TEMPORAL VULNERABILITY:

HISTORICAL ECOLOGIES OF MONITORING, MEMORY, AND MEANING IN CHANGING UNITED STATES FLOODPLAIN LANDSCAPES

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Abstract

DANIEL H. DE VRIES: Temporal Vulnerability: Historical Ecologies of Monitoring, Memory, and Meaning in Changing United States Floodplain Landscapes
(under the direction of Carole L. Crumley)

This dissertation addresses the relationship between temporality—being bounded in time—and population vulnerability to hazards. Researchers and program managers typically integrate temporality in vulnerability assessments by analyzing either historical change in the level of population vulnerability or the historical (root) causes for disasters. The thesis of this dissertation is that the influence of temporality on population vulnerability is further determined by human relationships to time. In the modern context of fast changing hazardscapes and a diminishing sense of place in a globalizing world, how do temporal reference making practices such as landscape monitoring, memorialization, and meaning attribution influence population-level emergency preparedness? Based on historical ecological fieldwork in four United States floodplains—New Orleans (LA), Savannah (GA), Kinston (NC), and Felton (CA)—the results of this study illustrate how *temporal vulnerability*, defined as the condition of population surprise, decreases population resilience in the contexts of hazard mitigation, historical preservation, early warning, and disaster evacuation. A dwelling model is constructed that can be used to guide temporal vulnerability assessments, adaptive management, and interventions aimed at increasing hazard resilience.

To Cara

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PREFACE

This dissertation was born in a conference paper. My challenge was to link up historical and political ecology, and I had just come back from Tanzanian woodlands where I had worked on a "baseline" study used to establish the initial conditions for tracking progress in an environmental intervention program. The experience made me aware that when it comes to the evaluation of program success or failure, some sort of temporal measurement paradigm has to be imposed. The simple solution was to measure pre-intervention and post-intervention indicators, and analyze the difference. Being trained in historical ecology, a method which consistently challenges the notion that initial conditions can be drawn at all, I felt uncomfortable with this. Could initial conditions for a community forestry program evaluation really be captured by asking local African villagers questions about the whereabouts and quantity of natural resources, without reference to historical ecological conditions? What about the momentum coming from years of colonial appropriation of forested lands, now imposed by the "rights" of western hunting companies? I concluded that what the baseline[1] did was to impose initial conditions on a complex historical situation in order to aid the external experts' political interest in continued funding. It defined what "success" was supposed to mean: what the baseline describes. From here we track change; in *relative* time.

[1] In program evaluation, a baseline is an analysis captures elements in the environment that are later compared to measured changes the project claims to produce.

I was not able to let go of the conflict between the needs of program evaluation and how our world is in fact historical (with only God and Big Bang theorists defining initial conditions). Applied to environmental perception, the idea of the baseline model in evaluation had become contagious to me. Don't we evaluate all the time on all sorts of issues? How do we do that without imposing this baseline? The problem spread ripples through my psyche, played itself out in the world around me, remodeled and reshaped itself in the various grants and dissertation proposals I wrote, and finally metamorphosed into this dissertation. The process was personal as well; I recognized that I had lost my own "baseline" as well, as a result of culture shock when I moved to the United States from the Netherlands in 1996. My referential knowledge of historical events—the TV-shows I grew up with, the dinners I knew how to behave in—appeared completely useless in Knoxville, Tennessee. In some profound ways, the culture around me did not make any sense, and lots of things surprised me, and put me at risk of psychological stress. I lost jobs. I had to relearn popular culture. I theorized that with the increasing mobility of the globalizing world around us, more and more people would experience similar loss of their sense of normalcy, their baseline, their reference point of the "normal" past conditions. Thrown into the unknown, we are all more vulnerable to surprises.

In graduate school I recognized this experience back when I learned about the ethnographic process. When a field worker goes into an uncertain field site at an arbitrary moment in time, the reflexive ethnographer is trained precisely to document how perceived chaos slowly turns into normalcy. During the ethnographic process, significance slowly returns when perceived chaos becomes patterned through the experience of events. The problem is to delineate what is significant and what is not. *In the beginning* all events seem chaotic. Or, from the moment of entry—our imposed baseline—we have no historical reference. It is only through time that patterns emerge. The process of relearning has its key in historical knowledge, both through lived experience, the sharing of important events, and by asking locals about their history, their temporal referentiality. In their training, ethnographers write down everything they perceive in a temporal document, their diary. Particular attention is paid to their experience of surprises; things that were striking, stood out as and odd, different from the expected. During the early experience it is not yet clear what in the notes is relevant. Only later, when patterns emerge and normalcy sets in, does the significance of the surprise become evident. It is probably no coincidence that normalcy and significance are the key terms in statistical analysis. In this dissertation I will extend this dynamic duo into the cultural realm. I will focus on how the experience of surprise among floodplain populations is temporally patterned, seen as if they are the ethnographers trying to make sense of their landscape, relative to their imposed baseline. The main argument that I will make is that this focus on temporality and surprise in fact imposes a vulnerability on populations that exacerbates the impact of hazards, and as such influences the likelihood of disasters. This lack of temporality is a condition for population vulnerability: temporal vulnerability.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

FEMA	Federal Emergency Management Agency
FIRM	Floodplain Insurance Rate Map
HMGP	Hazard Mitigation Grant Programs
NASA	National Aeronautic and Atmospheric Administration
NFIP	National Floodplain Insurance Program
NWS	National Weather Forecast Office
UCADE	United States Army Corps of Engineers
UNC	University of North Carolina
USGS	United States Geological Survey

1. INTRODUCTION

1.1. Hazardscapes in a Time of Temporal Intensification

One of my informants in the City of New Orleans told me in passing that the surveying *benchmarks*—the physical reference points that had been used to measure change in the vertical height of the land—were sinking in the City of New Orleans. To the people of southern Louisiana, knowledge about the rate in which the land sinks (subsidence) is critical, as they have faced a rise in sea level of six to eight inches in the past century. Tidal data indicates that Louisiana faces the highest rates of subsidence and sea-level rise in the United States, where mean relative sea-level rise (including subsidence) is more than five times the Gulf of Mexico average and ten times more rapid than the rest of the globe (AAPG 1998). In the 1950s, a network of about 300 vertical control benchmarks was put in place around New Orleans to measure the height of the land and calibrate subsidence (sinking) relative to "known" points. These benchmarks showed scientists and the public that in the past decades, the city had been sinking at a rate of about one-fifth of an inch a year. This knowledge not only guided engineers and planners in their calculation of the necessary height of bridges, buildings, levees, and other critical infrastructure elements relative to water and ground levels (NPR 2005), but also—as one would presume—provided the public with a certain sense of urgency with respect to flood mitigation.

Traveling through floodplain landscapes in the United States, it became clear to me how for those dwelling in and managing these type of areas, the idea of a sinking floodplain would equate to even deeper "sinking" feelings that the next flood event might be nearer on the temporal horizon than expected. The realization of this problem would mean an adjustment in expectations about future flood events. Expectations about events that are associated with a toxic-soup of water, sewage, mud, and chemicals that destroy carpets, walls, cabinets, and even entire houses. Expectations associated with the stressful anticipation of having to move belongings up high, putting wooden boards and sandbags in front of the doors, and arranging to stay a night or two with relatives on higher ground. Expectations about carefully watching the news, having hopes that the backyard creek won't be dammed by fallen debris or trees, and that the engineers will turn the pumps on in time. Expectations about repairs that will have to be done and pictures of belongings that need to be taken in order to be able to claim damages to floodplain insurance contractors. And for those managing the risk landscape, expectations include emergency preparations which start as soon as the first warning sign arrives, decisions concerning calls for evacuation which backfire if the threat appears false, and the anticipation of a large number of flood claims and mitigation applications that will trickle into the planning and mitigation departments after the event is over. Living in and managing the infrastructure of a floodplain comes with its own temporality; one in which the coming of the "next" event is always on the planning horizon and evaluated based on what is known from past experiences, the memories of long-term residents, media reports, and the benchmark measurements of scientists and engineers.

But while the ground in New Orleans is sinking, the benchmarks aimed at measuring the extent to which this is happening were sinking as well. Did this mean that to some extent the lowering of the land went *unnoticed*? Did the failure of our instruments to "see" the complete extent of the subsidence mean that the population became more vulnerable to disaster, because they were *unable* to adjust their expectations? As benchmarks are the anchors that calibrate our risk expectations, what happens when they become inaccurate or outdated? Elevation research that was conducted in 2006 used 150,000 satellite measurements taken from space to calibrate vertical height, instead of the fifty-year-old benchmarks, and indicated that parts of the City of New Orleans had been sinking *much faster* than had previously been imagined. The authors concluded that in the three years before Hurricane Katrina struck in August, 2005, about ten to twenty percent of the region had subsidence in the one inch-a-year range, or five times the rate of change believed before (Associated Press 2006). Significant to the context of the Hurricane Katrina disaster, this faster rate of subsidence included an area next to the Mississippi River–Gulf Outlet (MRGO) canal where the levees failed during Hurricane Katrina's peak storm surge (Dixon et al. 2006). While expectations concerning the spatial distribution of the rate of change appeared to be in need of adjustment, the local political context instead forced an optimistic discourse of rebuilding in which increasing rates of subsidence were not the preferred vision. At the Tulane and Xavier universities' Center for Bioenvironmental Research, researchers used LIDAR (precise light imaging detection technology) data from 1999-2001 to report that "contrary to popular perceptions, half of New Orleans is at or above sea level" (Times-Picayune 2007; Campanella 2007). While this finding was referenced in numerous media and blog reports, the research itself largely bypassed the connection between the LIDAR dataset used in the study to calculate elevation and the sinking vertical height control benchmarks. As one *Time-Picayune* blog critic remarks in a comment: "That generation of LIDAR (99-

01) was tied to benchmarks that are sinking; so unless the height is corrected it can easily be more than a foot off" (Times-Picayune 2007)[2]. While the criticism does not necessarily change the authors' argument (there *is* land above sea level), the decreasing extent to which this is the case makes the study seem to communicate a false optimism to the public. What these two examples illustrate is: first, even within the highly precise engineering world of land surveying, determining positions on the earth's surface is a *dynamic* activity wherein reference points change. These changes can have implications for population vulnerability, particularly if they go *unnoticed*. When reference points become outdated, homes, evacuation roads, hospitals and shelters appear built *in fact* further below sea level than engineers and emergency planners had thought. Or in other words, within the need for temporal coordination between our changing environment and our adjustments of hazard expectations, *deception* can enter into the equation. As a result, I argue, the cultural landscape is made more vulnerable.

The sinking elevation benchmarks of New Orleans provide an entry into what this study is about: population vulnerability resulting from a compromised human capacity to adequately monitor the changing environment, produce effective memory-networks, or correctly attribute the meaning of past events through effective temporal scales of reference. Because it deals with practices that coordinate the correspondence between cultural risk expectations and hazard probabilities in changing landscapes, it is about the influence of temporality—our being in time—on population vulnerability. What happens when flood

[2] According to the authors of the study (Campanella 2007), LIDAR elevation models were processed to identify above-sea-level areas within Orleans Parish, on both banks of the Mississippi and on both sides of the Industrial Canal, but excluding the rural marshes. They used recent LIDAR elevation data, measuring topographic elevations at the five-meter pixel level, and noted that "No adjustments were made for the amount of topographic subsidence that has occurred between 1960 and the date of the LIDAR data (1999-2001), because such estimates are difficult to validate, and natural levees tend to subside less than former marshes." (p.4)

baselines are outdated? What happens when we fail to remember past hazard events? What is the influence of high homeownership turnover rates on neighborhoods' ability to respond to early warning? What happens to public risk expectations if a river is dammed up, changing its flood ecology, during a thirty-year period with little flood activity? In an indirect way, the research focuses on the meaning of historical ecological knowledge that reminds us that all complex systems have particular histories that affect current behavior (Crumley 1994). In our tightly connected socioecological system, what happens if the interactive feedback between human history and ecological behavior are out of sync? How is this a driver for population vulnerability to hazardous events?

The field site of this research is specifically the hazardscape, or landscape in which the experience of hazards implies an influence of both the historical, material landscape and the perceptions, social constructions, discourses, and other cultural views used to make sense of its properties (Mustafa 2005). The hazardscape has been undergoing radical change in the past decades; several trends that have their origin in the enlightenment have led to a temporal intensification of dynamic environmental properties in hazardscapes. While landscapes have always been dynamic entities in constant flux, the speed or rate of landscape transformation has dramatically intensified since the 18th century relative to previous times in human history (Burton 1999; IGBP 2005; Whyte 2000). The expansion of industrialization and urbanization during the 19th century caused irreversible breaks with many "traditional" hazardscapes uses (often agricultural or with a short-term purpose) of which the hazardous properties had been known for centuries. Embedded in its larger historical context, this trend follows an overall rapid acceleration of the rate of landscape transformation since 1700, as illustrated in Figure 1 (adapted from Antrop 2005).

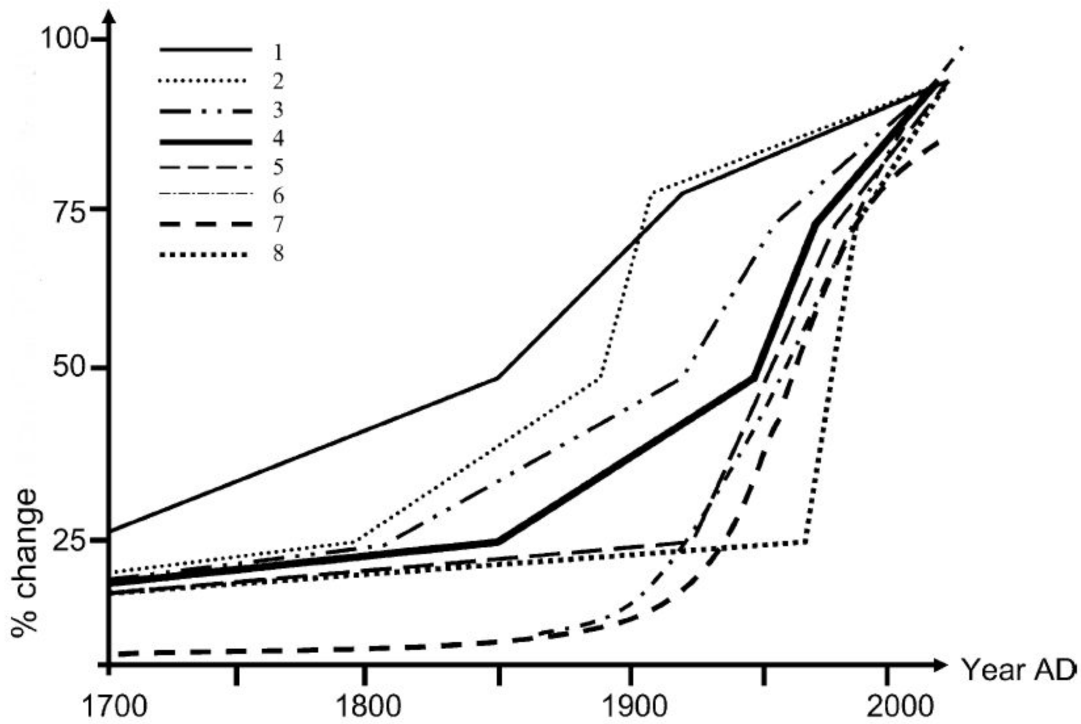

Figure 1: Percent changes observed in eight landscape ecology features since 1700 (from Antrop 2005).

This acceleration in the rate of landscape transformation is expected to further increase as a result of the impact of global climatic change. While there is limited understanding of the complex interaction and feedback loops inherent to the global socioecological system, the enormous uncertainties and important economic consequences of climatic change are expected to force socioecological systems to rapidly adapt to changing regional and local climatic conditions. While the ability of humans to rapidly transform their landscape can be an asset in adaptive management, the fast biophysical and human-induced landscape transformations at the same time make it more difficult for landscape managers, planners, and people living within hazardscapes to know how these landscape transformations alter the impact of hazards.

Responding to such challenges, humans have always kept an eye on landscape transformations to evaluate how it would change risk patterns in terms of agriculture, hydrology, epidemiology, and even warfare. Traditional, local environmental management systems excel particularly in the capturing of long time-series of local observations (Berkes & Folke 2002). Reliant on cultural memory, traditional learning formed a cumulative, intergenerational transmitted body of knowledge that evolves through adaptive processes and is helpful in capturing information important to risk evaluation. In modern times, this type of monitoring has increasingly been complemented, and often replaced, by a reliance on scientific measurement and management, which excels in the collection of simultaneously observed data, yet has a relatively shallow time-depth. For example, while sophisticated, the evaluation of sea level rise in southern Louisiana in the AAPG study (1998) is based on only 20 of the potential 80 tidal stations, because only those stations had more than 20 years of data. Because of the shallow time depth and the complexity of making spatial models, most landscape change studies do not focus primarily on rates of change and typically incorporate only a few time steps, usually two to four (Schneeberger et al. 2008). Knowledge about fluctuations in speed of change is not the primary goal of these analyses, and few quantitative approaches exist to examine rate of change.

But as our practices to evaluate and monitor landscape change have evolved, so have our *cultural frames of reference*—beliefs, thoughts, feelings, and attitudes—that help specify problems and set the baseline in the process of risk evaluation (Zube 1980). In the case of United States hazardscapes, the possibility of rapid landscape transformation has its roots in a western, modernist attitude, which stresses the notion of human mastery of the environment. Based on the philosophical trend of separation—indeed, alienation—of Culture from Nature, the unbridled manipulation of objective "property" is made possible. This has both facilitated an increase in the rate of landscape transformation as well as an increasing reliance on scientific monitoring as the most "objective" and "accurate" way to evaluate landscape risks. Ever since the first modern disaster of 1755 in Lisbon[3], disaster mitigation and recovery efforts have mostly remained aligned to this modernist attitude toward the hazardscape (White 1945; Dynes 2000).[4]

While on the one hand modernist Nature remains the dominant prescription for landscape transformation, evaluation, and risk management, the post-modernist impact of globalization has on the other hand made our understanding of what the landscape actually *is* more detached, fluid, irregular, and perspectival than ever before (Appadurai 1996). In the post-modern condition, global mass media technologies allow us to escape into imaginary worlds driven by globally distributed marketing interests that bring together distant landscapes while perfectly concealing their traces of origin and the connections between past and present. Harvey (1989) argues that this "time-space compression" affects business markets and policy makers in the form of stress, as it becomes harder and harder to plan ahead and react accurately to events, and public psychology in terms of sensory overload, which leads to the blocking out of stimuli, denial, cultivation of attitudes of indifference, reversion nostalgia for of images of a lost imaginary past, and excessive simplification. The

[3] The 1755 Lisbon earthquake disaster came during a time when there were many strains between tradition and new ideas about progress. Because it was difficult for the Europeans to explain the destruction of Lisbon as part of the overall plan of God, the event provided an entry point for Rousseau's idea that Man is capable of reason and as such can transform its surrounding independent from God's predestined will, and as such brought to general attention a new modernist "social science" understanding of disasters. The recovery and rebuilding of the City initiated the first time that a State assumed collective responsibility for a disaster consequences. As such, the Lisbon earthquake is seen as the first modern disaster (Dynes 2000).

[4] As Gilbert White has argued, this over-reliance on mastery through structural works in the United States actually increased damages caused by flooding rather than decreasing them: "Floods are an act of God, but flood losses are largely an act of man" (White 1945).

cumulative result of these cultural trends moves us to a situation wherein mental maps do not match realities anymore in an increasingly tightly coupled global world where the instantaneous moment dominates.

Within this cultural context of temporal intensification, the major challenge for emergency preparedness is to find effective ways to manage local risk expectations. Detached from the landscape, and increasingly lacking a historical sense of place, populations dwelling in hazardscapes do not notice the sinking benchmarks that miscalibrate their risk expectations. Increasing population mobility and the suburbanization process of the 20th Century have caused further alienation from the historical narrative embedded in our landscape. As concerns our historical relationship to the landscape, the cultural condition to which we have arrived is a *crisis of historical ecological knowledge,* which challenges the core goal for landscape sustainability and resiliency in the face of hazards (Gunderson & Holling 2002; Armitage et al. 2007)[5]. Its symptomatic consequence is a compromised ability to accurately set risk expectations that directly influence emergency preparedness. The result of this situation has been described for closed systems—such as nuclear reactors—as a situation where accidents become normalized (Perrow 1984)[6]. What is at stake in our rapidly changing hazardscapes is our ability to "see" what is going on in order to engage in adaptive management, a process that involves learning through trial and error. When less time is available because landscape changes are faster, and the shared historical sense of place is shallower, the hazard impacts are more tightly coupled (instantaneous); our ability to be resilient through learning from mistakes and adapting to new conditions is reduced. The

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[5] Increasingly the concept of resilience is implied in the application of adaptive management. This concept refers to the capacity of a system to absorb disturbance without flipping into a qualitative different state (Gunderson & Holling 2002).

[6] An anomaly or failure in one part of the system starts a cascading process of failures that cannot be adapted to on time because of the "tightness" of the coupling. The result is a catastrophic outcome.

result of this temporal challenge is a population prone to be caught by *surprise* in an emergency, with the potential for major disaster. I argue that in order to avoid the surprises which might be hidden in this situation—normal or not—major efforts need to be made to rethink the meaning of hazards, risk, and societal sustainability from a *temporal perspective*. What we need is an effort to analyze our *temporal vulnerabilities* in order to find ways to increase the human capacity of *temporal resilience.*

1.2. The Time of Risk and Vulnerability in Disaster Management

On their internet gateway to international development, the Australian government provides a graphic presentation of the "Disaster Risk Management Cycle" (AusAID 2005) (Figure 2). The cycle shows the three conceptual phases which have helped make the field of disaster management thrive: a pre-disaster phase, including risk assessment, mitigation, prevention, and preparedness; a disaster response phase, including early warning and evacuation; and a post-disaster phase, including immediate assistance and damage assessment.

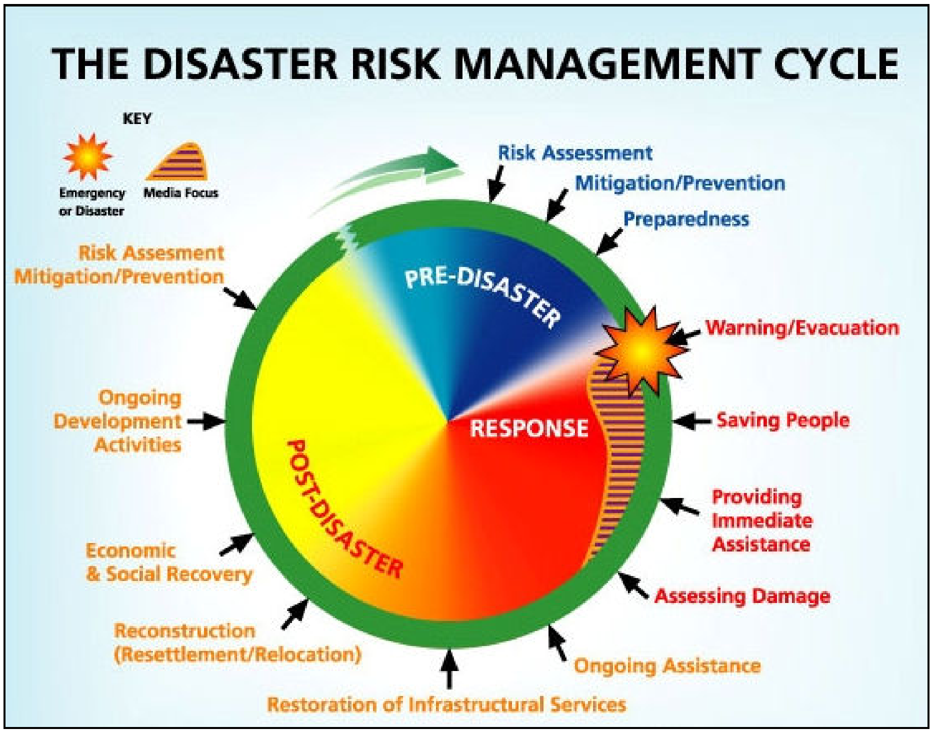

Figure 2: The Disaster Risk Management Cycle (AusAID 2005).

The cycle quickly and efficiently represents how disaster managers organize their attention in time. From the sizes of the pie pieces, it appears that most of this attention would include the red and yellow response and postdisaster phase. It is where it is "hot." The pre-disaster zone leading up to the emergency or disasters appears in "blue"; it is the cold, safe zone. What is further notable is that the blue, safe zone is relatively small, particularly compared to the post-disaster span. What this representation does very well is to illustrate the social context in which the time of disaster management is set. While far off in chronological time—predisaster time generally dwarfs the other phases—seen in social time the disaster cycle is a relatively accurate portrayal of the inner workings of emergency management practice wherein the predisaster period actually *is* very short. The embodiment of emergency practices in this *social time* includes awareness and exposure to disaster events, through travel or by "gazing from space" using remote sensing or other technologies (Harraway, 1989, 1991). It means dealing with the "hot zone," a zone which disaster managers encounter much more often than laypersons. Because the latter group typically dwells in the blue zone. And from this cold zone, what does the cycle look like? Square?

While chronological time suggest quantitative, measurable ordering of events—the endless chart where all duration is spread out before the mind (Durheim 1915)—social time is fundamentally rooted in qualitative understanding (Ingold 1993), grounded in the "rhythms, pulsations, and beats of the societies in which they are found" (Sorokin & Merton 1937). Yet, while relevant to disaster studies, the distinction between social time and chronological time has rarely been mentioned by the hazard community (NRC 2006, Forrest 1993). This despite the central and unique role of temporality in the experience of hazards and the eventual unfolding of a disaster. For example, the disaster cycle itself has been challenged for decades on its temporal assumptions. Critics have pointed at the false division of recovery phases in discrete units, since recovery and reconstruction have always been seen as overlapping in time (Neal 1995). Further, they have challenged the lack of historicity of the cycle when seen from chronological time. They have argued that recovery is dependent on pre-existing variations in access to resources and power. This means that with different portions of the communities in different stages of economic (under-)development, the time of reconstruction varies dependent on economic trends already in place (Geipel 1982; Haas et al. 1977, Rubin 1985; Schwab et al. 1998). These critics are correct of course. The generic disaster cycle does not include historical analysis of pre-existing conditions. One can safely argue that the cycle is completely a-historical and void of accurate chronology. Translations into chronology, if at all, are hidden in additional descriptions that suggest typical time-spans for each of the phases. For example, Haas et al. have suggested a logarithmic time relationship between the phases (Haas et al. 1977). Yet, this attempt to impose chronology is not reflected in any of the generic models one can find widespread in the disaster literature. These models are all historically "flat," providing the same circular portrayal of the cycle of emergency management in social time ignoring any possibility of transcendence, synthesis into "something different." Moreover, for the purpose of emergency management, this model is simply too *attractive* to be left unused, to be replaced easily, as evidenced by the general lack of available alternatives (Bosher 2005).

The suggestion made by the "historicist" critics of the disaster cycle that pre-existing conditions can cause some portions of the communities to be impacted differently (e.g. longer, harsher …more sudden!) by a hazard has become central to the field of population vulnerability assessment. Vulnerable populations are generally seen as those who live in a marginalized state of permanent emergency as a result of negative power relationships (Wisner 1993). There are many definitions of vulnerability in the disaster literature (see Appendix I). Most succinctly, and reflective of its origin as a physical measurement of structures in risk areas (physical vulnerability), vulnerability to hazard events is the potential for loss (Cutter 1996). To measure it more socially, vulnerability concerns a rather difficult assessment of local capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard (Blaikie et al. 1994, Weichselgartner 2001). From a system perspective, vulnerability is the degree to which a system or subsystem is likely to experience harm due to exposure to a hazard, either as a perturbation or stressor (Turner *et al.* 2003).

The historicist critics themselves came rather late to this field of practice. Disaster management has historically been dominated by the engineering mentality of hazard and risk analysis. Rational calculations of risk recurrence intervals have been central in this effort.

Yet this dominant interest in risk has been slowly paralleled by attention to "the other side of the coin," namely vulnerability analysis. Within disaster literature, the generally accepted equation of what constitutes a disaster is that "Disaster = Hazard + Vulnerable Populations."[7] This recognition is part of a larger theoretical movement which emphasizes that natural disasters are not the product of purely natural phenomena caused by external agents—as in Nature acting out on Culture[8]—but instead an outcome of the hazard event in interaction with a social and historical process of locally produced vulnerability. This cultural attention to the historical character of vulnerability is encouraging and has been very productive. Many disaster analysts have pointed out that over the past years the number of hazards has been relatively stable. Yet, Figure 3 shows the number of disasters that occurred globally over the past six years. The trend line ("Poly.") indicates that this number has been decreasing, and since hazards have been stable, one argument could be that this decline is the result of a decline in population vulnerability thanks to the increasing attention paid to the issue.

[7] Or: "Socioecological construct = Engineers + Social Scientists."

[8] I am using capitals here to indicate that I see these concepts as social constructions. I personally believe neither in Nature nor Culture. Since my first exposure to Bruno Latour's "We Have Never Been Modern" when I studied environmental psychology in the Netherlands, I have lost my innocence and continue to be haunted by the idea of hybrid modernities. I wake-up in the middle of the night sweating, trying the next morning to explain to my wife what subject-objects are, etc.

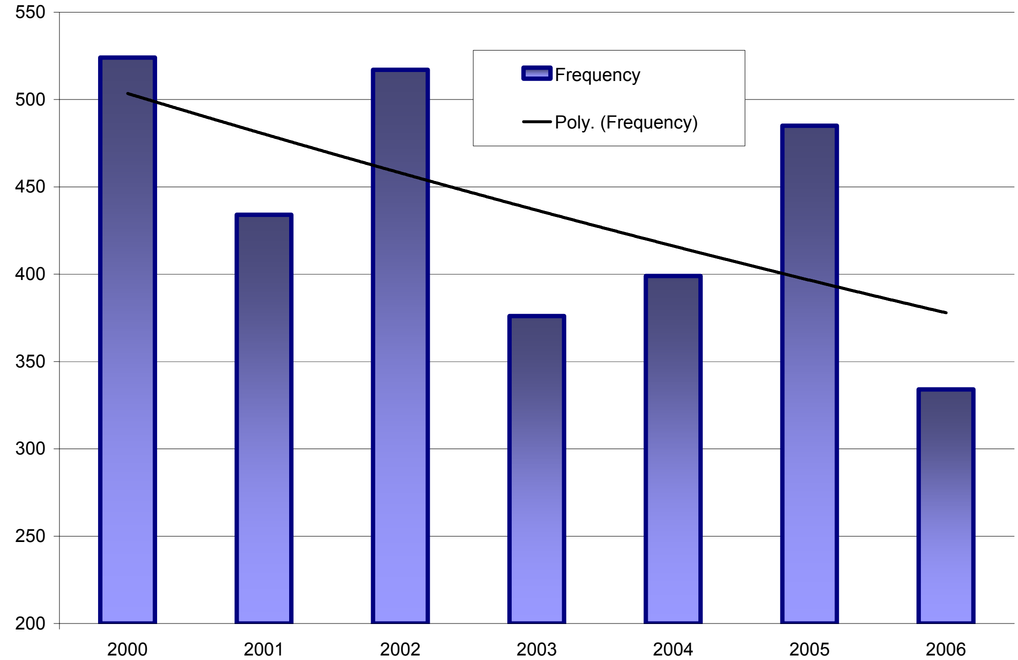

Figure 3: Total number of natural disasters globally 2000-2006
(source: "EM-DAT: The OFDA/CRED International Disaster Database)

But wait a minute. The astute observer would point out that perhaps it is worthwhile to analyze the global disaster trend from a larger temporal scale of analysis. Let us not put the baseline at the year 2000. Perhaps something is up with the year 2000? Y2K? How about we take the same global disaster dataset and instead put the baseline at the year 1900? The image shifts (Figure 4):

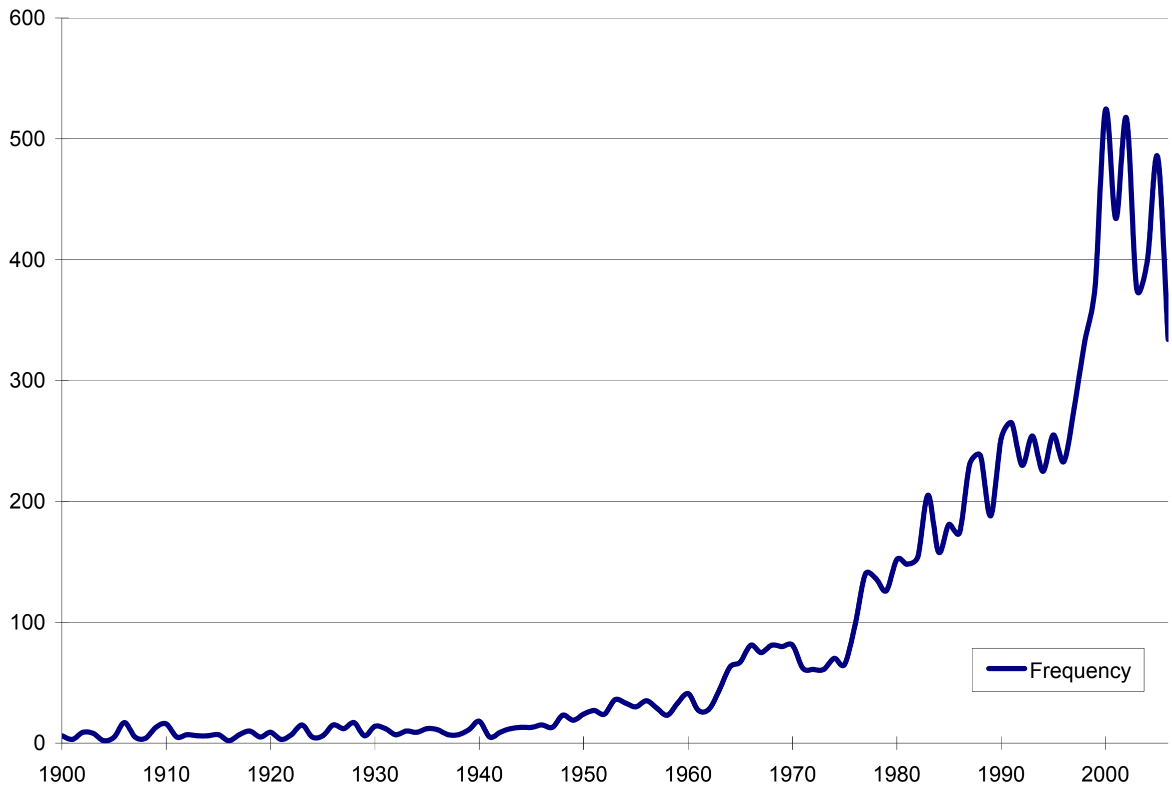

Figure 4: Total number of Natural Disasters Globally 1900-2006 (source: "EM-DAT: The OFDA/CRED International Disaster Database)

Instead of a decline, it can now be seen that there has been a *dramatic* global *increase* in the number of natural disasters at the county level over the past century.[9] However, reminding ourselves that (so far) this trend is *not* the result of an increase in hazards, then what does it mean? For a large part, the increase of disasters is the result of the increasing number of people who are living in risk-prone areas, particularly in underdeveloped countries, and is further exacerbated by poverty, population growth, political unrest, and unsound environmental practices (Annan 1999). In other words, social vulnerability has been increasing. To make matters worse, as a result of global warming scientists predict more intense extreme weather events (*not* more frequent) and enhanced climatic instability, further

[9] Of course, a substantial part of this statistical increase is due to the increased accuracy and detail inherent to new observation and monitoring technologies as well as the improved communication abilities that coevolved with our globalizing world. Unfortunately, it is difficult to estimate this portion.

increasing pressure on vulnerable populations living in risky environments (AGU 2006; SwissRe 2006a, 2006b). But what Figure 4 has also done is radically change our expectation for the future from contentment to concern. With Hurricane Katrina, the Pakistan earthquake, and the Indian Ocean Tsunami fresh in our minds, it seems that our knowledge of past conditions *calibrates* our expectations for the future. Or, in other words, while looking back into the past (in the moment), we project into the future. In 2008, our knowledge about past conditions influences our dire expectation about the future, but only relative to the scale of temporal analysis, or the baseline reference we use to evaluate change. And this is one of the key traits of social time: that the future is inextricably linked to our knowledge about the present and the past (NRC 2006).

1.3. Temporality in Vulnerability Research

The two previous examples are examples of the tension between chronological and social time. The disaster cycle focuses the attention of the emergency manager on the "hot" zone at the expense of chronological accuracy. Located in chronological time, the global disaster timeline appears to be embedded with the social after all, because of the choice of temporal scale. Both examples deal with temporality. Temporality is the condition of being temporal or bounded in time (American Heritage Dictionary 2003). The commonly accepted understanding of time follows Newtonian physics and is related to an absolute, true and mathematical time, which of itself, and from its own nature, flows equably without regard to anything external. In the early 20th Century, philosophical critique gave rise to a sociology of time in which the concept of "social time" came to be central (McTaggart 1908; Heidegger 1927; Durkheim 1915; Elias 1984). The opening up of the time concept allowed a plethora of notions of time to be identified. In an article titled “The Past is No Longer Out-of-Date”, Ming-Qian Ma (Ma 2000) illustrates how some philosophers such as Derrida have argued that time shrinks when it passes, and as such eventually disappears, ceases to take place (Derrida 1995). Others, such as Michel Serres suggest that time is a fluid, a space, a sheet or field that percolates (from “passoir” or “sieve”) and as such passes and does not pass (Serres & Latour 1995). On a less philosophical front, others have suggested for example a task or event-orientated time which is shaped by the onset, duration, and completion of daily, weekly or seasonal tasks. As Evans-Pritchard (1940) put it: “The daily timepiece is the cattle clock, the round of pastoral tasks, and the time of day and the passage of time through a day are to Nuer primarily the succession of these tasks and their relation to one another.” Mechanical clock-orientated time is time measured against some independent, reliable process, such as the apparent trajectory of the sun across the sky, or the use of a mechanical clock. Body time is an organic form of time which "squirms and wiggles like a bluefish in a bay, making its mind as it goes along" (Couclelis 1998). Harvey (1990) introduces several other concepts of time, including family time as the time implicit in raising children, industrial time as the rhythms of technological and locational change, religious time, environmentalist time, interest rate time, etc. What all these new ways of understanding time have in common is the way in which time is intrinsically connected to the rhythms of the social. Or, that temporality has been made relative to experience; the point of view of the observer. *Social* time.

In the world of disaster studies, one of the few frameworks including social time was recently prepared by the National Resource Council (2006) based on work done by

Zerubavel (2003)[10] and shown in Figure 5. The intention of including social time is made very clear:

> The scientific value of chronological time is unquestionable and taken for granted. But its value is not unlimited for analytical purposes, thus Figure 1-2 calls for a complementary treatment of social time. Social time is more complex than chronological time, but its consideration is very useful for expressing the singularity of hazards and disaster research. The distinction between chronological and social time has heretofore rarely been mentioned within the hazard and disaster research community (see Forrest 1993; Quarantelli 1998: 255-56), let alone seriously examined (for a notable exception, see Bankoff 2004). NRC 2006[11]

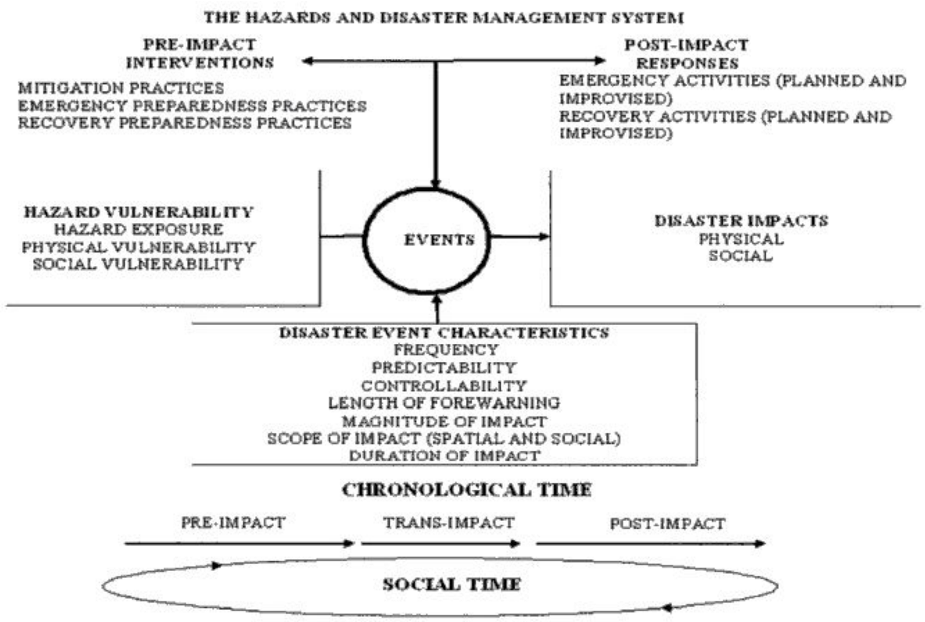

Figure 5: Societal Response to Disasters, from NRC 2006.

The council suggests that social time is nonlinear and multidirectional and experienced differently by individuals. Three ontological claims are made. First, within social time, the past may be reconstructed from the present. Second, the present may be reconstructed from the past. Third, the future is linked to the present and past in social time. Decisions to build in

[10] The council builds on the work of Zerubavel (2003) who has suggested the use of the term mnemonic communities to indicate inclusive social systems whose memories of the past are collectively shared and commemorated. To maintain continuity between events disparate in time, considerable mental bridging is required, which often occurs through catalytic events which he calls watersheds or benchmarks, such as the founding of new nations, but also disasters.

[11] See below for more on Bankoff (2004).

a floodplain are based on prior disaster experience and future disaster expectations as both relate to assessment of hazard vulnerability. According to the council, this ties disaster mitigation and preparedness to emergency response and recovery. Chronological time compresses and expands in social time as individuals and social systems create, define, and adapt to environmental hazards, the risks associated with them, and the disasters that occur for them.

The NRC call for more research on the linkage between disasters and social time is notable when the role of temporality is explored within vulnerability research. While researchers and policy-makers have increasingly shown an interest in the relationship between temporality and vulnerability, the way in which temporality is conceptualized generally remains embedded in chronological (or historical) time, to the exclusion of social time. If temporality is mentioned at all, it almost without exception is from the point of view of those studying disasters. Temporality here refers to forms of "objective" time against which the level of vulnerability can be "mapped" and understood. I have found that in the many models and descriptions of what vulnerability is, the most common way of conceptualizing the "role of time" is the acknowledgement that vulnerability is intrinsically dynamic, or varying through time. Graphically, this looks something like Figure 6:

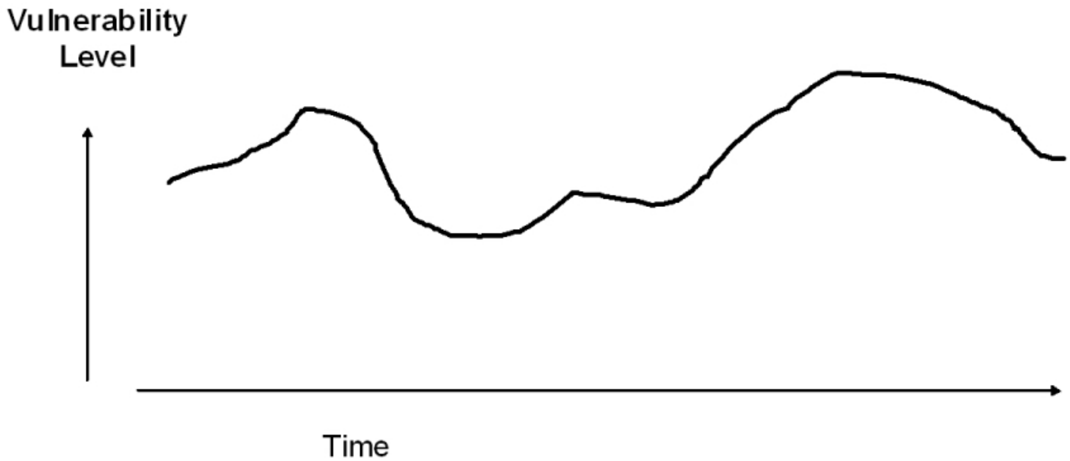

Figure 6: Vulnerability as dynamic temporality

For example, a definition provided by United Nations Development Programme illustrates this dynamic quality by emphasizing its processual nature: "... a human condition *or process* resulting from physical, social, economic, and environmental factors which determine the likelihood and scale of damage from the impact of a given hazard" (UNDP 2004, italics added). Similarly, a United Nations University publication suggests that: "Vulnerability changes continuously over time and is driven by physical, social, economic and environmental factors" (Thywissen 2005:34). Building upon this commonly agreed notion that vulnerability is a dynamic process, and not a stable condition, a second conceptualization of temporality adds to this that it is also *multidimensional*. Graphically, this might look something like Figure 7, including not only the general level of change but also different temporal scales at which change can be observed:

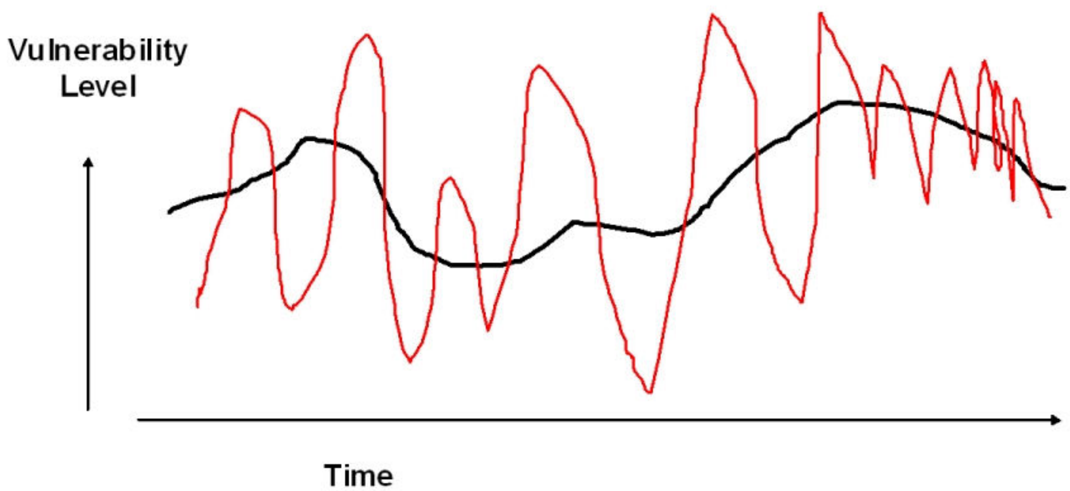

Figure 7: Vulnerability as dynamic and multiscalar temporality

I would argue that this multiscalar temporality by itself is already a complex way of understanding historical process. Building upon work done by the French historian Fernand Braudel and recent theoretical advances in the "New Ecology" of non-linear complex systems, the dynamic nature of vulnerability is suggested to include "temporal scales" of analysis (Holling 2001; Crumley 1994)[12]. Central is the notion that time moves at different speeds and that vulnerability changes accordingly, along a multiscalar temporal "highway" (sidewalk-bike path-road) that stretches from the past to the present. For example, Bankoff et al. (2004:6) introduce the issue of "time" in vulnerability analysis as follows in an edited volume called *Mapping vulnerability*:

> Finally, the fact that vulnerability lies at the intersection of different dimensions of time must be considered. Vulnerability changes through time in unpredictable ways and in varying directions: increasing, decreasing, accelerating, oscillating, concentrating or diffusing. It varies with the interplay of three different time frames: long-term, short-term, and cyclical change." (Bankoff et al., 2004:6)

[12] As the human ecologist C.S. Holling describes it, scalarity affects both temporal, spatial and social scales of analysis, "ranging from a leaf to the biosphere over periods from days to geologic epochs, and from the scales of the family to a socio-political region over periods from years to centuries" (Holling 2001: 392).

The implication of this multiscalar, dynamic temporality is that vulnerability cannot be assessed in absolute terms; "the performance of the [urban] place should be assessed *with reference to* specific spatial and temporal scales" (Rashed & Weeks 2002). Or, in other words, and illustrated earlier, historical time has been rendered social already.

Within the many models circulating concerning vulnerability, this dynamic and multiscalar temporal character of vulnerability is often referred to, to some extent, but never centrally present. For example, Turner et al. (2003) propose a vulnerability framework in which vulnerability is composed of exposure, sensitivity, and resilience which exists in larger, nested spatial scales (place is influenced by region and global pressures). In this model there is explicit attention to spatial scales, temporal scales are only implicitly mentioned under the heading "variability and change in human and environmental conditions."

In a third conceptualization of temporality the "processual" and "multiscalar" character of vulnerability becomes the playing field for rigorous historical analysis aimed to understand causal or root conditions of vulnerability and to carry out a critique of social reality. This type of understanding has been the cutting edge of social vulnerability analysis, referring to, for example, the human ecological perspective provided in the edited volume "Culture and Catastrophe" (Hoffman & Oliver-Smith 2001). This approach, they illustrate, by necessity includes a historical ecological understanding that is drenched with the notion that Nature and Culture are intertwined. Within this approach, the temporality of vulnerability is used as a means to explore the links between the increase and expansion of disasters, shown in Figure 4, and the dominant ideas, institutions, and practices that historically motivate social vulnerability (Hoffman & Oliver-Smith, 2001). For example, Virginia Garcia-Acosta (2001) points out:

> It is only by distinguishing hazards from disasters, by recognizing disasters as multidimensional processes and studying them in a historical perspective, framing them as diachronic, that we can advance in the theoretical and methodological development of this discipline. To a considerable degree we will also be able to decrease the growing effects of the encounter between hazardous agents and vulnerable populations. (Garcia-Acosta 2001:66).

But while this approach is crucial to the understanding of the life-span of a disaster as both an event and a process with historical origins, multiple temporal scales of understanding, I argue that it does not is easily step outside of chronological time into social time. While cultural, the analysis remains chronological. Graphically, this looks something like Figure 8:

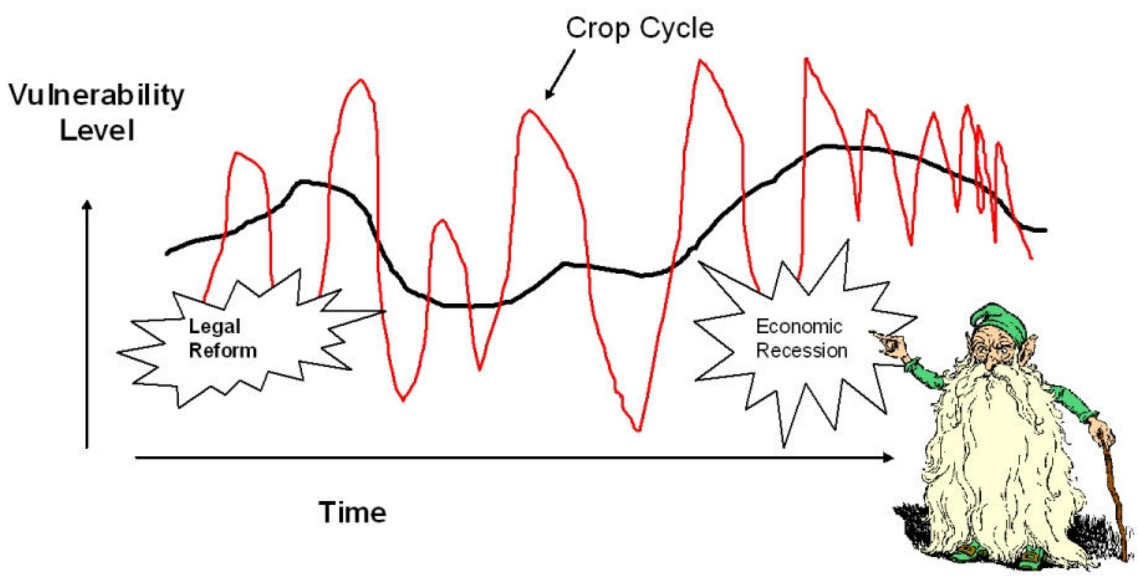

Figure 8: Vulnerability as a dynamic, multiscalar, and historically rooted temporality

One model which exemplifies this approach is the Pressure and Release Model (PAR), which emphasizes how a progression of driving forces shapes the degree of vulnerability. These forces include root causes, dynamic pressures, and unsafe conditions (Blaikie et al. 1994;

Wisner et al. 2003; Birkmann 2005). The dynamic component of this model spells out the temporal aspect of vulnerability. It suggests that changes in the macro-environment (e.g. deforestation, urbanization) create dynamic pressures influencing unsafe conditions. In this model, the progression of vulnerability is theorized to be shaped by long-term and slow-acting processes which remain unseen until a sudden event occurs[13].

What most theories and models still fail to adequately include is a fourth understanding of temporality wherein disasters are seen from the perspective of *social time* as I have outlined. I have referred elsewhere to this conceptualization of temporality as a "dwelling perspective" (De Vries 2007). The anthropologist Tim Ingold suggests that the landscape—the site of vulnerability—is constituted as an enduring record of, and testimony to, the lives and works of past generations who have dwelt within it, and in so doing have left there something of themselves. From this "dwelling perspective," the presumed continuity between mind and world "privileges the understandings that people derive from their lived, everyday involvement in the world" (Ingold 1993:152). In other words, the landscape through which vulnerability develops not only tells, but *is* a story. It enfolds the lives and times of predecessors who, over the generations, have moved around in it. As Ingold puts it: "to perceive the landscape is therefore to carry out an act of remembrance, and remembering is not so much a matter of calling up an internal image, stored in the mind, as of engaging perceptually with an environment that is itself pregnant with the past" (Ingold 1993:153). Taking this dwelling frame of reference, it is clear that temporality—our being in time—is

[13] In another example, scientists at the United Nations University Institute of Environment and Human Security have developed the BBC-framework. This framework suggests an analysis of social, economic and environmental vulnerabilities and coping capacity as well as potential intervention tools, emphasizing feedback loops that occur within the system. While the authors have an interest in exploring future vulnerability and go beyond retrospective loss and mortality assessment, it is also acknowledged that future research is needed on how to integrate the "time" and "spatial" dependency of vulnerability into methodologies to measure vulnerability and coping capacity (Birkmann 2005).

not sufficiently accounted for in vulnerability research by simply noting that vulnerability is "dynamic" or "multiscalar". Those are descriptions of our view of what temporality *is* as seen from the outside, in an objective, historicist view. What it does not do is provide information about how the condition of "being temporal" *acts* to increase population vulnerability to hazards. Turner et al. (2003) point out that the multiscalarity of the human-environment system can cause an increase of vulnerability because of a *failure* on behalf of analysts or decision makers to *acknowledge* larger temporal scales of operation of the systems they are trying to manage:

> Analysts must remain aware that vulnerability rests in a multifaceted coupled system with connections operating at different spatiotemporal scales and commonly involving stochastic and nonlinear processes. Failure to consider this larger context could lead to the identification of ''response opportunities,'' which, if implemented, lead to significant unintended consequences or ''surprise'' (Turner et al. 2003)

The point is that increased population vulnerability is not so much the result of the multiscalarity of the coupled system: this is a mere reality we cannot alter and thus has no policy implication by itself. Instead, the surprise is the result of *human failure* to acknowledge or remain aware of the multiple temporal contexts in policy decisions. In an analogous case, would it be correct to argue that economic vulnerability is caused by "macro-economics" instead of "poverty"? While macroeconomics can be used to theorize, describe, and explain poverty, the problem causing economic vulnerability to hazards remains poverty, not the existence of macroeconomics. At issue is decision-making and the human relationship to temporality, *not* the multiscalarity of time itself.

As I see it, the social time which underlies the dwelling perspective of vulnerability distinguishes itself by its frame of reference, or temporal referentiality, which is from the perspective of individuals and groups being vulnerable and bounded in time. An extreme example of this temporal referentiality is illustrated by the case of the Aymara Indians of Peru, who apparently see the future behind them and the past in front (Nunez & Sweetser 2006)[14]. This radical reversal from the western paradigm of social time reflects a difference is the frame of reference, or referentiality, an issue also pointed out by the philosopher of science Bruno Latour (1988, 1999). He uses the linguistic terms "shifting in, out, and down" to indicate how in a text the reader is shifted through different frames of reference, including different times (then, now) and different actors (he, I);

> When the reader is sent from one plane of reference to another, it is called shifting out; when the reader is brought back to the original plane of reference, it is called shifting in; when the matter of expression is entirely changed, it is called shifting down. These shifts result in the production of an internal referent, a depth of vision, as if one is dealing with a differentiated world (Latour 1999).

Taking this referential perspective into the world of vulnerability models, the temporal reference point of almost all models on vulnerability is from the point of view of those studying disasters and explaining vulnerability. Or, in other words, the "temporality" of the vulnerability concept remains *outside* of the perspective of the vulnerable population. Analyzing vulnerability in a processual, dynamic, multiscalar, historical way, researchers and evaluators presume that the populations studied will eventually benefit by a reduction in vulnerability[15]. This way of understanding time is rooted in western, rationalist or Cartesian

[14] It is widely recognized that time is conceptualized spatially in a broad range of languages and cultures—indeed, that all languages so far examined take their vocabulary of time primarily from that of space. Although a language typically has more than one metaphorical model of time, so far all documented languages appear to share a spatial metaphor about time in which time is seen as the motion of the self along a path, a linear conceptualization. The Aymara language instead has a major static model of time wherein the future is behind the self, and the past is in front of the ego. Nunez and Sweetser (2006) provide linguistic and gestural data to confirm this unusual culture-specific cognitive pattern. For example, Aymara speakers gesture forward when talking about the past, and backward when talking about the future.
[15] Historiographers would call such an understanding of time to be "historicist," in which temporality refers to a form of "objective" time against which the level of vulnerability can be "mapped" and understood.

tradition of thought, which promotes a desituated understanding of people and things by attempting to understand physical phenomena from fundamental laws. Brought about by Galileo and promoted by Descartes, Locke, and others, this perspective relies on the merits of detachment; a mode of being which allows a distanced view that enables us to obtain a wider view because we extract ourselves from the immediate pressures and passions of the moment (Florez & Drefus 1997). While this modern way of understanding temporality is slowly eroding in the West and being replaced by a postmodern temporality[16], it is the traditional modernist way which still provides the major philosophical grounding for most of the definition of temporality that underlie its description as "dynamic," "multiscalar," or "historical." As a result of this modernist dominance of temporality in the disaster literature, and without apparent solution in its post-modern revision, the dominant Western research approach annihilates history as a subjective way of being that is grounded in every day practices. Since the Western, commonsensical way of thinking depends on nonhistorical detachment (or nonhistorical improvisation in the post-modernist case), researchers and theorists dealing with temporality in disaster research are ill prepared to describe or even notice how history making is embedded in practices, activities, and the skills of people themselves. The field as a whole tends to undervalue the contribution which the situatedness of a floodplain population in time makes to its vulnerability or resiliency. A contribution

[16] Post-modern temporality is an equally disturbing attempt to escape from history. The post-modern world exists in a flow of events, where the analyst surfs through time and improvises, using his or her skills to the best advantage in whatever situation that comes along. With nothing expected to remain constant, post-modern expectations of the future have become short-term, and as such reference to the past is equally misguided. Postmodernism appears to try to make the most of whatever situation its find itself in and as such continuously reshuffles temporal identities. It is a disembodied temporality which lacks commitment to a integrated, coherent form (Florez & Drefus 1997).

which is embedded in practices, styles[17], or meanings derived from the stories within the floodplain landscape themselves; their slightly elevated homes, the floodplain maps, the river ecologies, the size of the culvers, the bridges, the cracks in the sidewalks. Those dwelling within and dealing with floodplain landscapes derive meaningful patterns from particular meaningful past(s).

Since the temporality which is relevant to those living and dealing—dwelling—within hazardscapes is non-modernist, it is sensible to identify research approaches which fit within this profoundly social context. Grounded in the everyday existence of populations in their "lifeworld," such a perspective is identified as dealing with social time. Only a few researchers appear to have explicitly focused on the "presentist" connection between vulnerability and populations situated in social time, looking at the biases which social groups construct in the present and which influence their understanding of the past. For example, Forrest (1993) uses a social time framework to explore how six communities acknowledged the first and second anniversary of Hurricane Hugo. Employing the concept *anniversary* with a conventional time framework, a comparative case study of coastal and inland communities is used to illustrate how past events surrounding a disaster, such as Hurricane Hugo, are reconstructed to have meaning and utility for the present, in particular enabling collective remembrance and expression of community memory.

> Disaster anniversaries entail an interactive process in which people share personal experiences. Public officials make declarative comments while the press and electronic media reconstruct the disaster experience by recording current thoughts and

[17] Florez and Dreyfus speak of certain "styles," ways in which practices ultimately fit together, which could be the coordinated result of experiences and practices that could for example characterize floodplain inhabitation. It is this dwelling-style which determines what matters and how this meaning is transferred from situation to situation. The significance of events form this perspective lies in their role in history making—in how they change style or the coordination of practices by bring some into sharper focus (articulation), make a marginal aspect of it can become more dominant (reconfiguration), or when new practices are obtained form the outside (cross-appropriation).

> reflections. In short, the disaster anniversary is a process of collective remembering (Forrest 1993:448).

Another example is work done by Bankoff (2004), who appears to be one of the few researchers who seriously examines the manner in which time is perceived in relation to disasters and vulnerability. As a historian, his frame of reference is a critique on the ill-conceived way in which historians have systematically seen disaster as non-sequential historical "events" caused by a combination of natural agents (occasionally war) that have detrimental consequences. Following the social science notion that social vulnerability is instead a social-historical process, in an article in the *Journal of Mass Emergencies and Disasters* he asserts that the cultural-historical or human-ecological approach fails to capture the temporality which is inherent to social time[18]. Bankoff writes in *Time is of the Essence*:

> In a sense, I would argue that there is a temporally produced state of vulnerability though Oliver-Smith probably would not go so far as to call it that. In other words, history also generates its own form of vulnerability that in a real sense underlies all other forms of vulnerability though its recognition as a factor is always more implicit than explicit. First, of course, there is the particular sequence of events that situate people in time and place; then there are the historical processes that determine their condition and their capacity to withstand its effects. But individuals also 'construct' disasters as both a function of their prior experience of hazards as well as from their particular 'class' or social group's perception of what is happening around them (Hilhorst 2004). Moreover, disasters are not so much objective events as subjective ones that can be privileged or erased according to a sense of selective memory or collective amnesia. Only when the study of a hazardous event is linked to its specific perceptual, social and cultural historical context can it really reveal the processes at work in creating a disaster. Thus, in a real sense, time itself is as much a factor that needs consideration in how disasters are created, as are politics, society, the economy, culture and the environment. Few historians, however, have approached disasters from this perspective (Bankoff 2004)

Even outside disaster literature, little research appears to investigate the influence of "time" on the vulnerability of complex systems. Most references to "temporal vulnerability" are related to the idea of "vulnerable times," which is an assessment of the impact of a hazard

[18] Bankoff writes that his intent is to provide more of a "line of thinking in progress than a work in progress."

during heightened vulnerability. The way in which this concept of vulnerable times is used is commonly from the same objective, chronological point of reference. For example, Tollich suggests that in the context of a medical ethics internal review board situation, temporal vulnerability occurs when children and prisoners are asked if they would like to participate in a research study immediately after they first learn about a serious medical condition (Tollich 2004, 2005)[19]. The notion of "vulnerable times" has a longer history among neurologists studying the impact of alcohol exposure and fetal development during pregnancy, where the third trimester is singled out as a period where the fetus' developing brain is more vulnerable to alcohol exposure then others periods (West 1987; Maier et al. 1997). While there is relevance of the timing of the risk event to the eventual outcome (a healthy infant), this example again more closely captures how vulnerability changes over time in a relatively closed system and within the context of a relatively stable developmental path.

In conclusion, I argue that a presentist, dwelling perspective in vulnerability research has been largely absent, and I propose that this can be called "temporal vulnerability," to distinguish it from a "historical vulnerability." The latter sensibly should refer to vulnerability from a historicist perspective that investigates changes in "vulnerable times," seen from the outside through chronological time. This fourth conceptualization of temporality based on presentism and in social time in vulnerability research would look something like Figure 9:

[19] Tollich argues that "vulnerable times" occur when ethical risks might have a greater impact then usual, for example during times of bereavement, birth, or job layoff. "People's lives may change in the course of the research, giving ethics a temporal dimension. The term "vulnerable times" needs to be added to the vulnerable persons' category given that all people are vulnerable at different times in their lives (Tollich 2004).

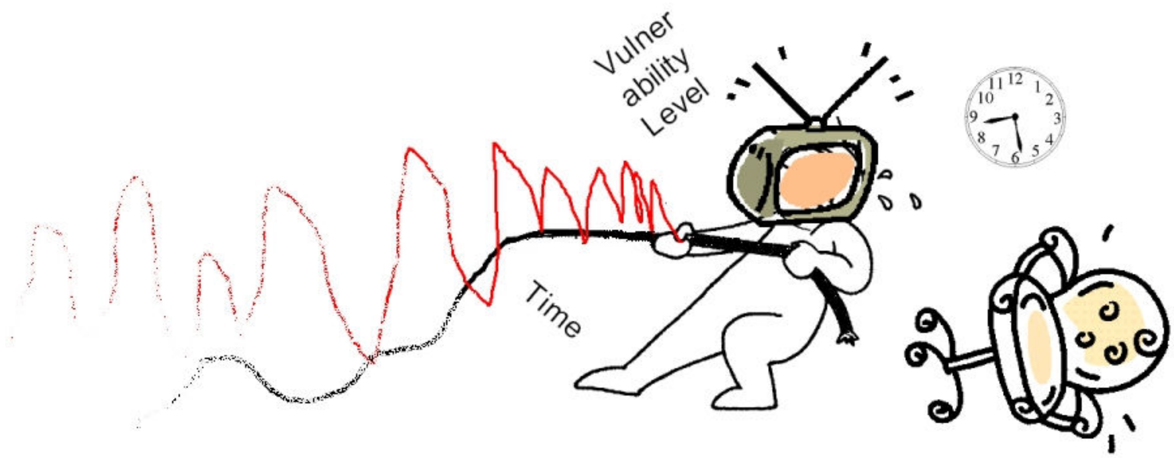

Figure 9: Vulnerability as dynamic, multiscalar, and historical in social time!

1.4. Temporal Vulnerability

Taking a non-modernist, dwelling perspective on temporality steeped in social time, I am close to defining what temporal vulnerability might be: *the temporally produced condition of population vulnerability*. In this definition, "temporally" does not refer to "short-term" (as in lasting only for a time, or passing), nor variable over time (as in historical). Temporal vulnerability refers to the idea that certain social times underrepresent or obscure hazard expectations in the landscape. It is possible to suggest that temporal vulnerability can occur when the temporal properties of a landscape are deceptive or difficult to understand, as in a flash flood context. It is also possible to suggest that it can occur when knowledge within the population is out-of-sync with the "real" temporal properties, as in a situation where memories of previous events are obscured. While this helps in explaining temporal vulnerability, it also imposes a dualistic separation of "the environment" from "knowledge of it." Perhaps it is more effective for this reason to speak not of a mismatch, but of *weak temporal properties of a cultural model* held within the population. The idea of a cultural models comes from cognitive anthropology[20]. Cultural models are seen as explanatory systems which connect parts and emulate relationships among mental constructs. They enable prediction and explanation, and are cultural because they are shared and reproduced within a culture (Holland & Quinn 1987). By necessity, the representation of the environment in cultural models must include historical ecological knowledge, including the recognition of temporal features in the changing landscape, and other forms of historical knowledge such as intergenerational memory. To a large extent, it is this type of temporal knowledge that is the basis for the calibration of future risk projections or expectations. For example, in a volume on historical ecology (Crumley 1994), Winterhalder writes that "a complete explanation of ecological structure and function must involve *reference* to the actual sequence and the timing of the causal events that produced them" (Winterhalder 1994, italic added). According to Winterhalder, this controversial claim in the philosophy of science suggests that any explanation that cites only the type, number, and cumulative value of the independent variables is incomplete. It also acknowledges their possible *novelty* and gives attention to the actual order and timing of their impacts. Most scientists and historians would agree that the past is intrinsically worthy of study, yet, the more difficult question to be answered is to what extent that history actually matters to our ability to explain the present or predict the future. Winterhalder asks: "What kinds of knowledge about a complex system are dependent on the specifics of that narrative history? Are there important properties not discernible from present observation and analysis?" As an answer to this question, Winterhalder follows Lewontin (1974) in suggesting that the full set of functional

[20] Cognitive anthropologists have studied how people in social groups conceive and think about the objects and events which make up their world—including everything from physical objects like wild plants to abstract events like social justice (D'Andrade 1995). They have focused on classification and naming, cognition in practice, socially distributed cognition, identity, and cultural models. In the past years, "cultural models" have become central to anthropologists interests in environmental relationships (Kempton 2001).

relationships that would enable us to predict the "phenotype" from each "genotype" in all possible environments is effectively hidden to analytical view:

> Using an analogy, this is much like the hiddenness of the dynamic properties of ecosystems (technically, the past, or domain of attraction). Functional ecosystems properties that we need to understand (such as resilience) reflect an equally deep and obscured history. As in the case of genotype-environment interactions, these properties remain potent but are incompletely and only indirectly revealed in the manifest form and behavior (phenotype) of the extant system. As with phenotypes, feasible manipulation of extant ecosystem processes provides only limited ability to explain and predict. An ecosystem is the indirect manifestation of its own special kind of history, a functional history arising from the partial coevolution and adjustments of the species composing it. Without knowledge about the system's actual history, our understanding is quite limited. (Winterhalder 1994:20)

From this perspective and similar to the historicist notion of social vulnerability, Winterhalder defines historical ecology as undertaking the temporal (diachronic) analysis of living ecological systems that in principle is necessary to fully analyze their structural and functional properties (p23). He has also provided an analytical basis for another perspective on temporal vulnerability: when the obscure and deep past of an ecosystem remains *hidden from view*. When temporal properties of cultural models are exposed and have meaningful significance to stakeholders, future expectations are made more realistic. On the other hand, when temporal properties of cultural models are somehow obscured or compromised, vulnerability to the changing environment is encouraged. Methodologically, I suggest that what is key to this hiddenness is the quality of temporal referencing. What connects temporal landscape dynamics with temporal aspects in a cultural model is how the model refers to the landscape (the referent). Focusing on the referent, the landscape remains closely tied to Culture (or in fact stays part of it), bypassing the separation of Nature from Culture (the purification).

"Reference" comes from the Latin *referre*, or "to bring back." Philosophers of language have commonly struggled with reference as the problem of how to link words to things, or how to build a bridge over the chasm of two ontologically different domains—language and nature[21]. Situated in this debate, Bruno Latour points out in a case study on soil sampling in the Amazonian forest (1999) that the word "reference" does not designate an external referent that is meaningless or lifeless without means to achieve its movement. Instead, he argues that referentiality concerns the quality of a *chain of transformations.* A chain in which the viability (the capacity for survival) of its circulation is hidden, as obscure as the history of Winterhalder's human ecosystem. Latour describes how the Amazonian soil eventually comes to be transformed ("transubstantiated") into the academic text through a succession of stages, traceable, and allowing for travel in both directions: "The earth becomes a cardboard tube, words become paper, colors become numbers, and so forth" (p69). According to Latour, reference is not simply the act of pointing or a way of keeping, on the outside, some material guarantee for the truth of a statement; rather it is our way of *keeping something constant through a series of transformations*. Knowledge does not reflect a real external world that it resembles via imitation or modeling, but rather a real interior world whose coherence and continuity it helps to ensure. The word "reference" designates the quality of the chain in its entirety. By ethnographically describing the labor required to transport a reference from the complex chaos of the actual forest to the nicely graphed diagrams in the scientific text, Latour suggests that instead of a bridge between two stable points (nature and language) or the rope between one fixed point and one that moves away, the accuracy of a reference indicates the fluidity and stability of a series of

[21] Indeed, using Google, itself a reference system, one of the few places where the keyword "temporal referent" even appears is in the context of computer language development.

transformations. Historicity is when this chain of transformation is somehow disturbed. This literally happens all the time[22].

Latour's referent is seen as a chain of transformations of one item into another. Importantly, these transformations are *symmetrical*, since the chains of transformations can be followed from data to texts and from texts back to data. As such, the referent indeed does more than resemble the actual object; it takes the place of the original situation. Based on his example of the soil and plant scientists, Latour identifies two basic features of the reference. First, the referent provides an economy, a shortcut, an induction, a funnel in which one specimen of plant counts as the sole representative of a whole class of objects. Secondly, the referent act as the preservation of the plant that will later act as guarantor, or validation, when the observer is in doubt or when someone else doubts certain claims that were made based on the referent. Crucial in this second feature is the issue of symmetry. Yet, Latour's analysis appears specifically aimed at synchronic references, and do not refer to diachronic, or temporal, referents. In the diachronic case, the initial, basic feature still holds up, since it is possible to say that temporal referents provide an economy, a shortcut, an induction, a funnel in which one moment in history counts as the sole representative of a whole class of moments in history. Yet, the second part of this definition—the validation issue—is more problematic. The extent to which the temporal referent acts as the preservation of the past that will later act as guarantor, or validation, when the observer is in doubt, or when somebody else doubts claims made based on the referent appears to be running in some philosophical problems. Here Pandora's box remains closed since temporal references are

[22] "We still imagine the thing to be somehow at one extremity waiting out there to serve as the bedrock for the reference, but if the reference is what circulates though the whole series, every change in even one element of the series will make for a change in the reference… every change in the series of transformations that composes the reference is going to make a difference, and differences are all that we require, at first, to set a lively historicity into motion" (p150).

intrinsically asymmetrical and irreversible and as such can not easily be validated on their representiveness. Humans cannot go back in time and re-experience the past to verify or validate the reference claim made, since the past moment does not exist anymore (or, as Derrida would argue, has shrunk!). There is no protocol book, no tags on trees, no pedocomparator, no record cards, no stakes, no delicate spider web woven by the pedofil that can help us find our way back to a disappeared forest from which the soil samples were derived. Instead, we can only imagine the past, from the present, based on traces left behind. In the case of the temporal (or diachronic) referent, the referents themselves are referents, creating Pandora's black box, the one Latour so fiercely tries to open.

Latour's theory is helpful because it connects present to past, and as such provides a methodology applicable to social time. Instead of seeing a hazard event as a moment in the past that quickly becomes a black box[23], Latour's theory challenges this notion by suggestion that the temporal referent exists in the present, "chained" to our current consciousness and transformed in its quality through disturbances (its historicity). Returning to the definition of temporal vulnerability, what becomes evident now is that temporal vulnerability could be defined as the situation in which the quality of the chain of temporal referentiality is compromised, when references become weak, are inaccurate, or simply forgotten, even expulsed from the cultural model of the hazardscape. The outcome of this situation is that when a hazard occurs, there is no referential knowledge to make sense of it, or to anticipate its arrival. In other words, a population is found unprepared.

[23] In Science in Action (1988) he suggests that well-established facts appear as black boxes, a concept from cybernetics, for a machine or set of commands that is too complex to be dealt with in detail. Instead a box is drawn, for which only input and output are known. When closing the black box, disputes cease, and this allows people to take the work of others as a resource and move on, rather than continually reproducing and questioning it.

1.5. Surprise as the condition of temporal vulnerability

I theorize that a host of influences shape temporal referentiality, such as the extent to which historical ecological knowledge is accurate, the extent to which memory networks are effective, the speed of change within the hazardscape, and the efficiency of environmental monitoring networks. When any of these components fails or is outside of the normal, the resulting and potential disastrous condition (symptom, dependent variable) is *population or community surprise*. The focus on surprise as the condition of temporal vulnerability has the advantage of making theoretical and applied sense. *Surprise occurs when causes turn out to be sharply different than was conceived, when behaviors are profoundly unexpected, and when action produces a result opposite to that intended—in short, when perceived reality departs qualitatively from expectations* (Holling 1986). The central element is expectation. From an applied perspective, this detour from the expected has become increasingly central in recent decades. For example, in the Amsterdam Declaration on Global Change made in July of 2001, researchers from four international global change research programs emphasized that the observed and accelerating processes underlying global environmental change cannot be understood in terms of a simple cause-effect paradigm (IGBP 2001). Worried about the lack of political progress, global change scientists pointed out that earth system behavior is full of *surprises*, exhibiting multi-scale temporal and spatial variability, and characterized by critical thresholds and abrupt changes. In recent decades, ecologists have come to see many ecosystems as examples of highly unstable systems where disturbances are seen as unpredictable and influential factors that cause structural change in ongoing development processes (Little & Leslie 1999; Winterhalder 1994; Cashdan 1990; Halstead & O'Shea 1989; Reice 2001). As this dissertation deals with a hazardscape—

floodplains—these are systems which are unpredictable, since their properties include both uncertain hazards and human induced environmental changes. These floodplain landscapes are complex and chaotic, non-linear, or “dissipative” systems (Kontopoulos 1993; Waldrop 1992; Nicolis & Prigogine 1989; De Landa 1997). Such systems are characterized by the potential emergence of truly novel organizational forms that were not predicted from previous organizational states. In other words, *surprise* is thought to be a defining element. One practical effect of this thinking is that even though a system may be deterministic and the governing laws known, long-term predictions are meaningless (Williams 1997). For this reason, Kontopoulos calls the historicity of environmental change in dissipative systems a "stochastic history" which is the contingent history of a system's evolution. It implies specific context, historicity, and irreversibility. What this also implies is that research aimed at predictive modeling might only be accurate to the extent that systems stay in their equilibrial state. When it comes to the surprise avoidance, I believe what counts is not only attempts to predict trends in the future, but moreover the building of social and institutional capacity that fosters preparedness to the *potentiality of surprise*. The analysis of temporal vulnerability does precisely this: it investigates under what temporal conditions the likelihood of surprise is increased and vulnerability heightened. In doing so, the resulting assessment can help identify and reduce vulnerability through interventions and capacity building.

Unfortunately, as is the case for temporality, little explicit attention has been given to the notion of surprise in disaster and risk literature. Many of the books on risk and culture do not carry the reference in the index. The issue seems often subsumed under resilience, or it is not mentioned at all (see for examples UN/ISDR 2004; UNDP 2004; WCDR 2005)[24].

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[24] In the compilation of Outcomes of the Regional and Thematic Meetings for the Preparation of the World Conference on Disaster Reduction (18-22 January 2005, Kobe-Hyogo, Japan), there is no mention of surprise in

Because of its relationship to decision making, research on surprise and expectations appears to be led by psychologists. For example, already in the 1960s, the environmental psychologist Berlyne has identified "surprisingness" in the landscape as one of four components (with complexity, novelty, and incongruity) that elicits a comparative or investigative human response (Berlyne 1960, 1974). More recently, the Harvard psychologist Jerome Kagen focused on surprise using advances in experimental and cognitive psychology, such as Event-Related Potentials (ERPs) which measure brain activity. Besides illustrating that the human brain is exquisitely sensitive to discrepant events that violate a person's expectations (Kagan 2002:115), Kagan argues that surprise is psychologically defined by a *relation* between the temporality of representations ("schemata") in the brain/mind, and an event. Surprise is not inherent in the event: "One must know both the content of the agent's mind and whether the representations were created during the previous few seconds, the prior day, or years earlier, in order to predict the consequences of the experience" (p17). In other words, surprise is psychologically referential.

This preoccupation with representations and their temporal origin in the analysis of surprise can also be found as a theme among at least one dissenting economist, G. L. S. Shackle (Ford 1994; Ford & Ghose 1998). An opponent of much of the equilibrium-centered orthodoxy in economics, the overwhelming concern of Shackle's work was the nature of time. In his view, too much of economic theorizing was concerned with a rigid, Newtonian definition of time, rather than one which emphasized human expectations and uncertainty.

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any of the documents. This while it is probably safe to argue that the unanticipated scale of the Kobe earthquake is one of the dramatic surprises of human history despite all of Japan's scientific and engineering prowess (Wisner 2003[24]). Similarly, the almost 600 page United Nations Report "Living with Risk: A Global Review of Disaster Reduction Initiatives" (UN/ISDR 2004) provides a global survey of examples of action by individuals, communities and governments, not only to reduce the risks and impacts of natural and technological hazards, but also to avoid creating those risks in the first place. Within this context the term "surprise" is not mentioned once in the report. Similarly, in the complementary United Nations publication "Reducing Disaster Risk: A Challenge for Development" (UNDP 2004), the term is not found once.

Central to his theory was a rejection of the notion of probability for unique decisions and its replacement by his own measure of uncertainty, the *degree of potential surprise* (Shackle 1955, 1961, 1972). This measure relies on the idea that the crucial element to be understood is the formation of a set of possibilities in the mind of an evaluator (Fioretti 2001). To Shackle, the "degrees of possibility" emphasize the emergence of novelties in empirical reality (Shackle 1961), and should be called a degree of surprise. Since surprise refers to imagined events, Shackle preferred to speak of a "potential surprise." This is the degree of surprise to which we expose ourselves, when we examine an imagined happening as to its possibility, in general or in the prevailing circumstances, and assess the obstacles, tensions and difficulties which arise in our minds when we try to imagine it occurring. This provides the indicator of the degree of possibility; it is the surprise we *should* feel, if the given thing *did* happen; it is *potential* surprise (Shackle 1961).

Recently, some psychologists have picked up where Shackle left off, proposing that potential surprise is an important mechanism underlying subjective probability judgment (Fisk 2002). Social psychologists have traditionally taken the lead in trying to understand how expectations influence decision-making, and have identified a number of universal heuristics underlying principles of belief concerning the projected likelihood of such events. The major conclusion from this line of work is that humans can be seen as “cognitive cripples” and are therefore cognitively vulnerable to making unwise decisions about the probabilities of events happening. For example, the psychologists Kahneman and Tversky (1974) have pointed out that humans typically evaluate the probability of an event by the degree of similarity with other events (representativeness bias), the ease with which instances of occurrences can be brought to mind (availability bias), and through adjusting a given initial value to yield the final answer (anchoring or adjustment bias). All of these biases can affect the perceived historicity of past hazards events. Further, psychologists have found that the human psyche tends to magnify the importance of events that are close in time (and space), while diminishing the importance of temporally more distant events. Social psychological biases include for example the tendency for people to believe information that is more comforting than realistic if a choice of interpretations exists (the normalcy bias). Another belief is that a recent disaster (or event) occurrence is unlikely to be repeated in the near future, whatever the objective probabilities may be (the gambler's fallacy). Finally, the theory of cognitive dissonance holds that contradicting cognitions serve as a driving force that compels the mind to acquire or invent new thoughts or beliefs, or to modify existing beliefs, so as to reduce the amount of dissonance (conflict) between cognitions. These results emphasize how personal involvement and experience is the key to the perception of disasters "for it embodies the historical imprint of events, as these are projected forward into the future through the mediation of experience and knowledge" (Alexander 2000:V).

1.6. Research Questions and Chapters

The central focus on surprise as the characteristic population outcome of *temporal vulnerability* distinguishes it from *historical vulnerability*, the latter being a perspective in chronological time that traces (multiscalar) changes in vulnerability levels. Temporal vulnerability also does not concern an analysis of "short-term" vulnerability, as in lasting only for a time, or passing. Temporal vulnerability instead is a population *condition*, which relates to emergency unpreparedness or lack of resilience caused by an enhanced potential for population surprise (a breakdown in common, adaptive practices). Fundamentally, this is a non-modernist, presentist, social dwelling perspective that is analytically different from the detached, modern and "historicist" conceptualizations that underlie temporality in most social vulnerability research. Further, temporal vulnerability distinguishes itself from the common conceptualization of social vulnerability, the latter being seen as a condition that is the result of unequal and inequitable power relationships, resulting in a disempowered lack of access (a political ecology). While populations who are socially vulnerable are often similarly temporally vulnerable (conditioned to surprise), this is not necessarily the case (as the case of Savannah in this dissertation might illustrate; the entire City—poor, middle, or upper class—was prone to surprise because of the lack of hurricane hazards in the past 100 years). While complementary, social and temporal vulnerability are not the same. The same can be said for environmental vulnerability, which is the idea that there is fragility in the services that dynamic environmental systems provide. This fragility can be exacerbated by human induced threats, for example through war or over-use of natural resources (Birkman and Wisner 2006). An increase in environmental vulnerability could also induce an increase in temporal vulnerability, but only if the changes in environmental fragility go unnoticed. Another example is the suggestion of institutional vulnerability, which arises from the mismatches in the interplay among different institutions involved in risk management. One of the main sources of this is coordination, which has a strong temporal element. One could argue that problems that arise in the temporal coordination of disaster response would induce their own form of temporal vulnerability. For example, in the case of Hurricane Katrina, the failure of coordination in the institutional response led to the tragic situation in which many residents found themselves—to their surprise—left behind.

Having introduced, defined, and differentiated temporal vulnerability, the remainder of this dissertation deals with the following questions:

- How does temporality produce population vulnerability?
- What are the major drivers of temporal vulnerability?
- How can temporal vulnerability be measured?
- What can be done to reduce temporal vulnerability?

I will address these questions through four case studies of neighborhoods in their larger urban contexts. The neighborhoods described are located in North Carolina (Lincoln City, City of Kinston, Lenoir County), Georgia (Ardsley Park, City of Savannah, Chatham County), Louisiana (Maplewood, City of Harvey, Jefferson Parish, Greater Metropolitan New Orleans), and California (Felton Grove, Town of Felton, Santa Cruz County). Each of these case studies focuses on a different theme, making use of the particular characteristics of the floodplain to create a general assessment of the temporal vulnerability present in the floodplain landscape. *The themes covered are hazard mitigation, historicity and conservation, early warning, and predictable surprise.* In the final chapter of this dissertation, the lessons learned in the case studies are integrated into a model for temporal vulnerability, and suggestions for measurement and assessment are made.

