LOUISIANA

HOMEOWNERS HANDBOOK TO PREPARE FOR NATURAL HAZARDS

Sea Grant Louisiana

GULF OF MEXICO ALLIANCE

Published by
Louisiana Sea Grant
March 2014 Version 3

Acknowledgements

The Louisiana Sea Grant College Program supports an innovative program of research, education and extension services directed toward the improved understanding and stewardship of coastal and marine resources of the State of Louisiana and the Gulf coast region. A searchable database of publications from the national Sea Grant network, comprised of 33 university-based programs, is available at the National Sea Grant Library website: *http://nsgl.gso.uri.edu*.

This handbook would not have been possible without the gracious support of numerous individuals, including Dennis J. Hwang, Darren K. Okimoto, Cindy Knapman and Heather Dudock (University of Hawai'i Sea Grant College Program); Tracie Sempier (Mississippi-Alabama Sea Grant Consortium); Claudette Reichel (LSU AgCenter LaHouse); Rhonda Price (Mississippi Department of Marine Resources); Laura Nola (Louisiana Department of Insurance); Hallie Dozier (LSU School of Renewable Natural Resources); Susan Taylor (New Orleans Hurricane Shutters and Windows); and Troy Price (Acadiana Blind Place). Special thanks to Melanie Gall (LSU Department of Geography and Anthropology), Patricia Skinner (LSU AgCenter), Michele Deshotels (Louisiana Coastal Protection and Restoration Authority), and John Ingargiola, Laura Ghorbi and Glenn Overcash (FEMA) for assistance with content review.

It is our hope that the information contained within this handbook, which is in part a compilation from numerous publications associated with natural hazards and hazard mitigation, will be widely used and adopted by homeowners in Louisiana and throughout the region.

Financial support for the printing of this handbook was generously provided by The Gulf of Mexico Alliance and the EPA/Gulf of Mexico Program.

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Sea Grant
Louisiana

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This book was developed as a project of the Gulf of Mexico Alliance (GOMA), a partnership of federal, state and local organizations that share a vision for healthy and resilient communities. Adjustments to day-to-day living are necessary to build resiliency in coastal communities. This book is designed to promote individual resilience through increased preparedness for natural hazards, thereby creating a fortified community.

GOMA partners that collaborated on this book include the National Oceanic and Atmospheric Administration (NOAA) Coastal Storms Program, the Louisiana Sea Grant College Program, the Mississippi-Alabama Sea Grant Consortium (MASGC), the Alabama Department of Conservation and Natural Resources (ADCNR) and the Mississippi Department of Marine Resources (MDMR). Editorial services were provided by Jim Wilkins, Melissa Daigle, Lauren Land, Roy Kron and Paula Ouder (Louisiana Sea Grant). Artwork was provided by Robert Ray (Louisiana Sea Grant). Layout and design was provided by Jessica Schexnayder (Louisiana Sea Grant). This publication was supported by GOMA grant number NA08NOS4730398 and the EPA/Gulf of Mexico Program grant number MX-95452810-2. The views expressed herein are those of the author(s) and do not necessarily reflect the views of GOMA, NOAA or any of its sub-agencies.

This document, as well as other Coastal Storms Program documents, is available as part of a searchable database available at the Coastal Storms Program website: www.csc.noaa.gov/csp/.

Louisiana Sea Grant would like to thank the University of Hawai'i Sea Grant College Program and the Mississippi-Alabama Sea Grant Consortium for allowing us to model this handbook after the original *Homeowner's Handbook to Prepare for Natural Hazards* authored by Dennis Hwang and Darren Okimoto. A special thanks to Darren and Dennis, as well as Tracie Sempier with MASGC, for providing text and graphics for the Louisiana handbook.

This guidebook was printed at a cost of $14,000 for 6,000 copies.

Contents

Frequently Used Acronyms

BFE – Base Flood Elevation

FEMA – Federal Emergency Management Agency

FIRM – Flood Insurance Rate Map (DFIRM is a Digital Flood Insurance Rate Map)

GOHSEP – Governor's Office of Homeland Security and Emergency Preparedness

HMA – Hazard Mitigation Assistance

IBHS – Insurance Institute for Business and Home Safety

LSUCC – Louisiana State Unified Construction Code

NFIP – National Flood Insurance Program

NOAA – National Oceanic and Atmospheric Administration

SFHA – Special Flood Hazard Area

Part 1

Introduction

This handbook was created to help you prepare for natural hazards so that risks to family and property may be reduced. While it is never possible to eliminate all potential damage from a natural hazard, as a homeowner you can take action and implement many small and cost-effective steps that could significantly lower your vulnerability. Mother Nature can be intense. Your family and home deserve protection that only you can provide.

Available as a free download at http://www.lsu.edu/sglegal/pubs/handbook.htm, the *Homeowners Handbook to Prepare for Natural Hazards* will be updated as new information becomes available. Additional resources can be obtained from your state and parish emergency management agencies, as well as handbook sponsors and participants. Relevant phone numbers and websites are included in Appendices A and B.

1.1 Eight Common Myths and Reasons to Prepare

Many Louisiana homeowners are not fully prepared for natural hazards because of reliance on popular myths. Those misconceptions include:

1) "I survived Hurricane Katrina or Rita, so I'm okay." Many people have the impression that since they survived a major storm, they do not need to prepare any more than they did in 2005. In Louisiana, the majority of damage was caused by the failure of floodwalls and levees and the subsequent flooding of New Orleans – not the direct effects of the hurricane itself. The same storm could make landfall at a different location (for example, west of New Orleans) and have more severe results. Likewise, Katrina showed that living behind a levee does not guarantee protection from storm surge and flood damages. Structural protection can and has failed in the past. Homeowners should always take additional steps to provide protection for their property, even if they live behind a levee.

2) "If a disaster happens, it won't be that bad." When a tornado, hurricane or flood event occurs, the damage can be devastating. Although Hurricane Katrina was a Category 3 when it made landfall, it was one of the deadliest storms in U.S. history. Approximately 1,800 people died and more than 275,000 homes were lost – ten times as many homes as any other natural disaster in U.S. history.[1] For those who have not

experienced a disaster, common practice is to underestimate the potential impacts and avoid the costs and inconvenience of evacuating and/or preparing homes. Some people who have been through storms forget the extent of damage, or guage their risk from only one element of a storm, such as wind speed, but not storm surge.

3) "I don't live near the coast, so I am safe." Storm surge from Hurricane Rita traveled 35 miles inland. Still, the majority of damage and destruction from hurricanes is caused by wind.[2] Hurricane Katrina produced hurricane-force winds 160 miles north of the coast, as far inland as the Metro-Jackson area of Mississippi.[3] After making landfall south of Houma, Hurricane Gustav caused significant wind and tree damage in Baton Rouge. Parts of the city were without power for three weeks. Tropical Storm Lee in September 2011 caused significant flooding in Livingston Parish, forcing more than 150 families from their homes. All homeowners in Louisiana must prepare, not just those along the coast.

4) "Installing hurricane clips doesn't guarantee there will be no damage after a storm, so I won't bother." Even though someone may wear a seat belt, shoulder belt and have an airbag, there is no guarantee that a person won't be injured in a major auto accident. Yet most people recognize the importance of these safety devices. Likewise, measures discussed in this handbook can significantly reduce risk, although there are no guarantees.

5) "If a natural disaster occurs, the government will come to the rescue." After Hurricane Gustav, many residents found that the government would not repair their damaged homes or provide adequate compensation for property damage. It is up to you to plan properly, strengthen your house and have appropriate financial protections in place, such as homeowners *and* flood insurance (where it is offered). After a natural disaster, local, state and federal governments may be overwhelmed by the number of people in need. Even if you received financial assistance from the government after a previous storm, there is no guarantee the government will have the same response after future storms.

6) "My house survived a major storm, so I do not need to retrofit for hurricanes." When another hurricane occurs, the resulting damage may be much greater depending on the strength and direction of the storm, associated wind speeds and rainfall amounts, tornadoes spawned and your location. The degree of damage varies from storm to storm, even if classified in the same category. Additionally, the stress placed on a home during a storm can weaken the structure, increasing the damage potential of a future storm. Homeowners throughout Louisiana should consider retrofits that provide a continuous load path connection, which helps

protect structures against both hurricanes and tornadoes. Additional measures, such as window coverings, are fortification options.

7) "Even if a disaster occurs, there is nothing I can do." Fortunately, there are many small steps you can take to reduce your risk of damage to life and property. While it is not possible to eliminate all risk or prevent all damage, these reasonable steps to plan and prepare can make a difference and can determine whether your house survives and receives only minor or no damage. Thus, the information in this handbook covers two major aspects of preparation: protecting yourself and your family (Part 3) and protecting your property (Part 4).

8) "Strengthening my house is too expensive and not worth the effort." Strengthening your house can provide protection from tornadoes, hurricanes and floods, and it increases the chance that you have a dwelling to come home to. This is a double benefit, especially for those in coastal Louisiana. Here are some cost-effective ways to strengthen your house:

- Adding hurricane clips or window coverings offers significant protection and can range in cost from a few hundred dollars to a few thousand dollars.
- Strengthening a roof structure with bracing (trusses and rafters) can be done at a minimal cost.
- While strengthening an existing roof can be expensive, consider doing so when you are ready to replace it with a new roof. The additional cost is a small percentage of the overall work.
- Upgrading the foundation of a house can be expensive but may well be worth it, especially if your house is your largest investment.

Many of the costs of these upgrades can be offset by insurance premium discounts and credits, which will be discussed later. However, strengthening your house should be considered a home improvement that adds value to your property and is worth the effort, even without external incentives. The time and money spent to prepare your home is a fraction of the resources that may be needed if you fail to take steps to minimize damage before a natural disaster strikes.

1.2 Eight Things You Can Do to Prepare

Here are eight actions you can take to provide greater protection for your family and property. All will be covered in more detail later in the handbook.

1) Gather your emergency supplies. Gather emergency supplies now. Check and restock supplies at least every three months to ensure necessary items are included and not outdated. During hurricane season, you may want to check your supplies more frequently. Avoid rushing to a store during an emergency to purchase supplies, as there will be long lines and empty shelves and you will only add to the crowd and confusion. The good news is many items you need are probably already in your home (see Part 3 of this book).

2) Assemble your evacuation kit. If your emergency hurricane plans include using a public shelter, you will need an evacuation kit that contains enough water, food, clothing, medications, personal hygiene products and other items to last for five to seven days. The kit should already be assembled and checked before hurricane season (see Part 3). If the kit will be used during evacuation for other hazards, three days' worth of supplies may suffice.

3) Create an evacuation plan for both a flood and a hurricane. They are different. For a hurricane, your plan may include sheltering in your home if it is sufficiently reinforced and located outside the evacuation zone. If you can't use your house, use a suitable alternative structure (a friend or relative's house) or an official public shelter (listen to local radio and television to find open shelters). Make sure to identify a meeting point with your family members in case you are driving multiple vehicles and get separated.

   For a flood, evacuate to high ground outside the evacuation zone. Do not drive through high water; as little as six inches of water can float a car. Turn around, don't drown. Evacuate before roads become impassable. If you have Internet access, check the Louisiana State Police website and the Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP) website for the latest evacuation news, road closures and contraflow information. The Louisiana Department of Transportation and Development sponsors 511 Traveler Information, which provides real-time updates optimized for Internet and for mobile phones. Visit www.511la.org for more information. Remember, once you have evacuated, you may not be able to return home for many hours or days (see Part 3). Discuss and practice your evacuation plan with your family each year.

4) Know your potential hazards and take appropriate action. If your land has flooded in the past or is inside a special flood hazard area, consider purchasing flood insurance as well as homeowners insurance. If trees overhang your home, consider trimming branches to reduce risk of damage to your house in a storm. If your property is near a ridge, open land or water, it may be especially susceptible to wind damage during a storm. By identifying the characteristics of your property, you can help determine the most effective measures to protect the structure.

5) Strengthen your house. After Hurricanes Katrina and Rita in 2005, Louisiana adopted the Louisiana State Unified Construction Code, based on the International Building Code. A house built after the implementation of these standards should have hurricane clips to tie the roof to the walls and strong connectors from the walls to the foundation. If your house was built before 2005, you can still retrofit at a reasonable cost. Looking at your blueprints can provide information about the construction techniques used. The blueprints may be available from your homebuilder, your local building department or your architect. In addition, all households should consider the many options available to protect windows, garages and doors. You can also strengthen your roof when it is time to re-roof. The corrective measures a homeowner can take will vary with each house, but for a majority of homeowners there are a few steps that can make a significant difference (see Part 4).

6) Seek the assistance of a qualified and licensed architect, structural engineer or contractor. This handbook covers work that you may be able to do yourself. If you cannot do the work, seek qualified assistance through trusted references from friends and family. State references include the Louisiana State Licensing Board for Contractors, Louisiana Board of Architectural Examiners, Louisiana Professional Engineering and Land Surveying Board and Louisiana Home Builders Association. Even if you do the work yourself, it is always best to seek professional advice for initial guidance because each house is a little different (see Part 4).

7) Finance creatively and take advantage of potential discounts for your insurance premiums. Consider efforts to strengthen your house as your most important home improvement project. For more costly projects, a small home improvement loan and potential discounts from hurricane insurance premiums can make these projects more affordable. Coverage may vary among companies, so call your insurance agent to find out about available discounts. Significant discounts may be provided for window protection, roof-to-wall tie downs (hurricane clips) and wall-to-foundation tie downs (see Part 5). It is also worth exploring eligibility for mitigation grant programs that can assist with the financing.

8) Insurance. Don't gamble with your house. Obtain adequate homeowners insurance for hurricanes and flood insurance if you are in a flood-prone area (see Part 5). You may not want to rely just on flood zone maps as an indicator for flood risk, as these may be outdated or not take into account the true nature of the risk.

Part 2

Natural Hazards: An Overview for Homeowners

In Louisiana, many types of natural hazards can occur, such as flooding, fire, tornadoes, hail, coastal erosion, sea level rise, subsidence and hurricanes. In terms of loss of life and property damage for coastal communities, this handbook concentrates on the most potentially devastating hazards: tornadoes, hurricanes and floods.

Preparing for these larger hazard events also will provide protection from smaller, more frequent events, such as severe thunderstorms and heavy rainfall. Included here is basic information that may play a role in how you as a homeowner can prepare for these hazards.

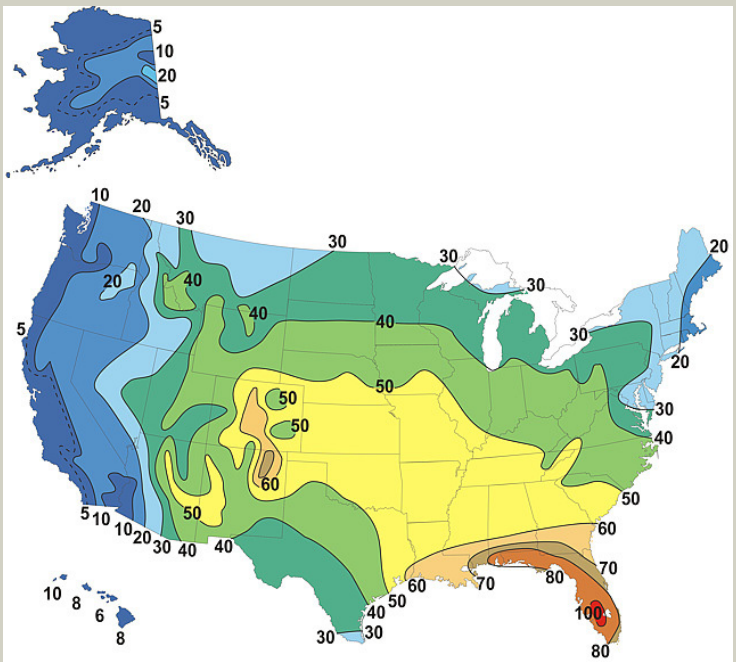


Figure 2-1. The average number of days with thunderstorms each year. Louisiana experiences between 60 and 70 thunderstorms annually. Preparing for larger hazard events can offer protection from these frequent storm events. Source: NOAA National Weather Service Southern Region Headquarters.

2.1 Tornado Hazards

Tornadoes are nature's most violent storms. Spawned from powerful thunderstorms, tornadoes can cause fatalities and devastate a neighborhood in seconds. Tornadoes come in different shapes and sizes, ranging from thin and pencil-like to wide and bowl-shaped. Waterspouts are tornadoes that form over water. A tornado appears as a rotating, funnel-shaped cloud that extends from a thunderstorm to the ground with whirling winds that can reach in excess of 250 miles per hour (mph). Damage paths can be more than one mile wide and 50 miles long.[4] On Oct. 3, 1964, a tornado killed 22 people and injured 165 in Lafourche Parish.[5]

While most tornadoes move southwest to northeast, tornadoes can travel in any direction. The average forward speed of a tornado is 30 mph, but this speed may vary from stationary to 70 mph.[4] The size of a tornado is not necessarily an indication of its intensity. Large tornadoes can be weak, and small tornadoes can be violent. Since 2007, the National Weather Service has used the Enhanced Fujita (EF) Scale to measure the strength of a tornado and describe its potential damage.[6]

Table 2-1. The EF Scale[6]

EF-Scale Number	Class	Wind Speed	Description[7]
EF0	Weak	65-85 mph	Gale: Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.
EF1	Weak	86-110 mph	Moderate: Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the road; attached garages may be destroyed (and might impact house).
EF2	Strong	111-135 mph	Significant: Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
EF3	Strong	136-165 mph	Severe: Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
EF4	Violent	166-200 mph	Devastating: Well-constructed houses leveled; structures with weak foundations blown some distance; cars thrown; large missiles generated.
EF5	Violent	> 200 mph	Incredible: Strong-frame houses lifted off foundations and carried considerable distances to disintegrate; automobile-sized missiles fly through the air in excess of 300 yards; trees debarked; steel-reinforced concrete structures badly damaged.

Source: NOAA's National Weather Service – Thunderstorm Hazards, Tornadoes[6] and The Fujita Scale project.[7]

Tornadoes generally occur near the trailing edge of a thunderstorm or accompany a tropical storm or hurricane as it moves onshore. Fuelled by the collision of moist, warm air from the Gulf of Mexico with cool Arctic air from the north, tornadoes form during the spring and summer months in the central portion of the United States between the Rocky Mountains and the Appalachian Mountains. This is the home of Tornado Alley and its deadly southeast extension, Dixie Alley, which includes Louisiana. On average, Louisiana experiences 37 tornadoes per year.[8] The tornado risk is highest in the northwest part of the state and decreases toward the coast.

Warmer daily temperatures can contribute to the formation of tornadoes, causing many to occur in late afternoon or early evening. Peak tornado season in the southern states is March through May, and they are most likely to occur in the late afternoon between 3 and 9 p.m. but can occur at any time if the conditions are right.[4] Unlike in the plains states of the Midwest, tornadoes are not easily visible over long distances in the heavily wooded areas of the Southeast.

Figure 2-2. Major tornado damage in LaPlace, La., from Hurricane Andrew. Source: NOAA's National Weather Service (NWS) Collection.

2.2 Hurricane Hazards

A hurricane is an intense tropical weather system with a well-defined circulation pattern and maximum sustained winds of 74 mph or more. This compares to a tropical storm, which is also an organized weather system with well-defined circulation, but the maximum sustained winds are between 39 and 73 mph. A tropical depression is an organized system of persistent clouds and thunderstorms with closed low-level circulation and maximum sustained winds of 38 mph or less. These definitions address only wind speed and do not take into account storm size, storm surge or the amount of rainfall generated. During a hurricane, there is a triple threat of damage from high winds (including tornadoes), storm surge and flooding associated with heavy rains. Even a tropical storm or tropical depression can cause substantial damage.

Winds

Hurricane strength is often listed in categories using the Saffir-Simpson Hurricane Scale, which rates hurricanes from 1 to 5 based on the intensity of the sustained winds (see Table 2-2). In a hurricane, winds rapidly increase in strength from the weakest on the outer edge to the strongest near the eye. Hurricane winds are most intense around the eye wall. Winds are also stronger on the east side of the storm path.

Hurricane Rating Does Not Predict Storm Surge

Hurricane size, depth of near-shore waters, topography and the hurricane's forward speed and angle to the coast all affect the surge that is produced. Thus, even smaller storms are capable of producing catastrophic storm surge. For example, the very large Hurricane Ike (with hurricane-force winds extending as much as 125 miles from the center) in 2008 made landfall in Texas as a Category 2 hurricane and had peak storm surge values of about 20 feet.[9] In contrast, the much smaller yet stronger Hurricane Charley (with hurricane-force winds extending at most 14 miles from the center) struck Florida in 2004 as a Category 4 hurricane and produced a peak storm surge of about 11 feet.[10] Hurricane Isaac made landfall as a Category 1 storm in 2012, but had a storm surge of 12 feet in Port Sulphur, La., and 13.7 feet in Braithwaite, La.[61]

TABLE 2-2. Saffir-Simpson Hurricane Wind Scale[11]

Category	Sustained Wind Speed	Damage Expected
1	74–95 mph	No major damage to sturdy buildings, though roof shingles and unprotected windows could be damaged; damage to poorly constructed homes, those with corrugated metal or vinyl siding and temporary units; some tree damage. Examples: Hurricanes Danny (1991), Erin (1995) and Isaac (2012).
2	96–110 mph	Some damage to roofs, doors and unprotected windows; considerable damage to poorly constructed or termite-infested homes; trees snapped or blown down, especially those that are shallow rooted. Examples: Hurricane Gustav (2008).
3	111–129 mph	Some structural damage to well-built small residences; extensive damage to termite-infested buildings; large trees blown down or snapped. Examples: Hurricanes Fredric (1979), Elaina (1985) and Dennis and Katrina (2005).
4	130–156 mph	Extensive damage to non-concrete structures; complete failure of many roofs, windows and doors, especially unprotected, non-reinforced ones; many well-built wooden and metal structures severely damaged or destroyed; considerable glass failures due to flying debris and explosive pressure forces created by extreme wind gusts; complete disintegration of structures made of lighter material; most large trees uprooted or snapped and power poles downed; considerable risk of injury or death to people, pets and livestock from flying or falling debris. Example: Hurricane Charley (2004).

