
The Water
is
Rising
Pleas


Cover: Stranded residents signal to rescuers from a rooftop surrounded by floodwater, New Orleans. Source: Smiley N. Pool/Reuters

This Page: Canal Street, New Orleans. Source: Gary Coronado/The Palm Beach Post

# THE PRICE OF NEGLECT:
## Social Infrastructure & Disaster Management in America's Vulnerable Communities

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Supervised Research Project

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## ABSTRACT

Social networks consist of relationships and connections between people and groups, forged through a multitude of shared identities and belongings. These linkages are important mediums through which knowledge and information are transferred and have been an invaluable resource in the response and recovery phases of the disaster management cycle. Yet the goals and action plans outlined in Hazard Mitigation Plans fail to reflect our knowledge of the centrality of social infrastructure, while the disaster management cycle often leaves socially vulnerable populations by the wayside. This research project argues for the reorientation from the protection of physical infrastructure to the enhancement of social infrastructure in hazard mitigation planning. Using case studies of Hurricanes Katrina, Sandy, and Harvey, I discuss the shortcomings of current hazard mitigation and disaster management practices, and make a number of recommendations that foster greater integration of social infrastructure in order to build more resilient communities.

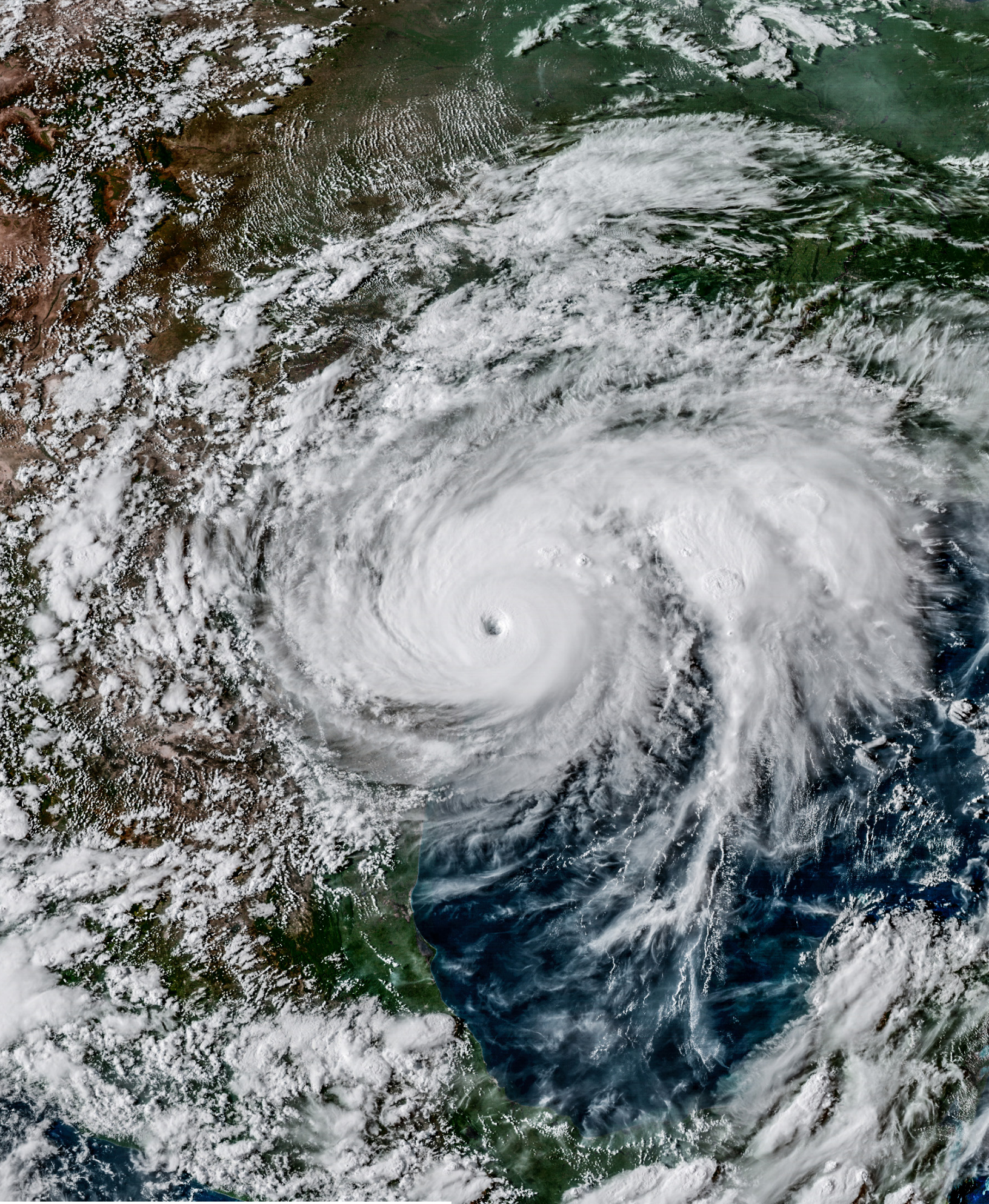


## RÉSUMÉ

Le tissu social est constitué de relations et de liens entre des personnes et des groupes. Ils sont forgés à travers une multitude d'identités et d'appartenances partagées. Ces liens sont des moyens importants par lesquels les connaissances et les informations sont transférées et ils sont une ressource dont la valeur est inestimable dans les phases d'intervention et de rétablissement du cycle de gestion des catastrophes. Pourtant, les objectifs et les plans d'action décrits dans les plans d'atténuation des risques ne reconnaissent pas la centralité de l'infrastructure sociale, alors que le cycle de gestion des catastrophes laisse souvent les populations socialement vulnérables à l'écart. Ce projet de recherche propose d'égaliser les efforts consacrés à l'infrastructure sociale à ceux dévolus à l'infrastructure physique dans la planification de l'atténuation des risques. À l'aide d'études de cas sur les ouragans Katrina, Sandy et Harvey, j'analyse les lacunes des pratiques actuelles d'atténuation des risques et de gestion des catastrophes puis je formule des recommandations qui favorisent l'intégration des infrastructures sociales afin de bâtir des collectivités plus résilientes.

New Orleans, LA. Source: Vincent Laforet/Reuters

Houston, TX. Source: Erich Schlegel/Getty Images



Hurricane Harvey. Source: RAMMB/CIRA SLIDER

# INTRODUCTION

Disasters occur from a combination of hazards – a danger or a risk – and vulnerability – the quality or state of being exposed to the possibility of being harmed. They carry a human implication that is often quantified in anthropocentric contexts, such as people injured, lives lost, or properties damaged or lost. The United Nations describes disaster risk reduction as strategies that aim to "find a way to live with [natural] phenomena, rather than [to] die from them"[125]. In recognition that any given place is susceptible to certain hazards, a set of actions can be implemented by various levels of the government, NGOs, non-profits, community groups, and citizens at large to reduce risk and vulnerability. These actions work together to prevent unnecessary loss from and reduce the cost of disasters. They can also be used to improve the probability of successful post-disaster community recoveries. These actions are what constitute hazard mitigation.

This research project investigates the role of social networks in the disaster cycle and the level of inclusion of social infrastructure in hazard mitigation planning. Using official Hazard Mitigation Plans of three US cities, I set out to answer the following questions:

1. What roles have social networks played in the disaster cycle? Why are they necessary?
2. To what extent do Hazard Mitigation Plans protect and enhance social infrastructure?

To do this, we must first understand what Hazard Mitigation Plans and their purposes are.

## Hazard Mitigation Plans

Hazard Mitigation Plans (HMPs) are documents that outline a city's hazards and vulnerabilities and detail sets of strategies taken on to mitigate them. They are a good way to quickly assess a city's disaster preparedness priorities and trace federal disaster funding allocation. The Federal Emergency Management Agency (FEMA) defines hazard mitigation as "sustained actions taken

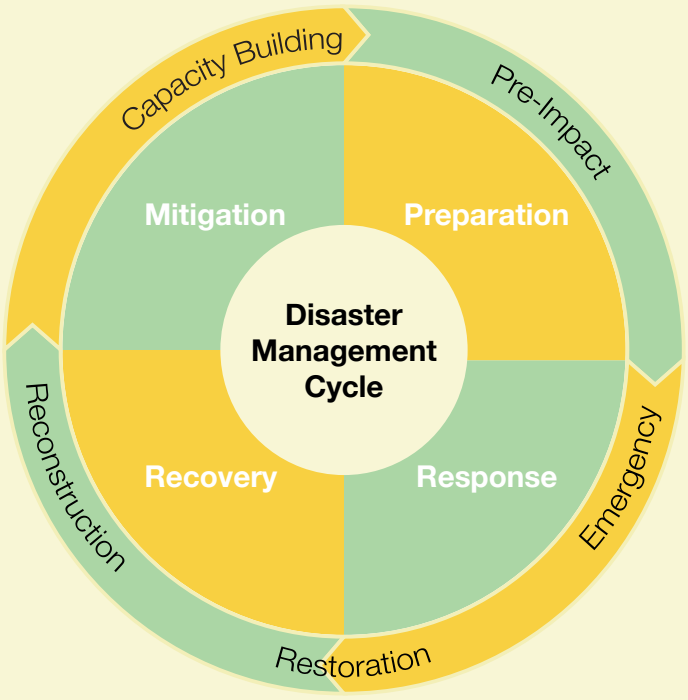



**Figure 1.** Disaster Management Cycle. Source: Author

to reduce or eliminate long term risk to people and property from hazard and their effects"[45]. These hazards can be natural – fires, flooding, earthquakes, tornadoes, etc. – or human-induced – cyber attacks, acts of terrorism, accidents, etc. HMPs are prepared by each city's local government and are publicly available.

In the United States, FEMA requires each city to update their Hazard Mitigation Plan every every five years in order to be eligible for the full range of federal hazard mitigation assistance funds and disaster relief[44]. FEMA, the National Flood Insurance Program (NFIP), and the NFIP's Community Rating System (CRS) have strict requirements that shape the contents of plans. As a result, regardless of a city's types of hazards, all Hazard Mitigation Plans follow a standardized structure.

In addition to detailing known hazards and the strategies adopted to mitigate them, FEMA[44] requires a process of open public participation, which must be documented in the plan itself:

> **Section 201.6(b)**: An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:
> 1. An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
> 2. An opportunity for neighbouring communities, local and regional agencies involved in hazard mitigation activities and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and
> 3. Review and incorporation, if appropriate of existing plans, studies, reports, and technical information
>
> **Section 201.6(c)**:
> 1. [The plan shall include] documentation of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

HMPs demonstrate a city's commitment to protecting its citizens

FEMA also promotes the use of the STAPLEE method in HMPs. STAPLEE stands for **S**ocial, **T**echnical, **A**dministrative, **P**olitical, **L**egal, **E**conomic, and **E**nvironmental. These seven criteria are used to prioritize mitigation actions according to their social, technical, administrative, political, legal economic, and environmental feasibility. These requirements and guidelines control the structure of HMPs, making the documents relatively easy to navigate and understand for the average citizen.

Above simply outlining a city's hazards and plan of action to mitigation them, HMPs also demonstrate the city's commitment to protecting its citizens and assets and facilitate governmental transparency and accountability. It is commonly agreed upon that having a response and recovery plan in place in advance of a disaster event is a highly effective strategy to protecting a city from natural disasters[12]. This is because proactive planning outlines policies and action plans far in advance so emergency managers and actors know what to do in the event of a disaster. It enables for careful, comprehensive assessment of resources and allows time for inclusive collaboration between professionals, stakeholders, and citizens. Proactive planning also provides room for adjustment or correction

in the disaster cycle (see **Figure 1**) before a disaster strike.

HMPs help to identify vulnerabilities, determine mitigation actions, build partnerships, improve sustainability, secure federal funding, and encourage public education and awareness. High-consequence, low-probability events (such as hurricanes, tornadoes, earthquakes, etc.) are difficult for ordinary citizens to grasp and plan for; they are often not prioritized because people discount the risks and rewards associated with ambiguous future events[85]. Decision making by planners and elected official is also affected. As a consequence, people forego the long-term investments in hazard mitigation and disaster preparation in favour of more immediate needs. However, this discounting can be overcome by learning from past events and understanding the importance of risk reduction for long-term sustainability.

HMPs allow cities to focus attention on building more disaster-prepared and resilient societies through sets of strategic goals and concrete actions. Their periodic updating allows for policies to be continually reassessed to ensure alignment with current knowledge and practices. HMPs are also a way to understand and monitor the use of federal funds, foster public engagement and participation in governmental decision making processes, and hold a city accountable for the protection of its citizens. In short, hazard mitigation planning is an investment in the long-term safety and sustainability of a city's residents.

Planning for hazards is neither simple nor straightforward, owing to a combination of social, economic, political, and cultural influences. Temporal and resource constraints also limit mitigation options. Disaster managers and planners use past events and existing knowledge to create hypothetical disaster scenarios to determine how to most effectively organize and protect residents from hazards. Cities have taken disparate approaches to disaster risk reduction in an effort to carry out protective, preparatory, response, and recovery actions – these approaches can range from protecting or building hard infrastructure, such as bridges and levees, to soft infrastructure, such as early warning systems and managed realignment policies[8,58].

> Physical defences can and do fail

## Traditional Hazard Mitigation Planning

Modern engineering has made it possible for humans to bend and control nature enough to allow us to build settlements in less-than-ideal places. Dams, levees, and seawalls are commonly used to keep water at bay and reduce inundation risk in coastal settlements[58]. The maintenance and repair of such physical infrastructure is critical to their effectiveness and therefore understandably require considerable attention and investment. A cursory look into most North American cities' disaster risk reduction landscapes shows that building resiliency largely involves control of land use and investments in protecting and expanding physical infrastructure and defences.

While there is no doubt that structural defences protect billions of people around the world, relying on them alone is risky. Failure can prove to be disastrous in the absence of redundant protective measures[92]; such failure was demonstrated catastrophically during Hurricane Katrina, when the storm surge breached or overtopped levees in over 50 locations, flooding approximately 80% of the city, in some areas to depths of over 10 feet[114].

In addition, disaster recovery has overwhelmingly been dominated by the provision of financial and physical aid; governmental and NGO responses typically involve the delivery of money, food, water, tents, supplies, and experts, all to repair what has been damaged or lost[5]. This approach is premised on the idea of recovering physical infrastructure and properties in order to restore communities to what they once were before the event. However, without the people who once inhabited these communities – complete with their intricate social and economic networks and bonds that facilitated informal means of mutual assistance and support – how complete is the recovery? After all, "a rebuilt bridge or refurbished home does not a community make"[5].

Such observations suggest that hazard mitigation and resilience building should not and cannot entirely rely on physical infrastructure; it must also involve a degree of social infrastructure. Since the magnitudes of disasters are measured in human consequences, it stands to reason that the networks that people form, identify with, and belong to should also be considered a quality that requires protection and maintenance. Further, studies have found these networks to be valuable assets in disaster management, as communities with strong networks are more likely to recover following a disaster than communities without[4,5,77].