The theme of mitigation is described in the case of Lincoln City. Located in the City of Kinston in hurricane prone eastern North Carolina, Lincoln City was a historical, middle class neighborhood located close to the Neuse River. After Hurricane Floyd hit in 1999, this neighborhood was entirely bought out after an aggressive FEMA funded buyout and mitigation program was used to provide homeowners with an alternative place to live in the City. The key issue in this chapter is that while FEMA programs only allow voluntary participation, a survey done among homeowners shows that about 1/3rd of the respondents felt pressured into doing so. While the mitigation program was highly successful from a mitigation point of view, it eradicated a historical neighborhood and as such was a disaster to the black community in the town. Why then did residents relocate? In this case study, I outline the historical development of the community relative to the referential knowledge available about hazard threats and the politics of mitigation and recurrence intervals. My argument is that the possibility of the buyout was partly possible because of the high temporal vulnerability of the population, who experienced the combined impact of Hurricanes Dennis and Floyd as a major surprise and failed to see Hurricane Fran as an early warning because it was deemed a "fluke," outside of the normal.

In the second case study, the North Carolina floodplains are exchanged for a complex Citywide landscape of levees, canals, coastal tides, hurricanes, and severe rainfall in the City of Savannah. Having identified the importance of historical knowledge as referential material, in this study the theme emphasized is the role of conservation and historical preservation in providing resilience against temporal vulnerability. However, interviews with city officials and residents from a neighborhood called Ardsley Park expose that despite its image as a historical city, the challenge of temporal vulnerability is much more multidimensional than initially expected. The case study details a severe macro-scale vulnerability to hurricane impact due to a lack of major hurricanes for the past 100 years, leading to widespread complacency. In order to counter this problem, the chapter focuses on the institutional and community level challenges which city management encountered when trying to provide and maintain intergenerational memory to counter this vulnerability. The existence of rainstorm flooding complicates this effort because of the different scale of impact. In the end, it is striking how the same perception of recent storms as fluke events seems to provide a false sense of security. It is concluded that in Savannah, the historical identity is no more than a façade for a temporally vulnerable situation.

The third case study deals with the issue of early warning in a flash flood environment of the Santa Cruz Mountains in California. Temporal vulnerability appears deeply embedded at many levels in the story of the Felton Grove neighborhood, located in a deceptively tranquil floodway along the San Lorenzo River. The case study describes how after early warning failed in 1998, the need for a people-centered early warning system remained problematic due to an increasing lack of internal capacity. The difficulty in negotiating and installing an early warning siren to improve neighborhood early warning illustrates in particular is how a small group of key residents served as maintainers of flood memory. The case study emphasizes how after the 1998 flood, the impact of neighborhood turnover eroded the lived experience that was needed to facilitate an adequate response to early warning and to recognize signs of environmental stress during monitoring of river and other biophysical conditions, resulting in an increase of temporal vulnerability. The dependency of the neighborhood early warning system on a few remaining residents and property owners emphasizes the importance of the "flood generation." The socio-demographic concept of a historical generation, or cohort, is emphasized because it refers specifically to the idea that a certain *event* provides a cultural imprint on a cohort. In this case, this imprints helps to reduce temporal vulnerability.

The final case study moves to the pre-Katrina "era" of Southern Louisiana, in particular the West Bank of Jefferson Parish, in a neighborhood located in the City of Harvey, south of the Mississippi River. This chapter investigates the notion of the predictable surprise which is theorized to occur typically in hierarchical political systems, where leaders might have known about a problem, but failed to act for various, often political, reasons (Bazerman & Waktins 2004). The chapter uses the framework of temporal vulnerability to investigate the still unsolved major question concerning the extent to which the disaster, and in particular the breaching of the levees, was a predictable surprise. The analysis shows that there were many temporal elements which combined to provide a culture of expectations in which the likelihood of a future levee breach was underestimated in the face of a fast moving Category 3 or higher hurricane. In the case study, I review the two temporal pathways through which this temporal vulnerability developed over time, compromising the ability of residents, officials, and institutions to be adequately prepared and resilient to the impact of a major Hurricane type hazard. The temporal characteristic of the first pathway deals with stakeholder reliance on misguided temporal references and analogs that were generally left unchecked by a gradual loss of historical and institutional emergency memory. The second temporal pathway deals with the inability of stakeholders to obtain up to date ecological knowledge about their fast changing environment. Together, these factors provided the conditions for ecological surprise.

Towards the Eye in Vulnerability Research

The **"eye"** is a roughly circular area of comparatively light winds and fair weather found at the center of a severe tropical cyclone. Although the winds are calm at the axis of rotation, strong winds may extend well into the eye. There is little or no precipitation and sometimes blue sky or stars can be seen.

The eye is surrounded by the **"eyewall,"** the roughly circular ring of deep convection which is the area of highest surface winds in the tropical cyclone. The eye is composed of air that is slowly sinking and the eyewall has a net upward flow as a result of many moderate - occasionally strong - updrafts and downdrafts.

Another feature of tropical cyclones that probably plays a role in forming and maintaining the eye is the eyewall convection. Convection in tropical cyclones is organized into long, narrow rainbands which are oriented in the same direction as the horizontal wind. Because these bands seem to spiral into the center of a tropical cyclone, they are sometimes called **"spiral bands."**

Some of the most intense tropical cyclones exhibit concentric eyewalls, two or more eyewall structures centered at the circulation center of the storm. Just as the inner eyewall forms, convection surrounding the eyewall can become organized into distinct rings. Eventually, the inner eye begins to feel the effects of the subsidence resulting from the outer eyewall, and the inner eyewall weakens, to be replaced by the outer eyewall.

From: Atlantic Oceanographic and Meteorological Laboratory,
Hurricane Research Division (2007)

2. METHOD

2.1. Historical Ecological Methodology

Halstead & O'Shea (1989) have suggested that a reason why researchers have in the past concentrated on the "normal" or "average" despite the universal prevalence and potential dramatic consequences of variability—surprises—such as a hurricanes, market crashes, or earthquakes, is simply because this variability is harder to grasp and present than some measure of central tendency[25]. Focusing on variability instead of the mean requires a historical approach. The methodological framework used in this dissertation has been largely informed by a perspective referred to as historical ecology. Historical ecologists emphasize multiscalarity of the spatial, temporal, and cognitive dimensions in the human-environmental dialectic (Marquardt & Crumley 1987; Crumley 1994; Balée 1998, 2006). In historical ecology, emphasis is on regionally documented ethnography, archaeology, and documentary evidence in an attempt to look at a human-environment system in its totality.

In this dissertation, I have mostly used qualitative and archival methodology, but have also explored some statistical tendencies using social survey data and geographic methods using spatial and U.S. Census 2000 data. Qualitative methods included participant observation and ethnographic description—of FEMA and other official meetings, residents,

[25] The mean is seen as the most efficient measure of central tendency because every variable has an impact upon the final computation. No data are wasted. The mean is also the most stable measure of central tendency. When one draws from a population, the mean will generally be found to vary only minimally between successive samplings.

mitigation managers, city officials, floodplains, monitoring technologies, etc.—but mostly emphasized formal, recorded interviews with respondents (n=75). In addition, I collected information through numerous informal conversations in various settings, ranging from formal meetings to bars, which I documented in field notes. Archival work mostly consisted of visits to local libraries and extensive searches of historical newspaper records. I also spent time looking at historical documents of drainage committees and other historical reference materials concerning the topic of drainage or flooding. In addition, I spent time finding records online, searching discussion boards, online archives, and other remotely accessible sources. In the field, I recorded about ten hours of video that I used to confirm and contextualize the topic. Statistical analysis included frequency tables, correlation analysis and regression models. GIS was used to delineate floodplain areas in order to overlay census data for analysis of spatial trends (U.S. Census 2000). This mix of data and methods allowed me to shift my perspective both spatially, temporally, and cognitively.

2.2. Data Collection

I was first introduced to floodplain communities after I received an ethnographic summer grant funded by the UNC-Chapel Hill Center for the Study of the American South, which I used to travel to the City of Kinston in eastern North Carolina. There, I interviewed city officials and residents and first applied the critique on the role of baseline referentiality in historical contexts on a hazardscape (De Vries 2002). After this, I was able to take a spatial look at the broader North Carolina flood landscape during a one year Research Assistantship at the UNC-Chapel Hill Carolina Population Center, where I build a spatial (GIS) database detailing the impact of Hurricane Floyd on Eastern North Carolina. In addition, this project enabled me to enter the field again in order to evaluate the impact which the fall 1999 flooding had on 2000 census counts. This brought me again back to the City of Kinston, but now focused on socially vulnerable populations potentially missed in the census survey (De Vries 2003). I was able to investigate historical ecological data for this site when I started working as a research assistant on a project investigating data sources for a historical ecological analysis of land-use changes along the Neuse River, supported by the UNC-Chapel Hill Carolina Environmental Program. Still interested in the floodplains of Kinston, I eventually started volunteering for an NSF- and FEMA-funded study undertaken by the UNC-Chapel Hill Center for Urban and Regional Studies (CURS). This study collected social data on decision making for buyout and relocation programs among natural disaster victims in (among other sites) the cities of Kinston and nearby Greenville in eastern North Carolina (Fraser et al. 2003; De Vries 2006). This study brought me into contact with Dr. Jim Fraser who invited me to become a research associate on his next FEMA-funded qualitative and quantitative research project. FEMA wanted to know why repetitively flooded property owners refused federal mitigation offers despite the 75% funding match, and we were flown up to Washington DC to organize the study. This study eventually brought me to all (and several more) research sites which I included in this dissertation. In all these sites, I spent weeks with Jim (to whom I am grateful) talking to local and state level mitigation officials and many residents. In addition to providing survey and qualitative field data useful to this dissertation, my work allowed me to meet FEMA representatives in Washington DC and obtain an in-depth understanding of way in which FEMA deals with flood mitigation. This provided an extremely valuable institutional context for the topic of temporal vulnerability. At the same time, I obtained a Wenner-Gren fieldwork dissertation grant which allowed me to conduct more qualitative and archival research in the City of Kinston and town of Grifton (Grifton is not included in this dissertation). I spent six months traveling back and forth to meet residents and attend public events. After this, I continued my work with Jim at CURS for FEMA, this time on a project focusing on emergency preparedness among disadvantaged communities, which gave me an in-depth understanding of the world of vulnerability analysis (I created spatial vulnerability assessments using GIS for U.S. states impacted by Hurricane Isabel in 2003). This project also allowed me to do more fieldwork in eastern North Carolina, meet FEMA representatives, and work with hazard researchers. During this period, I received a small National PERISHIP Dissertation Fellowship in Hazards, Risk, and Disasters from the Public Entity Risk Institute, University of Colorado Natural Hazards Center, and the National Science Foundation. This allowed me to return to the field sites Jim and I had studied under the repetitive loss study, where I spent several additional months interviewing residents. I also received a small summer travel grants for fieldwork from the Integrative Graduate Education and Research Traineeship program at the Carolina Population Center. Finally, I received funding from the MunichRe Foundation and the University of North Carolina at Chapel Hill Graduate School to attend the United Nations University Summer Academy on Social Vulnerability in 2006. Here I was able to present my ideas on temporal vulnerability to leading international experts and scholars in social vulnerability and senior scientists from the United Nations University and Munich Re Foundation (De Vries 2007).

Overall, I traveled to 11 different floodplain communities for about five years and worked within the mitigation research field for 3 years. In total, I recorded close to 75 formal and sometimes very long interviews (lasting half-days) and numerous unofficial interactions written up in four books of field notes. I collected enough digital materials to fill up a 100 GB external hard drive, excluding video footage.

2.3. Data Analysis

I organized these data using Nvivo qualitative software for transcribed interviews, SPSS statistical software, ArcGIS spatial analysis software, and excel spreadsheets. In my analysis, my aim was to distill the different conditions which sustained temporal vulnerability before surprise events. This included knowledge on what decision makers, evaluators, residents or other stakeholders actually understand or know about the history of their landscape, how this historical knowledge is constructed by scientists and experts, how this narrative is influenced and translated by media and other communication channels, and how it finally shapes risk expectations among stakeholders.

Borrowed from Actor-Network Theory (Latour 1988, 1999), the general methodology included an emphasis on the concept of referentiality, or bringing back the past into the present through chains of referential transformations (see Introduction). While Latour does not apply his theory to temporality, the idea of the referent appeared helpful in analyzing the linkage between the past and the present in social time. For example, when a mitigation manager mentioned how a risk landscape had changed over the past fifty years, he or she by necessity had to choose a “reference model” that served as a comparative baseline for this temporal analysis of change. Consequently, I have consistently asked myself in what ways respondents *brought back* the past in their narratives. As cultural and cognitive beings, my presumption had been that not all respondents chose to bring back the past in the same way, as we also do not all have access to consultants and experts providing us information about the past in the same way. In other words, by noting the differences in temporal referentiality I encountered in narratives and conversations in the field, I analyzed stories about people's cultural models of temporality in the hazard landscape. I also looked for common understanding of the past, and where this information comes from.

My focus on how people use temporal references to calibrate (or orient) their risk perception also meant a specific interest in the temporal horizon in which this referential knowledge was embedded. Talking about temporality imposes a certain temporal scale. As a historian and archaeologist, Crumley has suggested that the "effective scale" of analysis is the combination of analytic lenses which allow for patterns to be derived. While in my own analytical view the effective scale shifted within the past 100 years of change, I applied this concept to analyze how my informants, different stakeholders including institutions created and maintained *their* effective temporal scales in their risk evaluation. Crumley and Marquardt (1987) suggest that the bracketing, abstracting, and reification that go with the choice of temporal scales also impose political, economic, and other biases. It is precisely this presentist bias carried by those dwelling and dealing with the landscape and creating temporal boundaries which I saw as key source for temporal vulnerability, and which was therefore my focus of analysis.

In my fieldwork, temporal referentiality was often expressed through personal memories. Further, in my analysis I analyzed how people shared memory socially, which can act as ways of storing and transmitting knowledge about hazards from one generation to another through practices, images, stories, symbols, beliefs, and landscape design (Gunn 1994; McIntosh et al 2000; Crumley 2007). Beyond individual and social memory, I also focused on how institutional memory of hazards was described. This included institutions that specialize in storing historical ecological information and have an impact on public understanding of historical ecological conditions. Examples of such institutional memory include scientific monitoring organizations, historical and archaeological organizations, news organizations, and government agencies. All of these memory sources combine to provide a complex memory network, or memory-bank, which act as an important determinant in the provision of hazard expectations. Memory networks temporally order and connect a web of subjects (e.g. floodplain residents, government officials, scientists, etc.) and objects (e.g. floodplain maps, monitoring devices, neighborhoods etc.) to environmental risks. This network was important to my analysis.

Key to a historical ecological approach is knowing how the landscape changes over time. Historical ecologists typically see the landscape as a physical manifestation of human decision-making. As Crumley puts it, landscapes "record both intentional and unintentional acts and reveal *both* humans' role in the modification of the global ecosystem *and* the importance of past natural events in shaping human choice and action" (Crumley 2007). If temporality has any impact at all, this impact should be documented by looking at changes in the physical landscape. For the purpose of temporal vulnerability, I specifically looked at such changes relative to the capacity of informants and stakeholders to monitor changes in their environment. Monitoring is generally considered the activity of following the development of parameter(s) of concern in time and (sometimes) space (Mol et al. 2001). Environmental monitoring networks or laboratories usually sample cost-effective environmental indicators with the aim of identifying ecosystem trends and vulnerabilities and characterize drivers of change (NSTC 1997). Ecological anthropologists typically identify conventional, scientific forms of environmental monitoring in contrast to indigenous or traditional practices which tends to focus on qualitative information—memory. Arguing for a complementary approach, Berkes and Folke (2002) suggest that the strength of conventional science and management is in the collection of synchronic (simultaneously observed) data, whereas the strength of many local and traditional management systems is in diachronic information collection, or long time-series of local observations.

Finally, throughout all my fieldwork and central to the analysis was of course the focus on surprise, which was also a key question to each resident ("did the flood surprise you?"). I also looked in my analysis for references to perceived levels of risk (wherein the presumption is that probabilities are known) and at levels of uncertainty (where probabilities are not known). Most interesting to me was to understand what people felt ignorant about, where their "blind spots" were. This ignorance could also be an unwillingness or inability to consider or recognize that some outcome are not known, but perhaps possible. Because surprise is strongest during ignorance, I had the most interest in this, in particular when ignorance appeared shared (communal ignorance) or was due to epistemological problems (structural inabilities to know) (Schneider & Turner 1994).

2.4. The Floodplain Field Sites

The chosen field site for this dissertation is the floodplain. Researchers working in the human ecological perspective of risk, such as the frameworks of disturbance ecology or non-equilibrium ecosystems, have suggested that hazards are part of the cultural context of such communities rather than external elements (Little & Leslie 1999; Winterhalder 1994; Cashdan 1990; Halstead & O'Shea 1989; Reice 2001). In the case of floodplains, the cultural historicity of the hazardscape is strongly tied to the experience of major and even minor hazard events. While other disasters could also be included in this study, since these events also draw attention and organize behavior, the choice to focus on floodplains assures that documentation of temporal events can be contrasted and compared across sites, keeping at least "something equal" (flooding). Or, in other words, it reduces chaos by choosing one type of hazard. Another reason to chose the floodplain is more personal perhaps. Beyond the fact that I am Dutch and grew up in floodplains (behind levees which promise 10,000-year flood protection), the issues encountered in floodplains are of major applied importance[26].

The localities studied included residents and mitigation managers from neighborhoods in Louisiana, Georgia, North Carolina and California. The criteria for choosing these sites included the historical depth (both long term and relatively short colonization), biophysical diversity (riverine and coastal), and high number of repetitively flooded properties, following FEMA's definition. The latter refers to properties which had at least two or more flood insurance claims of more than $1,000 since 1978, or two or three claims that equal or exceed the building's value. In brief, the field sites are shown in Figure 10, and described below:

1) Residents from a neighborhood called "Maplewood." Located along the Mississippi West Bank as part of the City of Harvey in Jefferson Parish (New Orleans Metropolitan Region), Louisiana. This neighborhood is known as having one of the highest repetitively flooded insurance records in the United States, while being at risk

[26] Further, if the thesis argued fails to deliver, at least this dissertation documents the struggles and lives of those within floodplain landscapes. This, in its own right, is worth the effort. Floodplain residents are often poor or politically marginalized, and the topics at hand address issues of environmental justice and political ecology. An additional bonus of this relevance is that by focusing on risk landscapes I have had the opportunity to receive a few grants and otherwise get funding to do fieldwork by being engaged in applied research projects on decision making among floodplain residents for the Federal Emergency Management Agency. This made doing fieldwork possible and more interesting.

of major storm surge due to Gulf of Mexico hurricane activity. In addition to residents, Jefferson Parish officials and mitigation officials from the State of Louisiana were interviewed for contextual information.

2) City officials working on issues of floodplain management in the City of Savannah, Georgia, as well as residents from a neighborhood called “Ardsley Park,” one of the earliest suburban (car-friendly) neighborhoods and prone to flooding due to outdated drainage systems. A majority of the land which composes the City of Savannah is located in floodplains, at risk of both severe rainstorm events and storm surge from Atlantic hurricanes.

3) In eastern North Carolina, I engaged with residents from a neighborhood called “Lincoln City.” Located in the riverine City of Kinston, this dominantly African-American neighborhood participated in a federal buyout program after Hurricane Floyd caused major devastation in 1999. I also interviewed officials of the City, and analyzed survey results from homeowners in this landscape.

4) Residents and officials from a neighborhood called “Felton Grove,” located in the small town of Felton in Santa Cruz County, California. Located in a mountainous environment, flooding in this area is characterized having a short temporal response time (flash flooding) and in need of early warning.

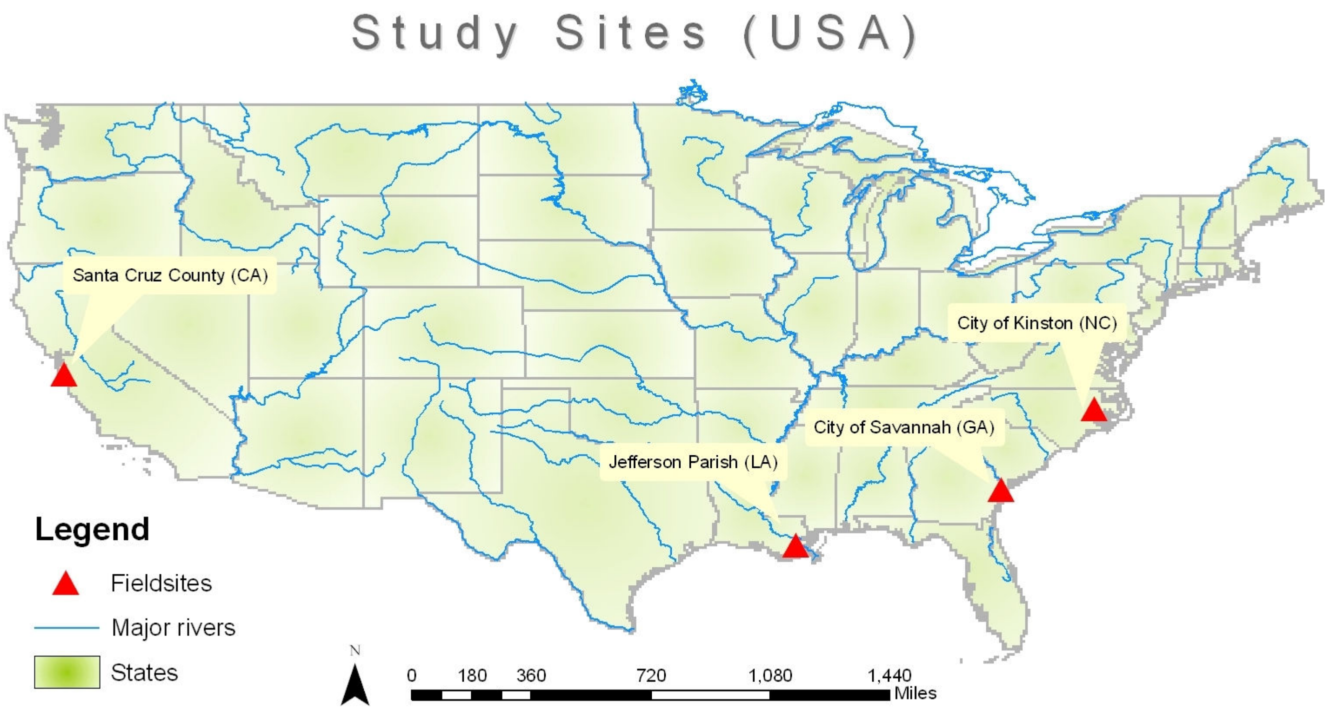
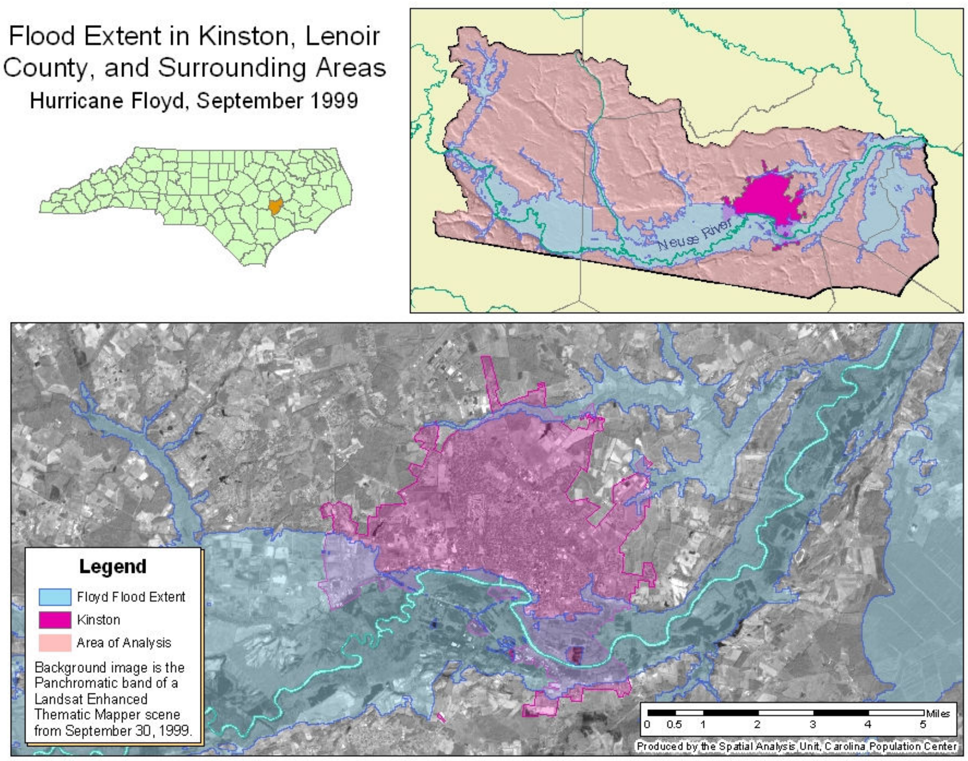


Figure 10: Study Sites

Hurricane Floyd (1999)



3. HAZARD MITIGATION IN KINSTON

3.1. A Forgotten Place

I walk alone on a grid of empty streets connecting vacant lots. Trees are growing where houses used to be. Rubble at the curbs. It is hot. Humid. Nobody seems to be here but me. In the distance, I hear the urban sounds of the small City of Kinston in eastern North Carolina. I see some maintenance-type crews driving around in trucks, apparently ready to cut down some trees.

Figure 11: Empty streets connecting vacant lots, City of Kinston, North Carolina. Photo by Danny de Vries (2002)

I come across a street sign laying flat on the ground. Thrown flat on its back by the unprecedented flood of water which rushed through these streets in the fall of 1999, the sign aptly reads: "Dead End." The symbolic summary of a place where human Culture met its match in Nature (or so it seemed). The remnants of Culture—the paved streets, curbs, and fire hydrants, the empty lots, the office desk standing straight up on its legs in an empty field—make it an eerie place to visit.

Figure 12: Dead End sign amidst remnants of culture.
Photo by Danny de Vries (2002)

Then there are the homes still standing. A pile of debris surrounds every one of them. Behind overgrown grass and bushes, a white, wooden structure is visible. Next to it a huge branch is cracked off an old tree. The home is empty. “Jesus loves,” graffiti claims on the shed standing to its side. On the door hangs a “NOTICE” from the City of Kinston:

> Dear property owner, based on damage assessment inspection and the best available information, the structure located at […] suffered significant damage as a result of the recent flood and is classified as “SUBSTANITALY DAMAGED” as defined in the City of Kinston Unified Development Ordinance and/or “CONDEMNED” under North Carolina General Statute 160A-426 and is unsafe to occupy in its present conditions.

Inside the smell of mold is overwhelming. The walls and floors are covered with algae. A pile of kids’ toys in the middle of what seems to have been the living room. Tables, chairs, a moldy couch upside down. Clothing, books, curtains, bedding, laundry baskets heaped on the floor. All kitchen drawers and cabinets open. Once a family lived here, I imagine. Playing, crying, laughing, cooking, being. I take a photograph. I wonder what people might think when they see me going in here. But nobody is here except me, and the birds.

Figure 13 : A flood house.
Photo by Danny de Vries (2002)

When I walk on I notice one still apparently inhabited home in the midst of the desolate emptiness. A young, black man stands in the yard. “How are you doing?” I ask.

> See the birds? Those are my gift. God gave the gift to me. I am taking care of them too. Yeah. I am doing okay. I talk to the birds. They come to me, anyway. I am taking care of them. Lots of birds now. Less people. They are more friendly. They are more friendly then the people.

He appears to be one of the boys staying in a group-home. Then I meet nurse Williams, the staff person, in her fifties and graying, her white, uncontaminated nursing outfit a stark contrast against the moldy, algae filled empty home I just visited. She explains to me that the owner of the group home building simply replaced the deck and continued her business. “There were houses everywhere. It was a nice neighborhood,” she says mournfully. “Really pretty over here. Until the flood came. Now they are tearing everything down. They torn quite a few down already. And all back on Holloway Drive, have you been there?” I nodded. A Kinston official had driven me around earlier, and had showed me some of the worst flooded places. Afterwards he had told me I better not go this way. “Why would you?,” he had said, “unless you want to buy crack.”

The buyout manager had been a key player in the federally and state sponsored acquisition and relocation program, which had bought out over 400 Kinston properties (3,6% of the total number of Kinston households) after they were declared substantially damaged. “Buyouts” are one way in which communities respond to natural disasters (Hunter 2005). Such buyouts generally refer to the acquisition of property (land and/or buildings) using federal and local funds, including in some cases additional financial assistance for relocation to complementary housing in a less hazardous site. Next to buyouts, communities can move to restoration and rebuilding efforts whereby pre-disaster culture is restored, or a response which includes partial reorganization, taking into account variation of risk by means of, for example, flexible land use zoning regulations. In the latter cases, alternative mitigation strategies such as elevation or flood proofing of floodplain homes are common. When it concerns risk mitigation, buyouts remain a popular mitigation strategy in the USA: since 1993, participating communities have purchased more than 20,000 properties as part of this program[27]. The buyout of Kinston was one of the largest buyouts in the pre-Katrina history of FEMA sponsored mitigation programs. It bought out all of the homes which made up the prominent, historical, black[28] neighborhood I had just walked through. Called "Lincoln City" by Kinston locals, the neighborhood had now ceased to exist. Or almost.

Nurse Williams tells me that the owner of the group home declined to participate in the buyout program because the City—the project manager—did not offer her enough for the property. "It is sad," she continues, "people lost everything they had. Some people now, they still don't have any place to go. They have these little FEMA trailers. It was really bad. Really bad." Do you think the people realized a flood of this magnitude could happen, I ask her?

> I really don't think so, no. Something just, like, happened. The tropical storm came, I think it was Dennis, and went back on the ocean to come again. Then Hurricane Floyd, all the water when the ground was already soaked. And then the river flowed over. And, I understand they had this reservoir in Raleigh they had to let the water out, otherwise it would burst, you know. It just happened. The river kept getting higher and higher and higher. Some people tried to wait it out but it got so high they had to bring boats to get them out. It was really terrible.

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[27] Since the early 1970s, buyout programs have been implemented through FEMA grants in hundreds of communities across the United States. It was not until the devastating Midwestern flood of 1993, however, that public acquisition of flood-prone property really took off. Since that record-breaking flood, voluntary buyouts, which include purchase of vacant property in floodplains, purchase and relocation of existing structures, and purchase and demolition of flood-damaged structures, have become a major new focus in FEMA's overall strategy to mitigate flood losses. Property owners are paid pre-flood fair market value for their homes.

[28] I will use the term "black", not African-American, following an article by Whorter in the Los Angeles Times (2004).

I walk on. Back to find the car I left behind in one of the empty Lincoln City streets. When I leave the area, I wonder; why am I so intrigued by this disaster? Why was I inside this house? Is it some sort of obsession with empty landscapes? Some obsession with the wrath of Nature? As soon as I leave Kinston to head back home I realize that the questions which keep my curiosity alive have to do with history and memory. How come an apparently thriving, nice neighborhood was located in an area of such tremendous risk? Did residents not know they were living in a floodplain? Was there no local memory able to warn them about the impending doom? And why does the place seem so forgotten, almost contaminated?

Figure 14: Bought out lots of Lincoln City.
Photo by Danny de Vries (2002)

3.2. Powers that be

Four years later. 2005. I go to the City of Kinston Town Hall. When I walk in, the buyout manager happens to walk out of his office. He is on his way the same direction as me, and I have a hunch he is, like me, heading towards the Planning Director of the City. The planning director is a pleasant man. He is older, calm and smart, and he seems to have a curiosity in him about things. He and the buyout manager are good buddies. When the manager sees me he nods, but he does not remember me until I speak to him. I met him first in 2001 when he showed me around the flooded areas, after Hurricane Floyd in 1999 obliterated the impact of Hurricane Fran. I tell him I am doing some historical work on Lincoln City, the black neighborhood. He knows what I am talking about. “They are all dying out now,” he says, “every time I open the paper and see the obituaries there is a name I recognize from them.” I empathize with him how difficult that might be. He agrees. For many years he has lived in Kinston. He has seen these people come in with problems many times. They knew his father, his family. He mentions Linda and Charley Wade, two elderly Lincoln City residents I tried in vain to contact for an interview after Charley had gotten very ill. “Charley Wade used to teach me,” he says, “they died within one week of each other.” I wonder. Wonder if there could have been a link to the floods, the relocation, the stress, the trauma, the reality of contamination. The buyout manager then speaks about how great their FEMA funded buyout program has been, how successful: “Our program was so good, that once we did 12 of them, or so, the word came out and they all went.“ And: “when I first came to talk to them about the buyout and told about what we had to offer, they looked at each other like this is too good to be true.”

I know he believes it. And I know it is true for the majority of homeowners as well. Ninety-five percent of the property owners relocated as a result of the program, a remarkable success for any mitigation program. Fellow planning students at UNC-Chapel Hill have documented at length the self-congratulatory rhetoric of City Officials and other Kinston stakeholders (Olivera 2006). The State of North Carolina included Kinston as one of the examples of their “Hazard Mitigation Successes” (NCDEM 1999). FEMA put out a CD-ROM detailing the amazing story of Kinston which integrated Geographic Information Systems into a model floodplain management program (FEMA 2003)[29]. Who would not believe these credible sources? I don’t. Nor does my colleague Jim. Working as a Research Associate with staff at University of North Carolina’s Center for Urban and Regional Studies on a buyout survey in Kinston (among other places), the study results only partly confirm the official’s reality (Fraser et al. 2004). Eighty six survey respondents and buyout participants from Kinston responded in a random

telephone interview. Most of them originally lived in Lincoln City. Six of them were white, 80 black. The data show that 36% of the 86 respondents answered “yes” to the question “Would you have stayed and rebuilt if you had been given a chance?” A ratio of one out of three respondents. Only 20% mentioned they were provided with choices other than a buyout. When asked what these alternative choices were, 20% answered “eminent domain,” “get nothing,” or “sue the city.” Thirty one percent thought buyout information was not very clear. Thirty six percent felt participation was not voluntary, and 21% mentioned they felt some to a great deal of pressure to accept the buyout offer. Twenty five percent did not trust the people doing the buyout. Thirty two percent was “not very” to “not at all” confident that the local managers had the best interest of the neighborhood in mind. Forty one percent noted “some” to “a great deal” of opposition to the buyout. Thirty one percent mentioned that the price offered for their home was “not very” to “not at all” fair. Overall, 17% mentioned to be “very” to “not at all” satisfied with the way the buyout went overall.

[29] According to FEMA (2003): “Successful floodplain management depends on a combination of detailed documentation, mitigation planning, community education, and project marketing. The City of Kinston-Lenoir County, North Carolina, used Geographic Information Systems (GIS) to integrate these elements into a model floodplain management program. The results, as you will see, are very impressive.”

It is hard to reconcile the attitude of the brash official with these data. But I can't say anything about this. I could not even propose to speak about it to the people of Lincoln City, Kinston, or any of the nearby towns. Not only would it be political suicide to my efforts as a local ethnographer gathering stories to understand what is going on, but I also had been told by other powers that be—this time within the University of North Carolina at Chapel Hill—that they do not want this data to become public. The reason: FEMA funding. *FEMA* does not want it to be public. The buyout study report had gone to FEMA where "final approval" had stalled. During this period, the Principal Investigator—Jim—published some of the findings in a local newspaper (News & Observer 2003) and UNC news (UNC News 2003). Receiving note of this, FEMA Mitigation Officials made clear to him that this sort of critical reporting was not the intention of their funding support. While in negotiation on another grant and dependent on soft-money funding to continue his employment, Jim—reluctantly—took note. When I started to officially work with him on the next FEMA grant he received late 2003 from the same FEMA Division (Mitigation)—a study on repetitive loss properties—the Buyout Report had still not been "approved." While the UNC-FEMA contract probably would back Jim up in his wishes to publish and Jim made clear that he wasn't going to stop publishing from the buyout report, the political pressure from his grantor certainly affected his ability to freely discuss the results. For example, when I took the initiative to set-up local community meetings to discuss the results, the obvious hint was that this wasn't a good idea. Now implicated myself, my employment came through FEMA funding as well, I let it go.

But beyond the survey numbers, I had already encountered qualitative information on the troubled Kinston buyout. For example, I visited Mr. and Ms. Spurlock at their new, relocated home in 2001. The house is surrounded by grass, all around it, and is situated on a hill, upslope. It reminds me of the old Dutch elevated hill (*terp*) on which the 12th century farmsteads were located, safe from the frequent floods turning their world into mud. “This place ain’t going to flood,” I think to myself. Ms. Spurlock is outside. She sits on her porch in front of the yellow house. A large woman, dressed in a blue and flowery blouse and white trousers. She has short hair, glasses, and a kind face. "Just come in," she says.

Figure 15: The Spurlock’s new house, built upon a hill.
Photo by Danny de Vries 2003

Inside, I meet Mr. Spurlock, who is sitting on the couch in the living room waiting for my arrival for our scheduled interview. They tell me that they lived together on Shine Street, at the edge of Lincoln City. They had met each other in Lincoln City as children, married, and bought a house adjacent to the Adkins canal, a tributary to the Neuse River. Recurring flooding had damaged the foundation of their old house, but with Mr. Spurlock being a carpenter, it could hold and looked fine. Out of precaution, they left their house during hurricane Fran in 1996. Afterwards, they chose to participate in the federal buy-out program designed to move properties out of the floodplain. To their dismay, the city did not want to move their old house to a safer place. Instead, it was burned down[30]. Many people in the neighborhood did not understand why. It was a perfect house. They told me they missed the house and community of Lincoln City. They were born there, grew up there, met each other there, bought a house there. Now it is all gone. Lincoln City is gone. "There is a lot of bitterness in the community," Mr. Spurlock tells me.

> Many people lived there for years and years and years. After Fran [1996], of course, a lot of those people, they did not want to sell. They wanted to really just have their homes redone and they wanted to stay there. We were on the first flood, Fran. So that made a big difference. You did not have that many people, you know, involved with it, because people made the decision not to sell, even though they gave them opportunity. They were told not to.

But it wasn’t only the flood which made people sell after Floyd. It was also an attitude. Why did people sell after Floyd? Mr. Spurlock:

> The same thing. The flood comes again…and they would get no assistance. You would not get any assistance. Even though you had raised your house on poles next to the canal. But it would not have made a difference. We could stay! They could stay! But what was made clear, if you choose to stay, you were on your own.

According to the Spurlocks, to many, the buyout money was a way out of a impoverished situation, but it wasn’t only the money:

> And one of the things that I appreciate, and that they appreciate I am sure, is they don't have to worry about their floodwaters. That was behind, you know. Even though we lost our community, we did not have to worry about the next year when it rains. So those are some of the good benefits.

Lack of assistance. Money. Everybody’s gone. Floods. A poor population does not have a lot of choice. Lincoln City did not organize to suggest an alternative—such as a levee or the elevation of homes—to the buyout.

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[30] I am later told this is a common way for the Kinston Fire Department to practice.

3.3. Reasons for mitigation

As is commonly suggested by observers who looked at the program from the outside, for a socially vulnerable population like black residents in Lincoln City, the money spoke. The buyout was an opportunity of a better home away for a poor neighborhood. Yet, opposition to the buyout was high, even though funding was available. Why did 95% of the residents still participate, despite this opposition? My analysis of the qualitative data which were part of the buyout survey conducted by CURS (Fraser et al. 2004) suggests that from the perspective of mitigation managers, there were a number of influences that made the decision to participate for both the cities of Kinston and nearby Greenville[31]. Those issues were related to sense of place, mistrust of government, dissatisfaction with the way the buyout process was handled (including program confusion, trust, program delays, and ownership issues), and larger macro-type influences including a general lack of alternative housing, income from rental economies, but also flood risk perception. With respect to the last variable, mitigation managers seemed to indicate that something happened between Fran and Floyd which made a lot of buyout resistance disappear. As one buyout manager said: "we didn't have to sell Floyd; it sold itself, plus Fran." In Kinston, one City official and his staff put it as follows:

> Official: Earlier you asked about outreach programs and getting people involved in the program. With Fran the intake people, the consultants, had to go out and walk the streets and knock on doors and sent out letters and that sort of thing in order to get people to sign up because there was not any threat of flooding at that time. They had already seen a flood that was minute compared to Floyd, and of course no one expected it to be like it was. So Fran was just an entirely different ball game. With Floyd we really didn't have to do that much, most of them met us down here.

[31] Where a similar situation occurred with a socially vulnerable, minority floodplain population being targeted for the buyout

Clearly, in terms of impact, Fran wasn't Floyd in terms of the size of its impact, which made a large difference in the willingness to participate among residents. Still, the buyout survey CURS conducted was in response to the disaster of Hurricane Floyd, and the results indicated that there still was a sizable minority—about 1/3rd of the 149 respondents in both Greenville and Kinston—indicating that they felt participation was not voluntary. A number of the residents who indicated to have left involuntarily mentioned the reasons for their decision to leave as listed in Table 1:

Table 1: Reasons provided for involuntary participation

Reason	Frequency cited
Had no choice	47%
Environment forced me	14%
Otherwise would loose money in the future	11%
City would not allow rebuilding	11%
Did not want to be left alone	8%
Don't know	8%
Total	**100%**

While those mentioned that the "Environment forced me" might have referenced environmental hazards as causal reason, all others (except "don't know"), suggested that the reason why they left had to do with human issues, in particular lack of choice to stay.

As it appeared from the buyout dataset, participants viewed their participation as more involuntary when they trusted the people running the buyout program less (pearson's r=0.34, p=.001) or the more they when they felt that local government officials did not have the best interest of your neighborhood in mind (Pearson's r=0.28, p=0.011). While most of the respondents in the end participated, it appeared that those respondents who claimed that their participation was involuntary took longer to make this decision (Pearson R=-0.23, p=0.038), illustrating their doubt and mistrust of the process. It is further interesting that the perception of involuntariness was higher among those who were unable to live in their home after the flood (40%) than those who were able to stay in their home (20%). What is further of interest is that the voluntary and non-voluntary group had similar scores on their perception of the likelihood of *future* flooding, and that none of the variables related to sense of place or neighborhood attachment showed any significance differences in mean values. Apparently, what mattered was trust.

3.4. Colonization

The initial colonization of the forested lands in the south of the City of Kinston near the Neuse River happened when a black, educated man called Lincoln Barnette bought three acres of land around the turn of the century. The land had been offered for sale by James McDaniel, a white entrepreneur (USGENWEB 2007)[32]. Barnette (see Figure 16), a son of two preachers, cleared the land of trees and started building a place of spiritual and recreational needs for the black community, including a "bush" church and park area.

Figure 16: Mr. Lincoln Barnette (Image courtesy of Ms. Winters)

[32] According to an article by the Kinston Free Press of around 1899, McDaniel had made efforts to built up a part of Kinston which he had called "Trianon." As a large real estate owner and farmer, Mr. McDaniel bought 350 acres of land in 1898, adjoining the town of Kinston, east of the railway (Atlantic Coast Line). While he built his own residence far out in the field, he began cultivating and improving the surrounding land. The article reports that he "laid the balance off into lots and extended the streets from the town through the farm, set out trees and began to offer all kinds of inducements to parties wishing to build." Starting in 1893 scores of residences and cottages were been built in Trianon. (USGENWEB 2007).

Soon, many of the labor workers who used to live near the City's harbor area—one of the ways of making a living for freed slaves before the civil war (Kinston Free Press 1976)—began to buy lots. The black community which developed out of these forest clearings was one which, in the highly segregated south, provided a golden opportunity for black, urban homeownership. Singled out as special and separate on the early 20th Century Fireborn Insurance Maps (see Appendix III), the area was officially located outside City limits in the country-side, even though its land directly bordered white neighborhoods. As one of its residents, the 87 year old Ms. Highgate, explains:

> Lincoln City was special because it was where most of the black people lived. At that time we were called Negros, and here people owned their own homes. And we had a dairy farm there, the Hudson family farm. Then there was a store run by Mr. David Warren where we go. Everybody bought from them. From the community. The people loved each other, they fed each other, clothed each other, and they took care of each other's children. It was a nurturing kind of community. And a very religious community.

Throughout the years, Lincoln City became spatially known to be bounded by Bright street to the north, Queen street to the west, Holloway Drive to the east, and the Peach Tree Wastewater treatment plant to the south near the river (see Figure 17).

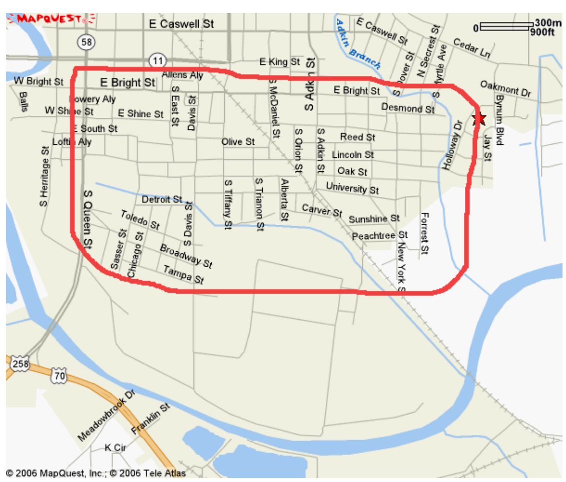

Figure 17: Boundaries of Lincoln City

As can be seen, the location of Lincoln City included several water features, including the nearby Neuse River, but also the Adkins Branch and a creek following the railway. One can assume that to the earliest colonizer of this landscape, very little knowledge or memory was available regarding the potentiality for flooding in these lands. With the increase of drainage and development, the occurrence of flooding was learned through experience of the new lands to geographical hazards. Plenty of such hazards occurred in the early 20th century, likely at the level wherein floodwaters would inundate the area for at least 1-2 days (see Appendix IV). Indeed, the elderly Lincoln City residents I interviewed consistently referred to Lincoln City as the “bottoms” or “lowlands.” According to Mr. Byrd, the land was in fact “too low,” since “water always stood out there.” Mr. Lewis, who was born in Lincoln City in 1924, mentioned that in his youth flooding was a reoccurring problem coming with the seasons. Since the flood stage for the Neuse River was 14 feet, anytime water was higher it inundated the neighborhood and blocked one of the entrances. “So all my life I was accustomed to avoiding the floods, moving out if I had to, and go to higher grounds.” Residents also indicated that some of the Lincoln City’s landscape was kept undeveloped for the grazing of livestock, which is a strategic use of flood-prone lands. However, the floodplain properties of the landscape were commonly not a top issue of concern for new buyers[33]. Mr. and Ms. Spurlock made a point to emphasize to me that the flood issue was simply irrelevant. Ms. Spurlock:

> You have to .. see, my mother was a tobacco factory worker. You have to keep in mind that most of the people were uneducated people. They did not know; they had no idea. It was an opportunity to have a decent place to live. That was their main,

[33] Mr. Spurlock explained to me that during World War II, barrack-type houses from the Military in Forth Bragg had been transported over in sections and put back together in Lincoln City. After the military left, developers saw an opportunity to buy the homes cheaply, rebuild and resell them to the local Black population. "And they knew it was flooded back then when they built these houses," Mr. Spurlock said, "yet a lot of people did not know it was in the floodplain when they bought them."

> main concern. They did not ask any questions. Nobody told them anything, so they did not ask any questions.

As is customary, the low, marginal lands in a city like Kinston was sold by developers to the minority black and poor white populations. Mr. Lewis suggests that the people in charge of selling land knew these were flood properties, but because of the rare opportunity for blacks to find affordable lands where they could buy, the issue was a mute one. “We weren’t offered better land. Naturally, when the floods came we had to live with it.” Mr. Spurlock emphasized that after people experienced one or two floods, that is how they learned.

> Because when you are living in a segregated society you know you have a white in one area and blacks in another, and where we was living, this was the only place that we could live. Cause you couldn't go to a white area and buy a house. That was a no no.

Ms. Highgate and Ms. Winters, elderly local historians, echoed these sentiments. Ms. Highgate explained to me that water mostly stood in the landscape after rainstorms, yet she thought people did not realize that they were living in an area that was an actual floodplain. She described her first experience with a large flood soon after she moved to Lincoln City. She remembered a flood during World War II, in 1944 or 1945[34]. Outside of this event, Ms. Highgate emphasized that she never heard parents talk about flooding at school or in the neighborhood, but did remember residents having conversations about river heights[35]. As Mr.

[34] On September 14, 1944, a Category 3 Hurricane with maximum winds of 110 mph hit closely followed the North Carolina coastline, and caused one statewide death and $1.5 million in damages. It was followed by a tropical storm on October 20, with 40 mph winds, which crossed Lenoir County. In 1945 a similar tropical storm also crossed Lenoir County. Ms. Highgate remembered not knowing where the water came from, but because the school was adjacent to a railroad track teachers and students were able to get out of the front door and walk home across the elevated tracks. According to Ms. Highgate, these flood waters never got inside Adkins High School, nor in any of the homes.

[35] It is likely that recurring interactions with the river through practices of fishing, recreation, and religious rituals (baptizing) helped residents remain aware of critical river heights. Boating was left to the more well-to-do whites.

Lewis explained to me, there were good reasons for people to be concerned with the flooding, but these were generally not because the hazard itself was perceived to be life threatening. Instead, it was the inconvenience and public health impacts which were central.

> Anytime you had a flood you had sewage flowing through the community. During my lifetime, I seen sewage lines installed. That was around WPA year, Work Progress Administration [1935-43]. Of course, this was the area where sewage came last! It was a threat to the lives. From a flood also come snakes. I have seen that. After the flood recede you have live fish, dead fish, all sorts of things that threatened the health of people in the community. Floods played havoc. Many times people had to stack up in houses when you already had minimum space for your own family. So with an extra family, you can imagine the congestion.

To cope with the recurrent flood issues, Ms. Highgate and Ms. Winters noted that drainage ditches littered the Lincoln City landscape, and these ditches had "always been there." Although the origin of these ditches were related to efforts to control malaria in the 1930s, their functionality for flood mitigation was locally enhanced by residents, who according to my informants built retaining walls and other protective structures around them to protect their homes. Mr. Lewis suggests that many learned to not plant too many gardens, because they knew they would lose it. The evolution of such floodproofing methods in the landscape certainly would have been shaped by the hazards which came to or very near to the Neuse River at the City of Kinston. These included storms in 1893, 1894, 1908, 1913, 1919, 1924, 1928, 1933, 1936, 1937, 1944, and 1945 (see Appendix IV). Yet, while repetitive flooding was an issue, the manner in which floodproofing and monitoring appeared to be dealt with remained relatively casual and implicit. When residents knew a big rain would come, they automatically went into their flood preparations, moving garbage cans from one location to another, elevating furniture on bricks, moving their animals to higher ground. Not too much was said about it: acceptance and resignation prevailed. Mr. Lewis explained how the attitude was part of daily life:

> I did not move myself, you know. I had lived there, and I had seen my mother and father live there. I bought a lot right beside them, and I built a house there later. So, I just had marginal thinking. I probably would have been there later as well had my wife not forced me to move.

He describes how his youthful dream of land and homeownership was what Lincoln City made possible for him: "People bought that submarginal land and moved in. People who could not afford a better place." Flooding simply did not *need* to be on the radar screen in Lincoln City. Ms. Winters:

> … the older blacks, they did not delve into the topographical, the geography, of the area they were in. I think they were really excited about owning their homes. They weren't interested in the weather as such. They lived through it….

Living through it meant adjusting expectations and behavior in culturally appropriate ways. For the blacks in east Kinston, this meant respect, and silence. With a nod of mutual understanding. Ms. Winters explained that when she grew up as a little girl, this to her meant sitting silent in the lap of her grandmother until the "thunder squall" (rainstorm) would pass.

> It is the five of us, and she would sit in the chair, and we could not say a word. The thunder and lighting flashing. We would just tuck each other. Quiet. Could not say a word! Until it was over. Could not get up, could not go to the restroom! That is the way they dealt with it. Was it fear? Respect?

"Both," Ms. Highgate remarked. "That was a form of respect. They used to say 'The lord is doing its work,' and you are supposed to be quiet. That is what my grandma told me. I used to sit in her lap during the storms." The true power of God's will—Nature—was to be matched with respectful silence, and because of the reality of spatial segregation, there was no other alternative than to accept the geographical peculiarity of the land assigned for habitation. It is unclear if this culture of indifference lead to a motivation to forget, a certain lack of concern or absence of severe emotional reactions to flooding. It is likely however that the nonchalance that came with the topic was informed by a lack of major flood events, although flood events did happen (Appendix IV). The implication was a lack of motivation by community members to disclose previous floods, a normalization of the existence of water in the landscape after rainstorms, and learning dependent on experience, inviting surprise. The result might have been a condition of temporal vulnerability.

3.5. The Arrival of the Floodplain

Major experience eventually came in 1954 with the arrival of Hurricane Hazel. There were no evacuation orders, no sirens, and very few Lincoln City locals had a radio (WRAL-TV 2007). Even if they had, they would have erroneously learned from broadcasts that Hazel was still a long way from the coast. Hurricane Hazel, an extremely fast and damaging hurricane, challenged many scientific assumptions about the behavior of hurricanes due to its freakish properties (see Appendix V). In Lincoln City, the flooding that resulted from this hurricane similarly taught residents to their surprise that a 3-4 day event causing displacement was a possibility in their neighborhood. According to Ms. Highgate, who arrived in the neighborhood in the mid 1940s, Hazel was the only time that people really were concerned about flooding. Ms. Winters explained that only after Hazel she learned that in some portions of the country there are different types of floods and storms. Mr. and Ms. Spurlock suggest that Hazel was the first major hurricane that they remember hearing about. Mr. Byrd and Dr. Reddick likewise both remembered Hurricane Hazel as their "first flood experience." They mentioned that water was standing in Lincoln City up to Lincoln street for three to four days, flooding Oak, Lincoln, and University streets. The flooding was knee-deep in the streets, flooding the cemetery and woodworking businesses, but not high enough to come in to people's houses, or for most people to have to move out. Only those people living in homes close to the river did, as Dr. Reddick summarized:

> Now, the further back this way you would come, the water would be deeper, and I do recall some people moving out. I don't know if water ever came into the houses, but it was a matter of you could not get out, you would have boats for transportation. So they would just leave the house and sit things on, you know, bricks or what not, off the floor. But basically, it did not go into the house. But water would come up knee deep or something like that, people would just leave until the water went down. The next thing about it, is once they found out that this was a floodplain, or zone, they started building the houses higher off the ground.

According to Dr. Reddick and Ms. Byrd, the people of Lincoln City did not know they were living in a "floodplain" until Hurricane Hazel showed them they did. They mentioned that "even the City" did not know the area was a floodplain area. "People were buying land and houses," was the pre-Hazel reality summed up by Mr. Byrd.

The hurricane historian Jay Barnes describes the great hurricane of October 1954 as a benchmark in the lives of many North Carolinians who endured the storm:

> From Holden Beach to Henderson and everywhere in between, anytime the topic of hurricanes is raised, stories about Hazel are sure to follow. Stories of heroic rescues and tragic losses are well remembered, as are testimonials to the awesome destructive forces the storm displayed. Hazel ranks as one of the most catastrophic hurricanes to strike the United States in the twentieth century. Fortunately, storms of its magnitude are relatively rare events, and few other hurricanes deserve comparison with it (Barnes 2001).

Barnes use of the term benchmark to describe the event. Generally, a benchmark refers to a point of reference or standard by which something can be measured or judged.[36] Barnes' quote illustrates some of the significant elements for this event to take on "benchmark-quality":

1) A significant impact on public memory.

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[36] "Benchmarking" has its linguistic origin in the surveyance of elevation of land. A benchmark is set by a surveyor to mark a point of known vertical elevation (chiseled, posts, pins, bolts permanently attached to a stable foundation). These marks are in their turn used by subsequent surveyors to establish the exact elevation of nearby points.

2) Reference to relative temporal isolation (“rare”), and
3) A temporally evaluative quality, used to re-evaluate the meaning of any other event (“few other hurricanes deserve comparison”).

To Lincoln City residents, Hazel’s benchmark qualities reoriented them to a new perceived reality, making the event an important temporal reference point. It shifted their frame of reference. Mr. Lewis called it a “new flood dimension.” Further, as illustrated previously, the anecdotal accounts suggest that in the pre-Hazel reality, the possibility of flooding was generally received with some sense of denial or inattention due to the realty of spatial segregation. Hazel, in all its memorable glory, created the beginnings of a flood history where previously no history had been actively remembered. Before Hazel, flooding was not perceived as a real threat in Lincoln City; after Hazel, residents realized their land had a new quality. Hazel culturally constructed the temporal reference model that implies the initial conditions of Lincoln City’s current flood memory. It provided a benchmark with *baseline referentiality* to the future evaluation of hazard events[37]. A baseline is a starting point or condition against which future changes are measured. Baselines are typically created when intervention project enter a situation and “start” measuring change to evaluate their impact (De Vries 2005).

What is most remarkable is that during the life-time of the Lincoln City neighborhood, from 1890 till Hazel’s occurrence, the extreme forces unleashed by the Hazel hazard could have occurred at any time: there are no reasons to believe 1954 was predestined

[37] I prefer to use the term baseline over benchmark. Nowadays, the term benchmark is often reserved for goal-setting in business performance evaluations, implying a temporality where the standard of comparison is “to be reached” (at a minimum) in the future (as in a company that is slow to reach certain benchmarks may compensate investors by increasing their stock allocation). In this context, the temporal impact of the Hazel event is less a to-be-desired standard of comparison as it is a starting point, an initial condition, for flood memory, or when flooding began. The closely related term “baseline” seems better suited to describe this phenomena.

to include the weather event called Hazel. Yet, the stochastic occurrence of the event in 1954 closed the temporal window of relative flood unpreparedness for almost half a century. After Hazel, ignorance about the real flood potential of the hazardscape was transformed into the uncomfortable realization that the enthusiastic clearing of the lowland forest and creation of human dwellings in not-so-ideal conditions had also meant the creation of a less favorable byproduct: serious flood risk. While the potential for severe events had been relatively stable since the neighborhood's beginnings, the significant change in the temporal orientation of its human inhabitants made "the lowlands" change in ways never visualized until 1954. The temporally coincidental or stochastic appearance of Hazel on the historical scene of Lincoln City had suddenly and radically shifted the meaning of the landscape: *Lincoln City had become a floodplain*. As a local Pastor mentioned to me:

> We never had that kind of experience. I mean the city had never had that. So nobody was aware. It was not something we could dream about until it happened. And as I said, we had seen the river overflow before, but nothing to that magnitude.

The cultural impact of the random timing of Hazel changed the temporal understanding of flood risk. As illustrated, Hurricane Hazel provided an opportunity for the entire cultural-ecological system to *learn,* and as a result it transcended local understanding of the ecological possibilities from a pre-Hazel temporally vulnerable reality into a revised and more flood conscious understanding of ecological reality. Changing temporal boundaries, it changed the worldview of lay people and scientists alike with respect to what is possible, and as such it changed the landscape from an African-American neighborhood into a floodplain.

3.6. The Beginning of the Mitigation Agenda

In 1964, a Hurricane event referred to as Hilda inundated Lincoln City. After doing historical damage in Louisiana[38], Hilda's hard rains over Lenoir County pushed the Neuse River to an unusually high flood level, cresting at 22.48 feet. In the City of Kinston at large, the flooding caused by Hilda created a change in public mood with respect to flooding. After Hilda, local movers and shakers in the City of Kinston were in an increased state of concern. While Hazel stands as the baseline flood for residents of Lincoln City, it seems that the flood of 1964 had a more powerful effect on the City's historical consciousness, seemingly qualifying the city-wide baseline flood to be different then the one for Lincoln City (Hazel). According to Mr. Lewis, there is a good reason why it was only in the sixties that the City started to pay attention:

> Once the City placed that Peachtree Wastewater Treatment plant out there in the early sixties, they became alert to the fact that it flooded down there. They had an investment there, you see. With control you get from state agencies they had to do something about it! So I think….

Construction of the plant was made possible by hauling fill material onto the proposed site. However, the location of the plant in the floodplain south of Lincoln City and even closer to the Neuse River made it very vulnerable to flooding[39]. The building of this plant at this location suggest how little the City took the hazardscape into consideration. As an environmental justice concern, it exposed the black community to an environmental hazard when it did flood, and it did this in spite of the flooding of Hazel, as if Hazel had been

[38] And earning name-retirement.

[39] FEMA Director Witt stated during his visit to the Peachtree Wastewater Treatment Plant in 2000 that "this plant has been an environmental embarrassment." The plant was finally wrecked by Hurricane Floyd in 1999. In 2007 Kinston's new $48 million Regional Water Reclamation Facility was opened to replace it.

discounted. The city perhaps argued that Hazel constituted the absolute maximum flood potential, and that the small elevation of the plant would suffice to cope with future floods. To the City, it was Hilda which became the flood baseline, not Hazel. Officials I spoke with mentioned the 1964 flood, yet rarely spoke of Hazel. Further, it is striking how the Kinston Free Press in it's 1996 review of flood history does not mention Hurricane Hazel as of significance to the City (Kinston Free Press 1996h).

But as did Hazel for Lincoln City, Hilda changed the City's relationship to the Neuse River as well. Soon after 1964, some city officials traveled up to Raleigh to engage in conversations about a system of several dams able to contain future Neuse River flooding. Further, the momentum created by Hilda helped initiate the first buyout project which the City of Kinston financed. It did this in a neighborhood called Happersville. While the threat of flood inundation was the official reason for the buyout, political motivation also came from redevelopment interest. Happersville was located at the entranceway of Kinston and as a run-down neighborhood with 100% low-income property owners, junkyards and other neighborhood challenges (including prostitution). It was not a pretty welcome. In addition, the City's new Riverway Committee had started to develop a restoration vision which included the building of a greenway and parks along the Neuse River. The committee had made conceptual plans for the whole river system, including Happersville, the downtown area, the Kinston farmers market and Lincoln City. These areas were subject to flooding, and inhabitants were very poor. A former, senior planning official told me:

> So really, those two ideas kind of came together. It was an opportunity, like right now you would have found the idea of the much later Acquisition and Relocation Program [FEMA], there were already some fundamental planning blocks, if you will, of ideas as far as creating the park system across the river as a place where it floods, a place probably not the best place to live.

With the same agenda in mind, the city started a $2.1 million HUD financed floodplain acquisition project in Lincoln City in 1978, from Maplewood cemetery east along Lincoln, Oak, and University Street, right in the middle of the floodplains areas.

As the senior planning official explained it, the early Lincoln City redevelopment project funds came with a lot of built in flexibility for the city to do both acquisition, relocation, park development, renovation of houses, paving streets, and more. However, this flexibility changed in the 80's when the State started ranking their competitive projects differently. As a result, the city's effort reluctantly turned more to renovation in place, and less on relocation. The senior planning official:

> When we got into the State programs and they decided competitiveness, it just so happened that our worst housing and our poorest people, rated the best in terms of getting the funds, were in the floodplains. Not all entirely, but many of them were. So we did a lot of renovation in place, put a lot of utilities upgrading, we did a lot of street paving, and you go back there now and drive through a part of the major buyout that came fifteen years later! Waste of money.

The renovation in place did not sit well with the city. They wanted relocation out of floodplain areas and the development of a park system, but were stifled by State funding priorities. When they applied for elevation of 30-40 houses in Reed and York streets to get them out of the floodplain, this failed due to the stiff competition for funds and the higher cost of elevations relative to other urban revitalization projects. Frustrated, the city's Planning Department stood by and watched, only able to only dream of its vision of acquiring the lowest floodplain properties and mandating elevation above the 100-year floodplain for any property sold back later, and a City-wide park system.

3.7. The Timing of Modernism

While the mitigation agenda had taken root and set its eye on Lincoln City as a target buyout area, as it happens, Neuse River heights between 1964 and 1996 never reached major flood levels (except for perhaps 1975), although there certainly were a number of hazard events pushing the Neuse to moderate flood levels (in 1966, 1972, 1978, 1979, 1983, 1987), as shown in Figure 18 below.

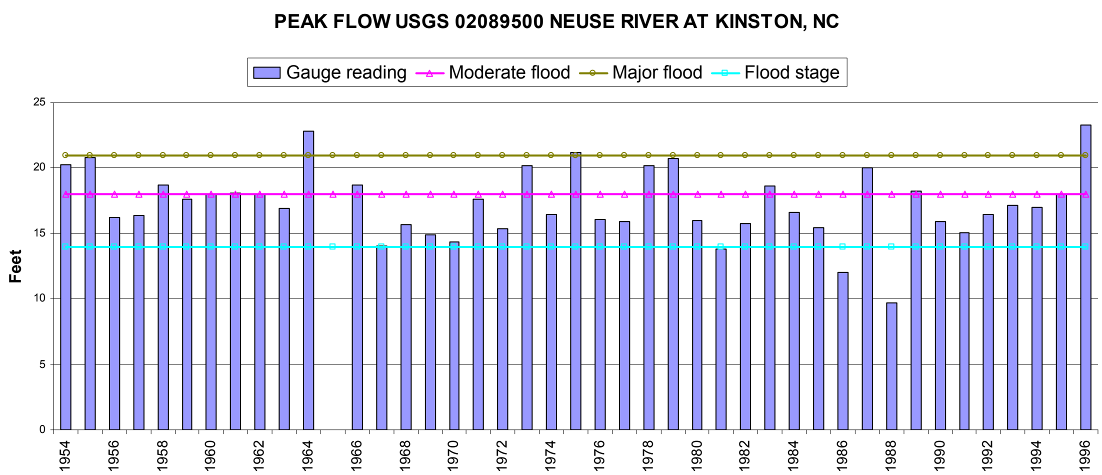

Figure 18: USGS 02089500 Neuse River at Kinston

The lack of flooding since 1964 is generally accepted to be part of a lull of intense hazards affecting North Carolina between early 1960 and late 1990s. On the Neuse River, this period coincided with the eventual building and completion of Falls Lake Dam and Falls Lake Reservoir in 1981. This altered the Neuse River's flood ecology, apparently reducing flood height levels by managing drainage release from Falls Lake upstream near Raleigh. This was an important moment, since from that point on "operations" started, or humans took control of part of the river's water heights downstream. Although Falls Lake Dam's operational mandate was not restricted to flood control alone and included important drinking water and recreational mandates as well, downstream communities understood its significance to be solely mandated by flood control. The river then, after 1981, was perceived as tamed. As it can be seen from Figure 19, river heights at Kinston seem to indeed have decreased in the period following 1981. To the people of Kinston and its Planning Department, flooding again took the backburner. Because of the lull in extreme hazard events, the reduction in flooding was easily attributed to the dam, an opinion which would make sense following the height of modernist technological progress in the second half of the 20th Century. With the Hazel flood baseline established and the reach of its potential damage affirmed with Hilda, the boundaries of risk within the floodplains were known, and soon projected to decrease. Modernism dictated that t*here were no more surprises to be had.* It was Culture which had won over Nature. Or so it seemed.

Figure 19: Falls Lake Dam on Falls Lake near Raleigh.
Photo copyright of the US Core of Engineers

Thirty-two years after Hilda, Hurricane Fran hit Lincoln City on September 6th, 1996. Most mortgages taken out before Hilda had by now been paid off. The generation of residents who had started families during Hazel were now to retire. Several homes had been sold to new owners. When Fran made landfall in Wilmington, Kinston ended up right on the edge of a swath of four to six inches of rain that moved north to Goldsboro. The eye went west of Kinston, putting the town on the east-side of the winds, which is (due to the counter-clockwise rotation of Hurricanes) the worst side of the storm. Wind gusts of 109 mph were measured at Lenoir Memorial Hospital. Because of the relative lack of recent experience with these events, initial expectations about the impact of the hazard were at first different from the reality that followed. In an early report on the impact of the storm, the Kinston Free Press quoted a local Kinston resident who evaluated the impact by referencing Hazel as comparison: "as bad as Fran was, she was no match for Hazel. That storm took the roof off my house." (Kinston Free Press 1996b). But soon after the immediate wind impact subsided, an early warning was communicated via the Kinston Free Press that heightened river levels as a result of heavy rains from Hurricane Fran north of Lenoir County was expected to travel down the Neuse River from Raleigh and could cause flooding in some low-lying areas of Kinston. While the Fire Chief precisely spelled out the area of Lincoln City likely to be affected, the paper provided an optimism shared with the City engineer that there was serious doubt if any of the structures would be affected, unless there is additional rain: "We know it is coming," they said, "there are only a couple of areas that will be affected. We're not expecting the Jonestown flood" (Kinston Free Press, 1996n). However, on September 11th the newspaper reported not only an additional 1-2 inches of upstream rain, but that in addition State Officials had to deal with rising waters released from dams across the state. Reports from anticipated flooding of homes in upstream Smithfield and Goldsboro sounded alarming. The newspaper quoted the Goldsboro City manager: "the expected crest is the highest I've ever seen *and I've been here 25 years*."

As the river continued to rise over the following days, the newspaper took column space to prepare its subscribers by reflecting on past floods. At the same time, the optimistic distancing suggested by the historical review article titled "Floods a more common occurrence in the past" made the series of pre-1964 floods come to life vividly in light of the developing event. It was in particular the 1964 Hilda flood event which became the significant baseline against which to evaluate the impact of the coming event. A small article on the evacuation of tobacco warehouses illustrated this. It quoted a floor manager, referring to the memories he had received from his elder colleagues:

> 'They tell me the floor was covered in water when the river flooded in 1964. If it made it in here then, it probably will this year, too.' The flood of 1964 put the river level up to 22.9 feet. This flood is expected to crest between 23 and 24 feet. 'This is a new experience to us,' he said. '*We've never experienced anything like this, we're having to pretty much go by what folks at Emergency Management tell us.*' (Kinston Free Press, 1996j) [italics added]

While the early historical floods, including Hazel, remained at a distance, to the residents of Kinston the 30-year gap between 1964 and 1996 suddenly seemed small. The benchmark flood of 1964 was close, real, and back in the present and the lack of experience made for a certain vulnerability to surprise. Finally, on Monday, September 16th, the Kinston Free Press reported "Neuse river swamps south Kinston" due to a combination of Hurricane Fran, subsequent heavy rains, and releases from the Falls Lake Dam, producing an "unprecedented flood" (Kinston Free Press 1996f). Two days later, the Free Press led with an article stating that water would remain high for at least a week, since there were still releases from Falls Lake Dam (Kinston Free Press 1996m).

Within a few weeks following the floods, the City organized a public meeting sat the Nature Center concerning the possibility of a Fran buyout, located in the lands which used to be Happersville. As Kinston's former senior planning official explained to me, the idea was to use the history of Happersville as a visible example of what would be possible in a buyout. This time, the City had taken note of FEMA's new Hazard Mitigation Grant Programs[40] (HMGP) and the attitude was to not waste any time getting started on the buyout. While Kinston residents recovered from Fran, a local and state supported "Disaster Team" was quickly formed to apply for FEMA mitigation grants. The Kinston Free Press quoted some of its driving forces: "We are looking at permanent solution. There are some places where they can just elevate the home, but relocation is our highest priority" (Kinston Free Press 1996n). On November 26th, an Kinston Free Press article titled "Kinston residents ponder a future in the flood plain" suggested a resistance among local residents to relocate in the face of increasing pressure from the City[41]. Kinston's floodplain administrator was quoted: "It all comes down to where you are going to put your money. Are you going to put it in harm's way?" But the opposition against a buyout after Fran did not disappear, despite Fran's damaging impact on the neighborhoods affected, including Lincoln City.

Why did people not want to relocate despite the financial grants available? Fran reminded local residents again that the possibility of flooding existed. But for many unfamiliar with previous flood events of Hazel and Hilda, those vulnerable by lack of deep

[40] The Hazard Mitigation Grant Program (HMGP) provides grants to States and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster.

[41] Kinston Free Press: "Local leaders say it would be a big gamble—in both dollars and lives—to rebuild hundreds of homes that lie in the Neuse River's 100 year floodzone. They want residents to consider a buyout from the federal government and moving."

temporal knowledge and experience, Fran came as a surprise, indicating a vulnerability with temporal origin. Even the floodplain administrator had not thought that Fran could occur:

> Floodplain administrator: Well, I have been the floodplain administrator since 92. To be honest, from 92 to 96 I did not think it would ever happen here. It was an area… I was new at the business. Until you see it, you just don't believe it will happen to you.
> Danny: It was a surprise?
> Floodplain administrator: Yes!

Within historical consciousness, Fran challenged the baseline scenarios provided by Hazel (in the case of Lincoln City) and Hilda (in the case of the City of Kinston). This scenario had predicted that a three to four day flood was in the realm of possibility and defined the normal. Fran reoriented this cultural model by extending flood duration from four days to a seven days of slow drainage of flood water, although the peak flow (cubic feet per second) of Fran (24,000) was less then that of Hilda (26,000). Yet, this change in the temporal referent model did not serve to warn people, or to pay attention to underlying, changed ecological conditions which might be of great concern. Instead, Fran was publicly perceived as a strange event. Although a surprise, to many locals the single event simply did not provide enough evidence that something was new or different. In other words, Hurricane Fran was interpretated as an accident, or *fluke*. When the buyout manager drove me around in the floodplains of Kinston, he told me that the people did not sign up in 1996 because they thought Fran was a once in a blue moon occasion. "The first one they thought was a fluke," he said. I clarified what he meant by first, "you mean Fran?"

> Fran, yes. One guy who taught my children in school had lived there for forty years. He was called out by the National Guard. I said why don't you sign up. Well, I've lived here all my life, this is not going to happen again.

The temporal referentiality used suggests that in a human lifetime, Fran would only happen once. Recurrence intervals calculated by USGS from site locations along the Neuse River confirm this perception (see Figure 20): the interval for site number 16, the City of Kinston, is colored green, and the chart on the USGS website suggests an event which happens once in "50 to 100 years" (Bales & Oblinger-Childress 1996).

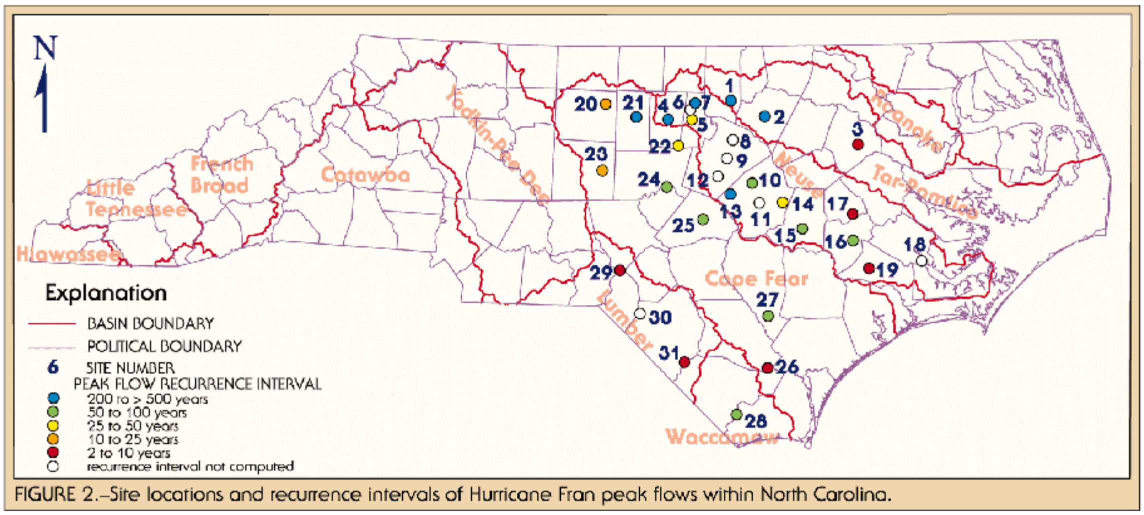

Figure 20: Recurrence Intervals: Kinston is site number 16
(from Bales & Oblinger-Childress 1996)

Furthermore, a second and important reason why the cultural model did not substantially change was related to the attribution of blame to the flood causality. Fran was believed to be a biased event. Many residents in Lincoln City and Kinston felt like it was not Fran which flooded their properties, but something else: human error. Since 1981, Falls Lake Dam had introduced safety to the area, as evidenced by the lack of flooding since Hilda in 1964. As a result, the struggles of the slow draining flood which the City encountered in 1996 were only partly attributed to the hazard itself. *Nature* had its part for sure, but without the interference of the upstream engineers failing to empty the dam before hurricane season—as the argument went—the duration of the flood would have been shorter, and to many the flood would have been less dramatic, less or equal than Hilda or Hazel. This sentiment was so prevalent, that a local social movement developed in Kinston which included petitions for justice and accusations towards the Corps of Engineers, detailed in Appendix VI. Outraged by the flood, public discourse theorized flood causality as a fixable management problem, and not Nature. This public discourse pushed risk perception back into the Modernist lull of relative safety—the technological victory over Nature—and certainly not beyond the original temporal risk boundaries congruent with the Hazel and Hilda benchmarks. Fran caused surprise to some, yet it failed to deliver an early warning of the new vulnerabilities hidden in the Neuse River flood ecology. Fran introduced an unprecedented issue to Neuse River flood ecology, namely that the dam had an influence on flood duration. Data from the Corps of Engineer show this (see Figure 21).

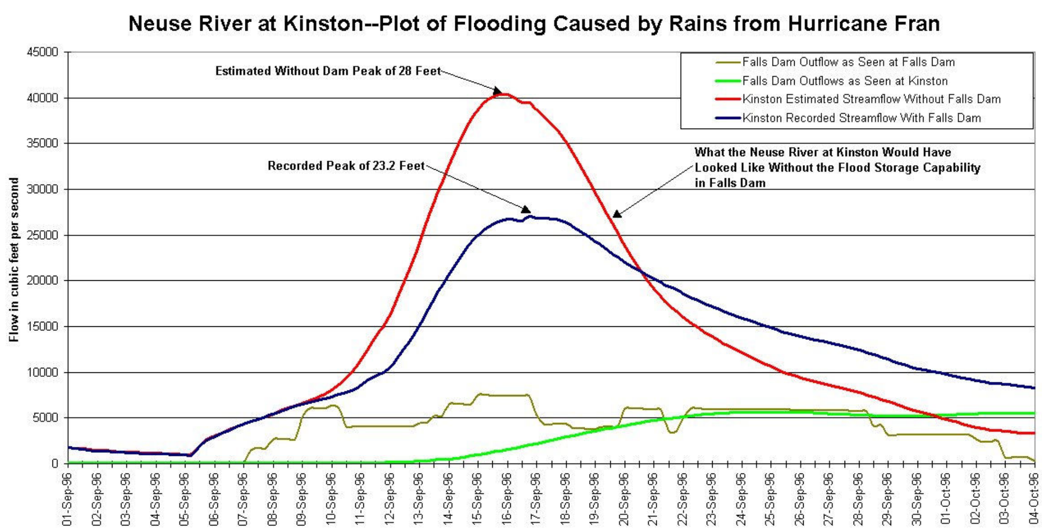

Figure 21: Neuse River at Kinston flooding through time during Fran

Without the dam, flood levels would have peaked higher, yet flushed through much quicker, in a similar fashion to the three to four day floods of Hilda and Hazel. While Fran introduced these new complications, the public was unable to see a temporal trend due to the temporal distance from the previous flood baselines of Hazel or Hilda which spanned almost a generation in time. In the end, to most residents, the surprise of Fran was rationalized away by many as either a rare fluke or an artificial flood, which in either case meant no fundamental change in local temporal understandings of flood risk. Residents did not line-up to consider a free buyout because they did not believe Nature had suddenly changed. There had been no temporal change in the flood narrative they were living: human error was to blame.

While the dam controversy in Kinston sizzled out, the State of North Carolina seemed convinced more than ever that the impact of hazards was on an upward trend. This perception was due to the scale of Fran's impact. Hurricane Fran had impacted 60% of the State's population, and became a catalyst for a more comprehensive planning effort led by a Disaster Recovery Task force commissioned by Governor Hunt aimed to "reverse, or at least stabilize, the trend of escalating disaster losses" (NCDEM 1999). Supported by this state level concern, the City of Kinston engaged residents from a neighborhood called Rivermond after 1998 El Nino rains flooded 200 homes in this area to participate in its buyout program. But the effort remained largely unsuccessful, as it had been during Fran. One official argued that one of reasons was because the City allowed residents to move back in their homes too soon after the flooding and telling them that they "could not build back" appeared closer to a battle than an information session. This was a lesson learned. With the aid of FEMA, City officials refined their mitigation strategy once again, now finessing the use of the "substantially damaged" designation to lock homeowners in a buyout through federal regulations which made it more difficult to repair or rebuild[42]. The experience further strengthened the resolve

[42] According to federal regulations, substantially damaged buildings are required to meet certain local building standards before making repairs or rebuilding. Substantial damage is defined as repair costs that exceed 50 percent of the building's value (this amount does not include the value of the land). As a result, flood victims of substantially damaged homes need to obtain building permits before making repairs. Structures in high-risk

of the Planning Department to relocate residents out of the floodplains. To the building inspector, seeing the folks who had been flooded before in their City receive disaster money to repair their homes, the wood in their house rotten from early floods, was a sure waste of taxpayers money:

> So I said, 'this is stupid.' Particularly if you have the HMGP program [Hazard Mitigation Grant Program from FEMA]. And we had a massive disaster of $50 million; we had the money to relocate these people. So… we were able to be much stronger when it hit badly in Kinston. We were all committed.

3.8. The Surprise of Floyd

The arrival of Floyd (see Appendix VI for more detail on the hurricane event) as a potential threat to the City of Kinston was noted only three days after Hurricane Dennis had made its remarkable two journeys over Kinston and left the Neuse River swollen above flood stage on September 11th 1999, cresting at 15 feet (Kinston Free Press 1999k). The timing of the monster hurricane Floyd could not have been worse and the news overwhelmed Lenoir County's Emergency Manager. Quoted in the Kinston Free Press, he told the paper: "My first inclination when they said there would be 155 mile per hour winds, I wanted to turn around and go to California" (Kinston Free Press 1999a). Suddenly, flooding became a major concern for Lenoir County: "I don't want to speculate and create a panic," Lenoir County's Emergency Manager said to the paper, "it's something we are going to monitor closely and I would encourage residents in the low-lying areas to do the same" (Kinston Free Press 1999b). The Kinston Free Press noted that Raleigh's Falls Lake Dam had historically been a major player in the way Lenoir County's floodwaters rise. Apparently, the engineers had

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areas that were substantially damaged must also comply with floodplain ordinances, meaning owners may need to elevate or take other steps to get out of harm's way. (http://www.fema.gov/pdf/fima/fema213.pdf) stopped releasing flood water from Tropical Storm Dennis. The critical timing of the event gives a good indication of the risks involved with dam management:

> If Dennis had stayed one day longer or Floyd had come a day earlier, the dam could have had a problem, officials said. We have just about brought our pool to normal conservation level, said Tom Freeman, assistant operations manager of Falls Lake Dam. This is exactly the position we want to be in." (Kinston Free Press 1999b)

Temporal referencing its readers back to the experience of Fran, the paper printed a map of southern Kinston showing the flood boundaries of Hurricane Fran three years earlier. While the amount of rainfall due to Floyd was not known, based on the temporal reference, the expectation noted was that "these same areas could be affected." One day later, the Kinston Free Press confirmed this expectation. Forecasters at the national Weather Service office in Newport projected that with the expected 9 inches of rainfall across the basin, the Neuse River could rise to 23 or 24 feet. "It's going to be Fran again," Lenoir County's Emergency Manager was quoted (Kinston Free Press 1999g). That evening, awaiting the storm's impact, Kinston's Mayor Johnnie Mosley proclaimed the City to be in a state of emergency and put a curfew in effect for all of the City's residents.

Floyd hit Kinston with winds of only 75 miles per hour, barely making hurricane strength. However, the next day, Daily remarked to the Kinston Free Press: "Your paper isn't long enough to list all the roads that are blocked." (Kinston Free Press 1999h). In the same article, a little squared off area provided temporal referentiality to the reader (Figure 22):

FASTFACTS
Neuse Flooding
■ After Dennis passed through, the Neuse River rose to 14.5 feet. Floyd added another 6 feet Wednesday. When rain that fell to the west arrives, the Neuse will rise to its prediction of 25 feet. The river crested at 23.3 feet during Hurricane Fran in 1996.

Figure 22: Neuse River Fast Facts

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While the newspapers reported on the immediate status of Kinston residents, including crowded Red Cross shelters, washed away bridges, closed schools, and the situation in nearby towns, counties, and the coast at large[43], the temporal uniqueness which will go down in history as "Floyd" started to become obvious only the next day, Saturday September 18th. The Kinston Free Press headlined: "The Downward Spiral; Snow Hill not high enough for Floyd: hundreds evacuated as flood waters claim more ground." Titles of other articles included "Floodwaters still on rise: Floyd flooding already exceeds Fran's total"; "Area almost isolated; fuel, food in short supply." The prediction is dire: "Brace for Impact: Winds and rain brought by Floyd have subsided, but Kinston officials say the worst effects will not be felt for several more days." In most articles not dealing with the immediate logistics of a major disaster, *the overriding sentiment was temporal*. Both in terms of certainty—as in "I have never seen anything like this in my 51 years"—and uncertainty—"I don't know what it's going to look like in the morning, God only knows." The following days, the dominant note in news reports was the prediction of river heights. Because of the large upstream drainage of water through the Neuse River watershed, in addition to the release of water from

[43] Apparently, Floyd did not stop the Eastern North Carolina Pirates from playing a match of football against Duke.

Raleigh's Falls Lake Dam, a delay in flood crest was expected. The uncertainty about the height of the flood caused an almost daily upward readjustments of the flood height. In Raleigh, engineers at Falls Lake Dam report to the Kinston Free Press that they have plans to release more water pending incoming rain. "We have a little over four feet of storage left," the Project Engineer Lloyd Williams was quoted, "It's a tightrope walk we're gambling that we won't get any more rain here. We're deviating from our normal schedule and holding it back now."

At the edge of Lincoln City, where Lincoln and Tiffany streets crossed, the rising flood waters increasingly alarmed residents. Already on Monday September 20, many prepared, packed, and prayed. "Some residents put their valuables as high as they would go and some packed up entirely," the Kinston Free Press reported (Kinston Free Press 1999l). While doing so, a pet rescue effort was ongoing, sending boats deeper into the murky flood water that had already engulfed the heart of Lincoln City in the previous days. According to the paper, the situation in Lincoln City was unlike anything ever seen before, and as time progressed, more and more residents had to be evacuated from their homes. As it appeared, the flood height had not been anticipated by many in the neighborhood. The fall of 1999 flood was so extreme that the small City of Kinston at one point became a virtual island in a sea of washed out roads and swollen creeks, canals, ditches, and tributaries.