5	> 157 mph	Extensive or total destruction of many homes and non-concrete-reinforced structures; structural damage or destruction of commercial buildings and apartment complexes; damage from wind-tossed debris such as cars or appliances; damage to almost all unprotected windows; many well-constructed storm shutters ripped off from structures; almost all large trees snapped or uprooted and power poles downed; almost complete destruction of mobile homes, regardless of age or construction; very high risk of injury or death to people, pets and livestock from flying or falling debris, even if inside a frame building. Example: Hurricanes Camille (1969) and Ivan (2004).

It is important to note that the Saffir-Simpson Scale only illustrates the "sustained winds" of a hurricane. Wind gusts can be much higher. For example, Hurricane Gustav was a Category 4 storm as it moved over Cuba but delivered the greatest wind gust ever recorded in a hurricane (211 mph).[12]

On the morning of Sept. 1, 2008, Hurricane Gustav made landfall in Louisiana near Cocodrie as a Category 2 storm. It carried 91 mph winds into Baton Rouge, knocking down power lines and trees in its wake.[13] Moving steadily north, Gustav was downgraded to a tropical storm with winds of 60 mph when it reached just south of Alexandria at about 10 p.m. After Gustav, Disaster Declarations were issued for 34 parishes. In Louisiana, 48 deaths were attributed to the storm.[14] Wind damage in Baton Rouge was the worst in memory and 1.5 million people across Louisiana were without power. Hurricanes can also produce tornadoes, which add to their destructive power.

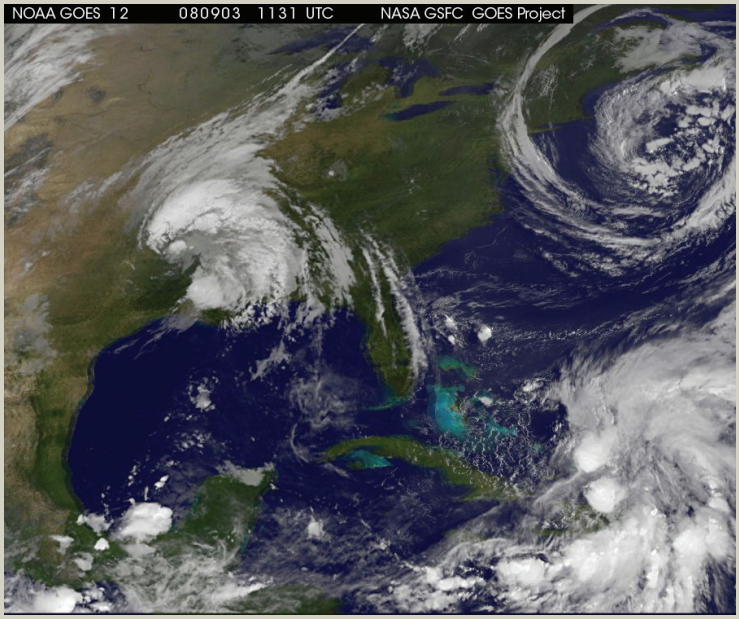


Figure 2-3. NOAA satellite image of Hurricane Gustav in September of 2008. The band of rain spread from Texas to Florida, with the heaviest rainfall in Louisiana, Mississippi and Arkansas.

Storm Surge

Storm surge is a large dome of water, often 50 to 100 miles wide, which sweeps ashore near a hurricane's landfall and is responsible for the largest amount of storm-related deaths around the world.[15] A surge of 10 feet or more can cause severe flooding miles inland and can cause severe damage along the coast, especially when wave action adds destructive power and height to the basic surge. This is particularly important when storm surge coincides with high tide. According to the National Hurricane Center's Tropical Cyclone Report for Hurricane Katrina, storm surge forced water as high as 18.7 feet on shore near Alluvial City in St. Bernard Parish, La.[16]

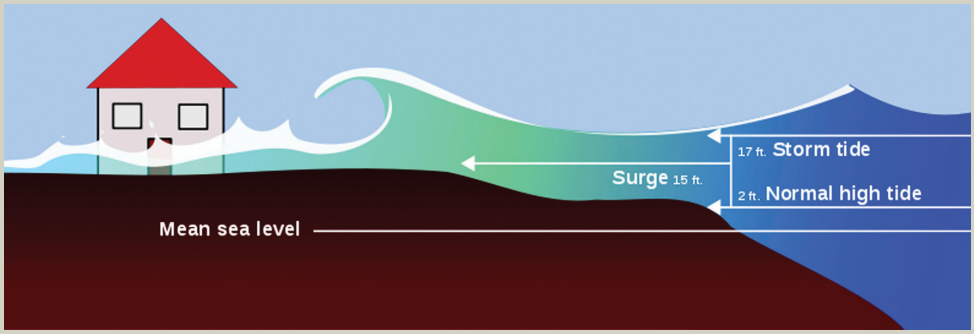


Figure 2-4. Storm surge depiction.

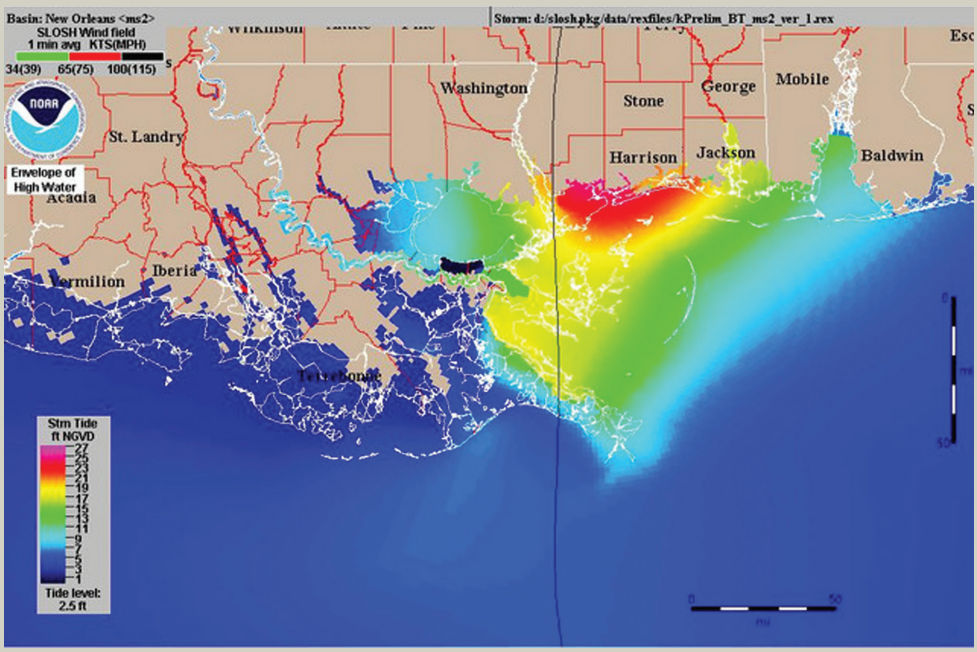


Figure 2-5. NOAA SLOSH model depicting storm tide experienced by the northern Gulf of Mexico during Hurricane Katrina on Aug. 29, 2005.

Figure 2-6. Storm surge associated with Hurricane Rita caused damage to properties in Cameron Parish, La. Source: Louisiana Sea Grant.

Rainfall

Rainfall totals of 10 inches or more are not uncommon when a tropical storm or hurricane moves across a coastal location. Torrential rains continue in upland areas long after the high winds of a hurricane diminish. Rainfall totals of high magnitude can result in destructive flash flooding near streams, bayous and rivers and also in areas that, while away from waterways, are affected by backwater flooding. Flooding also causes extensive property and agricultural losses. For example, Tropical Storm Allison (2001) dumped nearly 30 inches of rain in Thibodaux, causing extensive flooding.[17]

2.3 Flood Hazards

Flooding in Louisiana is probably the most common, if not the most intense, natural hazard in the state. All types of weather systems that produce heavy rains can cause flooding, including cold fronts, severe thunderstorms, tropical depressions, tropical storms and hurricanes. Flooding can build up gradually over a period of days or occur suddenly in a few minutes (commonly known as a flash flood). Coastal flooding and wave inundation can result from tropical storm or high tide events with waves generated by either local storms or storms that are hundreds of miles off the coastline. Floods can also occur due to levee and pump system failures.

You can determine if you are in a high-risk flood area by looking at the Federal Emergency Management Agency's (FEMA) flood insurance rate maps (FIRMs). These maps show which areas are likely to be susceptible to flooding and high-velocity wave action (for residences near coastal areas). The digital maps can be viewed online at www.msc.fema.gov. Copies may also be available for viewing at your city or parish building departments.

As a general note, FEMA flood maps delineate special flood hazard areas (SFHA) and are constructed from historical storm data and model projections (based on historical storms) that predict the likelihood of a 100-year flood event. This means that there is a reasonable expectation that something built in the SFHA at an elevation below the expected flood level will have an annual 1 percent or higher chance of flooding. A 100-year flood event has a 26 percent chance of occurring over a 30-year mortgage period. The FEMA flood maps are statistical representations based on past storms and do not account for the very real possibility that a future storm could be stronger or cause more damage than any previously recorded storm. Many people assumed that Camille in 1969 was the worst hurricane that could possibly occur. Hurricane Katrina proved the fallacy of that logic in 2005. FEMA flood maps also do not consider potential future increases in storm surge based on sea level rise and land subsidence.[18] Flooding due to storm surge can exceed the base flood elevations mapped in FEMA flood maps. With these considerations, the flood maps may not accurately reflect the true risk of flooding.

Even if you are not in a SFHA, you may be at risk from flooding and should consider purchasing flood insurance. For additional information, you can view parish-by-parish flood maps at www.lsuagcenter.com and type in your address to identify your flood zone. You can also go to www.floodsmart.gov and type in your street address in the "One-Step Flood Risk Profile" to determine a general estimate of the flood risk to your property. To find the current design wind speed zone and approximate elevation of your property, visit http://maps.lsuagcenter.com/windspeed_elevation/ and enter your address.

For homes located within a flood zone or an area historically inundated by storm surge, various housing practices can mitigate damages caused by flooding, as well as allow for reductions in flood insurance premiums. Refer to Parts 4 and 5 for more information on these topics.

Figure 2-7. Adding a small amount of height has very little effect on the look of a home but can pay dividends in flood protection. Source: Louisiana Storm Smart Coasts.

2.4 Key Definitions

Tornado Watch – Issued when tornadoes are possible in the area. Remain alert for approaching storms.

Tornado Warning – Issued when a tornado has been sighted or indicated by weather radar. If a tornado warning is issued for your area and the sky becomes threatening, move to your pre-designated place of safety.

Hurricane Watch – Issued when there is a good possibility of hurricane conditions (sustained winds of 74 mph or higher) and associated damaging winds, surf and flooding rains occurring anytime within the next 48 hours. As discussed in the next section, preliminary preparations should begin even before a watch has been issued. During the watch period, prepare your home and review your plan for evacuation in case a hurricane warning is issued.

Hurricane Warning – Issued when there is a high probability of hurricane conditions (sustained winds of 74 mph or higher) occurring anytime within the next 36 hours. Complete all storm preparations and leave the threatened area if directed by local officials. Keep in mind that a hurricane warning may not always be preceded by a hurricane watch.

Flood Watch – Issued when flooding is possible within the designated watch area. Be prepared to move to higher ground and listen to NOAA Weather Radio, local radio or local television for information.

Flood Warning – Issued when flooding has been reported or is imminent. Take necessary precautions at once. If advised to evacuate to higher ground, do so immediately.

Part 3

Protecting Yourself and Your Family

It is important that your household has emergency supplies, an evacuation kit and evacuation plans for a tornado, flooding event and/or hurricane. Each plan will differ, depending on the nature of the threat. Discuss and practice the plan with your family once a year, or whenever there is a major lifestyle change (for example, when a member of the family goes to a new school or is working in a different location).

GOHSEP sponsors the Get a Game Plan program and website (www.getagameplan.org), which offers plans and information for emergency situations tailored for your family, children and business. Emergency preparedness information also is available on the site in Spanish, and there is a Get a Game Plan App available for both iPhones and iPads.

3.1 Before Hurricane Season

3.1.1 Emergency Supply Kit for Your Home

When preparing for a hazard event, a general rule of thumb is to ensure you are able to be self-sustaining for the first 72 hours. Basic supplies may be unobtainable immediately after a disaster due to a lack of power, access or availability. Therefore, emergency supplies and an evacuation kit will help during a major event like a hurricane or tropical storm, as well as for a minor event like a power outage.

In September 2008, Hurricane Gustav demonstrated the importance of household emergency supplies when 1.9 million Louisiana residents were without electricity. Local water supplies in central Louisiana were affected as well because of dependence on electricity to power water wells. Three weeks passed before power was restored to all Baton Rouge residents.

Gather emergency supplies early and check them at least every three months to ensure your stockpile is complete and items are fresh (mark and check expiration dates). Old food and water should be used or discarded and replaced. Do not keep expired items. Your emergency supplies should include the following:

- Evacuation kit containing Grab-and-Go Box (suggested items listed in section 3.1.3)
- Five to seven day supply of water - A reasonable estimate is one gallon per person per day for drinking, cooking and personal hygiene. It is important to have good water containers; four- to six-gallon containers are available from most retailers. Store water for toilet use in bathtubs, rubbish containers, top-loading washing machines and water heaters. You may also want to keep water purification tablets in your kit. These tablets can inactivate most viruses, and some have a shelf life of four years.
- Camp stove with fuel, or barbecue grill with charcoal or propane. **Do not use these items indoors or in an area without ventilation.** Carbon monoxide poisoning and death can result. Follow all manufacturer instructions.
- Matches or lighter
- Disposable plates and kitchen utensils
- Sanitary supplies or portable toilet
- Waterproof plastic sheeting or blue tarp with grommets, along with rope
- Bedding, such as an air or folding mattress, for each person
- Rain jackets and pants
- Sunscreen and bug repellant
- Soap and shampoo
- Cleaners, household bleach (unscented), trash bags, towelettes
- Fire extinguisher (small canister, ABC type)
- Pliers, tape
- Shutoff wrench for household gas and water valves
- Corded, land-line phone, as well as a cell phone with a car charger. Cell phone networks may be overloaded during times of disaster. Cordless phones will not work without electricity. Some phone services that utilize modems will require a battery backup to function. If your phone requires a modem, obtain a battery backup and keep it charged. Also, use your phone during a disaster only in an emergency and to confirm family members' safety. Keep all calls brief so as not to overload the system.

- Alternate power supplies - During an emergency or power outage, alternative sources of power may be needed. Among these are generators, inverters, power stations and battery chargers. See Section 3.3 for descriptions of alternative power sources that may supplement your emergency supplies.

3.1.2 Evacuation Kit for the Road

By having your emergency materials in one location, you can easily grab your evacuation kit and go during a crisis. Your evacuation kit, like your emergency supplies, should be prepared ahead of hurricane season. The components of the kit should be stored in one place, perhaps in a duffle bag or backpack, so that it is ready to go at a moment's notice. The kit is primarily for evacuation during a hurricane or other flooding event, although it could be used for other situations, such as a train derailment, chemical spill, gasoline explosion, wildfire, etc. Your evacuation kit may include:

- Fireproof and waterproof Grab-and-Go Box (suggested contents listed in 3.1.3)
- Portable radio (preferably with NOAA weather station) and spare batteries
- Flashlight and extra batteries, or flashlight and radio with hand-crank rechargeable batteries. Flashlights with light emitting diodes (LEDs) last many times longer on the same set of batteries versus those with conventional incandescent bulbs
- First-aid kit (adhesive bandages, gauze pads, sterile dressing, antiseptic wipes, non-latex gloves, anti-bacterial ointment, coldpack, scissors, tweezers, face mask)

- Two-week supply of special medications (prescriptions and others, including pain relievers, anti-diarrheal, antacid, laxative and activated charcoal. Activated charcoal is a common and effective treatment for poison control and may be needed in a situation where poisoning has occurred, when recommended by the American Association of Poison Control center.)
- Denture needs
- Contact lens supplies and extra eye glasses
- Five to seven day supply of nonperishable foods such as ready-to-eat canned meats, fruits and vegetables. Include high-energy foods such as crackers, peanut butter and jelly
- Any special dietary foods and vitamins
- Can opener and utility knife
- Baby supplies (diapers, food, formula, medications, bottles, wipes, small toys, pacifiers)
- Toothbrush and toothpaste
- Toilet paper
- Rinse-free hand sanitizer
- Change of clothes
- Towels, pillows, blankets
- Paper and pencils
- Needle and thread
- Signal flare and whistle
- Pet supplies (food, leash, medications, vaccination records, identification tags, portable cage)

The American Red Cross recommends that the evacuation kit contain supplies for five to seven days. If the supply chain is disrupted due to a damaged airport or warehouse, inaccessible roadway system, long-term power outages or other issues, you will be better off than others who do not have adequate supplies.[19] If space is available and your house is protected, stocking up for a two-week period is prudent.

3.1.3 Grab-and-Go Box for the Road

The LSU AgCenter recommends that you have a "Grab-and-Go" box of important documents within your evacuation kit, which is a smaller subset of your emergency supplies.[20] The following materials should be placed in a portable, fireproof and waterproof box or backpack:

- Cash or traveler's checks for several days of living expenses – ATMs require electricity to operate and may not be available or accessible for weeks
- Map of the area
- Emergency phone numbers – doctors, pharmacies, financial advisors, clergy, repair contractors, family and friends
- Copies of identification documents – Social Security cards, driver's licenses, passports, visas
- Copies of important prescriptions – medications, eyewear, etc.
- Copies of immunization records
- Copies of medical information – health, dental and/or prescription insurance cards or numbers; special medical information; medical care directives
- Copies of insurance policies – auto, flood, renters, homeowners (at least the policy numbers)
- Insurance company telephone numbers – local agent and company headquarters
- Financial information – bank account numbers, credit card numbers, loan numbers, investment account numbers, debt obligation due dates and contact information, stock and bond certificates, recent investment statements, first two pages of previous year's federal and state income tax returns
- Other important documents – deeds, titles, wills and trust documents, durable power of attorney, home inventory, certificates (birth, death, adoption, marriage), employee benefit documents, proof of residence
- Back-up copies of computerized financial records
- Computer account user names and passwords
- Keys and combination to safe deposit box
- Important family photos or at least a flash drive or external hard drive containing backups of pictures

3.1.4 Family Evacuation Planning

If you are outside the recommended evacuation area and in an area that does not flood, you may choose to stay in your home where you may be better able to store food and water and take care of your loved ones, including those with special health needs, the elderly and your pets. Before making such a decision, you must consider the ability of your home to withstand high winds and whether or not there are nearby trees in poor condition that may fall or other debris that could become windborne in a storm. GOHSEP offers evacuation guides for both Southeast and Southwest Louisiana on their website (www.gohsep.la.gov).

In Louisiana, it is important for families to plan for both flood events and hurricanes. When putting an evacuation plan together, keep these things in mind:

- Know the difference between a hurricane watch and a hurricane warning (See Section 2.4). When each is triggered, there are different actions you and your family should take. Also note that local officials may issue a mandatory evacuation in the case of a hurricane warning or severe flooding event, such as the 2011 opening of the Morganza Spillway.
- In a hurricane, you must protect yourself from strong winds, torrential rain, rising water and storm surge. In a flood, you must protect yourself from rising water and inundation. Have a plan for both.
- As a general rule, you should evacuate if you are:
    - Along low-lying coastal areas
    - Along areas subject to flooding (for example, near a stream or river)
    - In any Federal Special Flood Hazard Insurance Zone such as a high-velocity wave zone (V zone) or flood zone (A zone), even if your house is built for wave action and flooding
    - Along ridge lines exposed to strong winds
    - Living in certain wood-frame structures or lightly constructed buildings (e.g., mobile homes, trailers, campers, manufactured housing).
- The *Official Louisiana Hurricane Survival Guide* is available online at the Louisiana State Police website (www.lsp.org/lcadeg.html) in English, Spanish and Vietnamese. In addition to useful tips for planning an evacuation, this guide provides information and maps for hurricane evacuation routes, phased evacuations, contraflow and emergency shelter information points (Figure 3-1). For the latest on road closures, log onto the State Police Road Closure website (www.lsp.org/roadclosure.html).

- Consider signing up for emergency text alerts at the Louisiana GOHSEP website (www.getagameplan.org).
- Your evacuation plan should take into account yourself, your family members, those with special health needs for whom you might take responsibility (like the disabled or elderly) and your pets. Practice evacuation procedures with your family annually.
    - For children: Parents should contact their child's school and confirm the evacuation plans that are in place. Specifically, for each type of natural hazard, where will students be and for how long? Will students be released early?
    - For people requiring assistance: Develop a plan to help those who cannot help themselves, such as the disabled or those with limited mobility. If a person with special health needs is with a care-provider, confirm that the care-provider has an evacuation plan. If not, identify who (you, family, friends or someone nearby) is designated to take responsibility for that person.
    - For pets: Check the local newspaper, listen to local radio or television and check the websites for GOHSEP, Louisiana Department of Agriculture and Forestry (LDAF), or State Police to determine if there are any pet-friendly shelter locations in the area you are evacuating to and any requirements the shelters might have. Visit www.petswelcome.com to find pet-friendly hotels. LDAF can also assist with information on large-animal evacuation. Visit www.lsart.org for species-specific emergency preparedness information.
- Consider how family members will communicate if they become separated. Each family member should have a list of telephone numbers, cellular phone numbers and email addresses of everyone in the family and phone numbers of a few contacts outside of the family.
- Decide the physical location you will go to in the event of an evacuation, depending on the storm characteristics (size, speed, strength and surge). Will you stay in your house, go to a shelter, or evacuate to a friend or relative's house?
    - Stay in a place that is away from any flood or inundation zones and that is able to withstand strong winds and rain.
    - First plan to evacuate to a friend or relative's house and plan to use a shelter as a last resort. There are a limited number of hurricane shelters and spaces that offer protection from wind, rain and rising waters. There may be a possibility you cannot enter.
    - If you plan to go to a shelter, familiarize yourself with the location of two or three shelters that are options for you. See Appendix C for more information on shelter policies. Some northern Louisiana parishes have entered into cooperative agreements to provide shelter for southern parishes. Be familiar

with the agreements your local government has made to help ensure your safety. The location of shelters may change frequently, so you are encouraged to check shelter locations before evacuating by checking www.getagameplan.org, www.dss.state.la.us, www.lsp.org, www.redcross.org/find-help/shelter, or by calling the American Red Cross toll-free number at (800) 733-2767.

- Know what your transportation options are and, if using a personal vehicle, have a plan to fill the gas tank well before the storm hits.

