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Responding to Risk: The Making of Hazard Mitigation Strategy in Post-Katrina New Orleans

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New Orleans faces unique types of catastrophic risk resulting from a combination of factors that include potential levee failure, land subsidence, coastal erosion, rising sea level, and stronger and more frequent storm activity. A comprehensive hazard mitigation strategy would address these unique types of catastrophic risks in addition to addressing the standard types of repetitive risk already covered by conventional approaches. Diverse actors are engaged in the making of this new strategy. This paper introduces New Orleans' response to its emerging risk profile, with emphasis on the risk of flooding.

Background

The premise underlying the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program is that future claims covered by the National Flood Insurance Program (NFIP) must be reduced. Such claims arise as a result of flood damage to homes insured under NFIP. Flood insurance for homeowners is federally subsidized and shared across the U.S. In the case of Louisiana, most claims are covered by payments from outside the Southeast region (FEMA 2008). Naturally, the federal government has an interest in reducing overall program costs, and for this reason it operates a national hazard mitigation program comprised of several types of grants to mitigate against flood risk and to reduce the cost of claims. Only those homes that have already filed numerous flood damage claims are eligible for these grants. FEMA keeps track of these repetitively damaged homes by identifying them as Repetitive Loss and Severe Repetitive Loss properties¹.

To meet the goal of reducing the overall cost of claims paid, the primary objective of the Hazard Mitigation Grant Program is to provide grants for mitigating Repetitive Loss and Severe Repetitive Loss properties (e.g., by elevation, reconstruction, acquisition, etc.) when the cost of the mitigation is less than the cumulative cost of NFIP claims. Only NFIP-insured property owners are eligible, and only those property owners that filed enough past claims to warrant inclusion on the Repetitive Loss and Severe Repetitive Loss lists can receive mitigation grant money. Therefore, these criteria prioritize properties with a documented history of flood damage, and they direct hazard mitigation funds to properties that were the subject of past flood risk. While necessary in its own right, this hazard mitigation strategy is insufficient on several grounds. Most fundamental of these is that the strategy manages risk as if it were a static phenomenon. In truth, risk is a changing phenomenon. The risks of the past are not the same as the risks of the future. Moreover, our understanding of risk continues to change over time. As a result, the conventional hazard mitigation strategy as performed under FEMA's Hazard Mitigation Grant Program contains gaps that preclude a focus on the elimination of future flood risk, which is considerable.

How Mitigation Funds are Prioritized

What does this mean in New Orleans? Figure 1 is a map of the properties on FEMA's 2008 Severe Repetitive Loss list for New Orleans. The most severely damaged properties are concentrated in the lowest lying area of the city, known as the bottom