Ms. Selena Pettiford was evacuated from a mobile home located below the United Free Will Baptist Church led by Bishop Reddick in Lincoln City, near the river. She described to me afterwards how she was able to salvage some of her belongings from her double wide trailer. Stuff that she had put on the bathtub. Most of her possessions—her bed, furniture, etc.—were unrecoverable. She had just bought a new mobile home three years before, and was told she had to elevate because the area was a floodzone. Despite this two feet elevation above the 100-year required elevation (“freeboard”), her house got substantially damaged. Selena:

> It was messed up. It got so bad. It got to about the socket of the… wall socket.. and then I had a double wide, it would mildew, by being double wide it had that kind of board that it started mildewing all to the top.

When Fran came Selena had lived close to the water. But the flood never ever got to her. Together with her girlfriend and son she stayed home from work and watched the water, measuring it at different times. According to her, at one point the high Neuse River surrounded the area where she lived, and it kept on getting closer. Yet, according to her, City Officials came down and told her that it would never get to her house. So, she did not worry about it too terribly: “When Fran came the fire men came around and told us put everything high off the ground, like your fridge.” With the arrival of Floyd, her expectation was that again it would not come to her home. In addition, there were no early warnings from the fire brigade to tell her of the possibility of flooding.

> They did not have no idea that it could come to me. I guess because they didn't think it could come to me. So the water kept on getting closer and closer. So my girlfriend, she left, cause the water kept on coming through the manhole…She had a single wide trailer, and she said ‘I ain't gonna stay in there another night!" So she left, and I said "I am just gonna stay here.’ I really was the last one to actually leave.

In total, the City of Kinston ended up evacuating residents from about 450 flooded homes in the flooded areas (Kinston Free Press 1999m).

3.9. Temporal Uncertainties

The flood impact of Hurricane Fran was attributed to both Nature and human error at Falls Lake Dam, and as such was seen as an artificial fluke in the midst of a belief in modernist security. When Hurricanes Dennis and Floyd hit the City of Kinston (followed by Tropical Storm Isabel), that same attribution had an entirely different context. Now, the flooding was not seen as a rare, fluke event, but instead as the outcome of a direct and steeply increasing series of floods impacts caused by fundamental problems in both flood management, flood ecology, and perhaps even climatic conditions. Instead of returning the temporal reference baseline back to Hilda and Hazel, “Floyd” blew all certainty out of the water. For Kinston, a large part of the temporal uncertainty about what Floyd was supposed to mean was caused by the now firmly rooted belief that while it used to be Mother Nature who distributed sorrow, this now had become engineers working for the City of Raleigh making the call to protect its drinking water at the expense of downstream communities. As one of the main critics of the dam in Kinston—a local business entrepreneur—explained to me:

> With the dam… people did not expect this, that is why they did not have any flood insurance. Might there be other reasons? No one ever felt that this could happen. With Fran it was a shock. With Floyd it was the straw that broke the camels back.

He himself had not fared very well during Hurricane Floyd. He told me he almost lost his life during the flood. Owner of a little county cabin close to a flooded Neuse river tributary called *Contentnea Creek*, he went to check on its status and to take his goats and ducks out of their cages after the peak flooding had passed. The cages were located in the lower portion of his property. His story emphasizes a sudden rise of flood levels:

> Within the hours that I was there, the water continued to rise and rise quickly and by the time I was trying to get back to my cabin it was over my head. It just came from nowhere. *Within an hour it went from this deep [knee deep gesture] to over my head*. I finally got hold of a tree, trying to get my clothing off which was pulling me down, and when I was pulling my shirt off, I had to lock my legs around the tree because the current was so strong. Somehow the current caught me, it flipped me upside down with my arms behind me trying to get my shirt off. And it was acting like a parachute pulling on my shirt. So I literally for a few moments hung under water with no way to get up, because my hands were tangled behind me on my shirt side. I just managed to keep my cool and tore my shirt off. Just tore it off, which freed me to come back above water. (italics added)

From the safety of his house, he watched his goats hanging on to trees as they gurgled their last breath. He was rescued by boat that night. His experience of a sudden rise in flood levels is echoed in many accounts which I heard locally. Ms. Sugar Hill Beech-Burrell was clearest of all on this to me when I spoke to her in 2005:

> No, I really don't think people thought it could be this bad. There were people during Floyd that had lived through hurricanes. We are in hurricane alley we have them all the time. So we don't really get very concerned about it. And these people, they did not move. They heard the warnings, they did everything, the normal shoring up the houses. And these were the people the boats had to go get. The helicopters had to go get. Because the water, you could see the flooding up the street, and the next minute it was halfway up the window. It was like a ten minutes difference. Ten minutes! And to me logically it lets me know that this just wasn't a normal natural disaster, it was somebody who opened up the dam!

To Dana the logical conclusion that Falls Lake Dam management was influencing the flooding could only be explained by pointing at regional power dynamics, and in particular the preferential treatment given by the City of Raleigh to its own richer tax-payers at the expense of eastern North Carolina:

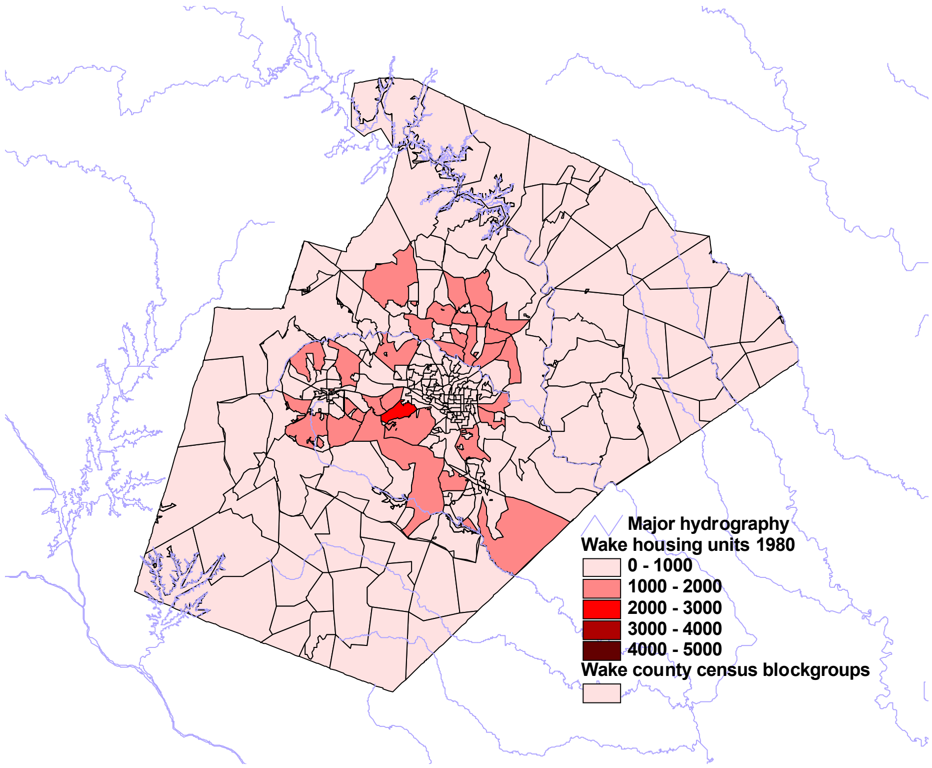
> Less then two miles from the dam they had million dollar houses built. Well, what developer has such elegant houses that close to the dam!? I guess it is easier to let the water down than to ruin million dollar houses!

Yet, despite these sentiments, among many residents skepticism remained because of a lack of actual proof that dam operations did affect Kinston. Selena Phillips, for example, was careful to squarely put the blame of the floods on Dam's management:

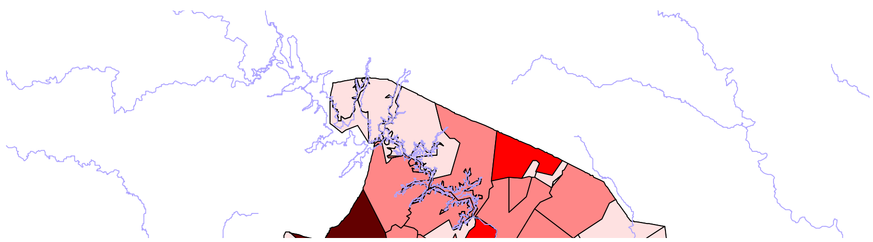
> Well you know, you look at TV, and read the paper and everything, and everybody got their own opinion. I really just don't know. I don't know and I hate to put the blame on anybody, even though they say that it come from Raleigh… that Raleigh was the reason why we got all this water, and that is possible. Very possible. Uhm… that they let that water out late and that is the reason we got it. I mean, to me I am a person you got to prove it to me. You know, prove it to me. I just won't put the blame on… I blame nobody.

In their turn local officials emphasized that some residents always played the blame game. For example, the buyout manager had been personally involved in designing the plans for the dam. "Everybody was behind it because it would reduce the floods," he explained. Emphasizing the extremeness of 20 inches of rain in three days, he dismissed blaming the Corps of Engineers as "searching for dragons" and "looking back 20/20." His irritation with the dam theory was clearly perceivable, and his frustration towards one particular council member who "just tried to get political gain" out of this situation still made him wildly grab another cigarette. Yet, his own theory was not too much different, and in a discursive move he switched responsibility away from the Corps of Engineers towards a bigger underlying beast called urban sprawl.

> I promise you we'll have another one, you can count on it. I know so. I know so. Because the hurricanes are gonna keep coming, They have been coming all my life. And…, Raleigh is so overbuilt, so much paved parking area, so much roof, that's why the '64 flood was so different… I lived in Raleigh in 65. It was 60,000 people. It is now about 360,000. Where they are building this outside loop [Interstate 495] was five miles or six miles out of town. There was not a damn thing out there. Well that land absorbed the water. Now the lake fills up bingo like that because it just runs this stuff into the creek, fills up the lake, they turn it loose. And it is getting more and more. And the development is getting closer and closer to the Falls [Lake Reservoir].



1980



2000

Figure 23: Development of housing units in Wake County from 1980 and 2000 (source: U.S. Census 2000).

Ironically, “The Dam,” seen by Kinston residents as this monstrous urban-entity biased to protect Raleigh’s recreation at the expense of eastern North Carolina’s flood security, actually is not located in Raleigh. While the physical operations are done near the City of Raleigh in Wake County, the brains behind its activities are sitting in cubicles far away in the coastal City of Wilmington. From this perspective, it is not surprising that it is easy for Corps of Engineers staff to identify with the Kinston story, which they, in fact, did. At the Wilmington Office I meet one of the operation managers. A nice man who worked with dam management projects for 28 years and seemed to have an open mind concerning the challenges dam management provides. He quickly acknowledged that operations had been difficult in the past decade. When I explained the perceptions of the Neuse river downstream residents, he expressed understanding, even identification with the folks in Kinston by seeing their perspective as his own.

> And that is an unfortunate perspective for downstream folks to have. I can see them having that. It is not so much that. They may very well look at it as a metropolitan area, and they are just doing what they want to do up there. And we down here don’t have the influence and the political wealth, so they just dump their waste on us, and we have to take it. That is unfortunate, that that thought process exists.

To get any flood benefits downstream, the operations engineer echoed what had been written in the Kinston media, that in order to solve the flood issue another reservoir should be built. Historically, three projects were proposed that would have better protected Kinston, but because of lack of funding only one was built. As one Army Corps engineer explained in a Kinston Free Press article: “The Falls Lake project costs $150 million to build and the likelihood of other dams being built in light of the federal deficit, is not favorable.” (Kinston Free Press 1996c). Still, even with a second dam, dam management has inherent uncertainty because of the uncertainty of the weather and the lack of, as the Corps officials often put it, "crystal balls." But the manager acknowledged that communication about the impact of the dam on the Neuse flood ecology had failed to reach public attention:

> We had done a terrible job of informing the public that lives on this river what to expect and how things. Obviously, when we make releases we don't have a crystal ball to look two to three weeks into the future. And many times that is what you have to look at when you get down to Goldsboro and Kinston, you are two to three weeks out. Releases today at Falls may not be seen for 3 weeks down the road in Kinston. The long time residents of the river are accustomed to flooding. What they were not accustomed to is having *prolonged* periods of flooding.

Because of its storage, the flood peak was lower, yet the continuous release after the event extends the flood. Particularly in the case of Hurricane Floyd, the dam prolonged the already long flood duration because management eventually was forced to release water considering concerns of approaching weather systems and dam safety. The effect of prolonged high water can be seen in the graph 3.16 provided by the Army Corps of Engineers from Hurricane Floyd when the streamflow lines with (blue) and without (red) Falls Dam are compared:

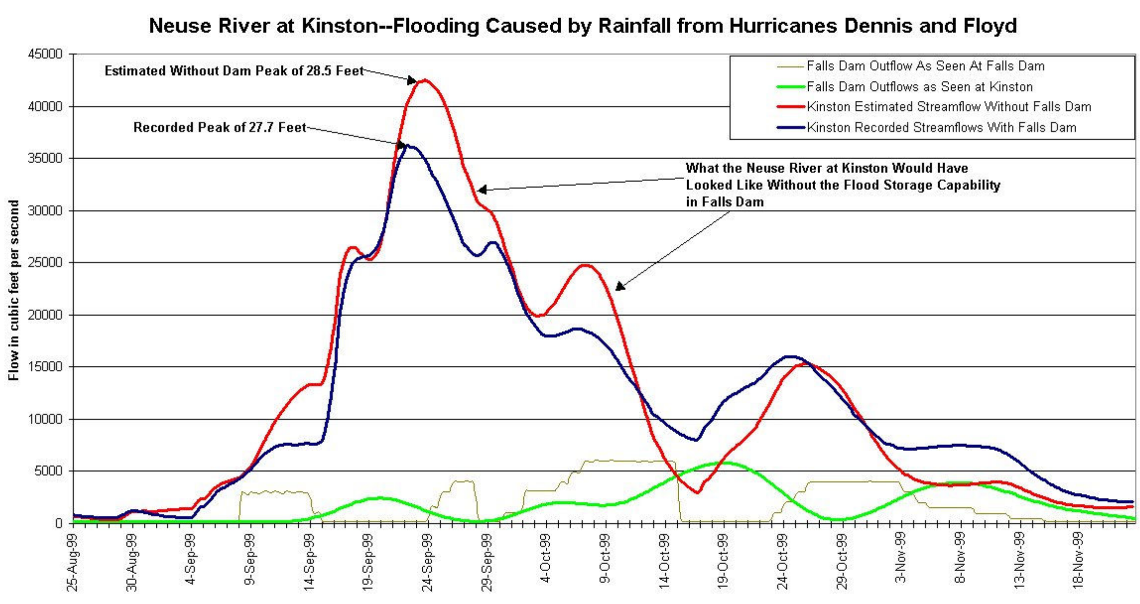


Figure 24: Neuse River at Kinston flood through time during Floyd

While the impact of prolonged flooding might not be as severe as a much higher river crest or the larger flood extent, duration certainly has an impact and many of these were felt severely in Kinston and surrounding rural floodplain areas. These included prolonged human displacement, higher risk of rotting of crops in agricultural fields (Kinston Free Press 1996d,e), an increase in mosquitoes and other pests, an enhanced risk of tetanus and diphtheria (Kinston Free Press 1996g), increased mold and bacteria growth, an increased loss of oxygen and fish kills due to algae in the water (Kinston Free Press 1996l), and, of course, psychological impacts.

Why did this happen? The Corps of Engineers dam operations manager explained to me that after the filling of the permanent conservation pool (236 – 250 elevation) was completed in December 1983 and operations began, Corps engineers quickly noticed that the storage capacity of Falls Lake Reservoir was less than expected. It was concluded that this was the result of faulty mapping. Physical modifications were made to correct for this, and the elevation for the conservation pool was adjusted to 251.5 in 1990. At the same time, a prolonged drought from 1981 through 1987 motivated a rapid development of the floodplain immediately below the dam. According to the operations manager, this situation offered immediate management problems:

> Long-time property that had never been developed over centuries, because it was flooded, the natural floodplain, was now in a process of development. And we are not talking mobile homes, we are talking very expensive homes. It was verbalized, we were told by this developer to shut the flow up, because he had a busload of prospective buyers coming and he wanted to show this property to them and did not want any water on it when he showed it to them!

Corps engineers testified before the Wake County planning board as to the impact of our operations on that area, which eventually helped increase restrictions. Still, homes were built, and a period of drought appeared to have substantially influenced operations for the long term:

> Initially… the initial plan for flood releases was that the capacity for the river downstream was 5000 cubic feet per second, or cfs. We found out very quickly that once we got to releases of greater then 3000 cfs., that we were getting phone calls from people that lived in areas never habituated before. It was primarily from the flooding of access roads. We from this office were given a project to operate and had our hands tied behind us almost immediately with what we could release. We were given a plan of operations, but if we held of the initial plan, it would have caused a lot of problems for a lot of folks… It goes back to what you came to talk here about, risk and uncertainty in the operation. What has happened as a result of these developments, no pun intended, if you will, changes since the dam was complete, is that we did not have the capacity to hold flood storage waters that we had anticipated we would have. We could not make the releases at the same magnitude as we originally thought we could make. Thus, we were holding this water behind the dam at a much longer time, and making these releases at a much slower rate.

As a result of these two developments Falls Lake Dam operations became increasingly vulnerable to weather uncertainties. And the timing of weather events obtained a more profound influence on flood management: less water could be held in storage, while less water could be released. The longer water was held back, the higher the risk that another event would develop and exceed capacity. The manager noted that it was particularly complex series of weather events which caused such problems.

> So you find that your flooding behind the dam is not so much result of maybe one event, which is likely to happen over a long period of time, but more so the occurrence of a number of medium or small size events mixed in. And this is what happened from 87 into the 90s, including Hurricanes Fran and Floyd.

3.10. A 500-year recurrence interval

While the ambiguity concerning the role of the dam in the flooding implied more uncertainty, the public discourse of flood recurrence intervals appeared to do the opposite: it re-imposed the lost temporal reference baseline. For example, in Lincoln City, Mr. Buck, an elderly black man with whom I conversed in the company of a local bishop at a small church, spontaneously used this designation to temporally place Floyd when I spoke with him. He referenced the experts ("they") who argued that the Hurricane carried unique temporal qualities: "They said it was a five hundred-year flood. The last one was 500 year since anybody lived… that was before slavery time." A long time indeed! To Mr. Byrd, the suggested temporality of a 500-year flood meant pushing the rarity of the event back into the past, far away from the moment of experience. 1999 minus 500 years = "before slavery time"! (and not 1499). And "before slavery time" is obviously a long time ago. Long enough to be considered the "longue durée," the archaeological time-scale, the floodplain "prehistory" of what later would become Kinston's Lincoln City, the unique middle class neighborhood where Mr. Byrd grew up during times of harsh segregation and explicit discrimination.

The discourse appeared an efficient way to understand and communicate temporal notions of risk, and Mr. Byrd's notion was shared widely. It was backed up by a barrage of media reports, which in their special attention to anything "extreme" tended to uncritically place the event at the 500-year recurrence interval. Why should they have been more critical? Did it matter to them? The North Carolina hurricane historian Jay Barnes (2001) gave some explanation why it perhaps did not: "The water was the highest in the memories of just about everyone who lived near the banks of eastern North Carolina's rivers and creeks, and reporting stations along the Neuse, Tar, and Northeast Cape Fear Rivers established all-time flood records in the days following Floyd" (Barnes 2001:228). To many of the stakeholders affected by this historic flood, the amazing and unprecedented impact of the flood led to a willingness to promote the idea that Floyd was indeed a rare event. Floyd earned the temporal designation of a “500-year flood” without much second-guessing involved. Even when the temporal designation was acknowledged to be uncertain, it still was referred to as such. Some examples might suffice to make this point, shown in the quotes below:

> **Currents of Change: N.C. Assesses Its Growth Policies Along With Flood Damage**
> *Sue Anne PressleyWashington Post Staff Writer*
> October 24, 1999; Page A3
> Hurricane Floyd generated what is described as a 500-year flood. In many places, as much as 20 inches of rain fell on ground already saturated by Dennis. The Tar and Neuse rivers, feeding into the delicate sounds that serve as nurseries for many types of fish and then on into the Atlantic Ocean, spilled out of their banks. (Washington Post 1999)
>
> **Swept away by N.C.'s budget woes**
> By Constance Stancil
> News & Observer, 7/9/02
> In September 1999, Hurricane Floyd hit Eastern North Carolina with rain that swelled rivers and swamped towns and homes. A 500-year flood, it was deemed, the worst natural disaster in North Carolina history. The General Assembly, meeting in special session, offered emergency aid to the flood victims. Acting quickly, then-Gov. Jim Hunt and the legislature appropriated more than $800 million to assist the victims. (News and Observer 2002)
>
> **More rain prolongs misery in North Carolina**
> GOLDSBORO, N.C., Wednesday, Sept. 29 (AP) - The second round of flooding in less than two weeks had Cora Sedlacek and Edie Brisson wondering whether fate has played a cruel trick on them. More than 8 inches of rain has fallen across eastern North Carolina in the past two days, following the 20 inches left by Hurricane Floyd. "My yard is flooded and they kept saying, this won't happen again in my lifetime," Ms. Brisson said. Added Ms. Sedlacek: "If this is a 500-year flood, then we're aging very quickly." (USA Today 1999)

Even engineers appeared to promote the notion that this was indeed a 500-year flood. Herring writes for NASA on their Earth Observatory website that “Hydrologists labeled this a 500-year flood event, meaning that a flood this severe is likely to occur only once every 500 years; or that it has only a 0.2 percent chance of happening in any given year” (NASA 2007). On the ground in eastern North Carolina, I spoke to an engineer at a floodplain map meeting in Greenville, a City north of Kinston, in 2002 along the Tar River. Speaking of Kinston, he assured me that based on high water marks—measurements made of how high the water reached on structures, trees, and other landmarks, the real benchmarking—“it was a 500 year flood indeed.”

Proposing Floyd as a 500-year flood provided a clear risk benchmark. It summarized how temporally “extreme” Floyd was; it firmly put it on the temporal map of significant events. Doing so, it imputed an expectation into the future. A flood like this every 500 years. As Mr. Byrd concluded, the last time was “before slavery”: a long time ago. Similarly, the next one would be a long time from now! Of course, experts know very well that the chance is the same each year, as for example the NASA quote above pointed out (0.2% chance each year). Yet, the popular, public imagination seemed to have set its mind on the erroneous interpretation of this temporal claim as a definite stretch in time were a safe-space of unlikelihood could be expected. They would be good for another 499 year if they would make it through the recovery process…

Considering the persistent perception of the 500-year temporal implication in the public mind, it is perhaps not surprising to see critical experts rise-up in arms to point out that Floyd in fact was not a 500-year event after all. For example, in a winter 2000 edition of the University of North Carolina’s popular research magazine *Endeavours*, Briggs noted that while state flood maps show the event was a 500-year event—”a flood predicted to occur only once in five centuries”—researchers were noted to be “*re-calculating* the flood frequency” (Briggs 2000). To the realist public this was odd. Recalculating would push temporality out-of-sync with linear time, suggesting that recurrence is relative to calculations, not to the event and time itself. But in fact, this criticism came very soon after the event itself. In a newsletter published only two months after the event by the North Carolina State University's Water Resources Research Institute (1999) it was argued that the then already persistent notion that Floyd had caused unprecedented flooding was inaccurate (WRRI 1999). The authors noted that the United States Geological Survey, the federal government institute in charge of the official recalculations of space and time, had moved to "correct" statements that Floyd brought a 500-year flood to North Carolina, suggesting that Floyd instead was perhaps a 150- or 200-year event. An editorial in the regional News and Observer newspaper by the geologists David Lawrence of Eastern Carolina University reminded North Carolinians about a 1954 storm called Hazel. This storm carried 120 mph winds and dumped 8-10 inches of water over central North Carolina. Further, he continued, there were the back-to-back storms called Connie and Diane in 1955, which resulted in a billion dollars worth of damage. According to the WRRI article, Lawrence noted that Dennis and Floyd "were just the last storms in a string of unwelcome visitors" (WRRI 1999:3). One of Lawrence colleagues at ECU, Stanley Riggs, a geologist, wrote a follow up editorial describing urbanization as the main driver of this problem. According to him, the continual conversion of forest and agricultural land to paved surfaces had increased storm water runoff, and extensive canalization in the coastal plain had prevented wetlands from retaining floodwaters. Riggs concluded: "we created our own crisis in Eastern North Carolina through systematic and traumatic modification of our watersheds" (WRRI 1999:3). Riggs, and other scientists, such as the biologists Doug Rader with the Environmental Defense Fund, argued that Hurricanes Dennis (the prelude) and Floyd (the blast) were relatively small storms. They argued that the severity of Floyd's impact was a result of poor management decisions regarding wetlands made over the last 30 years. In their opinion, intensive land use in marginal areas directly contributed to the seriousness of the flooding from expected and predictably large amounts of rainfall (Salon.com 1999). In fact, concern about these developments were already pointed out in a WRRI newsletter from 1978, in which the hydrogeologist Ralph Heath calculated that catastrophic flooding in the North Carolina coastal plain was inevitable. Noting urbanization in the state, Heath had warned: “We have built and are building below the level reached by past floods, none of which are as large as those that will occur” (WRRI 1999:4). What all these accounts have in common was an attempt to move the causation from nature and into culture. The interesting result was a shift in recurrence interval. Within this political discussion, where causation was placed affected the temporal rarity of nature.

What these critics implied was cause for alarm. Could it be that what we thought was a 500-year event now is a 150-year event? Is this because there a rise in the severity of hazards, as global change advocates might want to argue, or is it because our vulnerability of the landscape has increased? While the impact of Floyd might have been unprecedented, its conditions apparently were not. What Floyd did was to remind the scientists that the vulnerability of their flood ecology might have increased in the past decades beyond what they could previously envision. The surprise of Floyd, it seemed, propelled the region into a temporally unknown place. Or, as the Kinston Free Press summarizes it: “Floyd leveled the playing field for emergency response in Eastern North Carolina and set up an entirely new game” (Kinston Free Press 2004).

Floyd’s temporality was a big surprise. It was met with public belief in its rare extremity and scientific criticism. And finally it became part of political attempts to keep the repercussions of this criticism at bay from the responsible politicians. To politicians, the temporality of the event had to remain unpredictable, unknown, beyond the limits of rational understanding in order to argue that this surprise had been unpredictable. They achieved this in two ways. First, in an extra session of state legislature in 1999, the flood was acknowledged to be a 500-year flood, or even beyond:

> Section 2.(c) The General Assembly further finds that the devastation caused by Hurricane Floyd was of unprecedented proportions. Devastation of this magnitude was not planned for and could not have been planned for. Public and private decision making was predicated on the 100-year floodplain; actual flooding was throughout, and even outside of, the 500-year floodplain. No policies, no decision making, and no planning could adequately mitigate damage from or prepare an adequate response to such an extraordinary event (General Assembly of North Carolina 1999).

Later, when criticism of this recurrence interval increased, fingers were swiftly pointed at FEMA, responsible for the woefully outdated floodplain mapping program. Explanations tended to center on the notion that the size of the "real" floodzone heretofore had simply been "unknown" because no previous 500-year flood event had been recorded. As a result of this reasoning, the State further committed itself to the expansion of its technological monitoring network by embarking on the most ambitious, high-technology ("real time") floodplain mapping project ever undertaken by an individual U.S State, commonly referred to as the North Carolina Floodplain Mapping Program (Smith 2002).

3.11. Grounding Recurrence

The 500-year flood temporal symbolism remains popular locally in the City of Kinston and its surrounding County (Lenoir) up to the present day. The Kinston Free Press continued to repeat this notion in many commentaries after Floyd. Recently, the Lenoir County Emergency Management Director referenced the event as a 500-year flood in the Kinston Free Press: “the West Pharmaceutical plant explosion in 2003 and the 500-year flood in 1999 gave officials some indicator of what type of response this community will get” (Kinston Free Press 2005a). In another recent article reflecting on Floyd in the context of the devastation coast by Hurricane Katrina in Louisiana and Mississippi coasts, the paper remarked; “Most people have recovered physically from the 500-year flood of 1999, but their emotions will always carry the scars. They cringe today over the fate of people in Louisiana and Mississippi” (Kinston Free Press 2005b). In another article concerning the 2004 floods in western North Carolina, the paper writes about Kinston’s buyout manager and his supportive role in providing experienced advice. With his assistant, he traveled to western North Carolina to help officials understand how to run a mitigation buyout (acquisition and relocation) program as was done in Kinston. The paper emphasized his experience: “He helped Kinston navigate through the wall of red tape brought on by severe flooding in 1996 and especially 1999, when Hurricane Floyd drowned Eastern North Carolina beneath the so-called “500-year flood” (Kinston Free press, 2005c). So-called? Mediating between the public need to see the flood as anything other than a once-in-500-year event and the scientific understanding casting doubts on all of this, it was perhaps the influence of the city official himself which made the paper somewhat cautious with their 500-year temporal label. When I spoke to the manager in 2001 he already emphasized to me that while Floyd was a major "lead" flood by any definition, it looked worse then it was because the 100-year floodplain map had not been mapped accurately: "therefore, it looked like you had a 500-year flood while in reality it was not". According to the buyout manager:

> The scientific community, the survey guys, would tell you that it was about a 75 year flood. That is just what I heard people say. What they are saying is they don't know because they didn't know where the hell the floodplain ought to be.

Among most floodplain administrators it is well known that FEMA's floodplain maps are woefully outdated. But the difficulties of accurately defining the temporality of Floyd goes beyond old maps, and includes problems of distribution, particularity, and locality. This becomes evident when the various recurrence-intervals are mapped. I used a geographic information system to do this, with data provided by the USGS (Bales et al 2000). In their write-up on Hurricane Floyd and Dennis, USGS staff noted that "with the exception of the Lumber River Basin, all of the major river basins in eastern North Carolina experienced flooding at the 500-year recurrence interval." However, what this means is not that every *site* within the watersheds experienced a flood of such recurrence. Figure 25 shows the locations and recurrence intervals of 38 gauging stations from the Albemarle-Chowan, Roanoke, Pamlico, Neuse, Cape Fear, and Lower Pee Dee river basins in eastern North Carolina.

Recurrence Intervals for Floyd at selected locations

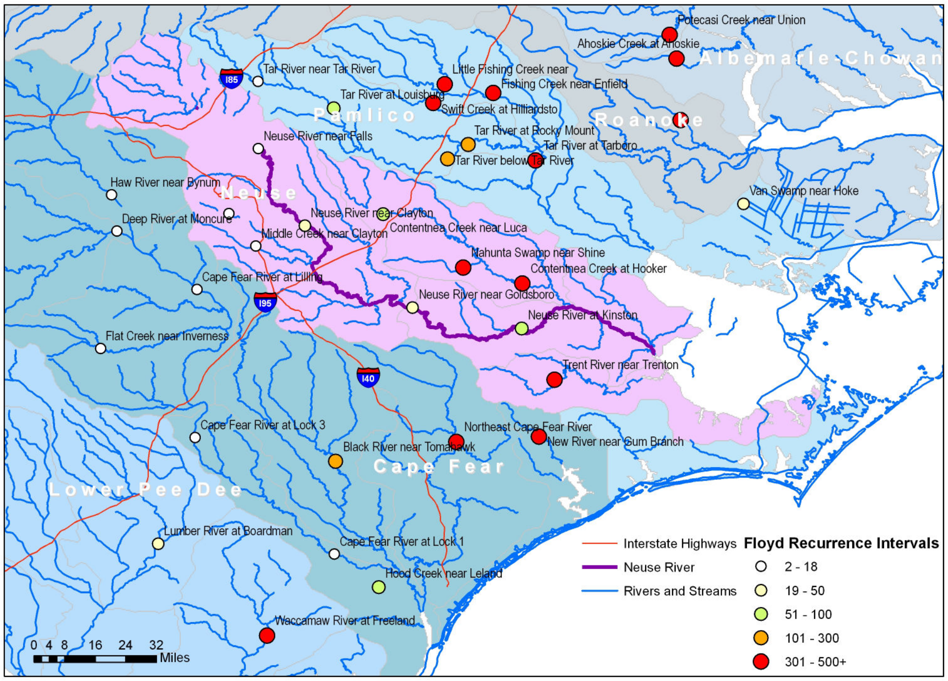


Figure 25: Recurrence Intervals for Floyd at selected locations

As it can be seen, there is no uniform distribution of the recurrence intervals. While in some places the interval is within the 300-500 year range, in other close by areas it is less then a 300 years, and in other less the 100, as appears to be the case along the Neuse River watershed, including Kinston. Reports stating “Floyd is a 500-year event”, or even “100-year event” can thus only be taken as broad generalizations. Recurrence, it appears, is a local, hydrological phenomenon.

In North Carolina a USGS network of stream gauges was used to collect flow-data for sites across the State. One USGS map shows all the gauges available to calculate flood-frequency statistics in the Neuse River basin. Thus, for the Neuse River at Kinston, actual discharge is measured at the stream gauge points, primarily USGS gauge #02089500. Following the description of how to calculate flood-recurrence in North Carolina by Pope et al. (2000), to calculate the recurrence interval, time-series of annual peak flows are statistically "fitted" to a known statistical distribution (a "log-Pearson Type III distribution") per recommendation of the International Meteorological Conference in Warsaw in 1933 (Pope et al 2000). The model used is basically a regression model, which estimates the probability that a certain stream flow is exceeded. However, historical data are used to create these models. Stochastic data relative to a temporal scale of analysis, with a relative and somewhat arbitrary baseline, specifically when measurement began. Interested in spatially visualizing this distribution of such time-series for the Neuse river and other river basins, I created a map showing the number of years of historical stream gauge data used in the calculation of recurrence intervals for Floyd. The results show the periods of analysis—the temporal windows—used in the calculation based on streamflow gauge data shown in Figure 26.

Years of historical stream gauge data used
in calculation of recurrence Intervals for Floyd

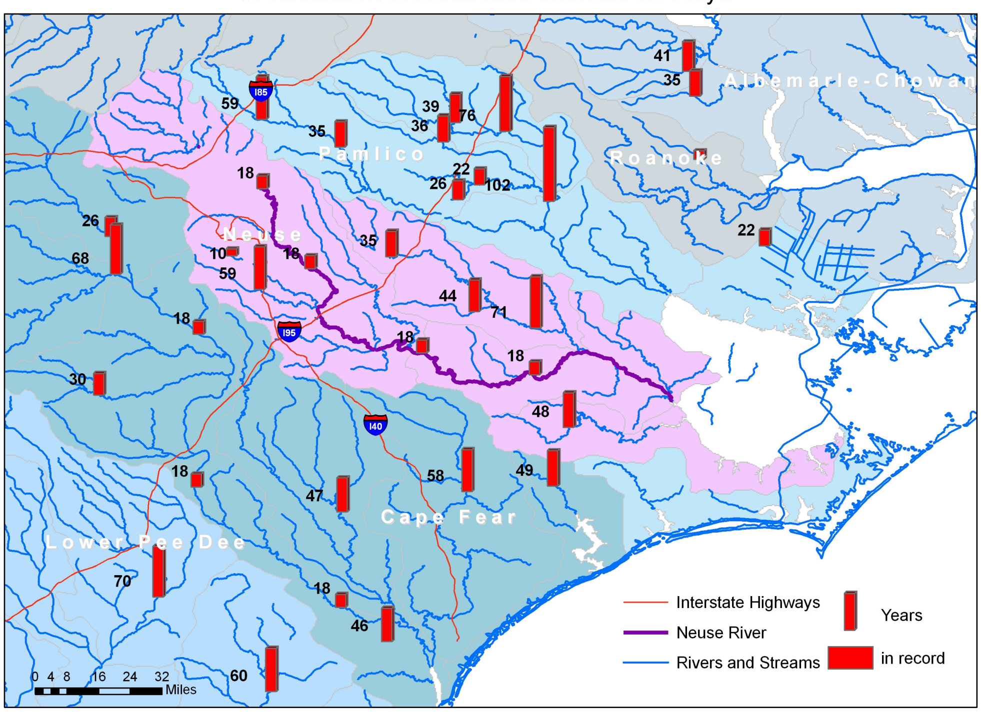


Figure 26: Years of stream gauge data used in calculation of recurrence for Floyd

As can be seen, considerable difference exists between the various stream gauges. The longest record appears to be 102 years of data, while the shortest are 18 years, for a number of gauges. One of these short data sets is for the city of Kinston. In fact, alongside all the river gauges in the purple Neuse River the number of available years is 18. What is going on?

As it appears, there is an important breaking pointing to be noted in Kinston's long time-series, namely 1983, which is when Falls Lake Reservoir completed its filling and Falls Lake Dam started operation. Thus, while before 1983 the Neuse River was a completely uncontrolled river, after 1983 human management took over downstream of Raleigh, including the entire lower Neuse River. The extent to which flood control is managed by the Corps of Engineers is dependent on the distance from the dam. In the case of Kinston, 30% of the floodwaters are under control of the Corps of Engineers. The USGS lists three gauges on their web portal for Lenoir County, shown in Table 2 below.

Table 2: USGS gauges on the Neuse River at Kinston

Station ID	Station Name	Drainage Area	Latitude	Longitude	Period of Analysis	Number of Peaks
02089500	Neuse River at Kinston	2692 mi2	35°15'29"	77°35'09"	1919-1980	53
02089500	Neuse River at Kinston	2692 mi2	35°15'29"	77°35'09"	1981-1996	16
02092520	Vine Swamp near Kinston	6.3 mi2	35°09'29"	77°33'16"	1953-1971	19

The impact of Falls lake Dam on this time-series can be immediately derived, since the data for gauge 02089500 is broken in two: before, and after Falls Lake Dam started to have an effect on the Neuse River. As a result, it can be seen that for Kinston, data for Floyd were only available since 1981, including 16 peaks[44]. With such a short period of record, how much scientific confidence can there be in the accuracy of the recurrence interval?

3.12. Local Difference

I did eventually meet one of the modelers responsible for the official recurrence rates in 2004 at a local presentation of results from the new floodplain-mapping program. His name is Mr. Smith, a certified floodplain manager formerly with the USGS and now with a private consultancy working for the State of North Carolina. A large, southern man, he told me that he has been instrumental in the floodplain mapping. I asked him about the recurrence intervals: "You know the landscape, you know the elevation. But how do you know how much water to expect in your model? How do you know the volume of water that will be affecting your model to calculate the recurrence interval?" Mr. Smith at first referenced Technical Paper #40 by the U.S. Weather Service, which shows the 100, 50, and 2-year rainfall data all across the country. Yet, he added, this data is also 30 years old (Hershfield 1961). Although there apparently was a new publication in the making for the new North Carolina Floodplain Mapping Program, the approach was to use river gauges data to measure rainfall and to calculate recurrence intervals. When I challenged him on the accuracy of this data due to the short historicity of the post-Falls Lake Dam Neuse river, he acknowledged that providing certainty with regard to recurrence intervals in this case in fact was very difficult:

> The Neuse is hard to talk about because you got Falls Lake on it. So you got a period with natural flow and then in 1981 they build the lake and it is no longer natural flow. You have two periods, a natural flow period and regulated flow period. You can't

[44] For Kinston, Data for USGS 32089500 shows that the pervious peak of record was in 1996, at 23.26 feet above datum (feet above sea level = 10.9), with a flow of 27,100. Floyd caused the gauge to rise to 27.71 peak stage above datum, with a flow of 36,600. Conclusion: a recurrence interval between 50 and 100.

> really do, pick those two, they are, … what is the word, it is a non-homogeneous population. That makes it complicated. And the Corps of Engineers operates these flows so that determines how much water comes out. So, there is no way to do a decent analysis on it.

I asked him how they figured out where the floodplain was. Smith replied that in fact the U.S. Army Corps of Engineers, in charge of dam management, posts the water discharges; “You ask them and they tell us. They will tell you what the 100-year flow is downstream of their dam. Part of their licensing is to have a public document that says so.” I asked him how a flood the magnitude of Floyd would influence the statistically fitted regression model. He explained that the calculations for the new floodplain maps were done based on equations from a report (USGS 01-4207) which was published in 2001. However, “it only includes data through 1996.” 1996 was the year Hurricane Fran flooded Kinston. Apparently, Fran hit the North Carolina coast when Smith finally concluded USGS 01-4207 when still working for the USGS.

> But really, what happened, although we had hurricane Fran, the report was originally scheduled to be finished in 1996, but we were doing the analysis while Hurricane Fran hit eastern North Carolina. And we said “Damn! A 100 year…! We got to hold, stop the presses!” And the later project included this data. And we did that and finished all the analyses around 1998. And around 1999 we put the final report to the presses and Hurricane Floyd happens. The idea is sometime in the next two years USGS is going to do another report.

The report provided background, data tables, analyses, and tested regression model for regions of North Carolina. According to Smith, within the time series available the data would not be skewed much by events such as Fran and Floyd, since it would be based on 105-110 years of record, as is the case in the oldest North Carolina river gauge stations.

> For a gauge with 100 year record a big event like Floyd does not change the estimate a whole lot, but if you have a gauge with a short period of record it will…. 100 years

> is a lot, short is….. the technical guidance says don't do it for less than 10 years of record. If there is less then 50 years of record you need to look at other things such as estimates of precipitation, you need to be somehow find another independent estimate or rate.

"Do not do it for 10 years of record," Smith suggested. How about 18, I wonder? What became apparent to me in my discussion with the floodplain engineer was that historicity matters: that Fran stopped the presses. That Floyd, the outlier, would have skewed the distribution. And furthermore, that Floyd's rainfall measurement was eventually not included in the calculation for the new, post-Floyd floodplain models presented to the public. It made me wonder; are the new maps accurate? When I made this point, Smith talked about temporal sampling. Not random sampling customary in social science survey design, but regular temporal sampling, and specifically *not* event-driven sampling:

> Another thing to consider is if you want to do a sample you can redo your equations right after the storm and find your bias of the estimate to the high end. Not only do you have all these long term, you also have like a big drought leading up to a storm introducing a skew. So the idea USGS is trying to take is to do this on a regular interval. You do not want the data to drive what is going on, you don't want a big change influence it. Then years later the impact of that change might have been damped out again a little bit.

It is strange and suspect for a non-hydrologist to encounter a 500-year flood boundary calculation on data which is only 18 years old. To me, it is also still strange for a 110-year-old gauge to suggest the meaning of a 500-year flood. Within the boundaries of such spatial-temporal, statistical knowledge, it appears there is a tendency for our minds to visualize some bedrock reference of what a "500-year flood" ought to look like. For example, Mr. Davidson, a regional, higher-level FEMA representative from Atlanta, touched on this issue in his interview in the book "Faces of the Flood" (Moore and Barnes 2004). In some cases, he explained, referring to the flood extent of Hurricane Floyd, "the flood was of such magnitude that it exceeded the frequency of our maps, if you will." To Davidson the inaccuracy of the seventies vintage maps was in some cases explained by the notion that the size of the "real" floodplain has simply been unknown because no previous 500-year flood had been recorded to delineate its boundaries. But this is misreading the data. As explained earlier, a 500-year flood technically is the 0.2% probability of a flood occurring in a given year based on a statistical *sample*. That this sample is different for different stream-gauges, is adjusted using additional data, interpolated—statistically guessed—for places where there is no gauge data at all, fitted in some regression distribution, modeled using physical attributes of the landscape, and projected back in time, does not mean that there is an "actual 500-year flood." The 500-year flood seemingly exists only relative to the time-depth of the data, and furthermore, this data sample appears heavily influenced by changes in the frequency of hazards (the timing of extreme events) and the physical environment which it impacts (the vulnerability we created by dredging wetland and sprawling cities and towns). Within this statistical business of making projections, it is clear that a calculation of a "500-year" event is more rock solid based on a 110 year recorded sample of analysis than an 18 year sample. That much I hope we can agree on. Too bad for Kinston.

3.13. The best thing that ever happened to the City

The influence of the samples numbers appeared problematic enough to Kinston that the planning director noticed. When I visited him in his office in 2005, he showed me a publication stating that for Kinston the maximum discharge from Floyd was about 36,800 cubic feet per second (cfs). Because 34,700 cfs is a 50-year event, and 40,500 cfs is a 100 year, Floyd was a 60-75 year event (or at least greater than 50 yet less than 100). However, the planning director had some doubts on this number:

> The extent of this flood seems to match the new 100-year floodplain. The reason I know that is because I visited this site at high water, and I know exactly where the water was at high point. And that is exactly where the 100-year line is on the new floodplain maps. And I was told that Floyd, at least for the county in general, was not a 100-year event. We only had 14 inches of rain, and the Tar got 24, Cape Fear got 24. I have a map showing what basins got, and we were essentially skipped over.

Thus, Floyd, presumed to have a 75-year recurrence period according to the streamflow data provided by the Corps of Engineers and calculated by the USGS, actually has flood extent boundaries matching a 100-year event according to the new State floodplain maps. I asked him if he knew if Floyd had been included in the calculations for the new floodplain maps. He thought so. Why would he not? Who would have thought that "the storm of the century" or "the 500-year flood" was actually left out of the spatial flood recurrence calculations? Who would have thought that the time-series of historical data used to calculate the flood is actually broken in two, with only an 18 year sample left for serious statistical modeling?

Kinston remained mired in temporal vulnerability. Considering that the Neuse River actually received less rainfall then some of the other river basins, and that the calculations suggest that the flooding was somewhere between a 50 and 100 year event, the Planning Director made a point to email me back a few days later, after we discussed his level of concern regarding the next flood:

> After our conversation I reflected on my answer to your question
> something like "are you concerned about the next flood?" I don't know if I answered it completely, but my usual answer to this question is "I'm certain we will have another flood, but I'm not overly concerned because the next one will most likely be just unusually high water - not a disaster. Almost 75% of the structures have been removed from our 100-year flood plain and most of the ones remaining are commercial buildings that can easily recover. However, when I contemplate the possibility of having a 500+ year event as happened in 1999 in the river basins south

> and north of ours, I get very concerned because of the economic impact of having our transportation system and part of downtown under water.

The 500-year flood is real to him: real enough to be concerned about the big storm in Kinston. Real enough to continue pushing for buyouts as the only way to mitigate the impact of this possible flood on vulnerable populations.

Both the Planning Director and buyout manager independently affirmed that after Floyd, everything changed. The Planning Director:

> We had the buyout after Fran ongoing when Floyd hit three years later. I am not even sure we even had acquired any. A lot of them on the buyout list for Fran were flooded in Floyd. We could have sold… we could have charged an application fee for Floyd for the buyout! We were at the waters edge at Floyd and we would not let them go back to their house without a ticket, secure the area, as part of the going back and talking got them, as part of our immediate response we were talking to them about the buyout. Word had already got out because a few people had already been bought out and did not get flooded. So, there were a few success stories out there, but too few. Second time it was like… where do I sign up? And: do I have to apply again?

Similarly, but four years earlier, the Buyout Manager told me the same thing when we drove around in the floodplain area:

> Floyd occurred on a Thursday, I came in this building on Friday. There was nobody here on this end of the building but me. I hear a knock on that window. It was the guy who said he would not sell after Fran. He said, you told me, I did not listen, I am here to tell you I am ready to go. So.. in a sense.. and this is a … personal observation.. the best thing that ever happened to the city of Kinston with regard to future flood was Floyd. … Because it came almost 3 years to the day, they were both.. one was September 6, one was September 15, and it made the point that *this can happen to us ANY time*. And therefore we had people, even though both of these projects were volunteers…. they came and signed up, *asked* to be bought out. The mindset changed from a once in forever circumstance to this can happen to us again, and there before we have had that much difficulty. [italics added]

Both officials seemed to suggest that the buyout after Floyd sold itself; it did not had to be sold. People stood in line to sign up. The mindset had shifted. From a cultural model in which Fran was seen as abnormal—"a fluke"—Floyd undermined the entire temporal paradigm and introduced serious uncertainty. The Buyout Manager summarized this new perceived risk culture as temporally indefinite: “this can happen to us *ANY* time”. What this observation indicates is that there was a strong, shared sense that flood risk had lost its temporal placement, its referentiality. No longer was it possible to feel reassured by the notion that the dam would protect, that hazard spacing would be in terms of decades, that flood extent would be within the scale of Hazel, Hilda, or even Fran, and that their duration could last up to four days at most. Temporally, Floyd collapsed all previously established referentiality to the established baseline events, and re-invented a reality in which perhaps there was no temporal certainty at all; it could happen any time[45].

The event carried with it major temporal implications. First, there is the coincidental occurrence of Dennis saturating soils and exacerbating the impact of the rainfalls associated with Floyd. Second, many residents returned to their homes after Floyd had passed, yet were relatively unwarned about the temporal lagging of the massive upstream drainage which had yet to creep through the Neuse River at Kinston. Call it the Katrina-effect: the presumption that the risk has passed while the worst is actually yet to come. During Hurricane Fran, the slow drainage of the Neuse through Kinston had already been observed, as had the implication of Falls Lake Dam in its flood ecology. Yet, this one-time major event had not prepared the City and its residents sufficiently for a hazard with the magnitude of the Dennis-Floyd combination. As illustrated by the story of Ms. Phillips, many residents were caught in the rising waters by surprise after they returned to their homes; they had not been sufficiently warned of the coming floodwaters. “They knew the floodwaters were coming,” one employee of a consulting firm working in Lenoir County whispered to me secretively during

[45] This state of shock was not unique to Kinston. The historic flooding brought by Hurricane Floyd is seen as the worst natural disaster ever to hit North Carolina. In dollar figures, it did some $6 billion in insured and uninsured damage across the state Hurricane Floyd Statistics. For more stats: http://www.nccrimecontrol.org/Index2.cfm?a=000003,001158,001159

a lunch I had with her. “But they did not tell the people.” Perhaps they did, perhaps they did not. In a retrospective article placed five years after Floyd (Coastwatch 2004), the North Carolina Seagrant Consortium—a coastal science and information funder—notes that staff at the National Weather Service Forecast Office (NWS) in Raleigh had expressed frustrations with the lack of their ability to engage in early warning concerning inland flooding after Floyd: "We learned that we have excellent, on-target forecasting capabilities, but we had antiquated methods of getting out the message that inland flooding is a serious threat."[46] In any case, what we know is that the river rise surprised enough residents to have them stranded on the roofs of their houses in the early mornings. A third temporal implication was that Floyd cut Kinston off from the outside world. Like an island. In the wake of this isolation, those whose homes became unlivable experienced locally unprecedented, long-term spatial displacement. Many of the flood victims were living with relatives, sleeping on sofas, were *out of place*, and did not have a permanent address for six months to as much as two years.

Historical hazard coincidence, relative inexperience with a new flood ecology, and the eventual long-term displacement of many residents caused the cultural collapse of the baseline model which had held steady since Hilda. Floyd combined spatial displacement with *temporal unplacement*, creating a cognitive crisis of perception which can be characterized by uncertainty and shock. As the senior planning official said when I spoke to him on the phone about the buyout, “Floyd made believers out of people.” He suggested it was in particular the influence of Fran, only three years earlier, which made the decisive difference:

[46] Perhaps it is no coincidence that after Floyd the NWS Advanced Hydrologic Prediction Service teamed up with several NOAA agencies, the Federal Emergency Management Administration (FEMA), the state of North Carolina and the U.S. Geological Survey (USGS) to develop a more effective means of delivering flood warning information to the public, emergency management leaders and other government officials.

> And I think that has to do with the repetitive issue. Before Floyd, Hurricane Fran came along. At that time it was a first-time event. Before that it was ‘64, so like 32 years for the previous one, and the persistent idea—what I noticed for the few decades that I was there before the 1996 floods—was “well it happens. But it will be so rare, so… as long as we build outside the 100 year floodplain we should not worry about it [flooding] too much.”

It is within this period of temporal, spatial, and cognitive disorientation that the City’s buyout strategy finally had it’s decisive, intended impact. In one of the interviews from the buyout study (Fraser et al. 2004), the way in which city officials sold the program illustrates how the various elements came together strategically to put flooded property owners in a situation where it would be difficult for them to remain unconvinced of the logic of participation:

> We were able to meet them at the center on the edge of the floodplain when they wanted to get to their house. We took them back in boats, whatever it took, to get medicine and clothes…whatever they needed out of their flooded house to where they could use it in a temporary location. At the same time we demonstrated to them how bad it was. We tried to impress the vision of what they were seeing in riding in a boat back to their house and get them to project that out a few years. Are you going to be able or are you going to want to deal with this again?. We were able to talk to them. We were able to sell HMGP. We were able to sell our buyout program. We were able to give them confidence in us that we knew…that we felt like we had a program that in the long run was going to be beneficial to them. We just convinced them that it made sense and again we had the experience of Fran. So, it wasn’t that hard in a lot of cases but in a few it was. We also had the determination and the resolve that we were not going to let them go back in there.

What better circumstance to push a buyout than when moving the flood victims to the rubble which was once his home in a boat? To add fuel to this fire, the City used legal pressure, using the “substantially damaged” designation, which created even more complications, in this case legal, for residents to reject the buyout idea. As it was explained by a Kinston Official:

> So, we would talk to them about the state of their property and the likelihood of them *legally* being able to move back in and get their [electrical] current back on and all that sort of thing. At the same time there was someone right beside us with the form

> for the buyout that was telling them about the buyout. We had examples of people that had been bought out and where they were living successfully."

In the midst of residents chaotic spatial, temporal, and cognitive uncertainty, the City had an opportunity to effectively align its planning goals. The City, in fact, added a fourth temporal element to the mix of vulnerabilities, namely the predetermined speed with which it handled the buyout in order to take full advantage of the duration of the crisis. As experience dictates, the concern that overrides normality in a crisis is bound to fade when things return back to "normalcy." For any emergency manager, it is this normalcy which is the first aim in the appeasement of human suffering.

The effectiveness of the buyout-speed can be seen in the data from the buyout survey, even when only the 87 flood-victims from Kinston who participated are looked at. These data show that a significant negative correlation exists between the affirmative response to the question "How important was the likelihood of future flooding in making your decision about participating in the buyout" and "From the time you heard about the buyout, how long did it take for you to make a decision" (R=-.248, p=0.02). Or, in other words, the more concern about future flooding, the less time it took for residents to sign up. The data also show significant correlations with a number of other variables which indicate the relevance of a speedy buyout offer during the time of crisis (Table 3):

Table 3: Selected significant correlations in buyout survey (n=87)

	How long did it take after the flood before you were approached to participate in the buyout (not long → very long)
Was your home condemned after the flood? (1=no, 2=yes)	-.261 (p=0.02)
How concerned were you about leaving your neighborhood when making the decision?	-0.231 (p=0.04)
How clear was the information presented to you about the buyout?	-0.289 (p=0.01)
How much did you trust the people running the buyout?	-0.253 (p=0.02)
How confident were you that local government officials had the best interest of your neighborhood in mind?	-0.225 (p=0.05)

In your opinion, how fair was the price offered for your home?	-0.300 (p=0.01)

Further, the longer it took for residents to receive an actual check to acquire their flood home and relocate after they had signed up ("how many months did it take from the time you signed up for the buyout until you received a check for your home"), the less they were inclined to be concerned about the likelihood of future flooding (R=-0.224, p=0.05) and their ability to find affordable housing (R=-0.350, p=0.01). What these data suggest is that speed was essential to the city's goals. At the same time, perceived voluntariness of the buyout process ("Did you feel that participation in the buyout program was voluntary?") was negatively correlated with the time residents took to make the decision to participate. Thus, while a fast and urgent approach created more participation, it also increased the likelihood for residents to feel their participation was less voluntary.

In the end, the buyout was successful due to its high participation rate and a gigantic effort on the part of local officials to relocate residents out of harm's way. But the process also created a persistent unhappy minority. In addition, in the buyout's aftermath, my conversations with residents suggested that what seemed to be lacking was any public or official City acknowledgment that alternative flood mitigation strategies—home elevation, for example—might have preserved a historic neighborhood. Residents were given few alternatives to the buyout. The buyout effort was a top-down, strategically imposed relocation effort catching a population during a temporal crisis. The Kinston buyout was part of a predetermined redevelopment strategy by the City which had its origin in the notion that some areas are "blighted," and therefore can be intervened upon. It is fair to say that this buyout policy extended beyond Kinston, and in fact had its origins in the planning culture common to the State and even FEMA. In 2003, FEMA and State officials appeared unwilling to be open to alternative forms of mitigation. One informant I met during my work for FEMA was a senior mitigation consultant. He had worked all over North Carolina administering FEMA's Hazard Mitigation Grant Programs for many localities. When we met with him in the town of Washington, where he was currently engaged in mitigation work, he spoke about mitigation after Floyd:

> The only thing I would want to say in retrospect on the state's response to all these things is that in Floyd they should have had an a little bit more open minded to the elevation alternative in areas where it already had been approved as an effective treatment. But, really, we had only been elevating for about a year, effectively, when Floyd came around. It was a lot of back and forth between me and my clients and the state agency about elevation, how you do it, the engineering analysis, and why we were doing substandard homes. Ultimately they were resolved, but they were not resolved in 1999. Some of the State's response might have been, well… they are working on it, but we got such a huge problem here we are just going to focus on acquisition. It obviously is a lot easier to just acquire 400 homes in Kinston than to elevate 200 and acquire 200.

While a mitigation success, the Kinston buyout was dominated by a sense of loss and forgottenness by the black community. In response to the sense of forgottenness, there was the eradication of a piece of City history. Dana and her husband aimed to revitalize the area, to help give voice to concerns many other have expressed: to memorialize Lincoln City.

> Once they demolished everything, if you never know there was something there you'd never know. We were trying to raise money to put a memorial back there, just in remembrance for the first families that started here and all the families that lived in this area. I am still working on it. I feel I am like a one man show in that.

Her sentiment was shared by all others I interviewed. For example, when I asked a local Pastor what he thought should happen to the area, he immediately responded:

> What I would like to see happen, it has such an impact, something like a museum. Where people that are away can come back. I have seen people come back here and cry. People from New York, and from across the street. Unless something is preserved it will eventually just die. Something like a museum that will help people to remember. Recently we had citizen to die that belonged to a church in another area but was born here, the last thing she wanted is to be brought back into this area. We

> had this funeral, that day that you came by. Just the memories of sending her from this area. People get out walking looking, taking pictures, a lot of them weeping. I used to play here. My aunt lived there. My grand dad's place. Now they torn down most of the houses.

Mr. Byrd remarked to me that he felt that 80% of Lincoln City was gone. He said that the only thing that is holding Lincoln City together now is Lincoln Street. I asked him how he felt about that.

> Hurt. People drive through who used to live here. You don't feel too good about it. That was God's business. You can't question him. What makes it even harder, with the houses being demolished, is that the grass and weeds come back. If the city would cut some, it would look like there is some hope, but now it just looks like it has been abandoned. Gives you a very bad feeling.

3.14. Conclusion

Natural hazards impose temporal randomness on human culture. Had Hazel occurred earlier in Lincoln City's colonization of woodlands, the floodplain would have emerged earlier, and black residents might have been able to organize a less casual approach to flooding at an earlier time. Had the period between Hurricane Hazel in 1954 until Hurricane Fran in 1999 not been one of low hurricane activity, a heightened concern with flooding might have been sustained on the part of floodplain residents. Had Fran been followed by another Fran, and not the scalar explosion of Floyd, the notion of a fluke would have been dispelled earlier and the structural problems with Falls Lake Dam might have been uncovered in time for residents to start to organize culturally appropriate mitigation possibilities before Floyd hit the area. Had a drought not followed the creation of Falls Lake Dam, expensive housing might have never been built in the floodplains right below the dam's outflow and its ability to manage its outflow would have been more flexible. Had

Dennis not made its turn, saturating the soils, it would not have exacerbating the impact of the rainfall associated with Floyd.

It is this type of climatic unpredictability what we can expect to happen in complex dynamic environments such as floodplains. The question central to this chapter has been to analyze what, if any, pattern there is in human cultural reactions to this randomness. The first observation is that these reactions are relative to a certain temporal situatedness of the population, a location in time. It is relative to this social, or situated temporal location that vulnerability can creep in. For example, the cultural construction of the flood baseline in 1954 after Hurricane Hazel meant that before this time Lincoln City residents simply were not aware of the potential impact which a hurricane might have on their landscape. Previous smaller scale flooding had been treated with indifference as part of the trade-off or homeownership by the segregated black community. After Hazel created the floodplain, it also essentialized its temporal boundaries. This baseline representation was kept in place despite Hurricane Hilda in 1969 and particularly despite the events which enfolded during Hurricane Fran in 1996. Because the flooding caused by Fran a generation later did not dramatically exceed what was known historically, the early warning which Fran provided was missed. This warning concerned the possibility of a *much* larger disaster due to changes in the ecological system, including Falls Lake Dam and wetland loss in the past decades. Fran was seen as a fluke because Hazel was kept as baseline reference and the presumption in the world of modernism was a declining flood trend. Fran provided insufficient justification to see an upward trend in flood severity and duration and to recognize an the impact of Falls Lake Dam and rapid land-use change. Keeping in line with the presumed flood "normal" as defined by Hazel (and Hilda, for the City), Fran was seen as an upstream accident of water management. That this perception was erroneous was borne out by Floyd, which amplified the problems of Fran many times, suggesting that the accident was no accident, but systematic. Fran was no fluke, but instead a warning of impending doom. While scientists documented the land-use changes and predictions of the potentiality of a storm like Floyd, and while the Governor's Task Force took these issues seriously, locally Fran's timing made it a fluke. In social time, Fran lost much of its significance due to the temporal distance from Hazel's baseline. This is what a "fluke" is: a chance occurrence. An accident.

The temporal situatedness of a floodplain is itself contextualized by official claims and documentation of historical risk. Summarized in the time-space map called the Floodplain Insurance Rate Map (FIRM), the temporal boundaries of risk are given by the recurrence intervals on this map. I have reviewed how in the case of the City of Kinston and the Neuse River at large, temporal uncertainty is relatively higher than surrounding watersheds because of the creation of Falls Lake Dam. For Kinston, the scientific calculations of the floodplain boundaries are uncertain due to inherent problems with historical data. Although the engineering trick remains largely hidden in this analysis (the black-box this anthropologist could not open), the evaluation of an engineer central to the calculation of the new floodplain maps that "no decent analysis is possible" on the Neuse River due to the dam speaks volumes to the systemic, temporal vulnerability which this situation has induced. The shallowness of river gauge data provides a situation that misinforms localities about the space-time risks involved, or in other words, the probability for surprise in the case of Kinston is enhanced. This, therefore, I believe, is another element to the case of temporal vulnerability in Kinston.

This second, scientific form of vulnerability is further exacerbated by the weak temporal properties of the mental flood model residing with the public, which appears to have been out of sync with scientific reality. To the public, media, and many policy makers, Floyd simply had become, and still is, the 500-year flood. The scientists disputing this notion are deemed powerless by the symbolic message which this temporal and spatial claim makes: it is rare. No-one could have prepared for Floyd. The 500-year flood is a cultural construction of temporal referentiality with a political aim. With politicians eager to avoid responsibility for not having planned better for this event despite Fran's early warning, Floyd's 500-year recurrence interval is a handy claim. When—counter to the current of the public and politicians—the science behind this notion is investigated, a swamp of historical assumptions and statistical complications enter the equation. In the end, one leaves unsure, uncertain. And this uncertainty seems to be what Floyd has created: the collapse of the temporal baseline referentiality of Hazel and Hilda.

In its immediate aftermath, Floyd combined spatial displacement (evacuation, buyouts, relocation) with temporal *unplacement*. Floyd created a cognitive crisis of perception characterized by reactions of surprise and shock. In retrospect to this period of intense temporal crisis, City officials explained that the combination of Fran – Dennis/Floyd sold the buyout, and not just Floyd. The close temporal proximity of Fran and Dennis/Floyd suggested to residents the possibility of a new *upward trend in hazard occurrences* and a notion that perhaps there are systemic issues which have enhanced population vulnerability. In the midst of this chaotic spatial, temporal, and cognitive uncertainty—an acute state of heightened temporal vulnerability—city managers had an opportunity to effectively align their planning goals with the concerns that fueled the collapse of cultural risk model and adding a hastened buyout as a temporal element to the mix of temporal vulnerabilities. For the City of Kinston, it was the window of acute temporal vulnerability which proved effective for enacting its buyout strategy. The result is clear: all residents moved. While the program was voluntary, I would argue that the timing of the buyout exploited the local population, making many move against their will. One can indeed conclude that from the officials or floodplain managers perspective, Kinston successfully mitigated against future disaster, since buyout and relocation strategies are the most effective ways of reducing population risk. On the other hand, Lincoln City simply ceased to exist. In Kinston, there was no participatory planning, no local political stronghold able to stand-up and argue against State and FEMA protocol that perhaps an elevation program could spare the unique, middle class neighborhood which was Lincoln City. It seems that city officials themselves appeared to not see the socially vulnerable populations living in these floodplain conditions economically viable enough to provide consideration of their preferences and views. To make matters worse for the former residents, after all is said and done, the City seems to have lacked sincere interest in officially remembering what was lost or thinking about the area in terms of a place with cultural heritage. It is almost as if the City wants to forget about Lincoln City. Temporally, whatever is left of the neighborhood remains vulnerable.

After the Flood

Inside of home flooded after Hurricane Floyd. Tick Bite, North Carolina.
Photos Courtesy of Ms. Teel

4. HISTORICAL PRESERVATION IN SAVANNAH

4.1. Introduction

Population vulnerability to hazards is the capacity of a population to anticipate, cope with, resist, and recover from the impact of a natural hazard. The aim of vulnerability research is to better understand when this capacity is compromised and how this type of vulnerability can be reduced. It was the social vulnerability of Savannah's floodplain population, in particular its poverty and minority status, which first steered Jim and me to Savannah for FEMA's repetitive loss study. After our visit, I left with a strong sense that I should return to the City for more study on its historical floodplain ecology, in particular the temporal relation of its inhabitants to flood events in relationship to my interest in temporal vulnerability, or the potential for population surprise to hazard events.

The immediate reason was the historicity of the City itself, and in particular its reputation of being a regional leader in the urban historic preservation movement. At the same time, it seemed that the City was aggressively marketing the notion that flooding needs to be taken seriously, and in doing this the City strategically used historical information. I was intrigued by the way in which history appeared as a reoccurring theme in our discussions with officials and the mitigation team that had taken Jim and me on a tour of Savannah's repetitively flooded neighborhoods. When we spoke with the Mayor and City Manager, both made a point to explain how history, flooding, and issues of mitigation were all closely linked. The City Manager in particular spoke with some passion about how he had been using a special CD with presentations about the historical ecology of the Savannah area every time he went to speak with local residents. He indicated that it helped him connect past and present in its relationship to the mitigation plans the City had implemented[47]. At City Hall, a lady of the Public Information Office had gathered an entire exhibition on the City's flood outreach program for us to view. The campaign included a special Citizens Office, serving as a resident advocate for citizens dealing with drainage issues in mitigation construction zones. The mitigation strategy also included a full reimbursement of the 25% match which FEMA required in buyout mitigation projects, as well as moving expenses. It seemed fitting in this context that the City had attracted a high quality mitigation team. When we met Georgia's State Hazard Mitigation Officer in Atlanta, he reported that from the start "Savannah seemed to have a good grasp of the program early on and pretty much took it and ran with it." Savannah takes pride in being a city of history. Founded in 1733 as America's 13th and final colony and Georgia's first City, and located at the mouth of the Savannah River, the city became an important commercial and social center with one of the largest harbors on the east coast. The city got wealthy by exporting cotton, rice, naval stores, ships, and other agricultural goods (Dick & Johnson 2004). Today, the historicity and beauty of the City has motivated a booming tourist economy in which an oak-shaded historical image blends elegance and refinement with some Southern sass. The old downtown was designated a National Historic Civil Engineering Landmark by the American Society of Civil Engineers, and also nominated by the Federal Interagency Panel to the UNESCO World Heritage List in 1994. The City's historical district is famous for its 22 legendary, 18th and 19th century public squares laid out by General James Oglethorpe in 1733 (see Figure 27). The squares are

[47] I unfortunately was never able to get a copy of this CD, even though it was promised to me several times.

lined with old homes, magnolia and oak trees, and spark the imagination of many visitors interested in recapturing that traditional Old-South feeling.

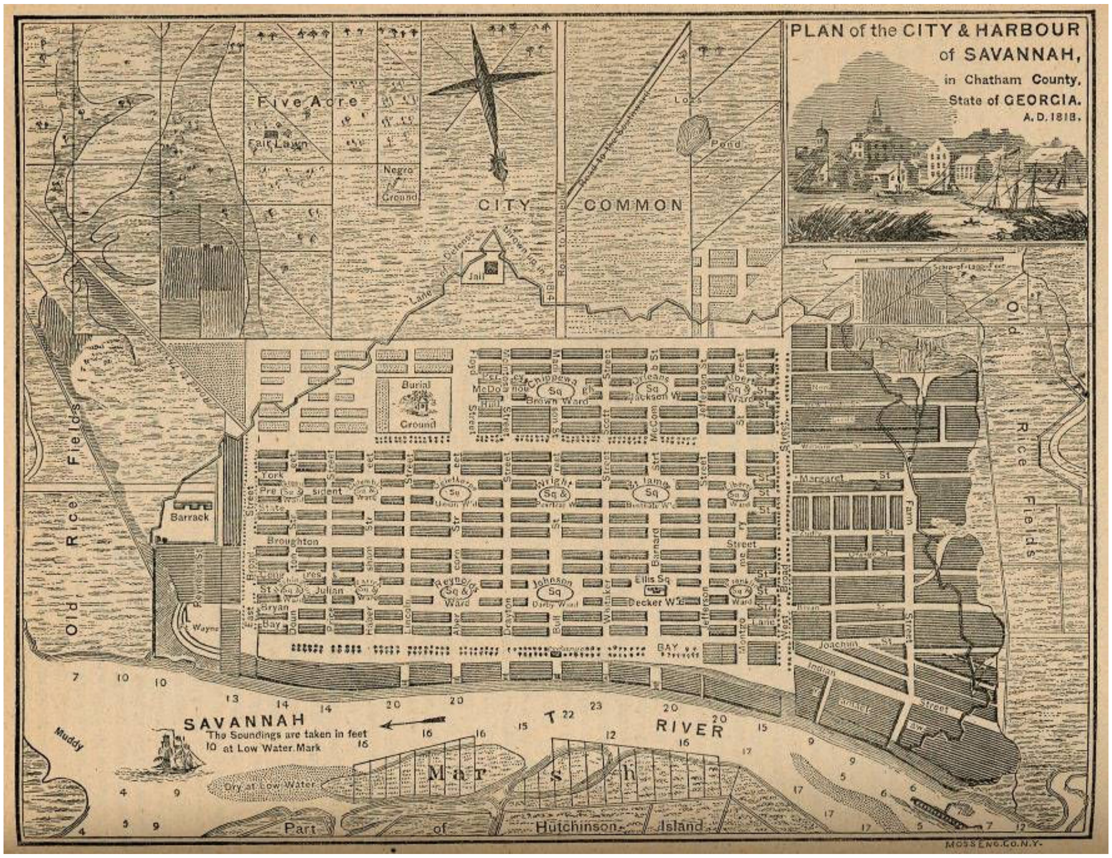


Figure 27: Historical Savannah

Fueling this perceived historical identity is a strong local commitment to historic preservation. This is perhaps most prominently evidenced by the strong influence of the Savannah College of Art and Design (SCAD) on the city's feel[48]. The historical downtown of the City is used as a field laboratory by its graduate students in historical preservation, urban design, and architecture programs. Clearly, Savannah has what it takes to preserve history.

What the City also has is a serious flood problem, which are severe in comparison to Savannah's neighbors. Table 4 shows 2004 FEMA data on repetitively flooded properties. It

[48] SCAD is the private entity that really caught the wave of redeveloping old buildings, coinciding with the College's educational aim and philosophy. The College has been a big buying force all over town.

can be derived, that compared to nearby coastal cities and New Orleans Parish, the percentage of housing units which are repetitively flooded in the city is substantially larger then that of the contrasting cities, with the exception of New Orleans. At the same time, the percentage of housing units with floodplain insurance coverage is lower than most of its direct neighbors[49]. But most interesting is to note that among all of these nearby southern coastal cities with flooding, the percentage of repetitively flooded homes which actually carry insurance is substantially lower then in all other places, including New Orleans. As a City with many socially disadvantaged residents, reflected in the low median value of owner-occupied housing units, this to a certain extent is expected.

Table 4: FEMA Repetitive loss data for Savannah and its urban neighbor, 2004

	City of Savannah (GA)	City of Charleston (SC)	New Hanover County (Wilmington) (NC)	City of Jacksonville (FL)	New Orleans Parish (LA)
Population	131,510	96,650	75,668	735,617	484,674
Housing Units	57,437	44,563	92,685	308,826	188,251
Repetitively Flooded Housing Units	316	151	259	138	5,003
% Housing Units Repetitively Flooded	0.6%	0.3%	0.3%	0.0%	2.7%
NFIP Policies	6,849	11,446	3,489	13,135	81,683
% Housing Units with NFIP policies	12%	26%	4%	4%	43%
Insured Repetitively Flooded Housing Units	151	115	201	90	2,961
% Insured Repetitively Flooded Housing Units	48%	76%	78%	65%	59%
Median Value of Owner-Occupied Housing Units, 2000	$78,500	$139,700	$135,600	$87,800	$87,300

[49] The exceptions are Hanover County, North Carolina, which could be an issue of measurement since this includes the City of Wilmington, as well as the surrounding county, and the much larger City of Jacksonville, Florida.

To residents in the city, the flood issues make themselves known mostly during the summer, when rainstorms frequently immerse city streets and roads, making it difficult if not impossible to get to work or buy groceries. For City Management this is a serious issue: if a resident cannot get out, emergency vehicles cannot get in either. Because Savannah is situated on the U.S east coast, where hurricane systems frequently make landfall between June and October, this poses more complicated challenges. What if a rainstorm hits right before a major hurricane? What routes will residents use for an evacuation if all the streets are flooded? It is not without reason that City officials take the issue of flooding seriously. At the end of our field site visit, Jim and I learned that the city's flood mitigation public relations campaign had been part of the current Mayor's election campaign, and had resulted in a local sales tax (SPLOSH) approved by residents.

Figure 28: Savannah home flooded
(Photo courtesy of the City of Savannah)

Jim and I talked and drove around with the Savannah mitigation team for two days. We learned about some of the barriers the local mitigation program faced in trying to relocate people out of the floodplain through buyouts. On the forefront were issues that hinted at a strong sense of place. People had planned to retire here, were born and raised here, and had a strong sentimental and historical attachment to their homes. According to the team, the unwillingness to move was further motivated by issues of mistrust towards government officials: "They [people] see the city wondering if they can buy your house, and they immediately think they are going to be thrown out of their house." The managers explained that even when people did eventually believe that they did not have eminent domain power and had not come for eviction, the next barrier to overcome was just as severe: "they are thinking: oh the appraiser is just going to lowball the value of our house". Mitigation barriers, it seemed, were connected to social tensions that were part of the City's history, in which many minority residents had a high distrust of the intentions of government officials. It hinted to the importance of history in understanding current mitigation behavior; conservatism rooted in a certain sense of place. Indeed, a good part of our conversation with the Savannah mitigation team dealt with the significant influence of historical preservation networks organizing against buyouts or other invasive forms of hazard mitigation[50]. The lead mitigation official mentioned this in the context of the most recent FEMA mitigation (PDM) grant, dedicated to buying-out properties in the historical neighborhood Ardsley Park:

[50] Part of the barrier with mitigating historical structures lies in the requirement of historical requidation requests, or federal laws which impose careful documentation and archiving when historical structures are involved in flood mitigation. Apparently, an outside consultant and engineering firm called URS had gotten involved in this issue and had made the mistake of informing the Savannah Historical Foundation of FEMA's intentions to acquire and relocate a historical home. Yet, failing to involve the local mitigation team and bypassing their communication strategy, URS got the entire historical community up in arms against the mitigation project. To amend the situation, the local mitigation team had to engage in lengthy damage control with the aid of the city manager.

> Knowing we were talking about a historical neighborhood, we knew we really needed to know which houses to include. There is just no way you would be able to go into Ardsley Park and create a bunch of HAP [Hazards Abatement Program]. One, because it would destroy integrity of what remains. And two, so many of these homes have historical value, that in between the State Historic Preservation Office and the Historic Savannah Foundation, it just was not going to happen.

Still, the emphasis on historical ecological education, the strong influence of the historical preservation movement, and residents' historical sense of place seemed a unique contrast to the floodplain sites we had visited previously. It all made me wonder: Has Savannah's reputation for historical preservation been an asset for mitigation? Does an interest in historical preservation include a careful conservation of flood memory-networks, and attention to issues of temporal vulnerability to natural disasters? To what extent is Savannah an example of using historical ecological education to reduce temporal vulnerability? To learn more about this, I went back to the City a year later in October 2005 for a few weeks to interview a number of city officials, speak to some residents in a neighborhood called Ardsley Park, and do archival research[51]. I wanted to know: 1) how temporally vulnerable is Savannah, and 2) how has the depth of Savannah's historical identity alleviated some of this vulnerability? In the remainder of this chapter I will address these questions.

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[51] The timing of my visit came two months after Hurricanes Katrina and Wilma hit the gulf, and ten months after the Indian Ocean earthquake and tsunami which devastated many coastal areas. I was at the tail end of a hurricane season which had been the only one on record to have had two hurricanes reach Category 4 before the end of July, and the most storms to form during the month of July (five).

Figure 29: Emergency evacuation of elderly woman in the City of Savannah.
(Photo courtesy of the City of Savannah)

4.2. Why We Escape Nature's Wrath

"*Hurricanes: Why We Escape Nature's Wrath*," is the front-page title of an article in the Savannah Morning News by Mary Landers that stared at me when Jim and I visited the City of Savannah, Georgia, to collect field data for FEMA's repetitive loss study in October 2004. We were at the tail-end of a uniquely busy hurricane season (see Wikipedia 2007), and the headline came as no surprise considering the large number of displaced Floridians recovering from the devastations created by Hurricanes Charley, Frances, Jeanne, and Ivan. "Not that we were trying to tempt fate, but after yet another near miss of a hurricane, you gotta wonder what's keeping us out of harm's way," the author, Mary Landers, pondered[52] (Savannah Morning News 2004). What explains this staying-out-of-harm's-way phenomenon of this small coastal City? Based on an on-line poll of its readers, the Savannah Morning News article noted a number of local theories, the number one among them being prayer, certainly no surprise in the deep-south, and the less serious one perhaps being "unseen spiritual forces from the past that protect Savannah."[53] The scientific conclusion is perhaps more sober, and simply suggest that hurricanes seldom make a direct landfall in Georgia because its coastline is only about 100 miles long, slopes gently, and just does not stick out as much as those of North Carolina or Florida.[54]

"Savannah was usually spared the worst of the hurricanes because of its location 20 miles inland on a 40 foot bluff. Tybee Island was rarely so lucky, often receiving the brunt of the storms," write Dick and Johnson (2001) underneath a photograph of a destroyed coastal barrier island (Figure 30). Whatever the cause for Savannah's luck, taking a look at the historical record can provide a false picture if one does not dig deep enough. Local WTOC TV Meteorologists Patrick Prokop notes in a write up on the history of Savannah area hurricanes: "If you look at the history of hurricanes that have made landfall along the Georgia coast during the 1900's, you might ask yourself, 'Why all the worry?' Only three

[52] For the 2004 season, the paths of hurricane damage mostly spared Savannah, with the exception of Tropical Storm Bonnie, a relatively small system which hit land right before Charley took over the news. Bonnie had tropical storm-force winds extending only 30 miles (50 km) out from the center. Upper level shear weakened the storm, and Bonnie made landfall as a 45 mph tropical storm just south of Apalachicola, Florida on August 12.

[53] The latter is not an uncommon notion. Savannah's tourist industry has embraced the image of the haunted house as a key conveyor of the City's historical charm. On my way out of the City, I picked up an audio book full of tales of ghosts and haunted homes. Unfortunately, there was no reference to hurricanes, although it did certainly seem to rain buckets in some stories.

[54] Some reference has been made to the temperature of the coastal water, but there is little evidence for this claim.

storms have slammed into the coast in the past 106 years (1900-present)! Is there a need to be concerned?" (WTOC-TV 2006)

Figure 30: Devastation on Tybee Island after the Hurricane of 1906 (from Dick & Johnson 2001).

Apparently there is. While only three weak storms hit in the 1900s, twelve such storms produced havoc for the developing coast during the 1800s, which in many cases were much more fierce, and certainly suggesting the spirits might have been hiding in the swamp with fear in those early days. The NOAA scientists Sandrik and Landsea (2003) provide a detailed overview of the major hurricanes, those which are category 3 or higher, affecting Northeast Florida and Georgia from 1565 through today. They conclude: "Most notable [from this figure] is a relatively even spacing with respect to major hurricane events during the early decades of the Nineteenth century, with a sharp increase in Major events during the 1890's followed by a absence of major events during the subsequent century." They remark that it is especially in this later period that significant population growth in the study area and a low experience level with major hurricane events can be seen. NOAA's online "Coastal Population Tool" is precisely set up to make this point for many of the U.S. east coast areas. Based on baseline data gathered by Jarrell et al. (1992), the tool graphs population change by decade for the period 1900-2000 and specifically charts hurricane strikes (1900-2002) by their category of fierceness according to the Saffir-Simpson Scale (USA-Today 2005). As the authors report: "While many people have experienced fringe conditions of major hurricanes or the direct effects of a weaker hurricane, only a relatively small percentage of the coastal population has experienced a direct hit by a major hurricane" (1992). Unfortunately, the hurricane and population data used by NOAA do not go further back then 1900. When I added the results found by Sandrik and Landsea (2003) and historical census data from the Census of Population and Housing, the result is a striking pattern which suggests not only that people have not experienced a major hurricane in Savannah, but also that the possibility of this occurring, based on historical records, is actually not that unimaginable. The result is shown in Figure 31 below. What this image conveys is a message of macro-level temporal vulnerability: while population has increased dramatically over the past 200 years, the proportion of residents with major or even minor hurricane experience has dramatically declined due to the random temporal distribution of damaging flood events. When one thinks in terms of generations, there are probably very few if any residents still alive in Savannah who experienced firsthand the major hurricanes of the 1890s. When one consults the elderly, their knowledge base would refer at the most to hurricane events in the 1920s.

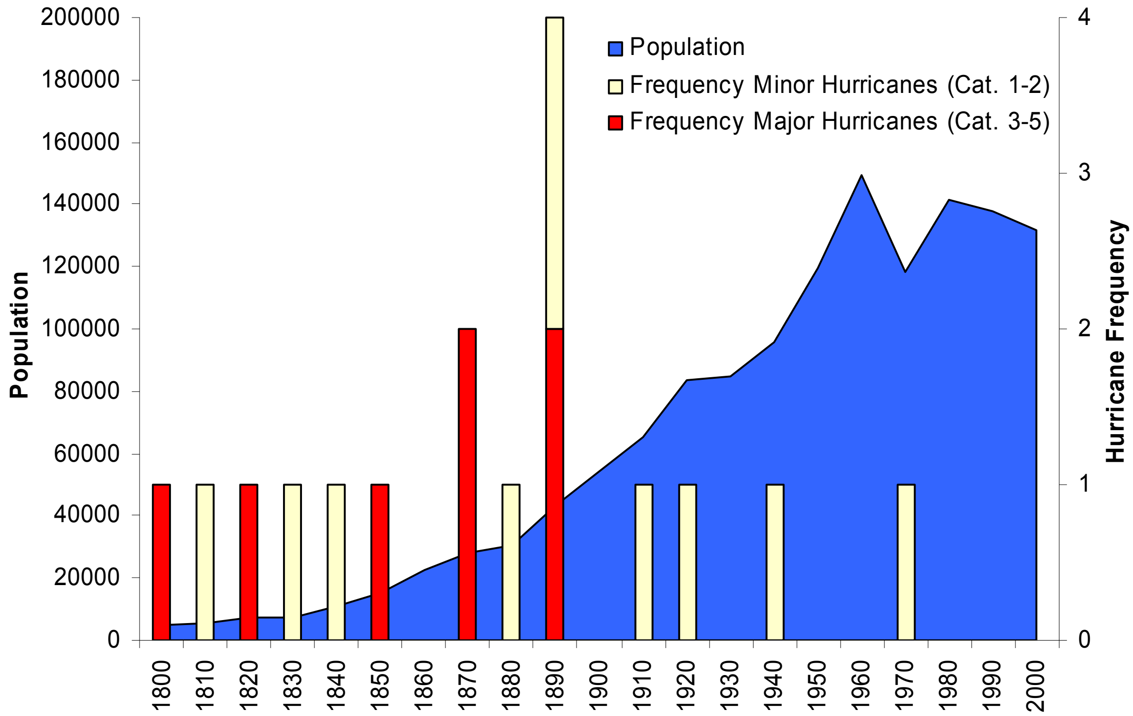

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Figure 31: History of hurricanes in Savannah relative to population growth

As it stands, the last minor hurricane to actually make landfall in the greater Savannah area was a minor hurricane called "David" in 1979 (September 4)[55]. Any of the professionals entering the workforce in their thirties today would barely remember this event. As a result, when it comes down to emergency preparedness—evacuation, early warning, mitigation, etc.—it can be argued that the general population lacks understanding of the damage which a major hurricane can do to their living environment. According to a State level emergency management official with whom we spoke who had been with the City for over twenty years,

[55] One good friend of mine—a Savannah native—told me that he remembered seeing his neighbor's fence flying into the sky. It was intense, but not devastating.

the coincidental lack of major impacts for more then 100 years eventually will cause a serious issue of surprise for many residents when a major event does hit:

> If you look at the hurricane history between 1800 and 1900, you will find that Georgia had more than its fair share of major hurricanes, but nothing since. Obviously that makes it a challenge locally for emergency management offices throughout that area to keep on preaching we have a hurricane threat. And they can see the news and see this is what one of these things can do. All we can do is just be thankful. Most people think it is going to go some place else.

These risks go beyond flooding, and include the problem of a hundred years of unbridled tree growth which will cause major damage and power issues for a lot of homes after they fall. In other words, when seen from the macro-scale, the population of Savannah could in fact be extremely vulnerable to surprise; there simply has been little opportunity for learning in past generations.

