to a parcel of real estate, even if nothing noticeable has happened or changed there. While changed risk assessments do not deprive people of their property altogether, they can reduce the value of a long-term investment or trigger changes in permitted land use.

Flood insurance in the United States is different from many types of insurance because the National Flood Insurance Program is a federally operated program. If you want to buy auto insurance, homeowners' insurance, life insurance, health insurance, or many other types of coverage, chances are good that you will buy an insurance policy backed by a private company. The company will likely be subject to various governmental regulations, but to a substantial extent, its decisions about who to offer coverage to, how much to charge for that coverage, and whether or how to try to reduce insured losses, will be made by the company itself. It hardly needs to be said that these decisions are usually based on keeping the insurance company profitable, or at the very least, solvent. The NFIP, on the other hand, is shaped by Congress and the law, and is implemented in large part by government bureaucrats answerable to neither the

[30] Theodore Steinberg uses unusual developments in the natural world to point out what he sees as the absurdities in contemporary ideas of property ownership in *Slide Mountain, or the Folly of Owning Nature* (Berkeley: University of California Press, 1996).

corporate administrative system nor the ballot box. Though you may buy your flood coverage through a private insurance company, that company will only be servicing a policy underwritten by the federal government and subject to its administrative decisions. Thus, the history of the NFIP is far more than a history of insurance, but also a history of political contestation, policy implementation, and the exercise of power by actors outside of the formal political system.

In the history of insurance, flood damage to property was a relative latecomer to the list of insurable hazards. Merchants started to sell insurance contracts over half a millennium ago, and groups of people exposed to similar hazards have both formally and informally pooled or distributed their risks for much longer. In the seventeenth and eighteenth centuries, practitioners of the emergent field of probability started to apply their knowledge to insurance, giving insurers more refined ways of estimating risks and setting premiums.

Insurance is an important contributor to economic growth, and a central component of modern capitalism. It provides an important way for holders of capital to manage the risk that is a necessary component of capitalistic growth. The operation of capitalism depends on holders of capital investing in business opportunities that they expect will yield profitable returns. But investors typically want to ensure that they can recoup as much of their investment as possible even if the opportunity they have invested in falls flat. One way to do that is by making sure the physical property held by their borrowers is insured. A widely familiar example is the requirement of banks that mortgage holders carry insurance on mortgaged properties, so that even if a property is destroyed, the creditor can potentially reclaim its former monetary value directly, rather than re-possessing damaged physical property.

Central as it is to modern capitalism, the origins of the insurance principle easily pre-date the development of modern capitalist economies. Yet, the meaning of the term itself can be

difficult to pin down. Spencer Kimball, one of the pre-eminent scholars of insurance law in the twentieth century, began one textbook he wrote by stating, "There is no good definition of 'insurance,' for any purpose. This book will not seek to provide one."[31] That statement notwithstanding, the principle of insurance in general terms involves the pooling of resources among a group of people who are exposed to similar hazards, so that whenever someone in the group is affected by the hazard, the collectively shared resources can dampen the hazard's effect. In the modern era, the term 'insurance' is often used to refer to an arrangement in which a third party—the insurer—facilitates the pooling and sharing of resources by collecting premiums and making payments after losses. Insurers make profits when they collect more money in premiums than they pay to cover losses, and determining the rates they charge to customers is a challenge that has plagued insurers for centuries, and still does in certain contexts.

Some methods of risk management exploit power differentials rather than sharing risk with any semblance of equity. Along with insurance, another tool used by lenders to manage the risks involved in lending is the use of collateral—assets pledged to secure a loan, and forfeited if the loan is not repaid according to the agreed terms. The use of collateral is not inherently unjust, but can be, depending on what is required as collateral. In ancient Babylonia, for instance, traders at sea had to post collateral to cover the hazards of shipping that often included the entirety of their property and even their family members. Sea traders, in this case, were captive to the demands of powerful land-based merchants. This practice, which limited trade because of the severe burdens placed on traders, was eventually supplanted by bottomry, an arrangement under which ship owners posted their ship as collateral for loans. If a loan was not repaid as

[31] Spencer Kimball, *Cases and Materials on Insurance Law* (Boston: Little, Brown, 1992).

stipulated, the owner forfeited the ship, but if the ship was lost at sea, the lender lost his investment.[32]

Early forms of risk management were not limited to traders and merchants. In the Roman Empire, some soldiers had their pay withheld to supply emergency funds for the families of soldiers killed in battle. Also found in burial funds from the Roman Empire are *collegia:* voluntary associations of people who paid periodic dues in exchange for their burial expenses being paid for upon their deaths. Similar friendly societies also existed in ancient Greece, China, and India. In medieval Europe, members of guilds committed to help each other out in times of need. By the fourteenth century AD, the Portuguese state used the insurance principle to provide a boost to its maritime ambitions, by enacting a tax on shipping profits that was used to reimburse ship owners for losses suffered for reasons other than their own negligence.[33]

The insurance contract, the direct predecessor of modern insurance, first appeared in Italy in the early fourteenth century, in the form of maritime insurance.[34] The first life insurance contracts were written in the late sixteenth century, although the practice of life insurance was banned in many European countries by the middle of the seventeenth century, the height of the Little Ice Age and the midst of the General Crisis.[35] England was the significant exception.

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[32] Vincent Covello and Jeryl Mumpower, "Risk Analysis and Risk Management: An Historical Perspective," *Risk Analysis* 5, no. 2 (1985): 103-120.

[33] On early forms of insurance, see Covello and Mumpower, "Risk Analysis and Risk Management;" Irving Pfeffer and David Klock, *Perspectives on Insurance* (Englewood Cliffs, New Jersey: Prentice Hall, 1977); Karl H. Van D'Elden, "The Development of the Insurance Concept and Insurance Law in the Middle Ages," in *The Medieval Tradition of Natural Law*, ed. Harold Johnson (Kalamazoo, Michigan: Medieval Institute Publications, 1987), 192-199; and W. R. Vance, "The Early History of Insurance Law," *Columbia Law Review* 8, no. 1 (Jan. 1908): 1-17.

[34] Florence Edler de Roover, in her article "Early Examples of Marine Insurance," *Journal of Economic History* 5, no. 2 (Nov. 1945): 172-200, argues that shipping insurance emerged between 1275 and 1325, as traveling traders started to be displaced by "sedentary" merchants who directed affairs from a terrestrial center of business, hiring others to do the actual traveling.

[35] The term 'General Crisis' refers to a period of conflict, upheaval, and instability that occurred throughout most of the seventeenth century, and spanning into the sixteenth and eighteenth depending on the interpretation. It has traditionally been used in reference to Europe, but more recently has been interpreted as a global event. For a recent, comprehensive work on the global nature of the General Crisis and its connections to the Little Ice Age, see

There, until the passage of the Life Assurance Act 1774, it was possible to take out a life insurance policy on anyone, and it became popular among certain circles to take out policies on complete strangers as a form of gambling. The 1774 act stipulated that policyholders must have a legitimate interest in the life that was being insured, part of a broader campaign against the perceived moral evils of gambling.[36]

An association with gambling was not the only moral question that faced insurance in its formative era. Early insurance efforts in the Western world sometimes conflicted with the Christian theology of their time in other ways. This took two major forms: questions whether insurance-like transactions countered the Catholic Church's teachings on usury and profits derived without labor, and concerns that the practice of insurance amounted to efforts counter to the will of God. As for the former, the decretal *Naviganti*, issued by Pope Gregory IX in 1236, equated maritime insurance premiums with usury and banned the practice in most situations. While this ban was not fully enforceable, it did lower the respectability of marine insurance. The ban started to break down by the sixteenth century, as judges began to see insurance as justified provided that the premiums paid were commensurate with the risks run.[37] Regarding the latter theological issue, it might be summarized by saying that if the Almighty had intended for a ship to sink at sea, or a man to be struck dead in the prime of life, or a farmer to lose his crop to hail,

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Geoffrey Parker, *Global Crisis: War, Climate Change and Catastrophe in the Seventeenth Century* (New Haven, Conn.: Yale University Press, 2013).

[36] On the Life Assurance Act 1774, see Robert Merkin, "Gambling by Insurance—A Study of the Life Assurance Act 1774," *Anglo-American Law Review* 9, no. 3 (1980): 331-363. On British life insurance more generally, see Geoffrey Clark, *Betting on Lives: The Culture of Life Insurance in England, 1695-1775* (New York: Manchester University Press, 1999); and Timothy Alborn, *Regulated Lives: Life Insurance and British Society, 1800-1914* (Buffalo, N.Y.: University of Toronto Press, 2009). Also see Lorraine Daston, "The Domestication of Risk: Mathematical Probability and Insurance 1650-1830," in *The Probabilistic Revolution, Volume 1: Ideas in History*, eds. Lorenz Krüger, Lorraine Daston, and Michael Heidelberger (Cambridge, Mass.: MIT Press, 1987), 237-260.

[37] Discussion of *Naviganti* drawn from Rémy Lestienne, *The Creative Power of Chance* (Urbana: University Press of Illinois, 1998), pages 10-11. See also John T. Noonan, Jr., *The Scholastic Analysis of Usury* (Cambridge, Massachusetts: Harvard University Press, 1957).

people believed they risked divine retribution for trying to lessen the impact of these events rather than absorb the lessons that God meant for the events to impart.[38]

However, despite the decline of concerns that insurance is subversive to the will of Providence, more recent critics have essentially reframed such concerns in secular terms. In particular, they worry that poorly considered insurance offerings can lead to *moral hazard*: a term that indicates a condition in which a person takes greater risks than they usually would because they do not bear the entire burden of those risks. As the business historian Robin Pearson relates, moral hazard and physical hazard—the chance of physical events causing loss, such as storms or fires—are two aspects of the liability that insurers purchase.[39] At the same time that insurers started to figure out how to better quantify the physical hazards that they insured, they had to grapple with how to address moral hazard. Prior to the nineteenth century, insurance had been rooted in personal relationships, and insurers could assess the character of those they insured. But as the nature of commercial relations changed in the nineteenth century, becoming more impersonal, insurers could not rely as heavily on character assessments garnered from personal relationships. Despite its being a term associated with insurance, the term 'moral hazard' is not used with great frequency in discussions of flood insurance. Nonetheless, one of the more frequent criticisms of the National Flood Insurance Program is that it encourages people to unwisely build houses in flood-prone areas. Substitute "nature" for "God," and one

[38] On hailstorms, see Frank Oberholzner, "From an Act of God to an Insurable Risk: The Change in the Perception of Hailstorms and Thunderstorms since the Early Modern Period," *Environment and History* 17, no. 1 (2011): 133-152. In his book *The Medieval Discovery of Nature* (New York: Cambridge University Press, 2012), Steven Epstein discusses the rise of insurance in the late medieval period, and argues that seeing the difference between natural and supernatural events was a key component of the development of insurance. See especially pages 180-184.

[39] There is, of course, interplay between moral and physical hazard. For example, someone with fire insurance may be less cautious about the risk of fire than someone without.

does not sound out of place in the early twenty-first century arguing that the NFIP has enabled people to counter the will of nature.[40]

In the historiography of insurance, two different approaches have been prominent. On one hand, there exist numerous institutional histories of insurance companies, frequently commissioned or financially supported by the companies themselves. These histories often tend toward the 'great man' approach to history, chronicling the moves of company leaders, and are prone to a whiggishness related to their intention to celebrate the histories of successful companies.[41] On the other hand, historians of science have taken an interest in the transformations in thinking that led to a turn toward statistics and probability as ways of thinking about the world.[42] A small but growing body of work focuses on an intermediate perspective: how high-level transformations in thinking, for example in the science of probability, have played out at the level of particular insurance industries, if not specific companies. A pair of historians, Geoffrey Clark and Timothy Alborn, have written books that look at British life insurance from this intermediate perspective. They have both interrogated the idea that premium-based insurance, and life insurance in particular, reflects the triumph of actuarial analysis over loosely informed 'gambling,' and both find the historic British life insurance industry to be less thoroughly mathematically informed than might be assumed. Clark calls into question the idea

[40] For an exploration of how the insurance industry grappled with moral hazard in the eighteenth and nineteenth centuries, see Robin Pearson, "Moral Hazard and the Assessment of Insurance Risk in Eighteenth- and Early-Nineteenth-Century Britain," *Business History Review* 76, no. 1 (Spring 2002): 1-35. For an overview of the concept of moral hazard, see David Rowell and Luke Connelly, "A History of the Term 'Moral Hazard,'" *Journal of Risk and Insurance* 79, no. 4 (December 2012): 1051-1075. For a related argument on catastrophe and the limits of the natural world, see Todd Shallat, "Losing Louisiana: Technological Progress and the Nature of Catastrophic Events," *Icon* 6 (2000): 149-159.

[41] Some of the more notable books of this genre include Barry Supple, *The Royal Exchange Assurance: A History of British Insurance, 1720-1970* (New York: Cambridge University Press, 1970); and Clive Trebilcock, *Phoenix Assurance and the Development of British Insurance* (New York: Cambridge University Press, 1985). A helpful historiographical essay that informed this paragraph is Geoffrey Clark, "*Regulated Lives* in Historiographical Context," *Connecticut Law Journal* 16, no. 2 (2009): 455-460.

[42] The key theorists are Lorraine Daston, Theodore Porter, and Ian Hacking, whose work is discussed at other places in this chapter.

that the Life Assurance Act 1774 demarcated an earlier era of poorly informed and immoral gambling from a later era of prudence, arguing both that life insurance prior to 1774 was perceived by contemporaries as more informed than later critics understood it to be, and that the supposed prudence of 1775 onward did not reflect a thorough turn toward actuarial approaches to insurance.[43] Alborn, whose focus is mainly on the nineteenth century, comes to a similar conclusion. He emphasizes that the statistical tables that the life insurance industry won acclaim for were limited in applicability to an idealized male with a healthy lifestyle, and instead of mathematically adjusting their mortality estimates for other groups of people, insurance companies simply made arbitrary adjustments or outright denied coverage to people who did not fit the standard profile.[44]

In the United States, life insurance did not become deeply entrenched until after the mid-nineteenth century. In her seminal 1979 work *Morals and Markets*, sociologist and historian Viviana Zelizer sought to determine why this was, noting that previous generations of economic historians had observed, but failed to explain, why life insurance had so much trouble gaining a foothold before its sudden success starting in the middle of the nineteenth century.[45] "Opposition to life insurance," she argues, "resulted largely from a value system that condemned a strictly financial evaluation of human life."[46] This value system, she writes, was based on a deterministic religious outlook that saw speculating on death as sacrilegious. As the United States shifted toward a religious ethic of voluntarism, the religious objection to life insurance receded. This happened in two waves, first, starting around 1850, aided by theologically liberal clergy

[43] Geoffrey Clark, *Betting on Lives: The Culture of Life Insurance in England, 1695-1775* (New York: Manchester University Press, 1999).
[44] Timothy Alborn, *Regulated Lives: Life Insurance and British Society, 1800-1914* (Toronto: University of Toronto Press, 2009).
[45] Viviana Rotman Zelizer, *Morals and Markets: The Development of Life Insurance in the United States* (New York: Columbia University Press, 1979).
[46] Zelizer, *Morals and Markets*, xi.

members who not infrequently served as spokesmen for the life insurance industry. This first shift was not rooted only in theology, but also in more practical concerns: "Congregations which had been unwilling to raise the meager salaries of their underpaid pastors and ministers were more easily persuaded to pay the relatively small premiums of a policy on the life of the clergyman."[47] The second wave, which took off after the Civil War, was encouraged by growing industrialization and a moral climate more favorable to risk-taking in business practices on the whole.

Life insurance in the nineteenth-century United States was especially embraced by wage-earning members of the rising middle class, mainly men who wanted to provide security for their families in the case of their death but who did not possess farms or estates sufficient to provide this security. Slaveowners also took advantage of life insurance policies to protect their investment in slaves, particularly slaves with valuable skills. Life insurance policies also helped fill the void left by the weakening of personal networks as people migrated to the city or new locales away from rooted rural communities. As Zelizer writes, through the instrument of life insurance, the local economy of friends, neighbors, and relatives who shouldered the burdens when community members died in the eighteenth century partially gave way to a professionalized, impersonal cadre of insurance bureaucrats. But while life insurance was a reaction to one form of anonymity, it brought with it a new intimacy: that of the relationship between the insurance agent and his customer. Before solid actuarial information was available, insurance agents depended upon detailed knowledge of their customers in order to make the right decisions about who to sell to, and at what price.[48]

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[47] Zelizer, *Morals and Markets*, 150.

[48] On the rise of life insurance in the United States, see also Sharon Ann Murphy, *Investing in Life: Insurance in Antebellum America* (Baltimore: Johns Hopkins University Press, 2010). On slave owners insuring the lives of their

Building on the findings of Zelizer and Pearson, we can say some things about how insurance changed during the nineteenth century. In the eighteenth century and earlier, ordinary citizens found less need for insurance against the everyday hazards of life, up to and including death, because tight social networks often meant that family or fellow congregants could pool resources to aid the dependents of someone who had died or suffered ill fortune. Insurance was more necessary for commercial enterprises, in which the financial value of transactions well exceeded the ability or willingness of social networks to step in and aid sufferers of ill fortune. But even in commercial insurance, premiums were dependent on individual reputations based on personal familiarity and social standing. Things changed in the nineteenth century, thanks to forces including industrialization, urbanization, and mechanization that weakened long-standing social bonds.[49] With weaker communal bonds, greater numbers of ordinary citizens began to see the appeal of life insurance that could offer support for their loved ones in case of an unexpected death, while insurers of commercial interests could no longer rely as heavily as they once did on personal relationships and reputations in determining insurance premiums—though social standing continued to play a role. This shift was initially most important for private insurance companies, but the growing impersonality and bureaucratic nature of risk management in both daily and commercial life made insurance a more likely field for eventual governmental intervention.

Insurance has long involved questions of morality, though those questions have changed over time. Concerns over human meddling with the plans of the Almighty—so central to

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slaves, see Murphy, "Securing Human Property: Slavery, Life Insurance, and Industrialization in the Upper South," *Journal of the Early Republic* 25, no. 4 (Winter, 2005): 615-652.

[49] In his book *The Search for Order, 1877-1920* (New York: Hill and Wang, 1967), historian Robert Wiebe identifies the weakening of communal bonds in the face of these forces, and argues that the Progressives of the late nineteenth and early twentieth centuries reacted to this weakening by turning to a bureaucratic way of organizing life.

insurance through the middle of the nineteenth century—have long been marginalized in contemporary secular societies, though with the diverse exceptions of religious groups.[50] But a different question has recently gained prominence: Can there be *too much* protection from risk? Law professors Tom Baker and Jonathan Simon argue in a 2002 essay that in the new millennium, we are experiencing a shift towards an *embrace* of risk. For them this means two things: conceiving of and addressing social problems in terms of risk, and reacting against the sharing of risk by attempting to hold people individually responsible for choices that lead to hazard exposure.[51] Baker and Simon write that "officials are now as concerned about the perverse effects of efforts at risk shifting as they are about the risks being shifted," citing as one poignant example a shift in policy emphasis from eliminating poverty to eliminating welfare.[52] These authors concede that shifts like this may be seen as having less to do with the morality of risk and more to do with attacks on the poor to the benefit of wealthier classes, but they counter that a similar shift of morality has also affected the middle class, such as the shift from defined-benefit pensions to defined-contribution retirement plans. Though such a shift has indeed happened, changes to pensions and retirement plans are only felt gradually. Other changes, like shifting flood risk back onto property owners by eliminating or reducing governmental insurance subsidies, are felt much more quickly. As this dissertation shows, when middle-class citizens are exposed to a rapid shift in risk morality of the type described by Baker and Simon, they offer strong resistance.

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[50] Though Christianity, and societies with Christian roots, had mostly resolved their major theological conflicts with insurance in the nineteenth century, Islamic societies have only much more recently approached resolutions to theological conflicts with insurance. See Tom Baker, "Risk, Insurance, and the Social Construction of Responsibility," in *Embracing Risk: The Changing Culture of Insurance and Responsibility*, eds. Tom Baker and Jonathan Simon (Chicago: University of Chicago Press, 2002), 33-51.

[51] Tom Baker and Jonathan Simon, "Embracing Risk," in *Embracing Risk: The Changing Culture of Insurance and Responsibility*, 1-25.

[52] Ibid., 4.

In contemporary usage, the term 'risk' is used to refer to any situation that involves exposure to hazards. Risk, however, is not an age-old concept. As Jonathan Levy notes in the prologue to his 2012 book *Freaks of Fortune*, through the end of the eighteenth century, the term 'risk' referred specifically to something that was traded in insurance contracts.[53] It was a material, financial instrument. "Outside the world of long-distance maritime trade," he writes, "risk had very little meaning or use."[54] During the nineteenth century, Levy argues, risk took on new meaning as a means of understanding modern life in the United States. "The spread of capitalism had brought the insecurity of the sea to the land. Human beings had long associated the power of chance with the capricious tides of the high seas. Now the image of the ship on stormy waters became a powerful metaphor for the possibilities of life under capitalism."[55] Key to the functioning of risk in capitalism is that it represents not only the possibility of loss or damage, but also tremendous gain. A risky investment might be entirely lost—but might also yield fantastic returns. Over the nineteenth century, risk itself was thoroughly financialized in much of the United States, and it became separated from mere hazard exposure and traded through various financial instruments.[56] Key to Levy's interpretation of the place of risk in the

[53] Jonathan Levy, *Freaks of Fortune: The Emerging World of Capitalism and Risk in America* (Cambridge, Massachusetts: Harvard University Press, 2012). A number of sociologists, including prominently Ulrich Beck and Anthony Giddens, have studied risk extensively, but Levy has focused on it more than any previous historian.
[54] Ibid., 1. While Levy speaks of the usage of the English word 'risk,' his assessment should not be applied to cognates in other languages. In Genoa and Venice, the Latin word *risicum* was used (along with the word *fortuna*, cognate for 'Fortune') to describe situations containing an element of chance. Risicum was more often, though not always, connected to negative outcomes. See Benjamin Kedar, *Merchants in Crisis: Genoese and Venetian Men of Affairs and the Fourteenth-Century Depression* (New Haven, Connecticut: Yale University Press, 1976).
[55] Levy, *Freaks of Fortune*, 2.
[56] The separation of goods or entities, and the financial instruments used to represent them, was not limited to risk, but was also taking place in other sectors of the developing capitalist economic system during the nineteenth century. Minimally processed goods such as agricultural products and lumber, for example, were increasingly traded as abstractions in commodity markets, rather than in direct exchanges of goods for money. In both risk markets and commodity markets, financial instruments created a growing sense of separation between the natural world and modern society, yet the connections between these financial instruments and the things they represented demonstrate the embeddedness of capitalism within the natural world. On the growth of commodity markets, see William Cronon, *Nature's Metropolis: Chicago and the Great West* (New York: W. W. Norton, 1991). Human life presented a unique challenge, as discussed by Zelizer in *Morals and Markets*. In Zelizer's description, "primitive (societies) where only the gods belonged to the sacred sphere" (150) took little issue with conceiving of human life in purely

nineteenth century milieu is that emergent liberal individualist Americans developed self-ownership by recognizing and mitigating their personal risks, a development that ironically brought them into greater reliance upon the corporate financial system. Like Baker and Simon, Levy observes an increased appetite for risk-taking at the end of the twentieth century and into the twenty-first—though Levy sees this as a cycling back to a Gilded Age, late nineteenth-century mindset, rather than an entirely new development—after the weakening of the risk-management paradigm enshrined by the New Deal.[57]

While Levy treats risk as yielding the possibility of both positive and negative outcomes, the sociologist Ulrich Beck defines and interrogates the idea of risk in line with its contemporary usage relating to hazard exposure. Beck is known for his theory of risk society, which he argues is a hallmark of reflexive modernization.[58] Reflexive modernization is associated with second modernity, which is a concept developed by Beck along with fellow sociologists Anthony Giddens and Scott Lash. Second modernity describes the status of societies that have, by and large, achieved the goals of modernity—not just the fulfillment of basic needs such as food and shelter, but also societal achievements such as universal education, suffrage, and civil rights—and have transitioned into a phase in which the modernization process itself is scrutinized, hence 'reflexive modernity.'[59] Risk societies are societies that have made a switch from focusing on addressing scarcity to an increased emphasis on risk management. The risks that must be

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quantitative terms, but "the growth of individualism resulted in a new respect for the infinite worth of human personality." (150) According to Zelizer, the commodification of death via life insurance did not so much profane human life as it sacralized money, at least in the form of life insurance.

[57] See page 34, this chapter.

[58] Beck introduced the idea of risk society in his 1986 book *Risikogesellschaft: auf dem Weg in eine andere Moderne* (Frankfurt am Main: Suhrkamp, 1986), translated into English in 1992 as *Risk Society: Towards a New Modernity*, trans. Mark Ritter (London: SAGE Publications). He continued to develop the idea of risk society through several subsequent publications, including *World Risk Society* (Malden, Massachusetts: Polity Press, 1998) and *World at Risk* (Malden, Massachusetts: Polity Press, 2009).

[59] The concept of reflexive modernization was developed in detail by Beck, Giddens, and Lash in their 1994 book *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order* (Stanford, California: Stanford University Press).

managed in reflexive modernity are themselves products of the modernizing process, and for Beck, the quintessential risk of modernity is nuclear fallout. Modern risks are often imperceptible to the senses, and can be difficult to understand, quantify, or avoid. An important characteristic of the risk society is that nobody is immune. Even the distant owners of ecologically destructive factories, for example, cannot escape the effects of nuclear fallout or global warming, a phenomenon that Beck dubs the 'boomerang effect.' Flooding, in Beck's conception, would mostly qualify as a pre-modern risk, in that it is hazard that is more easily understood and can be mostly avoided. As discussed in the final chapters of this dissertation, however, flooding frequencies are being affected by climate change, leading to a breakdown in traditional ways of understanding flood frequency. In this sense, flooding is becoming more like the risks of second modernity that Beck describes.

The modern practice of insurance is deeply dependent on probability analysis, and probability within insurance is the subject of its own discipline: actuarial science. But when merchants first started to sell insurance, probability had not yet emerged as a formal area of study. That happened starting in the seventeenth and eighteenth centuries, but only developed into a sophisticated science during the late nineteenth century.[60] Early insurance schemes used rudimentary methods of determining hazard exposure and setting premiums. One researcher, in an overgeneralization that nonetheless contains a nugget of truth, writes that through the seventeenth century, "insurance companies took care to give themselves comfortable margins of profit and had no interest in a better understanding of the risks they ran based on mathematical

[60] On statistics and probability, see Theodore Porter, *The Rise of Statistical Thinking 1820-1900* (Princeton, N.J.: Princeton University Press, 1986); Porter, *Trust in Numbers: In Pursuit of Objectivity in Science and Public Life* (Princeton, N.J.: Princeton University Press, 1995); Lorraine Daston, *Classical Probability in the Enlightenment* (Princeton, N.J.: Princeton University Press, 1988); and Gerd Gigerenzer et. al., *The Empire of Chance: How Probability Changed Science and Everyday Life* (New York: Cambridge University Press, 1989).

computations."[61] Shipping insurers, even into the nineteenth century, based their premiums more on news events and gut feelings than any exact calculation of risk.

To be sure, insurers sought the most detailed information available, congregating to seek and exchange information at places like Lloyd's coffee house in London.[62] In seventeenth-century Europe and especially London, coffee houses emerged as sites where people could gather for intellectual discussions of shared interests, developing a reputation strongly in contrast with the rowdiness of taverns.[63] Edward Lloyd's coffee house, which opened in the 1680s, quickly became a gathering spot for people involved in shipping, and by the 1720s, was a key meeting point for marine insurers. The British maritime insurance trade at that time was dominated by individual underwriters, who gathered at places like Lloyd's to connect with traders seeking insurance. Merchants specializing in trade with various parts of the world offered advice on risks and suggested premiums, and as traders became known to the coffee house clientele, their reputations also played into the rates that underwriters proposed. Lloyd himself gathered and publicized relevant information about subjects of interest such as ship movements and politics. Though Lloyd's was the world's leading center for shipping insurance during the eighteenth century, the information found there was rooted in personal relationships and observations rather than mathematical models.[64]

While shipwrecks and piracy threatened maritime commerce, fire was an omnipresent threat to property on land, especially in urban settings where it could spread quickly between properties. Mark Tebeau, a historian of fire insurance in the United States, asks in his book

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[61] Lestienne, *The Creative Power of Chance*, 10.
[62] See Levy, *Freaks of* Fortune, especially pages 30-36.
[63] For more information on the rise and role of coffee houses, see "The Internet in a Cup," *The Economist* 369, no. 8355 (20 Dec. 2003): 88-90.
[64] For more on Lloyd's, see Christopher Kingston, "Marine Insurance in Britain and America, 1720-1844: A Comparative Institutional Analysis," *Journal of Economic History* 67, no. 2 (June 2007): 379-409.

Eating Smoke how insurance underwriters perceived the hazard of fire, how they sought to control the problem of fire, and how their efforts shaped American cities.[65] He also asks these questions of the firefighting enterprise. Through the mid-nineteenth century, American fire insurers operated without detailed knowledge of how likely structures were to burn, making the industry quite a gamble to be involved with. Early fire insurers used property surveys—visits to potentially insured properties by hired inspectors—to assess properties, and based rates on characteristics such as construction materials, proximity to water, and adjacent buildings to name a few. Early on, rates were set based on anecdotal assessments, and it was not until the second half of the nineteenth century that fire insurers started to systematize their approach to risk assessment. This was done via the use of two approaches newly embraced by fire insurers: statistical tables and maps. Through the nineteenth century, fire insurers merely tried to assess and accurately price fire risk, but starting in the early twentieth century, embraced a much more proactive approach to fire losses, working to reduce fire hazards via such approaches as building codes, fire-resistant construction materials, and public awareness campaigns. Their role shifted from merely trying to price risk to trying to reduce it, allowing them to pass on savings to customers or keep these gains as increased profits.[66]

The origins of actuarial science, which is the application of mathematical and statistical methods to assess risk, can be found in the seventeenth century. Edmund Halley, most widely known as an astronomer, created the first actuarial table in 1693, which calculated the chances

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[65] Mark Tebeau, *Eating Smoke: Fire in Urban America, 1800-1950* (Baltimore: The Johns Hopkins University Press, 2003). On American fire insurance, see also Dalit Baranoff, *Shaped by Risk: The American Fire Insurance Industry, 1790-1920* (Ph.D. dissertation, Johns Hopkins University, 2004). On the early years of British fire insurance, approached from a cliometric perspective, see Robin Pearson, *Insuring the Industrial Revolution: Fire Insurance in Great Britain, 1700-1850* (Aldershot, U.K.: Ashgate, 2004).

[66] On urban fire, see also Knowles, *The Disaster Experts*; Amy Greenberg, *Cause for Alarm: The Volunteer Fire Department in the Nineteenth-Century American City* (Princeton, N.J.: Princeton University Press, 1998); and Christine Meisner Rosen, *The Limits of Power: Great Fires and the Process of City Growth in America* (New York: Cambridge University Press, 1986).

that a person of any particular age would die at various ages.[67] Actuarial science itself is applied to insurance and related applications, but historians have also taken an interest in the broader applications of the principles behind actuarial science, using the terms 'actuarial thought,' 'actuarialism,' and 'statistical thinking.'[68] In the nineteenth century, state authorities dramatically increased their emphasis on the collection of numerical data—the word 'statistics' itself being rooted in the Latin word *statisticum*, meaning 'of the state.' During this time, theorists initially sought to find statistical laws relating to social patterns, and wrestled with the determinism that statistical laws seemed to entail. The apparent determinism of statistics evaporated as later generations of scholars focused on the randomness that statistics represent.[69] The importance of statistical and actuarial thought in governance continued to grow during the twentieth century, with nascent welfare states using statistical information to manage social risks such as unemployment and poverty in retirement.

The historian Caley Horan argues that World War II was "a moment when actuarialism exploded onto the globe with unprecedented violence."[70] In this global conflict, she argues, statistics and probabilistic calculations were pervasive as never before, being used for everything from weeding "risky" individuals out of society, to making decisions about the use of nuclear weapons. But for Horan, World War II was merely the gateway to what she terms the 'Actuarial Age," the decades following the war. After the war, she writes, "Americans embraced actuarial rationality with a willingness, exuberance, and tenacity unseen before the War. The watchwords

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[67] Edmund Halley, "An Estimate of the Degrees of the Mortality of Mankind, Drawn from Curious Tables of the Births and Funerals at the City of Breslaw; With an Attempt to Ascertain the Price of Annuities Upon Lives," *Philosophical Transactions of the Royal Society of London* 17 (1693): 596-610.
[68] Caley Horan speaks of actuarial thought and actuarialism in her doctoral dissertation, *Actuarial Age: Insurance and the Emergence of Neoliberalism in the Postwar United States* (Ph.D. Dissertation, University of Minnesota, 2011). See also Porter, *The Rise of Statistical Thinking.*
[69] On the transition from determinism to randomness, see Ian Hacking, *The Taming of Chance* (Cambridge: Cambridge University Press, 1990) and Porter, *The Rise of Statistical Thinking*.
[70] Horan, *Actuarial Age*, 6.

of the era—security, safety, risk—reflected this embrace, as did the exponential expansion of the private insurance industry and the growing importance of risk management in fields as diverse as education, foreign policy, criminology, and medicine."[71]

In the United States, government has been involved in insurance in a variety of ways. Even types of insurance that are operated by private companies are regulated. This is done primarily at the state level—hence the existence of state insurance commissioners—though with increasing federal involvement. There are several reasons that insurance has become regulated, mainly relating to consumer protection, including prevention of fraudulent or deceptive practices, ensuring that insurers remain solvent and are able to pay claims, making sure that insurance is widely available, and limiting anti-competitive practices by insurers. In terms of programs specifically called 'insurance' and operated as privately sold insurance, in which a retail customer would purchase a policy to protect his or her property, entry into flood insurance was a big step for the federal government—earlier precedents such as experimentation in crop insurance notwithstanding. Even though the federal government did not sell many retail insurance policies to customers prior to the creation of the NFIP, it had been involved in what we now would call risk management even prior to the ratification of the Constitution in 1789. The business historian David Moss divides federal risk management into three eras: security for business (to 1900), security for workers (1900-1960), and security for all (1960 onward).[72] During the first era, federal risk management policy served to encourage trade and investment in ways such as limiting the liability of investors for investments gone bad. During the second, the federal government responded to the heightened insecurity of the industrial age with policies meant to mitigate the risks that laborers faced, such as workers' compensation, unemployment

[71] Ibid., 7.
[72] David Moss, *When All Else Fails: Government as the Ultimate Risk Manager* (Cambridge, Massachusetts: Harvard University Press, 2002).

insurance, and old age insurance. The third era is characterized by an ever-expanding array of risks mitigated by the federal government, including environmental hazards, faulty consumer goods, and increasingly, natural calamities.

Though the federal government undeniably became more involved with managing the risks faced by workers between 1900 and 1960, it also expanded its reach into areas of risk management less specifically concerned with workers. The New Deal, in particular, brought an array of developments. In response to the market crash of the Great Depression, the Glass-Steagall legislation of 1933 separated commercial and investment banking, which was meant to keep commercial banks from risking their depositors' funds in high-risk investments. This legislation also created the Federal Deposit Insurance Corporation, which insured deposits at participating banks.[73] Other New Deal legislation and programs such as the Agricultural Adjustment Act and the Soil Conservation Service were meant to protect farmers from losses or damages caused by overproduction or soil degradation.[74] As discussed elsewhere in this chapter, New Deal planers took a heightened interest in addressing flood risks. One of the many consequential ways that the federal government moved to mitigate risk during the New Deal was via mortgage insurance. This insurance, administered by the Federal Housing Administration and authorized by the National Housing Act of 1934, insured lenders making home loans. It was intended to stimulate the real estate and construction industries. It did this by insuring property loans with lower down-payments and longer terms than were previously available, making home

[73] On Glass-Steagall and other New Deal banking legislation, see Ellen Russell, *New Deal Banking Reforms and Keynesian Welfare State Capitalism* (New York: Routledge, 2008); and George Benston, *The Separation of Commercial and Investment Banking: The Glass-Steagall Act Revisited and Reconsidered* (New York: Oxford University Press, 1990).

[74] On New Deal agricultural policy, see Sarah Phillips, *This Land, This Nation: Conservation, Rural America, and the New Deal* (New York: Cambridge University Press, 2007); Sara Gregg, *Managing the Mountains: Land Use Planning, the New Deal, and the Creation of a Federal Landscape in Appalachia* (New Haven: Yale University Press, 2010); Jess Gilbert, *Planning Democracy: Agrarian Intellectuals and the Intended New Deal* (New Haven: Yale University Press, 2015); and Joshua Nygren, *Soil, Water, and the State: The Conservation-Industrial Complex and American Agriculture since 1920* (Ph.D. dissertation, University of Kansas, 2015).

buying a more widely available option. FHA insurance was especially consequential for the development of the American suburban form of development, and eventually for the NFIP as well.[75]

The FHA intersects with the NFIP most notably via the mechanism of zoning.[76] Since 1973, Congress has required that any borrower of a federally insured mortgage for a property in a high-risk flood zone must carry flood insurance. As this dissertation will show, this was a crucial requirement enabling the NFIP to fulfill the vision of floodplain management, because it forces property owners to confront flood hazards. But it has also been a source of recurring political conflict, in part because the floodplain zoning process can seem inaccessible and inscrutable to the people it affects. Some types of zoning are less clearly determined by the natural world, such as zoning that differentiates between residential and commercial districts. In these cases, zones are determined by debates between people over proper locations for various activities. There are environmental *components* to some types of zoning, especially industrial zoning, which is often intended to set environmental nuisances and hazards apart from other land uses. The relationship between floodplain zoning and the environment is different: it is, in theory, determined by disinterested technicians deploying a statistically determined interpretation of the natural world. Even though decisions about how these statistical determinations should be made are very much subject to human agency, the sense of powerlessness engendered by floodplain zoning on the part of property owners has been central to tensions that have plagued the NFIP over the course of its existence. Yet even while floodplain zoning has frustrated numerous property owners and local officials, it has not been able to prevent the continuing trend

[75] For an overview of the importance of FHA mortgage insurance, see Kenneth Jackson, *Crabgrass Frontier: The Suburbanization of America* (New York: Oxford University Press, 1985).
[76] For a historical overview of zoning, see Seymour Toll, *Zoned American* (New York: Grossman Publishers, 1969). For further discussion of zoning, see also Chapter 4 of this dissertation.

of flood-prone development and resultant financial losses for the NFIP. On the contrary, while the limits delineated by flood frequency analysis and codified by floodplain zoning were *intended* by a subset of architects and supporters of the NFIP, the program has evolved into one that approaches explicit support of floodplain inhabitation and development.

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This chapter has provided a broad overview of the history of insurance and its relation to governmental risk management. Chapter two lays the groundwork for the rest of the dissertation via an examination of the probabilistic methods of understanding flood recurrence that became so central to the operation of the National Flood Insurance Program. It begins with the first efforts in the United States to quantify flood recurrence in terms of magnitudes and probabilities in the early twentieth century. The dissertation's argument originates in this chapter, with my contention that floodplain quantification constitutes an attempt to calculate just how far people can safely push nature's limits. Early students of flood recurrence probability were mostly engineers, especially civil engineers working on sewer systems concerned with determining what level of flooding their designs must be prepared to handle. The federal government, little involved in these early studies, took an increasing role beginning in the 1930s. The New Deal brought with it a new approach to flood control, one that encouraged much wider federal participation. Universities also emerged as important centers of flood research, and no university scholar played a greater role in this than geographer Gilbert White. This chapter inquires into how early students of flood recurrence understood the natural world. For them, the dearth of long historical records necessitated probabilistic studies of flood recurrence, and may have also

contributed to the calcificiation of the assumption of climatic stability that held sway among many of these practitioners.

Chapter three focuses on the politics and technical struggles involved in creating a national system of flood insurance in the United States. Prior to World War II, the availability of flood insurance was limited to private companies that either went out of business or pulled out of flood insurance after major floods. This story picks up after the war in Kansas and Missouri, where major flooding in 1951 led to the first concerted effort to involve the federal government in flood insurance. Interested parties debated whether flood insurance was simply impossible to run without losing money, or whether the failed companies were not large or capitalized enough to absorb the losses from major floods. This effort proved to be abortive, but laid the groundwork for future efforts: a 1956 effort that was passed into law but left unfunded, and a final effort in the wake of Hurricane Betsy in 1965 that produced the National Flood Insurance Act of 1968. The chapter asks why flood insurance emerged when it did, what technical and political hurdles it faced, and what its political coalition of supporters looked like. Initially pitched as a component of Cold War preparedness, the idea of flood insurance proved to be a better political sell after coastal hurricane devastation. Despite the eventual linking of flood insurance with the ideas of floodplain management, this chapter finds that a crucial segment of early flood insurance advocates envisioned a federal program with the core purpose of encouraging rapid re-construction and continuing development in areas that had already suffered heavy flood damage. It identifies a crucial change between the 1951 and the 1965-68 proposals for flood insurance: the earlier focused heavily on industrial infrastructure, while the later emphasized insurance for residential properties. The dissertation's overall argument continues in this chapter with advocates of flood control and floodplain management contesting the meaning of the limits

identified in the second chapter: were they limits to push, or limits to approach but avoid transgressing as much as possible?

The fourth chapter examines the trajectory of the NFIP once implemented, with a particular focus on its first several years of existence. It focuses particularly on the practice of zoning at the heart of the NFIP's operation. Faced with slow growth in its early years, the program grew exponentially after legislation passed in the early 1970s mandated the purchase of flood insurance for properties in flood-prone areas purchased with federally regulated mortgages. These early years were critical in shaping the program's long-term trajectory. This chapter traces in particular how the program developed in reference to the vision of floodplain management that helped carry it to its initial enactment. It finds that even as the program moved closer to these ideals in theory, in practice it continued to struggle with how to keep from subsidizing construction that advocates of floodplain management would have found deeply irresponsible, and to swim against the tide of flood prone development propelled by other federal programs. The chapter concludes with an examination of the process of re-mapping flood risk, arguing that political controversies over the catastrophic nature of flooding were partially relocated to the supposedly objective, expert-led processes of mapping and re-mapping high-risk flood zones. The dissertation's overarching argument continues through this chapter as local freedom allowed by the NFIP diluted the emphasis on floodplain management.

The fifth chapter begins with Hurricane Katrina in 2005. Katrina definitively disrupted the NFIP's fiscal balance, sending the program into far more debt than it had ever previously carried. Though Katrina cannot be definitively pinned on climate change, it wrecked the NFIP's finances in a way that no previous storm had, suggesting the beginning of a new era for flood insurance and flood risk projections. This chapter examines the legislative process meant to

address the problems revealed by Katrina and subsequent storms, and its quick reversal once new rules were enacted. The dissertation's broad argument continues to develop as I argue that recent events in 2017 and 2018 have fully revealed the NFIP as a federal program perpetuating the status quo in regard to both development patterns and climate change.

Chapter six envisions the future of flood insurance. It examines the science related to various forms of flooding that will be exacerbated by anthropogenic global warming. Based on the historical precedents examined in previous chapters, this chapter predicts that the NFIP may expect to continue to receive congressional subsidies, or at least greater borrowing power, in an attempt to maintain the established status quo, even as a changing climate causes rising sea levels and potentially more erratic inland flooding. The overall argument of the dissertation concludes that at least in the short term, flood insurance seems destined to become a policy tool that be used to push and blur the limits of the natural world even as those boundaries shift along with the climate.

Chapter Two

Knowing Nature Through Numbers: The Origins of Flood Hazard Quantification

The Melan Arch Bridge formerly found in Topeka, Kansas, helps to illustrate the state of knowledge of flood levels at the close of the nineteenth century. Created by Austrian engineer Joseph Melan, the Melan bridge system was state-of-the-art at the turn of the century, and the Topeka bridge was the largest Melan bridge yet built at the time of its construction.[1] When the bridge was built over the Kansas River in 1897, the city engineer's river gauge records spanned 25 years. Within that time period, the records revealed a 15-foot range between the highest and lowest recorded water levels. "(T)he oldest inhabitant, who claimed that he had seen the river go clear out of its banks and flood the entire valley prior to 1850, was deemed to be in his dotage and untrustworthy," recounted civil engineer H. V. Hinckley.[2] Only six years later, however, a large flood caused the city engineer's records to be amended to reflect a 28-foot range, and the bridge sat under six feet of water. "The oldest inhabitant was vindicated, and the river proved what every one should have known," Hinckley wrote. What everyone should have known, in Hinckley's assessment, was that 25 years was not a sufficient sample of time to expect to see a river's greatest flood or anything close to it.[3] The flood of 1903 merely put the bridge out of commission temporarily, but after enduring several other floods higher than those its builders

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[1] Robert Thorn, "History of Kansas River Crossings at Topeka," in *International Engineering History and Heritage: Improving Bridges to ASCE's 150th Anniversary*, eds. Jerry Rodgers and Augustine Fredrich (Reston, Virginia: American Society of Civil Engineers, 2001), 290-294.

[2] H. V. Hinckley, "Response," *Transactions of the American Society of Civil Engineers* 77 (1914): 622-624. Quote on 622.

[3] Hinckley 1914, 622. Even time periods of observation much longer than 25 years still yielded bridges that were washed away by high waters. In a 1928 article on floods in the Connecticut valley, J. W. Goldthwait noted that even though bridges in that region had been rebuilt higher and higher after successive floods throughout the 1800s, many were washed away by the 1927 floods that exceeded previous records. See Goldthwait, "The Gathering of Floods in the Connecticut River System," *Geographical Review* 18, no. 3 (July 1928): 428-445.

designed for, the bridge collapsed during a flooding event in July of 1965, costing the life of a commuter who became trapped in his vehicle.[4]

If the bridge had been built in the late twentieth century or beyond, critics might have asked whether its planners were taking into account the hundred-year flood height, and probably also the five-hundred-year level. At the dawn of the century, however, such terminology was not yet in use, and the ideas it represented were embryonic, at best. There existed no accepted method to estimate the frequency and probability of floods of particular magnitudes. In a few cases, engineers had offered formulas that could apply to individual streams, but it was more common to rely on recorded flood marks, or the memory of local residents. In order to more accurately understand the levels of flooding that they needed to plan for, the designers of Topeka's Melan Arch Bridge would have needed a much more lengthy chronological record, which simply was not available given the recent settlement of the area by European settlers and their disinterest in informal records. Barring that, the designers needed another method of understanding and projecting potential flood levels.