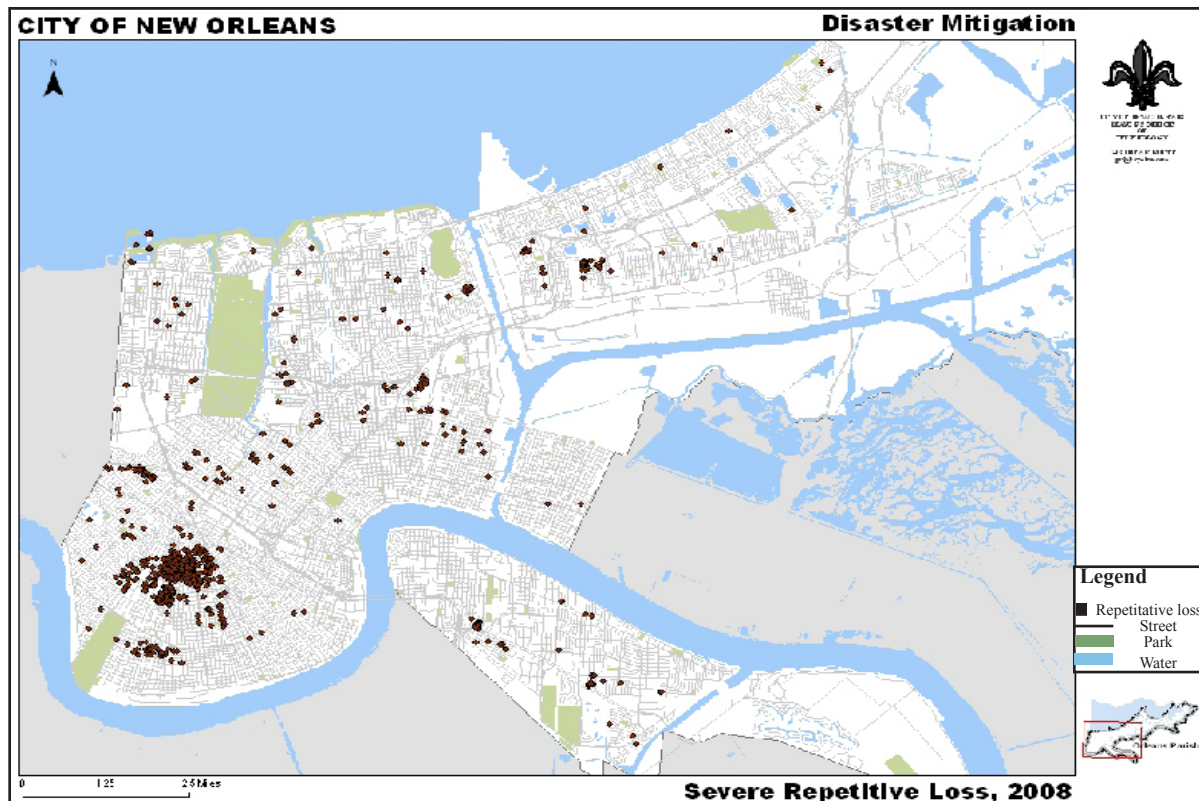


Figure 1. Severe Repetitive Loss sites in New Orleans (Source: Office of New Orleans, Mayor's Office of Technology, GIS Department).

of the New Orleans bowl, which happens to be in a neighborhood called Broadmoor. Broadmoor is a low and middle income area with a pre-Katrina average household income of \$36,399 (compared to a parishwide average of \$43,176 and a statewide average of \$44,833)². Benefit-cost ratios for mitigating the kinds of homes in Broadmoor range anywhere from 2 to 20, making mitigation quite a sound investment theoretically.

Most of the homes in Broadmoor are on the Severe Repetitive Loss list because their low elevation, and historically poor local drainage puts the area at high risk of flooding. In general, rainfall events above 0.5 inches per hour exceed the capacity of the city's drainage pumps (Roberts 2008) and result in localized flooding in the lowest lying areas. New Orleans receives an average of 62 inches of rain each year, often in torrential downpours typical of humid sub-tropical climates. A history of poor drainage and low ground levels have resulted in repeated flooding and NFIP claims, as documented by Broadmoor's prevalence on the Severe Repetitive Loss list. Housing developments

were allowed to proliferate even in the lowest lying areas after the 1950s, when the city was under great pressure to expand. FEMA's Hazard Mitigation Grant Program is perfectly designed for tackling the high frequency flooding that Broadmoor faces, and applying Program resources to Severe Repetitive Loss properties first achieves the Program's fundamental objective. The City of New Orleans is in fact doing this. The great majority of its post-Katrina hazard mitigation funds are being used to elevate and reconstruct homes in the Broadmoor area.

The City is subject to riverine, coastal, and rainfall-induced flooding. This flood risk was last codified by FEMA in 1980s-era flood insurance rate maps for New Orleans³. In those maps, the entire neighborhood of Broadmoor is designated an "A" Zone, indicating that the whole neighborhood is within the 1 percent (i.e., 100-year) flood zone and that NFIP flood insurance is required. So, despite its apparently undesirable location in the bottom of the bowl, the Broadmoor neighborhood is nicely covered by the NFIP and Hazard Mitigation Grant