When there are few opportunities for learning due a lack of feedback, the cultural implication is a growing complacency; a feeling of contentment or self-satisfaction, especially when coupled with an unawareness of danger, trouble, or controversy. As an answer to this problem, education is one of the few means to sustaining vigilance. While Jarrell et al. in their original paper on hurricane experience do not label this situation in terms of vulnerability, their motivation for the development of the NOAA tool rests with the same issue: “It is hoped that the information in this paper will help coastal residents and disaster preparedness groups to substitute *education* for hurricane experience.” [italics added]. While the immediate causation for the temporal distribution of Savannah’s hurricane impacts is stochastic or random, the consequences of this temporal situation are not random, instead showing an increasing need for a definite planning strategy. Perhaps it is because of this need to balance growing complacency through historical ecological education that the Savannah

Morning News article ended up on the front page. The point made in this article is that whatever the cause for Savannah's luck, the City eventually will be hit, and residents better be aware. As one respondent to the on-line survey is quoted: "Maybe it is the old curse of Savannah, that it always remain the same, or maybe the weather just wasn't right. I do believe, however, that we will be hit with a large hurricane soon, and the complacency of Savannah's residents will be in for a major shock." [sic.] (Savannah Morning News 2004:4A).

This temporally vulnerable situatedness of the City's population has not gone unnoticed to the disaster entertainment industry. In a television series called "It Could Happen Tomorrow" which premiered on January 15, 2006, the possibilities of various weather and other natural phenomena severely damaging or destroying America's cities is dramatically exploited. One of the shows profiles Savannah precisely because the area has been spared repeatedly from hurricane damage. Landers quotes Terry Connedly, senior vice president and general manager of the Weather Channel:

> Savannah's story is one of defying the odds and near-misses, by Hugo in '89 and Floyd in '99, and a resulting feeling by residents we talked to that they're more or less 'hurricane proof,' ….. Emergency managers and hurricane experts featured in this episode say the city is vulnerable to a potential land-falling hurricane and that complacency puts a large part of the Savannah populace at great risk because ... It (really) Could Happen Tomorrow. (Savannah Morning News 2007)

In the show, complacency is emphasized as the result of this temporal situation, despite the grave impact of the most extreme hurricane scenario. As the show points out, many residents appear to lack proper evacuation plans, while a bad storm could produce $30 billion in direct economic damage, leave 200,000 area residents homeless, and kill up to 3,000 people. That said, the macro-level temporal vulnerability of Savannah might have been attenuated after

Hurricane Katrina hit the Gulf States. For example, the Associated Press noted in June 2006 that after the event more than 2,500 Katrina evacuees fled to the Savannah area (Associated Press 2006). The local Red Cross chapter doubled its active volunteers from 130 before the storm to 260 entering the hurricane season beginning June 1. As such, an increase in experienced emergency services workers can be seen. The Associated Press quoted John Wright, emergency services director for the Savannah Red Cross on the Georgia coast: "and that experience matters, as much as the numbers."

In summary, complacency might be an important cultural characteristic of the Savannah situation. What has been the consequence of this situation? How has this influenced the landscape?

4.3. Flood Mitigation History

Figure 32: The Hurricane of 1898.

> Storm water runoff in Savannah is hampered by flat terrain, low elevations, and tidal influence from the Atlantic Ocean. These are major natural factors, common to coastal regions, that cause the City to be at risk for flooding during long periods of moderate rainfall or during high volume, short duration rainfall events. As a result of these factors, structural flooding has occurred in the City. Flooding during major storms and hurricanes date as far back as 1871 and as recent as 2003. (City of Savannah 2007)

Thus reads a prominently placed online City of Savannah informational brochure on the history of flooding. Testament to the forces of nature, the image provided is also one of historical knowledge, referring "as far back as" 1871. Yet, listening to the city officials themselves, both the causality of Nature and historical knowledge are challenged. According to the mayor, it was an error in human decision-making for city planners to urge spreading out from the high bluff without adequate flood mitigation planning. Another historical mistake was to combine the use of the underground piping system for sewage and storm water, which in fact prevented the City from quick remedial actions to control flooding. As the Mayor indicated, residents and planners must have had some knowledge, but invaded the swampy territories anyway:

> I don't know if people knew what a floodplain was, but they knew it was low, and took advantage of the land anyway. Then as the city continued to develop we got these rains, a lot of rain, and the water does not run off. A lot of paving. It ponds. Then again, historically, we had a sewer and drainage system all combined into one. One of the big challenges was to separate the storm water from the sewer. That took a tremendous investment. In the early development of the city we had all these things that did not take into account nature. So, it comes back to bite you. So now we see the price for not having good planning in the early days.

Adding detail to the story, the City Manager explained that in the 1830s the City council made the conscious decision to engage in rice farming in the wetlands, encouraging filling of the land. Archival records show that with regard to the expansion of the City itself, the early street railroads were seen by then-city-management as important opportunities to move capitalist investment southwards into the bottom lands. The push for this development was seen as necessary to counter the crowded conditions of housing deemed unfit for a true "European style" settlement to which the City aspired (Savannah Morning News 1869)[56]. An

[56] "Now that the street railroads affords a speedy means of communication between the extreme northern and southern sections of the city, we hope to see an impetus given to the building of houses on the lots now lying

archival reference from 1877 suggests that the first governmental organization of a drainage network started in this period with the initiation of the "Commissioners of Drainage," funded by the Central Rail Road and Banking Company, and focused on the ditches next to the Springfield Plantation (Committee on Drainage 1877). However, the initial impetus for the drainage network was not related to flooding, but instead to the prevention of diseases such as malaria and the dreaded yellow fever.[57] The latter had been brought to the area through West Indian trades and had found a ready vector in the many mosquitoes breeding in wet rice fields that surrounded the City in its early days. In 1820, yellow fever had a chance to spread after the town was partly ruined by a destructive fire after extraordinary summer and winter rains. The yellow-fever epidemic killed one-third of Savannah's population, including black slaves, and shrank the City's population from 7,500 to 1,500 (Waring 1968).

Early on in its development, the City constructed canals to carry off storm water, and over the years these canals were supplemented by drainage ditches of various capacity to help hold down the flooding (Drainage Improvement Task Force 1987). Throughout the century, this system of canals and drainage ditches reactively helped prevent some of the flooding. When the first suburban areas outside of the downtown core were developed in the

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open in the southern part of the City. A fine opportunity is now given to give to Savannah an appearance of beauty which it has never before known, by the building of handsome cottage houses out in that section…… houses which shall suit the pecuniary resources of a class of people who are not by any means wealthy, but who in point of respectability, intelligence, rank with the best. At present, such persons have either to adopt the tenement system, and live two or three families in one house, or else take refuge in a boarding house, the small houses which do exist in Savannah being nothing to brag on, many of them being scarcely fit to live in, and by no means respectable in appearance. In every city, both in the Country and in Europe, will be found most such houses as we have spoken of –frame cottage erected in a neat, tasty, and handsome style, affording accommodations for medium sized families " (Savannah Morning News 1869).

[57] The Committee on Drainage writes: "Parties appropriate as a special from mission: Thomas, Wheaton, Casey, Yilmer to carry out the provisions of "An Act" by the General Assembly of the State of Georgia, and the same approved by the Governor February 28 1877. The caption of said "Act" being as follows: to provide for the drainage of Chatham county, so as to protect the state against epidemics of Yellow Fever and other disease and to appropriate for said purpose one third of the State tax of said County form the year 1877" (Committee on Drainage 1877)

1920s, fueled by the automobile revolution and the City's economic prosperity, drainage pipes and culverts were an included feature. The upper class neighborhood of Ardsley Park illustrates this. Developed in 1910, the neighborhood became an architectural example of the renewed local interest in integrating urban parks in residential settings[58]. However, flooding occurred frequently. According to authors with the Historical Savannah Foundation, records noted that "the land as you went out Abercorn proceeded to get lower and swampier" (Lattimore Reiter 1978). Considering this, and the importance of this first and upper-class automobile neighborhood, it is striking that in Ardsley Park and many other early suburban neighborhoods the diameter of the pipes in the culverts often were inadequate to handle frequent rainfall events[59]. As an informational leaflet from the city suggests:

> At the time of development, engineers and builders believed that pipe sizes would be adequate to handle a 1-2 inch rainfall. As you know, we frequently have rainstorms of 3-5 inches which directly results in extensive flooding of homes, cars and property. (City of Savannah 2007)

According to the current City engineers, Ardsley Park's drainage system "today operates precisely at its designed capacity" (City Engineer 2005), yet this capacity appeared insufficient by today's standards.[60] Why did early planners build to this capacity? Does it

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[58] The developers of Ardsley Park deliberately place a series of parks which in their words, were 'in the center of blocks and do not obstruct direct traffic in the streets. They can never be run through by streetcar lines and fronts of lots face parks on all sides' (Lattimore Reiter 1978).

[59] This situation in fact appeared to have persisted until quite recently. According to Steve Bacho, a Chatham County staff engineer, this lack of adequate pipe sizes might have had something to do with a lack of adequate design guidelines until recently: "there was no real design established 20, 30, 40 years ago," he said in the article, "when the pipe is small, everything backs up behind it." (Savannah Morning News 1997)

[60] Speaking of Ardsley Park, the city engineers explained: "That design can handle a 2 year event, with ponding in the street. So, if it got like in one hour 2.2 inches of rain, that is a 2 year event, water would stand in the streets for 2 hours. And that is exactly what it does. That system today operates at its designed capacity." (City Engineers 2005). They had given me a sheet of paper with calculations about how the intensity and duration of rainfall events translates into a return period (in years). From this, one can see that such an event—if it occurred for about one hour—would be a one to two year event. In other words, the size of these pipes were planned to anticipate the prevention of relatively common events predicted to occur every one to two years, but excluding anything slightly more rare (like the same event for two hours!).

signify an historical under-prioritization of flooding and drainage issues? Maybe, as suggested by the combined use of the pipes for sewer and drainage as well as the original pre-occupation of planners with drainage not for flooding but for the control of water-borne disease vectors. But when going to the trouble of building pipes, certainly engineers could have built them slightly larger, anticipating larger rainfall events that occur at a slightly larger temporal scale. What is of interest to me, looking at temporal vulnerability, is to what extent this notion is motivated by a lack of knowledge about the history of flood events or, in other words, insight into the recurrence period of events, "real" probabilities which affect the Savannah landscape. Could it be that when the urban engineers calculated their needs there was a lack of adequate engineering knowledge about history of rainfall intensities and frequencies? The drainage properties of newly colonized landscapes might not have been so well known as that of the City center, thus creating a condition of potential surprise to residents inhabiting the newly conquered suburban landscape. However, it appears that some of the top extreme precipitation events in Savannah were in the early part of the century. According to the Charleston SC National Weather Service Forecast Office, of the top 5 list of climate extremes for Savannah, GA the two of the Greatest 1-Day Precipitation Events (inches) were in fact in the late 19th century, while the rest was before the middle of the 20th century (NWS 2007), as shown in Table 5.

Table 5: Top 5 list of climate extremes in Savannah Georgia (source: NWS 2007)

Rank	**Year**	**Rainfall Extreme (inches)**
1	1924	9.02
2	1872	8.57
3	1950	8.47
4	1871	8.12
5	1944	7.85

What this suggests is that at least since 1924 planners and engineers might have had ample opportunity to realize that extreme rainfall is possible. An article in the Savannah Morning news quotes a Chatham county engineer who, in an answer to the pipe size issue, suggests that there simply was "no real design established 20, 30, 40 years ago" (Savannah Morning News 1997). Aside from the fact that the pipes in Ardsley Park were laid down 80 years ago, did these early engineers just randomly lay down pipe without considering size?

One explanation might be that "design" might have meant something quite different to the people of the early 20th century. To them, 2" pipes might have been more than adequate protection. The Savannah City Manager seemed to suggest to me that the pipe size issue instead has everything to do with changing expectations.

> This is what it looked like in the late 1800s. That is the point when so-called planners and engineers come in. And, I think there were many knowledgeable people, but their understanding of risk is radically different than ours. My guess is that storm and flood events were part of their lives.

To him, changing expectations were still at the core of some of his struggles dealing with the public, who in his words had lost the art of patience and acceptance of Nature and how it impacts our daily lives: "You know, God has been bringing a bunch of rain this afternoon. Let's just all relax a little bit and be patient. Oh no, there is no relaxation. Every single person is upset about it." One resident in Ardsley Park with whom I spoke—Diane—illustrated this same notion by speaking of southern coastal culture in her youth. She had been born and raised in Savannah's Ardsley Park neighborhood, the first automobile suburb of Savannah. She said:

> Savannah always had a coastal flooding problem…..It is part of the culture. You grow up with it. Just like if you live in Savannah you will have mosquitoes. You will have humidity, it will never slow. It is just what you live with and what you know. Part of this… we have these people move in that can't accept it, who don't understand it,

> who think we are a bunch of rednecks down here and it is flooding. 'Why don't you all just fix it!?' Because it is just the way it is! You know.

While changing demographics and culture could explain the small pipes, another explanation for undersizing of the older drainage systems might be related to changing climate. Generally, climate scientists agree that precipitation has increased in North America over the past century, as shown in Figure 33 (Karl & Knight 1998; Kunkel 2003)[61].

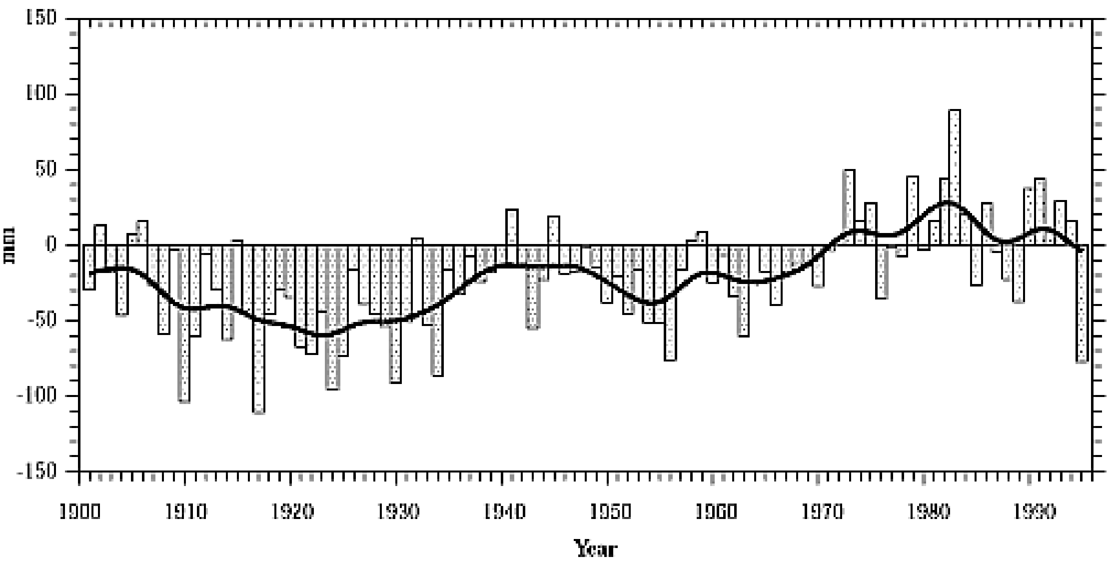

Figure 33: Precipitation anomalies from the 1900 - 1990 with moving average (period unknown) (from Watson et al. 1997)

In their report on the regional impacts of climate change in 1997, the Intergovernmental Panel on Climate Change (IPCC) published a graph of the conterminous U.S. precipitation trends for 1900-94 (converted to %/century), centered within state climatic divisions (Watson et al. 1997). Shown in Figure 34, the trend magnitude for each climatic division is reflected by the diameter of the circle. Solid circles represent increases, and open circles decreases. What can be seen is that the geographic distribution of this increase fits with the State of Georgia, where a 10 to 20 percent increase of rainfall is observed.

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[61] For example, the climatologists Karl and Night (1998) found that since 1910 total precipitation, including its frequency and intensity, has increased by about 10% across the contiguous United States, with 53% of that increase reflected in more extreme events (in the upper 10th percentile of precipitation events).

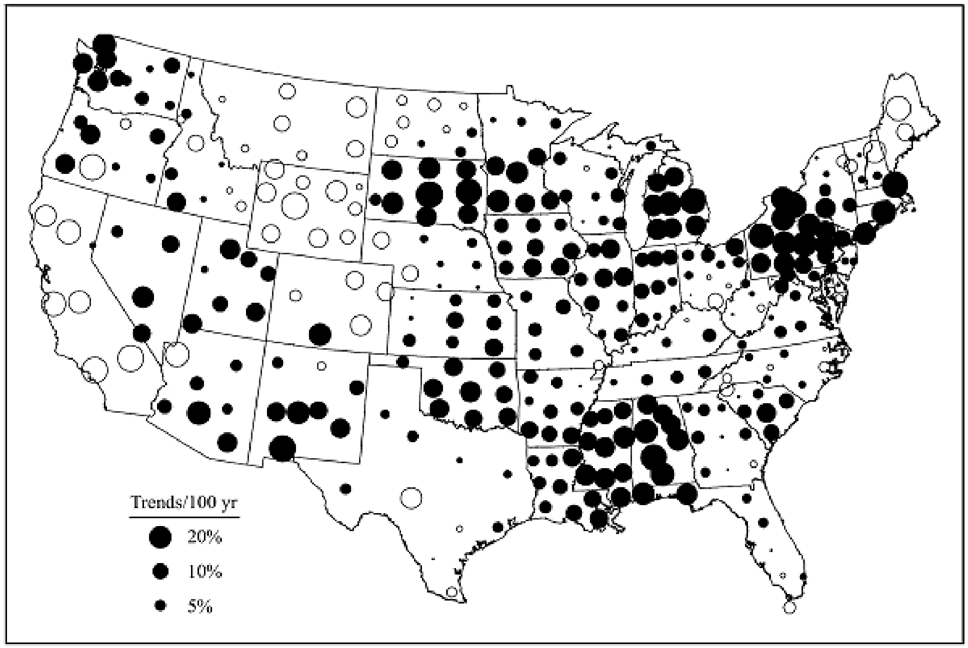

Figure 34: Rainfall trend magnitude for each climatic division, with solid circles representing increases and open circles decreases.

What this suggests is that when it comes to climate, it could have been that planners in fact might have laid down adequate drainage system for the early suburbs, but that this was based on a climatic normal reference of the early 20th century, and not today's norms.

The contrasting explanation is that in the name of modernity and progress, development might have trumped environmental protection and mitigation. One such impact of the modern way is the building of automobile suburbs such as Ardsley Park. Diane explains how, in the early days, many of the cross-streets of the neighborhood were left unpaved. She argues that when the City started paving more and more roads to allow automobile traffic, the drainage issues worsened because the natural drainage was blocked. Diane remembers the neighborhood filled with dirt roads, with drainage culverts that were deeper, and with less development surrounding it:

> We used to have nice deep curbs; six to eight inches. And they have paved and paved so now the curb is 1.5 inch tall. When we had the curb it channeled it to the drainage. You get rid of the curb it overflows. …When Ardsley Park first was built, the pipes

> worked, the curbs worked. These forefathers were pretty smart; they figured out these cross streets are natural drainage. The folks who lived here beforehand did not have the same problems as we do now.

Maybe Savannah's forefathers had planned correctly, but what they had not anticipated was the push for development sustained by private interests, which seems to have dominated the history of City planning in many U.S cities. As some city engineers describe it, it wasn't until the federal mandated FEMA guidelines came into existence that flood mitigation improved somewhat:

> The City brew…more pavement. And back in those days we did not have anything called detention of retention. You just went out and built a mall, paved two or three acres, and the water just went on the street. It wasn't until the 1960s that we started to write developmental ordinances. Some came with FEMA; the floodplain maps that came in the 70s nationwide.

Thus, it seems that previous to the 1960's but perhaps after real suburbanization started, flood prevention and reduction projects had not been carried out under any clearly-defined policy directive for the quickly sprawling city environment. As the City Manager explained in a 1997 Savannah Morning News article, this push for development "was allowed because it was historically allowed" (Savannah Morning News 1997). The first effort to establish a comprehensive program to prevent flooding was devoted to new developments that were part of City growth starting in the 1960s (City Drainage Task Force Report 1987)[62]. "We had to work through the conflict of private property rights versus what is in the interest of the general public," the City manager explained in 1997 (Savannah Morning News 1997). At the same time, the flood insurance program that motivated this planning, including federal

[62] To accomplish this objective, the City enacted a comprehensive subdivision ordinance in 1960. Under this ordinance, developers were required to analyze drainage conditions in a proposed subdivision and to design and install drainage facilities needed to carry off stormwater before flooding occurs.

coastal zoning regulations, had the unintended consequence of actually increasing the value of properties in the coastal zone, attracting more residents into flood-prone situations.

The uncontrolled growth was also mirrored in a structural lack of control and oversight that plagued City finances through much of the past century. In the first half of the 20th century, an ineffective form of government existed in which executive authority was dispersed among standing committees of City Council. Often, these committees functioned completely independent of each other, and the lack of coordination eventually ruined the financial health of the City. The result was a dire financial situation that continued to exist up to the point when, in 1953, a national consulting firm in Public Administration and Finance sounded the alarm bell. The consultancy published a report declaring that the city had been ‘in the red’ since 1923. In fact, the debt was so severe, the consultancy predicted that the City would remain in debt until 1982. They wrote: “In a lifetime of work with municipal governments, the authors of this report have seldom encountered a city that has allowed its finances to sink as low as that of the City of Savannah” (Anderson 2004).[63] While it indeed took the City 30 years to recover after overhauling its government system, when finally it paid off its debt in the 1980s, the first environmental priority was the building of an federally mandated waste water treatment plant. Additional drainage projects were restricted to lining canals to control erosion, but neglected to address the structural and historical drainage issues that plagued many of the historical neighborhoods in the City. The price tag of a comprehensive mitigation strategy—$50 million—remained beyond the reach of City

[63] “Decades, and apparently generations of reliance upon borrowing to finance expenditures in excess of revenues have brought the City of Savannah to a state, which for any commercial or industrial organization, would long have forced it into bankruptcy.”… “Continuous operation on this basis is unthinkable, even if, at ever increasing interest rates, the city should be able to borrow enough to keep it going.” … “The city has mortgaged its future so heavily and for so far ahead as to endanger that future unless drastic steps are taken to change the trend and to begin to reduce its indebtness, instead of increasing it” Anderson (2004).

council, even though commitments to address the issue intensified, as evidenced by the city's commitment in 1983 through 1988 to use City funds to address the flood problem, and the establishment of a Drainage Improvement Task Force in 1987.

What this review of the historical context of flooding exposes is that perhaps the existence of flooding in many of the older suburban neighborhoods simply cannot be explained by arguing that the original engineers might not have had any knowledge about history. Perhaps complacency was not as prevalent in the early days, and only received its primary motivation during the modernist push for development which ignored needed mitigation planning during a period of little flooding. As the previous Mayor noted in a quarterly report:

> Couple Savannah's terrain with the ocean tides, an aging drainage system, growing population, and rapidly expanding development, and it becomes clear why parts of the City tend to flood during heavy rains."

4.4. Memory Networks

Returning to Savannah, I enthusiastically scheduled time at the historic Savannah Foundation. I contacted the city archivist to set up appointments. I rolled up my sleeves to get going and dig up the history of drainage, flooding, and the impacts of the preservation movement on the City in an attempt to illustrate the coordination of historical preservation and mitigation. But, my Commission for Drainage trail ended in the late 1890's, while additional information was limited to a few articles only peripherally addressing drainage history in the City. At the City Archives, I was unable to find anything after 1928. The last information from 1928 concerned a special committee set up to investigate why the costs of the sewerage system had become so high. The drainage trail I had followed had indicated a concern by residents and the committee about the building of canals, drainage ditches, sewerage systems, and included also a series of protest letters and citizens' petitions against the paving of streets. While Diane noted that the paving of cross-streets increased flooding in Ardsley Park, none of the 1926-1928 objections directly referred to issues of flooding (Committee on Drainage 1925)[64]. Concerns seemed motivated by taxation costs and the increase of traffic as a result of paving, including hazards to children, congestion, and an increase of dust[65]. It wasn't until 1955, one year after the dire financial situation was revealed by an outside contractor and a new Council Manager system of government was introduced, that the archives again hosted annual reports, which mentioned the investment of the City in drainage and sewage systems, still second however in priority to street paving. With information about flooding and drainage disappearing from the archives during the budgetary crisis-days of the City, did this leave a hiatus in institutional memory? The disconnect returned to me in interviews with the City Manager. I asked him what had surprised him in his experience over the years with respect to flooding:

> Probably the surprise I suppose is I think is that peoples memories and their knowledge was completely out of sync with some of the realities of the problem. Some people did know that. Old timers knew this neighborhood flooded since the 1920s.

[64] The typical explanation is exemplified by this 1925 reasoning in relationship to East Broad Street: "The ground on which request is made that this paving not undertaken just now are: (1) Parts of this street have recently been, from Victory Drive northward, put into good condition, (2) the recent paving of streets just to the west and east of East Broad give relief to traffic north and south, (3) a large number who would be affected by the expense of the proposed project are already burdened with paving bills for their places which face east-and-west streets, (4) and we understand that there are a number of streets in other sections of the city which just now are in much greater need of permanent improvement from almost imperative demands of traffic. It will be noted that EVERY property owner between Victory Drive and 39th street signed this petition, except for one" (Committee on Drainage 1925).

[65] These street paving protests concern, among others, Reynolds, Waters, 33rd St. 42nd St., 44th St., 48th St., 49th St. Randolph, East Broad, Habersham, Harmon, etc. In many letters, people simply seem to think the paving is "unnecessary," particularly in non-sandy streets[65]. One letter, from a Mr. Graves in 1926, suggests that "The majority of the families, in moving out in this part of the city, wanted to get off of a paved street and race track," indicating their preference for a quiet place to live (Graves 1926). One Harmon Street protest petition, however, does suggest issues of soil and problems with pavement (October 2nd, 1929). According to the petition, Harmon Street property owners signed it because in 1911 Harmon street was paved from Gwinett to Wheaton and the abutting property owners were assessed a large sum for this, yet "very shortly after the above paving was laid, the paving blocks began to sink and settle in places, and the paving has been giving trouble ever since." What kind of trouble, unfortunately, is not mentioned.

The manager explained that to the City's leadership, this community memory lingering among old timers is a very important asset in keeping this type of understanding alive.

> There is a certain level of community knowledge about the risk that they face, and there are old people that understand those. Young people have to learn about those. And that that is where I think community history comes in. If you go through a period of time in which there are no major flood events that heightens the risk. Because people who build and develop lose that sense. People who move in that area and buy a house lose that as well.

When I asked them about the role of mandatory disclosure of flood histories during the purchase of a home, the officials note that this disclosure is really fairly weak, especially when the buyer is looking at the house on a nice day during a period of relative drought:

> The realtors will fudge it. We have one house now which is the most flood prone highest value house in Savannah. We told the buyer this is questionable. But the realtor just emphasized all these improvements the city has done!

The City Manager notes that this emphasis on civil engineering is set within the context of increasing expectations of the City as a protector. Yet, at the same time, the lack of community memory with respect to floods that have occurred in the past causes a situation in which the City has to strategically explain what engineers mean, and how this reality influences the realty of residents on the ground.

> They tend not to believe engineers because they tend to talk in engineering terms, which are cautious and moderate. There is nothing wrong with that, but we had to restore memory and build knowledge in a way that was crystal clear, graphics, with photos and maps, topographic maps and so forth. And then face to face. You can't just blow people over with graphics. 'That is pretty slick, but I still don't believe you.' What I had to do is to show that I have personally… and very intimately, if you will, gotten involved with this issue, so that any question they ask I could calmly and helpfully elucidate for them.

Thus, dealing with the lack of generational memory, engineers and city managers had to find ways of translating the flood issue to the general public in understandable ways. This form of strategic historical ecological education is the essence of their strategy:

> My point is that people's collective memories and history had to be brought rapidly, I almost say violently, rather harshly brought into sync with the reality of the risk that they faced. So, it was my job when I came back here to work with the engineers and with city council and with residents to say, okay now, let us understand this thing physically and historically. Maybe our predecessors made a lot of mistakes, maybe they should not have built here as they did, but we have to go deal with that reality. We need to make… improve… come up with an overall strategy to lower the level of risk we face.

But while he addressed this, it appeared that lack of flood and drainage memory among residents was reflected in a similar lack of institutional flood memory among the city administration itself. It was this lack of official memory which led to the initiative of historical ecological education:

> Until we knew it! Until we dug into the records, we did not know. So, I guess what is most surprising is this lack of knowledge of the history and topography and where we are actually living. That was a surprise. So, what we had to do in a compassionate way, with a lot of empathy, is to say… well… and then we began to dig into old newspaper accounts, talk to people who were there. And they said, as a matter of fact, Ardsley Park flooded since the beginning.

Officials learned to their surprise that one frequently flooded neighborhood used to be a holding pond for canal boats. When the canal fell into disuse, the locks were abandoned, and over time the neighborhood got filled in. Fifty years later houses got built. Subsequently, the main result of this radical transformation of the landscape from swamp to suburban sprawl has obscured the fact that the City was built in what originally was a tidal swamp. Illustrating his point, the City Manager gave an example of Baker Street. The city manager explained that after they dug out old topo-maps from the earliest days, they learned that the neighborhood was a tidal marsh: "Baker street in 1700 was a full tidal saline swamp. Now there are houses there. We got the maps to show what it looked like in the 1760s." The historical research conducted by city management helped to show that the houses and streets with the most flooding directly corresponded to the locations of serpentine tidal streams that were in the area prior to development. As such, historical ecological education became a strategic asset within the mitigation program, in particular those cases where lack of memory combined with new landscape developments.

The institutional lack of flood memory was further deepened by the struggle among the city's engineers to actually collect accurate flood data over time (see Figure 35). When I spoke to the drainage engineers in their industrial park office, filled with drainage maps, Don and Billy explained that the flood data they had used for their planning and public communication only extends back 20 years.

> Our data collection, where we beefed up our effort, goes back to 94. When we really started to keep track. In 94, we started putting together a structural flooding database. So every storm event we track by address.

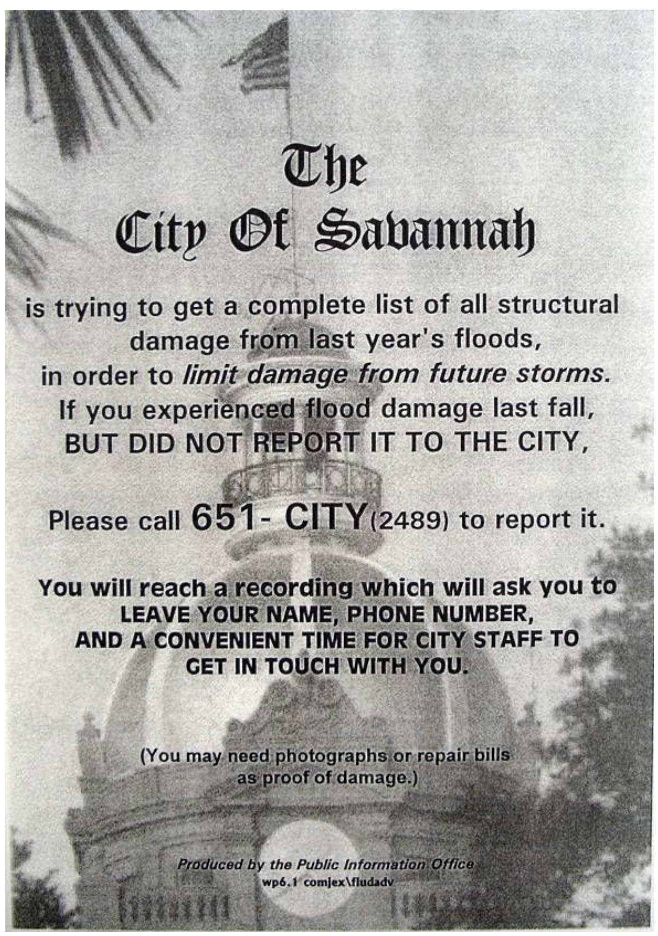

Figure 35: March 1995 request for more information about local flood damages.

They explained that while some records existed from what happened since 1982, they had not had an opportunity to extend their information back that far.

> I remember as a kid the street I lived it flooded and it still does. We have not gotten there yet. And that is back in the 40s and 50s when I lived back on that street. But, you just got to... keep working at this stuff and eventually you get it done. But the record keeping is what you have to do.

The problem lies in evaluation. Statistically one needs a good length of time to calculate flood probabilities, or, to provide an extreme example, one cannot evaluate a 100-year storm using three years worth of rainfall. The additional problem the engineers had is that the historical time-series of rainfall data made available by the weather bureau at the Savannah airport was not accurate because of the spatial micro-climatic diversity of the coastal zone.

> I think there is a lack of institutional memory with the way the data is collected. George Carlin always did this joke, there were five inches of rain at the airport, the question is were you at the airport? That is a real thing, because we have the airport, about 10 miles west of here, has an entirely different set of microclimate. Ten miles closer where we are, the airport is 20 miles from the ocean, and every mile closer to the ocean you have a greater risk of classic summer time storm. Especially when you have weather systems coming across that hit an urban heat area, which is extremely hot, so this natural tendency for coastal rainstorms is modified. And people might not even know that!

In response to this problem, Savannah engineers put up a system of 25 electronic rain gauges in an effort to show that there are and probably have been micro-storms in the City for a long time. Able to pull up how many inches it has been raining over the last minutes anywhere in the city, they learned that the weather channel data provided by the NOAA airport facility provided an inaccurate description of events in Savannah. As the city manager, in charge of mediating public perception with engineering reality, put it:

> Yeah, I will watch the weather channel, based on NOAA, or whatever, and they say there were 3 inches in Savannah. Well, we may have several rain gauges in Savannah that got 7 inches of rain. So, people go, 'we don't understand that!' So, what you have to do is say it is possible depending on your exact location. Downtown could literally be dry, eight miles away, on the Southside of the city they could get 3 inches of rain

> an hour. That lack of knowledge by people, all of that had to be synchronized, brought together, so you can begin to explain to people why is it that your neighborhood would flood and another did not.

In addition to the gaps in archival drainage data and the inaccuracy of rainfall time-series due to microclimates, the temporal complexity of Savannah's floodplain landscape has one more hurdle to overcome: inadequate floodplain mapping. When we spoke to the Georgia Hazard Mitigation Officer, he explained that for the City of Savannah no Floodplain Insurance Study (FIS) had been conducted. This means that the requirements for determining to what extent a property is in the floodzone are unclear. The temporal dimensions to this is implied by the temporal claim which floodplain maps make:

> The City of Savannah has no A-zones, which means base-flood elevations are determined, but they have not determined the 10-year flood elevation, the 100-year flood elevation, the 500-year flood elevation, and the associated flow rates that go with them.

To the FEMA state official this situation translates into an increased programmatic difficulty in calculating FEMA's "Cost-Benefit" ratio. The Cost-Benefit calculations take into account the benefits of relieving the national insurance program from covering a property with a certain expected flood frequency and depth of flood damages, relative to the costs of the actual mitigation. The flood frequency is based on historical data and floodplain maps and this data is lacking in engineering studies and support. As a result, these calculations are done on the historical losses that the City has recorded, which as we know have only recently been archived since 1994. For the Georgia official, this means making assumptions which fall on deaf ears at the regional level, where funding decisions are made[66]. On the ground, however, the conclusion is another uncertainty in the temporal landscape due to the relatively uncertain

[66] The Georgia Hazard Mitigation Officer said: "And sometimes even deafer ears at FEMA Headquarters. I don't think they understand some of their policies on benefit-cost and trying to aggregate benefits."

temporal characteristics of City parcels and the properties built upon them.[67] According to the State Hazard Mitigation Official:

> When you look at land use in the next 30 years, is that an area you want to keep clear? So, it just happens that Savannah has a lot of canals, low areas, and they have allowed development to occur, although most of that is pre-FIRM, 1950s, and 60s, some 70s, but not much. It is all built before floodplains were mapped. But even now the City needs an updated map.

4.5. An Unlikely Series of Unique Events

At the end of one of our interviews with the mitigation team, Doris—the team assistant—remarked on an issue directly related to temporal referentiality, namely the notion of a fluke event:

> I think the 99 event was just so extraordinary, and had just not been experienced prior to that, that people were thinking, 'Oh it is not going to happen again." [And] we really did not have anything after the 99 event.' And as time goes on, people get partly complacent about it.

Doris referred to the 1999 events as if it was the most recent flood benchmark, which in the minds of the people was just too abnormal to be seen as a "real" standard of comparison and basis for their risk judgments. Recent flood history, Figure 36 below, shows that, according to the repetitive loss data, the property damage from the 1999 flood was indeed more than any other flooding event, including hurricane/tropical storm or severe thunderstorm events[68]. Yet, the damage for 1999 is not so abnormal as to suggest that the event is clearly distinguishable from the 1996 and 1994 flood events. In fact, together this series of events

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[67] It is no coincidence that most of the properties which flood are the ones built before floodplain mapping was implemented in the 1970s. Floodplain maps are planning tools used by developers to build to code, relative to temporal expectations.

[68] Data from the Spatial Hazard Events and Losses Database for the United States (SHELDUS) at the Hazards & Vulnerability Research Institute, University of South Carolina.

reflects a very unlikely scenario where three 100-year storm events occurred within a five year period.

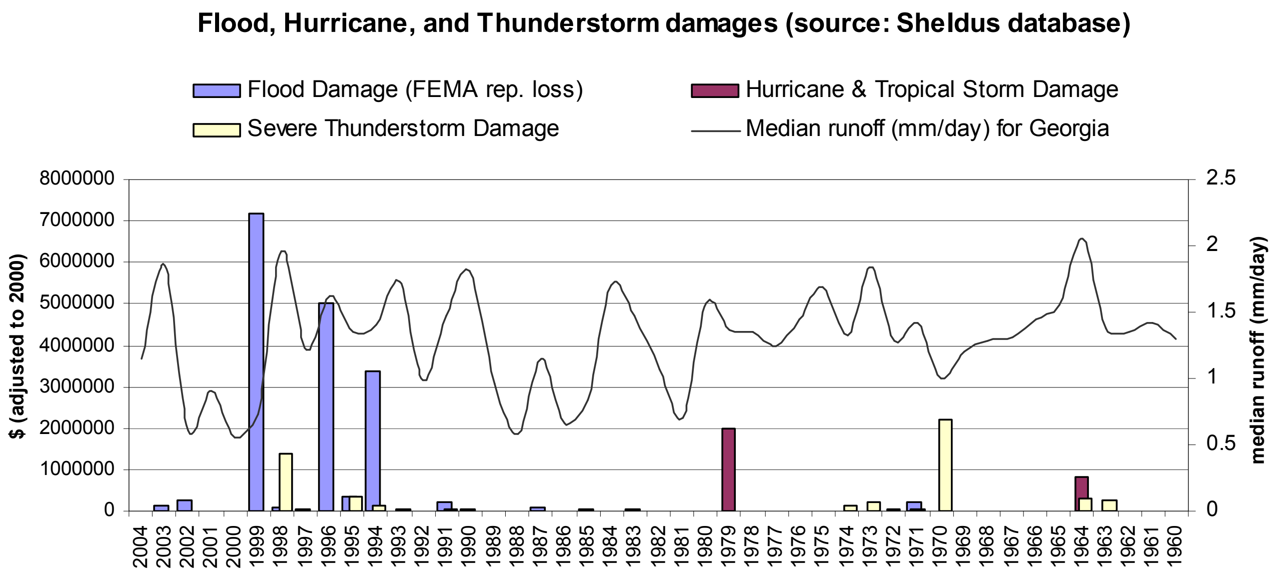


Figure 36: Flood, Hurricane, and Thunderstorm Damages from 1960 until 2004.

What this temporal distribution of events did in the short term is to challenge common sense perceptions among many residents. The three 100-year flood events came after a period of drought, as illustrated by the lower values of median runoff for Georgia from 1985 until 1990. Why was flooding suddenly so bad after all these years of much lower damage? What are the planners doing to the City that causes all these impacts? The logical conclusion was to attribute flooding to the enormous spatial growth of the City and its consequential increase in runoff, sprawling into marshlands that had previously been left alone. Diane's anger with the flooding in Ardsley Park is one example. The attributed reason for the flooding is not only the City's suggested failure of cleaning out drainage pipes and the mistake of filling in the streets and reducing the heights of the curbs:

> Further south, all these developments; everything runs down. Mr. Underwood's house did not flood near as bad as before Calvary [medical hospital] built all this stuff. It all flows down. And I feel sorry for them. You hear Michael Brown: he says we clean out our streets regularly and we clean out our pipes! Bull! This street has not been swept. When I was a little girl the street sweeper came buy twice a week every week. Now we get a once a week, if we get it.

What is striking is how convincing personal history is to her attitude. This is also the case for the City Manager. One of his early political causes was the flood issue, and in particular dealing with the public, upset about those three surprise floods.

Perhaps the motivation for the City manager to refer to the old landscape characteristics proved to be a somewhat effective way to dodge the bullet of urban sprawl and the complex hydrological explanation—the effects of current development patterns on local runoff. As he put it:

> Unless you have a set of people who are fairly knowledgeable on that [historical ecology], people will apply their knowledge and common sense to it. Specifically they will go, 'well… we never had this much flooding before they built the parkway.' Or 'we did not have it before this happened.' So they will associate human events… we don't need to build all these big huge facilities. We never had this kind of flooding until this happened; that is what caused this. So, their interpretation of cause and effect is distorted by their lack of knowledge about geography, topography, you know, the storm risks that we face.

Yet, while historical ecological education had its merits, it certainly did not fly with the highly-skeptical lawyer Diane, who insisted that the entire story was just "bull" and that the residential attribution of flooding to runoff caused by sprawl is certainly not a far-off guess. Even the city engineers admitted that the newer developments are occurring in more flood prone areas, while developers remain resistant to dealing with the costs of storm water. Generally, the development community sees the issue as a costly nuisance. As a City engineer elaborated on this position from the Storm Water office:

> Then it is Storm Water reviewing site plans. You need retentions. Pipes need to be submerged; what will you do about that? What will you do about your downstream

> runoff? Guess what… they are beating up on us, because ‘everything has been going fine until we ran into you guys.’

In addition to the obvious increase in development, the question of why there suddenly were three bad floods is further linked to the dynamic of mistrust. While theoretically the likelihood of sequential events is entirely stochastic—because the likelihood of any event is the same in each year—the three back-to-back 100-year storms caused serious communication problems between the public and engineers. In the words of the latter:

> And then they would go to meetings. The experts would stand up and say ‘well, one of the reasons this is so bad is because we had three 100-year storm events in the past years.’ Then the citizens would go ‘well that is the stupidest thing I ever heard. If you had three in the last years, you don’t know what you are talking about. Three one-hundred year events in the last years, you are stupid. That does not make any sense to us.’ But by flooding and engineering standards, yes, they were three 100-year storm events.

While engineers typically label the statistical calculation that an event has a likelihood of recurring 1% each year as a “100 year event”, the public persistently takes this to mean that if a 100 year event happens, it will be another 100 years before it happens again. Seen from the common, public perspective, disclosure of flood history at the time of purchase does not automatically help to inform buyers about flood risk. Wondering why people would buy properties in floodplain areas, one official remarked:

> ‘What were people thinking about?’ I ask that myself. We run into people and ask them ‘did you not know it was flooding back then?’ They say ‘well, yeah it was full disclosure, we knew it was flooding, but they told us that that was in a 100 year event… and we did not think it would happen again.’

What made the situation particularly odd in Savannah is the occurrence of three 100-year flood events in a five year period, leading to serious issues of mistrust. As a city official remarked to me: “People think it won’t happen again for 10 years or for 100 years. And so, when we had these events occurring in a close period of time, the public begins to mistrust us."

While this temporal situation presented itself at first as a helpful motivator for residents to support local funds requests for mitigation, as the mitigation projects started to progress, city management increasingly found itself dealing with political strife. The invasive procedures of the drainage improvement projects were seen by residents as over-engineering a problem. This situation was worsened because in some places the City had to bring facilities over ridge lines where residents never had flood problems. The impact of drilling sheet pilings into the ground to create the culverts created damage to such homes, exacerbating the movement against the drainage project. The mayor himself described to me and Jim that the City consisted of two types of residents, which he referred to as "high grounders and low grounders":

> The folks on the high ground are fighting mitigation of the massive drainage problem. The lowlanders support it because it will relieve their flooding. So, we have groups of citizens on both sides of this issue: one being inconvenienced for more than a year now by drainage projects; then the lowlanders fighting for years and years for the relief, which is now coming.

This resistance was further fueled by a relative lack of transparency on behalf of the City. Mistrust of city officials was already noted by the mitigation team as one of the main reasons for people refusing to cooperate with the city's buyout program. As it appears, this mistrust also affects the way resident input into planning is obtained. As one official explained:

> I think the residents in this day and age demand information. And should. And there is a hesitancy from the government standpoint to give the whole picture. I think the people recognize that, the residents. So public participation sometimes is scoffed at: 'Come on! You have already decided; why are you asking us? Your engineers in City Hall, you decided you will take out eight trees and put drainage in my front yard, so why the hell are you asking me now.' ….. I do think there is a lot of skepticism and distrust. I think if we move toward public-private partnerships, that will dissipate to a

> certain point. But, if you have the engineers and designers not talking to the residents, you get residents at city council fighting the project. That is ultimately what happens.

In addition to all this, the last of the three 100-year floods, the 1999 flood, coincided with the installation of new drainage pumps in some canals. Because no serious flooding occurred after 1999 when the pumps were installed, residents associated the installation of the pump with the lack of flooding, instead of a lack of serious hazards: "when the pump stations work, there is street flooding, no serious flooding." According to Diane, before the pumps, street flooding occurred five or six times in the summer, particularly during afternoon ocean storms and high tide. Now, it may happen once or twice a summer. The effect of the pumps on perceived risk is not a new phenomenon. In fact, this perception has been promoted by the city officials since drainage became a political issue in the 1980s. For example, in 1997, after the 1994 and 1996 storm and in an attempt to convince voters about a bond issue with which to address the flood problems, the Savannah Morning News quoted several officials suggesting that flooding stopped after pumps were installed:

> The area used to flood three times a year, and streets would be flooded almost twice a month, both as a result of summer rainstorms. But in 1978 the Kayton Street pump station was built behind the President Street sewer plant. 'That took care of flooding in that area,' said George Fidler, city engineering head" (Savannah Morning News 1997)

The promotion of pump technology as taking care of flooding in this situation appeared to be a double-edged sword. While it reduces the impact of flooding, it also increases complacency and perhaps a false sense of safety with respect to real storms which exceed the pumping capacity. Ardsley Park residents might not have objected to the massive drainage project a few years after 1999 if only another rainfall event would have illustrated that the pumps were inadequate to deal with such a massive amount of rainfall. But this did not happen.

According to one official, when it did rain the system worked, so the message was almost the opposite:

> We had a big storm on Easter this year and one Father's Day. But the system worked pretty well. So, that also plays into the memory loss. You know. 'Easter was here, we had a terrible storm, we only lost a couple of cars! So why are you building this system!?'….if it flooded tomorrow, we would get such support for this project… All these projects. We had a drought for a while. I know it is coming back. Everybody does. But when it is not fresh in someone's' memory; they tend to forget. We have pump stations; we are doing other things. So why build a system that large; you lose support.

What is striking, and in sync with the above quote, is how quickly community memory of the damaging impacts of the 1995, 1996, and 1999 floods started to dissipate, despite the efforts of city management to provide an historical ecological perspective. One reason cited by city managers, as well as Ardsley Park residents, is the rapid influx of newcomers, residents who had not personally been affected by any of these 1990s storms. Because they had no experience with any additional major flood since 1999, their understanding of why these projects were implemented was somewhat limited. In addition, outsiders often brought to the community an attitude that differed from local culture. As Diane put it:

> Part of this… we have these people move in that can't accept it, who don't understand it, who think we are a bunch of rednecks down here and it is flooding. Why don't you all just fix it! Because it is just the way it is! You know.

One official who interacted with residents on an almost daily basis about the structural mitigation efforts suggested that now, six years after the 1999 storm, people had generally adjusted the impact of the flood into a more detached attitude:

> I can tell you 1999, and we are 6 years away and people laugh about it now.
> People go like 'oh remember, we had to take the piano up the stairs!' I mean, it is very anecdotal. There are some people who are a bit dramatic; every time it rains they are hyperventilating. So those are fresh. But to the majority of the people, the flood of 1999 is not fresh in their mind anymore.

While the creeping in of memory loss only five years after a major flood certainly is not something residents who experienced major flooding might attest, to the general public flood awareness appears highly vulnerable and volatile when feedback does not occur through intermediate flood reminders, or when an influx of inexperienced outsiders change community memory. The Savannah officials I spoke with had created their own theories on the psychology behind this phenomenon. As one official suggested, the timing and history of sequential events appear to heighten the impact of concern after flooding:

> The history is critical. If there is a series that maintains community memory, everybody would probably be a little bit more cautious. Sequential events that happen. And that if those are strung together closely enough then people will go 'oh.. these things need to be… we need to think about this risk. We should not build in this spot.'

With hindsight, the city manager explained to me that the strategic use historical ecological education should have been used much more diligently on an overall basis. As it went, the use of old topo-maps, oral histories, and other information sources able to provide insight into historical conditions, was done on an ad-hoc basis when officials ran into adversity and public skepticism. As the City Manager explained:

> I am not saying we were ignorant. We were not simply going to accept an engineering solution. But, we would make a policy decision on how this was going to be applied. So we did get into history as a by-product I think from the very beginning, to talk about... to go back and do those histories.

The driving force of flood memory loss appears directly linked to neighborhood transitions, technological innovation, and the random distribution of flood events, placing an event "outside of the normal," rationalizing away its likelihood. In the case of Ardsley Park, this situation turned public support into public opposition for mitigation within a five-year period. As one official put it, the public perception went from "when in the hell are you going to get off your ass and build these facilities" to "why are you building these facilities? The sheet piling is damaging our houses! Are you getting paid by these contracts!?" Being placed outside the normal, the notion of the fluke seems to counter perceived potentiality for surprise because the event is not taken as part of a series of sequential events.

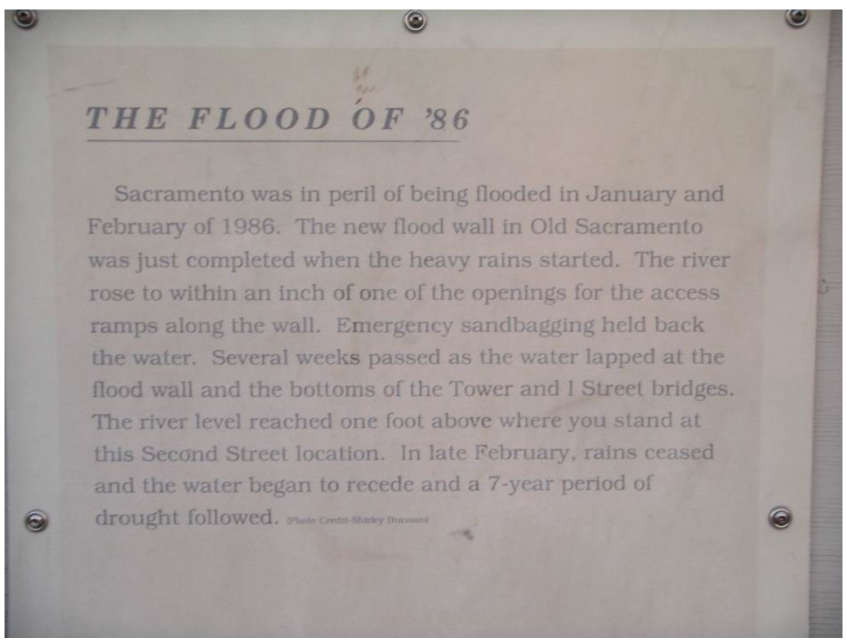
4.6. Conclusion

To what extent does Savannah's historical identity, its strong historical preservation movements, and the strategic use of historical ecological information in mitigation projects help to overcome temporal vulnerability? As it appears from the above review, the challenge of temporal vulnerability for the residents and officials in the City of Savannah is much more multidimensional than initially expected. To position the City temporally, two effective scales of temporal analysis are needed to describe the situation. From the largest temporal scale, the City's lack of major and even minor hurricane events in the past century, compared to the high hurricane activity at the beginning of the City's existence, is source for a generational and institutional lack of memory that impedes understanding of the impact such events might have on the City. This vulnerability to surprise is further enhanced due to large contextual changes that have characterized the city in the past century, including a major transformation of the drainage landscape due to sprawl, a potential change in climate, a dramatic increase in population, and a reduced cultural ability to endure flooding with patience and understanding.

As a consequence of this temporal situatedness of the City, complacency with respect to major hurricane events increased through the 20th century, possibly allowing 50 years of bad planning to actually occur. Fueled by growing public complacency and an internal financial crisis within the city, planners and decision makers did little to control the increasing runoff of urban sprawl deeper and deeper into the wetlands, until the Federal Emergency Management Agency started to mandate FIRMs (Floodplain Insurance Rate Mapping) as part of the program to alleviate the consequences of flooding for socially disadvantaged populations. This new era of public planning is the beginning of the second effective temporal scale, starting in the present and going back to the 1960s. Ironically, within this period an almost inverse flood scenario shows a relative lack of major events until, at the tail end of the period, an unlikely series of 100-year floods dramatically shook the perceived sense of normalcy among residents and officials alike. It is striking that, although these events must have come as a surprise to many, these events were not enough to convince skeptical residents of the importance of major mitigation projects to the overall benefit of the city. Reacting to this, the historical ecological public education campaign which the City initiated was an attempt to link the highly technological present back to the deeper, "natural" past. Referring back to the "natural conditions" of the environment, however, seemed to have fallen on deaf ears by those who were inversely affected by the construction of major structural mitigation projects, and connecting history to return periods seemed elusive in the face of stubborn belief among the public that a "1 in 100 year" flood means that the next one would be in 2099. It makes sense that, among many, the 1999 flood remains a "fluke". Unwilling to see its occurrence as normal, the fluke maintains the false sense of security and complacency which has been the status quo. At the same time, ignoring the potentiality of these hazards also induces vulnerability to surprise.

One can conclude that the key feature of Savannah's temporal vulnerability is one of disconnect, and that the City's culture of historical preservation did not help to prevent this gap from occurring. It is striking how little institutional memory existed about drainage and flooding within the City itself, and how general complacency seemed to have been rampant among residents. Perhaps it is the tendency to see flooding as an engineering problem that pushed the issue outside of the realm of the historical preservation movement. This is despite the fact that the mitigation projects themselves have major impacts on historical structures. Perhaps institutional and public memory about flood history might have been better preserved had SCAD been an engineering school. For many residents, it seems that the recent series of 100-year floods appeared to have been only partly understood as early warning signs of the flood risks which the City faces, including a serious need for strong commitment within the city to serious evacuation planning. In Savannah, the historical identity seems not more than a façade for a temporally vulnerable situation. In the end, this temporal vulnerability will in particular affect those residents who are deemed socially vulnerable to natural hazards: elderly and minorities mistrusting City officials and living in historical, flood-prone neighborhoods, and migrants lacking understanding of local history and culture.

Building public memory in downtown Sacramento, California



Photos by Danny de Vries 2004

5. EARLY WARNING IN FELTON GROVE

5.1. Introduction

The Indian Ocean Tsunami triggered by the record undersea earthquake of late 2004 rolled into coastlines killing nearly 230,000 coastal people who had been taken completely by surprise. While tsunami warning systems existed to protect the Pacific populations in the USA and Japan (where 85% of the tsunami's occur), lack of science funding and disinterest impeded implementation of a system in the Indian Ocean, mostly bordered by poor, developing countries with vulnerable infrastructure and minimal disaster preparedness (Marshall 2005). The widespread surprise suggests that the peoples of the Indian Ocean were temporally vulnerable to the impact of a tsunami[69]. The largest previous impact in the same area occurred as far back as 1883 when the Krakatau volcano erupted and collapsed, and killed 35,000 people. This event was ill remembered by many coastal populations in 2005. The exception appears to have been non-modern populations, in particular various indigenous groups located relatively close to the earthquake epicenter, such as the Moken in Surin Islands in Thailand, the Ong and the Jarawa in Andaman Islands in India, and the Simeulue Island peoples in Indonesia. According to a technical brief published by the United

[69] This notion seems to supported by data. While the recent historical record shows that major tsunamis occurred in the Indian ocean in 1524, 1762, 1819, 1847, 1881, 1883 (Krakatoa), 1907, 1941, 1945, and 1977 (Pararas-Carayannis 2007), the geographic spread would reasonably suggest a low awareness about tsunami impacts. Further, the earthquake which caused the 2005 tsunami is very rare indeed. With a magnitude of between 9.1 and 9.3, it was the second largest and first longest earthquake ever recorded on a seismograph (Lay et al 2005).

Nations (UNESCO), these groups escaped unscathed “because community members could read the signs of an impending tsunami and knew how to respond in a rapid and coordinated manner” (UNECSO 2007)[70]. Reports from the media based on accounts from local fieldworkers and anthropologists on the Onge suggests the existence of a folklore tale which talks of a "huge shaking of ground followed by high wall of water" (Voice of America 2004; BBC 2005)[71]. In the case of the Simeulue, Island folklore recounted an earthquake and tsunami in 1907. In 2004 the islanders fled to inland hills after the initial shaking, yet before the tsunami struck (Times Online 2005).

Early warning encompasses the generation and effective use of advance information on impending risks. In the aftermath of the tsunami, the lessons learned by the early warning community reflect to a large extent the importance of local knowledge in the face of current high-tech environmental monitoring abilities (EWCIII 2006)[72]. At the Third International Conference on Early Warning, which occurred in Bonn in March of 2006, former U.S. President Bill Clinton, emphasized it as follows: “All the sophisticated technology won't matter if we don't reach real communities and people. Satellites, buoys, data networks will make us safer, but we must invest in the training, the institution building, the awareness raising on the ground” (Clinton 2006). The conference emphasized the importance of a

[70] As another example, the UNESCO brief mentions that fishermen in south India warned local authorities a few days prior to the earthquake and tsunami that a dire event was imminent. They had captured in their nets a deepwater fish species that only streams upwards when severe storms or other devastating phenomena occur.

[71] According to Manish Chandi, an environmental protection worker who has studied the tribes and spoke to some Onges after the disaster "When the earthquakes struck, the Onges moved to higher ground deep inside their forest and escaped the fury of the waves that entered the settlements." (BBC 2005)

[72] The following is easily found back in the summary of the “Priorities and Project” forum: “incorporating local and traditional experience and knowledge into early warning systems” ; “ensure warnings are understood and acted upon” ; “close the gap between scientific information and local knowledge” ; “Technical monitoring and warning systems must account for the needs of recipients” (EWCIII 2006).

people-centered early warning approach, where in order to get warnings to the people, an integrated approach had to be based on needs, capacities, and cultures of those at risk. At the same time, it was noted that the sustainability of early warning systems under different conditions and contexts needs to be better understood (EWCIII 2006:19). People at risk needed to be partners in the system, not controlled by it. The traditional early warning approach emphasized top-down system redundancy. To emergency managers this meant the provision of multiple top-down information pathways simultaneously to decrease the likelihood of warning information failure. The new, people-centered approach is one that emphasizes bottom-up, local capacity: the ability of the local population to receive information, generate it locally, and accurately respond to it. In a people-centered early warning system, local context and historical experience of risk must align with the content of the institutional warning in order for the population to effectively receive and respond to the top-down warnings. When this alignment is out-of-sync or does not exist altogether, the dreaded problem of the "last mile" is constructed, referring to the situation wherein despite all institutional efforts the journey of the warning from generating institution to the targeted population fails to deliver at the most local level, or during the last miles of its travel. The most obvious reason for the last mile problem is perceived to be due to issues of social vulnerability. By this logic, disaster warnings tend not to reach the homes of the most vulnerable, such as undocumented immigrants, homeless people, or others living on the margins of society (Wallrich 2006). In academic theories about the behavioral response to early warning, local capacity to understand and agree with the warning has a central place in the motivation to take action. For example, the "protective action decision model" (Lindell & Perry 1992) suggests that when people receive a directive for protective actions (evacuation, sheltering) they collectively try to evaluate the extent to which the threat is “real” to them, how possible it is to protect themselves from it, how feasible these actions are, and if it will reduce their vulnerability. Lindell and Perry point out that these decision making processes are influenced by a range of recipient characteristics contextualized by their social environment, including physical clues if the crisis is coming, but also including prior belief and prior experience with hazard threats. In a review of collective action, Tierney argues that due to the psychological “normalcy bias,” people generally do not abandon routine activities until they have strong, verified evidence that they should do otherwise. Or, to put it another way, hearing, understanding, believing, and personalizing appear to be key pathways for action (Tierney 2004). Tierney also points out that evacuation or any self-protective action is often a collective decision, where discussions and deliberations are made among household members, and flight is often collective. What this suggests is that beyond the local capacity to monitor the environment independently (bottom-up), knowledge of local history also plays a crucial role in building early warning response.

Temporal vulnerability relates to the cultural conditions for ecological surprise. It is sensible to suggest that temporal vulnerability and early warning are strongly linked. Already mentioned is the notion many Indian Ocean tsunami victims lacked a baseline reference and were largely unaware of the hazard possibility, unable to read the signs, and were therefore caught by surprise as the disaster unfolded. This as opposed to, for example, the Indonesian Simeulue people who acted upon a generational temporal reference of the 1907 earthquake. The lesson learned from this example is that a people-centered early warning system means building local capacity to both recognize signs on the ground as well as being able to respond to top-down warnings when they arrive. In this chapter, I will describe a case study of a small

California neighborhood in Santa Cruz County in order to illustrate how local culture and history can enable or disable such early warning capacity, linking directly to the last-mile problem. I will focus on some of the factors which are seen as key to the issue of early warning, including prior experience, temporal referentiality, social memory, and technologies of environmental monitoring. I will describe how in the case of Felton Grove the local capacity to receive and act appropriately to warning about impending flooding was compromised and explore why this was the case.

5.2. Early Warning

The flash flood situation of the San Lorenzo River is not the most extreme in Santa Cruz County[73], but it still poses a temporal vulnerability to those inhabiting its floodplains due to the very short time of transition between the normal and the abnormal. The San Lorenzo River drains a small basin in the Santa Cruz Mountains in the Central Coast region of California. The small size of the Lorenzo drainage basin produces rapid responses to rainfall events, reducing warning time and complicating estimates of peak flood stage (Witter 2005).

[73] A Santa Cruz County Official explained that when they get ready for a storm, the municipality of San Lorenzo is not the first place they cover, although Felton Grove is the second place they warn on the San Lorenzo. They start watching Soquel Creek Watershed because the water peaks there first and the Soquel Village community on the southern end of the watershed is nearly entirely built in a floodway as well. This area is very vulnerable temporally. The largest floods of recent times, 1955 and 1982, are relatively low order events with recurrence intervals of 30 and 16 years respectively. A 100-year flood in combination with a log jam at the Soquel Drive Bridge would create much greater and damage (See Soquel Creek Storm Damage Recovery Plan 1983).

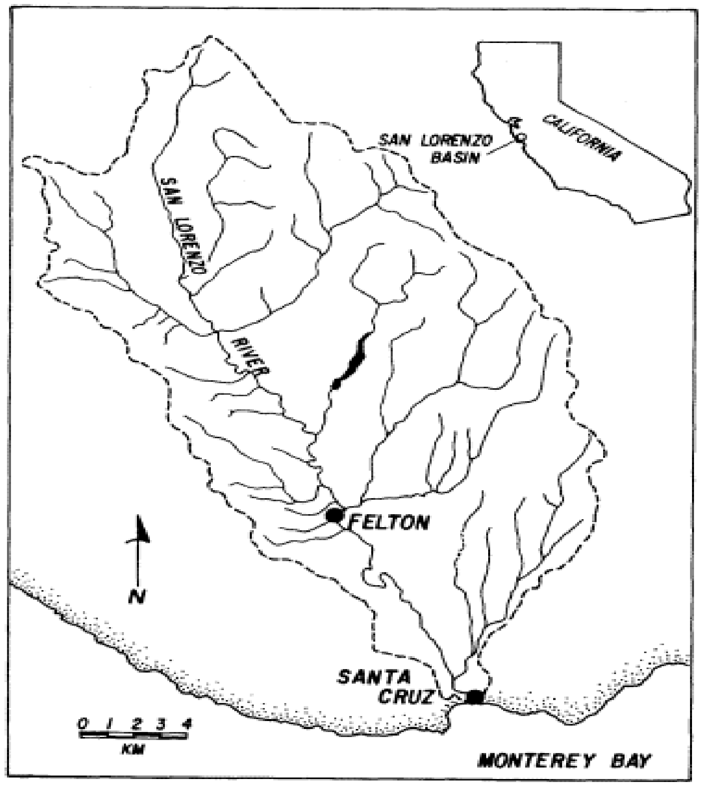


Figure 37: Map of Felton and the San Lorenzo River watershed and its location in California (from Griggs 2007).

In addition, the diverse landscape of the Santa Cruz Mountains creates many microclimatological niches which cause significant variation of rainfall over short distances. As a result, forecasts of floods require good observations of current conditions, as well as an understanding of the evolution of local weather systems. In 1982, Brian started to work for Santa Cruz County as an hydrologist in flood control. It happened to be a very bad year for storms and flooding. Brian himself narrowly escaped death when the Love Creek landslide destroyed his house while he was out, but it killed 24 of his neighbors asleep in their homes[74]. It drove home the importance of his work, trying to find ways to forecast rainfall

[74] Brian: "Nobody anticipated it. I think a storm came in and stalled on us. Sometimes on the coast they blow right through and are here for 6 hours. This one had been raining intensely for 2 weeks. We got 18 inches of rain that day, and unable to absorb at that level the amount of runoff, streams were out of their banks, taking their roads, inability to drive, so had people even known, pending lead time, were they able to drive out? I don't' know. Now, with the ALERT early warning system, we can get them out of their house before rivers hit

and the potentially resulting landslides. Because bad El Nino related storms repeated themselves in 1983, political pressure to improve forecasting and early warning in Santa Cruz County resulted in the installation of a new, real-time flood forecasting network in 1985, called Automatic Local Evaluation in Real Time (ALERT). The system would send radio wave responses to a base station when certain benchmarks were reached. As Brian explained:

> The time of concentration from the remotest area of the watershed rainfall to the Big Trees gauge close to Felton in streamflow is about 5 hours. We are fortunate to have 5 hours. It is not a long time, but we can watch it pretty closely.

When he was hired by Santa Cruz County in January 1991, the ALERT technology had not been used extensively. The period of 1985 through 1990 had been a period of drought and rainfall events only infrequently brought the river up to warning levels, and never to flood levels. Yet, the presence of the technology had posed a responsibility to the County because staff was held liable for the possibility of "knowing" all hours, 24 hours a day. Brian:

> So a lot of people don't sleep at night. We would be better off not having the equipment some people say, because we would not be liable for a bad call. But if we have it the public expects that new level of service. New level of service is for evacuation. In advance of rising waters.

Brian explained to me that the system allows him to provide information to emergency management in time for them make the call to residents alerting them that the river will hit a warning or flood stage. The liability of this knowledge meant that the moment the County knew, the goal would be to effectively notify local residents in time for them to evacuate all possibly affected areas. This proved a challenge, since in the end the fire department, or

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flood stage. If we see rainfall increasing in its hourly intensity, rivers are rising, projections are for rainfall to continue, you can get people out of their homes. That is a tremendous improvement."

police, had to go door-to-door in order to recommend residents to evacuate or get prepared otherwise. Further, when the ALERT system failed, the responsibility for the damages occurring might end up on the door of the County supporting the system. The County of Santa Cruz lost a major lawsuit in 1995 when levees broke along the Pajaro River. On behalf of local farmers and residents who were flooded, the plaintiffs argued that both Monterey and Santa Cruz County were liable for an aging levee infrastructure. The 22 million dollar settlement meant that Santa Cruz Resource Conservation District needed to divert three quarters of its revenues to finance the legal costs. Brian emphasized that this meant strong political pressure to do everything in his power to make sure his office would let communities know a hazard was coming, or reduce liability in the case of a mistake. This political scrutiny combined with the incapacitating financial impact of the lawsuit, resulted in a difficult situation wherein Brian's responsibility grew, while his ability to hire extra staff and improve the ALERT system itself was constrained. The system itself lacked an underlying watershed model, which would allow for an improvement of its predictability, and funds were lacking to hire consultants to calibrate an existing watershed model to the San Lorenzo River. In addition, Brian mentioned that two extra rain gauges could dramatically improve early warning time in the watershed from 5 to 6.5 hours, but the $12,000 annual costs of each of them were beyond budget as well.[75]

While the lack of funds motivated the Emergency Services and Water Resources Department in the County to think about some low-cost, remote observation solutions (like webcams pointed at old fashioned rain gauges), the main point Brian emphasized to me

[75] After the early nineties drought, the County cut funding for seven rain gauges because of budget cuts, and this trend appears State wide. Brian shows me several pages with lists of discontinued USGS rain gauge stations and tells me that when he first got there they were not using any of these stations. While this period was right after a drought, budget cuts motivated the decision to retire several. Brian argued that simulation would suffice using the 30-40 year historical record of the Big Trees gauge.

appeared his challenge in keeping liability away from the County. And while in theory Brian's responsibility ended at generating the warning, his mission would fail should the message fail to adequately warn the population at risk. Seemingly, early warning in Santa Cruz County had one foot in the institutional context of engineering liability, and the other in the challenge of bridging the gap between monitoring technology and the end-users of the early warning system—the last mile. In terms of temporal vulnerability, I found it intriguing how the story of Felton Grove helps to illustrate how the temporal challenge of short flood response time was further exacerbated by other temporal factors inherent to the community and institutional stakeholders organizing the hazardscape. These include influences which relate to dwelling, experience, surprise, the retention of historical knowledge, landscape features, history and memory and deal with the interaction between being in time, dealing with time, and being vulnerable to time.

5.3. Floodway Experience

Two homeowner examples from Felton Grove residents serve to suggest how experience makes a difference in understanding the temporality of hazards, and how this understanding helps in the preparedness and response after the impact of an unpredictable hazard.

Beth and Peter

I watched a video of the 1995 flood. The San Lorenzo River roared. A fast river. Very fast. Minutes of it. The river bursting out of its banks into the neighborhood. Afterwards we talked, the four of us; Beth, her husband Peter, her sister, and me. And while this happened, a loud beeping suddenly startled me. It was the emergency alert box, sitting in the middle of their living room in the bookcase. The black, plastic device went off twice in order to report two different child abductions. It gave me a chill. But it also showed the immediate, real-time connection of my hosts to disaster. When the alert sounds, they know immediately. This is true particularly in the case of a flood, the memory of which seems to have affected them deeply. Peter elaborated on this in some depth in my interview with him. He had developed a way of organizing his house such that what is worth least stays in the basement, and when you go up in their elevated house, you follow a gradual increase of flood-free zones. It is a house that is spatially embedded with notions of flood risk. Everywhere and at any level flood risk left its mark. The house is so sturdy no earthquake seems able to push it over, yet, the kitchen and living rooms were once flooded. Photographs were ruined. Memories went up in the sky. Elevated. Elevated memories. Amplified by the real time connection to risk and acting upon their community position as the last mile of the early warning system. I was in the neighborhood disaster headquarters.

Beth is an outspoken community organizer with a large investment in the Felton Grove neighborhood. She and her husband Peter first came to the Santa Cruz area from Southern California in 1985. At the time of my visit Beth's sister also lived with them in their now elevated house. The house had a one-story high, heavy brick foundation supporting the original house sitting on top like a mushroom. On the inside the house felt cozy. The home felt lived in, real. It was strange to hear Beth talk about a previous flood. She would point at her kitchen cabinets to show how high the water had come, yet while I looked outside I noted we were actually 12 feet above the ground. Of course the house had been on the ground before FEMA elevated it, but during the interview I repeatedly forgot this point. The elevation was beneficial, because flooding appeared to be one of the salient features of the neighborhood they were inhabiting. They knew this when they bought the house, which was one of the few affordable options available to them at the time. Before they moved up from Los Angeles, Beth and Peter occasionally went to spend time with family in Big Basin State Park and also had acquaintances in Felton Grove who had told them about the 1982 flood. "When we moved up here, his cousin who lived in Mount Herman showed a book which the Sentinel, the local paper, had put together about the '82 flood. There were houses with 5 feet of water in this neighborhood." Since the 1982 flood was called a 30-year flood, they figured that when they bought the house it would take another 30 or so years before a flood would happen again. The first flood they experienced was 1986, only three years later. Beth explained:

> My husband and I lived here since September 1985. The reason that is important because when we bought the house we were told the last large flood was in 1982. And that it was a 30 year flood, so we were thinking—not being snaps at statistics—that well, okay, we are not due for one really soon. February of 1986 we had our first flood. It was a small one. It only affected the living room.

They knew the river was coming up, but not until the fire department came barreling through the neighborhood with their big, heavy trucks—which as everyone agrees—sounds like a tank. Before the arrival of the fire department, they just did not "get it": "I mean, we had not been through one of these things." So they evacuated, got their animals, spent the night at friends, came back the next day, and found their living room had taken about 18 inches of flood water (a San Lorenzo River soup including toxic waste and other nasty substances). They had not moved anything from the garage or living room up-high. Their television got ruined, some furniture, a woodstove. They had to cut and pull out about 18 to 24 inches of the dry wall, but they only did this after they started noticing mold growing six weeks later. Peter elaborated how he stuck his finger on the wall and to his surprise went right through it.

The water had wicked up into the insulation and up into the wall. Besides learning some lessons on what to do in preparation for and response to a flood, they also learned that the floodplain where they had bought property actually was now an official floodway. Beth:

> Unbeknown to me, untold to us when we bought this property, that not only were we in the floodway, but in January 1986 new flood regulations went into effect. And we were told… because we had a little bit of money and wanted to expand the house, that we could not expand the house because of restrictions that had just gone in place. So, that was different for us. We went, oh…, okay, now we know that. But we were already committed.

In our conversation, Beth continued to emphasize how her inexperienced, non-statistical mind had to adjust to the engineering language of floodplain recurrence. They learned by doing; preparing evacuations about once a year, depending on the river height. Their experience with the 1986 flood and subsequent preparations helped them be swiftly on alert when the next big flood came in 1995. Beth:

> It was like '86, but just happened during the day. We had been warned… whatever this thing is what happened about humans, where you have a sixth sense about weather, we had developed it by then. We had a whole bunch of rain. The river was up... So when it starts raining and we get that feeling… I had that feeling the day we flooded in 86. I swear to god, I knew something was coming. Anytime I get that feeling now, I pay attention.

Beth and Peter explained how the flood created a common topic of conversation within the neighborhood, which had started to change by 1995. The neighborhood had become less of a low income neighborhood and more of a place for homeownership with people investing. By 1995, Beth had become known among many to be an elected official, and she took a natural leadership role in informing others about how to deal with flood preparation, method for cleaning up, and helping coordinate relief, including insurance issues. In addition, Peter had started to learn about emergency radio (HAM), a skill which proved very helpful in the isolated hills of the Santa Cruz Mountains. Peter and Beth had become the flood gurus of Felton Grove.

Suzan

Suzan and her husband bought their Japanese dream retirement house on a whim right before the big 1998 flood. They elevated their home, but did so with some reluctance, because the painstaking process meant some loss to the aesthetics which had attracted them to the structure in the first place. When I talked to her in her backyard, Suzan seemed somewhat uninspired by the topic in contrast to the passion of Peter and Beth, which was intriguing to me. She explained to me that they had bought their house in September 1996. In the spring. Everything was blooming and the river next to the house looked like a little creek. The house was already elevated six feet and the realtor did not mention it was located in a floodplain. "I think that is a legality," Suzan mentioned to me. "People say we need to go back and… but I don't like to do that." She said that when she and her husband bought the house they knew the river was across the street and that it could rain hard, but the knowledge was meaningless relative to the experience. She described with amazement: "We never experienced rain in this valley. And when it starts to rain, it is just the heaviest rain I have ever seen. It is just straight down. And it rains for maybe a week, a week straight." Soon after they bought the home, they learned how these rains could ably flush their Japanese Koi from their backyard pond down the Lorenzo River, assisted by a storm drain at the corner of their road, which flooded a substantial portion of their backyard. The next winter, it again rained hard. While it was wet in the yard, Suzan left items on the floor before leaving her house to return to San Francisco, her primary residence: "And I thought, no… it is never going to get in here. We are 6 feet above the ground!" Three days after she left, a neighbor called and told her she had lost most of her fence and that she should come down because there had been a flood. "And I thought, well… the fence fell down or whatever. But the house is, I think, built in 64." Her reference to 1964 served as a temporal reminder of her expectation of historical sustainability, but her sense of security was misguided. When she arrived, the entire neighborhood was cordoned off by the police and fire department. "I was shocked. I opened the door and there had been at least two feet of water in the house." What was most amazing to Suzan was how the water appeared to have lifted very heavy items: "The mud… everything in the southeast part was in the north. Everything swirled around." The flood of 1998 had not only pushed river water into the neighborhood, but also funneled water from a few backed-up creeks into her house.

Suzan explained to me that when she bought the house, her concern was with earthquakes, and since the house had withstood the 1989 Loma earthquake and was built by an architectural engineer, she had great confidence in its integrity. This sense of security was projected in her sense freedom from the risk of flooding: "I felt extremely secured. I felt like if the guy who built it is 70, he had gone through a few floods and it survived. Of course these people are long gone, and it would be interesting to talk to them." In her projection to the future, Suzan sees a cycle, suggesting that the big floods happen every 10-12 years. "So I am hoping that won't happen again…"

Figure 38: Deceptively tranquil flow of the San Lorenzo River near Felton Grove. Photo by Danny de Vries, 2005.

Those seeking to purchase their house in the Redwood forest mountains close to the Santa Cruz boardwalk find it difficult to recognize the landscape markers suggesting a seasonal flood cycle. Yet the speed of transition with which the San Lorenzo River can transform from a small creek into a raging river can be overwhelming, even to locals. For this reason, the role of historical experience among residents appears particularly pertinent in the case of a deceptive flash flood environment like the Santa Cruz County Lorenzo River. A local county mitigation official described it to me and my UNC colleague Jim as follows, when we visited the County in 2004 for our FEMA study:

> If you come here this time of year, you think it is the shire. Look at the beautiful stream. Realtors have no problem to say it rains occasionally, not really an issue. People build and buy in places where they don't notice the little creek and the 12 foot beam across the little creek, and the four feet diameter redwood log that floated up on

top of it. They just don't have any situational awareness of what the winter storms in particular can do here. And the next winter they come in and say 'nobody told me'

As flood-experienced residents remarked, the ability of this landscape to communicate to observers the profundity of a flood experience was limited. Similarly, the warnings of old-timers seems to also fall on deaf ears. It simply does not sink in until people experience a flood event for themselves. When it concerns an unimaginable event such as flash flooding that turns normality upside down, *experience appears to have primacy*. In our conversation with the two mitigation officials, this point was emphasized:

Official 1: Some of them are very well aware of it, the ones that have been through it. They know they have to watch the weather, when we put out the word that the soil is saturated they have to be prepared and they can do that. That helps alleviate the impact a little bit, in terms of personal possessions, but your house still gets screwed up. If you have not elevated your house you really are screwed up. Because people have not figured out what comes with a flood! But the new ones, that have not been through a flood—for years it has been darn close—they don't get it. For them it is like 'why would I want to do this!? It has not flooded in four years!'
Danny: But you would assume that if flooding could be so severe that there is some memory, or institutional memory, and people talk about it…
Official 1: There is, but there is a difference between 'man it really floods here and that is not a good thing' and actually seeing it and being there. Because it is an experience you won't…, you can not fathom what it is like and how fast it happens.
Official 2: Walking through your living room with deep mud.
Official 1: The flashiness of the river is the issue. People don't understand how fast and how bad it can get really quickly, where you won't have time to get your car out of the garage, you are running and there are these trees flowing by at the same time.
Jim: What have you heard in terms of experience?
Official 1: Well after the last time we had no time to warn anybody we heard a lot, like "why did you not tell us?" Well, why don't you have the first clue about where you live? Don't wait for the government to tell you to hold your hand and say "oh, by the way, it is raining"

5.4. Felton Grove History

To know the historical flood properties of the local landscape, the historical memory of the Felton Grove community has a challenge common to many similar communities located along the San Lorenzo river floodplains. Settled in the interest of timbering and logging, the San Lorenzo River valley only became colonized recently. While some of the other regional rivers had been occupied for over 100 years, this was rarely the case along the San Lorenzo. Felton, located in the hills ten miles north of Santa Cruz, was founded in 1843 as a mill town, but declined in population as the industry declined around 1920 (Pike 2001). Known for its fire hazards, the area became a quiet attraction to tourists because of the beautiful redwood surroundings. Already in the 1930's, Felton had become known as a vacation destination for many tourists. The neighborhood of Felton Grove itself started as a campground with some amenities in the early 1900s, to which small log cabins were added over time. Because many of the summer cabins continued to be flooded, they moved a number of them up away from the river in the '40's. Eventually one eccentric real estate investor, Bill Wright, bought the entire area, subdivided it in lots, and then sold it off to realtors and others over the years.

Figure 39: Cartoon posted on the cubicle wall of a local mitigation officer.

Two purchasers of lots were Andrew and Emily, both of whom had a familial ties to the area. Emily's mother was one of the earliest permanent residents in the floodway, while Andrew's grandfathers were caretakers of the cabins. Emily explained to me that the area had historically been aimed at entertainment, including a concession stand and dance hall, a baseball field, and a church. This land-use changed in the sixties, when year round use became more popular, but many of the houses remained rentals since investment in the flood prone lands appeared an unwise proposition to many prospective buyers. According to Emily, who is now a real estate agent representing properties in the neighborhood, people knew that the area flooded often. Andrew noted that the area remained a low-income neighborhood, because "It takes a particular mindset to live here, particularly knowing that it was going to flood. Especially if your house is not elevated!" The main property owner, Bill Wright, had worked in Emily's real estate office for 20 years, and according to her "he cobbled together his little cabins" from wood that came from torn down buildings (to which Andrew added: "I've got old road signs that were nailed down into the wall!"). Andrew and Emily told me that separately and together they lived in most of the old rental cabins of Felton Grove. As a builder and real estate agent, it seemed unavoidable that they started buying them and fixing them up. They mentioned that most of the cabins were built a few feet off the ground, some five to six feet, but most of the houses were built on a grade, with a standard foundation. They explained that in the neighborhood's early history through the 1980s there have really only been a few instances of major flooding, including the 1938 and 1955 flood.

Figure 40: Felton's Historic Covered Bridge during the 1932 flood.
Image courtesy of the Valley Press 1982.

While the floods of 1938 and 1955 were of major impact, most of the residents settling in Santa Cruz County arrived only after the 1960s, therefore having little direct historical reference to past conditions. It probably came as a surprise to many within the community that a rainfall event in 1982 caused not only a large number of unprecedented landslides and a number of deaths, but also caused the raging San Lorenzo River to take with it several of the Felton Grove cabins. Emily:

> There used to be three or four other lots with houses, and they all went away in the 1982 flood. The lots just dropped away. Most of the lot of where one of the houses was sitting on simply fell away, but the house was still there, red tagged. Sat there for years, and finally the neighborhood got together and had the county tear it down.

The 1982 flood was larger than usual and became generally seen by most Felton Grove residents as the baseline flood. The six feet of fast moving floodwaters piled mud four feet high in all but one of the homes. The 1982 rainfall that caused the flood came as a complete shock to many residents region wide. In a San Jose Mercury News article, the author James D. Houston notes that since half of the population was not here to experience the big flood of 1955, the region more often than not had gained a reputation of a benign and livable climate. Speaking of the average resident in the Town of Santa Cruz, he writes:

> We have seen its [1955 flood] memorial in the broad levee walls along the San Lorenzo River which last week saved the business district from drowning. But for the typical resident in 1982, that flood of 26 years ago has been legend rather then reality (San Jose Mercury News 1982)

In the face of this deceptively idyllic environment, the flood in combination with the landslides provided the baseline impact. A cultural baseline which severity was magnified due to the lack of historical knowledge available. Houston describes the temporal quality of this shock well:

> Last Monday, when these mountains with their timbered canyons and water-gathering creek beds suddenly became an adversary, it multiplied the shock factor. Nature then seemed doubly potent and fearful. If it is possible to compare the storm to the grotesque series of murders that assaulted this community in the early 1970s, it is seeming to come out of nowhere with no connection to past and present. The rash of killings took us by surprise, bearing witness to a social unraveling which seemed at the time totally out of character in a region so pastoral and sunny. (San Jose Mercury News 1982)

Because this time the assault was not social but natural, there was no villain to search for, and the population was simply humbled. Soon after the events, the need for historical reflection appeared evident as more newspaper articles surfaced, which aimed to provide the historical context for the 1982 floods which had been lacking. For example, a Valley Press newspaper article called “A look into the Valley’s past” on January 13, 1982, suggested that local flooding was nothing new (Valley Press 1982). In particular, the article noted that Felton Grove area had a long history of being inundated by the San Lorenzo River. Floods had occurred in 1907, 1938, 1943, 1955 and 1973. According to the article, “not too many people lived in the area when the first recorded flood of this century took place, but by 1938 the area was being developed and local volunteers evacuated victims in boats, as was the case last week.”

The way in which the neighborhood grew after most of the cabins became permanently inhabited was described by Beth:

> So what happened here is someone bought a cabin, added on without the benefits of permits—there was not formal planning at the time—and things just root. Sometimes organically like a tumor, sometimes organically in an attractive fashion. So this area had a reputation to be a hold out for people [sigh], old hippies, people who were kind of counter culture. I heard stories about one house and the guy was a drug dealer.

Beth explained that the off-beat culture of the neighborhood was in transition when they moved in the early 80’s. Housing was getting tight because of the influx of population from the Santa Clara Valley which increased prices for property. As the neighborhood evolved, the U.S. Corps of Engineers did a land survey and while concluding that the area was a floodway, started to offer elevation as an option to some of the homeowners, without any grants or loans. While a few residents accepted the elevation, most declined, as did Andrew and Emily:

> We got offered an opportunity to elevate at that time, and I said no, because once the house goes up we got all the road noise from down the hill. And we are at the far end. When they bring their sweeper truck through the Safeway parking lot at 2am, gravel trucks at 5am, even after the quarry, you catch all the road noise, I said.. forget it! Of course I had never been through a flood personally.

While residents were evacuated from Felton Grove in 1984 and 1986, the 1982 flood remained the baseline. It was this flood which residents had in mind in 1995 when the San

Lorenzo's rising waters mostly spared Felton Grove. The rains let up after five hours, keeping the river mostly within its banks (Sentinel 1995).

