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SENIORS SEEKING HOUSING, HEALTH, AND CLIMATE JUSTICE,
AN ORAL HISTORY OF HURRICANE RECOVERY IN THE GULF COAST

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree of Doctor of Philosophy in the Graduate School
of Texas Southern University

by

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Spring 2023

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ABSTRACT

On the Gulf Coast of Texas, a large disparity exists between the number of homes still in need of repair after Hurricane Harvey and the number of homes actually repaired by the City of Houston, Housing and Community Development, 6 years after the storm. This research was conducted through the lens of environmental justice, with attention to climate change impacts and the vulnerability of previously segregated neighborhoods over extended periods of time. The most vulnerable, seniors, were interviewed to collect their personal experiences post Hurricane Harvey to determine the true extent of home damage, how they recovered from the storm, and what impact that recovery period post-storm had on their health and displacement from the home. In the context of a just planning model and through the lens of environmental justice, their ecological knowledge and participation should be used to improve housing recovery. Oral histories allow others an alternative perspective to their own and offer policy makers insight into complex nuances, actors, and events that have transpired post-disaster.

Keywords: Hurricane Harvey, environmental justice, oral histories, hypersegregation, climate displacement, ecological knowledge

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ACRONYMS

AARP	American Association of Retired Persons
ADU	Accessory Dwelling Unit
CDBG-DR	Community Development Block Grant-Disaster Recovery
EDAC	Evidence-based design accreditation and certification
EJScreen	Environmental justice screening and mapping tool
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GLO	General Land Office
HGAC	Houston - Galveston Area Council
HCD	Houston Community Development
HANO	Housing Authority of New Orleans
HUD	Department of Housing and Urban Development
IA	Individual Assistance
IEQ	Indoor environmental quality
LEED	Leadership in Energy and Environmental Design
LULU	Locally unwanted land use
NO₂	Nitrogen dioxide
NFIP	National Flood Insurance Program
NGO	Non-governmental organization
NESRI	National economic and social rights initiative

NIMBY	Not-In-My-Back-Yard
PAHs	Polycyclic aromatic hydrocarbons
PM2.5	Particulate matter 2.5 microns or smaller
PPB	Parts per billion
SBA	Small Business Administration loan
SBS	Sick building syndrome
TRI	Toxic release index
USGBC	United States green Building Council
VOCs	Volatile organic compounds

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This dissertation is dedicated to my neighbors, the seniors in Independence Heights/Studewood and Fifth Ward whose strength and resilience inspired me every day; my own grandmother Amelia who showed me that wisdom never fades; and my daughter, Emmelia.

CHAPTER 1

INTRODUCTION

Hurricane Harvey hit Houston, Texas, in August 2017, during hurricane season, and left behind compounded devastation in the neighborhoods that have historically been the most impacted by natural disasters and environmental injustice. Within the City limits, Harvey damaged 208,000 single-family homes, primarily through flooding (City of Houston, 2019). Of those homes, 61,359 were owned by seniors, and 49.6% (103,451 households) were earning at or below 80% of the area median income for Houston and Texas (2019). Families without savings and seniors on fixed incomes, without home and flood insurance, were left teetering on the brink of permanent homelessness, threatening their lifelong investment and quality of life. The post-disaster landscape uniquely burdens African American seniors who are aging in place, in neighborhoods that have been historically segregated, disinvested, and reterritorialized through gentrification.

In Houston and other Gulf Coast areas, the post-disaster milieu reveals that seniors are hit the hardest by the challenges of sheltering in place, navigating temporary housing, protecting health, maintaining homeownership, repairing damage from reoccurring mega-storms and supporting their families as matriarchs and patriarchs to integrate environmental justice within disaster recovery programs and aid, “just planning” suggests policy makers include impacted stakeholders at the recovery planning table. In Houston, African American homeowners living in historically segregated neighborhoods have been left out or placated during planning and recovery periods. This research seeks to find the wisdom embedded in their local and historical knowledge of place, climate, and neighborhood ecology through their own oral histories post-Harvey.

Research Statement

A large disparity exists between the number of homes still in need of repair after Harvey and the number of homes actually repaired by the City of Houston years after the storm. Two years after Hurricane Harvey, of 208,531 homes that were flooded, according to Situation and Pipeline Report #1 (City of Houston, 2019) one single-family home had been reconstructed and 7,276 seniors living below 80% AMI had completed the City survey for recovery assistance. By 2020, seven homes, representing various incomes and demographics were reconstructed (City of Houston, 2020). The low number of and rate of repairs indicates the recovery process is not working.

Of the 20,822 homeowners who registered for assistance with the City of Houston by completing an intake survey, only 5,635 were invited to complete the application process (City of Houston, 2020. p. 2). According to the same report, 5,644 people were invited to apply (p. 7). Of the total number who reached out to the City for assistance, 71% were non-white (2020). Of the 5,635 invited to complete the application process, 78% were seniors earning at or below 80% AMI, and 40% were seniors earning at or below 30% of the AMI (2020). FEMA approved \$1,243,252,850.20 in housing assistance for Texas (Federal Emergency Management Agency, 2017). It was reported that 436,307 Harris County residents reached out to FEMA for assistance after the storm (Kinder Institute for Urban Research, 2017). It was also reported that 75% of 265,133 low income home owners (\$75,000 or below) impacted were denied Federal Emergency Management Assistance (Texas Housers, 2018). This research focuses on Hurricane Harvey housing recovery through the lens of environmental justice; therefore climate change impacts and neighborhood vulnerability must be viewed over extended periods, both before and after the storm.

Research Objective

This research seeks to propose recommendations for resilient post-disaster housing policies that would support aging in place for our neighborhoods' most vulnerable populations, as well as equitable inclusion of African American senior homeowners through communicative planning and ecological co-management. To what extent were African American seniors in Houston exposed to poor indoor air quality as a result of storm damage, mold, or inadequate or nonexistent air conditioning? Do slow repairs result in uninhabitable space that increases the risk of health deterioration and homelessness and thus leads to climate gentrification?

Research Questions

Research Question #1. What is the true extent of home damage that seniors experience?

Research Question #2. How do seniors recover, what does the recovery period look like and how does the recovery period post-storm impact senior health and displacement from the home?

Research Question #3. How can housing recovery be viewed and improved in the context of environmental justice?

Research Hypothesis

Research shows that hypersegregated, historically African American neighborhoods are facing exacerbated climate gentrification based on decades of environmental injustice over time despite the rhetoric of building sustainable communities and billions of dollars allocated to federal, state, and local agencies. The hypothesis is that there are gaps in recovery aid for seniors in need and that new housing recovery policies can address these gaps. The post-disaster landscape is uniquely positioned to support the rebuilding of homes if the resources are allocated in an equitable way. However, the hypothesis is that the current post-disaster recovery period and local municipal

planning process gaps are used to disinvest and disenfranchise African American homeowners, thus contributing to climate gentrification. Further, the hypothesis suggests that senior feedback has not been included in developing policy.

In this research, I collected oral histories from senior homeowners in Independence Heights (Studewood) and Fifth Ward, Houston, about the process of their own recovery and I hypothesized that this step is necessary to inform municipalities on how to address recovery from a more equitable and ecological position. The post-disaster landscape is uniquely positioned to support the rebuilding of homes if the resources are allocated equitably. Feinstein advocates that reflective dialogue between theory and practice questions the singular public interest and must include the most vulnerable voices (2013). This research will use citizen dialogue to make public policy recommendations for single-family homeowners in affected neighborhoods to reduce displacement and preventable compounding of health impacts on seniors that occurred immediately after the storm.

CHAPTER 2

LITERATURE REVIEW

Environmental Justice, Disaster Recovery Policy, and the Built Environment

This synthesis explores the threads of racial bias that disenfranchise historically segregated communities of color in the Gulf Coast region of the United States, specifically those occurring post-disaster. Recurring systemic patterns of housing inequity are compounded and exacerbated during the hurricane seasons and cycles in the Gulf Coast region. Research by Bullard and others reveal inadequate public housing and mega-storm policies throughout time that negatively impacted the health of neighborhoods and families.

Additionally, post-disaster research in New Orleans after Hurricane Katrina by Bullard and others revealed vulnerable populations received inadequate recovery responses, rooted in systemic racism. Environmental justice research expands our understanding of why non-white populations are already at a disadvantage to recover equitably from storm events even before damage to the home. Hurricane Katrina research suggests that disaster recovery policies may improve if they incorporate environmental and ecological planning approaches that integrate vulnerable populations, resource management, indoor environmental quality, and participatory planning (Gardner, 2009; Kish, 2009; Evans-Cowley & Canter, 2010).

Environmental justice research indicates that climate change compounds and exacerbates the burdens facing historically segregated communities. In the Gulf Coast region, this is most obvious during the hurricane seasons and cycles. This literature review includes case studies and policies in the Gulf Coast region after Hurricane Katrina, from Mississippi to Texas. Research in this literature review indicates that communities of color were treated insufficiently and left out of

their own recovery, which consequently diminished their ability to prepare for the next storm. The literature review revealed systemic gaps in public policy for communities of color that impact housing, indoor air quality and other pathways to resilience. Some gaps in the research included research on indoor environmental quality during recovery, as well as the inclusion in the research of equitable participation of residents in need. Gaps in local policies included equitable ecological resource management and the need to improve equity in current housing recovery policy.

Historic Institutional Racism and Housing Outcomes

Environmental justice research of the past ten years shows that systemic burdens are perpetuated through unfair and inadequate policies originally and theoretically developed to promote white majority communities and restrict access for African American communities. These long-standing prejudices weaken the ability of communities of color to prepare, respond, participate, recover, and have agency in their recovery. Further, the post-disaster recovery period is used to disinvest and disenfranchise African American homeowners, sometimes under the rhetorical pretense of healthy housing, resilience, and participatory design by those in decision-making positions. Environmental and urban planning discrimination have negatively impacted non-white communities in their daily lives, health, and ability to secure the American dream of home ownership regardless of economic status (Bullard, 1994). The research shows that previously segregated neighborhoods in Houston and New Orleans have experienced discrimination in terms of the location of and exposure to flooding in low-lying areas, waste facilities, clustered industrial facilities with pollutant externalities, freeway location, and lack of testing and cleanup. Bias is an extension of 400 years of anti-black prejudice and apartheid (Bullard, 1994). Housing discrimination has resulted in hypersegregation of neighborhoods and

disinvestment in non-white neighborhoods (Bullard, 1994). African Americans face limited housing choice and mobility, limited access to healthy homes with green building features, central air for climate control and ventilation, and community amenities that impact personal health and overall neighborhood temperatures (Bullard, 1994; Hoffman, 2020; Ito, 2018).

Much has also been written on the discriminatory practices and institutional barriers of segregation, redlining, and mortgage rejection (Bullard, 1994). Most recently, environmental justice advocates have connected cancer clusters to the location of contaminated railroad ties in entire neighborhoods in Houston (Douglas, 2020). From this vulnerable position, African American neighborhoods are less likely to “displace environmental threats that would cause them harm.” (Wright & Nance, 2012, p. 2). Case study research post-Hurricane Katrina reveals that current disaster recovery policies align with the pattern of discriminatory practices. Regarding housing recovery, African American Katrina survivors faced many insurmountable restrictions, including denied FEMA grants, redlined insurance policies, and lack of support services. Other such restrictions included green building and flood codes, eminent domain, forced wetlands restoration of their property, and discriminatory cleanup of debris and known toxins have restricted development (Bullard & Wright, 2012). Racial bias and NIMBYism prevented participants in the Katrina Cottages program from receiving replacement housing; despite the Fair Housing Act, they were met with exclusionary zoning (Evans-Cowley & Canter, 2010).

The Fair Housing Act of 1968 is an ineffective policy in terms of aiding African Americans, regardless of their economic status, in their struggles with discrimination in the street, the workplace, real estate agents, banks, and non-black neighbors (Bullard & Wright, 2012). In a series of 209 interviews conducted by Joe Feagin, African Americans give their firsthand accounts of

their daily struggles to secure the American dream. Of those interviewed, 65% were from the South, 47% earned \$56,000 or more, and 80% had college degrees (Feagin, 1994). One respondent sums up the overall concern:

“Once we have a nice place to live, maybe then we can think about becoming successful. Before we can move ahead, we have to have a place to go home to. You cannot be a doctor or a lawyer if you're worried about where you're going to be staying, and if you have a meal or a warm bed” (unnamed resident as quoted in Feagin, 1994, p. 20).

Another resident draws an important conclusion about home and community:

“One of the things that we have as black folk is that when the white world bites, we know that we can come home and find some healing there. And when I say home, I mean community” (unnamed resident as quoted in Feagin, 2012, p.22).

When looking at Houston's black population, Bullard (1983) found that racial segregation was high even as Houston was becoming one of the fastest growing populations in the South. In 1983, over three-fourths of African Americans in Houston lived in neighborhoods that were 70% racially African American. In a statistical study, Denton (1994) described the multidimensional layering of segregation and isolation as hypersegregation. Studies also show that residents receive inadequate public services, including schools, parks and recreation, and garbage collection (Bullard, 1983; Denton, 2012; Feagin, 2012). This is not a random coincidence but the result of historic segregation.

As Bullard (1983) explained, although Houston is the largest city in the United States that lacks zoning, disadvantages have been leveraged for white communities through exclusionary and poor regulatory enforcement. In one of his first studies, Bullard asked, “Are black children more

likely to attend schools near municipal landfills than their non-black counterparts?” (Bullard, 1983, p. 275). In his research on the location of landfills and other polluting industrial uses, he found that the answer was yes. Further, the Houston City Council making the decisions before the 1970s was of all-white, all-male composition, indicating that non-white residents were not represented during decisions that would burden their neighborhoods (Bullard, 1983, p. 275). In the research, Bullard always established a comparison of data between white and non-white to first establish the difference in population clusters or sociospatial groupings. Whether the underserved population has representation or a voice in the decision-making process impacts their homes and neighborhoods. Regardless of economic status, white neighborhoods receive faster environmental hazard enforcement with higher fines and more complete cleanup after a toxic spill (Bullard, 1994; Wright & Nance, 2012). In the case of the Deep Water Horizon Oil Spill, data showed that toxic waste was diverted to African American communities and that at least one white neighborhood was able to protect itself from receiving the waste (Wright, 2011).

With all of this already looming overhead like a storm cloud on the horizon for Gulf Coast communities, these Hurricane Katrina case studies also revealed that “pre-storm vulnerabilities limit participation of thousands of disadvantaged individuals and communities in the after-storm reconstruction, rebuilding and recovery” (Wright & Nance, 2012, pp. 9–10). Not only are the approaches to public policy for recovery ineffective for African Americans, but they also have the negative impact of disinvesting property owners of their homes and home values (Bullard & Wright, 2012; Wright & Nance, 2012).

Some of the ways that this happened during and after Katrina include lack of immediate rescue and relief; hostile media representation; serial displacement; slow, little, or no FEMA aid;

insurance redlining; the use of environmental restoration, green, or sustainable practices to restrict rebuilding; lack of cleanup; the creation of new exclusionary regulations; lack of enforcement and oversight; political collusion; and the devaluation of the rights of African Americans as citizens and cultural creators (Bullard & Wright, 2012; Evans-Cowley & Canter 2010; Gardner et al., 2009; Kish, 2009).

Nance and Wright (2012) also documented disparities in Katrina aid funding allocation. Four predominantly white planning districts collectively received more than double the funding received collectively by eight predominantly African American planning districts (Wright & Nance, 2012). The New Orleans Commission mapped white areas with less damage to be rebuilt first, while less affluent African American communities were slated to become green space (Wright & Nance, 2012; Bullard & Wright, 2012). Theoretically, the green rebuilding movement protects future generations but not vulnerable populations (Wright & Nance, 2012).

Citizen Rights, Climate, and Ecological Planning

Ecological planning perspectives include nesting systems and systems thinking, both of which include community engagement. The research on citizen participation during ecological planning shows that outcomes trend toward more equitable inclusion and outcomes. Much of the existing research post-Hurricane Katrina and other mega-storm disasters proves that citizen participation by African American residents was nonexistent or that it was merely at the bottom of Arnstein's ladder of citizen participation: in other words, manipulation, informing, placation or some combination of these (Arnstein, 1969). How can policy and practice support citizen efforts to exercise their rights? Eyben (2003) wrote that in many societies, the right to participate is

essentially the right to claim other rights. Under the Just Planning Framework, this participation must be at the top of Arnstein's ladder as partnership, delegated power, or citizen control.

During Hurricane Katrina, the government was most needed to uphold the rights of citizens, the right to be prepared, recover, rebuild, and to age in place. Residents were left to fend for themselves, stripped of dignity, and evacuees faced a backlash from white communities fearing resettlement in their areas, a recurring theme in housing recovery post-storm (Garder, 2009; Kish, 2009; Evans-Cowley & Canter, 2010). The narratives and discourse in the wake of Hurricane Katrina immediately labeled African Americans as refugees (Kish, 2009). A refugee is defined as a person who has been forced to leave his or her country to escape war, persecution, or natural disaster.

This representation of predominantly poor, African American residents who were abandoned in the Katrina disaster zone played out in both the local and national public discourse only to exacerbate xenophobia (Kish, 2009). Once the media had labeled them as refugees, the government response was racialized. After the storm, tens of thousands of African American Katrina survivors were excluded from food, water, or means of evacuation, essentially stripping them of their full rights of citizenship. Forced marginalization and homelessness were met with violence and exile, as the Louisiana governor issued a "shoot-to-kill" order under martial law in the disaster zone (Kish, 2009). Through the devaluation of the health and lives of the community in New Orleans, persecution victimizes the national African American community (Kish, 2009). How can ecologically sound policies be written to address long-standing systemic racism and protect citizen rights equally so that this does not happen again? Specific rights identified by the New Orleans case study research are the right to return, the right to cleanup, the right to funding,

the right to have public resources such as schools and transportation returned, and the right to healthy temporary and permanent housing.

Housing displacement during the storm and the slow recovery phase strips residents, especially the most vulnerable—seniors—of the “right to age in place.” This right has a critical impact on the health of seniors and the collective cultural heritage of historic neighborhoods (Iecovich, 2014). Housing design and policies that support aging in place has become an accepted best practice among planning and design practitioners, especially in the health industry and design of environments for aging (Iecovich, 2014).

Aging in place is a guiding strategy recognized to address and meet the needs of older people. An AARP study showed that the majority of older people want to age in place, remaining autonomous, active, and independent as long as possible while surrounded by family and friends (Iecovich, 2014). Iecovich defines aging in place and the conditions needed to enable it as multidimensional. *Place*, which in this synthesis is referred to as house and community, holds a physical dimension, a social dimension, and a cultural dimension. Aging in place is preferable from both the perspective of the older person and policy makers. While older people prefer to stay in their homes because it enables them to keep their identity and maintain their well-being, policy makers find that the cost of institutional care is much higher than providing community care at an individual’s home. Aging in place has many proven benefits, whereas relocation results in negative impacts such as loss of social relationships, changes in routine and lifestyle, and loss of independence and personal belongings. This can be identified in areas that are undergoing gentrification and revitalization which occur post mega-storm.

One report of the FEMA Katrina Cottages program concluded that local governments and neighbor prejudices created regulatory barriers to prevent the program from landing in their neighborhoods despite the Fair Housing Act (Evans-Cowley & Canter, 2010). In the City of Gulfport, the city council adopted several new ordinances and amendments in 2009 and 2010 to block the development of the Katrina Cottages program. In 2009, existing residents were granted the right to block the placement of a Katrina Cottage. A review of the public meetings and opinion letters from existing Gulfport residents revealed that 61 letters opposed the development of 19 Katrina Cottages. The most common concern was the perception of property value decrease. The most outwardly discriminatory letters referenced the “type of people” living in the Katrina Cottages (Evans-Cowely & Canter, 2010, p. 57).

As a result of Gulfport and surrounding municipalities’ exclusionary responses, all but 3000 families received new homes in the Katrina Cottages program. At one time, FEMA identified 14,000 households that were eligible for the program out of an estimated 50,000 damaged homes and 49,000 FEMA trailers deployed. Although architecturally designed to withstand future hurricanes, and designed to aesthetically match the area, the temporary-to-permanent housing solution was derailed (Evans-Cowely & Canter, 2010).

Another post-Hurricane Katrina study investigated the right to adequate housing, health, and dignity, and concluded that the Housing Authority of New Orleans (HANO) failed to protect fundamental human rights through discriminatory policies that included demolished still-viable housing units, serial displacement, placation, and intimidation of residents (Gardner, 2009). Gardner, the Director of the Human Right to Housing Program at the National Economic and Social Rights Initiative (NESRI), worked with two researchers from the Harvard School of Public

Health to also connect the health outcomes associated with HANO's poor housing response. They found that the most impacted populations were women, children, and the elderly. Of the 142,000 HANO units that were damaged during the storm, only 112,000 or 79% fell into affordable price ranges for low-income residents.

Additionally, only 8,900 units were funded for redevelopment. In 2009, the NESRI and Mayday New Orleans, a grassroots organization conducted a survey of public housing and Section 8 tenants. A result of that survey showed that 50.8% of residents before the storm were no longer living in public housing, and 70% of those identified the destruction of their housing development as the reason. Of those residents displaced, 21.4% were currently homeless (Gardner, 2009).

During community meetings at one site, citizens protested the destruction of their buildings in what was ultimately an empty ritual of participation. HANO demolished the buildings that had been home to some families for generations. When interviewed, one resident of that community responded, "When people ask me questions about my story, the first thing I talk about is the loss of my community and networks" (Gardner, 2009, p.106). Although more research is needed, health indicators from a Kaiser Family Foundation report showed that evidence of increased self-reported physical and mental health, which further increased each year after the storm. One elderly Section 8 resident was repeatedly forced to move because of poor housing conditions and lack of repairs after her first residence was demolished. During her interview she described the feeling of having moved for the eighth time: "Ever since Katrina I haven't been feeling well. I'm so worried about finding a stable place to live." She was hospitalized during the process for diabetes, hypertension, and heart complications (Gardner, 2009, p.107).

Natural disasters are more of a risk for poor populations and the research shows that this applies not only in the Gulf Coast but globally (Arnold, 2006). A new approach to policies regarding climate change events and the social structures that respond to those natural events is needed, as well as aid accountability and a new understanding of the complexities of risk (Arnold, 2006; Daly & Brassard, 2011; Richardson & Renner, 2007; Adger, 2006). Several of the major theoretical approaches recommended in the science and literature that are currently lacking in existing public policy in the Gulf Coast case studies include a social-ecological understanding of integrated and nested systems, a multidimensional understanding of and ability to access vulnerability, and adaptive co-management of resources (Ager, 2006; Tang, 2009; Turner et al., 2003). Top-down approaches to recovery are not well coordinated between the players. There is a lack of shared agency or decision-making with the local community, and the data collection and sharing across agencies needs improvement (Richardson & Renner, 2007; Burke, 2017). Additionally, aid accountability in post-disaster housing reconstruction is lacking (Daly, 2011).

Often multiple actors are involved in the distribution and allocation of federal disaster funding. Daily found that centralized top-down funding for housing reconstruction results in pervasive systemic barriers between beneficiaries and NGOs (Daly & Brassard, 2011). In an effort toward efficiency, often arbitrary standards and an extensive chain of subcontractors lead to weak accountability and reduced aid effectiveness (Daly & Brassard, 2011). Additionally, the massive influx of resources, limited capacities within organizations, extensive damage, and pressing needs become significant challenges for accountability and transparency, resulting in waste and corruption. Although the stated goals in much of housing aid development has included participatory community-driven language, the research shows that these goals were not always

met (Daly & Broussard, 2011). One assessment conducted immediately after the 2004 Indian Ocean tsunami reported that

serious problems occurred in the housing sector as a result of supply-driven approaches, inappropriate housing designs, and over-reliance on donor-driven processes. Moreover, many agencies that operated in the post-tsunami environment were new to the housing sector and lacked experience on the ground in post-disaster contexts (Daly & Broussard, 2011, p.510).

this led to the poor quality of transitional housing, and a slow shift from temporary to permanent housing. Overall, the housing sector was fraught with a wide-range of problems dealing with quality, quantity, location, and ownership, most of which can be related to issues of accountability (Daly & Broussard, 2011, p.510).

A multi-directional accountability flow shifts the relationship of the beneficiary as the only actor providing documentation. The intermediary agencies administering the aid are required to provide a series of accountability documents to the residents. Timely and transparent aid flow accountability in both directions also shifts the power of accountability (Daly & Broussard, 2011). Multi-directional accountability may potentially increase the part of the participatory and community-driven processes and establish a more formal structure for co-management of the aid resources to occur between governments and communities, and all of the complex web of actors and systems (Turner et al., 2003).

A report on housing recovery post-earthquake in Gujarat in 2001 “identified five approaches to housing reconstruction; owner-driven, subsidiary, participatory, contractor driven on site, and contractor drive off site” (Daly & Broussard, 2011, p. 513). The results showed that

owner-driven and participatory approaches resulted in both higher levels of beneficiary satisfaction and more efficient and cost-effective aid distribution (Daly & Broussard, 2011). In a social-ecological understanding of integrated systems, one would classify the housing stock and materials as common resources that are nested in the climate and require intense measurement and ongoing testing of their adaptability to the particular place. This is a gap in the current way in which post-disaster housing is approached. Aid accountability in both directions is also a current gap in the structure of the housing recovery system in the Gulf Coast region.

Researchers at the U.S. Department of Housing and Urban Development discovered, during their analysis of aid post Katrina, Rita, and Wilma, that natural and ecological disasters are not bound by societal geographic boundaries (Richardson & Renner, 2007). Richardson and Renner looked at how federal and local agencies could better use geographic information systems (GIS) to improve data sources after a storm used by multiple agencies to estimate damage and calculate and distribute aid. Richardson and Renner found that the American Red Cross, FEMA, HUD, and SBA all used different damage assessment systems, fed by different information at various times, thus impacting the effectiveness of where money went for long-term recovery (2007). The recommendations to use and share data through GIS post-disaster at the address and block level would allow public policy makers to identify specific properties that need repair and address why they may not be receiving repair.

Additionally, pinning FEMA assessments to parcel data will more accurately identify areas of damage, data on loans and grants provided for home repair, and local data on building permits. Richardson argues that this overlay of information will allow planners and public policymakers to better track recovery results and apply aid where needed (Richardson & Renner, 2007). This

reinforces scientists' recommendations to understand and evaluate resource management as nested social-ecological systems that cross traditional boundaries. This type of geospatial overlay would enable a more accurate assessment of vulnerability as defined by Adger (2006) and Turner et al. (2003).

Indoor Environmental Quality and the Built Environment

The previous section reviewed multiple systemic failures of the housing recovery process for aid recipients post-disaster and discussed the possibility of characterizing housing as a shared resource that is coupled with other human and natural systems. If public policy making is approached in this way, citizens can continuously monitor the effectiveness and health impacts of that resource. A more inclusive way for residents and communities to participate in the decisions, delivery, and monitoring of housing construction in partnership with experts and actors in various fields and agencies is necessary, especially for indoor air quality.

