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HOMEOWNER'S HANDBOOK TO PREPARE FOR COASTAL NATURAL HAZARDS

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T E X A S

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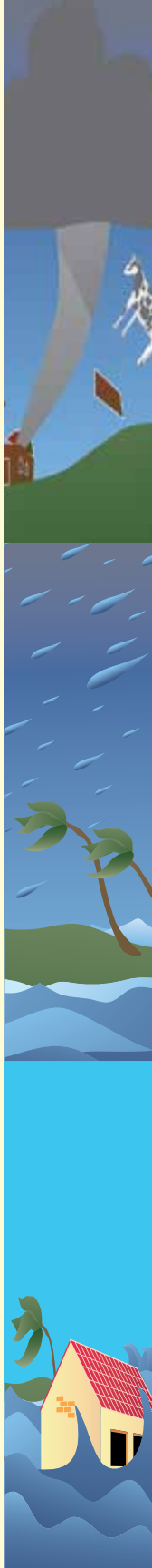

The *Texas Homeowner's Handbook* was developed as a project of the Gulf of Mexico Alliance (GOMA) Coastal Community Resilience Team. GOMA, a partnership of federal, state, and local organizations, shares a vision for healthy and resilient communities. A key priority of GOMA is to increase the resiliency of coastal communities from natural hazards. One major component of healthy communities is enhancing individual resilience and recognizing that adjustments to day-to-day living are necessary. This handbook is designed to promote individual resilience, thereby creating a fortified community.

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GOMA partners that collaborated on this book include EPA, NOAA, the Mississippi Department of Marine Resources, the Texas General Land Office (TGLO) Coastal Resources Division, and the Texas Sea Grant College Program (TSG).

The views expressed herein are those of the author(s) and do not necessarily reflect the views of EPA, NOAA, GOMA, TGLO and TSG. Authors and editors include Craig Davis, Cindie Powell, John Jacob, Tracie Sempier, Rhonda Price, Laura Bowie, and Dennis Hwang and Darren Okimoto.

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This handbook, as well as other documents, is available at the TGLO website (http://www.glo.texas.gov/publication-gallery/publications.php).

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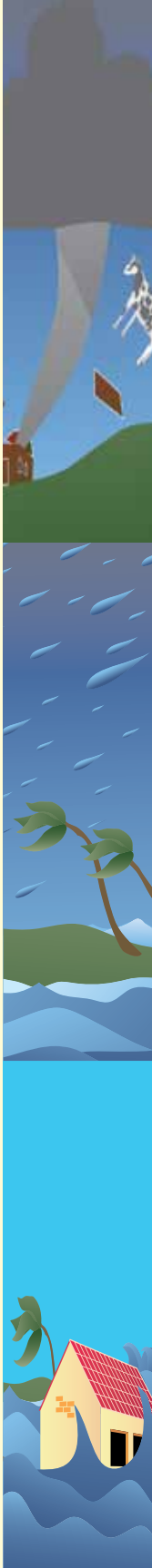


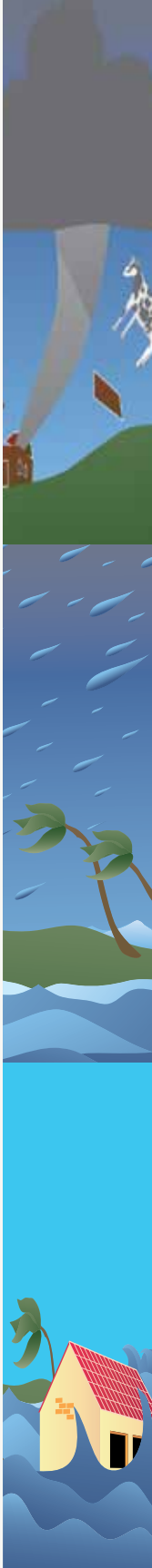
Part 1
Introduction

Purchasing a home is one of the major milestones in your life. It provides protection from the elements for you and your family as well as your worldly possessions. It is a major investment, but for many, purchasing coastal property also fulfills a lifelong dream to live or retire near the water. Unfortunately, coastal natural hazards such as hurricanes, tornadoes, floods, and erosion can take that lifelong dream away in an instant.

This handbook was created to help you prepare for natural hazards and help you reduce the risks to your family and property. Although it is never possible to eliminate all risk from a natural hazard, you as a homeowner can take action and implement many small and cost-effective steps that could significantly lower your risk and exposure to those hazards. Only you can provide the protection your family and your home deserve.

This handbook is divided into five parts. This Introduction presents the purpose and layout of the handbook and includes a discussion of common myths that may have prevented you from taking action in the past. There is a summary of nine things you can do to prepare. Part 2 provides basic information on hurricanes, tornadoes, and flooding, which will allow you to make an educated decision about the steps to take to protect your family and property. Part 3 provides a detailed discussion on how to protect yourself and your family. This section also includes a list of essential emergency supplies, evacuation kit, evacuation planning, evacuation procedures, and important information that the civil defense and emergency management agencies want you to know. Part 4 provides information on how you can protect your property from wind and water natural hazards. Part 5 presents insurance resources to aid in recovery if storm damage occurs.

This handbook is available free as a downloadable Portable Document Format (PDF) file at the Texas General Land Office website at http://www.glo.texas.gov/publication-gallery/publications.php. It will be updated on an as-needed basis as new information becomes available and feedback from the public is obtained. You can also request a copy by contacting the Texas General Land Office Coastal Resources Division at (512) 475-0773.



1.1 COMMON MYTHS AND REASONS TO PREPARE

There are many common myths that may cause complacency in homeowners and lead them to not fully prepare for a natural hazard. The most common ones are provided below in quotes and are discussed in order to encourage people to take action.

1. **"I survived Hurricane Ike so I am sufficiently prepared."** Many people have the impression that because they survived Hurricane Ike or a similar storm, they therefore do not need to prepare any more than they did in 2008. Although Ike was a storm with widespread damage, it was in fact a large, but otherwise unexceptional, hurricane. The same storm could make landfall at a different location, go in a different direction, or have a slower forward speed along the Texas Coast and have an entirely different impact on a particular location.

2. **"If a natural disaster occurs, it won't be that bad."** In 1900, Galveston, Texas, experienced one of the deadliest hurricanes in recorded history. The 1900 Storm struck on September 8 as a Category 4 with sustained winds of 145 miles per hour and a 20-foot storm surge, killing more than 6,000 people and causing $30 million in damages. If the 1900 Storm were to hit today, economic estimates predict it would cause almost $94 billion in damages. Hurricane Ike made landfall on September 13, 2008, as a Category 2 storm with sustained winds of 110 miles per hour and an 18-foot storm surge, and it caused an estimated $29 billion in damages.[1]

3. **"A natural disaster won't happen to me."** Scientists agree that it is not a matter of IF a hurricane will hit the Texas Coast, but WHEN. Since the 1900 Storm, Texas has been hit by 34 hurricanes, or about one every three years, and 16 tropical storms. Texas leads the nation almost every year in flood-related damage.

4. **"Hurricanes like Ike and the 1900 Storm only happen every 100 years."** Although it was a little over 100 years after the 1900 Storm when Hurricane Ike struck the Upper Texas Coast, Texas had already experienced 13 hurricanes with sustained winds stronger than Ike during that time period, and one in 1915 exceeded Hurricane Ike in total economic damage. Although, on average, storms of this magnitude occur every 100 years, there is a 1% chance they can occur

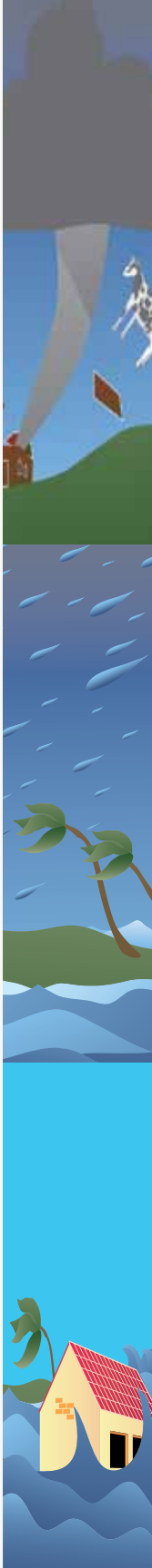
each year. Scientists agree that for the past 10 years, we have been entering a natural cycle of heightened hurricane activity, which can last for several decades.

5. **"I don't live near the coast, so I am safe."** Major hurricanes often carry powerful winds and devastating floods for many miles inland after landfall before weakening. The storm surge associated with Hurricane Katrina in 2005 was recorded 12 miles inland, and hurricane-force winds were felt near Hattiesburg, Mississippi.[2] Hurricane Ike weakened to a tropical storm just east of Palestine, Texas, approximately 175 miles north of where it made landfall. Devastating floods and hurricane-force wind gust associated with the remnants of Ike were recorded as far north as the Ohio Valley.

6. **"Installing hurricane clips or completing other retrofits won't guarantee there will be no damage after a hurricane, so I won't bother."** Even though someone may wear a seat belt, shoulder belt, and even have an airbag, there is no guarantee that he or she will not be injured in a major auto accident. Yet most people recognize the importance of these safety devices in reducing risk and use them. Likewise, the measures discussed in this handbook could significantly reduce risk, although there is no guarantee.

7. **"If a natural hazard occurs, government will come to the rescue."** After Hurricane Ike, many residents found that government would not repair their damaged houses or even provide adequate compensation for property damage. In most cases, the compensation that was received was many months later. After a natural hazard, the number of people in need may also overwhelm governments. It is up to you to plan properly, strengthen your house, and have the appropriate financial protections in place, such as insurance if it is available.

8. **"My house survived Hurricane Ike, so I don't need to retrofit for hurricanes."** The most destructive area of a hurricane is the northeast quadrant of the storm. In this area, you can expect the strongest winds and the highest storm surge. Damage to your house very much depends on the location of your house in relation to where the center of the hurricane makes landfall. Homeowners along the Texas Coast should consider retrofits that improve the structural



integrity of their homes to help protect them against hurricane winds and storm surge.

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

10. **"Strengthening my house is too expensive and not worth the effort."** Ultimately, strengthening your house should be considered a home improvement that adds value to your house and is worth the effort. The time and money spent to prepare your house is a very small fraction of the resources that may be needed if you have not prepared before a natural disaster strikes. Also, by strengthening your house so that it does not fall apart during a hurricane and become flying debris, you protect your neighbors as well as yourself. You also help the emergency efforts of the local, state, and federal governments by reducing the amount of debris that may slow response time.

1.2 THINGS YOU CAN DO TO PREPARE

As covered in later parts of this handbook, there are things you can do to prepare that will provide greater protection to your family and your property.

1. **Gather your emergency supplies.** You can do this in your house now. Many items you need are probably already in your home. Make a list of essential emergency supplies, such as gallons of water, non-perishable food items like canned food, etc. (see Part 3 and Appendix C), and check and restock each month so the supplies are complete and not outdated or used. Avoid rushing to a store during an emergency to gather your supplies. There will be long lines and empty shelves, and you will add to the crowd and confusion.

2. **Create an evacuation plan for both a flood and a hurricane.** They are different hazards that require different responses. For a hurricane, your plan may include sheltering in your house if it is

sufficiently strong (see no. 5 below) and outside the evacuation zone. If you cannot use your house, use a suitable alternative structure (a friend or relative's house), or a shelter that is officially open (listen to local radio and television) (see Part 3).