Even as statistics were applied more intensively to various types of risk during the late nineteenth century, flood hazards had not yet been heavily subjected to this type of analysis. By the turn of the twentieth century, only a few studies had attempted statistical analysis of flood frequencies in the United States, and each of these studies was concerned with only a particular stream that was not applicable more broadly.[5] Tropical cyclones, the storms that have wrought so much of the flood damage in the post-NFIP era, were subjects of intense study in the nineteenth century. Though today river floods and coastal floods are both insured by the NFIP, early

[4] Michael Hooper, "1965 Flashback: Melan Arch Bridge Tumbles," *Topeka Capital Journal* August 5, 2007.
[5] These earlier studies include Robert Horton, *Frequency of Recurrence of Hudson River Floods* (Washington, D.C.: U.S. Weather Bureau, 1913); and George Rafter, *The Relation of Rainfall to Runoff* (Washington, D.C.: U.S. Government Printing Office, 1903).

scholars of river flood recurrence paid little if any heed to hurricanes in their written works. This likely has to do with the differing reasons for study of the two phenomena. Hurricane prediction was an imperial science, driven by geopolitical and trade concerns, and the realm of atmospheric scientists preoccupied with wind speeds and destruction, and connected to the military or even religious institutions. In contrast, turn-of-the-century studies of river flood recurrence had their base in the work of civil engineers concerned with sanitary sewers and local flood protection structures associated with a range of urban improvements, including bridges.[6] The late nineteenth and early twentieth centuries were the time of what environmental historian Martin Melosi calls the "bacteriological revolution," a time when public health advocates started to connect bacteria and illness.[7] Owing to this connection, cities of the era increasingly emphasized the construction of sewer systems to remove infectious waste away from urban residents, often using storm water to help flush it through the system. Civil engineers working on sewer systems were necessarily interested in the volumes and levels of water that they needed to prepare their projects to withstand.

The growth of the idea that river floods are a quantifiable risk is a process to which few historians have devoted much attention, but it represents a compelling example of how people have come to know their natural surroundings numerically.[8] For nearly half a century, the methods and language of probability have been crucial to the operation of the National Flood Insurance Program. It is mostly because of the NFIP's needs that detailed surveys of flood risk in

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[6] On hurricane prediction, see Gregory Cushman, "The Imperial Politics of Hurricane Prediction," in *Nation States and the Global Environment: New Approaches to International Environmental History*, eds. Erika Bsumek et. al. (New York: Oxford University Press, 2013), 137-162.

[7] See Martin Melosi, *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present* (Baltimore: Johns Hopkins University Press, 2000).

[8] The works of history that do address this topic include Martin Reuss, "Probability Analysis and the Search for Hydrologic Order in the United States, 1885-1945," *Water Resources Impact* 4, no. 3 (2002), 7-15; and W. H. Kirby and M. E. Moss, "Summary of Flood-Frequency Analysis in the United States," *Journal of Hydrology* 96, no. 1-4 (1987), 5-14. Reuss' examination of the earlier developments in flood probability studies is particularly informative.

many parts of the United States exist. In many cases, "accounting for nature" via numerical representations was intended to maximize sustainable extraction of natural resources such as fish, forest products, and agricultural outputs. But in the case of flood risk quantification, the process can be seen as an attempt to account for nature not so much to enable sustainable use of natural resources, but to enable a sustainable method of coping with environmental risk.[9] In practice, this would mean understanding how frequently environmental hazards like floods would occur, so that their expected frequency could be balanced against their expected damages.

Civil engineers in private practice led the way in perceiving and representing this specific part of the natural world through the lens of probability. Their work was originally most important in determining specifications for flood protection and sewer infrastructure. Probabilistic analysis was also critical to creating cost-benefit analyses of proposed flood control structures like levees and reservoirs, studies that saw an increase in demand as the federal government took an increased role in flood prevention efforts starting in the 1930s. Civil engineers of the early twentieth century were also heavily involved in designing sewer systems and bridges, both of which would benefit from improved knowledge of flood flows.[10]

A generation later, interested parties increasingly thought not just about predicting flood magnitudes, but about understanding the areas that would be affected and about what constituted acceptable levels of flood risk. As this way of thinking developed, theoreticians, practitioners, and policymakers increasingly began to think in terms of recurrence intervals. The everyday

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[9] Contra the emphasis of Sabine Höhler and Rafael Ziegler in "Nature's Accountability: Stocks and Stories, Guest Introduction," *Science as Culture* 19, no. 4 (2010), 417-430, on taking nature into account "for the sake of maximizing sustained yield and producing sustainable quality" (p. 417). See also Hays, *Conservation and the Gospel of Efficiency*; and McEvoy, *The Fisherman's Problem*.

[10] Francis E. Griggs, "1852-2002: 150 Years of Civil Engineering in the United States of America," in *International Engineering History and Heritage: Improving Bridges to ASCE's 150th Anniversary*, eds. Jerry Rogers and Augustine Fredrich (Reston, Virginia: American Society of Civil Engineers, 2001), 14-35. The cost-benefit methodology was introduced in the United States by the Army Corps of Engineers, and used increasingly after the Flood Control Act of 1936. See Porter, *Trust in Numbers*.

prevalence of the idea of the 100-year floodplain demonstrates the extent to which American society now endeavors to know nature through numbers. It not only suggests an ability to predict the vagaries of the natural world, but also reveals an interest in calculating just how far people can safely push nature's limits.[11]

During the latter half of the nineteenth century, engineers and hydrologists had greatly advanced their knowledge of the hydrologic cycle. The demand for this advancing knowledge in the United States was spurred by increased urbanization, utilization of hydraulic power, and eventually irrigation. Great efforts went into developing correlations between rainfall and runoff or stream flow. However, the more that hydrologists learned, the more complicated the problem seemed to be, and by 1903, one noted hydrologist claimed that it was simply not possible to create a single formula correlating rainfall and runoff.[12]

Hydrological studies of Pittsburgh, Pennsylvania, and the Dayton, Ohio, area in the 1910s were given much more thorough consideration than had been given for the construction of Topeka's Melan Arch Bridge, and serve as representative samples of the state of the art in flood studies at that time.[13] The Flood Commission of Pittsburgh was composed of civil engineers, city officials, and business leaders, and completed a study of the city's vulnerability to flooding in 1912. In the commission's report, a section analyzing future possible floods went well beyond assuming that the greatest flood of record is the maximum flood that must be planned for. Nonetheless, the commission made no attempt to mathematically determine the likelihood of such a greater flood. Rather, it justified the claim that higher floods were likely by reviewing what could have happened if recent scenarios had unfolded differently. In the winter of 1909-

[11] Carmel Finley, *All the Fish in the Sea: Maximum Sustainable Yield and the Failure of Fisheries Management* (Chicago: University of Chicago Press, 2011).
[12] Reuss, "Probability Analysis and the Search for Hydrologic Order in the United States, 1885-1945."
[13] Flood Commission of Pittsburgh, *Report of Flood Commission of Pittsburgh, Penna.*, (Pittsburgh: Murdoch, Kerr & Co., 1912).

1910, for instance, the city had received unprecedented snowfall. "If a rain similar to any one of the frequent heavy, warm spring rains had occurred" when the winter's snows were melting, the report suggested that "the snow on the ground at the end of February, 1910, would have melted and run off with this rain," leading to a flood greater than that of 1907.[14] The Miami Conservancy District (MCD), organized in response to the heavy flooding that had hit Dayton and surrounding areas in 1913, produced several volumes of studies on the Miami River in connection with its project to build five flood control dams in the area. The engineers of the MCD stopped short of probabilistic modeling, but used several centuries of data on European river flows to observe that large "floods which occur on an average of once in a century or two"—which seemed an accurate appraisal of the 1913 Dayton flood's magnitude—"have been exceeded in the course of many centuries," even if rarely by much. In projecting the maximum possible flood in the Miami Valley, the MCD, headed by civil engineer Arthur Morgan, theorized that by designing for a flood 40 percent greater than that of 1913, they would achieve complete safety, with room to spare, assuming climatic stability.[15]

From Kansas, to Pennsylvania, to Ohio, none of the previously mentioned actors could effectively apply probability to their problems of flood recurrence because of an absence of developed methods to do so, but that situation would soon change. Weston Fuller, a civil engineer and a partner in the New York engineering firm Hazen & Whipple, published the first comprehensive statistical approach to estimating river flood frequencies and magnitudes in 1914.[16] Fuller himself remains a rather obscure character—he had few other publications to his credit, and his available biographical information is decidedly sparse—but his work on flood

[14] Flood Commission of Pittsburgh, *Report of Flood Commission of Pittsburgh, Penna.*, 48.
[15] Sherman Woodward, *Hydraulics of the Miami Flood Control Project* (Dayton, OH: Miami Conservancy District, 1920), 44-45.
[16] Weston Fuller, "Flood Flows," *Transactions of the American Society of Civil Engineers* 77 (1914): 564-617.

probabilities endows him with a definite historical significance. Fuller's work did have some precedents, but the critical distinction between his work and that which had come before was that earlier efforts tended to focus on individual bodies of water, whereas Fuller was proposing a method that would be applicable for rivers and streams throughout the country.[17]

The firm Fuller worked for, which produced much of the most important flood frequency research of the early twentieth century, was founded in 1904 by George Whipple and Allen Hazen and focused especially on city sanitation and water supply systems in the early twentieth century.[18] It comes as little surprise that those with an interest in sanitary engineering produced much of the early American work on flood probabilities. In a contemporary debate over whether it was better for cities to build individual sewer systems for wastes and for storm runoff, or whether combined systems that would handle both types of outflow were the better choice, many sanitary engineers – including Whipple and Hazen – favored the latter solution. Thus, the potential for downpours and floods was naturally an important component of their analysis.[19]

Fuller's paper *Flood Flows* was presented to the American Society of Civil Engineers in October 1913, and was published the following year.[20] Within the article, Fuller laid out the practices employed by Hazen & Whipple at the time, methods that were advanced beyond what had been described in any contemporary source.[21] Nearly a century after its publication, Fuller's paper remains a landmark in the study of flood frequencies, and it is likewise a sign of a significant shift in the way that experts understood the world in which they lived. Although the study of probability was nothing new by the early twentieth century, it had not previously been

[17] Rafter, *The Relationship of Rainfall to Runoff*; Horton, *Frequency of Recurrence of Hudson River Floods.*
[18] A. E. Kennelly, "George Chandler Whipple (1866-1924)," *Proceedings of the American Academy of Arts and Sciences* 60, no. 14 (1925): 654-57; David Hendricks, *Fundamentals of Water Treatment Unit Processes: Physical, Chemical, and Biological* (Boca Raton, FL: CRC Press, 2011).
[19] Joel Tarr, "The Metabolism of the Industrial City: The Case of Pittsburgh," *Journal of Urban History* 28:5 (2002): 511-45.
[20] Fuller, "Flood Flows."
[21] Allen Hazen, *Flood Flows* (New York: John Wiley & Sons, 1930).

applied to the workings of nature in such a manner. To understand the behavior of the natural world through the principle of probability is a much different approach than believing that it adheres to simple, consistent mechanistic rules, much less that it is under the control of supernatural powers.[22]

In many regions of the United States in the early twentieth century, stream flow records did not have a long history. The Topeka incident is a clear demonstration of this. The lack of long-term information posed a significant challenge to probabilistic flood calculations, a challenge Fuller readily acknowledged. "If the data for all the floods that have occurred in a single river for several hundred years were available, a relation could be established showing the average frequency with which floods of any size occur," the engineer wrote.[23] Without such data, however, Fuller and his colleagues had to take a different approach. With the equations proposed in Fuller's article, not only could one predict the probabilities for different levels of floods on a single stream, one could do so for almost *any* stream that had at least a relatively brief flow record available. Rather than simply tabulating flood records to highlight large floods, however, these engineers offered mathematical formulas that would enable one to calculate predicted frequencies and magnitudes, even in the absence of long-term written flood records. Fifteen years was suddenly enough of a record to produce a detailed set of predictions, in the view of the leading civil engineers of the day. Hazen, though perhaps biased due to his close professional relationship with Fuller, lavished praise on the latter's publication. His hailing of the article as "the first attempt to apply the principles of probabilities to the flood problem," despite receiving

[22] For a detailed discussion of the transition in understandings of natural disasters, specifically hail, from divine retribution to nature theology to experimental science, see Frank Oberholzner, "From and Act of God to an Insurable Risk: The Change in the Perception of Hailstorms and Thunderstorms since the Early Modern Period," *Environment and History* 17 (2011): 133-52. On a related shift in the field of physics, relating to James Maxwell's theory of electromagnetic radiation, see Bruce Hunt, *The Maxwellians* (Ithaca, N.Y.: Cornell University Press, 1991).

[23] Fuller, "Flood Flows," 573.

a bit of pushback from contemporaries who felt that they had prior claims to this title, generally withstands scrutiny, particularly when speaking of a generalizable model rather than one created for a specific stream.[24] The strongest pushback came from the hydrologist Robert Horton, on his own behalf as well as that of his uncle George Rafter. Horton noted that Rafter, by then deceased, had suggested a probabilistic analysis of flood recurrences in the 1890s, but that "the stream flow data were so meager as to make it desirable to defer the completion of the studies."[25]

Fuller's approach was to utilize data from many rivers, but over a shorter period of time. "As rivers follow the same general law, it is allowable to use the data on all the rivers in the same way as those on a single river, provided such data can be put on a common basis," he argued in defense of this method.[26] In other words, he worked on the assumption that all streams will demonstrate a consistent relationship between average yearly floods and infrequent, high-volume events. Because of this, ten years of data from ten rivers would be nearly as good as one hundred years from one river, and fifteen years or more of data from hundreds of rivers would be far better yet. He planned to create such a common basis through the use of the yearly average flood, which is the average of the highest level of flow reached each year for any particular channel. "(T)he ratio of the larger floods to the yearly average floods should be the same for all rivers for the same period of time," Fuller justified.[27]

Though the assumption that short chronological records from numerous streams can stand in for longer chronological records makes a certain sense, it nonetheless suggests a naiveté in regard to the natural world from a twenty-first century perspective. Since weather and climate

[24] Allen Hazen, "Response," *Transactions of the American Society of Civil Engineers* 77 (1914): 626-32. Quote is from p. 626.
[25] Robert Horton, "Response," *Transactions of the American Society of Civil Engineers* 77 (1914): 663-670. Quote is from p. 664.
[26] Fuller, "Flood Flows," 574.
[27] Fuller, "Flood Flows," 574.

patterns tend to affect large areas, neighboring streams will likely share common trends. If one region had experienced an especially wet fifteen years, chances are that nearby regions might have also experienced elevated moisture during those years. By way of example, using data from the Kansas River and ten nearby streams for 1900-1910, the sample size would have been one hundred years of river data (ten years each from ten rivers), but would have shown the 1903 flood to be a one-in-ten event if it had occurred on all ten bodies of water. Fuller was not unaware of these limitations, but dismissed their severity. "As most of the data were obtained during the last 10 or 20 years, objections to this method of analysis may be raised on the score that weather conditions may have been different during other periods in the past, or may be different in the future," he wrote. "Certainly, if weather conditions throughout the country were subject to permanent changes, this objection would be well taken. There is no evidence, however, that this is so."[28] Furthermore, Fuller contended, "a dry season in one section of the country may occur during the same year as a wet season in another section."[29]

Nonetheless, Fuller's reasoning resonated with other flooding specialists of the era. In an Illinois report published in 1919, engineers John Alvord and Charles Burdick wrote that Fuller's method "permits, to some extent at least, a utilization of our relatively short American records to give us information that it might be expected a longer record might, upon the average, approximately substantiate." The two engineers held that Fuller's method "apparently justifies the adding together of all the yearly records from all the rivers of the middle and eastern United States, setting down the yearly floods of each stream as ratios of the average of each stream, thus securing a composite record of great length for one stream. The record thus produced by Mr.

[28] Fuller, "Flood Flows," 574.
[29] Fuller, "Flood Flows," 574.

Fuller is some 1,672 years in length."[30] Fuller's own confidence in his data, combined with the praise lavished by other leading experts such as Alvord and Burdick, demonstrate the pervasiveness of the assumption that the climatic conditions which contribute to flood magnitudes were stable and not likely to change in the near future. Morgan, of the Miami Conservancy District, laid out this assumption explicitly in his response to Fuller's paper. "One of the fundamental assumptions is that weather conditions throughout the United States are not subject to 'permanent changes,'" Morgan wrote.[31] Morgan neither endorsed nor questioned this assumption, merely noting the need for future research on this count.

Fuller proposed a pair of formulas to be used in determining probable flood magnitudes. These formulas are as follows:[32]

$Q = C A^{0.8} (1 + 0.8 \log T)$

and, using the result of the first formula,

$Q\ (Max.) = Q (1 + 2 A^{-0.3})$

In these formulas, the variables have the following meanings:

Q: The greatest average flow for a period of 24 hours, within a given time period

Q (Max.): The maximum rate of discharge, or the greatest magnitude flood

T: The number of years in the time period to be considered

A: The catchment area of the river under consideration, also known as a drainage basin or watershed

C: A coefficient or multiplier that is constant for any particular river at a particular location

[30] John Alvord and Charles Burdick, *Report Made to Former Rivers and Lakes Commission on the Illinois River and its Bottom Lands: With Reference to the Conservation of Agriculture and Fisheries and the Control of Floods*, second edition (Springfield: Illinois State Journal Co., State Printers, 1919). Quotes are from p. 98.
[31] Arthur Morgan, "Response," *Transactions of the American Society of Civil Engineers* 77 (1914): 618-621. Quote is from p. 618.
[32] Fuller, "Flood Flows," 566-567.

In other words, the first formula allows one to determine the predicted greatest average flow over a 24-hour period (Q) to be expected over time period T, based on the river's catchment area A and its specific coefficient C. The second formula further allows one to take the number derived from the first formula to calculate the maximum probable flood over the same period of time T. For example, if T were set to equal 10, then the formulas would provide the greatest 24-hour average flow to be expected over the course of ten years, and the highest instantaneous flow to be expected over such a time period.

In these formulas, the coefficient played an important role. It was the component of the equation that allowed it to be applied to a wide range of streams, rather than tying it to a particular river or creek. The coefficient needed to be calculated for any specific riparian location for which one wished to compute flood probabilities. The practicality of Fuller's formulas was that the coefficient could be calculated based on the average yearly flood. Though this number would become more and more accurate with longer chronological records taken into consideration, relatively short periods of time nonetheless provided reasonably useful data, at least from Fuller's perspective. The 25-year records used in Topeka in 1897, while they were badly insufficient as a window of time in which to look for the upper limits of flooding potential, would have been more than enough to calculate a serviceable coefficient based on average yearly floods. In his study, Fuller set a standard of 15 years as a minimum level of information for calculating a sound coefficient.[33] This was a major break from earlier probabilistic analyses of flood recurrence, which only used data from the individual stream whose flood probability was being analyzed, and thus were limited to a few rivers with unusually long flow records. Yet, critics questioned some of Fuller's assumptions, suggesting for example that flow records from

[33] Weston Fuller, "Response," *Transactions of the American Society of Civil Engineers* 77 (1914): 676-94. Quote is from p. 684.

an amalgamation of streams cannot provide the same level of accuracy as long records from the particular body of water under analysis, owing to the different circumstances of different streams and watersheds.[34] This would not be the last time that proponents of generalizable models and specific analyses came into tension with each other.

Topeka was not a site of early flood probability work, but it offers a two-fold insight into how engineers working on flood probabilities needed a specific kind of data, and how their methods had difficulties incorporating other forms of flood knowledge. Without exact measurements and records from intervening years, it would have been very difficult for an engineer using Fuller's probabilistic model to incorporate vernacular knowledge of historical events such as the pre-1850 Topeka flood, or information obtained from other proxies, into a useful data set. Moreover, the United States was not uninhabited prior to the arrival of Europeans, and Native American inhabitants might have been able to corroborate the memories of senior settlers' memories – though such knowledge would have been equally difficult for probabilistic modelers to engage with. Only in recent decades have hydrologists and historians begun to establish the study of historical hydrology, which attempts to extend the hydrological record beyond the time period for which instrumental measurements are available using such sources.[35]

While the Fuller equations were broadly applicable because they did not require extensive flood records, they did nonetheless require *some* records. Fifteen years was Fuller's stated minimum record to create a reliable coefficient, and by the early twentieth century, the United States Geological Survey had collected stream flow data over at least fifteen years for

[34] See criticism found in Morgan, "Response," and Emil Kuichling, "Response," *Transactions of the American Society of Civil Engineers* 77 (1914): 643-663.
[35] On historical hydrology, see the October 2006 issue of *Hydrological Sciences Journal* (volume 51, number 5), a special issue devoted to historical hydrology. This issue contains several case studies and an editorial overview of the project of historical hydrology.

numerous waterways. Created in 1879, the USGS centralized the surveying responsibilities that had previously been filled by a wide range of private contractors and state geological surveys of varying proficiency. Those involved in its creation, including John Wesley Powell, were especially interested in cataloguing the country's water resources in order to enable widespread irrigation throughout the American West.[36]

The products of Fuller's equations came in the form of flood flows, a measurement of volume per unit time. Although the determination of probable flood flows was a notable achievement, simply understanding how much water will pass through a given location is not the same as understanding the extent of the area that will be affected. The two types of information are indeed closely related, yet the difference between them is critical. Hazen alluded to this difference in his 1930 book *Flood Flows*: "It would be theoretically possible to draw a line down the bank of a stream above which there would be only one chance in ten that water would rise in any one year," the engineer wrote, "and to draw another and higher line above which there would be only one chance in a hundred, and so on for higher and less frequent floods."[37] In 1930, this was a great challenge, one that was only "theoretically possible." Such knowledge would prove essential to endeavors such as the successful implementation of flood insurance.

Though flood probabilities could be put to use in a range of situations, Fuller and his contemporaries mainly saw them as a tool to determine the prudent magnitude of physical flood protection structures. But with the application of probability to flood recurrence, it was not a great leap to think of floods in terms of recurrence intervals, and Hazen made that small but crucial hop in his discussion of the Fuller article. "There is one chance in ten that the 10-year flood will occur in any one year; one chance in one hundred that the 100-year flood will occur;

[36] On John Wesley Powell and the early years of the USGS, see Donald Worster, *A River Running West: The Life of John Wesley Powell* (New York: Oxford University Press, 2001), especially pages 360-370.
[37] Hazen, *Flood Flows*, 2.

and one chance in 1000 that the 1000-year flood will occur," he wrote.[38] In the original article, Fuller pointed to a misconception that would become entrenched over the next century. Writing about *T*, the variable in his formula that represented the flood recurrence interval, Fuller wrote, "it must be remembered that the use of $T = 1000$ does not mean that the corresponding flood will come at the end of 1000 years, but that the chances are even that it will occur at some time during a period of 1000 years."[39] In his response to Fuller's article, Robert Horton noted that he "adopted 100 years in most cases as the average interval of recurrence of a flood of the magnitude to be made the basis of design."[40] Clearly, the concept of the return interval has existed since the earliest days of probabilistic flood recurrence analysis.

Hazen's 1930 book *Flood Flows*, finished just before his death, did not overturn Fuller's earlier work, but rather refined it. "The methods set forth in Mr. Fuller's paper have been added to and perfected with the lapse of time, but the basic method is still used as the most satisfactory available procedure," Hazen wrote in the introduction to his own volume.[41] Though Hazen's work included technical refinements to Fuller's methods, perhaps its more interesting contribution is its discussion of the applicability of flood-probability analysis to situations in the real world. This is not to say that Fuller's earlier analysis had been a mere intellectual or academic exercise, but Hazen's book provides insight into the ways that Fuller's work had been utilized in the years since its publication. One important contribution that probability studies added to the body of knowledge concerning floods related to the dominant form of protection employed during the early twentieth century: levees. "Flood prevention work must be wisely directed as otherwise it may prove to be worse than useless," Hazen wrote. "A levee that holds

[38] Hazen, "Response," 630.
[39] Fuller, "Flood Flows," 594.
[40] Horton, "Response," 664.
[41] Hazen, *Flood Flows*, v.

small floods, but is not high and strong enough to hold a large one, may inspire confidence in the minds of the people through a term of years when the levee functions, and so lead more people to live behind it, and ultimately bring greater disaster."[42] No doubt, this was a statement that could have been made decades or even centuries earlier. The difference, however, was that as probability grew in acceptance as a method to understand flood levels, people could more accurately understand whether the levees they built would be likely to stand up to the larger floods that were possible in their area, because they could gain a better idea of just how great and frequent those floods might be.

While Hazen was promoting judicious usage of flood frequency projections, another school of thought began to challenge outright the wisdom of such an approach. A pair of dam engineers both registered their concerns in the same year, 1939, in the journal *Civil Engineering*. "Not withstanding the fact that periods of record sometimes did not exceed 20 years and very seldom exceeded 30 or 40 years, these probability curves were extrapolated to estimate the flood which would be expected during long periods—once in 1,000, 5,000, 10,000 years, etc," wrote William Creager, author of the treatise *Engineering for Masonry Dams*. "Recently, however, it has been proved by advanced studies and a greater accumulation of data, that the probability method is entirely inadequate."[43] Creager went on to detail recent instances in which floods much larger than anything predicted by Fuller's method had occurred. Disavowing climate changes as a likely explanatory factor, Creager instead advocated for research that incorporated not only historic stream flows, but also the likelihoods of major storms centering directly over given drainage areas. At the same time, another engineer, Thaddeus Merriman, wrote

[42] Hazen, *Flood Flows*, 178.
[43] William Creager, "Possible and Probable Future Floods," *Civil Engineering* 9, no. 11 (November 1939): 668-670. Quotes are from p. 668. Creager's book referenced above is *Engineering for Masonry Dams* (New York: Wiley, 1929).

dismissively of "catch phrases" such as the "thousand-year flood," and the increasing use of modeling in dam design. "Every dam should be of the best—a Rolls-Royce and not a 'flivver.' Unfortunately however, most dams are in the latter class because the engineer continually harps on economy. It is a fetish he worships," he wrote.[44]

Creager and Merriman had indeed identified technical flaws in Fuller's approach that had become evident in the decades since he introduced it. But they also pointed to a divergence, in which different types of flood projections would be applied to different problems. Keeping a dam from being breached, for example, tends to carry much greater weight than projecting how often water will inundate a low-lying area. In the earlier era dominated by flood control structures, questions about probability would have been less important, because the objective was to protect against all floods to any extent possible. But the cost-benefit approach effectively implemented by the Flood Control Act of 1936 brought with it new thinking about the cost of any given endeavor versus the benefits it would provide.

Through the early 1930s, work on flood probability had generally been the purview of private enterprise. Though the work of these engineers had sometimes been at the request of municipalities or other governmental entities, government itself, especially the federal government, had been mostly uninvolved in the science of understanding flood frequencies. This would soon change, though. Over the coming years, the federal government would play a growing role in the work on flood probability. Universities also became centers of inquiry into the topic, where before they had not been leading players. The federal government's increased interest in flood probability studies was no doubt related to its increased role in flood protection, a change brought about in large part by the Flood Control Act of 1936. More generally, the

[44] Thaddeus Merriman, "Naught But the Best: One Engineer's Philosophy as Applied to Dams and Current Doctrines," *Civil Engineering* 9, no. 12 (December 1939): 701-702. Quote is from p. 701.

policies of Franklin Roosevelt's New Deal had also meant that the federal government was playing an increased role in the generation and dissemination of scientific expertise of various sorts.

Growing governmental interest in flood probability was clearly visible in the 1936 publication of *Floods in the United States: Magnitude and Frequency* by the United States Geological Survey.[45] Though published by the Geological Survey, this massive work was compiled in conjunction with the Mississippi Valley Committee, a New Deal agency created to "(study) and (correlate) projects involving flood control, navigation, irrigation, power, reforestation and soil erosion in the Mississippi drainage area," and its successor organization, the Water Planning Committee of the National Resources Board.[46] Its lead author, Clarence Jarvis, was a respected hydrologist who worked for the USGS. "The need for a more complete and systematic knowledge of floods was impressed upon the Mississippi Valley Committee early in its consideration of public works projects involving river utilization and control," the authors stated in the report's introduction.[47] To address this perception, the report offered an overview of the most important work that had been done on flood frequencies and magnitudes over the past half-century, and also provided flood data for over 200 flood-prone United States rivers, generally using at least 20 years' worth of information. The objective of the Jarvis report was not to break new theoretical ground, but to compile the state of the art, both in theory and data, and to make that information broadly available for general reference.

In addition to the release of the Jarvis report, the year 1936 also marked the climax of a dramatic shift in federal flood control policy that would lead the government to take a more

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[45] Clarence Jarvis, *Floods in the United States: Magnitude and Frequency*, USGS Water Supply Paper 771 (Washington, D.C.: U.S. Government Printing Office, 1936).
[46] On these organizations, see Joseph Arnold, *The Evolution of the 1936 Flood Control Act* (Fort Belvoir, Virginia: Office of History, US Army Corps of Engineers, 1988). Quote from page 31.
[47] Jarvis, *Floods in the United States,* 10.

active interest in the prediction and understanding of flood magnitudes. Earlier federal flood policy had generally held that benefitting localities must provide a majority of the financial support for flood control projects that received federal dollars. That requirement was lifted for flood control efforts along the Mississippi River in 1928, in recognition of the money already spent by states and localities along that river, and also in response to the devastating Mississippi River floods of 1927. As a result of the Flood Control Act of 1936, the rest of the nation was placed on the same standing as communities along the Mississippi River. That year's flood-control legislation declared flooding to be a threat to the national well-being.[48] Because of this assessment of the dangers of floods, the act declared that "the Federal Government should improve or participate in the improvement of navigable waters or their tributaries, including watersheds thereof, for flood-control purposes if the benefits to whomsoever they may accrue are in excess of the estimated costs, and if the lives and social security of people are otherwise adversely affected."[49]

In effect, if not in so many words, the Flood Control Act of 1936 introduced a cost-benefit analysis approach to the funding of flood mitigation projects. When used to evaluate potential flood protection projects, effective cost-benefit analyses are obviously dependent upon a strong understanding of flood probability. The potential damages caused by a flood of a certain magnitude may be balanced against the likelihood of that flood's occurrence to help determine whether the costs of a given effort at flood control are justified by the benefits they provide. A levee that prevents inundation every ten years would be valued much differently than one that only prevents such an event once every century.[50]

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[48] Arnold, *The Evolution of the 1936 Flood Control Act*.
[49] U.S. Public Law 738. 74th Cong., 2d sess., June 22, 1936.
[50] Theodore Porter, in his book *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (Princeton, N.J.: Princeton University Press, 1995), argues that in the United States, governmental agencies including the Army

By the 1930s, the federal government was changing its approach to the funding of flood control efforts, but federal dollars were also pushing back against floods in new ways. For roughly half a century straddling the turn of the twentieth century, federal money for flood control was spent almost exclusively on levees, and most of these expenditures took place along the banks of the Mississippi River. The levees-only policy was the brainchild of the Mississippi River Commission (MRC), a body that included three civilians, three representatives of the U.S. Army Corps of Engineers, and one representative of the Coast and Geodetic Survey. The MRC was given authority to regulate development along the river, authority that had previously rested solely with the Corps of Engineers. The levees-only policy was a response to nineteenth-century concerns that the federal government should not spend money on flood protection. Levees were often justified as providing improvements to shipping, even if their supporters actually cared as much or more about flood control as they did about shipping. As historian Matthew Pearcy writes, levees-only was not the preferred policy of the leading Mississippi River experts of the day, but emerged out of the narrow interests of locally powerful politicians. The nation's levees, and especially those along the Mississippi, failed numerous times, but each time those failures were explained away by the levees not yet being completed to the planned levels. However, by 1927, the levees had been completed to their intended heights, yet that year's floods still breached them. With incomplete levees no longer a plausible explanation for the levee system's failure, policymakers were finally forced to consider other options.[51]

Corps of Engineers turned toward cost-benefit analyses from a position of weakness, needing the perceived authority of such analyses to bolster public faith in their decisions. In this case, however, something else was the case: cost-benefit analyses could be used to justify projects that might not have otherwise been funded, rather than being used to justify to the public or to legislators projects that authorities already found necessary.

[51] On the Mississippi River Commission, see Matthew Todd Pearcy, *A History of the Mississippi River Commission, 1879-1928: From Levees-Only to a Comprehensive Program of Flood Control for the Lower Mississippi Valley* (Ph.D. dissertation, University of North Texas, 1996).

Universities were not major centers of inquiry into flood problems throughout the nineteenth and early twentieth centuries, but by the 1930s, that was starting to change. Few universities would do more to advance the study of floods and their interactions with human livelihoods than the University of Chicago, and the man who did more than any other to set Chicago on this path was geographer Gilbert White. White began his career working for several New Deal-era federal agencies, including the Mississippi Valley Committee, the Water Resources Committee, and the Bureau of the Budget. At Chicago, White studied under the prominent geographer Harlan Barrows, who was known for "emphasizing creative human adjustment to a passive natural environment,"[52] and would later serve on the university's faculty during the 1950s and 1960s.[53] The title of White's 1945 dissertation, *Human Adjustment to Floods*, indicates Barrows' influence on his thinking. [54] White was also influenced by the pragmatic school of thought, which emphasized learning from experience and putting knowledge to practical use.[55] His reputation would ultimately build upon the foundation he laid with this dissertation, in which he laid out his perspectives on the appropriate ways to use floodplains and to adjust to the danger of flooding. White had started graduate school in the early 1930s, but his advisor Barrows left his university post to work for the federal government in 1933, and brought his promising student along. White spent most of the 1930s working on flood control projects for various governmental agencies, a set of experiences that helped inform his dissertation.

White's dissertation and subsequent work were significant for the emphasis they placed on the need for society to coexist with periodic flooding, in an era when ever-greater flood

[52] For an overview of Barrows' work, see William Koelsch, "The Historical Geography of Harlan H. Barrows," *Annals of the American Association of Geographers* 59, no. 4 (Dec. 1969): 632-651. Quote is from page 637.
[53] Robert Hinshaw, *Living with Nature's Extremes: The Life of Gilbert Fowler White* (Boulder, CO: Johnson Books, 2006).
[54] Gilbert White, *Human Adjustment to Floods: A Geographical Approach to the Flood Problem in the United States* (Ph.D. dissertation, University of Chicago, 1945).
[55] James Wescoat, "Common Themes in the Work of Gilbert White and John Dewey: A Pragmatic Appraisal," *Annals of the Association of American Geographers* 82, no. 4 (December 1992): 587-607.

control and protection structures such as levees and reservoirs had long been the norm. "(F)loods are 'acts of God,' but flood losses are largely acts of man," the young geographer wrote in his dissertation. "Human encroachment upon the flood plains of rivers accounts for the high annual toll of flood losses."[56] Expanding upon this line of argument, White's dissertation focused on analyzing an array of possible ways for people to deal with inundation-prone lands. While he warned against the potentially false sense of confidence that can be created by structural flood protections like levees and reservoirs, White did concede that they had their proper places and purposes. He was somewhat less hostile to the idea of elevating land via fill, a reliable but expensive method of reducing flood hazard exposure. White's cautions about these types of flood protections were based on concerns related to expense and moral hazard. However, ecological integrity did not carry much apparent weight in his thinking at this point. Even his support for healthy forests was rooted in their utilitarian potential to slow runoff and erosion rather than more holistic notions of environmental interactions.

White reserved his strongest endorsement for approaches that might actually remove people from flood-prone places, whether temporarily or permanently. These approaches included land use readjustment or abandonment, zoning, and flood insurance. These adjustments, he believed, should work together symbiotically. Zoning could be used to prevent future risky development and gradually push previously developed areas in different directions, if necessary—though he acknowledged that lasting land use shifts might also require more active governmental intervention. Flood insurance would depend on floodplain zoning laws to ensure that overly risky properties did not get insured, and at the same time to discourage constructing buildings that would be ineligible for flood insurance. More effective emergency evacuations, he believed, were the lowest-hanging fruit of all. On a note similar to the Flood Control Act of

[56] White, *Human Adjustment to Floods*, 2.

1936, White stressed the importance of flood magnitude and frequency predictions for effective cost-benefit analyses.[57] He wanted to set limits to where land could be used freely, and he saw the need for probabilistic analysis to help determine these limits.

White saw flood insurance and flood frequency analysis as tightly linked. On this matter, his thinking followed the path blazed by the engineers and hydrologists discussed in this chapter. While there is no evidence of insurers using probability to think about flood risk through the 1940s, engineers had occasionally noted such potential dating back to Fuller's era. In his response to Fuller's original 1914 article, Hazen stated that "the best practical idea of the significance of these figures may be obtained by considering them from the standpoint of insurance," noting the potential to determine the projected return periods for floods of different magnitudes.[58] Alvord and Burdick placed Fuller's equations on par with the methods used by contemporary life insurers. "A determination (of flood recurrences) by this method is no more valuable, and probably not less valuable than the actuary tables of the life insurance companies," the two wrote. "It cannot be expected to successfully predict the maximum flood upon any river in a given period of years any more than the actuary tables can show the life of a particular individual, but in the long run, … there is apparently no better means of determining the likely future occurrences."[59]

White's emergence coincided with the appearance of a new generation of flood frequency analysts, who moved the field beyond the foundations laid by the likes of Fuller and Hazen. By the 1940s, flood frequency analysis was moving in the opposite direction from that pushed by Fuller and Hazen, toward more localized assessments rather than universal formulas. USGS

[57] See White, *Human Adjustment to Floods*, and also Brian Rumsey, *Beyond Bigger and Better: Gilbert White and America's New Approach to Floodplain Management* (M.A. thesis, Mississippi State University, 2010).
[58] Hazen 1914, p. 630.
[59] Alvord and Burdick, *Report Made to Former Rivers and Lakes Commission on the Illinois River and its Bottom Lands*, 98.

engineers H. B. Kinnison and B. R. Colby published a regional analysis for parts of New England in 1945, and many regional and state level analyses followed.[60] The work of Fuller and others of his era had played a crucial role in conceiving of floods as events to be thought of in probabilistic terms, but as the years of flow data piled up for more and more streams, a new generation of engineers realized that more localized models could provide better projections than universal ones.

By mid-century, then, the practice of flood frequency analysis was starting to mature. By calculating how frequently floods of certain magnitudes could be expected, engineers had offered a new way of quantifying the natural world while thinking about how to differentiate between land that was flood-prone and land that was not. Concurrently, by framing floodplains as lands that should have restrictions on uses, White was promulgating the idea that while the limits of the natural world may be approached, it is best not to try to push them, as with structural flood controls. Meanwhile, land-hungry developers sought places where they could fulfill the booming housing demand. Even bottomlands and other wetlands not protected by dams or levees attracted new levels of attention from developers in the post-war era, as suburbanization pushed demand for land to unprecedented levels. And, as the nation was emerging from World War II, the federal government was continuing to move toward a more active role in managing catastrophe. The new idea of federal involvement in flood insurance would take hold in the midst of building tension between the approaches of flood control and floodplain management.

[60] H. B. Kinnison and B. R. Colby, "Flood Formulas based on Drainage Basin Characteristics," *Transactions of the American Society of Civil Engineers* 110 (1945): 849-904.

Chapter Three

From Flood Control to Floodplain Management: Establishing Flood Insurance, 1951-1968

The year 1951 started looking like a wet one for the Kansas River valley in May. In that month, Salina, Kansas, received almost eight inches of rain in a single day, and Manhattan saw nearly double that amount over a three-day period.[1] By the end of June, yearly rain totals in central and eastern Kansas roughly doubled those from the same time a year earlier.[2] Through early July, the Kansas River and its tributaries were running high, closing scattered roads and bridges, but only sporadically disrupting daily life. But another round of storms sent the watershed's streams into a rapid rise on July 12, with the year's highest crest arriving in the twin cities of Kansas City, Kansas, and Kansas City, Missouri, the next morning. The Kansas side was especially hard-hit, though both suffered catastrophic damage. Levees were breached, and low-lying neighborhoods including Armourdale, the Argentine, and the West Bottoms were inundated. Many of the damaged neighborhoods in Kansas City were heavily industrialized. Onlookers could have been forgiven for thinking they had awoken in the middle of a dystopian nightmare. Some oil storage units floated downstream, while others caught fire, sending burning oil downriver where it ignited further conflagrations. Upstream, Lawrence, Topeka, and Manhattan also took heavy damages.[3]

This flood remains an important part of its region's history, and was significant by any standard. Though it has been eclipsed in historical memory by the 1927 flooding of the Mississippi River, as well as more recent events such as Hurricane Katrina, certain contemporary

[1] Brian Burnes, *High & Rising: The 1951 Kansas City Flood* (Kansas City: Kansas City Star Books, 2001), 15.
[2] Burnes, *High & Rising*, 16.
[3] "Kansas City Area Fights Flood, Fire; River Is Receding," *The New York Times* 16 July 1951.

observers perceived it to be among the nation's greatest-ever natural disasters.[4] It was and remains through 2018 the greatest flood in the gauged history of the Kansas River from its headwaters in Junction City to its confluence with the Missouri River in Kansas City, Kansas, and it is also the greatest measured flood of the Missouri River at Kansas City, Missouri. The Kansas River's other most severe floods for which we have historical records took place in 1903 and 1993, with 1951 being much more extreme than the other years along the Kansas River, but only slightly higher on the Missouri at Kansas City. The watershed's greatest flood within human memory, even higher than 1951, took place in 1844. Based on documented flood marks, the USGS has confirmed the 1844 flood's primacy, but more exact flow information is not known. Because of the paucity of European settlement in the Kansas River basin in 1844, that year's record flooding did not have the same impact on the area's Euro-American historical memory.[5]

Beyond the 1951 flood's physical and material significance, it is also important because of when it happened in relation to changing federal approaches toward floods and other types of hazards, and with regard to the development of new ways of thinking about living with the risk of floods. In particular, one idea that received concerted political attention for the very first time in the wake of the 1951 flood was federal involvement in flood insurance. Private insurers had previously experimented with flood insurance offerings, but most if not all had left the market years earlier after concluding they could not make it work financially. The 1951 attempt to create federal flood insurance proved to be unsuccessful, but by examining it along with later efforts in

[4] The term "natural disaster" being used here with full awareness of the argument that "natural" disasters have a much greater human component than the term implies. See discussion in Chapter 1. Some preliminary surveys did overestimate the financial damages of the 1951 floods, but financial damages are also a problematic metric because much of the human suffering caused by the 1927 floods struck poor rural residents without much wealth. The 1927 floods also gained notoriety more recently via John Barry's widely-read book *Rising Tide: The Great Mississippi Flood of 1927 and How It Changed America* (New York: Simon and Schuster, 1997).
[5] United States Geological Survey, *The 1951 Floods in Kansas Revisited* (Reston, Virginia: USGS, 2001).

1955-6 and 1965-8, we can gain insights into how justifications for flood insurance evolved, how the idea of insurance fit into evolving ideas of flood control versus floodplain management, and how the concept of flood insurance fit with emerging national priorities such as national defense and home ownership. In 1951, the ideas that fall under the umbrella of floodplain management were still little-known, and the political proponents of flood insurance envisioned it more aligned with the tenets of flood control. By the mid-1960s, however, floodplain management ideas were much more widely disseminated, and helped to give federal flood insurance the political strength necessary to be enacted and funded. Limiting flood-prone development proved to be a stronger proposal, politically, than using insurance to promote reconstruction in areas vulnerable to inundation. In addition to the philosophy behind flood insurance, its intended beneficiaries also changed. The 1951 flood insurance proposal focused on industrial rebuilding, with less emphasis on residential coverage. By 1968, this had completely shifted, as the enacted proposal was heavily geared toward insuring residential properties.

During the nineteenth and early twentieth centuries, the federal government had played a limited role in flood control and mitigation. Its most noteworthy involvement came in the building of levees along the Mississippi River, and even with levee building, those expenditures were primarily justified on the basis of navigational improvements rather than flood protection. The Flood Control Act of 1917 represented the first instance of the federal government explicitly funding projects for the purpose of flood control, but that legislation required beneficiary localities to make significant financial contributions at least matching the federal outlay. A later act in 1928 removed the funds-matching requirement for projects along the Mississippi River in places that had been devastated the year before, and the biggest change came with the Flood Control Act of 1936, which guided the federal government to undertake structural flood control

projects "if the benefits to whomsoever they may accrue are in excess of the estimated costs." The 1936 act also established a series of pilot programs run by the USDA that would attempt to mitigate floods via improved soil absorption of excess water.[6]

The Flood Control Acts of 1917, 1928, and 1936 focused narrowly on flood control and navigational improvements. A different approach took shape within the Tennessee Valley Authority (TVA), a federally-owned yet autonomous corporation with a broadly conceived mission that promoted regional economic development through power generation, conservation of natural resources, and flood mitigation. Its supporters hoped that it would become a model emulated in other parts of the country, but valley-authority advocates were unsuccessful, for the most part, in their power struggle against the proponents of flood control and navigation projects of far more limited scope. Nonetheless, the TVA fostered a good deal of innovation where floods were concerned. In its early years, its flood mitigation efforts focused on flood control, such as the use of structures such as levees and dams to control floodwaters. By the 1950s, however, the TVA broadened its focus to include floodplain management, which refers to practices that reduce vulnerability to flooding by regulating how flood-prone land is used and inhabited. The sociologist Karen O'Neill has argued that the passage of the Flood Control Act of 1936 signaled the defeat of the valley-authority model of resource management in the United States and thus the defeat of comprehensive planning for natural resources at the federal level. While it is true that the valley-authority model did not take broad hold in the United States, the TVA's embrace of a more comprehensive approach to floodplain management would ultimately spread well beyond the Tennessee Valley.[7]

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[6] U.S. Public Law 738. 74th Cong., 2d sess., June 22, 1936.