One case study of temporary FEMA housing solutions after Katrina failed the occupants in all these regards. In fact, when individuals experienced various health issues and complained to the relief agency, they were ignored. Symptoms experienced included eye, nose, and throat irritation; nausea, skin rashes, sinus infections, depression, asthma attacks, headaches, insomnia, memory impairment and difficulty breathing (Bullard & Wright, 2012). The Sierra Club tested thirty-one trailers and found that 83% of them had levels of formaldehyde above the EPA limit of 0.10 parts per million (Bullard & Wright, 2012). After testing results were made available, FEMA discontinued distributing the trailers because of high levels of formaldehyde and later admitted responding too slowly. The Center for Disease Control (CDC) tested and found hazardous levels of formaldehyde in 519 trailers. The CDC tests indicated formaldehyde levels were seventy-five

times the U.S.-recommended workplace threshold. Formaldehyde is a known carcinogen with serious health effects with exposure. The average level found in the CDC test was 77 parts per billion (ppb) and the average in a newly constructed home is 10–20 ppb. (Bullard & Wright, 2012). The highest level recorded was 590 ppb. An estimated 195,000 people were living in trailers two years after the storm (Bullard & Wright, 2012). This indicates a need for not only improved indoor air quality from an architectural perspective but also oversight during the recovery process and a need to reduce or eliminate the time families spend in low quality temporary housing.

Gary Adamkiewicz's (2014) published research in the *American Journal of Public Health* addresses the shift in environmental justice from outdoor air quality and environmental conditions to indoor environmental quality. It explores the indoor air quality of public housing through a simple box model simulation of a public housing apartment in Chicago. The direct effect of dilapidated housing and the lack of good public policy have historically been poor health indicators. Over the past century, the understanding between housing and health has expanded (Adamkiewicz et al., 2011).

Adamkiewicz and his team developed a framework to identify drivers of indoor air quality. They reviewed empirical evidence from the American Community Housing Survey to find links between socioeconomic disparities and indoor exposure to lead, allergens, PM_{2.5}, VOCs, and SVOCs. Some of the housing variables associated with high indoor pollutant exposure included construction before 1980, inside water leaks, and occupant density. Hazards associated with water leaks include mold and structural integrity.

Using an indoor air quality simple box model to look at NO₂ and PM_{2.5}, the research explored factors that may drive an increase of indoor air pollutants, such as the design of the space,

occupant behavior, poor ventilation (or no mechanical ventilation), household furniture, pesticides, and the infiltration of poor outdoor air. Indoor exposure may be influenced by many variables as well as contributions from outdoor air. However, it can be modeled to indicate emissions, air exchange, and deposition. Underlying determinants of exposure can be related to the overall burden of health disparities.

In addition to the box model and American Community Housing Survey data, Adamkiewicz and his team suggested that more community-based data collection is needed. Both research articles point to a lack of testing of indoor air quality in government housing and recovery programs, as well as a need to consider the indoor environmental quality in relationship to personal and family health, especially for vulnerable populations. Vulnerable populations include historically segregated communities and seniors. The poor indoor air quality measured in both studies was preventable. High levels of formaldehyde, VOCs, PM_{2.5} and NO₂ are associated with byproducts of building materials and lack of mechanical ventilation, which are relatively easy to avoid and upgrade from an architectural perspective.

Fundamentally, the home is the most important built environment in people's daily lives. It is a technology for living that impacts health and well-being. People spend 90% of their time indoors and 15.5–15.7 hours a day inside our homes (Wu, 2007). Environmental quality inside the home is now ubiquitously understood through science to have long-lasting and serious health effects on children and adults, including seniors, and may cause asthma, headaches, depression, cognitive development and cancer (Zota et al., 2005). Indoor toxins can include nitrogen dioxide, PM_{2.5}, lead, allergens, and VOCs (Adamkiewicz et al., 2011). Adamkiewicz found health-related outcomes to exposure for low-income and previously segregated communities in a pattern of

occurrences, causing indoor environmental health and policy to become a concern for the environmental justice movement.

One study of 828 residents from 20 different low-income housing developments in Boston found evidence of clustering and cumulative exposures through self-reported poor health conditions and visual inspections of the units. More than half of the homes were significantly associated with household exposure to pests, combustion byproducts, mold, and inadequate ventilation with self-reported health conditions. The study did not include lead or outdoor pollutants such as traffic emissions.

Another study conducted in seventy-seven public housing homes determined that indoor air quality for income-deprived populations in the public housing program did not meet ASHRAE ventilation standards and lacked exhaust fans in the bathrooms and kitchen (Zota et al., 2005). Additionally, nitrogen dioxide (NO₂) levels in 40% of the units exceeded the EPA's National Ambient Air Quality Standard of 53 parts per billion (ppb), and 93% exceeded the World Health Organization's annual average European Regional Standard of 21 ppb. (Zota et al., 2005, p.398). NO₂ has been linked to exacerbating asthma (Zota et al., 2005).

A study in four U.S. cities revealed that lack of air conditioning played a role in heat-related mortality and indicated a racial disparity (O'Neill et al., 2005). Lack of air conditioning is another major indoor environmental justice burden. Mortality rates among African Americans connected to lack of air conditioning can be avoided through the simple introduction of a mechanical system upgrade or intervention (O'Neill et al., 2005). O'Neill et al. explored and concluded that the prevalence of heat-related deaths among African Americans is more strongly associated with the lack of access to air conditioning. The data collected revealed that the prevalence of mechanical

air conditioning in white or other households more than doubled that of African American households. In the four cities studied—Chicago, Detroit, Minneapolis, and Pittsburgh—the heat-associated mortality among African Americans was individually higher than that among Whites and more than twice that of Whites when results from all four cities were pooled together (O’Neill et al., 2005).

Ito et al. (2018) conducted a heat-related study on equitable access to air conditioning and heat-related deaths. Driven by the understanding that heat illness is preventable, the authors looked at times of heat emergencies and heat advisories to see if they are sufficient, and specifically looked at New York City’s heat emergency plan. The methods used in this study could also be applied in vulnerability assessments and data collection during disaster recovery immediately after a storm to inform policy aid priorities. The authors used heat stroke death data from the New York City Health Department, Office of the Chief Medical Examiner, after the 2006 heat wave, which contains information such as the presence of air conditioners to determine who was dying of heat stroke and where (Ito et al., 2018). The research showed that 85% of heat stroke deaths recorded (48) between 2008–2011 had onset at home. Of those with information on the presence of an air conditioner (26), 100% did not have working air conditioning at home (Ito et al., 2018, p.750).

The U.S. national average for heat stroke death is 10 times greater than the New York City average. Ito et al. (2018) generated a heat vulnerability index for heat stroke death patterns, tracked with other modifiers such as non-Latinx Black, having congestive heart failure as an underlying cause of death, dying at home, percentage of public assistance in the neighborhood, percentage of green space, and surface temperature. Results showed that lower rates of air conditioning access and high poverty levels track with residential racial segregation. These indicators, along with

surface temperature, were strong negative predictors of seniors' air conditioning access. A telephone survey of seniors who did have air conditioners cited cost as one reason they would not use it. Thirty percent of residents without air conditioning are in the neighborhoods in New York with the highest poverty levels (Ito et al., 2018).

Another study looked at the variable temperatures in previously segregated neighborhoods compared with their counterparts. The research conducted looked at the patterns of historically redlined urban areas with regard to heat and found that 94% of the redlined areas had land surface temperatures elevated by 7 °F when compared regionally and 2.6 °F when compared nationally to non-redlined areas (Hoffman, 2020, p.1). This suggests that the areas may lack tree coverage and other environmental amenities caused by the disinvestment that followed redlining. These and other historical planning policies may be directly related to the disproportionate exposure to extreme urban heat. Extreme heat is a leading cause of summertime morbidity in these communities and has specific health impacts on those with preexisting conditions, those with limited access to resources, and the elderly (Hoffman, 2020).

The authors concluded that these preexisting inequities further exacerbate climate change inequities. Additionally, the authors look at the increase of impervious surface created in the 1950s when road and highway projects transformed neighborhoods, along with large industrial complexes sited in redlined neighborhoods rather than non-redlined neighborhoods (Hoffman, 2020). All these factors should be considered when developing equitable disaster recovery policies; however, this synthesis has not found evidence of the existence of these considerations.

Additionally, there has been no research to show that disaster recovery policies address mechanical systems or provide funding for ventilation and air quality testing during the immediate

time after storm damage to the property or during the rebuilding phase. Despite the adverse health risks and impact of public health that research has connected to indoor environmental quality (IEQ) and sick building syndrome (SBS), research has found that not enough concern for IEQ exists in home environments and policy recommendations (Wu, 2007).

In 2003, Saegaert et. al. conducted a study in the United States to review policy interventions meant to improve public health through housing modifications. Of seventy-two housing interventions found, including relocation, education for residents, physical infrastructure changes, and changes of indoor equipment, furniture, policy, or changes in health practitioners' behavior related to housing effects, only 14% were judged as extremely successful. Of the interventions, 92% addressed a single condition and were determined to be narrow in its definitions of housing and health, with brief time spans and limited geographic scope (Saegaert et. al., 2003). Of the most vulnerable populations, 57% of the interventions targeted children, and 13% targeted seniors. Saegaert et. al. suggested that the policies and practices would be more effective if developed through the ecological paradigm, which we will address later in the synthesis.

One housing response case study designed by students at the University of Virginia sought to offer low-income residents served by Habitat for Humanity a sustainable home option. The project was an architectural regional response to the natural disaster of Hurricane Katrina and the housing crisis that followed (Quale & Iverson, 2008). The authors describe being driven by a need to address social equity in sustainable design and the need to design a home that was climate responsive. Although the authors described an effort to monitor and analyze the home post-occupancy, limit the environmental impact of systems and materials, and enhance energy

performance, affordability, human comfort (occupant satisfaction), and constructability, no data or results were presented in the article that this was achieved (Quale & Iverson, 2008).

Although Quale and Iverson mention the use of “decision webs,” no resident input was discussed. The design team was composed of interdisciplinary students and unnamed outside advisers. Some of the design intentions with health impacts, such as natural ventilation, thermal efficiency, and reclaimed materials fell short because of cost considerations and limits of locally available products (Quale & Iverson, 2008). Other pitfalls mentioned were the limitations of Habitat for Humanity's guidelines, the inability of the organizations to deliver the scale of housing needed, and a lack of labor shortage. One demonstration home was built with a target of \$65/sqft in response to the more than 200,000 homes that were destroyed by the hurricane (Quale & Iverson, 2008, pp.101-102).

Semian and Nance (2019) propose community-based testing and education post-disaster. Nance (2009) makes the case for community-based laboratories to fill the environmental policy gaps she describes in New Orleans case studies post-Hurricane Katrina. Based on the principles of participatory development and the civil rights movement, community-based labs would offer testing, remediation, and education to residents who historically lack access to information needed to protect themselves and their families from environmental contamination (Bullard & Wright, 2012; Nance, 2009).

In addition, the opportunity for training and other tools enable people at the household level to discover, restore, and monitor their own property over time. Nance suggests that careless industry practices and forced segregation to low-lying areas put African American communities at risk and do not protect them from contamination (Nance, 2009). The EPA lacks systematic

solutions for the cleanup of residential properties, fails to protect people of color, and lacks representation for all citizens. Failure of the current systems transfers unjust environmental burdens onto vulnerable populations (Nance, 2009). The framework for community-tailored testing and education that Nance proposes gives actionable recommendations to address the lack of true sovereignty for neighborhoods and residents.

Post-Harvey Vulnerability and Justice Research

This section looks at some research articles published post-Harvey that have used vulnerability subsets and included and/or collected air quality and soil testing. All the studies have suggested that social vulnerability impacts resilience in terms of repair and long-term recovery. The research has also concluded that vulnerabilities and air and soil quality must be used in the future to determine and distribute aid, increased environmental monitoring, and cleanup.

Researchers post-Harvey have been widely influenced by new methods of compounded vulnerability and environmental justice research. Post-Harvey, researchers have advocated for new methods of collecting and analyzing disaster recovery data through the lens of environmental justice, citing the work of Dr. Bullard, his colleagues, and others (Emrich, et. al, 2019; Greigo, et. al, 2020; Lukasiewicz, 2018).

Kaufman and Hajat explain how race and exposome are reframed for research articles submit to *Environmental Health Perspectives* (2021). In health disparity research, the journal asked investigators to define the role of race and “why it was assigned as an analytical variable” (Kaufman & Hajat, 2021, p. 2).

That is, they (researchers) should explore how racism underpins social, economic, and environmental disparities that influence health. We expect authors to be thoughtful in

considering these aspects rather than assigning health effects to race or even specific measurable impacts of racism such as segregation. (Kaufman & Hajat, 2021, p. 2)

Building on the work of Dr. Bullard and his colleagues, Verchick and others have looked at disaster justice specifically defined by environmental justice (Lukasiewicz, 2018; Verchick, 2012). Verchick and Lukasiewicz argued that climate disasters are social disasters, controlled by governing structures, and their goal is to improve disaster management and the intent of policies- the allocation of resources, rights, and political power (2018; 2012).

Overall, the research post-Harvey has differed considerably in nature and approach from pre-Harvey research, calling for increased environmental testing and rapid and credible post-disaster research that fills the gaps in planning and executing interdisciplinary studies on the assessments of health impacts of disasters (Horney, et al, 2018). Horney et al. recommended that protocols be set in place pre-disaster and initiated quickly post-disaster without interfering with response and recovery efforts (2018).

In one study, Emrich et al. describe a need for disaster recovery housing research to become more nuanced and empirically driven (Emrich et al., 2019). The study explores the relationship between vulnerability and recovery aid following a major flood event in 2015 in South Carolina during Hurricane Joaquin. As in the case of other social justice research, the authors hope to contribute to the development of new equitable disaster recovery. Their work describes the potential for social vulnerability to drive pervasive barriers to recovery aid and disaster management programs. They make the point that social equity is not currently a factor in disaster management, planning, response, or recovery, and they argue that distributive equity in disaster programs should no longer be overlooked (2019). Researchers are calling for a need to include the

compounding of vulnerability and exposome in disaster and health equity research (Emrich et al, 2019; Nwanaji-Enwerem et al., 2021).

Emerich et al. (2019) found that the ability to accelerate the recovery phase is predicated on access to resources in every phase and that the Community Development Grant-Disaster Recovery (CDBG-DR) funding is delayed compared with the other programs in terms of taking months and years to distribute. The study included a look at the four major disaster programs for housing recovery: Individual Assistance (IA), the National Flood Insurance Program (NFIP), Small Business Administration (SBA) disaster loans, and CDBG-DR through several statistical models. Their results show areas with higher income received higher SBA loans, and although IA was distributed to the most diverse populations with the most need, the payouts were the lowest (2019). The SBA loans and the IA grants require a presidential disaster declaration, while the CDBG-DR requires special congressional authorization (2019). Emerich et al. (2019) found a lack of easily accessible information and lack of transparency on how the programs access property loss and their research did not include any people. The statistical results were consistent with their statement:

For each of the major programs for disaster recovery, households with the greatest need are largely identified based on physical damage. The identification generally occurs through field assessment of post-disaster damage and estimation of associated repair costs. Under this paradigm, households with damage to highly valued assets are prioritized in the distribution of recovery assets. (Emrich et al., 2019, p.3)

Their research hypothesis was supported by their results showing that funds have been unequally distributed and that new research questions have emerged as a result, suggesting that equity be

included in the development of future home repair programs so that “all people have full and equal access in resource distribution and opportunities that enable them to meet their needs” (Emrich et al., 2019, p.2). This suggests that the right to post-disaster resources is in a state of public health crisis and that policy makers must begin to ask, how do public policies on disaster management avoid existing systemic injustices? Do the social impacts of hurricanes outweigh the ecological impact?

In Houston, neighborhoods remain hypersegregated, and environmental injustices unequally burden non-white health and home environments (built environment). One group of researchers identified their Houston study area by vulnerability factors and then added soil samples to their pilot study. In the Houston neighborhood of Manchester, researchers collected dust samples prior to Hurricane Harvey and soil samples to test for polycyclic aromatic hydrocarbons (PAHs) after Harvey.

The dust samples were not directly compared with the soil samples and not having a baseline test was seen by the research team as a gap in their study. Horney, et. al also collected soil samples outside of homes to avoid contact with the residents, stating a desire not to add to their stress or state of recovery (2018). Horney et al. concluded that the indoor and outdoor PAHs are likely from the same source and found evidence of concentration and redistribution of PAHs due to extreme flooding from the storm (Horney et al., 2018). At the time of the soil samples from 25 homes, Manchester was 98% Hispanic, and the neighborhood was determined to be vulnerable given several compounding social and spatial factors, including its physical proximity to preexisting toxic release facilities located along the Ship Channel and Sims Bayou.

Bodenreider et al. (2019) also identified the vulnerability of their research populations through spatial proximity to TRI facilities and other LULUs. Bodenreider et al. rely on EPA databases as secondary data and describe the environmental justice risks in Houston due to the “large concentration of chemical and plastic plants, oil and gas refineries, Superfund sites, and fossil fuel plants” developed along Houston’s bayous adjacent to systemically income-deprived communities of color (Bodenreider et al. 2019).

During Hurricane Harvey, numerous industrial facilities in Texas, including plastic and chemical manufacturers, Superfund sites, and petrochemical facilities reported flood damage. More than 42 reportable emissions events were reported in Houston between August 23rd and September 1st, 2017. These facilities handle numerous hazardous chemicals, including PAHs, VOCs, and heavy metals, which are released during emergency shutdown and start-up operations or flooding. (Bodenreider et al., 2019, p.2)

PAHs are associated with combustion and can increase the risk of cancer among other health indicators (Horney et al., 2018). The interior wipe for dust particles was made as the entryway floor, which is a reasonable place to find soil particles brought in from outside. The U.S. Green Building Council (USGBC) Leadership for Energy and Environmental Design (LEED) sustainability rating system rates projects higher when they install entryway systems in the primary direction of travel to capture dirt and particulates entering the building at regularly used exterior entrances (LEED, 2021). Bodenreider et al. (2019) found their environmental justice overlay through the EJScreen tool. These post-Harvey vulnerability studies did not measure or address resident awareness of proximity to contaminants or the individual participation of residents in recovery efforts.

Bodenreider et al. (2019) looked at the potential of toxic release sites to be mobilized by the hurricane itself. They compared resident proximity and a spatial analysis of federally qualified health centers, hospitals, and home health centers (Bodenreider et al., 2019). They concluded that significant (reported and unreported) statistical burdens were found between locations of clusters of poverty, communities of color, and the risk of increased exposure to toxic releases during a mega-storm event (2019). They also found in their spatial analysis that the elderly lacked access to healthcare resource facilities (2019).

CHAPTER 3

JUSTIFICATION OF STUDY

Although much has been written on the disaster recovery process, in terms of the theory of equitable practices, little has been written by the residents in the study areas, and less has been applied on the ground. This study seeks to include the voice of residents most impacted by climate injustice to gain insight for more equitable housing recovery in the future.

Several studies both in the United States and globally have been done on pilot recovery housing programs; however, most of those programs were not co-created by residents in the community or did not include the voice of the residents post-housing recovery to access lessons learned and successes. In Houston, the two most recent, ubiquitous housing programs post-Ike were never independently researched through post-occupancy methods. In most of the research, residents in non-white neighborhoods continue to be marginalized and displaced throughout the recovery process. This research will look specifically at African American homeowners in historically segregated neighborhoods and measure through qualitative methods the extent that seniors informed or can inform an adaptive co-management strategy for housing recovery.

The goal of this study is to show that a just planning or environmental justice approach to disaster planning includes ways in which to find synergies and interconnections of resident rights, home, site-ecology, traditional ecological knowledge, and adaptive co-management. African American families who have lived in their communities for two generations or more, sometimes since the birth of the community as a freedman town, can provide important and relevant local knowledge of ecological systems that can guide redevelopment and housing development in important climate responsive and environmentally just ways. Without an equitable representation

of the social-ecological component, public policies for housing post-disaster will continue to be inadequate.

Literature Gap

The literature fails to include citizen voice in the historic analysis of Hurricane Harvey and lessons learned. It fails to assess the built landscape post-disaster from the senior perspective within the environmental justice framework. It fails to ask whether lack of citizen rights to participate in the recovery process and the right to age in place impact public policy and funding allocation in historically segregated neighborhoods and what specific public policy recommendations can improve disaster response for temporary and permanent housing solutions that will sustain long-term environmental justice and future storm event management. Can a vulnerability index and IEQ testing immediately after the storm improve recovery priorities for housing recovery funding? It fails to address the fact that the most affordable housing is the home that seniors already own and can pass down to their children and grandchildren. It fails to assess the direct and indirect health impacts of storm damage on non-white seniors post-disaster.

Study Area

In Houston and other cities and communities, the post-disaster milieu reveals that senior homeowners, living in previously segregated neighborhoods, are at high risk of displacement and homelessness, gentrification, and reterritorialization, caused in large part by compounded lack of access to resources, unequal distribution of disaster recovery aid, and housing recovery programs. Displacement patterns and pressures post-disaster will be established through direct oral histories from senior residents with long-standing home ownership in the community.

The study area included geographically identified neighborhoods that were historically segregated in the Gulf Coast region, including the City of Houston and Harris County. These areas were negatively impacted by storm damage, flooding, and systemic racism, including senior homeowners at risk of homelessness and negative health consequences caused in part by the pattern of coastal storms and a lack of official response to support recovery.

This study area includes historic single-family homeowner neighborhoods, Independence Heights (Studewood) and the 5th Ward. The study areas were among the hardest hit areas in terms of flooding and storm damage, with high rates of seniors living with the lowest median income. Demographic, storm, home damage, emergency response, long-term recovery aid, and floodplain descriptive data for the study areas will be provided.

The study area for both neighborhoods was researched in a co-occurring extended timeline correlating with the sections of this research proposal in a way that layered the development of the built environment with the phenomenology of the human experience. The timeline describes overlapping conditions that fell into the following categories: environmental justice, disaster recovery policy, and the built environment; historic institutional racism and housing outcomes; citizen rights, climate, and ecological planning; IEQ, the built environment, and the post-Harvey milieu.

The oral histories were collected post-Harvey and added to the timeline in two categories: short-term recovery period 2017–2018 (1 year) and long-term recovery 2017–2022 (5-years). Each neighborhood has its own individual timeline beginning with the earliest recorded time of settlement, Independence Heights (Studewood), 1900–2022, and 5th Ward, 1866–2022.

To understand the built environment and the social context for both neighborhoods, the following milestones establish the shared and overlapping timeline for the research period.

1861–1865 Civil War

1866 – 5th Ward settled (alderman representative in City of Houston)

1865 – 1965 Jim Crow Laws

1896 – *Plessy v. Ferguson*

1910 – Independence Heights settled

1915 – Independence Heights incorporated as a City in Texas

1929 – Independence Heights annexed into the City of Houston

1931 – H.H. Schultz and J.Q. Sherman invent first window air conditioning unit

1933 – The Home Owners' Loan Corporation (HOLC)

1938 – FHA Underwriting Manual (with HOLC maps later referred to as redlining)

1942 – Interstate 610 (voter approved in Harris County as the “Defense Loop”)

1944 – The Flood Control Act (puts U.S. Army Corps of Engineers over flood control and irrigation projects)

1950s – Air conditioners become popular in suburban homes

1957 – Interstate 10

1961 – Hurricane Carla

1964 – Civil Rights Act

1968 – Fair Housing Act

1971 – Interstate 45

1973 – Federal disaster relief and recovery under the umbrella of HUD

1978 – FEMA established

1980 – 2022 Rapid Urbanization

1994 – Executive Order 12898 “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations”

1997 – Environmental Justice; Guidance Under the National Environmental Policy Act

2001 – Tropical Storm Allison

2005 – Hurricane Katrina

2006 – “Department of Energy, Environmental Justice Strategy” Guide

2008 – Hurricane Ike

2011 – “Environmental Justice Strategy for the U.S. Department of Housing and Urban Development” guide

2012 – Department of Transportation Order 5610.2a Final DOT Environmental Justice Order

2014 – “Plan Environmental Justice Legal Tools” guide

2017 – Hurricane Harvey

2017 – 2018 Hurricane Harvey short-term recovery period

2017 – 2022 Hurricane Harvey long-term recovery period

2021 – Executive Order 13985, “Advancing Racial Equity and Support for Underserved Communities through the Federal Government”; Executive Order 13990, “Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis”; Executive Order 14008, “Tackling the Climate Crisis at Home and Abroad”

CHAPTER 4

METHODOLOGY

This research will use the primary qualitative methodology of oral histories as a blueprint for communicative planning and participatory co-management. Bruce Berg writes, “Oral histories draw people and groups out of obscurity” and “give powerless people a voice” (1995, p.221). A set of oral histories were collected from senior homeowners living in historically segregated Houston neighborhoods flooded during Hurricane Harvey. Institutional Review Board protocol for the oral histories was approved by the Texas Southern University Office of Research.

The oral histories will be corroborated by secondary background data and secondary sources of information, including a literature review, public records, government documents, newspaper articles, photographs, artifacts, articles, maps, diagrams, and reports. The records will be woven together to generate a meaningful narrative of the post-disaster landscape for seniors to offer solutions “that might otherwise go unmentioned and unnoticed” (1995).

The oral histories allow others an alternative perspective to their own, to take a deep dive into a study of issues that influenced the past, present and future of Houston neighborhoods outside of their own static time period (Berg, 1995). They offer public policy makers insight into complex nuances, people, and events that have transpired post-disaster. The research interview questions were developed from several theoretical perspectives covered in the literature review section, including ecological co-management and Arnstein’s ladder of citizen participation. Ecological co-management perspectives on place-based solutions aligned with popular narratives found in regenerative design practices and the architectural theory of critical regionalism that urge design solutions to be place based to be equitable.

Healthcare related questions connected to spatial design and the built environment were adapted from the Center for Health Design, evidence-based design accreditation and certification (EDAC) patient, post-occupancy, and facility evaluation tools.¹ The tools were supported by the California HealthCare Foundation and the Kresge Foundation in recognition that improving the design of healthcare environments improves healthcare outcomes. Some of the toolkit questions were adapted based on the trend in healthcare of moving toward outpatient and home-based care models. EDAC is founded on the principle that evaluation and feedback are essential to improving the built environment with short-, medium-, and long-term benefits. The conceptual framework guiding EDAC design and research is that organizational goals become design features, leading to a set of environmental conditions that have measurable healthcare outcomes. The interview questions developed for this research pilot study are conversational prompts arranged by the following categories: identity and milieu, hurricane recovery experience, mobility, and health/aging in place.

Data Collection

Primary data collection was done in person during face-to-face and semi-structured interviews with the researcher and the homeowners during the recovery periods post-storm. Interviews were recorded on video with the subjects' consent. Audio-only oral histories were recorded when the respondent elected out of visual recording.

¹ Some questions adapted from the Center for Health Design, Clinic Design Patient Survey and Clinic Design Post-Occupancy Evaluation Toolkit. The Center for Health Design is an institution in the U.S. that provides Evidence-Based Design Accreditation and Certification for architects and designers. Downloaded 22 October 2021 at: <https://www.healthdesign.org/insights-solutions/clinic-design-post-occupancy-evaluation-toolkit-pdf-version>

A Go Pro camera and other professional recording devices were used. Data will be stored with the researcher. Exact address locations will not be revealed at the block level. Mapping addresses involved a geographic stagger; however, the boundaries of the Houston Super Neighborhoods were exact.

Secondary data collection for the study areas was performed through a variety of sources, including the Justice40 Screening Tool, the United States Federal Emergency Management Agency, the Environmental Protection Agency Environmental Justice Screening and Mapping Tool, the Census Bureau American Community Survey, the City of Houston and Harris County planning departments, and the Harris Long-Term Recovery Housing Repair and Data committees established post-Harvey.

