



Reducing Future Flood Damage in New Orleans Through Home Elevation and Land Use Changes

RAND RESEARCH AREAS
 CHILDREN AND FAMILIES
 EDUCATION AND THE ARTS
 ENERGY AND ENVIRONMENT
 HEALTH AND HEALTH CARE
 INFRASTRUCTURE AND TRANSPORTATION
 INTERNATIONAL AFFAIRS
 LAW AND BUSINESS
 NATIONAL SECURITY
 POPULATION AND AGING
 PUBLIC SAFETY
 SCIENCE AND TECHNOLOGY
 TERRORISM AND HOMELAND SECURITY

Six years after the catastrophic failure of levees and other flood control structures during Hurricane Katrina, New Orleans continues to face the challenge of how to make the city more resilient and less vulnerable to future flood damage from the surge of water that can inundate cities and towns hit by major hurricanes.

Past experience in New Orleans and other places has clearly shown that “structural” protection measures—levees, floodwalls, pumps, and floodgates—are unable to protect the city from all possible storm surge events. Other measures are needed to reduce the risk of property damage from storm surges. Recent RAND research assessed options to augment the existing protection system with “nonstructural” measures, such as incentives for elevating existing or new structures or for relocation to lower-risk areas, revised building codes, and land use restrictions designed to curtail future growth in the floodplain.

Factors such as loss of coastal lands to subsidence (the sinking of the land surface) and rising sea levels, along with population recovery and growth, may lead to increasing risk over time, but their impact in the future cannot be known for certain now. The estimates of storm surge risk by the U.S. Army Corps of Engineers currently in use to support local planning do not fully address these types of uncertainties. As a result, improvements in levees, floodgates, and other infrastructure designed to protect coastal Louisiana could remain vulnerable to future risks that may be higher than currently predicted.

In contrast, our analysis used RAND-developed methods designed to address problems with large uncertainties. We estimated property risk for single-family homes in 72 Orleans Parish neighborhoods from 2011 through 2060, expanding on detailed models of flood risk developed by federal agencies. We define *risk* as the dollar estimate

Abstract

Nonstructural measures can make New Orleans less vulnerable to storm surge and can do so cost-effectively. These measures include incentives for elevating existing or new structures or for relocation to lower-risk areas and land use restrictions designed to curtail future growth in the floodplain. However, these measures alone may not be sufficient to reduce risk from the most extreme storms. Planners should combine nonstructural measures with additional wetlands restoration and ongoing levee upgrades to reduce likely future damage.

of storm damage reduced or “weighted” by the probability of the flood event and other uncertain contributors to damage, but we may lack good estimates of such probabilities to make precise estimates of risk. Instead, the RAND analysis hypothesized many different scenarios—combinations of coastal and economic conditions that could lead to lower or higher future flood damages—and identified an initial set of strategies that balance risk reduction and implementation costs.

The analysis shows that flood risk estimates vary considerably by scenario and in different locations within the city. Nonstructural strategies provide cost-effective risk reduction in high-risk neighborhoods and help to hedge against futures in which damages from the “100-year” (1-in-100 annual chance) flood events are greater than current levels. However, substantial risk remains from lower-frequency but more-severe events (1-in-400 to 1-in-1,000 annual chance), even with large investments in nonstructural risk mitigation (primarily home elevation). These excessive risks are typically associated with high rates of coastal land loss outside of the protection system and

This product is part of the RAND Corporation research brief series. RAND research briefs present policy-oriented summaries of published, peer-reviewed documents.

Corporate Headquarters
 1776 Main Street
 P.O. Box 2138
 Santa Monica, California
 90407-2138
 TEL 310.393.0411
 FAX 310.393.4818

© RAND 2011

levees that degrade over time. The results are preliminary, but they point to several useful insights for New Orleans planning.

Higher standards for elevating homes can provide cost-effective risk reduction. Elevating above ground level, and above potential floodwaters, is the most common method for reducing flood exposure to single-family homes. The house shown in the photo is in the process of being elevated above the revised base flood elevation (BFE) standard (the predicted flood elevation for the 100-year flood) adopted by the community after the flooding from Hurricane Katrina. In many plausible future scenarios, 100-year flood elevations increase over time, meaning that homes elevated today may not meet the 100-year standard one or more decades into the future. Particularly in the most vulnerable areas of the city, New Orleans should consider augmenting current hazard mitigation incentive programs to encourage residents to elevate their homes higher than current BFE standards require.