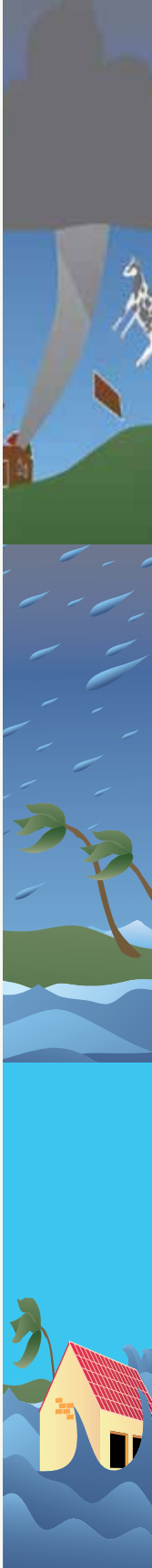
For a flood, evacuate to high ground outside of the evacuation zone only if: (i) you know that your house is located within a Special Flood Hazard Area, or (ii) you are instructed by local radio and television to evacuate. Once you have evacuated, the wait may be many hours to several days (see Part 3). Discuss and practice drills of your evacuation plan with your family each year. Plan to have critical personal items with you (emergency kit) when you evacuate, such as a clean set of clothes, money for travel expenses in an evacuation, and key personal records such as driver's license, birth certificate, etc.

3. **Know your property and take appropriate action.** Look at where you are located. If the land floods, consider flood insurance, if it is not already required by your lender. If trees overhang your house, consider trimming or cutting the branches overhead, which may damage your house in a storm. If the property is near a ridge, it may be especially susceptible to wind damage during a storm or hurricane (see Part 4).

4. **Know your house and take appropriate action.** When was your house built? Does it have connectors to tie the roof to the wall or the wall to the foundation? When do you need to re-roof? Look at your blueprints. They may be available from your homebuilder, your local building department, or your architect (see Part 4).

5. **Strengthen your house.** A house built after the early to mid-1990s should have hurricane clips to tie the roof to the wall and strong connectors from the wall to the foundation. If your house was built before then, you can still retrofit at a reasonable cost. All households should consider the many options now available to protect your windows, garage, and doors. You can also strengthen your roof when it is time to re-roof. The actions 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. **Finance creatively.** Consider efforts to strengthen your house as an important home improvement project. Most projects are not that expensive. For the more costly ones, a small home improvement



loan, combined with potential discounts from hurricane insurance premiums, can put these projects within reach. It is a great investment to strengthen your house and provide more protection for your family (see Part 4).

7. **Seek the assistance of a qualified, 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, the Structural Engineering Association, your county civil defense and emergency management agencies, or contractors' associations. Even if you do the work yourself, it is always best to seek professional advice for initial guidance, because every house is a little different (see Part 4).

8. **Insurance.** Do not gamble with your house. Obtain adequate insurance for hurricanes and floods (see Part 5).

9. **Take advantage of potential discounts for your hurricane insurance premiums.** Coverage may vary among insurance companies, so call your insurance agent to find out about discounts that may be available. Significant discounts may be provided for reducing the risk to your house with window protection, roof-to-wall tie downs (hurricane clips) and wall-to-foundation tie downs (see Part 5).

Part 2
Coastal Natural Hazards: An Overview for Homeowners

With 367 miles of Gulf shoreline and more than 3,300 miles of bay shoreline, Texas has one of the longest coastlines along with one of the highest erosion rates in the nation. The Texas Gulf shoreline is a diverse coast consisting of a system of six barrier islands (Galveston, Follett's, Matagorda, San Jose, Mustang, and Padre) and two peninsulas (Bolivar and Matagorda).

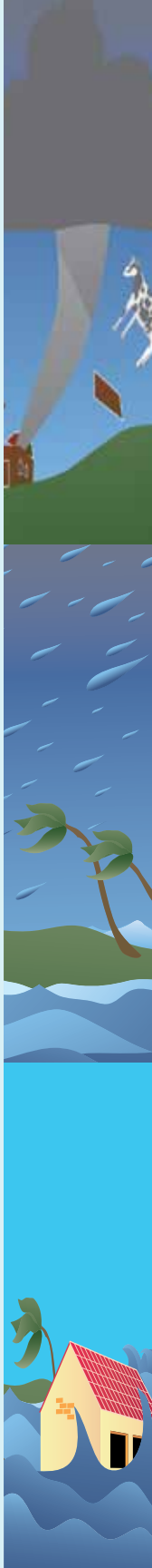
In Texas, many different types of coastal natural hazards can occur, such as high winds, flooding, tornadoes, subsidence, coastal erosion, and relative sea-level rise. Preparing for the larger events (hurricanes and flooding) will also better prepare you for the smaller, more frequent events such as tropical storms, high tides, and coastal erosion. This handbook is not intended to go into detail on all events, but to provide only basic information that may play a role in how you as a homeowner may prepare for these hazards.

2.1 HURRICANE HAZARDS IN TEXAS

2.1.1 HURRICANE FORMATION

Hurricane season in the Atlantic Basin is traditionally from June 1 to November 30, but can start earlier and end later than these dates. Most of the activity occurs from August to October.

A hurricane is an intense tropical storm with strong and very pronounced counter clockwise circulation in the Northern Hemisphere. An area of clear weather called an "eye" is present in the center of the circulation. A hurricane begins as an organized disturbed weather system of persistent clouds, thunderstorms, and closed low-level circulation with maximum sustained winds of up to 38 miles per hour. This stage is referred to as a tropical depression. As the depression further develops and its maximum sustained winds exceed 39 miles per hour, the system becomes a tropical storm. The tropical storm reaches hurricane status when the maximum sustained winds reach 74 miles per hour or more.



Tropical storms usually occur more frequently than hurricanes in the Gulf of Mexico and usually are more common early in the season. While not full-fledged hurricanes, tropical storms and even tropical depressions can still cause substantial damage. Tropical Storm Allison in 2001, for example, was the most expensive storm in Texas' history.

Hurricane strength is given in categories using the Saffir-Simpson Hurricane Scale, which rates hurricanes from 1 to 5 based on the intensity of the sustained winds. Earlier versions of this scale incorporated central pressure and storm surge as components of the categories. The central pressure was used during the 1970s and 1980s as a proxy for the winds as accurate wind speed intensity measurements from aircraft reconnaissance were not routinely available for hurricanes until 1990.

Storm surge was also quantified by category in the earliest published versions of the scale dating back to 1972. However, hurricane size, the depth of near-shore waters, topography and the hurricane's forward speed and angle to the coast also affect the surge that is produced. For example, the very large Hurricane Ike in 2008 made landfall in Galveston as a Category 2 hurricane and had a peak storm surge height of about 20 feet.

Figure 1. NOAA satellite image of Hurricane Ike on September 11, 2008. Although it was a Category 2 at landfall, the size of Ike's band of strong winds, rain and storm surge spread from Louisiana to Alabama.

In contrast, tiny Hurricane Charley (with hurricane force winds extending at most 25 miles from the center) struck Florida in 2004 as a Category 4 hurricane and produced a peak storm surge of about 7 feet. These storm surge values were substantially outside of the ranges suggested in the original scale.[3]

Figure 2. Gilchrist, Texas, September 22, 2008 -- An aerial view of a house on that survived the destruction of Hurricane Ike. FEMA/Jocelyn Augustino.

2.1.2 WIND AND THE SAFFIR-SIMPSON SCALE

To help reduce public confusion about the impacts associated with the various hurricane categories as well as to provide a more scientifically defensible scale, the storm surge ranges, flooding impact and central pressure statements have been removed from the scale and only peak winds are employed in this revised version known as the Saffir-Simpson Hurricane Wind Scale.

It is important to note that the Saffir-Simpson Scale only illustrates the "sustained winds" of a hurricane. Wind gusts can reach up to 135 miles per hour for a Category 2 storm and up to 160 miles per hour for a Category 3 storm.

During a hurricane, there is a triple threat of damage from high winds, storm surge, and flooding associated with heavy rains. In a hurricane, the winds rapidly increase in strength from the weakest on the outer edge to

Table 2-1. 2012 Saffir-Simpson Hurricane Wind Scale[3]

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74-95 mph 64-82 kt 119-153 km/h	**Very dangerous winds will produce some damage:** Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110 mph 83-95 kt 154-177 km/h	**Extremely dangerous winds will cause extensive damage:** Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3 (major)	111-129 mph 96-112 kt 178-208 km/h	**Devastating damage will occur:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (major)	130-156 mph 113-136 kt 209-251 km/h	**Catastrophic damage will occur:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (major)	157 mph or higher 137 kt or higher 252 km/h or higher	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Source: NOAA's National Weather Service website, The Saffir-Simpson Hurricane Wind Scale.

the strongest near the eye. Hurricane winds are most intense around the eye wall. This area is generally 15 to 20 miles wide and contains the most intense rainfall. Hurricane Ike carried hurricane-force winds more than 150 miles north into the East Texas area, knocking down power lines and trees in its wake.

2.1.3 STORM SURGE

Storm surge is a large dome of water, often 50 to 100 miles wide, that sweeps ashore near where a hurricane strikes land. It typically accounts for 90% of storm-related deaths. A surge of 10 feet or more can cause severe flooding far inland and cause severe damage along the coast when wave action adds destructive power and height to the basic surge elevation, particularly when storm surge coincides with a normal high tide. Hurricane Ike's highest officially surveyed storm surge was 19.38 feet above sea level at High Island.

"Run from the water, hide from the wind" is an adage that has been used from Florida to Texas by emergency management teams for hurricane preparedness. The author of the saying is unknown, but "Run from

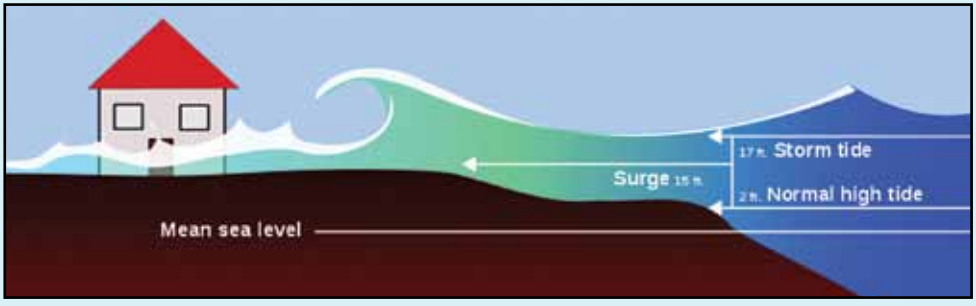


Figure 3. Storm surge depiction.

the water, hide from the wind" has been in use in Florida since at least September 1998.[4]

2.1.4 RAINFALL

Rainfall totals of 10 inches or more are common when a tropical storm or hurricane moves across a coastal location. Torrential rains continue inland long after the high winds of a hurricane have diminished. Even more significant is a "core rainfall" event, which can occur with a decaying tropical cyclone over land and usually occurs at night. The center, or

core, of a remnant low-pressure system can release substantial amounts of rainfall in a short period, causing tremendous flooding. How much rainfall accumulates depends upon the speed of movement of the low center.