Sample

The sample of oral histories came from the voluntary participation of non-white seniors (65 years or older), homeowners living in the identified study areas who received damage to their single-family home as a direct result of Hurricane Harvey. The sample included those wanting to share their personal historiography of the hurricane event itself, time leading up to the storm (including other storms of the past), and post-storm events (including housing repair and recovery). The homeowners have applied for some type of federal, local, or nonprofit assistance in repairing their homes post-Harvey. The sampled seniors were self-selected to participate in the oral history through nonprofit agencies on the ground, word of mouth, and social media. Four or more oral histories were collected. Each oral history generated its own unique data set.

Data Analysis

Qualitative data were analyzed by linking together information within the social and environmental systems surrounding post-disaster frameworks. Vulnerability was self-identified through the sample dialogue as well as secondary demographic and spatial data. Human-environment systems were coupled and compared within the context of post-Harvey evidence of stakeholder engagement, future ecological co-management, power-sharing, and social and local knowledge sharing. Quantitative data support the context of the post-disaster narratives within which the oral histories find themselves. Graphic timelines, flow charts, and visual mapping tools were used to overlay data to reveal neighborhood boundaries, hot spots, concentrations, and pathways of vulnerability. This study is not funded, and therefore the sample is small. One weakness of the methodology is recall bias. The ability to recall events, and the researcher's own presence, could have been subject to reflexivity.

Expected Outcomes

The data were expected to show that the experience post-disaster does not fulfill the just or communicative planning models, that the stakeholders were marginalized and left out of the decision-making process and used a variety of resources to aid in their own resilience post-storm. The data were expected to show the federal, state, and local policies and practices post-storm as resources unequally allocated and disconnected from the study areas. The hypothesis is that post-disaster housing recovery in Houston for African American seniors is inadequate and racially biased and that homeowners (and seniors) will benefit from new public policy recommendations that identify and address this bias. Adger (2006, p.274) suggests, "Vulnerability is a dynamic

phenomenon often in a continuous state of flux both the biophysical and social processes that shape local conditions and the ability to cope are themselves dynamic.”

Public policy recommendations include dynamic data collection, allowing citizens to test their own indoor air quality post storm to receive more immediate recovery assistance to address associated health stressors. Other methods toward social-ecological design and delivery policies for healthy housing (IEQ testing), participatory community engagement and hurricane safe design to tip the vulnerability scale for seniors and their families in previously segregated African American neighborhoods are recommended. The presumption is that no damage existed prior to the interview and storm; however, I expected to find damage to be cumulative and that long-term recovery has not been reached in the study areas. In the context of regenerative design, this means that neighborhoods in the housing recovery periods in between storms in the Gulf Coast are experiencing decline, entropy, and climate gentrification.

CHAPTER 5

RESULTS

Presentation of Findings

This section outlines the findings from the semi-structured interviews conducted in the Summer of 2022 for two historically African American Houston neighborhoods, Independence Heights (Studewood) and the Fifth Ward. The post-disaster landscape uniquely burdens African American seniors who are aging in place, in neighborhoods that have been historically segregated, disinvested, and reterritorialized through gentrification. This research seeks qualitative data and local ecological knowledge from African American senior homeowners in the two case-study neighborhoods, to answer the following research questions post-Hurricane Harvey:

Research Question #1. What is the true extent of home damage that seniors experience?

Research Question #2. How do seniors recover, what does the recovery period look like and how does the recovery period post-storm impact senior health and displacement from the home?

Research Question #3. How can housing recovery be viewed and improved in the context of environmental justice?

Demographic Characteristics of Key Informants

Participants' names were anonymized to protect the confidentiality of those who wanted their voices to be heard. Pseudonyms were assigned (Table 1). The residents participating in this study are senior, African American homeowners who occupy real spaces in their communities and have lived at the exact same address for either all or most of their lives. Exact addresses and street names will remain private. For both case study neighborhoods, one primary oral history is

triangulated with secondary data and organized around emerging themes. These histories are inextricably linked to the secondary data and existing research and echo the stories and shared concerns of their neighbors and relatives.

Table 1

Primary Participant Pseudonyms

Age	Years in neighborhood	Years on property	Neighborhood	Pseudonyms
67	67	67 (1953)	Independence Heights/ Studewood	River
81	74	74 (1946)	5th Ward	Iris
57	57	57 (1965)	5th Ward	Iris' Daughter

Research Question #1: What is the true extent of home damage that seniors experience?

Theme: Undiscovered Damage

During Harvey I thought we had escaped it also, I really thought we had escaped the water. It came all the way up to the top step and it saturated underneath the house, which I didn't know. After the cars were moved and everything, I found out it had eaten the bottom of my house off. That's why it was shifting, the house was lowering. (Interview with River, Houston, Texas, July 21, 2022).

Undiscovered damage is not a reliable indicator that no damage exists. Undiscovered damage worsens over time and can be misidentified in assessments as “preexisting” damage or “deferred maintenance.”

River discovered the long-term damage done to the foundation and floor assembly of her home four years after Hurricane Harvey. Secondary data show that other seniors also received flood water damage to the foundations of their homes, both raised and slab on grade. The delay in

the discovery of the damage could be due to River's reluctance to call for help or see herself as a senior in need. River is an active volunteer with the local churches, True Light, Bella Vista, Greater New Hope, and Yale Street, who provided rescue, water, and food for the neighborhood and help other seniors navigate recovery resources. According to River's firsthand account, no one came through the neighborhood to assess needs or damage immediately after the storm.

The community had to do it, we didn't have any saviors on you know, white horses coming through here trying to help us do what we had to do, we had to scrap down and do it. We work closely with Precinct One and we work closely with Sheila Jackson Lee on these efforts but other than it was us, and it's very few of those of us who are really going to get down and do it because we had a lot of seniors during that time. And a lot of our seniors are gone now, and I'm changing places and I'm going up to be where they were, you know.

(Interview with River, Houston, Texas, July 21, 2022).

Once River discovered the damage, she needed an inspection by a technical expert. She reached out to the City of Houston (the City) to follow up on her recovery application and found out the program had been moved to another governmental entity and was being administered by the State of Texas General Land Office (GLO). River refers to the GLO as "Glow."

What happened was that I initially started out with the City of Houston, then Glow took over the program, then they went back to Glow. Then the City of Houston was supposed to retake the program. And it went back to the City of Houston. So, all I'm saying is that between the City of Houston and Glow, we've had some applications lost (Interview with River, Houston, Texas, July 21, 2022).

River's suspicion about lost applications suggests that there may be other seniors whose houses still have undiscovered damages. Recent reports suggest that not only were applications lost during the switch from the City of Houston to the GLO but also that applications the City began were incomplete and disqualified. Not all the seniors who contacted the Federal Emergency Management Agency immediately after the storm applied for help with the City, perhaps because of mistrust developed through years of environmental injustice. Undiscovered damage leads to compounded damage over time. In River's case, the damage was not discovered until after another storm. The Federal Emergency Management Agency does not fully assess damaged homes post-storm.

This raises the very real possibility that other seniors who did not think that they had damage might have undiscovered damage. Undiscovered damage in the immediate recovery period may be one reason why low-income African American senior homeowners did not also reach out to the City for the housing recovery program. What limits the Federal Emergency Management Agency inspections? The agency may not be detecting the full extent of the damage because they are not looking for the full extent of damage. Fully repairing or replacing homes is not the current Federal Emergency Management Agency goal, which may limit the extent of their inspections. However, no other agency appears to be taking on this responsibility or fully describing a complete inspection process in Texas. What entities other than the Federal Emergency Management Agency send trained inspectors to assess damage, and when? Discovering flood damage four years after the storm reveals that these programs lack the capacity to connect on the ground with the African American seniors in need and perform technical assessments on a rapid

timeline. Post-storm damage assessments lacking at the local City and the FEMA level may contribute to undiscovered damage that accumulates over time.

Undiscovered damage leads to compounded damage over time, which may be misidentified by recovery agencies as “preexisting” damage. The concept of “preexisting damage” or “deferred maintenance” are terms aid agencies have historically used to deny or reduce recovery aid to African American seniors. River discovered the damage to her home after the winter storm freeze in 2021, the accumulation of which made her home uninhabitable. It was the tipping point that displaced her.

In addition to foundation damage from the flooding, River reported that inspectors found mold in the floor. Mold specifically contributes to headaches and other health complications. The presence of mold can be detected with the proper assessment tools and experts; however, the governor of Texas waived the need for licensed mold remediation post-Harvey. In every senior home that I visited with a local pastor in Independence Heights and Fifth Ward after Harvey, mold was present, some visible and some hidden in walls, floors, attics, air conditioning units, or behind kitchen cabinets. Is it possible that an elevated PM 2.5 reading inside the home can indicate the presence of unseen mold? Could this help make future assessments more health oriented and detect senior needs more quickly?

Public Policy Recommendations

1. The Federal Emergency Management Agency should increase its immediate response and assessments on the ground post-disaster. FEMA is one of the few agencies that has this ability and reach.

- a. The data need to be correlated with a shared inter-agency GIS database that captures and maps individual addresses.
2. The assessments need to be performed by technical experts, with the goal of complete structural and air quality assessment for long-term recovery.
3. Poor air quality (the presence of mold), poor structure in homes, and poor electrical or plumbing systems in homes built pre-1960s should be flagged for replacement.
 - a. Seniors will need temporary housing during the tear down and replacement of their home, along with agency support to store salvaged personal items.
 - b. Each agency receiving federal money should have both social worker case managers and technical case managers. The latter does not currently exist.
4. In underserved populations, like African American senior homeowners, living in historically segregated areas, shift the paradigm of the burden of proof of damage from the homeowner to the agencies receiving federal recovery money.
 - a. Agencies use the Justice40 Tool to identify areas during a declared public disaster period to send damage assessors and as a tool to qualify individual homeowners with assessed damage.
 - b. Require complete inspections by technical experts, not social case workers or untrained seasonal workers.
 - c. The Justice40 Tool can be used as one step in the process to prequalify homeowners in need.

- d. Local agency to provide technical physical assessments at individual addresses to identify and qualify seniors in need, without requiring extensive paperwork from the individuals.

Research Question #2: In what ways does the period post-storm immediately impact senior health and displacement from the residence?

Theme: Living with Damage, Temporary Displacement, and Resilience

This research previously revealed that senior homeowners will live in their damaged homes knowingly and unknowingly. In most cases, the damage has to be catastrophic for seniors to leave: for example, no running water. In Iris's case, she is still living without air conditioning or heat. In both cases, River and Iris were moved to temporary housing and hotels while their homes were being repaired and replaced. River stayed with her daughter until the GLO began demolishing her home; at that time, they paid for her to stay in a hotel.

One month after Hurricane Harvey flooded Iris's home, her brother, who had been receiving in-home health care through the Veterans Hospital, passed away. This initiated the process of a local nonprofit agency approving her for temporary relocation. Iris and her daughters received rental assistance from a local nonprofit agency. She had been living without a functioning kitchen in a home that had been partially "gutted" by the governor's unlicensed mold removal volunteers.

Unfortunately, even though the volunteers removed visible mold on the bottom drywall, they did not remove all the mold in the home. Additional mold was discovered later, and there may still be mold in the home today.

Other seniors who did receive assistance post-Harvey are also living with mold from Harvey flooding. Many seniors lived in partially “gutted” homes for years because of the governor’s emergency order to allow volunteers to perform mold removal and remediation without any certification. Many seniors did not know to check their foundations for flood damage or look for mold in hidden places. Both seniors were temporarily displaced, not knowing if they would ever be able to return home. And when they did return home, they noticed significant changes in the neighborhood.

Public Policy Recommendations

1. Reduce temporary displacement through construction of an accessory dwelling unit (ADU). For less than the cost of a hotel stay, a temporary-to-permanent ADU could be quickly built to house seniors waiting for new home replacements.
 - a. This will enable seniors to remain on-site during the recovery period. The ADU is permissible by code in Houston, whereas FEMA trailers are not, and modular housing causes confusion and delays in permitting. Panelized or pre-framed walls can reduce construction time in the field.
 - b. ADUs will establish new water and sewer line connections to City systems but can be powered off-grid by solar panels and batteries. This will provide a safe, mold-free place for seniors to live during their recovery period and allow them to better oversee their property and asset replacement.
2. Allow federal funding to establish temporary-to-permanent housing ADUs for local churches and nonprofit agencies. Establish a program that constructs ADUs on vacant agency lots to house seniors waiting for replacement homes or home repairs.

- a. The ADUs will be raised, constructed with water-resistant material finishes and a fortified roof for hurricanes, and include a renewable solar energy system.
- b. If there are no seniors in need of temporary disaster housing, the community the agency serves can use the ADUs to fill other emergency housing needs.

Theme: Displaced Neighbors

Where there are empty spots back here, were mostly homes that people torn down, City brought 'em out. When I was growing up those were homes on 40th and 40th ½ all the way up to the park on both sides (Interview with River, Houston Texas, July 21, 2022).

The seniors in this study lived with damage, were temporarily displaced, and returned to their homes after being homeless for a period of approximately two years. Others did not.

Returning to their neighborhoods, seniors concurrently observe the displacement of their neighbors. Post-storm, they returned home, avoiding permanent displacement, but their neighbors did not. They report an increase in demolished homes and ambiguity about the role the City plays in the vacancy that surrounds them. In contrast to the increased vacancy and loss of friends, family, and neighbors, the last remaining seniors observe an increase in new market-rate townhome development. They also describe pressure by outside investment firms wanting to buy their property. Five years after Hurricane Harvey, Iris and her daughter discuss the new townhome development they see being constructed where friends and neighbors used to live.

I think all of the houses around us, well, most of 'em in my neighborhood, been torn down, you know this. When they came back through and started rebuilding again, they start

building those uh, what you call them houses. (Interview with Iris, Houston, Texas, July 18, 2022)

Iris and her daughter describe the townhomes. The vacancy, demolition, displacement, pressure to sell, and new market-rate townhomes mentioned in the research prompted a deeper study of secondary data in several areas in both case study neighborhoods. To further illustrate a snapshot of changing land ownership in these historically African American neighborhoods, data were used from the Harris County Appraisal District Record Search and Mapping Tool, which provides homeownership and value information from 2013. This tool was used to map a snapshot of the ownership and values of the four displacement hotspots (DH1–DH4) identified by the seniors listed below in Table 2. Land values and ownership in the hotspots were also overlaid with a public list of LARA lots.

Table 2

Historic and Current LARA Parcel Values and Ownership 2013–2022 from Harris County Appraisal District. Online, 2022 (more in appendix)

LARA Lot #1 801 E 40th Street										
Year Built (2018) (1,595 SF)										
Tax Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Land Value (\$) (4,000 SF)	16,000	16,000	16,000	28,000	32,000	38,880	70,000	80,000	80,000	96,000
House Value (\$)	0	0	0	0	0	0	48,551	132,000	208,052	229,285
Total Value (\$)	16,000	16,000	16,000	28,000	32,000	38,880	118,551	212,000	288,052	325,285
Owner	-	-	-	-	Contemporary Development Corp	Contemporary Development Corp	Contemporary Development Corp	Cohen	Cohen	Cohen

It is a partial but incomplete snapshot of how many homes have been purchased by investment companies, the City, or by the Harris County Flood Control District. Homes valued at

over \$200,000 are assumed to be new townhomes and have a back record of investor ownership. Each displacement hotspot begins to illustrate property that has been disinvested from the community over time and describes a predatory pattern of displacement that indicates climate gentrification and policies that favor investors over homeowners in these communities.

River's street is 27% vacant lots, 19% church owned, and 27% investment company owned. Four investment lots are currently under construction with market-rate townhomes. When the City allows investors to subdivide the lots, they make a greater return on their investment but also increase the burden on drainage systems. Most townhomes have a floodable garage on the ground level.

New market-rate townhomes encroach on land where neighbors, classmates, and relatives used to live. Iris's street is 72% vacant lots, 44% investment company owned, and new townhomes are going up next door. Iris describes the cycle that occurs after every storm.

Look how things changed from the Harvey flood up to now, just look at the different stuff that done changed, houses have been torn down, rebuilt, torn down again and rebuilt and still we going through some of the same identical changes we went through when it did flood, so it doesn't make too much sense. (Interview with Iris, Houston, Texas, July 18, 2022)

Theme: Historic and Culturally Significant Neighborhoods Demolished

My dad helped build a lot of houses in the neighborhood, during the 40's-50's... on his property agreement it says "for \$10 and other stuff." (Interview with River, Houston, Texas, July 21, 2022)

The historic and cultural significance of these handcrafted African American neighborhoods are not protected by planning or zoning.

Given the cultural and historic significance of these neighborhoods, they should receive additional protection. Both case study neighborhoods were developed after the Civil War by freedmen and freedwomen and remained segregated even after the civil rights era and school integration. Both River and Iris recall that their fathers hand-built the first homes on their properties. Iris's dad used scrap wood from the railroad to build a raised shelter that lacked running water and electricity in 1956. She recalls her brothers helping to build the home, which had a pet alligator, a relief station (outhouse), and a more natural landscape with edible wild berries and domestic livestock.

River's neighborhood was originally developed in 1915 as the first African American city in the state of Texas. Part of the Independence Heights/Studewood area is designated on the National Register of Historic Places for its significant community planning and development. Ironically, they dissolved their independent City status and were annexed into the City of Houston in 1929 in the hopes of receiving basic city services and infrastructure that they still lack today. The original home Iris's father built was demolished post-Harvey because of a red tag from the City.

Research Question #3: How do seniors recover from a mega-storm, and what does that recovery period look like?

Theme: Limited Local Assistance

You can only talk to your representative on the phone, everything I've done through Glow has been on the phone, I have not seen one real person yet. I have had to send my paperwork

in through scans. They sent someone out to assess the house. I met my contractor but he's not with Glow, so I still haven't seen anyone from Glow's office (Interview with River, Houston, Texas, July 18, 2022).

Theme: Limited Local Assistance and Program Delays Place the Burden on Seniors

Without local assistance or a senior center, seniors in both neighborhoods are reliant on technology and self-advocacy and are left to manage contractors and aid programs on their own. Coordinating paperwork between multiple agencies and actors can easily get confusing, especially while living in temporary housing off site. Staying in temporary housing off-site means seniors must travel back home to meet with repair experts or agency case workers.

According to River and Iris, no one from the City or GLO has ever come out to visit them at home or in their temporary shelter. They all had to advocate for themselves and communicate via telephone and online. They had to find and submit paperwork to multiple agencies, all while from either a damaged home, a hotel, temporary rental, or relative's home.

I spent a year at my daughter's house. You know, my house was here. I had to stay in a hotel for four months. I get kind of confused, between the 20 [2020] and the 21 [2021] 'cause I have done so much. Yeah, so I was at my daughter's for Christmas. I was at my daughter's for New Year. So, the beginning of the year is when they told me they were gonna tear the house down. I was communicating with Glow all this time. So, Glow turned me over to Integrity, I guess fully and completely around February and we communicated from the hotel. So, I was in the hotel until May [2022]. . (Interview with River, Houston, Texas, July 18, 2022)

Moving the program from the City to the GLO caused additional delays in getting an expert to inspect River's home, and the transition of the program was not a smooth process.

When I called down there and I said this is (name redacted) and I have an application. They were saying, yeah, Ms. (name redacted) we sent it over to Glow. I said, okay, then I called Glow—no, the City of Houston hasn't released it. So, by the time I blew up a couple times, they found it, and they started working on it. . (Interview with River, Houston, Texas, July 18, 2022)

Because of the program transition, River's application process was delayed, and the aid to assess damage to her home was not initiated until she pushed repeatedly for someone to find and process her application. River and her daughters are still calling GLO to see if they can qualify for a raised replacement home.

Once the GLO began working on her application in 2021, the process to assess the damage moved more quickly, and River was qualified for a replacement home. She moved back into her replacement home a year and a half later. It is the only home of its kind on her block, a fact River mentions. It is a single-floor home raised six feet above the ground on a visible pier and beam structure with no garage or carport. We do not have a clear picture of how many other homes, if any, the GLO has built in these case study neighborhoods through this Harvey replacement process.

Policy Recommendations

1. Establish a one-stop recovery app that allows residents to upload documentation and see aid updates in real time. This app will be accessed by all the recovery agencies receiving federal recovery funding.

- a. It should have portals for damage assessments that link to the homeowner account.
 - b. It should connect to the Justice40 overlay areas and automatically determine for the homeowner and the agency if they are in a Justice40 overlay.
- 2. Establish a local long-term recovery hub that has sustained funding for local case managers, local vetted contractors, technical expertise, and industry partners. The hub is a physical co-working space operated by multiple entities for addressing residents' unmet needs.
 - a. Seniors and homeowners serve on a long-term recovery neighborhood committee before, after, and during a storm event.
 - b. The hub can serve as a distribution center for immediate, short-, and long-term recovery.
 - c. It should be designed to house multiple local nonprofit agencies and municipal resilience planning personnel.
 - d. Consider locating the hub in parks that need upgrading in the neighborhoods.
 - e. Local recovery centers should be designed to be hurricane ready.
- 3. Ensure that FEMA inspectors are trained to conduct moisture meter readings and indoor air quality readings immediately after the storm to determine damage and need. Technical readings should be part of the damage assessments FEMA and other nonprofit agencies perform, and these should be shared through one data portal.

- a. Indoor air quality with elevated levels of particulate matter may indicate the presence of mold growth, in addition to visual mold growth. Indoor air quality tests should include temperature, humidity, formaldehyde, CO₂, PM 2.5.
 - b. At least one outside air quality reading should be performed for comparison of levels. Data should be used to elevate need levels and better understand what damage occurred and what repairs need to be made.
 - c. Any visual mold growth should automatically qualify the homeowner in the designated area to receive immediate assistance.
 - d. Structural engineers should be sent out to specifically determine flood water damage to foundations.
4. All repair programs to be capped at \$350,000 per home or the equivalent to the market rate for homes in the area.
- a. Include funding for replacement homes that are raised on new foundations, include new central AC/heat and building envelope weatherization. Building standards to meet current FEMA water-resistant construction standards, material grade finishes, and Fortified Roof for Hurricanes construction techniques.
 - b. In replacement home programs, give the homeowner at least two floorplan options to choose from.

- c. Include the right for the homeowner to waive installation of the ADA ramp when the switchbacks become an excessive use of space on the property, given a ramp height of 6 feet or more.
 - i. Although the ramps are not typically considered hardscape in the lot coverage percentage calculation, a ramp that reaches 6 feet in height covers a significant portion of square area on the lot and may present flooding and runoff issues to neighbor yards.
- d. Total replacement or whole house repairs to include updated electrical, mechanical, and plumbing systems. Homes are raised regardless of the floodplain maps.
- e. Replace senior assets with raised homes that can serve as safe places to shelter in place during future storm events.
 - i. Built to hurricane-ready standards.

Theme: Whole Neighborhood Flooding

North Main and 610 floods, Crosstimbers and 45 floods, down by Pastor Preston's is a lake. We have water flowing through at all different points in Independence Heights, right there at Oxford and 43rd, Stokes area (Interview with River, Houston, Texas, July 21, 2022).

Whole neighborhood flooding indicates infrastructure neglect and failure

The areas that River identifies as regularly flooding include the entire neighborhood geographically: the major gateway access points, churches, parks, roads, businesses, gas stations, the City trash switching station, and all of the infrastructure in between. Additionally, River and

Iris talk about being stuck in the neighborhood because of flooding in the streets and at major intersections. This indicates a system failure in the drainage infrastructure that impacts not only private residences but also the right of way, schools, and businesses.

Floodplain maps do not always reflect the urban areas that flood or where the current drainage systems are ineffective. One of the major drainage systems in both neighborhoods includes the bayous and open street ditches in the front yard right of ways (ROWs). When these overflow, the water moves through the streets and into people's homes. Embankments such as the raised railroads and freeways in both neighborhoods trap water in the areas, filling up rather than flowing out.

Total neighborhood flooding outside of the floodplain maps also indicates undiscovered damage throughout the neighborhood infrastructure, including the movement of toxic releases from the bayous, surrounding industrial facilities, and railroad ties covered in creosote.

Whole neighborhood flooding prevents seniors from evacuating and prevents help from entering the neighborhood during storm events. With nowhere to go, seniors must shelter in place, sometimes without power, running water, and access to food or medical care. Neighborhood flooding also ruins vehicles parked outside. Many original homes in the neighborhood do not have garages or paved driveways.

In addition to a need for upgraded drainage infrastructure, neighborhood-wide flooding indicates a major need for comprehensive planning and zoning in these neighborhoods to mitigate rapid urbanization that has gone unchecked by a City lacking equitable environmental, zoning, and development protections and policies for residential neighborhoods.

Public Policy Recommendations

1. Conduct a hydrological study of the water holding and blocking effects at the elevated railroads and the outflow paths for the railroad drainage ditches in Independence Heights (Studewood) and in the Fifth Ward.
 - a. Include soil, surface water, and groundwater quality testing.
 - b. Establish long-term, locally run climate, weather, and ecology monitoring station through the Houston Parks Board to measure flooding, heat, and air, water, and soil quality over time.
 - c. Establish climate station locations at the Parks and along Little White Oak Bayou and Buffalo Bayou.
 - d. Conduct and make publicly available a comprehensive drainage report for each neighborhood.
 - i. Include the flooding impacts of the freeways, urbanization, and open ditches.
 - e. Reduce and restrict townhome development and subdivision of lots, which increase impervious development and reduce the ability of development to maintain stormwater management on site.

Theme: Being Ignored; Resident Requests for Infrastructure Upgrades Are Denied

Every flooding, we're stuck and that's why we are trying to get them to do Little White Oak Bayou, we've been yelling about that for years. We want them to clean it, preserve it, between Airline and Stokes (Interview with River, Houston, Texas, July 21, 2022).

River discussed being trapped in the neighborhood by flooding and feeling scared during Harvey.

"It was pretty scary, it was rattling" (Interview with River, Houston, Texas, July 21, 2022).

As a resident and community volunteer, River has participated in several City planning events throughout the years. Secondary data support her feeling that the community has been yelling for Little White Oak Bayou and the whole neighborhood drainage infrastructure to be assessed and fixed. There have been several major planning reports throughout the years with recommendations for neighborhood improvements and requests for improved flooding mitigation that have never been implemented. Currently, the City is conducting yet another Resiliency Plan funded through Harvey CBDG funding. These types of plans require the City to count the residents of the neighborhood in need. The City has a history of receiving funding which they distribute to investors and consultants rather than homeowners in need or improved infrastructure.

River and her neighbors have also been very vocal in opposition to an I-45 Freeway expansion proposal by the Texas Department of Transportation (TxDOT) that the neighborhood believes will worsen flooding. Based on questions of equity, the Federal Highway Administration has recently paused a project that is estimated to cost between \$9 and \$117 billion over its lifetime, despite the Texas Governor announcing his adoption of the plan (ABC News, 2022). To expand the freeway, TxDOT is proposing to fill in the last remaining non-culverted, natural portion of Little White Oak Bayou in Independence Heights, expanding the freeway that is already sitting intrusively on top of Little White Oak Bayou's waterway and has already been encroaching on the neighborhood way of life and green infrastructure.

If they fill it in the way that they propose they want to fill it in, then we become the retention pond. If they do a little mitigation and do it properly it might be a blessing, but they didn't do it properly when they built it the first time (Interview with River, Houston, Texas, July 21, 2022).