- Have a checklist of items in your evacuation kit as well as a list of actions to complete when a storm is in the forecast and evacuation is possible. See Appendix D for removable checklists.

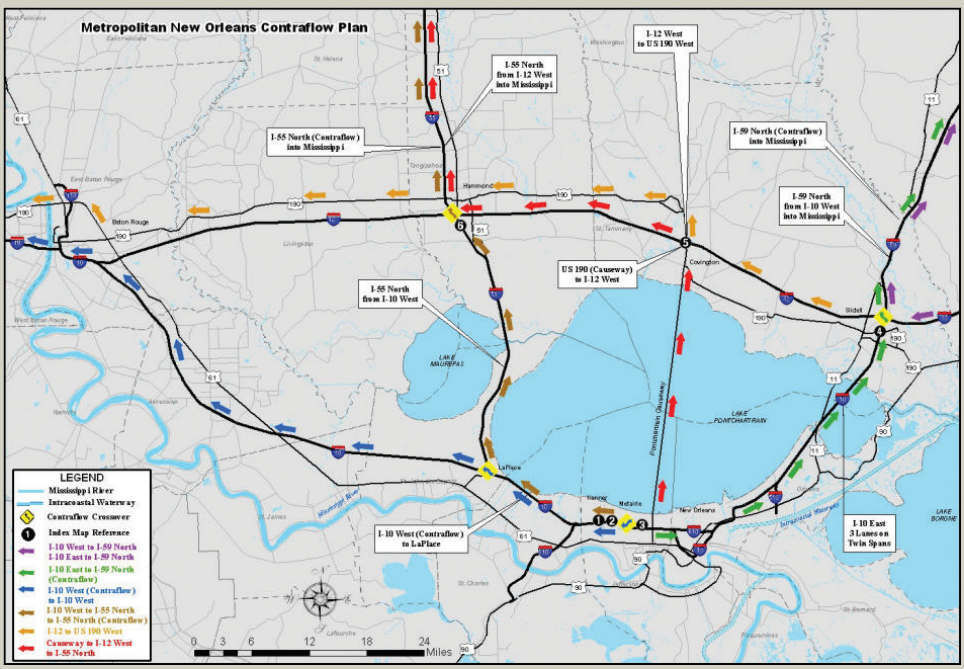


Figure 3-1. Contraflow plans and phased evacuations for South Louisiana. Source: The Advocate, May 27, 2012.

3.1.5 Storm Preparation Tips for Renters and Apartment Complexes

If you are renting a home or apartment, many of the preparation tips above also apply. Here are some specific tips for renters:

- Renters insurance is relatively inexpensive and can help cover most weather- and fire-related events. However, hurricanes, tornadoes and floods are not typically covered by basic plans. These events may be covered through the purchase of additional coverage. Check with your insurance company to make sure these natural hazards are included with the covered events.
- Make sure to have updated contact information (phone number and email address) for the person in charge of the property you are renting.
- Remove all items from the balcony or patio.
- Locate the nearest exit stairway and count the number of steps from your door to the exit in case stairway lighting is out.
- Determine a location outside of the building for members of your family to meet in case you are separated during an evacuation.

Tips for rental property owners:

- Determine if there is a safe area on the property for residents to congregate in the event of a storm.
- Instruct residents to stay away from windows and sliding glass doors during storm events.
- Prior to a storm, gather tools and materials that may be needed for repairs.
- Check first aid kits to ensure that they are fully stocked.

If your property has an elevator or a pool, there are several tips to prepare these items for storms. Detailed information can be found on websites, such as www.hurricaneshuttersflorida.com/preparedness.html.

3.1.6 Additional Preventative Measures

Here are some other tips that you may want to include in your hurricane preparedness activities:

- Back up photos and important documents on an external hard drive or USB drive that can be stored in your evacuation kit.
- Print copies of LSU AgCenter fact sheets (for example, disaster readiness for farmers, dealing with storm-damaged trees and sample menus for emergencies) that may be helpful for your specific situation and keep them with your hurricane preparedness supplies.

- Place a penny on top of a glass of ice in your freezer. If the penny is at the bottom of the glass after you return from evacuation, you will know that you lost power for some amount of time.
- Line your freezer and refrigerator shelves with trash bags to make cleanout easier in the event of long periods without electricity.

3.2 When the Storm Is in the Forecast

3.2.1 Prepare Your House (includes mobile homes) and Property

- Fill the gas tank of your car.
- Place boats on trailers and tie down close to home.
- Make sure that you have sufficient cash in hand to purchase goods and items if needed following the hurricane.
- Check outdoor items (i.e. patio furniture) that may blow away or be torn loose; secure these items or move small items, such as potted plants, inside.
- Store chemicals, fertilizers or other toxic materials in a safe place or secure area that is protected from both wind and flood risks.
- Secure all propane tanks, including small ones used for barbecues and patio heaters. They should not be stored near sources of heat (like your water heater or other appliances).
- Turn down canvas awnings or roll them up and secure them with sturdy rope or twine.
- Deploy window protections well in advance of the arrival of any winds (see Part 4). For those who have already prepared plywood shutters, partial deployment could begin before there is any official hurricane warning. Closely monitor advisories and warnings to guide your deployment.
- Wedge sliding glass doors with a brace or broom handle to prevent them from being lifted from their tracks or being ripped loose by wind vibrations.
- Place folded towels on windowsills and inside the bottom of doors leading outside to absorb any potential leaks.
- Check door locks to ensure doors will not blow open.
- Unplug all unnecessary appliances.
- Turn refrigerators and freezers to their coldest setting.
- Stay calm and informed!
- Pay attention to the latest local news announcements and listen to local radio and television stations carefully, as there may be additional or modified directions based on the best available information at that time. “Local” means newspapers and radio and television stations specific to the area in which you live.

- Limit telephone usage to emergency calls only. This is to prevent telephone lines from being overloaded with non-emergency calls.
- If you are going to evacuate, shut off electricity at the main fuse or breaker and water at the main valve. Turn off propane gas service, since propane tanks often become dislodged in storms. Unless local officials advise otherwise, leave natural gas on because it will be needed for heating and cooking when you return. A licensed professional is required to turn it back on, and in the aftermath of a storm or other disaster event, it may take weeks for a professional to respond.

In general, travel trailers and mobile homes are not safe shelter from storm-force winds. Anyone who lives in a travel trailer or a mobile home should pay close attention to radio and television reports to receive information from local and state officials concerning hurricane precautions. If government officials tell you to evacuate, then leave as soon as possible.

3.2.2 Procedures for a Tornado

If a tornado warning is issued, or if threatening weather approaches, consider the following actions:[21]

- The first action should be to move to a safe room in your home, if one is available, or a community safe room if there is one within a 5-minute travel time of your home. If a safe room is unavailable, consider moving to a pre-designated shelter, such as an interior room or hallway on the lowest floor and get under a sturdy piece of furniture.
- Stay away from windows.
- If outside in your car, abandon it immediately and lie flat in a nearby ditch or depression. Do not try to outrun a tornado in your car.
- Mobile homes offer little protection from tornadoes and should be abandoned.

Tornadoes can develop quickly without any advanced warning. Remain alert for warning signs and take caution to avoid flying debris.

3.2.3 Evacuation Procedures for a Hurricane

- Don’t forget your evacuation kit!
- Stay calm and follow the direction of your local or state emergency management agency.
- Listen to your local TV or radio station for updated evacuation information.

3.2.4 Evacuation Procedures for a Flood

The general rule if you are evacuating from a flood is to avoid flood waters and head to higher ground. Stay away from moving water. Depths as shallow as six inches can make you fall or cause your car to stall. Two feet of moving water can move your car.[22]

If there is a flash flood and you are caught in your house, go to the second floor or the roof, if necessary. In order to be able to get onto the roof in the event of a flash flood, you may want to keep a small hand axe in the attic to use to cut an escape hole if needed.

3.3 Electrical Power Issues to Consider

For any storm, visit http://stormcenter.entergy.com for the latest information on power outages and the status of power restoration.

In case of an emergency, the power to your house should be turned off through the main breaker switch, circuit breaker panel or fuse box. For guidance on turning the power back on after an outage, refer to FEMA's Hurricane Sandy Issue Paper, "Guidance for Turning the Power Back On" (www.fema.gov/library/viewRecord.do?id=6691). In addition, all homes should be equipped with ground fault circuit interrupters (GFCIs). GFCIs are inexpensive electrical devices that, if installed in household branch circuits, are designed to protect people from severe or fatal electric shocks and can prevent more than two-thirds of electrocutions.[23] Because a GFCI detects ground faults, it can also prevent some electrical fires and reduce the severity of others by interrupting the flow of electric current.

GFCIs are commonly found in kitchens, bathrooms, laundry rooms or other places where water and electricity are close together. If you don't have them, consider having a licensed electrician install some.[23] For coastal properties, any light switches, wiring and receptacles that are below the design flood elevation should have ground fault protected electrical breakers.[24] By following key safety precautions when dealing with electricity during and after storms and other disasters, you can help prevent death, injuries and property damage. Take care when stepping into a flooded area, and be aware that submerged outlets or electrical cords may electrify the water, creating a potentially lethal situation.

Flooded Areas: Do not use electrical appliances that have been wet. Water can damage the motors in electrical appliances such as heaters, freezers, refrigerators, dishwashers, washing machines and dryers.[25]

Wet Electrical Equipment: A qualified service repair dealer should recondition electrical equipment that has been wet. For more information, the National Electrical Manufacturers Association (NEMA) has produced a brochure, Evaluating Water-Damaged Electrical Equipment (available online at www.iaei.org), for use by suppliers, installers, inspectors and users of electrical products to provide advice on the safe handling of electrical equipment that has been exposed to water. It outlines which items will require complete replacement and which can be reconditioned by a trained professional. Equipment covered includes electrical distribution equipment, motor circuits, power equipment, transformers, wire, cable and flexible cords, wiring devices, GFCIs and surge protectors, lighting fixtures and ballasts, motors and electronic products including signaling, protection, communication systems, industrial controls and cable trays.[23] Another resource is FEMA's Hurricane Isaac Recovery Advisory 2, "Minimizing Flood Damage to Electrical Service Components" (www.fema.gov/library/viewRecord.do?id=6727).

Downed Power Lines: These can carry an electric current strong enough to cause serious injury or possibly death. The following tips can keep you safe around downed lines:[25]

- If you see a downed powerline, move away from the line and anything touching it. The human body is a ready conductor of electricity.
- The proper way to move away from the line is to shuffle away with small steps, keeping your feet together and on the ground at all times. This will minimize the potential for a strong electric shock. Electricity wants to move from a high voltage zone to a low voltage zone - and it could do that through your body.

Figure 3-2. Downed or damaged power lines in a residential area can pose a serious danger to public safety. Source: Louisiana Sea Grant.

- If you see someone who is in direct or indirect contact with the downed line, do not touch the person. You could become the next victim. Call 911 instead.
- Do not attempt to move a downed power line or anything in contact with the line by using another object such as a broom or stick. Even non-conductive materials like wood or cloth, if slightly wet, can conduct electricity and then electrocute you.
- Be careful not to put your feet near water where a downed power line is located.
- If you are in your car and it is in contact with the downed line, stay in your car. Tell others to stay away from your vehicle.
- If you must leave your car because it is on fire, jump out of the vehicle with both feet together and avoid contact with the live car and the ground at the same time. This way you avoid being the path of electricity from the car to the earth. Shuffle away from the car.
- Do not drive over downed lines.

3.3.1 Alternate Power Sources

Before discussing alternate power sources during an emergency, one general suggestion is to make your house as energy efficient as possible when replacing equipment and appliances. For example, if the lights, television or refrigerator need replacing, consider products with the EPA's Energy Star label (Figure 3-3). These products may cost slightly more, but over their lifetime, the energy savings will far outweigh the small initial price increase.

Figure 3-3. Items with the Environmental Protection Agency's Energy Star label use much less energy than standard models. Items include washing machines, dishwashers, refrigerators, freezers, air conditioning units and light bulbs.

Energy-efficient equipment is especially useful during an emergency, when you may be running on alternative forms of power. For example, a regular 100-watt lamp running off an emergency power station (essentially built around a car battery) may run for two hours. That same emergency station can run a fuel-efficient 23-watt compact fluorescent light almost 8-9 hours

with the same light output. Today, even more energy-efficient LED lighting has become feasible and bright enough for home use. As another example, a refrigerator with the EPA's Energy Star label can run on a fuel-efficient generator for 16 hours on one gallon of gas. Since most refrigerators do not need to run continuously, it may be possible to run the efficient refrigerator on one gallon of gas for one or two days.

3.3.2 Generators

Some households may require uninterrupted power because of the critical needs of some family members. For example, the elderly, disabled or sick may require a respirator, dialysis machine or other medical equipment. Medicines such as insulin, which can be stored for over a month, may need to be refrigerated. For many families, the most important major power requirement is to run a refrigerator or freezer. If your family has critical power needs for medical or other purposes, then you may want to consider a portable generator.

This handbook does not recommend any particular generator or brand. However, if you are considering a generator, some of the factors to consider include:

- **Power needs.** Size the generator so that it runs the equipment you need or want to run in an emergency. It will make a difference if you just run a refrigerator, versus a refrigerator plus lights and other equipment. Some appliances, such as a refrigerator, may require 500 watts to run but 1500 watts to start up. Each piece of equipment is different. You can get general guidelines from the manufacturers in the form of charts and tables for equipment power needs. A more accurate way to estimate, however, is to call your manufacturer or buy an amp meter that measures running and start-up wattage or amperage. You can also get good advice on sizing a generator from the dealer where you buy the unit.
- **Fuel efficiency.** During an emergency, fuel supplies will be limited. The amount of power you need and the efficiency of the generator will determine if you need one or two gallons of fuel per day instead of five or six.

- **Quietness.** Generators are usually noisy, but some are quieter than others. If you need to run a generator, your family and neighbors will appreciate if the generator is quiet.

Be careful with portable generators. They can provide a good source of power, but they can become deadly if improperly installed or operated. The misuse of portable power sources killed at least five people and sickened 46 others in Louisiana, Mississippi and Alabama after Hurricane Katrina.[26]

If you plan on buying or using a portable generator, here are some things to remember:

- **Read the instruction manual.** If the manual is lost, contact the manufacturer or look on the manufacturer's website for another copy.
- **Never use a generator indoors or in an attached garage**. The most important thing to remember is to never run a generator indoors or in your garage because of the buildup of carbon monoxide gas, which cannot be detected by sight or smell. This deadly gas can overcome and kill you and your family if the generator is indoors. It is important to operate the generator only outdoors in a well-ventilated, dry area away from the air intakes to the home.
- **Do not connect the generator directly to the home's wiring yourself, that job should only be done by a licensed electrician.** If not connected properly via a special transfer switch, power from generators can back feed into the power lines connected to your home. The increase in voltage is enough to electrocute anyone coming in contact with the lines, including line workers making repairs many miles away. You could also cause expensive damage to utility equipment and your generator.

For generators that are wired into your house, a qualified, licensed electrician should install the generator to ensure it meets local electrical codes.[25]

A hard-wired generator should be installed with an approved cut-off switch that will automatically disconnect the home from the power grid when the generator is used. Check with your local utility company before installing a hard-wired generator.

Here are some safety tips for generators wired into your house:

- **Connect a heavy-duty, outdoor-rated power cord to the generator.** Make sure the power cord has a sufficient wire gauge to handle the electrical load. Appliances should be connected to the power cord.

- **Do not overload the generator.** All generators have a power rating. The total wattage used by the appliances should be less than the output rating of the generator. If you put too many appliances on the generator, it could seriously damage the appliances and electronics. Overloading the generator could also cause a fire.
- **Make sure your generator is properly grounded to avoid electrical shocks.** Check the manufacturer's manual for information on how to ground the generator.
- **Be aware of fire safety when handling gasoline and the generator.** Do not store gasoline for the generator indoors. Gasoline should only be stored in approved, non-glass safety containers. Do not store gasoline in a garage if there is a water heater or other fuel-burning appliance in the garage. Heavy vapors from gasoline can travel invisibly along the floor and be ignited by a pilot light or other source of flame.
- **Elevate above the base flood elevation.** The generator and its fuel source should be elevated above the base flood elevation in order to prevent loss of generator function during the base flood.

Other tips include:[25]

- Keep the generator dry.
- Extinguish all flames or cigarettes when handling gasoline for the generator.
- Shut off the generator before refueling. Turn off all equipment powered by the generator before shutting it down.
- Always have a fully charged, approved fire extinguisher located near the generator.
- Use a ground fault circuit interrupter (GFCI) to help prevent electrocutions and electrical shock injuries. Portable GFCIs require no tools to install.
- Many generator parts are hot enough to burn you during operation. Stay away from the muffler and other hot areas.
- Keep children away from portable generators at all times.

In general, when running your refrigerator with a generator, keep the refrigerator and freezer at the coldest setting. Refrigerators may only need to run a few hours a day to preserve food. Using a refrigerator thermometer, you should aim to maintain a temperature no warmer than 40 degrees Fahrenheit in the refrigerator compartment and 0 degrees in the freezer. Open the refrigerator door as little as possible.

3.3.3 Power Stations

Power stations are found in many hardware stores and may have a radio, flashlight, air compressor, battery jump starter, AC outlet or DC outlet built around a modified car battery. These units can come in handy during a power outage, since they can be part of your emergency supplies and also provide limited emergency power. If your cordless phone does not work because the base of the unit has no power, a power station could supply electricity so that calls can be made. (An alternative is to use a corded phone.) It should be noted that after an emergency, there might be many reasons the phone does not work that are beyond your control, such as heavy traffic or loss of function with the phone system.

3.3.4 Inverters

Inverters take the 12-volt DC power from your car battery and convert it to 115-volt AC power that can run household appliances. This can be very important if you need to run power tools in an emergency and the power is out. The inverter will drain your car battery, so look for inverters that have a low-battery shutdown feature to prevent total battery drain. In addition, the car should not be run in a garage or carport, but rather in a well-ventilated area if the manufacturer approves of such procedures.

3.3.5 Battery Chargers

To keep the car battery charged, consider a battery charger as part of your emergency supplies. New units are small and portable and provide a quick charge to a dead battery in only a few minutes and a total charge in a few hours.

3.4 Emergency Information and Contacts

3.4.1 Where to Find Information

Each year, NOAA provides an "Extreme Weather Information Sheet" customized for each state in coastal areas. This information sheet provides general information and can be found at the NOAA website: http://www.ncddc.noaa.gov/activities/weather-ready-nation/newis/.

The Emergency Alert System (EAS) and the NOAA weather radio system are two official sources of natural hazard information and weather-related warnings and watches delivered statewide. The EAS messages, including warnings and instructions, are disseminated from the governor's office during emergencies through AM, FM and television broadcast stations, as well as cable television systems. Weather information and other messages, including National Activation, Civil Emergency and AMBER Alerts, are also broadcast through EAS. All local radio stations have voluntarily agreed to participate in the EAS system. A listing of NOAA weather radio frequencies and coverage areas for Louisiana is available at http://tinyurl.com/LAweatherradio.

FEMA is also developing the Integrated Public Alert and Warning System (IPAWS). More information is available online at www.fema.gov/emergency/ipaws. The goal is to develop a comprehensive system to alert and warn the public in the event of a disaster. It will provide multiple broadcast pathways, including mobile phone alerts, television and radio broadcasts (including NOAA Weather radio) and satellite broadcasts. IPAWS became operational at the beginning of 2012 and will continue to expand. Federal agencies, state government organizations, local government or public safety organizations, tribal governments and territorial governments can go through training on the system and sign up for it. EAS is a part of the IPAWS system.

For general emergency information, contact your state or local emergency management and preparedness agencies. The best time to contact them is when there is no emergency and you are planning and preparing. The worst time is when there is an emergency and the agencies are responding to hundreds or even thousands of calls. Nevertheless, call them if you absolutely need to. For a list of emergency contacts, see Appendix A.

3.4.2 Emergency Management Structure and Authority

Louisiana is divided into nine emergency management and homeland security planning districts.[27] Each district has a regional director and a regional coordinator. The regional director serves as the voice for the region to bring issues to the state and is an employee of one of the parishes in the district. The regional coordinator is an employee of GOHSEP who helps the parish with training, provides technical expertise on Homeland Security Grants and provides support during disaster events.

Louisiana follows the State of Louisiana Emergency Operations Plan in the event of a disaster, including natural disasters such as hurricanes.[28] GOHSEP is in charge of designing all plans, procedures and agreements related to

emergency preparedness. It is also in charge of coordinating emergency disaster operations under the direction of the governor. The plan provides a general framework that state and parish agencies, volunteer groups and private organizations can use to develop detailed Continuity of Operations procedures, arrangements and agreements.

The director of GOHSEP has the power to implement the plan if he decides a situation warrants it. Additionally, the plan will automatically be activated any time the governor declares a state of emergency. Under the plan, parish presidents have overall responsibility for the direction and control of emergency/disaster operations. Each parish president must appoint a Parish Director of Homeland Security and Emergency Preparedness, who is in charge of developing programs to provide for rapid and effective action in the event of an emergency.

FEMA has the responsibility for coordination of federal emergency/disaster operations and resources in support of state and local government capabilities. It also directs the delivery of federal disaster relief assistance programs. FEMA will issue a Declaration of Emergency for hurricanes when all of the following steps have been met:[29]

- The state submits a request,
- The National Weather Service determines that part of the state is threatened by landfall of a major hurricane,
- The governor has declared a state of emergency, and
- Mandatory evacuation orders for three or more parishes or more than 100,000 residents have been issued *or* the federal declaration is necessary to provide direct federal assistance to meet critical emergency protection requirements before landfall that would overwhelm the capability or capacity of state resources.

FEMA uses an Incident Command System (ICS) through the National Incident Management System. The ICS is a standardized organizational and management structure that is used for all hazards. The specific activities of the ICS are tailored to the hazard that warranted its implementation. The ICS is used by all levels of government – federal, state, tribal and local. More information on the ICS can be found at http://tinyurl.com/FEMAics.

Part 4

Protecting Your Property

Protecting your property and protecting your family go hand in hand, since your house should be able to provide shelter from most weather conditions and perhaps even severe conditions. It's never too early to prepare, and you can take several basic steps right now to protect your family and your home from disaster. By strengthening your house, you can reduce the risk of damage and possibly reduce insurance premiums. Additionally, you may be able to shelter in place during a minor hazard event.