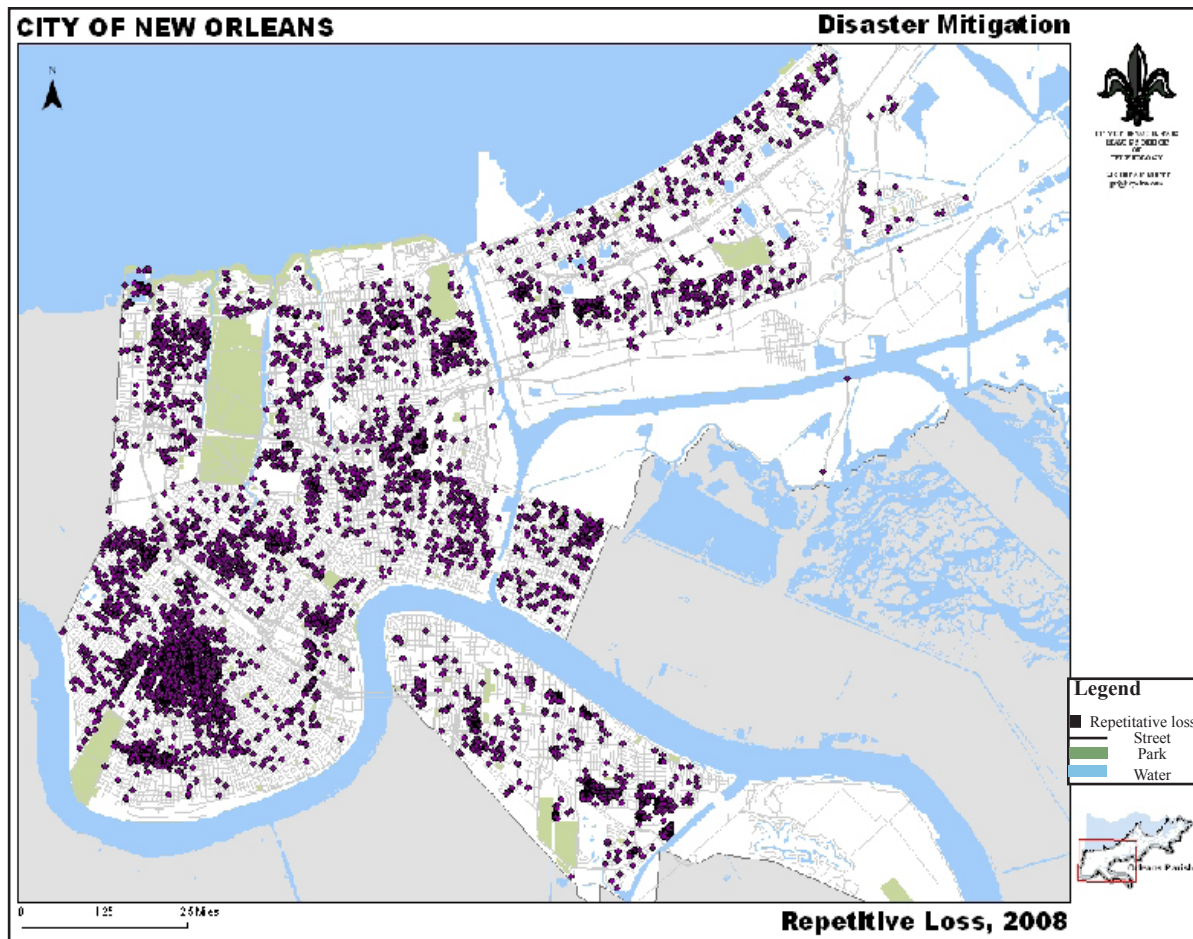


Figure 2. Repetitive Loss sites in New Orleans, 2008 (Source: Office of New Orleans, Mayor's Office of Technology, GIS Department).

Program programs.

In addition to these programs, the Broadmoor neighborhood has recently received local flood control infrastructure improvements as part of the Southeast Louisiana Urban Flood Control Project. These improvements, which include a pump station expansion and box culvert to transport rainfall-induced flood waters away from the area, were completed in 2004 by the Army Corps and Orleans Parish. The project has successfully reduced flood risk to the point where past risk no longer provides an accurate picture of future risk. Properties on the Repetitive Loss and Severe Repetitive Loss lists are no longer subject to the same flood risk that put them on these lists to begin with, as documented thoroughly by a neighborhood area analysis conducted by the University of New Orleans (Laska et al. 2007). This is a case study of success, where the conventional strategies of flood

plain management, flood control, and mitigation have combined to reduce overall risk in one of the most flood-prone areas of the city.

But despite this success, much more of New Orleans is at risk of flooding outside of the low-lying bowl. Figure 2 shows the properties on FEMA's 2008 Repetitive Loss list for New Orleans, and Figure 3 shows the properties that were substantially damaged as a result of Hurricanes Katrina and Rita. It is evident from Figure 2 that there are thousands (i.e., over 6000) of repetitively damaged properties in New Orleans primarily due to moderate rainfall events, and that these properties are quite evenly distributed throughout the city. On the other end of the scale are the catastrophically damaged properties that resulted from Hurricanes Katrina and Rita, which are also well distributed across the city. Figures 2 and 3 reveal that flood risk in New Orleans is widespread; however,

neither of these maps gives the policymaker any leverage in terms of prioritizing mitigation.

The question is whether the widespread risk shown in Figures 2 and 3 can be mitigated effectively using the conventional Hazard Mitigation Grant Program mitigation approach that is so well suited for mitigating the risk shown in Figure 1. There clearly is not enough Program funding to mitigate every home on the Repetitive Loss list or to mitigate every substantially damaged property in New Orleans, and it does not make sense to simply elevate random individual homes throughout the city (<https://ipet.wes.army.mil>). What is needed is a strategy for prioritizing mitigation beyond using the Severe Repetitive Loss list. Fortunately, more information about risk is now becoming available that will guide future mitigation efforts in a comprehensive way.