Secondary data corroborated that many of the long-term, major planning decisions that impact flooding, affordability of housing, access to nature and other environmental justice factors in the case study neighborhoods were not made in the best interest of low-income, historically segregated African American seniors who are aging in place. More research on the impact of these planning decisions over time is summarized in the discussion and conclusion section.

Despite their participation and sharing of local ecological knowledge, seniors have not received the infrastructure improvements they have been asking for, including the need for a community center or place to receive aid or relief during a storm event.

We have the Heights Park - but to say that someone has actually put something here in Independence Heights to service our needs, they have not done that, they haven't (Interview with River, Houston, Texas, July 21, 2022).

The historically designated Heights Park itself has not been updated and remains in a state of rust, mold, limited access, and disrepair. Tokenism occurs when residents are counted by agencies so that the agency can receive federal recovery funding to improve infrastructure and repair homes, which is then diverted to other neighborhood projects. Seniors' requests have historically been ignored, and the neighborhood has been denied infrastructure upgrades. The research participants in Independence Heights have expressed wanting to improve Little White Oak Bayou not only to improve flooding but also to restore the natural asset back to the neighborhood and improve the quality of life.

My brothers and them used to crawfish down there, my mom and them used to fish down there, when I was a girl. The crawfish were good. All the way down there past Bella Vista, all the way down at the Bayou right there. We used to call it the "big ditch" so we used to

go to the “big ditch” and crawfish. It flowed into Little White Oak Bayou when I was little (Interview with River, Houston, Texas, July 21, 2022).

In the Fifth Ward, Iris’s daughter recalls several major planning decisions that were made over time that impact her home, health, and pedestrian access in her neighborhood and around her home. Looking out on Buffalo Bayou, which runs along the southern border of Fifth Ward, from the local school yard where she works Iris’s daughter has watched new development surround the school. Iris’s daughter describes the new private market-rate townhome developments built on a former Superfund site. A site with a history of toxic industrial uses allowed along Buffalo Bayou. This area is mapped in the discussion and conclusion section as Displacement Hotspot Four (DH4). Historically, before it was industrial, the area consisted of neighborhood homes. The industrial area along Buffalo Bayou was always included in the Fifth Ward boundary but was excluded from the redlining that occurred. Redline maps were created during President Franklin D. Roosevelt’s administration by the Home Owners’ Loan Corporation (Middleton 2020).

Additionally, Fifth Ward has been coined a cancer cluster from the creosote toxin used by the railroad along the tracks that run through the neighborhood, as well as at the railyard. Residents’ complaints of toxic air and water were ignored for years. During storm events, flood waters flowing down from the elevated railroad switching station and at other industrial facilities along Buffalo Bayou move the toxic contamination throughout the neighborhood roads and homes. During development of the railyard, many homes were demolished, and an overpass was built that disrupted pedestrian and vehicular access for Iris, her daughters, and her neighbors.

These developments were done without concern for the best interest of the residents and their health. Impacts of the cancer cluster are currently in litigation. Iris developed cancer during

the COVID-19 pandemic, and her father had passed away from cancer many years before Hurricane Harvey, but she cannot find his death certificate, for which the lawyers have asked when she attends the public community meetings.

Theme: Partial and Low Quality Repairs

Parts of the things that they don't really want to fix. The house part, the structure of it is okay for them to want to fix. But if the lines, to say the electrical stuff or the piping stuff, those things they don't really wanna deal with unless you have insurance (Interview with Iris' Daughter, Houston, Texas, July 18, 2022).

Partial and low quality repairs leave seniors on fixed incomes with damage

Iris and her daughter worked with untrained volunteers, local nonprofit agencies, and FEMA to partially repair their damaged home, but not everything that was damaged was repaired. Because of the incomplete repairs, she has been living with damage ever since the storm and is still trying to qualify for a raised home through the GLO.

I would love for it [the house] to be up higher and if I had to walk up steps, I just have to walk up 'em. I don't want to get flooded (Interview with Iris, Houston, Texas, July 18, 2022).

Iris's slab on grade foundation is visibly sinking in some areas. Calls to various experts for quotes exceed what they can cover on their own. Although she received some home repairs that enabled her to return home, she is still missing central air conditioning, heat, and a dishwasher, and she will not qualify for flood insurance until she repairs her garage door. She uses the gas stove to heat the home in the winter and a ceiling fan to cool her bedroom in the summer.

When the volunteers removed Iris's moldy drywall, they found water damage to the framing, the electrical wiring, and the plumbing. The window air conditioning units were removed because of mold but were never replaced. Iris remembers times during past storms when she was able to make repairs without help.

When we were having some of our little floods, I was working, and I kept my flood insurance up. Now I ain't working. I ain't able to even keep up no flood insurance. I ain't able to keep up regular insurance let alone flood. I wanted to reinstate, keep it up. You know, you try to help yourself sometimes. You don't expect for people to come and give you handouts all the time. I'm not, that's the difference in me and my thoughts. Now some people want you, every time they say their little toe hurt they want you to take 'em to the doctor or do something. You know I'm not like that. If I was still working and able to work, everything that I've ever had if it increased, I just had to pay it. I'm looking for, not a hand out but a way up (Interview with Iris, Houston, Texas, July 18, 2022).

Iris expresses that she wishes she could still work and take care of the repair bills herself. She describes working post-Harvey for six months at the age of seventy-eight.

I was a crossing guard for six months. I was paying my small business loan, I had a small business loan. I paid and paid and paid. Now, that's another thing, I should have brought that letter with me. They want me to pay \$71 a month and I say, well why do I owe this? One week, they'll write me and say, ignore it but keep the paper. The next couple of weeks, they'll write me and say, you are so many months behind. And that worried me. I said, well hey, you know, instead of helping a person they keep you all upset all the time (Interview with Iris, Houston, Texas, July 18, 2022).

Iris's daughter explains that \$71 is taken out of her mother's social security, but it is hard to get anyone on the phone to better understand what it is for. The small business loan may be a recovery loan from an earlier storm, Ike. It is easy to see how Iris and other seniors can get overwhelmed on a fixed income by having to repay a recovery loan, especially when the repairs were not completed.

River's GLO replacement home in Independence Heights (Studewood) was raised six feet on wood piles. Not high enough to park under, the space below the first floor is exposed dirt without screening. The City of Houston describes the finishes for homeowners in the replacement program as low quality. Some of the design and interior finishes were disappointing to River: she was not given options or choices. She describes being expected to accept a lack of design finishes and the use of cheaper building materials than those used in wealthier, predominantly white neighborhoods.

I need people to know that we are not ungrateful and we are really happy about getting things done for us. We have been marginalized for so long, we have been underserved for so long. If you go over off of Braeswood every house they lifted has got some type of sculpture, some type of decoration, some type of lattice board to fill in up under the bottom ok, but over here we are supposed to be grateful. So therefore, no lattice board, bottom open. We are happy, believe me I am grateful for everything that people have done for me and I'm more grateful to God because he allowed it to happen but now we are at the point where we have to almost struggle and fight. I still have to go through and say things because my (vinyl) floor popped up, it just popped up, because you can't mop it (Interview with River, Houston, TX, July 21, 2022).

River describes calling the builder for repairs when the stairs and the vinyl flooring popped up: “I know it wasn’t my cause that the flooring popped up. So, we have things that are happening and then they get upset with us when we call them and tell them” (Interview with River, Houston, TX, July 21, 2022).

She also has had to get special permission from the General Land Office to enclose the bottom of the home with a screen based on a clause in her contract with GLO that dictates no major work can be done to the structure for three years. The GLO program, she says, pays for 3 years of insurance, and the contractor warranties the home for 3 years. A ramp the width of her home switches back at least four times to provide ADA access to the back door, taking up the space of the entire backyard.

Public Policy Recommendations

1. Homes in the case study neighborhoods that are not elevated should be flagged for immediate replacement and elevation. Elevated homes built pre-1960 with compromised foundations should be replaced and remain raised.
 - a. Homes should be raised high enough to allow for parking and vertical circulation underneath, or low enough to enclose with decorative screens.
2. The City of Houston engineers need to release new, updated details for various soil types found throughout Houston, to include wood pile and concrete pier and beam solutions.
 - a. The old block pier and beam foundations are outdated and structurally compromised by flooding.

- b. The correct foundation detail should be organized by neighborhood for residents and planning staff reference. This includes mapping soil types by neighborhood.
- 3. Replacement homes should include the FEMA recommended water-resistant grade flood construction material finishes and methods. For example; tile flooring and Fortified Roof construction techniques. AC and electrical systems should all be raised.
- 4. Replacement homes should have floor plan and elevation design options for homeowners to choose from.
 - a. Replacement square footage should be comparable with the demolished home.

CHAPTER 6

CONCLUSION

Discussion

In both case study neighborhoods, the seniors interviewed live in hotspots of irreversible displacement, reflecting infrastructural planning decisions that were made without and in spite of their input, which have only exacerbated the climate gentrification of the whole community. In this section, secondary data for the hotspot areas to which the residents have drawn our attention are mapped and discussed.

Emerging Themes

Senior homeowners who were interviewed drew attention to the difficulty they have assessing the full extent of their damage post-hurricane, in communicating with agencies, and in receiving complete recovery. As they returned home they observed more loss in the neighborhood. Those that were interviewed appear to be the last remaining homeowners senior residents of their communities. Through their observations, the true extent of damage from Hurricane Harvey was a broader loss of the neighborhood fabric, with an increase in demolished homes and displaced neighbors. These observations correlate with the secondary data. The true extent of the damage from Hurricane Harvey is climate gentrification, caused by policies that favor investors over African American homeowners and their assets.

Research Limitations

The qualitative data were collected five years after the storm. In this time, the participants' positions through the recovery process changed significantly. The focus and perspective of the

seniors and their needs may have been significantly different toward the beginning of the recovery phase from what they are now.

Another potential limitation to the research is that it relies on the memory of the seniors to recall events and details that occurred within the past five years during a stressful life event. There is some ambiguity in the way the City of Houston reported its program progress, and even greater ambiguity in the way the GLO reports the progress, leaving out the demographics, census tract, and zip codes of those who specifically received replacement or raised homes or were bought out. A list of all City of Houston and GLO Homeowner Assistance hurricane recovery home rebuilds for the case study neighborhoods was requested.

Future Research

Qualitative interviews should be conducted in the immediate period post-storm, six months to one year. Additional health data, mold testing, and air quality testing should be performed immediately after the storm to further this research.

Finally, there is a need to research how many underserved senior assets were actually rebuilt post-Hurricane Harvey, a need to study the replacement assets to see if they are protected during future severe weather (damage limitation), and a need for a closer look at how remaining seniors were able to adapt and maintain personal asset long-term resilience despite so many others being displaced throughout time. A preliminary logistic regression analysis conducted by this researcher found that being over 75 years old with a house built before 1938 increased the likelihood of a loss of homeownership and displacement. Future researchers could conduct a more comprehensive quantitative study of the property loss and replacement housing.

Compounded Vulnerability

The secondary data support the qualitative research data the senior homeowners provided in the case study neighborhoods. This implies that the research method is valid and the data are good. Despite the number of years that have passed since Harvey, the seniors were knowledgeable and able to contribute accurate, highly detailed and useful information. Many demographic reports for income-deprived, underserved neighborhoods correlate income level and educational level, suggesting that educational level is a factor in their intellectual ability to recall and understand facts. Lack of education should only reflect that education has been denied.

Homeowners living in poverty are economically and educationally deprived, but this is not a reflection of their intelligence, their ability to perceive or relay accurate information, the realness of their participation in planning events, or their ability to state their needs clearly. It is this researcher's hope that agencies seeking to improve public programs equitably should respect and listen to residents, including seniors, rather than ignoring and taking advantage of them.

Research Question #4: How can housing recovery be viewed and improved within the context of environmental justice?

Repair impacts made by inequitable planning decisions that compounded vulnerability and displacement in both Neighborhoods

Although some planning decisions are irreversible, the impacts in these study areas can be incrementally repaired. In 1991, delegates to the First National People of Color Environmental Leadership Summit met in Washington D.C., where they drafted and adopted the 17 Principles of Environmental Justice. Principle twelve states,

Environmental Justice affirms the need for urban and rural ecological policies to clean up and rebuild our cities and rural areas in balance with nature, honoring the cultural integrity of all our communities, and provided fair access for all to the full range of resources (1991). See Appendix A for the full list of principles.

Over time, being ignored and having infrastructure upgrades denied resulted in a compounding of storm damage and made recovery for seniors post-Harvey more challenging. New policy recommendations will positively impact these last remaining seniors, their families, future generations, and the overall health of Houston.

The amount of recovery money that the City of Houston allocated for the Homeowner Assistance Program, a program for seniors living under the poverty level, was, in comparison to every other program, the lowest. This suggests that this program was not the top priority and was underfunded.

Table 3 shows the final breakdown of Harvey recovery money after the GLO commented on the original City of Houston draft to increase the Homeowner Assistance Program allocation and eventually took over the housing recovery programs. The GLO also questioned the inclusion of the market-rate Single-Family New Development Program in their review of the Houston draft, which was at one time funded more highly than the Homeowner Assistance Program. The money would have been distributed directly to developers and investors.

Table 3*Final Hurricane Harvey Program Allocations (2022)*

Program Title	Amount	% of total
Administration	\$15,000,000	2%
Buyout	\$55,800,000	8%
Economic Revitalization	\$18,888,904	3%
Homebuyer Assistance Program	\$18,381,000	3%
Homeowner Assistance Program	\$69,188,511	10%
Multifamily	\$400,855,752	58%
Planning	\$23,100,000	3%
Public Services	\$20,000,000	3%
Single Family New Development	\$60,000,000	9%
Small Rental	\$12,943,423	1%
Total	694,157,590	100%

The City of Houston, the GLO, and FEMA have been under scrutiny and in litigation for their inequitable delivery of disaster housing recovery in Houston, Texas. Recent reports reveal significant back and forth between the City and the State over five years for control over the various federal recovery funding allocations.

FEMA’s own National Advisory Council concluded in 2021 “that FEMA was failing to meet its legal obligation to help disaster victims without discrimination on racial or other grounds” (Flavelle, 2021). The Federal Emergency Management Agency published a 52-page report with recommendations to improve equity, oversight, and operations within their own agency, including establishing FEMA as a cabinet-level agency reporting directly to the President (FEMA, 2020).

This conclusion section takes a closer look at the environmental justice issues that emerged during the interviews. The residents' perception of being ignored and being denied infrastructure upgrades and the increased displacement of neighbors can be corroborated in the secondary data. The City could have and still could mitigate flooding for both neighborhoods, however, the City greenlights improvements in other neighborhoods. Looking at planning decisions over time and the planning approach by the City of Houston after the storm, we can begin to see that infrastructure decisions around freeway, bayou and impervious development were made without consideration for the best interests of the residents and without or despite their input, exacerbating environmental injustice during the recovery period.

To get a clearer picture of how long the case study communities in the research have been denied infrastructure improvements, we have to start at the beginning. By some accounts, Houston was described as a "muddy town" from 1800 to 1920, built on a system of bayous (U.S. Department of National Park Services, 1997).

Independence Heights

The U.S. Geological Survey maps (USGS) from 1915 and 1947 show that the roads were not yet paved. Originally laid out on dirt roads and accessed by streetcar on the Studewood line, which came to 30th Street, the area of Independence Heights is sometimes referred to as "Studewood" by residents (U.S. Department of National Park Services, 1997). The entry point to the neighborhood was 30th Street, and the residents would walk from the streetcar drop off to their homes between 30th and 40th Streets because segregation would not allow the streetcar to circulate through the neighborhood. The original developers incorporated the middleclass suburban neighborhood as a city in 1915 and offered low-interest loans to African Americans, some paying

\$6 down and \$6 a month (1997). The National Registry describes a rapidly growing community where “most of the houses were built by residents of Independence Heights who were contractors, carpenters, brick layers, and electricians” (U.S. Department of National Park Services, 1997). In 1925, the City of Independence Heights received its first “shelled road” and dissolved its city status. The community was annexed into Houston in 1929, in the hopes of receiving basic city services and infrastructure.

Independence Heights is in the White Oak Bayou watershed. When it was developed in 1915, it was surrounded by nature, undeveloped forest to the north and northwest, and the City of Houston and all sloping topography and stream networks flowing to the southeast toward Little White Oak Bayou and Buffalo Bayou.

The 1920 census reported 720 people living in the community, which sat on the north edge of the City of Houston and offered “better living conditions and environment than the typical Ward neighborhoods” (U.S. Department of National Park Services, 1997). Today, census tract “48201530300” (5303) follows the original platt boundary of the City of Independence Heights and has 2,358 residents, including River and her home. Today’s Super Neighborhood of Independence Heights has 14,314 people in 3.4 SQ Miles, four census tracts, and 5,623 housing units.

Census tract 5303, where River lives was mapped in the Climate and Economic Justice40 Screening Tool (Justice40) and was identified as disadvantaged in six (6) categories: Climate Change, Clean Energy and Energy Efficiency, Clean Transit, Legacy Pollution, Health Burdens, and Workforce Development. Justice40 places the neighborhood in the 99th national percentile of expected building loss resulting from natural hazards. Although the economic loss rate negatively

impacts the neighborhood seniors, property values have increased. Additionally, the Justice40 Screening Tool places the neighborhood in the 95th percentile of low income, less than or equal to twice the federal poverty limit. Additionally, this tract is in the 95th national percentile of exposure to diesel exhaust in the air, the 96th in traffic count of vehicles at major roads within .31 miles, and the 93rd in proximity to proposed or listed superfund sites. Health outcomes include asthma (89th percentile), diabetes (99th), and heart disease (96th).

Fifth Ward

The Fifth Ward census tract, where Iris lives, was also mapped in the Justice40 screening tool and is disadvantaged in seven categories: in the 94th percentile for building loss rate in the climate change category, the 95th for equal to or greater than twice the federal poverty rate, the 91st with an energy cost burden, the 91st for exposure to PM 2.5 in the air, the 95th for exposure to diesel exhaust, traffic proximity and volume (due to the development of I-10 through the southern half of the neighborhood and I-69 to the western edge), the 99th for proximity to National Priorities List “superfund” sites, the 93rd for proximity to Risk Management Plan sites (under the legacy pollution category), the 93rd for cost burdened by spending more than 30% of their income on housing needs, the 94th for unemployment, the 99th for diabetes, the 94th for being 18 years or older and diagnosed with heart disease, and the 97th for low life expectancy.

The 1922 USGS map of the Fifth Ward area where Iris lives shows us that it was once an undeveloped, roadless green space with homes scattered throughout. The railroad yard at that time had oil storage tanks and would eventually expand, demolishing an estimated 493 homes in the Fifth Ward neighborhood (Figure 6). The Harris County Appraisal District Interactive Mapping Tool reveals some of the lots that were acquired by the Southern Pacific Railroad Company

throughout time, like a palimpsest map. What if anything they paid to displace these blocks of homes is unknown but the impact of their development made Iris's daughter feel ignored and invisible. The main railroad line near Iris's home stretches through Fifth Ward at an east-west angle for 2.25 miles, dividing the neighborhood. The switching station grew to become an 88-acre facility that further divided, disrupted, and contaminated the neighborhood pattern as it grew.

According to the current Fifth Ward cancer cluster maps, the area where Ms. Iris lives was recently identified for high rates of liver, and lung/ bronchus cancer (see Appendix D). Ingram Gully, a stream we see in earlier USGS maps draining into Buffalo Bayou from the epicenter of Fifth Ward, disappears over time, potentially another planning decision that impacts flooding.

Denial of Infrastructure Improvements

Independence Heights

Little White Oak Bayou stops showing up in maps as an obvious greenspace in the 1967 USGS map. This ecological drainage feature was, according to residents, forgotten, diverted, and thrown under the I-45 Freeway despite the community's efforts and continued requests to preserve it. In 2010, 7 years before Hurricane Harvey, the Independence Heights super neighborhood participated with the City of Houston and Local Initiatives Support Corporation (LISC) as a Great Opportunities (GO) Neighborhood. Community residents met and developed a Quality of Life Agreement in which failing infrastructure and flooding issues were identified as a high priority to "Improve and expand flooding and drainage infrastructure" and "open ditches that are not draining properly" (LISC 2010).

Two major freeways impose upon the Independence Heights neighborhood at the south and east boundaries. The planning decision to build the 610 Freeway loop (610 Loop) and cut

through the bottom of the neighborhood, resulted in demolished historic homes and the loss of a designated drainage “ditch” just north of the Adath Emeth Cemetery (USGS 1915, 1947). The 610 Loop placement further demarcates and draws a substantial concrete urban edge along the southern part of the community where the Studewood street car would stop and recent flooding has been recorded. The 610 Loop and I-45 Freeway intersect in the southeast corner of Independence Heights, interrupting Little White Oak Bayou from its downflow. The planning decision to divert Little White Oak Bayou into an underground culvert in this location is one reason neighbors believe the flooding is exacerbated. The Google Maps boundary line for Independence Heights includes this freeway intersection with the underground culvert. The I-45 Freeway runs north–south along the floodway of Little White Oak Bayou, treating the natural resource like a freeway easement and right of way with low-rent commercial feeder road development, but the City recovery plans never included commercial buyouts.

A wide variety of health and economic needs were also clearly identified and organized in the planning report, including needs for green space, ecological studies, affordable housing, vacancy and displacement, historic preservation, and the elimination of heavy truck traffic (the community has a waste switching station) (LISC 2010). Additionally, in 2012, the community worked with the Houston-Galveston Area Council and the Greater Northside Management District to develop a Livable Centers Plan. Funded by TxDOT, the vision included updated public park space, bike trails, improved sidewalks and street lighting, strategies for flooding and vacant lots, historic signage and markers, and strategies to improve environmental quality and create walkable mixed-use places (HGAC 2012). These plans have yet to materialize, and yet the City of Houston

is working on yet another Resilience Plan for the neighborhood, funded by Hurricane Harvey CDBG recovery money.

A U.S. Department of Homeland Security FEMA Flood Insurance Study, conducted in 1990 for Harris County, classified Little White Oak Bayou (8.56 miles of stream) as a “noticeable tributary” of White Oak Bayou and gave it the name “E101-00-00 Little White Oak Bayou.” Does Little White Oak Bayou naturally drain into White Oak Bayou, or was that an artificial diversion from draining directly into Buffalo Bayou? For this research, an overlay analysis was conducted of GIS shape files of the four neighborhood census tracts, the American Community Survey demographics and the FEMA floodplain maps to determine the number of non-white, seniors, living in poverty in the FEMA Flood Hazard Risk zones along Little White Oak Bayou in Independence Heights. Land area in the 100-year floodplain, 500-year floodplain, and floodway equals 56% of the whole super neighborhood. Within the flood risk zones, 75% of the neighborhood population have established residence. This includes 85% of all neighborhood seniors. Of those seniors, 44% are living below the poverty level.

On its website, the Harris County Flood Control District (Harris County Flood Control District, 2022) does have two Little White Oak Bayou projects listed as currently underway in various stages within the Independence Heights super neighborhood. However, they do not include the park amenities requested by residents in previous planning reports. The projects describe widening and deepening retention in two areas outside (north of) the historic tract (Harris County Flood Control District, 2022). According to Justice40, the wastewater discharge of toxic concentrations found in the stream segment in the northern tract of Independence Heights is in the 59th national percentile and jumps to the 71st national percentile at the southern historic tract in the

neighborhood. Is the increase due to the industrial development found there or the I-45 Freeway? The projects (including residential buyouts) are identified as part of the HCFCD's 2018 Bond Program with \$30 million identified for the Little White Oak Bayou "subwatershed" as part of the Department of Housing and Urban Development (HUD) Community Development Block Grants for Mitigation (CDBG-MIT). However, the HCFCD website states that it is "highly likely" they will not spend the full amount. Table 4 shows the program funding allocations from the HCFCD website. The budgets include residential buyouts, a feasibility study, and retention designs, which were not posted publicly (Harris County Flood Control District, 2022). The largest allocation \$8.2 million is for residential, not commercial, buyouts. Will the City wait until it has bought out the current residents before it turns Little White Oak Bayou into the park they have repeatedly requested? This appears to be what is happening in Fifth Ward along Buffalo Bayou.

Table 4

Little White Oak Bayou HCFCD CDBG-MIT Bond Program Project Budgets (HCFCD 2022).

Project Name	Current Stage	Budget	Funded	Spent
Little White Oak Bayou ROW Acquisition	In closeout	\$ 8.2 M	\$ 8.2 M	\$ 8.2 M
Little White Oak Bayou feasibility study	Feasibility	\$ 1.6 M	\$ 1.6 M	\$ 1.4 M
Riggs Stormwater Detention Basin	Design	\$ 1.6 M	\$ 1.6 M	\$67,972
Yale Stormwater Detention Basin	Design	\$ 5.6 M	\$539,000	\$86,293

Even the nearby Lower White Oak Bayou Channel Restoration project plans to restore that Bayou to a natural state by replacing the aging channel concrete lining. However, no plans were made to replace the aging concrete channel lining in Little White Oak Bayou with the green alternative. A 2019 City of Houston report titled "Hurricane Harvey Recovery: A Progress Report" states, "the integration of 'green' or 'nature-based' flood management systems with 'gray' or

‘engineered’ infrastructure is a key element of the City’s strategy for reducing stormwater flooding risks” (City of Houston, 2019). Additionally, the City’s own report described the neighborhood-wide flooding as “a result of inadequate urban infrastructure: undersized storm sewer systems, poorly maintained roadside ditches and lack of adequate sheet flow paths from neighborhoods to flood control channels” (City of Houston, 2019).

The two existing park spaces in Independence Heights that River recalls growing up in, were gifted by the original developer: McCullough Park (originally Independence Heights Park) and Independence Heights Park (referred to locally as Big Park). Both parks sit along streams that are labeled in the Flood Insurance Study as ditches. The railroad ditch “E101-08-00” runs along the northside of Independence Heights Park, and ditch “E101-10-01” runs along the north side of McCullough Park, both flowing into Little White Oak Bayou (FEMA, 1990). Historically, seniors report flooding at these two (2) parks and in the “big ditch.”

The original platt boundary for Independence Heights includes homes beyond Bella Vista that River mentioned in her oral history, leading to the waterfront area and providing direct waterfront access for the residents through land ownership along the “big ditch,” Little White Oak Bayou, and Bayou Drive. East 36th Street runs along the railroad in two separate sections. The high ground of the railroad creates what residents refer to as the “big ditch” that bypasses the neighborhood in the east/west direction and outflows into Little White Oak Bayou. These high rail embankments pose drainage risks to residents in the area that warrant further hydrological study. This researcher could not find current hydrological studies conducted by the Army Corps of Engineers or HCFCD (as mentioned on their website). Residents mention two other larger drainage ditch segments that have been filled in over time. The USGS 1947 map reveals a main ditch that

was filled in by the construction of the 610 Loop, once facilitating flows of water into Little White Oak Bayou and now filled in to support flows of traffic circling Houston. The drainage ditch at 43rd (E101-10-01) was recently disrupted and filled in during the development of the new high school, during which several blocks of homes were demolished. This ditch has also been modified based on the planning decision to insert an I-45 commuter ramp east of DH1.