Before you take shelter in your home, consider the following factors that may limit the amount of protection your house can provide from a natural hazard:

1) The Severity of the Hazard Event. Protecting your home against a tropical storm or Category 1 hurricane is much easier than against a Category 4 or 5 hurricane. For stronger storms, avoiding all damage is difficult, so the main goal is to lessen significantly the amount of damage that could occur. Each and every small improvement you invest in your home can make a difference. The more small improvements you make to your home, the less likely there will be severe damage in minor events.

2) Your Location. Even though a hurricane may be a Category 1, you might experience much stronger wind. Being on a ridge, for example, amplifies the wind speed. Additionally, if your home is close to the open beach, coastal prairie, a large bay or a large marshland, the force of the wind will be much greater than if the house were surrounded in all directions by buildings, other homes or trees.

3) How Your House Was Built. The building codes adopted by Louisiana after the storms of 2005 require new houses to have hurricane clips that tie the roof to the walls and other connectors that tie the walls to the foundation. This is known as a continuous load path connection. Because of this requirement, many newer homes are generally much stronger than those built before this requirement was in effect.

4) How Your House Is Maintained. Maintenance of your house is important. Painting the exterior regularly protects the wood and prevents rot, which can weaken the structure. Termites can also weaken a wood-framed house. If the wood in the house is rotten or has severe termite damage, it will be more difficult, or even impossible, to

strengthen. Proper maintenance will extend the life of a house in many ways.

5) How You Strengthen Your House. Even if your house was not built with hurricane clips, there are many small steps and some major ones that you can take to retrofit or strengthen your existing home.

For many homeowners, minor damage can be an extreme hardship. To guide you on the most cost effective ways to strengthen your house, we can learn from the past. Hurricane Katrina, for example, wreaked havoc on residential and commercial buildings because of storm surge, inundation, flood-borne debris, strong winds and scour on barrier islands. Storm surge rose over 20 feet in parts of Louisiana.[30] FEMA's Hazard Mitigation Assessment Team (MAT) issued a report on building performance observations, recommendations and technical guidance for rebuilding after Hurricane Katrina, which can be downloaded from the FEMA website (www.fema.gov/library, search publication 549).

In the MAT report, released in July 2006, FEMA recommended that future hurricane damage from floods and high winds be mitigated by the adoption and enforcement of building codes and standards.[30] During the First Extraordinary Session in 2005, the Louisiana Legislature enacted Act 12 to establish a statewide uniform construction code with uniform performance standards to govern the construction, reconstruction, alteration and repair of buildings (either before or after a natural disaster).[31]

Homes in Louisiana must be built according to mandatory state and local building codes. Since January 2011, the Louisiana State Uniform Construction Code (LSUCC) has modeled the 2009 versions of the International Building Code (IBC) (with the exception of chapters regarding electrical and plumbing work) and the International Residential Code (IRC). The IBC deals with condominiums, apartments and mixed-use occupancies, while the IRC covers free-standing, single-family homes and true townhomes with lot lines. The LSUCC provides detailed guidelines for home construction and addresses features such as exits, materials to be used, building height, fire protection, alterations of existing structures, home elevation and wind resistance.

At the discretion of local governments, existing buildings and structures may also be subject to IBC and IRC standards. Individual parishes, municipalities and regional planning commissions may elect to adopt Appendix J to the IRC, which governs building code requirements for existing residential structures (see Section 4.3 on retrofitting). The benefits of updating existing structures to new building codes include:

- Providing reasonable safeguards for health, safety, welfare, comfort and security
- Balancing durability with affordability
- Lowering long-term costs by using durable construction materials
- Increasing storm resistance
- Reducing insurance premiums

Houses must be able to endure high winds. The closer your house is to the Gulf of Mexico, the higher the wind risk. In 2013, Louisiana enacted statewide enforcement of wind design provisions based on the 2012 International Codes (Figure 4-1). Building codes change over time, which results in changes to the specific parameters of wind zones. In general, the closer a structure is to the Gulf of Mexico, the more stringent the wind design codes are, and houses will need to be built to withstand higher wind forces. To find the current wind zone parameters of your location, refer to LSUCC website (http://lsuccc.dps.louisiana.gov/).

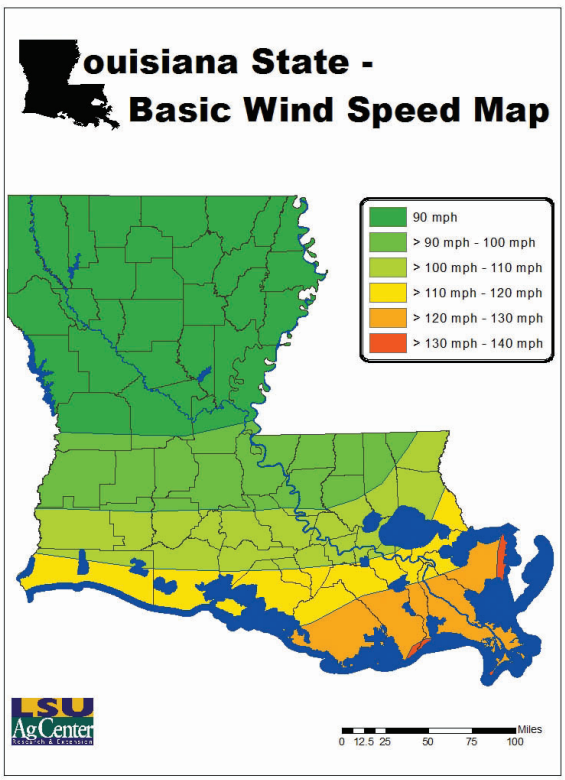


Figure 4-1. Wind zone map for Louisiana based on 2012 International Residential Code.

An interactive elevation and wind speed map, produced by the LSU AgCenter, is available at http://maps.lsuagcenter.com/windspeed_elevation/. Remember, this map cannot be used in place of an elevation certificate or as the official wind speed for meeting building codes, both of which are available from your local permit office.

Since higher winds exert significant pressure and force on buildings, structural requirements help buildings to better withstand hurricane-force winds. Some of these requirements may include wind-resistant windows, mandatory window coverings and additional structural requirements in home construction, which may include stronger materials, stronger connections, metal straps and clips, wood that bridges joints and anchors and cables.

The remainder of Part 4 addresses many of the options to consider when strengthening your home, whether you're designing a new home or planning to retrofit an existing home, including:

- Roof-to-wall connections
- Wall-to-foundation connections
- Hurricane clips with additional foundation connection
- Connection of the roof-sheathing to roof-framing members (rafters or trusses)
- Reinforcing gable ends with bracing
- Reinforcing weak roof framing members
- Protection for windows, doors and garage doors
- Flood protection measures (strengthening existing foundations and piers for flood forces, elevating mechanical equipment, elevating structures)

You may be able to perform the work for many of these measures, but it is best first to contact one or more of the following professionals to obtain guidance and details specific to your house. Consider hiring: 1) a structural engineer or architect to plan the strengthening and retrofitting program for your home and 2) a licensed contractor to do the installation and construction.

The topic of retrofitting existing homes has been tackled by numerous non-profit organizations and governmental agencies and the result of their hard work fills many reports and several excellent videos. The following sources can give you more information:

- The **Institute for Business and Home Safety (IBHS)** website has numerous articles, reports and videos that are extremely informative and explain preventative measures that reduce losses from all natural hazards, including hurricanes (http://disastersafety.org).

- **FEMA's Federal Insurance and Mitigation Administration** (FIMA) is continually researching hurricane resistant designs and building methods for the construction of residences and the performance of residences that have been subjected to hurricanes. FEMA publications referenced throughout this chapter are available free of charge, and most can be downloaded from the FEMA website (http://www.FEMA.gov/building-science-publications).

See Appendix E for a full list of helpful websites and FEMA publications.

4.1 Keep Your Roof On and Water Out: Creating the Wind- and Rain-Resistant Envelope

According to building codes and engineering standards, windows and doors create additional "openings" in the overall envelope of your house.[32] During a hurricane, it is very important to protect this envelope from wind and rain, which cause extensive damage if the envelope has any weak spots. Once a weakness is exposed, adjacent areas are more easily damaged and peeled away. A broken window during a hurricane can be harmful in several ways. Besides the incoming hurricane-force wind and torrential rain in your living room, broken windows allow shattered glass and debris to fly in from outside. Shattered glass and debris can make walking in your own house hazardous. Even more importantly, broken windows create a problem with internal pressurization of your house (Figure 4-2).

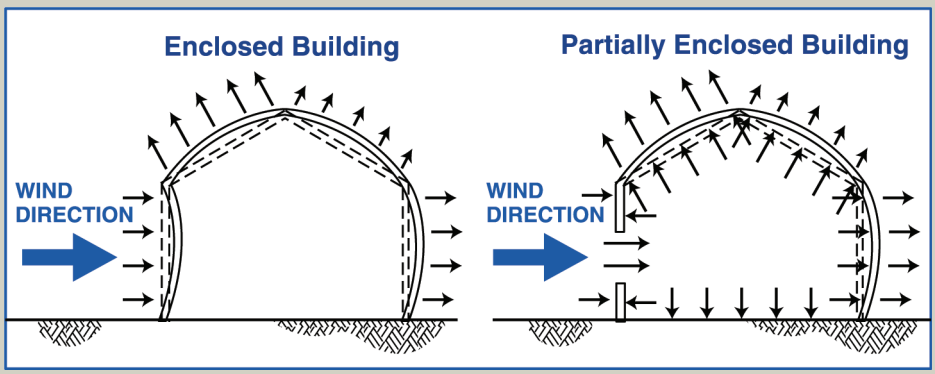


Figure 4-2. This figure illustrates the importance of protecting your windows. The diagram on the left shows a structure with the wind- and rain-resistant envelope intact. Pressure on the walls and roof comes from the outside only. In the diagram on the right, the structure's wind- and rain-resistant envelope has been breached due to a broken window. Now, pressure on the walls and roof comes from the outside and inside. The total amount of pressure on the roof and leeward wall increases significantly and can lead to the roof flying off and complete structural failure. Source: FEMA's *Coastal Construction Manual* (2000).

Some people believe that it is best to open the windows when a storm is approaching. However, when wind is allowed to enter a building, the external and internal pressures working on the structure create a situation where the structure may be blown apart. This is why windows should remain closed. When windows are unprotected, they can shatter and break the seal of the envelope of your house. Openings in your house need to be protected with shutters or covering devices that are impact-resistant, which helps create a wind- and rain-resistant envelope. Taping your windows will not

protect that envelope. In hurricane-prone regions, a building is considered enclosed if windows are protected with impact-resistant glazing, shutters or other impact-resistant protective devices.[33] If openings are not protected, then buildings need to be designed to withstand higher internal pressure, as identified in ASCE 7-10 (American Society of Civil Engineers Minimum Design Loads of Buildings and Other Structures).

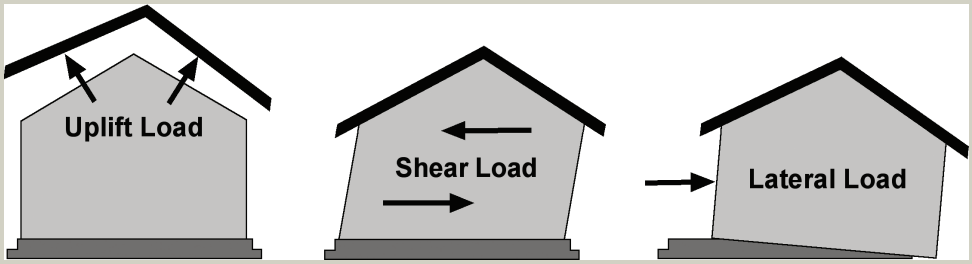


Figure 4-3. Strong winds create three types of force on your house. The uplift load occurs when wind pressure pushes a roof up from beneath or when wind flows over the house and pulls the roof up. The shear load occurs when horizontal wind pressure causes the walls of the house to tilt. The lateral load occurs when wind pressure on the walls causes the house to overturn or slide off the foundation. Source: Louisiana Sea Grant.

Hurricane-force winds can produce different types of stress on the structure of a house (Figure 4-3).[34] Visit www.safestronghome.com/highwind to view an animation about how high winds affect your house. Some reports indicate that a door or window breach can double the uplift forces on your roof and can significantly increase the chances that your roof will lift off.[35]

In the MAT report following Hurricane Katrina, FEMA indicated that even though most damage to structures was related to flooding, wind damage occurred in many areas because the houses were not built to withstand high winds. The most common type of wind damage was to building envelopes in the form of lost asphalt shingles and vinyl siding. Often, this breach in the envelope led to greater damage due to changes in internal pressure, leading to loss of roof sheathing and roof trusses.[33]

4.1.1 Continuous Load Path Connections

Naturally, all houses have some connection from the roof to the foundation, otherwise they would fall apart. The continuous load path concept (Figure 4-4) provides a connection between your roof and your house's foundation and helps to keep the roof from blowing off during a hurricane. You can view an animation of how a continuous load path connection strengthens the frame of your house at http://safestronghome.com/highwind/01.asp. Additionally, the Federal Alliance for Safe Homes (FLASH) has animations of retrofits and design (www.flash.org/video.php).

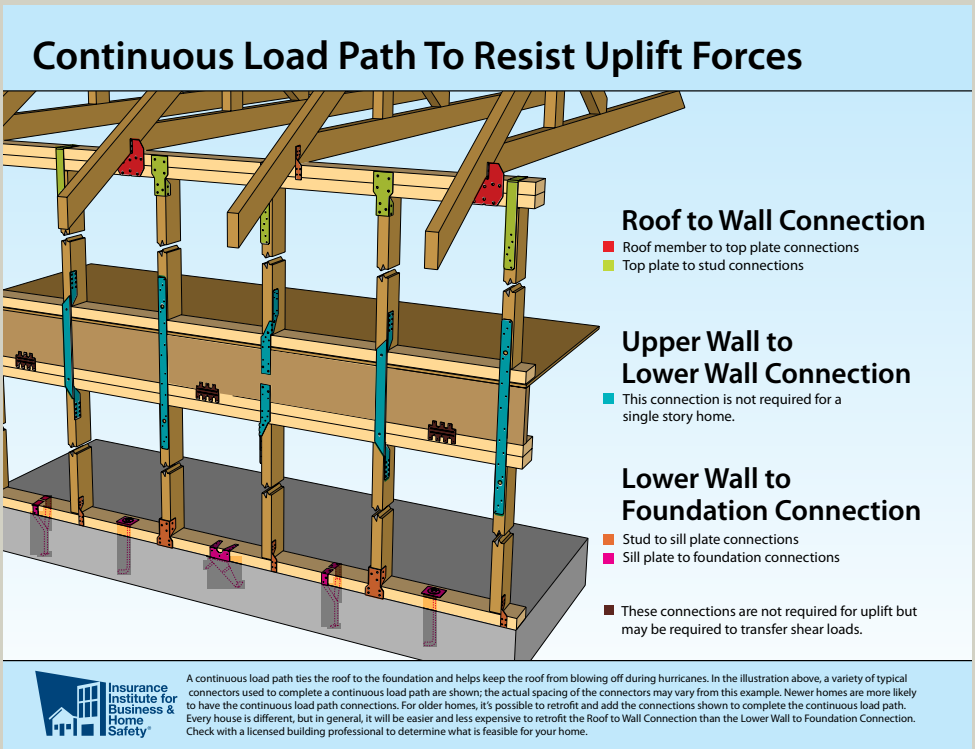


Figure 4-4: Continuous load path connection ties: the roof to wall, usually with hurricane clips and plate ties; the wall of a higher story to the wall of a lower story with straps; and the wall to the foundation with plate ties and anchors. Continuous load path connection ties should be in all new houses. Older homes usually will not have these features. In many cases, retrofit can easily be done for certain portions. Source: Simpson Strong-Tie.

The continuous load path connections for roof-to-wall, wall-to-foundation and sheathing-to-framing are analogous to a chain: both are only as strong as their weakest link. Historically, the weakest link has often been the roof-to-wall connection. In response to recent hurricane damage, much stronger connections are now required in the form of straps, anchors and hurricane clips (also known as hurricane ties) to protect against hurricane winds, as depicted in Figure 4-4. A hurricane clip is designed so that the only way for the structure to come apart is for the nails to be sheared off rather than just being pulled out. A variety of hurricane clips are available, with costs ranging from less than a dollar to over $4 per unit (as of May 2012). Hurricane clips can be purchased directly from Simpson Strong-Tie (www.strongtie.com) or from home improvement stores such as The Home Depot and Lowe's. Guidance on load paths can be found on FEMA's P-499 Fact Sheets (www.fema.gov).

Over time, the dimensions and shapes of hurricane clips may change, or certain types of clips may be discontinued. Be sure to double-check with a professional before purchasing hurricane clips. In order to get the correct clips, it is most important to know the load capacity of your house. A licensed architect, structural engineer or contractor can tell you what is suitable for your house and for the amount of protection you want.

Do-it-yourself wood frame construction manuals are available as guides to hurricane clip installation. These manuals, however, tend to be more conservative in load capacity estimates and therefore more expensive for cost estimates. There is a cost trade-off between using more prescriptive guides versus hiring an engineer to determine load capacity. The most important factor, of course, is ensuring the safety of your house against potential high winds.

For older houses, it is possible to retrofit to add components of the continuous load path connection (see Figure 4-5). It is preferable to do the roof-to-wall connection, wall-to-foundation connection and sheathing-to-framing connection. However, if the wall-to-foundation connection is too difficult or expensive because of the way your house was built, installing only the roof-to-wall connection is better than doing nothing. In general, it will be easier and less expensive to install hurricane clips than to do the wall-to-foundation connection. Potential costs of different levels of retrofit are available in FEMA's P-804 Wind Retrofit Guide, Appendix C, table C-3 (www.fema.gov).

Figure 4-5. This is the popular H2.5 hurricane clip installed during new construction of houses. Five nails are hammered into the lower beam (or top plate) and five more need to be used for the roof (truss-rafter) connection. A hurricane clip is required for each truss-rafter. Upon completion of this structure, the hurricane clip will be hidden from view. In 2012, this particular clip cost 35 cents. Ranging from less than a dollar to just over $4 in material cost per unit, hurricane clips can be installed for both new and retrofit applications.

4.1.2 Roof Framing or Truss Bracing

It is possible to strengthen your roof significantly by providing lateral and diagonal bracing to the rafter or trusses. This is particularly important for houses with gable-end roofs. Bracing can be done simply with 2-inch by 4-inch boards (2 x 4s); it is also possible to buy prefabricated metal braces at a local hardware store. Figures 4-6 through 4-8 are from the FEMA brochure *Against the Wind* (FEMA publication 247), which can be downloaded from FEMA's website at http://www.fema.gov/library/viewRecord.do?id=1641.

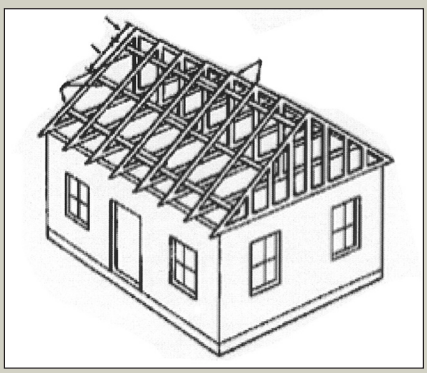


Figure 4-6. The trusses are built with a peak at the ridge line of the house. The trusses at the end of the house form an A-shaped pattern known as a gable end. During a hurricane, the gable end is subject to great forces from the wind and is likely to tip over, collapsing the other trusses in a domino fashion. Source: FEMA's *Against the Wind* brochure 247.

For lateral bracing, 2 x 4s are attached to the trusses that run the length of the roof. The 2 x 4s overlap over two trusses. Braces should be 18 inches from the ridge, in the center and at the base, about 8 feet to 10 feet apart. You or a professional can do this work. You should use two 3-inch, 14-gauge wood screws or two 16-penny nails for each truss.

Another important type of bracing for your gable end involves making diagonal braces (Figure 4-8). Diagonal braces provide additional support against collapse of the gable end. (See FEMA's *Protect Your Property from High Winds*, 2011).[36]

If it is not practical to install large pieces of lumber in the attic, additional designs for gable end bracing can be found in the *Wind Retrofit Guide for Residential Building* (FEMA publication 804, 2010; Figures 4-15 and 4-16) and the *Home Builder's Guide to Coastal Construction* (FEMA publication 499, 2010; Fact Sheet 9.2).

Figure 4-7. In this application of lateral bracing, the 2 x 4s are 18 inches from the ridge and connect to horizontal members that attach to the opposing trusses. Not all roofs will have the horizontal members. The 2 x 4s are connected with two No. 14 3-inch screws (A) and overlap over two trusses (A and B). The end is connected to the gable end with an angle or L bracket (C).

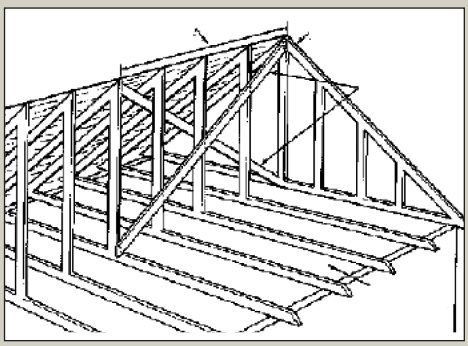


Figure 4-8. Diagonal braces form an X pattern from the top center of the gable end to the bottom center of the fourth truss and from the bottom center of the gable end to the top center of the fourth truss. The same screws as those for lateral bracing are used. Source: FEMA's *Against the Wind* brochure 247.

Hip-style roofs do not need as much bracing, as they are aerodynamically superior and have bracing built into the design of the structure. While gable-end roofs have a flat end that is A-shaped, hip-style roofs are similar to a pyramid and have the tops of all four sides of the roof sloping toward the center of the roof.

In general, additional information on roof bracing can be found on the IBHS web site (www.disastersafety.org) under the hurricane risk page. There is excellent information on repairing an existing roof or installing a new roof in addition to several construction tips.

4.1.3 Synthetic Roof Underlayment

Until the 21st century, most residential sloped roofs received a layer of asphalt-saturated felt paper underneath the roofing material. Mimicking the attributes of these house wraps, synthetic roof underlayments (Figure 4-9) are now available to serve the same function as a secondary weather barrier with increased resistance to tearing, moisture and ultraviolet rays.

Figure 4-9. Synthetic underlayments are typically made from polypropylene, polyester or fiberglass fabric that weighs less than felt paper, can be manufactured with anti-slip surfaces and can withstand exposure to the elements for six months. Source: Carlisle Coatings & Waterproofing.