This research project highlights the importance of social networks in the disaster cycle. It contributes to a growing body of literature that reorients disaster preparedness and resilience towards targeting social infrastructure in order to fill an existing gap in disaster recovery practices. While the benefits of including social infrastructure in disaster plans is not limited to hurricane-related hazards (wind, flooding, storm surge, etc.), for comparative purposes, I solely cover hurricane events.

This report is organized into three case studies: **1)** New Orleans, Louisiana/Hurricane Katrina; **2)** New York City, New York/Hurricane Sandy; and **3)** Houston, Texas/Hurricane Harvey. I begin each case study by examining the current Hazard Mitigation Plans in detail for inclusion of social infrastructure protection and enhancement. I then assess each city's experience with its respective hurricane event using existing studies, news reports, and semi-structured interviews. These case studies are followed by my analysis that identifies common themes among the disasters and brings attention to the central role of social infrastructure in the disaster cycle. I finish with recommendations that aim to support and enhance existing hazard mitigation practices.

The Carey Tunnel, New York City. Source: Andrew Burton/Getty Images

Hurricane Katrina/Louisiana Source: Jocelyn Augustino/FEMA

LITERATURE REVIEW

This section of the report provides an overview of the literature on social vulnerability, social infrastructure, and social capital; it discusses their relevance to disaster management and gives examples of social infrastructure in the disaster response and recovery phases.

## Social Vulnerability

Many American cities are strongly spatially stratified along racial, ethnic, and socioeconomic lines[18,67,111]. Looking at New Orleans and Hurricane Katrina alone, it is clear that hazard risk is strongly correlated with location in a given area[65]. Existing social structures also exert a strong influence on risk, as these social structures often influence spatial distribution and exacerbate segregation[61]. Similarly, recovery and rebuilding efforts have also proven to be spatially uneven, stratified along racial and socioeconomic lines[133].

The concept of social vulnerability seeks to explain these relationships by identifying people or populations whose social and demographic characteristics influence their **1)** sensitivity and exposure to various hazards; and **2)** their ability to respond to and recover from such hazards[36]. Among a wide assortment of characteristics, race/ethnicity, gender, age, and socioeconomic status typically exert the strongest influence on vulnerability. Place inequalities – those characteristics tied to a specific location such as growth rates, economic vitality, the built environment, and degree of urbanization – are also a component of social vulnerability[36]. Since social vulnerability is tied to people and places, it is ever changing through time and space. However, due to the difficulty of quantifying social vulnerabilities, they have often been ignored in hazard mitigation planning.

Cutter et al.[36] developed the Social Vulnerability Index (SoVI or SVI) to quantify and compare vulnerability across different groups. Using US socioeconomic data from all 3,141 counties, they determined 42 independent variables that have influence on social vulnerability. Of those 42 variables, 11 accounted for 76.4% of variance in vulnerability for all counties. These 11 variables, or dimensions, of social vulnerability are: personal wealth, age, density of the built environment, single-sector economic dependence, housing stock and tenancy, race (African American), ethnicity (Hispanic), ethnicity (Native American), race (Asian), occupation, and infrastructure dependence. Using these 11 dimensions, the SoVI can determine any given US county's social vulnerability, with negative values indicating low overall levels of vulnerability and high positive values indicating high overall

levels of vulnerability. The study showed that most US counties exhibited moderate levels of vulnerability, with counties in the south exhibiting higher levels of social vulnerability than ones in the north. The SoVI can be used to predict disaster impacts and to identify counties in need of socially based services that would improve individual and collective resilience to hazards and disaster events.

The Social Vulnerability Index is used by a number federal agencies such as the Center for Disease Control and Prevention (CDC), the National Oceanic and Atmospheric Administration (NOAA), and the US Army Corps of Engineers. It is also used in research fields focused on public policy and population dynamics, such as public health, sociology, planning, and human geography. Some cities in the United States use the SoVI in their hazard mitigation planning, which I discuss later in this report.

## Social Infrastructure

The ties that bind people are innumerable, diverse, and difficult to comprehensively describe as they are ever evolving through time and space. These bonds can be forged and strengthened through shared history, kinship relationships, faith communities, professional organizations, identity groups, local economies, and so much more. The networks that result from these linkages are important mediums through which knowledge and information are transferred. This is what some refer to as "soft infrastructure"[10] and what I define as social infrastructure throughout this report.

As was previously described in the introduction, traditional approaches to defence and risk reduction have largely focused on physical defences. Examples of hard infrastructure can be found all over the world, such as Germany's 1000-year-old dike rings used to protect farmland, Singapore's seawalls and revetments that combat sea-level rise[58], and Malaysia's submerged geotextile tubes used as shoreline management to address coastal erosion[74]. However, soft measures that target policies and social infrastructure can also be found. Examples of policy-based risk reduction measures include Florida and North Carolina's shoreline management policies that require reassessment of coastal setbacks every 10 years[59]; Helsinki's building code change in 1989 that raised floor levels from one to three metres above sea level[75]; and Cuba and the Cook Islands' early warning systems that alert residents of emergencies and evacuation procedures[78,125]. In the case for coastal hurricane defences, physical infrastructure often dominates the risk reduction landscape as they are less controversial and intrusive than many of their policy counterparts, in part because physical infrastructure requires no social change and do not affect property rights[58]. Due to its wider acceptability and easily quantified benefits, hard measures have been met with more favour. However, physical infrastructure need not, and should not, stand alone as the only line of defence.

## Social Capital

Social capital grants people access to resources that they may otherwise not have if they did not belong to certain groups. The OECD defines social capital as "networks together with shared norms, values, and understandings that facilitate cooperation within or among groups"[95]. This is the definition I use, and for the purposes of this research project, social capital is limited to social networks. Social networks are defined as "the networks and resources available to people through their connections to others"[6], and act as safety nets for people by empowering collective action. Social networks also allow people to better manage the psychological effects of their trauma and facilitate housing recovery. Three

types of social capital exist:

1. **Bonding** – the relationships within a group/network, e.g. a family or a religious group;
2. **Bridging** – the relationships between members of a group/network and other groups/networks, e.g. the intersection of two identities, ethnicities, languages, locations, etc. places such as reading rooms can facilitate bridging; and
3. **Linking** – relationships built by formal gradients of power or authority, e.g. relationships between rural villagers and government representatives.

It is important to note that while bonding social capital creates a sense of belonging, it can also create othering and isolate non-members[6]. Negative outcomes such as xenophobia can arise as a result. Bonding and linking, on the other hand, assists in extending networks by creates connections between larger groups. Additionally, linking social capital takes on some vertical distance and is especially important for underdeveloped communities as it grants them access to resources and information that they may otherwise not have. These three types of social capital support one another to build large networks of strong and weak connections, and have been used and referred to in other research regarding risk and resilience[4,49,54,70].

The decisions made by displaced people to either return and rebuild or permanently relocate after Hurricane Katrina have been found to be heavily influenced by interconnected social characteristics such as family, neighbours, and existing networks[26,70,77,90]. Many examples from communities in India, Japan, and the United States have illustrated the essential nature of social capital and networks to disaster recovery[5].

> Social networks provide informal insurance, capacity, and place attachment

These examples give credence to the call for a paradigm shift from the physical and financial to the social when attempting to understand why some neighbourhoods have demonstrated greater resilience while others have stagnated in the face of a disaster.

Based on statistics alone, communities affected by Hurricane Katrina should have been able to recover faster than those affected by the 1995 earthquake in Kobe, Japan, and the 2004 tsunami in the Tamil Nadu region of India. In the case of Hurricane Katrina, New Orleans had material advantages and the government provided more financial support than in both Kobe and Tamil Nadu. While it is true that some neighbourhoods recovered quickly following Katrina, the same could not be said of the rest of New Orleans. Of the neighbourhoods that did recover quickly, it was found that they had stronger pre-existing social networks and higher levels of trust than the rest of the city[4,77]. This strong social capital mediated recovery efforts. Using these three examples, social networks have been demonstrated as a resource to disaster recovery in three ways by providing **1)** informal insurance; **2)** greater capacity to mobilize through collective action; and **3)** greater place attachment that lent itself to more successful rebuilding[5].

Warner and Engel[131] use the variability in, and unpredictability of, human behaviour to argue for the prioritization of culture in disaster management in order to improve post-disaster resilience. They argue that since humans continue to settle in and inhabit areas known to be inherently hazardous, human behaviour and decision making does not always correspond to logical reasoning, and therefore is an important

component that cannot be ignored in disaster management. Culture and cultural diversity should thus be viewed as valuable resources and assets that can inform and guide disaster managers to better understand the differences in how people assess their risk landscapes depending on their culture, identity, and beliefs. It is through this understanding that disaster management can adapt to the circumstances at hand.

A key problem in disaster management is the communication, knowledge and interaction gap between disaster managers and community members. This gap persists even as disaster risk reduction responsibilities are increasingly shifted to citizens and local communities, such as assembling survival kits, creating risk reduction checklists, and adopting push technologies. These approaches are short sighted and fail to truly harness existing local social capital and cultural knowledge to carry out risk reduction, according to Baez Ullberg and Warner[10]. Using examples from Indonesia and Argentina, they suggest that it is collective cultural memory and local knowledge that enable people to know how to respond to danger and risk. Research also suggests that we must not underestimate the significance of local knowledge in disaster planning, for it may be critical to the acceptability and success of implementation strategies[12]. Further, informal socioeconomic networks have been found to rise to the occasion when hard infrastructure and formal institutions have failed. For example, the flexible informal networks of food hawkers in Dhaka, Bangladesh were able to mitigate the food crisis exacerbated by frequent flooding in 2007 and 2008[71]. These vendors were credited with strengthening the resilience of Dhaka's food system enough to avoid catastrophe, and yet remain unrecognized and unacknowledged by the state.

The benefits of social capital are not limited to recovery efforts, however, as collective decision-making has also been found to be critical in household-level choices. A great example of this is the decision of whether or not to take a government buyout. Regardless of whether a household choses to rebuild or relocate, this decision has been found to be tied to the decisions of one's neighbours, and, on a larger scale, the collective decisions of the community, as there are greater risks associated with being in the minority in either choice[13]. For example, if one homeowner chooses to stay and rebuild while their neighbours choose to relocate, he or she will be faced with potential issues of safety, property value fluctuations, severed social connections, and availability of services. Similarly, if a homeowner chooses to relocate while their neighbours choose to stay and rebuild, the loss of home and disruption in social networks will be felt more deeply.

Community resilience also includes being able to recognize and adapt, so recovery may not always be the end goal of community resilience. Sometimes, it is the ability to recognize inherent and overwhelming risks, and collectively move out of harm's way. Community networks can also lend a helping hand with that decision. However, it can be argued that although relocation may improve the resilience of larger social systems[53], it cannot be considered a community-level resilience response, as relocation changes the structure of a community and removes supporters from social networks[16].

Informal social networks are also an asset with respect to access and reach. Certain groups of communities may be more isolated than others. Religious orthodox groups, immigrants, illegal residents, and other "marginal" groups are well networked internally and operate on greater self-reliance, but may be more difficult to reach by governmental authorities[10]. Understanding this, framing culture as an asset, and recognizing that

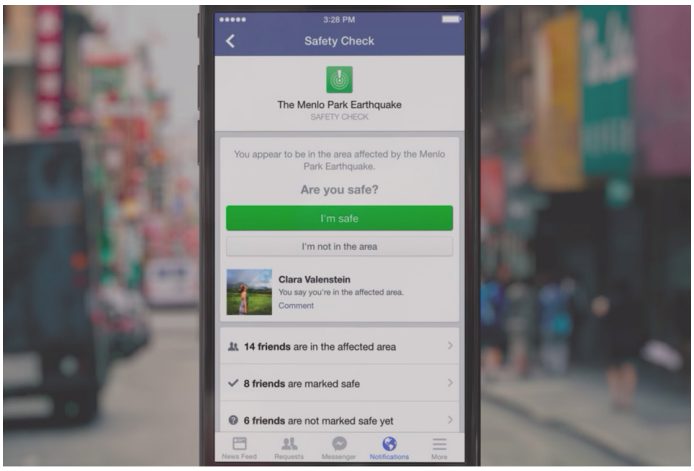



**Figure 2.** Facebok Safety Check. Source: Facebook

soft infrastructure is key to risk reduction will go far to improve disaster responses and make disaster planning more effective and sustainable.

## Examples of Social Infrastructure

Social capital is, of course, not a new concept, but social infrastructure within the context of disaster risk reduction and post-disaster recovery has not been given the attention it deserves from disaster managers and governmental agencies. Social infrastructure contains many components, ranging from simple smartphone apps to large organized church networks. A few examples of social infrastructure within the disaster context are:

**Facebook's Safety Check**, a feature introduced in 2015 that allows users to mark themselves safe in the event of a nearby disaster, incident, or emergency, is an example of integrating social media with emergency management[106]. It allows users to quickly communicate their safety status to their networks and any monitoring agencies in the event of a crisis or incident. These crowdsourced data can also be used by emergency managers and volunteers alike in what has been termed "crisis mapping" to estimate the breadth of an event by mapping the geolocations of users who marked themselves as "safe"[82]. Of course, this function is not without criticism, with some expressing concern that it may create or exacerbate unnecessary fear and


**Figure 3.** Volunteer rescue boats in Houston. Source: David J. Phillip/Associated Press

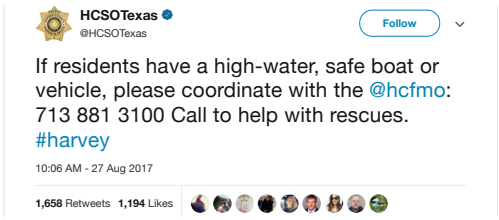



**Figure 4.** Tweet from the Harris County Sherriff's Office during Hurricane Harvey

panic[20,112]; that its algorithms for detecting events may be flawed and can broadcast incidents that are not real[128]; and in the cases of terror attacks, that it may play right into the hands of terrorists by increasing fear and hysteria[83].

The **Vietnamese community** in **Versailles**, New Orleans were able to recover faster and more effectively than many other neighbourhoods in New Orleans on account of their strong social capital and networks. The community, largely led by the Mary Queen of Vietnam Church and characterized by strong social cohesion and high levels of trust, used their bonding and bridging capital to facilitate post-Katrina recovery[4,6,77]. This community's experience with Hurricane Katrina is discussed in further detail in **Case Study 1**.

The **Cajun Navy** is an ad hoc volunteer coalition of citizens armed with private boats who have carried search and rescue missions in the Gulf Coast during flood events. The Cajun Navy came to the forefront of America's attention during the 2005 flooding of New Orleans following Hurricane Katrina. Hundreds of boats and their owners showed up to rescue countless lives alongside official Coast Guard rescuers[129], and even at times when federal responses were absent or deemed the situation too dangerous to carry out rescue missions[11]. The Cajun Navy was also present during the flooding in Texas following Hurricane Harvey[52,98]. In fact, law enforcement officials in Harris County used Twitter to mobilize citizens with boats to help in the disaster response.