Shmuel Thaler/Sentinel

Felton Grove residents watch the water rise Monday night.

Figure 41: Felton Grove residents watch the water rise in 1995.
Image courtesy of the Sentinel, Santa Cruz.

What most residents at the time shared was a common interest in flood issues, but also a strong sense of community. In a newspaper article in 1998, one area resident described living in a house which had been built by her husband's grandmother in the 1930s. She mentioned that the structure was not merely a building: "this is where our families grew up. This is a community and not just in tragedies" (Sentinel 1998). The increasingly tight-knit neighborhood became one where about 60 families knew each other and shared a common history. Leaving the area was hard to imagine: "where would you go?" Emily, who raised her family also told me:

> My kids are 34 and 27. I raised them here just down the street. If one of them fell off the bike and would skin their knee they would be able to get in to anyone's house and get help and they would call me. Oh, X fell down on his bike he is out here at my house. It was that kind of neighborhood.

5.5.The Disaster Cohort

In February 1998, 4.5 feet of water went through Beth and Peter's living room. The counters in their kitchen looked fine, but the drawers had water and muck in them. The event itself was no surprise; only three year earlier had Felton Grove experienced a relatively minor flood. What was a surprise in 1998 was the level of the flood and the early warning system which had failed. During the 1986 and 1995 floods, the County had sent the fire department through the neighborhood in their truck with their loudspeaker giving information about preparation for voluntary evacuation. In 1995 this happened in the middle of the day and residents already had had some warning the night before when the river had gone up to a high level. In 1998, late in the evening, Beth, her sister, and Peter had already gone out to check the river. Peter had heard on the police channels notice that an evacuation was been called:

> I was listening to the Sheriffs department talking about how Felton Grove needed to be evacuated. They were going to get the officers together, hold a meeting, then go out and go door to door. In the time that elapsed, I knew that the Grove needed to be evacuated. And a half an hour later they arrived. And in river time, that is a whole lot of time. So… a lot of people still got flooded. A lot of people did not find out about it. The police went door to door, told them "you need to get out", "are you going to get out?" "Okay." And they are taking notes and names, and which is fine but it is very slow.

By now, Beth, having taken the lead on a road improvement project in the neighborhood, also had become the person who would funnel flood information to unprepared residents. But in 1998 something went differently. Beth:

> The thing is, so here we are. Hair back of my neck is up. The river is up. We have already cleared out the living room the best we can. We are ready. We know where the cat carriers are, we have everything lined up. We go back to our house, and I walk in and the Sheriff's there. Understand in the past the system has been… when they thought the river is going to go over, they bring the fire trucks down here. And if you have the fire truck, I am serious, it is like a tank going in here. It rumbles, big diesel. You feel it in your bones, okay. And that had not happened. The Sheriff's department is here. And they tell us "we are doing the evacuations this year."

They had never been told of a change in emergency plans. While they already knew 45 minutes ahead of time that evacuation had been called for, the speed of the flood still surprised them to the extent that they were unable to get their cat out of the house before they saw the water rushing in. Beth theorized that there had been an obstruction somewhere in the river, which might have caused the water to suddenly rush in. However, while Felton Grove was about to be hit hard, the early warning system collapsed because of a competing flood in Pajaro River and the unusual speed of the 1998 flood. Margaret, a regional Red Cross disaster volunteer, explained to me:

> At the last flood, in '98, people waited for the fire department to come, and the flood happened so fast that rather than 4 hours they had 1.5 hours. So the fire department could not get there. They were up to their waist trying to get people out. People were waiting for the fire department to come. Why go anywhere if the fire department has not come yet?!

Margaret expressed her frustration with the residential inaction when the fire truck did not show. The flood had come 6 feet above flood stage, and while police officers tried to knock on doors, most residents were overwhelmed. Not everyone got out. Beth:

> So the response up here wasn't as strong as they liked. They had the officers of the Valley and that is it. So they are going door-to-door and were not fast enough. Then a flash flood hits. So… the outcome though, we got our stuff in and boom, we are out of here. We helped our neighbor next door. Literally, the water was coming up underneath the car as I am shoving blankets in the car. She had just recovered from cancer. She later died. I am sure the stresses of that year did not help at hall. So… we are getting out. Just ahead of the flood.

Figure 42: The San Lorenzo flooding Felton Grove in 1995.
Photos courtesy of Christian Selling

Similarly to Beth and Peter, Andrew and Emily were also able to get out, but barely on time: “We have been here for years and it surprised us! I mean if we… we weren’t new people here, we have been around the block here with this stuff. And we just barely got out. We are up to our knees, we are holding his [the dog’s] head up on a leash above the flood waters.” However, while Beth got 4.5 feet of water in her house, Andrew and Emily's house did not flood. It was one of a very few escaped water damage. The water got into the sleeping porch, but not in the newly renovated interior of the house. Regardless of the financial and practical impact, the emotional impact of the flood was huge, and unanticipated. Andrew: “You know. The silt in the neighborhood. Driving down after the flood. The neighborhood was deserted, because most of the homes were completely unlivable.” What the 1998 flood underscored was that the gap between early warning and community response was far from being bridged, and that sometimes the challenge would not simply be to communicate the message, but to instead build local capacity to recognize signs. The 1998 flood was a surprise to the emergency management community because the event was not registered in its monitoring network. Luc and Mike provided some details to Jim and me in 2004:

> In 1998 we had 3 feet of freeboard and we had a storm come in at mid-level at the mountains and it was raining about 1.5 inches per hour. And 1.5 inches per hour, you have trouble seeing through it. It came in below the rain gauges in our ALERT system, so we did not see it. In fact, it was raining buckets for two hours and it came in right above Felton Grove, so it came on in the San Lorenzo immediately and jumped right out of the banks. So before the fire department could get in there, and they are right there, to warn anybody it was four feet! [slams on table]. So there is situational awareness on behalf of the residents is crucial.

The importance of this situational awareness is repeatedly emphasized by experienced observers. This point is driven home by an image from the San Jose Mercury News (1998), with the caption: “Patricia Jackson of Felton rushed home from her Scotts Valley job

Thursday morning to make sure the storm drain near her house remained open as heavy rains again pelted the area."

Figure 43: Leaving routines to protect against potential flooding.
Image courtesy of San Jose Mercury News, Karen T. Borchers

After the first flood, the neighborhood was shaken again when the swollen San Lorenzo River jumped its banks again only a few days later, pushing the flood weary residents out of their neighborhood for the second time in a week. The Sentinel noted that emotions ranged from crying to laughing. Noting how property washed up in other people's yards, residents joked they would have to do a neighborhood swap to return the items after clean-up had finished (Sentinel 1998). While the second flood was relatively minor, the community spirit portrayed in the newspaper was probably what pulled many through it, the flood eventually symbolized a turning point: a substantial number of homeowners sold their homes and left. And while the efforts of those who remained to make the neighborhood more flood safe paid-off with the influx of FEMA assistance for a wide-scale home elevation program, this further resulted in many homeowners selling their homes and leaving after renovation began in 2003. Figure 44 shows the number of turnovers for the 41 parcels of Felton Grove over time, illustrating the 1999 peak in sales following the flood. This peak exceeded the turnovers that resulted from the 1989 Loma Pieta earthquake.

In the process of this turnover, Andrew and Emily were able to purchase two more properties located on the highest ground, which they fixed up and made their primary residence. But they pointed out that by 2005, the vast majority of the residents who lived in the neighborhood had never seen a flood. Suzan similarly sums up the impact of the 1998 flood:

> After that flood in 98, most of the people that surrounded us here have moved. They stayed long enough to fix their house, and get ready to sell. A couple of them had already been elevated, but not through FEMA, on their own. Because it was a new house. And to this day there are very few people who stayed. I could point at all of these houses; there is no one here who went through that 98 flood.

Suzan told me that one of the people who rented one of the river properties ironically ended up being a student in river ecology: “I laughed when I heard it; I thought she is going to be able to study it up close; it will be in her kitchen. But she did not stay long either. She went through one winter.”

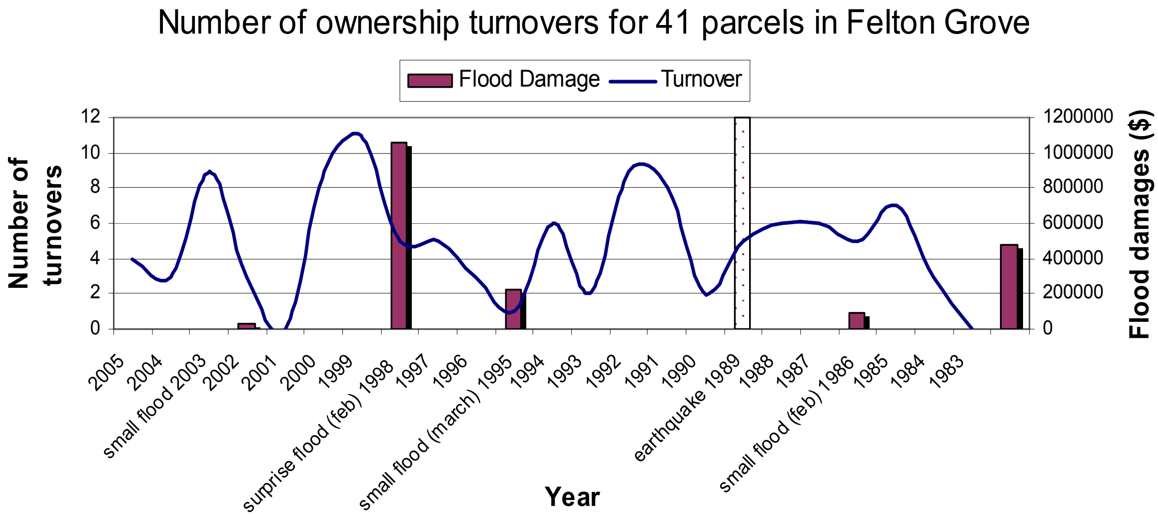

Figure 44: Number of ownership turnovers for 41 parcels in Felton Grove (California)

After the 1998 floods, the turnover rate in the floodway community was high enough to radically diminish the number of people dwelling there who had experienced the 1998, 1995, 1986, or even 1982 flood. The relocation of people with historical knowledge of flood events impacting Felton Grove in the past decades can be seen in Figure 45. This image shows the percentage of Felton Grove parcels in 2006 that had not had a full ownership turnover since a previous flood or hazard event.

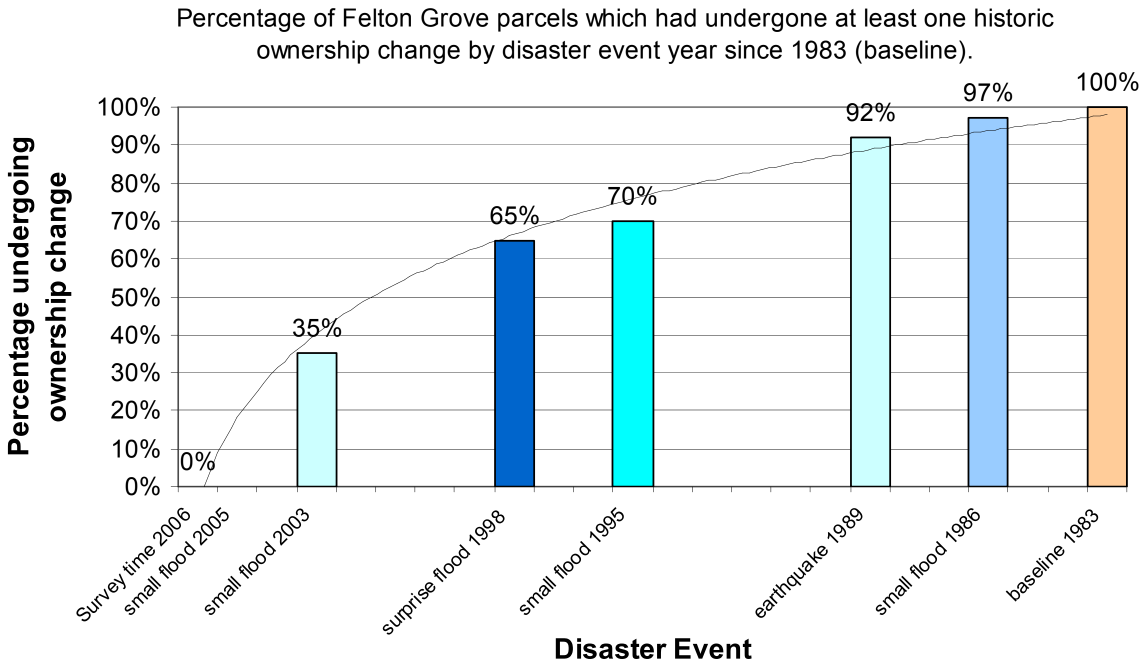

Figure 45: Parcels with at least one historical ownership change by disaster year.

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The graph provides a sense of the speed with which residential turnover occurred, taking with it residents' collective knowledge of flood impacts[76]. I obtained geographic data on floodplain parcels surrounding the Felton community and calculated the mean turnover rate in different types of flood risk landscapes—no floodplain, floodplain, floodway, and Felton Grove—using historical real estate data provided by the county. The results are shown in Table 6 below and show that the speed of turnover in the Felton Grove areas is statistically significantly higher than the other Felton landscape types.

[76] Movements within the neighborhood do not affect this, but this is a rare phenomenon within a floodplain.

Table 6: Turnover Rates in Felton Area

Type of Landscape	Number of parcels sampled	Mean Turnover (properties/year)	T-Test of difference in mean with no floodplain sample
No Floodplain	1669	2.2	
Floodplain[1]	244	2.4	T(1905)=-1.87, p=.06[2]
Floodway	204	2.5	T(248)=-2.74, p=.001[3]
Felton Grove	40	2.9	T(1704)=-2.82, p=.0005[2]

[1]Floodplain includes floodway and Felton Grove, etc.
[2] Equal variances assumed using Levene's Test for Equality of Variances
[3] Equal variances not assumed

While the number of parcels sampled is relatively low for Felton Grove, the trend in these data illustrates a definite tendency towards turnover for areas which are increasingly flood prone.

Since the turnover, the culture in the neighborhood has changed. FEMA's elevation project started to take hold in 2000. A number of the homeowners involved paid the 25% elevation match to elevate their house out of the floodplain into the air, and then sold and left. Some elderly residents moved because they physically could not climb the stairs that would now become a familiar part of the residential landscape. Some did not want to live in a neighborhood which was slowly being overtaken by outside commuters, eroding the sense of community which had made the neighborhood what it had been in the past decades. Because locals understood the risk of purchasing a house in the area and continued to avoid the peril of purchasing, the result was that most of the houses fell into the hands of geographic newcomers. Andrew and Emily noticed that the newcomers have the same inability to understand flood risk. Even when these new residents speak to old timers who have been in the neighborhood back before the elevation, their attitude remains one of disbelief: "If the old timers tell the stories, but they are still here, it can not be that bad!" Andrew:

> And it does not matter how much you tell people don't set up a full workshop in your garage because you can lose it all, make sure you have high shelves in here, so you can put your most important things really high. You give them all the advice and then they do whatever they want to do. People just look at that river and don't believe it floods. They just flat out look at that tiny stream of water and go 'I know you are telling me it does this,' but they have this level of denial, and go yeah yeah, yeah.'

5.6. Intentional forgetting and its institutional context

Andrew grew up near Santa Rosa, along the Russian River in a town called Guerneville in Sonoma County, California. I had heard of this place before I went to Felton. While Guerneville is similar to Felton Grove in that the homes are located in a floodway, the county of Sonoma had one of the highest repetitive loss rates in the country. FEMA did not send us to Sonoma County however. FEMA had hesitated in providing funds to mitigate (elevate) homes in floodway areas shortly before we wanted to visit, and as a result was not on good terms with the county. In FEMA terminology, the county was "a very difficult county to work with." Andrew's familiarity with flooding was clear. He used to swim and fish in the river during the summer, and saw it flood in the winter. "And I remember the '65 big flooding they had. That was a really big flood out there." Andrew mentioned that as a public reminder, the town of Guerneville had posted a sign four feet above the top of a bridge crossing the Russian River, symbolizing how high the water had come. It reminded me of the small signs hanging on a public wall in a historical downtown street in the City of Sacramento which in a similar way pulled the attention of those passing by towards flood history. At some point, Andrew mentioned to me that in the beginning he got some thrill from the Felton Grove neighborhood flood risk:

> Danny: You liked it?
> Andrew: I did! It is always exciting. I was a professional rescuer. In avalanches. All that stuff I find it exciting and exhilarating. It was really until 98 until I actually went

> through a flood firsthand. I got flooded. Not somebody else. Then emotional impact hit home.

The emotional impact appears harsh. While everybody deals with it differently, Andrew and Emily suggested that there is a lot of post-traumatic stress in the neighborhood. People simply cannot deal with the magnitude of what they have endured. Andrew and Emily mentioned that both of their neighbors ended up on disability because the stress was too much. They suggest that one way to cope with it was simply denial. As an example, they talked about one home where the owners just left the muck in their kitchen until they finally got it repaired months later. With the denial comes the motivation to forget. Andrew argues that the flood issue in Felton Grove reminds him of an alcoholic and its drinking: "It is only when you wake up from your drinking that you think oh my god, this is terrible. And then you sober up, the afternoon comes around, and you forget."

This denial is something also emphasized by a county official I met with in Santa Cruz, Barbara. She emphasized that there is a strong urge among residents to want to forget about past floods due to financial dependence on the value of their high-priced California property:

> First the community pulls together. People help each other. Taking care of the damage. And then, an American mindset kicks in which is "we are going to get over this." It is like you hear people talk about recovery and rebuilding before the flood is even finished. With property values the way they are, particularly in this community… the house is what most people have. Their property is the main thing people have. So they are very, very intense about their property value. It is very important to people on an individual basis. People perceive these natural events as damaging to their property value. And they just want to forget about it, and don't want anybody else to remember it. I think there is several really strong factors pushing people to just move on and not really absorb any lesson from what happened. And I am not surprised by that. I think it is human nature. An American human nature.

While Barbara referred not only to Felton Grove, but to the communities along coastal Santa Cruz County as a whole, the importance of flooding in the real estate calculation certainly seems central to the willingness to choose to purchase a home in the neighborhood. Emily, who has been a real estate agent dealing with homes in Felton Grove, explained to me that in her experience about 1/3rd of the buyers would not consider purchasing in a floodplain at all. Another 1/3rd would consider purchase, but only when everything else is perfect. Only the last 1/3rd says they will get flood insurance and will take their chances, because the location is great and the house meets their needs. She explained that she gives every buyer an overview of the flooding in the past 60 years, what it means in terms of the emotional toll. If the buyers remained interested, their calculation is one of judging expectations for the future based on knowledge of the past. When I asked her how she explains the past, she mentioned that she would refer them to the USGS Big Trees river gauge (USGS 11160500) where annual discharge statistics have been archived since 1937. The data that can be downloaded in raw form and translated with a spreadsheet shows the historical information of Figure 46.

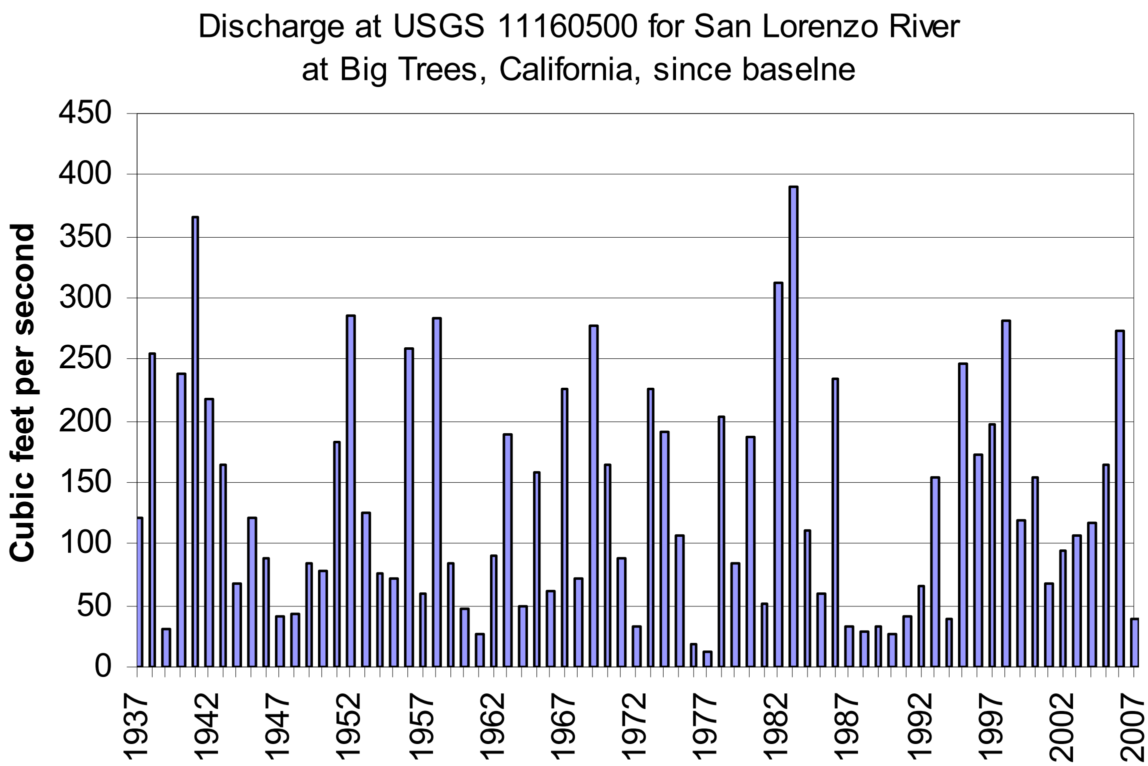


Figure 46: Discharge at USGS 11160500 for San Lorenzo River at Big Trees.

Emily explains that within the calculations going through the potential buyer's minds, the central question is: "if I live here 5 years, what are the odds of it flooding again?" She told me that when they look at that history and see what it has done so far, they know there is no way of knowing if it will flood next year or in ten years. "Next year and you are screwed, or in ten years."

> If you are talking about houses before elevation, or that have not yet been elevated, people really have to weigh all the positives, and there are many of those, with the one negative, and what is the odds that it will happen in the time that they own the house. That is what it boils down to. People say, what is the chance it will flood in the next few years. They ask that question, which obviously nobody can answer that question, but they think in their minds that if they live here a few years they won't have to deal with that.

The historical USGS data are not the only source of information residents have with which to make their purchasing decision; there is also a legal obligation of the realtor to disclose flood history. Barbara mentioned to me that in addition to disclosure, the County requires that whenever a building permit is given in a flood hazard area a short paragraph is added on the deed that says "I acknowledge this is a flood hazard area." While vague, it is a trigger that could warn a property owner of what might be in store. Often buyers call after they notice this and request additional information. According to Barbara, one of the things that really helps in this instance is the retention of her staff:

> People often call. I am interested in this property; what can you tell me? And something I notice is that it is really helpful that there is a lot of continuity in staff. We tell people what we remember about their particular property. "When I was on that property after this particular storm this is what happened." And that is really helpful; because the records don't really convey what the people need to know.

In addition to deed restrictions, the county also does hazard assessments, in particular the flood, landslide and earthquake assessments. And while the county explains the rules and notes that this is a FEMA requirement, Barbara notes that some homeowners really are resistant to this information: "Some people just don't want to spend the money; they only have so much money. If you are elevating and doing this other stuff, that makes it harder."

When looking back in reaction to my probes about flood memory, Barbara noted the term "half-life" to make sense of the idea that memory lapses. This term—common in physics and toxicology—denotes the interval required for a quantity to decay to half of its initial value. She noted that while the earthquake was seen as the major event, the "half-life" of the earthquake was actually shorter then that of the 1982 landslide where ten people died in a small community in a traumatic way. She is not sure why. While I can only speculate, the fact that the 1982 flood and landslides were a surprise and major shock to the Santa Cruz community might have something to do with this. As one of my informants noted, the temporal unpredictability of the earthquake seems to some extent make the perceived risk less dramatic:

> Earthquake is probably the least [threatening]. Even though we are under a constant threat. It is not something we can do anything about. If it happens, it happens. People do strap their water heaters. Bolt their frames. So they have done that.

While earthquakes of magnitude 7 or larger occur on average about once every 18 years in California, the period from 1895 to 1915 was very active in northern California, whereas the next 50 years were very quiet (McNutt 1990). This suggests that the population would have developed a similar false sense of security to earthquakes and landslides and as they did to flooding.

Another institutional factor introducing a temporal element to the mix is the County of Santa Cruz's notoriously complicated planning procedures. In terms of the permitting process, Santa Cruz County probably has one of the strictest and most comprehensive environmental regulations in the United States. The impact of this is that it also makes any type of hazard mitigation planning a complex and time intensive endeavor, or "convoluted, time consuming, and expensive," as mitigation managers referred to it in 2004. In addition, the geography of the area makes building complicated. The building code itself is one of the thickest around. In terms of temporal vulnerability, the impact of this is the high likelihood of delay in planning mitigation. As an official explained:

> Official: It is an issue that comes up every winter about October. These projects, they want to get this thing done before it starts raining. "Not so fast bucko..!" You have zoning approvals, hearings, studies, engineering, permits, and every year we are down there working with the planning department trying to make these things go fast. And of course everybody down there does this right before they realize it starts to rain soon. Six months for just the permits, plus three to do the elevation.

The county needs seven sets of building plans to be processed by seven departments, making the length of time for homeowners to get an elevation completed on average about nine months. This is nine months of headache, and according to the local mitigation manager involved with Felton, this is a discouragement to some homeowners. The long process makes them choose not to engage in flood mitigation, and as a result their home becomes more vulnerable to the hazard when it occurs. In addition, the manager points out that the mitigation of flood risk might be swapped for a financial risk. He particularly was upset by a sudden move by FEMA to make the mitigation grants given to people taxable retroactively[77].

> Over half of these people can barely afford to do this because of the 25% share. The financial risk turns out a worse risk than the flood. Now with the tax issue some people might lose their houses! They did not lose it through a flood, but because of a tax!

When I later asked the manager what the major surprise events were to the homeowners in the past years I was referring to hazards, but the answer returned the conversation right back into the risk of dealing with the government bureaucracy:

> It is the FEMA surprise! There are tons of them. But it is never the weather! It is not the flood. The big risk is the government. That this program is going to blow up in your face. That you won't pass the BC analysis. That you are taxed retroactively. Your house is assessed and you pay more property tax. There are all sorts of unseen pitfalls that make the flood seem trivial by comparison. That seems trivial, doesn't it? It is ridiculous.

Arguably this unpredictability of FEMA is partly due to the loss of institutional memory, which imposes temporal vulnerability in FEMA policies on the ground. As one of the emergency management officials emphatically noted in 2004:

> They don't speak with one organizational voice. There is not a clear methodology, pat-answer on programs. There is a lack of organizational memory. You deal with one guy one year, the next one next year. "Wait a minute are we talking about the same program?" "Oh yeah it is right here in chapter 224b subparagraph B of obscure legislation 2002." Then the biggest thing is being able to apply the intent of the programs to ad hoc situations that come up in the practical implementation of the program. It takes an act of god for somebody to make a decision that is outside of the box. If it is written down somewhere there is a collective constipation going on that nobody wants to make a decision.

[77] FEMA later decided against making this tax retroactive after much regional and local pressure.

Figure 47: Felton Grove elevation project in progress.
Photo by Danny de Vries 2004.

5.7. The Siren

Despite the extent to which neighborhood preparedness was lacking due to turnover, denial, and inexperience, in 2004, the county emergency management officials explained how they had contributed to improve the early warning system by providing a siren to the neighborhood. When I later spoke to residents, the history of how the siren actually came about appeared to have much less to do with the county itself than a key group of residents who I would refer to as the disaster generations, including Peter and Beth and Andrew and Emily. The idea of the siren had first been suggested after unspent earthquake funds from the Red Cross were funneled to the neighborhood in 1990. The $5,000 grant was endowed to the community after a drought, and as a result, the idea stalled until the early warning failure of 1998 surprised many residents. The frustration and anger toward the failure of the early warning system was expressed in the annual meeting of the Felton Grove road association, an ad-hoc neighborhood association led by Beth. That Peter had received the call for evacuation 45 minutes before the rest of the neighborhood suggested that residents themselves could play a much more active role in early warning (right at the "last mile"). Eventually, residents and county officials agreed with the installation of the siren for early warning in the neighborhood.

Peter and Beth appeared to be the ideal team to take on the project. As a radio engineer, Peter understood the siren technology: Beth had taken leadership in organizing residents, pulling the official strings on behalf of the neighborhood. The work involved a seemingly small project, but appeared a much bigger struggle then initially imagined. The equipment itself ended up costing over three times more then the projected $5,000. In addition, a combination of three bureaucracies became involved in hooking up the siren: power, telephone, and the county. The first hurdle appeared to be with the county itself. While the Pajaro River settlement had strangled county finances and the Bush administration further cut mitigation funding within emergency management, the issue of central concern to the County was the avoidance of liability. And when it came to the siren, the first legal concern was who would be responsible for setting it off. Beth spent several months debating county officials on the idea that responsibility lay with the County, and not the neighborhood. But "setting it off" also meant by implication that the siren was maintained, which is where Peter got involved:

> The reality is that right now it is like, if I don't maintain it—I pretty much put it up—if I don't maintain it, is going to fall into disuse. If the community does not pay for

> the electricity, nobody else will. The county at least has the responsibility to actually set if off when we have possible flooding. But, getting back to that story, is that … initially, the question comes up, now okay, we got the siren… people have an expectation of it working. If it does not work, are they going to blame somebody? Now I am involved. Are they going to blame me? Even if it is a loss of life or something. You hate to think about it, but some people aren't very good in taking responsibility for their welfare, blame others when something goes wrong. The county has greater resources for defending itself then I do[78].

In the end, the county would take responsibility for setting it off, while Peter decided to install a battery backup system just in case power would fail. This by itself proved a problem. For 1.5 years the neighbors had to run an extension cord to Andrew's property because funds were not sufficient to pay the local electrical contractors, while the Pacific Gas and Electric (PG&E) utility charged $4,000 for a 25 yard electric wire charging the batteries in order to "recoup upfront costs."[79] Returning to the liability issue, now it was Andrew taking a risk. He explained to me that his lawyer cautioned him against allowing the local hookup: "If something happens, they don't get the warning, they will sue everybody involved, and that will be you because it is on your property…so, don't do it!" But he did it anyway.

It was with the aid of Margaret, the Red Cross liaison who funneled the original grant to the community, that the County Supervisor finally convinced PG&E to provide more assistance. After this, Beth was again in contact with the organization:

> So the PG&E woman said you have to do this, this, and this. And I tell her, "I can't do all this. We can't afford this. This is going to kill our project. I can't fund raise that kind of money." She says; "just send us the $500, we will do the paperwork, evaluate the project, and let you know how much we can pare this back." I said okay, and am looking at more fundraising, garage sales. Because that is what I can do at the edges of my life. The paperwork comes, all this technical stuff. It was just… hit the wall. Andrew worked on it with me. Peter worked on it. It still took me a year to fill it out.

[78] Ironically, Peter notes that he actually is a registered county disaster worker. Thus, while in volunteer capacity his maintenance would represent the county, and as such the county could still be liable.

[79] According to Beth, a PG&E representative explained to her: "Well you guys will not be putting a heavy drain on this, so the regular bill is not going to very high. You are just recharging batteries. So we have to collect all of our costs upfront."

> Chalk it up to overwhelmed and depressed…. Finally got the paperwork filled out last year. About a year ago. And then they got back to me and they had reduced the amount down to about $1100.

The fundraising remained a struggle. From the emergency management side, the local mitigation officer explained to me that they had included the siren in the Flood Mitigation Assistance grant. But while the large $500,000 grant was approved, when they inquired by phone about the possibility of spending $2000 for the siren (and more on webcams for the bridges), these items appeared specifically excluded. FEMA money was only to be used for elevation, relocation, and acquisition. The end result appeared a regrettable lack of support from the county for the early warning project. As Andrew and Emily see it:

> Andrew: The County is not interested. The County was absolutely not interested and had nothing to do with it. The fact that we have this siren at all is responsible primarily Beth, secondary me. I pulled the permits, issued the construction contracts. Peter is the one who located the equipment. Beth is the one who wrote the grants. We found all the funds and raised the remainder ourselves. So, the County has had nothing to do with it.
> Danny: Did the County pay for any of it?
> Emily: [goes "pffffffff"]
> Andrew: No! Absolutely not.
> Emily: The County is not the county for the people. The county has nothing to do with assisting the welfare of the people.. in any way, shape or form.
> Andrew: And the Office of Emergency Services was not involved with us either except perhaps in a minor way but I don't believe we received any money. I can be wrong about that, Beth would know.

And while the county dragged it heels, voluntarily or not, the burden of the bake sales was on the small group of the disaster cohort, in particular Beth, while the donors eventually had to be the residents in the neighborhood itself. And these, unsurprisingly, were reluctant and slow to help. Andrew:

> Andrew: And if everyone in the neighborhood had kicked in $50 or $100 we would have had this flood siren two years ago.
> Danny: So there is something about people not wanting to pitch in money?
> Emily: It is that lack of community. Each person is their little island on to themselves. So, they don't feel that sense of community like they used to. And then also that

> disbelief that it really is going to flood. A lot of new people here who just haven't seen it and just really don't belief it.
> Andrew: It is kind of a curiosity. You know. I mean, Oh, a flood siren, yeah. We've got one.
> Emily: [laugh]
> Andrew: But you know, nobody really has seen the need for it yet.

Avoiding the fundraising issue, Andrew paid for the permits and the electricity himself. But

Beth went around and tried to get residents to pitch in, for the sake of the community:

> The county paid for part of the siren. They never paid for the entire package. The whole siren was probably less then $17,000. Okay. I did …pardon me…[slams her fist on the table] I did bake sales for that damn siren!! Okay!!

Figure 48: The Early Warning Siren of Felton Grove

5.8. Conclusion

The temporality inherent to early warning immediately links the topic to temporal vulnerability. Temporal vulnerability appears deeply embedded at many levels in the story of the Felton Grove neighborhood, located in a deceptively tranquil floodway along the San Lorenzo River. Table 7 below provides a summary of the temporal factors affecting the vulnerability of Felton Grove residents.

Table 7: Summary of temporality and its vulnerability

Temporal (Dynamic) Source	Vulnerability
Fast response time of San Lorenzo River relative to rainfall events	Early warning time reduced
Deceptive environment with high learning curve	Unable to properly evaluate magnitude of flood impact and consequential delayed response, also leads to post-traumatic stress
Recent colonization of San Lorenzo River floodplain (most residents arrived after the 1960s).	Little population level historical memory of the impact of past hazard conditions
Recent evolution of Felton Grove neighborhood from temporary to full-time inhabitation	Lack of flood memory within the neighborhood, also reflected in insubstantial architectural adaptations
Few major flood events. The 1938, 1955, and 1998 flood had a 50-year flood recurrence.	Underestimation of potential severity of flood impacts and misguided baseline referentiality
Felton Grove only surveyed in 1980s.	Late institutional acknowledgment of landscape as floodplain lead people to buy property in risk areas
Underdeveloped rain gauge and monitoring network leading to a short response time	Lack of preparedness and early warning time
Influx of outside commuters into the neighborhood	Erosion of historical memory and flood experience, increasing turnover particularly among seniors
High property turnover rates	Erosion of historical memory and flood experience
Increasingly competitive property market values	Increasingly strong urge among residents to want to forget about past floods to protect property values
Environmental monitoring means liability	Early warning support and funding compromised at the County and personal level
1998 flood warning protocol changed without notice	People did not leave their routine activities in time
Flood history disclosure to new home buyers difficult to evaluate	Underestimate of flood risk and increase of population at risk
Many competing hazards with different recurrence intervals	Risk saturation resulting in lack of attention
Lengthy hazard mitigation planning process due to code	Delays in planning and building of mitigation or other flood proofing measures
High turnover at FEMA	Lack of institutional memory leading to unpredictability of mitigation policies

While not all sources of these population vulnerabilities are strictly temporal or related to the condition of "being temporal," the impact of all sources specifically affected the relationship between residents' understanding of the past and their expectations for the future. In particular of importance to the history of the neighborhood appears to have been the transition that happened after the flood of 1998. After early warning failed in 1998, the need for a people-centered early warning system remained problematic due to an increasing lack of internal capacity. The difficulty in negotiating and installing a siren to improve neighborhood early warning illustrates in particular is how a small group of key residents served as maintainers of flood memory. It also shows how neighborhood turnover, which was significantly higher in Felton Grove than in non-floodplain areas, became an increasing challenge to this effort. The impact of the turnover of property owners after 1998 only further eroded the lived experience needed to facilitate an adequate response to early warning and to recognize signs of environmental stress during monitoring of river and other biophysical conditions.

In the case of Felton Grove, it seemed to have been a few remaining residents and property owners who, out of experience, understood the full risks involved in living in the floodway. Consequentially, it was this "flood cohort" which in the midst of neighborhood change insisted on having the siren installed. The socio-demographic concept of a historical generation, or cohort, is of interest in this context because it refers specifically to the idea that a certain *event* provides a cultural imprint on a cohort (Manheim 1952; Schuman and Scott 1989; Corsten 1999). The concept of historical generations refers to social time and as such is immediately linked to the experience of temporality. "Generations" share a picture of "their time," or a script of the drama of their collective development in the course of "their" historical phase. As such, they become a "temporal unit" (Ryder 1965:861). While the original concept of "generation" looks at the lifespan and theorizes that it is particularly in youth that imprinting of events occurs[80], in this case it seems that the cognitive understanding of those who experienced a flood versus those who did not provided two temporal units, creating in fact two (or more) cultural circles (Corsten 1999). Each circle is characterized by a certain flood events as its temporal benchmark. Considering the high turnover within the Felton Grove neighborhood, those who experienced the late 1990's floods could possibly be seen as one such cohort of residents since their risk perception is calibrated relative to these events (and in particular the surprise of 1998) and it is possible to trace their sub-cultural unity through time. While earlier generations still exist, as for example Beth and Peter had their first flood in 1986, these older residents are increasingly rare. As shown, in the case of Felton Grove, not one property still has the same owner since 1982.

But even when the key role of the flood generation is pointed out, the ability of this group of residents to improve people-centered early warning and built local capacity for response is contextualized by challenges that are institutional and historical. On the positive side, when new property owners ask the county planning department about previous risks, retention of staff at the county itself is an advantage in remembering risk. Similarly, local real estate agents do disclose the history of flood damages to a property to new buyers and other institutional measures exist to inform new owners of embedded risk. But the primacy of experience means that even those who have lived in the neighborhood for a long time and have endured several major floods are relatively challenged to imagine the impact of a real (or perhaps mythical) 100-year flood. The current flood cohort group itself has not

[80] This actually is by itself a case of temporal vulnerability, since one's temporal situatedness—year of birth—increases the vulnerability that certain events have an impact, or are imprinted as significant, shared benchmark. This temporal vulnerability is caused by the openness of the young age group to outside events. Further, events that occur during this time become the "first political and social events that people encounter for shaping their later views of the political and social world, so that subsequent events seldom seem as significant as those encountered earlier" (Schuman and Scott 1989:378).

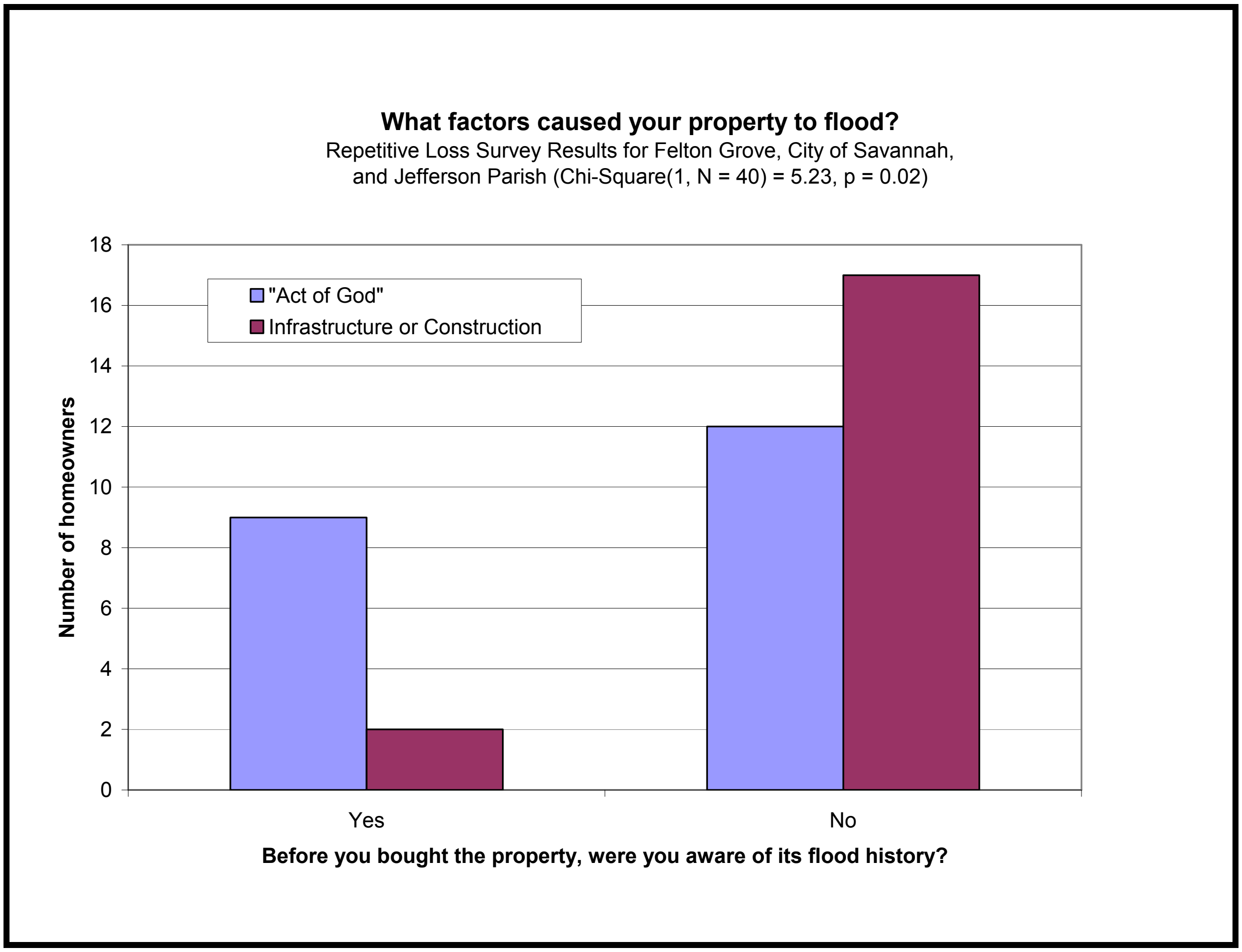
experienced the extent of the damage which the 1982 event caused in the neighborhood, which by itself was only a 50-year flood event. In addition, the high-priced housing market in combination with a saturation in the number of potential hazards (fire, earthquake, landslides, flooding) challenges new buyers to recognize and pay sufficient attention to flood risk. The advantages of finding affordable homes could result in risk denial, a casual amnesia, which is only partially challenged by warnings on deeds and disclosures of flooding by real estate agents. In addition, there are the hidden surprises in the mitigation bureaucracy, those involved in flood proofing and elevating homes. The institutions managing risk appear steeped in unpredictability and liability discourses that stifle local initiative and increase the chance of delays in the permitting and planning process of mitigation project.

The 2003 flood elevation project might have ended temporal vulnerability because many of the homes are lifted out of the immediate danger zone. If the floods stay away, however, it is certain that many of the new homeowners will slowly convert their downstairs areas into small living spaces, and potentially put items or even human beings at risk of flooding once again. This potential nonchalance may be observed in the following newspaper article appearing after the flood in 2005:

> Floodwaters crept into garages, washed away gardening projects and threatened to engulf cars. About 13 homes were damaged by the flood, county officials said. Fire alarms sounded outside Felton Grove at 8 a.m., telling those within earshot to consider heading toward higher ground. Residents moved their cars and got pets upstairs. Three hours later, the fast-moving river showed signs of having receded, and its neighbors showed signs of relief. They began taking breaks from their clean-up work, and shared anecdotes. (Sentinel 2005)

Not knowing flood history means seeking human attribution of causation

Source: FEMA Repetitive Loss Survey Data (2004)
Center for Urban and Regional Studies – UNC-CH



6. KATRINA'S PREDICTABLE SURPRISE

Hurricanes are a way of life for all of us in the Gulf South. We have rebounded from these storms for generations. What happened to us this year, however, can only be described as a catastrophe of Biblical proportions. We in Louisiana know hurricanes and hurricanes know us.
We would not be here today if the levees had not failed."
Governor Kathleen Babineaux Blanco, Testimony before the U.S. House of Representatives. December 14, 2005.

I don't think anyone anticipated the breach of the levees.
President Bush, ABC's 'Good Morning America' Thursday September 1, 2005

6.1. Katrina and Social Vulnerability

The impact of Hurricane Katrina on the City of New Orleans brought two issues to the front of American consciousness: social vulnerability and the inability of the American government to foresee and plan accordingly for a known and impending crisis. While most residents evacuated the City before the storm hit, those who were left behind were mostly poor, minority, and elderly. In assessing the vulnerability of the population to this hazard, the social character of this situation was undeniable even before Katrina hit. After the event, the "politics of disposability" of some parts of the American population was squarely put in full view through lens of the media (Dreier 2006; Kellner 2007)[81]. Katrina challenged presumptions of the democratic "risk society" which Beck and other theorized in the early late 1980s (Beck 1992): "The distinctly socially differentiated impact of the New Orleans

[81] For example, in Urban Affairs Review, Peter Dreier wrote: "The Katrina disaster exposed the major fault lines of American society and politics: class and race. It offers lessons for urban scholars and practitioners. Katrina was a human-made disaster more than a natural disaster. The conditions that led to the disaster, and the response by government officials, were the result of policy choices. Government incompetence was an outgrowth of a more serious indifference to the plight of cities and the poor" (Dreier 2006).

flood stands in marked contrast to the nonsocial character of disasters and inquiries we have become accustomed to in the risk society" (Burgess 2006:74).

The important place which social vulnerability had in emergency preparedness was not new to FEMA. A few months before Hurricane Katrina struck the Gulf Coast in late August 2005, I had started working on a research project funded through FEMA and which had been internally lobbied for to congress by FEMA's Community and Family Preparedness program for years. The project focused on the problems FEMA had in communicating the importance of emergency preparedness and mitigation to what they called "disadvantaged communities"[82]. While we started working on this in the context of Hurricane Isabel, which had affected six states around the Chesapeake Bay as well as North Carolina, Katrina made the urgency and political sensitivity of our project clear. While working on Isabel, all of us realized that the result of the project would be directly applicable to the socially vulnerable population in the Greater Metropolitan New Orleans area. While studying and writing about the social vulnerability of communities impacted by Isabel, we thought about Katrina. The social vulnerability of the Greater New Orleans area, in other words, was no surprise to any one of us when the disaster started to unfold. Neither was it a surprise to FEMA, nor should it have been to anyone in the government. And this introduces the second question that Katrina dramatically brought to the world's attention: why? How could anyone responsible knowingly allow a dire disaster scenario play out in front of the world's cameras?

[82] The overarching goal of the project was to identify and overcome barriers to increasing emergency awareness and preparedness in disadvantaged households and communities.

6.2. Predictable Surprise

In an overview of surprise and global climate change, Schneider and Turner refer to a typology showing that there are differences in the extent to which surprises are predictable (Faber et al. 1992; Schneider & Turner 1994). On the one hand, totally unpredictable surprises, the most extreme outcome, can be equated with ignorance. It is the most intractable: we are ignorant when we cannot or do not know a possible outcome. On the other hand there are predictable surprises. Charles Perrow (1984) might have been one of the first to theorize that likelihood of accidents is normal and to be expected in technological systems (e.g. nuclear reactors) which have interactive complexity and tight coupling. Failure in one part (material, human, or organization) may coincide with the failure of an entirely different part. This unforeseeable combination can cause cascading failures of other parts. In complex systems these possible combinations are practically limitless[83]. The obvious linkage of this perspective to the complex pumping ecology of the New Orleans area, a city situated in the middle of serious swamps, has been emphasized recently by some analysts looking at how risk became normalized (Henke 2007; Leavitt & Kiefer 2006)

Recently, Harvard Business School professors Bazerman and Watkins have popularized the concept of predictable surprise more broadly. They define a predictable surprise as an event or set of events that catch an organization off-guard, despite leaders' prior awareness of information necessary to anticipate the events and their consequences

[83] As Perrow has shown, system "unravelings" have an intelligence of their own: they expose hidden connections, neutralize redundancies, bypass firewalls, and exploit chance circumstances for which no engineer could reasonably plan. Cascading failures can accelerate out of control, confounding human operators and denying them a chance for recovery. Normal accidents typically involve interactions that are not only unexpected, but are incomprehensible for some critical period of time; the people involved just don't figure out quickly enough what is really going wrong. (Perrow 1984).

(Bazerman & Watkins 2004). The concept suggest that leaders had all the data and insight they needed to recognize the potential for, even the inevitability of, a crisis, but failed to respond with effective preventative action (2004). Bazerman and Watkins outline among the major traits of predictable surprises that leaders know that a problem exist, realize that it is getting worse, and know that fixing the problem requires significant cost in the present with no immediate benefit. Because humans tend to maintain the status quo if it functions, one of the outcomes of this situation can institutional inaction. This is predictable surprise.

On Saturday September 3, 2005, Homeland Security Secretary Michael Chertoff made headlines calling Katrina "breathtaking in its surprise. ... That ‘perfect storm’ of a combination of catastrophes exceeded the foresight of the planners, and maybe anybody's foresight... " (CNN 2005). This assertion was swiftly debunked and characteristically illustrated some of the institutional problems plaguing the Bush Administration. In contrast to the initial reactions, it was publically known that the event had been predicted, and as such could have been better prepared for. The Select Bipartisan Committee to Investigate the Preparation for and Response to Hurricane Katrina created on September 15, 2005 by the House of Representatives (H. Res. 437) wrote in its final report (Davis et al. 2006):

> It was a well known and repeatedly documented fact that a severe hurricane could lead to overtopping or breaching of the levees and flooding of the metropolitan area. In fact, for years, the U.S. Army Corps of Engineers (USACE) has had a written plan for unwatering (i.e. draining) New Orleans in such a contingency. This well-known threat was the motivation for FEMA to sponsor the ‘Hurricane Pam’ exercise. The potential for Katrina to be ‘the Big One’ and breach the levees was also the key reason for the National Weather Service, Governor of Louisiana, and Mayor of New Orleans to issue such dire warnings. (Davis et al. p.87)

Before Katrina hit New Orleans, FEMA already considered the likely damage from a strong hurricane hitting the city to rank in the top three potential catastrophes facing the country[84]. While everyone at all levels of the State knew the "Big One" would eventually come, the surprise was to be the way in which the levees breached, and the devastatingly slow response that followed. In his opening statement for the investigations, Chairman Tom Davis (R-VA) pondered the following: "Why did government at all levels fail to react more effectively to a storm that was predicted with unprecedented timeliness and accuracy? Why were all residents not evacuated? Why did the New Orleans levee system fail? Why were relief and medical supplies and support so slow in arriving?" (Davis 2005a). In an article in Homeland *Security Affairs*, Larry Irons argues that this general response failure is connected to a failure by emergency planners to take into account the possibility of a levee failure, or breach (Irons 2005). He further notes that in an overview of preparatory and response actions released by Governor Blanco, it was stated that "No one expected, or predicted, that the levees would fail in the manner which occurred after Hurricane Katrina." (Babineaux Blanco 2007). Irons illustrates that in preparation and response to Katrina, structures that support the avoidance of surprise were absent both within bureaucracies and across them at different levels of government[85]. Concluding that Katrina was a predictable surprise, he suggests a number of

[84] Indeed, the *Houston Chronicle* ran a story in December 2001 by Eric Berger offering the following assessment: "New Orleans is sinking. And its main buffer from a hurricane, the protective Mississippi River delta, is quickly eroding away, leaving the historic city perilously close to disaster. So vulnerable, in fact, that earlier this year the Federal Emergency Management Agency ranked the potential damage to New Orleans as among the three likeliest, most catastrophic disasters facing this country. The other two? A massive earthquake in San Francisco, and, almost prophetically, a terrorist attack on New York City. The New Orleans hurricane scenario may be the deadliest of all. In the face of an approaching storm, scientists say, the city's less-than-adequate evacuation routes would strand 250,000 people or more, and probably kill one of ten left behind as the city drowned under 20 feet of water. Thousands of refugees could land in Houston. Economically, the toll would be shattering."

[85] Following risk psychology, he suggests that individuals tend to take the risk not to invest sufficient time and resources in the present to prevent a large, but low-probability, loss in the future, and choose instead to take smaller losses in the present by investing less in preventative efforts. The result is that spending on prevention is

potential federal level organizational changes aimed at building structures that support surprise-avoidance processes, while discouraging surprise-conducive processes. In particular, he centrally places the need to integrate learning organization principles within federal bureaucracies responsible for both the protection of the area through the building of levees and dams (the U.S. Army Corps of Engineers or USACE), and federal response to the disaster (FEMA).

Was Katrina a predictable surprise? To what extent did the historical situation leading up to Katrina carry within it the temporal conditions of ecological surprise? After Katrina, the public lessons learned was a heightened awareness of the social dimensions of vulnerability and the institutional barriers which might limit emergency preparedness and response despite scientist's warnings (Laska 2006)[86]. In this chapter, I will illustrate how people's relationship to history and memory, their lived experience of temporality, might have acted as a catalyst to social and institutional vulnerabilities which existed previous to Katrina. Attention in this chapter will be given to the historical conditions prior to Katrina, and how these conditions influenced the dwelling within the risk situation among the public and officials. In addition to historical sources and retrospective papers trying to make sense of the Katrina impact, I will base this on fieldwork I did in July 2004 and January 2005, months before hurricane Katrina struck at the end of August 2005. During this time, the disaster hypothetically referred to as "the Big One" was still looming in the future. Using

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too often minimized until the threats are more tangible, or until people can imagine their results. Yet, at that point, it is often too late to avoid a large loss.

[86] In her analysis of Katrina, the hazards researcher Shirley Laska wonders why the scientists issued warnings were not heeded for years. She suggests a general distrust of scientists, who are seen as self-serving in their catastrophe predictions, as one part of the problem. In addition, she notes how there is competition with the even more dramatic media over attention is a difficult struggle. She notes the insularity of scientists to "speak to the choir", and a lack of respect by national leaders for local scientists from a marginalized part of our society (Louisiana) (Laska 2006).

these data, I will provide insight on how the predictable surprise of Katrina was based on a number of temporal vulnerabilities that the population of New Orleans and Jefferson Parish experienced. I will focus on Jefferson Parish and the site of my fieldwork, a neighborhood called Maplewood, located in Harvey on the west bank of the Mississippi River.

Figure 49: Hurricane Betsy, 1965.
Photo anonymous. NOAA Photo Library

6.3. Betsy's Baseline

I first met Peter in the bunker of the Jefferson Parish Emergency Management Center, in 2004. The building itself seemed to symbolize the topic we were discussing: flood mitigation. It looked like a castle. Stories high and windowless towering over the landscape with thick barb wire surrounding it acting as a moat. If the Parish would go under, this place certainly would be the last to fall, so it felt. Jim and I were meeting the local mitigation official—Andy—and Peter, an old high school buddy of Andy, came along. Not for fun, but as a representative of the Maplewood neighborhood Civic Association. The subdivision of Maplewood had been plagued with repetitive flooding, so Andy thought Peter's input would be valuable (Center for Hazard Assessment Response and Technology 2006)[87].

Jim asked Andy and Peter why people continue to live in these areas knowing that it floods. Andrew replied that to a lot of people the area is where they have lived all their lives, and they simply do not want to live anywhere else: "They like the community they live in, they like their neighbors. They like the area. They like what the area offers." Peter chimed in: "They have to move quite a ways to get out of the flooding. It is not just moving to this other subdivision. I mean, a whole area East and West Jefferson, St. Bernard Parish, they all have flooding. It is just the way we live. Unfortunately!" Tom emphasized that this way of living is attracted by the cultural atmosphere. He mentioned Mardi Grass, Jazz fest, and how people love to have a good time:

> Let me tell you. It is because of things like that that they like the area. They don't want to live anywhere else, you know. And when you get down lower, get down in the Lafayette, Maritaria area, that is another different culture altogether. It is fishermen, that is all they know. They live off the land, and they don't know anything else. They don't want to know anything else.

While the issue of sense of place was not new to me or Jim after Jim's study of buyout mitigation in Kinston, North Carolina, it appeared that the connection to the land was perhaps stronger than usual in Southern Louisiana due to its unique history and culture. Andy and

[87] According to a 2006 study of the University of New Orleans Center for Hazard Assessment Response and Technology, of the 567 homes in the neighborhood, 236 (42%) are designated by FEMA as "repetitive loss" properties and 107 of the 236 are "target repetitive loss" properties. These designations mean that these properties have had at least two or more claims of more than $1,000 since 1978, or two or three claims that equal or exceed the building's value. (Center for Hazard Assessment Response and Technology 2006)

Peter agreed that for many Louisiana natives, the land has been owned by three or four generations, and children seldom move away. “For the most part people down here tend to stick together.” I asked them what the influence was of this local historical knowledge on risk perception among repetitively flooded property owners. Peter and Andy’s reaction signifies a tendency with which I struggled myself since I had come to the area; a cognitive, scalar confusion between the smaller scale, more frequent “carpet” flooding, and the likelihood of less frequent, but larger scale hurricane hazards. This confusion often meant a seamless conversational jump from the topic of small scale flooding into the issue of catastrophic flooding. They replied:

> Peter: You are looking at two guys who lived through a hurricane in 65 [laugh]. There was six, seven, ten feet of water where we lived in New Orleans.
> Andy: Let me tell you, 1965 Hurricane Betsy where I lived, believe it or not, to this day we still own the property, it is a rental property now, but it is property I take care of for my family since the mid 70s when my dad passed away. Like he said we had like 3-4 feet of water in the house where he and I lived. Since that time they have made a number of improvements, so that property has not been flooded close to 12 years.

The answer provided also illustrates an important temporal property of the Greater Metropolitan New Orleans hazardscape, namely the baseline reference to Hurricane Betsy. When you talk about history and flooding, Hurricane Betsy speaks. During the rest of the conversation, the temporality of this storm was clarified as being “unique” by our informants:

> Peter: That was a unique situation, grade 3 or 4 hurricane that came into the Gulf at the worst possible time. And it put water over our levees outward canals, just went over the levels, hours of storm surge, with nowhere to go.
> Andy: Let me tell you, this area here could not take a direct hit from a category 4 or 5 hurricane. Or... a strong slow moving three would create problems, big time problems. Fast moving 3, 2, 1; the levees we feel can protect us. But a slow moving strong 3, 4, or 5, not kidding, it is not gonna cut it. The storm surge is gonna go over these levees.
> Danny: Does that mean people basically expect that something will happen in the near future.
> Andy: We hope it does not happen, but the possibility is there that it could.

> Peter: Same reason why people live in Los Angeles. They know they have earthquakes but they love their way of life, they say it is not gonna happen to us.
> Andy: It is the same in San Francisco, it is no different there than it is here, we are just talking about a different threat.
> Peter: Let's just hope it is never gonna hit us. We don't know, we certainly hope not. Since then the Parishes have come light years, I moved over here in 68 when I got married, I moved to the West Bank, my wife owned some property, we built, we had some problem with the flooding, but it seemed like it is getting better and better. They are doing a lot of improvements. Pumping stations, widening canals, drainage. Unfortunately there is never enough money to take care of everybody who wants the attention. I mean, that is just life.

What is apparent is that while the two men knew that the area was due for another hurricane, their hopes were that it just would not happen. In an effort to appease nerves, Peter mentioned that the Parish had been doing a lot of improvements, so that there was a sparkle of hope that the Big One, when it came, might in fact not be that bad. But the baseline storm provided some reassurance. While Tom, as a well-informed emergency management official, mentioned the prevailing risk attitude which included the notion that a slow moving Hurricane category 3 would top the levees, Betsy was explained by the men as a "unique" event which came at the "worst possible time." Placed on this "unique" pedestal, Betsy is made more temporally rare, and thus less likely to happen again.

Taking a broad view of Louisiana hurricane history, the notion of Betsy's temporal uniqueness quickly loses steam. Only a few years after Betsy, a fierce Category 4 storm called Camille missed the New Orleans area only slightly (see Figure 50)[88], and similar near misses occurred after Betsy with Hurricanes Andrew (1992), George (1995) and Ivan (2004).

[88] Camille made landfall near Bay St. Louis, Mississippi, on the night of August 17, 1969. Camille dropped localized rainfall amounts of up to thirty-one inches all the way into Virginia. It recorded the highest storm surge (more than twenty-four feet) in the United States prior to Katrina in 2005. Camille killed 143 people along the Gulf coast and was responsible for extensive flooding, which claimed an additional 113 lives. Nearly 9,000 people were injured and 5,662 homes were destroyed. The total damage estimate was $1.42 billion. http://www.hq.usace.army.mil/history/Hurricane_files/Hurricane.htm

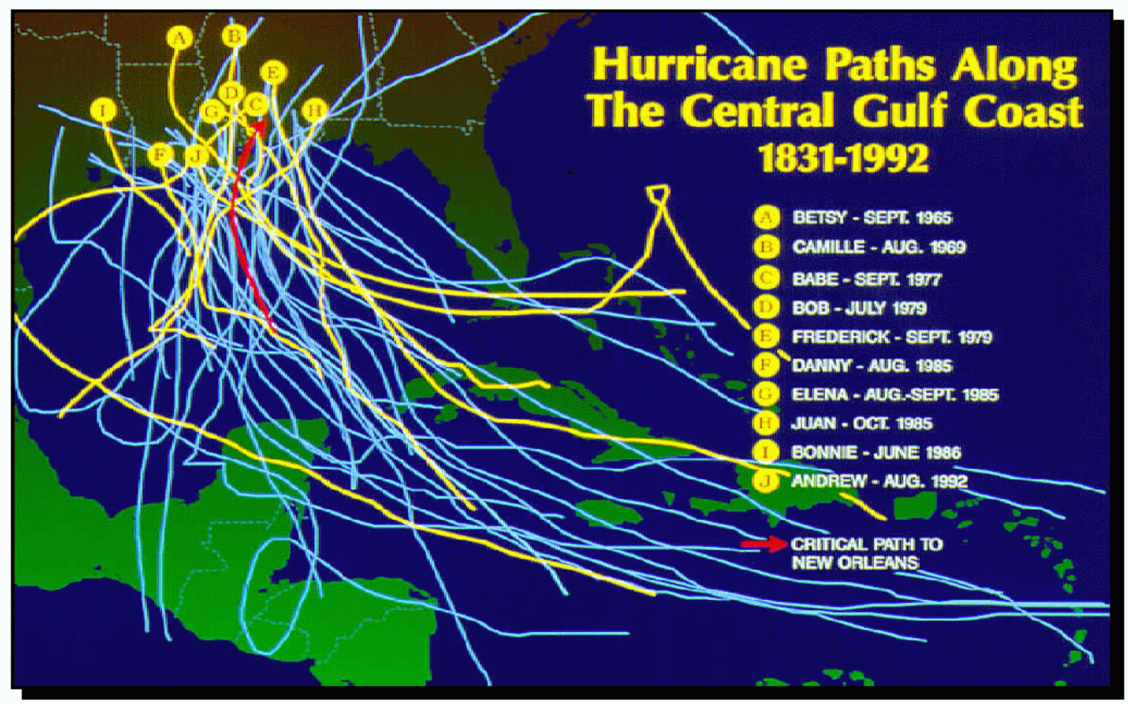

Figure 50: Hurricane Paths Along the Central Gulf Coast 1831-1992.
The red arrow indicates the critical path to New Orleans. Source: U.S. Army Corps of Engineers

Even before Camille, the major blows which could have devastated the City are too numerous to summarize[89]. The Great Mississippi Flood of 1927 swamped one million homes around the City, but the flood waters never reached new Orleans, because a levee was detonated with dynamite, displacing 10,000 poor inhabitants in neighboring Saint Bernard Parish and sparing the upper-class City inhabitants (Barry 1995)[90]. As with Katrina, the flood exposed the social vulnerability of the poor, and the racism, greed, power politics, and bureaucratic incompetence to which they were subject[91]. An article in the USA Today by

[89] Significant to mention are the unnamed August Hurricane of 1940, the September Hurricane of 1915, the Cheniere Caminanda Hurricane of 1893, the Isle Dernieres Hurricane of 1856, and the Racer's Storm of 1837.

[90] This also provided fuel for the ongoing (and never disproved) rumor that levees were also bombed during Betsy and even Katrina to flood the 9th Ward in order to save higher priced homes in the City.

[91] Hundreds of thousands of African Americans were packed into squalid refugee camps and many more migrated north and west as the myths of the friendly feudal plantation and sharecropping dissolved behind

James West mentions that the National Hurricane Center data shows that from 1900 to 1996 alone, 25 hurricanes hit Louisiana, including 12 with winds faster than 111 mph, and that many more storms hit neighboring states of Texas and Mississippi (USA-Today 2005). On average, a tropical storm is expected to strike somewhere along Louisiana's coast about once a year with a hurricane possible once every three years. Betsy however was the only hurricane with a major impact on the city in recent history. While Betsy was one of the fastest moving hurricanes in recorded history, providing little evacuation time, the hurricane did not hit the city directly[92]. Furthermore, according to group of hydrological modelers working on an Advanced Circulation Model called ADCIRC[93], Betsy occurred during a period of low river flow, which suggests that the six to eight meter river levees protecting New Orleans would have been more than adequate to protect the city (Westerink et al. 2005). What is evident from the model is that water was predominantly being blown from the east and then was stopped by obstructions, resulting in strong storm surge buildup. In New Orleans, the newly dug Intracoastal Waterway (ICW) canal was where the surge built up to 14 feet against the levee on the west side of the Inner Harbor Navigation Canal (IHNC). As with Katrina (see Laska, 2006), it was this canal which caused the problem. When I

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them. The 1927 flood became a turning point for levee management, since from that time on the USACE took over control of levee management.

[92] As one of the fastest moving Gulf of Mexico hurricanes on record with a hurricane warning time less than 12 hours, evacuation during Hurricane Betsy was difficult, but 250,000 people still managed to evacuate the city. The U.S. Army Corps of Engineers notes that this was “one of the largest evacuations of danger areas accomplished in the continental United States” (USACE, 1965). Clearly, the perceived risk of Betsy was substantial.

[93] The ADCIRC model is being applied in Southern Louisiana by the U.S. Army Corps of Engineers New Orleans District to design levee heights and alignments, by FEMA to establish flooding probabilities for insurance purposes, by the State of Louisiana at the Center for the Study of Public Health Impacts of Hurricanes to predict hurricane inundation and by the Louisiana State DNR to assess coastal restoration projects.

interviewed him again in his home in 2005, Peter described impassionedly his memory of the event in a neighborhood close to the Ninth Ward:

> Peter: I lived there during Betsy! I had 6 feet of water in my house. 1965, first day of high school for me. You don't forget things. Came home, terrible rain. By 9:30 that night all lights had gone out. What happened was that our neighborhood had water before in the streets, but never high. The water came much like it would do here over the industrial canal from the gulf outward. They made a channel called a "Gulf Outlet." They did that to run parallel to the Mississippi River, a straight shot for commerce to go through this canal. What it did is it pushed a terrible storm surge. The river had a strong current, but this intercoastal, had no current.
> Danny: No lock
> Peter: No. It dead ends at this canal, very deep canal which goes from the river to the Lake Pontchartrain called the industrial canal. The coastal waterway goes to it. When it came over the levee, the water came up 10 feet maybe, we were living there, within 1,5 hours we had 4-5 feet of water in our house. It caught people by surprise because we were not expecting it. It is not like today. The city had never experienced that type of water. The storm had never taken that path. This new channel had just opened. Nobody had predicted it.

Peter explained that the area flooded by Betsy became like a bathtub. He sat in a school for two weeks until the water went down, which was complicated by the fact that many pumping stations had shorted out. While Peter mentioned remembering his mother telling him about a Hurricane in 1947, he explained that there had been only wind damage, and no flooding. Previous to the ICW canal, the danger to the City came from an overflowing of Lake Pontchartrain. Eddie:

> We had heavy rains in New Orleans with hurricanes that put water in the street. It was a way of life. It wasn't…the most expensive neighborhood, but nice. Drainage was always a little bit of a problem, but never…, no one in their wildest imagination…. it caught my mom off guard, my dad, you know, we had not planned. We had people at our house go through a hurricane with us. We had kerosene lamp, drinks in an ice chest, little foods, canned goods. We expected the lights to go out, maybe a little physical damage to the home, like a tree would fall on our house. Never ever did we think to get six feet of water in our house. Where we were living that was unthinkable. But I was living close to a lake and we had a drainage canal three blocks away. It caught them off guard.

The surprise of Betsy had been brewing since the 1927 flood. This flood had made controlling the Mississippi the top job for the Army Corps of Engineers. In a radio show called "Living on Earth," University of Maryland engineering professor and retired General Gerald Galloway, who served 38 years in the Corps of Engineers, explained how Betsy surprised the Corps:

> The Mississippi was the big tiger that they were wrestling with. That's the front door to New Orleans. The back door was the coastal protection from hurricanes. In 1965 Hurricane Betsy alerted everybody to the fact that you could put New Orleans under water from the back door (Living on Earth 2006).

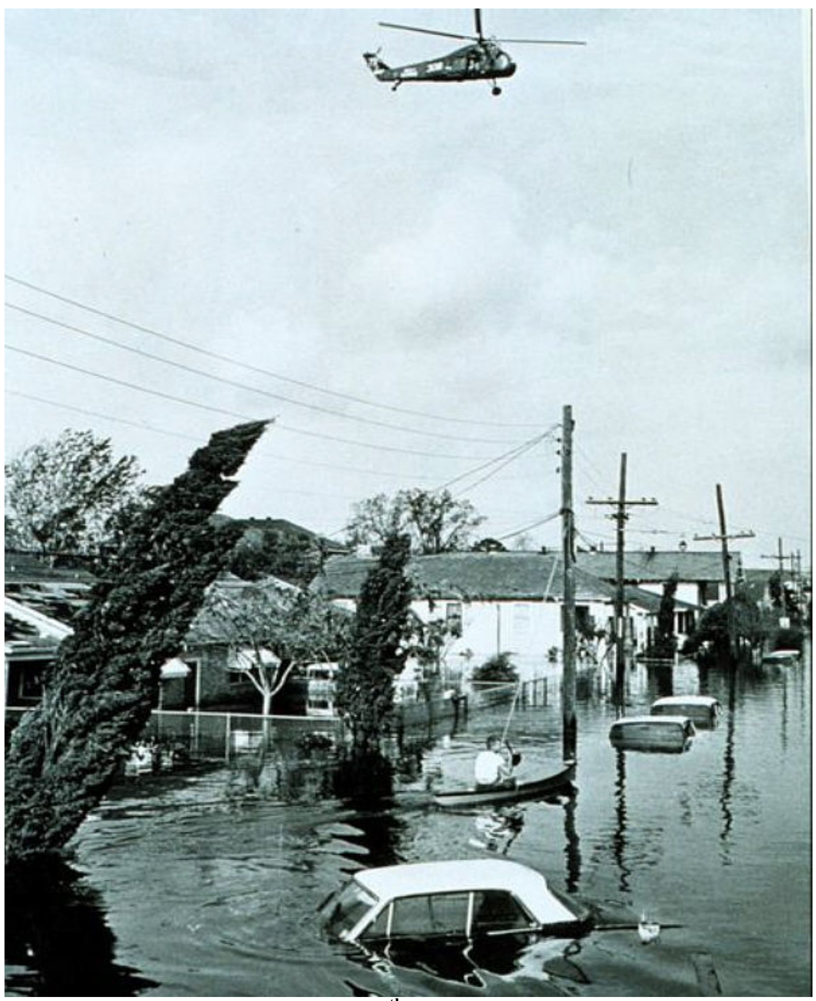


Figure 51: Helicopter hovers over Lower 9th Ward following passage of Hurricane Betsy. Photo by R. Vetter, American Red Cross, NOAA Photo Library, 1965.

Betsy served for Peter as the lived experience of a serious flood, and therefore as the baseline flood risk event. It was not only for Peter, but also for most scientists busy trying to predict the impact of "The Big One" on the City. Before Katrina struck, the ADCIRC Development Group mentioned in their 2005 paper that their Betsy (hindcast) computer model would be used by the U.S. Army Corps of Engineers to redesign the levees in Southern Louisiana and by the State of Louisiana to study the environmental impact of hurricane floods. As another example, the historical preservationists Colten and Welch took the hurricane as a model to understand the impact a severe storm would have on the architectural integrity of the City, by using the flooded Bywater neighborhood as a model to understand negative alteration or destruction: "This examination will offer insight into the potential recovery and maintenance of integrity following a significant flooding event" (2003). Yet, while Betsy was a fierce hurricane with devastating consequences for the City, it was no match to the impact of Katrina (and the rainfall associated with Tropical Storm Rita four weeks later) on the area, in particular the Metropolitan area of New Orleans itself. Table 8 and Figure 52 and

Figure 53 show contrasting data. What this comparison suggests is that while Betsy is the only baseline reference for a major hurricane impact on the city, as a hazard and disaster, it did not match the impact of Hurricane Katrina, and the potential impact which Hurricanes Camille, George and Ivan could have had had their paths been different.

Table 8: Betsy and Katrina contrasted

Characteristics	**Betsy**	**Katrina**
Highest Winds	155 mph (250 km/h)	175 mph (280 km/h)
Maximum Storm Surge	14 feet (Westerink et al. 2007)	27 feet
Damage	$9.3 billion (2007 USD)	$ 86 billion (2007 USD)
Number of homes damaged or destroyed	164,000	1 million
Number of people displaced	Unknown	2.5 million
Damage area (sq/miles) in LA	4,800	90,000
Deaths	81	1,836 – 4000
Missing	Unknown	700
Injured	17,600	2,018
Number of people evacuated	250,000	1 million
Time transportation and utilities disrupted	"For weeks" (USACE 1965).	Months – years
Storm Surge	See Figure 52 top	See Figure 52 bottom
Inundation Map	See Figure 53 top	**See** Figure 53 bottom

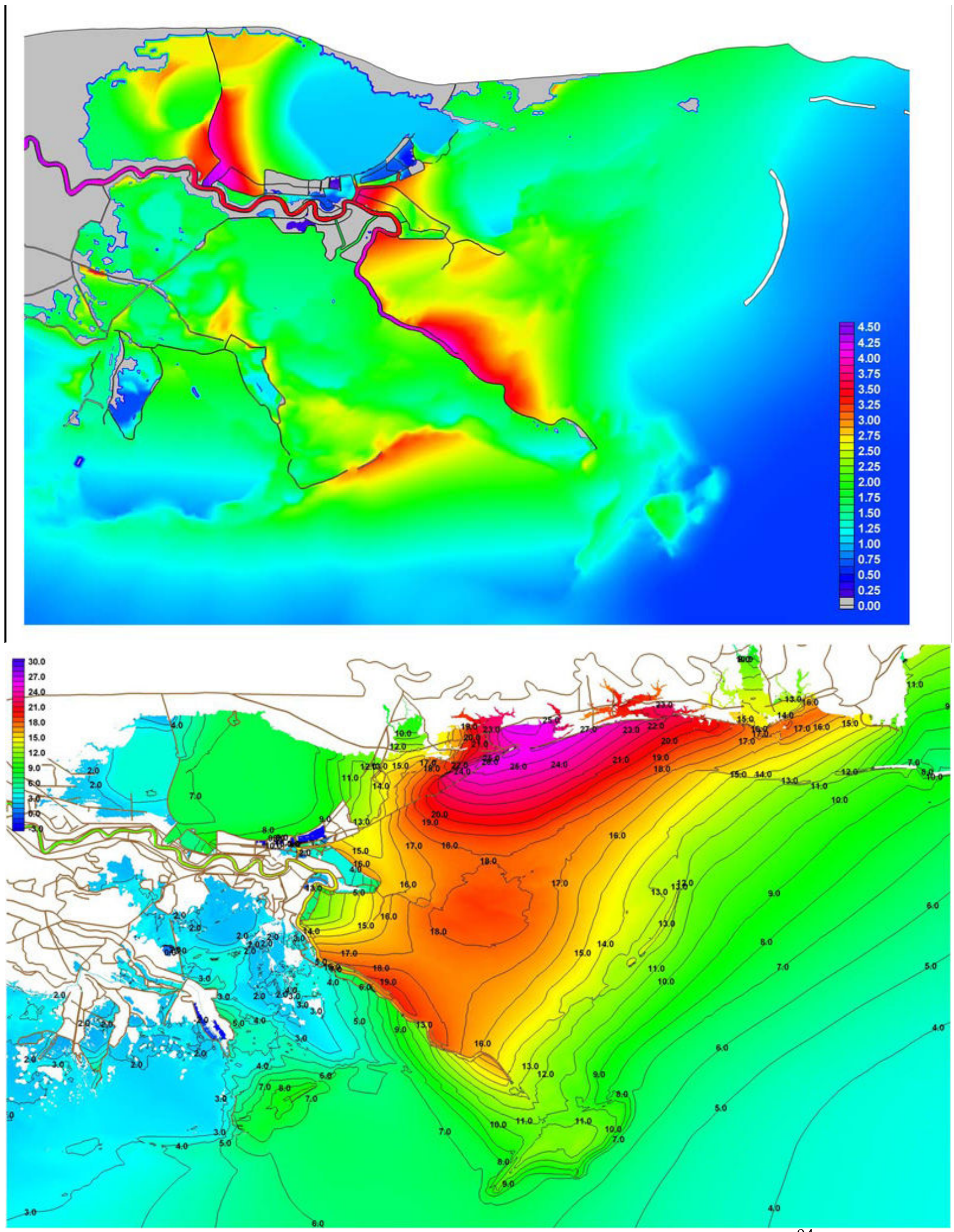
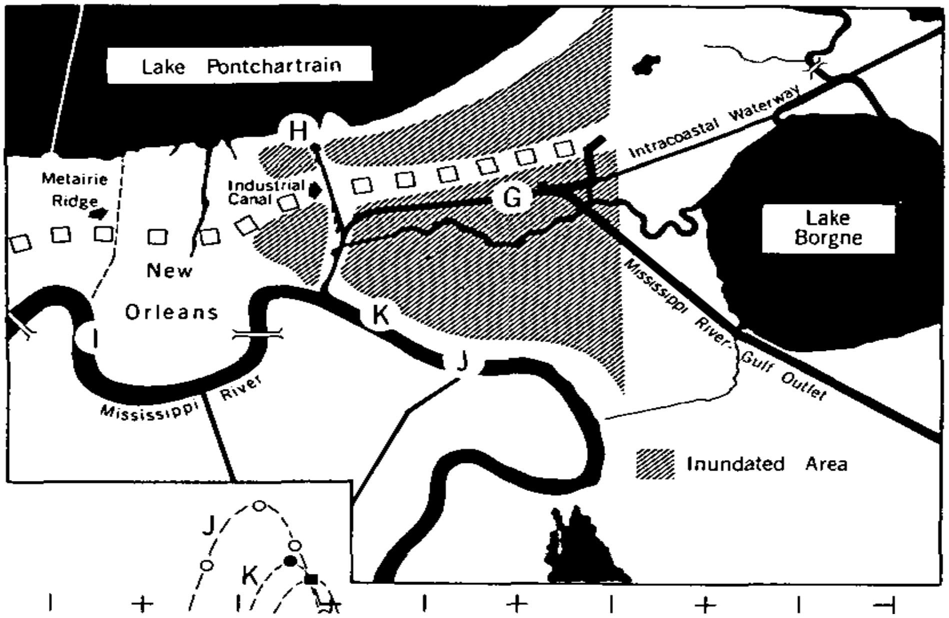


Figure 52: Storm Surges: Betsy (top) and Katrina (bottom)[94].
Areas in red to purple/pink have higher storm surge according to isolines

[94] Developing predictive models of hurricane storm surge in Southern Louisiana is difficult due to the complexity of the geography, the range of spatial scales involved and the long term change in the physical system. Peak storm surge elevations simulated by ADCIRC, during the Hurricane Katrina event (shown in meters) and simulated for Hurricane Betsy (1965). Images courtesy of Clint Dawson, and Joannes Westerink, University of Notre Dame.



STORM SURGE OVER THE MISSISSIPPI RIVER DELTA ACCOMPANYING
HURRICANE BETSY, 1965
D. A. GOUDEAU and W. C. CONNER
Weather Bureau, ESSA, New Orleans, La.

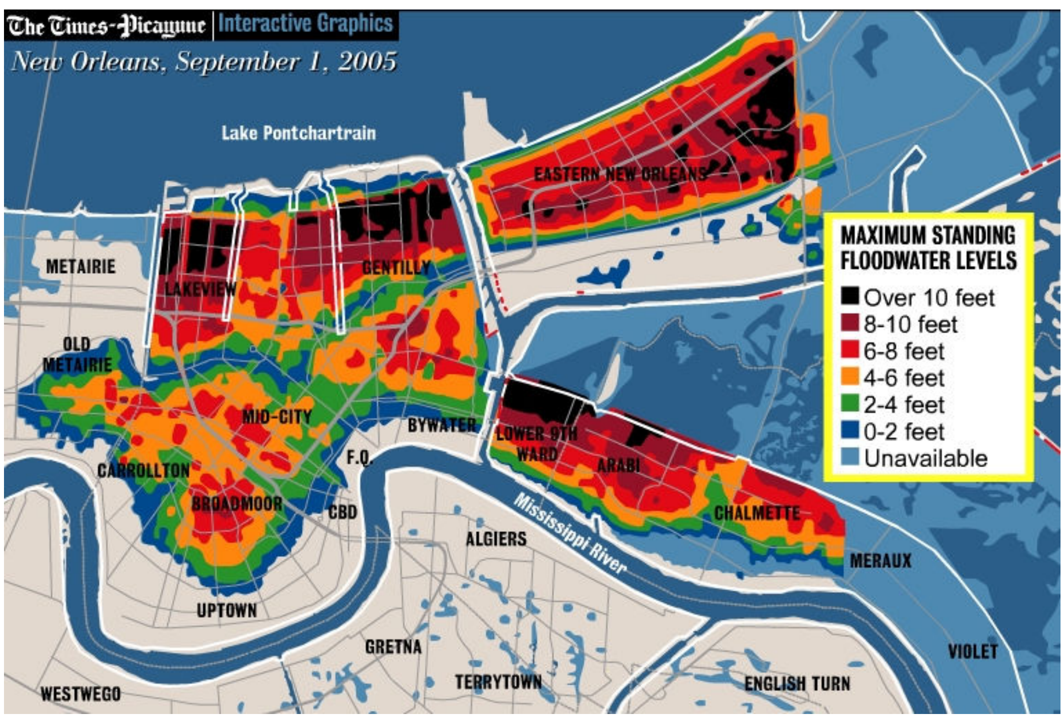


Image Courtesy of the Times-Picayune

Figure 53: Flood Inundation: Betsy (top) and Katrina (below)

6.4. The Standard Project Hurricane Baseline

In the wake of Betsy, many things changed in New Orleans. The South Lake Pontchartrain flood protection measures were authorized by Congress. This project included heightening of the protective levees along the Inner Harbor Navigation Canal and the Lake Pontchartrain shoreline to the Orleans-Jefferson Parish boundary, and around Chalmette in St. Bernard's Parish. This system was subsequently enlarged to include the Pontchartrain levee all the way to the Bonne Carré Spillway and along the principal drainage canals in New Orleans and Jefferson Parishes. Figure 54 shows an image of the authorized plan of protection in 1970 devised by U.S. Army Corps of Engineers.

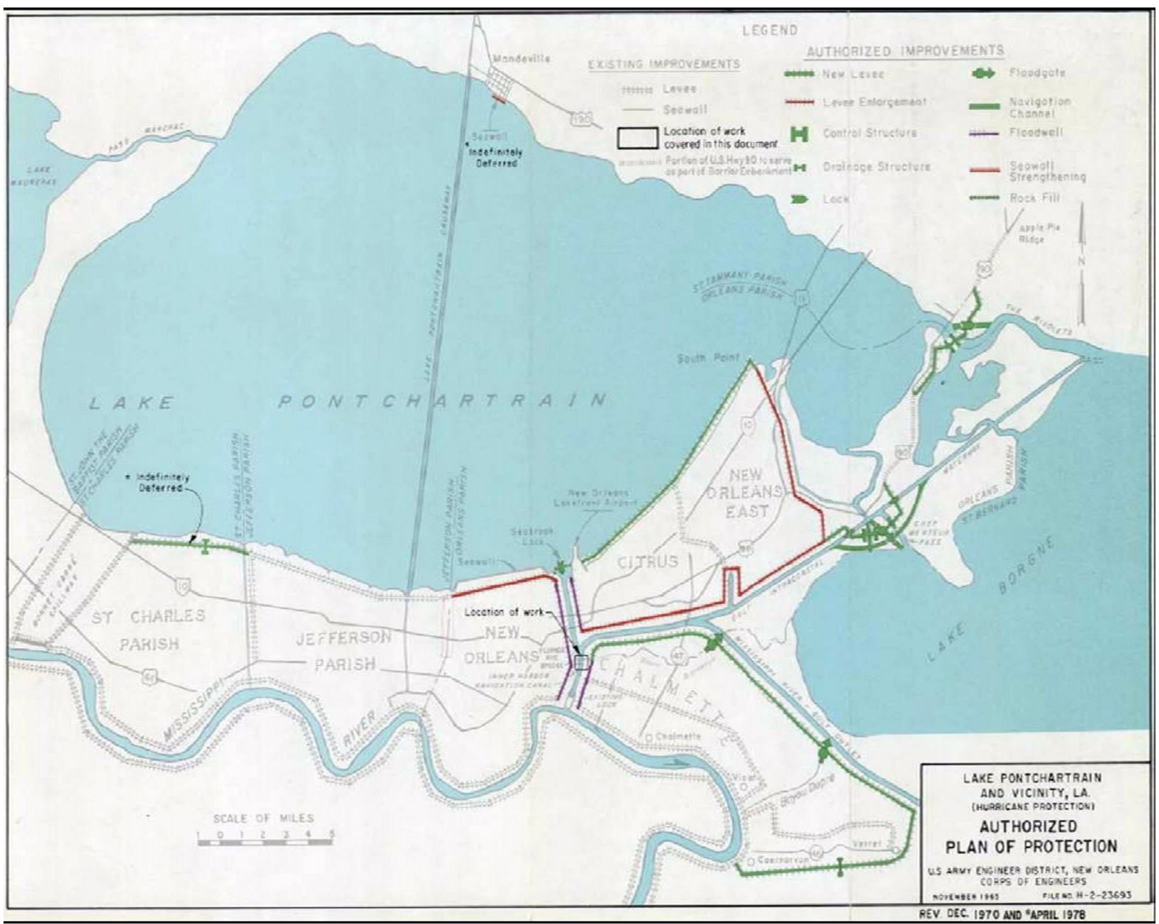


Figure 54: US. Army Corps of Engineers Authorized Plan of Protection, 1970.