2.2 TORNADO HAZARDS IN TEXAS

Hurricanes can also produce tornadoes that add to the storm's destructive power. Tornadoes are nature's most violent storms. Spawned from powerful thunderstorms, tornadoes can cause fatalities and devastate a neighborhood in seconds. A tornado appears as a rotating, funnel-shaped cloud that extends from a thunderstorm to the ground with rotating winds that can reach 300 miles per hour. Damage paths can be in excess of one mile wide and 50 miles long.[5]

The size of a tornado is not necessarily an indication of its intensity; large tornadoes can be weak, and small tornadoes can be violent. The Fujita (F) Scale was originally developed by Dr. Tetsuya Theodore Fujita in 1971 to estimate tornado wind speeds based on damage left behind by a tornado. An Enhanced Fujita (EF) Scale (Table 2-2), developed by a forum of nationally renowned meteorologists and wind engineers, makes improvements to and replaces the original F scale.[6]

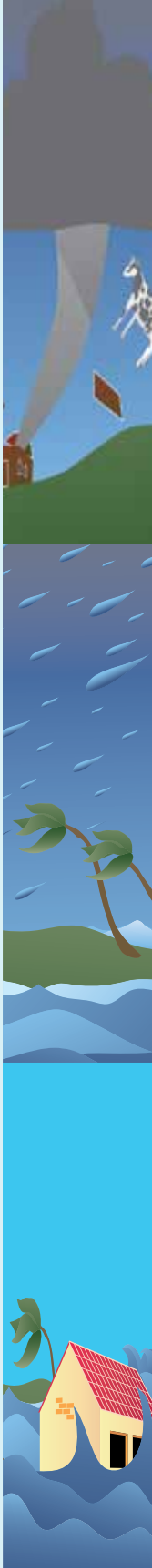
Tornadoes are most frequently reported east of the Rocky Mountains during spring and summer months, therefore, the entire state of Texas is at nearly equal risk for tornadoes. Peak tornado season in the southern states is March through May, and they are most likely to occur between 3 p.m. and 9 p.m., but can occur at any time.[7]

Before a tornado hits, the wind may die down and the air may become very still. A cloud of debris can mark the location of a tornado even if a funnel is not visible. It is not uncommon to see clear, sunlit skies behind a tornado.[8]

Tornadoes generally occur near the trailing edge of a storm. The average tornado moves southwest to northeast, but has been known to move in any direction. The average forward speed of a tornado is 30 miles per hour, but may vary from stationary to 70 miles per hour.[9] Waterspouts are tornadoes that form over water.

Table 2-2. The Enhanced Fujita Scale

EF - Scale Number	Class	Wind Speed	Possible Damage[5]
EF-0	Weak	65-85 mph	**Light**: Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages signboards.
EF-1	Weak	86-110 mph	**Moderate**: Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
EF-2	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.
EF-3	Strong	136-165 mph	**Severe**: Roof and some walls torn off well-constructed houses; trains overturned; most trees uprooted.
EF-4	Violent	166-200 mph	**Devastating**: Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
EF-5	Violent	>200 mph	**Incredible**: Strong frame houses lifted off foundations and carried considerable distances and destroyed; automobile sized missiles fly through the air in excess of 300 feet; trees debarked; steel reinforced concrete structures badly damaged; asphalt stripped from road surfaces.



2.3 FLOOD HAZARDS IN COASTAL TEXAS

Flooding in Texas is probably the most common natural hazard in the state, if not the most intense. Flooding can be caused not only by a hurricane, but also by a tropical storm, tropical depression, or other weather systems that produce heavy rain. Flooding can build up gradually over a period of days, or occur suddenly in a few minutes (this is commonly known as a flash flood). In addition, coastal flooding and wave inundation can be produced by a hurricane or high-surf event with waves generated by local storms or by those that are hundreds of miles from the Texas coast.

Texas ranks second in the nation for the number of flood-prone structures that flood repeatedly, according to the Federal Emergency Management Agency (FEMA). Flooding most often occurs near a body of water such as the Gulf of Mexico or a stream, river or reservoir. Of Texas' 171 million acres, an estimated 20 million are flood-prone, more than any other state.[10]

You can determine if you are in a high-risk flood area by looking at FEMA's flood insurance rate maps. These maps show what areas are susceptible to flooding and high velocity wave action (for those near coastal areas). Copies of the maps can be obtained digitally from the FEMA Map Service Center at http://www.msc.fema.gov. Copies may also be available for viewing at your city or county building departments.

Coastal Velocity Flood Zones

Coastal Velocity Flood Zones, or Coastal V-Zones, are high hazard flood zones subject to high velocity waters from storm surges. Coastal V-Zones will be designated as Zone V, VE, or Zones V1-30 on Flood Insurance Rate Maps. In addition to the flood prevention method of dry floodproofing, a method that completely seals the interior of a building by making the exterior walls impermeable to the passage of floodwater, there are some restrictions and prohibitions for constructing within a Coastal V-Zone.

All structures in Coastal V-Zones must be elevated on pilings or columns with the bottom of the lowest floor located above base flood elevation (BFE). Elevating a building's lowest floor above the predicted flood elevation may help mitigate damage from storm surge, and a higher elevation for the lowest floor translates to lower flood insurance cost. In addition, no structural fill may be brought into a Coastal V-Zone.

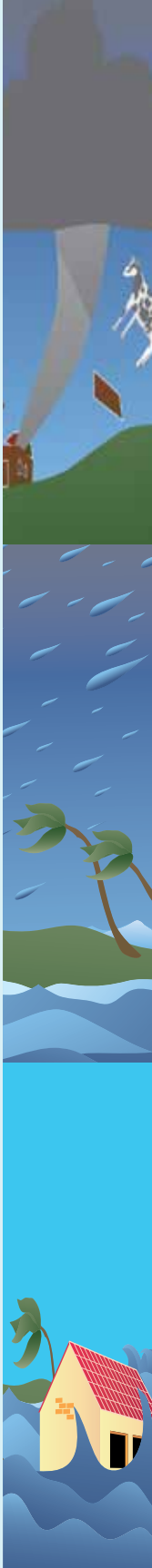
Elevating Existing Structures

Elevation Certificates are required for new construction and substantial improvements to existing structures within Coastal V-Zones and other floodplain areas; the forms demonstrate a structure's compliance with local floodplain ordinances. It is recommended that a structure be surveyed by a registered professional after major storm events or when purchasing a home in a Coastal V-Zone. The elevation certificate needs to be completed by a registered professional land surveyor, engineer, or architect to ensure that all elevations and requirements are met per the community's flood damage prevention ordinance.

The lowest floor elevation of a structure that is new or substantially improved (where repairs are 50% or more of the market value of the structure) must be at or above the BFE. Any area below the BFE in a Coastal V-Zone can only be used for parking, storage, or access. The area below the base flood level must be free of obstruction, and any enclosure must be made of breakaway walls. In Coastal V-Zones, a breakaway wall certification letter may be required. FEMA's publication Free-of-Obstruction Requirements (Technical Bulletin 5) provides more information on building and protecting homes located in Coastal V-Zones. **When constructing in V-Zones, elevation is the single most important factor in reducing the risk of flooding.** Major storms and flash floods can cause waters to rise higher than the BFE; therefore, it is always a good investment to build in a safety factor that is several feet above the BFE.

Even if you are not in an official flood zone, you may be at risk from flooding. You can go to the following website and type in your street address to determine a very general estimate of the flood risk for your property: http://www.floodsmart.gov/floodsmart/pages/riskassesment/findpropertyform.jsp.

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 will be greater during a storm or hurricane. You can protect yourself by improving the local drainage, making your house resistant to floods, and purchasing flood insurance. You do not need to be in an official flood zone to obtain flood insurance.



For those properties located within a flood zone, elevating a building's lowest floor above predicted flood elevations by a small additional height (known as "freeboard") has very little effect on the look of a home yet can lead to substantial reductions in damages caused by flooding as well as reductions in flood insurance premiums. The estimated flood insurance premium is $2,084 for the home with 3-foot freeboard, compared to $5,499 without freeboard.

Figure 4. Adding a small amount of height has very little effect on the look of a home. Source: Texas Storm Smart Coasts.

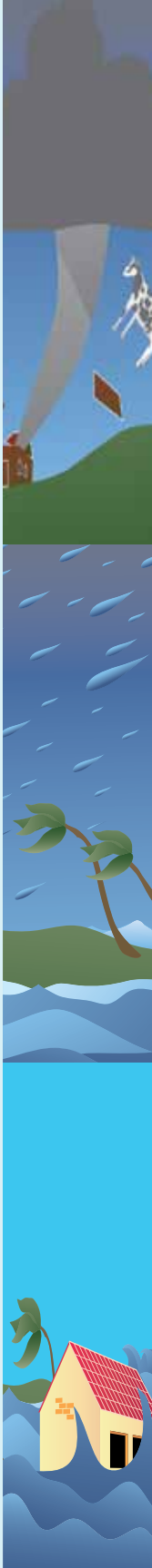
FEMA has several other tools and resources designed to help citizens build safely and cost-effectively in the Coastal V-Zone, including the *Home Builder's Guide to Coastal Construction* fact sheet series (FEMA P-499) and *Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations* (FEMA P-550, second edition).

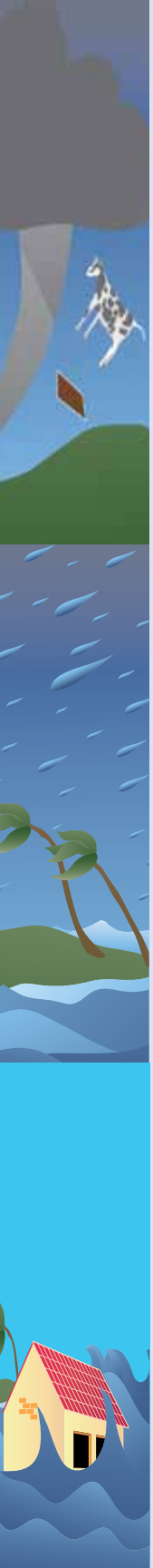
2.3.1 TYPES OF FLOODING IN COASTAL TEXAS

Coastal flooding results from storm surge and wave action and is usually associated with hurricanes or tropical storms. The low pressure inside a storm's eye sucks up a dome of ocean water near the center of the storm. As the storm approaches land, the storm's strong winds push the dome of water ashore as storm surge. An intense hurricane can have a dome of water that is many miles wide and more than 25 feet deep as it hits the coast. In addition, with this temporary increase in sea level rise, breaking waves and floating debris have access to areas and structures that were not designed to withstand the pounding of ocean waves. These battering waves are responsible for most beach erosion and extensive damage to coastal structures, including buildings, roads, bridges, marinas, piers, boardwalks and sea walls.[11]

Flash floods are defined in part by their speed. They begin within six hours of events such as heavy rainfall that cause them. Other characteristics are a rapid rise in water, high-velocity water flow, and large amounts of associated debris. These three characteristics can make a flash flood more dangerous than other types of flooding because the speed at which it occurs requires rapid responses to safeguard life and property, and there is a high potential for damage from the water's velocity in combination with debris and the density of the water itself. Major factors in flash flooding are the intensity and duration of rainfall and the steepness of gradients.[12]

Urban drainage (stormwater) management is comprised of both natural and man-made elements. The stormwater runoff system has two purposes: 1) the control of stormwater runoff to prevent or minimize damage to property and physical injury and loss of life which may occur during or after a very infrequent or unusual storm; and 2) the control of stormwater to eliminate or minimize inconvenience or disruption of activity as a result of runoff from more frequently occurring, less significant storms.[13]





Part 3
Protecting Yourself and Your Family

This part of the handbook covers the topic of protecting yourself and your family from natural hazards. In particular, it is important that your household have a stock of emergency supplies, an evacuation kit, and evacuation plans for a hurricane, tornado, and/or flooding event, since they will differ based on the type of hazard. You should 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).