[7] Karen O'Neill, *Rivers by Design: State Power and the Origins of U.S. Flood Control* (Durham, N.C.: Duke University Press, 2006). See also Tennessee Valley Authority, *Floodplain Management: The TVA Experience* (Knoxville: Tennessee Valley Authority, 1983).

While federal involvement in flood control had increased in the decades prior to 1951, federal disaster response had also been undergoing systemization. The year 1950 saw the passage of the Disaster Relief Act of 1950, a piece of legislation that provided a standing pool of disaster relief money and procedures for allocating it.[8] The standard narrative is that through 1950, the federal government had *reacted* to disasters entirely on a case-by-case basis, with legislative action needed to initiate any particular federal relief effort, though recent scholarship has shown that the *ancien régime* of federal disaster response was not entirely unstructured. The Disaster Relief Act of 1950 provided for the now ubiquitous presidential disaster declaration, a funds-granting executive power that has remained a central part of federal disaster response for almost 70 years now. The 1950 act only provided funds for disaster response, however, with legislation in later decades expanding into the realm of recovery funds. Though it is easy to see the Disaster Relief Act of 1950 as the beginning of a new era, historian Gareth Davies argues convincingly that the act was important more for its consolidation of existing and scattered programs rather than for dramatically reshaping federal disaster response.[9] Davies looks back to the 1930s to find the origins of systematic federal disaster response. Legal historian Michele Landis Dauber looks back much farther in time, to the early years of the republic. She has assembled evidence illustrating that even though federal disaster response was handled on a case-by-case basis legislatively, consideration of relief requests was based on prior precedent, and people who could present their situations as analogous to previous disasters for which the federal government had

[8] U.S. Public Law 875. 81st Cong., 2d sess., September 30, 1950.

[9] Extant or prior programs include the Disaster Loan Program (1935), crop insurance (1938), Public Health Service authorization to intervene after disasters to avert epidemics (1944), and a presidential emergency fund (1948). The Disaster Act of 1950 did not directly consolidate the functions of all of these programs, but Davies argues that their existence shows that "a substantial body of routinized disaster politics already existed by 1950." (262) This is a part of Davies' larger argument that the 1950s do not mark the birth of contemporary disaster politics. He argues instead that the disaster politics of the 1950s should more accurately be considered part of a fundamentally different era in which the principles of federalism held greater sway than in the 1960s onward. See Davies, "Pre-Modern Disaster Politics: Combating Catastrophe in the 1950s," *Publius: The Journal of Federalism* 47, no. 2 (April 2017): 260-281.

appropriated relief funds could also expect such funds themselves.[10] For the purposes of this discussion, both the standard narrative and the revisionists make important points: federal involvement in disaster relief was a long-standing precedent by 1950, helping to demonstrate that a proposal for federal flood insurance did not involve a radical break with the past. Yet neither Davies nor Dauber would argue that nothing changed after 1950, and indeed, the possibility of a federally-backed flood insurance program aligned much more naturally with the systematized federal approach to disaster relief that took hold after 1950 than the scattered and case-by-case approach that was in place in earlier years.

The seeds of flood insurance landed in rich, alluvial soil that was also starting to sprout another crop in increasing numbers: houses. A country that had seen a trickle of suburban growth prior to World War II quickly became so suburbanized that this mode of living would come to be seen as part and parcel of the American Dream. In the process, suburbanites as well as those interested in more bucolic coastal settings moved onto low-lying lands as never before.[11] A building spree of flood-control dams further encouraged this move. On the East Coast and Gulf of Mexico, increasing hurricane activity brought with it questions about climatic stability and change and the wisdom of coastal construction.

Flood insurance had not played a central role in past episodes of flood recovery in the United States, and it was not the first thing that came to the minds of residents and regional

[10] The most crucial part of making a case for disaster relief, Dauber argues, was the ability to present oneself as the blameless victim of circumstances beyond one's own control. Michele Landis Dauber, *The Sympathetic State: Disaster Relief and the Origins of the American Welfare State* (Chicago: University of Chicago, 2012).
[11] The classic text on American suburbanization is Kenneth Jackson's *Crabgrass Frontier: The Suburbanization of the United States* (New York: Oxford University Press, 1985). Adam Rome's *The Bulldozer in the Countryside: Suburban Sprawl and the Rise of American Environmentalism* (New York: Cambridge University Press, 2001) offers an examination of suburbanization and environmentally sensitive lands. For an overview of suburbanization from an environmental history perspective, see Chris Sellers, "Cities and Suburbs," in *A Companion to American Environmental History*, ed. Douglas Cazaux Sackman (Malden, Massachusetts: Wiley-Blackwell, 2010), 462-481.

leaders as they considered the path to recovery and preparations for future floods that summer.[12] Letters to legislators predominantly centered on dams and levees.[13] In a July 28 editorial, the *Kansas City Times* made a similar call:

> Arguing theory is fine in its time and place, but the thing, now, is action. In the midst of an appalling job of relief and reconstruction we have to get assurances of a prompt start on flood prevention. Thousands of homeowners, thousands of farmers and hundreds of businessman face a shocking rebuilding job. They ask the inevitable question, 'What is the protection against the next big flood?' The only flood protection that can be pushed immediately is the system of reservoirs and levees planned by the army engineers and reservoirs planned by the bureau of reclamation.[14]

This call was completely in line with the precedent of the preceding decades. For roughly half a century between 1879 and 1927, the federal government had adhered to a policy known as levees-only, a policy that enshrined levees as the only federally sanctioned means of flood control.[15] This narrow policy was washed away by the Mississippi River floods of 1927, in which the system of levees built to protect the Mississippi valley from floods was massively overwhelmed. As a result of that year's floods, scientists and politicians began working toward a new flood control policy. The singular focus on levees disappeared, but the focus on control of water via the building of structures to restrain, store, or divert floodwaters retained primacy. One

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[12] Several works that touch on the early history of flood insurance in the United States, including both historical works and those of other disciplines, cite a 1938 book, *Insurance: Facts and Problems*, by Alfred Manes (New York: Harper and Brothers Publishers). Manes wrote that the first company to offer flood insurance in the United States did so in the mid-1890s, but was flooded out of business in 1899. A number of companies, he wrote, were offering flood insurance policies by the mid-1920s, but none continued to do so after the massive flooding of 1927. Manes did not offer any citations for this information, and an extensive but not exhaustive search on my part has failed to turn up further information. In this 1938 work, Manes offered an early suggestion for federal involvement in flood insurance, arguing that "the best solution of the problem would be to bring together the private initiative of many companies and a government guarantee." (168) He claimed that if insurance companies thought offering flood insurance without government intervention was possible, they would have done so after the flood season of 1937, of which the largest flooding occurred on the Ohio River.

[13] Albert Cole Papers, Box 33, Folder 12, Kansas State Historical Society. Letters regarding 1951 flood.

[14] *Kansas City Times*, "Build Now and Argue Later," July 28, 1951.

[15] On the levees-only policy, see Charles Camillo and Matthew Pearcy, *Upon Their Shoulders: A History of the Mississippi River Commission from its Inception through the Advent of the Modern Mississippi River and Tributaries Project* (Vicksburg, Miss.: Mississippi River Commission, 2004). John Barry and John McPhee also discuss the policy in their respective books *Rising Tide: The Great Mississippi Flood of 1927 and How It Changed America* (New York: Simon and Schuster, 1997) and *The Control of Nature* (New York: Farrar, Straus, Giroux, 1989).

type of structure that came into favor during the 1930s was the reservoir. The Pick-Sloan Plan, established by the Flood Control Act of 1944, led to the building of numerous reservoirs and improvements to levees in the Missouri River watershed and waterways in many other parts of the United States.[16]

Only days after the crest of the floodwaters, the agenda for regional recovery and rehabilitation started to materialize. On July 25, 1951, the governors of Kansas, Missouri, and Nebraska convened a meeting of the Missouri River States Committee (MRSC) to discuss flood recovery. In attendance were senators and congressmen from the region, other governmental officials, and leaders of business and industry, including Lewis Pick, the Chief Engineer of the Army Corps of Engineers and an architect of the Pick-Sloan Plan.[17] The MRSC had been organized in 1942 by political leaders from the states of the upper Missouri River, with the purpose of advocating for a unified project of power development, irrigation, flood control, and navigation throughout the Missouri valley—much like the Tennessee Valley Authority. Kansas and Missouri had not been founding members, but joined in 1943 on the heels of major flooding on the lower Missouri. Through the 1940s, the MRSC devoted most of its energy to advocating for a system of dams and reservoirs in the Missouri valley.[18]

Conference delegates unanimously approved a series of resolutions that included a call for a federally sponsored program of flood insurance.[19] On the heels of that call, Samuel Roberts, the director of the Research and Budget Department for the city of Kansas City, Missouri,

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[16] For further reading on the Pick-Sloan Plan, see Martin Reuss, "The Pick-Sloan Plan," in *Builders and Fighters: U.S. Army Engineers in World War II*, ed. Barry Fowle (Fort Belvoir, VA: Office of History, U.S. Army Corps of Engineers, 1992), 233-243; and Robert Kelley Schneiders, *Unruly River: Two Centuries of Change along the Missouri* (Lawrence: University Press of Kansas, 1999).
[17] *Kansas City Times*, "Two Main Goals Today," July 25, 1951.
[18] Information on the MRSC drawn from Schneiders, *Unruly River*.
[19] *Kansas City Times*, "United on Flood Prevention," July 26, 1951, 1.

produced a report entitled *A Suggested Federal Flood Damage Insurance Program*.[20] The report was quickly sent to the White House, where it was received on August 10. The proposal offered by the MRSC treated flood insurance not only as a protection against future financial losses, but also as a way to offer relief to the victims of the 1951 flood. Its proposal included a suggestion that those who suffered losses from the recent floods be given retroactive coverage on the same terms as what would be offered in the future.[21]

The 1951 Roberts Report estimated that less than five percent of the total dollar value of the losses caused by that year's floods were covered by insurance. In almost all cases, those policies were not specific to flooding, but included policies such as all-risk policies held by contractors and implement dealers, transportation-risk insurance covering commodities while being shipped, and comprehensive automobile insurance policies. The report mentioned that only a single case of a flood-specific insurance policy within the affected region existed, though it provided no further description of the conditions surrounding that policy.[22]

In making a case for a federally supported flood insurance program, the Roberts report used three main arguments. Federal support was necessary, the report argued, because private insurers had found flood insurance impossible to sustain. By the 1950s, none were even offering flood-specific insurance at a significant level. Property owners on high ground would be unlikely to purchase flood insurance, because their risk of flood damage is low. Conversely, those on low ground often avoided coverage because the likelihood of losses made premiums prohibitively expensive. Secondly, the report argued, the availability of insurance was critical to the rehabilitation of flooded areas, because those who owned property in the affected areas would be

[20] Sam Roberts, *A Suggested Federal Flood Damage Insurance Program* (Unpublished report of the Emergency Flood Conference, called by the Missouri River States Committee and held July 25, 1951 at Kansas City, Missouri). Truman Official File 121-E, Box 657.
[21] John Gage to Harry Truman, August 8, 1951, Box 657, Truman Official File.
[22] Roberts, *A Suggested Federal Flood Damage Insurance Program*, 2.

reluctant to invest in rebuilding without some sort of assurance that another flood could cause them to lose their investments again. Protections such as additional dams and levees would offer substantial reassurance, but the MRSC was concerned that even if approved, those structures would not be built for several years, significantly delaying the recovery effort. Finally, the report argued that reconstruction was justified despite the probability of future floods, due to the importance of rivers as avenues of transportation and sources of water for industry, and the logistical suitability of flat floodplains for building industrial infrastructure.

In the nascent debate over whether insurance should enable or discourage re-building in flood-prone areas, the Roberts report clearly held to the former stance. In fact, the report did not even acknowledge the existence of such a debate. In 1951, this issue had not substantially moved beyond academic circles, so it was not as if Roberts was ignoring broad precedent. A few scattered cities had instituted floodplain zoning restrictions by 1951, but this type of governmental control over land-use did not start to become more widespread until the later 1950s and especially the following decades, as discussed in chapter four. Land use regulation had certainly been debated for decades—to what extent forest cover and conservation practices can reduce flooding, and how much they should be promoted, for example. In other words, governmental control over land use upstream of population centers with the intention of limiting flooding was not without precedent. In most population centers, however, the ethos remained one of rebuilding rather than retreating. In part, this had to do with the differing approaches of the agencies charged with addressing flooding in upstream and downstream situations, the USDA upstream and the Army Corps of Engineers downstream.[23]

[23] Samuel Hays discusses forest cover and flooding in *Conservation and the Gospel of Efficiency*, especially pages 103-106. For further information on upstream versus downstream approaches to flood control during the mid-20th century, see Joshua Nygren, *Soil, Water, and the State: The Conservation-Industrial Complex and American Agriculture since 1920* (Ph.D. dissertation, University of Kansas, 2015), especially pages 89-95.

The Roberts report came to the same conclusion that would later be reached by numerous other observers: without dramatic changes to the way it operated, the private insurance industry would continue to be unable to offer flood insurance. But for MRSC officials, maintaining the status quo in the aftermath of the 1951 flood was unacceptable, and thus federal intervention was necessary to ensure the widespread availability of flood insurance. They couched this imperative most centrally in the need for rebuilding of their region's industrial districts that were found in flood-prone areas, and argued that in failing to guarantee the availability of flood insurance, the federal government was failing to fulfill the new responsibilities related to flooding that it had taken on in the 1930s, as discussed in the previous chapter.[24]

Beyond simply rationalizing the federal government's involvement on the basis of feasibility, Roberts also offered several justifications for why becoming involved in flood insurance would be consistent with the federal government's traditional roles and priorities. First, he emphasized that flooding was an issue of nationwide concern, not limited only to the region that had been inundated in 1951. Second, he noted that flood control on navigable rivers was, by 1951, a well-established precedent. "It is entirely logical to say," the report stated, "that the provision of flood insurance is almost as important to the economy of flood-hazard areas as are the flood-protection works themselves."[25] Third, Roberts observed that federal agencies including the U.S. Weather Bureau, the Geological Survey, and the Army Corps of Engineers had all been involved with providing warnings of impending floods, a function essential to the minimization of flood-related losses. Finally, the report cited the existence of substantial precedent for the federal government becoming involved in offering types of insurance that private industry had been unable to offer. The primary type of insurance cited in this section was

[24] Roberts, *A Suggested Federal Flood Damage Insurance Program*, 2-4.
[25] Roberts, *A Suggested Federal Flood Damage Insurance Program*, 4.

war damage insurance during World War II—a program, the report noted, that returned a handsome profit to the government when it was liquidated after the war.[26]

The war damage insurance program was an obvious model in some ways, but in other ways the comparison falls flat. War damage policies had been underwritten by the federal government and serviced by private agents, a model that seemed to be a good fit for flood insurance. Yet the program's financial windfall was not at all suggestive of similar results for flood insurance. War damage insurance was written mainly for coverage in the continental United States, an area that avoided damage during the war. If active warfare had spread to continental North America, the program could easily have been a financial drain. In flooding terms, it was akin to an insurer having the good fortune to offer flood insurance only during a time period that happened to be a severe drought. Furthermore, premiums were not based on any actuarial risk assessment, but simply based on dollar amount of coverage. Finally, the war damage program was only intended to be temporary, for the duration of hostilities.[27] The Roberts report made no effort to reconcile these differences in offering war damage insurance as a model for flood insurance. In short, the war insurance model was much more useful for bolstering the argument that flood insurance was an appropriate governmental role with precedent than for modeling a successful program.

In terms of what a flood insurance program would look like, the Roberts report envisioned a federal-private partnership, rather than a wholly federally operated program. This was viewed not only as a means of avoiding federal encroachment on a market traditionally run by private enterprise, but also as a way of saving money for the government. By offering reinsurance (a second level of insurance for insurance companies in case of high losses) to

[26] Roberts, *A Suggested Federal Flood Damage Insurance Program*, 3-4.
[27] Joseph Reeve, "War Damage Insurance in World War II," unpublished manuscript, 1955. Joseph Reeve Papers, Truman Library, Box 2, Folder 1.

private companies that would offer flood insurance, the federal government could save the effort, time, and expense needed to train and employ agents who would deal directly with customers.[28] As a closing pitch for the value of insurance, the report noted that up to 40 percent of flood losses would be tax-deductible, but if those losses were retroactively insured, tax revenue would be preserved.[29] Although tax policy is sometimes legislatively tailored to respond to particular disasters, the Roberts report did not suggest that something like this would have been the reason for the tax deductions. Instead, the report presumably referred to the casualty loss deduction, which allows taxpayers to deduct losses due to a range of disasters from their taxable income. This deduction was included in the tax code of 1913, which was created after a peacetime income tax was legalized by the Sixteenth Amendment. By 1951, it had been clearly established that the casualty deduction applied to flood losses.[30]

The attention granted here to the Roberts flood insurance proposal is not meant to suggest that flood insurance was the top priority of the MRSC. The insurance proposal notwithstanding, flood insurance was but one, and certainly not the highest, policy priority among the conference delegates. Of the several resolutions adopted by the delegates, nearly all of them related to calls for increased funding for flood control projects. Only one resolution addressed the ideas described in the report on flood insurance.[31] Newspaper coverage of the conference relayed the same emphasis. "A demand for federal appropriations to carry out the prompt completion of the Pick-Sloan flood-control plan highlighted the huge Missouri River States Flood conference here yesterday," read the lead sentence of the Kansas City *Star*'s coverage of the conference. The

[28] Roberts, *A Suggested Federal Flood Damage Insurance Program*, 4-6.
[29] Roberts, *A Suggested Federal Flood Damage Insurance Program*, 7.
[30] Even prior to 1913, some federal income taxes levied during the nineteenth century included deductions for casualties such as floods. For more on the casualty deduction, see "The Casualty Loss Deduction and Consumer Expectation: Section 165(c) (3) of the Internal Revenue Code," *The University of Chicago Law Review* 36, no. 1 (1968): 220–238; and "Federal Income Tax: The Dilemma of the Casualty Loss Deduction," *Duke Law Journal* 1961, no. 3 (1961): 440–451.
[31] *Kansas City Times*, "Resolutions Adopted by Flood Conference," July 26, 1951, 6.

Kansas City *Times* devoted a mere three sentences of its conference coverage to discussing the call for flood insurance, and two of those described an objection that was caused by misunderstanding and ultimately overruled. The story did, however, mention insurance in one of its several sub-headlines.[32]

In addition to forwarding a copy of the Roberts report to President Truman's office, the MRSC also submitted its plan to a flood relief coordinating committee headed by former Kansas senator Harry Darby.[33] Darby was not a career politician, and had come to prominence as a Kansas City industrialist. His Darby Steel Corporation produced munitions during World War II at a plant in the West Bottoms, one of the more heavily hit areas of Kansas City during the 1951 flood. The Darby committee joined the MRSC in championing flood insurance, but made its availability a top priority. Darby's senatorial career lasted less than a year, as he had been appointed to fill the seat of the deceased Clyde Reed in late 1949 and had not sought election to a full term during the 1950 election cycle. Darby appointed yet another committee to study the possibility of flood insurance, headed by insurance agent William Welch.[34] In newspaper coverage, Welch argued that television coverage of the Kansas City floods had been crucial in developing a broad base of support for insurance. "Heretofore the powerful policy committee of the big insurance committees has considered only regional inundation problems, in one valley or another," he was paraphrased in the Kansas City *Star*.[35]

On August 20, the Truman administration issued a comprehensive statement on the recent floods, placing the president's authority behind a proposal for rehabilitation of the areas that had recently been under water. Truman urged a vigorous intervention by the federal

[32] *Kansas City Times*, "United on Flood Prevention," July 26, 1951, 1.
[33] *Kansas City Times*, "Flood Risk Plan," August 9, 1951.
[34] Cited as Welch in the story "Flood Policy Bid." Cited as "Welsh" in *Kansas City Times*, "To Study Flood Risk," August 4, 1951.
[35] *Kansas City Star*, "Flood Policy Bid," August 10, 1951.

government, based on grounds of both humanitarian concern and worries about national security. On humanitarian grounds, Truman argued that it would be fundamentally unfair to force the flooded region to fend for itself. "In this land we do not take the view that a man's misfortune, suffered through no fault of his own, is his own affair, or that a stricken community shall be left to shift for itself," the president stated. "Normally the aid comes from local resources or from those of private relief agencies."[36] When the disaster was beyond the responsive capabilities of those organizations, Truman argued, the nation as a whole must step in.[37] Couching his argument in concerns over national security, Truman noted that the industries in flooded regions "turned out hundreds of products that are critical in the building of military and economic strength."[38] If industry and agriculture in the region were not rapidly rehabilitated, "not only this nation but the whole free world may suffer," Truman warned.[39]

As the historian and legal scholar Michele Landis Dauber has shown, the federal government has had a long history of extending disaster relief to victims portrayed as blameless, dating back to the early years of the republic. In this way, Truman, was tapping into an established precedent for disaster response.[40] His emphasis on national defense, however, was more a product of his own time and priorities. Coming out of World War II, and considering the new global geopolitical landscape, the federal government prioritized military readiness in a way that it had not done before the war. The National Security Act of 1947 reorganized the country's armed forces toward this end, and in 1950, Truman created the Office of Defense Mobilization—on which more below—by executive order. National security priorities were not limited to

[36] House Document 228, 82nd Congress, 1st session, 3.
[37] In his "through no fault of his own" phrasing, Truman exemplifies the "narrative of blameless loss" identified by Dauber as a rhetorical tool frequently used by United States politicians to argue for disaster relief. See Dauber, *The Sympathetic State*.
[38] House Document 228.
[39] Ibid.
[40] Ibid.

mobilization of actual fighting units, and extended to the productive capacity to meet the needs of industrialized warfare.[41]

Truman identified five goals of his proposed flood relief program: partial indemnification of flood-related losses, affordable and accessible loans for homeowners and business owners, rehabilitation of farms, loans to state and local governments to allow them to be more involved in the recovery process, and—significantly—the creation of a national system of flood insurance.[42] Truman argued that if flood insurance had been more widely available, fewer people would have been left destitute and in need of indemnification. But for those people left with little or nothing besides their losses and debts, he said, even loans with favorable terms would not be of much assistance.

This point was re-emphasized in the section where Truman argued specifically for the creation of a national flood insurance program. "Once the system of flood insurance is in effect, there should be no need in the future for a program of partial indemnities such as is now proposed for the Midwest flood victims," the president stated. "As a permanent national policy, insurance is far superior to direct Federal payments."[43] This assessment of superiority was rooted in two justifications: a conviction that people should be able to take responsibility for their own flood protection—not necessarily by avoiding flood-prone areas, but by being able to purchase insurance against flood damage; and a desire to remove the need for the relief appropriations process. In addition to his vision of insurance as a means for people to provide for their own security in case of future inundations, Truman also argued that the availability of flood insurance

[41] On the focus on national security, see Michael Hogan, *A Cross of Iron: Harry S. Truman and the Origins of the National Security State, 1945-1954* (New York: Cambridge University Press, 1998); and Douglas Stuart, *Creating the National Security State: A History of the Law that Transformed America* (Princeton: Princeton University Press, 2008).
[42] House Document 228.
[43] House Document 228, 5.

could have a very real effect on efforts to rebuild from the most recent floods, echoing the report commissioned by the MRSC. "It is a basic requisite to the rapid reopening of plants in the flood region," Truman stated, "where dikes cannot be rebuilt for some months, and companies are unwilling, in some cases, to undertake the risk of being inundated in the meantime."[44]

Using similar reasoning, another sector that heavily advocated flood insurance in the aftermath of the 1951 floods was the financial sector. Wichita businessman Alfred E. Howse, who had been appointed to lead the federal flood response by Office of Defense Mobilization director Charles E. Wilson in the weeks after the flood, had called for the creation of several committees to study flood recovery proposals, most of them regionally organized but some organized by economic sector. Highlighting the importance of insurance to the world of finance, the financial committee's report addressed flood insurance first in its report, as opposed to the reports of other committees, which buried their discussions of flood insurance within their documents. "Underlying all financing arrangements for rehabilitation of both rural and urban flood stricken areas is the need for a program of flood insurance," wrote the committee's chairman, H. G. Leedy, president of the Federal Reserve Bank of Kansas City. "The ever-present threat of a recurrence of floods would make the extension of needed credit of those located in the flood areas, without the protection of insurance, extremely hazardous both to lenders and borrowers."[45] This statement by Leedy handily summarizes the central role that insurance plays in capitalist economies: it spreads risk, helping to diminish fears of personal catastrophic loss and encouraging capitalists to invest their holdings in new projects. Implicit in his approach was the idea that floodplain development should be encouraged by reducing risks for investors. Leedy's statement, but also Truman's view of flood insurance, also suggest that if exposure to

[44] Ibid.
[45] H. G. Leedy to A. E. Howse, 8 September 1951. A. E. Howse papers, Wichita State University Special Collections, Box 31, notebook 1.

flood hazard presents any sort of limit to development, this limit should be pushed with all available tools rather than observed and deferred to,

The Truman-backed flood insurance proposal was never fleshed out to the point of revealing exactly how it would have treated residential properties as opposed to commercial and industrial ones, but the evidence seems clear that Truman and his underlings envisioned a program much more geared toward industrial properties than the residence-oriented program that was actually enacted in 1968. As it turned out, flood insurance was one potentially lucrative subsidy that was denied to the emerging military-industrial complex, but Truman's couching the program's necessity in terms of national defense was not a bid for the support of homeowners by virtue of their homeownership. In fact, at least one public feud developed over the proposed relief program's support for homeowners, or lack thereof. A Missouri bureaucrat took Howse to task for publicly celebrating his support for "the little people who have been left with nothing but despair," while testifying in hearings that his intention was only "to rehabilitate productive plant," referring to industrial and commercial capacity.[46]

Due to his envisioning of flood rehabilitation as an issue of national security, Truman assigned responsibility for further developing his long-range flood relief program to the Office of Defense Mobilization. This office, which had only been established by executive order in 1950, was headed by Charles E. Wilson, a former president of General Electric, and was charged with preparing the country to mobilize for war much more quickly than had been possible the lead-up

[46] Statement of W. F. Norrell, A. E. Howse Papers, Special Collections, Wichita State University, Box 32, Notebook 2. For citations of Howse disavowing humanitarian interests in hearings, see U.S. Congress, Senate, Committee on Appropriations, *Rehabilitation of Flood-Stricken Areas: Hearings before the Committee on Appropriations, United States Senate, Eighty-second Congress, first session, on H.J. Res. 341, making appropriations for rehabilitation of flood-stricken areas for the fiscal year 1952, and for other purposes,* 82nd Cong. 1st sess., October 10, 1951, pages 35, 111, 112.

to World War II.[47] "Industrial activities of great significance to the defense effort have been brought to a standstill," Truman wrote to Wilson in conferring upon him the duties of overseeing the relief effort.[48] Wilson, a Truman appointee, designated Howse, a member of his staff and a Wichita businessman who had been involved in military procurement during World War II, as the director of the flood effort under ODM, and it fell to Howse to field the questions of the House and Senate Committees on Appropriations when those committees took up discussion of the proposal.

Throughout the 1951 effort to respond to flooding and create a flood insurance program, its supporters were dogged by charges that they were motivated by regional interests rather than the interests of the nation at large. This was exacerbated by the fact that Truman's proposed flood insurance program was bundled with legislation providing for rehabilitation money intended solely for the states affected by the 1951 floods, as well as the fact that it promised retroactive flood insurance for the victims of the Missouri valley floods, but not other recent floods. "(Our constituents) are looking to us to see that this Government is just as generous to them as they are to Missouri and Kansas," Minnesota Republican senator Edward Thye told Howse during a hearing on the proposed legislation, emphasizing that his state had also been the victim of damaging floods that spring. "Do you not realize that and the predicament I am in as a representative of my State?"[49] In one episode of questioning, Thye challenged Howse on why flood insurance was included in a bill that was intended to provide immediate relief to flood-stricken areas. Thye perceived flood insurance as a means of forestalling future losses more than

[47] ODM helped spur dispersal of military plants into the South and Southeast, away from their coastal and Midwestern homes. This was to make them harder for enemies to target by being more dispersed, but also had unintended long-term consequences in political realignment.
[48] Harry Truman to Charles Wilson, July 19, 1951. A. E. Howse papers, Wichita State University Special Collections, Box 31, notebook 1.
[49] United States, *Rehabilitation ... Senate*, 16.

as a remedy for the current situation, but Howse saw it differently, his views aligning with those expressed by both Truman and the MRSC. Without the availability of insurance, Howse argued, many of the business owners—and he emphasized business owners, not homeowners—would be reluctant to rebuild. That reluctance, Howse believed, could be remedied by the availability of insurance against future inundations.[50]

The effort to make insurance coverage retroactive to the recent Kansas and Missouri floods certainly lends an air of regionalist parochialism to the Truman-led effort. And though the available evidence does not reveal any specific charges of this sort by flood insurance opponents, Truman's political connections to the Pendergast political machine in Kansas City may well have influenced their opinions.[51] But, in the bigger picture, the charge of regionalism probably had more to do with the fact that because flood insurance did not have an established lobby or base of support at the federal level, its strongest advocates were those hailing from the affected regions, and because the program was bundled legislatively with what was unapologetically a regional relief effort. The 1951 effort is particularly notable for its lack of support from coastal regions, a potential core constituency that would eventually help pass flood insurance legislation in the 1960s.

Anticipating much later criticism of the National Flood Insurance Program, Howse's congressional interlocutors also challenged him on how the program would be able to be anything other than a subsidy for irresponsible development. Facing tough questioning from

[50] United States, *Rehabilitation … Senate*, 18.
[51] Truman's election to county administrative positions and to the U. S. Senate came with the support of Tom Pendergast's Kansas City political machine, known for questionable ethics and shady electoral tactics, and during his time in the Senate, opponents called him names like the "Senator from Pendergast." By the time of Truman's ascent to the presidency, Pendergast was dead and Truman had built some distance from his reputation as a man of the political machine, yet old suspicions may have lingered. For more on Truman and Pendergast, see Robert Ferrell, *Truman and Pendergast* (Columbia: University of Missouri Press, 1999).

Arkansas Democrat William Norrell, a long-time supporter of structural flood protection, one exchange went as follows:

> (Norrell) How do you propose to administer this program so as not to serve as an inducement for indiscriminate investments in property subject to recurring floods?
>
> (Howse) Well—
>
> (Norrell) You can't do it, can you?
>
> (Howse) I think so, but I can't tell you how now.
>
> (Norrell) That is a $64 question, isn't it?
>
> (Howse) It is a tough question. I think you would have to have some kind of a differential rate of exposure. And you would have to have some areas in which you just would not insure at all, the same as you would not rebuild now at all.[52]

Howse's acknowledgement of the "tough question" of differential rates is a revealing comment on where the 1951 effort stood in relation to actuarially sound flood insurance. Howse acknowledged the necessity of rating risk exposure, but was stumped by the prospect of how that could be done. As discussed in the previous chapter, engineers and hydrologists had been thinking about related questions for over a third of a century by this time, and while their work had not been specifically applied to flood insurance, the foundation was there. Further, in accord with the philosophy espoused in Truman's own statements, the "tough question" would not have related only to differential rates, but to which investments were indiscriminate. Clearly, the administration saw certain types of construction in flood-prone zones, such as that related to national defense infrastructure, as worth insuring even at a loss.

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[52] U.S. Congress, House, Committee on Appropriations, *Rehabilitation of Flood-Stricken Areas: Hearings before a Subcommittee of the Committee on Appropriations, House of Representatives, Eighty-second Congress, first session*, 82nd Cong., 1st sess., 1951, 68.

Even with flood insurance advocates citing the precedent of federal involvement in other forms of insurance, especially war damage insurance, Congressional hearings revealed that those precedents were not enough to entirely quell concerns about the propriety of federal involvement in flood insurance. New Hampshire Republican Norris Cotton brought this concern to light while questioning witness J.R. Berry, an insurance industry lawyer. Cotton, a self-described "rock-ribbed conservative Republican," asked Berry whether he was "aware of the dangers to the entire insurance field in this country" stemming from the proposal for a national flood insurance program. Berry confirmed that "some of us are lying awake nights," though the rest of his testimony does not seem to indicate a particularly strong opposition to the proposed program. Continuing the exchange, Cotton related his fears of some future visionary who would say, "if we are going to do this in floods let us have a gigantic Government insurance corporation and get the cream as well as the skimmed milk and do the whole thing."[5354]

In at least one instance, however, observers saw insurance as a possible *remedy* to a regional and even "socialistic" flood relief bill. An editorial in the Greensburg, Indiana, *Daily News* expressed outrage at the $400 million of relief proposed by Truman, calling it an abandonment of "traditional American principles relating to disaster relief in the interest of state socialism." But, the editorialist suggested, it would be better to have a system of flood insurance operated by private companies, with some government assistance tolerable.[55]

The bill that Congress ultimately passed to relieve the victims of the 1951 floods, the Flood Rehabilitation Act of 1952, fell well short of what Truman had sought, appropriating 133

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[53] U.S. Congress, House, Committee on Appropriations, *Rehabilitation,* 328. For Cotton's self-description, see Wolfgang Saxon, "Norris Cotton, 88, Former New Hampshire Senator," *The New York Times* February 25, 1989.
[54] The political tensions over privatizing profits while socializing risk are certainly not new. One of the central political battles of the 1830s in the United States, for example, saw Andrew Jackson attacking the 'money power' behind the Second Bank of the United States for using it for private gain.
[55] "Flood Plain Is Another Socialistic Scheme," *Greensburg Daily News* September 19, 1951. May be found in the Congressional Record, Vol 97, Part 15, 82nd Congress, 1st session. Page A5850.

million dollars (about $1.2 billion in 2016 dollars) for the rehabilitation of the flooded areas rather than the 400 million he had asked for. Truman lamented the act's limited funding and focus on loans rather than grants in an October 24 statement, but he saved his harshest criticism for the bill's failure to implement an insurance program. "Until such a system is developed and put into effect," the president said, "we shall continue to face the danger that floods may wipe out overnight the savings that homeowners, farmers and businessmen have slowly accumulated over a period of years."[56]

Despite this second call to action, the Appropriations Committee continued to sit on Truman's proposal. The administration blamed House Appropriations Chairman Clarence Cannon for the failure of flood insurance to move forward. Despite the fact that Cannon was, like Truman, a Missouri Democrat (though from the other side of the state), Cannon was a noted fiscal hawk, and the administration accused him of being unwilling to move flood insurance forward because he viewed it as new legislation over which his committee lacked jurisdiction without an explicit authorization bill.[57] For his part, Cannon said that he himself supported flood insurance, but did not move it through his committee "for the simple reason that 85 percent of the members of the House and Senate would not vote for" it, in his judgment.[58]

Not yet ready to give up on flood insurance, the administration continued its efforts to pass a flood insurance bill the next spring. On May 5, 1952, Truman made yet another detailed policy statement calling for the passage of a flood insurance program.[59] Unlike his earlier messages, this one related solely to insurance, not to relief payments, new reservoirs, or any

[56] Statement by the President, October 24, 1951. Papers of Harry S Truman, President's Secretary's Files, box 103.
[57] *Washington Insurance Newsletter*, no. 99, December 24, 1951. A. E. Howse Papers, Wichita State University Special Collections, Box 31, Notebook 2.
[58] "Statement by Cannon," *Kansas City Times* October 24, 1951. A. E. Howse Papers, Wichita State University Special Collections, Box 33, Notebook 5.
[59] United States, and Harry S Truman, *National Flood Insurance* (Washington: United States Government Printing Office, 1952).

other aspect of flood relief or mitigation. It contained a draft of a proposed bill, this time sent to the House Committee on Banking and Currency. Truman's statement accompanying this proposed bill substantially repeated the reasoning he had expressed in his 1951 support of flood insurance. It did contain one statement, however, that seems overly optimistic in retrospect: "I believe that this flood-insurance program should be set up on a basis that is designed to permit the Government to break even."[60] While breaking even would certainly be an admirable goal, contemporary insurers found it unlikely, and it has since proven to be persistently elusive.

The nature of flood risk makes it inherently difficult for insurers to break even, much less make a consistent profit over time. When based on voluntary participation, the size of the flood insurance risk pool is relatively small. Despite the challenges involved in making precise determinations of flood risk, the general risk level is easy for the layperson to understand. An owner of property on high ground will tend to have little interest in purchasing flood insurance, because he or she intuitively understands that the risk of flooding is minimal. Thus, likely purchasers of flood insurance are limited to those who have a reasonably high chance of experiencing flooding. A small risk pool would not necessarily be a crippling problem in a situation where losses would be scattered or minimal, but such is not the case with floods. When a body of water floods, most or all nearby flood-prone properties are likely to be affected, not just a few here and there. Finally, the losses endured are likely to be significant. Such a combination—a small risk pool, a high probability of loss, and potentially catastrophic widespread damage—makes it all but inevitable that insurers will face major payouts if they stay in the business long enough. Of course, it would be entirely possible to set rates commensurate with projected claims, but insurers have repeatedly found that potential customers are unwilling to pay the rates that insurers would find necessary.

[60] United States, *National Flood Insurance*, 2.

While it is easy for even a layperson to distinguish bottomland from hilltop, a thorough understanding of flood risk requires maps that were simply not available in the early 1950s. The report of the Insurance Executives Association drove the point home especially effectively: "If flood insurance were to be undertaken without unfair discrimination, it would be necessary to have not only a complete hydrological survey of each river basin and flood area in the country but also a detailed hydrological survey of each 'reach' of each river and, in addition, a detailed survey and appraisal of each property to be insured."[61] The cost of developing such ratings, the report argued, would be "considerable and perhaps in many cases … disproportionately prohibitive."[62]

A study undertaken by the Manhattan (Kansas) Chamber of Commerce in the wake of the 1951 flood helps demonstrate both the levels of interest in flood insurance in the early 1950s as well as more general challenges of insurance participation. Of the survey ballots distributed to Chamber of Commerce members, roughly five out of six expressed an opinion about flood insurance. Of these, around sixty percent supported a federal flood insurance program, and similar numbers indicated that they would purchase flood insurance at an unspecified "reasonable rate." Yet support for flood insurance was strongly correlated with having experienced flood damage in 1951. Of those who experienced flood damage, almost 80 percent supported an insurance program, but of those who experienced no flood losses, only around 25 percent were in favor of such a program.[63] Though this survey only represents the specific viewpoints of the business community of one mid-sized Kansas town, the key insight to be gained is this: *even in a town that had just been devastated by flooding*, only one in four

[61] Insurance Executives Association, *Report on Floods and Flood Damage* (New York: Insurance Executives Association, 1952), 9.
[62] Insurance Executives Association, *Report on Floods and Flood Damage*, 9-10.
[63] Manhattan, Kansas Chamber of Commerce. "Chamber of Commerce Flood Control Opinion Survey March 1952." Albert Cole Papers, Kansas State Historical Society, Box 35, Folder 9.

Chamber of Commerce members, excluding those who experienced flood damages themselves, supported the idea of a flood insurance program. Riley County, where Manhattan is located, was certainly not Truman country, giving Republican presidential candidate Thomas Dewey its votes by a nearly 40 percent margin in 1948. Even so, such weak levels of support from the very region that had motivated the proposal in the first place suggested that the idea did not have the widespread grassroots support that would have bolstered its chances in Congress.

The Insurance Executives Association, representing numerous insurance companies from around the country, undertook a detailed examination of the idea of flood insurance, resulting in a report that was unanimously approved at its annual meeting on May 15, 1952. The report concluded that due to several challenges, including the ones described above, flood-specific insurance could never be profitably offered by private insurers—while noting that insurers were already absorbing some losses due to floods, in cases such as auto policies, all-risk policies, and fire policies in cases where fires had resulted from flooding. The intractable problem, as one might surmise, amounted to "providing specific flood insurance coverage on a basis acceptable to the public and at the same time according to sound insurance principles."[64]

Furthermore, the industry group questioned whether the federal government would be able to be any more successful in breaking even or making a profit if it attempted to offer flood insurance. Essentially, the IEA had two central objections to a federal flood insurance program: its being called insurance, and its economic justification. Assuming that the program would have to be operated at a loss, the IEA suggested that it would be better to understand a government-supported program as a subsidy rather than as true insurance. Typically, insurance works as a business model when insurers are able to reliably bring in at least a little more money than they pay out in claims. Taking the cost of a potential flood insurance program into consideration, the

[64] Insurance Executives Association, *Report on Floods and Flood Damage*, 4.

IEA argued that it would make more sense for the government to simply continue building structural flood protections like dams and levees, while paying out relief money in cases of widespread loss. In the end, however, the industry group did not prove to be an especially fierce opponent of the idea of a national flood insurance program, stating that "if the Congress of the United States determines to provide specific flood indemnity by subsidy or otherwise, the complete facilities of the insurance business would be available to the Government … in a manner similar to their utilization in connection with the War Damage Corporation program of World War II."[65]

In suggesting that it would make more sense for the federal government to stick to the strategy of flood control and relief payments rather than get into the business of insurance, the IEA seemed to overlook the possibility that insurance could be used as a tool to actively reduce flood losses by discouraging inhabitation of some areas. However, a rising generation of scholars was starting to formulate and enunciate new ideas about the relationships between humans and floodplains. None of these scholars would play a greater role than geographer Gilbert F. White, whose 1945 doctoral dissertation would prove to be highly influential in the field of floodplain management, and who remained professionally active almost until his death in 2006.[66] White's concerns were shaped by the years he spent working for a variety of water-related New Deal agencies in the 1930s, and he especially took issue with the methods of cost-benefit analysis employed in evaluation of flood control projects, and the cost of many such projects.

In his dissertation, White acknowledged that private companies had found flood insurance to be a losing proposition, and conceded that such insurance could probably only be made available with government support. However, he saw flood insurance as far more than a

[65] Insurance Executives Association, *Report on Floods and Flood Damage*, 15-16.
[66] White, *Human Adjustment to Floods*.

means of subsidizing development in flood-prone areas. Rather than only that, he saw it also as a tool to discourage such development. By adjusting premiums to risk, and by not even offering coverage in the most flood-prone areas, White believed that people could be prompted to consider more thoroughly the consequences of locating their homes and businesses in areas prone to flooding. Additionally, he believed, flood insurers would encourage the adoption of other loss-reducing adjustments such as early warnings and structural modifications to at-risk buildings. These functions, he argued, made operating a flood insurance program fully worth the government's efforts, even at a net loss of revenue.

Though White envisioned flood insurance as a tool to discourage inhabitation of flood-prone places, this vision has never been fully embraced throughout the pre-history and history of the NFIP. White himself was not heavily involved in the 1951-1952 discussions of flood insurance, having stepped back from his research to assume the presidency of Haverford College between 1946 and 1955. It is certainly not normal for an academic to move from completed dissertation to college presidency in one year, but White had already started to build a career working on New Deal flood control projects in the 1930s. He actually completed his dissertation in 1942, but spent the wartime years doing humanitarian work in accord with his Quaker beliefs. This discord is clearly evident in the way that Truman framed the need for an insurance program. The Truman administration's statements emphasized a desire for flood-damaged families and businesses to be able to provide for their own needs via insurance rather than relying upon relief appropriations, but did little to question the site choices that would lead to such damage in the first place. Further, they emphasized that insurance would give industry the confidence to rebuild quickly after one flood without the fear of losing everything in a subsequent one. Though White's conception of flood insurance was for a program that encouraged people to avoid

building in floodplains, the Truman-era proposal helps to illustrate that merely the enactment of a flood insurance program would not ensure the realization of White's ideas about floodplain occupance. It was a flood control approach, rather than a floodplain management approach, to flood insurance. In fact, while not specifically on account of insurance or the lack thereof, Americans of the postwar era were migrating toward, rather than away from, flood-prone lands.

This move happened both along the country's coasts and near inland streams. Articles in the real estate development trade press actively encouraged the filling of marshes, many of them in coastal regions, to create space for housing developments. The flat expanses of riverine floodplains also proved to be inviting. Developers were drawn to these regions for a variety of reasons. Around many major American cities, prime development land had fallen into short supply by the middle of the century, and the uncorking of housing demand after the conclusion of World War II brought that shortage into sharp relief. Relative to their distance to urban centers, marshlands and land in floodplains could be purchased cheaply. Tract-style housing developments, which only emerged after World War II, involved the clearing and bulldozing of large tracts of land prior to building, and flat floodplains required comparatively small amounts of preparation of this sort. Specific information about flood risks was not widely available, but the dam-building that was also picking up pace in the postwar years lent a greater sense of confidence to some prospective homebuyers that they were not buying houses doomed to watery graves. Along with the increased allure of cheap riparian lands, those who could afford it also started to move closer to bodies of water out of a newfound aesthetic appreciation for riverfront, lakeside, or oceanside living.[67]

[67] This discussion is built on Adam Rome's *The Bulldozer in the Countryside: Suburban Sprawl and the Rise of American Environmentalism* (New York: Cambridge University Press, 2001), especially chapter 5, "Where Not to Build: The Campaigns to Protect Wetlands, Hillsides, and Floodplains." On the increasing desirability of living near water in the post-World War II period, see Samuel Hays, *Beauty, Health, and Permanence: Environmental Politics*

The damages wrought by the 1951 flood reflected older patterns of floodplain inhabitation. Smaller cities like Manhattan, Lawrence, and Topeka sustained notable damage to residential areas, as did the Kansas City metropolitan area. But the total estimated damage to urban residential properties, about $50 million (in 1951 dollars), paled in comparison to the estimated $1.6 billion of damages to industrial and commercial properties. With such a distribution of losses, it is little surprise that the insurance proposal coming out of this event focused to the extent that it did on industrial and commercial property.[68] Even without such a discrepancy in residential versus industrial damages, Truman's propensity to see flood insurance through the lens of national security also encouraged an emphasis on industrial properties.