In addition to the use of the 610 Loop and I-45 specifically for commuters, Airline Drive is also used to move major vehicular circulation from the ever-sprawling urban areas north of Independence Heights (today, as far north as the Woodlands) into the downtown areas. The I-45 commuter on-ramp crosses Little White Oak Bayou with an entrance off Airline Drive near McCullough Park right over the ditch, E101-10-01. Showing up on the 2009 USGS Map, the commuter on-ramp has never been officially opened.

The community of Independence Heights carries the burden of street-level and freeway commuter traffic flows and vehicular infrastructure for the rest of the City, which negatively impacts this once pedestrian-friendly community recorded on the National Registry for its historically significant planning and development. The park spaces at McCullough Park and Independence Heights Park are severely lacking in updates and amenities. The concrete block building at Independence Heights Park has one main room for activities with no windows, and the open air basketball court is rusted. Again, the community has requested in previous planning reports that this facility be updated, that a facility that can assist seniors and hurricane recovery resources be constructed, or both

Fifth Ward

In contrast, there is a Buffalo Bayou Restoration Plan that moved forward to the Houston City Council and the Commissioners Court for approvals this year. This development is primarily located near the area of Buffalo Bayou that Iris's daughter mentioned is being developed as a private market-rate development area called East River. This area is Displacement Hotspot Four (DH4).

Funded by \$5 million from the HCFCD and \$30 million from the Kinder Foundation, the Kinder funding is believed to be the largest gift ever given to a park project in Houston (Houston Chronicle, 2022). Buffalo Bayou Master Plan is over 200 pages of goals such as, "A place that maintains the Bayou as a public resource, offering its banks and waters as a safe, clean, visible, and accessible amenity for all to enjoy," and the Restoration Plan includes a vegetation management plan that is over 60 pages of ecological details on restoring and maintaining riparian, tributary, forest, wildflower, prairie, and wetland ecologies. HCFCD also has a Restoration Plan for Lower White Oak Bayou Channel that will cost between \$30 million and \$60 million and includes "stormwater detention, dozens of acres of enhanced habitat and stormwater quality features, and additional green space. Expansion of the existing trail system" (Harris County Flood Control District, 2022). Other examples of recent park restoration projects that are moving forward include the wetland restoration project by the Houston Parks Board. All these projects acknowledge the need to restore Houston's ecological infrastructure to increase drainage and healthy park access for residents, but none include the restoration of Little White Oak Bayou. The magnitude of the Bayou infrastructure in Houston is extremely large (16,000 lane miles, 3,000

miles of storm sewers and 3,000 miles of roadside ditches). According to a City report, rebuilding the infrastructure will take decades (City of Houston, 2019).

Each storm is a recurring refrain in the continuum of life in the Bayou City, where floodwaters push and pull on historic homes that were built on prairie marsh soils with older construction methods and technologies. The flowing and standing floodwaters saturate the underside of the floor, weakening the floor structure and assemblies. During Harvey and previous storms, moisture in the floor assembly was slow to dry and generated mold growth.

Displacement Hotspots of Single-family Homeowners

Through the oral histories, four hotspots were identified. There is a general lack of mutual trust between the residents of the case study neighborhoods and the City of Houston that stems from an idea of generational property loss throughout time, lack of new infrastructure, lack of transparency, being ignored, and a City history of not being able to complete affordable housing or hurricane recovery housing programs in a timely manner without litigation. The amount of vacancy in the neighborhood and concerns about the City's role in that vacancy came up repeatedly in the research.

In a 2018 presentation to the City Council titled "Hurricane Harvey Recovery FEMA Public Assistance – Infrastructure Briefing," the City presented three strategies: Home Elevation, Mitigation Reconstruction (demo/rebuild) and Acquisitions (buyout). Mitigation Reconstruction (demo/ rebuild of residential homes) funding received the smallest allocation. The dollar cap amount of \$150,000 for demolition and rebuilding also appears low. The programs were described thus:

Home Elevation - Existing home is lifted to the minimum flood protection elevation and a new foundation is built under the existing home. Mitigation Reconstruction (Demo/Rebuild) - Existing home is demolished and a new compliant home is built on the same lot. Projects are capped at \$150,000. Acquisitions (Buyout) - Existing home is demolished. The lot can only be used for stormwater management and recreational green space. (City of Houston, 2018)

It would be ironic but unsurprising if the City of Houston turns the Hurricane Harvey buyout lots into recreation green space after the residents who have been requesting green space for over ten years have been bought out.

For the purposes of better understanding the extent to which homeowners in Independence Heights and Fifth Ward have been disinvested of their property over time while being denied infrastructure upgrades, the vacant lots mentioned by the seniors were mapped. The housing programs and planning decisions throughout time identified in this research that have an impact on displacement in both neighborhoods are the development of the railroad embankments and switching stations, placement of freeways, disinvestment in drainage ditches and infrastructure, disinvestment in green space, the Houston Hope program, the HCFCD buyout program, and the Hurricane Harvey GLO program. Research on the vacant lots identified in both neighborhoods by River and Iris indicates that many of the lots were at one point in time “Houston Hope” lots owned by the City of Houston. A publicly available data set with a partial list of LARA lots contains 51 properties in Independence Heights and 19 properties in Fifth Ward. Although the stated goal of Mayor White’s 2007 “Houston Hope” program was affordable housing, this research suggests that it might have been a misguided response to undiscovered storm damage over time. The stated goal

of the program was to purchase tax-delinquent properties, demolish the homes, and sell the lots to developers for \$1 to build and resell as affordable housing (\$70,000–\$80,000).

Mayor White was quoted in the local media as having used anti-drug rhetoric to promote the program. “You have these properties that aren't paying taxes to support the schools, and people don't want to move in next door. It's a downward cycle,” White said. “And some of these properties, when you walk in and see needles on the floor, it's not hard to figure on what's going on there” (Goldsmith, 2005).

Mayor White's program had already purchased 971 properties in 2007 with a goal of 1,500 in seven neighborhoods identified by the City as needing “reinvestment” and “stabilization,” including Independence Heights and Fifth Ward. The lots purchased and controlled by the Land Assembly Redevelopment Authority (LARA) have been developed today under a cloud of suspicion. Lots that were not developed were rolled into the current Houston Land Bank program as the Houston Hope program disappeared.

In 2007 the Houston Hope LARA lots on the partial list made up approximately 11% of DH1 in Independence Heights. DH1 is 39% vacant, DH2 is % vacant, and DH3 is % vacant. Investment company ownership is % in DH1, % in DH2, and % in DH3. DH4 is 100% developer owned or recently developed, then sold with property values currently between \$323,000 and \$530,000 and new subdivision names like Ballpark and Eado Park Circle. For example, one townhome in BallPark, currently valued at \$323,668, was developed on or before 2013 with a recorded value of \$221,000.

The data suggests that the City of Houston Recovery program for seniors in the case study neighborhoods is not robust enough to discover the damage or repair and replace assets for senior

homeowners in need. Additionally, planning decisions made over time appear to disinvest the residents of their assets and infrastructure. Investors have been displacing residents, and many of the planning decisions appear to favor investors over residents.

Independence Heights

Displacement Hotspot One (DH1) and Displacement Hotspot Two (DH2) fall within a one mile radius around River's home in Independence Heights, within the boundary of the historic census tract 5303 and the 100-year Flood Hazard Zone. DH1 is described by McCullough Park to the north, Southern Pacific Railroad Company to the south, Cornell Street to the west, and Airline Drive to the east. DH2 includes the Bayou waterfront area along Bayou Drive and Little White Oak Bayou, with the Southern Pacific Railroad Company to the north, Airline Drive to the west, 610 Freeway to the south, and the I-45 Freeway and Little White Oak Bayou to the east.

River identified displacement properties along McCullough Park in DH1. Five of the Houston Hope/ LARA Lot properties developed between 2013 and 2020 are directly adjacent to or along McCullough Park with park front views. According to the tax assessor website for Harris County, when developers were given Houston Hope lots for \$1 in 2013, they were valued at \$16,000. The lot values were without home values until 2017 and 2018. Land values alone increased from \$16,000 to \$48,000 in 2018. Once the new homes were appraised, the land values jumped to \$70,000 in 2019, \$80,000 in 2020, and \$96,000 in 2022. By 2022, the land with new home values ranged from \$303,486 to \$325,285, much higher than the affordable homes promised by the City.

These home prices also exceed, by at least double, the cap on Hurricane Harvey replacement housing set by the City of Houston. The development of these lots is a strange

counterpart to both the eminent flooding and negative health indicators in the area and the justification for removing residents based on to safety concerns through residential buyouts. HCFCD owns several lots across the street from the park that are simply labeled in the assessor's system as "right of way" property. Additionally, the City of Houston owns several lots adjacent to the park.

Fifth Ward

Displacement Hotspot Three (DH3) and Displacement Hotspot Four (4) are in Fifth Ward within approximately a one-and-a-half mile area that includes Iris's home. DH3 is defined by the Southern Pacific Railroad Company to the north, Southern Pacific Railroad Company to the west, Solo Street to the east and I-10 Freeway to the south. DH4 is defined by the I-10 Freeway to the north, Buffalo Bayou and the freeways to the west, Buffalo Bayou and the Southern Pacific Railroad Company to the south, and Hirsch Road to the east. Like Independence Heights, Fifth Ward has had multiple freeways, railroads and industrial uses that cut through the neighborhood and were allowed to expand over time. Fifth Ward residents were also redlined, although the redlining excluded the industrial uses along Buffalo Bayou.

In DH3 in the Fifth Ward, there are over fifty different investment companies listed as owners, including names like ABE125 Capital LLC, 53 5th Ward Investments, South by Northwest Limited Partnership, and Parra Design Group, Ltd. Iris's daughter recalled a conversation she had with a man from Parra Design Group, Ltd. 'Parra' which translates to grapevine. She also recalls seeing Parra signs going up in the front yards of old classmates who had moved or passed away.

The Parra website says that they acquired over 200 lots. Their office along historic Lyons Avenue is valued at over \$1.5 million and is also the office for the Democratic Party of Texas. A *Houston Chronicle* article from 2017, “Homebuilder sees Fifth Ward as the next Heights,” reported that Parra bought over 100 lots in 2012 at the county tax auction. The Houston Hope program was purchasing tax-delinquent properties at the same auction (Goldsmith, 2005). List prices for the Parra Design Group, Ltd., start at \$364,000, which their representative described to Iris’s daughter and is also described on their website as “affordable.” Iris’s daughter wonders what the new townhomes look like inside but doesn’t consider them affordable. The site plan map on their website shows the locations of the homes they displaced in DH3 (see Appendix D).

Rather than assess whether homeowners were struggling to repair homes that had undiscovered storm damage, the Houston Hope program moved to repossess and reterritorialize the case study neighborhoods. Homeowners could have received tax aid and replacement homes; however, it appears the investors saw an opportunity to capitalize and profit from the land and worked collectively to put mechanisms in place to disinvest the current residents. This may be why only a handful of residents have been able to return to the neighborhood after Hurricane Harvey and previous mega-storms.

Public Policy Recommendations

1. Return Houston Hope lots to original homeowners in a family trust.
 - a. If a family member cannot be found, develop affordable housing as promised.
2. Remediate and return Southern Pacific lots to original homeowners in a family trust.

- a. If a family member cannot be found, develop as a regenerative recovery hub and park space.
 - b. Conduct a transportation study of the train line and if possible, discontinue train line through Fifth Ward.
3. In future recovery proposals for the City of Houston, eliminate Homebuyer Assistance, Single-Family New Development, and the Buyout Programs. These programs direct money toward investors and displace residents from their neighborhoods.
 - a. Reduce allocations that assist developers and investors over current homeowners.
4. Increase the Homeowner Assistance Program allocation to meet or exceed the Multifamily Program, to preserve single-family homeownership in income-deprived neighborhoods.
5. No freeway expansion or development projects in Justice40 areas.
 - a. If anything, transportation and flooding studies are needed to reduce the negative impacts of the freeways, including the I-45 Freeway on Independence Heights.
 - b. Alternative solutions to reduce traffic need to be considered.
 - c. Where possible, reduction of the freeways must be considered.
6. Restore Little White Oak Bayou ecologically as green infrastructure so that it can function as part of the greater Houston network of Bayous to drain flooding naturally out of the City toward Galveston Bay.

- a. Include little White Oak Bayou in the beautification plans for other bayous and newly constructed wetland parks in Houston.
 - b. Conduct a study of the plant and wildlife species along Little White Oak Bayou, as well as water quality. Designate the entire length of Little White Oak Bayou as park space to be maintained by the Houston Parks Department.
- 7. City of Houston to establish a planning overlay using the Climate and Economic Justice40 Tool to direct funding into neighborhoods that have experienced compounded distress during a declared disaster or major storm due to environmental injustice over time.
 - a. The Planning Overlay established by the Justice40 Tool must begin to implement residential zoning for communities of historic cultural significance.
 - b. The goal should be to phase out toxic industrial uses along the bayous and within the case study neighborhoods.
 - c. Homeowners in the Justice40 overlay area are automatically pre-qualified for disaster assistance without having to show proof of need. This will lift the burden of proof to discover damage, for the senior homeowners during the disaster recovery period.
 - i. Seniors should be given priority status, as well as seniors with multiple generations living in the home.

- ii. Historic homes over 100 years old should be given priority status for raised replacement housing.
- d. Provide updated streets, sidewalks, street lighting, and drainage in Justice40 overlay areas.
- e. Update green infrastructure and park space.
- f. Provide buyout allocations for toxic industrial and commercial uses along the bayous and within the neighborhood.
- g. Provide environmental remediation for flood prone areas to reduce continued spreading of contamination during future storm events.

APPENDIX

Appendix A. The Principles of Environmental Justice. 1991.

WE, THE PEOPLE OF COLOR, gathered together at this multinational People of Color Environmental Leadership Summit, to begin to build a national and international movement of all peoples of color to fight the destruction and taking of our lands and communities, do hereby re-establish our spiritual interdependence to the sacredness of our Mother Earth; to respect and celebrate each of our cultures, languages and beliefs about the natural world and our roles in healing ourselves; to ensure environmental justice; to promote economic alternatives which would contribute to the development of environmentally safe livelihoods; and, to secure our political, economic and cultural liberation that has been denied for over 500 years of colonization and oppression, resulting in the poisoning of our communities and land and the genocide of our peoples, do affirm and adopt these Principles of Environmental Justice:

The Principles of Environmental Justice (EJ)

- 1) **Environmental Justice** affirms the sacredness of Mother Earth, ecological unity and the interdependence of all species, and the right to be free from ecological destruction.
- 2) **Environmental Justice** demands that public policy be based on mutual respect and justice for all peoples, free from any form of discrimination or bias.
- 3) **Environmental Justice** mandates the right to ethical, balanced and responsible uses of land and renewable resources in the interest of a sustainable planet for humans and other living things.
- 4) **Environmental Justice** calls for universal protection from nuclear testing, extraction, production and disposal of toxic/hazardous wastes and poisons and nuclear testing that threaten the fundamental right to clean air, land, water, and food.
- 5) **Environmental Justice** affirms the fundamental right to political, economic, cultural and environmental self-determination of all peoples.
- 6) **Environmental Justice** demands the cessation of the production of all toxins, hazardous wastes, and radioactive materials, and that all past and current producers be held strictly accountable to the people for detoxification and the containment at the point of production.
- 7) **Environmental Justice** demands the right to participate as equal partners at every level of decision-making, including needs assessment, planning, implementation, enforcement and evaluation.
- 8) **Environmental Justice** affirms the right of all workers to a safe and healthy work environment without being forced to choose between an unsafe livelihood and unemployment. It also affirms the right of those who work at home to be free from environmental hazards.
- 9) **Environmental Justice** protects the right of victims of environmental injustice to receive full compensation and reparations for damages as well as quality health care.
- 10) **Environmental Justice** considers governmental acts of environmental injustice a violation of international law, the Universal Declaration On Human Rights, and the United Nations Convention on Genocide.
- 11) **Environmental Justice** must recognize a special legal and natural relationship of Native Peoples to the U.S. government through treaties, agreements, compacts, and covenants affirming sovereignty and self-determination.
- 12) **Environmental Justice** affirms the need for urban and rural ecological policies to clean up and rebuild our cities and rural areas in balance with nature, honoring the cultural integrity of all our communities, and provided fair access for all to the full range of resources.
- 13) **Environmental Justice** calls for the strict enforcement of principles of informed consent, and a halt to the testing of experimental reproductive and medical procedures and vaccinations on people of color.
- 14) **Environmental Justice** opposes the destructive operations of multi-national corporations.
- 15) **Environmental Justice** opposes military occupation, repression and exploitation of lands, peoples and cultures, and other life forms.
- 16) **Environmental Justice** calls for the education of present and future generations which emphasizes social and environmental issues, based on our experience and an appreciation of our diverse cultural perspectives.
- 17) **Environmental Justice** requires that we, as individuals, make personal and consumer choices to consume as little of Mother Earth's resources and to produce as little waste as possible; and make the conscious decision to challenge and reprioritize our lifestyles to ensure the health of the natural world for present and future generations.

More info on environmental justice and environmental racism can be found online at
www.ejnet.org/ej/

Delegates to the First National People of Color Environmental Leadership Summit held on October 24-27, 1991, in Washington DC, drafted and adopted these 17 principles of Environmental Justice. Since then, the Principles have served as a defining document for the growing grassroots movement for environmental justice.

Appendix B. Displacement Hotspot Figures

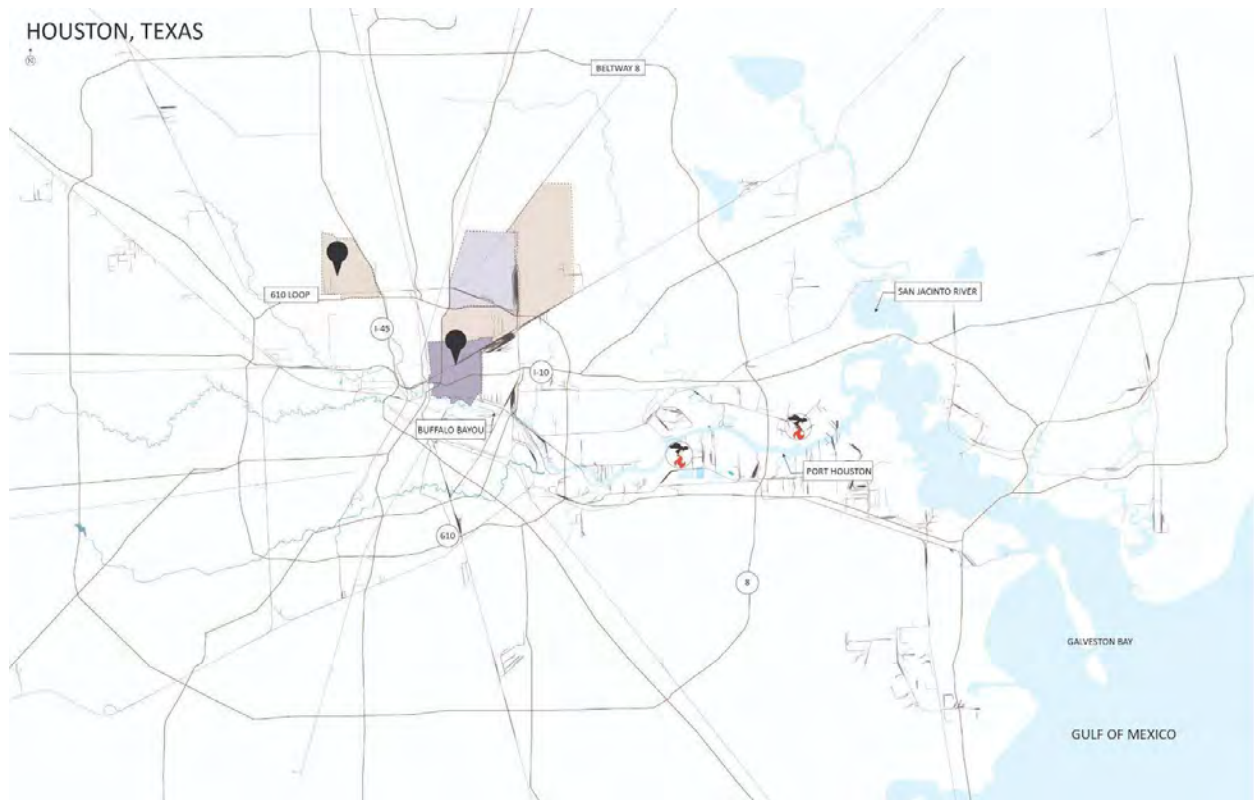


Figure 1. City of Houston with Independence Heights (Studewood) and Fifth Ward Neighborhoods

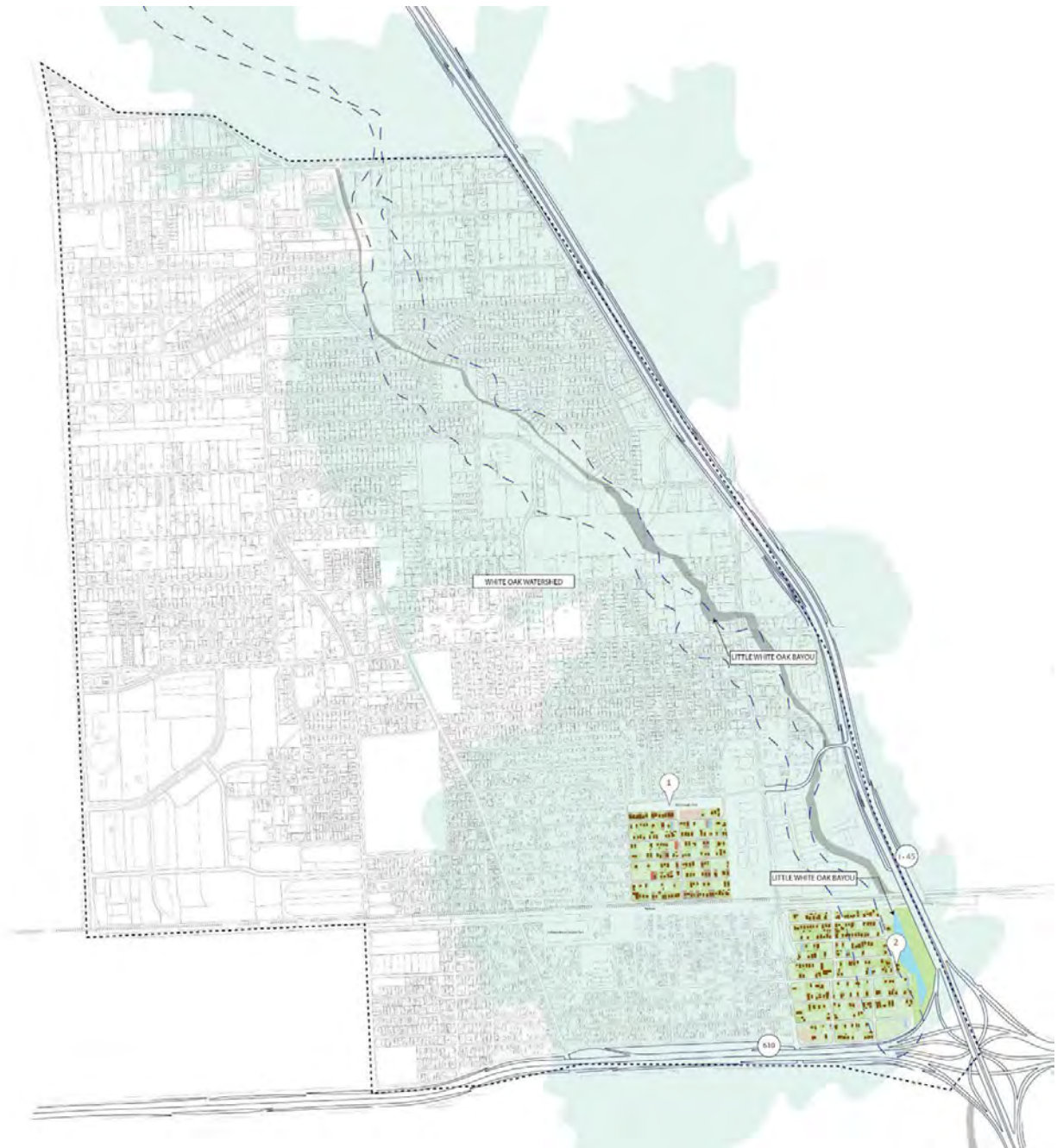


Figure 2. Independence Heights (Studewood) Neighborhood with Floodplain Risk and Displacement Hotspots One and Two. 2022.



Figure 3. Independence Heights Displacement Hotspots One and Two. 2022



Figure 4. Independence Heights (Studewood) Neighborhood with Displacement Hotspot One in the 100 year Floodplain. Blue lots are owned by the Harris County Flood Control District, Red (and pink) Lots are owned by the City of Houston, Brown Lots are currently new market rate townhomes over \$200,000, that were once on the 2017 LARA Lot list, and were historically Houston Hope lots.

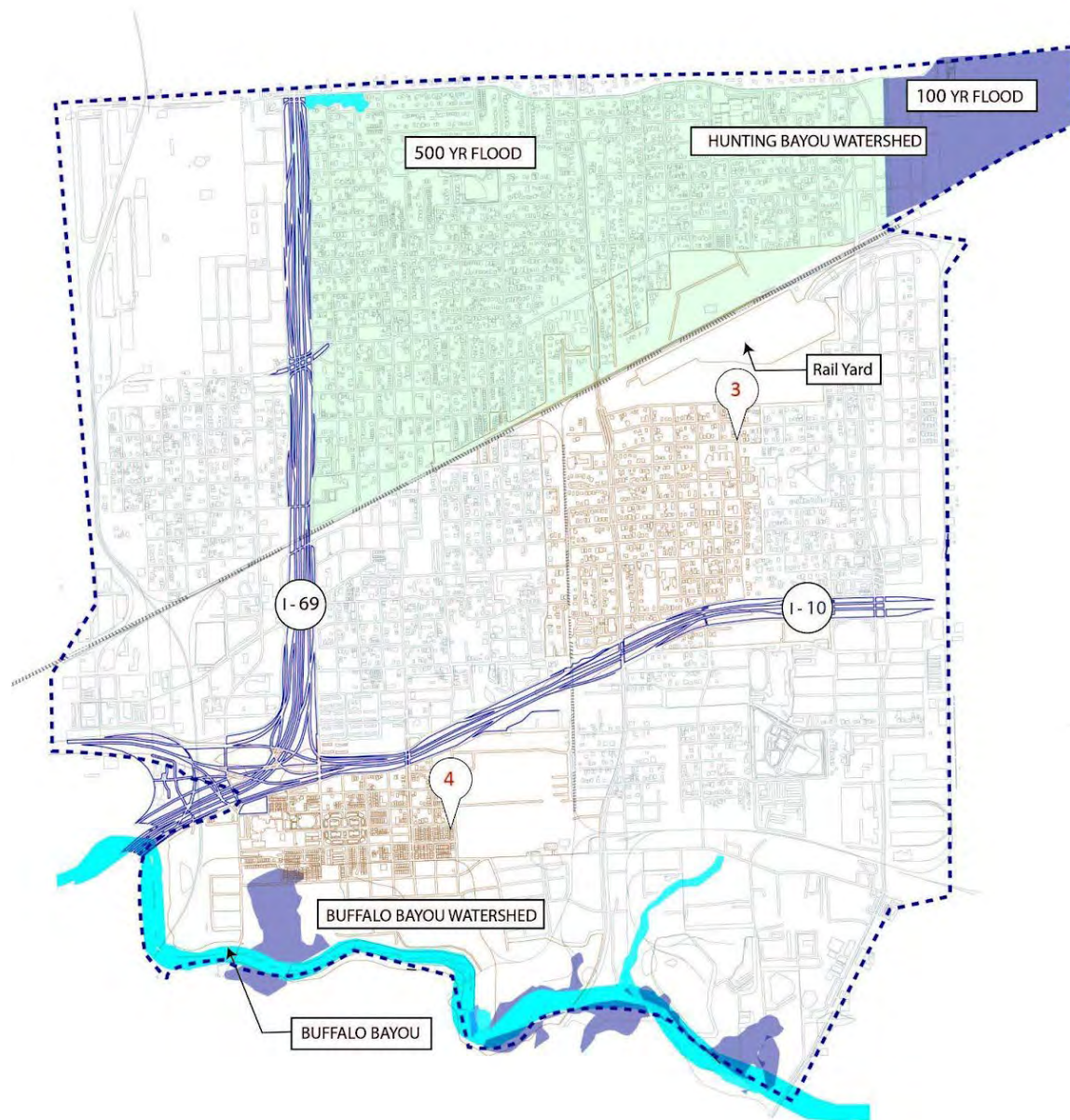


Figure 5. Fifth Ward Neighborhood with Floodplain Risk and Displacement Hotspots Three and Four. 2022.