As covered in later parts of this handbook, there are several steps homeowners can take to plan, prepare, and provide greater protection and safety for coastal properties.

Gather Emergency Supplies

Many common items needed are probably already in your home. Check and re-stock at the beginning of each hurricane season so the supplies are complete and not outdated or expired (see Part 3.1 and Appendix C).

Create an Evacuation Plan

Each area of the coast has evacuation zones. Locate your area and identify the designated evacuation route. Visit the Texas Department of Transportation's website (http://www.txdot.gov/travel/hurricane.htm) for evacuation routes. ***It is of the utmost importance that you pay attention to evacuation orders and not leave before your time.*** Priority has to be given to evacuees in the lowest and most dangerous zones closest to the coast first.

Take Appropriate Action

Homeowners should examine the area around their home and eliminate potential hazards. If trees are overgrown, consider trimming or cutting the branches over the home. Secure items that may be blown around by wind, such as outdoor furniture and barbeque pits.

Strengthen the Home

A house built after the early to mid-1990s should have hurricane clips tying the roof to the wall and strong connectors from the wall to the foundation. If a home was built prior to the mid-1990s, homeowners can retrofit at a reasonable cost. Retrofitting is making changes to an existing building to protect it from flooding or other hazards such as high winds and earthquakes. All households should consider the many options available to protect windows, garages, and doors.

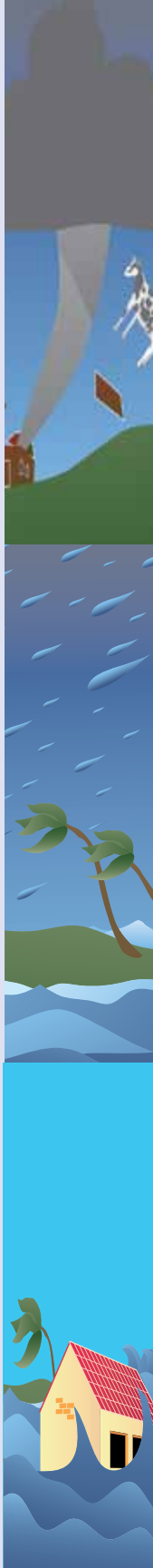
3.1 EMERGENCY SUPPLIES FOR THE HOME

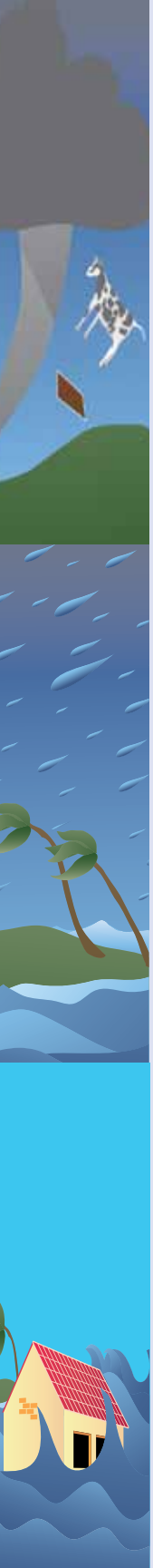
A general rule when preparing for a hazard event is to try to be self-sustaining for at least the first 72 hours. Due to a lack of access or availability, basic supplies may be unobtainable during this time. Emergency supplies should be assembled as soon as possible and checked monthly to ensure they are fresh. Do not keep expired supplies, and do not wait until an emergency to gather supplies.

If taking shelter in the home (outside the evacuation zone, well inland of the strongest winds of the hurricane, and in an exceptionally strong dwelling), emergency supplies may be necessary. If the space is available and the house is well-protected, stocking up is prudent. It is essential to maintain a supply of food before a storm hits to avoid long lines at the Points of Distribution (PODS) that may be available after a disaster. At least a week-long supply of food, preferably a month-long supply, should always be in your home and rotated to ensure freshness.

Emergency supplies should include at least the following:

- **Food:**
  - 7-day supply of non-perishable foods
  - Manual can opener
  - Baby formula, bottles, and diapers with wipes, as needed
- **Water:**
  - Supply: A reasonable estimate is one to two gallons per person per day for drinking, cooking, and hygiene. A two-week supply for one person would be 14 to 28 gallons. Remember that children, nursing mothers, the elderly and sick individuals require more water.





- Storage: Milk jugs can be used prior to the arrival of a storm to store water either under a bed or in the garage. Empty 14- to 15-gallon barrels can also be purchased online for water storage.

- **Other:**
  - First aid kit
  - List of any special medications and at least a two-week supply
  - List of physicians providing care for specific or chronic health conditions
  - Matches and a lighter
  - Portable radio with extra batteries, or a NOAA all-hazard weather radio
  - Flashlight and extra batteries
  - Pet supplies with vaccination records, as needed
- **Additional items to add may include:**
  - Sanitary supplies and personal hygiene items
  - Extra cash, since ATMs may not be working
  - Waterproof plastic sheeting or tarp with rope
  - Cell phone and car charger, and a hardwired single line phone
  - Bedding and clothing (including rain gear) for each person
  - Sunscreen and bug repellant
  - Bleach, trash bags, water-free hand sanitizer
  - Copies or electronic back-up of important documents, including driver's license, Social Security card, proof of residence, insurance policies, deeds, birth and marriage certificates, and medical records
  - Alternate power supplies: generators, inverters, power stations, and battery chargers
  - Gas tank(s) for portable generators (if applicable)

Figure 5.

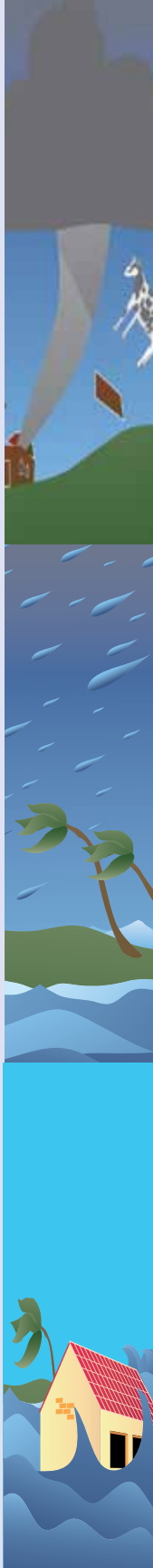
3.2 EVACUATION KIT

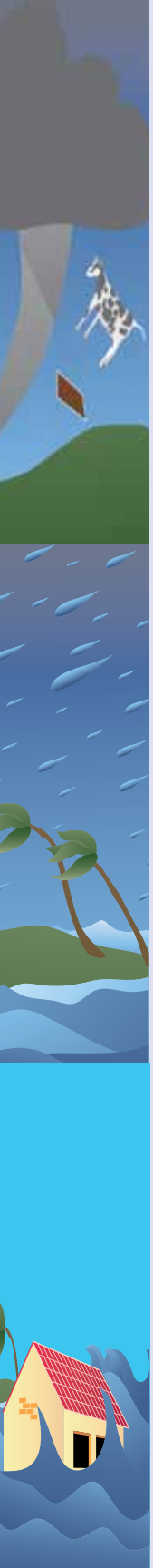
The evacuation kit differs from emergency supplies because the kit is what homeowners take with them if evacuations are necessary. Evacuation kits should be prepared as soon as possible and checked before the beginning of hurricane season. Your evacuation kit should contain essential food, water, and supplies for five to seven days. Keep this kit in a designated place and have it ready if you have to leave your home quickly. Make sure all family members know where the kit is kept. A 10- or 15-gallon plastic tote bin makes an ideal container for your evacuation kit.

The components of the evacuation kit should be stored in one place so that they are ready to go at a moment's notice. The kit should include the following at a minimum:

- Cash (keep in mind that many ATMs will not be working during a power outage)
- Key personal records such as driver's license, birth certificate, etc.
- One gallon of potable water per person per day
- Personal hygiene items and family needs, such as a two-week supply of any prescription medications
- Supply of nonperishable food to last five or more days
- List of any medical care directives, health insurance card, personal identification, and other important documents
- First aid kit
- Flashlights, batteries, portable radio
- Change of clothes, towels
- Pillows, blankets, sleeping bags, or air mattresses

FEMA recommends the evacuation kit contain supplies for five to seven days.[14] Keep in mind that evacuation shelters have very limited space, so bring only what is recommended unless instructed otherwise by emergency management agencies.





3.3 EVACUATION PLANNING

An evacuation plan should be created and reviewed with all participants every year. When forming an evacuation plan, here are some things to consider:

- Stay alert, stay calm, and be informed. Tuning in to local radio and television stations is important. Listen to your local radio and television stations carefully as there may be additional or modified directions based on the best available information at that time.
- The Texas Department of Transportation has hurricane information, evacuation maps, and up-to-date road conditions available on their website. See http://www.txdot.gov/travel/hurricane.htm for evacuation maps for your area.[15]
- Evacuation plans should consider all members of a household, especially those with special health needs. Practice evacuation procedures annually. Parents should learn their child's school's evacuation plans and confirm where students will be held and for how long in the event of a disaster. Parents should not drive to school to pick up their children unless directed to do so by school officials.
- If needed, develop a plan to help the disabled or those with limited mobility. If people with special health needs are with a care-provider, confirm that the care-provider has an evacuation plan.
- Develop a plan for your pets. Be advised that not all shelters take pets. Listen to local radio or check with the American Red Cross to determine if there are any pet-friendly shelter locations nearby. Plan ahead and visit the Humane Society of the United States for information on creating evacuation kits for your pet: http://www.humanesociety.org. Microchip pets at your veterinarian's office or local Humane Society well in advance of a storm event to aid in the quick identification and return of your pet in case you are separated during an emergency.
- Consider how family members and friends will communicate if they become separated. Create a list of telephone numbers and email addresses of everyone in the family and phone numbers of a few contacts outside of the family.
- Vehicles should be kept in good operating condition and gas tanks should be full. Ensure all emergency kits are packed.

- Become familiar with the closest shelter or shelters in case of evacuation. Check for updates to the list of shelters on the American Red Cross website: http://app.redcross.org/nss-app/. Plan and prepare to be at your evacuation point for at least several hours.

3.3.1 KEY DEFINITIONS

Note the difference between a watch and a warning in the definitions that follow. Do not confuse the two. When each is triggered, there are different actions to take. Also, note that civil defense or emergency management agencies may issue a mandatory evacuation in the case of a hurricane warning. Familiarize yourself with these terms to help identify a hurricane hazard:

Tropical Depression. An organized system of clouds and thunderstorms with a defined surface circulation and maximum sustained winds of 38 miles per hour (33 knots) or less. Sustained winds are defined as one-minute average wind measured at about 33 feet (10 meters) above the surface.

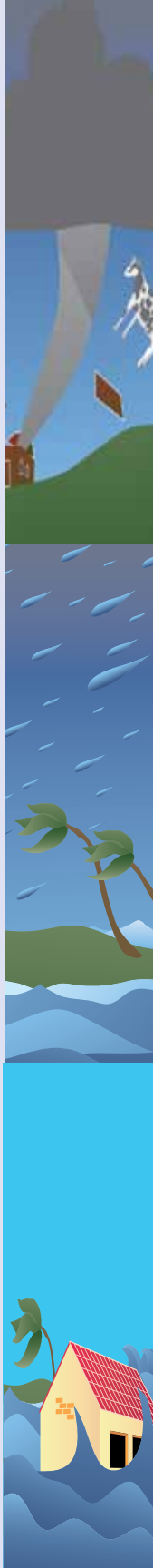
Tropical Storm. An organized system of strong thunderstorms with a defined surface circulation and maximum sustained winds of 39-73 miles per hour (34-63 knots).