Recent natural disasters and subsequent rebuilding efforts have proven the versatility of synthetics as roof underlayment. After several hurricanes ravaged the Gulf Coast, many people were forced out of their damaged homes. To minimize further damage due to water intrusion, large numbers of homes required quick roof repair and "drying in," thereby making houses impervious to rain. With limited resources, contractors triaged homes by repairing critical components and installing synthetic underlayments as temporary roofing. The underlayments performed better than FEMA's blue tarps and did not require removal and disposal when new shingles were installed.[37]

4.1.4 Window Coverings

If your home is located in a windborne debris region (any location where the basic wind speed for code purposes is 110 mph or greater), window coverings need to withstand hurricane force winds and impacts from windborne debris.[24] The standard for impact-resistance is known as the "Large Missile Impact Test" as defined by several standard specification tests (e.g., ASTM E1886/1996, Miami-Dade TAS 201, 202 and 203, or SSTD 12).[38] Essentially, these tests determine whether a given opening protection can withstand the impact of a nine-pound 2 x 4 fired at 30+ mph, followed by cyclic wind-load testing.[39]

Window coverings must be installed properly in order to function. They must be attached to the frame of the house – not just the frame of the window. Installed coverings should be tested and approved to meet industry standards for hurricane impact. The International Hurricane Protection Association (a trade association group comprised of manufacturers, contractors and other industry professionals) website has several tips, including product selection and choosing an installation contractor. Visit www.inthpa.com for more useful information. Additionally, FEMA P-499 Fact Sheet 6.2, *Protection of Openings*, and Fact Sheet 6.1, *Window and Door Installation*, contain information on selection and installation of storm shutters and impact-resistant glazing.

In the following pages, the handbook generically describes several types of opening protection systems. For each type, numerous reputable manufacturers provide different products, each with individual features, benefits and costs. The prices shown are an estimate for installation costs and represent local and nationwide averages as of July 2012. Pricing varies between providers and will change over time. Check with the manufacturer for impact rating and always use licensed contractors and reputable dealers who specialize in supplying and installing window protection systems. Look for certified contractors who comply with the appropriate building codes.

Roll-down Shutters

Roll-down shutters are the window covering type that is easiest to deploy and offers the best overall protection features (Figures 4-10 and 4-11). These are permanently attached to the building. The shutter consists of a movable "curtain" of slats that is held in place by vertical tracks. When not deployed, the shutter stores in a hood that is mounted above the protected window or door. Most of the components of roll-down shutters are made from extruded aluminum.

Figure 4-10. Coastal home protected with roll-down shutters on all windows and doors. The shutter is held in place by vertical guide tracks and can be deployed manually or with an integrated electric motor. Source: Roll-a-way/QMI.

Figure 4-11. Interior of home with deployed roll-down shutters. Roll-down shutters can be used not only for storm protection but also for security, privacy and light, heat and noise control. Source: Roll-a-way/QMI.

Roll-down shutters offer the highest level of protection against wind-driven rain, in addition to wind and debris, because they make solid contact with the windowsill, patio deck or other solid structure at the bottom. Roll-down shutters can be installed directly over windows and doors, or in some cases, at the balcony's edge to form an enclosure. Roll-down shutters are deployed using various types of operators, including manual and electric. Since roll-down shutters are easily deployed, they often are used on a regular (non-storm) basis for light control, insulation against heat and noise, or for privacy and security. The variety of features and methods of operation leads to a wide range of costs for this shutter type.

Accordion Shutters

A commonly used shutter type in hurricane-prone regions is the accordion shutter (Figure 4-12). This is a permanently installed system with interconnected "blades" that operate between horizontal tracks. When not in use, the blades fold and are stored on either side of the door or window being protected. Accordion shutters are manually deployed and can be deployed from the inside of the home, if the opening is a single- or double-hung window or an in-swinging window or door.

Figure 4-12. Accordion shutter (shown in the open position) installed over large window grouping of a coastal home. The shutter has been installed to allow deployment from inside the home. Source: Roll-a-way/QMI.

Decorative yet Protective Shutters

Bahama (or Bermuda) and colonial-type shutters are available for homeowners who wish to add a decorative flair to the home's exterior while simultaneously protecting windows against storm forces (Figures 4-13 and 4-14). These shutters are most commonly made with extruded aluminum frames and louvers, although some composite materials have also been applied. Typically, these shutters are finished with a durable exterior grade powder coating or automotive-grade polyurethane paint.

While these shutter types imitate the design of traditional wood shutters, it should be noted that no wood shutter of either type has been tested and approved as opening protection.

Figure 4-13. Bahama shutters made from durable extruded aluminum components add island flair to homes and provide effective opening protection. Source: Roll-a-way/QMI.

Figure 4-14. Colonial shutters made from durable extruded aluminum components add a traditional look to homes and provide effective opening protection. Source: Roll-a-way/QMI.

Storm Panels

Removable storm panel systems (Figure 4-15) are widely used and cost-effective systems available for opening protection. These consist of a series of panels made from steel, aluminum or impact-resistant polycarbonate. When not in use, panels are stackable for convenient storage. A wide variety of track options are possible. While these systems are relatively inexpensive (approximately $7-15 per square foot, depending on panel type and track options), panels require much more effort to deploy than the other types mentioned.

Figures 4-15. These 0.050 gauge aluminum storm panels offer cost-effective storm protection. In this example, panels slip into a track above the window and secure onto a bottom track using wing nuts. Source: Roll-a-way/QMI.

Impact-Resistant Screen Units and Flat Polycarbonate

Impact-resistant systems that are permanently installed on a structure can be an attractive option for opening protection because they require no advanced deployment. Two types of impact-resistant systems currently on the market are: 1) impact-resistant stainless steel screen units and 2) installed flat impact polycarbonate. Both of these have little, if any, negative aesthetic impact on the home.

Impact-resistant stainless steel screen systems (Figure 4-16) include a heavy-gauge stainless steel screen mesh that is secured in an extruded aluminum frame and installed over the window to be protected. These are available with hinge operation and can be opened from the inside of the house, which facilitates cleaning and emergency egress. Screen units also provide excellent solar shading characteristics.

Figure 4-16. In-place stainless steel impact screen protecting several windows of a coastal residence. This system requires no deployment and provides shade. Source: Roll-a-way/QMI.

Flat impact polycarbonate units (Figure 4-17) are available to protect most single and double window sizes found in residential homes. These are made from UV-stable optical quality grades of polycarbonate and provide excellent protection against all storm forces. Because these systems are not operable from the inside of the home, the need for emergency egress from the home must be considered before installing this type of window protection. Typical systems cost approximately $25-35 per square foot.

Fabric Screen Panels

Impact-resistant fabric panels (Figure 4-18) made from high-tensile strength geosynthetic fibers, such as polyethylene or reinforced PVC, have become increasingly popular for use as window and door protection. The polyethylene fabric types, which are basket weave systems, allow some light and visibility through the deployed screens. Some models incorporate emergency egress zippers. The PVC types are somewhat translucent and allow light in the dwelling but do not allow visibility through the screen. Fabric panels are attached on the two opposite sides of the window or door, usually to permanently installed panel mates or tracks with mounting studs. The panels include integrated grommets, which facilitate the deployment of the windscreens. These systems are also relatively inexpensive.

Figure 4-17. Flat impact polycarbonate panels installed directly over windows of a coastal home. This window covering provides excellent storm protection with minimal aesthetic impact. Source: Roll-a-way/QMI.

Figure 4-18. Polyethylene basket weave fabric windscreen deployed directly over ground floor windows of coastal home. Source: Roll-a-way/QMI.

Geosynthetic screens also have been extensively employed to enclose large, even irregularly shaped openings (Figure 4-19). Such systems range in price from $20-40 per square foot. Site-specific engineering for geosynthetic screens is required due to installation requirements and transfers of extreme wind loads to the structure at attachment points. Consultation with a competent contractor is recommended.

Figure 4-19. Polyethylene basket weave fabric windscreen deployed at edge of patio, enclosing the entire area. Source: Roll-a-way/QMI.

Impact-Resistant Windows and Glazed Doors

In order to withstand both wind forces and impact from windborne debris, window and door manufacturers have developed products with sturdier frames and laminated (impact-resistant) glazing (Figure 4-20). Several configurations of these systems are available in various styles and costs.

Figure 4-20. This attractive window can be fitted with energy-efficient glass, impact-resistant glass or both. The impact-resistant glass consists of a laminate or film sandwiched between two glass panes. The frames are reinforced, and the hinges have extra fasteners to withstand high wind events. During a wind event, debris may crack the glass, but the laminate will hold the window pane together in the frame and prevent breaching of the wind- and rain-resistant envelope. After the storm, damaged glass will need to be replaced.

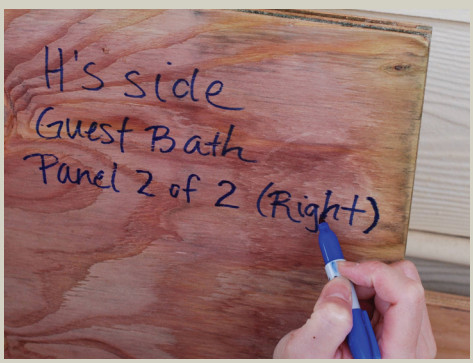
While impact-resistant openings offer deployment-free protection, the glass can still break (but remain in the frame). While these products are often available to the consumer through home improvement stores, professional installation is highly recommended in order to ensure that windows are properly attached to the structure.

Window Film

Security window film is an after-market product used to enhance glass breakage characteristics. Such products are often touted as "hurricane film" or similar for residential use; these claims cannot be substantiated by testing. According to the International Window Film Association (IWFA), "It should be noted that the testing of commercial windows does not imply performance of residential windows."[24] Application of any of these window films to existing residential windows does not constitute adequate protection and should not be considered for use. For laminates, the amount of protection is a function of the thickness of the film, the type of glass being protected (safety glass versus plate glass), the existing frame in which the window is set and the attachment of the frame to the house structure.[40] For more information, visit the IWFA website: www.iwfa.com.

Plywood Covers

Historically, plywood is the most commonly used option for protection of window openings. This is undoubtedly due to its relatively low cost and ready availability. However, plywood covers offer a limited amount of protection in moderate level storms and only if properly installed (Figures 4-21 and 4-22). The 2009 IBC and IRC have provisions (Table 1609.1.2 and Table R301.2.1.2, respectively) for plywood covers as an alternative for opening protection, provided that the covers meet local building code requirements, are installed with corrosion-resistant attachment hardware and are permanently attached to the structure.[24] For example, plywood covers are acceptable for two-family dwelling units with a mean roof height of 45 feet or less and wind speeds that do not exceed 140 mph.



Figures 4-21 and 4-22. Not only is it necessary to install plywood opening covers correctly, it is also important to label them correctly and store them away from heat and humidity.

The Federal Alliance for Safe Homes (FLASH) recommends and encourages installation of tested, code-approved and certified impact-resistant wind protection measures. However, in an emergency where temporary measures are the only option, FLASH offers online do-it-yourself instructions for how to install plywood covers, available at http://tinyurl.com/plywoodcovers.

The disadvantages of plywood are that it can rot or warp if stored in a wet or warm area. Plywood shutters are also relatively heavy. You will need two people who can lift 30-40 pounds to help with preparation and deployment of plywood shutters. Plan accordingly, as it will not help if the people you are counting on to assist you are not available during deployment. Because of the weight, it will be difficult and dangerous to install plywood shutters if a ladder is needed. Thus, plywood shutters are more practical for easily accessible windows on the first floor or windows that can be easily reached by a terrace or patio on upper floors. You may also want to consider the time needed to install these shutters properly.

Most significantly, however, plywood is increasingly viewed by insurance entities as an inadequate means of protecting openings. Simply put, plywood does not demonstrate the levels of performance achieved by the engineered shutter types described in previous sections.

Table 4-1 below lists the advantages and limitations of each type of window covering discussed above. For most homes, it may be preferable to mix and match the options, based on the needs and budget of the homeowner. For example, use plywood shutters for easily accessible windows, use storm panels for windows with medium accessibility and use roll-down shutters or laminates for windows that are difficult to reach. This will allow all windows to be covered at reduced costs. Upper level installations on elevated houses might involve additional costs, such as Man Lift rentals (an estimated $450 per day). The table below gives estimates of the installation cost for each type of window protection, assuming that the chosen type will protect 16 square feet, which includes a 3' x 5' window and an extra square foot for overlap anchoring onto the window frame.

Table 4-1: Pros and Cons of Various Types of Window Protection

Type of Protection	Pros	Cons	Approx. Cost for 3'x5' Window
Roll-down Shutters	Easiest to deploy Best overall protection, esp. wind-driven rain	Cost	$675 - $1245
Accordion Shutters	Easily deployed, Simple manual operation, Good overall protection, Modest cost	Possible aesthetic issues	$64 - $512
Bahama Shutters	Easily deployed, Island decorative flair, Provides shade	Blocks some light and view	$570 - $1245
Colonial Shutters	Easily deployed, "Traditional" decorative flair	Cost, Requires adequate room for "swing" of shutters	$675 - $1245
Storm Panels (steel, aluminum or polycarbonate)	Removable, Inexpensive	Manual deployment required, Must be stored when not in use	$225 - $464
Stainless Steel Impact Screens	Always in place, Provides shade	Some aesthetic impact, Egress issues must be considered, Less effective for wind-driven rain	$550*
Flat Impact Polycarbonate Units	Always in place, Minimal aesthetic impact	Egress issues must be considered, Care must be taken in cleaning	$270 - $300*
Fabric Windscreen	Inexpensive, Easy to handle and store	Manual deployment required, Greater shutter deflection than metal systems	$225*
Impact Resistant Windows	Always in place, Many styles and options	Costs vary widely and can be high, Glass can still break, requiring expensive replacement	$775*

Note: These window protection options were provided by Acadiana Blind Place and New Orleans Hurricane Shutters & Windows. An asterisk (*) indicates price estimates from one company. The pricing is current as of July 2012.

4.1.5 Exterior Opening Protection

Wind- and Impact-Resistant Entry Doors
The door is one of the most important yet overlooked openings in a home that requires protection. Most major suppliers of entry doors and garage doors offer products (with or without glazing options) that meet both wind- and impact-resistance requirements. Often, replacing a non-rated door with one of these newer types is more cost-effective than providing a covering for the door.

Replacement of an entry door with an impact-resistant entry door should be done by a qualified professional installer because of the extreme wind load that is transferred to the structure at attachment points.

Double-entry doors can be reinforced through the following actions:[41]

- Install slide bolts at the top header and bottom threshold of the inactive door
- Replace existing deadbolt or add a stronger deadbolt with at least 1-inch throw length between each door
- Replace the hinge screws in each of the three hinges for each door with longer hinge screws that extend further into doors and frames

These precautions are similar to other guidelines for single-entry doors, which call for at least three hinges and a bolt long enough that it goes into the 2x4 framing of the door.[35] When entry doors are fortified, at least two of them must be operable for access and exiting at any time.

Wind- and Impact-Resistant Garage Doors
Garage door reinforcement or replacement with wind- and impact-resistant doors is one example of protection from high winds. High winds from hurricanes and tornadoes can damage garage doors or even blow them in. If wind enters a garage, it can cause dangerous and expensive structural damage. Reinforcing a garage door helps you protect the garage and its contents and strengthens the building envelope.

The garage door is a significant weakness during a hurricane due to its large area and the stress it encounters (Figure 4-23). Garage door options include:

- Replacement with a stronger door
- Horizontal bracing
- Vertical bracing (For many garage doors the vertical bracing is a popular and reasonably priced option.)
- Other types of bracing kits

Figure 4-23. Because of their width, double-wide garage doors are more susceptible to wind damage than single doors. The wind can force it out of the roller track, especially if the track is light weight or some of the anchor bolts are not in place. This occurs because the door deflects too much under excessive wind pressure and fails. You should reinforce your garage door by installing horizontal and/or vertical bracing onto each panel using wood or light-gauge metal girds bolted to the door mullions. You may also need heavier hinges and stronger vertical supports for your door.»Source: Florida Hurricane Depot.

Any determination to reinforce or replace a garage door should be based on an inspection by a trained door systems technician or a qualified professional engineer. A professional should be able to assess the current wind load requirement of your garage door, which is based on size, local design wind speed and location of the structure. Garage doors should meet the design wind speed requirements for the area or be retrofitted to withstand the design wind speed.

Because of structural limitations on the original door, however, this may not always be possible. Adding weight to a garage door in the form of reinforcement may require an adjustment to or replacement of the door's counterbalance system. Windborne debris can still break glazed windows in a garage door and should be avoided, if possible. If you are replacing a garage door, be sure that it meets the standards for both wind- and impact-resistance, as these are separate ratings. Do not wait until a hurricane warning is issued to have your garage door evaluated. If you do, there will probably not be enough time for the service to be provided.

More information on the design of new garage doors or retrofitting existing doors can be obtained in *Home Builder's Guide to Coastal Construction* (FEMA publication 499, 2010; fact sheet 6.2); *Local Officials Guide for Coastal Construction* (FEMA publication 762, 2009; Chapter 10); and FEMA's *Protecting Your Property from High Winds* (2011). Additionally, the Door & Access Systems Manufacturers Association (DASMA) has guidance on fastening the track to the framing (www.dasma.com).

For further information regarding protection of all openings in a house, visit the IBHS website at www.disastersafety.org, in particular the FORTIFIED for Existing Homes Program.

4.2 Keep Rising Water Out: Flood Prevention

You can protect your property from flooding through a variety of actions, from inspecting and maintaining the building to installing protective devices. Most of these actions, especially those that affect the structure of your building or its utility systems, should be carried out by qualified maintenance staff or professional contractors licensed to work in your parish or city. When considering flood prevention techniques, the most important information to know about your home is the flood history of your area, the base flood elevation (BFE) shown on the FIRM for your community and neighborhood, and the elevation of your lowest floor.

The BFE is calculated based on the peak elevation of flooding, including wave height, which has a one percent or greater chance of happening in any given year, also known as the 100-year flood event. For example, a house on a site that has a reasonable chance of flooding to a depth of three feet would be required to have its first floor three feet above the natural ground. A house that is in an area not likely to flood can have its first floor at-grade.

For residential structures in a flood-prone area, the most effective way to reduce risk and loss from flooding is elevation (covered later in section 4.3.4). If elevating your home is not an option, another way to reduce damage from floods is to "wet floodproof" your home. To wet floodproof means that a homeowner has taken measures to protect the structure, contents and building system even if water enters the home. This technique is best for areas that flood infrequently and are subject to only a few inches of water. Wet floodproofing encompasses a variety of techniques:[42]

1) Use flood-resistant materials. Materials have different abilities to resist flood damage. Flood resistance classifications have been developed for floor, wall and ceiling materials and the adhesives used to install them. These classifications are published in FEMA Technical Bulletin 2-08, "Flood Damage-Resistant Materials Requirements". Examples include: clay tile, stone or brick with waterproof mortar; solid vinyl flooring with chemical-set adhesives; stained concrete; terrazzo; decay-resistant or pressure-treated woods; and rigid, closed-cell foam insulation.

2) Create flushable, drainable walls. In wet floodproofing, floodwater should be able to flow into and drain out of walls and other cavities to prevent damage from water pressure. After flooding, there should be a way to drain, clean and dry these spaces easily to remove silt and contaminants and to prevent the growth of harmful fungi and bacteria. Consider removable wide baseboards or wainscoting.

3) Prevent wicking. Create gaps in materials that tend to wick (such as gypsum wallboard) to prevent wetness from rising above the flood level. Fill the gaps with a flexible caulk or a gasket and cover with decorative trim or finishes.

4) Elevate appliances and utilities. Items to elevate include your outside air conditioner compressor, inside furnace or air conditioning unit, washer and dryer (choose front-loaders if on platform), water heater, freezer, generator, and electrical outlets and switches. Also substitute cooktop and wall ovens for free-standing range or drop-in units. An appliance can be elevated by placing it on a sturdy, flood-resistant platform or a strong shelf, which is securely attached to structural support that can withstand flooding. If wood is used, it should be solid, pressure-treated lumber. (See FEMA Publication 348: *Protecting Building Utilities from Flood Damage*).

5) Install barriers around appliances. Build a mini-floodwall around appliances where shallow-depth flooding often occurs, or set the washer and dryer on sturdy plastic sheeting or bags that can be raised during a flood threat.

6) Add a storage building above flood levels. Relocate some appliances to a new building elevated enough to be safe from flood damage. Keep enough space available in it to store valuable furnishings during a flood threat. Building construction may be subject to regulation.

Keep these points in mind when you wet floodproof:[42]

- Activities that involve work on the electrical system, gas or air conditioning compressor usually require the services of a licensed contractor. Check with the local permit official to find out about requirements in your area.

- Raising the electrical system above flood levels will protect it from water damage, but it won't make it safe to have service turned on while water is in the building.

- Even when a home is allowed to flood, sewage back-flow prevention is important to avoid the serious health hazards and more expensive cleanup procedures associated with that type of contamination. A back-flow valve should be installed.

- Since wet floodproofing does not keep the structure dry, cleanup is very important. Even if you successfully stop sewage backup through your plumbing, there is a good chance that water coming in from outside has some chemical and biological contaminants. Disinfection, cleansing and thorough drying are essential to remove contamination and to prevent decay and the growth of hazardous molds.

- Wet flood proofing (like dry flood proofing) is not allowed under the National Flood Insurance Program for new and substantially damaged or improved structures located in the SFHA.

Excellent sources of information on protecting your property from flooding include the *Homeowner's Guide to Retrofitting*, Second Edition (FEMA publication 312, 2009), the *Coastal Construction Manual* (FEMA publication 55, 2011), and to FEMA's *Protecting Your Property from Flooding*. You can also familiarize yourself with the *Home Builder's Guide to Coastal Construction* (publication FEMA 499, 2010), which is geared toward homebuilders.