The Cajun Navy is a powerful example of an informal group that uses social networks and modern social networking services to carry out informal disaster response and recovery missions. According to reports, they use social media platforms such as Facebook and Twitter to determine where help and rescue are needed[119]. In fact, **Zello**, a smartphone walkie-talkie app, has become the go-to tool for communication, both between members of the Cajun Navy, and stranded civilians and rescuers. On Twitter, members of the Cajun Navy posted phone numbers of people with rescue boats for stranded civilians to contact through the app should they need help[66]. Zello was even backed by a Texas County Commissioner during the floods as a way to call for help.


**Figure 5.** Tweets encouraging Houstonians to use Zello to coordinate rescue

New Orleans. Source: Michael Appleton/NY Daily News Archive

Hurricane Sandy/Rockaway, NY. Source: Spencer Platt/Getty Images

# METHODOLOGY

The purpose of this research project is to determine the degree to which social infrastructure is factored into mitigation planning and determine ways to integrate social infrastructure into disaster management. To do this, official Hazard Mitigation Plans and other supplementary plans and documents relating to resiliency were reviewed. Interviews were then conducted with a variety of participants.

Hazard Mitigation Plans were chosen as they are mandatory, highly structured documents that are updated regularly. Additionally, they are publicly available, easily accessible, and outline the goals and mitigation actions of each city's departments of emergency management. They also include FEMA funding allocation, making them a good starting point when attempting to understand how a city prioritizes its mitigation efforts.

This research project outlines the importance of social infrastructure to hazard mitigation planning and identifies gaps in plans where they should belong. It does so by using case studies of three coastal American cities: New York City, NY, New Orleans, LA, and Houston, TX, each of which has experience a significant hurricane event in recent history – Hurricane Sandy, Hurricane Katrina, and Hurricane Harvey, respectively. Each case study will identify important networks and/or groups that were instrumental to the disaster response and recovery efforts, detail their contributions, and determine their significance to disaster management at large. It will use a combination of existing literature, HMPs, media reports, and one on one interviews with key actors in disaster management and community resilience. I will then draw conclusions based on my findings, and present a set of recommendations that seek to encourage better integration of social infrastructure in disaster planning.

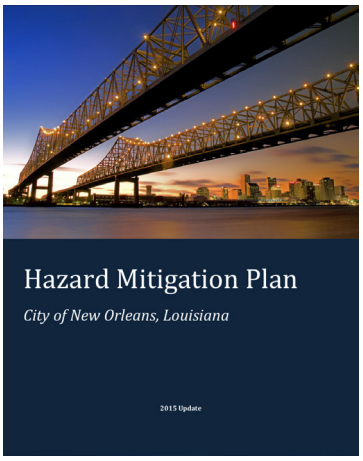
## Selected Cities

Three coastal cities were selected to compare and contrast for several reasons:

1. Each city has experienced at least one hurricane event that resulted in significant damage and injury in recent history;
2. Each city is relatively racially diverse and displays strong racial and social segregation; and

Each city's latest official Hazard Mitigation Plan was assessed: New York City's 2014 Hazard Mitigation Plan, the City of New Orleans' Hazard Mitigation Plan 2015 Update, and the City of Houston's Hazard Mitigation Plan Update 2017. Supplementary plans and documents mentioned in the Hazard Mitigation Plans were also considered for review where relevant. It should be noted that although Houston's HMP was published in December 2017 after Hurricane Harvey, the hurricane hit during the planning

**Table 1**. Selected Cities

| Case Studies | New Orleans, LA | New York City, NY | Houston, TX |
|---|---|---|---|
| **Region** | Gulf Coast | Northeast | Gulf Coast |
| **Pre-Hurricane Population** | 484,674 | 8.361 million | 2.303 million |
| **Current Population** | 391.495 | 5.538 million | - |
| **Land Area** | 906km2 | 789km2 | 1,625 km2 |
| **HMP Update** | 2015   | 2014   | 2017   |
| **Hurricane** | Hurricane Katrina | Hurricane Sandy | Hurricane Harvey |
| **Date of Landfall** | 29 August 2005 | 29 October 2012 | 25 August 2017 |
| **Magnitude** | Category 3 | Tropical Storm | Category 4 |
| **Fatalities** | 1,800 total<br>1,400 in New Orleans | 206 total<br>44 in NYC | 88 total |
| **Estimated Damage** | $135 billion total | $20 billion property<br>$20 billion economic | $89 billion property |

process. Hurricane Harvey is therefore only marginally included as recovery efforts were still underway and the extent of the storm's damage had not yet been determined. Additionally, since it has been over a decade since Hurricane Katrina hit New Orleans, and a wealth of data and research already exists surrounding New Orleans' response and recovery, it was decided that interviews would yield few new facts, and thus were omitted in this study.

## Measures and Analysis

Each city's most recent Hazard Mitigation Plans were assessed for mention of specific vulnerable populations and/or communities and their associated risks, mitigation actions that directly relate to social infrastructure or community groups, and mitigation actions that indirectly support social infrastructure or community cohesion. In particular, I look for actions that create partnerships with community groups or non-profit organizations, involve community members in collective mitigation and resilience projects, fund community-led resilience initiatives, particularly those made for and by socially vulnerable groups, or transfer power to community leaders, entrusting them with facilitating the communication of resilience priorities between the city and members of a community.

Existing research studies were taken into account, and were relied upon for New Orleans and New York City. News and media reports were also assessed to determine themes in the narrative of all three storms. These narratives affect perceptions of the disaster and can influence government and public responses. For Hurricane Harvey, these reports, along with participant interviews, were the only sources used as, at the time of writing, no studies relevant to planning had been published.

Semi-structured interviews were conducted. Both quantitative and qualitative data were collected. Research Ethics Board I approval was obtained from McGill University. The data used in this study are largely qualitative and anecdotal as the components that make up a social infrastructure are dynamic, difficult to define, and, more often than not, difficult to measure in a standardized way. Defining relationships, groups, or identities is challenging because not all relationships, groups, or identities conform to a set of universal rules. As a result, what is measured may not be an accurate representation of reality. While my research was guided and enhanced by the conversations with professionals in each city, I do not quote them for confidentiality reasons.

Major topics included:

- Accounts of grassroots disaster response and recovery efforts
- Developing relationships between government and community groups to promote resilience and preparedness
- Challenges and barriers in building and promoting long-term disaster resilience
- Government-led disaster planning community outreach and public participation
- The relationships between groups involved in disaster response and recovery

## Participants

A number of planners, government officials, NGOs, non-profits, and academics were asked to participate in this research in New York City and Houston. Owing to a wealth of existing literature on Hurricane Katrina, as well as time and resource constraints, no interviews were conducted in New Orleans. Participants were selected based on their experience with and knowledge of disaster planning, emergency management, city planning, social capital, community resilience, post-disaster recovery,

and/or disaster resilience. Participants were contacted via publicly available information over the course of three weeks.

A total of **17** participants were interviewed: nine in New York City and eight in Houston. **Table 2** shows a breakdown of the different fields to which participants belonged (note that some participants fell under more than one category). Owing to ongoing recovery efforts for Hurricane Harvey in Houston at the time, many of the potential participants contacted for interviews were unavailable for interviews.

**Table 2.** Breakdown of interview participants

| | Government & Planning | NGO & Non-Profit | Academic |
|---|---|---|---|
| **NYC** | 6 | 3 | 1 |
| **Houston** | 4 | 3 | - |
| **Total** | 10 | 6 | 1 |


Residents rescued by boat during Hurricane Harvey. Source: Joe Raedle/Getty Images

Photo: f11photo/Shutterstock

# CASE STUDY 1:

## New Orleans, LA

Located along the Gulf Coast, New Orleans is the largest city in the southern state of Louisiana, with a population estimate of 383,000[121]. The City of New Orleans and Orleans Parish share the same boundary so the two names are used interchangeably throughout this report. New Orleans has a rich and distinct history steeped in French roots that date back to the early 1700s, when the city was the capital of the French colony. New Orleans became a part of the United States as a part of the Louisiana Purchase in 1803 and was a prominent port city and railroad hub in the 19th century.

Demographically, the city is notable because it is one of the largest cities in the United States with an African American majority – 68% pre-Katrina and 60% post-Katrina[121]. The racial makeup of New Orleans is as follows: 59.8% Black, 34.0% White, 2.9% Asian, and 3.3% Other. Today, the city's economy relies heavily on tourism and trade, though it has been more diverse in the past. The city's unemployment rate is comparable to the national average – 6.0% and 4.7% respectively, while the city's median household income is significantly below the national average at $37,488 – compared to $55.322[121].

New Orleans is also notable because about half of the city lies around or below sea level. The city did not start off this way. Decades of urbanization and urban development has resulted in anthropogenic land subsidence,

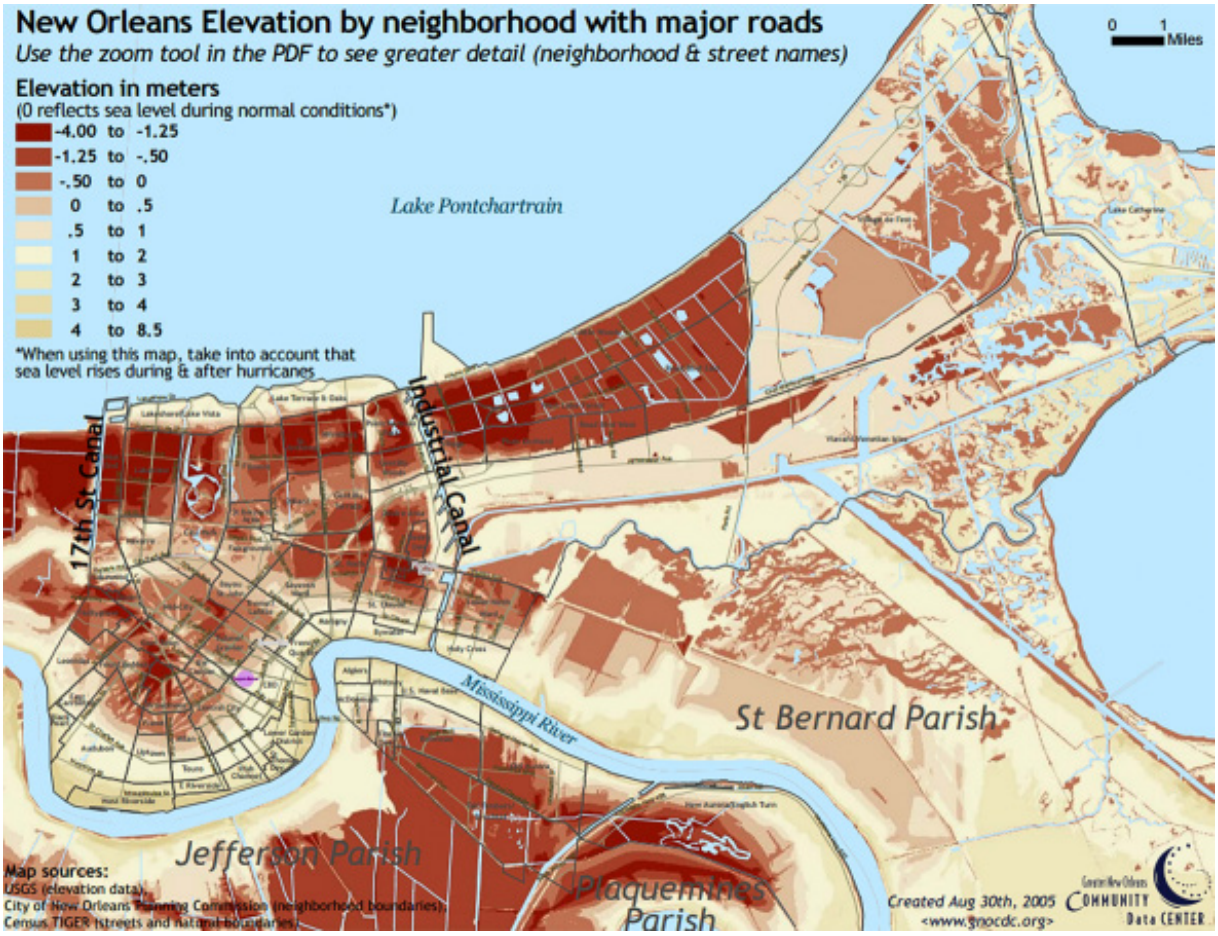



**Figure 6.** New Orleans elevation map. Source: https://www.datacenterresearch.org/

slowly sinking the city below sea level[30]. Projects aimed at draining New Orleans' surrounding swampy marshes and storm runoff began in the 1800s. In addition to this, the city is protected by a system of levees that keep the river at bay. These activities decreased groundwater levels and caused parts of the city to progressively sink below sea level over the last 200 years. In fact, subsidence is one of the listed hazards in the plan. Flooding is therefore unsurprisingly one of the most common natural hazards in New Orleans, and an ongoing challenge for the city. Louisiana has the most number of NFIP claims of all the states while New Orleans has received over $7 billion in flood insurance payments from 1978 to 2015 – the highest in all of Louisiana[30]. Additionally, there have been 26 Presidential Disaster Declarations, all from extensive flooding, in New Orleans.

Additionally, since the city is surrounded by bodies of water, traffic congestion is a major concern during evacuations as there are limited routes exiting the city. This is exacerbated by the fact that that neighbouring areas adjacent to the city also rely on these routes during evacuations.

## Hazard Mitigation Plan

New Orleans' Hazard Mitigation Plan was last updated in 2015. It identifies the city's main hazards as: floods, tropical cyclones, storm surge, dam and levee failure, coastal erosion, hazardous materials spills, tornadoes, subsidence, winter storms, drought, extreme temperatures, power outages, pandemic, terrorism, infrastructure failure, building collapse, civil unrest, and thunderstorms. Of these, seven were introduced in 2015 plan update. The plan includes a section about Hurricane Katrina under subchapter **6.3.2 Tropical Cyclones**. Discussion of the impacts of Hurricane Katrina can also be found in other relevant hazard chapters, such as hazardous materials spills, subsidence, and coastal erosion.

In developing the HMP, 17 non-profits and community organization groups were consulted to determine their concerns, needs, and preferred methods of communication with NOHSEP (New Orleans Office of Homeland Security and Emergency Preparedness) with respect to hazard mitigation. Additionally, public meetings were held to determine, among other things, hazard mitigation priorities for the communities.

The NOHSEP team reviewed a number of documents that make reference to or directly address social vulnerability. These documents make a particular emphasis on social equity and promotes the strengthening of community ties. They are:

- **Resilient New Orleans Strategy**, developed in partnership with 100 Resilient Cities, is a document that identifies vulnerabilities and outlines actions that seek to improve the city's resilience. One of the commitments is to build social cohesion by tackling issues of crime and racism. Some of the ongoing actions include Welcome Table New Orleans – an initiative addressing racial reconciliation and community building, and Nola For Life – a mentorship initiative addressing the city's high rates of murder and gun violence[28,29]. The Resilient New Orleans Strategy also calls for creating a pre-disaster plan for post-disaster recovery.
- **Resilience and Resistance: Addressing Acute and Chronic Adversity in Communities of Colour** 96 is a white paper that brings attention to the gap in emergency management that accounts for the wellbeing and successful post-disaster recovery of vulnerable individuals. It takes a sociological approach to trauma and examines the effects of chronic adversity. In the context of vulnerability, this paper highlights the

importance of social factors with respect to effective coping and recovery following a disaster.