While flooding experts, most notably Gilbert White, looked upon dams and especially levees with a critical eye, their skepticism toward structural flood control had different roots than the anti-dam activism that became prominent in the American West during the 1950s. Dam-building opponents like Bernard DeVoto attacked proposals such as Echo Park Dam because of concerns about encroachment into park and wilderness areas and the submerging of spectacular natural features. Flood insurance also addresses buildings that exist in ecologically sensitive areas such as floodplains, wetlands, and coastal zones, yet discussions of flood insurance in its embryonic years reveal a nearly complete lack of interest from people motivated by concern about the natural world. Truman, though he pushed for flood insurance, was also a noted supporter of dam construction.[69] White's concerns about human inhabitation of flood-prone areas centered not on the natural characteristics or ecological roles played by riparian zones, but much

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in the United States, 1955-1985 (New York: Cambridge University Press, 1987), especially chapter 5, "The Countryside: A Land Rediscovered, Yet Threatened."

[68] Statement in justification of appropriations request, Alfred Howse papers, Wichita State University Special Collections, Box 32, notebook 1.

[69] See Karl Brooks (ed.), *The Environmental Legacy of Harry S. Truman* (Kirksville, Missouri: Truman State University Press, 2009).

more narrowly on potential financial losses, both to landowners themselves and to governments called upon to relieve them. It was not as if there were no connections to be made between environmental issues and flood insurance, even from a purely pragmatic perspective. In their 1954 book *The Flood Control Controversy*, Luna Leopold (the son of Aldo) and Thomas Maddock synthesized the current state of knowledge, clarifying connections between upstream conservation efforts and downstream flooding.[70]

Though the Truman administration came up empty handed in its effort to institute a national system of flood insurance, the attempts of 1951 and 1952 helped to highlight some of the political and practical challenges that would need to be worked through in future considerations of flood insurance, and brought the idea of flood insurance into the public consciousness far more than it ever had been previously. In newspaper coverage critical of the proposed program, probably the most frequently raised concern was rate determination. Editorialists wondered both how exact rates would be determined effectively and how potential buyers would afford those rates. Relatedly, they voiced concern that a voluntary program would not attract much participation. Finally, press coverage from across the country revealed a continuing belief in the adequacy of flood control structures. "We could suggest that (programs of conservation and water control are) really the best form of insurance against a repetition of the recent disaster," stated an editorial in the *New York Times*. "Flood prevention … is a government responsibility. … But insurance should be left to insurance companies," wrote the right-leaning *Los Angeles Times*. Nebraska Governor Val Peterson, quoted in the *New York Times*,

[70] Gordon B. Dodds, "The Stream-Flow Controversy: A Conservation Turning Point," *The Journal of American History* 56 (June 1969): 59-69; Luna B. Leopold and Thomas Maddock, Jr., *The Flood Control Controversy: Big Dams, Little Dams, and Land Management* (New York: The Ronald Press Company, 1954).

acknowledged interest in the idea of flood insurance while also saying that "the major concern still was stopping floods before they started."[71]

Though the Truman-era flood insurance legislation never became law, it marked a point in time when experts interested in flood mitigation started to pay more attention to insurance. In their 1954 treatise, Leopold and Maddock concluded that the primary barrier to the availability of flood insurance was the large reserve of capital necessary to withstand an especially expensive year, implicitly endorsing the idea that the federal government should take the lead in making coverage available.[72] Leopold had begun his career working for the Soil Conservation Service and then the Bureau of Reclamation, and was a USGS hydraulic engineer by this time. Maddock's career followed a similar trajectory to Leopold's, starting at the Soil Conservation Service, and then moving to the Bureau of Reclamation where was employed in 1954.[73]

Leopold and Maddock's discussion of flood insurance was based on a 1953 article by Walter Langbein, in which Langbein more explicitly endorsed the idea of federal government involvement. Langbein, a civil engineer by training, spent the majority of his career working for the USGS, focusing especially on flood hydrology, the social impacts of floods, and the relationship between groundwater and land use.[74] Langbein's work had been used to prepare the 1951 proposal for flood insurance, and he had attended hearings in a support role.[75] Flood insurance "cannot pay off in the working life of an individual and hence would not be attractive

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[71] See William Blair, "Flood Insurance Scheme Faces Practical Obstacles," *New York Times* May 11, 1952, E7; "Flood Insurance," *Washington Post* May 14, 1952: 12; and "Flood Insurance? A Bad Idea," *Los Angeles Times* August 31, 1951, A4.
[72] Leopold and Maddock, *The Flood Control Controversy*, 26-27.
[73] On Leopold and Maddock, see Will Hager, *Hydraulicians in the USA: A Biographical Dictionary of Leaders in Hydraulic Engineering and Fluid Mechanics* (Boca Raton, Florida: CRC Press, 2015), pp. 2288 (Leopold) and 2303 (Maddock).
[74] Nick Matalas, "Walter B. Langbein: 1907-1982," *EOS* 64, no. 5 (February 1, 1983): 41.
[75] U.S. Congress, House, Committee on Banking and Currency, *Miscellaneous Hearings, Committee on Banking and Currency, House of Representatives, Eighty-Second Congress, on H. J. Res. 196, H. J. Res. 197, and H. R. 5745, 5120. 5792, 6102, 6909, 7726, and S. 2128 and 2252*, 82nd Cong., 1st sess., 1951.

to the managers or stockholders of a business enterprise," Langbein wrote. "But government as a permanent, enduring function, with much already at stake, can take a long-range course." Langbein acknowledged that Truman had seen war damage insurance as a model, but suggested that a better model for federal involvement would be crop insurance. The federal government had been experimenting with crop insurance since 1939, though it would only become widely available in later decades.[76] White also took a professorship at the University of Chicago in 1955, soon drawing graduate students who would continue and extend his research agenda that included ideas of floodplain management. He oversaw studies such as *Regulating Flood-Plain Development* (1958) and *Hazard and Choice Perception in Flood Plain Management* (1962), the latter by Robert Kates, who would become a prominent student of floods in his own right.[77] Some of the most important practice-based expertise was developed by the Tennessee Valley Authority, which had been producing detailed flood risk studies and encouraging their application to land use regulations since 1953.[78]

Langbein, along with co-author William Hoyt, returned to his examination of flood insurance as a part of their 1955 book *Floods*.[79] The discussion of flood insurance within this book was mostly a reprise of Langbein's 1953 article, but *Floods* became a standard work in the study of flood hazards for the ensuing decades, re-printed several times through 1970, disseminating Langbein's ideas to a much broader audience. The two authors gave their strong support to government involvement in flood insurance, arguing that "it would spare the public

[76] Walter Langbein, "Flood Insurance," *Land Economics* 29, no. 4 (Nov. 1953): 323-330. Quote found on 329.
[77] Francis Murphy, *Regulating Flood-Plain Development* (Chicago: University of Chicago, 1958); Robert Kates, *Hazard and Choice Perception in Flood Plain Management* (Chicago: University of Chicago, 1962).
[78] Tennessee Valley Authority, *Floodplain Management: The TVA Experience* (Knoxville: Tennessee Valley Authority, 1983).
[79] William Hoyt and Walter Langbein, *Floods* (Princeton, NJ: Princeton University Press, 1955).

the tremendous handouts that follow every flood (private handouts would also be replaced), and it would avoid the considerable loss in tax revenue."[80]

As devastating as the 1951 floods in Kansas and Missouri were, they were broadly perceived as isolated, or at least random events—as true extremes. Historical records do not show any evidence of citizens, lawmakers, or scientists viewing the floods as parts of a broader climatic trend. But by the mid-1950s, an upward spike did seem apparent in another sort of flooding: coastal flooding associated with hurricanes—especially in the northeastern United States—and observers speculated whether this involved a change or swing in climatic cycles. In 1954 alone, the Northeast was hit by Hurricanes Carol, Edna, and Hazel, a startling trifecta for storms that are more typically a southern phenomenon. Those three storms were followed a year later by two more, Connie and Diane, which both brought major flooding to Connecticut. Meteorologists correctly hesitated to label this a new normal, but newspaper coverage indicates that the question of a changing climate had garnered interest beyond the meteorological profession, and among at least a segment of the lay public.[81]

The northeastern floods of the mid-1950s produced not only a curiosity about climatic changes, but also a renewed interest in flood insurance. The year 1955 saw almost $1.7 billion in damages ($15 billion in 2014 dollars), approaching the $2 billion tally of 1951 ($18.6 billion in 2014 dollars). Besides those two years, no year's damages had topped the seven-billion mark since the back-to-back flood years of 1936 and 1937.[82] While the 1951 damages had been concentrated in the Kansas River valley, the floods of 1955 were far more widely distributed,

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[80] Hoyt and Langbein, *Floods*, 112.
[81] See, for example, Nona Brown, "Northeast Hurricanes: Freaks or Portents?," *The New York Times* October 24, 1954; and Alvin Shuster, "Northern Hurricanes: New Weather Pattern?," *The New York Times* August 14, 1955.
[82] National Weather Service, "Hydrologic Information Center – Flood Loss Data, http://www.nws.noaa.gov/hic/. Last visited April 3, 2018. This web site provides all loss information in 2014 dollars. Conversions to 1955 and 1951 performed via the US Inflation Calculator web site, http://www.usinflationcalculator.com, last visited April 16, 2018.

affecting New England, Texas, and the West Coast, as well as inland locales including Kentucky, Nebraska, Kansas, Oklahoma, Colorado, and Idaho. Hurricanes Connie and Diane, which combined to cause massive flooding in Connecticut, were the greatest catalysts for political action. The two storms hit in successive weeks in August, dumping cumulative rainfalls of up to two feet and causing several of the state's rivers to swell to extreme levels. The cities of Waterbury and Farmington were among the hardest hit.

In the immediate aftermath of the 1955 floods, four committee prints (drafts of bills that were not yet ready for formal introduction) received hearings before the U.S. Senate's Committee on Banking and Currency. Most of the senators whose staffs had prepared these drafts, including Prescott Bush of Connecticut (progenitor of the Bush political dynasty), John F. Kennedy and Leverett Saltonstall of Massachusetts, and Herbert Lehman of New York, represented coastal, northeastern states that had taken severe damage during that year's storms. Kansas senator Frank Carlson, who had been supportive of but not centrally involved in the 1951-52 effort, also offered a draft bill.[83] In comparison to previous efforts, these bills put forward a broader vision of disaster insurance, with some calling for coverage of other natural disasters like tornadoes, earthquakes, and blizzards. Lehman even pushed for a program that included coverage of man-made disasters such as nuclear war. Even though these trial balloons garnered some interest, only two bills were formally introduced, and both of these focused solely on flood insurance and asserted the need for a trial before a permanent program might be instituted. The two bills, one introduced by Lehman and the other by Bush, were not radically different, but proposed different maximum amounts of coverage, $250,000 per purchaser under

[83] The committee prints can be found in U.S. Congress, Senate, Committee on Banking and Currency, *Federal Disaster Insurance: Hearings Before the Committee on Banking and Currency, United States Senate, Eighty-Fourth Congress, First Session, on Bills to Provide Insurance against Natural and Manmade Disasters, and for Other Purposes, Part 1*, 84th Cong., 1st sess., October 31, November 1, November 3, November 4, November 9, November 10, November 14, and December 19, 1955, pages 3-27.

the Bush bill and $100,000 per purchaser under the Lehman bill.[84] These efforts attracted the support of Republican President Dwight Eisenhower, who went as far as to support a federal flood insurance program in his written State of the Union remarks in January 1956, but his activism for flood insurance was not as extensive as Truman's had been.[85]

This stretch of increased hurricane activity had come to the attention of the lawmakers working on flood insurance in the wake of the 1955 floods. The new emphasis on the coasts was unable to quash concerns that flood insurance would mainly have regional benefits. "There certainly is some new pattern which has developed in the last two or three years," noted Democratic Senator Paul Douglas of Illinois in an executive session of senators dedicated to discussing the proposed insurance program. Douglas's comment referenced his concerns that newly flood-prone regions like the Northeast would pay the same insurance rates as seemingly less vulnerable areas. Bush, in response, pushed the position that flood insurance would benefit the entire country—riverine as well as coastal areas. "But the big losses have been caused by these hurricanes which carry with them tremendous downpours of water," Douglas insisted.[86] In another instance, Prescott Bush parried a suggestion from Arkansas Democrat William Fulbright, meant to represent the interests of people vulnerable to Mississippi River flooding, that this would be a hurricane-specific bill. "It's not a local bill or a provincial bill," Bush said. "High water, rain, any water," anywhere could potentially be covered.[87] Premium rates were clearly on

[84] National Flood Indemnity Act, S. 2862, 84th Congress (Bush); Federal Flood Insurance Act, S. 3137, 84th Congress (Lehman).
[85] Dwight D. Eisenhower: "Annual Message to the Congress on the State of the Union.," January 5, 1956. Online by Gerhard Peters and John T. Woolley, *The American Presidency Project*. http://www.presidency.ucsb.edu/ws/?pid=10593. Last visited April 3, 2018.
[86] U.S. Congress, Senate, Committee on Banking and Currency, *Flood Insurance, Transcript of Proceedings, Committee on Banking and Currency, Executive Session, April 11, 1956, Volume II* (New York: Rund Reporting Company, 1956), 96.
[87] U.S. Congress, Senate, Committee on Banking and Currency, *Flood Insurance, Transcript of Proceedings, Committee on Banking and Currency, Executive Session, April 11, 1956, Volume I* (New York: Rund Reporting Company, 1956), 13-14.

Douglas's mind. "That was my way of finding out whether you fellows were willing to pay a higher rate, because of what I think is a higher risk," the senator stated.[88] Douglas's question regarding regional differentiation of flood risk was not unfounded. The 1956 bill grappled with rate determination in a more sophisticated way than its 1951 predecessor had, but still left lingering questions. In 1951, flood insurance advocates never got to the point of trying to figure out how rates would be set. National coverage of the flood insurance proposal was relatively sparse, but in one editorial, the *New York Times* warned that the ability to assess flood risk actuarially had never been demonstrated.[89] By 1956, advocates for flood insurance had settled on the necessity of providing federal subsidies for flood insurance premiums, subsidies that were not intended to exceed 50 percent of actuarial rates. At least for the time, hope for a flood insurance program that did not require federal subsidies was abandoned.

The possibility of providing subsidized flood insurance helped bring class issues to the surface. In one exchange between Senators Bush, Fulbright, and Oregon independent-turned-Democrat Wayne Morse, Morse took up the cause of people living in the most vulnerable areas, who were, as he noted, "always the poor people, aren't they."[90] The ensuing discussion revealed a tension among flood insurance supporters between creating subsidies seen as unfairly benefiting people of lower incomes, and enacting a program that would be attractive and affordable to potential customers. Class issues have long been a challenge for the National Flood Insurance Program, and they are one of environmental historian Ted Steinberg's focal points in his discussion of flood insurance within *Acts of God*. The 1956 discussions reveal that flood insurance had not yet crystallized into the wealth-favoring program criticized by Steinberg, as

[88] *Flood Insurance … Volume II*, 97.
[89] "Flood Aid and Insurance," *New York Times* August 22, 1951. Clip from Howse papers, box 33, notebook 6.
[90] *Flood Insurance … Volume II,* 98.

the senators were still grappling with how to bring the poorest floodplain residents under its umbrella.

As it had done in 1951-2, the Insurance Executives Association produced another study of flood insurance after the severe flooding of 1955, again retaining the services of the engineering firm Parsons, Brinckerhoff, Hall & Macdonald for technical analysis.[91] On the whole, the Association's position in 1956 was essentially the same as in 1952: questioning the feasibility of an insurance program that would be financially self-sustaining, and the appropriateness of the term 'insurance' for a program based on government subsidies, but expressing willingness to assist with implementing any program that was ultimately instituted. Interestingly, the 1956 report took the possibility of climate change seriously, acknowledging the challenges that a changing climate would present to insurers, even while expressing doubt that recent patterns of increased storm damage being observed were part of any larger climatic shift. The authors noted that scientists believed a gradual change of climate could be occurring, albeit on the same long timescale as past climate cycles, and likely not observable on timescales of 50-100 years or less. "Nevertheless," they concluded, "the possibility of such cyclic variations in climate should not be neglected in estimating flood probabilities."[92] Despite their agnostic stance on climatic change, the authors argued that the extreme flooding events of recent years only served to underline the difficulties of estimating annual flood losses for insurance purposes.

Although it is easy to forget, the 1956 legislative effort that emerged in the Senate actually produced a national program of flood insurance, backed by the federal government, that

[91] American Insurance Association, *Studies of Floods and Flood Damage 1952-1955* (New York: American Insurance Association, 1956).
[92] American Insurance Association, *Studies of Floods and Flood Damage,* 159.

was passed into law as a hybrid of Lehman's and Bush's bills.[93] While legislators were sufficiently convinced of the idea's general merits to vote for it, funding the program was another matter. By mid-1957, the national flood insurance program had been mothballed, a victim of budget hawks who did not necessarily oppose flood insurance on philosophical grounds, but who saw a program that was not yet active as an easy one to cut while minimizing political blowback.[94]

Nearly a decade after this funding failure, another hurricane re-kindled legislative interest in the latent idea of flood insurance. Hurricane Betsy, in September 1965, was the first hurricane to cause over $1 billion in damages without adjustment for inflation. Betsy's first landfall in the United States took place in southern Florida, but after crossing the Gulf of Mexico, the storm returned to land in perfect position to deal New Orleans a powerful blow. Similar, in so many ways, to Hurricane Katrina, its harshest impacts were caused by a storm surge that was driven into Lake Pontchartrain that reached 12 feet and pushed through unfinished levees. Betsy was dubbed 'the worst disaster in the state since the Civil War' by governor John McKeithen, while an insurance industry spokesman went so far as to call it the greatest disaster in American history.[95]

Flood insurance still had its advocates even in the intervening years before Betsy. During the early 1960s, New Jersey Democratic Senator Harrison "Pete" Williams had been one of the most dogged advocates for activating the federal flood insurance program. Williams later gained notoriety as one of the highest-ranking catches of the Abscam anti-corruption sting operation,

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[93] Federal Flood Insurance Act of 1956, S. 3732, 84th Cong. Passed into law as U.S. Public Law 1016. 84th Cong., 2d sess., August 7, 1956.

[94] "Imperiled Flood Insurance," *The Washington Post and Times-Herald* June 18, 1957; "Flood Insurance Plan Placed in Mothballs; No Funds Were Voted," *The Wall Street Journal* June 24, 1957.

[95] The description of Hurricane Betsy, including the superlative descriptions, is drawn from Todd Shallat, "Losing Louisiana: Technological Progress and the Nature of Catastrophic Events," *Icon* 6 (2000): 149-159. Shallat argues that Betsy helped catalyze an increasingly moralistic view of disasters in the United States that linked the severity of natural disasters to human modifications of the natural world.

bringing about his resignation from the Senate in 1982 ahead of a planned expulsion vote. But in his two-plus decades of Senatorial service prior to the sting, Williams was propelled by a broad vision of federal management of the natural and built environments in the United States, a vision that led to his involvement in issues such as endangered species protection, open space preservation, and reduction of traffic congestion and air pollution.[96] Williams traced his commitment to flood insurance back to the Ash Wednesday Storm of 1962, a powerful nor'easter that battered coastal New Jersey as well as other states along the East Coast. In an early 1965 letter to President Lyndon Johnson, Williams decried the extant system of relief bills after floods, arguing evocatively that the federal government had "been swatting flies instead of draining the swamp."[97] At a basic level, Williams was only suggesting the need for addressing a problem's cause rather than its symptoms, but his comment also alludes to the mindset that wetlands should be drained for development rather than preserved for ecological benefits and services including floodwater storage, a mindset that prevailed in the United States through the early 1960s. Historian Ann Vileisis argues that wetlands have presented a persistent challenge to American ideas of private property, because they combine elements of land (subject to private ownership, and potentially to insurance) and water (usually publicly owned).[98]

On the very same day that Betsy slammed into New Orleans, September 9, 1965, a new cabinet department was established within the executive branch of the federal government: the United States Department of Housing and Urban Development (HUD). This new department continued the work of the Housing and Home Finance Agency, with its most well-known work

[96] "Biographical Sketch of Harrison A. Williams, Jr." Harrison A. Williams, Jr. Papers. Available online at http://www2.scc.rutgers.edu/ead/manuscripts/williams01f.html. Last visited April 3, 2018.
[97] Draft, letter from Harrison Williams to Lyndon Johnson, 5 January 1965. Harrison A. Williams, Jr. Papers, Box 875, Folder 20.
[98] Vileisis examines American attitudes toward wetlands in her book *Discovering the Unknown Landscape: A History of American Wetlands* (Washington, D. C.: Island Press, 1997). The mindset that swamps should be drained has not disappeared, but as Vileisis shows, opposition to this mindset began to increase from the 1960s onward.

involving housing access for poor urban residents, many of them racial minorities. One of HUD's first tasks, by dint of when the department was created, was to undertake a study of flood insurance. The Southeast Hurricane Disaster Relief Act of 1965, mostly a relief bill, also contained a provision calling for the Secretary of HUD to examine alternative methods of assisting flood victims. Specifically, the study was to examine the dormant 1956 flood insurance program. In his signing statement, President Johnson noted that it was the sixth disaster relief bill he had signed in the past eighteen months, with all the others only focusing on a single catastrophe. "Such a basic study is long overdue," Johnson wrote, expressing his pleasure that not only the authority but the funding for such a study had been approved.[99]

The HUD study was directed by Marion Clawson, a man who was in the midst of a long and productive career. Trained as an agricultural economist, Clawson already had a stint as the director of the Bureau of Land Management under his belt, and by 1965 was a decade into a position working with the nonprofit group Resources for the Future (RFF), an organization well-known as representing a "cornucopian" optimism for economic and material growth.[100] For his part, Clawson praised the explosion in productivity of twentieth-century agriculture, which had left "Mr. Malthus…standing on his head over there in the corner," though his work also reflected a respect for wilderness and wildlife preservation.[101] The Clawson-led HUD report explicitly envisioned flood insurance as a cornucopian program that could "limit future flood damages

[99] Lyndon B. Johnson, "Statement by the President Upon Signing the Southeast Hurricane Disaster Relief Act of 1965," November 8, 1965. Online by Gerhard Peters and John T. Woolley, *The American Presidency Project*. http://www.presidency.ucsb.edu/ws/?pid=27358. Last visited April 3, 2018.
[100] As discussed in Donald Worster's *Shrinking the Earth: The Rise and Decline of American Abundance* (New York: Oxford University Press, 2016). Worster's position is that the "cornucopians" had an unfounded optimism in perpetual material abundance, and he views Resources for the Future with a critical eye, at least its mid-century perspective.
[101] "Marion Clawson's Long View of the Land," *Resources Magazine* 132 (Summer 1998): 18-19.

without hampering future economic development."[102] One of the most significant and influential recommendations of the HUD study for what came afterward was that any federal flood insurance program should start by focusing on residential, rather than commercial or industrial properties. The stated reason for this recommendation was that because residences are more common and their value more uniform within a given area than other types of properties, rate determination would be easier.[103] The symbolism is powerful, though: in the same year that housing concerns were elevated to a Cabinet department, highlighting the increasing federal interest in residential issues, flood insurance shifted into a proposal focused directly on homeowners.

At the same time that HUD was working on its report, another federal office, the Bureau of the Budget, brought together a task force charged with a broader examination of floodplain policy. This group, the Task Force on Federal Flood Control Policy, was a nine-member group headed by Gilbert White. One of its most active members was James Goddard, who represented the Tennessee Valley Authority and who had guided the TVA toward policies of floodplain management starting in the 1950s. The task force's report was sent to Congress accompanied by a letter of endorsement from President Lyndon Johnson. The task force highlighted several key goals for future work: improved basic knowledge about floods, establishment of a uniform technique for determining flood frequency, better collection of information on flood damages, and further research on flood plain occupancy and urban hydrology. Johnson's letter of transmittal made clear where he stood on how to limit flood losses, stating in part, "the key to the problem lies, above all else, in the intelligent planning for and State and local regulation and use

[102] U.S. Congress, Senate, *Insurance and other Programs for Financial Assistance to Flood Victims. Report from the Secretary of the Department of Housing and Urban Development to the President, as Required by the Southeast Hurricane Disaster Relief Act of 1965 (P.L. 89-339, 89th Congress, H.R. 11539, Nov. 8, 1965,)* 89th Cong., 2d sess., 1966. 9.
[103] U.S. Congress, Senate, *Insurance and other Programs*, 72-73.

of lands exposed to flood hazard."[104] The report helped to bring into focus specific problems that needed to be addressed before a flood insurance plan could be successfully implemented. For instance, flood frequency was a problem left unresolved in previous attempts to implement a flood insurance program. Both reports also acted to draw leading floodplain management experts directly into the debate over a flood insurance program.

Beyond Johnson, floodplain management was also a clear priority for many supporters of the legislation that developed in Betsy's wake. In the Senate Committee on Banking and Currency's report on the National Flood Insurance Act of 1967, a standalone piece of legislation that was very similar to the legislation passed the following year, the committee reported that it had "given special attention to the fact that relief measures for those who suffer flood losses do nothing to encourage the wise use of land subject to flooding, or to discourage increased exposure of property and life in such locations." It lauded the potential for flood insurance to "provide an efficient and easily usable mechanism for balancing the costs and advantages if increased use of any area with a flood hazard."[105] Aubrey Wagner, chairman of the Tennessee Valley Authority, wrote in a statement that any flood insurance program "should not encourage occupancy of high risk flood zones," and that the proposed legislation "will serve gradually to reduce the flood damage potential in the country."[106] Yet while those who had considered flood insurance deeply, both experts and politicians alike, tended to laud the floodplain management aspects of the proposed legislation, Congressional hearings reveal a deep reservoir of support for flood insurance from legislators and private citizens who did not speak of any prudent limits to

[104] U.S. President, *A Unified National Program for Managing Flood Losses: Communication from the President of the United States Transmitting a Report by the Task Force on Federal Flood Control Policy,* 89th Cong., 2d. sess., 1968, H. Doc. 89-465. Quote from page iii.
[105] Committee on Banking and Currency, U.S. Senate, *National Flood Insurance Act of 1967*, Report No. 549. Washington, D.C.: U.S. Government Printing Office, 1967. Quotes are from pages 4 and 5, respectively.
[106] United States, *National Flood Insurance Act of 1967. Hearings before the Subcommittee on Securities of the Committee on Banking and Currency, United States Senate, Ninetieth Congress, First Session, on S. 1985, S. 1290, and S. 1797* (Washington: U.S. Government Printing Office, 1967), 245.

floodplain usage, instead envisioning the program as simply a way to give homeowners another type of insurance coverage that they were then unable to obtain. Testimony of Houston-area Democrat Jack Brooks is representative: "We must formulate and hammer out in Congress some system or combination of private and public insurers to give (flood victims) an opportunity to buy minimum protection from these devastating losses."[107] The differences in reasons for supporting flood insurance speak to the fact that while experts had developed a strong interest in determining and adhering to natural limits, the public at large was less devoted to this approach.

The 1956 legislation, but especially the Johnson-era program, had different bases of support than the initial 1951 effort. Much more than previous efforts, the push for flood insurance that started in 1965 focused on homeowners rather than industry or commerce. As Williams triumphantly proclaimed in August 1966, "Home-owner flood insurance is a practical possibility for the first time."[108] These later efforts had been spurred by hurricanes that had done heavy damage to residential areas. Moreover, these were not just any residential areas, but included newly emerging pockets of wealth in beachfront areas as well as culturally important cities like New Orleans. In contrast, the 1951 flooding had done some of its most newsworthy damage to industrial sections of Kansas City, though it had also affected numerous homeowners and farmers. But the homeowners most heavily affected in 1951 were working-class people of less political clout, living in low-lying neighborhoods accessible to the factories where many of them worked. Many of the residents of those neighborhoods were also racial minorities, particularly of Hispanic descent.[109]

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[107] United States, *National Flood Insurance Act of 1967. Hearings before the Subcommittee on Housing of the Committee on Banking and Currency, House of Representatives, Ninetieth Congress, First Session, on H.R. 11197* (Washington: U.S. Government Printing Office, 1967), 180.

[108] "Home Flood Cover Supported," *Journal of Commerce* August 29, 1966, 7. From Harrison Williams Papers, Box 875, Folder 20. See also "Flood Insurance On Way for Homes, Says Williams," *Daily Journal* (Vineland, N.J.) August 24, 1966.

[109] Lucille Bluford, "Flood Leaves Hundreds of Families in West Homeless," *New Journal and Guide* July 21, 1951.

By the mid-1960s, however, the Civil Rights movement had helped give a much louder voice to impoverished city dwellers, including those belonging to racial minorities, and Lyndon Johnson's Great Society agenda had given them newfound legislative attention. Letters written in favor of flood insurance to House Whip Hale Boggs, a Louisiana Democrat and strong supporter of flood insurance, suggest that even if flood insurance was not explicitly planned to be a bone thrown to whites, it developed some of its support, particularly among Southern Democrats, on racialized terms. "The insurance racket as it is now is the biggest racket in the world and the government should do something about it," wrote one of Boggs' constituents, a widowed pensioner, urging a completely government-run flood insurance program. "If our Great Society would spend less time helping the free loaders to get something for nothing and protect those who are willing to pay their way and don't get a fair deal, then we would have a Great Society."[110] Using more explicitly racial language, another constituent wrote, "Surely it is the WHITE race from whom most of the taxes are paid, but it is Luther King's people who are deriving the benefits. Don't you think it is the time to start doing something for the people who pay the taxes? The flood bill would only mean we could purchase insurance to cover our loss. At the present time we cannot buy any such insurance."[111] Boggs, more sympathetic to civil rights than many of his southern colleagues, but still mindful of the nature of his constituency, replied to the second letter writer that he "found myself agreeing with you in paragraph after paragraph."[112] It would be inaccurate to deem the post-Betsy movement for flood insurance

[110] Louise Jimerson to Hale Boggs, October 1966. Hale Boggs Papers, Louisiana Research Collection, Tulane University, Box 57, folder 4.
[111] Fred Oster to Hale Boggs, February 10, 1968. Hale Boggs Papers, Louisiana Research Collection, Tulane University, Box 61, Folder 4.
[112] Hale Boggs to Fred Oster, February 16, 1968. Hale Boggs Papers, Louisiana Research Collection, Tulane University, Box 61, Folder 4. On Boggs and civil rights, see Scott Balius, *The Courage of His Convictions: Hale Boggs and Civil Rights* (M.A. Thesis, Tulane University, 1992).

entirely a manifestation of a white racial backlash seeking to derive benefits for poor whites from Great Society programs, but those sentiments seem to have contributed to its support.

Aside from this racially motivated reasoning, the post-Betsy effort to provide federal flood insurance seems to have received stronger grassroots support relative to previous efforts, based on letters to elected officials. Even interests ideologically predisposed to oppose new governmental programs emerged as supporters of a flood insurance program. "The Founding Fathers would be appalled over the vast unconstitutional expenditure of federal funds on strictly local projects," wrote one man to Boggs, a Republican lawyer from Seattle. Nonetheless, he continued, "it would be in accord with my political beliefs for the government to enter into a National Disaster Insurance Program." This, he explained, was because "the government should do only those things which the people cannot do for themselves, (and) I think natural disasters are an area in which people are for the most part helpless."[113] Another letter-writer, who noted his concerns about the growth of government, called flood insurance "an intelligent solution and a 'happy marriage' between the federal government and private enterprise."[114]

Post-Betsy, legislative support for flood insurance proved to be broad, and resistance minor, though the legislation faced some dark moments similar to 1956 when key funding appeared to be in question.[115] It was ultimately passed into law as the National Flood Insurance Act of 1968, as a section of the Housing and Urban Development Act of 1968.[116] In the Senate, the vote was nearly unanimous, 67-4 in favor, with 29 not voting. All four nays came with

[113] Alfred Schweppe to Hale Boggs, August 16, 1967. Hale Boggs Papers, Louisiana Research Collection, Tulane University, Box 61, Folder 3.
[114] Patton Tunstall to Hale Boggs, January 20, 1967. Hale Boggs Papers, Louisiana Research Collection, Tulane University, Box 59, Folder 17.
[115] Boggs intervened to restore $1.5 million in funding needed for preliminary studies before the first policies could be written, funding that had been removed by the House Appropriations Committee. Boggs press release on flood insurance, October 17, 1968. Hale Boggs Papers, Louisiana Research Collection, Tulane University, Box 794, Folder 2.
[116] U.S. Public Law 448. 90th Cong., 2d sess., August 1, 1968.

conservative Southerners, Democrats John Stennis (Mississippi), Spessard Holland (Florida), and Richard Russell (Georgia), and Republican Strom Thurmond (South Carolina).[117] In the house, the tally came to 295-114.[118] That flood insurance was passed into law as well as funded in 1968 is reflective, in part, of an effort that was backed by well-developed expertise and on-the-ground knowledge and experience developed over the preceding decades. But stepping back from the detailed planning and legislative processes, the successful enactment of a flood insurance program had much to do with larger societal changes afoot. A coastal constituency that had been almost entirely silent during the Truman-era effort helped power the passage of the 1968 legislation, which was geared to benefit homeowners rather than industrial development. Lawmakers and their constituents, even those predisposed to be suspicious of government growth, had made peace with the idea of using insurance as a governmental tool of environmental risk management, at least on a conceptual level. For some, it was a counterbalance to perceived governmental favoritism of racial minorities. Furthermore, between 1951 and 1968, dam-building had begun to fall out of favor, making more space for alternate ideas such as flood insurance.[119] Perhaps most importantly, the increasing acceptance of the floodplain management mindset set flood insurance apart from the structural methods of flood control that had eclipsed the 1951 insurance proposal. Not just scattered academics, but politicians all the way up to the president endorsed the idea that there was wisdom in working

[117] Congressional Record, Senate, May 28, 1968, 15283.
[118] Congressional Record, House of Representatives, July 10, 1968, 20561-20562.
[119] Dam-building faced opposition from a range of perspectives, not only environmentalist but also small-government. See Karl Boyd Brooks, *Public Power, Private Dams: The Hells Canyon High Dam Controversy* (Seattle: University of Washington Press, 2006); Mark W. T. Harvey, *A Symbol of Wilderness: Echo Park and the American Conservation Movement* (Albuquerque: University of New Mexico Press, 1994); Theodore Steinberg, "'That World's Fair Feeling': Control of Water in 20th Century America," *Technology and Culture* 34 (April 1993): 401-402; and David Billington, Donald Jackson, and Martin Melosi, *The History of Large Federal Dams: Planning, Design, and Construction* (Denver: U.S. Department of the Interior, Bureau of Reclamation, 2005).

with the natural limits imposed by floodplains rather than focusing solely on overcoming those limits.

Chapter Four

Zones of Tension: NFIP Implementation, 1969-2005

As it turned out, the apparent victory for floodplain management that the passage of the National Flood Insurance Act seemed to represent was much less than complete. For while the approach of floodplain management did indeed gain enhanced legal standing through the National Flood Insurance Program, the 1960s were also a decade that saw a trickle of migration toward the nation's coastal regions—particularly in the hurricane-prone Southeast—start to swell into a torrent, in parallel with the tsunami of suburban development and urban sprawl that came to occupy flood prone locales on the periphery of American cities. Over the subsequent 35 years, the NFIP received both a thicker stick and a sweetened carrot to incentivize the floodplain management approach, but on the whole, remained constrained by its reliance on local jurisdictions to implement effective floodplain management.

The stick was a legal requirement, established in 1973, that anyone buying a house in a mapped floodplain and using a federally backed or regulated mortgage must purchase flood insurance. The carrot was discounted flood insurance based on implementation of various floodplain management strategies at the community level, implemented by the Community Rating System in the 1990s. Both of these approaches—and the entire operation of the NFIP, for that matter—rely upon the practice of zoning. This chapter situates floodplain zoning within the broader history of urban zoning in the U.S, and the emerging discipline of public planning. Like many types of zoning, floodplain zoning ordinances are implemented at the municipal level. Yet unlike most types of zoning, floodplain zoning in the NFIP era is based on maps created with modeled interpretations of the natural world by technocrats, rather than on neighborhood or city

boundaries that are often human constructs that can be negotiated. Because floodplain ordinances are implemented locally, there can be a wide range of outcomes, from communities that strongly embrace the idea of nature having boundaries that are best not pushed, to communities that only meet the minimum zoning standards set by the NFIP. Because floodplain zoning is based on processes that may seem remote and inscrutable to lay people, those affected by the limits it imposes often react strongly and negatively against them. The imposition of flood zone boundaries can dramatically affect property values, and for landowners whose property is found to lie in flood-prone areas, the mapping process has often been perceived of as a disaster in its own right.

With the primary political hurdles of enactment and funding cleared in 1968, the nascent NFIP faced a new set of challenges. First and foremost, it needed participants, and it needed a way to set premiums. Initially, participation in the program was minimal. The program was (and still is, as of 2018) only available to people whose communities had joined it, and so for most potential policyholders obtaining flood coverage through the NFIP was not simply a question of individual desire, especially during its early years. As the program was originally created, where municipalities were concerned there was little obvious incentive for them to join beyond creating a situation where their residents could purchase insurance. There was even a potential *dis*incentive for participation: anybody who had been eligible for flood insurance for more than a year, but did not purchase it, was denied eligibility for disaster relief.[1]

The NFIP was initially operated through the Department of Housing and Urban Development, under the auspices of the newly created Federal Insurance Administration. Quickly, the FIA set itself to identifying flood-prone areas via rudimentary flood hazard boundary maps (FHBMs), which merely delineated places that were and were not exposed to

[1] U.S. Public Law 448. 90th Cong., 2d sess., August 1, 1968. Section 1314.

significant flood risk, drawing on existing geological surveys when available. As time passed, more deeply researched flood insurance studies, which involved careful analysis of a community's flood risk, created far more detailed maps called flood insurance rate maps, or FIRMs. The former were not a part of the original plan for the NFIP, but were provided for by the Housing and Urban Development Act of 1969.[2]

Even at its genesis, many facets of the NFIP looked the same as they have over the duration of the program. One original provision that has remained a constant was that prior to NFIP participation, a community was required to make a commitment to regulate building in and usage of flood-prone terrain, and thus make a general commitment to the principles of floodplain management and the discipline of public planning. The idea, central to the federal government's involvement in flood insurance at all, was that by tying the availability of flood insurance to limiting land uses in floodplains, the nation's exposure to flood hazards would gradually decline as new buildings were built. To become insurance-eligible, a community was required to take the initiative, notifying the Federal Insurance Administrator of its interest.[3] Along with this statement, the community was required to demonstrate that it would implement land management regulations with provisions for enforcement. Then, once the community's application was approved, it would become eligible for flood insurance as soon as insurance rates were established.[4]

These provisions were published June 18, 1969, to become effective immediately. Just a week later, on June 25, federal flood insurance became available for the first time, in the cities of

[2] U.S. Public Law 152. 91st Cong., 1st sess., December 24, 1969**.** Section 408.
[3] 'Community' is the terminology used by the NFIP. In practice, this means an incorporated municipality such as a city, town, or village. Counties may also join the NFIP, enabling rural residents who do not live in incorporated municipalities to obtain flood insurance.
[4] The requirements for participation in the National Flood Insurance Program are found in the Federal Register, 34 Fed. Reg. 9553-60 (June 18, 1969).

Fairbanks, Alaska, and Metairie, Louisiana. Only two other cities joined this number by the end of the year, though. The foremost problem was rate determination. The original rules stated that actuarially sound insurance rates must be established for any community prior to its joining the NFIP, and determination of these rates did not exactly proceed with the speed of a flash flood. The program initially called for existing buildings to be eligible for up to $17,500 of structural coverage and $5,000 of contents coverage at subsidized rates, but any coverage beyond that (up to maximums of $35,000 for structural coverage and $10,000 for contents coverage) would be priced at actuarial rates. In 2018 dollars, the dollar limit for subsidized structural coverage would be about $120,000, and unsubsidized structural coverage $240,000—fairly modest limits.[5] In other words, extant construction would be eligible for insurance up to one threshold at subsidized rates, and up to another at calculated actuarial rates. Coverage for buildings themselves and for building contents counted against different thresholds. For the subsidized coverage, the federal subsidy was initially around ninety percent.[6]

From its creation, but even more so after Congress instituted stronger flood insurance purchase requirements in 1973, the NFIP both implicitly and explicitly affected land use decisions and patterns of development. It did so implicitly in that being mapped into a zone of high flood risk tends to affect building and land-use decisions, and explicitly in that as a requirement for participation in the NFIP, communities must implement local floodplain management programs administered at the municipal or county level, which rely heavily on the mechanism of zoning. Floodplain zoning was not a creation of the NFIP, although the NFIP dramatically increased its prevalence. Prior to the enactment of the NFIP, certain cities had been

[5] 2018 dollar valuation calculated using the US Inflation Calculator online. See CoinNews Media Group, "US Inflation Calculator," last accessed March 30, 2018, http://www.usinflationcalculator.com.
[6] 34 Fed. Reg. 9553-60 (June 18, 1969); Robert Felton, William Ghee, and John Stinton, "A Mid-1970 Report on the National Flood Insurance Program," *Journal of Risk and Insurance* 38, no. 1 (Mar 1971): 1-14; "US Subsidizes Home Insurance in Flood Areas," *Los Angeles Times*, November 29, 1970, C1.

experimenting with their own floodplain development regulations. But it was the NFIP that made flood mapping and floodplain zoning ubiquitous. Floodplain zoning, as used here, is to be distinguished from regulations prohibiting channel encroachment. The former deals not with buildings that would potentially obstruct flood flows, but those that could be damaged by high waters. Ideally, it limits the usage of floodplains to purposes that are not highly vulnerable to flood damages, and sometimes it entirely forbids any building on floodplains. The latter is meant to preserve the flow of rivers and streams, and channel encroachment laws were introduced as early as 1913 in Pennsylvania.[7]

By the second half of the twentieth century, the practice of zoning was well established in the United States. This practice was first established in urban municipalities, but gained rural footholds as well.[8] Prior to the Progressive Era, nothing that would be recognized as zoning in its present form was practiced in the United States, but other methods of land use control were practiced, including restrictive covenants and nuisance and trespass litigation. The first modern zoning ordinance in the United States, in New York City, was implemented in 1916. This ordinance included regulations dividing the city into business, residential, and industrial districts, and also governed the height and bulk of buildings. Its proximate impetus was the accelerating construction of multi-story skyscrapers that covered their entire lots and towered far above neighboring buildings, limiting sunlight and airflow. Zoning in New York had been under discussion for almost two decades before the ordinance was enacted. This ordinance represented a triumph for city planners and urban reformers, but even more for wealthy landowners concerned with preserving property values. In addition to some concern about encroaching

[7] Francis Murphy, *Regulating Flood Plain Development* (Chicago: University of Chicago, 1958).
[8] On rural zoning, see Joshua Nygren, "A Producers' Republic: Rural Zoning, Land Use, and Citizenship in the Great Lakes Cutover, 1920-1940," *Michigan Historical Review* 40, no. 1 (Spring 2014): 1-26.

skyscrapers, landowners were particularly keen to limit the growth of the garment industry, and its associated work force, too close to their holdings in lower Manhattan.[9]

Other jurisdictions quickly followed New York's example, establishing zoning codes that benefited not just wealthy landowners but single-family residences. A 1926 Supreme Court decision, Village of Euclid, Ohio, v. Ambler Realty Co., further opened the door for cities to establish zoning ordinances, by upholding the legality of zoning in the country's highest court. The most persistent legal concern with zoning has been that it may violate the Takings Clause of the Fifth Amendment of the U.S. Constitution, which forbids the taking of private property for public use without fair compensation. In Euclid v. Ambler, lawyers representing the Ambler Realty Company argued that a zoning ordinance in the Cleveland suburb of Euclid amounted to an unconstitutional taking of Ambler's property because it limited how the company could use its own land. Ambler had desired to develop a piece of land it owned for industrial purposes, but the village of Euclid acted to keep industrial development outside of its boundaries. In a six to three decision, the court found that Euclid's zoning laws were constitutional and protected the public welfare. Another Supreme Court decision two years later, Nectow v. City of Cambridge (Massachusetts), overturned a zoning ordinance that was found to be overly injurious to a landowner whose sale of a tract of land fell through when a portion of the tract—not zoned when the sale was agreed upon—was zoned for residential use only. The Euclid and Nectow decisions established the guidelines for zoning jurisprudence in the United States for the following several decades. Euclid established the general constitutionality of zoning, while Nectow established that

[9] In her article "Zoning and Zeitgeist: The Skyscraper City in the 1920s," *Journal of the Society of Architectural Historians* 45, no. 1 (March 1986): 47-59, Carol Willis describes the 1916 New York ordinance and argues that even though the ordinance was conceived of simply in restrictive terms, zoning helped to drive a new vision of the modern city by the 1920s. On the New York ordinance, see also Seymour Toll, *Zoned American* (New York: Grossman Publishers, 1969); and Harvey Kantor, *Modern Urban Planning in New York (*Ph.D. dissertation, New York University, 1971).

the right to zone was not unlimited, and that zoning ordinances must be reasonable (a characteristic that itself had to be established through judicial precedent and not through simple definition) and bear "a substantial relation to the public health, safety, morals or general welfare."[10]

Historians have frequently viewed zoning in a negative light. The typical charge is that zoning was either a tool of the wealthy from the start, used to keep lower classes, people of color, or other classes of 'undesirables' away from high-value real estate holdings, or that it was co-opted by the wealthy even if its origins could be traced to more admirable impulses for societal reform.[11] In his widely read work on American suburbia, *Crabgrass Frontier*, Kenneth Jackson neatly lays out this view: "In actuality zoning was a device to keep poor people and obnoxious industries out of affluent areas. And in time, it also became a cudgel used by suburban areas to whack the central city."[12] A contrasting view emphasizes the aesthetic sense that zoning fostered, both in individual buildings and in the layout and development of entire cities.[13] In terms of zoning and related mechanisms that have come to regulate the usage of environmentally sensitive areas during the postwar period, the historian Adam Rome regards them in a strongly positive light, as indicators of an increasingly ecologically minded populace.[14] Nevertheless, one can reasonably question whether this type of zoning has also been co-opted by more affluent real

[10] On Euclid v. Ambler, see Michael Allan Wolf, *The Zoning of America: Euclid v. Ambler* (Lawrence: University Press of Kansas, 2008). On Cambridge v. Nectow, see Helen Monchow, "The Cambridge Zoning Decision," *Journal of Land & Public Utility Economics* 4, no. 3 (August 1928): 322-324. Quote is from Monchow, 323.
[11] This perspective can be found in *Zoned American*, and in Mel Scott, *American City Planning Since 1890: A History Commemorating the Fiftieth Anniversary of the American Institute of Planners* (Berkeley: University of California Press, 1995); and Francesco Dal Co, "From Parks to the Region: Progressive Ideology and the Reform of the American City," in *The American City: From the Civil War to the New Deal*, eds. Giorgio Ciucci et. al. (Cambridge, Massachusetts: MIT Press, 1983).
[12] Kenneth Jackson, *Crabgrass Frontier: The Suburbanization of the United States* (New York: Oxford University Press, 1985). Quote from page 242.
[13] This is the perspective of Carol Willis in her article "Zoning and Zeitgeist."
[14] See Rome, *The Bulldozer in the Countryside: Suburban Sprawl and the Rise of American Environmentalism* (New York: Cambridge University Press, 2001), especially chapter 5, "Where Not to Build: The Campaign to Protect Wetlands, Hillsides, and Floodplains."

estate interests. In its early years, floodplain zoning was primarily the project of earnest-minded reformers influenced by the disciplines of geography and public planning and New Deal statism. Their concerns were not primarily ecological, nor were they racial or class-based. They were united by their concern for the material, economic effects of floods: damages caused and how to prevent them. In other words, they believed that the natural world had boundaries that could be determined by the application of expert knowledge and technique, and the process of determining and abiding by these boundaries would yield societal benefits.