After this, the Southern Louisiana Flood Protection system was authorized by Congress. This levee system was supposed to protect the area from the kind of storm that would come only once in two centuries, or with a recurrence interval of 200-300 years (General Accounting Office 1982). It was expected to take about 13 years to complete and cost about $85 million, according to a history by the Government Accountability Office[95]. Undiscovered until Katrina was that this system of levees, spurred by Betsy, ironically failed to include calculation of extreme storms such as Betsy and Camille. According to the chapter addressing levees in the Post-Katrina investigation conducted by the House of Representatives and led by Raymond B. Seed (Professor of Civil and Environmental Engineering at the University of California, Berkeley), the main tool used to design the system was a hypothetical storm referred to as the "Standard Project Hurricane" (Davis et al. 2006). In the report, the authors describe the standard project hurricane as a "statistical compilation of many combined hurricane parameters or characteristics intended to simulate a natural hurricane occurrence in southeast Louisiana" (Davis et al. 2006:89)[96]. The authors of this report critically highlighted that this standard actually excluded the fiercest storms such as Hurricane Camille in 1969 from the database. In fact, the criteria were based on Weather Bureau data on hurricanes which approached the coastal area from 1900 until 1956 (Anderson 2007). Not until 1979 did the Weather Bureau provide updated data including Camille and Betsy. However, "it does not appear that the USACE used the updated Standard Project Hurricane criteria" (Anderson 2007:20). In their Katrina report, the Berkeley group

[95] When Hurricane Katrina hit New Orleans 40 years later, the system was still not finished, and it had already cost $738 million. In the eight months since the storm, the Corps of Engineers has spent some $800 million in direct costs to repair the system — $62 million more than it had cost in the first place (The New York Times 2006)

[96] This standard project hurricane was used not only for the Lake Pontchartrain project, but also nationwide for all hurricane protection projects where there is potential for the loss of human life.

noted that Camille, a rare category 5 hurricane, was excluded because it was presumed to be outlier data, which as they argued "is not appropriate in the context of dealing with extreme hazards" (Davis et al. 2006:89)[97]. Further, the authors note that there appeared to be no direct comparison of the Standard Project Hurricane to a specific category on the Saffir-Simpson Hurricane Scale, which did not exist when the levees were designed. The authors concluded that the Standard Project Hurricane was in fact equivalent to a hurricane with category 2 winds, category 3 storm surge, and category 4 barometric pressure. Not nearly as intense as Betsy. Finally, they pointed out:

> "there is no 'standard' hurricane — the actual forces that levees need to withstand are a function of several factors. According to the preliminary NSF study, "the actual wind, wave and storm surge loadings imposed at any location within the overall flood protection system are a function of location relative to the storm, wind speed and direction, orientation of levees, local bodies of water, channel configurations, offshore contours, vegetative cover, etc. They also vary over time, as the storm moves through the region." (Davis et al. 2006:89)

According to the report, the Standard Project Hurricane was enshrined by the Army Corps of Engineers, and was uncritically presumed to be relevant and accurate. The Berkeley research group wrote that the corps saw little need to go back and reanalyze "the true risks of catastrophic flooding" in New Orleans. Even when the National Oceanic and Atmospheric Administration, the successor agency to the Weather Bureau, recommended increasing the strength of the model, the corps did not change its construction plans. A report released in 2006 by the Senate Committee on Homeland Security and Government Affairs, argued that calling the Standard Project Hurricane a Category 3 storm was "at best a rough estimate, and at worst, simply inaccurate." (The New York Times 2006).

[97] They also noted that in the calculations of the cost-benefit ratios the economic and social costs of failure were not taken accurately into account, making projections more optimistic than they should have.

To make matters worse, while UCADE was responsible for the overall functioning of the levees. It was a patchwork of independent contractors not held to a single quality standard, and among which many had an interest in protecting their turf. Davis et al. report that “The different local organizations involved had the effect of diffusing responsibility and creating potential weaknesses.” One such weakness lay in the quality with which the levees were monitored for structural integrity and obstructions. While records indicate that the contractors all inspected the levees and had given them “adequate” ratings, NSF-funded investigators later found out that brush and even trees were growing along the 17th Street and London Avenue canals’ levees, disallowed under the established standards for levee protection (Davis et al 2005).

The potential of the levees to cause surprise was further exacerbated by the marvelous complexity of the engineering involved. The levee system with pumps, canals, channels and other critical infrastructure elements involved a cascading interdependency of multiple infrastructure systems. One of my elderly informants, Mr. Williams, provided an example to me from his own experience explaining how an area which was on higher land suddenly flooded because the building of Jefferson Highway acted as a trap for water coming from the Mississippi River. Engineers did not foresee this possibility and built culverts (pipes channeling water underneath a road) of too small diameter resulting in unexpected flooding to the south. Leavitt and Kiefer write about such complex interactions at a regional scale in the context of Katrina (2006):

> As the levee system began to fail, and water started rising in the City, adjacent parishes hastily called on their public works departments to construct temporary levees along parish lines, with little reliance on accurate flood maps (Brown, 2005). The result was that in some places rising water was effectively slowed; however, in other locations barriers were useless, consuming valuable time and the limited resources of already stressed public works departments in their construction. Many of

these temporary levees served to effectively block evacuation routes from the City, hindering the exodus of city residents. (Leavitt & Kiefer 2006:311)

Exacerbating this problem were long histories of mutual distrust and even animosity between fragmented Parishes "with a tradition of behaving more like independent fiefdoms than good regional citizens" (Leavitt & Kiefer 2006:311). In the context of disaster vulnerability assessment, these authors argue for greater attention to interdependencies which are in fact temporal in nature, since they are related to close tight chains with cascading effects (like ripples in a pond). This is a perspective that follows Perrow's theory of the normal accidents outlined in the introduction[98].

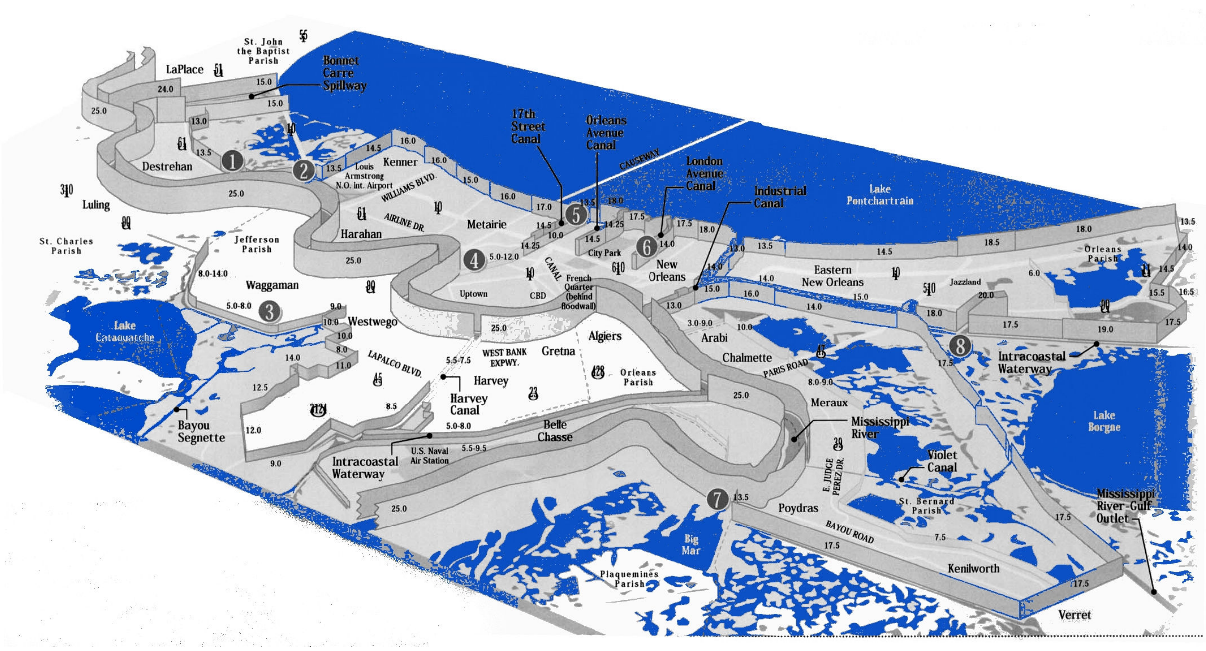


Figure 55: The New Orleans USACE Levee System (After Davis et al. 2005)

98 Leavitt and Kiefer follow Perrow and argue: "It is essential for managers of each infrastructure system to determine which other infrastructure systems they must depend on to continue in operation and which other systems must be involved in the restoration of service following a major disruption. Each infrastructure system must also be prepared to assess the risks of potential environmental impacts resulting from system failures" (Leavitt and Kiefer 2006:311).

Summarizing the previous sections, several vulnerabilities can be pointed out. First, Betsy served as a baseline event which provided an erroneous mental model of the actual impact which "the Big One" could have. This was further exacerbated by a false sense of security that followed from the construction of levees calibrated against a weak, simulated temporal referent with little historical accuracy. In addition, two more temporal impacts contextualized this situation. First, lacking quality monitoring of the conditions of the levees, degradation of their condition was potentially missed. Additionally, the temporal complexity of the canals that the levees protected induced a temporal lag and cascading dependency which further induced conditions of surprise. These were the characteristics of the condition for temporal vulnerability previous to Katrina.

6.5. **Evacuation**

The impact of this vulnerability is illustrated by its impact on emergency evacuation. For example, Terry Tullier, Director of the city's Office of Emergency Preparedness of the City of New Orleans, places the issue of temporal referentiality central to the discussion of evacuation:

> I'm always asked what's my worst nightmare, and I talk about the generations of New Orleanians who have no historical reference in their brain about how bad this will be," Tullier said. "And when I preach the gospel of evacuation, they won't take it seriously. Evacuation, that's such a tough decision for our officials to make, so once they make that decision, to have people say, 'Ah, I ain't going to go,' that scares me. (The Times Picayune 2004)

While social vulnerability—poverty, lack of transportation, language, etc.—is the predominantly stated reason why so many residents stayed behind to ride out the storm (Dreier 2006; Burgess 2006; Kellner 2007), it is clear from this quotation that a lack of historical referentiality complicated the evacuation scenario. Not only were those without the lived experience of a major storm event at risk, but those with who did experience Betsy seemed to have taken this event not as a warning, but instead as evidence that the "Big One" could be weathered as well. Particularly the elderly who weathered Betsy, and for whom the decision to evacuate came with substantial additional costs, might have used this baseline to argue against leaving the area. In "Act I" of his movie "When the Levees Broke," Director Spike Lee interviews a number of residents who decided to stay during Hurricane Katrina. When reasons for staying put are mentioned in these interviews, one item Lee highlights is the Betsy baseline. For example, Donald Harrison, musician and resident of Broadmoor, tells the Director:

> I was here during Hurricane Katrina. Because my mother in law decided, as many New Orleanians did, that they could weather the storm. We had not had a major Hurricane since 1965. That was Hurricane Betsy. I remember, when I was 5 years old, the water coming up then and driving through it, surviving it. So, I have always been afraid of hurricanes (When the Levees Broke 2006).

Similarly, Herbert Freeman Jr. , resident of Central City and another of Lee's informants, on camera tells the dramatic story of his mother, who eventually perished at the side of the road waiting for a bus which never came:

> My mother, she had been bedridden for a while, but she was in good spirits. I told her, 'mamma there is a hurricane coming.' She said, 'oh yeah, well we survived Betsy, you remember?' And I said 'yeah I remember that. But I am boarding up the windows.' We are just going to try to survive it out. ….. Then for a minute, when I seen the water in, I knew we had to get off. And she said 'why do we have to go now, explain it to me,' that the water was coming up and rising up. Cause she said we did not have to leave for hurricane Betsy. I said 'no we didn't, but we have to leave now.' So I had to get a guy who lived in the neighborhood to get someone with a canoe, a little boat. And I took her in her wheel chair and I had to get all the way to St. Charles Ave where the water subsided a little bit (When the Levees Broke 2006).

They went to a crowded area where an officer suggested he would wait for an evacuation bus. But while he waited for hours his mom became unresponsive and died. The bus never came. He had to leave her behind on the sidewalk with a note with his contact information on it. This pattern is also picked-up and noted by Cynthia Hedge-Morell, City Council member District D, Resident of Gentilly:

> The same things always happen when a hurricane comes to New Orleans. There is a group that says we are going to leave, you don't have to tell me twice. And then there is the other group that says I rode out Betsy and I am going to stay here and I will be okay (Cynthia Hedge-Morell, When the Levees Broke, 2006).

During the pre-Katrina years, evacuation behavior was the major emergency management concern. In efforts to have the public understand the reality of evacuation, Jefferson Parish released a public education video in 2003 called "The Cries of a Hurricane," in which computer simulations were used to try to communicate to the public the meaning of an evacuation message[99]. The video shows Aaron F. Broussard, President of Jefferson Parish, explaining how the Parish is one of the most vulnerable areas in the country[100]. The narration continuous: "For those who have been lulled into false sense of security by false alarms, your are gambling with your lives and those of your family" (The Cries of a Hurricane 2003). The video is dramatic, showing dramatic pictures of the City submerged (see Figure 56).

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[99] The video's introduction shows black and white footage of an elderly, French speaking Cajun man who experienced the 1893 Chenière Caminada Hurricane. The Chenière Caminada Hurricane was a powerful hurricane that devastated the island of Chenière Caminada, Louisiana in early October of 1893. It was one of two deadly hurricanes during the 1893 Atlantic hurricane season; the storm killed an estimated 2,000 people, mostly from storm surge. The footage is dramatic: "We began to hear cries. People about to be drowned who were crying for their papa or mama, and there… women were continuing to pray to the Good Lord, to ask the Lord not to leave us, not to die, not to leave us."

[100] While this message is accompanied by relaxing music one generally hears in a shopping mall, the video ironically speaks of catastrophe and horror.

Figure 56: Screenshots from the public education video "Cries of a Hurricane." Courtesy of Jefferson Parish.

The message is clearly spelled out by William M. Gray, Ph.D., Professor of Tropical and Marine Meteorology at Colorado State University: "We may have to evacuate four or five times for every time you really needed to, but that effort will be worth it. Obey what the

Jefferson EM says, they have your best interest at heart." The push for evacuation is also illustrated by a video produced by Total Community Action in 2005 called **"**Preparing for the Big One." In it the likely possibility of a complete, mandatory evacuation is mentioned and explained by Mayor Ray Nagin:

> I want to remind everyone we live in a bowl. Everything above a category 2 hurricane has real possibility of flooding. Historically, people think they go to school site and they be safe. Our experts are now telling us that the school sites might not be strong enough, and the superdome is only a shelter of last result. People need to have their own plan (Preparing for the Big One 2005)

In the video, Oliver Thomas, City Council President, mentions that there has been a significant increase of hurricanes, and uses Hurricane Betsy to bring the point home:

> Both my sets of families have experience. With Betsy being stuck on the roof of a house waiting for people to come rescue us. I experienced it as a child. I understand how important it is. Every family needs to have an idea of what they will do when a hurricane comes this way. … People are inclined to do what they've always done, or what their parents or grandparents always did. And it is really hard to convince people that things have changed (Preparing for the Big One 2005).

Despite these media campaigns, evacuation numbers had increased only marginally. Polls done by the University of New Orleans Survey Research Center after Hurricanes Andrew (1989), George (1998), and based on a hypothetical scenario which is close to that of Katrina (2004), and after Hurricane Karina (2007), show that before the Katrina struck, evacuation warnings were often unheeded (see Table 9).

Table 9: Hurricane Evacuation Poll Data

Event	**Jefferson**	**New Orleans**	**Both**
Hurricane Andrew Poll *Evacuated after Hurricane Andrew*			15%
Hurricane George Poll (1998) *Evacuated after Hurricane Georges.*	45%	27%	
June 2004 Hypothetical Scenario Poll (before Hurricane Ivan) *Percent likely to evacuate when recommended.*	27% definitely 43% probably	30% definitely 40% probably	
March 2007 (post-Katrina) *Percent likely to evacuate when recommended.*	55% definitely 22% probably	75% definitely 14% probably	

After the 1998 poll, the Times-Picayune reported that the polls offer "sobering statistics," showing many residents evacuate too late (The Times Picayune 1998). In 2004, this situation was still severe enough that a Times-Picayune newspaper summary of the 2004 poll concludes that "Officials attending the workshop said that the poll shows officials need to do a better job of educating the public about the risk posed by catastrophic storms" (The Times Picayune 2004). The poll data particularly illustrate the difference between the pre- and post-Katrina paradigms. Based on the 2007 poll data, researchers who conducted and analyzed it noted that Katrina had a dramatic effect on residents' tendency to evacuate when recommended by public officials:

> Today, over three-quarters of the residents in both Orleans and over half in Jefferson say they would "definitely evacuate" if public officials recommended it. These answers are certainly somewhat inflated by the desire to give the correct response, but the change since 2004 indicates that a much larger proportion of residents in these parishes are certain about their intention to evacuate if recommended (Howell et al 2007).

What is clear from these data is that the event caused a cultural shift in resident's orientation to risk, which prior to Katrina included an association that was most recently informed by the evacuation experience of Hurricane Ivan in 2004. Many of my informants described this evacuation as "horrendous." Peter mentioned the Ivan warnings and evacuation as "scaring the living hell out of everybody." He mentioned that people were beyond themselves: "They took people out of hospitals. It was the most chaotic thing." An elderly informant, Mr. Jacks, suggested a similar increase in risk awareness:

> We had some close calls before. My general feeling is that people are getting more aware. More emphasis on it. But, I don't think all of them are. There is not enough of them. That is the problem: That is why so many will die.

Dottie and Ed Juniper called the Ivan evacuation a "20 hour nightmare," and told me that their neighbor "started to evacuate, but the traffic was so terrible he turned around and stayed." In their assessment, the Ivan experience made a lot of people less inclined to evacuate the next time (which was Katrina). Buck, owner of a pipe fitting business, described to me some of the lessons he learned from the Parish on evacuation. While Buck packed his bags during Ivan and left the City, he still emphasized his dilemma in choosing when to heed the warnings:

> Buck: I would not be here with a 4. I am not going to stay. The Parish told us if we get a strong 3 moving slow, or 4-5, it would be 6 months before we can get back in. The pumping stations would be flooded, which are run by electricity. All the water plants would be done. They would have to blow the levees to get the water out. Cause no pumping station would be able to pump it out. Then rebuild the infrastructure. It would be 5-6 months. What does an individual do? Working for this company we have offices in other parts of LA, I can probably work out of that office. But most of my business is based on here south. Most of it comes from Venice. Oil fittings. Providing for pipelines and stuff like that. It would be a…. what would a normal individual do?
> Danny: What do you think?
> Buck: I don't know. You got a million people that you are trying to evacuate out of an area you want them to leave 72 hours before the storm hits. They can't tell you where the storm hits in 72 hours. So where do you run? East, west, north? Then you try to figure out when you go north, how far do you have to go before you can get a hotel, and how long will you stay? It is a situation you live with here. California I would not live in for nothing. I can run from a hurricane. It is hard to run from mudslides, earthquakes, firestorms.

In her testimony to Congress, Governor Blanco of Louisiana testified to the chaos which Ivan spurred as "not very pretty" (Babineaux Blanco 2005). While Ivan motivated Blanco to create a new evacuation plan that includes contra-flow, where both sides of the interstates are used for outbound traffic, it is of interest that it took the event of Hurricane Ivan for this to be implemented. Evacuation policy seems to have been slowly adapting to a newly discovered disaster awareness in the city. According to Peter, a major change in the City's evacuation policies had already occurred prior to Hurricane George, which struck the area in 1998:

> Peter: They had George, Hurricane George. For years the theory was to take residents from low lying area that never been flood and put them in superdome and high

> buildings. Then the Government said these high rising buildings were not safe, and then they got the idea to evacuate the entire city.
> Danny: When did this shift happen?
> Peter: In the 90s. We evacuated with George. It was coming in a week or two. We did not know what to do. We did not want to go on a highway.
> Danny: George was the one before Ivan.
> Peter: It kind of veered of. No problem whatsoever. But at the time it was a class 5 hurricane. Theoretically, it could have come here and wiped New Orleans off the map. If you could see what Betsy did. Furniture on the street. 20 feet water. Days and weeks with trucks. You can imagine the smell.

The hypothetical scenario Peter sketched for George was one many had investigated for years. One such response scenario was written by Shirley Laska of the Center for Hazards Assessment, Response and Technology, at the University of New Orleans in November 2004 as a response to Ivan. In the Natural Hazards Observer she laid out a hypothetical case in which Hurricane Ivan had hit New Orleans. It eerily forecasted the impact of Katrina;

> Recent evacuation surveys show that two thirds of non-evacuees with the means to evacuate chose not to leave because they felt safe in their homes. Other non-evacuees with means relied on cultural traditions of not leaving or were discouraged by negative experiences with past evacuations. Should this disaster become a reality, it would undoubtedly be one of the greatest disasters, if not *the* greatest, to hit the United States, with estimated costs exceeding 100 billion dollars. Survivors would have to endure conditions never before experienced in a North American disaster. Hurricane Ivan had the potential to make the unthinkable a reality. Next time New Orleans may not be so fortunate (Laska 2004).

As Laska pointed out, false perceptions of safety were the main reasons for people not to evacuate. After the 2004 evacuation polling, University of New Orleans researchers concluded that people believed that their homes were safe being protected by levees or situated on high ground. This exactly is what Howell et al reported in 2005 as a result of a study in which they compared willingness to evacuate across southern Louisiana (Howell et al 2005). Interestingly, the authors concluded that the most remarkable finding in this study was the low perception of risk felt by most residents in southeast Louisiana.

> In nine of the twelve parishes, 60% or more of the respondents said they felt safe in their homes if a Category 3 hurricane came near. Far fewer residents believe they would be safe in a Category 4 storm, indicating that the difference between Category 3 and Category 4 is the border at which most people believe they are at risk (Table 1). However, based on predictions about flooding from federal agencies, disaster officials in all of these parishes consider nearly everyone in the areas surveyed to be at risk in their home in a Category 3 hurricane (Howell et al. 2005:3).

Even more interesting is how the study emphasized two particular factors as to why people felt safe in their homes during a Category 3 hurricane. The first of these included beliefs about the strength or location of their house, and the second was their *past experiences*. The results suggest that having lived in south Louisiana more than thirty years, and having never lived in a home damaged by a hurricane significantly *decreased* residents likelihood of evacuation. As the researchers wrote:

> People naturally rely on their past experiences to assess how safe they are. Many residents of southeast Louisiana have lived here all of their lives and never experienced hurricane damage to their home. In fact, an average of 40% of residents in these parishes have both lived in southern Louisiana more than thirty years *and* have never had hurricane damage to their home. It is difficult for some of these longtime residents to realize that the environment is much different today, and that past experiences are probably not relevant. (Howell et al. 2005:3)

The data from Table 10 below illustrate these findings.

Table 10: Percentage evacuating in last recommended evacuation by type of people who evacuated

Parish	Having Lived in a Damaged Home	Never Having Lived in a Damaged Home	Living in Southern Louisiana	Living in Southern Louisiana more than 30 Years	Feeling Safe in a Category 3 Storm	Not Feeling Safe in a Category 3 Storm
Assumption	46	31	59	31	17	57
Jefferson	50	52	60	47	49	55
Lafourche	40	24	34	30	23	59
Orleans	44	42	47	40	37	54
Plaquemines	58	54	67	51	31	72
St. Bernard	55	43	43	51	40	65
St. James (half)	30	19	29	20	12	42
So. St. Tammany	15	14	13	16	9	30
Terrebonne	53	30	51	40	25	69

(south)						
St. Charles	74	70	80	68	64	82
St. James (half)	30	33	36	31	18	60
St. John	52	39	45	41	38	50
So. Tangipahoa	20	17	26	15	10	41
Overall	**44**	**36**	**45**	**37**	**29**	**57**

The authors note that in six of the twelve parishes, *people who have lived in a home damaged by a hurricane* are more likely to heed the official recommendation to evacuate. They are more likely to feel they are at risk[101]. In six of the twelve parishes, *people who have lived in southern Louisiana more than thirty years* are less likely to evacuate[102]. The authors argue that long-term residents have lived through many hurricane threats and since most of those hurricanes have not directly hit southern Louisiana, these residents are less likely to feel that they should leave their homes. An average of 74% of the residents in these six parishes have lived in southern Louisiana more than thirty years. In no parish were long-term residents significantly more likely to evacuate:

> In some ways southern Louisiana is now a victim of its past good luck; most residents have not experienced damage, and lack of prior hurricane experience promotes a feeling of safety and thus resistance to evacuation[103] (Howell et al. 2005)

[101] Parishes are Assumption, Lafourche, St. Bernard, St. James, Terrebonne, and St. John.

[102] Parishes are Assumption, Jefferson, Plaquemines, St. Charles, Terrebonne, and Tangipahoa.

[103] In order to overcome these challenges, Howell suggest that officials need to communicate to the public how their ideas about risk are false (“My home is strong, sturdy, brick”; “My home is on high ground, not in a flood zone”; “I am in danger only in a Category 4 or 5”). These efforts should include the notion that “your past good luck is misleading now.”, “Many assume they are safe in a Category 2 or 3 hurricane. This has been true for the last 30 years.” And “Over the last three decades SE Louisiana has sunk farther below sea level. The surrounding wetlands that act like sponges have shrunk.” The eventual result of this would be acceptance by the public that a relatively low storm surge from a slow Category 2 or 3 hurricane could flood an area that is below sea level, which is commonly known by scientists.

In a National Geographic video on Katrina, Dr. Walter Maestri, Jefferson Parish Emergency Management Director, summarizes how this sentiment is directly linked to knowledge of historical ecology:

> They will tell you 'oh we have been here through Betsy, or Camille, or any of the other hurricanes. There have been all kinds of hurricanes which have come through here, none of them could truly devastate the area.' (National Geographic Video 2005)

6.6. A Competing Flood Temporality

Terence Blanchard, musician, composer and resident of the garden district, talks in the Spike Lee movie about his experience during Katrina:

> I turned on the news, and the commentator said eighty percent of New Orleans is under water. And they had not shown any pictures yet. And I am still thinking, when they say eighty percent of New Orleans is under water, I am still thinking they mean like 2 feet of water, 3 feet of water or something like that. We are used to that, I grew up with that. The water would come right up to the door. We sit there and look at it, made paper boats and throw it in there, you know. But man, I looked and I saw a picture of the Circle Food Store, and the water was midway to the door! What messed me up about that picture was the fact it was more inland, not near the lake. If the water was that high at the Circle Food Store, I knew we had a problem in the city (When the Levees Broke 2006).

The above excerpt illustrates the cognitive challenge of having two spatial and temporal scales of flood impacts. While on the one hand the catastrophic impact of Betsy, Katrina, and other big storms are statewide, on a smaller spatial and more frequent temporal scale, residents of New Orleans have a lot of experience with small scale, "nuisance" flooding. This partly serves as a guiding cultural model for flood risk expectations. Within FEMA, the repetitive flood nature of much of the Greater New Orleans Metropolitan Area is notorious because of the large volume of flood claims processed by the National Floodplain Insurance Program office. Jefferson and New Orleans Parishes are ranked the highest repetitively flooded counties in the United States, with respectively 7% and 6% of all flood insured properties submitting more than two $1,000 flood claims to FEMA in the past 10 years. The cause of this flooding is not hurricanes, but rainstorms. Andy, the Jefferson Parish mitigation official, explained to my colleague Jim and me:

> Let me tell you of the kind of flooding we have here. It is not the 3, 4, or 6 feet type flood. We have what we call nuisance flooding. Six inches to eighteen inches. That is about the extent of the majority of flooding. It is just enough to ruin the floors, the carpet, the baseboard, and maybe the bottom of the sheetrock but it is not enough for it to cause structural damage. In 1995 we had two or three feet. But like I said that was 100 year event, you know. And Jefferson Parish has had a history of flooding that goes all the way back to the mid 70s, and it has continued through the years.

According to Mr. Williams, the two flood scales related to each other like apples and pears. Whereas both can lead to flooding, the source is different and thus the floods ought to be treated differently.

With respect to the smaller scale, nuisance floods, their occurrence in Jefferson Parish initially provided a significant source of surprise to the local population. Mr. Williams told me he had come to the area in 1957 to take on a job with Western Oil Company and had lived into New Orleans until he bought a home in the Jefferson Parish suburbs in 1964. He never had any problem with flooding in those days, and as he argued, before 1978, flooding "was not part of the vocabulary" in Jefferson Parish. Indeed, when I looked for instances of the words "flooding" or even "drainage" at the Jefferson Parish library archives before 1978, none of the index cards for the newspaper articles contained the terms. The 1978 flood was a truly a surprise. Mr. Williams:

> We moved in a different kind of cycle where you get excessive rains, heavy rains, in a short time. The morning of May 3rd 1978. I left the house at 7:30 am. It might have been a few drops. Nothing to be worried about. The day before in the afternoon you got some heavy rain that passed. 7:30, I leave my house. I go up the road 14 miles to work. My wife calls me at 10:30 and says the water is coming in the house. 3 hours! I left the factory. I had a Volkswagen diesel with the engine in the rear. As I approached Marrero it was like being at sea. Everywhere you went it was water. Everywhere. "Is it possible we caught a tidal surge?," I wondered. So much water

> was everywhere. Then when I passed Westwego airport on Laplace Boulevard heading to Marrero, this water was just coming across the road. Great Bayou's over the road. Is this just a rainfall? My first impression was that this was a tidal surge!

Having grown up in Bay St. Louis, Mr. Williams natural inclination was to equate the flooding with a tidal surge. There simply had not been a flood precedent like this in the area. To make sense of the event and being an engineer, he later dug through climatic archives and concluded that starting in 1978 the area entered a climatic period with extremely heavy rains. This cycle of rainfall stayed with the area for years and had its height with the 1995, 100-year flood, which shut the City down in its entirety for weeks[104].

The relationship between the two flood temporalities—rainfall and storm surge—is perhaps precarious. The 1995 flood was the worst flooding the city had experienced between hurricanes Betsy in 1965 and Katrina in 2005, yet because of the difference in source it was conceived off very differently. Perhaps the only comparable floods caused by rain alone were the 1927 Good Friday flood and the 1978 flood. While the catastrophic flood scale is of epic proportions, the daily nuisance of flooding is much more vividly expressed through these frequent storms, providing the common notion among many that in New Orleans one "lives with flooding." That this notion excludes catastrophic events is expressed through the Floodplain Insurance Rate Maps. When I asked researchers at the University of New Orleans what people were thinking when they built houses in areas flooded by Betsy, the response was "Well, they are building up to code, the base flood elevation required…" Since I had

[104] During a short period of twelve hours, some areas received twenty inches of rainfall. The next day, the North Shore of Lake Pontchartrain, including Slidell, Covington, etc. received similar amounts of rain and flooding resulting in six casualties. The City of New Orleans suffered $360 million in damages, and the damage in surrounding areas put that total above $1 billion. Some 56,000 homes were damaged in 12 Parishes. Thousands of cars were flooded. 14,600 homes and apartments were flooded in Jefferson Parish. The cause of the massive rain fall totals was a stalled out frontal system from the northwest. It produced a "train effect," in which rain and/or thunderstorms continued to form over the same area. Pumping stations were overwhelmed and could not pump out the water into Lake Pontchartrain, since they were only rated to pump one inch per hour, maximum.

asked about catastrophic flooding, not repetitive flooding, and pondering the confusion of scale in the answer, I asked them what it means for people to "build up to code" relative to a storm surge that can put 20 feet of water over the roofline. It appeared that the floodplain maps calculated temporal flood risk based not on storm surge, but on rainfall alone, institutionalizing the strict segregation of the two sources of flooding.

> Danny: Do you feel that code is valid?
> Researcher: Well it is, except for the big ones. You know. Because of the drainage.
> Danny: Because of the drainage. The floodplain maps are created based on models that don't take into account the big hurricanes?
> Researcher: I would say so. I have to plead ignorance, its been a time since I learned the 100 year flood or the chance of it occurring and the BFE. I don't know. But the city, because of the levees, is considered a B zone, which means that in most places you don't need flood insurance. However, there is a policy on part of mortgage companies to require flood insurance. But it is not a law. It has just become a policy.

This segregation provided me another source of insight into the lived reality of New Orleans culture: the ever-present possibility of the demise of the entire City remained *unspoken,* since there was no point in dwelling on the inevitable. The Big One pervaded City culture by providing a temporal vacuum, a sinking place that should not be, and should never have been and whose lure was its ability to escape from eternity to a timeless state, where temporality became a long, drawn-out moment. It was remarkable to me how a sense of overwhelming fatalism pervaded many discussions I had with both residents of the City as well as those living in Jefferson Parish. In the City, everyone had a flood story. Everyone believed that the Big One could wipe the City of the map at any moment. This relationship to the built environment was rare. Many off the residents I spoke to explained that they chose to rent, and that the experience of living in an old, historical structure with the knowledge that perhaps they would be the last ones to have a chance to live in this environment provided a special sense of being. Combined with the improvised attitude of jazz and mimicked by the

French Quarter bar's Hurricane drinks luring tourists for their sought after stupor, New Orleans is the city where time does not exist. A consciousness of timelessness which includes a relationship to place where letting Nature run its course is part of the landscape, the necessity of accepting fate which yields the unboundedness of constraints for which the city is famous. Some residents I spoke to argued that flooding was taken for granted and that drawing attention to its problems meant putting the spotlight of scrutiny to oneself. In a city of timelessness where people went to disappear in the moment, such scrutiny was perhaps better avoided. Flooding is a way of being, normalized by the experience of frequent rainstorms to be survived by moving your car to higher ground.

Probably most significant in the lived experience of those who had been in New Orleans since the mid nineties was the image of flooding provided by the 1995 "Great Carpet Flood" (a FEMA label). Among all other flood events, this flood defined the benchmark of risk, influencing public attitudes toward flood mitigation and flood preparedness in the City and quality of life in general. When contrasted with bi-annual indicators of quality of life surveyed by the University of New Orleans Survey Research Center (UNO 2004), it looks as if the 1995 flood might have had some role to play in a general turnaround in public perceptions of quality of living, occurring immediately after the 1995 flood had occurred, as shown in Figure 57. While quality of life in both the past and the future were rated as declining due to the fast increasing problem of crime, the Great Carpet Flood might have been a catalyst in turning this perception around, as the turnaround point occurs immediately thereafter. Of further interest is how the perception of quality of living in the past 5 years recuperates faster than the expected quality in the coming five years after the flood event. It is as if the flood's impacts includes an element of nostalgia.

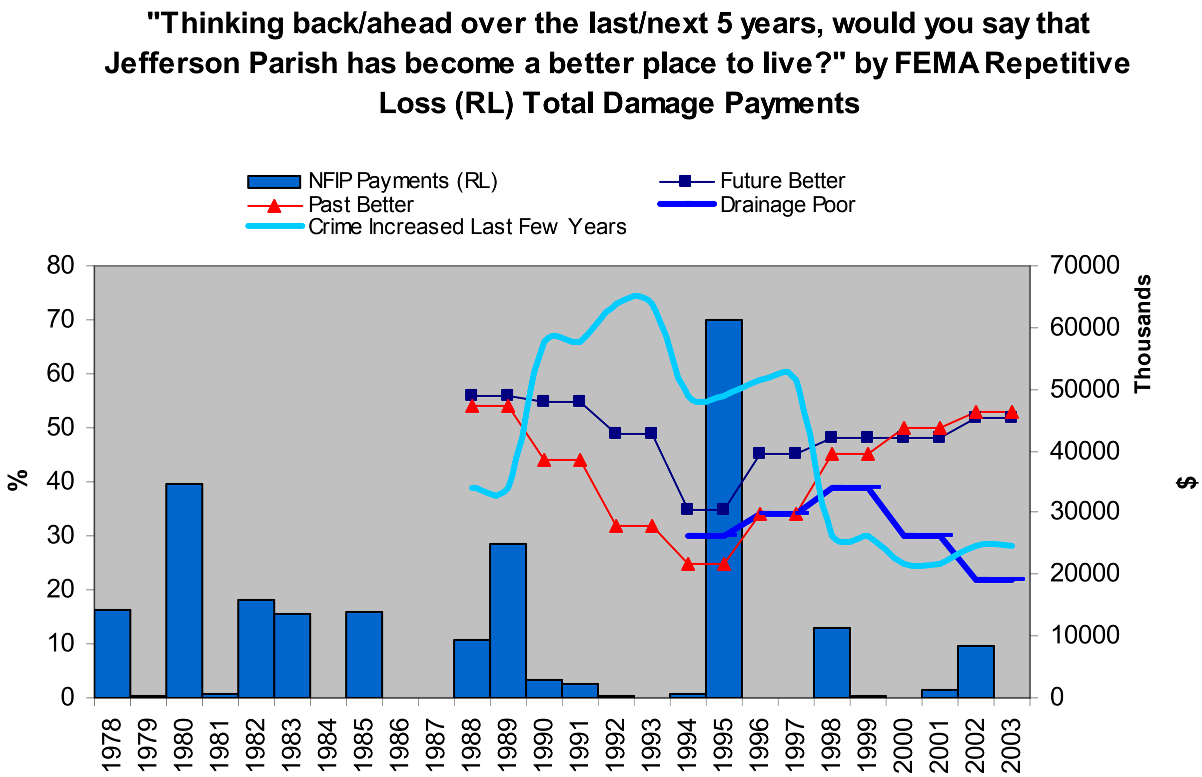

Figure 57: The impact of the 1995 event on perception of past and future relative to NFIP payments[105]

While there is insufficient data to suggest that the changes in quality of life are related to flooding, crime, or other data, the point is that the event had a cultural impact or at least coincided with a shift in cultural attitudes. While Hurricanes Camille, George and Ivan remained hypothetical disaster scenarios, having missed the City, it was Betsy and the Great Carpet Flood of 1995 that provided the lived experience of flooding in the Greater New Orleans Metropolitan Area.

Letting go of the normalized sense of rainstorm-induced flood risk and the false sense of safety they provided may have been so overwhelming that to many that the costs of doing

[105] These data show the total flood insurance claims made in Jefferson Parish in each year. The numbers for the 1978 particular flood are lower then the other floods since to many residents this flood came as a total surprise, hence many did not have any floodplain insurance. In addition, the overall pattern is likely an underestimate; non-repetitive flooded insurances policies were not included. Also, NFIP records do not include claims before 1978. Also, many property owners do not submit claims after being flooded (See UNO, 2006).

so failed to measure up to the benefits of staying in the temporal vacuum. A belief in technological optimism and hope was the only remedy against this vacuum. Letting-go of this, the stress felt overwhelming. The direness of this situation was expressed to me in terms that left me stressed out as well; for example, sitting in the library after five hours of exchange with the retired Chair of the Jefferson Parish Citizen's Drainage Advisory Board, I wrote in my notes that the nickname "The Big Easy" had in my mind become "The Sitting Duck." I wrote:

> This area is a disaster waiting to happen. Mr. Bill can't say anything else. And everybody knows it. It is the total uncertainty that we don't know how many more years the city will remain spared. But it could have been last summer. Imagine a tidal surge of 20 feet hitting the entire place, incapacitating all the pumps, and sitting in your house for 6 months. There is no way in hell the city will ever recuperate. How come investors even consider locating here?[106] It stuns me. Maybe I am overreacting, but the fact is that the city is not prepared for a major hurricane flood, *and there is no good temporal reference for a hurricane and what it might do*." [107]

6.7. Retention and Institutional Memory

Jim and I drove to Baton Rouge to meet the State Hazard Mitigation Officer. We drove onto the campus of the Louisiana Military Department where in one of the impersonal buildings we found the Mitigation Officer in a cubicle next to the fortified State Emergency Operations Center. He had worked in the military himself for 28 years, and had found this job of interest when he joined. When we asked him about the challenges he faced in

[106] The City of New Orleans was bankrupt before Katrina struck. In addition, the City had been losing population since the 1980s, many whom had moved to the new suburban developments in St. Bernard and Jefferson Parishes, leaving behind inner city urban poverty.

[107] I added to this entry that this perception that a valid benchmark is lacking actually had changed somewhat since the Christmas period before I visited Maplewood as a result of the Indian Ocean Tsunami, which had come up in my conversations with some of the residents. The tsunami drove home the reality of a city under water, a point driven home to me by all informants I spoke to. Still, an ill comparison. While Senator Mary Landrieu (D-LA) likened the Katrina toll to "our tsunami," the full Indian ocean tsunami death toll was around 250,000. The US toll at this writing is close to 4,000.

accomplishing the tasks that were set out for the agency in terms of mitigation, his issue was clear: retention.

> When I first got here I was by myself. There was a temporary here, but she was not full time, she was here maybe 3 months then she left. The hardest thing for me was to get a complete and total understanding of all the ongoing projects in the State of Louisiana. Because my predecessor went to work for a company and transitioned exactly 2 days with me. I literally had to take every project folder and read it entirely to try to figure out where we were. Multiple actions at any give time. Then create some spreadsheets to help me track what was going on. So I could reference back to a project number and see the last action taken.

He mentioned that in addition to having to learn on the job without much training from his predecessor, there was no formal training from FEMA to help him settle in as the statewide hazard mitigation officer: "when you first walk in here, who do you talk to? You don't even know what you are supposed to ask for at this point in time." He indicated that it took a little while for him to settle in the job: "And fortunately, during the time period, we did not have any disaster."

He was aided by a hazard mitigation team appointed by the governor, which helped him maneuver through the political minefield which Louisiana appeared to be. When Tropical Storm Allison hit, his office staff was increased with some additional temporary employees who came from field offices. He was also able to hire an environmental officer to help with state clearances. When Tropical Storms Isabel and Lilly came he was granted $80 million of mitigation project funding and two more technical assistants were hired. But he was unable to keep them very long; the fickle nature of money tied to hazards means that a state needs hazards to continuously retain staff. In addition, the close ties between the mitigation and emergency management communities meant that reliance on military trained personnel interfered with retention:

> I had people transitioning all the time. Because… right after [Tropical Storm] Isabel and [Hurricane] Lilly in maybe a year ago my environmental officer decided he wanted to join the National Guard. I lost him to basic and advanced individual training. Which was okay, but then I lost more people to mobilization. The people I was able to get then, I lost them again to subsequent mobilization. But I did get 3 more DAE of which two had worked with me before. I was still maintaining a staff, but every time I turned around I lost somebody.

While he was successful in getting money out to the Parishes and communities to do mitigation projects, his ability to focus was compromised because of a constant need to train new employees: "I have to train every time. What happens is I become the Shell answer man for everything. That can be overwhelming." In addition, those who did work and learned, left, taking with them knowledge and experience needed to do the more specialized job efficiently:

> What would help me a lot more is if I get more robust permanent staff to specialize. One guy in planning, one guy in environmental, one guy in acquisition. They are killing me right now, because I have to do quarterly reports, I have to do payments. At my hourly rate, that is counterproductive, yet it has to be done. Some administrative support would help.

The benefit of experience and institutional memory in the context of disasters is illustrated by an example from Mayor Ray Nagan, taken from the Spike Lee movie "When the Levees Broke: A Requiem in Four Acts." On the evening before Katrina struck, the Mayor was having dinner with his family when the phone rang. Nagan:

> I got a phone call form Max Mayfield. He said, 'Mr. Mayor, I just finished speaking with the Governor, This is one of the worst storms I have ever seen in my 33 year history. The conditions are the worst and this storm is one of the worst I have seen. If I was you, I would heed a mandatory evacuation, because this is the real deal.' (When the Levees Broke 2006).

As the Mayor explained later on a public television broadcast, Mayfield's 33 years of experience gave him acute context for a disaster estimate: "When you get someone like the head of the hurricane center saying in the last 33 year we have never seen anything like it, you should think about that."

Before Katrina struck, institutional disaster experience seems to have been eroding in Jefferson Parish as well. My key informant Mr. Williams made it very clear that one of the main problems was the increasing loss of institutional memory within the drainage department. He expressed with concern that obtaining the history of what happened in the Parish in 1978 was crucial, since many of the key players involved in managing this disaster were retiring, or deceased. Williams:

> Ralph Ketchum technical assistance. Joe Winney. Dead now. They had lots of info. Hands on, when it happened. Like in 1985, lot of detail. We had a hurricane sitting off the coast. More like a winter storm anyway. Hurricane Guan started pumping water up through the swamp. It broke through the levees to the south, right on Lapalco boulevard. It flooded a couple of subdivisions. One of them Lincolnshire. Water rose through it about a week. Harvey canal right over here water was reaching over, entering the drainage system. Only things that saved the bank were some new pumping station not yet accepted by the Parish. But they fired them up anyway; and the water was coming in through the drainage canal to the top, the pumping station kicked it backed out. So it was recirculating. So as Ralph Ketchum said, had that not balance not been obtained, it would have overflowed in the drainage canal and the water would have been up to the West Bank expressway. So… people like that are gone now. That is the problem.

He further mentioned that the government just cleaned house. The drainage director retired, and many young councilmen had little to no historical knowledge about the management strategies used in the past. Noting the loss of dedicated old timers in the flood protection and drainage organizations, Williams emphasized that it is for this reason that someone should collect the historical drainage information for the county:

> Create a good paper for reference. And I say that because the new councilmen; a lot of them are young. The older one people who lived through this thing, the old officials, we had some good young officials through this time. They put their heart and soul in it. The ones I knew from 78, Peter Russo who was the public works

director, really put it all, you know. They were dedicated people in the Parish. Unfortunately they are gone now, they retired and some died.

Unlike Max Mayfield and the old timers in the Jefferson Parish drainage department who were able to keep their post for decades, the State Hazard Mitigation Officer we met in Baton Rouge did not. He lost his position after being accused of committing perjury to a grand jury as part of a lawsuit involving a contractor, Aegis Innovative Solutions, which had previously hired away two of the former State Hazard Mitigation Officers. A federal investigation into the Louisiana program had begun in Ouachita Parish in 2003 after information surfaced during a separate investigation into the Parish police jury. FEMA concluded that the State had neglected to use money designated between 1997-2002 to mitigate properties and had sent the state a bill for $30.4 million (Associated Press 2003). The FEMA investigation expanded into at least 32 other parishes that also hired Aegis Innovative Solutions of Baton Rouge to administer the programs. While we did not know this was coming when we spoke to the official, the relationship between the Louisiana mitigation office and FEMA was not very good:

> What you have got is some problems that are procedural in the program. But you got a renegade FEMA investigative auditor going around subpoena everybody. I am going out for my 4th testimony before the grand jury in a Parish. Nobody can pull the reigns on them. They need to tell this person to get back out of Louisiana, indict someone else, and leave us to do the job we are supposed to be doing. It is a feeding frenzy. This person is trying to make a career off the backs of some people in the state of Louisiana. Make a name, take down some people.

The impact of this process on this work of the state hazard mitigation officer seemed to make his staffing matters worse:

> I have lost hours and hours of my time trying to take care of those stupid audits. And it is a self-fulfilling prophecy. They come down and tell me I don't do quarterly

> reports. Well you know why? Because I am sitting here with you trying to take care of your questions.

6.8. The Rate of Landscape Changes

While Katrina created havoc in a population ill-prepared to imagine its impact, this situation of temporal vulnerability was further exacerbated by the inability of many residents and officials in the area to truly understand how rapidly their landscape had been changing. Temporal vulnerability to misguided temporal referents or scalar confusions would not have been as catastrophic if southern Louisiana had not undergone major environmental change in the period between Betsy and Katrina. For Southern Louisiana as a whole, environmental change appears to be a dramatic issue, but the consequences of this situation to disaster impact was understood very late, and probably too late, in order for the public to fully grasp its consequence until the near miss of Hurricane Ivan in 2004. This problem might have particularly impacted those populations already socially vulnerable to hazard impacts with less means to study and respond to Katrina's eventual impact. Returning to one of my informants, Mr. Williams, his passionate concern for the issue illustrates how elderly people in particular might have more problems understanding the swiftness of this change.

> Williams: A lot of people… old time people, who have been here all their lives, they seem to think they are far away from the Gulf of Mexico, and you really aren't going to have a problem. They don't understand that the tidal surge will just go right across here. Say the eye is on Lake Salvador. Counterclockwise she is coming in from this direction and is driving that water up all the way to the Mississippi levee. Say the eyes comes across Lake Salvador. The river levee will block the water going to the east. Just like the east side during Betsy got wiped out. But the tidal surge is going to come up, and you will have 25 feet of water where you will be sitting. This scenario was in the paper, with a little arrow, and about 20-25 feet of water. Joe Dardy, he wrote this, I could not find the article. That was in 85-88 he wrote that article. I just could not find it. If you could look back. Joe Dardy. Ask him about the hurricane coming up on the Westside of the river out of the south or southeast.

> Danny: Then this scenario was in the papers already. So people have been aware of this possibility since the early 80s.
> Williams: People just don't believe. Got a acquaintance who grew up here. Family was here before him. He asked me the other day, where is all this water coming from!? I said out of the Gulf of Mexico!! All this marsh and everything is not going to save you. It is like people don't seem to understand this.

Awareness of the growing coastal erosion problem seems to have grown steadily among the environmentalist and scientific communities after the 1960s, which became more vocal in the early 1990s (Louisiana Wetland Protection Panel 1985; Barras et al. 1994). According to Hecht, because few people live around the wetlands of Louisiana's gulf coast, land loss in this area received little attention for many years (Hecht 1990). In addition, while most of the losses occur when inland wetlands become open water, Hecht argued that this process was poorly measured. In a recently published study on place attachment and environmental change, the research group at UNO showed that land loss is a salient feature of life-history narratives from individual interviews with residents inhabiting the southern most Louisiana areas of Grand Isle and Terrebonne: "They have watched the land erode and subside for generations and were ignored in the past when they raised the issue." (Burley et al. 2007:362).

But the generational concerns voiced by local fishermen and other coastal residents, confronted daily with its impact, also coincided with a sense of alienation from those deciding how to fix this problem. The issue is one of larger public ignorance, the politics of oil, and a pervasive belief in the technological mastery of nature. When the Mississippi River was levied off, seasonal flooding was eliminated, stopping the natural build up of sediment deposits which equaled about 200,000 dump trucks a day. In addition, canals dug by oil companies in the mid sixties broke-up the wetlands and increased saltwater saturation from the Gulf of Mexico, while runoff and pollution from exploration and extraction compounded the problem (Hecht 1990; Burley et al. 2007). An article published by former petroleum geologists argued in 2002 that the oil and gas industry's extraction of millions of barrels of oil and trillions of cubic feet of natural gas has caused a reduction in subsurface pressure causing underground faults to slip and the land located above them to subside (Morton et al. 2002)[108]. However, while environmentalists' concern about the intrinsic value of the coastal marshes has a longer history (CWPPRA 1990; Coalition to Restore Coastal Louisiana 2007), it was not until late 1990s that the impact of wetland loss came to the awareness of leaders in the disaster community, as a result of the publication of the book Bayou Farewell (Tidwell 2003) by Washington Post journalist Mike Tidwell. According to an interview in the popular Magazine Mother Jones*:*

> Few Americans had any idea what was going on 'down 'da baya.' Local politicians continued to drag their feet, mainstream media continued to avoid the matter, and most of our country's major conservation groups remained conspicuously absent while a vast ecology and billion-dollar seafood industry edged towards the point of collapse (Mother Jones 2005).

While traditional environmental concerns seemed less relevant to the general populace, when the connection was made between a New Orleans disaster scenario and the disappearing wetlands a nerve was struck for a much larger audience. With a chunk of land acting as a Hurricane surge buffer the size of Manhattan disappearing annually into the Gulf of Mexico, the environmental changes became tentative fodder for adventurous journalists taking note of systemic ecological issues in the region. In an article called "Keeping its head above water: New Orleans faces doomsday scenario," the Houston Chronicle science reporter

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[108] Ironically, this later came to haunt the industry. As the Houston Business Journal writes in 2003: "Many pipelines that were previously buried beneath the wetlands are no longer buried due to greater areas becoming open water. The water is sometimes shallow, which Franchina says makes the pipelines susceptible to damage from fishing vessels and barges." Friday, July 11, 2003 Houston oil giant backs research project on Louisiana wetlands (Houston Business Journal 2003)

Eric Berger wrote in 2001 that scientists predicted New Orleans would be devastated by a major hurricane: "In the face of an approaching storm,… the city's less-than-adequate evacuation routes would strand 250,000 people or more, and probably kill one of 10 left behind as the city drowned under 20 feet of water (Houston Chronicle 2001). In the same year, an article in Scientific American titled "Drowning New Orleans," by journalist Mark Fischetti warns that a "major hurricane could swamp New Orleans under 20 feet of water, killing thousands. Human activities along the Mississippi River have dramatically increased the risk, and now only massive reengineering of southeastern Louisiana can save the city." (Fischetti 2001).

But while the issue seemed to finally have taken root in public consciousness, the problems had gotten so out of hand that solutions were increasingly daunting and awareness slow to advance. In 2003, the USGS published a Digital Data Series DVD-ROM called "Coastal Erosion and Wetland Change in Louisiana: Selected USGS Products" in which data, papers, and a movie were combined to communicate the seriousness of this issue (Williams et al. 2003). The film, created by Walter Williams and made for public television broadcast, reminisces that "the worst hit we ever had was hurricane Betsy. Aug. 27 – Sept. 10 1965, " but goes on to note that "…the city is not anymore what it was." Linking the disaster scenario to fast-paced environmental changes (a loss of "one football field an hour"), the film emphasizes that "most people don't realize that wetland protection is your buffer against hurricanes." In its conclusion, the film maker suggests that "by now" many people have finally come to the realization that the situation is unsustainable. Yet, the environmental challenges are too huge to be solved by the state alone, and the film ends with a strong call for partnership, in particular with the federal government responsible for the common welfare of one of is states, its industries, and its fragile wetland environment: "We need federal help. It is so hard to get congress to take action on something like this. Educating the public and officials how to deal with this situation is very important."

To make matters worse, the fast paced destruction of the wetland buffer was exacerbated by suburban sprawl into the wetlands surrounding the urban inner city. The growth of this pavement occurred during a time of very little concurrent environmental feedback from rainfalls and hurricanes, which would have shown the potential problems of developing into marshes away from the Mississippi river ridges. Mr. Williams explained to me how when he first moved to the New Orleans area in 1957, he took the ferry to get across the Mississippi in 1957. During this time, small old towns such as Westwego and Marrero were developed right off the river's edge, taking advantage of the higher lands. "The causeway was the end of the world. The Veterans Memorial Boulevard was Veterans Highway and there was nothing after this; just a highway running through". When the Huey P. Long bridge was built the West Bank was opened for development and subdivisions mushroomed south of the River's west bank. As West Jefferson developed, the Department of Transportation constructed the West Bank Expressway in the late 1950s, which is now an elevated roadway. After this, development turned south into the swamplands. Using major development arteries such as Manhattan or Baratara Boulevard, the underbrush was swiftly dried out using canals to pump the water. Williams:

> And like I said, you can see no thought was put into drainage. They apparently issued permits to develop subdivisions without a master drainage plan; how to get this water out of it.

6.9. The Surprise of 1978

Maplewood is one such subdivision. Built 45 years ago, and stretching south along Manhattan Boulevard without much environmental planning or code enforcement, Peter noted that instead of filling the lots, they "just cut the streets below to save money," and "the height we are now are lots that were never filled." Peter estimated that the size of the West Bank when the area was built was 25% of what it was in 2005. According to him, there was a direct connection to the sprawl and flooding:

> I moved here in 1971, in the house I am living presently. The house had never flooded. It went to Hurricane Betsy 1965, 1968 with Camille with no water in any homes, in this neighborhood. Reason being is that they had more green area undeveloped land that absorbed most of the water. They have build up all around..

What remains unacknowledged in his account is the influence of climatic events themselves. Urban sprawl into the wetlands coincided with a period of less rainfall. Residents did not have much idea of the flood potential of their landscape. This changed in 1978.

Buck sits across from me at his desk in his office, at the south end of Maplewood neighborhood. He runs a pipe-fitting and welding business geared to the oil industry. In the back room his men work. The television is on. He leans backwards with his feet on the table and crossing his arms behind his head, he says:

> I have been flooded five times in 16 years. The first flood was the day I moved into the house. I had 12 inches of water in the house at 1am that night. It's more or less the rainfall coming down at such a tremendous rate that floods most of the time, what caused it to flood. The water can't get to the canal fast enough. It backs up into the street. Comes through your house.

He continues to explain to me that in the past five years he has not been flooded, since the Parish has been making improvements in the neighborhood. "Of course, this is only so if the rain is not 8 inches per hour," he adds. When I asked him if the first time he flooded was a surprise to him, he said it was. "I did not know it flooded. We had some heated meetings. After the first and second flood. I can't remember the exact dates."

Those dates were 1978 and 1980. The 1978 flood came with a vengeance and shocked residents out of their sense of relative safety. That this flood was experienced as a surprise illustrates how the conditions of sprawl and lack of rainfall events combined to increased temporal vulnerability. When the rain came, the consequence was shock and surprise.

Figure 58: Car flooded on Whitney Avenue, Jefferson Parish May 1978. Image courtesy of the Times-Picayune, May 5 1978.

Dottie and Ed Juniper described it as something they "never dreamt of." Moving out of the city to raise their family, they had bought a home in the new Maplewood subdivision which, according to officials, was located on a ridge. While they had heard about Betsy, in official discourse flooding was not supposed to be a problem in the newly colonized neighborhoods on the Westbank. As a consequence, very few residents carried flood insurance. Their sense of safety was born out by their experience during the first years:

Dottie: Figure 10 years no flood means no problem. We had water in the streets occasionally, but it always went down.
Ed: People were more confused about the whole thing. Because it happened and they still could not believe it. They were standing in the water and drinking beer. They could not believe it. You could not do anything until it receded.

Like the Junipers, Peter also had reason to believe his property was safe from flooding:

Danny: Did you think this property might flood when you bought it?
Peter: No, it never flooded here. My mother in law had lived in a house for 30 years and never had seen water in the street. It was an extreme rainfall, the highest recorded. They had several things that got in the news. Seemingly had some pumps, but some things never got installed. Some people went to jail. Some money… got people more aware and involved, including myself.

What happened next was another surprise. While the first event made many think heavy rains were responsible for the flooding, the second event which came only two years later brought the realization that something else beyond Mother Nature must be going on. The Junipers:

After the second one we started thinking about it. It was not normal. The water could not be taken out what was put in. It makes you think, where is the pump at? Where is the pipes at?

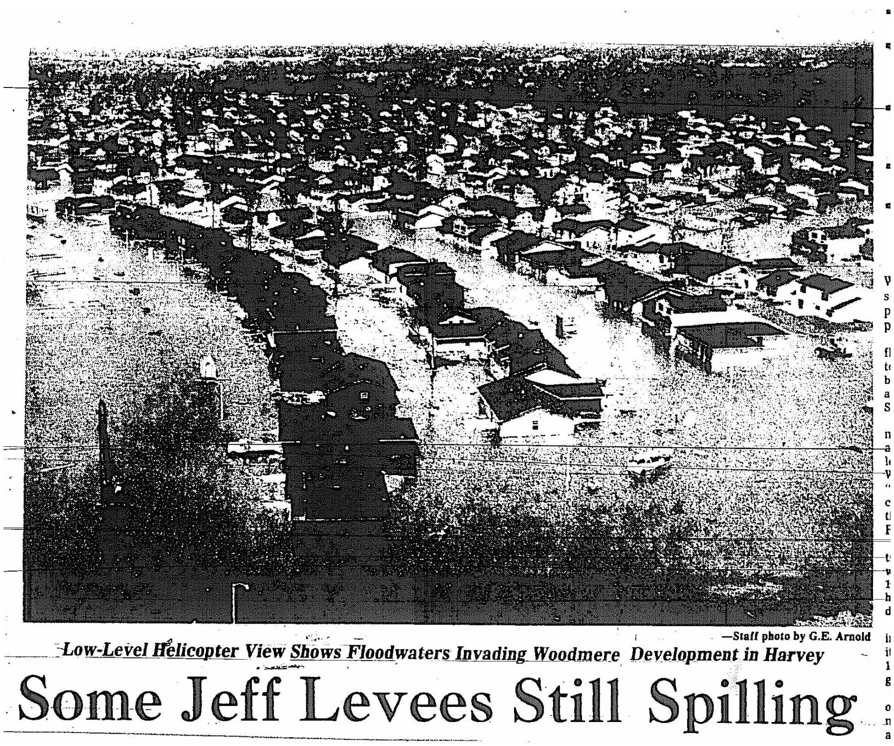


Figure 59: 1980 flood entering Woodmere, Harvey (close to Maplewood)
Image courtesy of the Times-Picayune, April 15, 1980.

Peter described the second flood in 1980 as "devastating." They had just renovated the house, figuring a repeat of the 1978 flood was unlikely. Peter:

> Yeah, you always are going to think it was not going to happen again. You figure you put all the money you have in your house, you want to stay, neighborhood nicer, all neighbors young.

Peter argued that the two first floods could have been prevented. In 1978 the Parish was doing construction on a non-drainage canal and built an illegal levee which caused the canal to simply back up under the stress of heavy rain. The second flood, however, provoked the Maplewood community to organize and litigate. This event started the Maplewood Civic Organization, a neighborhood organization which eventually became one of the stronger neighborhood voices in Jefferson Parish. According to Peter, it was reasonable to blame politicians:

> I was on record saying after the second flood… 1980, the politicians told us 1978 was a 100 year flood, an act of God. Well, a 100 year you people don't have to worry about flooding anymore. In 1980 it looked like God is 99 years ahead of schedule. It got some headlines. Made some politicians not very happy. I did not mean to me sarcastic. I was a little frustrated at that time.

The Civic Organization started to play a major role in monitoring environmental issues concerning drainage. The complexity of the pumping ecology created a specific flood problem to a neighborhood that was theoretically not located in the 100-year flood zone. Since the biggest pumping station was 2.5 miles away, the canals draining flood waters out of the neighborhood meander only slowly to the pumping station. This complex situation provides both spatial and temporal vulnerabilities:

> Theoretically we can have a heavy 4-5 inches of rain here and the pumping station can have very little, so they won't turn the pumps on because you need a certain height in the canal to pump. So by the time we have water problems here, we can be flooded before they are reacting with their pumping stations.

In the end, Peter's house flooded six times. The Junipers' flooded 8 times, the last instance during the flood of 1998. Figure 60 below shows the flood history of the neighborhood in aggregate since the flood in 1978 (UNO 2006).

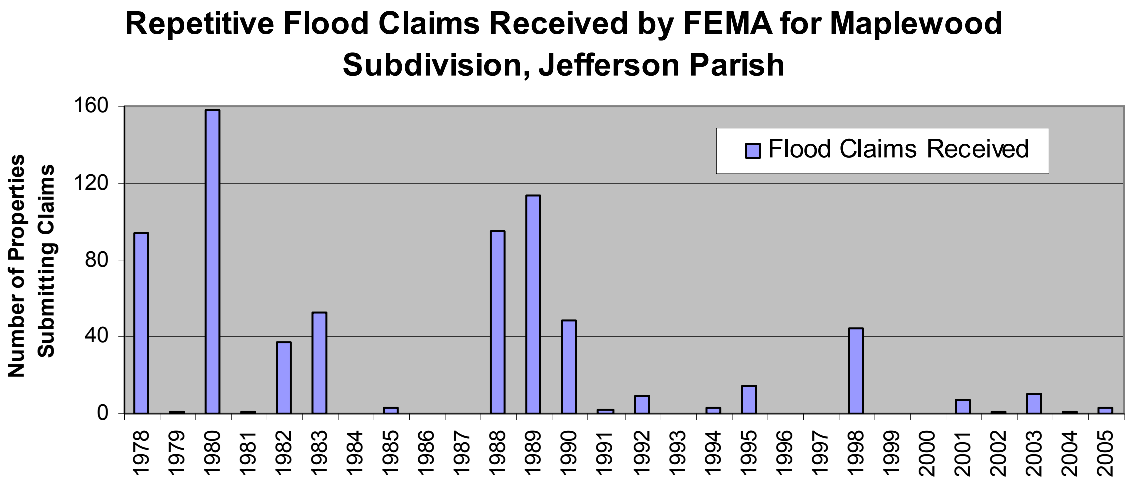


Figure 60: Claims received by FEMA after floods in Maplewood (n=236 properties)

Residents mentioned that while they learned from each flood, they also kept on believing it would not happen again. Dottie:

> Ed: Each time was a surprise.
> Dottie: We know this is the last. You know. Each time. Especially if you get that many. It can't go on. We know they are doing things. They are building pumping stations. Well, guess what…
> Danny: So you hear stories of them trying to fix the problem.
> Ed: The leaders saying we got so much money appropriated. We are going to do something about it. But a lot of times it does not work that way. They took the money for something else, you see. So, we have..
> Dottie: We don't know that.
> Ed: They do! I had political people tell me that, that they do this. Come and tell me Louisiana is not crooked and such things. All states are crooked but in a different way.

Still, the Civic Organization was able to bring momentum to major flood improvements, including a push for a drainage project on 7th street in Maplewood. As can be seen, the most recent trend is indeed toward a decline in flood events, related to the technological fixes believed to be both part of the solution and the problem. The Junipers:

> The rain… it hasn't done that since then, rained that much consistent. And now we have a new system that they just put in, pipes 30 inches in diameter. That is supposed to take the flow of the water that comes down. The pumps again elevated to the top. That is not going to be completed till another year or so. We are really not safe yet, but we are safer to a degree if it does not rain like that. If it rains 7 inches we flood. Pumps can't take that.

6.10. The Harvey Canal

Peter explained that after he experienced Betsy, he moved to the West Bank to get as far away from the problem as he ever could. The Maplewood neighborhood became his home. When frequent flooding in this area eventually started to haunt him, he learned that he had moved right back into a situation he'd sought to escape, wherein a canal could funnel a storm surge into his neighborhood[109]. The canal in question is called the Harvey Canal. Originally built in 1835 following an extant drainage ditch that was used for trade in sugar and indigo connecting the Mississippi River with the Gulf of Mexico. The land was inherited by Colonel Harvey in 1849. Harvey lobbied for an enlargement of the waterway and installation with locks and dams along its length. This initial widening was met with resistance over flood concerns as early as the 1850s. Claire Harvey Byrne writes in her family history:

> As expected, neighbors and others of narrow vision voiced strong opposition. They feared that a widened and deepened canal with its mechanical apparatus would endanger the lowlands of the west bank of Jefferson Parish by flooding waters of the Mississippi River." (Byrne-Harvey 1987:35).

[109] Just as the Mississippi River Gulf Outlet had pushed a storm surge into the industrial canal, breaching the levees during Betsy and Katrina.

However, the industrial importance of this canal was such that opposition was futile, and in 1854 Louisiana's legislature passed Act No.142 to complete the enlargement. Seen as a vital and strategic economic watercourse, the federal government purchased the canal in 1924. Private business had a large stake in the maintenance of this canal, described as a "flowing road to the rich oil and gas lands of lower Louisiana" (Bezou 1987). Unsurprisingly, the industrial area growing up along the banks of the Harvey Canal was substantial.

Along with its economic development, the Harvey Canal also enacted a disaster scenario, which remained carefully monitored by residents along the Harvey Canal. After 1980, the Maplewood Civic Association in particular became a vigilant monitor of the canal's potential disastrous impact. All the scenario required to flood a large population in Jefferson Parish was a particular storm path. Peter, the chair of the Association:

> The real problem is if a storm will come from Texas from the west, up Louisiana west of the Mississippi river, it would devastate the area right here. The Harvey canal drains into the gulf to Barataria basin, it would just push a tidal surge up that canal.

While most of the frequently flooded Maplewood residents eventually learned how to deal with their repetitive losses, what caused them to lie awake in their beds at night was the potential impact which this storm scenario could have on their neighborhood, and on the approximately 200,000 people living in Jefferson Parish east of the Harvey canal. In testimony provided by the Honorable Bob Livingston before the Public Works and Transportation Committee of the House of Representatives, Livingston urged congress to approve funding for the levee on the east side of the Harvey Canal:

> Over 130,000 thousand residents and 31,650 residential structures in this area cannot wait for the next two year authorization bill in 1996 for hurricane protection. The Corps has confirmed that 40% of these residences would be flooded by a 100 year project hurricane and 82% would be flooded by the standard project hurricane. At least eight hurricanes and tropical storms have passed through or near this project area since 1915. These residents deserve the same level of Federal commitment and

> protection that is being provided for the residents west of the Harvey Canal. (Livingston 1994)

Ironically, seemingly very few of those people were actually aware of the risk which this situation posed to them. Williams, chair of the Jefferson Parish Citizens Advisory Board, continuously monitored levee development, and in particular appeared to have spent several sleepless night with this case. As he explained:

> You get a class 5 storm on the right track, it can drive a tidal surge in here. Apparently, the living memory of people around here, this has never happened before. There has never been, or anyone can remember, I can't find it either, any record of a hurricane coming up on the Westside of the river from the south. That means to me that our time is runnin' out. It is going to happen!

Though it wasn't this scenario that occurred during Katrina, the vulnerability which the Harvey Canal posed to the larger Harvey and Gretna areas has been an urgent matter for years. In 1988 following a federal study of hurricane flood protection USACE proposed a series of floodwalls running parallel to each side of the canal. Though approved and funded by a $90 million bond issue, the proposal failed. Williams:

> What happened was the industries here started raising cane. They did not want to be locked in with the levee. They were supposed to keep their land 6 feet above sea level, but there were no laws requiring them to do that. So what happened was in the 80s, they decided rather than to pay for this levee, to get river locks and get protection to the people on the west side. The powers to be said alright, we would build a flood gate.

The alternative plan included construction of a flood gate in the Harvey Canal south of Lapalco Boulevard which would close off the canal in case of a hurricane (see Figure 61). The authorization for this project became the "East of Harvey Canal Project," and was part of the West Bank and Vicinity Hurricane Protection Project in 1996. While construction of levees for the west side of the Harvey canal proceeded, the east side of the canal again remained unprotected due to resistance from thirty businesses, including offshore industries and pipe companies dependent on access to the Canal. Additional resistance came in the form of the budget priorities set by the Clinton Administration. The decision to fund the project was held up by the U.S. Corps of Engineers and Clinton Administration because the recommendation for the project was "not consistent with the policies and budget priorities reflected in the President's Fiscal Year 1996 budget" (Eu Rota 2007).

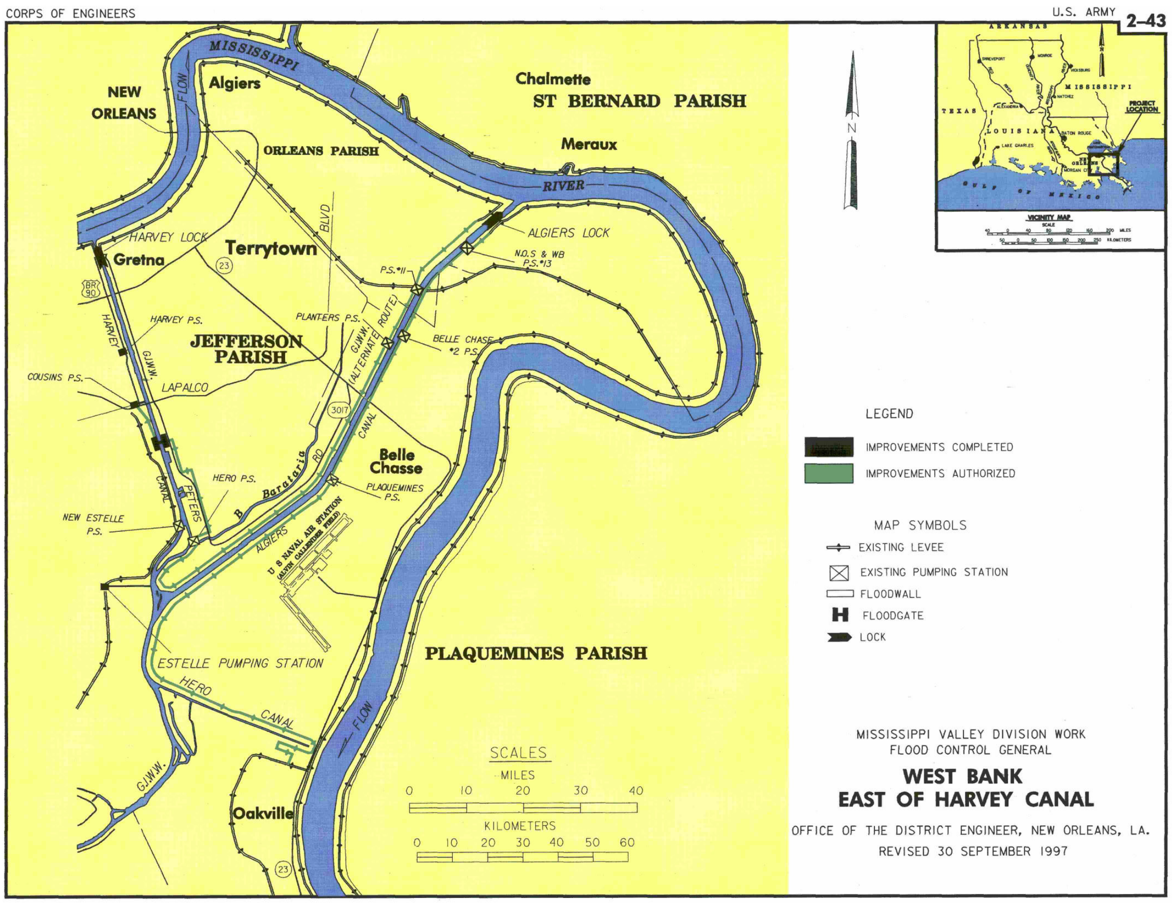


Figure 61: Floodgate shown on USACE project map
(left, middle, under Lapaloco Blvd.). Source USACE.

Maplewood residents verbalized the problem as to be caused by an unwillingness of UCASE and local business owners to agree on right-of-way issues for a particular 25-mile stretch of levee. As a result, the project completely stalled for two decades, leaving a gaping hole in West Jefferson's hurricane protection east of the Harvey Canal. William Jacks explained that the industries resisting the levee had connection with local Senate representatives. Their actions spurred him to caution:

> I was complaining about it with a TV reporter. Guess what… I got a call from a federal house of representative in this area one day. This is the deal. Explained the things. You make any waves, in a small place like this, the powers that be in these towns, they have been here for generations, news travels fast. I was going around talking to nursing homes, libraries, and things like that. One time I went to a library and mentioned it. Before you know it we had a meeting and I got a call [laugh]. So news travels fast.

Compounding the visibility of this problem was a general lack of public understanding of the impact of this canal on the flood ecology. As Williams explained:

> Look, I have gone out there and complained about this thing back in the 80s, with TV camera's and all that. One thing I don't think people understand is what the canal does. On TV one time, the reporter was asking the powers that be in the west Jefferson district, in one of the storm situation, and he asked how much does the Harvey canal hold; some people think it is a drainage ditch or something. They don't understand it goes all the way to the Gulf of Mexico.

Peter shared with me his opinion that in Gretna, an area which would be heavily affected by a breach of the levees, only very few people appeared aware that they could get affected: "The average person does not understand this situation with the levees. It is out of sight, out of mind. A very few people really understand this." This lack of awareness is not only local, but also at the federal level where funding decisions are made. Williams was furious about the lack of funding which kept this vulnerability in existence for more than 20 years:

> And the government is not helping by cutting off funding of the SELA project. We spend all this money. What really irritates me is that we can not get adequate funding to prevent 200,000 people from flooding here. I think they really don't have a handle on what is going on. They should send someone down, educate themselves, go back like you are doing, talk to different people, and the go back and explain if you can.

In 1998 Tropical Storm Frances finally showed West Jefferson and Algiers the danger that the slightest tidal surge poses to the Harvey Canal. According to the Times Picayune, Frances' surge came within 6 inches of washing away the low patchwork of levees and drowning the West Bank. The vulnerability it revealed spurred state legislators to secure the local financing needed to finish the area's hurricane protection system (Times Picayune 2006), but by 2005 when I visited the neighborhood, the latest news was another estimated delay of 7 years in the project. Monitoring this situation, the Civic Association called a meeting with all responsible parties, including the West Jefferson levee Board, Parish council members, State Representatives, USACE, and Gretna managers to call attention to the ongoing vulnerability:

> At the present time we have the threat of two tropical storms heading for Louisiana with the possibility of becoming a hurricane. The Hurricane Protection Project has been discussed for numerous years and to date there has been no movement on the purchase of any property to build the protection levee on the east side of the Harvey Canal. It is time to take action NOW! (Maplewood Civic Association Invitation letter, 2004).

These efforts paid off to the extent that a temporary mud levee was built along Peters Road. While on the other side of the canal homes in an affluent suburb of Barklay Estates received swift protection, the lower valued east side of the Harvey Canal continued to be inadequately protected. One reason suggested to me by several FEMA officials is that when local officials and State delegates go to Washington to secure funding for mitigation projects, the money often goes to projects that are ready to go. Barklay Estates was easy because the homes generate significant tax revenue and the project used land that was not yet developed. According to Buck, an active member of the Civic Association: “It is just… you are in a trick bag of politicians. They want the tax base. They bent over backwards for the businesses. Individuals don’t get enough support.”

After Katrina hit New Orleans, largely sparing Jefferson Parish’s Westbank, Hurricane Rita barreled straight to the Harvey Canal area in September 2005. Jefferson Parish officials ordered a mandatory evacuation, but the storm eventually did not cause the predictable surprise of the destruction of the area east of the Harvey Canal. While the Parish continued to push the levee, they eventually decided to use Parish money to create the levee if State financing continued to stall. By this time, more people residing in neighborhoods adjacent to the Harvey Canal have well understood what Katrina could have done had it gone 40 miles to the west, sweeping up a surge in Lake Cataouatche, slamming into the new floodgate, and spilling over Harvey Canal's unprotected eastern bank. In a 2006 article by the Times-Picayune (2006), Morgan details how neighborhood groups pressed Governor Kathleen Blanco and Parish Officials to speed up the floodwall project along Peters Road. Yet, the situation remained one of a predictable surprise. Quoting Cocie Rathborne, chairman of Jefferson Parish President Aaron Broussard's committee to investigate Category 5 hurricane protection, Morgan writes:

> Despite the repeated close calls, residents' awareness of that risk decreases the further they are from the Harvey Canal.

After Katrina exposed the urgency, Congress allocated $147.6 million in December 2007 to speed completion of the remaining 4 1/2-mile levee gap southeast of the floodgate, which would complete the West bank's first end-to-end wall of hurricane protection. Ironically, the businesses on the waters edge will not benefit from this levee. In order to solve the right-of-way stale mate, the Corps shifted its design from being adjacent to the canal, to positioning it off Peters Road on the other side of businesses' properties. Ironically, some of the business owners who organized against the levee for years, now end up arguing that it negatively impacts their commercial viability, calling for a southward shift in the flood gate instead. The Times-Picayune quotes Jefferson Parish Councilman Chris Roberts as saying that he tried to convince dissenting businesses that it would not be in their best interest to fight the U.S. Corps' revised plan. They would be at fault, he said, if their complaints delay the floodwall, and neighborhoods flood before it is built. After Katrina, the urgency of the matter became clear. In the Times-Picayune, Morgan writes (The Times Picayune 2006):

> ‘I'm not going to sacrifice 200,000 homes for a few business owners,’ Roberts said. ‘I feel sorry for them, but this project has been delayed entirely too long.’

In the case of the Harvey canal, political and institutional forces maintained the conditions for a predictable surprise. This provided the conditions for temporal vulnerability for a large proportion of the 200,000 residents living east of the Harvey Canal. This history is therefore in a large part a political ecology, fueled by an engineering culture where repair is seen as “maintenance” instead of it being conceived as “improving” what is there (Henke 2007). While the levees and canals lead to wetland erosion and the possibility of risk events, this situation had to be maintained to protect investment connected to this urban ecology.

6.11. Conclusion

While the lessons learned by Hurricane Katrina include a heightened public awareness of social vulnerability and the institutional problems of emergency management as operated by the Bush administration, the major question that remains unsolved is the extent to which the disaster, and in particular the breaching of the levees, were a predictable surprise. While the possibility of the Big One was no surprise to anyone, what this analysis has shown is that there were several elements which combined to provide support for the generally accepted notion that the levees provided a false sense of security in the face of a fast moving Category 3 or higher hurricane. I have identified two temporal pathways which compromised the ability of residents, officials, and institutions to be adequately prepared and resilient to the impact of a real Hurricane type hazard. The temporal characteristic of the first pathway is that it deals with stakeholder reliance on misguided temporal references and analogs that were generally left unchecked by a gradual loss of historical and institutional emergency memory. The temporal characteristic of the second pathway is that it deals with the inability of stakeholders to obtain up to date ecological knowledge about their fast changing environment. The illustrations provided for each of these pathways are shown in Table 11 below.

Table 11: Overview of temporal vulnerabilities in the Greater New Orleans area

Misguided Temporal Referentiality	**Problems in Environmental Monitoring**
Hurricane Betsy as a faulty public temporal baseline reference	Delayed public awareness of coastal erosion and its linkage to storm surges
The Standard Project Hurricane as a faulty engineering baseline reference	Fast colonization of new environments with unknown temporal properties
Evacuation false alarms and lack of impacts in recent historical experience	Delayed public awareness of the ability of canals to funnel storm surge
A competing temporal flood scale	Institutional slack in regular levee maintenance and early warning structures
Problems with institutional memory	Cascading temporal interdependency in the drainage ecology

Taken together, these two temporal pathways provide reason to suggest that in the pre-Katrina period the ability of the population of the Greater New Orleans area to be resilient in the face of the "Big One" was compromised. Thus, if temporal vulnerability indeed was an enduring element within the pre-Katrina world, it seems reasonable to conclude that the overall inadequacy of preparedness and response can be related to a level of public and institutional surprise. Moreover, this temporal vulnerability seems to have enacted its influence on general resiliency in tandem to both a reluctance by federal officials to invest in flood mitigation in Louisiana and a pervasive existence of social vulnerability of the general population in the bankrupt City prior to the Katrina event.

The University of New Orleans hazard researcher Shirley Laska suggests that one of the key reasons why the disaster was predictable yet still happened has to do with the paradigm of controlling Nature that most modern cultures demonstrate (Laska 2006). Indeed, the Western idea of control of Nature suggests a temporal relationship between people and their environment wherein Nature is conceived of as static, perhaps equilibrial, and as such controllable. What is shown by this case study is that within the complex interaction of populations and their environment, such stability is never really obtained. Instead, vulnerability is introduced due to the unpredictable shifts both in the environment itself and the reference making in which the population engages to makes sense of its surroundings. This temporal relationship always changes, either through the loss of accurate information about the environment or the increasingly outdated or because of false reference models which residents, engineers, or politicians use to make their decisions. During the pre-Katrina period, it seems that both environment and mental models of it increasingly got out-of-sync to one another, eventually causing a situation in which the condition for surprise flourished.