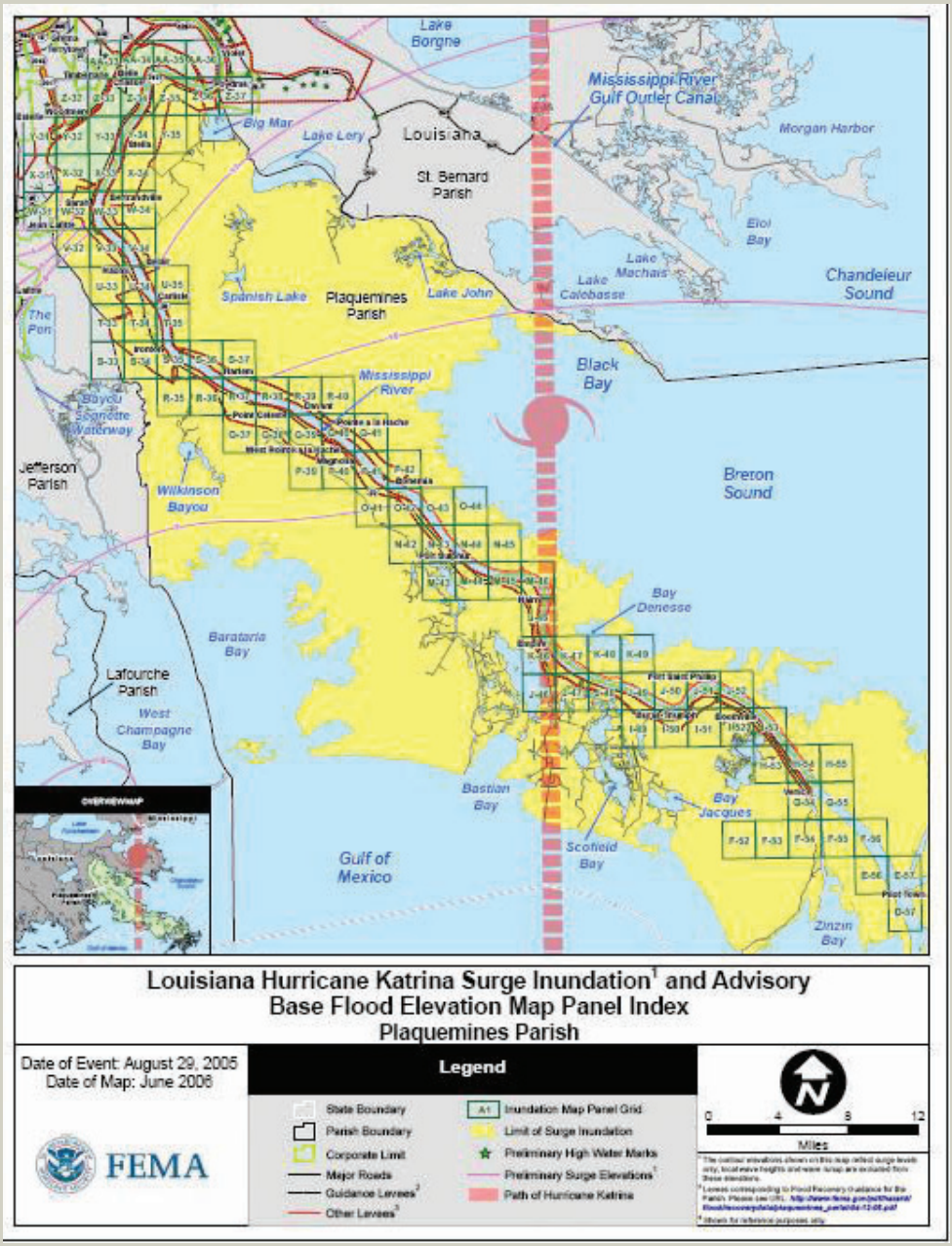


Figure 4-24. FIRM map in Plaquemines Parish indicating BFE. Source: FEMA.

4.3 Retrofitting an Existing Home

The LSUCC gives detailed, mandatory minimum standards for construction and provides different standards for buildings based on things like the type of building, the method of construction and the geography of the building site. These standards apply to new construction, reconstruction, additions to a home previously built according to the IRC, extensive alterations and the repair of buildings and other structures. "Extensive alterations" means the value of the work exceeds 50 percent of the total value of the structure. If improvements to an existing house total more than 50 percent of the value of the house, then this constitutes "substantial improvement," and the home will be required to meet all LSUCC guidelines, including elevation levels. Be aware that some communities have adopted much lower substantial improvement thresholds, such as 40 percent or even 25 percent. Your local permit office can tell you what the substantial damage and substantial improvement thresholds are for your community and about other regulations that may be applicable.

For existing homes, many opportunities exist to add flood-, wind- and water-resistance when doing repairs, restoration or routine maintenance. Any retrofits or new construction must comply with the state and local building codes. A permit is required to do any projects beyond surface work (for example, painting). Each parish has a permit process, and some parishes may have their own permitting office. Be sure to double-check any retrofit or new construction projects with a building official to ensure code compliance.

There are insurance incentives for increasing hurricane resistance of a home in Louisiana (see Part 5). Insurance companies are required to provide a discount for any homeowner who builds or retrofits to the current wind code. The closer your house is to the Gulf of Mexico, the greater the insurance discount that is available. In addition, some insurance companies offer insurance discounts when hurricane-resistant packages are installed according to IBHS FORTIFIED Program. To receive any type of insurance discount, any addition (retrofit or new construction) of hurricane-resistant features must be documented and verified by a certified inspector. Such documentation must take place while the fortification measures are still visible, i.e. before being hidden by wall coverings, roof soffit, etc. A list of certified inspectors is available on the Louisiana Department of Insurance website (www.ldi.louisiana.gov).

FEMA P-804, *Wind Retrofit Guide* (FEMA, 2011) was developed in response to Hurricane Katrina and addresses wind vulnerabilities in existing homes through a mitigation "package" approach congruent with the IBHS FORTIFIED program. P-804 summarizes technical information needed for

selecting cost effective wind retrofit projects for existing homes by focusing on mitigating high wind vulnerabilities that include roof and wall coverings, openings and load path connections. Retrofit projects may be eligible for federal financial assistance through FEMA's Hazard Mitigation Grant Program and the Pre-Disaster Mitigation Program.

When retrofitting an existing home, you should consult with a licensed structural engineer or architect. The structural engineer can explain the costs and benefits of installing the following common retrofit options:

- Roof-to-wall and wall-to-foundation connections;
- Hurricane clips, without additional foundation connection; or
- Stronger connectors than those required in the current building code.

4.3.1 Roof-to-Wall Connection

It is possible in many older houses to strengthen certain portions of the structure by strengthening the continuous load path connection (see Figures 4-25, 4-26 and 4-27). You can install hurricane clips after consultation with a licensed structural engineer or architect, or you can hire a licensed contractor who has experience in this area of work.

Figure 4-25. This is an example of retrofitting an existing house, originally built without hurricane clips. The popular H3 clip is used here; four nails attach the clip to the roof (truss-rafter) and four more nails attach to the wall or top plate below. For a retrofit, the clips are exposed on the outside of the house; therefore, both the clip and fasteners should be corrosion-resistant and painted to blend with the exterior of the house. With the correct clip and nails, you could perform the work or, if you prefer, hire a licensed contractor.

Figure 4-26. In this retrofit example, a hurricane clip attaches the roof structure to a horizontal ridge beam, which is in turn attached to the vertical post with a metal strap. This is an attempt to tie the load from the roof to the foundation, or create the complete load path connection. Note that these clips and straps are in the process of being painted. Source: Hurricane Protection Services.

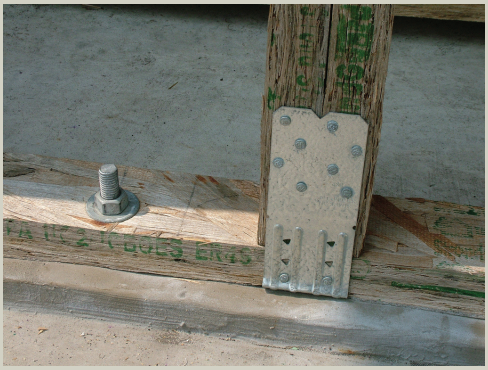


Figure 4-27. In some retrofit examples, it is possible to tie a portion of the house to the foundation. Here, a metal strap connects the vertical post to the foundation, which finishes the continuous load path connection from roof to the foundation. Source: Louisiana Sea Grant.

4.3.2 Roofing

Consider strengthening the roof when roofing is replaced at the end of its expected lifespan. If reroofing is unlikely to take place in the near future, existing older roofs can still be strengthened with spray polyurethane foam. (See FEMA's P-499 Fact Sheet 1.8, *Non-Traditional Building Materials and Systems*). Once the roofing is removed, several strengthening techniques can easily be employed:

- Replace damaged sheathing
- Install synthetic underlayment
- Add more nails
- Replace traditional shingles with hurricane-resistant shingles installed according to high-wind guidelines
- Remove the bottom row of sheathing and install hurricane clips, tying the roof to the frame of the house, before replacing the removed sheathing

You should seek a licensed roofing contractor to do this work. FEMA P-499 Fact Sheets on roofing elements include details such as roof sheathing attachment, underlayment for asphalt shingles and enhanced shingle attachment. See: *Home Builder's Guide to Coastal Construction* (publication 499, 2010; fact sheets 7.1 through 7.6 on roofing) and *Wind Retrofit Guide for Residential Buildings* (publication 804, 2010).

In addition to large roof retrofits, there are small things you can do to strengthen the roof, even if it is relatively new. For example, if you climb in your attic and see that nails meant to attach the plywood sheathing to the truss have in fact missed the truss, then you have found what could be a

structural weakness. The joint can be strengthened with wood epoxy or spray polyurethane foam.

4.3.3 Resisting Uplift Failure from Rising Flood Waters

Strengthening the foundation of your house to resist uplift from water will generally require the removal of interior finishes. There are several ways to modify the foundation of your house to prevent moisture penetration and to reduce potential intrusion by water.[43,44] In addition, wall-to-foundation connections reduce the chances of failure due to uplift forces. Installing uplift connections should be planned by a licensed structural engineer only after he or she has inspected your house to understand the materials and methods used to construct the home and to calculate the uplift requirements.

Efforts are underway to research and implement buoyant foundations, similar to those used on houses in the Netherlands. In Louisiana, while buoyant foundations might work to reduce flood damage, they do not fulfill legal requirements in flood damage prevention ordinances and building codes.[45] To comply with flood ordinances and wind provisions of the building code, follow the legal requirements to anchor your house.

4.3.4 Elevating an Existing Home[46]

Elevation is the most effective on-site method of reducing future flood damage. Homes in areas prone to hurricanes have to be able to withstand a certain level of wind and flooding. Elevation is often required to make sure that the lowest floor is above BFE. New buildings, or existing buildings that have been substantially damaged or will be substantially improved, depending on location, are also required to have either the lowest floor or the lowest horizontal structural member at or above BFE. Elevating to the BFE may not protect against actual flooding threats in a given area. The BFEs do not take into account changes in land subsidence or sea level rise and the storm surge of record is often considerably higher than the BFE. Home owners should consider elevating homes above the BFE to account for subsidence and sea level rise and the likelihood that future floods will exceed the BFE. Some homeowners in New Orleans, for example, have elevated their homes above the maximum height of the flooding from Hurricane Katrina even though the post Katrina BFEs only require a much lower elevation.

The homeowner must determine whether he or she wants to elevate an existing building, or tear it down and reconstruct a new building above the

BFE. The building must be examined to determine whether it will survive the elevation process. The elevation project includes design and drafting; preliminary site work; lifting the building; rehabilitating the building with stairs, porches and decks; possibly altering the roof; repairing walks and driveways; and landscaping. It is important to keep in mind that not all of these costs are eligible for grant funding.

If the building is being lifted, the elevation contractor should have control of the job from the time the house has been prepared for lifting until it has been set on its new foundation. The elevation contractor, not the homeowner, should subcontract the work on the new foundation so that he will assume complete responsibility for the structural integrity of the elevated home.

Structures built on piers or posts are the easiest to lift since the floor, walls and roof can usually be lifted as a unit to add a new foundation. For homes built on a slab, three techniques have been used to elevate successfully:

- the slab, walls and roof can be lifted as a unit
- the walls and roof can be lifted, leaving the slab on the ground
- the roof can be removed, a second story added (forming the new first floor) and the roof replaced.

The higher a building is raised, the greater the wind-load it transfers to the foundation. The elevated structure must have a foundation designed to withstand these extra forces. FEMA published the second edition *Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations* (publication 550) in 2009 to provide engineered foundation designs for elevated home construction in flood hazard areas near the coast. Your engineer may review the foundation plan to assure that it is appropriate for your home, the wind and flood exposure and soil conditions. Elevated foundation plans in V zones must be stamped by an engineer. Other considerations for the elevation plan include reference to standard, foundation walls, columns, pilings, bracings and bearings, local regulations, aesthetics and the cost of building access ways such as stairs, ramps, lifts and elevators.

For older residents in Louisiana or people with mobility-related concerns, elevators and lifts provide an access alternative to stairs for elevated homes. Visit the LSU AgCenter website for more information (http://www.lsuagcenter.com).

Raising a home does not remove it from the SFHA designated by FEMA, so it does not exempt homeowners or mortgage holders from flood insurance mandates. There are flood insurance advantages for exceeding the minimum

elevation requirements (also known as freeboard), but this may be offset by higher insurance premiums for wind and fire coverage or loss of coverage by private insurers, depending on the total elevation of the home. Be sure to check with your homeowner's insurance agent when you are deciding how high to elevate your home, because there may be additional techniques you can implement on the elevated foundation to mitigate for wind damages and to reduce the impact of elevation on homeowner's coverage. For example, elevating your house transfers additional wind shear forces to the entire structure. By using anchors and hurricane clips to build the continuous load path connection, homeowners may be eligible for lower premiums on their homeowners policies.

If your house is a historic structure or in a historic district, consult with the Louisiana Office of Cultural Development, Division of Historic Preservation (http://www.crt.state.la.us/hp/) to assure that your elevation design choices are compatible with the structure's architectural and historic aspects. Incompatible elevation could result in the loss of eligibility for grants, tax credits or tax abatements based on the structure's historic status. Refer to FEMA's *Floodplain Management Bulletin on Historic Structures* (Publication 467-2) for information specific to historic structures and the National Flood Insurance Program. In some cases, homes listed on or eligible for listing on the National Register of Historic Places may have different guidelines for rehabilitation and updates. Refer to the National Park Service website for general guidelines and preservation techniques for historic structures (http://www.nps.gov/tps/index.htm).

4.4 Other Measures to Protect Property

4.4.1 Tree Trimming/Planting

Trimming trees that overhang your house is an additional measure you can take to protect your property against storm damage. Even though trees can buffer your home from the full strength of the wind, there may be serious danger if large trees or limbs are close enough to fall onto your house. Few roofs are strong enough to withstand a falling branch or tree larger than 20 inches in diameter, but each homeowner must make their own assessment of the tradeoffs between the benefits a tree provides – beauty, energy savings, property value, protection from wind – and risks posed by large trees during a storm. If it is not possible to remove trees, then cutting off branches that hang over the home will reduce the risk of damage from the tree. You should only hire a state licensed arborist to perform this work. Hire a trained, licensed professional to assess tree health and structural integrity of large trees near your home regularly.

Tree trimming is something that homeowners can easily do – on small trees. Good pruning on young trees is key to having a mature tree with strong structure and desirable form. Trees that receive appropriate pruning while they are young will require much less corrective pruning when they mature. This can increase the life span of the tree and save the owner a great deal of money over the long run.

Every pruning cut you make has the potential to change the growth of the tree. Do not make unnecessary pruning cuts, because every time you remove green tissue (leaves) it lowers the tree's ability to make its own food through photosynthesis. This reduces its ability to grow. Each cut that you make should have a purpose – to remove a damaged limb, to correct poor structure, or to remove a hazard. Good pruning promotes structurally strong trees and poor pruning can permanently damage a tree. It pays to learn where and how to make the cuts before you start.

Each pruning cut is a wound, but trees do not heal the way people do. Instead, a tree just grows new tissue (callus) over the wound. The wound remains inside the tree for the life of the tree. In the best case, the tree can grow callus tissue completely around the wound, closing it off from the rest of the tree. In the worst case, the callus tissue never covers the wound completely, leaving the exposed wood open to decay and insects. It is much easier and faster for a tree to close off a small wound than a big wound. That means that small cuts on smaller trees do less damage than larger cuts on older, larger trees. Waiting to prune a tree until it is mature creates the need to make large cuts on large branches that the tree cannot easily close, if at all.

It is important to use the right tool for the job. Tree trimming and pruning tools include hand pruning shears (secateurs), loppers, pruning saws and chainsaws. For small branches, scissor-type, or bypass blade hand shears or loppers are best for making clean, accurate cuts. Use hand pruning shears for branches less than a half-inch in diameter; loppers are best for larger diameter branches. For branches too large for loppers, a hand-held pruning saw is best. You should not use hedge cutters (long flat blades) to prune trees, as they tend to shred woody tissue, leaving a ragged wound the tree cannot close over.

Are you ready to make the cut? Where you make a pruning cut can affect how well the tree will grow and close the wound. Cuts should be just outside the branch collar. The branch collar is the slight swelling of tissue where the branch and trunk meet. The branch collar is actually part of the trunk and contains specialized cells that form callus tissue that grows over the wound. Cutting into this tissue damages the tree unnecessarily, and may stop the tree from growing over the cut. When pruning cuts are too large and do not

callus over completely, the tree may suffer permanent internal decay. If you need to shorten a large branch, cut it back to a lateral branch or bud rather than remove it completely. Cuts that leave too much stub between lateral branches or buds (inter-nodal cuts) may lead to decay, sprout production, and misdirected growth.

Homeowners should keep all cutting tools clean, sharp and in working order so they are ready to use when needed and so cutting can be done safely and without damaging the tree. To clean tools, wash with water and wipe away caked dirt with a stiff brush. After you remove the dirt, dry the tool and apply a thin layer of layer of oil or lubricant (such as a spray lubricant or even cooking spray) with fine steel wool. Wipe away excess lubricant with a soft cloth. You can sharpen loppers or shears by carefully following the factory bevel on the blade side of the tool (flat and wide) by passing a file over it four or five times. Next run the file along the flat side of this blade to remove any metal burs formed from sharpening. Spray the metal parts of the tool with cooking spray or lubricant and wipe away excess with a soft cloth.

Pruning large trees is difficult for the average homeowner to do correctly and safely. It is difficult to reach branches on larger, taller trees from the ground, and it is necessary to climb the tree to reach them. This can be risky for someone who is not a trained climber and who does not have the appropriate safety equipment. In addition, branches on mature trees can have such large diameters that they must be cut with a chainsaw. Tree branches, even dead ones, can be heavy and difficult to handle easily or safely without special training and equipment.

Chainsaws can be dangerous, even in skilled hands. Most homeowners, including those with sawing experience, should carefully consider hiring a professional when a pruning or trimming job requires a motorized saw. Chainsaw injuries can be severe or fatal, and include burns, electrocution, crushing, and cuts to arms, hands, legs, torso, feet, head and shoulders. In 2009 more than 23,500 people in the U.S. went to the emergency room because of chainsaw injuries. On average, each cut required more than 100 stitches. The average chainsaw injury in 2000 cost each injured person over $12,000.[62] Hiring a professional can cost as little as $500.

Saw operators should always wear head, eye and hearing protection that meet requirements of the American National Standards Institute (ANSI) and protective clothing such as cut-resistant footwear and leg protection. Chainsaw leg chaps, or pants with ballistic or cut-resistant fabric, help reduce the risk of injury or death due to chain contact. But clothing will not protect an unskilled operator or one unaccustomed to proper methods of use. Operators should familiarize themselves with the owner safety manual for

safe use of a saw and practice to hone their skills. A chainsaw must never be used one-handed, left-handed or while in a tree or on a ladder. If the branch is too high or far to reach comfortably with both feet on the ground and both hands on the saw, it is time to call a professional.

The best time to prune a tree is when it is dormant. In Louisiana, the best time to prune is November through late February. However, you can prune to correct damage or remove dead wood or potentially hazardous limbs any time. It is best to avoid heavy pruning just after spring growth flush. Although pruning up to one quarter of the branches and leaves is acceptable, it is best to remove the minimum. Young trees tolerate pruning better than older trees. Removing even one large branch from a mature tree can cause a wound that the tree may be unable to close. Over-pruning can permanently damage a mature tree and lead to branch failure. Pruning paint is not necessary and may encourage decay in some species.

Tree Selection and Planting

People who live in areas where there are tropical-strength storms should consider wind resistance when they select and plant trees. Trees with a large mature size (most oaks, pines, etc.) are at greater risk of failure because they are higher above the ground where wind speeds are greater. Older trees tend to be less flexible and may break in high wind. Older trees have also been around longer and may have weak spots caused by injuries, pathogens and disease.

Three species of large-stature trees that tend to resist wind best are southern live oak (*Quercus virginiana*), bald cypress (*Taxodium distichum*) and southern magnolia (*Magnolia grandiflora*). Planting the trees in clumps helps them resist winds. Planting in good soil and avoiding root damage (such as construction and parking vehicles under the tree) also helps trees remain strong. Even so, there are species that tend to fail in tropical storm-strength winds, including water oak (*Quercus nigra*), southern red oak (*Quercus falcata*), Chinese elm (*Ulmus parvifolia*), Bradford pear (*Pyrus calleryana*), pecan (*Carya illinoiensis*) and southern pines (*Pinus* spp.).

Medium- and small-stature trees, including dogwood (*Cornus* spp.), holly (*Ilex* spp.), crape myrtle (*Laegerstroemia indica*), redbud (*Cercis Canadensis*), magnolia (*Magnolia* spp.) and fringe tree (*Chionanthus virginicus*) show medium to high wind resistance. These are all good choices for Louisiana landscapes.

Planting the right tree in the right place is the most important thing a homeowner can do. Trees that grow to a large mature size will grow best when they are far enough away from buildings and utilities to give them room to grow without damaging these structures. If a tree has enough room

to grow large without repeated pruning to keep it small, it is better for the tree and far cheaper for the owner. Use smaller-stature trees for tighter spots and areas near buildings and utilities. Giving the trees you plant the room they need to attain their full mature size without excessive and repeated pruning will allow you to enjoy the benefits, beauty and value trees can add to your landscape.

Poor planting is a common reason that trees fail in modern landscapes. Planting holes should be no deeper than the root ball; when in doubt, dig the planting hole shallower. The old saying is, "If you plant high, it won't die." That is especially true in places where the underground water table is high. Do not amend the planting hole with mulch or other organic material, as this will break down over time, causing the tree to sink under its own weight. Make the planting hole at least three times as wide as the root ball – wider is better. A wide, shallow planting hole encourages wide root development, which increases the tree's stability and its ability to get nutrients and water from the soil. Putting more time and energy into preparing a proper planting hole will pay off with a healthy tree that has a sound root system. Trees planted in undersized holes or holes that are too deep often do not develop strong root systems and may fail unexpectedly.