Figure 6. Harris County Appraisal District palimpsest (dashed outline) of individual single-family home lots and blocks in Fifth Ward currently owned by Southern Pacific Railroad Company. North edge of Displacement Hotspot Three. Recorded online 2022.



Displacement Hotspot One Snapshot, 2018.



Displacement Hotspot One Snapshot, 2022.

Figure 7. Displacement Hotspot One 2018 and 2022.



Displacement Hotspot Two Snapshot. 2018.



Displacement Hotspot Two Snapshot. 2022.

Figure 8. Displacement Hotspot Two 2018 and 2022.



Displacement Hotspot Three Snapshot. 2018.



Displacement Hotspot Three Snapshot. 2022.

Figure 9. Displacement Hotspot Three 2018 and 2022.

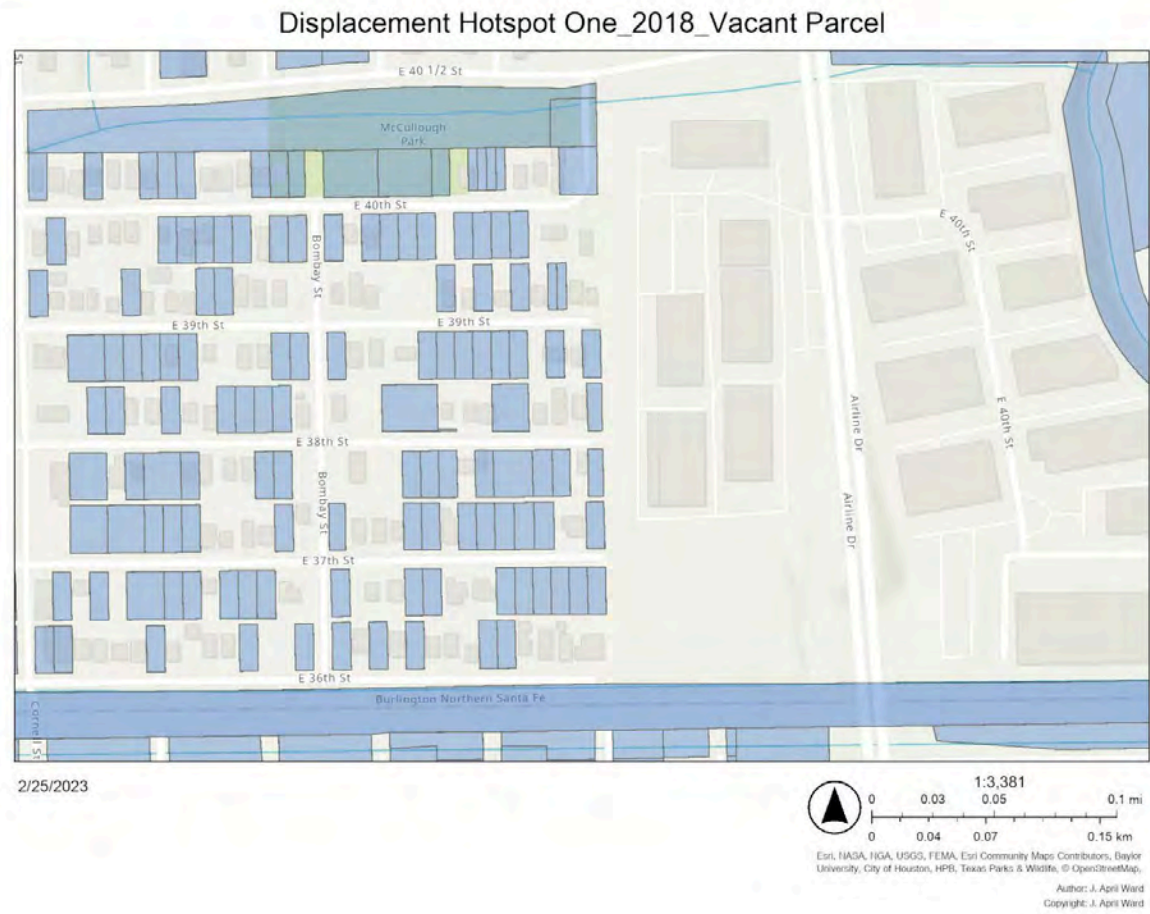


Figure 10. 2018 Vacant Parcels in Displacement Hotspot One.

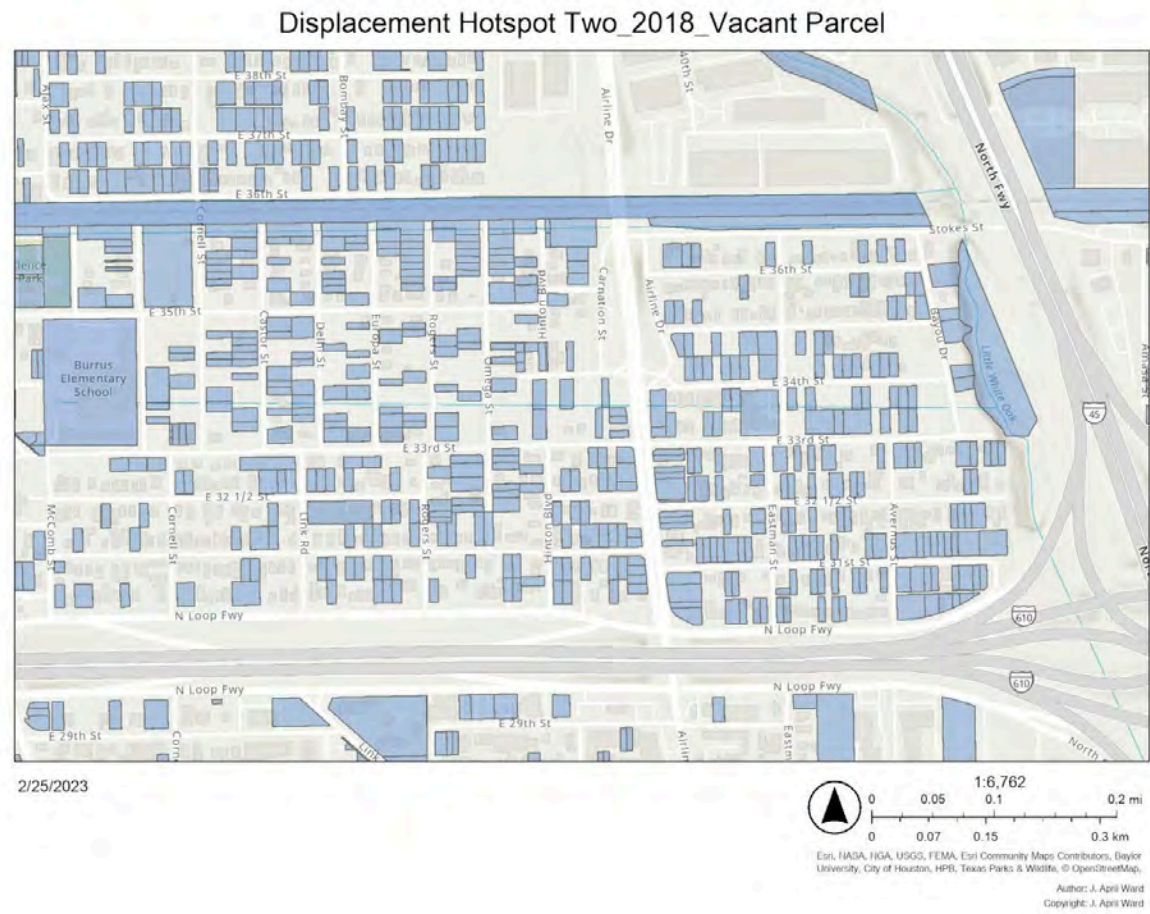


Figure 11. 2018 Vacant Parcels in Displacement Hotspot Two.

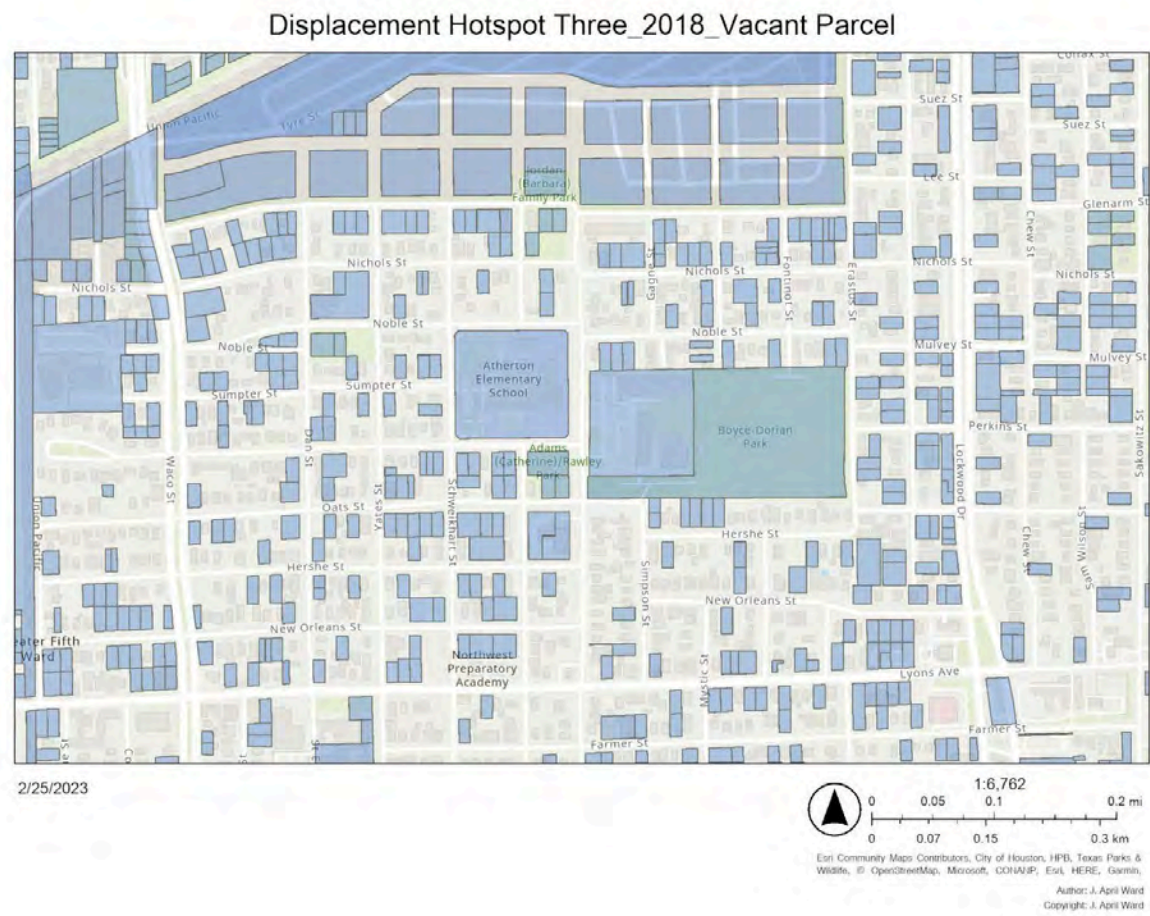


Figure 12. 2018 Vacant Parcels in Displacement Hotspot Three.

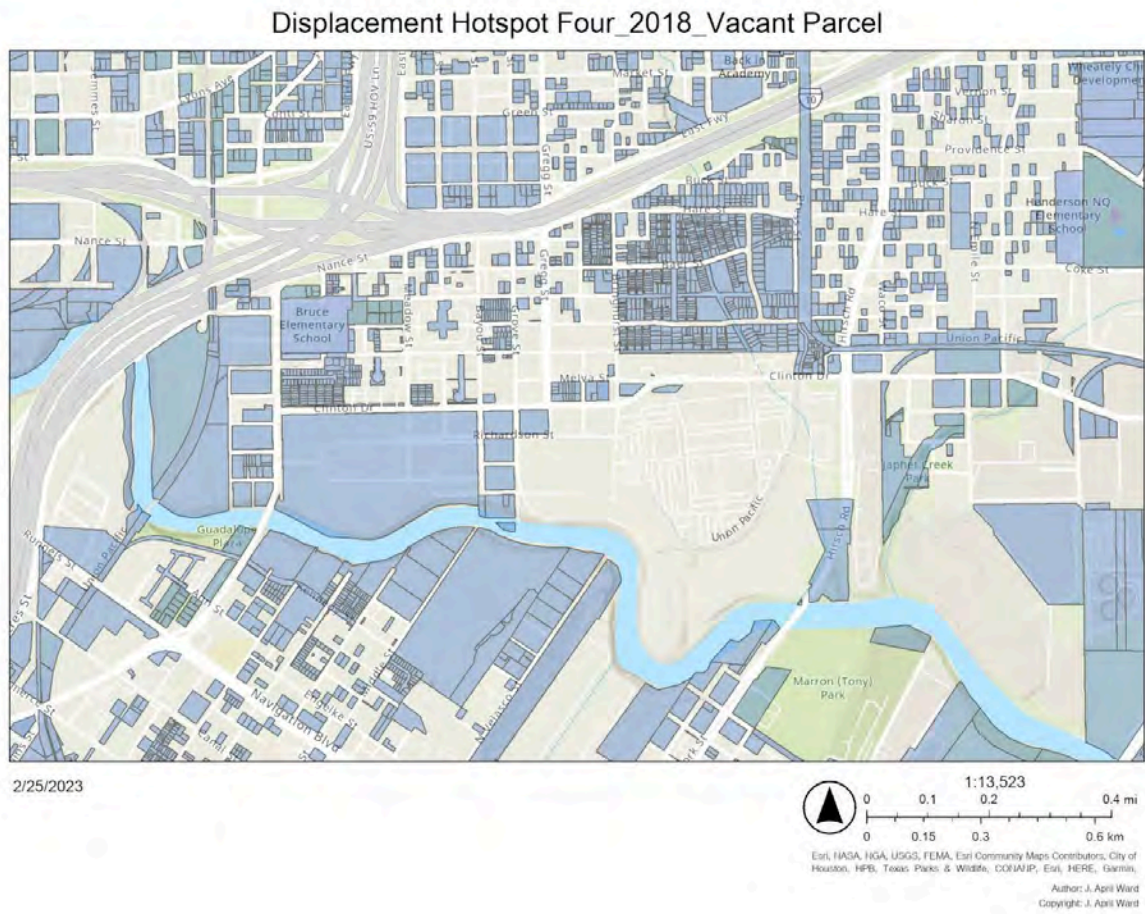


Figure 13. 2018 Vacant Parcels in Displacement Hotspot Four.

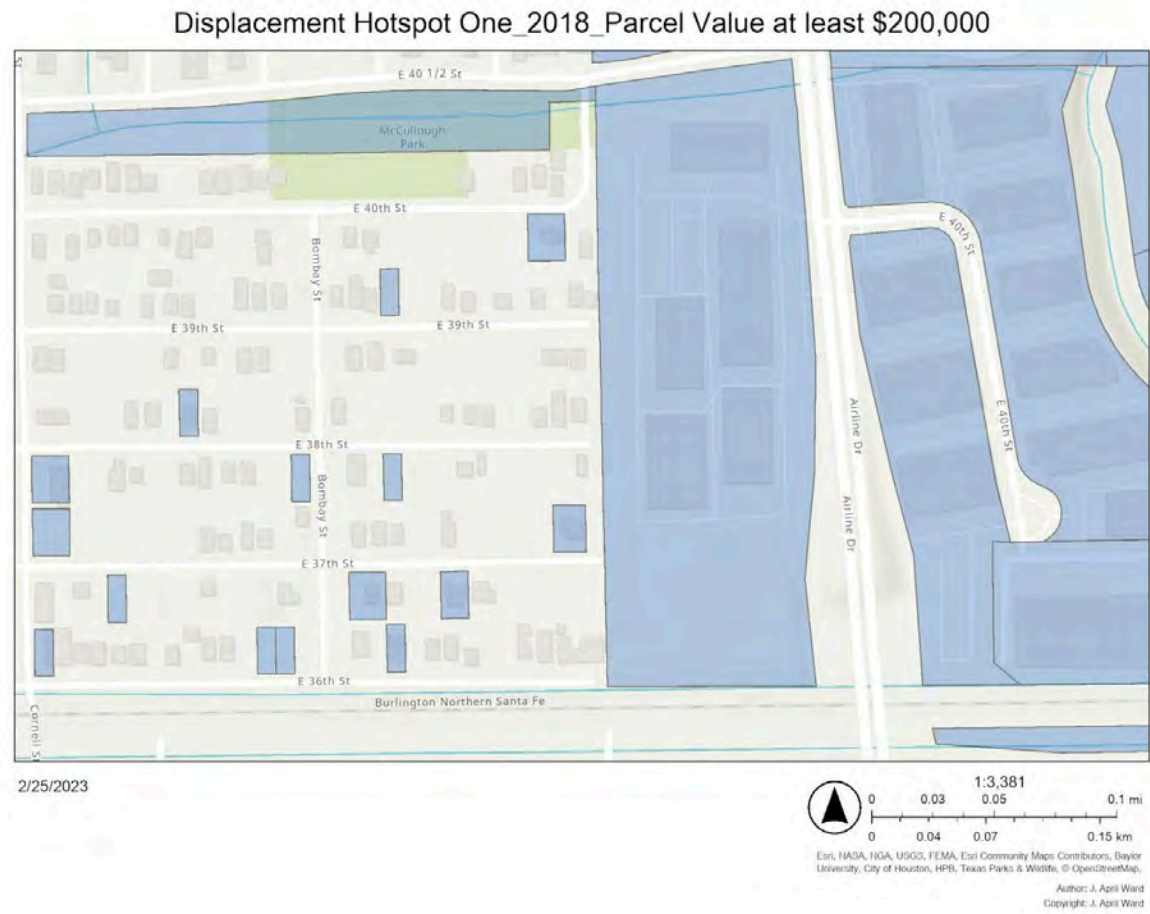


Figure 14. 2018 Parcel Market Value at least \$200,000 in Displacement Hotspot One.

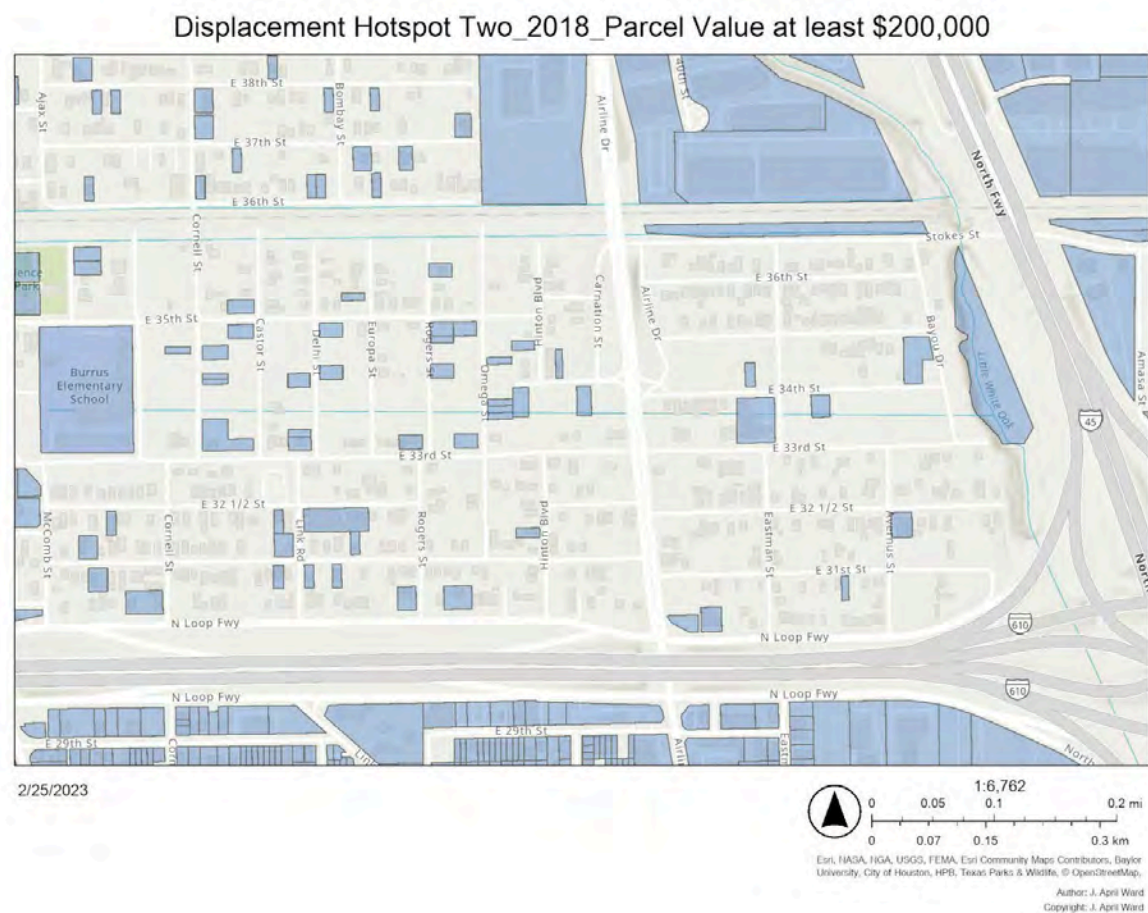


Figure 15. 2018 Parcel Market Value at least \$200,000 in Displacement Hotspot Two.

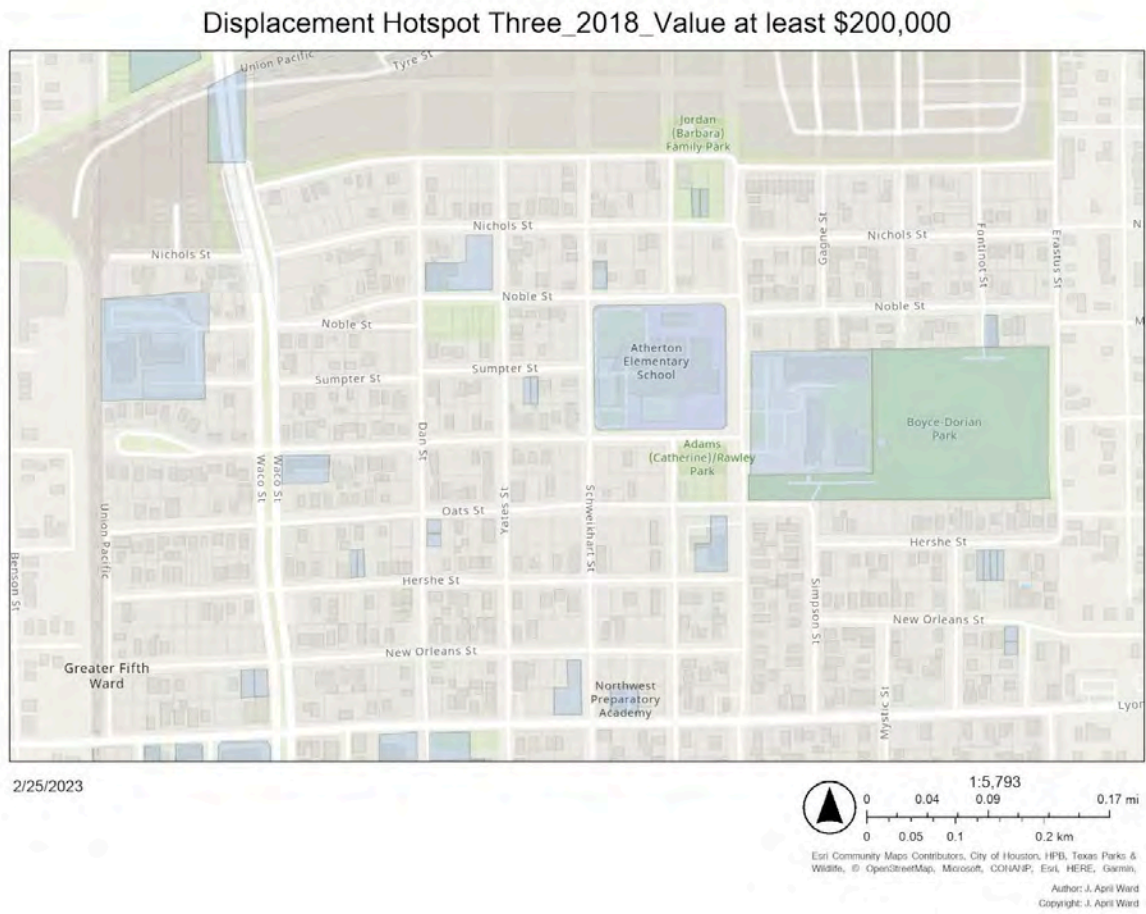


Figure 16. 2018 Parcel Market Value at least \$200,000 in Displacement Hotspot Three.