Prior to World War II, zoning was only infrequently a part of the conversation regarding ways to reduce flood losses.[15] One 1937 article that made a call for floodplain zoning lamented a consistent "refusal to recognize the right of rivers to their floodways," and indeed, flood policy of this era was focused much more on containing rivers in order to facilitate further land development, rather than containing people to minimize the damages caused by rivers' natural cycles of flooding.[16] Isolated examples do exist of cities during the interwar period denying construction permits for reasons of possible flooding under the authority of zoning codes designed to promote the general well-being of the community, or using agricultural zoning to limit construction in flood-prone areas. In 1927, the city of Keene, New Hampshire, denied permission for a developer to build on flood-prone land that he had bought from the city because the difficulty of providing adequate sewerage would constitute a health hazard. This denial was upheld in 1930 in the US Court of Appeals for the First Circuit in American Land Co. v City of

[15] For example, see Arthur Shurtleff, "Flood Destruction and Town Planning," *City Planning* 4, no. 1 (January 1928): 62-64; and "The River's Rights," *Engineering News-Record* 11 March 1937: 385. Shurtleff called for restrictions on floodplain construction in the wake of flooding in 1927 along the Connecticut River in New Hampshire, Vermont, and Massachusetts. In the unattributed *Engineering News-Record* piece, the author calls for reduced and restricted usage of low-lying terrain adjacent to streams.
[16] Quote is from "The River's Rights."

Keene.[17] A decade later, in the wake of the catastrophic floods of 1938, Los Angeles County, California, zoned certain flood-prone lands into agricultural and industrial zones in 1940, but this zoning only covered a small portion of the county's flood-prone land.[18] In the late 1930s, Jefferson County, Wisconsin, adopted a zoning ordinance that specifically included prohibitions on buildings to be built below the "high-water mark," which was defined based on soil and vegetation characteristics—a distinctly different way of determining natural boundaries than the probabilistic methods discussed throughout this dissertation, and one perhaps more attuned to the natural world itself.[19] Despite these isolated instances, floodplain zoning in the interwar era was mostly an idea discussed in theory, rather than a widely employed practice. As a key part of this discussion, planning experts pondered what level of governance would be most effective to manage floodplain zoning. Since rivers and floodplains typically extend beyond municipal boundaries, state-level zoning ordinances could potentially be far more effective than scattershot municipal ordinances, especially considering that the planning implemented by one city might be compromised by different approaches taken by cities upstream. But as Gilbert White observed in a 1940 assessment of the possibilities for state-level floodplain regulation, the legal precedent for state-level zoning was not nearly as clear as it was for municipal zoning, and the data and studies needed for state-level zoning ordinances would be exponentially greater than for local ordinances.[20]

Implementation of floodplain zoning after World War II took shape slowly and did not adhere to uniform standards. Through the 1950s, there was no nationwide mandate for floodplain

[17] 41 F. 2d 484 (1st Circuit, 1930). On American Land Co. v. City of Keene, see DePaul College of Law, "State Flood-Plain Zoning," *DePaul Law Review* 12, no. 2 (Spring-Summer 1963): 246-262.
[18] On flooding in Los Angeles, including that of 1938, see Jared Orsi, *Hazardous Metropolis: Flooding and Urban Ecology in Los Angeles* (Berkeley: University of California Press, 2003).
[19] On the Jefferson County ordinance, see J. M. Albers, "New Uses for County Zoning: The Jefferson County, Wisconsin Ordinance," *Journal of Land and Public Utility Economics* 14, no. 4 (November 1938): 460-462.
[20] Gilbert White, "State Regulation of Flood-Plain Use," *Journal of Land and Public Utility Economics* 16, no. 3 (August 1940): 352-357.

zoning, and its application continued to depend upon the interest of local authorities. A successful implementation of flood plain zoning also required available expertise to analyze flood hazards. In Iowa City, for example, J. W. Howe was a longtime professor at the University of Iowa's hydraulics lab and was also involved in local and state governance. The hydraulics lab was itself a recognized authority on flooding. In Appalachia, the Tennessee Valley Authority took an especially active role in encouraging floodplain zoning.[21] In 1953, the TVA established a Local Flood Relations Branch to help support communities with flood-related regulations, especially zoning, and by the late 1950s, several of the American towns and cities with floodplain zoning ordinances in effect were found in Tennessee.[22] In Milwaukee County, Wisconsin, provisions for a "valley district" zone, which would include land no more than eight feet higher than the highest recent floods of record, were created in 1943, but no such zones were actually mapped until 1949. Within Milwaukee County's valley district zone, construction of housing was permitted, but the lowest level of the lowest floor was required to be at least three feet above the indicated flood level.[23] Milwaukee County was one of only a handful of jurisdictions to enact floodplain zoning ordinances prior to 1955. It took this action in response to repeated instances of homeowners seeking redress from local government after their homes experienced flooding, and who insisted on building even when shown photographs of their prospective home sites covered by flood waters.[24] By 1958, there were forty-nine jurisdictions with floodplain zoning codes on the books. Of these, most took a similar approach to Milwaukee County, basing their flood zones on historical floods, although some also employed flood

[21] Established in 1933 to promote economic development in Tennessee and surrounding areas, the TVA's congressional mandate included flood control and land use planning. Both the TVA's governmental supporters and its administrators saw land degradation as a primary cause of the Tennessee Valley's impoverished state. See Sarah Phillips, *This Land, This Nation: Conservation, Rural America, and the New Deal* (New York: Cambridge University Press, 2007), especially pages 83-107.
[22] This paragraph draws on Murphy, *Regulating Flood Plain Development*.
[23] Murphy, *Regulating Flood Plain Development*, 63.
[24] Ray Behrens, "Zoning Against Floods in Milwaukee County," *The American City* 67 (September 1952): 112-113.

frequency projections or arbitrary elevations or distances from the stream bank. This wide range of flood standards meant that floodplain zoning could look very different from one community to another.[25]

Even in the early days of floodplain zoning, landowners were reluctant to have their lands identified with the word "flood," because of concerns about property value and desirability.[26] In a 1958 study of floodplain regulations, flood control engineer Francis Murphy noted that "there is considerable evidence that attaching the word 'flood' to a parcel of land in a proposed zoning ordinance is a deterrent to such zoning. People resent the work [sic] 'flood' officially attached to their property and frequently resist it. When Milwaukee County changed the wording of its ordinance from 'flood district' to 'valley district,' the opposition vanished."[27] A similar transformation took place in Iowa City, where "the ominous words 'encroachment,' 'inundation,' and 'flood plain' were dropped in favor of 'valley channel' and 'valley plain' zones."[28]

White's influential dissertation *Human Adjustment to Floods*, building off of his earlier work, identified zoning as one possible way of adapting to the existence of floods, as opposed to trying to prevent or displace them. After the war's conclusion, floodplain zoning gained increasing currency in discussions of flood damage mitigation.[29] In late 1958, the University of Chicago held a conference on flood plain regulation and insurance, directed by White, that White at the time believed would mark a turning point in flood control policy. It was significant

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[25] Murphy, *Regulating Flood Plain Development*, 56-59.
[26] Historians have observed other instances in which the causes of catastrophes are obfuscated in subservience to development interests. In *Acts of God*, Ted Steinberg discusses the San Francisco earthquake and fire of 1906, describing how the city's business interests went to great lengths to try to identify the catastrophe as a fire, rather than an earthquake, because fires can happen anywhere, whereas earthquakes happen in zones of seismic activity. The business interests feared that if San Francisco developed a reputation for being in a zone of seismic activity, its economic prospects would flag.
[27] Murphy, *Regulating Flood Plain Development*, 146.
[28] J. W. Howe, "Modern flood-plain zoning ordinance adopted by Iowa City," *Civil Engineering* 33, no. 4 (April 1963): 38-39.
[29] Gilbert White, *Human Adjustment to Floods: A Geographical Approach to the Flood Problem* (Ph.D. dissertation, University of Chicago, 1945).

especially for two reasons: it was the first-ever meeting (according to White) bringing together local, state, and federal officials to discuss non-structural means of reducing flood losses, and it was not called in the wake of any particular instance of catastrophic flooding.[30] Instead, the meeting was held because a large-enough contingent of officials felt that flood loss reduction had developed "a special urgency quite aside from the kind of emergency that brings dramatic headlines proclaiming loss of life or property," in White's words.[31] The most tangible outcome of the conference was a set of policy recommendations, several of them focusing on increasing the existence and availability of flood hazard information.[32] In his recap of the conference, White especially emphasized the need for state and local agencies to strengthen their voices in discussions of floodplain regulation and zoning. Since the 1930s, the federal government had become the dominant actor in the construction of flood control structures, but as White recognized, regulations and zoning must be shaped by local needs in order to gain maximum acceptance.

The urgency that White spoke of arose from the fact that even though the federal government had been heavily involved in structural flood control for two decades at that time, flood damages and the incidence of catastrophic floods were continuing to increase, as traced in the last chapter. This continuing trend had drawn the interest Resources for the Future, the think tank discussed in the previous chapter as the professional home of economist Marion Clawson, which helped to fund a study carried out by a team directed by White on how urban usage of floodplains was changing.[33] The TVA's efforts at encouraging flood plain regulation also

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[30] White reported on this conference in an article, "Action Program for the States: A New Attack on Flood Losses," *State Government* 32 (Spring 1959): 121-126.
[31] White, "Action Program for the States," 121.
[32] "Conclusions Adopted at the Conference on Flood Plain Regulation and Insurance," *State Government* 32 (Spring 1959): 126-127.
[33] Gilbert White et. al., *Changes in Urban Occupance of Flood Plains in the United States*, Research Paper No. 57. (Chicago: University of Chicago, Department of Geography, 1958).

reflected that organization's recognition of the continuing upward trajectory of flood damages, and in 1958 the TVA produced a report that aimed to facilitate national implementation of the floodplain regulation efforts that it had undertaken in its home territory.[34]

Following the legal precedent established in the Supreme Court cases on zoning of the 1920s, floodplain zoning ordinances would need to meet the 'reasonable' threshold in order to be legally defensible. This was a major incentive for the incorporation of probabilistic analysis in flood mapping, despite the high costs of implementation. "For the areal extent and elevation determinations of the land placed in the flood-plain to be 'reasonable,'" wrote Murphy, a long-serving engineer at the Seattle District of the Army Corps of Engineers who spent nine months working on it while on a Research and Study Fellowship grant funded by the Secretary of the Army, "they should be based on historical evidence of flooding, a computed frequency of floods, an engineering study of flood potential, an acceptable of flood protection afforded by other methods of regulation, and the degree of flood protection offered by engineering structures." These requirements, he held, "are best based on an engineering investigation."[35] This assessment may seem self-serving, or at least myopic, coming from an engineer. But while it did represent an overt effort to place a disciplinary boundary around the practice of floodplain determination, it was also, to an extent, simply reporting things as they were commonly perceived. Historical floods of record, used in many of the early examples of floodplain zoning, had a weakness not shared by probabilistic flood analysis: historic floods may be extremely large, in which case landowners may argue that they over-state flood risk because a similar flood is so unlikely to recur again, or relatively small, in which case probabilistic analysis would show that the flood of record could easily be exceeded. Murphy's survey of floodplain zoning methods, a collaboration

[34] Tennessee Valley Authority, *A Program for Reducing the National Flood Damage Potential* (Knoxville: Tennessee Valley Authority, 1958).
[35] Murphy, *Regulating Flood Plain Development*, 50.

that White embraced because he thought it could help legitimize his team's work with the Army Corps of Engineers, did not carry any official weight.[36] Nonetheless, his assessment of engineering surveys as the surest way of meeting the 'reasonable' threshold was nonetheless a position widely shared by cities then engaged in flood zoning decisions. While the historian Theodore Porter has argued that reliance on quantification is often indicative of weak professional standing within policy debates, in this case the need for engineering studies may be less a commentary on the low standing of zoning as a policy tool, and more a commentary on the high legal requirements of the 'reasonable' standard.[37]

The definition of floodplains in terms of the frequency of return periods of high waters makes particular sense for an application like insurance that is itself dependent on quantification. There are, however, other ways that floodplains can be defined—recall the way that Jefferson County, Wisconsin defined the high water mark based on soil and vegetation. In light of the slow pace of NFIP floodplain mapping after 1968, the geographer M. Gordon Wolman—an influential scientist who helped to shape the modern discipline of geomorphology—offered an analysis of some of the other options for floodplain determination not employed by the NFIP.[38] These ranged from determining inundation boundaries of previous floods, to analysis of topographic features, to examination of prevalent soils and vegetation. Thinking about floodplains ecologically might have made practical sense to Wolman, who was a strong advocate for

[36] On White's thinking, see Martin Reuss, *Water Resources People and Issues: Interview with Gilbert F. White* (Alexandria, Virginia: Office of History, U.S. Army Corps of Engineers, 1993).
[37] Theodore Porter, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (Princeton, New Jersey: Princeton University Press, 1995). Porter argues that the political culture of the United States, which is less deferential to expertise, has led to an increasing reliance on quantification as a public-facing justification for bureaucratic decisions. In contrast, in European countries like France that have a stronger tradition of trust in bureaucrats, quantification is used more heavily as a tool for aiding decisions in internal bureaucratic discussions.
[38] M. Gordon Wolman, "Evaluating Alternative Techniques of Floodplain Mapping," *Water Resources Research* 7, no. 6 (December 1971): 1383-1392.

interdisciplinary work in the university setting, but ecological concerns did not register as a major factor in the initial design of the NFIP or the probabilistic mapping methods it employed.

The language of the land use requirements instituted by the NFIP allowed for a range of stridence in local implementation, but included some specific requirements.[39] Namely, any land use plan that would meet the requirements of the NFIP needed to be based on probable exposure to flooding, and at a minimum, to regulate usage of the Special Flood Hazard Area (SFHA), a term used by the NFIP to refer to what is commonly called the 100-year floodplain. Land use on the 100-year floodplain would need to be "regulated" or "controlled," but program rules provided no exact definition of what these terms entailed, except that new construction or substantial improvements in the floodway itself were to be prohibited. Taken as a whole, these regulations were written so that they could be interpreted very strictly by an official committed to reduction of vulnerability—or much less strictly by an official less concerned about reducing exposure to flood hazards. This may have been with the intent of giving municipalities freedom to implement regulations as they saw fit, but it had the impact of diluting the floodplain management standards that the NFIP was mandated to implement. As detailed flood maps became available, it meant that municipalities had a choice about where to situate nature's limits in regard to acceptable flood risk. Though the 100-year floodplain, the standard set forth by NFIP requirements, is the one most towns and cities choose to use, those wishing to be more cautious about flood exposure may base their regulations on the so-called 500-year floodplain, which is less exposed to floods.

In practice, the 100-year floodplain (SFHA) is the most important boundary delineated by NFIP mapping. NFIP maps consider any land that has at least a one percent chance of being

[39] U. S. Department of Housing and Urban Development, Reprint from Federal Register, 34 F. R. 9553-60, June 18, 1969.

flooded in a year to be part of the SFHA, a zone that is also sometimes referred to in official NFIP usage as the 'base flood.' As we have seen in previous chapters, this terminology was not newly developed in the 1960s. As early as 1934, an Army engineer had published a paper specifically addressing methods of determining the hundred-year flood at any given observation station, and as discussed in the second chapter of this dissertation, he was not the first to think of floods in terms of recurrence intervals.[40] As originally legislated, the NFIP did not include a specific standard for the magnitude of flood upon which insurance should be based. Rather, the legislation called upon the Department of Housing and Urban Development to come up with a suitable standard, and to achieve this goal, HUD enlisted the aid of the Center for Urban Studies at the University of Chicago—Gilbert White's institution. The Center for Urban Studies held a seminar that addressed the question, and the consensus of the experts present at the seminar was that the hundred-year standard marked a reasonable compromise between prudence and development interests.[41] Developers did not want a limit that excluded too much land from future use, and less ethical ones did not need to worry about prudence when they would not be the long-term inhabitants of homes built on flood-prone lands.

Regulations and decisions based on probabilistic flood recurrence projections had looked different when used to consider flood control structures. Because of the certain catastrophic effects of structural failure, agencies involved in structural flood control typically based their design decisions on very large floods with low chances of occurring. The failure of a large dam, for example, would be extremely destructive, and it would not be wise to build a dam that would only have the structural integrity to withstand a maximum of a hundred-year flood. In structural

[40] C. R. Pettis, "Flood Probability Formula Modified to Simplify Application," *Engineering News-Record* 112 (Jan-Jun 1934) 804-805.
[41] Gilbert White et. al., *Report on Flood Plain Management Guidelines Seminar* (Chicago: Center for Urban Studies, The University of Chicago, 1969).

flood control, the TVA and the Army Corps of Engineers used the "maximum probable flood" and "standard project flood" respectively, both of which represent the worst conceivable flooding based on combinations of meteorological and hydrological conditions. As these and other agencies started to become involved with floodplain management during the 1950s and early 1960s, they shifted toward lesser floods as regulatory standards. The TVA and the Army Corps of Engineers settled on the 100-year flood by the early 1960s, while the Soil Conservation Service and the USGS used even smaller floods.[42] Different intended land uses need to observe different boundaries: a dam with catastrophic potential should be built to withstand extreme flooding, while a farmer may plant up to the five-year floodplain, reasoning that one lost crop is a reasonable tradeoff for four bumper crops in fertile, alluvial soil.

The process of mapping floodplains is labor-intensive from a technical perspective alone. The entity in charge of a specific mapping project—whether the Federal Insurance Administration in the NFIP's early years, FEMA in more recent years, or a third-party contractor hired to do the work, must gather historic flow information, hydrological information, topographical information, and data on infrastructure and land use. Using methods similar to those discussed in the second chapter for riverine floodplains, historical flood data is used to determine the magnitude of projected floods such as the hundred-year flood.[43] Technical considerations aside, the challenge is compounded by the need for flood maps to gain community acceptance. This challenge must be met on two levels. On one level, a community

[42] This paragraph draws on Michael Robinson, "History of the 1% Chance Flood Standard," in *Reducing Flood Losses: Is the 1% Chance (100-year) Flood Standard Sufficient?*, background reading for the Gilbert F. White National Flood Policy Forum (Association of State Floodplain Managers, 2004), 2-8.

[43] The initial guidelines used by the NFIP were found in Water Resources Council, Hydrology Committee, *A Uniform Technique for Determining Flood Flow Frequencies*, *Bulletin 15* (Washington, D.C.: Water Resources Council, 1967). This document has been updated three times, with the most recent being John F. England et. al., *Guidelines for Determining Flood Flow Frequency—Bulletin 17C*, U.S. Geological Survey Techniques and Methods, Book 4, Chapter B5 (Reston, Virginia: U.S. Geological Survey, 2018). This was the first update to the guidelines since 1981.

must formally adopt a flood risk map before it is officially issued. This is left up to local officials rather than being subjected to an open vote. Then, even after a map is officially adopted and issued, it may face continuing skepticism from community members who are upset about its determinations. At its heart, the map-making process is the process of making concrete judgments about the character of landscapes—and about where their limits lie. Mapping risk exposure formalizes risk assessments that tend to reduce the value of real estate in a floodplain. If a parcel of land is determined to be vulnerable to any sort of catastrophic natural hazard, it loses market value. In the case of floods, this happens in two ways. First and most simply, many property owners prefer to reduce their exposure to flood hazards and are thus less likely to purchase land that has been deemed to be in the SFHA. With a more immediate impact, property mapped into the SFHA is subject to higher insurance costs. In the U.S., property in the SFHA is subject to mandatory flood insurance purchase when backed by a federally regulated mortgage, as discussed below. Ask someone why they decided against buying a property in a SFHA, and their answer may well be "we were afraid that the flood insurance costs would be too much to manage," rather than "we were afraid of being flooded."

* * *

As we have seen, flood policy in the United States is generally reactive, and the first significant changes to the NFIP were in response to Hurricane Camille. Camille, one of the strongest hurricanes to ever make landfall in the United States, came ashore in coastal Mississippi on August 18, 1969, and did over one billion dollars in damage (1969 dollars, $6.8 billion in 2018 dollars), much of it from storm surge flooding. Camille's damage was most

severe in Mississippi and Louisiana, but it also brought major flooding to parts of Virginia. The first federal flood insurance had become available less than two months prior to Camille, but rather than highlighting the nation's prescience in creating a flood insurance program, Camille instead drew attention to the fact that almost none of its victims were covered by flood insurance. The only city in its extensive damage area that had flood insurance available was Metairie. Pass Christian, Mississippi—a city that suffered severe damage from Camille—had submitted its application for participation in the NFIP the month before the storm hit, but the necessary actuarial studies were not completed in time for it to join before Camille's devastation. As of July 31 of that year, in addition to these two cities, twenty-four cities or jurisdictions had rate-making studies under way, fifteen other studies were soon to be started, and over eighty jurisdictions had requested participation but their studies were not yet under way—and in all cases were still far away from being able to complete the procedures needed to offer insurance.[44]

In order to speed the adoption of flood insurance, in 1969 Congress authorized the NFIP to create an emergency program in which communities that had not yet been mapped and rated, but were identified as flood-prone, could participate in the program prior to the completion of their rate studies. Communities in the so-called emergency program were still required to establish land-use regulations to become eligible for NFIP participation. The emergency program was initially authorized to operate until the end of 1971, but still exists as of 2018 and has become an accepted long-term component of the NFIP. The 1969 bill also extended coverage to damage caused by landslides. The sponsor of the amendment authorizing landslide coverage, Democrat Thomas Rees of California, represented Los Angeles, where mudslides were fresh in

[44] "Insurance Aid is Unavailable," *The Washington Post and Times Herald,* August 21, 1969, A6; U.S. Congress, House, Committee on Banking and Currency, *Housing and Urban Development Legislation, 1969, Hearings Before the Subcommittee on Housing of the Committee on Banking and Currency, House of Representatives, Ninety-First Congress, First Session, July 17-30, 1969*, 91st Cong., 1st sess., July 17, 18, 21-24. 28-30, 1969.

the city's memory from recent events. Rainfall-caused mudslides have been a longstanding challenge for Los Angeles, but some of the worst in its history occurred in January and February of 1969. These changes were included in the Housing and Urban Development Act of 1969, and are sometimes referred to as the St. Germain Amendment to the NFIP.[45]

With the implementation of the emergency program, participation in the National Flood Insurance Program grew much more quickly than in the program's initial year. But in the short term, this did little to remedy the problem of participation. The losses covered by flood insurance in 1972 were again but a small fraction of all flood-related damages. That year's most noteworthy floods occurred in the wake of Hurricane Agnes, a storm whose effects were felt across broad swaths of the eastern United States but most heavily in Pennsylvania. One of the nation's deadliest inland flooding episodes also occurred that year, in Rapid City, South Dakota.

Congressional hearings for the proposed Flood Disaster Protection Act of 1973 revealed a new level of concern amongst both politicians and constituents. This can be attributed to two factors. First, since the program had by that time been operational for a few years, testimony addressed not just the proposed amendments, but also general concerns about the program's ongoing efficacy. Second, the amendments proposed in 1973 hoped to give the program teeth that it lacked in its original incarnation and slapdash rules meant to increase community participation, fully linking federally regulated mortgage availability to participation in the NFIP. Senate hearings on the proposed act provide a wealth of insights into how the program was perceived five years into its life. Outright opposition to the program was not a common theme of the hearings. But the proposed changes that would have compelled communities to participate in the program or lose access to federally regulated mortgages (in other words, most mortgages) for

[45] "Flood Measure Broadened to Include Slides, Slippage," *Los Angeles Times* September 20, 1969, 1; U.S. Public Law 152. 91st Cong., 1st sess., December 24, 1969; Dan Anderson, "The National Flood Insurance Program: Problems and Potential," *Journal of Risk and Insurance* 41, no. 4 (Dec. 1974): 579-599.

properties designated at risk of flooding worried a range of congressmen and local officials. In stating their concerns, they emphasized the lack of local control over how flood risk determinations were made. "The legislation would give unrestricted power to the Secretary of Housing and Urban Development to make a fundamental judgment concerning local building codes," stated Georgia Democrat Ronald Ginn. "He would do this by setting the specific elevation below which no construction can take place." The designations of flood risk that had taken place since the program's inception, Ginn said, were "made in a capricious manner and utterly without proper consideration of sound hydrological engineering."[46] In this framing, the concern was less that experts would overrule local decision making, and more that decisions about flood zoning would be left to unaccountable bureaucrats who did not even possess relevant expertise. Ginn's call for "sound hydrological engineering" was likely less reflective of a concern about scientific methods, and more reflective of a concern about economic issues, but given its popular reputation of detached objectivity, science is often used to frame economic disputes.[47] Ginn joined eight other congressmen, all but one of them from the Southeast and all representing coastal states, in a letter calling for local communities to have a greater voice in flood risk determination.[48]

While Ginn and his allies did not get what they sought in terms of local control, their concerns about coastal flood hazard determination were not altogether unfounded. In his

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[46] U.S. Congress, Senate, Committee on Banking, Housing, and Urban Affairs, *Flood Disaster Protection Act of 1973: Hearings Before the Subcommittee on Housing and Urban Affairs of the Committee on Banking, Housing and Urban Affairs, United States Senate, Ninety-Third Congress, First Session, on S. 1495 and H.R. 8449, to Expand the National Flood Insurance Program by Substantially Increasing Limits of Coverage and Total Amount of Insurance Authorized to Be Outstanding and by Requiring Known Flood-Prone Communities to Participate in the Program, and for Other Purposes, October 31, 1973*, 93rd Cong., 1st sess., October 31, 1973, 45.

[47] See Thomas McGarity, "Our Science is Sound Science and Their Science is Junk Science: Science-Based Strategies for Avoiding Accountability and Responsibility for Risk-Producing Products and Activities," *University of Kansas Law Review* 52 (2004): 897-937. There is a large literature on the idea that the perception of science as objective is much more a perception than a reality. For an introductory text, see Harry Collins and Trevor Pinch, *The Golem: What Everyone Should Know About Science* (New York: Cambridge University Press, 1994).

[48] Ibid., 46.

congressional testimony, Gilbert White nodded to the decades of research that had been performed on riverine flood magnitudes over several decades, while acknowledging the much smaller body of knowledge on coastal flood recurrence intervals. "(T)his method is less well tested, and less well formulated, and therefore subject to more scientific debate with respect to the calculation of storm surge flooding generated by hurricane wind and water on our coasts," White stated.[49] It was little surprise, then, that much of the concern over flood risk assessments came from representatives of coastal regions.

In an exchange with Louisiana Senator Bennett Johnston, James Wright, a young employee of the Minnesota Department of Natural Resources who would go on to a long career in floodplain management, provided an expert's take on flood hazard determination. Wright argued that while state governments have important roles to play, "the local citizen should not be involved in technical matters which he does not understand, but which he might have an opinion on."[50] Wright suggested that if individual citizens wished to dispute flood risk determinations, they should be able to do so via the services of hired engineers. This is indeed the route down which the NFIP has traveled—a route that imposes a financial threshold for disputing flood hazard determinations. In order to challenge NFIP flood risk assessments, property owners must submit a Letter of Map Change request, which is typically prepared with the assistance of a surveyor or engineer. While the costs of these professional services make them difficult for people with low incomes to afford, wealthier property owners have less trouble hiring them. A successful Letter of Map Change request usually results in the concerned property being removed from the Special Flood Hazard Area, thereby removing the purchase requirement for flood insurance created by the Flood Disaster Protection Act of 1973, and reducing insurance

[49] Ibid., 100.
[50] Ibid., 123.

premiums for people opting to retain flood insurance. Once submitted for federal review, Letter of Map Change requests are usually successful, but this is because consulting engineers can usually tell if a request is likely to succeed before submitting it. Little information is readily available about the frequency of consultations with engineers in which the engineer determines an appeal is unlikely to be successful.[51] The irony of Wright suggesting that citizens should dispute flood maps by essentially hiring their own experts is that ends up pitting expert versus expert—thereby potentially reducing the credibility of the government-backed expertise behind map creation.[52]

In the 1973 hearings, the hundred-year standard came in for particular questioning. Witnesses questioned both the methods used to determine flood zones and whether the hundred-year standard was the best one for the program to use. In questioning how flood levels were determined, witnesses often revealed their discomfort with modeled, rather than historical, assessments of flood risk.[53] A delegation from Savannah, Georgia, noted that while their records for the previous hundred years revealed a maximum flood elevation of 8.1 feet, their city's hundred-year flood level was pegged at 13.5 feet.[54] A similar discrepancy was noted for New

[51] For more on the Letter of Map Change process, see Miranda Leitsinger, "For Average Joes, Fighting FEMA Flood Maps Isn't Easy or Cheap," *NBCNews.com* February 20, 2014, https://www.nbcnews.com/news/us-news/average-joes-fighting-fema-flood-maps-isnt-easy-or-cheap-n23871. Last accessed April 3, 2018.
[52] On this dynamic in the area of nuclear power, see Balogh, *Chain Reaction*.
[53] Pushback against modeled results or statistical correlations is a recurrent theme in studies of how non-experts relate to these types of analysis. Two noteworthy examples in recent history are questioning of modeled climate scenarios and pushback against statistical correlation between smoking and cancer. On the former, On the latter, see Paul Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge, Massachusetts: MIT Press, 2010). On connections between the former and the latter, see Naomi Oreskes and Erik Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues From Tobacco Smoke to Global Warming* (New York: Bloomsbury, 2010). On the latter, see Allan Brandt, *The Cigarette Century: The Rise, Fall, and Deadly Persistence of the Product that Defined America* (New York: Basic Books, 2007); Richard Kluger, *Ashes to Ashes: America's Hundred-Year Cigarette War, the Public Health, and the Unabashed Triumph of Philip Morris* (New York: Alfred A. Knopf, 1996); and Robert Proctor, *Cancer Wars: How Politics Shapes What We Know & Don't Know About Cancer* (New York: Basic Books, 1995).
[54] U.S. Congress, Senate, Committee on Banking, Housing, and Urban Affairs, *Flood Disaster Protection Act of 1973*, 52.

York City.[55] While there may have been legitimate concerns about how flood levels were determined in these locations, the numbers themselves do not necessarily mean that anything was amiss. Savannah may have simply been lucky, as the 13.5 foot level only had a small percentage of occurring each year according to calculations. On the Atlantic coast, Savannah is exposed to hurricanes, and the 13.5-foot level may have been based on the possibility of a stronger hurricane than Savannah had seen in the past hundred years.

Savannah mayor John Rousakis, in a statement made on behalf of the National League of Cities and the United States Conference of Mayors, said that the 100-year standard "poses no problem if the Secretary approves a contour established on the basis of adequate historical data. However, if the contour is established on the basis of unsupported theoretical data, the results can be disastrous."[56] As the vice president of the National Association of Home Builders put it, "(e)very section of the country that might be susceptible to flooding has not, in fact, experienced the type of flood projected by the scientists on their computers."[57] For Rousakis, the potential disaster was an economic one: flood risk assessments would limit economic development, or burden existing property owners. Better to be under-prepared for floods, in his book, with greater exposure to hazard at an unspecified time in the future, than to potentially be over-prepared with extra costs imposed in the present.

Though formulas for projecting flood recurrences had been under development for half a century by this time, and employed in the construction of public works such as dams and levees, their application to flood insurance, and its impending purchase requirement, was indeed something new. In the past, property owners were left to their own judgment to decide what level of flood risk they were willing to expose themselves to—a status that became more problematic

[55] Ibid., 69.
[56] Ibid., 59.
[57] Ibid., 78.

as suburban developments popped up in cheap, flat floodplains. At the same time, the US population was not only increasingly mobile, but migrating away from occupations such as agriculture that fostered an intimate knowledge of the land and toward office jobs for which understanding landscapes had little everyday relevance. With the implementation of the insurance purchase requirement, people would still be left to their own judgment about where to build or buy, but would henceforth have to pay for the decision to build or buy on flood-prone terrain. And, the determination of flood-prone terrain would not be based only on historic observations, but on models of what might be expected.

Questions about floodplain determination aside, congressional witnesses were also not unanimous in the belief that the hundred-year level was the proper magnitude of event to organize the program around. Hart, speaking for the National Association of Homebuilders, argued for a 50-year standard, on the basis that "it more closely coincides with the life expectancy of buildings than does the 100-year standard."[58] He claimed that the cost of raising construction to the 100-year level "can pose a severe cost limitation on construction in many areas and thus seriously impede growth and development in many communities."[59] On the other end of the spectrum, Jon Kusler, who was then a resource planning consultant and who would go on to co-found the Association of State Floodplain Managers, not only supported the hundred-year standard but suggested that an even higher standard might be warranted. This was due in large part to concerns over climatic variability. "(I)n some areas of the country we have been suffering calculated 100-year events on a rather regular basis," Kusler said. "We have had three in the upper Mississippi area since 1965, and the feeling is that perhaps due to climatic changes, perhaps, or cycles, or for some other [reason] these actually underestimate the long-term

[58] Ibid., 78.
[59] Ibid., 78.

flooding."[60] In the end, however, the hundred-year standard remained in place despite the displeasure of real estate development interests and the warnings of long-term planners. One thing that no doubt helped resolve the issue was that several state-level officials highlighted that their states had already embraced the hundred-year standard and that abandoning it would lead to unnecessary difficulty. As articulated by Secretary of the Army Howard "Bo" Callaway, the hundred-year standard was found to be "neither too slight for realistic adjustment to the hazard nor too restrictive to property rights."[61] Speaking for the position of the Army Corps of Engineers, Callaway's input carried weight but was not authoritative. In the end, though, he spoke for the majority position.

Ultimately, the Flood Disaster Protection Act of 1973 passed into law as Public Law 93-234, placing the final building blocks on the foundation of a program that remains recognizable if not unchanged in the second decade of the twenty-first century. It included a means for the public to appeal flood risk assessments, the aforementioned Letter of Map Change, along with the provisions that compelled NFIP participation, and also raised the ceilings for available coverage. It also revealed a disconnect between the coastal and the inland components of the program. Even though coastal storms providing the final push for program creation, it was built on a body of knowledge oriented toward inland flooding. Not surprisingly, its inland constituents were more fully on board than those living on the coasts, particularly in the Southeast. Most significantly where the immediate costs of the program were concerned, by all but mandating program participation for communities with flood risk if they were to receive federally insured mortgages, the 1973 act exponentially expanded the need for mapping manpower, expertise, and

[60] Ibid., 117.
[61] Ibid., 47.

funding, not to mention an expanded bureaucracy at the state and city levels for other aspects of administration.

By the 1970s, the use of federal housing policy to promote goals beyond simply putting people into houses was nothing new. The practice of federal backing of mortgages, critical to the post-1973 operation of the NFIP, is a case in point. The Federal Housing Administration (FHA) was a New Deal agency created by the passage of the National Housing Act in 1934. It provided federally backed insurance for lenders offering mortgages to homebuyers, with longer terms and lower down payments than had typically been available until that time. The FHA also imposed home construction standards for properties that would be purchased using FHA-backed mortgages, standards that were ultimately adopted widely in the homebuilding industry. Thus, there was already significant precedent for tying FHA-backed mortgages to floodplain regulations. On the whole, the FHA mortgage program had the effect of putting home ownership within reach of millions of new customers, and it was a crucial component of the postwar housing boom that suburbanized the United States—in the process, dramatically increasing the amount of development vulnerable to floods. Nevertheless, for its architects within the Roosevelt administration, expanded home ownership was not the immediate goal. Rather, they sought to address unemployment by stimulating the construction industry, one of the industries hardest hit by the Great Depression. The transformation of the home mortgage, construction, and real estate industries into one of the strongest interest groups in American politics was therefore an unintended long-term consequence of the federal embrace of home mortgage insurance.[62]

[62] On FHA mortgages, see Kenneth Jackson, *Crabgrass Frontier: The Suburbanization of the United States* (New York: Oxford University Press, 1985). The FHA mortgage program has also become notorious for its historic discriminatory treatment of potential borrowers from racial minorities and neighborhoods with significant populations of racial minorities, treatment that was just coming to an end around the time of the establishment of the NFIP.

In the postwar United States, few regions experienced more explosive growth than the hurricane-prone coastal South. This was certainly connected to the end of the Jim Crow era, which had set the South apart from other parts of the country, but was connected to a much broader demographic and economic shift toward the "Sunbelt."[63] As emphasized by historian Andrew Kahrl, the explosion of the Sunbelt cannot be solely attributed to cultural factors. Its growth was also the direct result of a large infusion of federal spending, from military spending to transportation and infrastructure projects. The coasts in particular benefited from federal largesse that went to projects such as beach enhancements and bridge construction.[64] As such, the overt goal of the NFIP to put a damper on development beyond the limits of mapped floodplain boundaries was in clear conflict with the federal goal to spur development that was manifested in other forms of governmental spending.

Though the country's demographics were shifting rapidly, the internal structure of the NFIP did not evolve as quickly after the passage of the Flood Disaster Protection Act of 1973. The 1970s and 1980s were marked by a rapid increase in communities participating in the program, and years of mapping work to transition those communities from the emergency program into the regular program. Outside of the NFIP itself, but driven by its land management requirements, floodplain management underwent professionalization that included an umbrella organization, the Association of State Floodplain Managers, subsidiary floodplain management organizations in most states, and a title, Certified Floodplain Manager, granted to those who passed a qualifying exam. Many larger cities have come to retain one or more full-time staff

[63] On Jim Crow and Southern growth, see Matthew Lassiter, *The Silent Majority: Suburban Politics in the Sunbelt South* (Princeton, New Jersey: Princeton University Press, 2006).
[64] Andrew Kahrl, "The Sunbelt's Sandy Foundation: Coastal Development and the Making of the Modern South," *Southern Cultures* 20, no. 3 (Fall 2014): 24-42. See also Bruce Schulman, *From Cotton Belt to Sunbelt: Federal Policy, Economic Development, and the Transformation of the South, 1938-1980* (Durham, NC: Duke University Press, 1994); and Orrin H. Pilkey, *The Corps and the Shore* (Washington, DC: Island Press, 1996).

members dedicated to flood insurance and floodplain management, usually a Certified Floodplain Manager, while smaller cities and towns more frequently delegate this responsibility to employees who also bear other responsibilities. [65]

At the federal level, responsibility for administering the NFIP, including its mapping needs, was passed to the Federal Emergency Management Agency after that agency's creation in 1979. The creation of FEMA can be traced to a shift in U.S. disaster preparedness priorities. With the Cold War as an impetus, disaster preparedness in the post-World War II era had come to focus heavily on civil defense, particularly preparedness for nuclear attack. However, by the mid-1970s, state-level officials were growing impatient with this emphasis, desiring a more diverse federal approach to disaster preparedness to complement their own needs. This entailed a range of disasters—not just attacks by hostile powers, but calamities such as floods, earthquakes, chemical spills, and malfunctions in civilian nuclear power installations. In early 1978, the National Governors Association, a group intended to speak collectively for the governors of U.S. states, issued a call for a federal disaster management agency, and in June of that year, President Jimmy Carter, the former governor of Georgia, issued his Reorganization Plan No. 3 of 1978, which created FEMA, effective the next year. FEMA brought a wide range of government agencies, which were formerly administered through many different departments, under a single umbrella of disaster preparedness and management. In the small picture, the move to FEMA did not mean terribly much for the NFIP, because whether operated by HUD or FEMA, it still ran according to the same guidelines established by Congress. But in the big picture, the creation of

[65] For further reading on the Association of State Floodplain Mangers, see James Wright, *The Nation's Responses to Flood Disasters: A Historical Account* (Madison, Wisconsin: Association of State Floodplain Managers, 2000).

FEMA signaled a commitment to preparation for a wider range of catastrophes by the federal government.[66]

By the early 1990s, the NFIP's Congressional overseers, in the form of the House Committee on Banking, Finance, and Urban Affairs, had developed a number of concerns about the NFIP. One was the program's descent into debt after the Midwest floods of 1993, with the recognition that major storm activity could bring about substantially greater indebtedness. The NFIP is authorized to borrow from the federal treasury when necessary, with the expectation that it will repay its debts in years with low payouts. The committee also noted that the mandatory flood insurance purchase requirements instituted in 1973 were frequently flouted by lending institutions, which it linked to the NFIP's increasing debt. Finally, it observed that the program had not been serious about taking additional steps to incentivize reductions in flood hazard exposure, beyond linking insurance rates to risk.[67] While there was a lot of truth to this final observation, change was under way. In 1990, the program took a significant shift toward floodplain management via the Community Rating System (CRS). In short, the CRS provides participating communities with discounts on their flood insurance premiums that are tied to additional flood loss prevention measures. The CRS was the most important component of the National Flood Insurance Reform Act of 1994, which was passed into law as Title V of the Riegle Community Development and Regulatory Improvement Act of 1994.[68]

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[66] This paragraph is informed by Knowles, *The Disaster Experts*. Knowles organizes U.S. disaster history into three eras: the Conflagration Era (1860s-1940s), when fire was the most omnipresent hazard, the Civil Defense Era (1940s-1980s), when external threats such as Soviet missiles were seen as the pre-eminent threat, and the All-Hazards Era (1960s-present), when mitigation as a means of avoidance for a wider range of hazards received a greater focus. Knowles sees the creation of FEMA as a signifier of the All-Hazards Era. He also sees the NFIP as one of the earlier indicators of this era.

[67] U.S. Congress, House, Committee on Banking, Finance, and Urban Affairs, *Report on National Flood Insurance Reform Act of 1994*. 103rd Cong., 2d sess. H. Rep. 103-414. See especially pages 24-27.

[68] U.S. Public Law 325. 103rd Cong., 2d sess., September 23, 1994. Other titles of this law dealt with consumer protection, small business issues, paperwork reduction, and money laundering.

Prior to 1990, the CRS had been in development for several years. Discussion of such a system dated back to at least 1983, and in 1987, Federal Insurance Administrator Harold Duryee created a community rating task force that established three goals for what a CRS would accomplish: encourage flood mitigation activities beyond the requirements of the NFIP, improve the accuracy of insurance ratings, and promote flood insurance awareness. The CRS, even in its early days, was envisioned as a voluntary program, and has remained so through 2018—with reduced insurance rates providing sufficient incentive for strong participation. Though written into law and given a greater sense of permanence in 1994, the CRS was first put into action in late 1990.[69]

Implementation of the CRS was relatively uncontroversial. Its initial enactment was not accomplished legislatively at all, as NFIP administrators considered it to be within the authority to manage floodplain development granted by the legislation that had initially created the NFIP. By all appearances, it was a win-win proposal: participating communities benefited from lower insurance rates and a reduced potential for flood damages, and the flood insurance program—and thus, taxpayers at large—benefited from reduced claims in the wake of floods. When working as expected, the reduced insurance rates paid for themselves in the form of lower claim payouts. Organizations from across the spectrum of flood-related interests weighed in favorably on the CRS in a Senate subcommittee hearing, from housing lobby groups to environmental groups to financial organizations.[70] One congressman from Nebraska raised concerns about the manpower needed to enact the measures leading to discounted insurance rates, fearing that small towns and

[69] Testimony of Harold Duryee, found in U.S. Congress, House, Committee on Banking, Finance, and Urban Affairs, *Community Rating System: Hearing Before the Subcommittee on Policy Research and Insurance of the Committee on Banking, Finance, and Urban Affairs, House of Representatives, One Hundred First Congress, Second Session, June 6, 1990*. 101st Cong., 2d sess., June 6, 1990, pages 5-7.
[70] U.S. Congress, Senate, Committee on Banking, Housing, and Urban Affairs, *National Flood Insurance Reform Act of 1993—S. 1405: Hearings Before the Subcommittee on Housing and Urban Affairs of the Committee on Banking, Housing, and Urban Affairs, United States Senate, One Hundred Third Congress, First Session, on S. 1405, September 14 and 15, 1993*, 103rd Cong., 1st sess., September 14-15, 1993.

cities would not have the resources to take advantage of the CRS in the same way that larger cities could.[71] Aside from him, perhaps the most notable voice of caution was none other than Gilbert White, well into his 80s at the time but still professionally active, who suggested that lawmakers should wait for detailed information on how effective the CRS had been in early-adopting communities before formalizing its legislative commitment to the incentive program.[72]

The CRS was inspired by the system used by fire insurers to rate communities for their fire risk mitigation efforts.[73] This was a break from previous precedent. Prior to its implementation, all communities paid for insurance at the same rates, even though some were much more active than others in working to mitigate their flood hazards. From one way of looking at things, the existing status quo had a compelling logic, since the regulatory floodplain denotes the same level of risk, no matter whether it exists behind a levee or along a naturally flowing stream. A community with poor floodplain management may have more properties within the floodplain, but should each of those properties still be insured at the same rates as a community with far fewer properties in the floodplain?