Post-Planting Care

Staking a newly planted tree may be necessary to help it keep standing upright while its roots grow into the new site. It is important to allow some movement of the tree so it can develop a strong trunk and roots. Only use staking if the tree will fall over without it. Staking materials should not cut into or damage the bark of the tree. You should provide the tree at least three anchors. Check the staking regularly to make sure the materials are not too tight on the trunk/branches. Remove the staking as soon as possible, ideally after one growing season. Staking materials left or forgotten on the tree will eventually girdle the tree and lead to poor growth or even death.

For established trees, a wide, shallow layer of mulch is the very best thing a homeowner can do to improve tree health and vitality. Mulch helps moderate soil temperatures and moisture. Mulch discourages weeds and grass growth so you do not need to mow or trim near the tree. Mowing and trimming near the base of the tree can damage the bark, and make it possible for insects and disease to enter the tree. Mulch also encourages the growth of soil organisms that benefit the tree, including beneficial insects, earthworms and fungi. These organisms slowly break down the mulch, releasing nutrients into the soil that the tree needs. They also help improve soil bulk density (ratio of air spaces to solids) and structure. Improved aeration allows important gas and water movement in the soil. The perfect mulch ring is two to four inches deep and at least as wide as the canopy of the tree. This may seem like a lot, especially for large trees, but mulch

promotes healthy roots, and the wider the mulch, the better it is for the tree. Be careful not to lay the mulch too deep, as this can slow water and oxygen movement into the soil. You should also pull the mulch away from the very base of the tree, so it does not hold moisture against the trunk. It is easy to manage weeds and grass with occasional hand pulling or use of a safe herbicide such as glyphosate.

Hiring a Professional
People who remove and prune trees for a living must carry a State of Louisiana arborist license. For pruning and removal jobs that are too big for you to take on yourself, call a state licensed arborist. When a storm strikes and the cleanup requires you to climb, use a ladder, use a chainsaw, or if you need to remove branches larger than four inches in diameter, call a professional, state-licensed arborist. Arborists have the know-how, the skills and the equipment needed to do the job well and safely. Hiring an unlicensed tree cutter may put you at risk for liability if something goes wrong. To find a licensed arborist call the Louisiana Department of Agriculture and Forestry at (225) 952-8100, or visit http://www.ldaf.state.la.us/portal/ to find a list of currently licensed tree care professionals. When you hire, make sure to get a contract that describes the work plan in detail, the price, start and end dates, and who will remove the debris.

4.4.2 Property Drainage

A good way to determine the risk of flooding for your house is to observe and study your property. Even inland properties may be susceptible to flooding if there is poor localized drainage. If your property floods during small rain events, then the problem may be greater during a storm or hurricane. You can reduce your risk yourself by improving the drainage on your property, by increasing your house's resistance to floods and by purchasing flood insurance. Examples of how to improve drainage include sloping property toward drainage areas or installing drains to redirect surface water away from structures.[47] Additionally, you should inspect ditches and drains in the area surrounding your home to make sure they are not blocked by excessive vegetation or debris.

4.4.3 Safe Rooms

A safe room is a room designed to withstand winds from the strongest hurricanes (Categories 3-5) and strong tornadoes. This option should only be considered if the house is outside of all known flood and storm surge zones and is strengthened to the highest level. Safe rooms should not be built in a flood zone where there is threat of moving water. During a hurricane or other high flood event, even these areas need to be evacuated no matter how fortified the room is against the wind.

It is much less expensive to install a site-built safe room at the time a new house is built. FEMA notes that while construction costs vary nationwide, the cost to build a safe room (which can also double as a master closet, bathroom or utility room) inside a new house ranges from $6,300 to $8,300 (2008 dollars) for an 8' x 8' room.[48] The additional cost can then be wrapped into the original home mortgage. This is a good investment that yields a sizable return in that it adds value to your house as well as protection and peace of mind for your family. If constructing a safe room on-site is impractical, then another option is to purchase a prefabricated safe room that can be installed in your home or in-ground. Prefabricated safe rooms can be located with the help of the National Storm Shelter Association (www.nssa.cc).

You can see an example of a shelter room in a house in Louisiana by visiting the LaHouse demonstration home at LSU (see http://tinyurl.com/LSULaHouse for more information). For more information regarding the design and construction of safe rooms, see *Design and Construction Guidance for Community Safe Rooms* (FEMA publication 361) and *Taking Shelter from the Storm* (FEMA publication 320) available from www.FEMA.gov. FEMA P-320 includes a risk-assessment tool for homeowners, guidance on emergency preparedness and prescriptive site-built safe room design drawings that were developed using the design criteria presented in FEMA P-361. Also look at the Federal Alliance for Safe Homes, Inc. website (www.flash.org) and the safe room website (www.highwindsaferooms.org/).

Part 5

Protecting Your Property with Insurance

There are two ways to protect your property investment from natural hazards. The proactive way is to strengthen your house to address potential hazards. If there is still damage, insurance can provide resources to aid recovery.

Insurance that covers both wind and flood damage is important for all residents, and flood insurance is a requirement for bank loans that involve mortgages on property in the Special Flood Hazard Area (SFHA). However, even if flood insurance is not required, you should consider purchasing it, especially if your home is in an area subject to periodic flooding. Louisiana ranks No. 1 in terms of flood claims paid by the National Flood insurance Program (NFIP), which reflects the generally high risk of flooding in the state. The insurance rates for properties outside declared flood zones are affordable and are "priceless" if an exceptional flood event should occur beyond the "100-year" event. Tropical Storm Lee, forming quickly just off the coast of Louisiana in early September 2011, came ashore and stalled, dumping more than eight inches of rain in parts of Baton Rouge, more than 13 inches of rain in Ponchatoula and parts of New Orleans, and more than 15 inches of rain in Holden.[49] Hurricane Isaac, a Category 1 hurricane in August 2012, had both high storm surge and intense rainfall, leading to flooding in many areas of the coast. Flood insurance can help provide peace of mind as well as help maintain financial stability in heavy rain events. You do not need to be in an official flood zone to obtain flood insurance.

The Louisiana Administrative Code, Title 37 Section 12703(A), now requires insurance companies to provide an "actuarially justified discount, rate differential, adjustment in deductible or any other adjustment" to insured customers who "build or retrofit a structure to comply with the requirements of the State Uniform Construction Code." Insurance premium discounts are thus applied when an owner builds or retrofits a structure to code compliance, installs damage mitigation improvements or retrofits property utilizing construction techniques demonstrated to reduce the amount of loss from a windstorm or hurricane.[50] Premium discounts apply to one- or two-family owner-occupied homes and modular homes. These discounts are not mandated for commercial or commercial residential properties with three or more units, manufactured homes or mobile homes.[51] Discounts are granted based on damage mitigation improvements and construction techniques listed on the Louisiana Hurricane Loss Mitigation Form.[52]

Examples of these damage mitigation improvements and construction techniques include building design; roof bracing; secondary water barriers; roof-to-wall strength; window, door and skylight strength; roof-to-floor foundation strength; and others. You should contact your insurance company or agent for more information. To receive any type of insurance discount, any addition (retrofit or new construction) of hurricane-resistant features must be documented and verified by a certified inspector.

Inspection and certification must be performed by a building code enforcement officer, registered architect or engineer, or a registered third-party provider authorized by the Louisiana State Uniform Construction Code Council to perform building inspections. For a list of registered third party providers, visit http://lsuccc.dps.louisiana.gov.

5.1 Wind Insurance

Some people may be surprised by what their homeowner's insurance policy actually covers. Although your homeowner's policy does not cover damage caused by rising floodwaters, it usually offers protection from loss caused by wind, rain, hail, snow, lightning and freezing temperatures. Before you experience a loss or damage to property, review your policy's provisions, including the deductible, and contact your insurance agent to update your policy to include the coverage that may be needed in the future. Be sure that your coverage amount is always at least 80 percent or more of the current replacement cost of your home, otherwise you may not be paid the full cost of replacement following a loss. You may also want to think about buying replacement cost coverage for losses to your contents, which pays for the full cost to replace things like furniture, clothes and appliances, rather than opposed to actual cash value minus depreciation. Additionally, do not wait until a hurricane is approaching to purchase homeowner's insurance. As pointed out on the Louisiana Department of Insurance website, most insurance companies will not issue new homeowner's coverage once the National Weather Service has issued a hurricane watch or warning.

A regular homeowner policy may have a special provision that: 1) excludes coverage for wind and hail losses, 2) provides a separate wind and hail deductible, 3) provides a separate named storm and hurricane deductible, or 4) provides a separate hurricane deductible. In example "1," a separate wind and hail policy must be purchased to cover any wind or hail loss. Coverage is typically provided in terms of replacement costs, or the cost to rebuild your house. Check with your agent and policy for the following:

- Does the policy have an inflation guard that increases each year as the cost to rebuild goes up? Construction costs have steadily increased and may increase even more after a natural disaster.

- After a hurricane, there can be widespread damage and very few contractors or supplies available to perform repairs. The heavy demand can result in an increase in cost and the length of time to rebuild.

- Additions or improvements to your house made since your initial policy purchase may not be covered, so it is important to have a periodic appraisal to ensure your coverage is adequate.

- Check with your agent to see if there is a named-storm deductible written into your policy. For example, a two percent named-storm deductible would require you to pay up to two percent of the insured value of your home (for example $4,000 on a home valued at $200,000 instead of the usual deductible you pay when you have other types of losses. In some instances, you may be able to "buy back" or choose a lower named-storm deductible by paying a higher premium.

- Check with your insurance agent about discounts, since different companies provide different discounts for hurricane protective devices. Over time, discounts can pay for the cost of certain retrofit upgrades.

- Make sure you have coverage for: 1) your main structure, 2) detached structures, 3) the contents in your house, and 4) expenses for loss of use (like hotel stays). Only the first item is required by the mortgage-holding bank, so you may not have sufficient coverage for the remaining items.

5.2 Flood Insurance

Your homeowners, renters and business insurance policies will not cover floods even if it can't be determined whether wind or water destroyed or damaged the structure. A separate flood insurance policy is needed to protect homes, businesses and personal property from flood damage. Although flood insurance is a federal program, you can purchase it through your local insurance agent. Your wind insurance likely covers water intrusion resulting from rainfall entering your house due to a wind-caused opening; however, check your policy or talk to your insurance agent to be certain.

Flood insurance will cover inundation or flooding of homes near a river, stream, lake or along the coastline or localized flooding from poor drainage. In addition, mudflows (defined as movement of the land by viscous water-

saturated soil) are covered, but landslides are not (for example, movement of the land by earthquakes). Coastal flooding and flooding from high surf and hurricanes are covered.

You should consider flood insurance if you are at risk of flooding. You may need flood insurance if you live near the coastline, a river or stream system or any other body of water in or near the SFHAs shown on the FIRMs. You should also consider flood insurance if you have poor localized drainage.

Contact your insurance agent to see if he or she offers federally backed National Flood Insurance. The following website provides a listing of agents issuing flood insurance for your community: www.tinyurl.com/commins. For low risk areas, the cost of insurance is minimal compared to the protection it can provide.

The National Flood Insurance Program[53]

FEMA manages the National Flood Insurance Program (NFIP). The NFIP's three main components are flood insurance, floodplain management and flood hazard mapping.

Around 20,000 communities across the United States and its territories participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP provides federal flood insurance available for purchase by homeowners, renters and small business owners in these communities. Community participation is voluntary. A list of communities in Louisiana participating in the NFIP and a list of high-risk communities not participating can be found on FEMA's website (www.fema.gov/cis/LA.html).

FEMA produces Flood Insurance Rate Maps or "FIRMs" to set the rates for the flood insurance policies sold through the NFIP. These official maps delineate both the SFHAs in a community and the risk premium zones applicable to the community for the NFIP program.[54] FEMA defines a SFHA as the area where the ground would be covered by water in a base flood. When property is determined to be in the SFHA, there is a reasonable expectation that something built on that property at an elevation below the expected flood level will have a 1 percent or higher chance of flooding every year.

For this reason, if a building is in a SFHA, the federal government mandates that mortgaged properties be protected by flood insurance. If your home is located in a FEMA-identified high-risk flood zone, a separate flood insurance policy should have been required on the mortgage transaction.[55] The NFIP has an arrangement with private insurance companies to sell

and service flood insurance policies, but it has its limits. You can get up to $250,000 for your house and $100,000 for its contents. If you need more coverage, you can purchase excess flood insurance through private insurers.

Don't wait until a storm is coming to purchase flood insurance, as it will take 30 days after purchase for a flood insurance policy to go into effect. Also, many companies restrict the sale of insurance once a hurricane or tropical storm enters the Gulf of Mexico.

You could also be partially reimbursed for steps you take to prevent flood damage, even if the flood never reaches your house.[56]

5.3 Hazard Mitigation Assistance

FEMA's Hazard Mitigation Assistance (HMA) programs are intended to encourage investment in long-term mitigation measures to reduce vulnerability to natural hazards. In Louisiana, GOHSEP administers the HMA program to reduce the risk to individuals and property from natural hazards while simultaneously reducing reliance on federal disaster funds. As such, GOHSEP encourages state, local and tribal governments and communities to take advantage of funding provided by HMA programs in both the pre- and post-disaster timeframes.

Funding under HMA programs is subject to the availability of appropriations. For the Hazard Mitigation Grant Program, availability of funds depends on the amount of FEMA disaster recovery assistance under the Presidential Major Disaster Declaration. To assist in establishing funding priorities, local and state mitigation plans are utilized to identify the highest risks.

Among other things, the program can provide funds to states to assist homeowners in implementing mitigation measures for existing structures. Some of the project types that have been approved by FEMA to assist homeowners are:

- Property Acquisition and Structure Demolition. The acquisition of an existing at-risk structure and typically, the underlying land, and conversion of the land to open space through the demolition of the structure. The property must be deed-restricted in perpetuity to open space uses to restore and/or conserve natural floodplain functions.

- Property Acquisition and Structure Relocation. The physical relocation of an existing structure to an area outside of a hazard-prone area and, typically, the acquisition of the underlying land. Relocation

must conform to all applicable state and local regulations. The property must be deed-restricted in perpetuity to open space uses to restore and/or conserve natural floodplain functions.

- Structure Elevation. Physically raising an existing structure to an elevation at or above the BFE or higher if required by FEMA or local ordinance. Foundations must be properly designed to address all loads, be connected to the lowest floor structural member and allow for proper elevation of utilities. FEMA encourages applicants and sub-applicants to design all structure elevation projects in accordance with the American Society of Civil Engineers 24-05 *Flood Resistant Design and Construction*.

- Structural Retrofitting of Existing Buildings. Modifications to the structural elements of a building to reduce or eliminate the risk of future damage and to protect inhabitants. The structural elements of a building that are essential to protect in order to prevent damage include foundations, load-bearing walls, beams, columns, structural floors and roofs and the connections between these elements. FEMA Publication 804, *Wind Retrofit Guide for Residential Buildings*, is a good source for more information.

- Mitigation Reconstruction. Construction of an improved, elevated building on the same site where an existing building and/or foundation has been partially or completely demolished or destroyed. Mitigation reconstruction is only permitted for structures outside of the regulatory floodway or coastal high hazard area (Zone V) as identified by the existing best available flood hazard data. Activities that result in the construction of new living space at or above the BFE will only be considered when consistent with the Mitigation Reconstruction requirements. There are some limitations on activities that fall under this program; check www.FEMA.gov for more information.

5.4 Louisiana Storm Mitigation Tax Incentives

Several other storm mitigation incentives exist for Louisiana homeowners in addition to insurance premium discounts available to homeowners who build or retrofit their homes in compliance with the LSUCC.

The Louisiana Legislature encourages implementation of the code by providing tax incentives to homeowners who are willing to strengthen their homes against storms and hurricanes. Homeowners must take action to take advantage of these financial incentives.

Sales Tax Exclusions
Insurance policy holders can receive exclusions on state sales and use tax when purchasing storm shutter devices that provide window damage protection in a storm or hurricane.[57]

Tax Deductions
The Louisiana Legislature has provided for tax incentives for insurance policy holders who voluntarily retrofit an existing home to bring it into compliance with the LSUCC.[58] This construction code retrofitting deduction is an amount equal to 50 percent of the cost paid for the retrofit after January 2007, minus the value of any other state, municipality or federally sponsored financial incentive for the cost paid. The taxpayer must claim the homestead exemption for the home being retrofitted, and the home cannot be rental property.

This tax credit can be no more than $5,000 per retrofitted residential structure and is claimed on the tax return for the year in which the work is completed. Along with the tax return, applicants must submit proof that the retrofit complies with the LSUCC, documentation of the cost of the project and assurance that the project was voluntary as defined by the law.[59]

5.5 Other Insurance Questions[60]

Here are some frequently asked questions about hurricane-related property damage, with answers provided by *The Advocate* in 2012. Additional FAQs and responses are available at www.floodsmart.gov/floodsmart/pages/faqs.jsp.

1) Do automobile insurance policies cover flooding? Yes, if you bought comprehensive coverage. If you have only liability coverage, your vehicle is not covered for flooding.

2) Can I buy flood insurance if my property has flooded in the past? Yes. But there may be a 30-day delay before flooding is covered. See your insurance agent for details.

3) My neighbor's tree fell on my property and caused damage. Is the neighbor's homeowners insurance company responsible for paying my repairs? Generally speaking, if your neighbor's healthy tree falls on your home, fence or other property, it is your insurance company's responsibility to cover the damage.

4) How soon does the insurance company have to pay me the money it owes me for repairs to my property? Sometimes you will receive a check quickly. However, an insurance company has up to 30 days to pay your claim after you give them satisfactory proof of loss.

5) How do I file a complaint with the Department of Insurance? You can call the department for a form at (800) 259-5300 or (225) 342-1258; or file your complaint online at www.ldi.la.gov.

Appendix A
Emergency Contact Information

Louisiana 211

Dial 211 from any landline or cellular phone for 24/7 up-to-date information on critical health and human services available in your area during a crisis or at any time. Service is provided in several languages and provides information on the coordinated disaster relief effort, food, clothing and shelters, special needs housing, volunteers, evacuation routes, transportation assistance, crisis counseling, prescription assistance, missing persons, post-disaster child care, rebuilding assistance and other vital resources.

Coastal Parish-by-Parish Emergency Management and Sheriff Numbers

Parish	Emergency Mgmt.	Sheriff
Acadia	(337) 783-4357	(337) 788-8700
Ascension	(225) 621-8360	(225) 621-8300
Assumption	(985) 369-7386	(985) 369-2912
Beauregard	(337) 463-3282 Ext: 1142	(337) 463-3281
Calcasieu	(337) 721-3800	(337) 491-3600
Cameron	(337) 775-7048	(337) 775-5111
East Baton Rouge	(225) 389-2100	(225) 389-5045
Evangeline	(337) 363-3267	(337) 363-2161
Iberia	(337) 369-4427	(337) 369-3711
Jefferson	(504) 349-5360	(504) 349-5322
Jefferson Davis	(337) 824-3850	(337) 821-2100
Lafayette	(337) 291-5075	(337) 232-9211
Lafourche	(985) 537-7603	(985) 532-2808
Livingston	(225) 686-3066	(225) 686-2241
Orleans	(504) 658-8700	(504) 827-8505
Plaquemines	(504) 297-5671	(504) 564-2525
St. Bernard	(504) 278-4267	(504) 271-2501

Parish	Emergency Mgmt.	Sheriff
St. Charles	(985) 783-5050	(985) 783-6807
St. James	(225) 562-2364	(225) 562-2200
St. John the Baptist	(985) 652-2222	(985) 652-9513
St. Landry	(337) 948-7177	(337) 948-6516
St. Martin	(337) 394-2800	(337) 394-3071
St. Mary	(985) 385-2600	(985) 384-1622
St. Tammany	(985) 898-2359	(985) 898-2338
Tangipahoa	(985) 748-3211	(985) 345-6150
Terrebonne	(985) 873-6357	(985) 876-2500
Vermilion	(337) 898-4308	(337) 893-0871

Louisiana State Police	
(225) 925-6006 (*LSP or *577 from any cell phone)	
www.lsp.org	
Troop A (Baton Rouge)	(800) 969-2059
Troop B (Kenner)	(800) 964-8076
Troop C (Gray)	(800) 659-5907
Troop D (Lake Charles)	(888) 225-5577
Troop E (Alexandria)	(800) 256-4160
Troop F (Monroe)	(866) 292-8320
Troop G (Bossier City)	(866) 853-6580
Troop I (Lafayette)	(888) 768-8746
Troop L (Covington)	(888) 339-8659

Appendix B
Useful Websites and Numbers

Louisiana Department of Transportation and Development (DOTD)
(877) 452-3683
www.dotd.state.la.us

Traffic and Road Closure Information

Road Closures
511 (within Louisiana) or (888) 762-3511
www.511la.org

Federal Highway Administration: Louisiana Traffic Information
www.fhwa.dot.gov/trafficinfo/la.htm

Louisiana State and Federal Highways Closure page
http://dpsweb.dps.louisiana.gov/roadandincident.nsf

Federal Emergency Management Agency (FEMA)

(800) 621-3362
www.fema.gov

Governor's Office of Homeland Security and Emergency Preparedness

(225) 925-7500
www.gohsep.la.gov

Weather

NOAA's National Weather Service
www.weather.gov

Southern Region Headquarters
www.srh.noaa.gov/

NOAA Weather Radio Call Signs:
Baton Rouge – KHB46
Bogalusa – WNG521
Buras – WXL41
Lafayette – WXK80

Lake Charles – KHB42
Morgan City – KIH23
New Orleans – KHB43

Louisiana Emergency Alert System

The following radio stations are key participants in the Louisiana Emergency Alert System. In the event of an emergency, these stations will broadcast emergency information:

Baton Rouge
AM 1150 (WJMF)
FM 102.5 (WFMF)

Crowley
FM 102.9 (KAJN)

Lafayette
FM 99.9 (KTDY)

Lake Charles
AM 1470 (KLCL)
FM 99.5 (KHLA)

New Orleans
AM 870 (WWL)
FM 101.9 (WLMG)

Northeast
AM 540/FM 101.9 (KNOE)

American Red Cross

(800) 733-2767
www.redcross.org

Northwest Louisiana Chapter (Shreveport) (318) 865-9545
www.redcross.org/la/shreveport

Northeast Louisiana Chapter (Monroe) (318) 323-5141
www.redcross.org/la/monroe

Central Louisiana Chapter (Alexandria) (318) 442-6621
www.redcross.org/la/alexandria

Southwest Louisiana Chapter (Lake Charles) (337) 478-5122
www.swla-redcross.org

Acadiana Area Chapter (Scott) (337) 234-7371
www.acadianaredcross.org

Louisiana Capital Area Chapter (Baton Rouge) (225) 291-4533
www.redcross.org/la/baton-rouge

Southeast Louisiana Chapter (New Orleans) (504) 620-3105
www.arcno.org

Louisiana Department of Children and Family Services

(888) 524-3578
www.dss.state.la.us

Louisiana Department of Health and Hospitals

(225) 342-9500
www.dhh.state.la.us

Louisiana Department of Insurance

(800) 259-5300 or (225) 342-5900
www.ldi.louisiana.gov

Louisiana Division of Medicaid

(877) 598-8753
www.lamedicaid.com

Lodging and Campsites

Louisiana Department of Culture, Recreation and Tourism
(225) 342-8115
www.crt.state.la.us/

Mississippi Tourism
(866) 733-6477
www.visitmississippi.org

Alabama Tourism
(800) 252-2262
www.alabama.travel/

Arkansas Tourism
(501) 682-7777
www.arkansas.com

Texas Tourism
(512) 936-0101
www.travel.state.tx.us

Information for Nearby States

Mississippi Department of Transportation
(601) 359-7001
www.goMDOT.com

Mississippi Emergency Management Agency
(800) 222-6362
www.msema.org

Mississippi Highway Safety Patrol
(601) 987-1212 (Within Mississippi *hp from any cell)
www.dps.state.ms.us

Texas Department of Transportation
(800) 558-9368
www.dot.state.tx.us

Texas Department of Public Safety – Highway Patrol Division
(512) 424-2000
www.txdps.state.tx.us/tle/index.htm

Arkansas Department of Transportation
(800) 245-1672
www.arkansashighways.com

Arkansas State Police
(501) 618-8100
www.asp.state.ar.us

Tennessee Department of Transportation
(615) 741-2331 or (877) 244-0065 (Road and Travel Conditions)
www.tdot.state.tn.us/tdotsmartway/

Tennessee Highway Patrol
(615) 251-5175
www.tn.gov/safety/thp.shtml

Georgia DOT
(888) 635-8287 or (404) 635-6800
www.georgia-navigator.com

Georgia State Patrol
(404) 624-7000
www.georgiastatepatrol.com

Florida Department of Transportation
(866) 374-3368
www.dot.state.fl.us

Appendix C
Hurricane Shelters

Louisiana does not provide lists of hurricane shelters prior to emergency situations because shelter locations are subject to change. As situations develop, the governor's office and your local parish governments will notify the public of open shelters. Shelters may be opened selectively, depending on the severity of the storm. Should an evacuation become necessary, please call 211 or listen to your radio or television for up-to-the-minute information on shelters, locations and driving directions, and emergency evacuation bus pick-up points in your area. You may also contact your local chapter of the American Red Cross (see Appendix B) for information concerning the state's evacuation plan and available shelters by parish. Shelter personnel will be onsite to direct you to the specific shelter buildings.