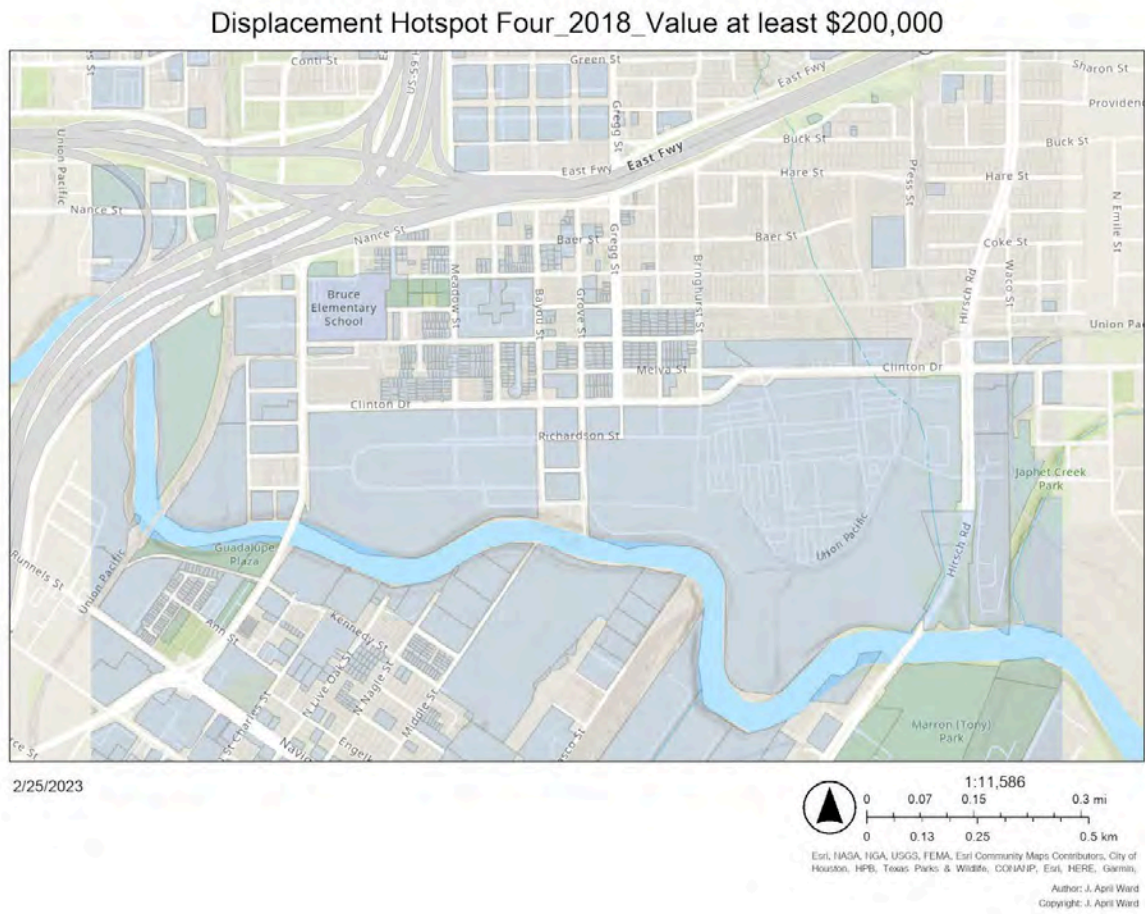


Figure 17. 2018 Parcel Market Value at least \$200,000 in Displacement Hotspot Four.

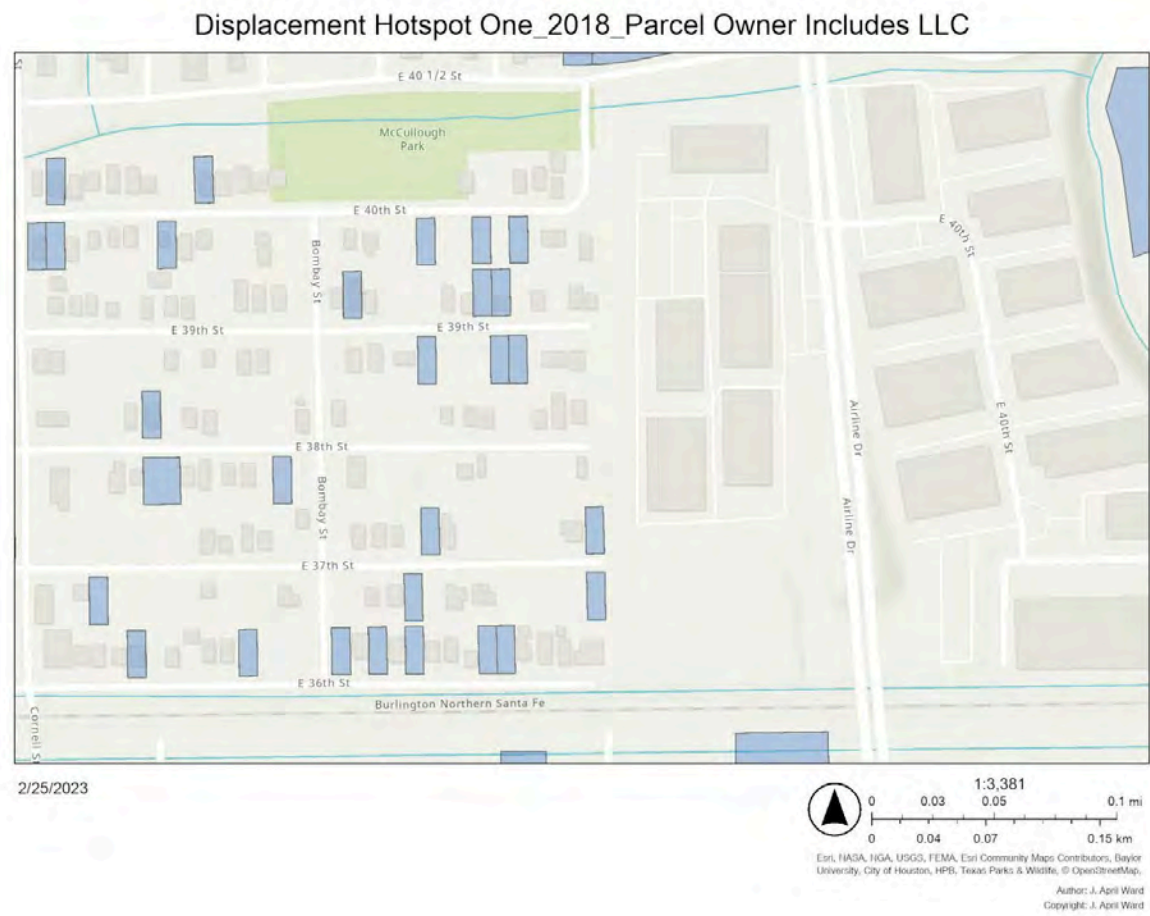


Figure 18. 2018 Parcel Owner is an LLC in Displacement Hotspot One.

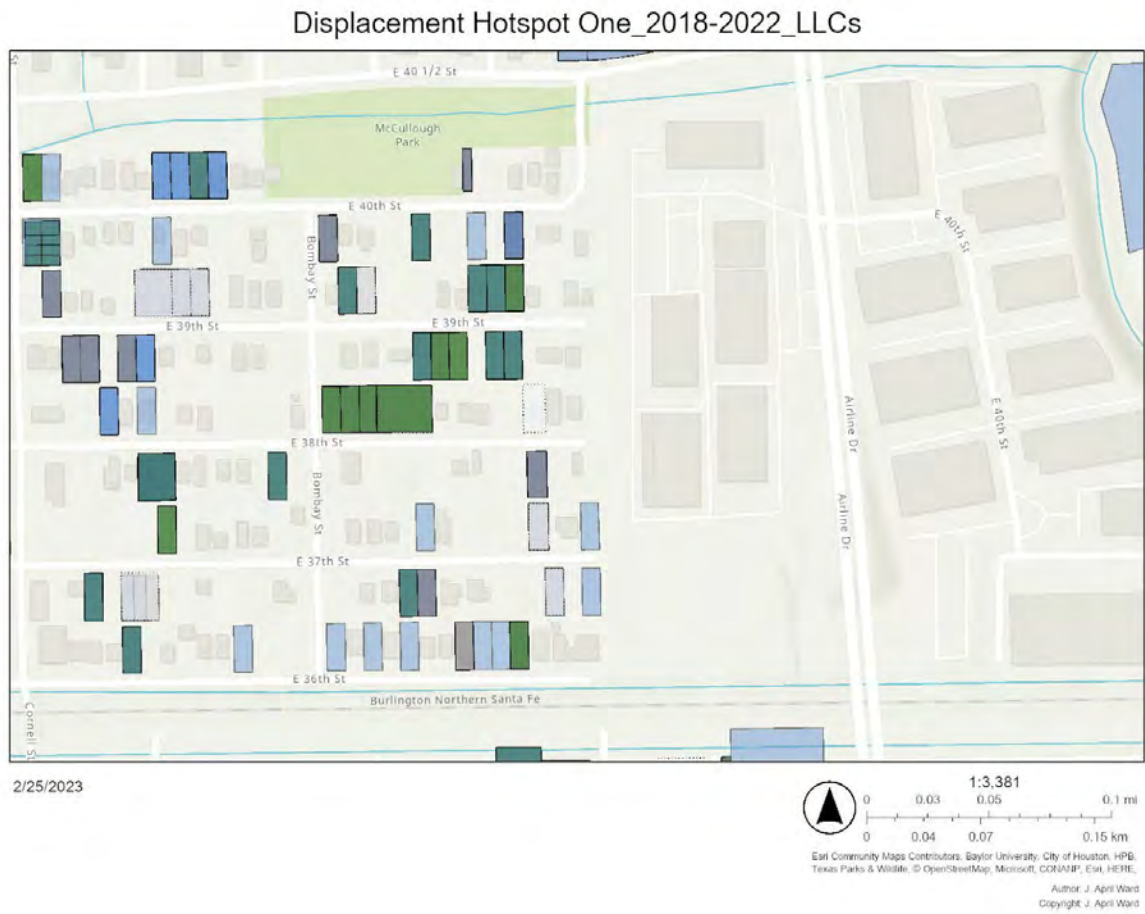


Figure 19. 2018-2022 Parcel Owner is an LLC in Displacement Hotspot One.

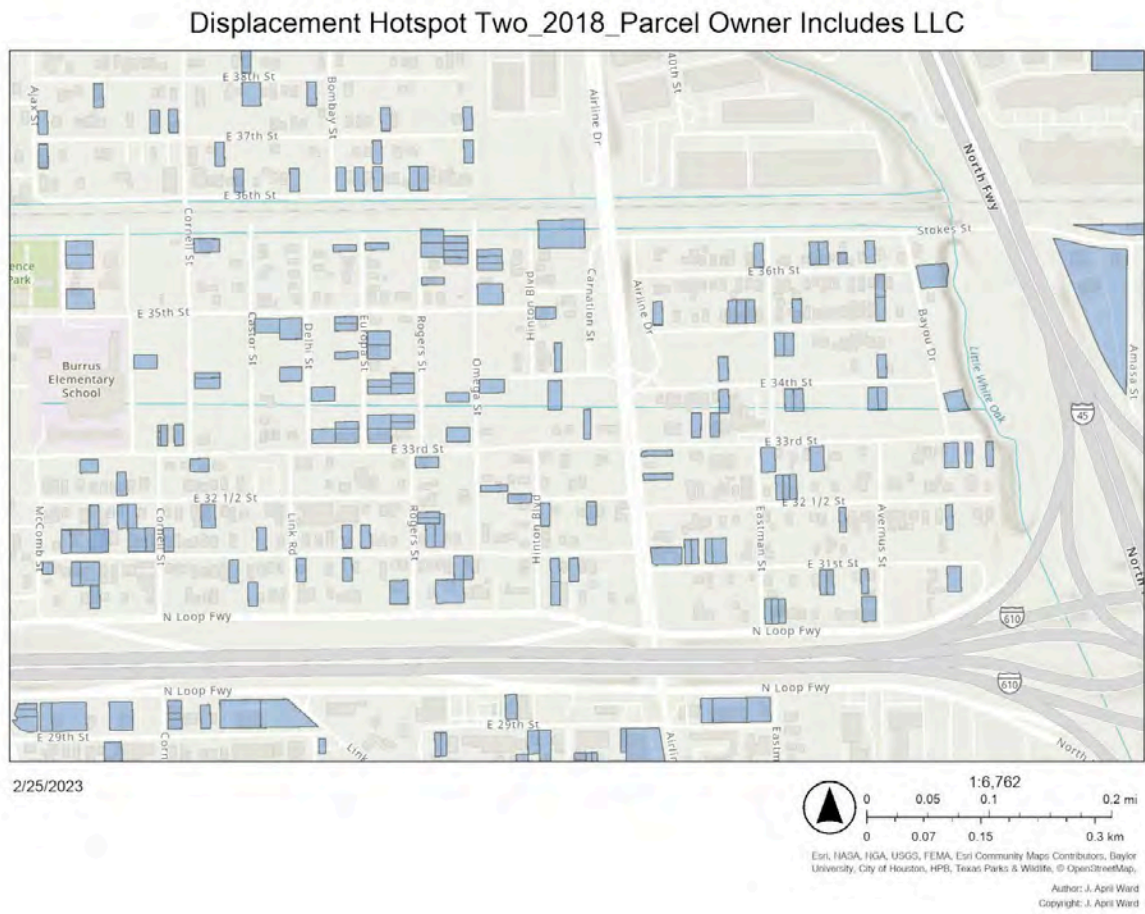


Figure 20. 2018 Parcel Owner is an LLC in Displacement Hotspot Two.

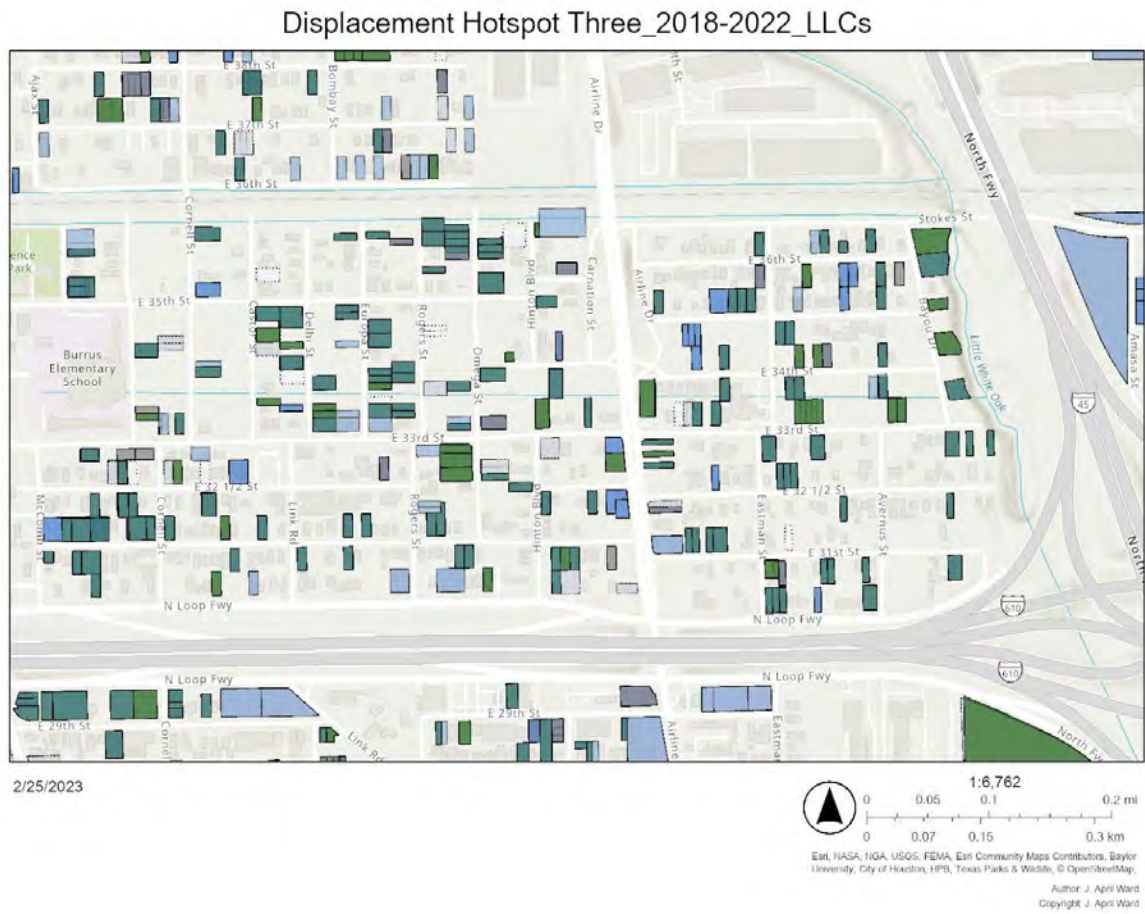


Figure 21. 2018-2022 Parcel Owner is an LLC in Displacement Hotspot Two.

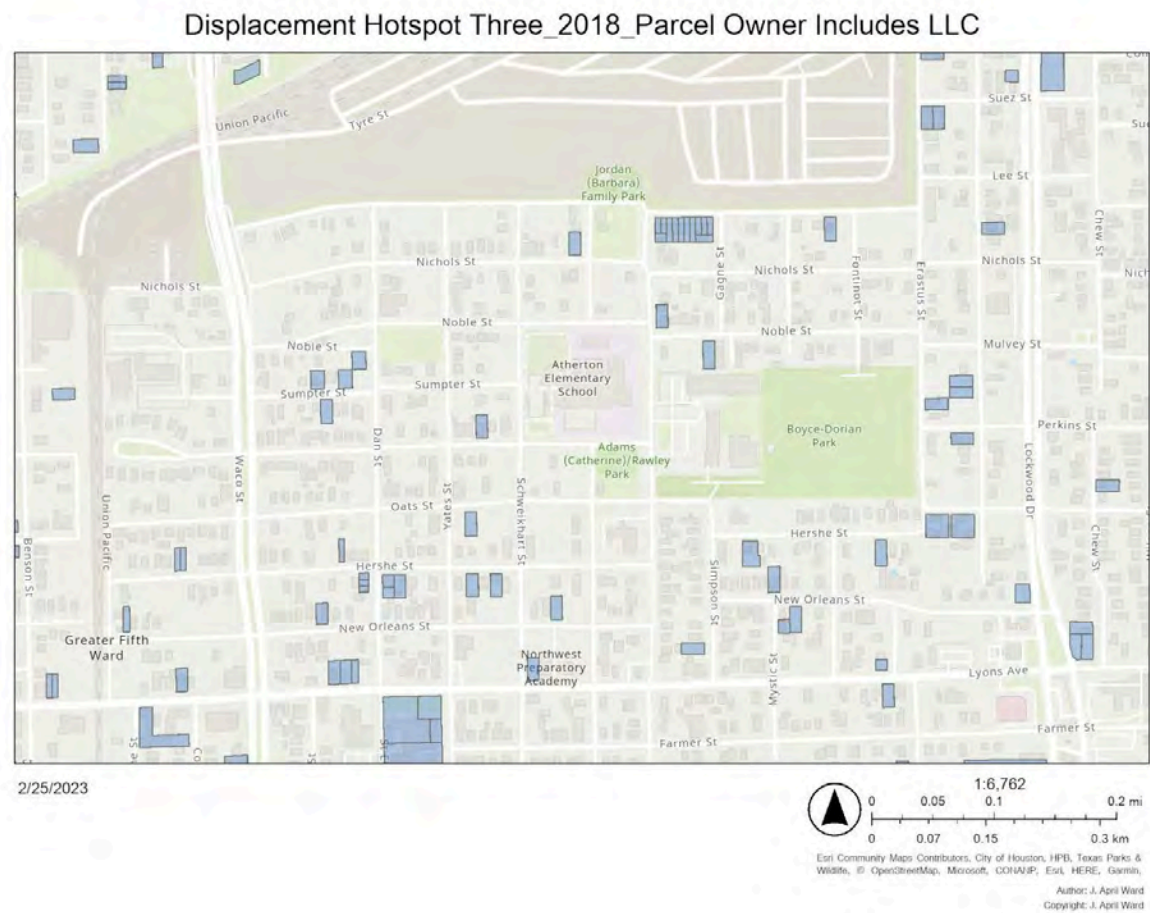


Figure 22. 2018 Parcel Owner is an LLC in Displacement Hotspot Three.

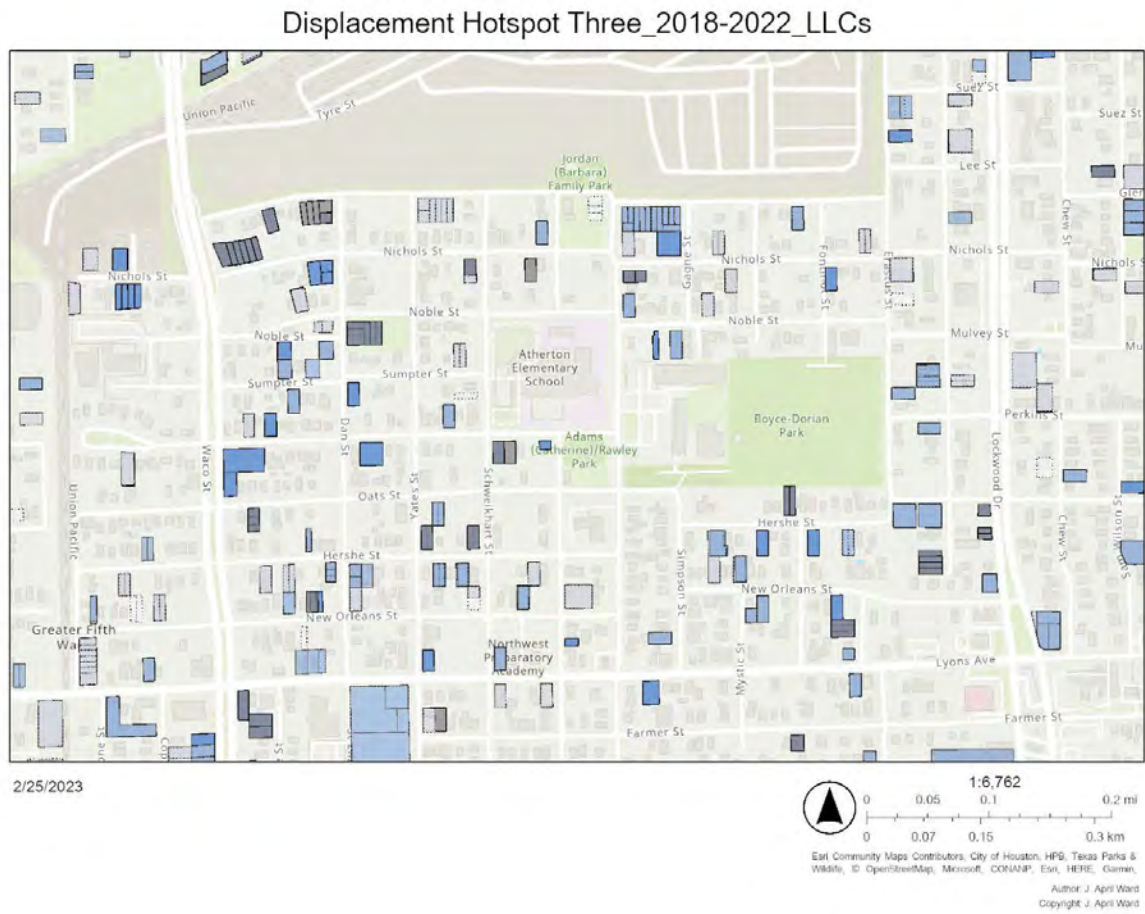


Figure 23. 2018-2022 Parcel Owner is an LLC in Displacement Hotspot Three.

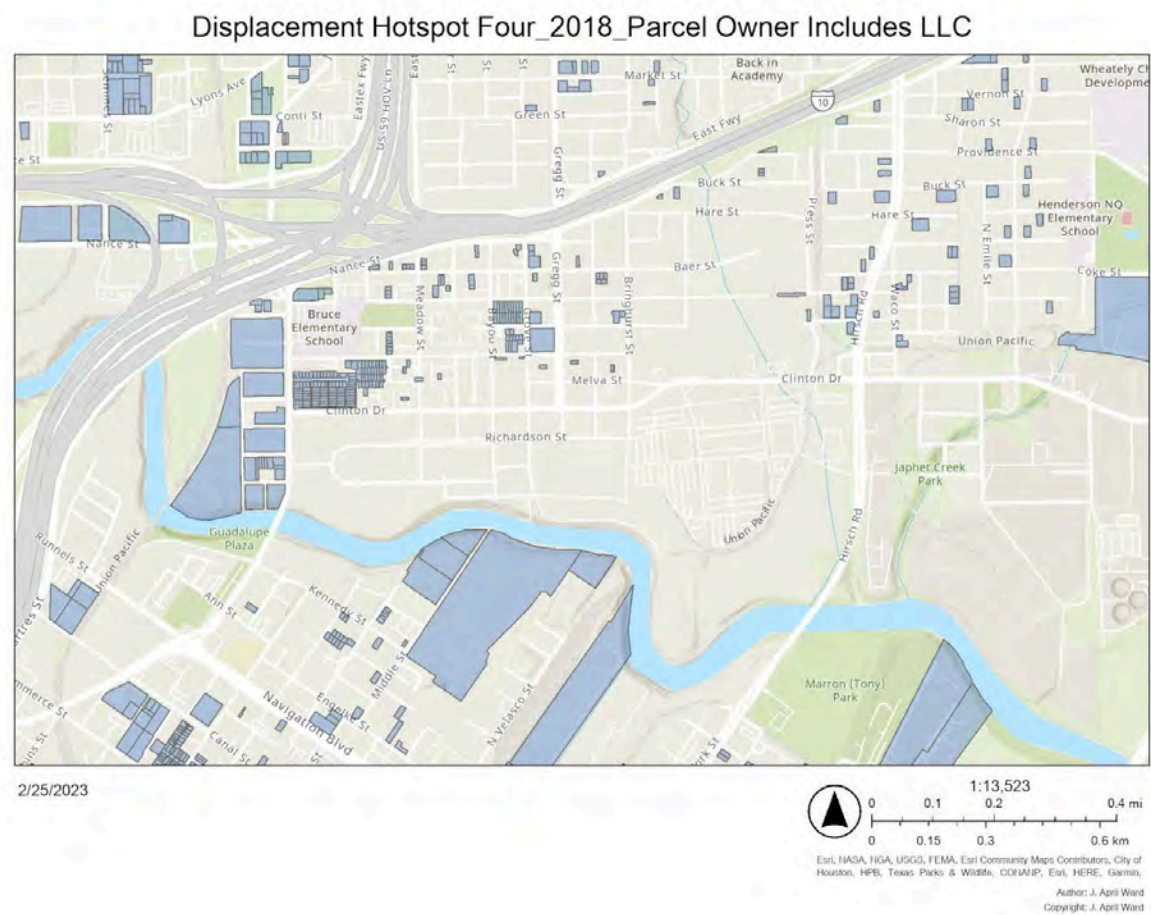


Figure 24. 2018 Parcel Owner is an LLC in Displacement Hotspot Four.