The Emerging Picture of Flood Risk

No city in the world understands its future flood risk better than New Orleans. Because of the severity of Hurricanes Katrina and Rita in 2005, New Orleans now has the best available surge and flood risk models in the world, including the complex storm surge model produced in collaboration with the Army Corps by the Interagency Performance Evaluation Task Force. New Orleans now has a better idea of which sections of the levee system are weaker than others, and we now know exactly what areas are most at risk of flooding. Figure 4 is one of the Interagency Performance Evaluation Task Force risk maps recently made available to the public on the Army Corps' website (as of March 2008). It highlights the areas of the city most at risk of surge-induced flooding during a 1 percent (i.e., 100-year) storm with 50 percent

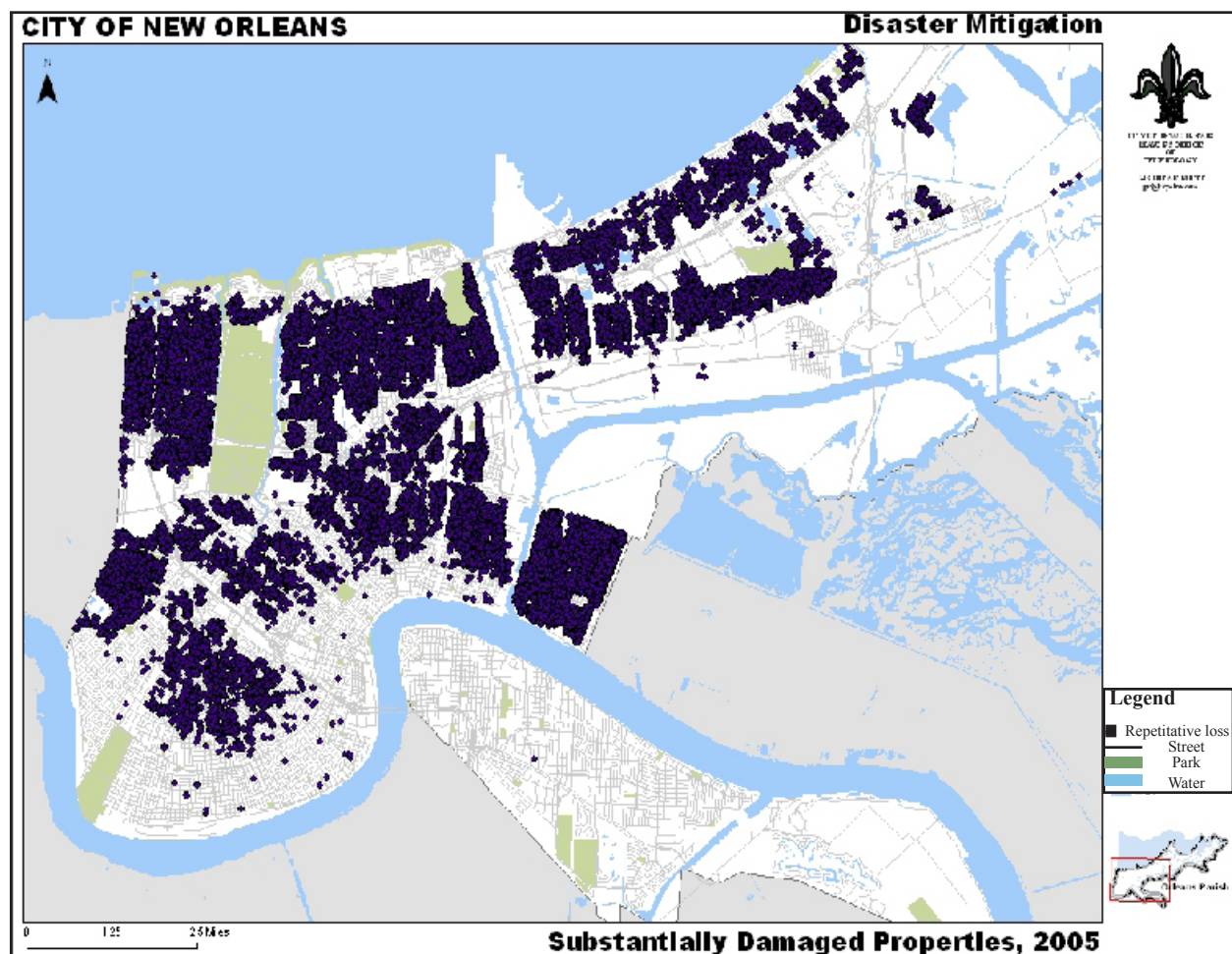


Figure 3. Properties in New Orleans substantially damaged by Hurricanes Katrina and Rita in 2005 (Source: Office of New Orleans, Mayor's Office of Technology, GIS Department).