- **City Assisted Evacuation Plan** is a program that partners with agencies, such as Evacuteer, in the city tasked with assisting in emergency evacuations, with a particular focus on people who may not be equipped to self-evacuate. The plan also identifies facilities that are partnered to host evacuees.

In addition to these documents, the goals and actions of the 2010 Hazard Mitigation Plan were reviewed. Of particular relevance to social infrastructure is **Goal 2**, which centers around developing a culture of preparedness and addresses many education and awareness initiatives regarding hazard mitigation and resiliency. **Action #7** of **Goal 2** is a good example of actions that tightly couple with the goal:

- **Action #7:** partner with non-profit organizations, universities, and professional associations to build a strong broad support bas to promote non-structural hazard mitigation practices within the city.

Most of the actions from the 2010 were carried over into the 2015 plan. The 2015 action plan proposes six mitigation goals. Two of these address community outreach and public participation in resilience:

- **Goal 4:** Maximize the involvement of individuals, businesses, and groups in risk reduction measures through education/ outreach on hazard mitigation appropriate to all groups, particularly vulnerable populations. 9 actions support this goal.

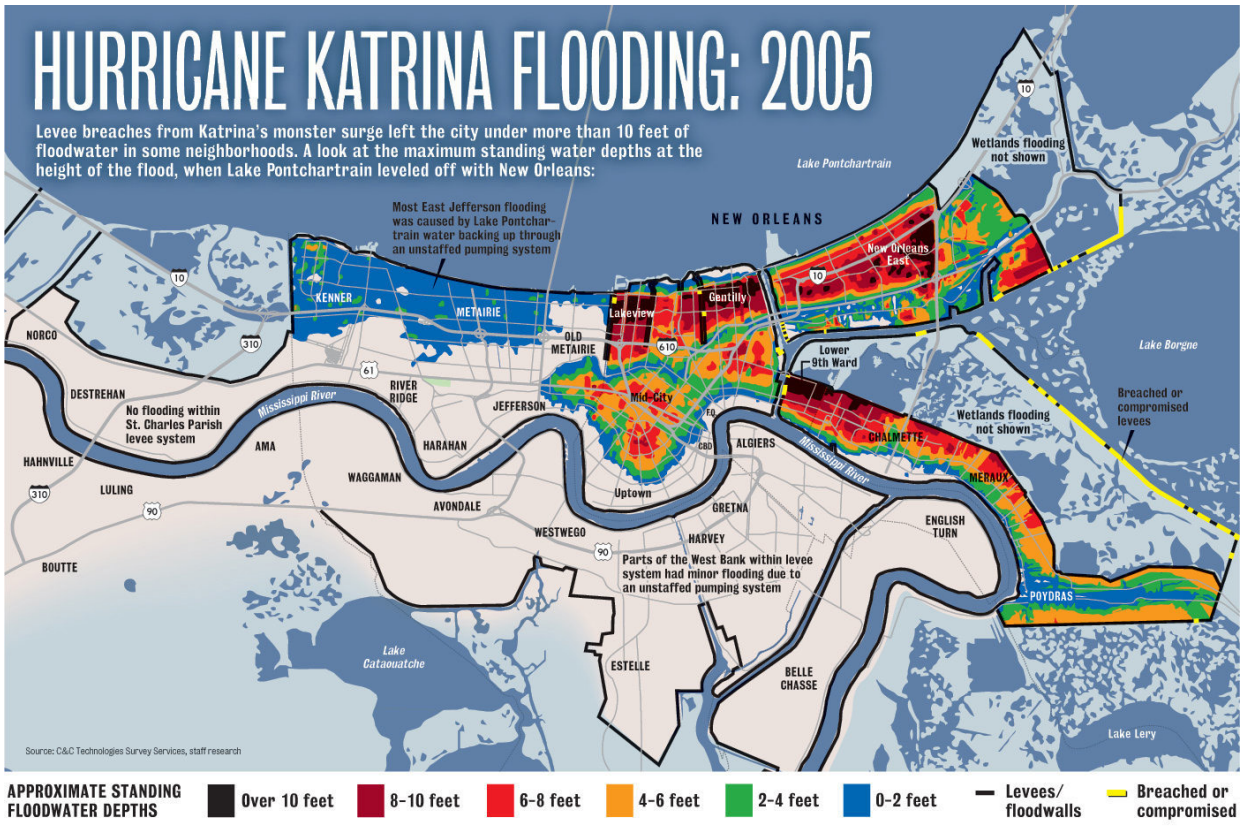



**Figure 7**. Inundation depths in New Orleans. Source: Nola.com

**Figure 8.** Smoke billowing out of a flooded downtown New Orleans after Katrina. Source: Vincent Laforet/New York Times

- **Goal 5:** Promote coordination locally, regionally and nationally, including all levels of government, private sector entities, as well as nonprofits and community based organizations. 20 actions support this goal.

## Hurricane Katrina

Hurricane Katrina struck the Gulf Coast on August 29, 2005. It was one of the most catastrophic disasters to hit the United States and resulted in the unprecedented near-total evacuation of an entire city[40]. Powerful storm surge from the hurricane, estimated at 15-20 feet, overtopped (rose above) or breached (broke) multiple points along the levee system that surrounds and protects New Orleans[114,127]. This infrastructure failure resulted in the inundation of 80% of the city over the following days.

Katrina caused an estimated $90-95 billion in property damage[56]. Over 1,800 lost their lives, around 1,400 of them in New Orleans alone, and the city has yet to fully recover its pre-Katrina population after the evacuation of 1.5 million people in the New Orleans and surrounding areas. Over $12 billion in NFIP claims were paid to people across Louisiana.

Mayor Ray Nagin issued the city's first ever mandatory evacuation on Sunday, August 28 – a mere 24 hours before landfall. In the end, approximately 25% of residents – over 300,000 people – in New Orleans and the surrounding areas to the south, for various reasons, did not evacuate. For those who remained, many sought shelter in hotels, while the Superdome was opened up as a last-resort refuge. Estimates of the number of people that the Superdome

**Figure 9**. Water pours into New Orleans' Lower Ninth Ward through a breached levee along the Industrial Canal on 30 August 2005. Source: Reuters

sheltered vary depending on the source, ranging from 15,000 to 30,000.

## Studies and Media Reports

Katrina was a national tragedy that captured international attention and came to represent the failures of the American system to protect its vulnerable populations. Katrina also heightened national awareness of the racial inequalities and systemic discrimination that exist in American society. Hurricane Katrina was covered extensively in the media in the months and years that followed. The flooding and subsequent mismanagement of response and recovery efforts by the local, state, and federal governments generated widespread criticism in the media, and gave rise to many studies in a wide range of fields.

News coverage showed destroyed houses, flooded neighbourhoods, stranded civilians on their balconies and roofs, downed power lines, and, occasionally, a hauntingly lifeless body floating in the floodwater. The narrative quickly changed to reports of rampant crime – looting, assault, rape – both in the city and in the Superdome. A quick Google search today for "Superdome Katrina" shows "Superdome Katrina horror stories", "Katrina Superdome cannibalism", and "Superdome Katrina murders" as automatic suggested searches. News coverage fixated on the post-Katrina "crime wave". Stories quickly painted a picture of a anarchic city filled with criminals, with headlines such as "Thugs' Rein of Terror"[109] and "The Looting Instinct"[68], describing the scenes as a sinister "orgy of looting and lawlessness" and characterizing New Orleanians as savages and

hoodlums. It also did not help that FEMA director Michael Brown described response efforts in New Orleans as operating "under conditions of urban warfare"[33]. While there was some veracity to these reports – such as confirmed reports of looting, deaths inside the Superdome, and shootings perpetrated by both police officers and civilians[24,69] – many of them were unsubstantiated and most were grossly exaggerated and deeply sensationalized.

News reports often had racial and political undertones, and Black New Orleanians were quickly criminalized in the media. Patterns emerged in the way media outlets represented flooded residents in the city. The most well-known example of this is the incident with two photos published by Yahoo. One depicting a Black man was captioned, "looting a grocery store", while the other depicting a White couple was captioned, "finding bread and soda from a local grocery store"[100]. This incident sparked outrage. Notably, hip hop artist Kanye West went off-script during a televised fundraiser on September 2, 2005, in a memorable outburst, to explain to viewers that America is structured help "the poor, the Black people, the less well-off as slow as possible" before proclaiming, "George Bush doesn't care about Black people!"

West was not wrong. Responses have been widely criticized for being slow, bureaucratic, and filled with needless delays[103]. Local, state, and federal officials were quick to point fingers and spread the blame. A report titled *A Failure of Initiative* was published by a bipartisan committee from the U.S. House of Representatives in early 2006, detailing its findings from an investigation into the planning and response involved in Hurricane Katrina[122]. The report identified widespread failures across all levels of the government and criticized media coverage of the disaster. The committee found deficiencies ranging from the delayed mandatory evacuation notice to FEMA's lack of adequately trained and experienced staff to the lack of coordination within and between federal and state agencies. Among a myriad of issues detailed in the report was also the finding that response experiences were stratified across race and class lines.

> US House of Representatives report identified widespread failures across all levels of the government

The government response showed a lack of planning and preparation for a disaster of this magnitude. The city was unprepared for such an event, and Mayor Ray Nagin expressed that he expected the federal government to take over in such cases[127]. Indeed, once President Bush officially declared Katrina a national disaster, the federal government was, by law, responsible and in charge, but it still stands that nobody was prepared. And yet, FEMA knew the consequences of such a disaster. In 2004, a year before Katrina, a simulated exercise named Hurricane Pam was carried out by FEMA and the Louisiana Office of Emergency Preparedness, along with over 270 federal, regional, and local partners. It was meant to serve as an exercise that readied Southeast Louisiana for its next big storm, mapping out an action plan in case a slow moving Category 3 hurricane was to hit. The action plan included identifying emergency shelters for evacuees, debris and hazardous waste disposal sites, developing search and rescue command structures, and a medical action plan. The exercise called for a hurricane that flooded the entire city of New Orleans, and predicted that a large percentage of the population would not evacuate. Although the

**Figure 10**. Victims of Hurricane Katrina argue with National Guard troops as they try to get on buses headed to Houston on Sept. 1, 2005 Source: Reuters

number of fatalities were almost double that of Katrina, The Hurricane Pam exercise predicted many of the horrors that would befall New Orleans, from the near total inundation of the city to highly toxic floodwaters[81].

An important unmet assumption made by the Hurricane Pam exercise was that federal, state, and local officials would work in coordination with one another. But, as New Orleans-based hurricane researcher Ivor Van Heerden recounts, communication systems – landlines, cell phone networks, internet – within the hurricane damaged areas went down during the storm[127]. In the absence of functional communication systems, the passage of information relied on word of mouth and briefings, even among government officials and researchers, slowing down communication and coordination. In addition to this, they were simply not ready.

In an independent study, some inconclusive disparities were found in FEMA relief distribution. FEMA trailers were provided as a means of temporary emergency housing, available to owner-occupied dwellings, intended to tide residents over until they are able to return to or find more permanent housing. One study carried out independent aerial counts of trailers using satellite imagery and compared them to FEMA trailer data. It was expected that aerial counts should show higher numbers than FEMA trailer

data as there is no way to distinguish between FEMA and private trailers in satellite images. The study, however, found significant differences between aerial counts and FEMA data in the opposite direction, with significantly higher (2-5x) FEMA numbers than that of the aerial counts in most neighbourhoods[35]. Significant differences were found between neighbourhoods that correlated with race, but the study was inconclusive because of the incomplete FEMA data and the impossibility of distinguishing FEMA trailers from private trailers in aerial counts.

News reports influenced public perceptions of New Orleanians. These perceptions were more often than not to the detriment of New Orleanians and those perceived as the urban poor. A group of armed law enforcement officers, along with residents from the neighbouring city of Gretna, blocked the Crescent City Connection out of New Orleans on September 1, 2005 as hundreds of majority Black Superdome evacuees attempted to leave the flooded city. A warning shot was fired, and the evacuees were forced to turn around, but the US Department of Justice found no sufficient evidence for criminal prosecution[99]. A similar but more tragic incident occurred on September 4, 2005. Six unarmed civilians were shot by NOPD officers on the Danzinger Bridge – all were Black, two died, one of whom was mentally disabled. In the latter case, five police offers were convicted – four were sentenced to 7-12 years for the incident, while one was sentenced to thee years for participating in a cover-up of the incident[37].


**Figure 11**. Critical sign of President Bush and FEMA outside a New Orleans home. Source: Getty Images

Hurricane Katrina also generated countless rumours, myths, falsehoods, and outlandish conspiracy theories. However, some of these were not without reason. FEMA's Michael Brown claimed, a year and a half after Katrina, that party politics played a role in the abysmal federal response to the disaster. He accused the Republican administration of federalizing Louisiana to embarrass Kathleen Blanco, the state's Democratic governor[120]. The White House denied these claims. Many believed that the government orchestrated the levee breaches to flood the city in an attempt to "whiten" the majority-Black city and to obtain black-occupied land[35]. This belief is not without foundations, and is not the first time such a rumour has spread. In 1927 during the Great Mississippi Flood, on advice from the U.S. Army Corps of Engineers, the government intentionally blew up a levee and flooded land owned and inhabited by poor farmers south of New Orleans to relieve pressure on the city. During Hurricane Betsy in 1965, the

memory of the event in 1927 gave rise to rumours that the city would repeat such an action. During Hurricane Katrina, the same assumptions resurfaced.

These rumours, sensationalized news reports, and conspiracy theories were able to come about, in part, because of the information vacuum that was left by physical communication infrastructure failures. They also flourished because of the existing deep rooted social tensions that became amplified during the disaster. In those moments, it is not the truthfulness of the stories that mattered, but rather that there was an environment in which they could develop and be readily believed and accepted as fact.

Hurricane Katrina changed the demographics of the affected neighbourhoods of New Orleans. This is due to the difference between the composition of evacuees who chose to return and those who did not return (either by choice or circumstance, many evacuees who wanted to return were not able to). After the city recovered from the storm, there were fewer Black people (21.7% in 2004 vs. 24.7% in 2007), poor people (19.3% vs 12.6% earning <$15,000), and less educated people (15.7% vs 10.4% with less than high school), while there were more Hispanic people (3.2% vs. 6.6%), and old people (30.7% vs 32.4%)[56].