If you are advised to evacuate, try to keep family members together and don't forget your evacuation kit with grab-and-go box. It is essential that you take your survival kit with you because food, cots, blankets and other comfort items will probably not be available. Only bring supplies that are absolutely necessary since typical shelter space is 10 square feet per person. Alcoholic beverages, and weapons are not allowed in public shelters. If you have pets, make sure to find a pet-friendly shelter.

Shelters used may vary from season to season and storm to storm, based on maintenance needs and other local uses. It is very important to listen to your local emergency management office if you are considering going to a local public shelter to confirm the shelter will be open.

Emergency Shelter Information Points

- Take a bath and eat before you leave home.
- Register immediately upon entering the shelter.
- Obey shelter rules.
- Keep the building safe and sanitary.

Appendix D
Emergency Checklists

Items for Emergencies

Grab-and-Go Box

- Cash or traveler's checks
- Map of area
- Emergency phone numbers
- Identification documents
- Copies of important prescriptions
- Copies of immunization records
- Medical insurance cards
- Medical care directives
- Copies of insurance policies
- Insurance company telephone numbers
- Financial information
- Back-up copies of computerized financial records
- Computer account user names and passwords
- Keys and combination to safe deposit box
- Flashdrive with backups of pictures
- Important documents (deeds, titles, wills, power of attorney, home inventory, certificates, employee benefits, proof of residence)

Evacuation Kit

- Grab-And-Go Box
- Portable radio and spare batteries
- Flashlight and spare batteries
- First-aid kit
- Two-week supply of medications (prescriptions and others)
- Denture needs
- Contact lens supplies and extra eye glasses

- Five to seven day supply of nonperishable, ready-to-eat foods
- Any special dietary foods and vitamins
- Can opener and utility knife
- Baby supplies
- Toothbrush and toothpaste
- Toilet paper rolls
- Water-free hand sanitizer
- Change of clothes
- Towels, pillows, blankets
- Paper and pencils
- Needle and thread
- Signal flare and whistle
- Pet supplies

Emergency Supplies

- Five to seven day supply of water per person
- Camp stove with fuel (or BBQ grill with charcoal or propane)
- Matches or lighter
- Disposable plates and kitchen utensils
- Sanitary supplies or portable toilet
- Waterproof plastic sheeting or blue tarp with grommets
- Rope
- Bedding for each person
- Rain jackets and pants
- Sunscreen and bug repellant
- Soap and shampoo
- Cleaners, household bleach, trash bags, towlettes
- Fire extinguisher
- Pliers, tape
- Shutoff wrench for household gas and water valves

Actions to Complete Prior to Evacuation

- Fill the gas tank of your car
- Place boats on trailers and tie down
- Obtain sufficient cash
- Secure outdoor furniture and other items
- Store chemicals and fertilizers in a safe location
- Secure propane tanks
- Turn down and secure canvas awnings
- Deploy window protections
- Brace sliding glass doors
- Place folded towels on windowsills
- Check door locks
- Unplug unnecessary appliances
- Turn freezer and refrigerator to coldest setting
- Listen to local radio and TV stations
- Limit telephone usage to emergency calls only.
- Shut off electricity and water
- Don't forget your evacuation kit

Appendix E
Helpful Resources

Emergency Preparedness Websites

Entergy Storm Center
http://stormcenter.entergy.com/default.aspx

FEMA Incident Command System Overview
www.fema.gov/emergency/nims/IncidentCommandSystem.shtm

FEMA Integrated Public Alert and Warning System
www.fema.gov/integrated-public-alert-and-warning-system

GOHSEP's Get a Game Plan
www.getagameplan.org/

Louisiana Department of Agriculture and Forestry Emergency Programs
http://tinyurl.com/LDAFemergency

Louisiana Emergency Operations Plan
www.gohsep.la.gov/plans/eopindex.htm

Louisiana's Homeland Security and Emergency Management State Regions
www.gohsep.la.gov/regions.aspx

Louisiana State Animal Response Team
www.lsart.org/

Official Louisiana Survival Guide (English, Spanish, Vietnamese)
www.lsp.org/lcadeg.html

LSU AgCenter Storm Recovery Guide
http://tinyurl.com/AgCtrSRG

NEMA Evaluating Water-Damaged Electrical Equipment
http://tinyurl.com/NEMAWaterDamageEval

NOAA Extreme Weather Information Sheets
www.ncddc.noaa.gov/activities/weather-ready-nation/newis/

NOAA National Weather Service Safety Brochures
www.nws.noaa.gov/os/brochures.shtml

NOAA Weather Radio Frequencies for Louisiana
www.nws.noaa.gov/nwr/stations.php?State=LA

Specific Tips for Hurricane Preparedness
http://hurricaneshuttersflorida.com/preparedness.html

Building and Construction Websites

Federal Alliance for Safe Homes
www.flash.org

FEMA Building Science
http://www.fema.gov/building-science

High Wind Safe Rooms
www.highwindsaferooms.org

Insurance Institute for Business and Home Safety
www.disastersafety.org

International Hurricane Protection Association
www.inthpa.com

International Window Film Association
www.iwfa.com

Louisiana Board of Architectural Examiners
www.lastbdarchs.com/

Louisiana Home Builders Association
www.lhba.org/

Louisiana Professional Engineering & Land Surveying Board
www.lapels.com/

Louisiana State Licensing Board for Contractors
www.lslbc.louisiana.gov/

Louisiana State Uniform Construction Code Council
http://lsuccc.dps.louisiana.gov/

LSU LaHouse
www.lsuagcenter.com/en/family_home/home/la_house/

Prepare Your Home for Strong Winds and Hurricanes
www.safestronghome.com/highwind/

Simpson Strong-Tie
www.strongtie.com/

Technical Preservation Services, National Park Service
www.nps.gov/tps/index.htm

Flood Insurance Websites

FEMA Flood Insurance Rate Maps (FIRMs)
www.msc.fema.gov

Louisiana Flood Map Portal
http://www.lsuagcenter.com/floodmaps

Official Site of the National Flood Insurance Program
www.floodsmart.gov

FEMA Publications

FEMA publications can be downloaded from the Internet by going to www.fema.gov/library and searching for the publication number or the publication title. FEMA Building Science publications are also categorized by hazard type at http://www.fema.gov/building-science-publications. Below is a list of some FEMA publications referenced in Part 4 of this Handbook.

NFIP Technical Bulletins

- Openings in Foundation Walls and Walls of Enclosures
- Flood Damage-Resistant Materials Requirements
- Elevator Installation
- Free-of-Obstruction Requirements
- Wet Floodproofing Requirements
- Design and Construction Guidance for Breakaway Walls Below Elevated Coastal Buildings

Construction Guides

- 55: Coastal Construction Manual, 4th Edition
- 320: Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business

- 361: Design and Construction for Community Safe Rooms
- 499: Home Builder's Guide to Coastal Construction
- 550: Recommended Residential Construction for Coastal Areas
- 762: Local Officials Guide for Coastal Construction

Retrofit Guides

- 259: Engineering Principles and Practices for Retrofitting Flood-Prone Residential Structures
- 267: Against the Wind: Protecting your Home from Hurricane and Wind Damage
- 312: Homeowner's Guide to Retrofitting, 2nd Edition
- 347: Elevating Your Flood-Prone House
- 348: Protecting Building Utilities from Flood Damage
- 467-2: Bulletin on Historic Structures
- 804: Wind Retrofit Guide for Residential Buildings
- 805: Protecting Your Home and Property from Flood Damage

Mitigation Assessment Team Report

- 549: Hurricane Katrina in the Gulf Coast
- Hurricane Katrina Recovery Advisories
- Hurricane Isaac Recovery Advisories
- MAT Report Page – www.fema.gov/fema-mitigation-assessment-team-reports

Endnotes

1. "Hurricane Katrina Relief." Hurricane Katrina Relief. 2005. Accessed December 2012. www.hurricanekatrinarelief.com.

2. McGee, B.D., R.W. Tollett, and B.B. Goree. "Monitoring Hurricane Rita Inland Storm Surge". Science and the Storms - the USGS Response to the Hurricanes of 2005. Ed. G.S. Farris, G.J. Smith, M.P. Crane, C.R. Demas, L.L. Robbins, and D.L. Lavoie. U.S. Geological Survey Circular 1306: 283 p. Accessed December 2012. http://tinyurl.com/USGS1306.

3. Mississippi Emergency Management Agency and National Weather Service. 2010. Mississippi Hurricane Preparedness Guide.

4. "Tornadoes." The Ready Campaign. Accessed December 2012. www.ready.gov/tornadoes.

5. "Lafourche Parish Severe Weather." NOAA National Weather Service Southern Region Headquarters. 2009. Accessed December 2012. http://tinyurl.com/severeLaf.

6. "Thunderstorm hazards – Tornadoes." NOAA National Weather Service. 2011. Accessed December 2012. www.srh.noaa.gov/jetstream/tstorms/tornado.htm.

7. "The Fujita Scale." Tornado Project Online. 1999. Accessed December 2012. www.tornadoproject.com/.

8. "U.S. Tornado Climatology." NOAA NESDIS NCDC. March 2012. Accessed December 2012. http://tinyurl.com/NCDCtornadoes.

9. "Hurricane Season 2008: Hurricane Ike." NASA. October 2008. Accessed December 2012. http://tinyurl.com/NASAike.

10. Beaches and Shores Resource Center. The Institute of Science and Public Affairs. Florida State University. "Hurricane Charley: Characteristics and Storm Tide Evaluation." April 2005. Accessed December 2012. http://bcs.dep.state.fl.us/reports/strmtide/charley.pdf.

11. "Saffir-Simpson Hurricane Wind Scale." NOAA National Weather Service National Hurricane Center. May 2012. Accessed December 2012. www.nhc.noaa.gov/aboutsshws.php.

12. "Looking back at Hurricane Gustav's record 211 mph wind gust." Dr. Jeff Masters' WunderBlog. December 2008. Accessed December 2012. http://tinyurl.com/gustavgust.

13. "Hurricane Season 2008: Gustav." NASA. September 2008. Accessed December 2012. http://tinyurl.com/NASAgustav.

14. Beven II, J.L., and T.B. Kimberlain. "Tropical Cyclone Report: Hurricane Gustav." National Hurricane Center. January 2009. Accessed December 2012. http://www.nhc.noaa.gov/pdf/TCR-AL072008_Gustav.pdf.

15. "What was the Largest Hurricane to Hit the United States?" News and Information about Geology. 2012. Accessed December 2012. www.geology.com/hurricanes/largest-hurricane/.

16. Knabb, R.D., J.R. Rhome, and D.P. Brown. "Tropical Cyclone Report: Hurricane Katrina." National Hurricane Center. December 2005. Accessed December 2012. http://tinyurl.com/NHCkatrina.

17. United States. Department of Commerce. NOAA. Service Assessment: Tropical Storm Allison, Heavy Rains and Floods, Texas and Louisiana, June 2001. 2001. Accessed December 2012. http://www.nws.noaa.gov/om/assessments/pdfs/allison.pdf.

18. Wilkins, J.G., R.E. Emmer, D.J. Hwang, G.P. Kemp, B. Kennedy, M. Hassan, and B. Sharky. Louisiana Coastal Hazard Mitigation Guidebook. Louisiana Sea Grant College Program. 2008.

19. "Evacuation Kits." Red Cross Website. 2012. Accessed December 2012. www.redcross.org.

20. Tucker, J.A. "Preparing Your Evacuation 'Grab and Go Box'." LSU AgCenter Disaster Information Resources. 2006. Accessed December 2012. http://tinyurl.com/grabngo-box.

21. "What to Do In Case of a Tornado". Louisiana Office of Homeland Security and Emergency Preparedness. 2010. Accessed December 2012. http://tinyurl.com/gohsep-tornado.

22. "Flood Safety." NOAA National Weather Service River Forecast Center. 2008. Accessed December 2012. http://tinyurl.com/floodsafety.

23. "Storm Damage Resources." Mississippi Forestry Commission. Accessed December 2012. www.mfc.ms.gov/storm-damage.php.

24. FEMA. Home Builder's Guide to Coastal Construction. Publication No. 499. 2010. www.fema.gov/library.

25. "Electrical Safety Precautions During Disasters." Electrical Safety Foundation International. 2012. Accessed December 2012. www.publications.usa.gov/epublications/safety/precautions.htm.

26. Centers for Disease Control and Prevention. "Carbon Monoxide Poisoning after Hurricane Katrina." Morbidity and Mortality Weekly Report. 2005. Accessed December 2012. http://tinyurl.com/cdckatrina.

27. "Louisiana's Homeland Security & Emergency Management State Regions." Louisiana GOHSEP. Accessed December 2012. www.gohsep.la.gov/regions.aspx.

28. "State of Louisiana Emergency Operations Plan." Louisiana GOHSEP. 2009. Accessed December 2012. www.gohsep.la.gov/plans.aspx.

29. FEMA. Pre-Disaster Emergency Declaration Requests Policy. Publication No. 010-4. 2012. www.fema.gov/library.

30. FEMA. Hurricane Katrina in the Gulf Coast. "Chapter 4: Structural Systems Performance." Publication No. 549. 2006. www.fema.gov/library.

31. "Louisiana State Uniform Construction Code Council." Department of Public Safety. Accessed December 2012. http://lsuccc.dps.louisiana.gov/index.html.

32. "Hurricane." Insurance Institute for Business & Home Safety. 2012. Accessed December 2012. www.disastersafety.org/hurricane.

33. FEMA. Coastal Construction Manual, Vol. II. 4th Ed. 2012. www.fema.gov/library.

34. "What's a Wind Load?" LSU AgCenter. 2012. Accessed December 2012. http://tinyurl.com/WhatsWindLoad.

35. Insurance Institute for Business & Home Safety. "Is Your Home Protected from Hurricane Disaster? A Homeowner's Guide to Hurricane Retrofit." Connecticut Insurance Department. 2002. http://www.ct.gov/cid/lib/cid/app10_hurricane.pdf.

36. FEMA. Protect Your Property from High Winds. 2011. Accessed December 2012. www.fema.gov/library.

37. "Synthetic Roof Underlayment." National Association of Home Builders Research Center. 2001. Accessed December 2012. http://tinyurl.com/buildingroof.

38. "Thunderstorms: Doors and Windows – Protecting." Federal Alliance for Safe Homes. 2012. Accessed December 2012. http://tinyurl.com/protectingdoors.

39. "Miami-Dade County Impact Testing Process." Broward Impact Window & Door. 2009. Accessed December 2012. http://tinyurl.com/impacttest.

40. Hwang, D.J. and D.K. Okimoto. Homeowner's Handbook to Prepare for Natural Hazards. University of Hawai'i Sea Grant College Program. 2011. http://seagrant.soest.hawaii.edu/homeowners-handbook-prepare-natural-hazards.

41. "Hurricanes: Double Entry Doors – Securing." Federal Alliance for Safe Homes. 2012. Accessed December 2012. http://tinyurl.com/doubledoors.

42. Skinner, P.M. "Preventing Flood Damage." LSU AgCenter. 2012. Accessed December 2012. http://tinyurl.com/floodproof.

43. Skinner, P.M. "Foundations in Flood Hazard Areas." LSU AgCenter. 2011. Accessed December 2012. http://tinyurl.com/foundationFHA.

44. Skinner, P.M. "Water-Managed Foundation." LSU AgCenter. 2011. Accessed June 2012. http://tinyurl.com/waterfoundation.

45. Skinner, P.M. "Buoyant Foundations." LSU AgCenter. 2011. Accessed June 2012. http://tinyurl.com/bouyantfoundation.

46. Skinner, P.M. "Elevating an Existing Home." LSU AgCenter. 2006. Accessed December 2012. http://tinyurl.com/elevateexisting.

47. Abbey Associates, Inc. Technical Design Standards: Landscape Design Components and Storm Water BMPs for the Model Storm Water Based Landscape Code. Louisiana Department of Environmental Quality. 2009. Accessed December 2012. http://tinyurl.com/BMPsLA.

48. FEMA Release Number 1969-021. "Building a Safe Room Q&A." FEMA. Accessed December 2012. http://coop.fema.gov/news/newsrelease.fema?id=54686.

49. "Hurricane Season 2011: Lee." NASA. September 2011. Accessed December 2012. http://tinyurl.com/NASAlee.

50. LA. Admin. Code tit. 37, XIII § 12703 (2008).

51. LA. Admin. Code tit. 37, XIII § 12705 (2008).

52. LA. Admin. Code tit. 37, XIII §§ 12713 and 12721 (2008).

53. "The National Flood Insurance Program." FEMA. 2012. www.fema.gov/business/nfip/.

54. "Flood Insurance Rate Maps (FIRMs)." FEMA. 2011. www.fema.gov/hazard/map/firm.shtm.

55. "Residential Coverage: Homeowners." The Official Site of the NFIP. July 2012. Accessed December 2012. http://floodsmart.gov/floodsmart/pages/residential_coverage/homeowner.jsp.

56. Dozier, H., L. Hannaman, T. Koske, J. Pyzner, B. Reames, C. Reichel, D. Ring, D. Sasser, P. Skinner, J. Tucker, and R. White. Disaster Information Resources: Storm

Recovery Guide. LSU AgCenter. 2006. Accessed December 2012. http://tinyurl.com/LSUAgCtrSRG.

57. La. Rev. Stat. §§ 47:301.10 and 310.18 (2007).

58. La. Rev. Stat. §§ 47:293.10 and 293.2 (2007).

59. "Residential Property Storm Mitigation Incentives." Louisiana Department of Insurance. Accessed December 2012. http://tinyurl.com/LDIsmi.

60. "Before the Storm: Are You Prepared?" The Advocate. 27 May 2012: 11-15.

61. Hurricane Isaac with and without 2012 100-Year HSDRRS Evaluation, Preliminary Report. U.S. Army Corps of Engineers. 2012.

62. Al Tompkins. "Monday Edition: Chain Saw Injuries." Poynter.org. 2 March 2011.

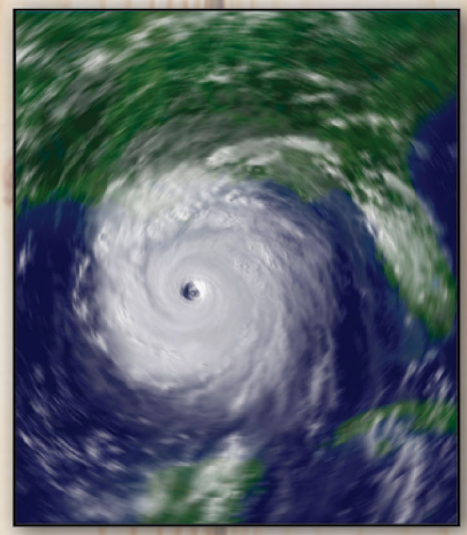
Notes

NOW THAT YOU KNOW HOW TO PREPARE YOUR HOME, HERE'S HOW TO PREPARE YOUR COMMUNITY

StormSmart Coasts
Connect. Communicate. Collaborate.

StormSmart Coasts website
http://la.stormsmartcoasts.org

- Learn how to identify your community's risks
- Find ways to reduce those risks (and the funding to do so)
- Discover what other communities across Louisiana, the Gulf of Mexico and the nation are doing to address their risks
- Find others working to protect their communities



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ISBN 978-0-9850952-1-5
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