Buyouts or growth restrictions can be cost-effective, but substantial hurdles remain. Voluntary or mandatory buyouts can provide robust and cost-effective risk reduction in low-elevation areas of the city, particularly in suburban



A home in the process of being retrofitted

SOURCE: Robert Kaufmann/FEMA.

areas where the protection system is not yet substantially upgraded. However, successful implementation of a voluntary buyout program, mandatory buyouts, or mandatory growth restrictions will require the city to resolve legal barriers and improve the level of public acceptance for these actions. One plausible path forward for existing home buyouts might be to identify vacant homes or parcels of land in nearby higher-elevation neighborhoods and provide a mechanism for residents in low-lying neighborhoods to move to these lower-risk locations while remaining in the city.

Location matters. Programs targeting mitigation funds to the lowest-elevation neighborhoods tend to yield the greatest net social benefit. In contrast, providing mitigation incentives uniformly across the city may allocate scarce funding inefficiently. That said, there is an inherent tradeoff between equity and efficiency when considering where to target incentives; unless a carefully structured approach is used, providing elevation incentives in only the riskiest areas might inadvertently induce development. Nevertheless, the analysis points to areas of particular concern that should be considered for any future mitigation programs. In addition, although post-Katrina rebuilding and recovery has focused attention on areas heavily flooded during the storm, low-lying neighborhoods that were unaffected in 2005 nevertheless remain at substantial risk and should be treated as high-priority for future mitigation.

Local risk mitigation is not necessarily effective in isolation. Nonstructural risk mitigation is not necessarily effective against low-probability events in isolation. High damages are observed in scenarios with continuing coastal land loss and levee heights that decline with relative sea level rise. This suggests that local risk mitigation must be combined with additional wetlands restoration and ongoing levee upgrades in order to provide reliable risk reduction—a finding consistent with the “multiple-barriers” approach proposed for coastal risk reduction. Furthermore, the analysis suggests that the only plausible way to reduce risk from extreme events may be to augment the protection system to a higher design standard. ■

This research brief describes work done within the Pardee RAND Graduate School documented in *Managing New Orleans Flood Risk in an Uncertain Future Using Non-Structural Risk Mitigation*, by Jordan R. Fischbach, RGSD-262, 2010, 282 pp., available at http://www.rand.org/pubs/rgs_dissertations/RGSD262.html. This research brief was written by Shelley H. Wiseman. The RAND Corporation is a nonprofit institution that helps improve policy and decisionmaking through research and analysis. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors. RAND® is a registered trademark.

RAND Offices

Santa Monica, CA • Washington, DC • Pittsburgh, PA • New Orleans, LA/Jackson, MS • Boston, MA • Doha, QA • Abu Dhabi, AE • Cambridge, UK • Brussels, BE



PARDEE RAND GRADUATE SCHOOL

CHILDREN AND FAMILIES
EDUCATION AND THE ARTS
ENERGY AND ENVIRONMENT
HEALTH AND HEALTH CARE
INFRASTRUCTURE AND
TRANSPORTATION
INTERNATIONAL AFFAIRS
LAW AND BUSINESS
NATIONAL SECURITY
POPULATION AND AGING
PUBLIC SAFETY
SCIENCE AND TECHNOLOGY
TERRORISM AND
HOMELAND SECURITY

The RAND Corporation is a nonprofit institution that helps improve policy and decisionmaking through research and analysis.

This electronic document was made available from www.rand.org as a public service of the RAND Corporation.

Support RAND

[Browse Reports & Bookstore](#)

[Make a charitable contribution](#)

For More Information

Visit RAND at www.rand.org

Explore the [Pardee RAND Graduate School](#)

View [document details](#)

Research Brief

This product is part of the RAND Corporation research brief series. RAND research briefs present policy-oriented summaries of individual published, peer-reviewed documents or of a body of published work.

Limited Electronic Distribution Rights

This document and trademark(s) contained herein are protected by law as indicated in a notice appearing later in this work. This electronic representation of RAND intellectual property is provided for non-commercial use only. Unauthorized posting of RAND electronic documents to a non-RAND website is prohibited. RAND electronic documents are protected under copyright law. Permission is required from RAND to reproduce, or reuse in another form, any of our research documents for commercial use. For information on reprint and linking permissions, please see [RAND Permissions](#).