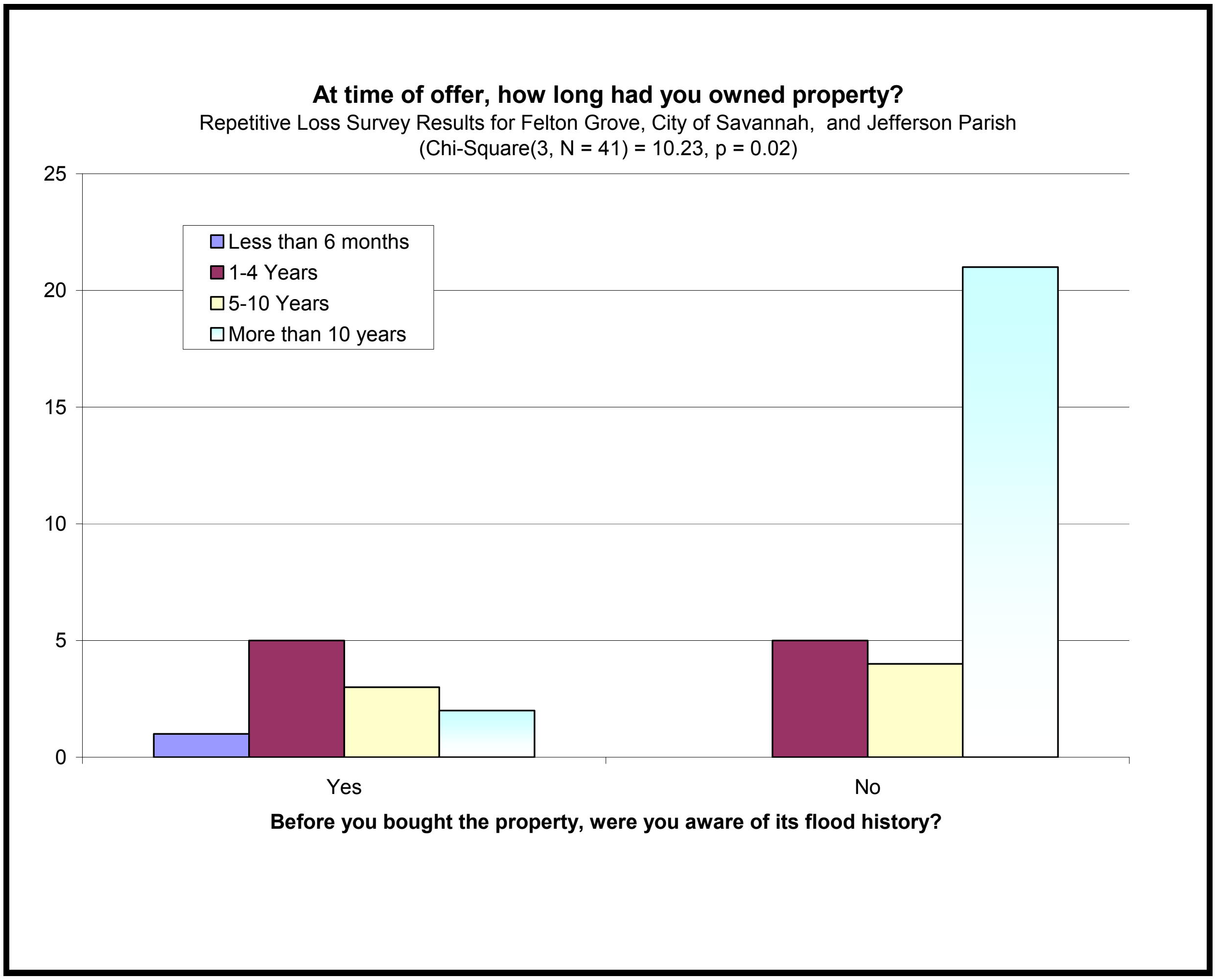
In the post-Katrina era it is hard to imagine that a situation of such temporal vulnerability might reappear. Yet, one can wonder what the two million southern Louisiana residents displaced after the great 1927 Mississippi flood would have thought about the ignorance of today's population, had they known. The key lesson to take from this is that it is not enough to simply measure and chart temporal vulnerability based on the speed of environmental changes or temporal distance of the last baseline hurricane. The aim is to go beyond this and build local capacity in memory and monitoring that brings the resilience needed to avoid surprise. However, the inclusion of temporal vulnerability in the resiliency concept remains an elusive goal. For example, while in Laska's urgent call for a focus on resilience, she suggests an explicit focus on "preexisting conditions," yet she does not mention any factor of influence in the temporal relationship between populations and their environment, as the following quote illustrates:

> Often times described as multidimensional—personal, social, economic, natural, physical—the concept of resiliency directs our attention to the preexisting conditions that are necessary to prevent or reduce the severity of disaster impacts. Such an approach also calls for a very close scrutiny of social vulnerability to disasters. This means focusing on the populations that would suffer the most after a disaster because of their income, race, ethnicity, and/or marginality and exploring way in which their vulnerability may be reduced (Laska 2006).

The multidimensional mix which the resiliency concept promises, follows the objective paradigms of interest in the academy, but not the anthropological embeddedness of humans in their landscape. However implied, resiliency remains an a-temporal concept, to be studied historically for the sake of battling social vulnerability. The temporality of the community to be made resilient is acknowledged only to the extent that their local knowledge provides information about conditions in the past. As such, will it prevent another surprise?

Not knowing flood history was more prevalent in the past

Source: FEMA Repetitive Loss Survey Data (2004)
Center for Urban and Regional Studies – UNC-CH



7. CONCLUSION

7.1. Being in Time

The underlying premise of this dissertation has been that if expectation and surprise (planning and crisis) are based on referential knowledge of historical variation, then understanding how humans perceive and process their past experience is key to human adaptation and resiliency. My fieldwork has enabled me to explore and identify the temporal relationship with flood hazards exhibited by four floodplain communities in the U.S.A. Using qualitative and historical ecological methods focusing on floodplain hazards and their physical and temporal components, I have provided four case studies, each dealing with a different theme, to explore the following overarching research questions:

1. In the non-linear context of social time, does temporality produce population vulnerability?
2. What are the major drivers of temporal vulnerability?
3. How can temporal vulnerability be measured?
4. What can be done to reduce temporal vulnerability?

I will provide answers to these questions by reviewing my findings and placing them in an integrative model based on a metaphorical eye of the hurricane. As a heuristic, this model will identify different drivers of temporal vulnerability within several ontological dimensions—scales of temporal vulnerability—which I believe underlie the production of the *condition of temporal vulnerability*. This condition explicitly refers to a conceptualization of population vulnerability that is based in social time, a perspective which according to the National Research Council is lacking in the vulnerability research literature (NRC 2006). Conceptualized as "being in time," the idea behind my research perspective is to go beyond the historicist perspective in which time is a chronological chart that helps to map out either changes in vulnerability levels or historical root causes that lead to disasters. Social time gives primacy to the contextually perspective of the population itself—an explicitly presentist approach—and how this location in time influences vulnerability to surprise. In this context, temporal vulnerability refers to the situation when the socially constructed "temporal eye" of a floodplain population and the mitigation agencies with which they intersect is weakened and its reflective vision obscured by various factors. I have argued that the result of this situation is a weakening of the temporal properties of cultural models (models that serve to make sense of the environment and provide guidance on how to act in the face of uncertainty). As a methodological tool, I have placed central to my analysis of temporal vulnerability the experience of *surprise*, or a deviation from expectations. The consequence of surprise for the population is unpreparedness, including a lack of evacuation, failures of early warning, trauma and shock, which taken together reduce the ability of a population to cope with and respond to a hazard ("vulnerability"). The applied message is that if this aspect of the vulnerability equation is not adequately managed, "being in time" can become an obstacle to hazard mitigation.

7.2. The Eye of the Hurricane

The idea behind the temporal vulnerability model which I will propose originated through a poster presentation of my findings on the Kinston case study at the Population Association of America (PAA) in 2003. In this poster, I worked with the Carolina Population

Center graphic designer on the idea of superimposing a schematic image of a hurricane system over a U.S. Census map depicting the City of Kinston's buyout properties relative to their racial classifications (see Figure 62).

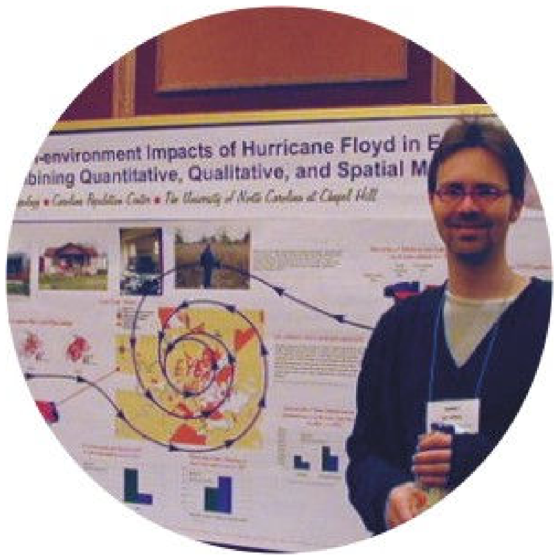


Figure 62: Population Association of America poster presentation

I used this image to focus the viewer's attention on the City map as if it were the central eye of knowing—the cultural model—used by the local population to make sense of the event. What had struck me about the hurricane image was how the spiraling rainfall bands were actually drawing energy into the eye (note the direction of the arrows), sustaining the existence of the eye because the winds had become too strong to permit the air to spiral all the way into the center of the hurricane. Using this idea, I organized my historical data on the left and argued that the past was drawn into the eye by the "southwestern" hurricane rainfall band. Next, I placed my post-Floyd recovery data representing "the future" on the "northeastern" right side. Drawing in past and future the schematic symbolically depicted the legacy impact of Floyd by how it was written into the urban landscape. "And so the lens of the demographic experience—the Eye—is constructed," I argued to the poster referees trying to figure out best posters winners. Perhaps my (then-) stark red glasses helped, but the poster won a Blue Ribbon Award. While the poster itself meant little else, the idea of the hurricane eye metaphor stuck.

What is compelling about the metaphor of the hurricane eye is that it represents a well-protected calmness in the center of a storm; an attractive state of being. From the perspective of population dwelling in social time, the eye represents the stable temporal experience which provides the phenomenological context for our everyday life. Further, when the hurricane is seen from above (the “gaze from space”), dense overcast does not allow the observer to see anything but the calm inner core (see Figure 63).

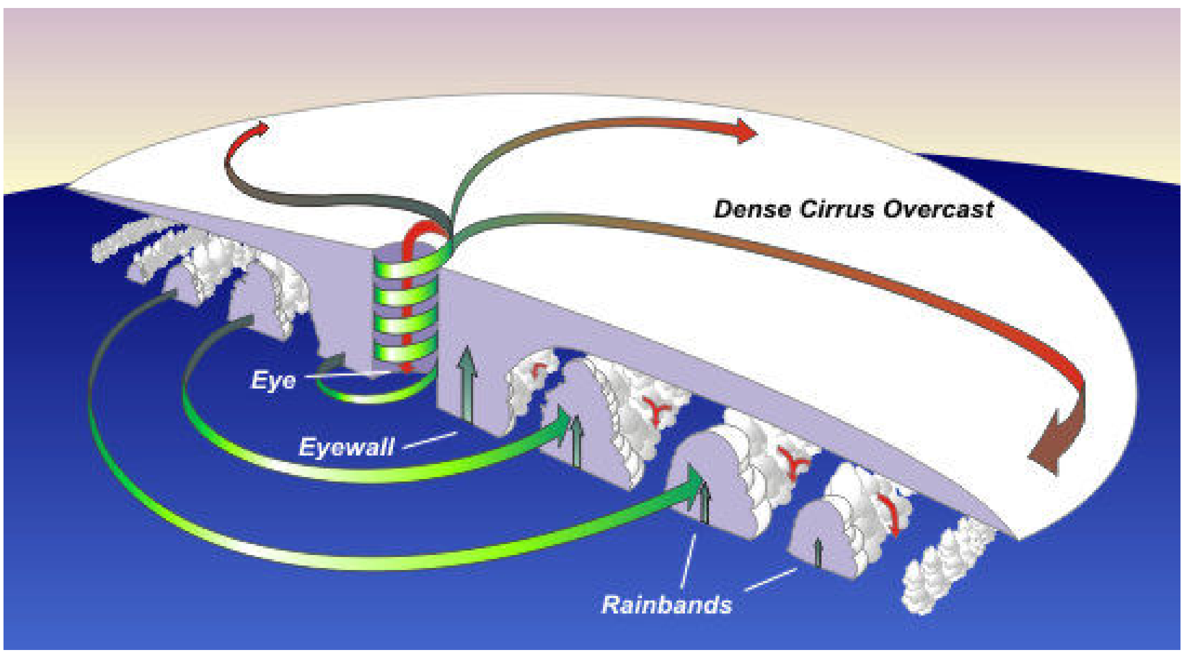


Figure 63: A diagram of the structure of a hurricane.
Image courtesy of NOAA (2007)

The eye seems to have the quality of received knowledge, of understanding, togetherness, and the totality seems to be on a stable linear path that is goal oriented, forward moving. This objective, historical temporality is deceptive. From within the eye, the calmness is held together only by the surrounding storm which never reaches into the center. Further, it is protected by the eyewall, a towering wall of tall thunderstorms producing heavy rains and strong winds and sheltering those within from the stormy zone surrounding it.

Beneath the dense overcast of the hurricane system there are concentric, curved rain bands surrounding the eye. The rain bands provide the energy and moisture that keep the eyewall in place by sucking up moisture and circulating it into the eye. While capable of producing heavy bursts of rain and wind and tornadoes, there are sometimes gaps in between spiral rain bands where no rain or wind is found. Using the analogy of the eye of the hurricane, it is in a similar way that I see our immediate experience of time as chronological and "sensible," as surrounded by a difficult to penetrate "eye wall" that keeps us from recognizing that the experience of time is a social construction. Radiating outwards from the phenomenological core are concentric rings (the inner-rainbands, Figure 64), each representing different scales of temporal knowing which protect and sustain the temporal narrative inside the eye, capturing the imagination, providing stability, and keeping the individual moving forward[110]. It is this forward motion which attracts our temporal attention.

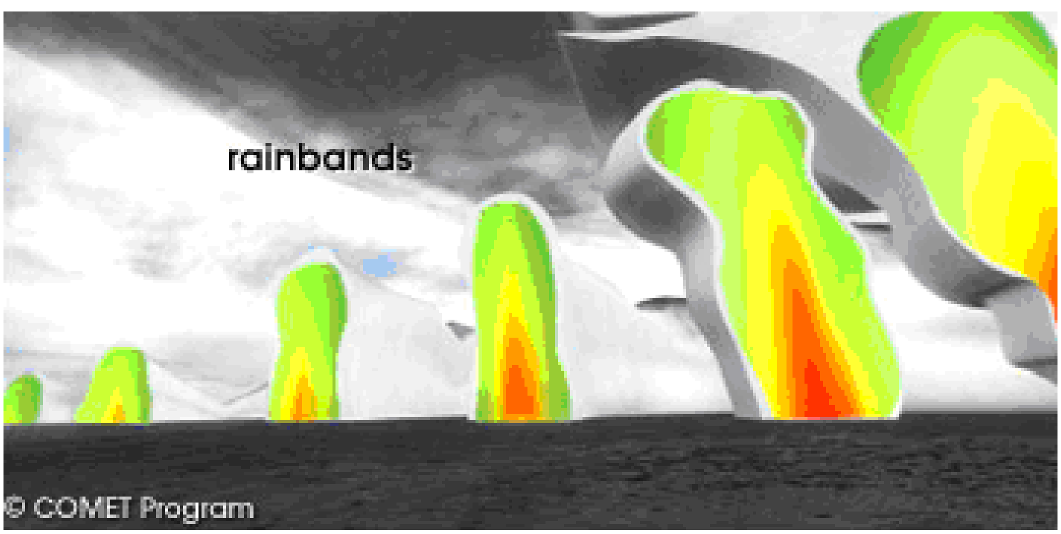


Figure 64: Concentric rings of the hurricane's inner-rainbands

[110] The most destructive section of a hurricane is in the eye wall on the side where the wind blows in the same direction as the storm's forward motion.

The forward motion of the hurricane system is also inherently unpredictable. When the hurricane system changes course, we are rightfully alarmed because of the damaging impact which it might have on a population caught by surprise, unable to receive early warning and evacuate. Seen as the analytical, temporal eye of the cultural model, such changes in course are also unsettling. When the system suddenly shifts its orientation, it recalibrates itself relative to the temporal referents that make up our temporal experience. These referents are metaphorically located in the spiraling, curved outer hurricane rainbands which surround and trail away from the hurricane and which themselves are capable of producing heavy bursts of rain and wind (see for example Figure 65).

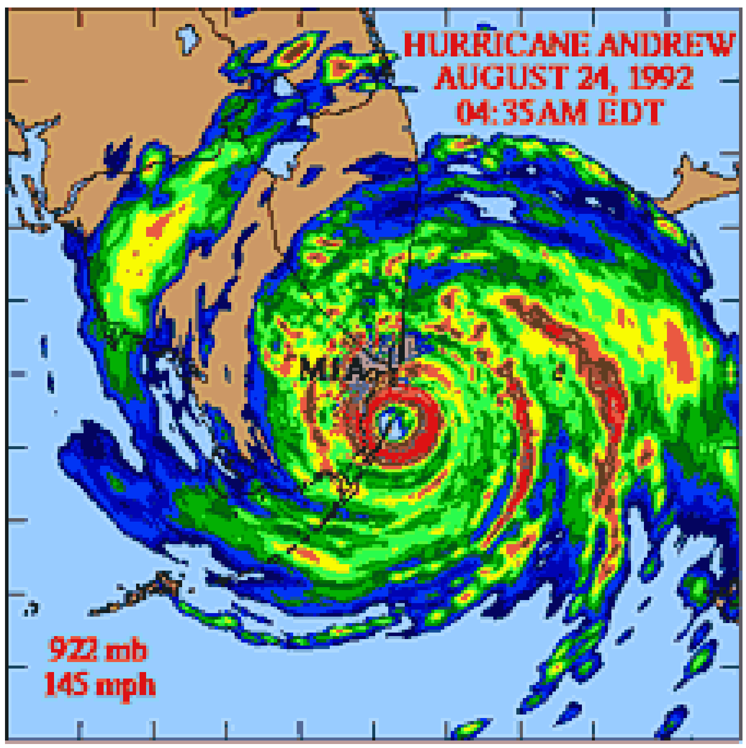


Figure 65: Outer-rainbands of Hurricane Andrew

While seemingly projecting their energy outwards, these outer-rain bands actually keep the eye inside by funneling energy upward and inward towards the eye. Going back to the PAA poster, symbolizing the system as a cultural model, I see the major outer-rainbands as symbolizing the past and the future which together are drawn into the eye through the calibration of temporal referentiality. When the presumed stability (the "eye") of the referential system (the storm) shifts its (temporal) frame of reference (its direction), the consequence is a new reality—the experience of new temporal risk boundaries—which unplanned or unanticipated causes surprise. Consequent to the metaphor, temporal vulnerability is expressed through such shifts, which reduce a population's ability to rely on "usual" coping strategies.

With respect to the issues of expectations and surprise, I believe that the metaphorical hurricane eye perspective provides a powerful way of visualizing the role of temporality in population vulnerability. Following the hurricane metaphor, I have identified three different rainbands—"dwelling scales"—that surround the eye and describe vulnerabilities in temporal dimensions: a psychological scale, a sociocultural scale, and an epistemological scale (referring to the boundaries of temporal knowledge, or uncertainty) (see Figure 66). The scales function to integrate past and the future into a stable experience in the phenomenological eye through the use of temporal references (and consequential future projection).

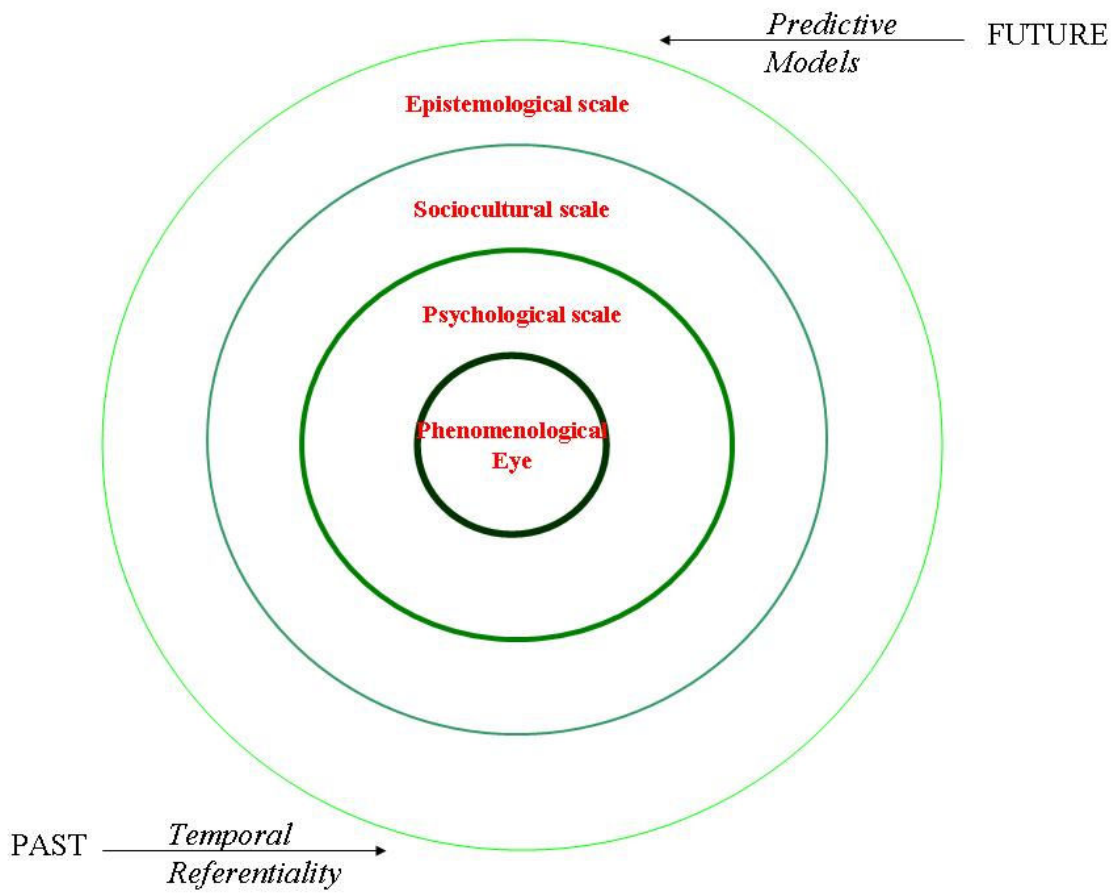


Figure 66: A Dwelling Model of Temporal Vulnerability

I suggest that the outer scales heterarchically organize to influence the core Eye experience, wherein any of the scales can be of higher importance than other scales depending on the context of analysis or question asked. Interactions flow both inward and outward, radially. Disturbance of the fragile balance retained within the eye can have a profound impact on the individual's psychological health, including trauma, psychiatric disorders, cultural shock, and other symptoms which guide our experience during times of temporal crises. In the following sections, I will provide examples of motivating, driving factors located in the rainbands surrounding the core, which compromise clarity of vision in the Eye itself; these are the factors which motivate temporal vulnerability. While the placing of specific motivating factors in particular scales is somewhat subjective, I believe the merit to this organizational scheme is that it presents a coherent framework from which to view temporal vulnerability.

7.3. Temporal Vulnerabilities at the Epistemological Scale

The outer edges are characterized by vulnerabilities which are related to uncertainty existing in the temporal properties of the hazards and lead to obscurity of information ecologies. One example is when a population *colonizes a new environment,* about which little to no historical ecological knowledge is available. Lincoln City inhabitants in North Carolina simply were not aware of the extreme flood potential of their newly deforested urban landscape until Hurricane Hazel showed them. Similarly, white settlers only started living in large numbers along the San Lorenzo River floodplains in California in the late 19th century, and had little knowledge about San Lorenzo Valley flood history previous to this period (except for what might have been obtained from Native American Tribes and early settlers affiliated with church missions). Stakeholders in the City of Savannah, Georgia, might historically have had more opportunities to obtain local information from Native Americans tribes due to the early date of colonization. But in all cases, colonization remains relatively recent compared to the inhabitation of many places on our planet for millennia, as is common for many cultures outside the United States.

But even where inhabitation has a relatively deep and celebrated history, there can still be a *lack of availability of historical data*. For example, in the case of the City of Savannah, engineers were using a database on structural flooding with data going back not more than 20 years, even though the City itself was first founded in 1733. In this example, this temporal hurdle is further exacerbated by a *lack of hazard models* such as the federal

Floodplain Insurance Rate Maps (FIRMS) which simulate temporal boundaries in the landscape. In this case, FIRMS are lacking because the federal government has not conducted an official Floodplain Insurance Study (FIS). Such studies use landscape properties and hazard histories to model potential flood recurrence in the landscape (10 year, 50 year, 100 year, 500 year flood). The impact of this vulnerability is translated in compromised mitigation proposals in which cost-benefit ratios are calculated based on shallow histories of City parcels and their properties. Lack of accurate floodplain mapping is particularly problematic for property owners who bought their homes prior to the 1980s.

Another form of temporal risk comes from *uncertainties inherent to hazards themselves*. Clearly, rain and flood hazard events are stochastic with only some cyclical predictability (e.g. El Nino/La Niña), the most obvious temporal vulnerability to any population. Humans also exacerbate this problem through interaction with the landscape. The situation in Falls Lake Dam close to Raleigh is illustrative in this respect: Dam managers lack "crystal balls" to look into the future, in order to calculate how much water can safely be released without flooding downstream communities over the weeks to come. In addition, the dam's ability to store water was reduced due to urban construction in the floodplain below the dam. This construction took place during a extended drought that coincided with initial operation while engineers miscalculated the volume of the reservoir. The result was a misapprehension of flood potential. Another example can be taken from the case of Greater Metropolitan New Orleans, Louisiana, where residents mentioned that knowing when to evacuate is a problem, since forecasters can not tell exactly where or when a hurricane hits until it is too late to evacuate. Another commonly mentioned factor affecting uncertainty is the projected impact of global climatic change, which shifts the hazard norm in many places.

It is possible that the undersizing drainage pipes in the City of Savannah is the result of unanticipated changes in climate occurring during the past 100 years. Similarly, in suburban Jefferson Parish (LA) “drainage” did not become part of the common vocabulary until a decade of unprecedented heavy rains beginning in 1978 introduced the possibility of drainage problems.

Another mechanism for vulnerability at the epistemological temporal scale is *rapid change in the temporal properties of the hazardscape.* For example, the rapid response time of the San Lorenzo River in Santa Cruz County to upstream rainfall events means a much reduced window of knowing, compromising residents’ ability to react in a timely fashion. Another example is the idea of “vulnerable times” where the properties of the hazardscape change dynamically over time. For example, the summertime tranquility of the San Lorenzo River contrasts greatly with the raging river seen after a February winter storm. Another example is the seasonality of afternoon rainstorms and the rhythm of tides on the Savannah hazardscape. Flood issues present themselves mostly in summer in early evenings when many residents come home from work. When this coincides with high tide, the hazardscape’s temporal properties are sped up and intensified. The most common form of rapid changes in the temporal properties of hazardscapes comes from rapid land-use changes. An example is the unplanned development of Raleigh upstream from its dam causing a rapid intensification of runoff and faster flooding. Both in the City of Savannah and Jefferson Parish, the rapid development of swamplands into suburban neighborhoods with pavement and parking lots similarly contributed to this temporal intensification of flood risk. On the other end of the spectrum, change which occurs too slowly to be observed as notable can also obscure dramatic landscape changes. Examples are when an early 20th century holding pond for canal boats is turned into a suburban subdivision or when secondary gravel roads are paved over, reducing the soil's ability to percolate floodwaters. The lack of land-use planning in most U.S. urban areas appears a prime motivator of this change in temporality, guided by a push for modernist development in the age of the automobile, and only somewhat slowed by federal attempts to impose floodplain regulations in the early seventies. The most extreme example of intensification of the temporal hazardscape comes from the Greater New Orleans Metropolitan Region, where the rapid erosion of wetlands as a result of oil exploration and levee building moved the Gulf of Mexico closer to the City. While such changes intensify the magnitude of the hazards, it is also possible that there are changes which slow down the temporal properties. In the case of the Neuse River in Kinston, flooding appeared prolonged due to the influence of Falls Lake Dam. The surprise impact of Hurricane Fran in 1996 was the result of such temporal lagging. Many residents were unwarned and simply assumed the worst of the flooding had already happened, while the most severe flood surge had yet to travel down the Neuse River to affect the City. I have referred to this as the "Katrina-effect," where the news media moved on under the impression that all was clear—the Big Bowl had been spared—while the levees where about to break causing the biggest disaster in U.S. history.

Another epistemological factor motivating temporal vulnerability relates to the tight coupling of large drainage infrastructure projects, causing *cascading risks,* central to Perrow's theory of "normal accidents." Temporality is constrained by unintended consequences consequential to the interdependency of infrastructure systems, wherein failure in one part of the system cascades to other tightly coupled systems. The most obvious example comes from the influence of the Intercoastal Waterway on the City of New Orleans.

Here the creation of the waterway canal ended up having the unintended byproduct of a storm surge building up against the Industrial Canal, which eventually gave way during Hurricanes Betsy in 1965 and Katrina in 2004, flooding substantial portions of the City. Another example is the influence of the Jefferson Highway in Jefferson Parish, which trapped floodwaters that overflowed the undersized culverts and caused unexpected flooding in the newly-constructed suburbs to the south. In the Maplewood neighborhood in Jefferson Parish, a cascading impact is illustrated by the slow drain of water through the neighborhood's canals to a pumping station 2.5 miles away. Impacted by different microclimatic conditions and because pumps need a certain depth of water to maintain hydraulic pressure, they may not be activated in time to help drain neighborhood in various microclimatic conditions.

Central to the capacity to evaluate the severity of the above mentioned vulnerabilities is the ability to monitor the hazardscape for changes and cascading impacts. For this reason, *failure or non-existence of environmental monitoring systems* is a key property of temporal vulnerability. In the case of the City of Savannah, the ability to measure rainfall in the City on a real-time basis was compromised by the location of the rainfall gauge at the airport, which was located 20 miles from the ocean. In a coastal landscape where distance means substantial microclimatic change, this discrepancy can make a decisive difference in knowing when, and if, a hazard will occur. The end result of a failure to effectively monitor the environment is a reduction in early warning and response time. A similar situation affects the mountainous landscape of Felton Grove, California. Emergency Services officials indicated that the surprise storm of 1998 came in "just underneath" the monitoring network's threshold of detection, so the hazard remained undetected until its impact had increased to a much broader scale. Environmental monitoring problems also plagued the levees in New Orleans, which were closely monitored “on paper” but which in reality this monitoring did not receive the quality control which serious ongoing maintenance required. Concurrently, concerns expressed by Gulf Coast fishermen and coastal residents about the rate of wetland loss were left unheard, largely due to their political disempowerment. As it appears, perceived lack of local, environmental monitoring and the temporal vulnerability that results is often a motivation for local neighborhoods to organize politically in order to allow their voice to be heard. These case studies also show that where temporal vulnerabilities exist, often the only effective tool for neighborhoods to establish environmental monitoring is political organization.

7.4. Temporal Vulnerabilities at the Sociocultural Scale

While vulnerabilities at the epistemological scale have a common focus on the impossibility of knowing hazard event histories, at the sociocultural level I have placed vulnerabilities which relate to a loss of knowing. The first part of this is a *weakening of lived experience* with hazards. The most obvious example of this might be in Felton Grove, where the seriousness of the flood risk simply does not sink in until someone experiences a flood event. The “sixth sense” which develops among residents who have experienced a flood is testimony to this problem. Similarly, it seems that elderly residents in Lincoln City knew about risk in their landscape, while younger residents were unable to understand after the 30 year lull in major events. It was the elderly group which moved more eagerly and appeared more willing to trust the intentions of officials. A more severe example of weakened lived experience was the pre-Katrina Louisiana case, where many had resided their entire lives in the same locality yet never experienced hurricane damage to their home. Instead, they experienced horrendous mandatory evacuations motivated by false alarms. The result of this deficit of lived experience combined with evacuation fatigue, was a historical inability of residents to accurately comprehend or visualize the impact of wetland loss and potential hurricane hazards on their living environment. People's experience and generalized knowledge was simply out-of-sync, and the evacuation issue became one of the biggest emergency management issues in the City pre-Katrina.

Further enhancing temporal vulnerability are situations where lived experience includes a *misguided baseline temporal reference,* also referred to by some as a "benchmark". These vulnerabilities are the result of lived experience which includes an event which has a significant impact on public memory, suggests relative temporal isolation ("rare"), and has a temporal, evaluative quality used to re-evaluate the meaning of any other event ("few other hurricanes deserve comparison"). For example, to Lincoln City residents, Hazel's benchmark qualities reoriented them to a new perceived reality which illustrated their state of relative ignorance about the hazardscape they in habited. The event shifted their frame of reference: a "new flood dimension." Another way in which the baseline event influences lived experience is through essentializing temporal boundaries. In North Carolina, the Hazel baseline representation was kept in place despite the events which unfolded during Hurricane Fran in 1996. Fran signified underlying structural changes, but was instead seen as an "accident," or "fluke." Fran was the symptom of a underlying change in flood ecology which returned with a vengeance during Floyd three years later. Another example comes from Greater Metropolitan New Orleans where the misguided baseline reference of Hurricane Betsy of 1965 continued to provide a false sense of security to the population. As a result, a number of elderly residents decided not to evacuate because they had lived through Betsy, and used this deceptive reference to mentally assess the impact which Hurricane Katrina would have. A misguided baseline reference combined with weak lived experience seems to pose a grave condition for temporal vulnerability.

Another problem increasing temporal vulnerability is when memory captured in lived experience needs to bridge multiple generations. The story of the City of Savannah where no major hurricane struck the area since the late 19th century illustrates such a *lack of intergenerational memory*. It is no coincidence that City management aimed for an explicit historical ecological communication campaign to bridge the generational gap that existed. Interestingly, the case of the City of Savannah also illustrates a general *lack of institutional memory* due to a lack of reliable archives resulting from a "dark age" in the city's management (wherein it experienced high debt, corruption, etc.) which threw the city in debt for decades, further exacerbating the City's temporal vulnerability. Closely related to this is a *lack of mandatory disclosure of flooding* in real estate transactions. An institutional issue safeguarding intergenerational memory, this type of disclosure is at times ignored or "hidden" by real estate agents with a rational interest in selling homes. Further, in a situation such as Felton Grove where the difference between summer and winter is extreme, disclosure during summer conditions might lose much of its meaning to the recipients.

Partly because it exacerbates all prior temporal vulnerability factors at the sociocultural scale, a very important temporal vulnerability is a *loss of the flood generation*. In the Felton Grove case study I have pointed out the importance of the "flood generation," a group of residents who experienced the baseline flood and who have a special place in community education. When this generation is reduced, the critical mass available to adequately provide emergency preparedness diminishes. A general example of this is the rapid influx of newcomers, or residents who have not personally been affected by the baseline storm. In particular, in the case of Felton Grove I have illustrated how property turnover rates are statistically significantly higher in floodways than in floodplains, and turnover in both of the former is much higher than in non-floodplain residential areas. The impact of this on the neighborhood is the erosion of memory networks necessary to sustain vigilance. The loss of older residents in this process, those who are the key enablers of intergenerational memory, appears to be exacerbated by the elevation of homes (stairs are difficult to climb) or the loss of the general sense of community which defines a neighborhood. Another impact of residential turnover is illustrated in the City of Savannah, where outsiders new to the community brought an attitude that differed from local culture, wherein understanding and patience with flooding was lacking. Such changed expectations can enhance temporal vulnerability, by redefining what it means to be "surprised," an issue also touched upon in the case of undersized drainage pipes in historical Ardsley Park neighborhood in the City of Savannah. Another form of lack of hazard information retention comes from the situation of Felton Grove, which as a campground was for a long time only seasonally settled, reducing the ability to build the community-level memory needed to sustain historical ecological knowledge.

At an institutional level, *lack of retention of key personnel* appears to be a problem plaguing State emergency management, especially when closely linked to a military culture with frequent "deployments." In Jefferson Parish, the State Hazard Mitigation Officer appeared challenged by his job because of high staff turnover and internal struggles. This problem is further exacerbated because FEMA funding is tied to specific occurrence of natural disasters, which means that staff funding is unstable. Further, emergency managers in Santa Cruz as well as Jefferson Parish complained about the lack of consistency of FEMA staff at federal level , which eventually induced institutional surprises to homeowners involved in mitigation schemes. At a more local level, one informant in Jefferson Parish emphasized how city officials and council members with historical knowledge and experience of the inner workings of the cascading levee-infrastructure are slowly dying out, leaving younger members vulnerable to surprise as well, unless some of this history is documented, and preserved.

The influence of institutional capacity on temporal vulnerability goes beyond retention. Institutional forces can induce surprise by *manipulating the temporality of the hazardscape* through bureaucratic procedures which might lengthen mitigation processes or landscape vulnerabilities. This is illustrated in Felton Grove, where complicated planning procedures can cause unforeseen delays in mitigation applications. The result is that homeowners can be exposed to seasonal hazards and other unwelcome surprises (e.g. higher costs). Institutions can also manipulate the hazardscape through the timing of mitigation programs, such as described in the case of Lincoln City. North Carolina mitigation managers learned to finesse the art of approaching residents in the window of opportunity following a disaster when their agreeability to the logic of participation is enhanced due to shock. In this way, they added a vulnerability element to the shock which Floyd had already imposed. Another example of institutional influence heightening temporal vulnerability is demonstrated by the continued existence of the “hole in the dike” east of the Harvey Canal, which continued to exist for over 20 years despite community concerns and its potential impact on 200,000 residents. While this issue straddles social vulnerability—a disempowered population unable to defend itself—the temporal implication is two decades of a landscape-level risk of a predictable surprise. One aspect closely connecting this factor to temporal vulnerability is the lack of learning endemic to large, hierarchical bureaucracies, leaving systemic problems unresolved. This issue particularly appears to have been a major factor in the predictable surprise which Katrina came to be. At a broader spatial scale, this situation is similar to the U.S.-wide lack of floodplain regulations that lead to unbridled floodplain development up to the 1970s when master drainage plans and floodplain regulations were finally mandated as part of a social welfare program with the aim of protecting low-income households.

7.5. Temporal Vulnerability at the Psychological Scale

Most of the research done about the role of temporality on risk perception has been at the psychological scale. In the above I already have extrapolated one of the major assertions, individuals' psychological anchoring of risk to "initial" conditions which generally bias the outcome of an evaluation (the anchoring and adjustment bias) to the cultural level through the notion of the baseline flood. It is arguable that the baseline flood is a psycho-social issue, falling at the boundaries of these scales of analysis. The baseline flood to one floodplain resident does not necessarily need to coincide with that of another since the particularities of flood impacts on the landscape are often high. In the above, I have illustrated that there appears a shared sense of a cultural benchmark, which I call the baseline flood.

For the purpose of this dissertation, I argue that temporal vulnerabilities at the psychological scale include vulnerabilities which are mostly caused by residents or other stakeholders actually wanting to forget about a flood hazard in order to move on with their normal lives. I have labeled this tendency *casual amnesia* (note: not causal), after a use of this term by the critic Naomi Klein concerning the U.S. debate on torture (Klein 2005)[111]. This term is used to suggest that there is a "casual" or "indifferent" attitude associated with intentional forgetting that is perhaps a form of collective amnesia rooted at a psychoanalytical level. Denial is the most common symptom. For example, in the high priced California housing market in which Felton Grove is situated, there appears to be a strong urge among residents to want to forget about past floods due to the *extreme financial dependence on the value of homes*. A more generalized form of denial could be found in pre-Katrina New Orleans, where residents to some extent knew their City could be destroyed by a major hurricane, yet in an effort to protect normalcy they continued to deny these thoughts. To an extent such casual amnesia is motivated by the distracting influence of hazards at competing scales, such as common, seasonal carpet flooding which provides a vivid illustration of a "flood," yet does little to accurately portray the impact of a major hurricane. Such "*scalar confusion*" is also experienced in the earthquake, fire, and landslide prone Santa Cruz Mountains, putting the flood hazard issue in some perspective and cancelling out the entire risk debate as threatening to the sense-of-self. The *short-duration memory* which accompanies this denial is one that thrives when the willingness to forget and the benefits of living in an affordable place are not discounted by reminders that one lives in a floodplain.

[111] Klein dispels a popular, anti-historical narrative commonly held by many Americans which suggests that the idea of torturing prisoners first occurred to US officials on September 11, 2001, at which point the interrogation methods used in Guantánamo apparently emerged, fully formed, from the sadistic recesses of Dick Cheney's and Donald Rumsfeld's brains. Klein argues that the U.S.'s engagement with torture in fact pre-dates the Bush administration. She writes: "Every time Americans repeat the fairy tale about their pre-Cheney innocence, these already hazy memories fade even further. The hard evidence still exists, of course, carefully archived in the tens of thousands of declassified documents available from the National Security Archive. But, inside U.S. collective memory, the disappeared are being disappeared all over again. This *casual amnesia* does a profound disservice not only to the victims of these crimes but also to the cause of trying to remove torture from the U.S. policy arsenal once and for all" (italics added).

The case of flooding in the City of Savannah shows that it can take only a few years until a major flood impact is reduced to an anecdote among those not directly or harshly impacted by it. As one Felton Grove resident described it metaphorically: "It is only when you wake up from your drinking that you think oh my god, this is terrible. And then you sober up, the afternoon comes around, and you forget." Further, *trauma* can serve as an additional motivator for denial among deeply affected flood victims. The competing interest of benefits versus costs easily favors denial when choice is limited, such as was the case for black residents living in Lincoln City in a segregated culture. The implication in the City of Kinston hazardscape was a *culture of indifference* characterized by a lack of motivation to disclose previous floods, a normalization of the existence of water in the landscape after rainstorms, and learning dependent on experience, inviting surprise. Another form which such indifference can take is illustrated in the case of City of Savannah, where due to a lack of major hazard events, few opportunities for learning lead to a growing *complacency*; a feeling of contentment or self-satisfaction, especially when coupled with a lack of awareness of danger, trouble, or controversy. As a result, 50 years of bad planning was allowed to occur. Finally, a factor which influences the impact of casual amnesia is the tendency for populations to refer to *false technological optimism* as a way of believing in hazard reduction, enabling denial. In Jefferson Parish the complexity of the drainage environment allows residents to refer to drainage improvements in the hopes that it reduces their risk, which may have no effect on their neighborhood at all. The complexity of drainage systems particularly induces such thinking (few laypersons are going to learn hydrogeology, even if it directly affects them). In the City of Savannah, new drainage pumps allowed some local residents to argue that a mitigation project was "overkill" because flooding had now been curtailed, while in reality no 100-year event had occurred to provide feedback which would illustrate the limits of the pumps in such a situation. In North Carolina, the lack of flooding since 1964 was seen as the result of increasing flood protection provided by Falls Lake Dam, instead of a result of the lull of intense hazards affecting the state between 1960 and the late 1990s. After 1981 the river was perceived as tamed, an idea that fit the modernist view of engineering projects as testimony to mankind's triumph over nature. I conclude that the promotion of technology mitigating flood impact is a double-edged sword. While it reduces the impact of flooding on the one hand, on the other it also increases complacency and perhaps promotes a false sense of security in respect to storms which exceed technological capacity. Technology elevates the threshold for surprise, but increases the impact of a surprise when one inevitably does occur. The North Carolina Neuse River situation is a case in point; the influence of Falls Lake Dam on the river ecology meant a reduction of small scale flooding, yet an exacerbation of surprise when the larger events happened.

Another issue motivating temporal vulnerability at the psychological scale is the general *misunderstanding or manipulation of recurrence language*. For example, in North Carolina the bedrock idea that Hurricane Floyd was a "500-year flood" seems to have been motivated by a willingness to enhance perception of its temporal rareness, to affirm the absolute "impossibility" of a recurrence, and as such protect normalcy by keeping the projected likelihood of occurrence in the future at bay. This is particularly handy for politicians trying to avoid responsibility for bad planning. The latter group tends to swiftly point at FEMA's outdated floodplain maps when problems arise, dodging the bullet of political backlash from impacts created by urban sprawl occurring under their watch. Further, in the case of New Orleans, it appears that temporal vulnerability was dramatically enhanced because the calculation of recurrence intervals—floodplain maps—does not include the risk of storm surge. Relying on rainfall alone, this scalar discrimination institutionalized the strict segregation of the two sources of flooding, giving primacy to only one effective scale (more frequent summer rainstorm flooding). Generally, misunderstanding of recurrence language appears to be an engineering black-box which commonly confuses the public. In all case studies presented herein, residents typically appeared to be under the impression that, for example, a 100-year event would mean that if the event had just happened, it would take at least another 100-years for the next to occur (gambler's fallacy). For example, when the City of Savannah experienced three 100-year events in a row, residents looked with (partly justified) suspicion at the City engineers and their urban development projects, but failed to recognize that in the stochastic chaos of hazards each year has the same likelihood of a 100-year event to occur (one in a hundred).

Finally, a psychological impact on temporal vulnerability is found to be related to *the impact of aging* on the ability to monitor change. As the case of New Orleans suggests, elderly residents in particular appear unaware of the speed with which wetlands had disappeared. While on the one hand elderly populations know very well what has visibly changed in their local environment, and in addition are the carriers of intergenerational information crucial to reduction of temporal vulnerability, what they are perhaps less able to assess is the speed at which more abstract regional changes affect the landscape with which they are familiar. In the New Orleans context, the public appeared to have been largely unaware of rapid wetland reduction. In particular, for elderly residents the impact which new technologies have on the hazardscape might be more difficult to assess. In addition, elderly residents might be more prone to the psychological tendency to favor a conservative outlook of stability over change, in order to maintain their long-held sense of normalcy.

7.6. Temporal Vulnerabilities at the Phenomenological Eye

At the core of the Eye is the immediate experience of temporality: an engagement with a hazardscape which in of itself is pregnant with the past. Central to the dwelling perspective, Ingold points at the "education of attention" to describe the properties of this perspective. I hope to have shown that it is a multiplicity of factors at different temporal scales which affect this temporal attention. At the level of the phenomenological Eye, the temporal biases and ontological boundaries which restrict our temporal attention are incorporated into cultural models which enable us to predict, understand and make sense of the world around us. As seen in the case studies, a phenomenological tendency for humans is to favor stability over the unsettling shifting in the experience of temporality, caused by recalibration of the temporal frame of reference. This is similar to the semiotic shifting in, out, and down of the different frames of reference (here, now, I) when a reader engages with a book. These terms designate the act of signification through which a text relates different frames of reference to another (e.g. one moment versus another). How unsettling such textual shifts can be is exemplified by the response of my dear friend Jj, who during the course of helping edit this dissertation took extra effort to call me on the phone to alert me that my use of verb-tenses shifted from past to present tense and back again throughout the Kinston chapter (and I am sure in other places as well), resulting in a jarring reading experience. Analogous to the textual analysis of semiology, the phenomenological experience of temporality includes a "shifting out" of the temporal frame when the Eye is sent from one plane of reference to another, a "shifting in" when the Eye is brought back to the original frame of reference, and a "shifting down" when the matter of temporal expression is entirely changed. While these shifts result in an anthropological depth of vision, they are also alarming when it comes to our sense of normalcy with respect to environmental hazards. Major shifts downward arguably occur during disasters themselves. It is commonly known that during crises social time shrinks (or expands; depending on your perspective) rapidly; minutes become hours, hours become days, etc. The case study of the City of Kinston illustrates the overriding temporal sentiment which news stories carried after the unprecedented impact of Hurricanes Dennis and Floyd. Floyd combined spatial displacement with temporal unplacement. The event created a cognitive crisis of perception which can be characterized by surprise and shock in which the mitigation strategy of the City finally took hold.

Because of the presumed stability of the Eye and the relationship to surprise when this equilibrium is disturbed, the Eye functions as a temporal "basin of attraction." A basin of attraction is defined as a source of order in large dynamic systems (Kauffman 1995; Kontopoulos 1993; Waldrop 1992; Nicolis & Prigogine 1989; De Landa 1997). This source of order is the basis for decisions which guide landscape change. Because there is a direct feedback loop between such human-imposed decisions and changes to the landscape and temporal vulnerability, (i.e. Savannah's sprawl into wetlands which eventually caused more intense runoff and ensuing changes in flood frequency, increasing the likelihood of surprise) the structure of the Eye itself creates its own basin of attraction to which it periodically returns. The Eye escapes this basin only as a result of major events—surprising disasters—which catalytically shift down the entire system to a new temporal frame of reference, a new steady state. The way in which baseline temporal referentiality influences the experience of the "fluke" is an example of this. In the case of Kinston, Hurricane Fran was denied a role as a potential warning sign of the possibility of Floyd because of the baseline temporal referentiality to Hazel and Hilda. These events shifted the temporal frame of reference back into the "normal" despite major environmental change, left unrecognized. In other words, the cultural model underlying the experience of the Eye organizes the uncertainty of the dynamic environment by imposing itself as a stable temporal attractor. This in a way is a form of temporal essentialism that underlies the (illusory) experience of a permanent, unalterable, or eternal time, external to ourselves and chronologically measurable. The Eye's baseline claim undervalues what passed before and temporalizes the hazardscape by attracting all human attention and memory to its impact. In the case of a dynamical system, chaos and surprise arise if the system shows sensitive dependence on initial conditions. This means that the slightest departure from literally perfect precision in establishing the initial values of the system's variables or parameters leads to an evolution of time which becomes chaotic, resulting in the breakdown of predictability in anything more then the very short term. If the Eye imposes temporal essentialism, the risk is surprise, and the resulting condition is temporal vulnerability. Altogether, the overlap of temporally complex environments and the boundaries and weaknesses of human understandings of it suggest that urgent attention need be paid to how a population's temporal tools and capacity to see influence its projections onto the future.

7.7. Temporal Resilience

The analysis of temporal vulnerabilities is a tool for the strengthening of temporal resilience. The resilience concept refers to the capacity of a system to absorb disturbance without flipping into a qualitative different state (Gunderson & Holling 2002). Based on this research, building temporal resiliency is asking the question how surprises can be avoided through strategic historical ecological education. As I hope to have laid out, an important step is to understand where a population's temporal vulnerabilities are located. Social surveys, archival and media studies, and landscape change research are important element in assessing the status of the host of temporal influences which influence vulnerability. How is the population historically situated relative to the uncertainty of the hazards to which it is exposed? What temporal references are commonly reproduced to make sense of this hazard history? How well is the population informed about the impact of changing landscape conditions on flood patterns? How well do engineering and planning documents communicate to the public the uncertainty of the recurrence intervals involved?

The general policy recommendations that results from this research is a call for a careful evaluation of the extent to which historical ecological knowledge and flood memory networks are sustained, accurately reflective of changing conditions, and effectively used to inform risk behavior. An active management of this aspect of vulnerability can be motivated by providing general educational strategies which aim at the explicit preservation, archiving, and dissemination of hazard memory and historical data. For example, an easy intervention is to secure the placement of historical high water marks in the cultural landscape or provide other visual clues (photographs, descriptions) of past events that provide referential knowledge to newcomers. A more elaborate strategy could focus on the role of museums in addressing local and regional hazard history, support to archival institutions for the preservation of historical flood documentation, or grants to historical societies to engage in neighborhood level oral hazard histories. A useful tool to implement would be the creation of a generalizable "temporal vulnerability index" which spatially maps out the distribution of temporal influences on population vulnerability. For example, it is possible to calculate an spatially referenced index which standardizes and summarizes temporal vulnerabilities such as the last time a major event hit a floodplain area, the turnover rate of property ownerships,, the rate of in- and outmigration, the time-depth of historical data, or the year properties in the floodplain were built. As an example, Figure 67 shows a map illustrating temporal vulnerability represented by the increasing decay of cultural and institutional memory due to temporal distance from the baseline flood event. In this case, a proxy measure is taken to represent the baseline flood event, namely the flood or coastal storm surge event which occurred in the period from 1960 through 2005 with the highest economic damage (adjusted for inflation to 2005) due to property and crop losses combined. I mapped the year in which this event occurred for each United States county (with county boundaries dissolved to create a surface) and showed the major river areas. The data are obtained from the University of South Carolina's Spatial Hazard Events and Losses Database for the United States (SHELDUS 5.1). The result is a map which highlights counties of possible concern with respect to issues of emergency preparedness. In particular, it shows that about 1/3rd of all United States counties experienced their most damaging flood or storm surge hazard event almost three to five decades ago, which is an amount of time with significance to generational change. Several of these areas are located right along major rivers and coastal areas. What this map obviously does not take into account is the influence of the second, third or any other large hazard event, nor the complexities involved in the precise timing of these events. But as an illustration, it provides strategic guidance to the planning of interventions that aim to enhance population resiliency to flood and coastal disasters. An important aspect to be integrated in this type of mapping is the rate of change of the landscape itself, since the faster landscape ecological properties are changed, the more likely it is that unintended consequences occur. Integrating such spatial layers by standardizing information, the resulting temporal vulnerability index can be overlaid with geographic distributions of historical hazard, spatial hazard models, and other population data of relevance to social or other types of vulnerability assessments. The integration of such knowledge in environmental planning would help target intervention programs aimed at reducing overall social vulnerability.

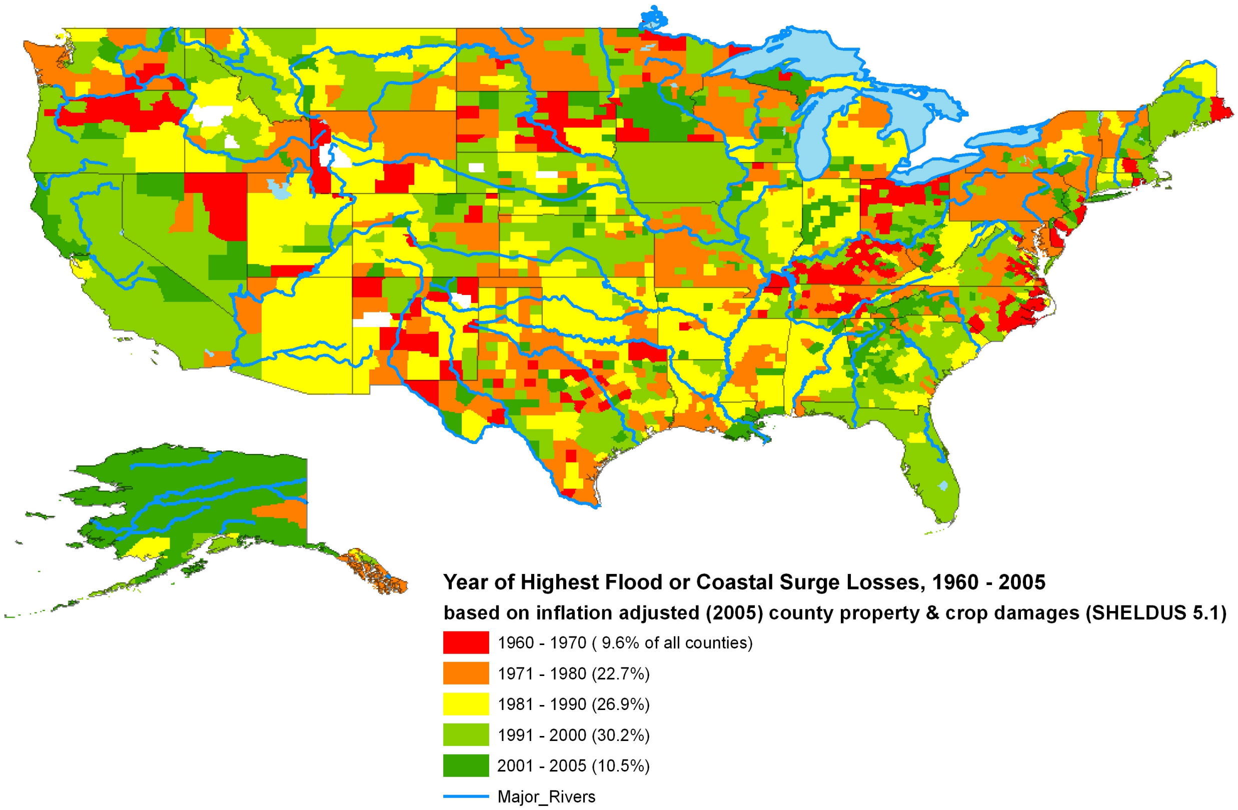


Figure 67: Vulnerability map based on temporal distance from (proxy) baseline flood/surge event

The results of this study further show that when it comes to environmental monitoring, strategically building capacity at the level of neighborhood organizations is key. It is at this level that long-time residents function as anchors of past knowledge of events (the flood generation) with an interest in reducing property turnover and increasing retention. Similarly, such capacity building is important to institutional management of hazardscapes, where retention directly helps to increase memory of past events. For example, a Santa Cruz County official testified that when residents requested information about hazards affecting a property, the most beneficial characteristic of her staff was the length of time they had been on the job, "because the records don't really convey what the people need to know." Efforts to increase retention of emergency management officials include a focus on for example improving job satisfaction, workload, or salaries. At the neighborhood level, the maintenance of good relationships with those who are part of the flood generation—those residents who have experience key flood events—is important. While neighborhood turnover is associated with larger socio-economic forces, to some extent the decision for these key residents to stay can be motivated by encouraging governments to provide special support to this group and the neighborhood association in which they participate. This can be in the form of giving them responsibility for the distribution of grant money, providing financial compensation for their time, encourage their involvement in prestigious risk management committees, or provide opportunities for specialized trainings and networking otherwise not available to them. A interesting way to built local capacity and knowledge of historical conditions is by providing support for community-based oral history programs, ideally managed through local or regional historical societies or other professional organizations, to address issues pertinent to emergency management and preparedness.

Oral history is the systematic collection of living people's testimony about their own experiences. While community initiated and managed oral history projects are constraint by sensitivity to local politics and the skills of the members involved (Shopes 1997), they have the advantage of not only encouraging disaster relevant historical knowledge, but moreover help sustain an ongoing level of interest and awareness about past hazards and disasters and the different ways of interpreting the events. Further, input from community members in how local history is written and remembered helps those involved (and outsiders) to learn about how the past can be “seen” in different ways and is under constant negotiation (Blatti 1990). In the context of disasters that include serious impact to community structure, ongoing oral history efforts can also facilitate the collection of documents and information which might otherwise be lost. For example, in the aftermath of Hurricane Floyd, elderly residents in the Kinston’s Lincoln City neighborhood went to churches, club meetings, ladies’ garden groups, and other social gatherings to ask local residents if they had any pictures, documents, maps, or other historical materials of the neighborhood that could be copied and archived. As one of the elderly members explained to me:

> We are documenting every person that was affiliated with the flood and what not. Because we are loosing the houses and we are losing ground. And we said, we got to remember all the older homes that was involved in the flood and what have you. So, we were salvaging what we could do. And from that we went on to get the attributes of what so many people did to make it a city; that caused Lincoln City to be.

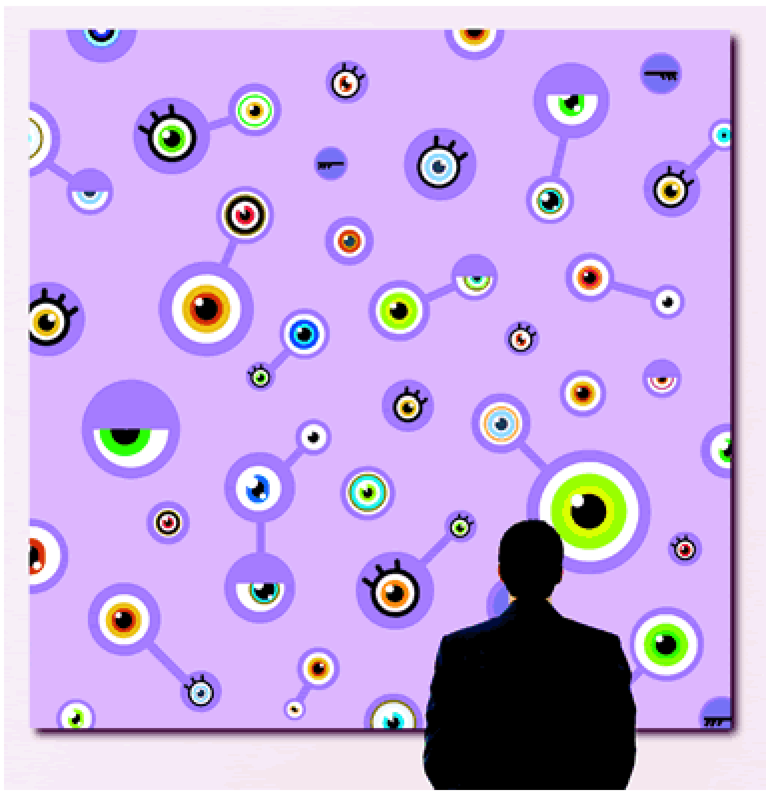
Their effort resulted in three large books full of pictures and information on the neighborhood and several newspaper articles. Referential material that can be used to remember the hazardscapes properties of Lincoln City up to the 1999 event. With respect to public risk perception, the outcome of such community history efforts can help improve the accuracy of public perception of flood risks, reduces denial, and builds a healthy environment for the preservation of public memory. In addition, floodplain managers can aim to improve the disseminating of up-to-date information and help facilitate accessibility of counseling for community members who experienced trauma. Special efforts should include a focus on elderly residents in order to make sure knowledge about recent environmental changes are understood relative to the flood risk ecology. Altogether, such strategies might help to prevent cultural models of historical ecological conditions from becoming enemies, rather then friends, when dealing with hazard preparedness, mitigation, and early warning.

7.8. Concluding Thoughts

Anthropology is commonly defined as the study of humankind in all times and places (Haviland 1997). Still, anthropologists have given little priority to the investigation of how humans understand and conceptualize time (Adam 1998). Results of this study suggest that when temporality, the process of being in time, is seen from an ethnographic and ethnohistoric perspectives aimed at identifying how population groups socially construct their past, present, and future, the resulting analysis exposes vulnerabilities which are inherently connected to risk management issues such as mitigation, historical preservation, early warning, or evacuation. Or, in other words, these are *temporal vulnerabilities*. I have argued and illustrated that temporal vulnerability can be distinguished from other types of vulnerability, building on the contrast between "temporal vulnerabilities" on the one hand and "historical vulnerabilities" on the other hand. Historical vulnerability, the historicist form, represents an objective history of vulnerability, but not the condition of "being temporal" (temporality) itself. The latter is a presentist perspective which explicitly investigates the "human bias" historicists so vigorously try to avoid. Perhaps the general failure to acknowledge temporal vulnerability is the result of an uneasiness among scientists, historians, and the public to step beyond the safe boundaries of chronological time. This is, of course, understandable. Our cultural lives are drastically imprinted with the notion that time is a linear, measurable entity that "goes by," while our science has been studying the objective properties of Nature for centuries. Stuck in objective time, we perceive historical analogs as "out-of-date," simply irrelevant to the "new" times in which we have arrived where all conditions are different. As such, the momentum of the past quickly loses its relevance, and what is left of the analysis of historical vulnerability is to find the root causes for the objective changes that have taken place. Many have argued that it is more fruitful to track quantitative measures of change over time, than to dwell in "messy" qualitative and ethnohistorical data (Crumley 1994). Yet, neglecting to address social time, vulnerability models fail to acknowledge the historical situatedness of populations and the temporal connections which increases or decreases their vulnerability to hazard events.

There are a plethora of types of vulnerability—economic, social, demographic, etc.—and I certainly believe that there are only so many adjectives necessary to describe the vulnerability concept as a whole. Yet, I believe the issue of time, timing, or temporality, is particularly to understanding of the human dimension of natural disasters due to its direct relevance to issues of surprise, early warning, and emergency preparedness. The notion of temporal vulnerability thus not only relates to the historical dimension of social vulnerability, to the dynamic multiscalarity of temporality in models of vulnerability, but also informs how other aspects of population vulnerability are understood and interact. My suggestion of coining (yet) another vulnerability construct must be seen as a tool aimed at challenging the synchronic (a-historical) state of affairs and further refine understanding of the diachronic , anthropological analysis of vulnerability. Temporal vulnerability ironically functions to deconstruct current vulnerability dogma, while providing an avenue from which to explore the important issue of temporality in emergency preparedness, and in particular population surprise to hazard events.

A Revolution in Progressive Lens Design



8. APPENDICES

Appendix I: Vulnerability Defined (from Thywissen 2005)

Adger (2000)
'Individual and collective vulnerability and public policy determine the social vulnerability to hazards and environmental risks, defines here as the presence or lack of ability to withstand shocks and stresses to livelihood (following Chambers 1989; Watts and Bohle 1993; Adger 1999)'

Alexander (1993)
'Human vulnerability is a function of the costs and benefits of inhabiting areas at risk from natural disaster.'

Blaikie et al. (1994)
'By vulnerability we mean the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard. It involves a combination of factors that determine the degree to which someone's life and livelihood are put at risk by a discrete and identifiable event in nature or in society.'

Board (1989)
'Vulnerability is operationally defined as the inability to take effective measures to insure against losses. When applied to individuals vulnerability is a consequence of the impossibility or improbability of effective mitigation and is a function of our ability to detect the hazards.'

Bohle et al. (1994)
'Vulnerability is best described as an aggregate measure of human welfare that integrates environmental, social, economic and political exposure to a range of potential harmful perturbations. Vulnerability is a multilayered and multidimensional social space defined by the determinate, political, economic and institutional capabilities of people in specific places at specific times.'

Cannon (1994)
'Vulnerability is a measure of the degree and type of exposure to risk generated by different societies in relation to hazards. Vulnerability is the a characteristic of individuals and groups of people who inhabit a given natural, social and economic space, within which they are differentiated according to their varying position in society into more or less vulnerable individuals and groups.'

Chambers (1989)

'Vulnerability refers to exposure to contingencies and stress, and difficulty in coping with them. Vulnerability has thus two sides: an external side of risks, shocks, and stress to which an individual or household is subject: and an internal side which is defenselessness, meaning a lack of means to cope without damaging loss.'

Cutter (1993)
'Vulnerability is the likelihood that an individual or group will be exposed to and adversely affected by a hazard. It is the interaction of the hazards of place (risk and mitigation) with the social profile of communities.'

Cutter (1996)
'Vulnerability is conceived as both a biophysical risk as well as a social response, but within a specific areal or geographic domain. This can be geographic space, where vulnerable people and places are located, or social space—who in those places is most vulnerable.'

Cutter et al. (2000)
'Broadly defined, vulnerability is the potential for loss of property or life from environmental hazards. '

Dow (1992)
'Vulnerability is the differential capacity of groups and individuals to deal with hazards based on their positions within physical and social worlds.'

Dow and Downing (1995)
'Vulnerability is the differential susceptibility of circumstances contributing to Vulnerability. Biophysical, demographic, economic, social and technological factors such as population ages, economic dependency, racism and age of infrastructure are some factors which have been examined in association with natural hazards.'

Downing (1991b)
'Vulnerability has three connotations: it refers to a consequence (e.g., famine) rather than a cause (e.g., drought); it implies an adverse consequence; and it is a relative term that differentiates among socioeconomic groups or regions, rather than an absolute measure of deprivation.'

Gabor and Griffith (1980)
'Vulnerability is the threat (to hazardous materials) to which people are exposed (including chemical agents and the ecological situation of the communities and their level of emergency preparedness). Vulnerability is the risk context.'

IPCC (1997)
'Vulnerability is defined as the extent to which a natural or social system is susceptible to sustaining damage from climate change. Vulnerability is a function of the sensitivity of a system to changes in climate and the ability to adapt to system to changes in climate. Under this framework, a highly vulnerable system would be one that is highly

sensitive to modest changes in climate.'

Kates (1985)
'Vulnerability is the capacity to suffer harm and react adversely.'

Liverman (1990a)
'Distinguishes between vulnerability as a biophysical condition and vulnerability as defined by political, social and economic conditions of society…vulnerability is defined both in geographic space (where vulnerable people and places are located) and in social space (who in that place is vulnerable).'

Living with Risk: A Global Review of Disaster Reduction Initiatives. UN
'The conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards.'

Mitchell (1989)
'Vulnerability is the potential for loss.'

Pijawka and Radian (1985)
' Vulnerability is the threat or interaction between risk and preparedness. It is the degree to which hazardous materials threaten a particular population (risk) and the capacity of the community to reduce the risk or adverse consequences of hazardous materials releases.'

Smith (1992)
'Risk from a specific hazard varies through time and according to changes in either (or both) physical exposure or human vulnerability (the breadth of social and economic tolerance available at the same site).'

Social vulnerability
'Complex local networks sustain humans in normal times. Human vulnerabilities during change, hazard, disaster or conflict related to global warming are usually a matter of disruption of these networks. Ursula Springer Oswald, lecture to the MunichRe UNU EHS summer academy, 2006 '

Social vulnerability as critique
'Social vulnerability is a critique of the modern project to create a rational society; it is fundamentally a political enterprise, of social critique of the failure of society. Tony Oliver-Smith, interpreted from remarks to the UNU EHS and MunichRe Summer Academy, 2006'

Susman et al. (1984)
' Vulnerability is the degree to which different classes of society are differentially at risk.'

Timmerman (1981)

' Vulnerability is the degree to which a system acts adversely to the occurrence of a hazardous event. The degree and quality of the adverse reaction are conditioned by a system's resilience (a measure of the system's capacity to absorb and recover from the event).'

UNDP (2004) Reducing Disaster Risk: A Challenge for Development.
'A human condition or process resulting from physical, social, economic and environmental factors, which determine the likelihood and scale of damage from the impact of a given hazard.'

UNDRO (1982)
' Vulnerability is the degree of loss to a given element or set of elements at risk resulting from the occurrence of a natural phenomenon of a given magnitude.'

UNEP (1999)
'Vulnerability is a function of sensitivity to present climatic variability, the risk of adverse future climate change and capacity to adapt…The extent to which climate change may damage or harm a system; vulnerability is a function of not only the systems' sensitivity, but also its ability to adapt to new climatic conditions.'

Vogel (1998)
'Vulnerability is perhaps best defined in terms of resilience and susceptibility including such dimensions as physical, social, cultural and psychological vulnerability and capacities that are usually viewed against the backdrop of gender, time, space and scale (e.g. Anderson and Woodrow, 1989)'

Watts and Bohle (1993)
'Vulnerability is defined in terms of exposure, capacity and potentiality. Accordingly, the prescriptive and normative response to vulnerability is to reduce exposure, enhance coping capacity, strengthen recovery potential and bolster damage control (i.e., minimize destructive consequences) via private and public means.'

Appendix II: The Spatial Segregation of Lincoln City

The earliest maps suggesting any sign of habitation in the Lincoln City neighborhood are on the Sanborn Fire Insurance Maps of the City of Kinston of 1914. While the Index Map (which overviews the entire City) does not suggest extant development, merely showing the roads and railroads simply ending at the City boundary, a small reference on a detail map (sheet 19) just south of Kinston's most southern road (E. Shine Street) suggests that a "Negro Tenement" borders the cemetery[112] (Figure 68).The reference is small, and both the cemetery and tenement disappear in spatial no man's land, as they are seemingly not interesting for fire insurance purposes.

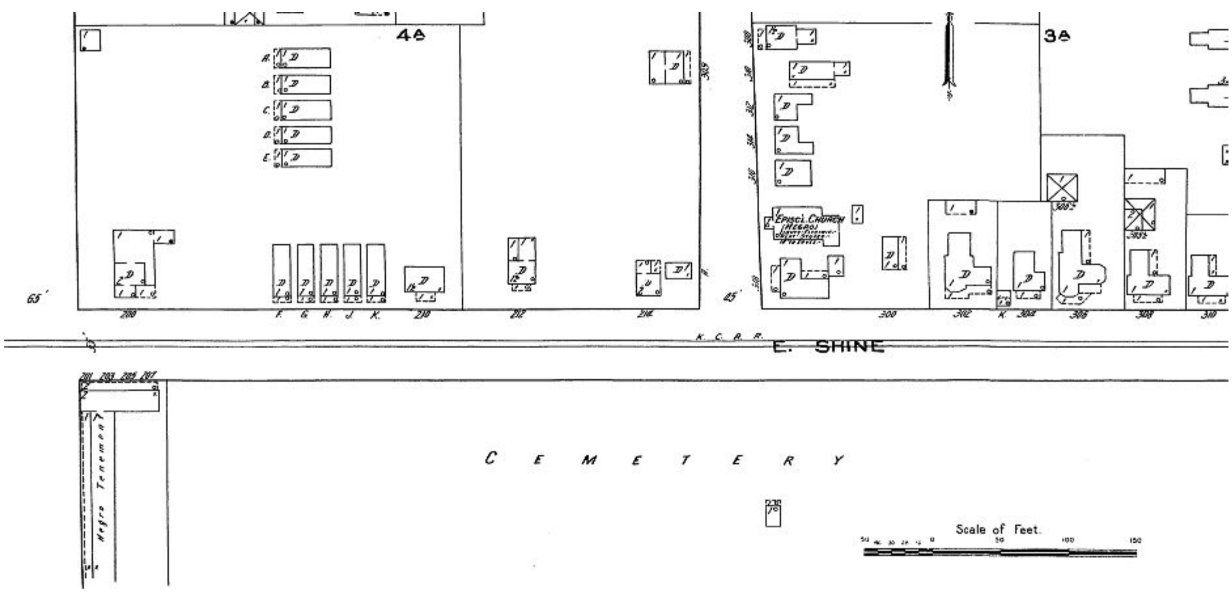


Figure 68: 1914 Sanborn Fire Insurance map of Lincoln City

It is not until the Sanford Fire Insurance maps of 1925 are published that Lincoln City is officially designated as an existing area. What is striking however is that the 1925 Index map

[112] The Free Dictionary defines a "tenement" as "a rundown, low-rental apartment building whose facilities and maintenance barely meet minimum standards."

of the entire City explicitly names Lincoln City, yet no other neighborhood is singled out as such (see Figure 69). Doing this, the map suggestively orients the reader to this “special” area as being juridically incorporated, yet still separated. On the copy of this map, the title of the Lincoln City area is on the bottom-right, panel 24.

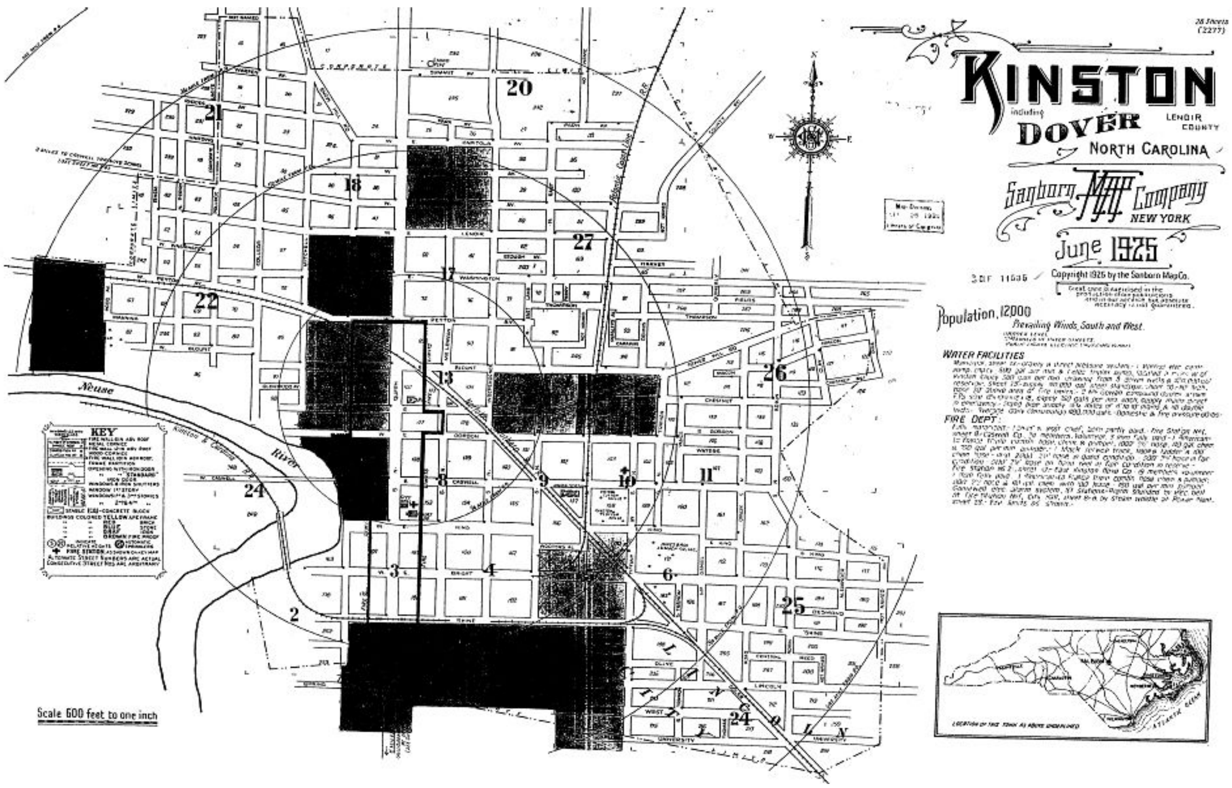


Figure 69: 1925 Sanford Fire Insurance Index Maps for Kinston

The detail of Map panel 24 (Figure 70) indeed shows the development which comprises the heart of Lincoln City, including Lincoln, Oak, and University Streets. Still, a thick black line ends the mapped out space, leaving the southward going roads to our imagination.

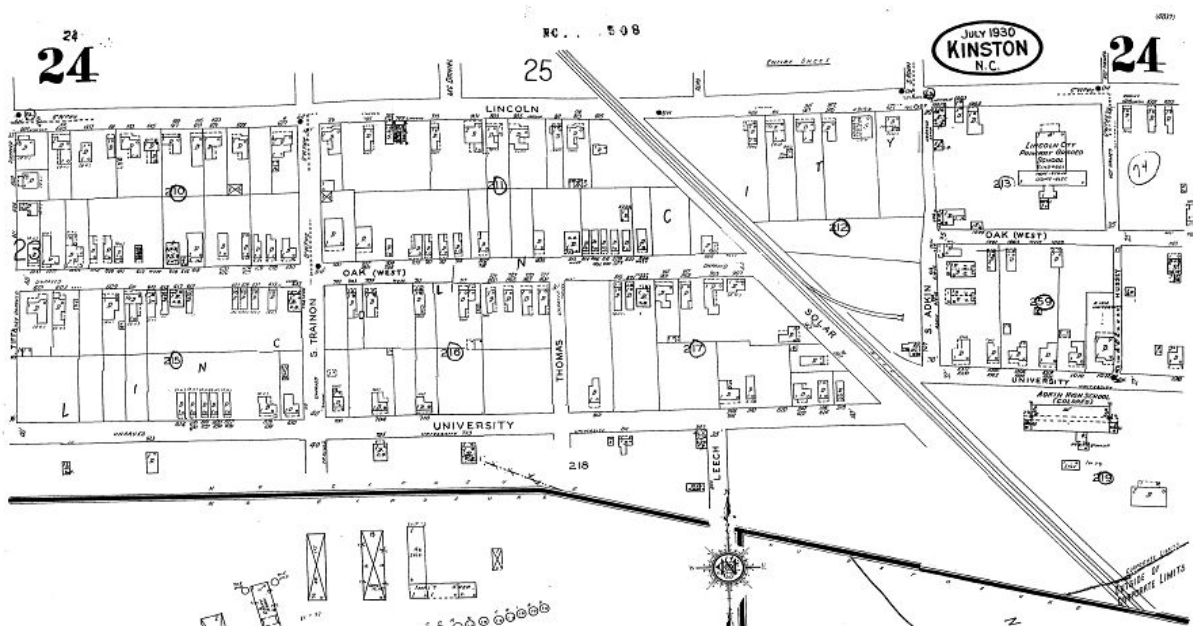


Figure 70: Detail of Kinston Map panel 24, 1925 Sanford Fire Insurance Map

The implication of the spatial hints carry a racial reality which is all too well known in south. As Ms. Edna Barnette Speights, Lincoln's daughter, tells the local historians Louis and Mavis Anderson in an interview[113]:

> Where J.D.'s supermarket is was all white folks. The nearest black folks was on Reed Street. A hill up on Adkin Street leading to J.D's. You couldn't go there this time of evening. The white folks would throw at you, chunk at you, call you nigger. It was called *Crackertown*. I heard my grandmother talk about some man who got lynched in Snow Hill. His last name was Black. I remember that name.

[113] Courtesy of the collection of Ms. Waters.

Appendix III: 20th Century flood hazards to Kinston and Lincoln City

How likely is it that Lincoln City flooded before Hurricane Hazel? In a 1996 article by the Kinston Free Press, Kinston's flood history is summarized (Kinston Free Press 1996q). The article notes a string of flood events which apparently affected the City: 1908, 1919, 1924, 1928, 1945. According to another source, the hurricane historian Barnes (2001), another string of events can be said to have affected the region more generally, including the event on September 13, 1913, which brought a "surprising amount of floodwaters" (p64). This storm severely flooded New Bern, the major boating transportation hub south of Kinston in the mouth of the Neuse River: "the streets were inundated by the overflowing Neuse River, which reached a new record level for that location; nine feet above normal high water. A large railroad bridge that spanned the Neuse was washed away, and damage to homes and businesses was extensive. Crop damage was significant throughout the region." (p64-65). Barnes also notes that for Goldsboro, located upstream of Kinston, this storm was "the worst in history." Although Kinston is not mentioned, situated between Goldsboro and New Bern on the same river, it is likely to have been affected by the same storm. Another flood mentioned is the flood of 1929, October 1-2, with flooding very near the 1928 record levels, and the hurricane of 1933, which traced along coastal eastern North Carolina, and left a severe imprint yet again on the City of New Bern. The highest flood known since 1913, the water reached a height of three to four feet in some streets, and rowboats and skiffs were used to evacuate people. Barnes notes that "the Neuse River bridge that linked New Bern and Bridgeton on U.S. 17 was washed out at about 1:30 a.m. on September 16th. A three-quarter-mile-long section was taken out by the surging waters of the Neuse, and pieces of the bridge were scattered along the shores for miles downriver" (Barnes 2001:69). While it is clear that this flood was due to rising tides of salt water and affected mostly those who made their living off the sea, the rising waters likely would have affected the Neuse River upstream at Kinston, and Lincoln City. Finally, the hurricane season of 1944 brought a category 1 hurricane close to Lenoir County in early August, doing much damage in Carolina and Wrightsville Beach. Barnes notes that a Carolina Beach newspaper boldly reported that this was “the greatest storm to strike here in the past 200 years” (Barnes, 2001, p75). While its path does not suggest a direct storm surge up the Neuse River, it is again clear that rainfall and wind damage could have affected Lincoln City.

The chain of references suggested by the Kinston Free Press and historian Barnes—1908, 1913, 1919, 1924, 1928, 1933, 1944, 1945—can further be refined by linking it up with historical data provided by scientific monitors, such as the historic river gauge data kept by the automated and database archives of the United States Geological Survey (USGS). Since 1918, USGS has installed a river gauge (# 02089500, specifically) in Kinston measuring river-heights in the Neuse river on a real-time basis. Anyone interested in researching historic river heights can download this data for free. Figure 71 shows the Neuse River’s annual peak-heights, with filled lines indicating the estimated flood levels of the Neuse River at Kinston according to USGS information from the Army Corps of Engineers in Wilmington. When peaks reach 14 feet at gauge #02089500, flood stage is reached at Kinston. Eighteen feet is considered a moderate flood, and 21 feet is a major flood .

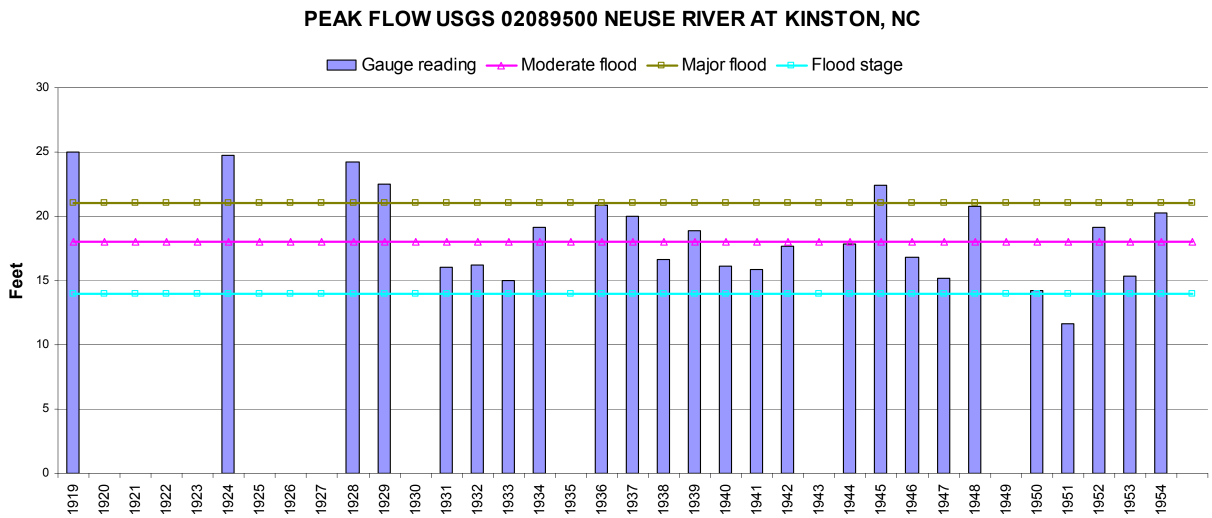


Figure 71: USGS gauge #02089500

From this, additional potential flood events can be identified, including 1936, 1937, 1929. What can further be seen from the results is that flood stage during Hazel itself was not the highest recorded flood stage since 1918. Pre-Hazel, the Neuse river reached flood stage on 24 occasions between 1918 and 1954. Five of these would be considered major floods, and seven moderate floods by the Army Corps of Engineers in Wilmington. In this time series, the 1908 and 1913 events do not show up, occurring prior to the baseline value for USGS #02089500 dataset of 1919. Finally, and spatially shifting gears again to a more regional scale, the growing string of identified flood events—1908, 1913, 1919, 1924, 1928, 1933, 1936, 1937, 1944, 1945—can further be compared to the electronic portal of climatic memory provided by the North Carolina's State Climate Office (NCSCO 2007), called "History of Hurricanes in North Carolina." This website pushes hazard-memory baseline as far back as 1886. According to the site, 1886 is when "reliable classification of the intensity of tropical cyclones began." Based on this memory (which apparently is obtained from a database in Colorado, called the "Colorado State Tropical Cyclone database,") the office provides not only a strong temporal reference model for North Carolina's past, but also connects this history to a projected path into the future: "The coast of North Carolina can expect to receive a tropical storm or a hurricane once every four years, while a tropical cyclone affects the state every 1.3 years." The table provided, called the "North Carolina Tropical Cyclone Statistics (1886-1996)," actually provides a wealth of temporal information. First, the temporal window which bounds our hazard perception starts in 1886 and ends in 1996. Looking from this temporal scale, we receive a number summarizing the *number of years between storms* and its miraculous opposite, *number of storms per year*. While the underlying temporality is the same for both summaries (1/ Average number of years between storms = Average number of storms per year), the framing gives it a different feel. In "Average number of years between storms" we are waiting four or 1.3 years to have the storm arrive again. In "Average number of storms per year" we realize that each year there is a probability of the storm occurring, of .25 or .75 odds respectively. Either way, the office nicely transforms memory into expectations; all of this immediately accessible through the references provided. The usefulness of this generalization is evident; we certainly want to know when the next Hurricane will hit Lincoln City, or for that matter what the odds are of it occurring this year!

The climate office provides a bar chart of hurricane activity by decades, shown below in Figure 72. As can be seen from this, Hurricane Hazel coincides with an apparent two decades increase in North Carolina Hurricane activity in the 1940s and 1950s. It also appears that some previously unidentified tropical storms directly hit Lenoir County and possibly Kinston's Lincoln City. These are the storms of 1893 and 1894. Old accounts describe the area during the civil war days as impassable roads due to hard rains and swampy: "Marched on the railroad track all the afternoon.