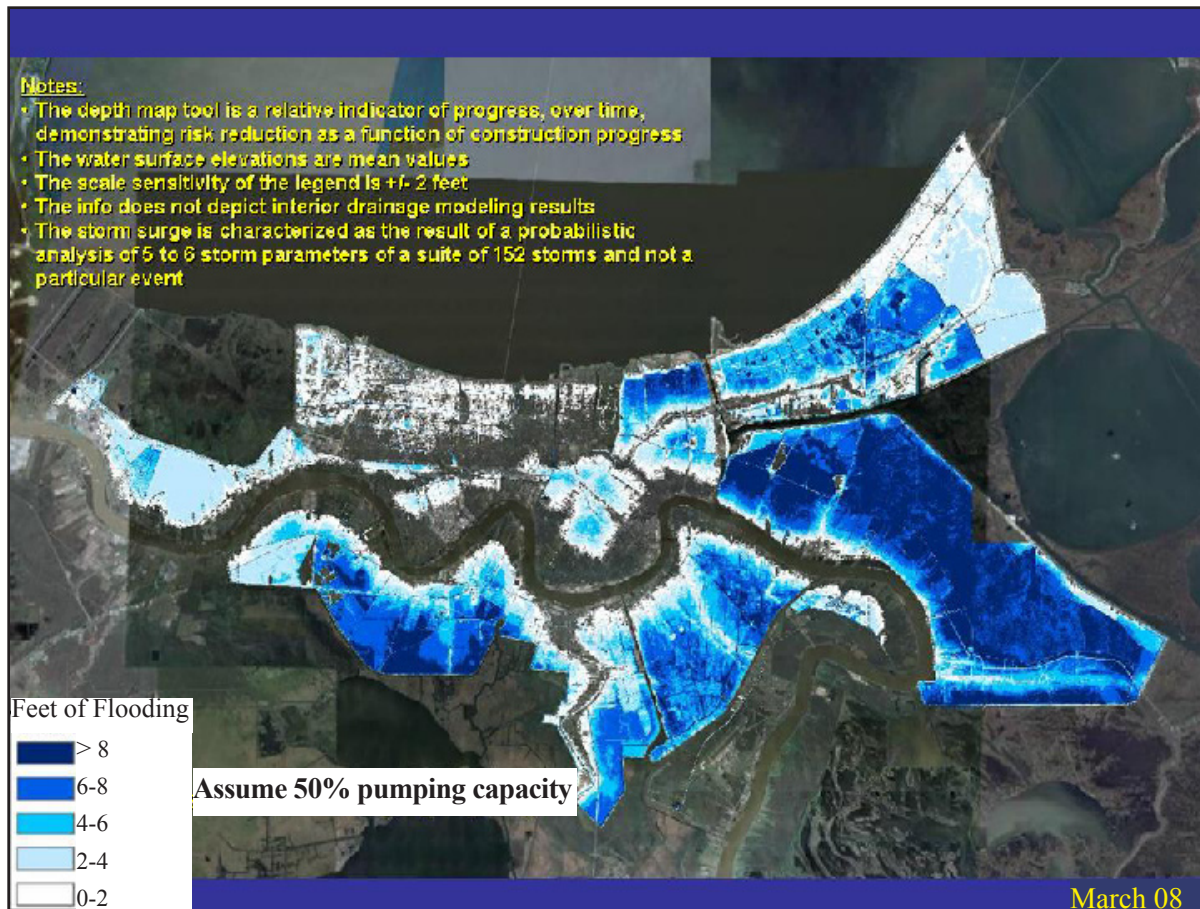


Figure 4. Areas of New Orleans most at risk of surge-induced flooding during a 1 percent (i.e., 100-year) storm with 50 percent pumping. Source: Interagency Performance Evaluation Task Force 2008 (Source: Office of New Orleans, Mayor's Office of Technology, GIS Department).

pumping⁴. Figure 4 includes levee repairs and improvements completed as of June 2007 (IPET 2008). Like many of the maps released with the Interagency Performance Evaluation Task Force Report, it reveals that the eastern half of the city is more at risk of flooding than the western half. These high risk areas include the neighborhoods of Gentilly, New Orleans East, and the Lower 9th Ward. These areas do not have the historical and well-documented drainage problems of Broadmoor; in fact they rarely flooded at all.

It is important to point out the striking contrast between the areas of past risk that were mostly contained inside the New Orleans "bowl" (Figure 1) and the areas of future risk that are primarily located in the eastern half of the City (Figure 4). It is also important to recognize several key distinctions when viewing the various maps. Figures 1 and 2 were developed from actual cumulative damages

caused by intense rainfall and hurricane-induced flooding, while Figure 3 was developed from actual damages caused by two catastrophic hurricane-induced flood events. Figure 4, on the other hand, was derived from probability calculations of the risk of surge-induced flooding caused by a wide range of hypothetical events. The conventional mitigation approach has been developed on the basis of an accumulation of actual damages, not on the basis of catastrophic events or hypothetical risk. As a result, the areas of New Orleans that are at highest future risk (i.e., the eastern half of the city), are not currently prioritized for Hazard Mitigation Grant Program mitigation funding because of their low prevalence on the Severe Repetitive Loss list.