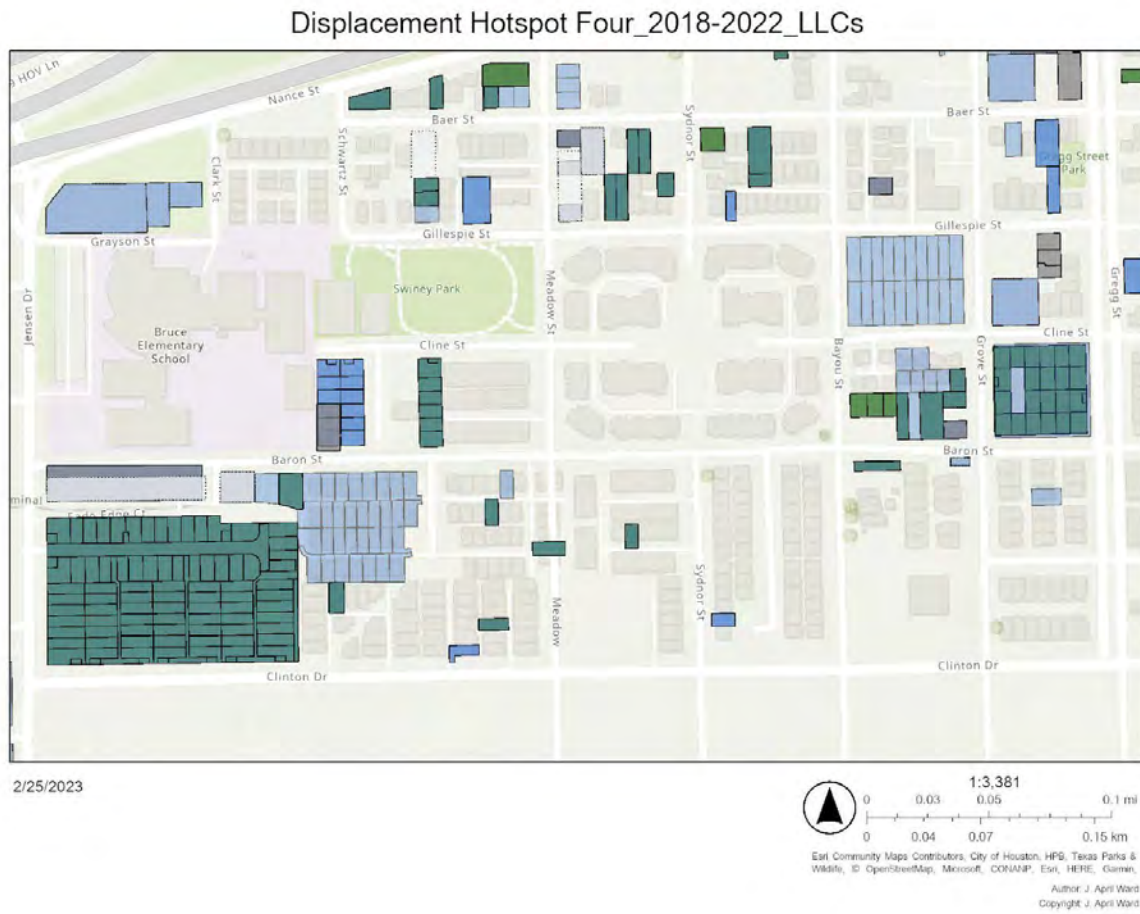


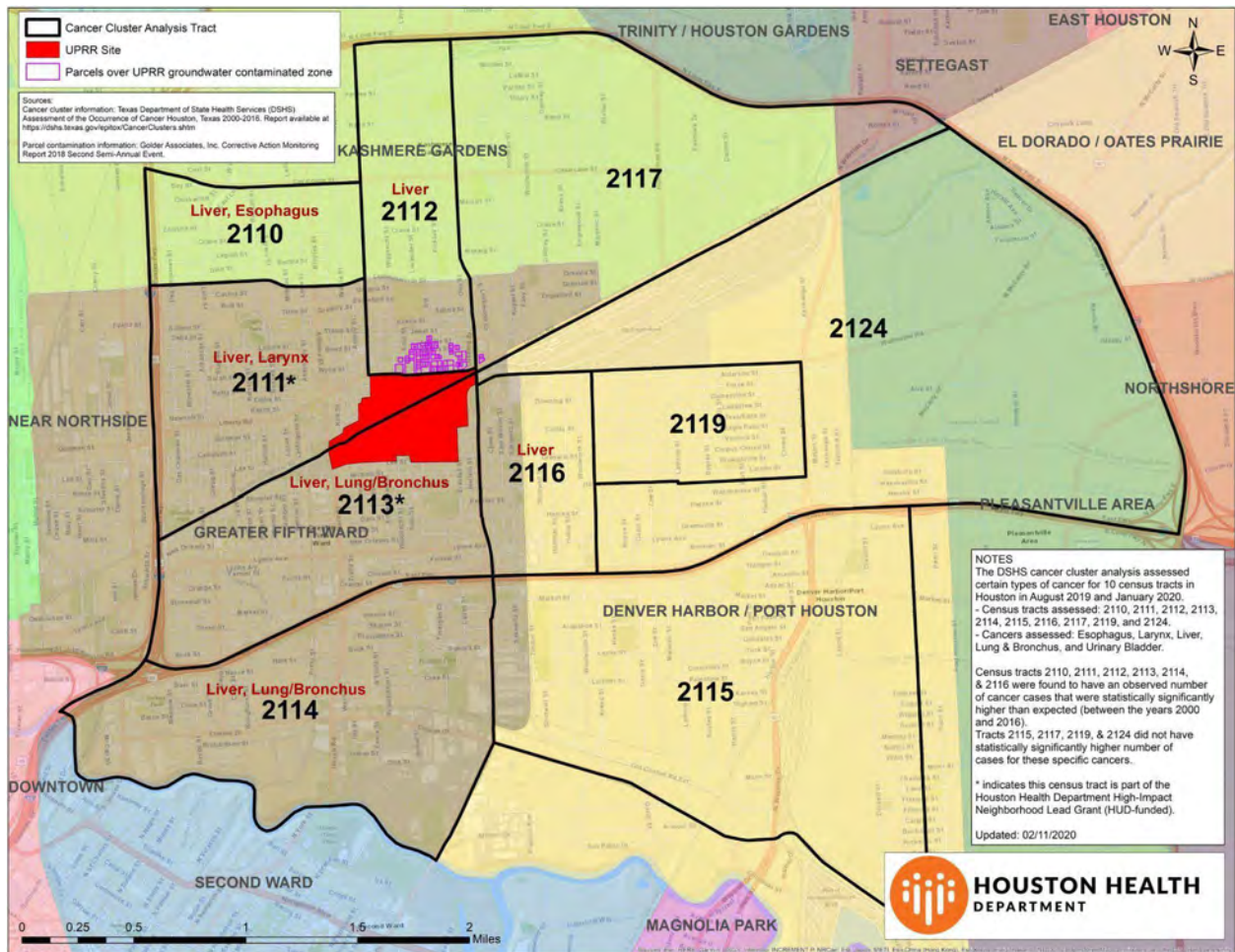
Figure 25. 2018-2022 Parcel Owner is an LLC in Displacement Hotspot Four.

Appendix C. LARA data 2013-2022 from Harris County Appraisal District. Downloaded 2022.

LARA Lot #4: 807 E 40th St										
Year Built (2018) (1,632 SF)										
Tax Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Land Value (4,000 SF)	16,000	0	0	28,000	36,000	48,000	70,000	80,000	80,000	96,000
House Value (\$)	0	0	0	0	0	0	214,560	172,986	187,354	207,486
Total Value (\$)	16,000	16,000	16,000	28,000	32,000	38,880	284,560	252,986	267,354	303,486
Owner	-	-	-	-	JGH Investment Inc.	Chase Patrick	Chase Patrick	Chase Patrick	Joshua Saphier	Joshua Saphier
LARA Lot #7: 815 E 40th St										
Year Built (2017) (1,654 SF)										
Tax Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Land Value (4,000 SF)	16,000	16,000	16,000	28,000	32,000	48,000	70,000	80,000	80,000	96,000
House Value (\$)	0	0	0	0	0	171,000	149,000	139,000	145,000	213,997
Total Value (\$)	16,000	16,000	16,000	28,000	32,000	219,000	219,000	219,000	225,000	309,997
Owner	-	-	-	-	Contemporary Development Corp	Current Owner	Current Owner	Current Owner	Current Owner	Current Owner
LARA Lot #13: 833 E 40th St										
Year Built (2018) (1,654 SF)										
Tax Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Land Value (4,000 SF)	16,000	0	16,000	28,000	36,000	48,000	70,000	80,000	80,000	96,000
House Value (\$)	0	0	0	0	0	0	0	179,812	170,000	216,200
Total Value (\$)	16,000	16,000	16,000	28,000	32,000	48,000	70,000	259,812	250,000	312,200
Owner	-	-	-	-	JGH Investment Inc.					Shawn Manderscheid
LARA Lot #14: 837 E. 40th St										
Year Built (2018) (1,632 SF)										
Tax Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Land Value (4,000 SF)	16,000	0	0	28,000	36,000	48,000	70,000	80,000	80,000	96,000
House Value (\$)	0	0	0	0	0	0	0	132,000	187,354	207,486

Total Value (\$)	16,000	16,000	16,000	28,000	32,000	48,000	70,000	212,000	267,354	303,486
Owner	-	-	-	-	JGH Investment Inc.	Pennamon & Harris	Pennamon & Harris	Pennamon & Harris	Pennamon & Harris	Pennamon & Harris

Appendix D. Houston Health Department Fifth Ward Cancer Cluster Map. Downloaded 2022.



Appendix E. Parra Design Group Fifth Ward Map from their website. Downloaded 2022.

Appendix F. Research Consent and Questions. 2022.

Informal Consent Form - Participation Research Statement

You have been chosen to participate in a research study to examine the impact of Hurricane Harvey on homes and seniors in Houston, Texas. The study investigates the risk to health (health Implications) from a mega-storm such as Harvey with a notion of measuring the displacement from the home and health impacts during the housing recovery period.

The purpose of this research study is to conduct an environmental health assessment and environmental survey about perceived toxic exposure symptoms in order to propose an efficient and sustainable option that will improve the federal, state, and local housing recovery practice. The outcome of this research will foster re-evaluation of the current housing recovery system as well as establish policy recommendations that will aid seniors in their rights to age in place and have a voice in the ecological management of their neighborhoods.

Confidential and Privacy Issues

This is to ensure you that the various data gathered to toward this research study will be well protected. All personal information provided will only be available to the researcher and the advisory committee. Also, all your information such your name, identity, and any other information that directly identifies you will be kept safe during the study, removed after the research is completed and never to be disclosed to any person.

Contact

The Texas Southern University's Committee for the protection of the Human Subjects (CPHS) responsible for protection of rights of human subjects has approved current research and the board can be contacted via the division of academic affairs and research at 713-313-7011 and 713-313-4301 or go to (<http://www.tsu.edu/research>). The researcher can be contacted at 281-777-0633 and the researcher's adviser Dr. Glenn Johnson can be contacted at 713-313-4897.

Voluntary Participation Statement

This is to notify you that your participation in the study is strictly voluntary and you have the right to discontinue your participation at any point in time without any objections. Also, participation in this survey is appreciated and will help in providing sustainable options that will improve the housing recovery practice and protect public health and physical environments in Houston neighborhoods most impacted by environmental injustice. Please print your name and sign:

Participant Name:

Signature:

Date:

Researcher Information

Researcher's Name: Jessica April Ward

College: Texas Southern University

Department: Urban Planning & Environment Policy

Phone: 281-777-0633

Email: j.ward6452@student.tsu.edu

Semi-structured Interview Questions

1. Spell your name.
2. What is your age?
3. Gender
_Male _Female
4. Marital Status
_ Single _ Married _ Divorced _ Widowed _Separated
5. How many years have you lived in and owned your home?
6. Who built the home or purchased it? Do you remember what year that was or how much it cost?
7. Who lives with you? Ages?
8. Does anyone receive in-home health care?
9. Where do you go if you fall sick? Where is the closest Dr. Office/ Hospital? Is there a long wait? How do you get there?
 - a. How often do you go a week/ month?
 - b. How many different types of doctors do you go to?
10. Are you near any toxic facilities or environmental quality areas of concern? How is your water quality? Air quality? Access to the Bayou? The freeway proximity?

11. Do you take daily walks around the neighborhood? Go to the park? Gym? Grocery store?
Use your yard/ garden?
12. Do you drive? Do you have a carport/ garage/ driveway? Do you use it for parking, storage,
or living?
13. Do you smoke? Would you consider your air fresh and clean? Have you ever tested your
indoor or outdoor air quality or water quality?
14. Do you or anyone in your home use a wheelchair? Do you expect you may have to at some
point?
15. What is the name of your neighborhood? Is it quiet or noisy?
16. How well do you know your neighbors?
 - a. How has that changed over time?
 - b. What changes have you noticed in your neighborhood throughout the years?
 - c. What changes would you like to see?
 - d. What is your favorite thing about your neighborhood?
17. Is there a neighborhood association or community center?
18. Do you know where the closest bayou, green space, freeway, and/ or train tracks are in
your neighborhood?
 - a. What is access to and around these areas like?
 - b. How has it changed over time?
 - c. Does it flood?
19. Do you know who started your neighborhood or if it has a historic area?

20. What type of home foundation do you have? Raised or slab on grade?
21. Does your home have central ac/heat? How do you heat/ cool your home?
22. Do you have a shaded place outside where you can sit?
 - a. How often do you use it?
 - b. Front yard or back yard?
23. What room in your home do you spend most of your time in? Does it get bright/ direct daylight?
24. How close is your bathroom to your bedroom? Is it close enough? Private enough?
25. If you could change anything about your home design, what would it be?
26. Where were you and what were you doing when Hurricane Harvey (or Ike) hit Houston?
27. Did you prepare for the hurricane, if so how? Were you told to evacuate or shelter in place?
 - a. Do you know where or how far the evacuation centers are? Could you get there?
28. Describe the damage and or flooding in your home caused by the hurricane.
 - a. Where was water coming inside the home? How high was the water?
29. How is the drainage in your yard and street?
 - a. Are you aware of flooding in your neighborhood?
30. Who did you reach out to for help and when?
31. Have you corresponded with FEMA, Red Cross, or the City of Houston?
 - a. What did they tell you? What was that process like?

- b. How did they assess your damage?
 - c. Did you have homeowners of flood insurance?
32. Would you consider your home habitable or did you need to leave? If so, why?
33. Describe where you stayed while your home was repaired and how long. Who funded that?
Did the funding cover what was needed?
- a. Did you or anyone else in the home get sick?
 - b. For how long? What care did you/ they get?
34. What type of help did you receive to repair your home and when?
- a. Did you have any trouble with contractors or agencies completing the work? If yes, describe.
 - b. Were you given any water-resistant materials or sustainable materials?
 - c. Was your roof repaired/ replaced?
 - d. Was your ac/ heat damaged, removed, or replaced?
 - e. Did you have wood rot? Did you need electrical repair?
 - f. Did you raise your home or become aware that you are in a floodplain?
 - g. Did your home have visible mold? If so, where? Who removed it? When?
 - h. Did the funding cover all repairs?
35. How many different volunteers and agencies did you work with?
36. How long did it take to complete your home repairs? Would you consider all of the repairs complete? If not, what was not repaired and why?
37. How many people will be living with you after the repairs?
38. Was this the first time a storm damaged or flooded your home? If not, describe the previous storms. To what extent was the damage repaired after those storms?

39. After the storm, how long did you live in the home? Were the walls removed/ or partially removed? Was there mold? If yes, did you feel ok? Have headaches or feel sick?
40. Were you able to use the bathroom and kitchen?
41. Did you receive any red tags from the City after the storm? What were they for? Did that start or increase after the storm?
42. Did you receive more offers to sell your home after the storm?
43. How did you keep track of your repairs and aid agencies? Would you use a phone app if there was one?
44. Did anyone from the City, FEMA, or local agencies invite you to participate in a recovery planning session?
45. What would you tell the City or FEMA if you could? Advice you would give to help improve the process of recovery after the storm?
 - a. What areas of daily life were disrupted that we did not cover?
 - b. Do you consider your recovery complete? If not, why? If yes, how long did it take?

References

- Adamkiewicz, G., Spengler, J. D., Harley, A. E., Stoddard, A., Yang, M., Alvarez-Reeves, M., & Sorensen, G. (2014). Environmental conditions in low-income urban housing: Clustering and associations with self-reported health. *American Journal of Public Health*, 104(9), 1650–1656. <https://doi.org/10.2105/ajph.2013.301253>
- Adamkiewicz, G., Zota, A. R., Fabian, M. P., Chahine, T., Julien, R., Spengler, J. D., & Levy, J. I. (2011). Moving environmental justice indoors: Understanding structural influences on residential exposure patterns in low-income communities. *American Journal of Public Health*, 101(S1). <https://doi.org/10.2105/ajph.2011.300119>
- Adger, W. N. (2006). Vulnerability. *Global Environmental Change*, 16(3), 268–281. <https://doi.org/10.1016/j.gloenvcha.2006.02.006>
- Arnstein, S. R. (1969). A ladder of citizen participation. *Journal of the American Planning Association*, 35(4), 216–24.
- Arnstein, S. (2020). A ladder of citizen participation. *The City Reader*, 290–302. <https://doi.org/10.4324/9780429261732-36>
- Arnold, M. (2006). Disaster reconstruction and risk management for poverty reduction. *Journal of International Affairs: The Globalization of Disaster* 59(2): 269–279. <https://www.jstor.org/stable/24358436>
- Berg, Bruce L. (2001). Qualitative research methods for the social sciences. Pearson. NY, NY. Fourth Edition.

- Berke, P. R., & Campanella, T. J. (2006). Planning for post disaster resiliency. *The ANNALS of the American Academy of Political and Social Science*, 604(1), 192–207.
<https://doi.org/10.1177/0002716205285533>
- Berkes, F., Colding, J., & Folke, C. (2000). Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications*, 10(5), 1251–1262.
[https://doi.org/10.1890/1051-0761\(2000\)010\[1251:roteka\]2.0.co;2](https://doi.org/10.1890/1051-0761(2000)010[1251:roteka]2.0.co;2)
- Bodenreider, C., Wright, L., Barr, O., Xu, K., & Wilson, S. (2019). Assessment of social, economic, and geographic vulnerability pre- and Post-Hurricane Harvey in Houston, Texas. *Environmental Justice*, 12(4), 182–193. <https://doi.org/10.1089/env.2019.0001>
- Bullard, R. D. (1983). Solid waste sites and the Black Houston community. *Sociological Inquiry*, 53(2-3), 273–288. <https://doi.org/10.1111/j.1475-682x.1983.tb00037.x>
- Bullard, R. D., & Wright, B. (2009). *Race, place, and environmental justice after Hurricane Katrina: Struggles to reclaim, rebuild, and revitalize New Orleans and the Gulf Coast*. Westview Press.
- Bullard, R. D., & Wright, B. (2012). *The wrong complexion for protection: How the government response to disaster endangers African American communities*. New York University Press.
- Bullard, R. D., Grigsby, J. E., & Lee, C. (1994). *Residential apartheid: The American legacy*. CAAS Publications.
- Bullard, R. D. (1993). Environmental racism and invisible communities. *West Virginia Law Review*, 96(4), 1037–50.

- Bullard, R. D. (1994). The legacy of American apartheid and environmental racism. *Journal of Civil Rights and Economic Development*, 9(2), 1–30.
- Carlsson, L., & Berkes, F. (2005). Co-management: Concepts and methodological implications. *Journal of Environmental Management*, 75(1), 65–76.
<https://doi.org/10.1016/j.jenvman.2004.11.008>
- City of Houston. (2019). Build it Forward Homeowner Assistance Program Situation and Pipeline Report #2. September 30, 2019.
- City of Houston. (2020). Build it Forward Homeowner Assistance Program Situation and Pipeline Report #7. 2020.
- City of Houston. (2018). Hurricane Harvey Recovery FEMA Assistance – Infrastructure Briefing. February, 14, 2018.
- City of Houston. (2019). Hurricane Harvey Recovery: A Progress Report. January 2019.
- Daly, P., & Brassard, C. (2011). Aid accountability and participatory approaches in post-disaster housing reconstruction. *Asian Journal of Social Science*, 39(4), 508–533.
<https://doi.org/10.1163/156853111x597305>
- Dargin, J., Berk, A., & Mostafavi, A. (2020). Assessment of household-level food-energy-water nexus vulnerability during disasters. *Sustainable Cities and Society*, 62, 102366.
<https://doi.org/10.1016/j.scs.2020.102366>
- de Koning, K., & Filatova, T. (2020). Repetitive floods intensify outmigration and climate gentrification in coastal cities. *Environmental Research Letters*, 15(3), 034008.
<https://doi.org/10.1088/1748-9326/ab6668>

Denton, Nancy A. (1994). Are African Americans Still Hypersegregated? In R.D. Bullard et al (Ed.) *Residential apartheid: The American legacy* (pp. 49 – 81). Los Angeles, CA: CAAS Publications.

Douglas, E. (2020, July 7). High cancer rates found in Houston Gardens, downtown in expanded cluster analysis. *Houston Chronicle*. Retrieved September 9, 2020, from <https://www.houstonchronicle.com/business/article/High-cancer-rates-found-in-Houston-Gardens-15391535.php>.

Emrich, C. T., Tate, E., Larson, S. E., & Zhou, Y. (2019). Measuring Social Equity in flood recovery funding. *Environmental Hazards*, 19(3), 228–250.
<https://doi.org/10.1080/17477891.2019.1675578>

Evans-Cowley & Canter (2010). Hurricanes, Oil Spills, and Discrimination- Oh My: the Story of the Mississippi Cottage. *Journal of Affordable Housing & Community Development Law*, Vol.20, No. 1 (Fall 2010), pp. 35-78

Eyben, R. (2003). The rise of rights. *Institute of Development Studies Bulletin*, (17), 1–4.

Fainstein, S. S. (2000). New directions in planning theory. *Urban Affairs Review*, 35(4), 451–478. <https://doi.org/10.1177/10780870022184480>

Fainstein, S. S. (2013). The just city. *International Journal of Urban Sciences*, 18(1), 1–18, <https://doi.org/10.1080/12265934.2013.834643>

Federal Emergency Management Agency. (2017). Disasters Texas Hurricane Harvey DR-4332-TX. <https://www.fema.gov/disaster/4332>

Federal Emergency Management Agency. (2020). National Advisory Council Report to the FEMA Administrator. November 2020.

Feagin, Joe R. (1994). A house is not a home. In R.D. Bullard et al (Ed.) *Residential apartheid:*

- The American legacy* (pp. 17 – 48). Los Angeles, CA: CAAS Publications.
- Flayelle, Christopher. (2021). FEMA says it's still working to fix racial disparities in disaster aid. *New York Times*. October 27, 2021.
- Folke, C., & Gunderson, L. (2012). Reconnecting to the biosphere: A social-ecological renaissance. *Ecology and Society*, 17(4). <https://doi.org/10.5751/es-05517-170455>
- Gardner, T. M., Irwin, A., and Peterson, C.W. (2009). No shelter from the storm: Reclaiming the right to housing and protecting the health of vulnerable communities in post-Katrina New Orleans. *Health and Human Rights*. 11(2), 101–114. <https://cdn1.sph.harvard.edu/wp-content/uploads/sites/2469/2013/07/9-Gardner.pdf>
- Goldsmith, Barrett. (2005). Mayor reviews Project Hope with residents. *Houston Chronicle*. August 11, 2005. <https://www.chron.com/news/article/Mayor-reviews-Project-Hope-with-residents-1951262.php>
- Hoffman, Jeremy S. Shandes, V. and Pendleton, N. (2020). The effects of historical housing policies on resident exposure to intra-urban heat: A study of 108 US urban areas. *Climate*. 8(12). <https://www.mdpi.com/2225-1154/8/1/12>
- Horney, J. A., Casillas, G. A., Baker, E., Stone, K. W., Kirsch, K. R., Camargo, K., Wade, T. L., & McDonald, T. J. (2018). Comparing residential contamination in a Houston Environmental Justice neighborhood before and after Hurricane Harvey. *PLOS ONE*, 13(2). <https://doi.org/10.1371/journal.pone.0192660>
- Iecovich, E. (2014). Aging in place: From theory to practice. *Anthropological Notebooks*, 20(1), 21–33.
- file:///C:/Users/jaward/Downloads/The_Emerging_Imperative_of_Disaster_Just.pdf

- Ito, K., Lane, K., & Olson, C. (2018). Equitable access to air conditioning: A city health department's perspective on preventing heat-related deaths. *Epidemiology*, 29(6), 749–752. <https://doi.org/10.1097/ede.0000000000000912>
- Kinder Institute for Urban Research. (2017). Hurricane Harvey Relief Fund Needs Assessment Phase One. <https://kinder.rice.edu/research/hurricane-harvey-relief-fund-needs-assessment-phase-one>
- Kish, Z. 2009. “My FEMA people”: Hip-hop as disaster recovery in the Katrina diaspora. *American Quarterly*, 61(3), 671–92.
- Lukasiewicz, A. (2018). The emerging imperative of disaster justice. *Natural Hazards and Disaster Justice*, 3–23.
file:///C:/Users/jaward/Downloads/The_Emerging_Imperative_of_Disaster_Just.pdf
- Nance, E. (2015). Exploring the impacts of flood insurance reform on vulnerable communities. *International Journal of Disaster Risk Reduction*, 13, 20–36.
<https://doi.org/10.1016/j.ijdr.2015.03.001>
- Nwanaji-Enwerem, J. C., Jackson, C. L., Ottinger, M. A., Cardenas, A., James, K. A., Malecki, K. M. C., Chen, J.-C., Geller, A. M., & Mitchell, U. A. (2021). Adopting a “compound” exposome approach in environmental aging biomarker research: A call to action for Advancing Racial Health Equity. *Environmental Health Perspectives*, 129(4).
<https://doi.org/10.1289/ehp8392>
- O'Neill, M. S. (2005). Disparities by race in heat-related mortality in four U.S. cities: The role of air conditioning prevalence. *Journal of Urban Health: Bulletin of the New York Academy of Medicine*, 82(2), 191–197. <https://doi.org/10.1093/jurban/jti043>

Quale, J., & Iverson, K. I. (2008). A sustainable housing response to Hurricane Katrina. *Journal of Industrial Ecology*, 10(3):101–12.

https://www.researchgate.net/publication/256004149_A_Sustainable_Housing_Response_to_Hurricane_Katrina

Richardson, T., & Renner, R. (2007). Geographic information systems supporting disaster response and recovery. *Cityscape* 9(1), 189–215. <https://www.jstor.org/stable/20868612>

Saegert, S. C., Klitzman, S., Freudenberg, N., Cooperman-Mroczek, J., & Nassar, S. (2003).

Healthy housing: A structured review of published evaluations of U.S. interventions to improve health by modifying housing in the United States, 1990–2001. *American Journal of Public Health*, 93(9), 1471–1477. <https://doi.org/10.2105/ajph.93.9.1471>

Semien, J., & Nance, E. (2019). K.A.P.S.: A disaster training approach for high-risk communities. *International Journal of Mass Emergencies and Disasters*, 37(3): 264–285.

Texas Housers. (2018). Low-income households disproportionately denied by FEMA is a sign of a system that is failing the most vulnerable. Posted November 30, 2018. <https://texashousers.org/2018/11/30/low-income-households-disproportionately-denied-by-fema-is-a-sign-of-a-system-that-is-failing-the-most-vulnerable/>

Turner II, B.L. et al. (2003). A framework for vulnerability analysis in sustainability science. *Proceedings of the National Academy of Sciences of the United States of America*, 100(14).

U.S. Environmental Protection Agency. 2013. Model guidelines for public participation: An update to the 1996 NEJAC model plan for public participation. *A report of recommendations of the National Environmental Justice Advisory Council*. January 25, 2013. <https://www.epa.gov/sites/default/files/2015-02/documents/recommendations-model-guide-pp-2013.pdf> [Accessed 4 November 2021]

- Verchick, Robert. (2012). Disaster justice: The geography of human capability. *Duke Environmental Law & Policy Forum*, 23, 23–71.
<https://scholarship.law.duke.edu/delpf/vol23/iss1/2>
- Wright, B., & Nance, E. (2012). Toward equity prioritizing vulnerable communities. *Duke Forum for Law and Social Change*, 4(1), 1–21.
- Wright, B. (2011). The post-disaster struggle for equity and justice in communities of color along the Gulf Coast. *Florida A&M University Law Review*, 6(2), 197–199.
- Zota, A., Adamkiewicz, G., Levy, J. I., & Spengler, J. D. (2005). Ventilation in public housing: Implications for indoor nitrogen dioxide concentrations. *Indoor Air*, 15(6), 393–401.
<https://doi.org/10.1111/j.1600-0668.2005.00375.x>