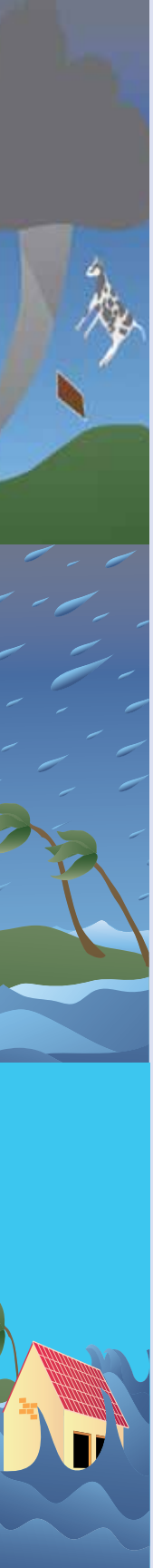
Tropical Storm Watch. Issued when there is a good possibility of tropical storm conditions and associated damaging winds, surf, and flooding rains occurring anytime within 36 hours. Homeowners should prepare their homes and review plans for evacuation in case a tropical storm warning is issued.

Tropical Storm Warning. Issued when there is a high probability of tropical storm conditions occurring anytime within 24 hours. Homeowners should complete all storm preparations and leave the threatened area if directed by local officials. A tropical storm warning may not always be preceded by a tropical storm watch.

Hurricane. An intense tropical weather system of strong thunderstorms with a well-defined surface circulation and maximum sustained winds of 74 miles per hour (64 knots) or higher.

Hurricane Watch. Issued when there is a good possibility of hurricane





conditions and associated damaging winds, surf, and flooding rains occurring anytime within 36 hours. Homeowners should prepare their homes and review plans for evacuation in case a hurricane warning is issued.

Hurricane Warning. Issued when there is a high probability of hurricane conditions occurring anytime within 24 hours. Homeowners should complete all storm preparations and leave the threatened area if directed by local officials. A hurricane warning may not always be preceded by a hurricane watch.

Short-Term Watches and Warnings. These warnings provide detailed information about specific hurricane threats, such as flash floods and tornadoes.

Flood Watch. Issued when flash flooding or flooding is possible within the designated watch area. Homeowners should be prepared to move to higher ground and should listen to NOAA weather radio, local radio, or local television stations for information.

Flood Warning. Issued when flash flooding or flooding has been reported or is imminent. Take necessary precautions at once and avoid going through flooded areas as the force of the water may cause your vehicle to drift into the water. Turn around, don't drown. If advised to evacuate to higher ground, do so immediately.

Storm Surge. A dome of water pushed onshore by hurricane and tropical storm winds. Storm surges can reach 25 feet high and be 50-100 miles wide.

Storm Tide. A combination of storm surge and the normal tide (*i.e.*, a 15-foot storm surge combined with a 2-foot normal high tide over the mean sea level creates a 17-foot storm tide).

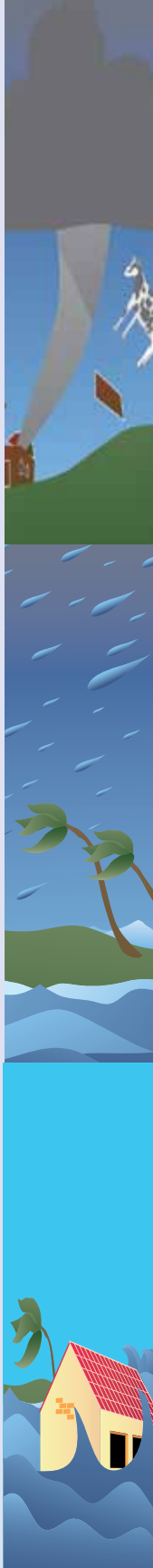
3.3.2 EMERGENCY ALERT SYSTEM

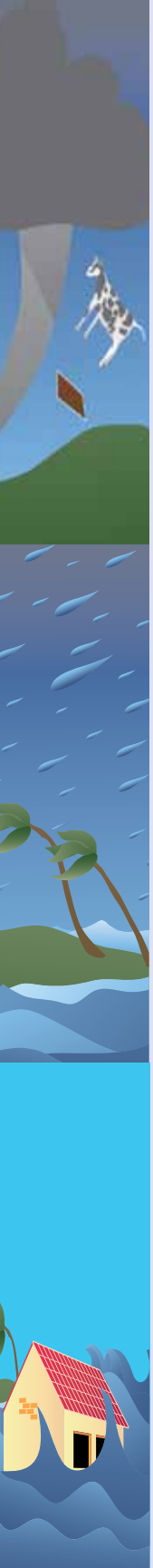
The Emergency Alert System (EAS) is the official source of natural hazard information and instruction in Texas. This information can originate from county, state, or federal agencies. The statewide network may be activated by the National Weather Service to disseminate weather-related watches or warnings.

If an alarm sounds, turn on the radio. Some radios with the NOAA weather radio band turn on automatically when an emergency broadcast through the EAS is announced. This could be useful for homeowners along the coast. The NOAA weather radio station broadcasts round-the-clock weather and participates in the EAS system. All local radio stations have voluntarily agreed to participate in the EAS system. Additional information may also be available on local and cable television.

Table 3-1. Coastal Emergency Alert System Stations

City	Local Primary 1	Local Primary 2	Local Primary Spanish	National Weather Service
Austin	KLBJ 590 AM	KASE 100.7 FM		WXK-27 162.4 VHF
Beaumont	KLVI 560 AM	KQXY 94.1 FM		WXK-28 162.475 VHF
Bryan-College Station	KJXJ 103.9 FM	KSAM 101.7 FM		WXK-30 162.55 VHF
Corpus Christi	KNCN 101.3 FM	KZFM 95.5 FM		KHB-41 162.55 VHF
Houston	KTRH 740 AM	KUHF 88.7 FM	KLAT 1010 AM	KGG-68 162.4 VHF
Laredo	KRRG 98.1 FM	KJBZ 92.7 FM		WXK-26 162.475 VHF
McAllen	KFRQ 94.5 FM	OPEN		KHB-33 162.4 VHF
San Antonio	WOAI 1200 AM	KKYX 680 AM		WXK-67 162.55 VHF
Victoria	KIXS 107.9 FM	KVNN 1340 AM		WXK-34 162.4 VHF





3.4 PREPARATIONS BEFORE A HURRICANE

In addition to preparing a stock of emergency supplies and an evacuation kit, the following are some additional preparations that should be taken before a hurricane arrives:

- 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.
- Deploy window protections well in advance of the arrival of any winds.
- Bring in any outdoor objects such as patio furniture, hanging plants, trashcans, large planters, and barbecue grills. Propane tanks should not be stored near sources of heat.
- Moor boats securely or move them to designated safe areas well in advance of hurricanes. Do not attempt to tow a trailer or boat in high winds.
- Store chemicals, fertilizers, or other toxic materials in a safe section or secure area of the premises.
- Adjust refrigerator temperatures to the coldest settings to reduce the potential for food spoiling if the power is temporarily lost. If power is lost during the event, try not to open the refrigerator unless necessary. Put several containers of water in the freezer — this will help keep items frozen or cold longer.
- Package valuables, such as jewelry, titles, deeds, insurance papers, licenses, etc., for safekeeping in waterproof containers. *Do not forget to protect your family photos*. Large plastic zipper seal bags make for quick and secure storage of your irreplaceable family memories.
- All digital information should be fully backed up, preferably offsite. If you leave your home, it is wise to take your hard drive with you. If you have everything already backed up on an external drive, take that with you as well. Protect any hard drives that remain in your home.
- If an evacuation is necessary, shut off electricity at the main switch near the meter, turn off gas to prevent leaks from occurring, and turn off water to prevent flooding from broken pipes.

- Once it is your time to evacuate, leave as early as possible to avoid traffic, preferably in daylight, and have your destination planned well in advance to make the trip as smooth as possible. ***However, evacuate when it is your time — not before!***

3.5 EVACUATION PROCEDURES FOR A HURRICANE

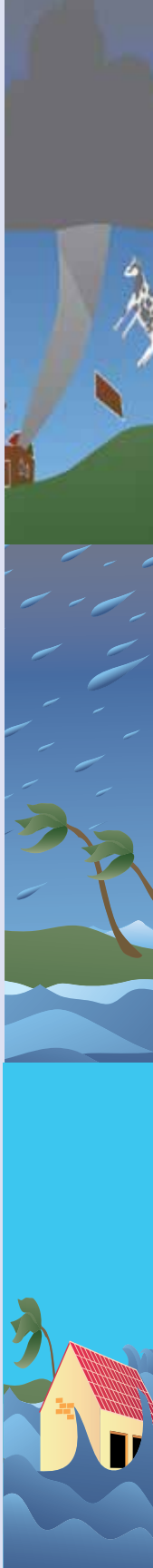
Another hurricane adage is "Should I Stay or Should I GO?" Do not be deceived into disregarding a Category 1 or 2 hurricane. As previously mentioned in this handbook, Hurricane Ike was a Category 2 hurricane based only on sustained winds; however, the overall size and 20-foot storm surge created one of the most destructive and deadly hurricanes to strike the Texas coast in many years.

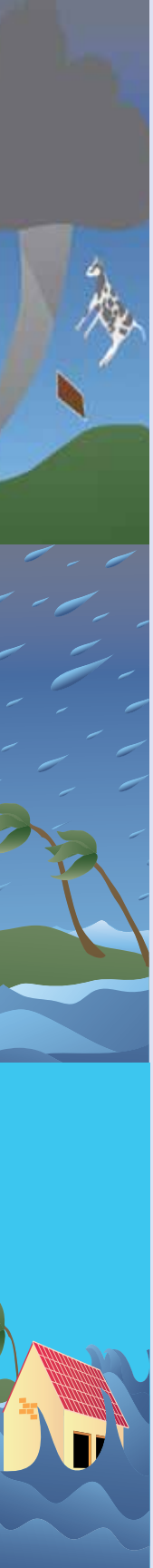
It is recommended that no matter the hurricane's category, you should GO if any of the following conditions apply:

- You live in a mobile home or temporary structure.
- You live in a high-rise building.
- You live on the coast, on a floodplain, near a river, or on a peninsula or barrier island.
- You live in any Federal Flood Insurance Zone such as a high velocity wave zone/storm surge zone (V zone) or flood zone (A zone).
- You live in certain wood frame structures (*e.g.*, single wall without a continuous load path design) or lightly constructed building.
- You live in an area that has been directed to evacuate by local authorities.

County judges and city mayors have the authority to order an evacuation. To implement a large-scale, multi-jurisdictional evacuation, evacuation zones have been designated based on the severity of the storm to determine if an evacuation is necessary. Color-coded maps can be found on the Texas Department of Public Safety website.[17]

When you evacuate, stay in a place far away from any flood or inundation zones, one that is able to withstand strong winds and rain. Emergency and rescue services may not be available for assistance during the storm, and other communications may be rendered inoperable. Plan ahead and get out of the danger area as soon as authorities indicate it is time to do so.





Listen to your local TV or radio station for shelters that are open to the public. Evacuation shelters have a maximum space of 10 square feet of bare floor per individual. Bedding, food, water, and other essentials will not be provided; your evacuation kit should contain all of these important items.