What is so different about the risk in these two areas that the outcomes can be so disparate? Broadmoor's risk is largely due to frequent intense rainfall events and occasional hurricane

events, while risk in the eastern neighborhoods (i.e., Gentilly, New Orleans East, and the Lower 9th Ward) is mostly due to catastrophic hurricane-induced flooding. This difference in risk – high frequency risk versus high consequence risk – is significant because the conventional mitigation approach is designed to handle high frequency type risk quite well, but not high consequence risk. Most of New Orleans' high consequence risk is mitigated by the levee system and flood zone management, but, despite this system, local differences in high consequence risk remain.

While the differences in high frequency risk were widely known because they were visible every year, the differences in high consequence risk were not widely apparent before Hurricane Katrina. As a result, residents had no way to know what they were getting into (in terms of high consequence flood risk) when they made decisions about where to live. It is critical for all New Orleans residents to understand not just risk, but the type of risk and how it is geographically distributed.

Developing a Hazard Mitigation Program for New Orleans

What can New Orleans do to reduce residual high consequence risk across the city if the funding available through the Hazard Mitigation Grant Program cannot be readily targeted to the areas of the city most at risk? Prior to Hurricane Katrina, mitigation had not been deeply incorporated into urban development decisions in New Orleans. Rather, New Orleans had relied historically on a federal system of levees, floodwalls, and pumps to provide the primary protection from flooding. Despite the fact that much of the city was below

sea level and that land subsidence was a continuing reality, large swaths of the city were allowed to be constructed with slab-on-grade construction and many residents in elevated homes were allowed to inhabit the first floor, thus placing people and property in direct risk of flooding. An exaggerated sense of reliance on the levee system (now known as the hurricane protection system) probably fueled these settlement patterns, which in hindsight now seem foolish. Furthermore, after Hurricanes Katrina and Rita the City was unable to strictly enforce elevation requirements on substantially damaged properties (USA Today, Sept. 2008). Urban planning decisions, enforcement of building standards, flood plain management, and emergency preparedness all have enormous impacts on risk exposure and on actual damages to life and property, and these are the kinds of decisions to which municipal officials can directly contribute. One of the positive outcomes of the catastrophic levee failure in New Orleans is that the stage was set for strengthening these areas and for incorporating mitigation into the city's rebuilding and recovery process.

A hazard mitigation unit was launched in February 2007 as part of the city's recovery management office (see Table 1). In August 2008, the hazard mitigation unit transitioned into its permanent organizational home in city government, the Office of Homeland Security and Emergency Preparedness. The hazard mitigation unit is developing mitigation policy along two major lines: 1) maximize the city's participation in FEMA's conventional hazard mitigation grant programs to provide protection in areas of the city at highest historic risk based on past NFIP claims

Table 1. Objectives of the New Orleans hazard mitigation unit.

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- Communicate hazards and risks to New Orleans residents in coordination with the Office of Emergency Preparedness, the Office of Communications, the Office of Recovery, the LRA, GOHSEP, FEMA, and the Army Corps of Engineers.
 - Develop comprehensive solutions, policies, and programs to manage hazards and risks in coordination with the Department of Safety and Permits, the Office of Emergency Preparedness, and the City Planning Commission.
 - Build long-term City capacity in hazard mitigation and risk reduction, including acquiring funds for hazard mitigation projects.
 - Include knowledge about hazards and risks into city planning and project development processes.
 - Incorporate hazard mitigation and risk reduction principles and requirements into the City's Master Plan and Municipal Code.
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(i.e. high frequency risk mitigation), and 2) seek Hazard Mitigation Grant Program and other funds to develop a non-structural program that provides mitigation in areas of the city at highest future risk (i.e., high consequence risk mitigation)⁵. These two policy components are a direct response to the two broad types of risk that were described previously. Since Hurricane Katrina, the hazard mitigation unit has sought over \$100 million in FEMA mitigation grants for activities including (1) elevating and reconstructing homes on the Repetitive Loss and Severe Repetitive Loss lists; (2) hardening drainage pump stations, the emergency operations center, and other critical facilities; (3) implementing flood control projects in several neighborhoods; (4) conducting a citywide all-hazards risk assessment; (5) updating the city's mitigation plan; and (6) scoping new mitigation projects. FEMA has also expanded the amount of hazard mitigation funds directly available to homeowners.