Perhaps not. There are many different philosophies that can guide insurance. On one end of the spectrum, the insurer takes no active interest in hazard mitigation, but simply attempts to evaluate risks and price insurance policies accordingly. On the other end of the spectrum, insurers may actively seek to reduce their exposure to the hazards being insured against. In the case of federally supported flood insurance, its early intellectual theorists mostly viewed flood insurance as an incentive meant to reduce flood-prone development. And, to some extent, it always functioned in such a manner, since a jurisdiction's ability to join the NFIP was dependent

[71] U.S. Congress, House, Committee on Banking, Finance, and Urban Affairs, *Community Rating System,* 11.
[72] U.S. Congress, Senate, Committee on Banking, Housing, and Urban Affairs, *National Flood Insurance Reform Act of 1993,* 299.
[73] On the history of fire risk mitigation by insurers, see Mark Tebeau, *Eating Smoke: Fire in Urban America, 1800-1950* (Baltimore: The Johns Hopkins University Press, 2003).

upon its adopting floodplain zoning regulations. But until the advent of the CRS, there was no nuance to the incentive. Either a community met the NFIP's requirements, or it did not, with no recognition of the differences between communities that barely met the minimum requirements and those that went above and beyond them. Further, the CRS took into account other hazard reduction options that were not accounted for by the original program.

The CRS originally included eighteen activities that could provide credit toward reduced flood insurance premiums, grouped into four classifications: public information, mapping and regulations, flood damage reduction, and flood preparedness. Public information activities included maintaining elevation certificates (which describe a building's elevation relative to the one percent flood level) for all buildings in the SFHA; making publicly available the floodplain status of properties in the community; creating outreach projects to increase community awareness of floods, flood insurance, and/or flood protection methods; requiring realtors to tell prospective property owners about flood risk; creating and maintaining a collection of resources on flood protection, insurance, or floodplain management at a local library; and creating an office that offers technical advice to property owners who want to address flood risk. Mapping and regulatory activities included creating detailed floodplain maps for areas unmapped or only roughly mapped by the NFIP; preserving undeveloped flood-prone land as publicly owned or controlled open space; implementing stricter floodplain building regulations than those required by the NFIP; updating floodplain maps; and regulating developments to limit the effect of their storm water runoff on stream levels. Flood damage reduction activities included projects to address properties with repeated flooding issues; removing buildings from the SFHA via either demolition or relocation; retrofitting buildings for better flood preparedness; and ongoing maintenance of the channels and retention ponds that provide storm water drainage. Flood

preparedness activities included flood warning systems; maintenance of levees that offered less than 100-year protection in order to recognize that even these smaller levees offer some flood protection; and implementation of a statewide dam safety program (in which case, credit is awarded to all CRS-participating jurisdictions in the state).[74] On the whole, the thrust of the CRS was both to make affected residents more aware of the floodplain boundary, and to affect the ways things were done to reduce vulnerability within that boundary.

Despite some changes to the specific activities that garner CRS credit, the basic layout of the program has remained consistent. As of 2012, 1,211 communities participate in the CRS, only a small percentage of the more than 21,000 NFIP communities. However, these communities account for over two thirds of all NFIP flood insurance policies. As the Nebraska congressman had suspected would happen more than two decades earlier, the majority of cities participating in the CRS are mid-size or larger. In Nebraska, for example, only six cities participate as of 2018, including the state's two largest, Omaha and Lincoln, two others among the state's largest eleven cities, and only two with populations smaller than 18,000.[75] As one would expect, the incentives for devoting resources to CRS participation are much higher in communities with higher numbers of flood-prone properties. Participating CRS communities receive an integer score between 10 and 1, with lower score numbers representing higher achievement of the CRS objectives. Each score increment lower than 10 leads to a five percent reduction in flood insurance premiums for properties in the SFHA, up to a maximum forty-five percent reduction for communities scoring a 1.

[74] National Flood Insurance Program, *Community Rating System: Coordinator's Manual*. Washington, D.C.: FEMA, 1990.
[75] "Community Rating System (CRS) Communities and their Classes – October 2016," FEMA, https://www.fema.gov/media-library-data/1476294162726-4795edc7fe5cde0c997bc4389d1265bd/CRS_List_of_Communites_10_01_2016.pdf. Last accessed April 3, 2018.

While the Community Rating System helped nudge the NFIP in the direction of floodplain management, the program faced another problem that grew with each passing year: aging maps. The NFIP has always included provisions for map revisions, and by statute, this is supposed to happen every five years. However, because of challenges including logistical demands, funding shortages, and community resistance, the five-year threshold is often missed.[76] Re-mapping is necessary because flood risks are not unchanging. Risk itself may change because of a range of factors, including land use changes, precipitation changes, and changes in structural flood protections. Risk assessments should also theoretically change all the time because they are built in part upon historical observations, and the corpus of observations is always growing, as discussed further in the upcoming chapters. The infrequency of re-evaluations can lend a heightened sense of permanence to mapped flood zones. Individual property owners build equity in houses as a form of savings, and land developers make building decisions, based on flood zone maps. In reaction to a 1985 re-mapping event in the San Diego area, Oceanside city engineer Bud Herrell gave voice to the disastrous nature of the re-mapping his city was undergoing from the perspective of property valuation and investment. "How do I explain it to them?," he asked, rhetorically. "How do I tell all those people who built out there in the valley that they are three feet under water?"[77] As the reporter who was covering the incident noted, "Herrell isn't as concerned about the advent of FEMA's 100-year flood as he is about the financial hardships the federal agency's flood insurance program could place on local economic development."[78] In other words, economic development could be hampered by the shifting

[76] *Age of Flood Maps in Selected Counties That Account for Most of the Expected Claims in the National Flood Insurance Program: Supplemental Material for The National Flood Insurance Program: Financial Soundness and Affordability* (Washington, D.C.: Congressional Budget Office, 2017).
[77] Nancy Ray, "Cities, Developers Upset Over Tough New Flood Maps," *Los Angeles Times* July 14, 1985, SD A1.
[78] Ibid.

boundaries of the natural world, and for this local official, the concerns about that knowledge outweighed even a potential flood.

New flood maps are certainly not the only way that flooding can affect property values. Physical factors also play roles in diminished property values. A house left moldy after being inundated by floodwaters would clearly have less value than one without such damage. But flood risk maps carry with them losses in values separate from the natural disasters themselves. That moldy, inundated house might regain its prior value after flood insurance payments enable its owner to clean and repair it, or at least destroy and rebuild it. But even then, it may lose value once again if it is mapped into a higher-risk flood zone. For property owners, the mapping process itself may become the new site of the perceived disaster.

Because flood frequency projections represent human interpretations of the natural world, remapping episodes frequently involve disputes over accuracy. Even though FEMA has attempted to standardize the method for floodplain determination, there are still variables that can lead to different flood projections. A remapping event in Fort Collins, Colorado is instructive. In 1997, Fort Collins experienced the heaviest rainfall in its recorded history, causing extensive flooding. The worst of the flooding happened in areas that were not mapped into the 500-year floodplain, let alone the 100-year floodplain. As a result of this flood, the city undertook a project to recalculate its maximum rainfall estimates, which would then be used to update its flood maps. But the task force assigned to re-assess rainfall levels, despite being populated by well-qualified experts, could not reach a consensus. Ultimately, it produced three different estimates based on differing data sources and assumptions. In the end, the city went with the lowest estimate, which still expanded the regulatory floodplain from its previous state, but by less than either of the other two options. Notably, some of the main support for the higher

estimates came from residents whose properties had been damaged by the 1997 floods. For those with first-hand experience, flooding itself loomed large in their consciousness. But for those without that experience, the possibility of "disastrous" over-regulation took precedence.[79]

The preceding paragraphs have demonstrated the contentiousness of remapping flood risk. It is not uncommon for political pressure to be applied to the re-mapping process. However, the lifespan of the NFIP has revealed another way that the flood mapping process can benefit the interests of development and economic growth, one that involves much less deliberate action. With a strapped budget for mapping and re-mapping projects, FEMA has tended to prioritize mapping areas that are already developed. The problematic gap that this can leave is undeveloped yet flood-prone areas. When these areas are not mapped until after they have been developed, this can lead to a handful of issues, most notably newly built houses that are eligible for subsidized insurance (since they were built before their lots were mapped into the regulatory floodplain) and contentious mapping processes when the mapping does happen.[80]

By the turn of the millennium, the NFIP had been the driving force behind maps offering floodplain boundaries for large swathes of the United States. Yet these boundaries did not mean the same thing for everyone. For property owners who felt as if the boundaries were arbitrarily imposed upon them, they could feel nothing short of disastrous. For experts and bureaucrats on board with the vision of floodplain management, the boundaries offered a way to set prudent limits on land use in flood-prone areas via floodplain zoning. And the meaningfulness of these boundaries was reduced by the flexibility that the NFIP offered in their implementation. On the

[79] For further reading on Fort Collins, see Mary Downton et. al., "Interactions Between Scientific Uncertainty and Flood Management Decisions: Two Case Studies in Colorado," *Environmental Hazards* 6 (2005): 134-146.
[80] On the issue of mapping following development, see Sarah Pralle, "Drawing Lines: FEMA and the Politics of Mapping Flood Zones" (paper presented at the annual conference of the American Political Science Association, August 31, 2017). Available online at https://www.maxwell.syr.edu/uploadedFiles/faculty/psc/Pralle_Drawing%20Lines_APSA2017.pdf. Last accessed April 3, 2018.

whole, through the turn of the millennium, it remained a credible position to believe that the NFIP was having the effect of ensuring that these boundaries acted as limits. But upcoming events would provide a strong challenge to this position.

Chapter Five

From Katrina to Harvey: The NFIP Submerged, 2005-2018

Hurricane Katrina's blast to the Gulf Coast in late summer 2005 represented a turning point in many ways. The George W. Bush administration, riding high after being re-elected in 2004, saw its popularity disintegrate in the shadow of a bungled hurricane response, among other factors. For New Orleans neighborhoods such as the Lower Ninth Ward, Katrina wrought destruction that remains widespread more than a decade later. For many lay people around the country, the back-to-back blows of Katrina and Rita suggested that climate change might be hitting home in a tangible way. And while connecting any particular event to climate change is a difficult business, the flood losses of 2005 destabilized the NFIP as never before, smashing prior assumptions about expected losses and generating the wave that would start to wash the program toward a new financial reality. More than a decade later, Katrina remains etched in the American consciousness, but it was only the first of several blows that would batter the NFIP in the early twenty-first century. Though federal flood insurance was rooted in the study of severe riverine floods, it was breathed into life by Hurricane Betsy, and its connection to the coasts would become ever more evident during the 2010s, as Superstorm Sandy (2012), and then Hurricane Harvey (2017) further destabilized it. As the program's debts mounted, legislators and lobbying groups intensified efforts to shape the program's future. For a brief moment, it appeared that the program might evolve into something closer to the vision of floodplain management that emphasized the limiting of floodplain usage via insurance rates tied much more closely to flood risk exposure. But as soon as that evolution started to become evident to the broader public, a mighty pushback nipped it in the bud. As of early 2018, the program remains in limbo, with its

debts continuing to mount and the specter of climate change already visible on the horizon. Events that have transpired in the years since Katrina, but especially since Superstorm Sandy, strongly suggest that the NFIP is drifting ever farther from its moorings in floodplain management and becoming a governmental program that explicitly subsidizes the persistence of existing development patterns at a macro level, even as it still fosters an understanding of the natural world's boundaries in specific situations.

Climate change makes sporadic appearances in this chapter, but even when it is not being discussed in the text, it is not far beneath the surface. The time between Katrina and the present may be thought of as a period of transition. The NFIP was not wholly unaffected by climate change, but neither could its post-2005 challenges be pinned exclusively on climate shifts. While each of the storms that helped to shape the NFIP's trajectory can be linked in some way to a changing climate, the major losses caused by these storms can also be tied in part to the demographic shifts discussed in previous chapters, to political failings, and to land-use changes that affected specific regions.

The system that would become Katrina coalesced on August 23, 2005, above the southeastern Bahamas, when an extant tropical depression combined with other atmospheric troughs. By the next day, it had strengthened into a tropical storm, christened Katrina. One day later, Katrina had crossed the 74 m.p.h. wind speed threshold to be considered a hurricane, as it arrived on Florida's southeastern coast. Making landfall directly over the Miami metropolitan area, Katrina was not strong enough to cause catastrophic damage, and it weakened back to tropical storm status as it moved southwest across the Everglades, where storm surge nonetheless caused significant damage to national park infrastructure. Exiting Florida, Katrina entered the Gulf of Mexico, rapidly regaining hurricane status and eclipsing its previous maximum strength.

By the beginning of August 28, Katrina had strengthened to a Category 3 hurricane, and during that day, it further exploded into a Category 5 storm, also growing in diameter while crossing the Gulf of Mexico.

Katrina followed an arc from southwest to northwest to north, lining up for a nearly direct hit on New Orleans. The storm reached its maximum intensity several hours before making landfall, and had dropped into the upper ranges of a Category 3 storm before coming ashore near Buras, Louisiana on August 29. This decline in strength was not enough to avert catastrophic damage, though—while maximum wind speed certainly has a correlation with the damages a tropical cyclone can cause, it is not a foolproof indicator of a storm's potential to cause flood damage either from precipitation or storm surge. After briefly making landfall at Buras over the levee-controlled mouth of the Mississippi River, the eye of the storm continued across the ocean before making its final landfall near the Louisiana-Mississippi border, passing 20 miles to the east of downtown New Orleans. The deadliest and most damaging component of Katrina was its storm surge, which covered an exceptionally large area because of both the size and intensity of the storm. Storm surges are water that is pushed ashore by tropical cyclones. They are created primarily by storm winds, but also by the storm's low barometric pressure and declining depth of the seafloor close to shore. They do not typically manifest as walls of water like tsunamis, but can nonetheless occur over periods as short as a few minutes, and move at the same speed that the storm is moving. Surge heights reached 28 feet along the Mississippi coast, and neared 20 feet in the New Orleans metropolitan area. Many of the city's floodwalls and levees were breached, with about 80 percent of New Orleans under water at some point.[1]

[1] Information on Katrina's trajectory and storm surge is from Richard Knabb, Jamie Rhome, and Daniel Brown, *Tropical Cyclone Report: Hurricane Katrina, August 23-30, 2005* (Miami: National Hurricane Center, 2005).

This all may sound familiar: the way Katrina affected New Orleans bore strong similarities to what Betsy had done forty years earlier. Over those four decades, however, New Orleans and its suburbs had grown behind an enhanced network of hurricane-protection structures. Prior to 1965, federal support for flood protection had focused mostly on riverine flooding. In and around New Orleans, local interests had provided some funding for barriers against coastal surges dating all the way back to 1727, and starting in the 1950s, the Army Corps of Engineers had begun to work on plans for a nationwide system of structural hurricane protection. It was not until after Betsy, however, that federal funding for coastal protection began to ramp up. In the vicinity of New Orleans, this took the shape of several separate projects—not only levees under the direction of the Corps of Engineers, but also a complex system of pumping stations to remove water from the city. These projects, still unfinished when Katrina hit, had the effect of making the low-lying areas they enclosed seem more safe, leading to increased suburban development in the intervening years between Betsy and Katrina.[2] The projects, in other words, were *meant* to encourage the development that Katrina devastated. Structural flood control remained a prominent part of the New Orleans approach to flood hazard (as it did and does in other places, too), and its effect was to push back against the limits that Katrina then re-asserted.

Situated at the mouth of a massive river and on low-lying ground vulnerable to storm surges, New Orleans is unique among large American cities for its vulnerability to both riverine and coastal floods.[3] Yet in the geographical pattern of growth it experienced between 1965 and

[2] This paragraph draws especially on Craig Colten, *Perilous Place, Powerful Storms: Hurricane Protection in Coastal Louisiana* (Jackson: University Press of Mississippi, 2009).

[3] New Orleans and its relationship with the Mississippi River and Gulf of Mexico, including its susceptibility to flooding, have been of interest to historians. Ari Kelman's *A River and Its City: The Nature of Landscape in New Orleans* (Berkeley: University of California Press, 2003) focuses on the waterfront as a space where the relationship between the city of New Orleans and the Mississippi River is mediated, including responses to the flood of 1927. Craig Colten's *An Unnatural Metropolis: Wresting New Orleans from Nature* (Baton Rouge: Louisiana State

2005, New Orleans was unremarkable in the context of the country's coastal regions as a whole. Areas with such ready access to navigation have long been more populous than those without, and New Orleans is also an important railway terminus. In the United States in 1880, population densities of counties that had direct access to oceans, the Great Lakes, and navigable rivers were all about two-and-a-half times greater than the country's overall population density. However by 1960, ocean coastal counties were populated almost four times as densely as the country at large, compared to about 3.5 times the density for Great Lakes counties and less than two times the density for counties with navigable rivers. By 2000, that discrepancy had grown larger still to a factor of 4.2 for coastal counties, versus 2.8 for Great Lakes counties and 1.5 for navigable river counties.[4] It should be little surprise, then, that the storm that turned the NFIP upside down was a tropical cyclone rather than an inland flood.

In the wake of Katrina, the National Flood Insurance Program paid nearly 168,000 claims, with an average payout of nearly $100,000 per claim, unadjusted for inflation. Prior to Katrina, only two events had caused over $1 billion in NFIP claims, Tropical Storm Allison in 2001 ($1.1b) and Hurricane Ivan in 2004 ($1.6b). Katrina's bill came to over $16.3 billion, with almost another half-billion tacked on to the year's total a month later by Hurricane Rita when it struck Louisiana and eastern Texas.[5] The NFIP has the authority to borrow money from the federal treasury in years of high losses, with the expectation that that money would be repaid during years of lower losses. Before Katrina, the NFIP had exercised its borrowing power three times in the previous ten years, each time repaying the borrowed amount with interest. After Katrina and Rita, however, Congress increased the NFIP's borrowing authority from $1.5 billion

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University Press, 2005) examines the ways in which people have built and sustained a city in a location with many environmental challenges, including susceptibility to both riverine and coastal flooding.

[4] Population data is from Jordan Rappaport and Jeffrey Sachs, "The United States as a Coastal Nation," *Journal of Economic Growth* 8 (2003): 5-46.

[5] "List of Significant Flood Events." https://www.fema.gov/significant-flood-events. Last visited April 4, 2018.

to $18.5 billion in November 2005 and then to $20.8 billion in March 2006. This debt only increased in the following years: Hurricane Irene (2011) surpassed a billion dollars in payments, Hurricane Ike (2008) and the 2016 inland flooding in Louisiana passed the two-billion threshold, and Hurricane Sandy's insurance bill came to around half of Katrina's, at over eight billion dollars.[6] Much of that debt was erased in late 2017, not because payments by insurance holders balanced the books, but by congressional action to write off the debt after yet another season of severe storms.

Though the value of the insurance claims that Katrina generated was overwhelming, this high dollar value did not even reflect a fully insured city. The relative lack of claims because of lack of flood insurance coverage, particularly in more impoverished parts of the city, was also notable. In the heavily devastated Lower Ninth Ward of New Orleans, for example, only about a third of all households carried flood insurance. There were at least two major reasons for this. One was that many of the Lower Ninth Ward houses were not mortgaged, and thus were not affected by the federal flood insurance mandate. The other was that large parts of the Lower Ninth Ward had not been mapped into the hundred-year floodplain due to their supposed protection by levees. While these issues were not themselves responsible for the financial strain placed on the NFIP, they revealed the program's gross failure to offer uniform, equitable protection to citizens regardless of racial or class background.[7]

Even as Katrina churned, mainstream news outlets gave voice to the idea that the storm had been amplified by anthropogenic global warming. "Is Global Warming Fueling Katrina?"

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[6] U. S. Government Accountability Office, *National Flood Insurance Program: New Processes Aided Hurricane Katrina Claims Handling, but FEMA's Oversight Should Be Improved* (Washington: GAO, 2006). For major NFIP events, see https://www.fema.gov/significant-flood-events.

[7] For more on the NFIP and the Lower Ninth Ward, see Lisa Bates and Rebekah Green, "Housing Recovery in the Ninth Ward," in *Race, Place, and Environmental Justice After Hurricane Katrina: Struggles to Reclaim, Rebuild, and Revitalize New Orleans and the Gulf Coast*, eds. Robert Bullard and Beverly Wright (Boulder, Colorado: Westview Press, 2009), 461-493.

asked the headline of a story in *Time* magazine.[8] Staff science writer Jeffrey Kluger cautiously laid out the case for why warmer sea-surface temperatures would strengthen hurricanes, but stopped short of directly attributing Katrina's destructiveness to climate change. Not so journalist and environmentalist Ross Gelbspan, author of a pair of non-academic books on climate change in the decade before Katrina.[9] Gelbspan declared that "The hurricane that struck Louisiana yesterday was nicknamed Katrina by the National Weather Service. Its real name is global warming," in the *Boston Globe* on August 30.[10] Bill McKibben, then and now one of the most prominent journalistic voices on the subject of climate change, disavowed the possibility of Katrina being "the result" of climate change in an article days after the storm, but called climate change "the only plausible cause" of a trend toward longer-lasting and more intense tropical cyclones, referencing a recently-published article by the noted atmospheric scientist Kerry Emanuel that identified such a trend.[11] While the damages discussed in the previous paragraph show that Katrina wrought the destabilization of the NFIP, the commentary of writers like Gelbspan and McKibben worked to create a link between the NFIP's destabilization and anthropogenic climate change.

Hurricanes feed on warm ocean waters, so the connection to a warming climate is easily drawn, though until very recently most scientists have been loath to draw causal links between

[8] Jeffrey Kluger, "Is Global Warming Fueling Katrina," *Time* August 29, 2005. Published online. http://content.time.com/time/nation/article/0,8599,1099102,00.html. Last visited April 4, 2018.
[9] Ross Gelbspan, *The Heat is On: The Climate Crisis, the Cover-Up, The Prescription* (Reading, Mass.: Perseus Books, 1998); Gelbspan, *Boiling Point: How Politicians, Big Oil and Coal, Journalists, and Activists are Fueling the Climate Crisis—and What We Can Do to Avert Disaster* (New York: Basic Books, 2004).
[10] Ross Gelbspan, "Katrina's Real Name," *Boston Globe* August 30, 2005, A17.
[11] Bill McKibben, "Tomgram: Bill McKibben on Planet New Orleans, *TomDispatch.com* September 6, 2005, http://www.tomdispatch.com/post/20027/. Last visited April 13, 2018. The article cited by McKibben is Kerry Emanuel, "Increasing Destructiveness of Tropical Cyclones over the Past 30 Years," *Nature* 436, no. 7051 (Aug. 4, 2005): 686-688.

climate change and any particular meteorological event.[12] Tropical cyclones—*hurricane* is the name given to those that form in the Atlantic or eastern Pacific oceans—form when warm, moist air above the ocean rises upward, creating low atmospheric pressure near the surface that new air is drawn into. As that air is warmed and picks up moisture, it too rises, leaving low pressure that draws in yet more new air. As long as the system remains above warm water, and is not disturbed by strong winds or descending air masses higher in the atmosphere, it can continue to grow, from a tropical depression, to a tropical storm, and ultimately into a hurricane. Besides the warming waters, other ingredients in hurricane formation such as wind shear may be negatively affected by climate change. Current modeling suggests that numbers of tropical cyclones may decrease as the global temperature warms, but that the strongest storms will become more intense with higher levels of rainfall.[13]

As for historical trends, studies of historic cyclone activity levels are hindered by changes in observation capabilities throughout the past century. Most notably, satellite observation of hurricanes became possible in time for the 1966 storm season. Prior to 1966, tropical storms were reported by terrestrial observers. Since the numbers of available observers grew along with coastal populations and increased shipping activity, there is some question about how much faith should be placed in pre-1966 statistics.[14] Nonetheless, there is strong evidence that both

[12] This is starting to change, though. For example, see the World Weather Attribution project, a collaboration between Climate Central, the University of Oxford Environmental Change Institute, the Royal Netherlands Meteorological Institute, the University of Melbourne, and the Red Cross Red Crescent Climate Centre. Project URL: https://www.worldweatherattribution.org. Last visited April 4, 2018.
[13] Kevin Walsh et. al., "Tropical Cyclones and Climate Change," *WIREs Climate Change* 7 (2016): 65-89.
[14] Climate scientists debate the significance of increasing cyclonic observation capabilities. Chris Landsea is strongly associated with the position that lesser observation capabilities in earlier decades has contributed to the perception that Atlantic tropical storms are becoming more common due to climate change. See in particular Landsea, "Counting Atlantic Tropical Cyclones Back to 1900," *Eos* 88, no. 18 (1 May 2007): 197-208. Landsea's 2007 article was partially in response to the analysis of Michael Mann and Kerry Emanuel, who highlighted increasing tropical storm frequencies in their article "Atlantic Hurricane Trends Linked to Climate Change," *Eos* 87, no. 24 (13 June 2006): 233-241. The debate over hurricane trends remains unresolved as of 2018, especially as factors such as hurricane intensity and duration are taken into account. For a recent review, see Kevin Walsh et. al., "Tropical Cyclones and Climate Change," *WIREs Climate Change* 7 (2016): 65-89.

frequency and intensity of hurricanes in the North Atlantic Basin have increased since the 1970s.[15]

But just as importantly, sea level rise means that hurricanes do not have to become more powerful or more frequent in order to be more destructive. A ten-foot storm surge under baseline conditions, for example, would be equaled by an eight-foot surge of a sea that had risen by two feet. A team of engineers compared the actual Hurricane Katrina to a hypothetical similar storm occurring in 1900, with lower sea levels, and found that damages would have been 15-60 percent lower under 1900 climatic and sea-level conditions than those of 2005. The storm surge would have been lower because of lower mean sea level, but also less damaging because coastal wetlands—which help absorb the impact of storm surges—would have been larger with lower sea levels.[16] Even if one questions the possibility that Katrina as a meteorological event was caused or intensified by climate change, the fact that the storm hit a coast where the sea level had risen and the land had subsided are solidly established.

Aside from factors possibly related to ongoing climate change, the dramatic increases in damage wrought by hurricanes in the twenty-first century are attributable in part to the increased population levels, numbers of buildings, and overall wealth found in coastal regions. This thesis might sound uncontroversial, but has in fact been at the center of one of the larger debates over interpretations of climate change in recent years. Its most well-known proponent, environmental studies professor and trained political scientist Roger Pielke, Jr., argued famously in 2014 on the popular-audience data analysis web site *FiveThirtyEight* that the upward trend of financial losses

[15] Dennis Hartmann et. al., "Observations: Atmosphere and Surface," in *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. Thomas Stocker et. al. (New York: Cambridge University Press, 2013), 159-254.
[16] Jennifer Irish et. al., "Simulations of Hurricane Katrina (2005) under Sea Level and Climate Conditions for 1900," *Climatic Change* 122 (2014): 635-649.

to weather-related disasters "are not part of a trend driven by climate change."[17] Pielke's assertion was met with widespread public outrage and eventually led to the ending of his relationship with *FiveThirtyEight,* though his work has been widely published in refereed academic journals.[18] While Pielke's claim that there is *no* statistical evidence for a connection between climate change and increasing damages is an absolute statement that was all but certain to garner controversy, his position minus the absolute language is certainly not without merit. Even Emanuel, who was commissioned by *FiveThirtyEight* to rebut Pielke's piece, noted his "(sympathy) to Pielke's emphasis on the role of changing demographics in increasing damages from natural disasters," and cited the National Flood Insurance Program in particular as an example of policy that encouraged subsidized risk-taking in disaster-prone development.[19] To plan for the long-term viability of the National Flood Insurance Program, it would be critical to determine the relative impacts of climate change and demographic/developmental trends on the program's finances. In the short term in the late 2000s and early 2010s, however, climate change mostly lurked as a menacing shadow rather than taking center stage in planning for the program's future.

Even for those who were not convinced of its connections to climate change, Katrina seemed to present a clear message that *something* had changed about US floods. But it was not the only signal. Inland, nothing compared to Katrina's damage or notoriety, but in several cases,

[17] Roger Pielke Jr., "Disasters Cost More than Ever—But Not Because of Climate Change," *FiveThirtyEight* 19 March 2014, https://fivethirtyeight.com/features/disasters-cost-more-than-ever-but-not-because-of-climate-change/. Last visited April 4, 2018.

[18] Even before the publication of his *FiveThirtyEight* article, advocates of climate action had already viewed Pielke as a dangerous climate skeptic, and a good deal of their displeasure was directed toward *FiveThirtyEight* for giving Pielke its platform. Pielke himself disavows the 'skeptic' label, acknowledging the reality of anthropogenic global warming, yet he questions how quickly its effects are appearing, and is frequently referenced by people committed to the position that anthropogenic climate change is not happening.

[19] Kerry Emanuel, "MIT Climate Scientist Responds on Disaster Costs and Climate Change," *FiveThirtyEight* 31 March 2014, https://fivethirtyeight.com/features/mit-climate-scientist-responds-on-disaster-costs-and-climate-change/. Last visited April 4, 2018.

floods gained attention for their unforeseen intensity.[20] Much further upstream in the Mississippi River watershed, major flooding revisited eastern Iowa in June of 2008—the second flood in 15 years to be considered a 500-year flood, at some locations. Though this flood wreaked havoc on the lives of thousands, its impact was not so much its contributions to bankrupting the NFIP as its apparent signal that established understandings of flood frequency, central to the operation of the NFIP, might not be holding up.

In Iowa in 2008, memories of severe floods in 1993 remained vivid. The 1993 event had been a regional one, affecting not just Iowa, but also other Midwestern states including Illinois, Missouri, Kansas, Wisconsin, Minnesota, and the Dakotas. Heavy rainfall over an extended time period brought the region's largest rivers, the Mississippi and Missouri, to record-breaking crests. In Iowa, virtually the entire state was affected. The state's capital and largest city Des Moines lost its municipal water supply for almost two weeks, university towns Ames and Iowa City suffered major inundations, and vast swaths of farmland lay under water for months.[21] The 2008 event was more geographically focused, bringing even greater flooding to a smaller area. Eastern Iowa, and particularly the Cedar and Iowa River basins, were hit the hardest. The greatest damage struck Cedar Rapids, the state's second-largest city, where the Cedar River crested at over 31 feet, a remarkable 11 feet above the previous record measurement and 19 feet above official flood stage. The 2008 flood was the result of more localized heavy rain, and

[20] Besides the Iowa episodes, Hurricane Harvey (discussed in more depth later in this chapter) was the third five-hundred-year flood in Houston in less than three years, the other two unrelated to tropical cyclones. See Christopher Ingraham, "Houston is Experiencing its Third '500-year' Flood in Three Years. How is That Possible?," *Washington Post Wonkblog* 29 August 2017, https://www.washingtonpost.com/news/wonk/wp/2017/08/29/houston-is-experiencing-its-third-500-year-flood-in-3-years-how-is-that-possible/. Last visited April 4, 2018. In Colorado's Front Range, a rain event that was deemed a thousand-year event caused hundred-year flooding in 2013, hitting areas that included those affected by the Big Thompson Canyon flood of 1976.

[21] Sources for further information on Iowa-specific impacts of the Flood of 1993 include Jeff Zogg, *The Top Five Iowa Floods* (Des Moines: National Weather Service Weather Forecasting Office Des Moines, 2014); and *The Floods of 1993: Iowa Flood Disaster Report* (Experience Iowa, 1994). On the flood as a whole, see Stanley A Changnon, ed., *The Great Flood of 1993: Causes, Impacts, and Responses* (Boulder: Westview Press, 1996).

developed much more suddenly than in 1993. Just five days prior to the river's June 13 crest of 31-plus feet, predictions only called for a 20-foot crest, but continued heavy rains meant that projections continued to increase on a daily basis. Over nine square miles of Cedar Rapids were flooded, including the city's central business district. From the perspective of flood insurance, the inundated areas included land outside of officially demarcated flood plains.[22] "I never even thought about flood insurance," one Cedar Rapids resident told a *New York Times* reporter. "They said this place would never flood in 500 years."[23] While Cedar Rapids was hit hardest of all, neighboring Iowa City and the University of Iowa located there also took heavy damage. The city was virtually cut in two as bridges over the Iowa River became impassable, and major university buildings were rendered unusable, their replacements not completed for upwards of a decade.

The Iowa floods lacked the human drama of Katrina, their total financial damages were much less, and they did not affect an area of widely recognized cultural significance, and thus they did not receive nearly the same magnitude of national attention. Even so, they inspired national mass-audience publications to re-visit the possible connections between flooding and climate change. One article noted the recurrence of major flooding after unusually short intervals not just in Iowa but in other places too. "The question is, are you going to face (major floods)

[22] On the 2008 flood in Cedar Rapids, see Linda Langston, "Linn County and the Flood," in *A Watershed Year: Anatomy of the Iowa Floods of 2008*, ed. Cornelia Mutel (Iowa City: University of Iowa Press, 2010), 45-51. For a hydroclimatological examination, see Dagmar Budikova et. al., "Hydroclimatology of the 2008 Midwest floods," *Water Resources Research* 46, no. 12 (2010): W12524.

[23] Christopher Maag, "In Eastern Iowa, the City That 'Would Never Flood' Goes 12 Feet Under," *New York Times* June 13, 2008, A18. This is an excellent example of common misperceptions about flood recurrence. Presumably, somewhere in the chain of communication, the 500-year floodplain became the place that would never flood in 500 years—perhaps the resident himself misunderstood official literature, or perhaps he trusted a real estate agent who either misinterpreted or knowingly misled him about flood recurrence, for example.

once a century or once every 10 years," stated a civil engineer, asked in an article about flood recurrence and climate change.[24]

As Iowa State University climate scientist Eugene Takle wrote in the aftermath of the 2008 floods, "when rare or extreme weather events seem to increase in frequency, either locally or regionally, both statisticians and thoughtful lay people begin to wonder if something unusual is going on."[25] In assessing Cedar Rapids' climate history, Takle found some changes easy to link to anthropogenic global warming, and others less so. Observations that have found more days with extreme precipitation in Cedar Rapids between 1951-2000 than 1901-50, and models projecting increased precipitation for Cedar Rapids, gave Takle the confidence to argue for "a compelling case that climate change may have played a role" in the region's 2008 flooding.[26]

Tensions over the NFIP's financial situation came to a head in the years after Katrina, but they had been building over the previous half-century. Throughout its history, the NFIP's fiscal health has been subject to differing interpretations. Some have seen it as a program that will generally be able to balance its premiums and payouts, while others have seen it as a program that will be dependent on federal subsidies as long as it exists in its current form. One may not see this second interpretation as particularly problematic, if you believe that development in flood-prone regions is worth subsidizing by the federal government for other reasons. But if your goal is a program that does not lose money, then the greatest threat to the NFIP's fiscal health is subsidized insurance rates, granted to properties built before the NFIP was enacted but also to properties built more recently in places not mapped into a flood zone at the time of construction. In these cases, insurance rates are capped at amounts deemed to be affordable by the purchaser

[24] Richard Mertens, "Why Flooding Worsens," *The Christian Science Monitor* June 17, 2008.
[25] Eugene S. Takle, "Was Climate Change Involved?," in *A Watershed Year: Anatomy of the Iowa Floods of 2008*, ed. Cornelia Mutel (Iowa City: University of Iowa Press, 2010), 111-116. Quote from page 111.
[26] Takle, "Was Climate Change Involved?," 115.

rather than adjusted to reflect the actual calculated flood risk. The continuation of subsidies, though costly to the NFIP in terms of uncharged premiums and its attempts to balance income and payouts, have proven to be resilient in the face of political pressure. Until Hurricane Katrina, premium payments generally balanced out claims over the long run. But since Katrina, insured losses have far outstripped premium payments, leading lawmakers to take an increased interest in reforming the program.

The Biggert-Waters Flood Insurance Reform Act of 2012 is, as of 2018, the most recent, and the most ambitious, in a series of legislative acts meant to strengthen the fiscal position of the NFIP. Sponsored by Republican congresswoman Judy Biggert, a moderate Republican from suburban Chicago who lost her seat in 2012 after redistricting, and Democratic congresswoman Maxine Waters, a long-serving Los Angeles-area Democrat from the left flank of her party, still in office as of 2018, the bill passed by large margins in both chambers of Congress as one component of a much larger appropriations bill, entitled the Moving Ahead for Progress in the Twenty-First Century Act.[27] In its final vote, the much larger bill passed by margins of 373-52 in the House of Representatives and 74-19 in the Senate. In each chamber, Democratic support was unanimous. These margins should not be construed as explicit support for the insurance proposal, however, because the bill's main provisions dealt with surface transportation, not floods or insurance, and represented other priorities of the Democratic Barack Obama administration.

Biggert-Waters was the culmination of legislative efforts that had progressed sporadically, starting just months after Katrina made landfall. The first legislative effort to address the impacts of Katrina on the NFIP occurred in March of 2006, with the introduction of a bill that would have gradually eliminated subsidized insurance rates for nonresidential properties,

[27] U.S. Public Law 141. 112th Cong., 2d sess., July 6, 2012.

vacation homes, and second homes.[28] This bill, which passed the House with strong support but got nowhere in the Senate, was sponsored by Representative Richard Baker, a Republican from the Baton Rouge area who generally maintained a conservative voting record but favored an activist government in certain contexts, especially those that directly benefited his constituents. Most notably, he proposed a Louisiana Recovery Corporation that would have been funded to the tune of $80 billion to buy out and re-develop flood-damaged portions of New Orleans in the wake of Katrina.[29] The NFIP reform effort picked up bipartisan support, including Democratic co-sponsor Barney Frank of Massachusetts and Mississippi representative Gene Taylor, a conservative Democrat who represented the Katrina-ravaged gulf coast of the Magnolia State. Re-introduced in 2007, the legislation made further headway, with added provisions to cover wind damage caused by hurricanes. On its second go-around, the flood insurance subsidies fix passed both House and Senate, but faltered in conference when the two houses could not come to agreement on exactly how the reduction or elimination of subsidies should be handled.[30]

One of the most strident proponents of the ideas that became law in Biggert-Waters was an organization originally called Americans for Smart Natural Catastrophe Policy, a group that later went by the name SmarterSafer. The group coalesced in 2007, in reaction to a proposal to expand federal involvement in property insurance in coastal areas. SmarterSafer's membership included (and includes) a range of political perspectives, from libertarian-leaning organizations that prioritized small government, to left-leaning environmental and conservation groups, to representatives of the private insurance and reinsurance industries. Each came to the table with different priorities, but those priorities converged in a coherent agenda that substantially aligned with the principles of floodplain management. For the environmental groups, the limits of the

[28] Flood Insurance Reform and Modernization Act of 2006, 109 H.R. 4973.
[29] Adam Nossiter, "A Big Government Fix-It Plan for New Orleans," *New York Times* January 5, 2006.
[30] The 2007/2008 legislation was the Flood Insurance Reform and Modernization Act of 2007, 110 H.R. 3121.

natural world were important to adhere to because of concerns about the preservation-worthy character of lands beyond the littoral limits, while for the libertarians, these limits were important because pushing them tends to be an expensive proposition.

Among the constituent groups of SmarterSafer, some had already taken interests in flood insurance prior to Katrina, though Katrina's destabilization helped draw the groups together. One of the most involved constituents of SmarterSafer, the National Wildlife Federation, began as a conservation-minded group in the 1930s and shifted toward full-spectrum environmentalism in the 1960s and 1970s. It had been working on flood insurance since at least 1998, when it produced a report that focused on repeated-loss programs within the NFIP.[31] The NWF's interest in the NFIP stemmed from its emphasis on "restor(ing) the full panoply of life that thrives in the rich habitat along the banks of rivers and streams."[32] In its 1998 report, the NWF was supportive of an NFIP as envisioned by architects like Gilbert White, as a way to limit development in flood-prone areas. But its emphasis on the inherent environmental value of these areas, rather than simply the potential for human suffering or financial losses, was an important innovation not much seen in the debates surrounding the program's original creation. Another coalition member, Taxpayers for Common Sense, a nonpartisan advocacy group with bipartisan credentials, had also pushed for reforms to the NFIP before 2005. Its advocacy focused heavily on trimming NFIP expenses by reducing the number of subsidized insurance policies.[33] The SmarterSafer coalition today counts over 20 organizations in total, including American Rivers, the Natural Resources Defense Council, Defenders of Wildlife, the Coalition to Reduce

[31] David Conrad and National Wildlife Federation, *Higher Ground: A Report on Voluntary Property Buyouts in the Nation's Floodplains: A Common Ground Solution Serving People at Risk, Taxpayers and the Environment* (Washington, DC: National Wildlife Federation, 1998). On the history of the National Wildlife Federation, see Thomas Allen, *Guardian of the Wild: The Story of the National Wildlife Federation, 1936-1986* (Indianapolis: Indiana University Press, 1987).
[32] Conrad and National Wildlife Federation, *Higher Ground*, vi.
[33] Taxpayers for Common Sense, "Flood Insurance Reform Could Save Billions," Press release, August 1, 2001, https://www.taxpayer.net/infrastructure/flood-insurance-reform-could-save-billions/. Last visited April 4, 2018.

Spending, the National Taxpayers Union, the Taxpayers Protection Alliance, and Habitat for Humanity.

As Congress debated the proposals that would become Biggert-Waters, testimony from congressional hearings reveals some bastions of opposition for the measures that would be passed into law in 2012. The National Association of Home Builders, which had a strong interest in limiting regulatory hurdles to new construction, offered qualified support for the ideas that would be passed into law as Biggert-Waters. A representative of that organization told the Senate Committee on Banking, Housing, and Urban Affairs that while "NAHB commends the Committee for addressing reform of the NFIP," his organization held that any effort to reduce the NFIP's use of subsidized insurance rates "must ensure that overall affordability is not adversely affected."[34] A good deal of his statement emphasized affordability—and indeed, from the perspective of a homebuilder, "affordability" is a term much more closely linked to housing prices, insurance rates, and profitability than to federal deficit spending.

Another real estate group, the National Association of Realtors, established its own concerns about potential subsidy eliminations in congressional hearings. A representative of the National Association of Realtors argued that even if elimination of subsidies would improve the fiscal soundness of the NFIP, "there may be significant unintended consequences for renters, business owners, potential homebuyers, neighborhoods and local economies."[35] He further argued that the term 'subsidies' was misleading because "No federal tax dollars are used to pay for the difference between the 'subsidized' and actuarial NFIP insurance rates. The difference

[34] U.S. Congress, Senate, Committee on Banking, Housing, and Urban Affairs, *Reauthorization of the National Flood Insurance Program,* hearing before the Committee on Banking, Housing, and Urban Affairs, United States Senate. 112th Cong., 1st sess., June 9 and 23, 2011. Testimony of Barry Rutenberg, First Vice Chairman, National Association of Home Builders.

[35] U.S. Congress, House, Financial Services Committee, *Flood Insurance Revision*, *Hearing before the Subcommittee on Housing and Community Opportunity, Financial Services Committee, House of Representatives, June 12, 2007,* 110th Cong., 1st sess., June 12, 2007. Testimony of Vince Malta.

between the actuarial and 'subsidized' rate is simply not collected."[36] While accurate in a narrow sense, this outlook ignores the reality that premiums are used to pay claims, and with claims outstripping premiums, tax dollars will inevitably have to make up the difference at some point. A more realistic reading of the argument would be that lost insurance premiums were a price worth paying for the stability of the housing market provided by subsidized insurance premiums.

The Biggert-Waters legislation was intended to achieve fiscal balance for the NFIP mostly by weaning purchasers off of subsidized flood insurance rates. Starting in 2013, a gradual phase-out of subsidized rates was scheduled to begin for businesses and for residential properties that had had previous large or repetitive losses. The premiums for those properties could increase by as much as 25 percent per year until the subsidy had been eliminated. For properties receiving subsidized insurance that had not had prior large or repetitive claims, subsidies would not be removed immediately, but would be immediately eliminated if a policy was allowed to lapse or upon sale of an insured property. Biggert-Waters included a spate of other provisions as well. Mapping received a good deal of attention. The bill codified an ongoing process of remapping for high-risk flood areas, and allotted $400 million per year toward this end. It also created a Technical Mapping Advisory Council, composed of representatives of federal agencies, state and local governments, and the private sector. This advisory council was meant to bring a range of perspectives and expertise to the remapping effort. To further enhance efforts at fiscal sustainability, the legislation provided for the possible collection of additional premiums in order to establish a reserve fund for high-loss years. A previous bill, the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004, focused specifically on insured properties that

[36] Ibid.

incurred repeated losses.[37] Over its initial decades, an inordinate percentage of the NFIP's payouts had gone to properties that had been damaged two or more times.

For such a momentous piece of environmental and economic legislation, the final passage of Biggert-Waters was rather anti-climactic. Rolled into a larger funding bill, it received support from legislators who prioritized other parts of the bill. Out of the Louisiana delegation, for example, only Democratic Senator Mary Landrieu expressed any concerns about the issue of subsidies and affordability prior to the final vote, but even she voted in favor of the larger bill. Louisiana's delegation was focused on another of the bill's provisions, which transferred funds from Clean Water Act fines for the Deepwater Horizon oil spill over to state control, and Landrieu prioritized that objective over her concerns about Biggert-Waters.[38] Either legislators were ready to embrace a definite turn toward floodplain management principles, or they did not fully grasp what they were voting for—and as we will see in upcoming pages, the latter seems closer to the truth.