3.6 EVACUATION PROCEDURES FOR A FLOOD

The general rule for evacuating from a flood is to stay away from floodwaters and head to higher ground. If caught in a home during a flash flood, go to the second floor or the roof, if necessary. Stay away from moving water; six inches of fast flowing water can cause a car to stall, while two feet of water can move the vehicle.

In areas covered with water, the depth of the water or the condition of the ground under the water may not be apparent. This is especially true at night, when vision is limited. ***Never*** attempt to cross through flooded roadways. Roadbeds may be washed out under floodwaters. Remember; turn around, don't drown.[18]

3.7 EMERGENCY INFORMATION AND CONTACTS

Each year, NOAA provides an "Extreme Weather Information Sheet" customized for Texas that provides general information and important contact information. To download the latest updated version of this sheet, go to http://www.ncddc.noaa.gov/NEWIS. [19]

Become familiar with the Texas Division of Emergency Management website: http://www.txdps.state.tx.us/dem/.The best time to contact them is not during an emergency, but during the planning and preparing phase of emergency preparedness. [20]

For general emergency information, contact your local Office of Emergency Management.

Figure 6.

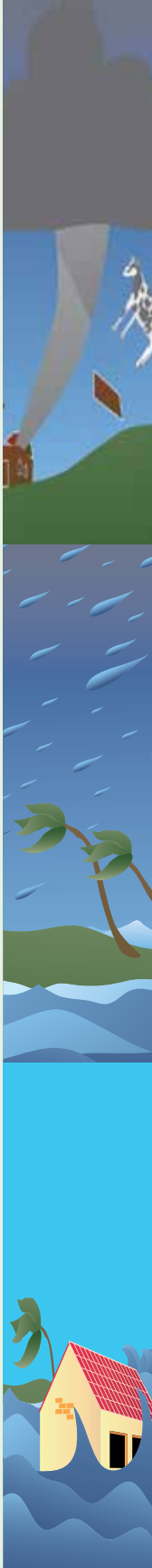
Part 4
Protecting Your Property

Homeowners can take several steps to protect their property and reduce property damage caused by natural disasters. This section of the Homeowner's Handbook briefly covers roof and foundation enhancements, flood prevention measures, and coastal velocity flood-zone concerns. Additional details on structural protection are available from FEMA.

The Mitigation Directorate of FEMA is continuously researching hurricane-resistant designs and building methods for the construction and performance of structures impacted by storms. All of FEMA's publications are available online at http://www.FEMA.gov.

A particularly important manual to reference is the *Home Builder's Guide to Coastal Construction* (FEMA P-499). The manual contains 37 fact sheets providing technical guidance and recommendations concerning the construction of coastal residential buildings. The fact sheets present information aimed at improving the performance of buildings subject to flood and wind forces in coastal environments. Many of the fact sheets also include lists of FEMA's and other resources that provide more information about the topics discussed. The fact sheets can be accessed at http://www.fema.gov/technology-transfer/home-builders-guide-coastal-construction-technical-fact-sheet-series-fema-p-499.

Another important document to reference is the *Wind Retrofit Guide for Residential Buildings* (FEMA P-804), which summarizes the technical information needed for selecting and implementing cost-effective wind retrofit projects for residential buildings. The guide presents mitigation measures in packages, which are required sets of retrofit measures that must be implemented for a home to provide a consistent level of protection, and identifies three successive protection packages: Basic, Intermediate, and Advanced. Implementing the mitigation packages in this guide on existing vulnerable homes within the hurricane-prone regions of the United States will result in their improved performance in high-wind events. The guide can be found by searching the FEMA website or downloading a PDF at http://tinyurl.com/cyx2ojy.



4.1 CREATING THE WIND- AND RAIN-RESISTANT STRUCTURAL ENVELOPE

The building envelope consists of the roof, exterior walls, and exterior doors and windows. Protecting the structural envelope during a storm is essential to preventing water intrusion associated with roof and window damage.

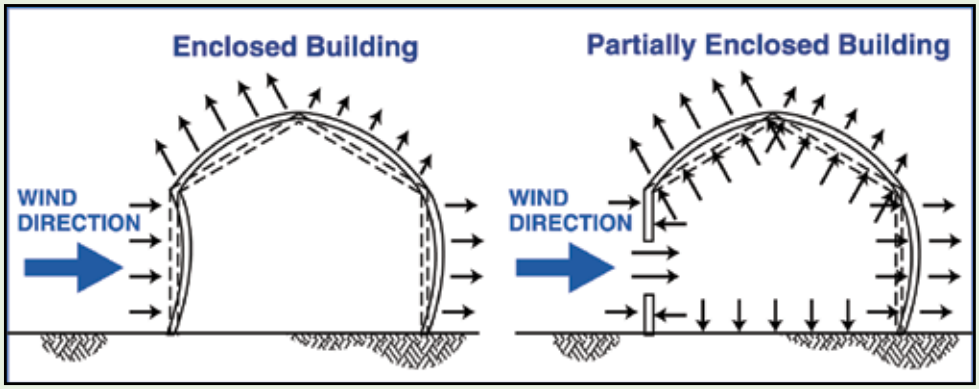


Figure 7. The diagram on the left shows a structure with the wind- and rain-resistant envelope intact. Pressure on the walls and roof comes from the outside only. In the diagram on the right, the structure's wind- and rain-resistant envelope has been breached due to a broken window. Now, pressure on 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 (2011).

It is important to recognize that strengthening your home for wind resistance is a top-down process. Strong winds create uplift on homes and cause them to lift off the ground rather than fall over vertically. By connecting the highest components of the home with lower components, the connected system gets progressively heaver and harder for the wind to pick up. Design and retrofitting of homes should start at the top of the roof and work down, ideally into the foundation and the ground. Conversely, flood design and retrofitting is bottom-up with freeboard the only safety factor.

4.1.1 ROOF STABILITY

Roof Framing and Truss Bracing

Strengthening a gable-end roof by providing lateral and diagonal bracing to the rafter or trusses is recommended. Figures 8 and 10 are from the FEMA brochure "Against the Wind" (FEMA 247) and can be downloaded from FEMA's website at http://www.fema.gov.

For lateral bracing, 2 by 4s are attached to the trusses that run the length of the roof. The 2 by 4s overlap 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. Another important type of bracing for your gable end involves making diagonal braces (Figure 10). Diagonal braces provide additional support against collapse of the gable end.

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

Additional information regarding roof bracing can be found at the Insurance Institute for Business and Home Safety (IBHS) website at http://www.disastersafety.org.

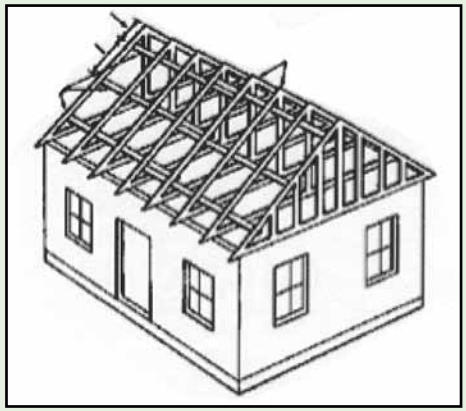


Figure 8. Trusses are built with a peak at the ridgeline of the roof, which forms an A-shaped pattern known as a gable end. During a hurricane, the gable end is subject to high wind intensities that may damage other trusses if not property stabilized. Source: FEMA's "Against the Wind" brochure (FEMA 247).

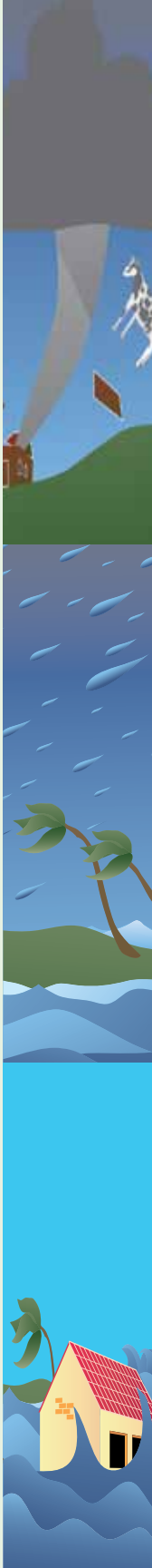


Figure 9. For lateral bracing, 2 by 4s are 18 inches from the ridge and connect to horizontal members that attach the opposing trusses. The 2 by 4s are connected with two #14 3-inch screws (A) and overlap over two trusses (A and B). The end is connected to the gable end with an angle or L bracket (C).

Contiuous Load Path Connections

All homes should have a continuous connection from the roof to the foundation. The continuous load path connection is 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. New homes require a complete load path connection, and older homes may need to be retrofitted to add components of the connection.

Naturally, all houses have some connection from the roof to the foundation; otherwise, they would fall apart. However, in response to recent hurricane damages, much stronger connections are now required to protect against hurricane winds.

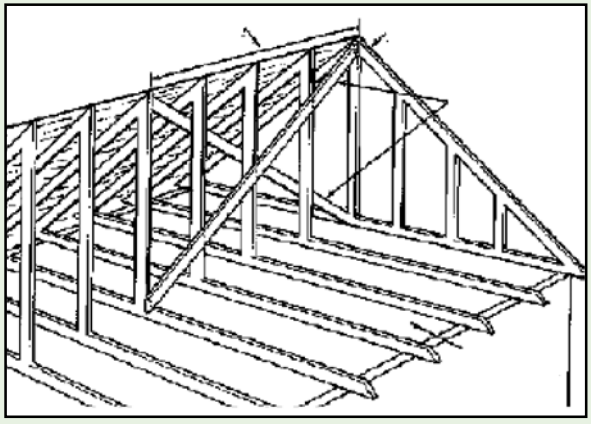


Figure 10. Diagonal braces form an X pattern from the top center of the gable end to the bottom center of the fourth truss and from the bottom center of the gable end to the top center of the fourth truss. The same screws as for lateral bracing are used. Source: FEMA's "Against the Wind" brochure (FEMA 247).