A number of studies have looked into the decision making processes involved in return decisions. Both material and non-material factors were found to have played roles in decision making, such as family, place attachment, home ownership, risk, community, and intersections of different multiple factors[40,62]. In low- to moderate-income neighbourhoods, place attachment, dependence, and identity were factored strongly in evacuees' desires and decisions to return. Numerous interviews cited New Orleans' vibrant social life, food, and large networks of friends and family as central to the sense of place that drew them to return, and many described their discomfort and anger at being perceived as alien others – "Katrina refugees" – by their host communities[26]. Having said that, family also held some back from returning to New Orleans as evacuees found better schools in other cities or had familial obligations to care for those unfit to return to post-Katrina New Orleans.

The neighbourhood of Versailles in Village de L'Est is often used to demonstrate the important role social capital plays in facilitating successful post-disaster recovery[4,6,77]. Versailles is a tight-knit, largely Vietnamese community in eastern


**Figure 12**. Vietnamese residents protesting against the creation of a Katrina landfill site adjacent to their neighbourhood of Versailles. Source: Alex Brandon/Associated Press

New Orleans that made a remarkable recovery, with high and sustained post-Katrina evacuee return rates (around 80% by mid-2006). Similarly, business recovery rates were more than double than that of New Orleans East by early 2006 at 25%[4]. Led by the Mary Queen of Vietnam Church (MQVC), the religious and social centre of the Vietnamese Catholic community, residents were able to use their existing social capital to coordinate recovery efforts that included repairing houses, providing healthcare, and challenging homeowners' insurance compensation. During the storm and subsequent flooding, 200-300 people sought refuge at the MQVC, and the pastor, using his established networks, was able to pass this information on to the larger Vietnamese communities in Houston, TX and Orange County, CA, who then mobilized to create an online thread that would keep those interested informed about the evacuees' whereabouts[4]. Further away in Houston, where many evacuated to, Vietnamese organizations mobilized to assist evacuees in tasks such as filling out FEMA forms and administering Hepatitis A shots. Versailles and MQVC continued to demonstrate their unity as they successfully petitioned for power to be restored[64] and contested the creation of a Katrina landfill site near their neighbourhood in the aftermath of Katrina.

Hurricane Katrina taught America hard lessons about its social order and reminded American cities that they were still deeply unprepared for large scale emergencies. It highlighted the gaps that existed in local and federal disaster management and showcased the many failures of the government to adequately plan for and respond to natural disasters. It demonstrated the central role of people and networks in place-making that leads to greater recoveries, and illustrated the importance of social trust in the disaster cycle. Hurricane Katrina also showcased the influence of the media on public perceptions and how these biases can affect disaster responses. Hurricane Katrina's impact on New Orleans now serves as a warning to cities rife with social tension and ill-prepared for its natural hazards.


Photo: Francisco Diez/Flickr

# CASE STUDY 2:

## New York City, NY

New York City, located along the northeast coast in the State of New York, is the largest city in the country with a population of 8.5 million across its five boroughs[121]. Established in the early 1600s, New York was one of the original 13 English colonies, and has a long history in trade, politics, and civil rights, and played an important role in the American Revolution. Its proximity to Europe allowed it to secure its place as the trading capital of the United States. Throughout its history, the city has boasted a diverse population made up of immigrants from around the world. This influx of immigrants proved to be valuable in the mid 1900s, as after many New Yorkers left the city for the suburbs, immigrants from Africa, Asia, the Caribbean, and Latin America counteracted the out-migration and revitalized many neighbourhoods.

New York City today maintains its central position in global commerce, finance, foreign affairs, politics, media, and the arts. It boasts numerous iconic landmarks that attract over 40 million tourists annually from around the world. New York City's economy is highly diversified and dynamic. It has been referred to as the financial capital of the world, and is the leader in banking, finance, communications, advertising, and journalism in the nation.

New York City's population is highly ethnically and racially diverse: 32.3% (non-Hispanic or Latino) White, 29.0% Hispanic or Latino, 22.2% (non-Hispanic or Latino) Black, 13.6% (non-Hispanic or Latino) Asian, and 2.9% Other[121]. The city's foreign-born population is large (37%) and over 200 languages and dialects are spoken in the city[31]. There has been an increase of older New Yorkers in recent decades, with 12% of the population being over the age of 65 in the 2011 US Census. NYC's unemployment rate is slightly higher than that of the national average at 5.5%, and its median household income is on par with the national average, at $55,191.

Four of the five boroughs are built on three islands: Staten Island, Manhattan Island, and Long Island. As such, the city is surrounded by waterways, numerous bays, and the Atlantic Ocean. Elevation generally varies from 15m to 91m above sea level, while some neighbourhoods are lower lying.


**Figure 13.** New York City's 5 boroughs. Source: NYC Hazard Mitigation Plan

## Hazard Mitigation Plan

New York City's Hazard Mitigation Plan was most recently updated in 2014, though the city releases a Hazard Mitigation Annex annually to monitor activities in the years between the updates. New York City identifies its main hazards as: coastal erosion, coastal storms, disease outbreaks, drought, earthquakes, extreme temperatures, flooding, severe weather, wildfires, winter storms, chemical, biological, radiological, and nuclear (CBRN) hazards, cyber threats, and infrastructure failures. Much like New Orleans'

plan, NYC's HMP contains a Hurricane Sandy Retrospective Analysis, which covers the impact of the storm, recovery and resilience efforts, and the lessons learned. The plan also notes that Hurricane Sandy has pushed the prioritization of flooding and coastal storm mitigation.

Community involvement in the planning process included non-profit and volunteer organizations, academics, neighbouring communities in in New Jersey, the private sector, and regional partners, as well as an online survey for the public and a webinar event for members of research institutions, religious organizations, social services, and hospitals.

New York City is unique in that there are many disaster resilience, preparedness, response, and recovery materials and programs across a number of agencies. Some of these include: *Ready New York*, *NYC's Risk Landscape: A Guide to Hazard Mitigation* (2014), *New York City Emergency Management Strategic Plan 2017-2021* (2016), *Resilient Industry: Mitigation and Preparedness in the City's Industrial Floodplain* (2018), *Urban Waterfront Adaptive Strategies* (2013), and *One New York: The Plan for a Strong and Just City* (2015).

The HMP contains several sections that address social vulnerability and social infrastructure:

- **Linguistic Isolation**: New York City is home to a diverse population, many of which are foreign born. As such, the plan acknowledges that 23% of the population are considered to be linguistically isolated (speaks English less than "very well"), and identifies these individuals and groups as of special concern during emergencies. This data set is available at the census tract level, and is mapped (see **Figure 14**). Many of NYC's disaster and emergency management information and brochures are available in at least 10 languages.
- **Disability:** an estimated 10.3% of the population of NYC are living with one or more of the four major categories of disabilities. The plan discusses the four categories of disabilities and how they may affect risk. However, this is not mapped as the data are only available at the borough level and not at the census tract level.
- **Special Needs Advance Warning System**: this system supports preparedness, response, and recovery by pushing targeted information to those with special

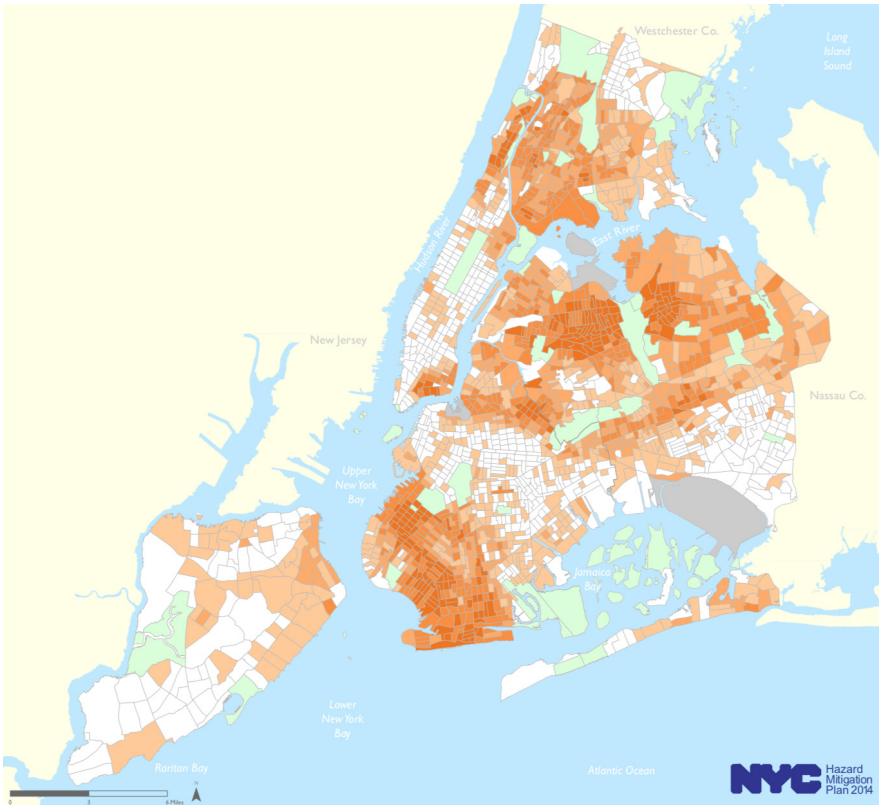



**Figure 14**. Linguistic isolation by census tract in New York City. Dark orange indicates high linguistic isolation. Source: NYC Hazard Mitigation Plan

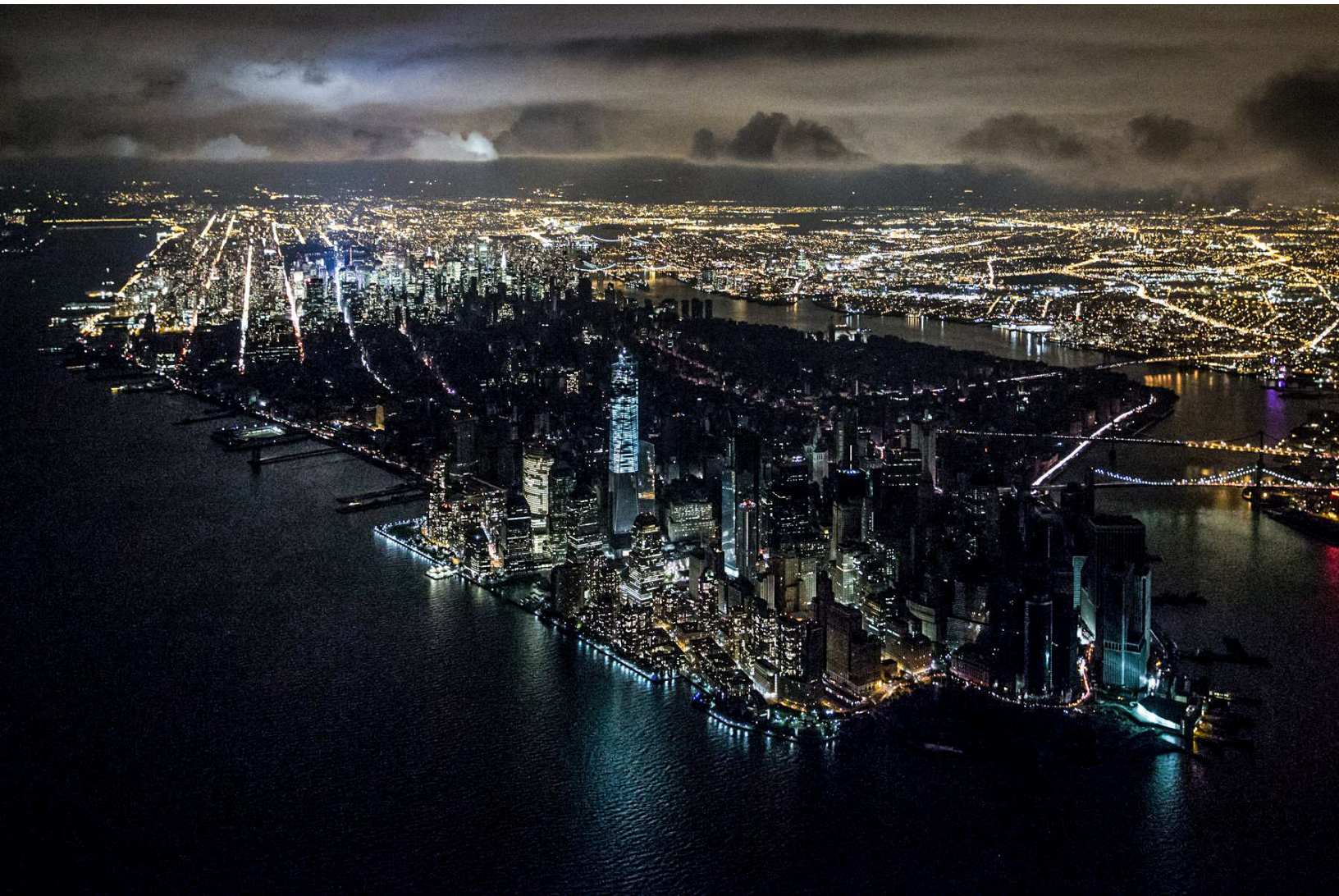
needs during a number of emergencies and service disruptions that may affect their wellbeing and independence.

- **Community Recovery Playbook**: this playbook helps people and communities receive assistance by guiding them through Community Development Block Grants for Disaster Recovery programs and applications. This playbook is a separate document from the HMP but is a part of the outlined mitigation strategy.

Of the 1000+ existing and proposed mitigation actions listed in the HMP, a number of them contain social components or make reference to other plans and initiatives that do. Most of them involve education and awareness programs. For example:

- **MH.P.43**: Mental health volunteer preparedness and response: promote involvement of mental health consumers in volunteer preparedness and response activities. Peer volunteers would receive training on emergency preparedness and be linked to a network of programs that mobilize volunteers to respond to an emergency such as Community Emergency Response Teams, American Red Cross, City Serve, and NYC Cares.

**Figure 15.** Power outage in lower Manhattan during Hurricane Sandy. Source: Iwan Baan/New York Magazine



## Hurricane Sandy

Hurricane Sandy made landfall on the northeast coast on October 29, 2012. It caused widespread flooding, transportation disruptions, and power and telecommunications outages, and was the costliest natural disaster in the city's history, amassing $20 billion in infrastructure and building stock damages and a further $20 billion in economic losses. 44 people died in New York City, 23 of whom were in Staten Island, while almost half were over the age of 65[41].

In advance of the storm, the Coastal Storm Plan was activated, and the city began preparing for Hurricane Sandy, including shutting down its city parks and many transportation services and route, as well as building storm barriers around utility facilities[31]. Residents in Zone A, the Rockaway Peninsula, Hamilton Beach, and City Island were ordered to evacuate, emergency shelters opened, and residents were advised to shelter in place in anticipation of the storm. Despite the pre-emptive shut downs, subway stations and tunnels still flooded[89]. In all, Sandy flooded 17% of the city, displacing approximately 150,000 people, and affecting 10% of NYC's critical infrastructure[31].