The NFIP's ongoing destabilization and subsequent efforts to bring it back to firmer ground opened political fissures over the program's future in ways that had not been seen in decades. Economically libertarian organizations such as the R Street Institute supported Biggert-Waters, seeing it as a good start that did not even go far enough in its reforms. R Street was founded by staffers of another conservative think tank, the Heartland Institute, in reaction to that organization's denial of anthropogenic global warming. R Street does not deny anthropogenic global warming, instead aiming to "take a page from the liberal playbook and use the climate

[37] U.S. Public Law 264. 108th Cong., 2d sess., June 30, 2004.
[38] Bruce Alpert, "How Controversial Biggert-Waters Flood Insurance Bill Became Law," *The Times-Picayune* August 13, 2013.

change issue to push policies that (conservatives) favor anyway."[39] "All of these changes make sense," wrote Eli Lehrer, the president of the R Street Institute and a co-founder of SmarterSafer, referring to Biggert-Waters, "but they're hardly the kinds of radical reforms that the program would need to put itself on firm fiscal footing for the long term."[40] Lehrer did not lack for credentials in the world of mainstream American conservatism, with experience working for conservative think tanks like the Heartland Institute and the Heritage Foundation and journals including *The American Enterprise* and *The Washington Times*. Elsewhere, Lehrer commented that "stupid, rich people who want to should be able to build wherever they want to as long as taxpayers don't have bail them out."[41] The essence of this libertarian-inspired position was not that natural limits or boundaries should never be transgressed, but that those that do transgress them must take responsibility if they find themselves in high water. The contours of this debate were much different than other land use debates, in which property rights groups and land conservation interests are often at odds. One difference between this debate and many of the other most heated debates between property rights and conservation groups was that this one did not involve *extraction* of valuable resources from the land, unlike mining, drilling, or grazing debates.

It would not be long before Biggert-Waters was put to the test. Though eastern Iowa was subjected to two five-hundred-year floods in a fifteen-year period, a congressman representing Long Island claimed that his own district was hit by disasters in far more rapid succession: "It was just 17 months ago that residents in my congressional district … were devastated by

[39] Eli Lehrer, "Climate Change: It's Time for a Conservative Alternative," August 30, 2013, http://www.rstreet.org/2013/08/30/climate-change-its-time-for-a-conservative-alternative/. Last viewed April 13, 2018.
[40] Eli Lehrer, "Dead in the Water: The Federal Flood Insurance Fiasco," *The Weekly Standard* January 28, 2013.
[41] Darryl Fears, "Rise in Government Insurance Rates to Mirror Rising Waters, Flood Debt," *Washington Post* March 28, 2015.

Superstorm Sandy," said Democratic New York congressman Gregory Meeks in the spring of 2014. "Little did they know then that they were about to be hit by another storm."[42] What second storm? "Then came FEMA [the operator of the NFIP] with astronomical rate increases to their flood insurance program."[43] Meeks' concern speaks to the core tensions that have plagued the NFIP over the course of its existence. Property owners do not like paying premiums. And they especially dislike when they are forced to re-think their assumptions about a fair price for their insurance. It may feel like a low blow to be hit with premium increases while wounds from a recent flood remain raw. Yet a large flood event is a data point that shows floods to be more common than previous data would show, just like a car accident is likely to make one's auto insurance premiums increase. A history that had showed two major floods in 99 years, or roughly a two percent chance of one occurring in any year, would show three major floods in 100 years if a flood hit the following year, or a three percent chance of one occurring in any year.

While Katrina was the storm that pushed the NFIP off of its precarious perch of fiscal equilibrium, Sandy helped to dissolve Biggert-Waters, the glue that was meant to hold the program together. Sandy hit the east coast of the United States just months after the passage of Biggert-Waters. As a manifestation of a changing climate, Hurricane Sandy's credentials are a bit unclear. The storm's winds were not extreme by hurricane scales, only measuring in the Category 1 range by the time it made landfall in New Jersey. But while its winds were unremarkable, Sandy's size was incredible, with a maximum diameter of gale-force winds of around 1000 miles. Sandy affected most of the states in the eastern United States to greater or

[42] Congressional Record, House, Mar 4 2014, H2133.
[43] Ibid.

lesser extents, but its damages were most severe in New York and New Jersey, especially the metropolitan region of New York City, and it damaged or destroyed over 650,000 houses.[44]

The great size of the storm helped contribute to the high storm surge that battered the mid-Atlantic, but so did Sandy's angle of impact. Most tropical storms travel up the Atlantic seaboard nearly parallel to the coast, making landfall by grazing the coast from the side. But Sandy's trajectory led it into the mid-Atlantic coastal region nearly perpendicular to the coast.[45] Warmer-than-usual sea surface temperatures likely had some influence on Sandy's strength, but the reasons for its unusual path are complex, and a consequence of synoptic weather conditions, not long-term climatic trends. A blocking high-pressure system over the western North Atlantic and interactions with another upper-level disturbance both contributed to Sandy's unusual trajectory. Some studies have found that a weakened jet stream—an expected manifestation of anthropogenic global warming—may result in stronger and more persistent high-pressure systems, while others have predicted the opposite.[46] A pair of researchers who studied Sandy's trajectory concluded that under average 1950-2010 conditions, the recurrence interval for a storm following Sandy's trajectory would be approximately 600-700 years, meaning that either Sandy was an extremely rare event or that changes to the region's climate had made such a storm more likely than their calculations would suggest.[47]

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[44] Eric Blake et. al., *Tropical Cyclone Report, Hurricane Sandy, 22-29 October 2012* (Miami: National Hurricane Center, 2013).

[45] For a detailed description of Sandy's trajectory and development, see Blake et. al., *Tropical Cyclone Report, Hurricane Sandy.*

[46] Studies arguing for stronger high-pressure systems include Jennifer Francis and Stephen Vavrus, "Evidence linking Arctic amplification to extreme weather in mid-latitudes," *Geophysical Research Letters* 39 (2012): L06801; and Jiping Liu et. al., "Impact of declining Arctic sea ice on winter snowfall," *Proceedings of the National Academy of Sciences of the United States of America* 109, no. 11 (March 13, 2012): 4074-4079. Arguing against the likelihood of more persistent high-pressure systems are Etienne Dunn-Sigouin and Seok-Woo Sun in "Northern Hemisphere blocking frequency and duration in the CMIP5 models," *Journal of Geophysical Research Atmospheres* 118, no. 3 (16 February 2013): 1179-1188.

[47] Timothy Hall and Adam Sobel, "On the Impact Angle of Hurricane Sandy's New Jersey Landfall," *Geophysical Research Letters* 40 (2013): 2312-2315.

As the provisions of Biggert-Waters started to be felt, particularly via Sandy, an outcry of such intensity emerged that the 2012 reforms were mostly rolled back less than two years later. On the popular-audience web site *Slate*, historian Scott Knowles wrote that Hurricane Sandy, "with its tens of thousands of under-insured victims, made Biggert-Waters look like visionary legislation."[48] Yet for those under-insured victims, it was easy to paint FEMA as the villain, and opponents of Biggert-Waters did not hesitate to play up this sentiment. In early 2013, the *New York Times* identified residents of the New York metropolitan areas whose flood insurance premiums were slated to increase by factors of 10 or more over the upcoming decade. Some of this increase was due to Biggert-Waters, but some was also due to remapping. Some of these residents threatened to cancel their policies, others turned to grassroots activism, but the outrage seemed universal.[49] The National Association of Homebuilders called upon its supporters to contact their congressional representatives to advocate reversing key Biggert-Waters measures that the organization claimed "will continue to severely impact the construction, remodeling, and sale of homes in many communities across the nation."[50] The outcry over Biggert-Waters, which came in large part from middle-class homeowners upset about potential impacts to the value of their homes, was no doubt exacerbated by the lingering malaise of the 2007-2008 Great Recession.

Given the strong congressional support that Biggert-Waters had received upon its initial enactment, its legislative rejection just two years after its passage meant that many lawmakers had turned against it in short order. Even its one co-sponsor who retained her congressional seat,

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[48] Scott Knowles, "Flood Zone Foolishness," *Slate* 23 March 2014, http://www.slate.com/articles/health_and_science/science/2014/03/biggert_waters_and_nfip_flood_insurance_should_be_strengthened.html. Last viewed April 4, 2018.

[49] Jenny Anderson, "Outrage as Homeowners Prepare for Substantially Higher Flood Insurance Rates," *The New York Times* July 29, 2013, A12.

[50] National Association of Homebuilders, *NAHBNow* (blog), "Call Your Senators: We Need this Biggert-Waters Fix," 9 January 2014, http://nahbnow.com/2014/01/18/. Last viewed April 4, 2018.

Maxine Waters, threw her support behind efforts to blunt the impact of the original legislation. In late 2013, the veteran congresswoman expressed shock that the legislation she co-sponsored had led to such dramatic jumps in insurance premiums, stating that "neither Democrats nor Republicans envisioned it would reap the kind of harm and heartache that may result from this law going into effect."[51] Not only did Biggert-Waters "undermine … the pursuit of the American dream," Waters worried, it could also "kick off a similar cycle of stagnant home sales and depressed home values that was one of the leading drivers of the recent recession."[52] Other lawmakers who had also supported the bill's original passage turned against it with similar justifications.[53]

The recent struggles over flood insurance reform have not consistently pitted liberals against conservatives, or Democrats against Republicans. Lehrer's commentary may have represented the distilled essence of free-market conservative thought in regard to flood insurance, but opposition to Biggert-Waters came most notably from real estate interests, whch are also a typically conservative political element, if not always aligned with the right wing in the American party system . And at the same time, Lehrer and fellow free-market conservatives carried on with their alliance with environmental activists who were concerned about creating disincentives for development in fragile riparian and coastal habitats, trying to preserve what Biggert-Waters had enacted.[54]

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[51] "Waters Calls on Congress to Address Flood Insurance Rate Increases." Press Release, U.S. House Committee on Financial Services, Democrats, Rep. Maxine Waters, Ranking Member. September 30, 2013. http://democrats.financialservices.house.gov/news/documentsingle.aspx?DocumentID=383029. Last viewed April 4, 2018.

[52] "Waters Calls on Congress to Address Flood Insurance Rate Increases."

[53] Comments from several Florida lawmakers can be found in Jeremy Wallace, "On Flood Rates, A Sea Change in Congress," *Sarasota Herald-Tribune* November 8, 2013. Comments from Louisiana lawmakers are found in Alpert, "How Controversial Biggert-Waters Flood Insurance Bill Became Law."

[54] Eli Lehrer, "Strange Bedfellows: Smartersafer.org and the Biggert-Waters Act of 2012," *Duke Environmental Law & Policy Forum* 23 (Spring 2013): 351-361.

The piece of legislation that kneecapped Biggert-Waters, known as the Homeowner Flood Insurance Affordability Act of 2014 (HFIAA), took special aim at price increases for insurance. For properties that received subsidized flood insurance and were to lose their subsidies as a result of Biggert-Waters, premiums would now only be allowed to increase by five percent per year. Under the new legislation, properties could also be grandfathered into old risk designations if their risk level changed under a new flood insurance map, an option that had been terminated by Biggert-Waters. A non-binding provision of the new legislation called upon FEMA to limit the number of policies with premiums greater than one percent of coverage value. For some policies that increased in price after the elimination of subsidies via Biggert-Waters, policyholders were to be granted refunds equal to the increase in premiums they paid. To partially offset the reduced revenue from maintaining subsidized policies, the new legislation enacted a universal surcharge paid by all policyholders, regardless of whether or not their insurance was subsidized.[55] On the whole, though the 2014 legislation left in place some fraction of Biggert-Waters' provisions, it marked a brisk retreat from the goal of achieving fiscal stability by reducing subsidies for floodplain inhabitation. Remapping, and not just the removal of subsidies, had been an important factor in the post-Sandy outrage, but by opening up the possibility that properties could remain categorized in old risk zones even after new maps were created, HFIAA moved to shape the NFIP into a program that explicitly subsidized existing settlement patterns, rather than responding to best understandings of nature's limits.

Advocacy for the HFIAA came partially from well-funded real estate lobbies, but the legislation also had a legitimately grassroots base of support. New Jersey Senator Robert Menendez spoke of the thousands of letters he had received after Sandy, imploring action to

[55] Federal Emergency Management Agency, "Homeowner Flood Insurance Affordability Act Overview," 3 April 2014. Available online at https://www.fema.gov/media-library-data/1396551935597-4048b68f6d695a6eb6e6e7118d3ce464/HFIAA_Overview_FINAL_03282014.pdf. Last viewed April 4, 2018.

reverse increasing flood insurance premiums.[56] Similar support was reported by Steven Palazzo, the Republican Mississippi congressman who had defeated Gene Taylor in 2010.[57]

Even though the opponents of Biggert-Waters easily carried the day in Congress, the legislation maintained its supporters. The Natural Resources Defense Council blasted the 2014 legislation as an "over-correction" that "sets back efforts to prepare for climate change."[58] The Union of Concerned Scientists scolded Congress for acting as if reducing insurance premiums was the greatest good it could do for its flood-prone constituents.[59] The libertarian-leaning Cato Institute suggested that the new legislation would be "counter to both sound economic policy and sound environmental policy."[60] The R Street Institute, in advance of the final vote to weaken Biggert-Waters, published an open letter to Congress in support of Biggert-Waters signed by an all-star roster of conservative and tea party pundits of the 2010s, including Chris Chocola of the Club for Growth, Matt Kibbe of FreedomWorks, Grover Norquist of Americans for Tax Reform, Christine Hanson of Americans for Prosperity, and Larry Hart of the American Conservative Union.[61]

With the NFIP's finances reeling from the combined effects of storms like Katrina and Sandy, and the effective reversal of the most significant reforms included in Biggert-Waters, the

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[56] U.S. Congress, Senate, Committee on Appropriations, *Insuring Our Future: Building a Flood Insurance Program We Can Live With, Grow With, and Prosper With*, Hearing before the Subcommittee on Homeland Security Appropriations, 113th Cong., 2d sess., July 23, 2014. Testimony of Robert Menendez.

[57] "Palazzo on Passage of House Flood Insurance Bill," 4 March 2014. *Targeted News Service*. Retrieved from https://search-proquest-com.www2.lib.ku.edu/docview/1504065682?accountid=14556. Last viewed April 4, 2018.

[58] Rob Moore, "House Moves to Reinstate Flood Insurance Subsidies and Increase Flooding Risk," *NRDC Expert Blog* 25 February 2014, https://www.nrdc.org/experts/rob-moore/house-moves-reinstate-flood-insurance-subsidies-and-increase-flooding-risk. Last viewed April 4, 2018.

[59] Rachel Cleetus, "Grimm-Cassidy Bill Seeks to Gut Biggert Waters Flood Insurance Reforms," *Union of Concerned Scientists Blog* 25 February 2014, http://blog.ucsusa.org/rachel-cleetus/grimm-cassidy-bill-biggert-waters-flood-insurance-reforms-428?utm_source=tw&utm_medium=tw&utm_campaign=tw. Last viewed April 4, 2018.

[60] Chris Edwards, "Folly of Federal Flood Insurance," *Cato at Liberty* 26 February 2014, https://www.cato.org/blog/folly-federal-flood-insurance. Last viewed April 4, 2018.

[61] Andrew Moylan et. al., "An Open Letter to the United States Congress: Don't Gut Flood Insurance Reform by Extending Subsidies!," 7 November 2013, http://www.rstreet.org/outreach/dont-gut-flood-insurance-reform-by-extending-subsidies-2/. Last viewed April 4, 2018.

program was not well-situated for another round of costly floods after 2014. Three years later, though, the 2017 hurricane season proved to be one of the most damaging in years. Three hurricanes did major damage to parts of the United States: Harvey, Irma, and Maria. Maria devastated the island of Puerto Rico, but its effect on the NFIP was minimal because few Puerto Ricans held flood insurance. The design of the NFIP, with its use of the mortgage as a way of ensuring participation, inherently targets the middle-class and wealthy, who are able to afford mortgages and homeownership. In Puerto Rico, a high percentage of the housing stock is "informal" construction, built without permits, inspections, and sometimes even land titles.[62] Irma's U.S. impact centered on Florida, and as of late 2017 the NFIP had paid over half a billion dollars worth of claims resulting from Irma, a significant amount but not a program-altering total.[63] The year's most consequential storm in terms of flood insurance payments was Harvey, a storm that made landfall near Houston and delivered rainfall totals in excess of 40 inches. In contrast to Katrina and Sandy, in Harvey's case it was extreme rainfall rather than storm surge that caused most flood damage. Houston's approach to urban planning is very lightly regulated in comparison with other major US cities, and this lack of regulation and its potential connection to flooding was hotly debated in national US periodicals in the wake of Harvey.[64] While there

[62] Andres Viglucci, "Half of Puerto Rico's Housing was Built Illegally. Then Came Hurricane Maria," *Miami Herald* February 14, 2018.
[63] Gloria Gonzales, "NFIP Irma Payments Top $609 Million in Florida," *Business Insurance*, posted online 4 January 2018, http://www.businessinsurance.com/article/20180104/NEWS06/912318290/NFIP-Irma-payouts-top-609-million-dollars-in-Florida. Last viewed April 4, 2018.
[64] In support of the position that Houston's lax zoning exacerbated flooding, see Steve Russell, "Houston is Drowning—In Its Freedom From Regulations," *Newsweek* August 28, 2017, http://www.newsweek.com/houston-drowning-freedom-regulations-656087, last viewed April 4, 2018; Ian Bogost, "Houston's Flood is a Design Problem," *The Atlantic* 28 August 2017, https://www.theatlantic.com/technology/archive/2017/08/why-cities-flood/538251/, last viewed April 4, 2018; and Shawn Boburg and Beth Reinhard, "Houston's 'Wild West' Growth," *The Washington Post* August 29, 2017, https://www.washingtonpost.com/graphics/2017/investigations/harvey-urban-planning/, last viewed April 4, 2018. In opposition to this position, see Emily Hamilton, "What Houston's Critics Get Wrong," *U.S. News and World Report* September 18, 2017, https://www.usnews.com/opinion/economic-intelligence/articles/2017-09-18/land-use-wasnt-to-blame-for-houstons-hurricane-harvey-destruction, last viewed April 4, 2018; and Scott Beyer, "Don't Blame Houston's Lack of Zoning for Harvey Flooding," *The Hill* 3 September 2017, http://thehill.com/blogs/pundits-blog/state-local-politics/349021-opinion-dont-blame-houstons-

may be some merit to suggestions that Houston could have been designed to better deal with flooding problems, it is also true that even the best-laid plans would have been challenged by thirty-plus inches of water falling in a few days on the region's heavy clay soils.

Harvey made landfall on the Texas coast as a Category 4 hurricane. But instead of continuing to move inland and dissipating, Harvey stalled out and inched up the coast, pouring water on the Houston metropolitan area for nearly a week in late August. Its storm surge and the wind damage it caused were not trivial, but paled in comparison to the flooding caused by seven-day rainfall totals more than twice as high as any recorded since 1950. This truly unprecedented amount of rain caused large numbers of properties outside of the mapped hundred-year floodplain—and thus, without flood insurance—to receive flood damages, even as those property owners who *did* have flood insurance filed claims that will likely be in excess of $10 billion.[65] In terms of climate change, Harvey's heavy rainfall is in line with the understanding that warmer air can hold more moisture, a relationship known as the Clausius-Capeyron relationship. A pair of scientists who studied Harvey found that the storm's precipitation totals were at least 19 percent higher than would have been expected without climate change, a number even higher than the six-to-seven percent increase predicted by use of the Clausius-Capeyron equation.[66]

In light of the NFIP's ongoing financial circumstances and their further exacerbation by claims from Harvey, a rarely-considered political option suddenly emerged: debt forgiveness.

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lack-of-zoning-laws-for, last viewed April 4, 2018. Central questions in this debate included the pervasiveness of impervious surfaces in Houston and the extent to which Houston's extant land use regulations effectively achieved the same things that traditional zoning would have. For a historian's (pre-Harvey) take on land use and flooding in Houston, see Andrew Baker, "Encroaching on Suburban Nature: Rural Politics, Development, and the Floodplains of East Texas," paper presented at the Southern Forum on Agricultural, Rural, and Environmental History, Starkville, Mississippi, 11 April 2015.

[65] As of January 2018, an official number for the dollar amount of losses paid by the NFIP for Hurricane Harvey has not yet been released by FEMA. On properties without flood insurance, see Roger Yu, "Less than 20% Harvey Victims Have Flood Insurance as FEMA Braces for Tons of Claims," *USA Today* August 29, 2017.

[66] Mark Risser and Michael Wehner, "Attributable Human-Induced Changes in the Likelihood and Magnitude of the Observed Extreme Precipitation during Hurricane Harvey," *Geophysical Research Letters* 44 (2017): 12,457-12,464.

Prior to Harvey, Maxine Waters had offered a proposal to forgive a large percentage of the NFIP's debt in 2016, but the proposal gained little traction. After Harvey, however, debt forgiveness became a bipartisan priority. Mick Mulvaney, the director of the Office of Management and Budget in the Donald Trump administration, sent a letter to Vice President Mike Pence and Congressional leaders calling for $16 billion of the program's debt to be simply forgiven—and forgotten—without strings attached by the U. S. Treasury.[67] Within weeks, the Republican congress had added this proposal to a disaster relief bill that was already in the works, and the debt was officially written off with a signed bill on October 27.[68] Rushed through Congress without hearings, the debt relief legislation was part of a larger disaster relief bill that lent it a sense of urgency.[69] Mulvaney, a former Republican congressman from South Carolina who had developed a reputation as a deficit and spending hawk during his time in Congress, also emphasized in his letter of support the continued structural problems facing the NFIP and the need for long-term changes. Yet the enacted law included only the debt forgiveness, not linking it to any required changes in the way the program operates.[70] Many popular commentators and journalists have pointed out that both major American political parties, though especially the Republicans, only seem to care about federal deficits when out of power.[71] On one hand, it is true

[67] Letter from Mick Mulvaney to Mike Pence, 4 October 2017, https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/Letters/Letter%20regarding%20additional%20funding%20and%20reforms%20to%20address%20impacts%20of%20recent%20natural%20disasters.pdf. Last viewed April 4, 2018.
[68] Additional Supplemental Appropriations for Disaster Relief Requirements Act, 2017, 115 H.R. 2266.
[69] Somewhat ironically, though the legislation offered debt relief for the NFIP, it did nothing about the debt load crushing Puerto Rico, one of the devastated areas its efforts were aimed at. In fact, part of the assistance it offered to Puerto Rico took the form of loans, creating further debt for the commonwealth. A notable difference between the NFIP's debt and the debt of Puerto Rico is that while the former is held by the U.S. Treasury, the latter is held primarily by private investors.
[70] U.S. Public Law 72. 115th Cong., 1st sess., October 26, 2017. Section 308.
[71] See, for example, Jared Bernstein, "Do Republicans Really Care About the Deficit?," *The New York Times* September 26, 2017; Thomas Kaplan, "With Tax Cuts on the Table, Once-Mighty Deficit Hawks Hardly Chirp," *The New York Times* September 28, 2017; and Ezra Klein, "'The Hypocrisy is Astounding': This Tax Bill Shows the GOP's Debt Concerns were Pure Fraud," *Vox* December 2, 2017, https://www.vox.com/policy-and-politics/2017/12/2/16724978/gop-tax-bill-deficit-debt-fraud, last viewed April 4, 2018.

that there are politicians who make disingenuous claims to boost themselves into office. On the other hand, however, the politics of flood insurance helps to demonstrate that even sincere deficit hawks may find that once in control of the levers of power, the pressures to embrace deficit spending can be powerful especially when tied to a program that sustains existing patterns of inhabitation.

As of mid-April 2018, a long-term re-authorization of the NFIP has not made its way through Congress.[72] Based on historical precedent and political pressures, it is highly probable that *some* sort of re-authorization will pass—if not, the program would cease to exist, likely making the uproar over Biggert-Waters seem minor in comparison. More open to question is whether the 2018 re-authorization will include any serious attempt to grapple with the program's recent history of hemorrhaging money. If not, then a precedent will have been set, that the program is meant to perpetuate the status quo, and will receive support from Congress for this to happen in the form of written-off debt.

Ultimately, Hurricane Katrina unleashed a struggle over the role of the NFIP that remains unresolved as of 2018: Will it continue to subsidize the persistence of development that was perhaps flood-prone even when built but is rapidly becoming more so? Will it become a more forceful enforcer of nature's limits as determined by probabilistic flood recurrence analysis? Sandy and Harvey strongly suggest that Katrina was no one-off event, and that those planning for the future of the NFIP must assume that storms causing similar or greater levels of damage will continue to occur, even without climate change. There is no going back to the delicate balance that held from 1968 through 2005, which may have been an extraordinary spree of good luck. Whether or not any of these path-defining events is attributable to climate change, the

[72] After several short-term reauthorizations, the next possible opportunity for a long-term reauthorizations currently appears to be coming in July 2018.

composite effect is that the baseline for storm damage is changing. These storms also demonstrate the extent to which the NFIP in the twenty-first century has come to be shaped by hurricanes. From its creation in 1968, to the reformism that set Biggert-Waters in motion, to its reversal, to the debt forgiveness of 2017, each of these major policy shifts has been catalyzed by a hurricane. Environmental events have played an undeniable role in shaping public policy.

The most recent political developments as of 2018 reveal that the NFIP is rapidly becoming a program that is knowingly subsidized in order to maintain the status quo for coastal real estate. These developments are forcing a reckoning with latent contradictions in the original program, between expert flood plain management advocates and flood-prone landowners looking for a way to insure against catastrophes that are sure to come. Recent developments have not been couched as any sort of climate change policy, but they effectively constitute a policy of responding to climate change by declaring that even as the climate changes and sea levels rise, Americans will continue to inhabit coastal regions just as they have for several decades. This certainly seems like a rejection of the NFIP's intellectual heritage as a policy of interior floodplain management. However, a look back to the early 1950s shows that there is a continuity between the Truman administration's desire to use flood insurance to make sure manufacturers stayed in the flood-prone river bottoms of Kansas City, to the hopes of everyday flood insurance advocates in the lead-up to the creation of the National Flood Insurance Program, to the coastal disasters of 2005, 2012, and 2017, and the likely future reality that flood insurance will be involved for the continued habitation of coasts as sea levels rise and hurricanes intensify. Few politicians since Truman's era have been so frank about using flood insurance in that manner, but if the forgiveness of NFIP debts becomes a pattern after major disasters, then this intent needs to be made visible and stated explicitly. Even if this approach becomes more deeply entrenched,

however, one must question its permanence as losses continue to mount. In the next and final chapter, the focus turns directly to the future of the NFIP: to politics, to climate change, and how their interactions may develop.

Chapter Six

The Death of Stationarity: The Future of Flood Insurance

In 2018, the National Flood Insurance Program has reached a crossroads. As its losses mount, there seem to be two likely trajectories it will take. It could be reformed in the manner attempted by Biggert-Waters, pushing it back toward the approach of floodplain management that was held by Gilbert White and his school of thought, and toward a balanced budget. Or, it could continue to evolve further into a program that bolsters the status quo in the real estate world, especially on the coasts. A lack of legislative activity would essentially further entrench this second approach, assuming that Congress continues to raise the NFIP's borrowing limit or wipe away its debts. The challenges that face the NFIP moving forward can be grouped into three related categories. One set of challenges relates to demographic and land-use shifts in the United States. Another centers on the political conflicts that have bedeviled the program throughout its existence and especially since Katrina, as detailed in the previous chapter. The third is climate-related destabilization, which involves not just changing temperatures—warming on the average, but not in every circumstance—but also sea level rise and changes to precipitation patterns. Climate destabilization is leading to a breakdown of the assumption of stationarity—that natural events such as floods are random but occur within set parameters—an assumption that will be further discussed within this chapter. Looking forward, the physical manifestations of climate change will become more and more tangible, according to rigorously peer-reviewed studies and modeling, and will become the paramount challenge to the practice of flood insurance.[1]

[1] The most prominent of these are the reports of the Intergovernmental Panel on Climate Change, and for the United States in specific, the National Climate Assessment reports.

Demographically, coastal areas are becoming more populous concurrent with expected growth of high-risk flood zones, which itself will lead to deepening financial challenges for the NFIP so long as premiums do not keep pace with payouts.[2] While populations in flood-prone areas are expected to increase, home ownership may decrease. Trends from the decade 2006-2016 show the U.S. homeownership rate declining by over five percent, a trend that was not isolated to the financial crash of 2008.[3] If homeownership rates in the U.S. continue to drop, one eventual result could be a reduction in political support for the NFIP, which currently is mostly of benefit to homeowners, or program modifications to increase its relevance to renters. Related to demographic trends, land use changes also affect the hydrological cycle, bringing the potential to upset established flood risk assessments. Land use changes may be agricultural or urban in nature, and in addition to affecting hydrological cycles, can even cause land subsidence.[4]

Politically, the post-Biggert-Waters landscape reveals two clear camps with relation to flood insurance, one that might be termed the 'idealistic' camp that prioritizes ideals such as fiscal balance and environmental stewardship. With differing reasons, as discussed in the previous chapter, this group tends to favor using the boundaries created by floodplain mapping to

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[2] Barbara Neumann et. al., "Future Coastal Population Growth and Exposure to Sea-Level Rise and Coastal Flooding – A Global Assessment," *PLoS ONE* 10, no. 3 (2015): e0118571.

[3] U.S. Census Bureau, "Quarterly Residential Vacancies and Homeownership, Fourth Quarter 2017," Release Number CB18-08, 30 January 2018, https://www.census.gov/housing/hvs/files/currenthvspress.pdf. Last visited April 5, 2018.

[4] Agricultural land use changes usually expedite the drainage of water from agricultural lands, which can lead to more intense and faster-forming floods. For one explanatory case study, see You-Kuan Zhang and Keith Schilling, "Increasing Streamflow and Baseflow in Mississippi River Since the 1940s," *Journal of Hydrology* 324 (2006): 412-422. On the contributions of accelerated runoff to the Midwest floods of 1993, see Hugh Prince, "Floods in the Upper Mississippi River Basin, 1993: Newspapers, Official Views and Forgotten Farmlands," *Area* 27, no. 2 (June 1995): 118-126. For a historical perspective on agricultural drainage, see Joseph Otto, *Plumbing the Prairies* (Ph.D. dissertation, University of Oklahoma, forthcoming). In urban settings, increased coverage by surfaces impervious to water penetration exacerbates flooding problems. For a review of this issue, see William Shuster et. al., "Impacts of Impervious Surface on Watershed Hydrology: A Review," *Urban Water Journal* 2, no. 4 (December 2005): 263-275. Land subsidence can have both anthropogenic and geologic causes; the anthropogenic ones include land compaction and removal of underground water or mineral deposits. In the U.S., subsidence is of great concern in coastal Louisiana. See Juan Gonzalez and Torbjorn Tornqvist, "Coastal Louisiana in Crisis: Subsidence or Sea Level Rise?," *EOS* 87, no. 45 (November 2006): 493-508.

place limitations on land use. The opposing camp, which might be called the 'pragmatic' camp, is responsive to both constituent outcries and the desires of well-funded lobbies. This camp, which prioritizes the perpetuation of extant real estate ownership arrangements, rode high after 2014, but the camps are sure to clash again, as the NFIP faces periodic congressional re-authorization. Re-authorizations of the NFIP provide opportunities for legislative debate, and offer the best chances for major changes to be made to the program. The present political landscape is not barren of hope for rapprochement, however. Reconciliation between the NFIP's fiscal idealists and the pragmatists seems unlikely, but might be achieved on some level if Congress did away with the idea that the NFIP would be financially self-sustaining. This would not affect its continued burden on the federal budget, but if the NFIP turned into a program with planned federal expenditures, it would simply look more similar to many other programs—and to other forms of disaster relief that are not expected to be self-funding. Reconciliation between the environmental idealists and the pragmatists is easier to conceive of: if the NFIP were to increase incentives for ecologically sound coastal and riparian regulations and infrastructure, this might serve to mollify the environmentally focused groups for whom fiscal balance is not such a critical issue. One area where some mutual agreement exists is re-mapping. The idealists strongly favor investment in new maps that better reflect current risk exposures. The pragmatists, despite some concerns about the effects that new maps may have on insurance rates, tend to at least pay lip service to the importance of accurate flood insurance maps.

In terms of the effects of a warming global climate, sea level rise looms as the greatest challenge for the NFIP over the long run. As far as mapping, the technical challenges it presents are relatively straightforward: for each increment of sea level rise, corresponding areas would move into high flood risk classifications. The challenge presented by sea level rise is at its core a

political one. The large numbers of people and high property values found on the coasts near sea level guarantees that as sea levels rise, many more people should be mapped into high-risk zones, with commensurate high insurance premiums. Based on past precedent, it seems likely that one or both of two possibilities will happen: remapping of coastal flood zones will be slowed in the face of political pressure, or coastal rates will be more explicitly subsidized. Also potentially factoring into the equation are coastal structural protections such as seawalls that are being proposed and built with increasing frequency in high-population coastal areas.

A larger technical challenge for the coasts and flood insurance is to understand how tropical cyclones will be affected by climate change, and to translate that understanding into policy. But from a technical standpoint, a greater challenge still is to understand how river flooding will be affected by a changing climate. The effects of climate change on precipitation and hydrology are complex, not easily modeled, and highly uncertain, particularly for specific locales. As discussed in previous chapters, the recurrence of river floods has traditionally been viewed through the lens of stationarity, a term that refers to environmental processes that are random but occur within set parameters. In 2008, a landmark article declared the death of stationarity as an organizing concept in public works engineering, attributable especially to climate change.[5] Though the death of stationarity has become widely acknowledged in theory, no comparable replacement way of thinking about river flooding has yet emerged as of 2018.

Sea level rise is driven by warming temperatures primarily in two different ways. One is thermal expansion: as temperatures rise, warmer ocean waters expand. Thermal expansion has accounted for about half of the 4-8 inches that global sea levels have risen since the start of the twentieth century. (Thermal expansion also causes a decline in the density of surface waters,

[5] P. C. D. Milly, et. al., "Stationarity is Dead: Whither Water Management?," *Science* 319 (February 1, 2008): 573-4.

which can have a major impact on patterns of ocean circulation.)[6] Over the long term, the potential effects of thermal expansion are minor compared to the projected effects of the other mechanism, the melting of terrestrial ice caps and glaciers. Melting sea ice will not have significant effects, because ice that is floating already affects sea levels approximately the same amount that it will when it melts. The two major ice caps globally are found in Antarctic and Greenland. On the time scale of centuries, the melting of these ice caps is expected to be the main driver of sea level rise, and could easily exceed six feet by 2100 and fifty feet by 2500, depending on emissions trajectories, environmental feedback effects, and, perhaps, geo-engineering schemes.[7] On the annual and decadal time scales that are most relevant to the immediate future of the NFIP, scientists do not expect these major icecaps to provide significant contributions to sea level rise. Most of the ice melt contributions to sea level rise in the coming decades will come from smaller bodies of ice. At the present, global mean sea levels have risen about three inches in the past 25 years, and current best estimates project about 3-7 further inches of rise by 2030 and 6-14 inches by 2050. These global levels will be subject to some regional and temporal variation, caused by factors including ocean currents, atmospheric dynamics, and gravitational forces. Research suggests that these factors will likely exacerbate regional sea level rise on the Atlantic and Gulf Coasts of the United States, and may mitigate it on the Pacific Coast. The conditions for sea level rise through 2050 are mostly already determined, though future emissions scenarios will be very consequential to how much sea levels will rise in the more distant future.[8]

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[6] Robert Nicholls and Anny Cazenave, "Sea-Level Rise and Its Impact on Coastal Zones," *Science* 328 (June 18, 2010): 1517-1520.
[7] Robert DeConto and David Pollard, "Contribution of Antarctica to Past and Future Sea-level Rise," *Nature* 531 (31 March 2016): 591-597.
[8] On twenty-first century sea level rise in the US and regional variations in sea level rise, see William Sweet et. al., "Sea Level Rise," in *Climate Science Special Report: Fourth National Climate Assessment, Volume I*, eds. Donald

Rising sea levels will affect coastal flooding in various ways. The projections for 2100 and beyond would be catastrophic for entire coastal regions. But even the smaller increases in sea level rise that have already been observed and that will continue to develop in the coming decades will exacerbate coastal flooding problems. They will do this in part by creating a higher baseline sea level during tropical cyclones, so that storm surges will become more damaging, as described in the previous chapter. They will also cause an increase of "sunny day floods," also known as tidal floods, high-tide floods, or nuisance floods. Sunny day floods received their name because their occurrence is unconnected to storm systems. Instead, they are caused by unusually high tides. Tidal magnitudes are affected by the alignment of the sun and the moon, by the distance between the earth and the moon, and geomorphological factors. Though sunny day floods are not associated with major storms, they can be influenced by local wind patterns. The highest tides, called perigean spring tides, or colloquially 'king tides,' occur 3-4 times annually and are the most likely times for sunny day floods. Sunny day floods have always occurred, but have been and will continue to be exacerbated by rising sea levels, as the gap between mean sea level and current definition of flood stage progressively diminishes.[9]

The term 'nuisance flood,' common in the scientific literature, suggests that these floods are merely inconveniences rather than truly damaging events. Some politicians wishing to downplay the severity of climate change have pushed use of the term 'nuisance flooding' instead of 'climate change' or 'sea level rise'—a choice of terminology that is technically accurate but

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Wuebbles et. al. (Washington, D.C.: U.S. Global Change Research Program, 2017), 333-363; and William Sweet et. al., *Global and Regional Sea Level Rise Scenarios for the United States* (Silver Spring, Maryland: NOAA, 2017).

[9] On sunny day floods, see Hamed Moftakhari et. al., "Increased Nuisance Flooding Along the Coasts of the United States due to Sea Level Rise: Past and Future," *Geophysical Research Letters* 42, no. 22 (28 November 2015): 9846-9852. 'Flood stage' is a subjective metric that has nothing to do with flood frequencies, determined instead by potential damages caused. In some places, flood stage may never be reached, while in other places, it may be reached multiple times annually.

intentionally misleading.[10] In the past, it is true that these floods have much more often been inconveniences than truly damaging events. But as sea levels rise, that is going to become less and less accurate in the future, hence my choice of the 'sunny day flood' terminology. At least one recent analysis has found that over time, the cumulative damages caused by sunny-day flooding in the United States will exceed those caused by high-impact events like tropical cyclones.[11] This may be especially difficult for U.S. legislators to grapple with, considering the long legislative precedent traced in this study of promulgating flood-related legislation in the wake of major floods. Cities on the Atlantic, Pacific, and Gulf Coasts have all experienced upticks in sunny-day flooding. Annapolis, Maryland, has experienced a 925 percent increase in sunny day flooding since the middle of the twentieth century, with some of the city's streets often submerged by water at high tide.[12]

Even though sunny day flooding is a growing menace, as recent history has shown, tropical cyclones will continue to be a major driver of flooding in the United States as long as the Atlantic and Gulf Coasts remain heavily populated. Sea level rise will exacerbate the damage caused by tropical cyclones even if the storms themselves do not become more powerful, because each increment of sea level rise brings the shoreline closer to buildings and infrastructure. But the strongest tropical cyclones do appear to be getting stronger.[13] Predicting tropical cyclone frequency trends under a warming climate is subject to greater uncertainty, but is not as important for flood insurance as the intensity of the strongest storms, in any case,

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[10] In particular, Florida governor Rick Scott has directed state agencies to avoid using 'climate change' and 'sea level rise' in favor of 'nuisance flooding.'

[11] Hamed Moftakhari et. al., "Cumulative Hazard: The Case of Nuisance Flooding," *Earth's Future* 5 (2017): 214-223.

[12] William Sweet et. al., *Sea Level Rise and Nuisance Flood Frequency Changes Around the United States*, NOAA Technical Report NOS CO-OPS 073 (Silver Spring, Maryland: National Oceanic and Atmospheric Administration, 2014).

[13] James Elsner et. al., "The Increasing Intensity of the Strongest Tropical Cyclones," *Nature* 455 (September 2008): 92-95.

because the few strongest storms have done the great majority of the damage that was covered by flood insurance in recent decades.

Inland, warmer rivers are not going to simply swell in the same way that sea levels will rise, but their behavior is becoming much more difficult to predict based on established methods. Stationarity, a term that received increased attention in the hydrological community following a seminal and highly-cited article declaring its "death," is used to refer to processes that occur randomly but within known and unchanging parameters.[14] For a simple example, consider drawing a numbered marble from a jar with marbles numbered 0 through 100. Subsequent draws will usually produce different numbers, but assuming the previous marble is returned before each subsequent draw, the pool of possibilities remains constant, or stationary, over time. If each drawn number is tallied, the mean of all draws will creep ever closer to 50, which is the arithmetic mean of all integers between 0 and 100. But what happens if after each draw, the lowest-numbered marble—first 0, then 1, then 2, and so on—is removed from the jar and replaced with a new, higher-numbered marble—101, then 102, then 103, and so forth? The pool of possibilities gradually shifts (or is no longer stationary), as does the running mean of all numbers drawn. And if the replacement marbles do not follow an observable pattern—say, 117, then 239, then 108, and so on, then it becomes much more difficult to say anything very specific about how the running mean will shift.

Most formulas used to determine flood frequency during the twentieth century, including the ones discussed in previous chapters, have treated flood recurrence as process that exhibits

[14] Milly, et. al., "Stationarity is Dead: Whither Water Management?" The term remains most commonly used in the context of hydrology and water management, although one environmental journalist has applied it more broadly to the effects of climate change and destabilization. See Mark Schapiro, *The End of Stationarity: Searching for the New Normal in the Age of Carbon Shock* (White River Junction, Vermont: Chelsea Green, 2016). Schapiro's book was originally published two years earlier with the title *Carbon Shock: A Tale of Risk and Calculus on the Front Lines of the Disrupted Global Economy*, before being re-titled to include stationarity in its title.

stationarity. In other words, the assumption was that even though the occurrence of individual floods could not be predicted, the frequency of floods of different magnitudes on any particular stream would become statistically predictable over time, once an adequate baseline of meteorological history became available. All flood possibilities were drawn from the same marble jar, to relate to the above example. This belief was grounded upon assumptions that the climatic factors controlling flooding—including precipitation and temperature—are unchanging, and that the impact of land use changes can and will be accounted for. These assumptions have never been *entirely* true, as the authors of the article referenced above, "Stationarity Is Dead: Whither Water Management?," concede. However, climatic factors were thought to change slowly enough, or have limited enough effects, that stationarity could be assumed. FEMA Bulletin 17B, the official guidelines for flood frequency determination that the NFIP used between 1981 and 2018, stated that "available evidence indicates that major changes occur in time scales involving thousands of years. In hydrologic analysis it is conventional to assume flood flows are not affected by climatic trends or cycles. Climatic time invariance was assumed when developing this guide."[15] The document freely acknowledged that "it is becoming increasingly difficult to find watersheds in which the flow regime has not been altered by man's activity."[16] But while it is easy to observe and account for large-scale impacts on stream flows, such as dam construction, it is nigh impossible to keep track of and calculate for every parking lot, field tile, and incident of soil compaction that affects the hydrological cycle.

Land use changes can affect flooding in a variety of ways. In the American Midwest, one of the most frequent land use modifications to affect flood flows is agricultural drainage.

[15] United States Geological Survey, Interagency Advisory Committee on Water Data, *Guidelines for Determining Flood Flow Frequency*, Bulletin 17B of the Hydrology Subcommittee (Reston, Virginia: Office of Water Data Coordination, 1981), 6.
[16] Ibid., 7.

Farmers generally prefer that their fields are not soggy or flood-prone, and they, along with local governing entities, can implement a variety of techniques toward this end. These techniques include channel straightening, which enables small streams to carry water away from fields more quickly and keeps them from being choked by sediment; conversion of prairie land, which is more effective at retaining water, into cropland; and installation of field tile, tubes under the soil surface that drain water quickly into drainage ditches. In cities, channel straightening and modification can also occur, but an especially important modifier of urban hydrology is impervious surfaces—surfaces that cannot absorb water, like pavement. Just like field drainage, impervious surfaces in cities have the effect of moving water into streams more quickly than in unmodified landscapes. Especially in coastal areas, flooding can be affected by land subsidence, or sinking. This happens for a variety of reasons, including compaction and subsurface fluid extraction (such as oil drilling).[17]

In light of "the magnitude and ubiquity of the hydroclimatic change apparently now under way," the authors announcing the "death" of stationarity asserted that this assumption should no longer serve as the guiding principle in assessment of water-related risks.[18] In other words, while changes in land-use, which affect plant cover and soil characteristics, may affect the stationarity of particular streams, the death of stationarity is premised on the idea that climate change is destabilizing the assumption of stationarity globally. At its core, the breakdown of the stationarity assumption requires a radical shift in certain ways of understanding the natural world. Under this assumption, historical observations were used to predict the future. But if stationarity is no longer a valid assumption, then the past is no longer predictive of the future, This is less revolutionary for humanistic approaches to environmental change that have been

[17] Prince, "Floods in the Upper Mississippi River Basin, 1993;" Shuster et. al., "Impacts of Impervious Surface on Watershed Hydrology;" Gonzalez and Tornqvist, "Coastal Louisiana in Crisis."
[18] Milly et. al. 573.

more likely to assume variability than stationarity, even before the effects of climate change became more widely known. But disciplines such as engineering and climatology also use historical data, and have tended to employ the assumption of stationarity as a rule.