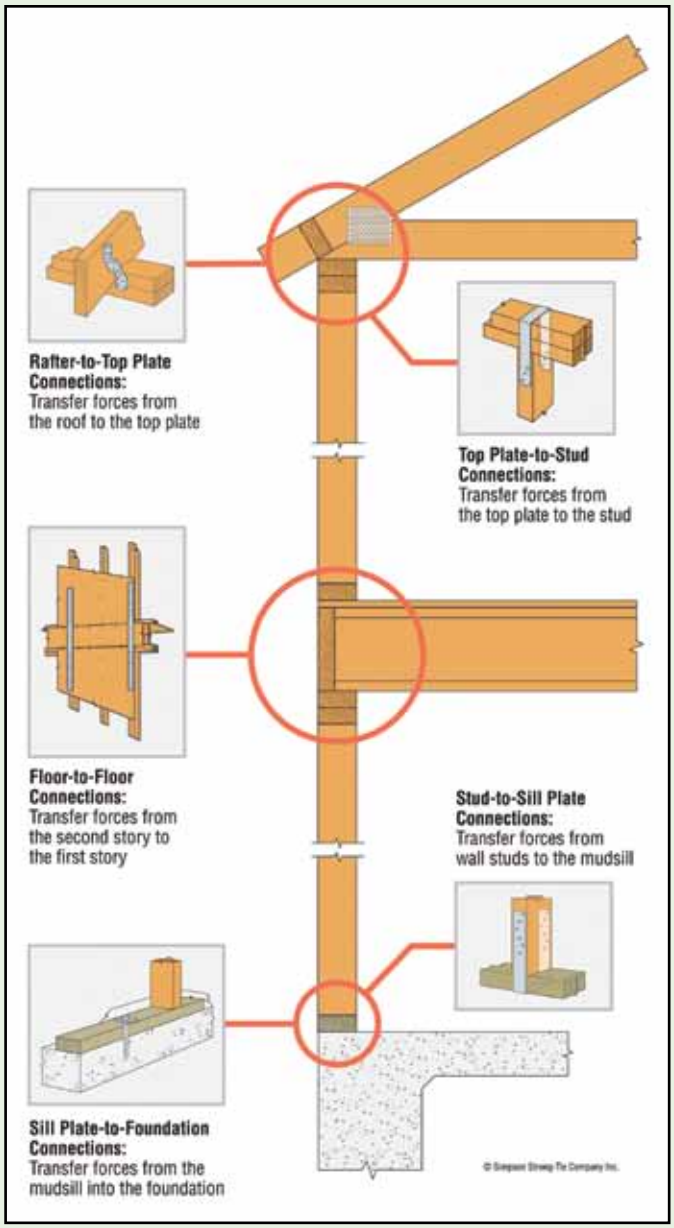
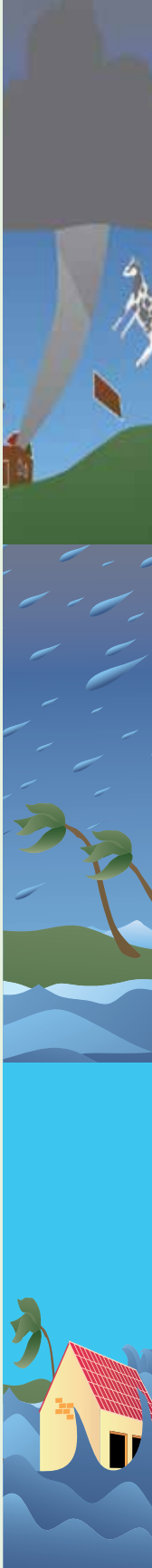


Figure 11. Continuous load path connection ties: (i) the roof to the wall, typically with hurricane clips and plate ties, (ii) the wall of a higher story to the wall of a lower story, with straps, and (iii) the wall to the foundation with plate ties and anchors. For a single-story house, the connections between the higher and lower stories are not needed. These connections are in all new houses. Older homes usually will not have these features. In many cases, retrofitting can easily be done for certain portions. Source: Simpson Strong-Tie.

The specifics of the continuous load path connection are illustrated in Figure 11. This connection ties your roof to your home's foundation and helps to keep the roof from blowing off during a hurricane. The hurricane clip was created to improve the roof-to-wall connection and is now required along with straps and anchors to protect against hurricane-force winds. Examples of the different types of hurricane clips are depicted in Figure 12.



For older houses, it is possible to retrofit to add components of the connection (see Figures 11 and 13). Each house is different but, in general, it will be easier and less expensive to put in hurricane clips than to do the foundation connection. Check with a licensed structural engineer or architect to determine what is feasible for your house. It is preferable to do both the roof-to-wall connection and the wall-to-foundation 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. Remember, the weakest link for many homes is the roof-to-wall connection, and thus the hurricane clip will make that weakest link significantly stronger.

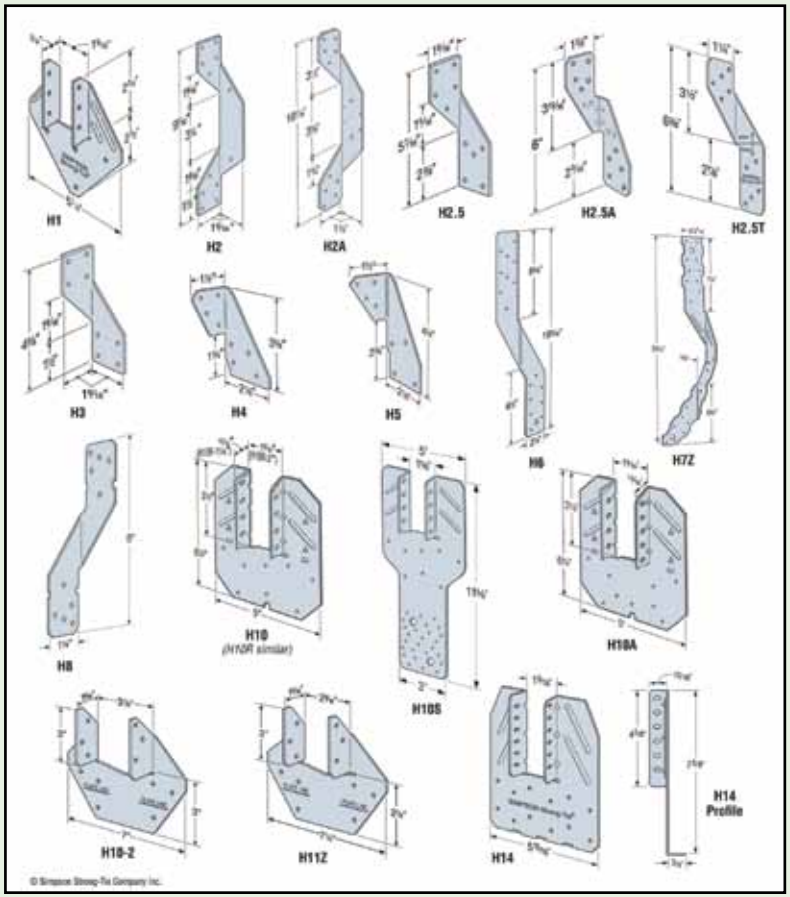


Figure 12. There are many different types of hurricane clips. Your licensed architect, structural engineer, or contractor can tell you what is suitable for your house for the amount of protection you want. Figure courtesy Simpson Strong-Tie.

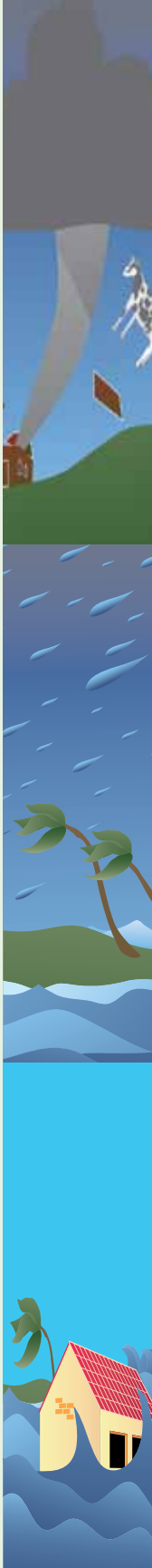
Patented in 2004 by Bostitch, a division of Stanley Works, HurriQuake construction nails are a designed to provide more structural integrity against hurricanes or earthquakes. Features include angular barbs on the lower half of the nail, a spiral shank below the head, and a nail head that is 25% larger than average.[21]

Figure 13. A hurricane clip installed during new construction. A hurricane clip is required for each truss-rafter that is hidden from view upon completion of the structure.

Figure 14. Synthetic underlayment is typically made from polypropylene, polyester, or fiberglass fabric that weighs less than felt building paper, and withstands exposure to varying weather conditions. Source: Carlisle Coatings & Waterproofing.

Synthetic Roof Underlayment

Synthetic roof underlayments (Figure 14) recently began replacing traditional roofing felt as an underlayer beneath roofing material on residential sloped roofs. When synthetic materials were used as the most expedient material for temporary roof repair after a series of hurricanes in the southern United States, it was discovered that they better resisted tearing, moisture and ultraviolet rays than asphalt-saturated felt building paper and can serve well as a secondary weather barrier.[22]



4.1.2 KEEP WATER OUT

Flood Prevention

Protecting your property from flooding can involve 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 their utility systems, should be carried out by qualified maintenance staff or professional licensed contractors. The most important information to know about your home when considering flood prevention techniques is the base flood elevation (BFE) shown on the Flood Insurance Rate Map (FIRM) for your community.

The best way to protect a structure and its contents from flood damage is to seal the building so that floodwaters cannot enter. This method, referred to as "dry floodproofing," encompasses a variety of measures: [24]

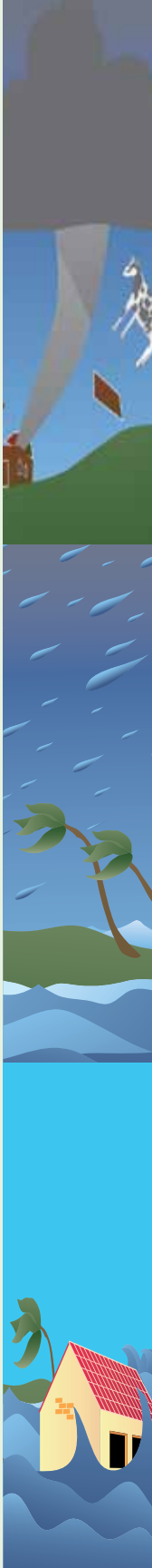
- Applying a waterproof coating or membrane to the exterior walls of the building.
- Installing watertight shields over doors, windows and other openings.
- Anchoring the building as necessary so that it can resist flotation.
- Installing backflow valves in sanitary and storm sewer lines.
- Raising HVAC and electrical system components above the flood level.
- Anchoring fuel tanks and other storage tanks to prevent flotation.
- Installing a sump pump and foundation drain system.
- Strengthening walls so that they can withstand the pressures of flood waters and the impacts of flood-borne debris.
- Building with materials that can withstand flood waters for at least 72 hours (examples: concrete, ceramic tile, pressure-treated lumber, steel, metal, brick, epoxy paint, foam and closed cell insulation).
- Ensuring wells are properly constructed to avoid contamination from flood waters.

Keep these points in mind when you dry floodproof: [25]

- Dry floodproofing is appropriate primarily for slab-on-grade buildings with concrete or solid masonry walls. Concrete and masonry are easier to seal, more resistant to flood damage, and stronger than other conventional construction materials.
- If you dry floodproof a "substantially damaged" or "substantially improved" building (as defined by the National Flood Insurance Program [NFIP] regulations) or a newly constructed building, and if the building's lowest floor (including any basement) is below the BFE shown on the FIRM map for your community, your dry floodproofing must be certified as providing protection from the BFE. To obtain this certification, you must floodproof your building to a height at least 1 foot above the BFE. Check with your local floodplain manager or building official for more information.
- The height of your dry floodproofing should not exceed 3 feet. The pressures exerted by deeper water can cause walls to buckle or collapse. Before you use dry floodproofing to protect against greater flood depths, have a structural engineer evaluate the strength of your walls.
- If your dry floodproofing measures require human intervention before flood waters arrive, such as placing shields over doors and windows, you should have an operations and maintenance plan that describes all the actions that must be taken and lists the persons who are responsible. It must also include a schedule of periodic maintenance that states how often the dry floodproofing measures will be inspected and who will perform the inspections.
- The cost of individual dry floodproofing measures will vary with the size, condition, and use of your building, the dry floodproofing height, and the extent to which you use contractors and engineers.

In many cases, flooding on a property can be caused by poor drainage. If this is the case, it may be of great benefit to address the drainage issue with the professional advice of a licensed civil engineer.

An excellent source of information for protecting your property from flooding is found in FEMA's *Coastal Construction Manual* (available by searching FEMA's website at http://www.fema.gov/) or refer to *Protect Your Property from Flooding*, found at http://www.fema.gov/plan/prevent/howto/index.shtm#4.