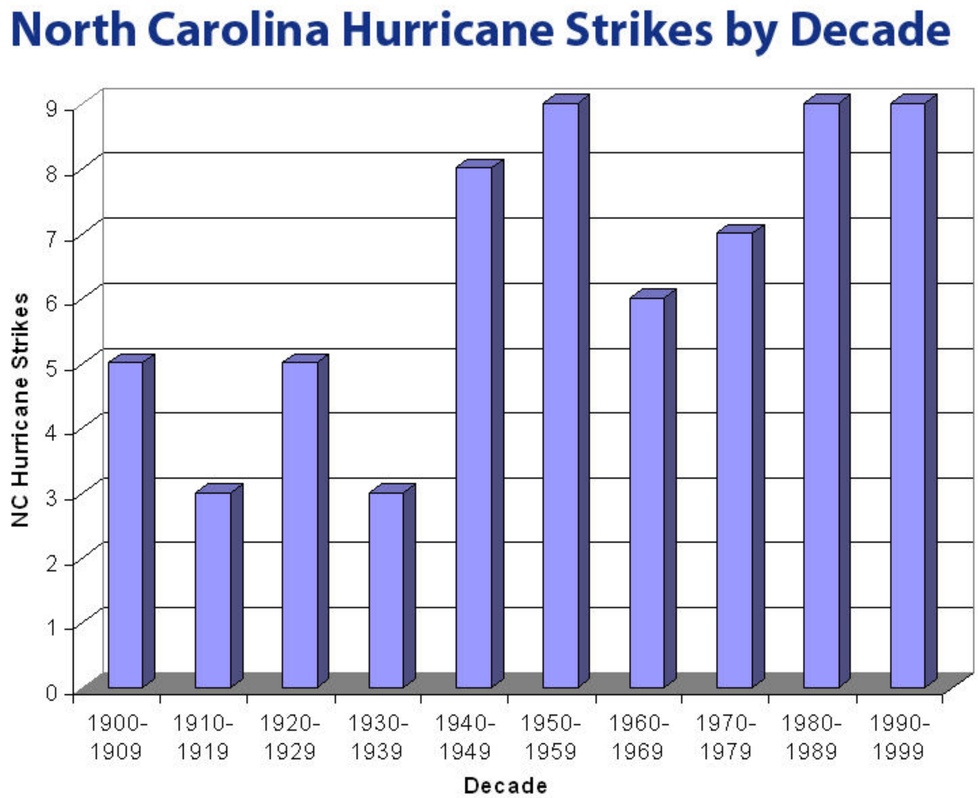


Figure 72: North Carolina Hurricane Strikes by Decade (Tropical storms not included in chart)

The main road was impassable. We got to Kinston at 4 in the afternoon, and made camp in a swamp, two and a half miles out of town. We had nothing to eat, but slept good for all that" (Unknown 1913). Leaving the science monitors behind and now armed with an impressive number of potential Lincoln City flood dates—1893, 1894, 1908, 1913, 1919, 1924, 1928, 1933, 1936, 1937, 1944, 1945—I returned to UNC's Wilson Library to consult the archives of the North Carolina Collection, where a temporal reference tells me that in 1925 the City of Kinston business investment promotional literature noted optimistically that the City is "well drained." (Eastern Carolina Chamber of Commerce 1925). Further, and perhaps somewhat to the contrary, I find a 1936 report written by the State's Emergency Relief Administration which shows that Lenoir County received a substantial sum of financial support to engage in malaria drainage projects, which included drainage in the City of Kinston (North Carolina Emergency Relief Commission, 1936). My conclusion, based on these references, is that the information ecology which pre-dates Hurricane Hazel provides ample evidence that flooding in the City of Kinston would likely have occurred before Hurricane Hazel's arrival, and possibly to an equal or greater extent than that caused by Hazel.

Appendix IV: Hurricane Hazel

Hurricane Hazel was described by many observers as "freakish." It was a very destructive chaotic event. It was remarkable because its dynamic properties had not been experienced before. The North Carolina hurricane historian Jay Barnes writes: "As Hazel swept inland, its winds endured with freakish intensity. Grannis Airport in Fayetteville reported gusts of 110 mph, and estimates of 120 mph were made by observers in Goldsboro, Kinston, and Faison." (Barnes 2001). Hazel appeared to have been so freakish that she never really ceased to exist in North Carolina's or even North American public memory, as far as Toronto, Canada (CBC 2007). On her 50th years anniversary in 2004, Hazel returned in full force by means of an outpouring of materials which commemorated the significance of this event. For example, National Geographic News published a commentary suggesting "meteorologists are *still* amazed at how long Hurricane Hazel held together after it made landfall." They had called it a "stubbornly intense, fast-moving hurricane," a "bulldozer storm riding the highest lunar tide," it's punch staying with it for so long because "essentially, it was outrunning the normal process of weakening." (National Geographic News 2005). The North Carolina media outlet WRAL-TV published a multimedia site with materials from Hazel noting that "it was the only category 4 hurricane to hit the state in the 20th century," and included a documentary film allowing the public to relive the event: "The documentary includes never before seen film footage of the storm, rare photographs of its aftermath and a recording of a 1954 radio report by one of the first news reporters to view the damage." (WRAL-TV 2007). Another multimedia example comes from a Star News Online site (covering southeastern North Carolina) called "Hurricane Hazel: October 15, 1954. The Hurricane of Hurricanes. Remembering her 50 years later." This site has downloadable footage of old film materials including commentary by the local residents who shot it. The coastal dwellers providing commentary to the footage note that nothing they have seen since then, except for maybe Hugo, had been this bad (Star News Online 2007). The historical significance of Hazel lies beyond its damages: an estimated $136 million in property damage, including 15,000 destroyed and 39,000 damaged homes, 19 deaths and 200 injuries. Before Hazel, scientists did not now a hazard event like this was possible, particularly because of its remarkable sustenance of wind speed far inland. This historicity was further enhanced by Hazel's remarkable timing, which was during the full moon of October, the highest lunar tide of the year. A resulting storm surge in excess of 15 feet inundated southeastern North Carolina, including a significant rise of the Neuse River. Because of its impact, the name Hazel was officially retired in the Hurricane naming system (NOAA 2007).

Appendix V: The Blame the Dam Movement

One of the major driving force behind the "blame-the-dam" movement was Mr. Ted White. White never lived in Lincoln City. A white male in his forties at the time I met him in 2001, Ted was the co-owner of a nice restaurant, Kinston's driving force in the building of a 158 foot replica of Kinston's Civil War ironclad CSS Neuse—the wreckage of which can be found in the Neuse River off the City—and publisher/editor/writer of the U.S. Veteran Dispatch. He was also concerned about flooding. He almost yelled at me when I first met him in his restaurant: "If you want to study anything, study that damn dam!" Apparently, Ted was told that his land would be safe. Talking about his near death experience trying to escape the floods of Floyd which came in 1999, he illustrates the powerful influence which the notion of "flood control" through dam operations had on local risk culture:

> One of the reasons by the way, why I built my little cabin, is that I had heard that Raleigh built this dam and it was to protect from flooding, that they never get another flood that they had in October 1964. Officials sat around the table and decided they would have to go build a dam for flood control. They promised to build two, one in Raleigh and one more downstream and closer to Kinston in Goldsboro. But only the Raleigh one was built. What happened to the rest of the money?

Ted argued that the Army Corps of Engineers purposefully used Hurricane Fran as an excuse to "flush their system out": "….they used the hurricane as an excuse, to send the shit and sewage down on us." Yet, moreover, he argued that the Corps of Engineers had let the water out too late, which formed the core of the public movement of blame and the tendency to explain the flood event in terms of regional power differences:

> But you wonder why they built the dam in the first place? You have to look at the larger picture. There is a certain flow they have to maintain here for water usage,

> which shows they are in control. If they are in control, then why did they flood us? Because buying out the rich people in Cary[114] is more expensive?

Ted tells me with some pride that as an activist, he had brought the dam issue to the attention of the City Council in 1996. His aim was to have the City Council submit a request for congressional investigation of U.S. Corps of Engineers handling of the water during the hurricane. According to Ted, the petition he crafted was signed by more than 900 local people. The City Council endorsed it and asked for congressional investigation. Congressman Walter Jones' took note and promised an investigation. Rep. Sherwood W. Boehlert (R-NY) and Chairman of the subcommittee on Water Resources and Environment started an inquiry in the matter quickly thereafter. The eventual result of this inquiry did not find the Corps of Engineers at fault.

According to Ted, the Corps of Engineers just continued to allege that the dam actually has no impact on the flooding that far downstream, He insists that this argument has logical flaws. In 1964 the Corps were advocating to build two dams for flood control, but in 1996 they say that the one dam built has no impact, and that it is mostly for Raleigh's recreation and water. Frustrated, he vents to me:

> They built it from flood control funds from the federal government, they quit when Raleigh got theirs, and they abandoned Eastern North Carolina. The Corps of Engineers and the royal government of Raleigh abandoned the peasantry in Eastern North Carolina along the Neuse basin.

While Fran brought the issue of dam management to public attention, those who believed that the dam might not be implicated still did not consider the flood to be part of a trend, or extreme enough to warrant an entirely new baseline flood risk model. This is well illustrated

[114] Cary is a middle class, suburban town at the edge of Raleigh known for its high housing prices and income levels.

by an editorial in the Kinston Free Press called "*There's no point in playing the blame game*" (1996o) which asked its readers:

> Could the Corps of Engineers dumped water downstream earlier in the year to prepared for Hurricane Fran? Certainly, but crystal balls are fiction. How could the Corps have known this was about to happen? Who would have figured Fran would take the path she did? When was the last time a hurricane caused this sort of problem on the Neuse? It's all speculation. (Kinston Free Press 1996o)

Clearly, time was on the side of the engineers avoiding blame. The lull in hurricane activity had combined with the establishment of Falls Lake Dam to give the Army Corps of Engineers a 32 year flood-free buffer to support its argument that the engineers were not to blame. In defending against public criticisms, the Corps provided a number of arguments to the media. First, it vehemently hung on the notion that indeed it was Mother Nature which had caused the flooding, and not the Corps. The argument usually boiled down to something like this: "We didn't cause the flooding, Mother Nature did" (Kinston Free Press 1996k). This answer did not satisfy White and others who were pointing not at the disaster from a hazard point of view, but emphasized vulnerability of the landscape as a result of human intervention. According to the critics, the transition from the Neuse into a controlled flood ecology moved the Corps into a position of liability as concerns flooding. The second argument emphasized this issue of control. The point made was that the extent to which flood control is managed by the Corps of Engineers is dependent on the distance from the dam, as shown in Table 12 and Figure 73 below. In the case of Kinston, 30% of the flood waters are under control of the Corps of Engineers. The other 70% of the water running through Neuse at the City of Kinston comes from drainage below the dam, the flood plain in between Smithfield and Kinston, and is unregulated by the dam.

Table 12: US Corps of Engineers summarizing the workings of Falls Lake Dam

Location	Total Drainage Area (sq. mi.)	Uncontrolled Drainage Area Downstream of Falls Dam (sq. mi.)	Uncontrolled Drainage Area Downstream of Falls Dam (percent of total area)	Distance above mouth of Neuse River (miles)	Distance Below Falls Dam (miles)	Normal Travel Time from Falls Dam (hours)	Normal Travel Time from Falls Dam (Days)
Falls Dam	770	---		234	---	--	---
Clayton	1150	380	33	202	32	14	0.5
Smithfield	1206	436	36	178	56	20	0.8
Goldsboro	2399	1629	68	135	99	80	3.3
Kinston	2692	1922	71	90	144	128	5.3

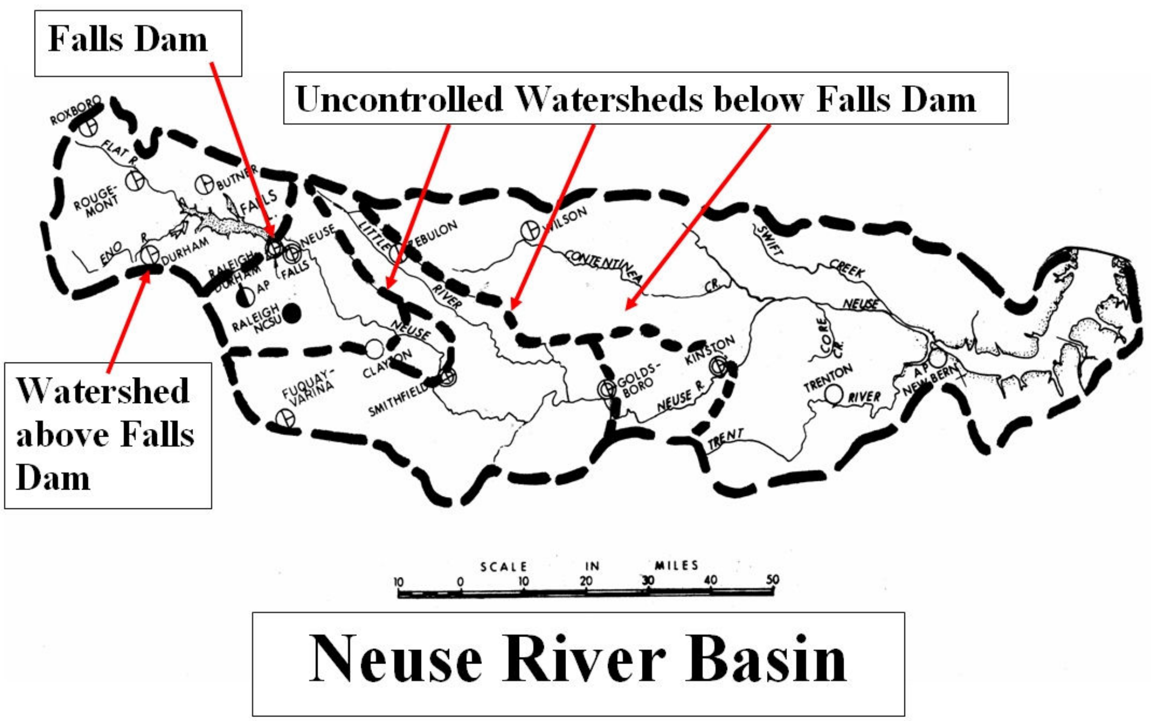


Figure 73: Controlled and uncontrolled watersheds in the Neuse River Basin (source: Corps of Engineers, Wilmington District)

This lack of control is summarized by Corps officials as ”like having 30% of a roof on your house” (Kinston Free Press 1996p). Again, the critics had reasons to doubt. One

Kinston Free Press article suggests that there actually is evidence to support the assertion that the dam releases played a role in the flooding. The paper quotes a forecaster at the National Weather Service's River Center in Atlanta involved in the accurate prediction of the Neuse's crest who argued that "there is a direct relationship." (Kinston Free Press 1996a) The newspaper notes that the model that was used included outflow totals from the dam as well as runoff predictions. However, as the forecaster argued to the newspaper, the most important element in the calculations was the volume of water released from the dam. "That's a key point," he had said, "you would probably get more water from that than from runoff."[115]

A third argument the Corps of Engineers used convinced officials and environmental managers of the logic of the dam. Found in numerous articles, it suggested that flooding would have been much worse if the Falls of the Neuse Dam had not been there (Kinston Free Press 1996i). The Corps argued that the dam was doing what it was designed to do: reduce the flood crest, and in so doing, the basin area had avoided $140 million in damages. However, what Corps staff and media articles on this issue emphasized less is that these benefits are actually relative to geographic position: the further away, the less the crest reduction in flooding. A Corps of Engineers staff person provided me with an image which according to him had been useful in their public outreach, shown in Figure 74. It illustrates this argument, but also shows the apparent amnesia concerning omission of the Kinston details. What can be seen at first glance is that there is indeed significant flood reduction at al locations

[115] Unfortunately, I was unable to track down this person.

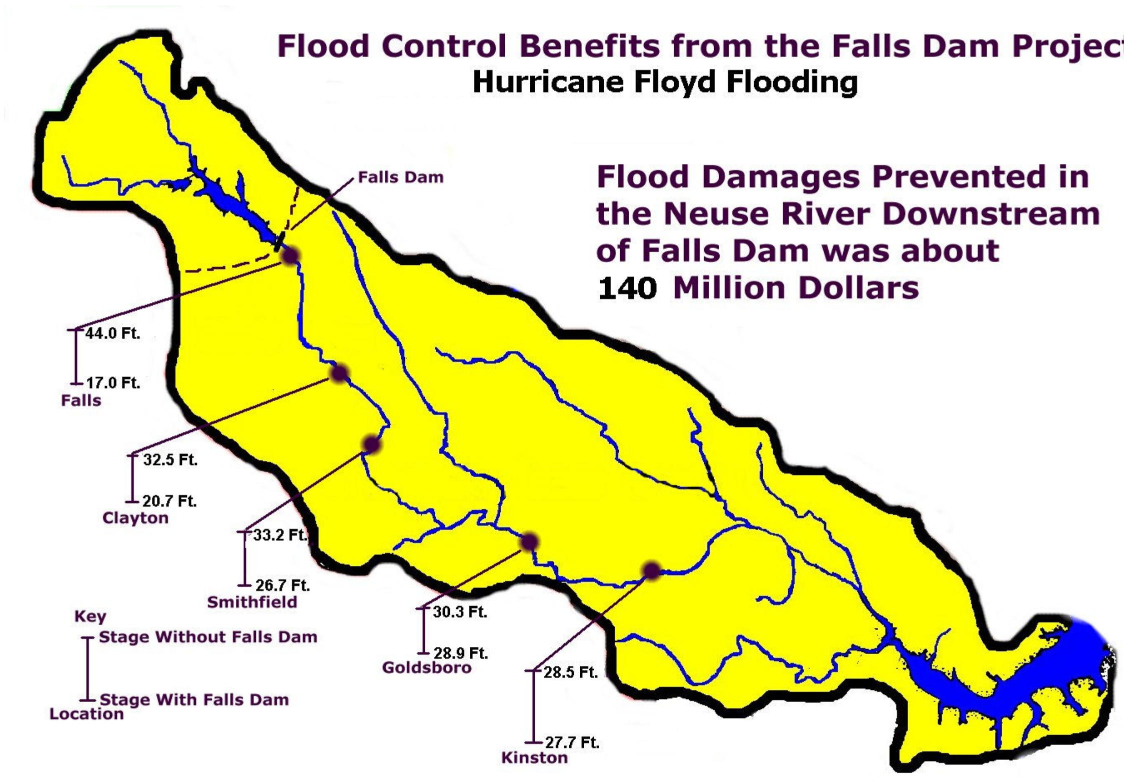


Figure 74: Flood Control Benefits from Falls Lake Dam Project. (source: U.S Corps of Engineers)

However, a closer look at the key scale lines showing the stage without Falls Lake Dam and the stage with Falls Lake Dam shows how the symbolism on this map is deceptive regarding the reduction in flood crests at the shown locations: while the length of the vertical bars suggests that there was equal flood reduction at all places, if one calculates the flood crest reduction differences and—as I did—and paste them on the original map, a slightly different impression is given, in particular for the people of Kinston. I show this in Figure 75**.**

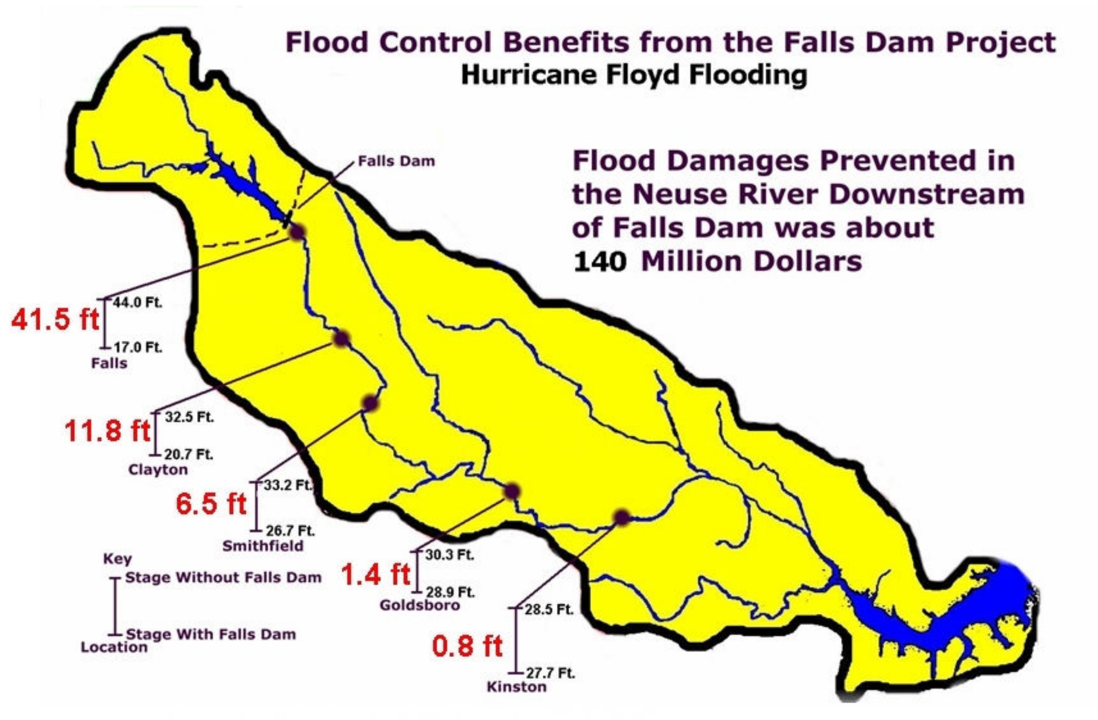


Figure 75: Flood Control Benefits form Falls Lake Dam Project (Altered)
Source: U.S. Corps of Engineers

What is painfully obvious is that while the crest reduction is huge in Clayton—11.8 feet—this is not so much the case for Kinston, where it is less than 1 foot. Regardless, and overall, the conclusion of the image appears to be that the dam prevented $140 million in flood damages. No politician would want to argue against such number.

Finally, as a fourth argument, the Army Corps of Engineers consistently asserted that early release of water was impossible or difficult because of federal mandates (Kinston Free Press 1996p). No water could have been released before the hurricane hit without dipping unto the portion of the "pool" that provides Raleigh with water. The reservoir is divided in pools, shown in Figure 76. The top of the dam is at 264 feet. The bottom of the flood pool is 251.5 feet and below that is for Raleigh's water. Federal law prohibits the Corps from emptying water below 251.5 feet. Clearly, this argument gave the Army Corps of Engineers a political escape against the public criticism with respect to the argument that water should have been released before the hurricane season.

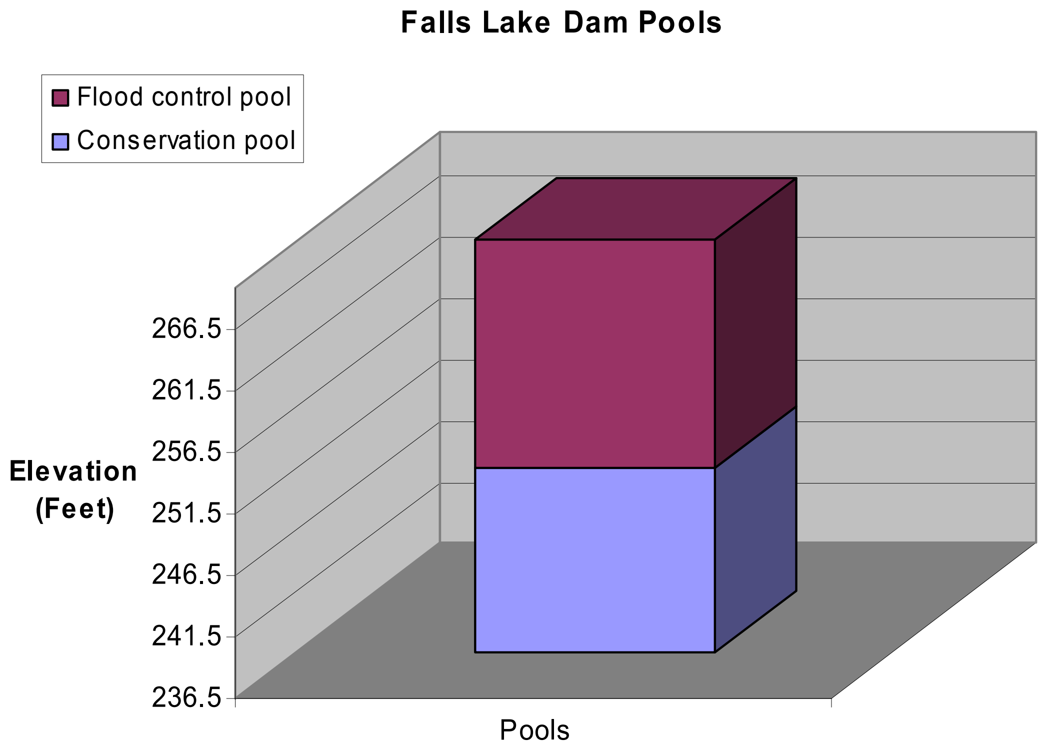


Figure 76: Falls Lake Dam Pools

Appendix VI: Background on Hurricane Floyd

The flooding of “Floyd” actually was a combination of rainfall from tropical storm Dennis and hurricanes Floyd and Irene in the fall of 1999. Hurricanes Dennis, Floyd, and Irene occurred within a 6-week period between September 4 and October 17, 1999. All three storms brought extremely heavy and, in some cases, unprecedented rainfall to eastern North Carolina. On their website, the USGS notes that rainfall throughout most of the Tar-Pamlico River Basin was two to three times greater in September 1999 than in August 1955. This is interesting, because it suggests that in the case of the scientific monitors it seems that it is not the flooding associated with Hurricane Hazel, nor the floods of Hurricane Hilda, but the rainfall occurrences of 1955 which serves as baseline reference used to evaluate the Floyd. USGS notes that the comparison between September 1999 and August 1955 is valid because both were months during which two hurricanes made landfall in North Carolina:

> ”Only in the extreme eastern part of the State did August 1955 rainfall exceed September 1999 rainfall. The heaviest rainfall was more widespread in September 1999 than in August 1955, and fell over parts of the river basins that are more susceptible to flooding.”

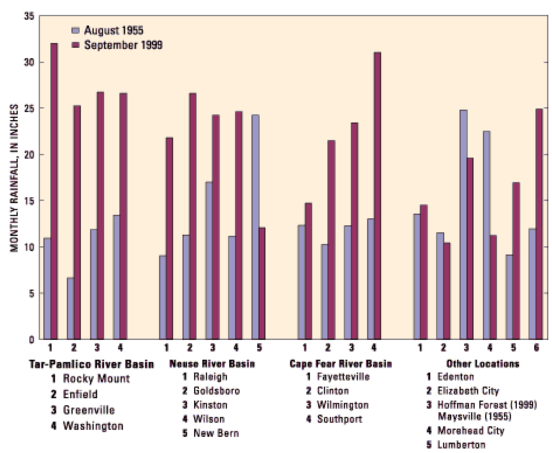


Figure 77: August 1955 and September 1999 monthly rainfall at selected sites in the Tar-Pamlico, Neuse, and Cape Fear River Basins, and at selected other sites.

The USGS further summarizes rainfall totals for the Neuse River relative to the last known peak, Hurricane Fran (see Table 13). It can be seen from this table that in some places, including Kinston, more than half of the average annual rainfall fell during this 6-week period.

Table 13: Rainfall amounts, in inches, associated with Hurricanes Dennis, Floyd, Irene, Fran, and annual average (1960-90) at selected locations

Location (fig. 3)	Hurricane Dennis (Sept. 3 - 7, 1999)	Hurricane Floyd (Sept. 14 - 17, 1999)	Hurricane Irene (Oct. 17 - 18, 1999	Sept. - Oct. 1999 total	Sept. 4 - 6, 1996 (Hurricane Fran)	Annual average rainfall
Durham	3.30	5.98	0.91	18.60	8.38	48.10
Raleigh	8.46	6.55	1.50	24.24	8.80	41.43
Clayton	5.35	9.80	2.59	20.98	6.98	45.11
Goldsboro	7.19-7.94	12.06-12.70	4.36	32.10	6.41	49.27
Wilson	7.60	10.73	5.07	31.05	4.27	46.96
Kinston	6.07-6.93	13.35-13.98	5.37	29.48	5.15	51.20
New Bern	4.00	5.51	6.39	19.82	--	53.11
Trenton	7.42	14.98	--	>24.60[116]	8.33	52.22

Previous to Dennis and during most of 1999 prior to September, almost the entire State of North Carolina was in a drought condition and as a result some restrictions concerning water use had been implemented at numerous locations in the State. The USGS reports that according to data from the National Climatic Data Center in Asheville the rainfall deficit for the 12 months preceding September 1999 was 13 inches in Kinston[117].

"Dennis the Menace" had missed the North Carolina coastline at first, but then stalled for a few days before it made an unwelcome trip back to North Carolina with wind just below hurricane force, yet still cutting Hatteras Island in half. Its six inches of rainfall had drenched the soils by the time Hurricane Floyd hit North Carolina and left Kinston's two

[116] October rainfall records are unavailable

[117] They also note that this deficit is calculated with reference on a 1960-1990 monthly average. This period exceeds the internationally agreed upon Climatic Normal. Climatologists define a climatic normal as the arithmetic average of a climate element such as temperature over a prescribed 30-year interval. The 30 year interval was selected by international agreement, based on the recommendations of the International Meteorological Conference in Warsaw in 1933. The logic behind this choice of 30 years is that within this interval is sufficiently long to filter out many of the short-term inter annual fluctuations and anomalies, but sufficiently short so as to be used to reflect longer term climatic trends. Currently, the 30-year interval for calculating normals extends from 1971 to 2000.

wastewater treatment plants overwhelmed (Kinston Free Press 1999f). One of these treatment plants, the Peachtree plant, is located just south of Lincoln City, on the floodplain. From Dennis, Peachtree received 21 million gallons of water, while it was designed for 6.5 million, allowing many solid materials to leave the plant untreated (called a "washthrough"). The Kinston Free Press noted that the City happened to be installing new "dewatering" equipment that transforms sludge from a liquid into a cake. According to the City's Engineer, damage caused by washthroughs might have been less severe had they occurred just a few weeks later.

Dennis causes the Neuse River to be above flood stage on September 11th 1999, cresting at 15 feet. "Just because the river is above flood stage doesn't mean there will be any damage," Lenoir County's Emergency Management Director Roger Dail was quoted (Kinston Free Press 1999n). According to the paper, the river had to get between 17 and 18 feet before it would flood lowlands in the county and Davis street on Kinston's east side. "We know from history that it will have to get to 21 feet before it gets into any of the houses," Dail had followed.

> "Rising rivers can easily put residents on edge, especially those who remember hurricanes Bertha and Fran three short years ago. The river rose to a record 23 feet following Fran, forcing river water and raw sewage into homes across the county. The waters rose again to 20.23 feet on March 17, 1998 in a flood that extended from January to April. 'People shouldn't think that this is going to be 1996 again, because it is not,' Dail said. We just want the residents in the low-lying areas to be aware.' The only way the current projections could change is if the area sees another six to seven inches of rain in the next week. That isn't expected to happen." (Kinston Free Press 1999n)

Floyd hit Kinston with winds of 75 miles per hour. The next day, Dail remarked to the Kinston Free Press: "Your paper isn't long enough to list all the roads that are blocked." (Kinston Free Press 1999n).

In the ensuing days, concern among Kinston Officials focuses on projected rainfall from a new Hurricane system in the Gulf of Mexico (Gert) combined with conflicting projections of the to be expected Neuse River crest made by the national Weather Service in Newport (25 feet, 6 inches) and the Southeast River Prediction Forecast Center in Atlanta (the River Center) (24 feet). The Kinston Free Press quotes Fire Chief Greg Smith:

> The River Center said we would not have normally crested this soon, that the flood waters would have normally risen a lot more gradually. However, the massive amounts of rain and the effects of Dennis caused us to reach our crest almost immediately. Right now, the river has reached a point of equilibrium. As much is going out as is coming in (Kinston Free Press 1999o).

Yet, even in this unprecedented level of uncertainty, temporal referentiality still provides important information, as Smith suggests: "During Hurricane Fran, the river center predicted the Neuse River would crest at 19 feet. The actual figure was 23 feet 3 inches," and "We historically crest 3 feet below Goldsboro, which would put us a foot higher than the River Center predicted for Kinston."[118] With Kinston's King Streets Bridge hanging slightly above the swollen river, Kinston officials note that the water was about to touch the bottom of the bridge. If that would occur, flood water might back up, and massive flooding might affect downtown. "We are in a world of hurt if it goes underwater," Daily said to the Kinston Free Press, "but I don't think it will." (Kinston Free Press 1999e)

The article reports that more rain is to be expected, but that predictions suggest it will not affect the Neuse River. Upstream in Raleigh, Engineers at Falls Lake Dam report to the paper that they have plans to release more water on Tuesday, pending incoming rain. "We have a little over four feet of storage left," the Project Engineer Lloyd Williams is quoted, "It's a tightrope walk we're gambling that we won't get any more rain here. We're deviating

[118] Kinston Free Press (1999) Experts offer conflicting predictions of crest levels. Local officials take no changes are prepared for the worst. Sunday, September 19.

from our normal schedule and holding it back now." On Tuesday September 21, the Kinston Free Press reports that water is creeping up the King Street Bridge and that the wastewater plants are overwhelmed, forcing the city to ask industrial users to immediately cease flow into the system. Adjusted predictions now have the river cresting on September 27th at 26 feet. The paper notes that the late crest and impending releases from Raleigh's Falls Lake Dam will extent the duration of the flood (Kinston Free Press 1999c). "Everything is new to us," said Assistant County Manager Reginal Lee. "The river crest is much more than the 23.3 record of Hurricane Fran" (Kinston Free Press 1999j). On Wednesday, the crest is once more readjusted to 27 feet. On Thursday September 23, the Kinston Free Press reports that the river has crested at 27.7 feet. That day, City Officials held their breath as the rise of the Neuse River slowed, stopped and finally reversed. Kinston's Fire Chief expresses relief, and then notes to the Kinston Free Press "The biggest fear we have now is did we leave anyone behind? If people were there in 5 feet of water in those houses…" (Kinston Free Press 1999d). That day, no roads across the Neuse River were passable anymore. Lenoir County had been divided. Kinston, in its own right, had become an island with all major access routes blocked by floodwaters (Kinston Free Press 1999i).

City of Savannah Research Library & Municipal Archives

9. REFERENCES

9.1. Introduction

AAPG (1989) DOI: 10.1306/A1ADDC70-0DFE-11D7-8641000102C1865D. *GCAGS Transactions* (American Association of Petroleum Geologists), 39.

AGU (2006) *Hurricanes and the U.S. Gulf Coast: Science and Sustainable Rebuilding.* American Geophysical Union. Accessed December 2007. Web Site: http://www.agu.org/reports/hurriccanes/.

Alexander, David (2000) *Confronting Catastrophe: New Perspectives on Natural Disasters*. New York: Oxford University Press.

American Heritage Dictionary (2000) *American Heritage® Dictionary of the English Language*. Fourth Edition. Houghton Mifflin Company.

Annan, Kofi A. (1999) An Increasing Vulnerability to Natural Disasters. *International Herald Tribune*. September 10.

Antrop, Marc (2005) Why landscapes of the past are important for the future. *Landscape and Urban Planning,* 70 (2005), 21–34.

Appadurai, A. (1996) *Modernity at Large: Cultural Dimensions of Globalization*. University of Minnesota Press.

Armitage, D., Berkes, F. and Doubleday, N. (2007) *Adaptive Co-Management: Collaboration, Learning, and Multilevel Governance*. Vancouver: University of British Columbia Press.

Associated Press (2006) New Orleans Sinking Faster Than Thought. *Associated Press*, May 31.

Bankoff, G. (2004) Time is of the Essence: Disasters, Vulnerability, and History. *International Journal of Mass Emergencies and Disasters*. 22, 23-42.

Bankoff, G., Frerks, G., Hilhorst, D. (2004) *Mapping vulnerability*. London: Earthscan.

Bazerman, Max .H. & Watkins, Michael D. (2004) *Predictable Surprises: The Disasters You Should Have Seen Coming and How To Prevent Then*. Boston: Harvard Business School Press.

Berlyne, D. E. (1960) *Conflict, arousal, and curiosity*. New York: McGraw-Hill.

Berlyne, D. E. (1974) *Studies in the new experimental aesthetics: Steps toward an objective psychology of aesthetic appreciation*. New York: Halsted Press.

Birkman, Jorn, & Wisner, Ben (2006) *Measuring the Un-Measurable*. Studies of the University: Research, Council, Education. No. 5. Bonn: United Nations University.

Birkmann, Jörn (2005) *Vulnerability Assessment: Applicability and Usefulness of Indicators to Measure Vulnerability*. Paper presented at the Fifth Annual IIASA-DPRI Forum on Integrated Disaster Risk Management. Beijing Normal University, Beijing, China. 14-18 September 2005.

Blaikie, P. Cannon, T. Davis, I, & Wisner, B. (1994) *At Risk: Natural Hazards, People's Vulnerability, and Disasters*. London: Routledge.

Bosher L.S. (2005) *The divine hierarchy: The social and institutional elements of vulnerability in south India*. Dissertation. Flood Hazard Research Centre. London: Middlesex University.

Burton, Rosemary (1999) Landscape Evaluation. In Pacione, M. (ed.) *Applied Geography: Principles and Practice*. New York: Routledge.

Campanella, R., Meffert, D.J., and Schwartz, E. (2007) *Above-Sea-Level New Orleans: The Residential Capacity of Orleans Parish's Higher Ground*. White Paper. Center for Bioenvironmental Research (CBR). April 2007.

Cashdan, E. (ed.) (1990) *Risk and Uncertainty in Tribal and Peasant Economies*. Boulder: Westview Press.

Couclelis, H. (1998) Aristotelian Spatial Dynamics in the Age of Geographic Information Systems. In Egenhofer, Max J. & Golledge, Reginald G. (Eds.), *Spatial and Temporal Reasoning in Geographic Information Systems*. Oxford: Oxford University Press.

Crumley, C.L. (Ed.) (1994) *Historical Ecology: Cultural Knowledge and Changing Landscapes*. Santa Fe: School of American Research.

Cutter, S.L. (1996) Vulnerability to environmental hazards. *Progress in Human Geography,* 20(4),529-539.

De Landa, M. (1997) *A Thousand Years of Nonlinear History*. New York: Zone Books/Swerve Editions.

De Vries, D. H. (2007) Being Temporal and Vulnerability to Natural Disasters. In Warner, Koko (Ed.), *Perspectives on Social Vulnerability*. Studies of the University: Research, Counsel, Education, No. 6/2007. Bonn: United Nations University Press.

Dixon, T.H. Amelung, F., Ferretti, A., Novali, F., Rocca, F., Dokka, R., Sella, G., Kim, S.W, Wdowinski, S., Whitman, D. (2006) Space geodesy: Subsidence and flooding in New Orleans. Nature, 441(7093),587-588.

Durkheim, E. (1915) *The Elementary Forms of Religious Life*. London: Allen & Unwin.

Dynes, Russell R. (2000) The Dialogue Between Voltaire and Rousseau on the Lisbon Earthquake: The Emergence of a Social Science View. *International Journal of Mass Emergencies and Disasters*, 18,97-115.

Elias, Norbert (1984) *Über die Zeit. Arbeiten zur Wissenssoziologie II*. Frankfurt am Main: Suhrkamp. (Published in English as Time. An Essay, Oxford: Blackwell, 1991).

Evans-Pritchard, E.E. (1940) *The Nuer: A Description of the Modes of Livelihood and Political Institutions of a Nilotic People*. Oxford: Clarendon Press.

Fisk, J.E. (2002) Judgments under uncertainty: Representativeness or potential surprise? *British Journal of Psychology*, 93,431-449.

Ford, J. L. (1994) *G. L. S. Shackle: The Dissenting Economist's Economist*. Brookfield: Edward Elgar Publishing Company.

Ford, J.L. & Ghose, S. (1998) *The Primitive Uncertainty Concept: Possibility, Potential Surprise, Probability and Belief; Some Experimental Evidence*. *Metroeconomica*, 49(2),195-220 (Publication No. 001444).

Forrest, T. (1993) Disaster Anniversary: A Social Reconstruction of Time. *Sociological Inquiry*, Vol. 63(4),444-456.

Forrest, T. (1993) A Social Reconstruction of Time. *Sociological Inquiry* 63,444-57.

Fraser, J., Elmore, R., Godschalk, D. and Rohe, W. (2003) *Implementing Buyout Programs in Floodplains*." Unpublished. Center for Urban and Regional Studies, University of North Carolina at Chapel Hill.

Garcia-Acosta, V. (2001) Historical Disaster Research. In S. M. A. Hoffmann & A. Oliver-Smith (Eds.), *Catastrophe and Culture: The Anthropology of Disaster*. Santa Fe: School of American Research Press.

Geipel, R. (1982) *Disasters and Reconstruction: The Friuli Earthquakes of 1976*. London: George Allen & Unwin.

Gunderson, L. H. & Holling, C.S. (2002) *Panarchy: understanding transformation in human and natural systems*. Washington: Island Press.

Haas, J. Eugene, Robert W. Kates & Martyn J. Bowden (Eds.) (1977) *Reconstruction Following Disaster.* Cambridge: MIT Press.

Halstead, P. & J. O'Shea (Eds.) (1989) *Bad Year Economics: Cultural Responses to Risk and Uncertainty*. Cambridge: Cambridge University Press.

Haraway, D. (1989) Introduction: the persistence of vision. In: *Primate Visions: Gender, Race, and Nature in the World of Modern Science*. New York: Routledge.

Haraway, D. (1991) Situated Knowledges. In: *Simians, Cyborgs, and Women: The Reinvention of Nature*. New York: Routledge.

Harvey, D. (1990) *The Condition of Postmodernity*. Oxford: Blackwell.

Heidegger, Martin (1927) *Sein und Zeit*. Halle: Max Niemeyer.

Hoffman, S.M. & Oliver-Smith A.O. (2002) *Culture and Catastrophe: The Anthropology of Disaster*. Santa Fe: The School of American Research Press.

Holland, D.C.& Quinn, N. (1987) *Cultural models in language and thought.* London: Cambridge University Press.

Holling, C. S. (1986) The Resilience of Terrestial Ecosystems: Local Surprise and Global Change. In W. C. Clark & R. E. Munn (Eds.), *Sustainable Development of One Biosphere*. Cambridge: Cambridge University Press.

Holling, C. S. (2001) Understanding the complexity of economic, ecological and social systems. *Ecosystems,* 4, 390-405.

Hurricane Research Center (2007) *Frequently Asked Questions. Atlantic Oceanographic and Meteorological Laboratory*. By Chris Landsea. Accessed December 2007. Web Site: http://www.aoml.noaa.gov/hrd/tcfaq/A11.html.

IGBP (2001) *The Amsterdam Declaration on Global Change*. International Geosphere-Biosphere Program Open Science Conference: Challenges of a Changing Earth. 10-13 July 2001. Amsterdam, The Netherlands. Accessed December 2007. Web Site: http://www.sciconf.igbp.kva.se/fr.html.

IGBP (2005) *Global Change Newsletter 63*. International Geosphere–Biosphere Programme. Stockholm.

Ingold, T. (1993) The temporality of landscape. *World Archaeology*, 25(2), 152-174.

Jacques Derrida (1995) The Time Is Out of Joint. In Anselm Haverkamp (Ed.), *Deconstruction Is/in America: A New Sense of the Political*. New York: New York University Press.

Kagan, Jerome (2002) *Surprise, Uncertainty, and Mental Structures*. Cambridge: Harvard University Press.

Kontopoulos, Kyriakos M. (1993) *The logics of social structure*. Cambridge: Cambridge University Press.

Latour, B. (1988) *Science in Action: How to Follow Scientists and Engineers Through Society*. Cambridge: Harvard University Press.

Latour, B. (1999) Circulating Reference: sampling the soil in the Amazon Forest. In Latour, B. *Pandora's Hope*. Cambridge: Harvard University Press.

Little, A.M., & Leslie, P.W. (1999) *Turkana Herders of the Dry Savanna: Ecology and Biobehavioral Response of Nomads to an Uncertain Environment*. Oxford: Oxford University Press.

Ma, Ming-Qian (2000) The Past Is No Longer Out-of-Date: Topological Time and Its Foldable Nearness in Michel Serres's Philosophy. *Configurations* 8(2), 235-244.

Maier, Susan E., Chen, Wei-Jung A., Miller, Jennifer A., and West, James R. (1997) Fetal Alcohol Exposure and Temporal Vulnerability: Regional Differences in Alcohol-Induced Microencephaly as a Function of the Timing of Binge-Like Alcohol Exposure During Rat Brain Development. *Alcoholism: Clinical and Experimental Research*, 21(8),1418.

McTaggart, Ellis (1908) The Unreality of Time. *Mind: A Quarterly Review of Psychology and Philosophy,* 17(1908), 456-473.

Mustafa, Daanish (2005) The Production of an Urban Hazardscape in Pakistan: Modernity, Vulnerability, and the Range of Choice. *Annals of the Association of American Geographers*, 95(3), 566-586.

NPR (2005) Saving New Orleans: A Sinking City. National Public Radio Broadcast, September 8.

National Research Council (2006) Facing Hazards and Disasters: Understanding Human Dimensions. Division on Earth and Life Studies. Washington DC: National Academies Press.

Neal, David M. (1995) *Transition from Response to Recovery: A look at the Lancaster, Texas Tornado*. Quick Response Report #79. Natural Hazards Research and Applications Center. Boulder: University of Colorado.

Nicolis, Gregoire & Prigogine, Ilya (1989) Complexity in nature. In Nicolis, H. and Prigogine, I. (Eds.), *Exploring Complexity*. New York:W. Freeman and Company.

Núñez, R. & Sweetser, E. (2006) With the Future Behind Them: Convergent Evidence From Aymara Language and Gesture in the Crosslinguistic Comparison of Spatial Construals of Time. *Cognitive Science*, 30(3),401-450.

Perrow, Charles (1984) *Normal Accidents: Living with High-Risk Technologies*. Princeton: Princeton University Press.

Rashed, T. & Weeks, J. (2003) Assessing Social Vulnerability to Earthquake Hazards through Spatial Multicriteria Analysis of Urban Areas. *International Journal of Geographic Information Science*.

Reice, Seth, R. (2001) *The silver lining: the benefits of natural disasters*. Princeton: Princeton University Press.

Rubin, Claire B. (1985) Contributions to effective recovery. In Rubin, Claire B, Saperstein, Martin D, Barbee & Daniel G. (Eds.), Community Recovery from a Major Natural Disaster. Boulder.

Schwab, Jim, Topping, Kenneth C., Eadie, Charles C., Deyle, Robert E. & Smith, Richard A. (1998). *Planning for post-disaster recovery and reconstruction*. Planning Advisory Service Report, December 1998.

Serres, Michel & Latour, Bruno (1995) *Conversations on Science, Culture, and Time*. Translated by Roxanne Lapidus. Ann Arbor: University of Michigan Press.

Shackle, G.L.S. (1955) *Uncertainty in Economics and Other Reflections*. Cambridge: Cambridge University Press.

Shackle, G.L.S. (1961) *Decision, Order and Time in Human Affairs*. Cambridge: Cambridge University Press.

Shackle, G.L.S. (1972) *Epistemics and economics: a critique of economic doctrines*. Cambridge: Cambridge University Press.

Sorokin P.A. & Merton R.K. (1937) Social Time: a methodological and functional analysis. *American Journal of Sociology*, 42,615-29.

SwissRe (2006a) *The effects of climate change: storm damage in Europe on the rise.* Focus Report. Swiss Reinsurance Company.

SwissRe (2006b) *Influence of global warming on tropical cyclones, hurricane, and typhoons. Climate Change facts compiled by ProClim-*. Climate change factsheets. Swiss Reinsurance Company.

Thywissen, K. (2005) *Components of Risk. A Comparative Glossary*. Studies of the University: Research, Counsel, Education, No. 2. United Nations University Institute for Environment and Human Security. Bonn: United Nations University.

Times-Picayune (2008) Study bust myth that New Orleans is sunken city. *The Times-Picayune*, April 20. Accessed April 2008. Website: http://blog.nola.com/times-picayune/2007/04/study_bust_myth_that_new_orlea.html.

Tolich, M. & Baldwin, K. (2005) Informing Consent in New Zealand Research: Researcher's Conflict of Interest and Patient Vulnerability. *New Zealand Medical Journal* 118, 121.

Tolich, Martin (2004) Internal Confidentiality: When Confidentiality Assurances Fail Relational Informants. *Qualitative Sociology*, 27(1).

Turner, B. L., Kasperson, Roger E., Matson, Pamela A., McCarthy, James J., Corell, Robert W., Christensen, Lindsey, Eckley, Noelle, Kasperson, Jeanne X., Luers, Amy, Martello, Marybeth L., Polsky, Colin, Pulsipher, Alexander and Schiller, Andrew (2003) *A framework for vulnerability analysis in sustainability science.* Proceedings of the National Academy of Sciences 10.1073, June 5.

Tversky A. & Kahneman. D. (1987) *Judgment under uncertainty: heuristics and biases*. Cambridge: Cambridge University Press.

United Nations Development Programme (2004) *Reducing Disaster Risk: A Challenge for Development. A Global Report.* Accessed 12 September 2006. Web Site: http://www.undp.org/bcpr/disred/rdr.htm. Bureau for Crisis Prevention and Recovery.

Waldrop, M. (1992) *Complexity*. New York: Simon and Schuster.

Weichselgartner, J. (2001) Disaster mitigation: the concept of vulnerability revisited. *Disaster Prevention and Management*, 10(2),85-94.

West, J.R. (1987) Fetal alcohol-induced brain damage and the problem of determining temporal vulnerability: a review. *Alcohol Drug Res*. 1987(5-6),423-41.

White, G. (1945) *Human adjustment to floods*. Dissertation. Department of Geography, University of Chicago.

Whyte, Ian D. (2000) *Landscape and History since 1500*. London: Reaktion Books.

Wisner, B. (1993) Disaster vulnerability: scale, power and daily life. *Geojournal* 30(32),127-140.

Wisner, B., Blaikie, P., Cannon, T. , & Davis, I. (2003) *At Risk. Natural hazards, people's vulnerability and disasters*. New York: Routledge.

Zerubavel, E. (2003) *Time Maps: Collective Memory and the Social Shape of the Future*. Chicago: University of Chicago Press.

Zube, E.H. (1980) *Environmental evaluation: Perception and public policy*. Cambridge: Cambridge University Press.

9.2. Method

Balée, W. (ed.) (1998) *Advances in Historical Ecology*. New York: Columbia University Press.

Balée, W. (2006) The Research Program of Historical Ecology. Annual Review of Anthropology, 35.

Berkes, F., & Folke, C. (2002) Back to the future: ecosystem dynamics and local knowledge. In Gunderson, L. H. & Holling, C.S. (Eds.), *Panarchy: understanding transformation in human and natural systems*. Washington: Island Press.

Crumley, C. L. (2002) Exploring venues of social memory. In: Climo, Jacob J. and Cattell, Maria G. (Eds), *Social memory and history: Anthropological perspectives*. Lanham: Altamira Press.

Crumley, C.L. (Ed.) (1994) *Historical Ecology: Cultural Knowledge and Changing Landscapes*. Santa Fe: School of American Research.

Crumley, C.L. (2007) Historical Ecology: Integrated Thinking at Multiple Temporal and Spatial Scales. In: Hornborg, A. and Crumley, C.L. (Eds.), *The World System and The Earth System: Global Socioenvironmental Change and Sustainability Since the Neolithic*. Left Coast Press, Walnut Creek.

De Vries, D.H. (2003) *Assessing the population-environment impact of Hurricane Floyd: combining quantitative, qualitative, and spatial methods.* Poster presented at the 2003 Population Association meetings, Minneapolis.

De Vries, D. H. (2007) Being Temporal and Vulnerability to Natural Disasters. In Warner, Koko (Ed.), *Perspectives on Social Vulnerability*. Studies of the University: Research, Counsel, Education, No. 6/2007. Bonn: United Nations University Press.

De Vries, D.H. (2002b) *Place and crisis: cultural memory in the eastern North Carolinian floodplains*. Paper presented at the American Anthropological Association annual meetings, New Orleans, November 2002.

De Vries, D. H. and Fraser, J. (2006) *Internal Migration Through FEMA's Acquisition and Relocation (Buyout) Programs: Obstacles and Difficulties Experienced in Eastern North Carolina after Hurricane Floyd*. Paper presented at the Southern Demographic Association Annual Meeting.

Fraser, James, Elmore, Bekki, Rohe, William, and Godshalk, David (2004). *Implementing Floodplain Land Acquisition Programs in Urban Localities*. Federal Emergency Management Agency: Washington, D.C.

Latour, B. (1988) *Science in Action: How to Follow Scientists and Engineers Through Society*. Cambridge: Harvard University Press.

Latour, B. (1999) Circulating Reference: sampling the soil in the Amazon Forest. In Latour, B. *Pandora's Hope*. Cambridge: Harvard University Press.

McIntosh, Roderick J., Joseph A. Tainter, & Susan Keech McIntosh (Eds.) (2000) *The Way the Wind Blows: Climate, History, and Human Action*. New York: Columbia University Press

Mol, G. Vriend, S.P. Van Gaans, P.F.M. (2001) Environmental monitoring in the Netherlands: Past Developments and Future Challenges. *Environmental Monitoring and Assessment* 68:313-335. Dordrecht: Kluwer Academic Publishers.

Schneider, Stephen S. & Turner, B.L. (1994) *Summary: Anticipating Global Change Surprise. Elements of Change*. U.S Global Research Information Office. Columbia University.

9.3. Kinston's Mitigation Success Story

Bales, Jerad D. , Oblinger, Carolyn J. & Sallenger, Asbury H. Jr. (2000) *Two Months of Flooding in Eastern North Carolina, September - October 1999: Hydrologic Water-Quality, and Geologic Effects of Hurricanes Dennis, Floyd, and Irene*. Water-Resources Investigations Report 00-4093. Raleigh, North Carolina 2000.

Bales, Jerad D. & Oblinger Childress, Carolyn J. (1996) *Aftermath of Hurricane Fran in North Carolina—preliminary data and water quality*. United States Geological Survey. FR96-499. Accessed December 2007. Web Site: http://pubs.usgs.gov/of/1996/ofr96-499/.

Barnes, Jay (2001) *North Carolina's Hurricane History*. Chapel Hill: University of North Carolina Press.

Briggs, Mark (2000) *After the Flood, A Carolina Tide Endeavors*. Chapel Hill: University of North Carolina Press.

Coastwatch (2004) *Weathering the Storm: Five Years After Floyd*. Accessed January 2007. Web Site: http://www.ncseagrant.org/index.cfm?fuseaction=story&pubid=131&storyid=173.

FEMA (2003) *Innovative Floodplain Management Case Studies: Kinston, North Carolina. Mitigation Case Studies*. Federal Emergency Management Agency: Washington, D.C.

Fraser, James, Elmore, Bekki, Rohe, William, and Godshalk, David (2004). *Implementing Floodplain Land Acquisition Programs in Urban Localities*. Federal Emergency Management Agency: Washington, D.C.

General Assembly of North Carolina (1999) *Extra Session 1999, Session Law 1999-463, House Bill 2*. General Assembly of North Carolina.

Hunter, Lori M. (2005) Migration and Environmental Hazards. *Population and Environment*, 26(4),273-302

Kinston Daily Free Press (1976*)* Historical Highlight. *Kinston Daily Free Press*, Sunday July 4th, by Miriam Maynard.

Kinston Free Press (1996b) 300,000 households without power. Electricity: sustained winds of 70 and 90 mps recorded. *Kinston Free Press,* September 6.

Kinston Free Press (1996c) Corps maintains Falls lake Dam handled properly; Angry residents want to see flood control. *Kinston Free Press,* October 30.

Kinston Free Press (1996d) Field crops in danger of rotting. *Kinston Free Press,* September 18.

The Kinston Free Press (1996e) Heavy rains swamped sweet potato crop. *Kinston Free Press,* October 24.

Kinston Free Press (1996f) Flood swamps south Kinston: Neuse at 23.1 feet and rising; higher then floods of 1964. *Kinston Free Press,* Tuesday, September 17.

Kinston Free Press (1996g) Flood waters pose health hazard. *Kinston Free Press,* September 16.

Kinston Free Press (1996h) Kinston Flood History: Floods a more common occurrence in the past. *Kinston Free Press,* September 15.

Kinston Free Press (1996j) Tobacco warehouses evacuated as flood waters continue to rise. *Kinston Free Press,* Friday, September 13th.

Kinston Free Press (1996l) Water Sample, Paerl studying Neuse algae populations. *Kinston Free Press,* October 9.

Kinston Free Press (1996m) Waters will remain high for at least a week. *Kinston Free Press,* September 18.

Kinston Free Press (1996n) Floods threaten state in wake of Fran. *Kinston Free Press,* September 8.

Kinston Free Press (1999a) Floyd puts fear into local officials. City county gearing up for one more round. *Kinston Free Press,* September 15 1999.

Kinston Free Press (1999b) Agencies make preparations for hurricane. Flooding now major concern for Lenoir County. *Kinston Free Press,* September 15, 1999.

Kinston Free Press (1999g) Eye expected at or near Kinston. Neuse expected to reach 24 feet next week. *Kinston Free Press,* September 16.

Kinston Free Press (1999h) Floyd's rain, wind swamp area. County roads reported in terrible condition. *Kinston Free Press,* September 17.

Kinston Free Press (1999k) Neuse expected to crest Sunday. *Kinston Free Press,* September 11.

Kinston Free Press (1999l) Southeast toughing out the worst. *Kinston Free Press,* September 22.

Kinston Free Press (1999m) Neuse Loosens Grip: Kinston burdens ease slowly. *Kinston Free Press,* September 25.

Kinston Free Press (2004) A Flood of memories, *Kinston Free Press,* September 18.

Kinston Free Press (2005a) Lenoir County has a plan for dealing with disaster, but is it a workable plan? *Kinston Free Press,* October 23.

Kinston Free Press (2005b) Scars from Floyd flooding still fresh for some. *Kinston Free Press,* September 23.

Kinston Free Press (2005c) Western N.C. flood victims turn to Kinston. *Kinston Free Press,* May 3rd

Los Angeles Times (2004) Why I'm Black, Not African American. *Los Angeles Times.* Accessed December 2007. Web Site: http://www.manhattan-institute.org/html/_latimes-why_im_black.htm.

Moore, Richard & Barnes, Jay (2004) *Faces from the Flood, Hurricane Floyd Remembered*. Chapel Hill: The University of North Carolina Press.

NASA (2007) *Hurricane Floyd's Lasting Legacy: Assessing the Storm's Impact on the North Carolina Coast*. By David Herring. Earth Observatory Website. Accessed December 2007. Web Site: http://earthobservatory.nasa.gov/Study/FloydIntro/..

National Geographic News (2004). Worst Hurricane in North Carolina: 50 Years Later. Willie Drye, October 14.

NCDEM (1999) *Hazard Mitigation in North Carolina: Measuring Success*. North Carolina Division of Emergency Management and Federal Emergency Management Agency. Raleigh, North Carolina.

News & Observer (2002) Swept away by N.C.'s budget woes. *News & Observer*, July 9.

News & Observer (2003) Trust in flood buyouts often tied to affluence. *News & Observer*, August 25.

Olivera McCan, Monica (2006) *Case Study of Floodplain Acquisition / Relocation in Kinston, NC after Hurricane Fran (1996) and Floyd (1999).* Masters Thesis, Department of City and Regional Planning, University of North Carolina at Chapel Hill.

Pope, Benjamin F., Tasker, Gary D. & Robbins, Jeanne C. (2000) *Estimating the Magnitude and Frequency of Floods in Rural Basins of North Carolina — Revised*. Water-Resources Investigations 01-4207. United States Geological Survey.

Salon.com (1999) *The flood next time: Hurricanes may be the hand of God, but the disaster in North Carolina is entirely man-made*. By Fetzer Mills. Accessed December 2007. Web Site: http://archive.salon.com/news/feature/1999/09/29/floyd/index.html?pn=1.

Smith, B.R. (2002) Floodplain Fliers: North Carolina's Massive LIDAR Project. In: *Geospatial Solutions*, February 2002.

Star News Online (2007) *Hurricane Hazel: October 15 1954. The Hurricane of Hurricanes. Remembering Her 50 years later.* Accessed December 2007. Web Site: http://www.starnewsonline.com/apps/pbcs.dll/section?Category=specialsections04.

UNC News (2003) *Hurricane victims' decision-making processes just one way federal research funding is helping N.C. Aug. 19, No. 412*. Accessed December 2007. Web Site: http://www.unc.edu/news/archives/aug03/hurricane412.html

USA Today (1999) More rain prolongs misery in North Carolina. *USA Today*, Sept. 29.

USGENWEB (2007) *Vertical File Bell 02433-5. Original copy found at Heritage Place*. Lenoir County Community College, Kinston, North Carolina. Accessed December 2007. Web Site: http://ftp.rootsweb.com/pub/usgenweb/nc/lenoir/bios/jamcdaniel.txt.

Washington Post (1999) Currents of Change: N.C. Assesses Its Growth Policies Along With Flood Damage. *Washington Post*, October 24; Page A3.

WRAL-TV (2007) *Hazel: WRAL Documentary Revisits Deadly Day In N.C.* Accessed December 2007. Web Site: http://www.wral.com/hurricanes/3698406/detail.html.

WRRI (1999) *Hurricane Floyd: Have we seen the worst?* Water Resources and Research Institute News. No 320, November/December 1999.

9.4. Historical Preservation in Savannah

Sandrik, Al & Landsea, Christopher W. (2003) *Chronological Listing of Tropical Cyclones affecting North Florida and Coastal Georgia 1565-1899*. National Oceanic and Atmospheric Administration. Technical Memorandum. Accessed May 2007. Web Site: http://www.aoml.noaa.gov/hrd/Landsea/history/.

Associated Press (2006) Red Cross enters hurricane season with Katrina volunteer surge. *New Orleans City Business*, Jun 13.

Reiter, Beth Lattimore (1978) *Early 20th Century Savannah boasted diverse industry; Ardsley Park Developed*. Historic Savannah Newsletter, July, 5.

City of Savannah (2007) *City of Savannah*. Accessed December 2007. Web Site: http://www.ci.savannah.ga.us/spr/sprguide.nsf/3781A6E58F48A80F85256DAC0076F28A/$file/OUTREACH.pdf

Committee on Drainage (1877) *5600 DC-10, P2. March 7 1877*. City of Savannah Research Library & Municipal Archives.

Committee on Drainage (1925) *East Broad Street Paving*. November 20, 1925, City of Savannah Research Library & Municipal Archives.

Dick, Susan E. & Johnson, Manid D. (2004) *Savannah 1733 to 200: Photographs from the Collection of Georgia's Historical Society*. Charleston: Arcadia Publishing.

Drainage Improvement Task Force (1987) *Report to the Mayor and Aldermen*. City of Savannah, Georgia. July. Research Library and City Archives 1987-001-01.

Anderson, Glenda (2004) *Observance of the 50th Anniversary of Council-Manager Form of Government in Savannah*. March 18. Presentation given to the Mayor, Council, and interested parties.

Graves E.Y. (1926) Letter *from Superintendent Stations and Transfers, Seaboard Air Line Railway Company, Savannah GA, August 2nd. 1926*. City of Savannah Research Library & Municipal Archives.

Jarrell, Jerry. D., Herbert, Paul J., Mayfield, Max (1992) *Hurricane Experience Levels of Coastal County Populations From Texas to Maine*. National Oceanic and Atmospheric Administration Technical Memorandum, NWS NHC 46.

Ioor Waring, Joseph (1968) *The Yellow Fever Epidemic of Savannah in 1820, with a sketch of Dr. William Coffee Daniell*. Georgia Historical Society 52, December, 398-404.

Karl TR, Knight RW (1998) Secular Trends of Precipitation Amount, Frequency, and Intensity in the United States. *Bulletin of the American Meteorological Society*, 79(2), 231–241

Kunkel, K.E. (2003) North American trends in extreme precipitation. *Natural Hazards* 29,291-305.

National Weather Service Forecast Office Charleston SC. (2007) Savannah GA Top 5 Lists of Climate Extremes. Accessed December 5 2007. Web Site: http://www.erh.noaa.gov/chs/fire/SAVTop5ExtremeLists.htm.

WTOC TV (2006) *History of Savannah area Hurricanes*. WTOC TV. . Accessed December 5 2007. Web Site: http://www.wtoctv.com/Global/category.asp?C=80160

Savannah Morning News (1869) Savannah Expands South. *Savannah Morning News*, 2-20.

Savannah Morning News (1997) As Growth Flooded Chatham, so did rains. *Savannah Morning News*, June 9.

Savannah Morning News (2007) What if a Category 4 hit here? *Savannah Morning News*, January 8..

Savannah Morning News (2004) Hurricanes. Why we escape nature's wrath. Explanations range from the divine to the diabolical. *Savannah Morning News*, October 1, page 1.

Watson Robert T, Zinyowera, Marufu C., Moss, R.H., & Dokken, David J. (1997) *IPCC Special Report on The Regional Impacts of Climate Change. An Assessment of Vulnerability.* Annex A: Regional Trends and Variations of Temperature and Precipitation.

Wikipedia (2007) *Timeline of the 2004 Atlantic hurricane season*. Accessed January 2007. Web Site: http://en.wikipedia.org/wiki/Timeline_of_the_2004_Atlantic_hurricane_season. Accessed January 2007.

USA Today (2005) Hurricane scale invented to communicate storm danger. *USA Today*, May 17.

9.5. Early Warning in Felton Grove

BBC News (2005) Tsunami folklore 'saved islanders. *BBC News*, January 20. Accessed February 2008. Web Site: http://news.bbc.co.uk/1/hi/world/south_asia/4181855.stm.

Times Online (2005) Tsunami disaster: Focus: Nature's timebomb. *Times Online*. January 2, 2005. Accessed February 2008. Web Site: www.timesonline.co.uk/article/0,,18690-1422835,00.html.

Clinton, Bill (2006) *Highlights of speech. UN Special Envoy for Tsunami Recovery*. Presentation at the Third International Early Warning Conference in Bonn, Germany, March 2006. Accessed February 2008. Web Site: http://www.alertnet.org/thefacts/reliefresources/114372361721.htm

Corsten, Michael (1999). The Time of Generations. *Time Society,* 1999(8),249

EWCIII (2006) *Early Warning – From concept to action. The Conclusions of the Third International Conference on Early Warning*. 27–29 March 2006 Bonn, Germany.

Accessed February 2008. Web Site: http://www.ewc3.org/upload/downloads/Early_warning_complete2.pdf.

Marshall, Jeff (2005) *2004 Sumatra Earthquake & Indian Ocean Tsunami*. Lecture Notes. Accessed February 2008. Web Site: http://www.csupomona.edu/~marshall/Ind_Oc_Tsunami_Lec.v4.htm

Tierney, Kathleen (2004) *Collective behavior in times of crisis.* Paper prepared for the National Research Council Roundtable on Social and Behavioral Sciences and Terrorism. Meeting 4, “Risk Communication for Terrorism,” Washington DC, January 30, 2004.

Lay, T., Kanamori, H., Ammon, C., Nettles, M., Ward, S., Aster, R., Beck, S., Bilek, S., Brudzinski, M., Butler, R., DeShon, H., Ekström, G., Satake, K., Sipkin, S. (2004) The Great Sumatra-Andaman Earthquake of December 26, 2004. *Science*, 308, 1127–1133.

Lindell, M.K. & Perry, R.W. (1992) *Behavioral Foundations of Community Emergency Management*. Washington DC: Hemisphere Publishing Corporation.

Mannheim, K. (1952) The Problem of Generation. In K. Mannheim (Ed.) *Essays on the Sociology of Knowledge*, pp. 276–320. London: Routledge & Kegan Paul. [first published in German 1928 in Kölne Vierjahreshuafte für Soziologie, 157–85, 309–30].

McNutt, S. (1990) Loma Prieta Earthquake. October 17, 1989 Santa Cruz County, California. *Geology*, 43(1).

Pararas-Carayannis, George (2007) *Tsunamis of the Indian Ocean*. Accessed December 17 2007. Web Site: http://www.drgeorgepc.com/Tsunami2004IndianOcean.html.

Pike, Arlene (2001) *Felton History from the start. A summary review*. Felton Volunteer Fire Department. Accessed February 2008. Web Site: http://www.feltonfire.com/pictures/feltonhistory.html

Ryder, Norman B. (1965). The Cohort as a Concept in the Study of Social Change. American *Sociological Review*, 30(6), 843-861.

San Jose Mercury News (1982) After the deluge: the land is formed again. *San Jose Mercury News*, January 10.

San Jose Mercury News (1998) The Storms of ’98. Image by Karen T. Borchers. *San Jose Mercury News*, February 11th.

Schuman, H. & Scott, J. (1989) Generations and Collective Memories. *American Sociological Review*, 54(3), 359-381.

Griggs, Gary B. (2007) *Flood Control and Riparian System Destruction. Lower San Lorenzo River, Santa Cruz County, California*. Accessed December 17, 2007. http://content.cdlib.org/xtf/view?docId=ft1c6003wp&doc.view=content&chunk.id=d0e22976&toc.depth=1&anchor.id=0&brand=eschol

Sentinel (1998) Felton Grove evacuates, again. Week's Second flood interrupts cleanup efforts. *Sentinel*, February.

Sentinel (1998). No end in sight. *Sentinel*, February 6.

Sentinel (2006). Floods wash away 2005. *Sentinel*, February.

Sentinel Staff Report (1995) Rising Water spared Felton Grove: Residents evacuated as San Lorenzo River raged under downpour. *Sentinel*, Jan.11.

Soquel Creek Storm Damage Recovery Plan (1983) *The Nature and History of Flooding in Soquel Village*. pp. 21-24, 28. Accessed December 2007. Web Site: http://www.santacruzpl.org/history/disaster/soqflood.shtml.

The Valley Press (1982) A look into the Valley's past. *The Valley Press*, January 13, p.13.

UNCESO (2007) *Indigenous Knowledge and Changing Environments: Biological and cultural diversities in transition*. Concept Note 18-07-07. International Experts Meeting 19 to 23 August 2007, Cairns Australia. Local and Indigenous Knowledge Systems (LINKS) programme 18-7-07 UNESCO

Wallrich, B (2006) *Disaster Warnings: The Problem of the Last Step Reaching the Hardest-to-Reach With Critical Information*. Early Warning Systems – A Public Entity Risk Institute Symposium. April 2005. Accessed December 2007. Web Site: http://www.riskinstitute.org/PERI/PTR/Early+Warning+Systems+Interdisciplinary+Observations+and+Policies+from+a+Local+Government+Perspectiv.htm.

Witter, Donna (2007) *Flooding of the San Lorenzo River at Big Trees, CA*. Accessed December 10 2007. Web Site: http://www.personal.kent.edu/~dwitter/homepage/slr.html.

Voice of America (2004) *Indigenous Tribes on India's Andaman Islands Survive Tsunami Disaster*. 31 Voice of America, December. Accessed December 2007. Web Site: http://www.voanews.com/english/archive/2004-12/2004-12-31 voa58.cfm?CFID=171877780&CFTOKEN=97820611.

9.6. Katrina's Predictable Surprise

Associated Press (2005) Federal agency says state owes $30.4 million. *Associated Press*, March 30.

Barras, J.A., P.E. Bourgeois, & L.R. Handley (1994) *Land loss in coastal Louisiana 1956-90*. National Biological Survey, National Wetlands Research Center Open File Report 94-01. 4 pp. 10 color plates.

Barry, John (1995) *Rising Tide: The Great Mississippi Flood of 1927 and How It Changed America*. New York: Simon & Schuster.

Bazerman, Max H & Watkins, Michael D. (2004) Predictable Surprises: The Disasters You Should Have Seen Coming, And How To Prevent Them. Boston, Massachusetts: Harvard Business School Press.

Bezou, Henry C. (1987) *Jefferson Parish Historical Markers*. Jefferson Parish Historical Commission, p34-40.

Babineaux Blanco, K. (2005) *Testimony before the U.S. house Select Committee to investigate the preparations for and response to Hurricane Katrina*. U.S. House of Representatives Select Committee to Investigate the Preparation for and Response to Hurricane Katrina. December 14.

Babineaux Blanco, K. (2005) *Overview of Governor Kathleen Babineaux Blanco's Actions in Preparation for and Response to Hurricane Katrina.* Response to the U.S. Senate Committee on Homeland Security and Governmental Affairs Document and Information Request Dated October 7, 2005 and to the U.S. House of Representatives Select Committee to Investigate the Preparation for and Response to Hurricane Katrina. December 2,18.

Burgess, Adam (2006) The Shock of a Social Disaster in an Age of (Nonsocial) Risk. *Space and Culture,* 9,74

Burley, David, Jenkins, Pam, Laska, Shirley & Davis, Traber (2007) Place Attachment and Environmental Change in Coastal Louisiana. *Organization Environment*, 20, 347

Byrne-Harvey, Claire. (1987) The Harvey Canal (written earlier). In: Bezou, Henry C. (Ed,) *Jefferson Parish Historical Markers*. Jefferson Parish Historical Commission, p.34-40.

Center for Hazard Assessment Response and Technology (2006) *Repetitive Loss Area Analysis Jefferson Parish Maplewood Subdivision Area*. May 31. New Orleans: University of New Orleans.

Christine F. Andersen (2007) *The New Orleans Hurricane Protection System: What Went Wrong and Why: A Report*. American Society of Civil Engineers Publications.

Christopher R. Henke (2007) Situation Normal? Repairing a Risky Ecology. *Social Studies of Science*, 37,135

CNN (2005) Chertoff: Katrina scenario did not exist. However, experts for years had warned of threat to New Orleans Monday. *CNN*, September 5. Accessed December 7 2007. Web Site: http://edition.cnn.com/2005/US/09/03/katrina.chertoff/index.html

Coalition to Restore Coastal Louisiana (2007) *History*. Accessed December 1 2007. Web Site: http://www.crcl.org/History.html

Colten, Craig E. & Welch, John (2003) *Hurricane Betsy and Its Effects on the Architectural Integrity of the Bywater Neighborhood*. Summary. May. Accessed December 1 2007. Web Site: http://www.lwrri.lsu.edu/downloads/Colten_LWRRIFY02-03.pdf.

CWPPRA (1990) *The Coastal Wetlands Planning, Protection and Restoration Act*. Article II. Authorizing Bill. Public Law 101-646-NOV. 29, 1990 Title III-Wetlands.

Davis, T., Rogers H., Shays, C., Bonilla, H., Buyer, S., Myrick, S., Thornberry, M., Granger, K., Pickering, C.W., Shuster, B., & Miller, J. (2006). *A Failure of Initiative: The Final Report of the Select Bipartisan Committee to Investigate the Preparation for and Response to Hurricane Katrina*. Select Bipartisan Committee to Investigate the Preparation for and Response to Hurricane Katrina. February 15. House of Representatives.

Davis, Tom. (2005) *Opening Statement of Chairman Tom Davis*. Select Bipartisan Committee to Investigate the Preparation For and Response to Hurricane Katrina. House of Representatives. Thursday, September 22, 2005. Accessed February 2007. Web Site: http://katrina.house.gov/hearings/09_22_05/witness_list092205.html

Douglas Kellner (2007) The Katrina Hurricane Spectacle and Crisis of the Bush Presidency. *Cultural Studies <=> Critical Methodologies*, 7; 222

Dreier, Peter (2006) Katrina and Power in America. *Urban Affairs Review,* 41; 528

EU Rota (2005) *US Left: All Straws Clutched, Every Barrel Scraped*. Accessed December 5 2007. Web Site: http://eurota.blogspot.com/2005/09/us-left-all-straws-clutched-every.html.

Faber, M., R. Manstetten, & J. L. R. Proops (1992) Humankind and the Environment: An Anatomy of Surprise and Ignorance. *Environmental Values,* 1(3),217- 241.

General Accounting Office (1982) *Report to the Secretary of the Army: Improved Planning Needed By the Corps of Engineers To Resolve Environmental, Technical, And Financial Issues On The Lake Pontchartrain Hurricane Protection Project*. U.S. Army Corps of Engineers. August 17.

Hecht, J. (1990). The incredible shrinking Mississippi Delta. *New Scientist*, April 14, 1-13.

Henke, Christopher R. (2007) Situation Normal? Repairing a Risky Ecology. *Social Studies of Science,* 37/1,135–142

Houston Business Journal (2003) Houston oil giant backs research project on Louisiana wetlands. *Houston Business Journal*, July 11, 2003.

Houston Chronicle (2001) Keeping its head above water: New Orleans faces doomsday scenario." *Houston Chronicle*, December 1.

Howell, Susan E. & Bonner, Dean E. (2005) *Citizen Hurricane Evacuation Behavior in Southeastern Louisiana: A Twelve Parish Survey*. Released by Survey Research Center In Collaboration with the Center for Hazards Assessment, Response and Technology (CHART) and the Department of Geography. The Southeast Louisiana Hurricane Taskforce. New Orleans: University of New Orleans.

Howell, Susan E. , Burchard, Stephanie & Hubbard, Megan (2004) *The 2004 Quality of Life Survey in Orleans and Jefferson Parishes*. Survey Research Center, UNO. April 2004.

Irons, Larry (2005) Hurricane Katrina as a Predictable Surprise. *Homeland Security Affairs*, I(2),Article 7

Laska, Shirley (2004) What if Hurricane Ivan Had Not Missed New Orleans? *Natural Hazards Observer*, Vol. XXIX (2),5-6.

Laska, Shirley (2006). Respect for Nature as Cornerstone to Community Resilience: The View from Katrina "Ground Zero". *Natural Hazards Observer*, Vol. XXXI (2).

Leavitt, William M. and Kiefer, John J. (2006) Infrastructure Interdependency and the Creation of a Normal Disaster: The Case of Hurricane Katrina and the City of New Orleans. *Public Works Management Policy,* 10, 306

Living on Earth (2006) A Checkered Past. *Public Radio International*, June 2.

Livingston, Bob (1994) *Testimony of Honorable Bob Livingston*. House Public Works and Transportation Committee. Water Resources Act of 1994, July 26

Louisiana Wetland Protection Panel (1985) *Saving Louisiana's Coastal Wetlands: The Need for a Long Term Plan of Action*. Louisiana Geological Survey and Environmental Protection Agency.

Maplewood Civic Association (2004) *Invitation Letter*. Maplewood Civic Association. September 21st 2004.

Mark Fischetti (2001) Drowning New Orleans. *Scientific American Magazine*, October, 2001.

Morton, R. A., Buster, N. A., & Krohn, M. D. (2002) Subsurface controls on historical subsidence rates and associated wetland loss in Southcentral Louisiana: Transactions. *Gulf Coast Association of Geological Societies*, 52, 767-778.

Mother Jones (2005) Mike Tidwell. *Mother Jones*, October 3.

National Weather Service (2007). *Tropical Cyclone Structure. JetStream - Online School for Weather*. National Oceanic and Atmospheric Administration. Accessed January 2008. Web Site: http://www.srh.noaa.gov/jetstream/tropics/tc_structure.htm.

Perrow, Charles (1984) *Normal Accidents: Living with High-Risk Technologies*. Princeton: Princeton University Press.

Schneider, Stephen S. & Turner, B.L. (1994) *Summary: Anticipating Global Change Surprise. Elements of Change*. U.S Global Research Information Office. Columbia University.

Survey Research Center (2007) *Keeping People: The 2007 Quality of Life Survey in Orleans and Jefferson Parishes*. University of New Orleans Survey Research Center Report. May .

The New York Times (2006) An Autopsy of Katrina: Four Storms, Not Just One. *The New York Times*, May 30.

The Times Picayune (1998) Evacuation reporting. *The Times-Picayune*, 11-16.

The Times-Picayune (2004) In case of emergency: officials hope eight days of intense training for a catastrophic hurricane will aid recovery efforts if the real thing ever hits. *The Times-Picayune*, July 20, 2004

The Times-Picayune (2004) Have Evacuation Plan, Will Travel: Survey offers insight in locals' attitudes. *The Times-Picayune*, December 1.

The Times Picayune (2006) Incomplete levee system has West Bank nervous. Evacuation reporting, June 4th.

Tidwell, Mike (2003) *Bayou Farewell: The Rich Life and Tragic Death of Louisiana's Cajun Coast*. New York: Vintage Books.

Ulrich Beck (1992) *Risk Society, Towards a New Modernity*. London: Sage Publications. [originally publ. 1986].

USA-Today (2005) Hurricanes are a regular part of life in Louisiana. *USATODAY.com*. Accessed February 2007. Web Site: http://www.usatoday.com/weather/hurricane/history/louisiana-hurricanes.htm

Westerink, J. J., Feyen, J. C., Atkinson, J. H., Luettich, R. A., Dawson, C. N., Powell, M. D., Dunion, J. P., Roberts, H. J., Kubatko, E. J., & Pourtaheri, H. (in review) A New

Generation Hurricane Storm Surge Model for Southern Louisiana. *Bulletin of the American Meteorological Society*.

Williams, Jeffress S., Reid, Jamey M., Cross, VeeAnn A., & Polloni, Christopher F. (2003) *Coastal Erosion and Wetland Change in Louisiana: Selected USGS Products*. U.S. Geological Survey Digital Data Series DDS-79, Version 1.0.

9.7. Conclusion

Adam. B. (1998). Perceptions of time. In Ingold, T. (ed.) *The Encyclopedia of Anthropology.* New York: Routledge.

Blatti, Jo (1990) Public History and Oral History. *The Journal of American History*, 77(2),615-625.

De Landa, M. (1997) *A Thousand Years of Nonlinear History*. New York: Zone Books/Swerve Editions.

Haviland, W.A. (1997) *Anthropology*. Fort Worth: Harcourt Brace College Publishers.

Kauffman, S. (1995) *At Home in the Universe*. New York: Oxford University Press.

Klein, Naomi (2005) 'Never Before!' Our Amnesiac Torture Debate. *The Nation*, Dec. 26.

Kontopoulos, Kyriakos, M. (1993) *The logics of social structure*. Cambridge University Press.

Nicolis, Gregoire & Prigogine, Ilya (1989) Complexity in nature. In Nicolis, H. & Prigogine, I. (Eds.) *Exploring Complexity*. New York: W. Freeman and Company.

Shopes, Linda (1997) Oral History and the Study of Communities: Problems, Paradoxes, and Possibilities. *The Journal of American History*, 89(2),588-598.

Waldrop, M. (1992) *Complexity*. New York: Simon and Schuster.

9.8. Appendices

Barnes, Jay (2001) North Carolina's Hurricane History. Chapel Hill: University of North Carolina Press.

CBC (2007) CBC Radio Archive on Hazel. Accessed December 2007. Web Site: http://archives.cbc.ca/IDC-1-70-77-276/disasters_tragedies/huricane_hazel/clip3.

Eastern Carolina Chamber of Commerce (1925) 69 Progressive and Prosperous Towns of Eastern North Carolina. Eastern Carolina Chamber of Commerce (Kinston, N.C.).

Kinston Free Press (1996a) When flood hit, residents asked "why us?' Army Corps of Engineers insist they operated Falls Lake Dam by the book." *Kinston Free Press,* September.

Kinston Free Press (1996i) Second fist of storm's one-two punch is more rain, flooding. *Kinston Free Press,* September 11.

Kinston Free Press (1996k) U.S Corps of Engineers to explain lake releases. *Kinston Free Press*, September 19.

Kinston Free Press (1996o) There's no point in playing the blame game. *Kinston Free Press*, September 19.

Kinston Free Press (1996p) Corps maintains Falls lake Dam handled properly; Angry residents want to see flood control. *Kinston Free Press*, October 30.

Kinston Free Press (1996q) Floods a more common occurrence in the past. *Kinston Free Press*, September 15.

Kinston Free Press (1999c) City's burden quickly growing. Roads, evacuations, wastewater systems top priorities. *Kinston Free Press,* September 21

Kinston Free Press (1999d) Crest gives city reason to cheer. Evacuations complete; the wait for floodwaters to recede begins. *Kinston Free Press,* September 24, 1999.

Kinston Free Press (1999e) Crest level becomes guessing game again. *Kinston Free Press,* September 20.

Kinston Free Press (1999f) Dennis leaves Kinston wastewater headaches. *Kinston Free Press,* September 9, 1999.

Kinston Free Press (1999i) Lenoir county "divided". Officials waiting for Neuse River to crest. *Kinston Free Press,* September 23.

Kinston Free Press (1999j) Lenoir County bracing for river crest. *Kinston Free Press,* September 21.

Kinston Free Press (1999n) Neuse expected to crest Sunday. *Kinston Free Press*, September 11.

Kinston Free Press (1999o) Floyd's rain, wind swamp area. County roads reported in terrible condition. *Kinston Free Press*, September 17.

National Geographic News (2004). Worst Hurricane in North Carolina: 50 Years Later. October 14.

NCSCO (2007) Aspects of NC Climate » History of Hurricanes in North Carolina. North Carolina Tropical Cyclone Statistics Accessed January 2007.Web Site: http://www.nc-climate.ncsu.edu/climate/hurricanes.html.

NOAA (2007) The Retirement of Hurricane Names. National Oceanic and Atmospheric Administration. Accessed December 2007. Web Site: http://www.publicaffairs.noaa.gov/grounders/retirednames.html.

North Carolina Emergency Relief Commission (unknown) Emergency Relief in North Carolina. A Record of the Development and the Activities of the North Carolina Emergency Relief Administration, 1932-1935. North Carolina Emergency Relief Commission, State administrator, Mrs. Thomas O'Berry. Edited by J.S. Kirk, Walter A. Cutter [and] Thomas W. Morse Edwards & Broughton Publishers.

Star News Online (2007) Hurricane Hazel: October 15 1954. The Hurricane of Hurricanes. Remembering Her 50 years later. Accessed December 2007. Web Site: http://www.starnewsonline.com/apps/pbcs.dll/section?Category=specialsections04.

Thywissen, K. (2005) *Components of Risk. A Comparative Glossary*. Studies of the University: Research, Counsel, Education, No. 2. United Nations University Institute for Environment and Human Security. Bonn: United Nations University.

Unknown (1913) Diary of A Tar Heel Confederate Soldier. Charlotte: LEON Stone Publishing Company.

WRAL-TV (2004) Hazel: WRAL Documentary Revisits Deadly Day In N.C.POSTED: 11:12 am EDT August 31, 2004. http://www.wral.com/news/3694567/detail.html and http://www.wral.com/hurricanes/3698406/detail.html. Accessed December 2007

– Nee toch,'t is niet waar, het einde! Verrassing?
Nou, in ieder geval bedankt voor het lezen! –