Overall, flood risk in New York City is correlated with the intersection of a number of social factors. Flooding from Hurricane Sandy disproportionately impacted neighbourhoods that were poorer, older, and/or had larger Black populations[41]. The storm had a significant impact on the city's public housing residents. Over 400 public housing buildings belonging to the New York City Housing Authority (NYCHA) lost essential services such as electricity, heat, and hot water, affecting some 80,000 people[117]. Flooded census tracts had high representation of poorer African American and Latino populations when compared to dry tracts, which may be due to the presence of public housing in the flooded neighbourhoods of Red Hook, Coney Island, and the Rockaways[41].

## Studies and Media Reports

The widespread damage left behind Hurricane Sandy forced affected New York City residents to make the difficult decision of whether to return and rebuild or relocate. Similar to Hurricane Katrina, this decision-making process was studied. A Staten Island study using vignettes – hypothetical stories that ground a scenario so participants can envision themselves in a circumstance and play out how they would make decisions – supports the hypothesis that the decision to return or relocate depended on family bonds and family mechanisms[90]. This finding echoed the pre-existing belief that people respond to disasters as families[97]. Of course, this would depend on the quality of the relationship rather than the pure presence of family, but this finding lends support to body of work about the central role of familial relationships in some post-disaster decision making.

Another study compared two coastal neighbourhoods in New York to understand the decision making process behind whether to stay or leave[13]. The two communities were selected for their many demographic and cultural similarities – they were both coastal, stable, working class communities with similar per capita incomes, populations, and racial makeup. Residents of both communities expressed strong place attachment and referred to their neighbourhoods in similar ways – a small beach getaway from the city. Both neighbourhoods suffered significant damage during Hurricane Sandy. Interestingly, while residents in Rockaway Park largely decided to return and rebuild, the majority of residents of Oakwood Beach chose to pursue Governor Cuomo's buyout plan and leave. The study demonstrates that while the decision to return or relocate is at the household

**Figure 16.** Residents of Breezy Point, a neighbourhood in Queens, return to their burned down home. Source: Anthony DelMundo/New York Daily News

level, there is evidence that such decisions are influenced by the decisions of neighbours too, if not the community at large. Here, the decision came down to context and shared perceptions – while those in Rockaway Park saw Sandy as an anomaly, residents of Oakwood Beach saw it as a part of a larger pattern of increasingly extreme weather events. The authors noted that both communities displayed high levels of community cohesion and resilience – that the decision to recognize and adapt by relocating can also be viewed as a form of personal or household resilience, albeit one that dissolves the community to which the individual or household belonged.

According to sea level rise projections, the Jamaica Bay communities of Hamilton Beach and Broad Channel will both experience more frequent flooding in the next few decades. In fact, Broad Channel today already floods twice a month at high tide[32]. However, the while Broad Channel has adopted many resilience measures to adapt to flood hazards, such as upgrading their sewers, considering boats and high axel vehicles to address mobility solutions, and elevating their streets by two feet to reduce street flooding, Hamilton Beach has rejected plans to do the same. While there may be a variety of reasons for this difference in the adoption of resiliency measures, Broad Channel is said to have a stronger social

fabric than Hamilton Beach, with prominent civic advocates, strong connections to the city, and an active and engaged civic community(Interview, February 23, 2018). These characteristics no doubt play into decision making at the community level.

Hurricane Sandy highlighted some gaps in local disaster management. Although national response teams are deployed for disasters, they do not typically stay for the entire duration of the recovery period[107], leaving recovery efforts at the hands of locals. Community leaders tasked with supporting disaster recovery services – local elected officials, local public health directors, hospital emergency operations leaders, and chiefs of fire and police – should thus, in theory, be equipped with adequate knowledge, skills, and training, allowing them to aid in community disaster recovery in cases of emergency. However, many surveyed community leaders reported that they received little to no formal training and relied on transferable skills obtained through other means or prior experience with disasters[130]. The respondents expressed that they did not have a thorough understanding of available FEMA programs. Community leaders also recognized the importance of cooperation and partnership between volunteer organizations, but expressed that facilitating such relationships for long-term recovery was challenging.

These relationships are indeed important for volunteer organizations. In fact, they facilitate in social learning and can allow for successful grassroots response and recovery. The strong social capital that exists within members of the Orthodox Jewish community in Far Rockaway allowed them to recover from Hurricane Sandy without much help from the government. Although members of the Orthodox Jewish community belonged to different synagogues, they were still, however loosely, connected through a network of rabbis, schools, and club goods provided by their religious leaders[113]. Using these networks provided by the Orthodox Jewish community, members were able share knowledge, information, resources, and assistance. Community leaders, together with their communities, used existing networks and local knowledge to carry out relief and recovery work, including distribute food and supplies, request, receive, and distribute monetary donations, coordinate volunteers, aid community members with mobility issues, disseminate information, collect data, coordinate recovery efforts, and provide support and other resources where needed.

Since the community had no disaster playbook, they had to figure things out as they went along. People discussed problems, ideas, and useful solutions along the way, and this bonding social capital allowed the community to rapidly learn and develop ways to respond and recover more efficiently[113]. Social learning is not limited to bonding social capital, as it was demonstrated that the weak ties that make up bridging and linking social capital can also prove to be very useful in learning. For example, one community leader, with weak ties to the Orthodox Jewish community, witnessed the operations of an Orthodox Jewish organization while on a visit, and adopted some of their features into his own distribution centre.

The Occupy Sandy movement is another instance of a group using existing social networks, in this case from Occupy Wall Street, to carry out disaster relief efforts. The movement set up distribution centres in local communities and, with the help of droves of volunteers, assisted in various relief and clean up efforts in affected neighbourhoods[48]. Partnered with other local organizations, Occupy Sandy recognized the importance of solidarity and mutual aid, rather than temporary relief and charity, in disaster management[19,73] and were able to carry out response and recovery work when and where others, such as FEMA and

The Red Cross, could or did not[19]. For example, based on word of mouth information, they sent help to an apartment building in the Rockaways where many elderly and disabled residents were stranded with no electricity, water, or heating[86]. The movement has been widely praised for rising to the occasion when official responses could or did not and has been credited for its valuable contributions to the disaster response efforts following Hurricane Sandy. The movement has expanded into a disaster relief network that represents a number of disaster preparedness, response, and recovery projects in New York and New Jersey.

Hurricane Sandy, like Hurricane Katrina, revealed gaps in the city's disaster response. The storm disproportionately affected low-income, elderly, and disabled residents who lived in public housing in affected areas and demonstrated that the burden of environmental hazards is unevenly shouldered upon socially vulnerable populations. Many of the response efforts around the city were carried out by local non-profit organizations and community groups, often without the help of formal agencies. The response and recovery efforts following Hurricane Sandy showcased the value of existing networks in disaster management. Social networks were relied upon by local groups in disaster response and recovery for mutual assistance and social learning. Similar to Hurricane Katrina, studies found that return decisions were influenced in part by a homeowner's social networks – namely, they were influenced by the decisions of their neighbours. Likewise, findings also may suggest that the adoption of community resilience measures depend somewhat on the extent of social cohesion and collective civic participation. New York City's numerous disaster resilience, preparedness, response, and recovery materials and programs can be seen as a reflection of the city's experiences with risks and disasters, and demonstrate the city's commitment to mitigating known hazards.

Lower Manhattan skyline. Source: Eduardo Munoz/Reuters


Photo: visithoustontexas.com

# CASE STUDY 3:

## Houston, TX

Situated in the Gulf Coast, Houston is the largest city in Texas, and fourth largest city in the United States, with a population of over 2.3 million, and 6.5 million in the Houston Metropolitan Area. Houston was founded in the 1830s, and was named after Sam Houston, a former Tennessee governor and US congressman. Easily accessible by railway, its extensive bayou system, and, later, by air, Houston quickly became the commercial hub of Texas. Following the completion of the Houston Ship Channel in 1914, the Port of Houston flourished owing to a combination of attractive offerings (cheaper prices and protection from gulf storms) and circumstance (the reconstruction of Galveston's port following a 1900 hurricane stalled)[63]. The Houston Ship Channel soon played a key role in Texas' oil boom in the early 1900s. It was around this period when Houston came to be named the Energy Capital of the World.

Houston is ethnically and racially diverse. According to the 2016 estimates for Harris County (to which Houston belongs), the population is made up of 31.2% who identify as (non-Hispanic or Latino) White, 41.8% Hispanic or Latino, 18.5% Black, 6.6% Asian, and 1.9% other[121]. Houston's median household income is on par with the national average, at $55,584, as is unemployment rates, at 4.8%[121]. Houston has a strong economy based in the oil and gas industry.

The city's topography is relatively flat and the region's water table is relatively high owing to its proximity to bodies of water, water channels, and the coast. However, much of the city is reasonably above sea level. Additionally, its soil has high clay content, which decreases absorbency.

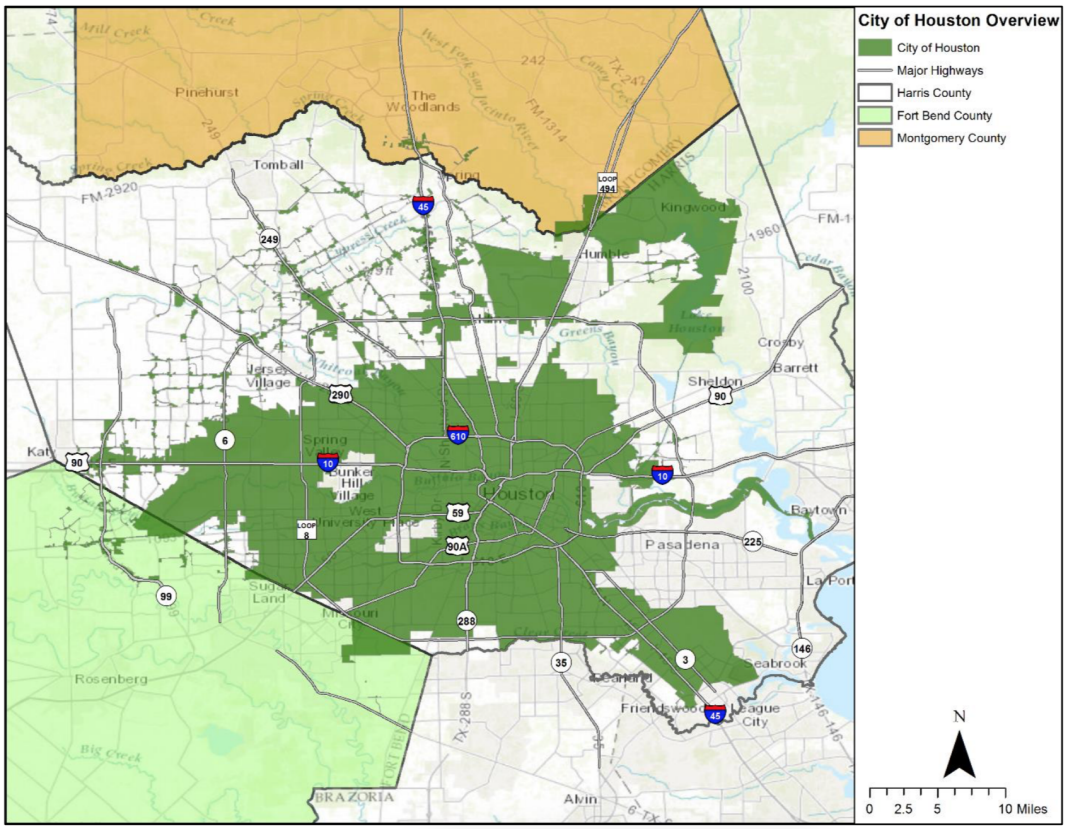



**Figure 17**. Map of Houston and its surrounding areas. Source: Houston Hazard Mitigation Plan

The city saw a housing boom in the 1970s – a 72.4% increase in 10 years, the highest in the country. These houses were concentrated in the suburban peripheries, and only "modest amounts of construction" took place in the inner city[18]. The city's planning is unique in that there are no zoning regulations. Zoning ordinances have been proposed many times (1948, 1962, 1993) through the city's history, but have been repeated rejected by voters. Houston is therefore seen as a "developer's dream", with its relatively lax development regulations and policies. As a result of this lack of zoning, homes, hospitals, and schools can be found neighbouring refineries and chemical plants[42].

## Hazard Mitigation Plan

Houston's Hazard Mitigation Plan was last updated in 2017. It identifies the city's main hazards as: floods, hurricanes/tropical storms, extreme heat, thunderstorm wind, lightning, tornadoes, expansive soils, hail, wildfires, drought, dam failure, and winter storms. Of these hazards, flooding is identified as the most common hazard for Houston.

As was previously mentioned, the drafting of the plan coincided with Hurricane Harvey. Although it was already clear at the time that Hurricane Harvey caused unprecedented destruction, its inclusion in the HMP is minimal, particularly when compared with New York City and New Orleans' inclusion of Hurricane Sandy and Hurricane Katrina in their respective HMPs. This is understood to be because the full extent of the hurricane's impact was not yet understood, with response and recovery efforts still underway.

While some public involvement took place during the drafting of the plan, it was limited to public meetings, survey instruments, and making the plan available online. The plan makes no mention of consultation with community groups. Stakeholder engagement is similarly limited, with six out of the seven stakeholders coming from other government agencies.

**Goal 2** of the Mitigation Strategy directly addresses building local capacity and reducing vulnerability while **Goal 3** aims to increase public knowledge and support for hazard mitigation. Both goals are accompanied by tightly coupled objectives:

> **Objective 2.1**: Build and support local partnerships to continuously become less vulnerable to hazards
> **Objective 2.2**: Build a cadre of committed volunteers to safeguard the community before, during, and after a disaster
> **Objective 2.3**: Build hazard mitigation concerns in county planning and budgeting processes
> **Objective 3.1**: Heighten public awareness regarding the full range of natural and man-made hazards the public may face
> **Objective 3.2**: Educate the public on actions they can take to prevent or reduce the loss of life and/or property from all hazards and increase individual efforts to respond to potential hazards
> **Objective 3.3**: Publicize and encourage the adoption of appropriate hazard mitigation measures

Of the 24 mitigation actions, two contain social components, and both of them involve education and awareness programs used to inform the public about risks and disaster preparedness.

Additionally, there is a short section at the end of the HMP regarding public engagement, but it appears minimal, unidirectional, and provides limited scope to facilitate public discussion of risks and mitigation. Based on the HMP, Houston's approach to hazard mitigation takes a much more top down approach relative to New Orleans and NYC.

**Figure 18**. A flooded Houston August 27, 2017. Source: Paul Jordan Anderson/Doublehorn Photography

## Hurricane Harvey

Harvey struck the Gulf Coast on August 25, 2017, and flooded 30% of Harris County. A total of 88 people died in Texas[2]. Shelters were set up around the city, and reporters likened the scenes of evacuees at the George R Brown Convention Centre to those of Hurricane Katrina[39]. Hurricane Harvey, like Katrina, is one of the most catastrophic disasters to hit the United States. The extent of the damages from hurricane-related hazards was made worse by outdated and inaccurate flood plain maps[57,72]. Only a small percentage – 17% – of homeowners impacted by flooding had flood insurance under the NFIP[79]. **Figure 19** shows the distribution of flooding during Hurricane Harvey overlaid on a social vulnerability by census tract map. The map's accuracy is limited as buildings and trees obscure the the satellite recording's ability to detect flooding. As a result, flooding is likely to be worse in central Houston and heavily wooded areas than the map suggests. Nevertheless, it is clear that peripheral regions suffered severe flooding. This pattern correlates with neighbourhoods that display moderate to high social vulnerability. Damages from the storm have been estimated to be $125 billion, the highest of a string of severe hurricanes in 2017 that include Hurricanes Irma and Maria[88], and possibly the highest of any disaster in the USA. As of the writing of this report, recovery efforts are still underway, with some 10,000 families still displaced.