The City's hazard mitigation unit is developing a non-structural program to protect the most at-risk areas of the city using Hazard Mitigation Grant Program grants to incentivize mitigated development on higher ground. A non-structural strategy will be incorporated into the City's long-term urban development policy via a number of steps. First, the policy will be articulated in the update to the City's Hazard Mitigation Plan. This plan will be linked to the City's master plan, zoning ordinance, and municipal code, and projects will be scoped and implemented.

In selecting pilot and demonstration projects, the City will prioritize projects located in Target Recovery Areas identified in the City's recovery plan⁶, projects located in areas with a high or medium residual risk of flooding to maximize the benefit of investing in mitigation, and projects that facilitate the creation of clustered communities and that keep neighborhoods intact. There is widespread agreement that the target recovery areas are critical to the City's economic and neighborhood development, and for this reason these are the City's priority areas for investment. It is also widely understood that returns on investment in mitigation are higher when the avoided cost of damage is high, resulting in higher benefits at higher risk levels and lower benefits at lower risk levels. Furthermore, building clustered development around strong

economic and commercial centers and maintaining existing neighborhoods to the degree possible are aspirations that were widely cited by New Orleans residents in the 2007 Unified New Orleans Plan. These principles will be carried forward as part of a non-structural policy. Five types of non-structural protection will be demonstrated:

- *Property Buyouts and Relocation to New Elevated Structures.* This option involves buying out homeowners located in low-lying, high risk areas and offering them new elevated homes elsewhere in the same or an adjacent neighborhood. The cost of the buyout and the cost of providing mitigated housing would be covered by the project. For an existing urban area like New Orleans, the bought out property must be able to be redeveloped appropriately.
- *Elevation of Structures in Place.* Existing homes or commercial structures would be elevated on their existing site. To qualify for this option the site can be at more than medium risk, where relocation is not required, but mitigation is still achieved. Higher risk sites will require relocation because structures cannot be elevated above the maximum 12-15 feet. For most structures, elevations of this height would be undesirable for functional reasons.
- *Secondary Levees/Floodwalls.* This option involves the construction of small secondary levees or floodwalls, up to 6 feet around critical public facilities or commercial facilities.
- *Dry Flood Proofing of Commercial Facilities.* In this option waterproof walls up to 4 feet in height would be installed on the surface of the existing external walls of a commercial structure. To qualify for this mitigation method the structure must be located in an area that has not received more than 2-3 feet of flooding.
- *Hardening of Critical Facilities.* Critical facilities would be retrofitted to increase their operability during a typical flood event. Changes would include: elevating pumps, generators, electrical wiring, and

other critical equipment above a structure's flood zone; moving operations above the first floor.

Developing a clustered residential elevation program (i.e., the first example listed above) is particularly difficult to implement in existing neighborhoods for several reasons. The first challenge is the extensive information needed at the address level about risk, cost, and the desire of existing property owners to make appropriate siting decisions. Also, large scale property acquisition is problematic in most cities because removing property from commerce in perpetuity (as required under FEMA's traditional mitigation rules) is undesirable from a local economic development and recovery perspective (FEMA 1999). Voluntary buyout programs (such as the buyout option associated with FEMA's Road Home Program) typically yield only scattered sites rather than contiguous land, so this approach only goes so far in terms of risk reduction. A demonstration of clustered, elevated residential development will most likely be associated with new construction and will probably have to target specific homeowners from a medium-to-high risk location. Most of the arrangements for this kind of demonstration project will have to be worked out with individual homeowners on a case-by-case basis.

Less than half of the households have returned in 16 of the 50 New Orleans neighborhoods that flooded in Hurricane Katrina (Greater New Orleans Community Data Center 2008). And with each additional significant storm, the public increasingly wonders about the level of risk and the recurring cost of rebuilding. FEMA's ongoing project to update the country's flood insurance rate maps, including the New Orleans maps, will incorporate much of the now-public risk information provided in the Interagency Performance Evaluation Task Force maps. This could result in the re-zoning of some at-risk areas and possibly an increase in flood insurance rates in those areas, which would further incentivize existing residents to mitigate their properties or move to higher ground. To avoid the potential dampening effects on the City's recovery and on the rate of population return, it is important to have non-structural options available to affected residents so they can make decisions based on full knowledge of risk and cost. Such

options should be widely available, but prioritized for known areas of risk such as the eastern half of the city and the bowl. In order to succeed in doing this, conventional hazard mitigation criteria must be adjusted to the new conditions of existence in New Orleans. If these criteria are not updated, then much of the city will not be eligible for mitigation in spite of their risk level and the degree of flood damage caused by Katrina and Rita.