Nonstationarity will manifest itself differently in different places. In some cases, it will mean that projections based on historical data will overstate future precipitation and flooding levels. For many parts of the world, including the midwestern United States, precipitation and especially extreme precipitation events have trended upward over the twentieth century and into the twenty-first.[19] In the American Midwest, the magnitudes of the greatest floods have not changed significantly over the past half-century, but the frequency of high-magnitude river floods has increased markedly.[20] In other parts of the United States, the trends are different: decreasing river flooding in the Northwest, and a lack of a pronounced trend in the Northeast.[21] A recent study using outputs of multiple climate models projected that the return period for the flood magnitude that is currently defined as the hundred-year flood will decrease (flooding will become more common) in the American Southeast and Lower Midwest during the twenty-first century, while the return period will increase (flooding will become less common) around the

[19] Studies documenting this include Jim Angel and Floyd Huff, "Changes in heavy rainfall in Midwestern United States," *Journal of Water Resources Planning and Management* 123, no. 4 (1997): 246-249; Thomas Karl and Richard Knight, "Secular trends of precipitation amounts, frequency, and intensity in the USA," *Bulletin of the American Meteorological Society* 79 (1998): 231-241; Thomas Peterson et. al., "Changes in North American extremes derived from daily weather data," *Journal of Geophysical Research* 113 (2008): D07113; and Sara Pryor et. al., "How spatially coherent and statistically robust are temporal changes in extreme precipitation in the contiguous USA?," *International Journal of Climatology* 29 (2009): 31-45. Also see Gabriele Villarini et. al., "On the frequency of heavy rainfall for the Midwest of the United States," *Journal of Hydrology* 400 (2011): 103-120.
[20] Iman Mallakpour and Gabriele Villarini, "The Changing Nature of Flooding Across the Central United States," *Nature Climate Change* 5 (2015): 250-254.
[21] On both the Northwest and the Northeast, see Gregory McCabe and David Wolock, "Spatial and Temporal Patterns in Coterminous United States Streamflow Characteristics," *Geophysical Research Letters* 41, no. 19 (16 October 2014): 6880-6897. On the Northeast, see also Allan Frei et. al., "The Seasonal Nature of Extreme Hydrological Events in the Northeastern United States," *Journal of Hydrometeorology* 16 (October 2015): 2065-2085.

Great Lakes and especially in the Southwest.[22] Even though stream flows are also affected by changes in land use, studies are starting to separate land use and climatic factors in flow trends, confirming that land use alone is not responsible for all of the changes seen throughout the past century.[23] This is an important distinction because while land use can have dramatic impacts on local environments, nonstationarity means that even streams untouched by land use changes (if such things even exist) will nonetheless behave differently than models assuming stationarity would predict.

The concept of stationarity has most frequently been employed in connection with inland floods and heavy precipitation events. In the United States, severe coastal flooding usually comes with tropical cyclone storm surges, though heavy rain brought by such storms can also contribute to flooding (as in Hurricane Harvey), and scientific discussion of nonstationarity has focused less on the coasts than inland waterways. But the same broad concept can be applied to tropical storms in terms of changes to their frequency and severity. Sea level rise also affects coastal probabilistic flood modeling, but since it can be measured, it is more easily accounted for than changes in storm frequency and intensity. One of the world's preeminent students of tropical cyclones and climate change, Kerry Emanuel, along with a younger scholar who he had previously mentored, considered the status of tropical cyclone prediction in a 2016 article.[24] They developed the useful metaphor of the 'grey swan' tropical cyclone: a storm "that would not be predicted based on history but may be foreseeable using physical knowledge together with historical data."[25] The 'grey swan' terminology builds off of the concept of the 'black swan'

[22] Yukiko Hirabayashi et. al., "Global Flood Risk Under Climate Change," *Nature Climate Change* 3, no. 9 (2013): 816-821.
[23] Gabriele Villarini and Aaron Strong, "Roles of climate and agricultural practices in discharge changes in an agricultural watershed in Iowa," *Agriculture, Ecosystems and Environment* 188 (2014): 204-211.
[24] Ning Lin and Kerry Emanuel, "Grey Swan Tropical Cyclones," *Nature Climate Change* 6 (2016): 106-111.
[25] Lin and Emanuel 111.

developed by the philosopher Nassim Nicholas Taleb to refer to consequential events that are completely unforeseen before their occurrence.[26] Their study focused specifically on three locations around the globe, including Tampa, Florida, finding that storm surges now seen as vanishingly unlikely could become much more probable by the end of the twenty-first century under current global warming scenarios. But the more important contribution of the term 'grey swan' is to provide an easily understood way to think about changing storm probabilities. When government officials refer to storms as 'thousand-year events,' they may be intending to convey that they could not have been expected to prepare for them. But in a world where the likelihood of severely damaging storms is increasing, such abdication of responsibility based on historical probabilities does not serve very well anyone besides buck-passing politicians and interests they represent that benefit from the status quo, such as real estate and fossil fuel interests.

In spite of the widely perceived breakdown of stationarity and the well-studied effects of climate change on flooding, through 2018, climate change has not featured prominently in the NFIP's official guidelines or legislative authorizations, regardless of which political party was in power. If the program were operating as designed, with the legally prescribed five-year mapping cycle fully funded, it would be somewhat less important to explicitly address climate change, because frequent re-mapping of high-risk flood zones would incorporate ongoing shifts in statistical flood frequency and ensure that all holders of unsubsidized policies were paying premiums commensurate with their current risk exposure. Alas, as we have seen, that is rarely the case. The political pressures not to address how climate change will affect flood insurance come from both the Republican Party's general aversion to acknowledgement of climate change, and from the specific effects that accounting for climate change could have on entrenched

[26] Taleb develops the idea of the Black Swan in his book *The Black Swan: The Impact of the Highly Improbable* (New York: Random House, 2007). The term refers to ancient societies that did not believe black swans could exist until seeing them.

interests, especially owners of coastal properties—pressures that neither party is immune to. Reconciling the NFIP with both the extant and predicted manifestations of climate change, as the program is currently designed, ultimately depends on accurate and timely remapping of flood risks under the status quo. In this sense, Biggert-Waters was a major step toward preparing the program for climate change, with its greatly increased annual appropriations for the flood mapping program and creation of an expert advisory council for the mapping project. The legislative wrangling over Biggert-Waters can thus be seen as an early attempt to reconcile flood insurance and climate change. The partial repeal of Biggert-Waters did not specifically target the mapping appropriations, though they have been targeted for reduction in the years since. The 2014 partial repeal legislation did call for remapping to be based on "technically credible" data, a somewhat arbitrary requirement which was meant to be interpreted by the Technical Mapping Advisory Council. While Biggert-Waters supporters backed measures to bring the program more in line with the expected costs of climate change, its opponents balked at higher premiums, either refusing to acknowledge the costs of climate change—or implicitly demanding that the costs be borne by the nation's taxpayers at large rather than charging it to their specific constituencies.

There are, of course, many involved with flood insurance who understand that climate change is an existential challenge for the NFIP. FEMA itself has been responsible for a pair of reports on climate change impacts and flood insurance, and it is hardly a surprise that the experts who study flood insurance are aware of the potential for climate change to affect the NFIP, even if politicians try to obscure the connection. The first report was released in 1991, long before the post-Katrina turmoil of the NFIP. Its authors concluded that sea level rise was not occurring fast enough to be a major concern for the NFIP, and emphasized coastal subsidence on the Gulf Coast as a greater threat. The lack of concern about sea level rise was built largely on the

assumption that its gradual occurrence would allow plenty of time for flood maps to be re-drawn to reflect accurate sea levels.[27] Then, in 2008, FEMA commissioned a major assessment of climate change, demographic shifts, and the flood insurance program, upon the recommendation of the nonpartisan Government Accountability Office. One major outcome of this project was a 2013 report, *The Impact of Climate Change and Population Growth on the National Flood Insurance Program through 2100*.[28] This report, like the 1991 report before it, mostly steered clear of the political debates that have surrounded the NFIP. Its findings, while certainly not alarmist, suggested more looming challenges than the 1991 report had. It found that special flood hazard areas are expected to increase by about 45 percent in riverine areas by 2100, and by up to 55 percent on the coasts. The 2013 report differed from the 1991 report in one key way regarding coastal projections. The 1991 report had assumed that shorelines would recede as sea levels rise, leading to flood zones that would not substantially change in area, only move inland. But the 2013 report recognized the efforts many localities are taking to prevent coastal recession, which would lead to larger flood hazard areas because new land would become flood-prone while land that would naturally be overtaken by water remained inhabited. Even though it is only five years old, the 2013 report is in a sense dated, as it makes no mention of Sandy and the ongoing destabilization it caused for the NFIP, much less the storms of 2017. Though Sandy happened prior to the report's 2013 publication, it was presumably in its final draft stage by then.[29]

Though NFIP legislation has not specifically addressed climate change, it is an explicit concern for some legislators. Prominently, Maxine Waters, after whom Biggert-Waters is named,

[27] Federal Insurance Administration, *Projected Impact of Relative Sea Level Rise on the National Flood Insurance Program* (Washington, D.C.: FEMA, 1991). The study was authorized by Pub. L. No. 101-137 (1989).
[28] Perry Rhodes et. al., *The Impact of Climate Change and Population Growth on the National Flood Insurance Program through 2100* (Arlington, Virginia: AECOM, 2013).
[29] Katrina did not feature heavily in the report, either. Its focus was mainly on engineering and economic methods, and it did not explicitly attempt to grapple with the NFIP's financial hole.

had been addressing climate change in her legislative proposals to reform the NFIP since 2007.[30] In the wake of the 2004 and 2005 hurricane seasons, Senators Joe Lieberman and Susan Collins, the chairman and ranking member of the Senate Committee on Homeland Security and Governmental Affairs, requested the Government Accountability Office produce a report on climate change risks to federal and private insurers including the NFIP published in 2007.[31] Among environmental groups that have dedicated attention to the NFIP, many belonging to the SmarterSafer coalition, climate change is central to their NFIP advocacy. The Natural Resources Defense Council identifies flood preparedness as a component of its climate resilience initiative.[32] Similarly, the National Wildlife Federation emphasizes climate change in its floodplains initiative.[33] Two of the major lobbying groups for the real estate and homebuilding industry that aided the effort to partially reverse Biggert-Waters, the National Association of Realtors and the National Association of Home Builders, in stark contrast, do not emphasize concerns about flooding or other types of damage in their positions on climate change. Instead, their stated concerns regard the ways that legislation to mitigate climate change will affect home prices and the costs of homebuilding.[34]

Legislation meant to bolster the NFIP's preparedness for climate change has mostly been unsuccessful through 2018, despite the best efforts of a range of environmental groups and concerned lawmakers. However, there are some forms of societal adaptation to climate change

[30] Found in her proposed Flood Insurance Reform and Modernization Act of 2007, 110 H.R. 3121.
[31] The result of this request was a report, *Climate Change: Financial Risks to Federal and Private Insurers in Coming Decades are Potentially Significant* (Washington, D.C.: U.S. Government Accountability Office, 2007).
[32] See National Resources Defense Council, "Prepare for Flood," https://www.nrdc.org/issues/prepare-flood, last visited April 5, 2018.
[33] See National Wildlife Federation, "Protecting Floodplains," https://www.nwf.org/Our-Work/Habitats/Floodplains, last visited April 5, 2018.
[34] For the climate change statement of the National Association of Home Builders, see "Climate Change," https://www.nahb.org/en/research/nahb-priorities/climate-change.aspx, last visited April 5, 2018. For the climate change statement of the National Association of Realtors, see "Energy Efficiency and Climate Change," https://www.nar.realtor/energy-efficiency-and-climate-change#section-170113, last visited April 5, 2018.

that will affect the program and the property owners it insures. Just as levees can be built to contain riverine floods, seawalls can be built to hold back coastal waters. Seawalls are not a new technology; they have been used for thousands of years to protect against coastal inundation and erosion. But with rising sea levels wrought by a warming global climate, they have assumed a new prominence. From New York, to San Francisco, to climate-denying President Donald Trump's own golf course in Ireland, seawalls are being planned, built, or strengthened in order to guard against rising seas—and rising insurance premiums. As long as the NFIP continues to reduce insurance rates and requirements for people living behind seawalls, it may actually play a part in building political support for them. In a statement heralding plans for a $620 million seawall project planned for his Staten Island district, New York Congressman Dan Donovan especially highlighted the fact that the project would lead to lower flood insurance premiums. Because this particular seawall is designed to protect against a 300-year flood, areas behind its protective reach will be mapped out of the special flood hazard area.[35] While the Staten Island seawall is planned to be twenty feet tall and even protect against tropical cyclones, even much shorter seawalls would still offer protection against sunny day flooding for at least several decades.

Along with their structural similarities, there are concerning parallels between coastal seawalls and riverine levees. Most notably, they offer no protection when they are breached, and can even increase losses due to the sense of safety that they have created and abrupt onset of floods once technological protections fail. The portions of Staten Island receiving protection against 300-year flood levels will no longer be required to purchase flood insurance, and for those that do opt to purchase it, rates will be substantially lower than prior to the seawall's

[35] "Donovan: Army Corps Seawall Will Reduce Flood Insurance Premiums," Press Release, Office of Congressman Dan Donovan, 30 October 2017. Available online at https://donovan.house.gov/media-center/press-releases/donovan-army-corps-seawall-will-reduce-flood-insurance-premiums, last visited April 5, 2018.

construction. Yet so-called 500-year floods are happening with increasing frequency, so it is not inconceivable that the Staten Island seawall could be overtopped. In fact, the 20 feet of protection to be offered by the seawall could easily be below sea level before the passage of three hundred years, to say nothing of floods by that time that exceed sea level.[36] Armored seawalls are a symbolically powerful representation of human efforts to latch onto extant natural boundaries, rather than abide by shifts in the limits of the natural world brought about by a changing climate. They may be effective in this purpose, but any flood that breaches the seawall will do massive damage, and if current practices continue, will impact neighborhoods that are either uninsured against flood losses, or have paid low premiums for their insurance.

In the long term, if global temperatures continue to rise as current models forecast, then coastal floodplain management will look more like managed retreat, with the possible exceptions of large, wealthy cities hunkered down behind gargantuan seawalls.[37] In the short term, there are ways that the NFIP could be used as a tool to reduce flood hazards without turning the coasts of the United States into an armored fortress.[38] Seawalls seem to be an inevitable development surrounding the most heavily developed coastal areas, because of the high levels of investment found there. But they are not the only way that coastal flooding can be mitigated. "Living shorelines" is a term that describes coasts with natural or restored ecosystems such as coral reefs, mangroves, or salt marshes. These living shoreline regions provide protection against storm surges by helping to absorb them. The National Wildlife Foundation, in discussing one particular

[36] Andra Garner et. al., "Impact of Climate Change on New York City's Coastal Flood Hazard: Increasing Flood Heights from the Preindustrial to 2300 CE," *Proceedings of the National Academy of Sciences* 114, no. 45 (November 2017): 11861-11866.
[37] On the possibility of retreat, see Robert Verchick and Lynsey Johnston, "When Retreat is the Best Option: Flood Insurance after Biggert-Waters and Other Climate Change Puzzles," *John Marshall Law Review* 47, no. 2 (Winter 2013): 695-718.
[38] "Armor" is a term often used to describe coastal structural protections such as seawalls. Around 14 percent of the US coastline is currently armored, a number that is projected to more than double during the twenty-first century. See Rachel Gittman et. al., "Engineering Away our Natural Defenses: An Analysis of Shoreline Hardening in the US," *Frontiers in Ecology and the Environment* 13, no. 6 (August 2015): 301-307.

coastal marsh, dubbed it "Nature's Flood Insurance."[39] Their benefits are not as easily mapped as the protections offered by seawalls, but even if their presence is not reflected in altered mapping, it could be recognized by the NFIP's Community Rating System, which offers discounted insurance rates to communities that take various floodplain management actions.[40] Living shorelines offer a dramatic contrast with armored seawalls in terms of human relationships with natural boundaries: not only do they promote acknowledging and abiding by these boundaries, but some forms of living shorelines such as salt marshes may even be able to migrate to reflect shifting boundaries.

Retreat itself is also already on the table. One way that the abandonment of flood-prone lands can take place is through buyouts of flood-prone properties, often at least partially federally funded. This is not something that the NFIP itself undertakes or facilitates, but buyouts are often done with the involvement and financial support of FEMA. While buyouts can be very expensive when done at scale, they can help remove some of the most flood-prone properties and liabilities from the rolls of the NFIP. Buy-backs have the added advantage of allowing property owners to cope with increasing flood risk without the sense that their investment in real estate is slowly slipping away.[41] Federally-assisted buyouts have the potential to be an important way of helping the NFIP—and the nation as a whole—deal with encroaching oceans, though funding is sure to be a challenge.

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[39] Doug Stewart, "The Great Marsh: Nature's Flood Insurance," *National Wildlife* February-March 2015, https://www.nwf.org/Magazines/National-Wildlife/2015/FebMarch/Conservation/Great-Marsh, last visited April 5, 2018.

[40] See Kevin MacWhorter and Kathleen Zaratzian, *Green Infrastructure in the Community Ratings System: A Proposed Path to National Flood Insurance Program Recognition* (Williamsburg, Virginia: Virginia Coastal Policy Center at William & Mary Law School, 2016). On balancing flood barriers, preserving or rebuilding coastal wetlands, and zoning and building codes in large cities, see Jeroen Aerts et. al., "Evaluating Flood Resilience Strategies for Coastal Megacities," *Science* 344 (2 May 2014): 473-475.

[41] On the other hand, land that is deemed appropriate for buyouts, but where finances have not allowed buyouts, is a worst-case scenario for landowners. For a recent journalistic account of such a situation in Louisiana, see Tegan Wendland, "Louisiana Says Thousands Should Move From Vulnerable Coast, But Can't Pay Them," *National Public Radio All Things Considered* January 4 2018, https://www.npr.org/2018/01/04/572721503/louisiana-says-thousands-should-move-from-vulnerable-coast-but-cant-pay-them, last visited April 5, 2018.

While this chapter has dealt heavily with climate-related threats to the stability of the NFIP, the federal program may also find itself under increasing pressure from a source of competition that would have seemed unlikely at the time of the program's creation: privately-owned insurance companies. There has never been any legal barrier preventing private insurers from offering flood coverage, but their absence from the market was what spurred federal involvement in the first place, and through most of the NFIP's existence, few if any private insurers have taken the initiative to enter the market. Interest from homeowners in private flood insurance started to increase after Katrina, and one of the less-controversial parts of the Biggert-Waters legislation clarified that private flood insurance was eligible to meet the coverage requirements for mortgage holders in the special flood hazard zone.[42] Biggert-Waters also mandated a pair of reports about how to encourage private sector involvement in flood insurance.[43]

As of early 2018, the penetration of private flood insurance remains minuscule, but there is bipartisan interest in further encouraging the private market in the next long-term reauthorization of the NFIP. Legislation that was proposed but not ultimately passed into law in 2017 would have encouraged private insurers to offer flood insurance by further clarifying the specific requirements that private policies would have to meet in order to fulfill the insurance requirements for holders of federally-backed mortgages in high risk areas. It also would have strengthened the position of private insurers by allowing private flood insurance to meet the continuous coverage requirements of the NFIP. This legislation, called the Flood Insurance

[42] The increased interest in flood insurance post-Katrina is noted in Andrea Wells, "Private Insurers Ready to Plunge Into Flood Market," *Insurance Journal* 10 July 2017, https://www.insurancejournal.com/magazines/mag-features/2017/07/10/456390.htm, last visited April 5, 2018.

[43] These reports have since been completed: United States Government Accountability Office, *Flood Insurance: Strategies for Increasing Private Sector Involvement* (Washington, D.C.: Government Accountability Office, 2014); and Federal Emergency Management Agency, *National Flood Insurance Program: Report to Congress on Reinsuring NFIP Insurance Risk and Options for Privatizing the NFIP* (Washington, D.C.: Federal Emergency Management Agency, 2015).

Market Parity and Modernization Act, received strong bipartisan support, and stalled less because legislators opposed it on its own terms and more because of a sense that it should not be prioritized over other legislation to re-authorize the NFIP for the long term. It received support both from real estate lobbies and from the SmarterSafer coalition, and chances seem good that it may eventually reach passage. Currently, if an NFIP policyholder whose rate is subsidized lets their policy lapse, then they lose their eligibility for subsidized rates. If moving to a private plan meant breaking continuous coverage, this would be a barrier that would discourage people from making the switch. But if both private and NFIP policies meet the continuous coverage requirements, then property owners would be more free to move from one policy to another.

There are strong arguments and political forces against many similar types of privatization, including privatization of public health insurance programs that benefit people who are impoverished or living with complicated medical conditions. A private take-over of the U.S. flood insurance market may not be such a bad thing, though, depending on how it were to unfold, at least from a fiscal point of view. The NFIP has certainly been an effective tool for implementation of the principles of floodplain management in some ways, but has also subsidized the efforts of irresponsible developers of floodplain lands. If the flood insurance market were to become completely privatized, with no governmental subsidies or promises of bailouts, then private insurers would likely take a firmer stand than the NFIP has against insurance rates that do not accurately reflect flood risk. One potential pitfall of private flood insurance is that it may offer weaker coverage than the NFIP, enticing customers with low premiums but leaving them with the wrong kind of "high-and-dry" feeling in the wake of flood losses not covered by their policies. Perhaps a greater concern for advocates of good governance is that with improved risk analysis, private flood insurers could entice low-risk customers by

undercutting the NFIP's rates, while refusing to cover high-risk properties or only covering them at extremely high rates, effectively privatizing the profits to be made in flood insurance while leaving the losses to be socialized. Alternatively, they could maintain the current status quo, profiting on governmental subsidies while insuring flood-prone development. However the effort to increase private flood insurance develops, it seems reasonable to assume that some type of governmental subsidy mitigating the real costs of insurance will continue. It is difficult to be sanguine about the social costs of such a program. The privatization wave of the late twentieth and early twenty-first centuries has typically weakened benefits for the poor and politically powerless, not those who have the clout to make their voices heard.

The even more unlikely development of a privately operated flood insurance industry, entirely without governmental contributions or subsidies, might nonetheless turn out to be a boon for proponents of floodplain management. High premiums would provide a market disincentive that discourages inhabitation of the most flood-prone places, just as Gilbert White envisioned. But with the effects of a warming global climate becoming more and more pronounced, floodplain management—especially on the coasts—will face a different set of pressures than it has in the past. Two emerging ways of dealing with changing coastal risk, seawalls and property buyouts, have very different relationships with floodplain management and the limits created by the natural world. The increasing interest in seawalls represents something of a turn away from the principles of floodplain management and toward flood control. Buyouts, on the other hand, represent not merely floodplain *management* but floodplain *abandonment*. Yet both the context and the stakes are somewhat different than when Gilbert White helped lead the initial turn toward floodplain management. White's thinking about floodplain management centered on rivers and their floodplains, more than those of coasts. The idea of floodplain management looks

different when applied to static floodplains rather than to ones that will encroach relentlessly into new terrain. And while the floodplain management mindset recognizes that there are parts of floodplains best left undeveloped or even abandoned, some of the coastal regions vulnerable to sea level rise include some of the most populous cities and most valuable real estate in the world. Retreating from them, while not impossible, would be a much bigger task than anything previously accomplished in the name of floodplain management. In the twenty-first century, the sweet spot for maintaining a floodplain management approach may involve the federal government helping to fund buyouts for flood-prone properties in areas of lower settlement density and valuation, and only becoming involved in seawalls when lower-level jurisdictions or private entities provide partial financial support. The old 1936 directive that federal flood control works are justified whenever the benefits to whomever they may accrue outweigh the costs—though not necessarily the basis on which current flood control projects are evaluated—would become completely untenable financially as sea levels continue to rise, and as costs become infinite.

In the decades since anthropogenic climate change has been identified as an important problem, interested parties have debated the merits of adaptation and mitigation. In short, adaptation to climate change involves adjustments meant to enable the continued existence of familiar social structures even as the global climate changes, while mitigation of climate change involves actions taken to slow, stop, or reverse the anthropogenic causes of climate change. Both seawalls and property buyouts are examples of climate adaptation. Historically, there has been some level of tension between advocates of climate adaptation and climate mitigation.[44] For

[44] For one perspective on the adaptation-mitigation debate, arguing in favor of embracing adaptation, see Roger Pielke, Jr., et. al., "Lifting the Taboo on Adaptation," *Nature* 445, no. 7128 (2007): 597-598. Lead author Pielke Jr. has gained some notoriety as a skeptic of climate change, though he himself disavows this label. The skeptic label comes particularly from his arguments that increased financial damages due to natural disasters are caused by

proponents of climate mitigation, adaptation may represent a sort of surrender, a giving-up on the goal of slowing down and halting practices that have led to high levels of greenhouse gas emissions. Coinciding roughly with the ascendance of Barack Obama to the presidency, adaptation has received increasing attention from scientists and policymakers alike. By no means is this to suggest that widespread support for climate mitigation has disappeared. As of 2018, organizations and activists continue to call for reducing emissions to keep global warming within thresholds of 1.5 or 2 degrees Celsius. But barring an unforeseen series of events, we appear locked into not just the current levels of atmospheric greenhouse gases, but into a trajectory that has continued its upward trend unabated despite all efforts to date to restrain it.[45] The recognition that some amount of anthropogenic global warming is now all but locked-in has made adaptation seem like more and more of a sensible approach, even for those who may be philosophically inclined to support continued mitigation efforts.

Insurance can work as either an adaptive or a mitigative tool, but in the case of flood insurance and climate change, adaptation would seem to be its more likely role. For insurance to help mitigate a hazard, concern about insurance premiums must be great enough that it motivates either insurance providers or customers to take effective steps to reduce relevant hazards. In fire insurance, for example, the insurance itself can help mitigate fire risk, because insurers incentivize actions that reduce risk. Flood insurance can be a mitigative tool when considering flood risk itself, by encouraging actions such as elevating properties out of the special flood hazard area. But for climate change and sea level rise, the efforts needed are so large that the

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greater dollar value of infrastructure exposed to risk rather than increasing severity of disasters due to climate change.

[45] One study, for example, finds that already-emitted greenhouse gases have likely 'locked in' between 1 and 1.5 degrees Celsius of warming, regardless of future actions. See Thorsten Mauritsen and Robert Pincus, "Committed Warming Inferred from Observations," *Nature Climate Change* 7 (2017): 652-655. Another study models future CO2 emissions and finds that there is only a five percent chance that warming will be kept to less than two degrees Celsius of warming by 2100. See Adrian Raftery et. al., "Less than 2°C Warming by 2100 Unlikely," *Nature Climate Change* 7 (2017): 637-641.

effects of flood insurance rates to spur action would be minuscule. As a tool of adaptation, flood insurance may serve either to provide an incentive for people to abandon places that have become flood-prone, or to subsidize the risks of maintaining properties found in newly flood-prone regions and thus perpetuate the status-quo usage of those areas. As the developments detailed throughout this dissertation, the latter mechanism seems a more likely outcome than the former, at least in the short term. Perhaps no single incident gives more credence to this prediction than the collapse of the Biggert-Waters flood insurance reforms. But there are reasons to suppose that the NFIP could be employed in a way that would do more to prioritize abandonment of, or advance flood preparations for, areas that see their flood risk levels increase. Certainly, the pendulum could swing forcefully in the direction of the ideals held by many Biggert-Waters proponents, whether that might mean an increased public focus on riparian and coastal ecological issues or a dedication to balanced budgets that expands beyond think-tank scholars and out-of-power political opportunists. Economic hard times or exploding budget deficits could make continued subsidization of the NFIP politically toxic. But even aside from these idealistic reservoirs of support, there are pragmatic, legal reasons to think that in the future, flood risk maps may be updated with better frequency, mitigating one of the ways (through outdated maps) that the NFIP fails to keep up with changing hazards related to climate change.

Throughout the history of the NFIP, most of the property-related lawsuits that have been brought against it have involved charges of regulatory takings, or in other words, plaintiffs upset that flood risk assessments have unfairly taken some of the value of their property away from them. In most cases, courts have ruled in favor of the NFIP, and by the program's maturity, judicial precedent typically recognized the right of the federal government to impose regulatory floodplains even though they had the potential to take monetary value away from property

owners. But as some legal theorists, most notably the lawyer-scientist Jon Kusler, have argued, governments may have to walk a legal tightrope in the future. They may have to deal with potential lawsuits not only from property owners who think that their property rights have been unfairly limited by regulatory action, but conversely, from property owners who have suffered damages attributable to climate change and who allege that governments have not done enough to adequately prepare for anticipated effects of climate change.[46]

While lawsuits of this type have not yet become a part of the legal landscape, Kusler argues that there are good reasons to think that they could be in upcoming decades. One reason is the increasing foreseeability of natural disasters. Kusler distinguishes between predictability (location and time of a specific event) and foreseeability (more generalized anticipation, which is aided by improved models), and notes that legal precedent requires only foreseeability, not prediction.[47] Second, suits claiming that governments have exacerbated flooding and flood-related erosion in conventional, non-climate-change contexts have become common, and there is no reason to think lawsuits of this type will not eventually include suits involving flooding exacerbated by climate change. Third, advances in techniques for minimizing hazard-related losses mean that there is also a rising standard of "reasonable conduct" for engineers, architects, and others involved in construction of houses and infrastructure. Courts have held that when reasonable conduct standards are not met, then entities ranging from governments to professional practitioners may be found negligent and held liable for damages. Fourth, advances in hazard modeling make it likely that causation for particular incidents may become easier to pinpoint

[46] See Jon Kusler, *Government Liability and Climate Change: Selected Issues for Wetland and Floodplain Managers*, published online by the Association of State Wetland Managers, 2016, https://www.aswm.org/pdf_lib/government_liability_and_climate_cahnge_kusler_0416.pdf, last visited April 5, 2018. Portions of this e-book are also found in Kusler's print book *Government Liability for Flood Hazards* (Association of State Wetland Managers, 2017). See also Brian Mayer, "Climate Change, Insurance, NEPA, and Article III: Does a Policy Holder Have Standing to Sue a Federal Agency for Failing to Address Climate Change under NEPA?," *UMKC Law Review* 74, no. 2 (2005): 435-453.

[47] Kusler 2016, 12.

than in the past, including climate change as a causal agent. Finally, certain legal defenses frequently used in cases of negligence have evolved or weakened. “Assumption of risk,” a doctrine that holds that a person is liable for risk that they knowingly assumed even if the risk was created by the negligence of others, has been found inadequate in some recent legal cases, while the doctrine of “contributory negligence,” which may prevent a plaintiff who is found to bear even a small percentage of the negligence from collecting any damages, has been increasingly replaced with a doctrine of “comparative negligence” under which damages are awarded based on percentage of responsibility.

The most obvious way that this potentially shifting legal landscape interacts with flood insurance is that flood victims who receive insurance payouts are much less likely to sue for damages than those who do not. If the federal, state, and/or local governments begin to face and especially to lose lawsuits over inadequate preparation for climate change, then the incentives for keeping a generous flood insurance program in place—whether or not it is actuarially sound, or running at a consistent deficit—will only increase. But while the possibility of lawsuits over inadequate preparation for climate change would not inherently incentivize an actuarially sound flood insurance program, such a possibility would most certainly provide a strong enticement to make sure that flood risk is properly mapped. In the past and at present, most mapping disputes involve people who are upset about being mapped into high-risk zones and the prices they are thereby required to pay for insurance. Following Kusler’s logic, however, it is conceivable that flood victims without insurance might begin to sue because they were *not* mapped into a high-risk flood zone, where they would have been required to carry flood insurance.

Most published analyses of the future of the National Flood Insurance Program, as well as much of the analysis presented in this chapter, assume a relatively stable economic situation

extending into the foreseeable future. The AECOM report is an exemplar of this assumption, in the economic analysis it undertakes for years as distant as 2100. Yet in light of the resource pressures wrought by an expanding global population, exacerbated by an unstable climatic situation, that type of stability seems somewhat less than assured. Numerous scholars of the 1960s and 1970s predicted impending general catastrophe based on environmental degradation and overpopulation, most notably Paul Ehrlich and the Club of Rome.[48] Though their reputations took beatings as many of their predictions failed to materialize on their projected time scales, they retain an ardent set of defenders who maintain that they got the big picture mostly right, as described by the environmental historian Donald Worster.[49] Richard Heinberg, one of those persistent defenders, argues that climate change is not itself the greatest environmental problem facing the 21st century world, but rather a (very dangerous) symptom of a more comprehensive problem that he calls "overshoot," the overshooting of Earth's long-term carrying capacity. This overshoot, he argues, has been accomplished through the use of cheap energy from fossil fuels, which has powered mining, production, and consumption, and population levels, all leading to increased levels of pollution and natural habitat loss.[50] The significance of Heinberg, and his contemporaries who are making similar arguments, is not that they developed the idea that

[48] Ehrlich's *The Population Bomb* (New York: Ballantine, 1968) focused on overpopulation as a cause of environmental degradation, while *The Limits to Growth; a Report for the Club of Rome's Project on the Predicament of Mankind* (Donella Meadows and Club of Rome, New York: Universe Books, 1972) considers several factors, including population but also pollution, resource depletion, and food production. The Club of Rome is an organization of scientists, industrialists, and economists concerned with the global pace of socio-economic development. It is named after the meeting in Rome that led to its creation in 1968.

[49] Worster mounts a strong defense of the proponents of natural limits to growth in his book *Shrinking the Earth: The Rise and Decline of American Abundance* (New York: Oxford University Press, 2016). Along with Worster's recent book, popular writer Charles C. Mann has also surveyed the clash of views between proponents of environmental limits and environmental optimists in his recent book *The Wizard and the Prophet: Two Remarkable Scientists and Their Dueling Visions to Shape Tomorrow's World* (New York: Alfred A. Knopf, 2018). Historian Paul Sabin assesses a famous bet between Ehrlich and his critic Julian Simon about Ehrlich's predictions for the future, and the growing divide between the mindsets they represent, in his book *The Bet: Paul Ehrlich, Julian Simon, and Our Gamble over Earth's Future* (New Haven: Yale University Press, 2014).

[50] This is a general theme of much of Heinberg's body of work, but is tidily encapsulated in his essay "Systemic Change Driven by Moral Awakening is our Only Hope," *EcoWatch* 14 August 2017, https://www.ecowatch.com/climate-change-heinberg-2471869927.html, last visited April 5, 2018.

humans are overshooting Earth's carrying capacity—others, including many environmentalists, have been making that argument for decades—but their recognition of climate change as a symptom of a broader phenomenon, rather than a root problem in and of itself.

If it is true that resource shortages, overpopulation, and a changing climate are suggesting a global trajectory that points toward some sort of general contraction if not full-scale collapse, or even just a global economy with much slower growth than the past two centuries of history—and it seems short-sighted not to at least entertain the possibility—then flood insurance could conceivably be the blade of the razor that separates the current regime from the era of contraction. Even in less dramatic terms, if the global contraction predicted by the likes of the Club of Rome is not just around the corner, flood insurance could play a major part in a future economic downturn or depression. A 2016 analysis published by the Federal Home Loan Mortgage Corporation, better known as Freddie Mac, argued that the economic losses and social disruption caused by a collapse of value in flood-prone real estate could be greater than that of the Great Recession of 2008.[51] Such a collapse, also suggested by Waters in her comments suggesting the reversal of her namesake legislation, could easily be triggered by a spike in flood insurance rates, or insurance becoming completely unavailable in some locations. In the current political climate, flood-prone property owners have used their clout to prevent such rate spikes from taking place. But in a political climate in which the federal government's budget is so burdened by servicing old debt that it can no longer afford to borrow much more, the billions of dollars' worth of debt that the NFIP has been authorized to take on may become impossible to sustain, and it would be similarly impossible for the federal government to keep 'forgiving' NFIP debt.

[51] "Life's a Beach," *Freddie Mac*, April 26, 2016, http://www.freddiemac.com/finance/report/20160426_lifes_a_beach.html, last visited April 5, 2018.

The long-term future of the National Flood Insurance Program may hinge upon the voting public's experience with flooding, and how it perceives flooding in relation to other effects of climate change. A body of research supports the position that people are more likely to believe in climate change and think it is a serious problem if they have personally experienced events that are linked to climate change.[52] Researchers have also found that experiences of flooding in particular lead to greater concern about climate change as a larger phenomenon.[53] If rising sea levels and strong tropical storms come to be seen as the most prominent manifestations of climate change, then the future may look a lot like the present, with people from non-coastal regions and their representatives protesting (mostly in vain) perceived subsidies of coastal zones. But if other parts of the country come to see themselves as being affected by climate change through phenomena such as droughts, wildfires, or even severe inland flooding, then conditions may be more ripe for a "we're all in this together" mindset to develop, under which greater flood losses would be seen as part of a unified reckoning with climate change. In this case, continued and even expanded subsidies for flood insurance may be a realistic political outcome. Since 1980, the six costliest weather-and-climate-related disasters to affect the United States have all been hurricanes, three of them occurring in 2017 alone. The worst drought/heat wave during this time period, that of 1988, ranks seventh, and the worst wildfire episode, that of California in 2017, ranks seventeenth.[54] Dollar values are certainly not the only way to measure the severity of

[52] There is a related "chicken-and-egg" question: does belief in climate change increase after experiencing events that can be connected to climate change, or do people interpret natural phenomena and their potential relationships to climate change based on their previously held ideas about climate change? A study seeking to answer this question found that while both processes, experiential learning and motivated reasoning, do occur, people who are less engaged on the issue of climate change and thus more open to persuasion are more likely to demonstrate experiential learning than motivated reasoning. See Teresa Myers et. al., "The Relationship Between Personal Experience and Belief in the Reality of Global Warming," *Nature Climate Change* 3, no. 4 (2013): 343.

[53] See Alexa Spence et. al, "Perceptions of Climate Change and Willingness to Save Energy Related to Flood Experience," *Nature Climate Change* 1, no. 1 (2011): 46-49.

[54] Disaster damages are adjusted for inflation, and are drawn from NOAA, "Billion-Dollar Weather and Climate Disasters: Table of Events," https://www.ncdc.noaa.gov/billions/events/US/1980-2017, last visited April 5, 2018.

calamities—the human drama caused by wildfires or localized floods can be extremely powerful—but the preponderance of hurricanes on the list of top disasters demonstrates how central flood insurance will likely be in addressing the chaos wrought by a destabilized climate.

Biggert-Waters certainly seems like a needed, if not wholly sufficient, repair of the NFIP. Yet it also foregrounds some fairly major questions about societal approaches to risk, especially given predictions about how the climate of the future may be destabilized relative to long-standing expectations. While it seems prudent and logical to expect owners of property in flood-prone places to pay insurance rates corresponding to their actual risk, this type of arrangement has not been a foregone conclusion in every arena of risk-management policy. In the United States (and even more so in other developed countries), health insurance is a noteworthy example. Over the past half-century, health insurance customers on group plans have typically paid relatively equal rates within their groups, whether they average one doctor visit per decade or have a chronic medical condition that guarantees a need for hundreds of thousands of dollars of medical services per year. The comparison between flood insurance and health insurance is, of course, imperfect. Whereas people who live on floodplains can always move (at least in theory), some medical conditions are completely beyond personal control. Yet most group medical plans also insure against conditions that could have been avoided by different behavioral choices. Collectively, Americans (as well as citizens of many other countries) have decided that we prefer a society that offers a promise of adequate medical treatment (at least to those who have secured group health insurance), rather than a society in which prior health experiences can make it impossible to obtain coverage for future needs.

Health care is unique in that people cannot simply switch into new bodies. As far as flood risk, people can always relocate, even if in the worst cases that might entail major losses of

investment, moving in with family, or even living on the streets or being sentenced to prison. But next to our bodies, the places we live have been central to many generations of Americans' conception of the good life.[55] The arguments for making flood insurance premiums better reflect risk exposure are compelling, but as the aftermath of Biggert-Water shows, their political support may wither in the face of making it unaffordable for people to continue living in their own homes. This is a tension that can be expected to increase as the effects of a changing climate cause changes in flood risk assessments, as well as levels of other types of environmental risk. Living in a flood-prone area is a decision that might have once seemed, and even still seems today, analogous to deciding to smoke and then getting cancer.[56] But if the effects of climate change begin to unfold in ways that are unpredicted, or foreseen only to insular groups of scholars, living in a flood-prone area might begin to seem more and more like being stricken by a pandemic flu that would be hard to avoid even with the best preventative practices. Indeed, as noted in the previous chapter, one of the most noteworthy aspects of recent storms such as Hurricane Harvey is how much of the flooding damage they caused occurred *outside* of the mapped hundred-year floodplain. Besides pandemic flu, another relevant analogue would be radioactive fallout—the hallmark hazard of Ulrich Beck's reflexive modernity. In his landmark book *Risk Society*, Beck differentiates between pre-modern risks that are easily understood, and modern risks that can be difficult to understand, quantify, or avoid. Until recently, flooding has

[55] Some prominent works of history have honed in on the ideal of suburban home ownership that strengthened after World War II, such as Adam Rome's *The Bulldozer in the Countryside: Suburban Sprawl and the Rise of American Environmentalism* (New York: Cambridge University Press, 2001) and Elaine Tyler May's *Homeward Bound: American Families in the Cold War Era* (New York: Basic Books, 1988). Jim Cullen traces the centrality of home ownership much deeper in American history, to founding fathers George Washington and Thomas Jefferson, in his book *The American Dream: A Short History of an Idea that Shaped a Nation* (New York: Oxford University Press, 2003).

[56] The decision to live in a flood-prone location is certainly not always an irresponsible decision isolated from other factors. Among numerous other scholars, the environmental historian Ted Steinberg has noted in *Acts of God* that people often live on floodplains not so much because they seek a laid-back, vacation-like lifestyle, but because flood prone land is often one of the cheapest places to live.

been a classic premodern risk. But with a destabilized climate and shifting patterns of land use changing where and how frequently floods occur, they are becoming more of a modern risk. Beck theorizes that in the new era of 'reflexive modernity,' society will focus more and more on the management of modern risks. If his ideas are correct in the realm of flooding, then continued subsidies for flood insurance as well as other types of insurance that deal with climate-related hazards seem likely. [57]

So, what might be hoped for the NFIP? The long-dead British historian Herbert Butterfield critiqued the historians of his day for adhering to a "whiggish" view of history in which the arc of history is a path leading ever onward and upward toward fulfillment of the ideals of liberal democracy.[58] A conservative outlook on history, in contrast, would hold that there are unchanging characteristics of human nature that foreclose any sort of perfectibility or thorough fulfilling of liberal ideals. In the case of human relationships with flood hazards, floodplain management is an effective substitute for liberal democracy in Butterfield's formulation of history. As admirable as the ideals of floodplain management may be, their fulfillment via the NFIP has consistently been thwarted by a range of interests centered on the imperatives of economic growth. Whatever one's evaluation of Butterfield's thesis may be in the larger scope of history, when it comes to floodplain management and flood insurance, the history presented in this dissertation suggests that the more conservative outlook is most realistic one. Work for further implementation of the principles of floodplain management, if that is your view of the best way to relate to the limits of the natural world, but do so with eyes wide open about the headwinds you will be facing.

[57] Beck, *Risk Society*. Beck's ideas are further discussed in the first chapter of this dissertation.
[58] Herbert Butterfield, *The Whig Interpretation of History* (London: G. Bell, 1931).

In the short term, in other words, the status quo of the NFIP seems likely to endure, with the program effectively subsidizing ownership and development of high-risk coastal real estate. Private flood insurance offerings, aided by legislation that seems likely to be passed sooner rather than later, will probably increase, but seem unlikely to upset the current system of subsidies. However, even if the basic federal flood insurance model remains in place for the foreseeable future, improvements can be made. Refinements such as adding "living shorelines" to the Community Rating System could be feasible even without major changes to the way the program maps and prices risk. This way, even if the program continued to drain taxpayer dollars, taxpayers would gain more in return: not just subsidized residences for a few of their fellow citizens, but a more ecologically sound approach to coastal flood hazard mitigation. Insurance rates can indeed be powerful incentives for large projects, as demonstrated by the Staten Island Seawall, a project expected to cost north of half a billion dollars. Even if subsidies remain mostly untouched, a continued commitment to updating flood insurance maps can ensure that flood risk is more widely understood even if it is not always reflected in insurance rates. One team of risk scholars put forth an agenda for NFIP reform that did not attempt to completely uproot the third rail of subsidized rates, but included suggestions such as multiple-year insurance contracts (to counteract myopic failure to renew policies), insurance policies being attached to properties rather than property owners, and purchase of reinsurance.[59] They proposed to deal with the challenge of subsidized rates by making all policies priced at actuarial rates, but with vouchers granted in cases of demonstrated need, taking the place of the subsidies that presently exist. All of these reforms have the potential to improve the long-term sustainability of the NFIP, but despite the renown of the scholars proposing them—Howard Kunreuther has studied flood

[59] Erwann Michel-Kerjan and Howard Kunreuther, "Redesigning Flood Insurance," *Science* 333 (22 July 2011): 408-409.

insurance for decades, and Erwann Michel-Kerjan is one of the rising stars in risk management studies—none of the proposals, save reinsurance, have been seriously taken up by Congress in the two cycles of NFIP reauthorization since the study was published.

Assuming that the federal program persists long enough, even the most zealous defenders of the NFIP's status quo will have to come to grips with change, as ocean waters encroach more completely onto insured properties. The American relationship with riparian and coastal boundaries has long been characterized by efforts to define and then push perceived natural limits on where structures can be built, whether this has meant pushing the boundaries through built infrastructure like dams and levees, or quantifying boundaries via probabilistic assessments of flood risk. But with the effects of a warming global climate, nature will push back much more forcefully than ever before. Seawalls may protect many of the most heavily developed urban centers for centuries, but their expense makes them a less likely strategy for coastal sections outside of major population centers. This grappling with change could certainly could happen if different political winds blow into the American political scene. But based on the history of US flood policy, which shows us that policy changes tend to come in the wake of severe events, the most likely winds to affect major change are not just metaphorical, but rather the winds of a massive tropical cyclone, more damaging than Katrina or Harvey. If that is the case, we can hope that it will be a few years from now, and only marginally more severe than those storms, rather than a generation away, causing exponentially more damage to a coastline whose increasing development has been silently subsidized by the availability of cheap flood insurance.

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