## Media

Some reports cited global warming as the reason for the unprecedented levels of rain dumped on Houston by Hurricane Harvey[1,84]. Meanwhile, numerous reports blamed Houston's planning for exacerbating flooding during heavy rains[14,15,96]. Indeed, Houston has experienced more urban flooding than anywhere else in the US since the 1980s[108]. Houston's flooding issues have often been attributed to its rapid uncontrolled growth and expansion of low-rise strip malls and residential developments in the last several decades, exacerbated by its level topography

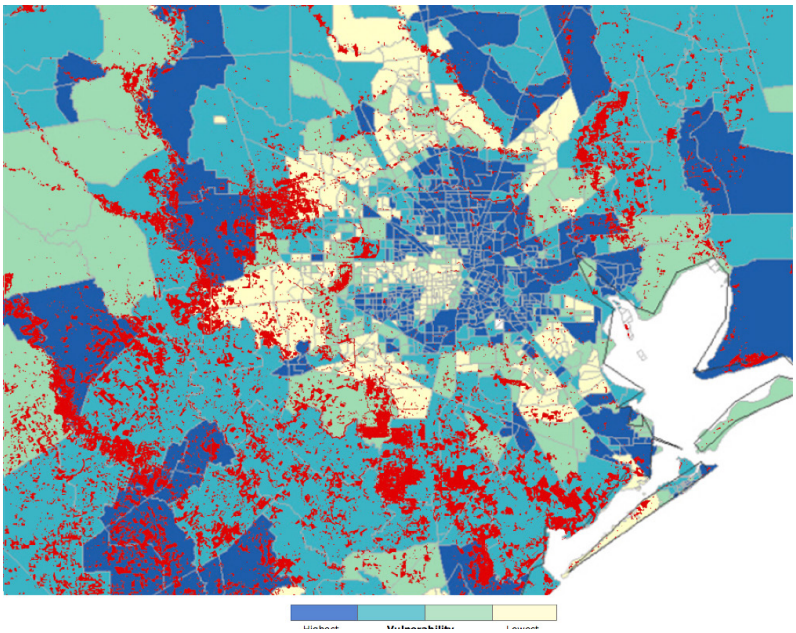


**Figure 19.** This map overlays flood data (in red) with social vulnerability data by census tract. Note that flood data in urban or heavily wooded areas are incomplete. Source: Dartmouth Flood Observatory.

that impedes stormwater drainage. This sprawl has significantly increased the area's amount of paved and hard surfaces that have decreased the land's permeability. News reports covering Hurricane Harvey often criticized the city's lack of zoning regulations and links it to the city's increased vulnerability to flooding as development has quickly outpaced stormwater infrastructure capacity [42,76,108].

Others have criticized the city's development policies for causing "virtually unchecked" growth. This has been worsened by flood insurance programs that have allowed people to build their homes on risky floodplains[15]. For decades, housing developments were erected upon floodplains due to lax development policies that allowed runaway development, "creating short-term economic gains for some while increasing flood risks for everyone"[108]. This has been supported by some county and city officials, who stubbornly refuse to acknowledge the scientific evidence of the correlation between development and flooding[34].

Amidst the criticism against the city's planning, President Trump's response[55], the federal response[47], and that of the Red Cross[25], were stories of heroism and generosity. Photos and videos surfaced online of human chains in floodwaters trying to rescue stranded people[17], while the Cajun Navy were quick to arrive in boats to carry out search and rescue missions[98]. There were numerous incidences of people helping people as neighbourhood security patrol volunteers ventured out in the rain to rescue residents and pets trapped by the flood[115]. The stadiums around the city did not flood, and while some opened their doors to people fleeing their flooded neighbourhoods[50], others delivered their food and drink supplies to those in need, as well as picked up the uniforms of emergency responders to be laundered in their facilities[(Interview, 12 March 2018)].

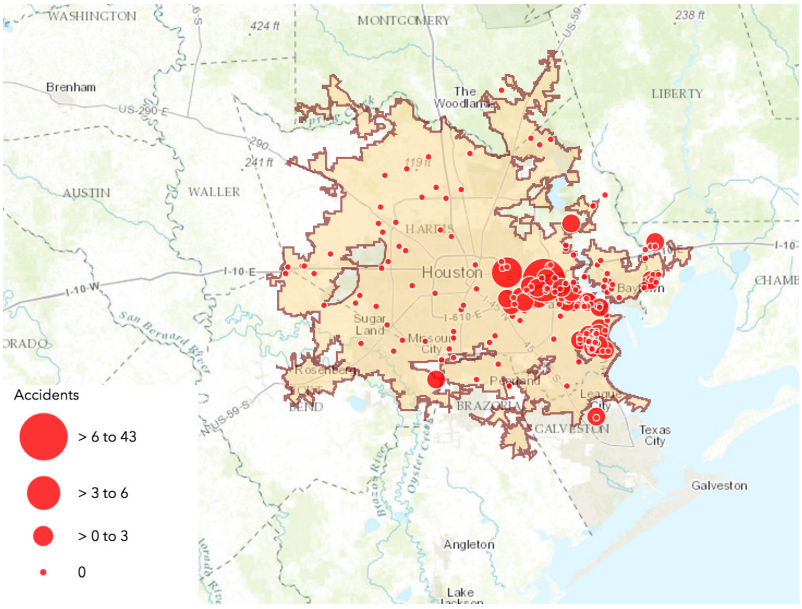



**Figure 20**. This map shows the number of accidents due to flooding. Source: Union of Concerned Scientists.

Trae Tha Truth, a Houston rapper and philanthropist, carried out rescue missions by boat during the flood[110]. It is not uncommon for entertainers, celebrities, and other public figures to donate money and hold charity functions for disasters, but rarely do we see prominent entertainers in the thick of rescue missions. In the weeks following Harvey, Trae bought and distributed supplies and mattresses to people in need, helped to gut damaged homes, and obtained a warehouse from which relief operations were carried out[105]. Relief and recovery efforts were privately funded by Trae and his network(Interview, March 15, 2018). Together with DJ Mr. Rogers, a local radio DJ, they formed Relief Gang, a non-profit aimed at providing emergency aid for Hurricane Harvey victims. Relief Gang has received over $200,000 in donations, with no overhead costs[101].

DJ Mr. Rogers used social media to communicate with people in need, identify needs for aid in various neighbourhoods, and coordinate rescue missions with people in rescue boats(Interview, March 15, 2018). In particular, a local high school teacher brought his students in canoes to assist DJ Mr. Rogers with the recovery[116]. Trae Tha Truth, DJ Mr. Rogers, and their partners were hailed as heroes on Twitter, as their work continued after the storm, helping families who have been denied by the NFIP and FEMA[105].

There are also accounts of local and regional businesses coming to the aid of flood ravaged residents in the aftermath of the storm in displays of corporate social responsibility. The owner of Gallery Furniture, Jim "Mattress Mack" McIngvale, opened the doors of his retail stores to provide 400 Hurricane Harvey evacuees places to shelter[22]. This was communicated to the public via posts on Facebook and Twitter. Likewise, Two Men and A Truck helped to transport supplies[80],


**Figure 21**. Relief Gang pictured delivering supplies to Forest Brook Middle School. Source: @reliefgang/Instagram

while the University of North Texas offered to immediately admit displaced students and waive application fees[126].

Similarly, Airbnb waived registration fees as a part of its ongoing disaster response program[94]. As well, its Open Homes program continues to allow and encourage those with available homes in the Houston area to offer their homes for evacuees for $0/night[3]. Airbnb went further to offer evacuees the option to add an affiliation to their profiles in order to match evacuees with known social connections through social, religious, or professional affiliations(Interview, 12 March 2018). This allowed people to find others in their extended social networks to stay with.

As expected, access to social services increased in the months following Hurricane Harvey. For one group, the spike in assistance with FEMA and other disaster-related topics died down within two months. LegalLine is an anonymous service available to Houstonians seeking legal advice. In the period immediately following Hurricane Harvey, the September 7, 2017 breakdown of legal questions, typically dominated by family law, saw a rise in questions about FEMA (33%), Insurance Issues (19.5%), and Real & Personal Property Issues (16.4%). As the weeks passed, hurricane-related questions subsided. By mid October, FEMA questions only made up 2.3% of the incoming calls, while Family Law regained its top position at 27.5%. FEMA questions dropped off entirely by February of 2018. Additionally, LegalLine calls relating to Hurricane Harvey steadily declined in the weeks following landfall, which was expected.

On a larger scale, Houston's experience with Hurricane Harvey highlights the impact of climate change and urban sprawl on flood risks. Hurricane Harvey is a painful reality check of what can happen when we ignore environmental hazards in favour of continuing development with minimal restraints. In Houston, local groups demonstrated an ability to respond with urgency that official responses may be unable to match. Similar to New York City, local organizations and groups were quick to carry out rescue missions and relief efforts, and used established networks to do so. Since the most recent HMP update coincided with Hurricane Harvey, it is understandable that there may be a disconnect between the policies outlined and experience. However, we should reasonably expect the 2022 update of Houston's HMP to have translated the lessons learned from the hurricane into concrete policies, much like New York City and New Orleans.

**Table 3.** Proportion of LegalLine calls related to Hurricane Harvey in the weeks following the disaster

| Week | # of calls | % related to Hurricane Harvey |
|---|---|---|
| 1 – Sep 8 to Sep 14 | 173 | 65% |
| 2 – Sep 15 to Sep 21 | 284 | 49% |
| 3 – Sep 22 to Sep 28 | 364 | 49% |
| 4 – Sep 29 to Oct 5 | 294 | 50% |
| 5 – Oct 6 to Oct 13 | 289 | 42% |
| 6 – Oct 17 to Oct 20 | 330 | 43% |
| 7 – Oct 23 to Oct 27 | 136 | 39% |

Katrina evacuees at the Houston Astrodome. Source: Andrea Booher/FEMA

# DISCUSSION & RECOMMENDATIONS

Currently, hazard mitigation principally focuses on physical infrastructure. By that token, the target of hazard mitigation plans is securing funding for capital projects. While emergency managers recognize the importance of social infrastructure and social capital, it still appears to be a peripheral topic when addressing disaster planning in practice. This is evidenced by the lack of concrete detailed strategies that support social infrastructure, even when they are mentioned as overarching goals in many plans.

Over the course of this project, I have reviewed many studies and collected many stories and opinions that support the argument that **1)** social infrastructure is important to the disaster cycle; **2)** there is insufficient support and action for social infrastructure; and **3)** social infrastructure is particularly strongly relied upon by socially vulnerable groups during the disaster cycle. I aim to add to the existing body of work that pushes for greater integration of social infrastructure in hazard mitigation planning.

In the following section, I discuss cases of discriminatory actions and attitudes that have impacted various groups and people during disasters, examples of the use of social capital during the response and recovery phase, and instances of public-private partnerships that have assisted in the disaster cycle. I finish by making recommendations to better integrate social infrastructure into disaster planning.

## Discrimination

In many reports of hurricane-related disasters, the phrase “hurricanes/natural disasters do not discriminate” was repeated. This phrase is meant to signify that rich or poor, black or white, there is little one can do to stop nature from appearing at their doorstep to wash everything away. But while extreme weather events may not discriminate, people and the systems we have created and occupy certainly do. Hurricanes are not this great equalizer that sets everyone to zero. Instead, like most adverse events, disasters disproportionately affect the poor, the disenfranchised, the socially vulnerable. This effect is amplified in cities, where the populations are more diverse and dense, but also more unequal and segregated.

We already have many examples of when disasters have disproportionately affected socially vulnerable populations. Following Katrina, low-income African Americans were more likely to experience job loss than their low-income White counterparts[133], while Latino migrants were more likely to face discrimination

and exploitation in the housing market[132]. During Hurricane Sandy, many service workers and other low-income residents of New York City did not have the luxury of taking time off from work to evacuate or shelter in place[41,104]. Meanwhile in Houston, poor communities of colour lived in more hazard-prone neighbourhoods with less protective infrastructure than their affluent counterparts[38], a fact that rings true in most American cities[87].

With every disaster, we discover new ways that emergency management, response, and recovery efforts have failed socially vulnerable populations. There is unevenness in federal and local response and recovery efforts that correlate with a number of social factors. Craemer's study on trailer counts in New Orleans, though inconclusive, indicated that claimed FEMA relief did not match up with reality and majority-black neighbourhoods were underserved[35]. Moreover, following Katrina, multiple bridges were blocked by groups of armed law enforcement officers, including National Guard troops, to prevent evacuees, majority of whom were Black, from leaving the flooded city. By then, the media had already established its racially charged narrative with reports of violence and rampant criminal activity in the Superdome and around the devastated city. In these reports, the colour of one's skin often determined whether they were "foraging" or "looting"[65]. The people attempting to cross the Crescent City Bridge were told, "There will be no Superdome here". Without going too much into America's history of slavery and discrimination, Black movement has long been contested and regulated, and freedom of movement is often symbolic of freedom itself. These incidents stripped away these citizens' constitutional rights to freedom of movement, and communicated to them that their survival and safety did not matter. This is an unacceptable response to people attempting to flee a disaster.

**Figure 22**. Residents of a nursing home in Dickinson, southeast of Houston, sit in Harvey floodwaters. Source: Trudy Lampson/Associated Press

We also already know that socially vulnerable populations are often located in areas of the city with higher risks. This was true in New Orleans, New York City, and Houston, and should come as no surprise. It is well documented that low-income housing and minority community developments are often relegated to less desirable areas that carry a disproportionate burden of environmental hazards[40]. Yet little is done to counteract this, and time and time again, disasters overwhelm our ability to adequately respond and protect the communities that need us the most. It is no wonder that vulnerable populations sometimes do not have much hope that the government will intervene or "do right" by them. In Houston,

**Figure 23**. Angela Perkins on her knees screaming "Help us, please!" outside the Earnest N. Morial Convention Center in New Orleans. Source: Brett Duke/The Times-Picayune

the father of environmental justice Dr. Robert Bullard describes this as "the wrong complexion for protection"[38]. The issue, of course, stretches beyond race.

Following Sandy, the Centre for Independence of the Disabled won a class action lawsuit against New York City for discriminating against residents with disabilities. The City was found to have failed to provide meaningful access for people with disabilities in their emergency response services and programs that affected their ability to evacuate and was ordered to revise and improve their emergency preparedness programs[93].