Several tensions and challenges have emerged thus far in developing these parallel policy approaches. First of all, funding is readily available for the first policy area through a range of hazard mitigation grants provided by FEMA; however, there is no direct funding for a city-driven non-structural program per se. The funding that is available is very short on administrative support, leaving most cities, including New Orleans, without an ongoing source of funds to establish permanent hazard mitigation divisions with adequate levels of capacity and authority. New Orleans has been fortunate to receive supplemental support by outside organizations, especially the Orleans Recovery Foundation, which has provided the City with a mitigation director. A more sustainable solution would be for FEMA to enhance the administrative funds available to local jurisdictions and municipalities to cover the actual administrative costs of running a hazard mitigation division, particularly in cities like New Orleans that must manage both frequent and catastrophic risk.

With regard to the second policy area, City officials have been discussing a non-structural strategy with officials from the Army Corps' non-structural division, and the outcome of these discussions appears in the Draft Louisiana Coastal Protection and Restoration (LACPR) Report as a set of recommended pilot projects (US Army Corps of Engineers 2008); however, funding for these projects is currently unidentified. The non-structural policy directive remains on the city's policy agenda; however, the city is attempting to use the Hazard Mitigation Grant Program to fund similar pilot projects that are designed to address the residual risk that will remain after the Army Corps has the 100-year hurricane protection system in place by 2011. The projects will target substantially damaged homes in target recovery

areas and housing opportunity zones most at risk of flooding (structures subject to 3-13 feet of flooding) in order to provide more uniform levels of protection against future flood hazards. At an average reconstruction cost of \$93.50 per square foot, a typical 1800 square foot home would cost \$168,300 to reconstruct and elevate. The city plans to use a \$3 million non-competitive Hazard Mitigation Grant Program allocation associated with Hurricane Katrina to develop an elevated cluster of about 15 reconstructed homes. Because these funds have been made available on a non-competitive basis, the City has more discretion in establishing criteria for the use of these funds. The exact location of the project will be determined using information on damage estimates, flood depths, residual risk, and repetitive loss history.

Other than program and administrative funding, the second major challenge that has developed in establishing and implementing non-structural hazard mitigation policy in New Orleans has been a lack of access to technical information and modeling results. Such information is typically kept confidential by the Corps and FEMA until it is ready for public release. However, cities should be seen as real partners in hazard mitigation rather than consumers who are the last to know. If non-structural approaches are to succeed, local jurisdictions will need access to technical information in real time in order to engage our communities in discussions of risk as people are making decisions about where to rebuild and where to invest scarce resources. We need technical information to back up the advice and recommendations we make to elected officials who are the final decision makers when it comes to budget priorities. Cities must be involved not only as stakeholders, but as decision makers in responding to risk if we are to remake New Orleans.

Conclusion

The City of New Orleans is developing a comprehensive mitigation program that embraces non-structural approaches for managing both high frequency risk and high consequence risk. According to the Interagency Performance Evaluation Task Force results, over half of the city is at risk of significant flooding, and some areas will continue to live with residual risk after repairs

and improvements to the hurricane protection system are complete. FEMA's conventional Hazard Mitigation Grant Programs are well-suited for dealing with high frequency risk at scattered individual sites; however, in cases where selection criteria are less restrictive, the City is using Program funds to initiate non-structural pilot and demonstration projects that include clustered elevated housing developments. As more and more details emerge about the flood risk in New Orleans, the City's response has been to embrace non-structural approaches that increase overall risk reduction beyond that provided by the hurricane protection system.

Author Bio and Contact Information

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End Notes

1. The 1968 National Flood Insurance Act (Section 1361A) and the 2004 Flood Insurance Reform Act (Section 102, 42 U.S.C. 4102a) define Repetitive Loss properties as having at least four damage claims of over \$1000 each or two separate claims within a 10-year period that when combined equal or exceed the market value of the property or at least three claims that equal or exceed the market value of the building. Severe Repetitive Loss properties must have at least four building and content claim payments over \$5000 each or two separate building claim payments within a 10-year period that when combined exceed the market value of the building. In both cases, the designation applies only to residential property.
2. These data are available at www.gnocdc.org/index.html.
3. The FEMA flood maps that were in effect for New Orleans as of September 2008 are available at <http://www.cityofno.com/portal.aspx?portal=1&tabid=56>.

4. Because of storm-induced power outages and flooding, the city had only 15 percent pumping capacity during Hurricane Katrina (Interagency Performance Evaluation Task Force Report 2007).
5. The term “non-structural” differentiates secondary flood protection from primary “structural” protection provided by the federal system of levees, floodwalls, pumps, and gates that allows the greater New Orleans area to exist. A non-structural flood protection strategy would further reduce the risk of property damage from future disasters in New Orleans beyond the structural protection provided around the perimeter of the city by the U. S. Army Corps of Engineers’ hurricane protection system.
6. A map showing the location of target recovery areas (and the surrounding Housing Opportunity Zones) is viewable on the City of New Orleans website at <www.cityofno.com>.

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