However, discrimination is not always explicit and may manifest itself in more benign ways, such as lack of visible representation. An interviewee in Houston explained that some relief efforts simply do not get attention in mainstream media when they involve Black people helping Black communities. Jim McIngvale and Trae Tha Truth are two prominent Houstonians whose contributions have been described in **Case Study 3**. McIngvale's good deeds made headlines nationally and internationally – Time, CBC, ABC, Global News, CNN, CNBC, and many other news outlets applauded his philanthropy. McIngvale's good work was even publicly praised by President Trump in his remarks at the Welcoming of the 2017 World Series Champion Houston Astros[118]. Meanwhile, reports of Trae's story have mostly been via local news (ABC13, Houston Chronicle, CW NewsFix) or hip hop outlets (XXL, Complex, BET). A look at their social media presence shows that Trae has almost four times more followers than McIngvale

and his company combined.

It may seem reasonable to argue that McIngvale has a history and reputation of generous philanthropy. But Trae is no newcomer to giving back to the Houston community; Trae has held Trae Day, an annual charity carnival and concert inaugurated by Mayor Bill White, for the last ten years[21]. Surely, a man who has been honoured with his own day by the then-mayor of Houston warrants more recognition, particularly as he offers help to vulnerable low-income populations(Interview, March 15, 2018)?

Discrimination manifests in benign ways such as biases in the media

I bring attention to this not to minimize or invalidate McIngvale's contribution to the Houston community, as he undoubtedly is a hero to many Houstonians. I do this to highlight the biases in mainstream media. Trae is a reasonably well known entertainment figure who has recently been honoured by the City of Houston for his selfless rescue and recovery work[43], so where are his Time features?

It is clear that government-led disaster responses are not perfect, especially when it comes to socially vulnerable populations. We cannot expect them to be perfect as disaster management is a dynamic system with many moving parts. Disaster mitigation and preparedness, in contrast, focuses on the pre-emptive steps taken to reduce the loss of life and property, and, hand in hand with response and recovery, may be able to better address protecting socially vulnerable people.

## Social Infrastructure

Social networks have proven themselves to be instrumental to the success of disaster response and recovery efforts for a number of communities. Studies have demonstrated the central role of social networks in the response and recovery phases in communities such as Versailles, New Orleans, and the Orthodox Jewish community of Far Rockaway, New York. Social capital afforded members of these groups the connections and resources that they may not be able to mobilize alone – resources such as financial help, physical assistance, and information. Local non-profits in Houston depended on their bonding and bridging social capital to carry out relief work, including dispatching rescue efforts, collecting donations, distributing food and supplies, communicating information, and providing emotional support (Interview, March 15, 2018). Additionally, non-profits in both New York City and Houston identified their networks with other organizations as central to their relief operation - one person described these relationships as the "infrastructure to people's lives"(Interview, February 27, 2018).

For some socially vulnerable populations, particularly those who are poor, social capital may be the only and most powerful resource they have. It is a medium through which information is transmitted, and goods and services are informally exchanged, such as money, food, clothes, medicine, and supplies during emergencies. Socially vulnerable people depend on these relationships more than their affluent counterparts do because they may not have the financial means to, for example, take out a loan, stay at a hotel, or hire babysitters or care workers. The resources that social networks provide can, and often do, fill the gaps and allow people to carry on with their lives, which is why disruptions in these networks can be even more devastating.

Social networks are comprised of those people

we may know, trust, or communicate with the most. This is why social capital in disaster management matters. One planner expressed that there is cultural distrust due to the media, and communities may not distinguish between federal and local governments. Particularly in ethnically diverse societies, there may be greater social trust within communities than in government institutions. This is especially true of religious leaders, as they are highly regarded and trusted within their communities to guide their congregation and communicate important information, particularly about disaster knowledge(Interview, February 22, 2018). Indeed, many of the success stories have religious organizations at the centre of recovery operations, in no small part due to the large existing network that they have. Similarly, the presence of family and neighbours have been shown to aid and influence decision making through the entire disaster cycle, from pre-event evacuation to post-event recovery. This was demonstrated in studies carried out in New Orleans and New York City, where many residents cited family and sense of place as primary factors for choosing to return and rebuild rather than relocate. Since family and neighbours make up a significant part of one's social and support network, this is understandable.

Online social networking platforms – Facebook, Twitter, Instagram, etc. – have also had important roles in recent disaster responses. As previously discussed, Facebook's Safety Check has been used to communicate safety status to one's social network, while Twitter has been used extensively during both Hurricane Sandy and Hurricane Harvey. Social media has undoubtedly infiltrated the communication landscape of North Americans, and disaster managers, volunteers, and relief workers have been able to use the messages shared on these platforms to coordinate and dispatch assistance 9,66. However, social media is a double edged sword and can exacerbate negative developments such as disseminate false reports, promote the terrorist agenda, and undermine authority[7]. Nonetheless, social media remains an increasingly important part of emergency management as it facilitates social cohesion, communication, and the exchange of information.

What about businesses? Businesses that have built themselves on the model of providing platforms or services that connect people with one another undoubtedly recognize the importance of social infrastructure, particularly as some attempt to remove the vertical relationships that traditional means of the services entail – think hotel staff, taxi drivers, customer service reps. They can also act with the type of rapidity and urgency that local, state, and federal actors may not be able to. Take, for example, the story of Airbnb's feature where users can identify their social affiliations – this came from an overheard conversation at a bar in Mexico during the hurricane. A Houston planner was discussing the idea with their friend. By chance, an Airbnb employee was also at the bar, and joined the conversation. Ideas like this may seem small, but they can make a significant difference for some, particularly those that may have reservations about seeking help or shelter, such as members of the LGBTQ community. Since a platform already existed, Airbnb was able to quickly roll out this new feature with relative ease. The same could be said of Facebook's Safety Check feature.

Businesses have also come under fire for not acting rapidly or appropriately. This is particularly true if the service is relied upon in everyday life and affects people's safety and wellbeing. For example, Uber was heavily criticized for hiking up prices in New York City during Hurricane Sandy[23] and Sydney, Australia during a hostage situation[60]. To counteract the negative press, Uber, in partnership with the New York State

Attorney General, worked to turn its image around by implementing pricing caps during emergencies and natural disasters[91,123] and offered free rides to shelters during Hurricane Harvey[124].

Public-private partnerships such as these are mutually beneficial for a number of reasons. They provide necessary services (food, transportation, shelter) during emergencies and may be more easily adapted to specific needs because of the existing infrastructure of their platforms. These partnerships in turn benefit the businesses as they allow them to publicly display corporate social responsibility which casts the brand in a positive light.

## Planning and Public Policy

During Katrina, many people believed that those who remained "got what they deserved". But, as Ivor Van Heerden discusses in his book *The Storm*, this attitude does not and should not influence public policy as "no government – no nation – can sit by and watch tens or hundreds of thousands of people drown or otherwise die, even if it is the result of their own bad decision"[127]. So what can we do? Planners and disaster managers have a professional and moral responsibility to ensure equitable protection in everyday life, but especially in situations of disasters or emergency. Through a thorough understanding of the risks, hazards, and vulnerabilities in their city, disaster planners and managers can influence the outcomes of a traumatic event and help ensure successful community recoveries.

### Best Practices

To understand how to address socially vulnerable populations and communities, the first step is to look towards existing examples and best practices. For example, the HMP for Tulsa, OK outlines explicit strategies for addressing Special Needs populations; Fairfield, SC uses the Social Vulnerability Index to identify and classify vulnerable communities within Fairfield County; and Baltimore, MD coordinates with vulnerable populations to improve their protection and prioritize retrofitting public housing units to improve their resiliency. Linn County, IO uses a voluntary emergency assistance registry that allows residents to mark themselves as requiring special assistance during evacuations, and New Orleans, as previously mentioned, has built partnerships with volunteer organizations, like Evacuteer, that assist in evacuations. Additionally, as many cities, such as New York City and Houston, with ethnically diverse populations are already doing, making disaster-related materials available in multiple languages is a great way to improve resource accessibility for linguistically isolated groups.

> Public attitudes towards "bad" decision making should not influence public policy

### Funding

We must then establish funding priorities. It is clear there is a fundamental problem with the way disaster management is funded. Echoed across most non-profits and community groups is the need for more funding, as financial capital, more than anything else, is the number one factor that limits their ability to carry out ongoing resilience work which involves continued network building. Many professionals in the field agreed that there is a gap in long-term planning and, while there is a sharp rise in federal funding for resiliency and mitigation following a major disaster, it quickly dies down in the months and years that follow. People's interest in resiliency and disaster readiness follows a similar pattern,

which is also a challenge for community groups as they struggle to find the resources to fund the dedicated coordinators required to carry out sustained disaster preparedness work and manage volunteer groups during disasters. Additionally, federal funding is limited. For example, FEMA caps Individual Assistance funding to homeowners for home repairs at $33,300[46,51]. The idea is this funding supplements NFIP's flood insurance, which can provide more money. However, many homes outside of predetermined high risk areas, where flood insurance is not mandatory, become inundated during disaster events. This leaves homeowners and communities responsible for their own recovery, which they may not be equipped to do. Other solutions, such as federally funded buyout programs, require difficult decision making within traumatic environments. Their often time-sensitive nature exacerbates the stressful nature of the response and recovery phases.

**Community Outreach**

We must also reassess the way we carry out community outreach, which requires a shift in approach from traditional planning. Planners have historically handled planning with a top-down approach, particularly in poor neighbourhoods. After seeing the failure in evacuation planning in New Orleans, we now understand that effective plans require consultation with citizens, especially as it relates to decisions and plans that impact them[12]. Good planning requires community engagement because people deserve to have a say in plans that affect them. Successful community outreach, particularly in communities that planners may not be familiar with, requires a bottom-up approach.

Care must be taken in the planning process to validate the reality of the members of a community. We must speak to the public in a way they understand, to listen to their needs, and to ask questions and engage in meaningful conversation, and come to solutions that are in line with what they ask for. Questions about who they trust and what they identify as critical in emergencies are important to establish as they inform successful disaster preparedness and response. In New York City, the Office of Emergency Management transfers much control to community groups to create their own networks and establish their own emergency plans.

Of course, there are limitations to community outreach, and barriers may exist within communities. One planner noted that although community boards may have good representation, they may also exhibit the negative effects of bonding social capital and discourage community engagement or be exclusionary for various social or political reasons. They noted that if the city wants to engage with communities, they must go through community boards, who have control over their members' access to planners and can create barriers for communicating feedback. Knowing this is important as planners continually work towards overcoming barriers.

Available ongoing solutions would also help promote greater resiliency and adaptation. A good example of this is Mecklenberg County, NC, which experiences regular riverine flooding. In the past, many homes, businesses, and other properties have been allowed to develop on the county's floodplains because of the NFIP program. To reduce flood damage, the county offers floodplain residents voluntary/optional buyouts[27]. Unlike many other buyout programs that arise following a disaster, this program is an ongoing part of a strategic plan to mitigate losses from flooding and is almost entirely locally funded by the county's stormwater management funds. The program's ongoing nature gives homeowners time and space to make careful decisions free of the trauma and pressure of a flooding incident.


Cajun Navy rescues residents during Hurricane Katrina. Source: R&R Construction

# CONCLUSION

With every disaster, we learn a little more about the gaps in the disaster cycle that require attention or intervention. From previous experience with major hurricanes, we know that federal and local government agencies cannot carry the full weight of the response and recovery phases. Grassroots responses and networks have frequently had to assume responsibility as they wait for the government's help.

Communities that have quickly and successfully recovered from a disaster have often been found to have depended heavily on their social networks, looking to them to communicate and coordinate recovery efforts with one another. The growing body of literature on social capital indicates that communities with more trust and stronger networks are better able to mobilize shared resources that aid them in successful recoveries. Moreover, social capital has often afforded people goods and services essential to survival that they may not be able to obtain on their own.

Three common themes emerged from the case studies presented in this report:

1. Hazard mitigation planning remains largely focused on the protection of physical infrastructure and does little to addresses the social impacts of disasters. Community outreach for the purposes of hazard mitigation and resilience building is limited, uneven across cities, and constrained by funding;
2. Disaster response and recovery remains uneven, most commonly stratified across racial and/or socioeconomic lines. Disasters disproportionately affect socially vulnerable populations owing to a number of factors such as pervasive systemic discrimination, lack of access to resources, and low social capital; and
3. Social capital, in the form of social networks, plays a valuable role in many people's disaster response and recovery as well as their collective ability to tackle resilience issues. These networks have proven to be instrumental in coordinating response efforts and have enabled successful recoveries, regardless of demographic characteristics such as race, religion, or income level.

Hazard mitigation and emergency management priorities do not reflect the findings of the body of literature on social capital as it relates to disaster management. If it is true that social capital enables more resilient communities, then it stands to reason that social infrastructure should be a mitigation priority. Given the integral role that social networks play in grassroots disaster response and recovery, we have to work towards integrating the enhancement and protection of social infrastructure into hazard mitigation planning and disaster management.

From this research, I draw three conclusions and make several recommendations: First and foremost, the inclusion of social infrastructure in hazard mitigation planning is uneven across

cities. While New York City and New Orleans' HMPs and disaster programs display moderate inclusion, Houston's do not. Therefore, more attention must be brought to the importance of social infrastructure such that its inclusion in hazard mitigation becomes standard. Policy makers need to understand that if social capital helps communities bounce back after a shock, then the community's long term wellbeing depends on the strength of its social infrastructure before a disaster strikes. We also have to rethink what critical infrastructure means with respect to social infrastructure, and work to identify the key community members, social services, and communication networks that members of each community depend on in emergencies.

Second, the field of planning has typically been a top-down exercise, but as we all know, human behaviour does not conform to plans, especially in emergency situations. Community outreach and engagement has to be a bottom-up exercise if we want it to be meaningful, genuine, participatory, and effective. We can start to do this by bringing planning and disaster preparedness to the community by integrating presentations into events where people already meet, rather than asking people to come to a meeting they may not think is relevant or of interest to them. We also need to take a bottom-up approach to the way we engage with communities in disaster discourse and recognize that communities have a better understanding of their needs and know what they want. We must give communities more power – by giving them the necessary resources and tools – to build their own preparedness plans that identify what is critical to them. We must validate their realities and work with them to fill in the gaps.

Lastly, disaster management funding is sometimes at odds with long-term community mitigation planning, and communities and cities may find it difficult to prioritize and commit to mitigation and preparedness without adequate funding. Planners need to build a culture in which ongoing prevention and mitigation trumps response and rebuilding, and consider establishing more public-private partnerships to formally involve local organizations and business in emergency response and recovery efforts.

While it may impossible to provide absolute protection at all times for everybody, there remains ample room for improvement in hazard mitigation planning. These plans do a disservice to their citizens if they are not able to protect and enhance the social infrastructure that afford cities their character and life. It bears repeating that "a rebuilt bridge or refurbished home does not a community make"[5]. This adage rings true for disaster planning, and disaster management practices need to find balance between protecting physical infrastructure and protecting the lives that exist within and in between them.


Hurricane Harvey Source: Alyssa Schukar/The New York Times

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