Window Coverings

Protection of your home's envelope from breaches during a windstorm is critically important, particularly its vulnerable windows and doors. If your home is located in a windborne debris zone (any location where the basic wind speed for code purposes is 120 miles per hour or greater), it is important that window coverings not only withstand hurricane force winds, but also withstand impacts. The usual standard for impact resistance is known as the "Large Missile Impact Test" as defined by several similar norms. Essentially, these tests determine whether a given shutter can withstand the impact of a 9-pound 2 by 4 fired at the shutter at 30+ miles per hour, followed by cyclic wind load testing.

Several types of opening protection systems are available and described below. Coverings that are installed should be tested and approved to meet industry standards for hurricane impact. Check with the manufacturer, and always use only licensed contractors and reputable dealers.

The International Hurricane Protection Association (a trade association group comprising manufacturers, contractors and other industry professionals) has several tips regarding selection of projects, selection of installing contractors and other useful information on its website: http://www.inthpa.com.

Below, several types of opening protection systems are generically described. Within each category, numerous reputable manufacturers provide different products, each with individual features, benefits, and cost. The prices shown are estimates for installed costs and represent local and nationwide averages as of May 2010. Pricing will vary between providers and will change over time. We encourage you to consult with a competent contractor specializing in supplying and installing these systems.

Roll-Down Shutters

Roll-down shutters represent the window covering type that is easiest to deploy and offers the best overall protection features (Figure 15 and 16). 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 housed above the window

Figure 15. Interior of home with deployed roll-down shutters. Roll-down shutters can be used not only for storm protection, but also for security, privacy, light, heat, and noise control. Source: Roll-a-way/QMI.

Figure 16. 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.

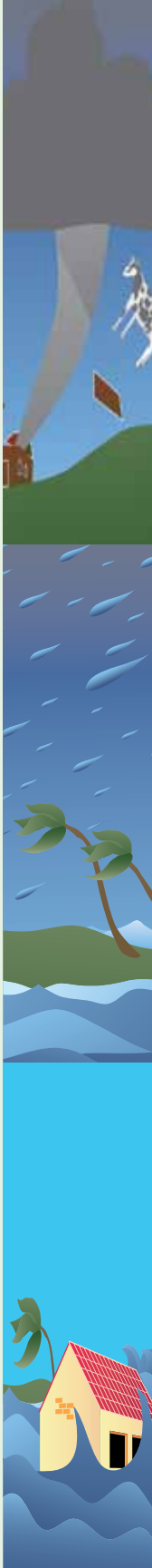
or door being protected. Most of the components of roll-down shutters are made from extruded aluminum.

Because the roll-down shutter makes solid contact with the window sill, patio deck or other structure at the bottom, this shutter type demonstrates the highest level of protection against wind-driven rain in addition to wind and debris. Roll-down shutters can be deployed using a variety of operators, both manual and electric motor types. These can be installed directly over windows and doors, or in some cases, at balcony's edge to form an enclosure.

Since roll-down shutters are easily deployed, these 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 lead to a wide range of costs for this shutter type.

Accordion Shutters

One of the most commonly used shutter types in hurricane-prone regions is the accordion shutter (Figure 17). 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. Installed prices range from approximately $16 to $30 per square foot.

Figure 17. Accordion shutter (shown in open position) installed over a large window group of a coastal home. Shutter has been installed to allow deployment from inside the home. Source: Roll-a-way/QMI.

Decorative/Protective Shutters

For homeowners who wish to add a decorative flair to the home's exterior while protecting windows against storm forces, Bahama or Bermuda and colonial-type shutters are available for window protection (Figures 18 and 19). These are most commonly made using extruded aluminum frames and louvers, although some composite materials have also found application in these types of shutters. Typically, these are finished using a durable exterior-grade powder coating or automotive-grade polyurethane paint system.

Figure 18. Bahama shutters made from durable extruded aluminum components add "Island" flair to a home and provide effective opening protection. Source: Roll-a-way/QMI.

Figure 19. Colonial shutters made from durable extruded aluminum components add a traditional look to the home and protect window openings. Source: Roll-a-way/QMI.

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

Storm Panels

Removable storm panel systems (Figures 20 and 21) are one of the most 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. Wide varieties of track options are possible. While these systems are relatively inexpensive (approximately $7 to $15 per square foot, depending on panel type and track options), they require much more effort for the homeowner to deploy than the other types mentioned above.

Figure 20. Although installation varies, this example shows panels that slip into a track above the window. The bottoms of the panels are secured by bolts that permanently attach to the window. Photo courtesy Hurricane Secure.

Figure 21. 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.

In-Place Systems

Requiring no advance deployment, impact-resistant systems that are permanently installed on a structure can be an attractive option for opening protection. Two types 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.

Figure 22. In-place stainless steel impact screen protecting several windows of a coastal residence. This system requires no deployment and provides shade.

Impact-resistant stainless steel screen systems (Figure 22) consist of a heavy-gauge stainless steel screen mesh that is secured in an extruded aluminum frame. This unit is installed over the window to be protected. These are available as operable units, which facilitates cleaning and emergency egress. Screen units also provide excellent solar shading characteristics. These systems cost approximately $25 to $50 per square foot.

Flat impact polycarbonate units (Figure 23) are available to protect most single and double window sizes and types 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, emergency egress from the home must be considered before installing this system. Typical systems cost approximately $25 to $35 per square foot.

Figure 23. Flat impact polycarbonate panels are installed directly over windows of a coastal home. This window covering provides excellent storm protection with minimal aesthetic impact. Source: Roll-a-way/ QMI.

Fabric Windscreen

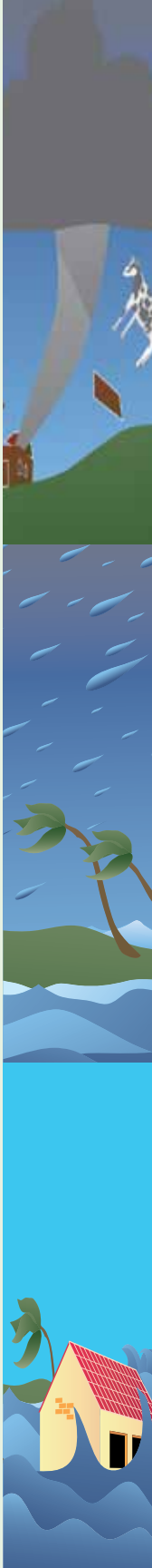
Figure 24. Polyethylene basket-weave fabric windscreen deploys directly over the ground floor windows of a coastal home. Source: Roll-a-way/QMI.

Impact-resistant fabric panels made from high-tensile strength geosynthetic fibers such as polyethylene or from reinforced PVC have become increasingly popular for use as window and door protection. These systems are attached on two opposite sides of the window or door, usually to permanently installed panel mates or tracks with mountain studs. The panels include integrated grommets, which facilitate the deployment of the windscreens. These systems are also relatively inexpensive, costing approximately $7 to $12 per square foot.

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, allowing light in the dwelling, but do not allow visibility through the screen.

Figure 25. Polyethylene basket-weave fabric windscreen is deployed at the edge of a patio, enclosing the entire area. Source: Roll-a-way/QMI.

The geosynthetic screens have also been extensively employed to enclose large, even irregularly shaped openings (Figure 25). Such systems range in price from $20 to $40 per square foot. Because of the installation requirements of such systems, site-specific engineering is often required, and consultation with a contractor is recommended.



Impact-Resistant Windows and Glazed Doors

Window and door manufacturers have developed products with both sturdier frames and laminated (impact-resistant) glazing to better withstand wind forces and debris (Figure 26). Such systems are available in a variety of styles, options, and costs. When installing any window or door, be sure to follow the manufacturer's installation standards.

While impact-resistant openings offer deployment-free protection, the glass can still be broken (but remains in the frame). In addition, while these products are often available to the consumer through home improvement stores, professional installation is highly recommended to ensure proper attachment of the windows to the structure.

Figure 26. 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 an extra fastener to withstand high winds. During a wind event, debris may crack the glass, but the laminate will hold the windowpane together in the frame and prevent breaching of the wind- and rain-resistant envelope. After the storm, the glass will need to be replaced.

Plywood

Plywood has been the most commonly used option for protection of window openings due to its low cost and ease of availability. Plywood covers (Figures 27 and 28) should be secured with fasteners, screws, or clips depending on the type of construction and exterior veneer of the structure. To ensure performance, nails should never be used to secure plywood. Plywood offers a limited amount of protection in moderate level storms and only if it is properly installed.

Figure 27. After the plywood is cut for each window, each piece should be labeled so the panels for one window are not mixed with those for another. It would also save time to indicate on the panels, well before any threat of a storm, where the fasteners will be attached.

Figure 28. For larger windows, such as this sliding glass door, two 2 by 4s face outside and are oriented with the narrow end against the plywood. The fastening screws attach from the plywood into the 2 by 4.

The disadvantages of plywood are that it can rot or warp if stored in a wet or warm area. In addition, plywood shutters are relatively heavy. You will need to two people to help with the preparation and deployment of these shutters. Because of their weight, if would be difficult, or even dangerous, to install plywood shutters if a ladder is needed.

Most significantly, however, plywood is increasingly viewed by both code and insurance entities as an inadequate means of protecting openings. While the International Residential Code (and other similar codes) allows some use of plywood under very specific conditions, these are restricted to areas where the design wind speed is 130 miles per hour or less. Simply put, plywood does not demonstrate the levels of performance achieved by the engineered shutter types.

Window Film

An after-market product used to enhance glass breakage characteristics is commonly known as security window film. Such products are often touted as "hurricane film" or similar, claims that cannot be substantiated by testing. Application of any of these window films to existing windows does NOT constitute adequate opening protection and should not be considered for use as opening protection. For more information, visit the website of the International Window Film Association (IWFA) at http://www.iwfa.com.

For further information regarding opening protection, visit the IBHS website, http://www.ibhs.org, in particular the Fortified for Existing Homes program. Table 4-1 lists the advantages and limitations of each type of window covering discussed above. For most homes, a combination of different covering types is employed, based on the needs and budget of the homeowner.

Impact-Resistant Garage and Entry Doors

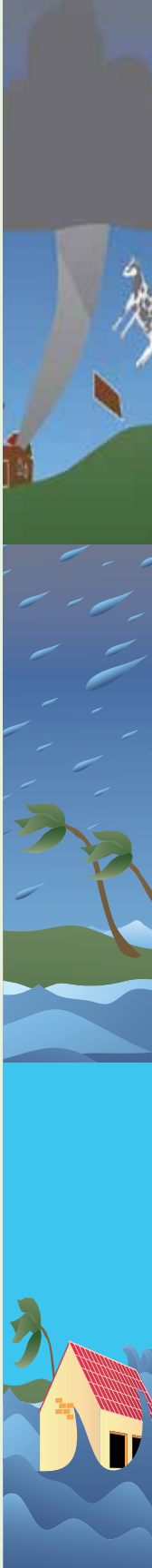
One of the most important yet frequently overlooked openings in a home that also requires protection are its doors — both the garage door and entry doors. Most major suppliers of both types of doors offer products (with or without glazing options) that meet both wind and impact resistance requirements. Often, replacement of a non-rated door with one of these newer types is cost-effective when compared to the cost of providing a covering for the door. As with impact-resistant glazed windows and doors, any replacement of a door with an impact-resistant garage or entry door should be done by a qualified professional installer.

Figure 29. 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 lightweight 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 end and vertical supports for your door. Source: Florida Hurricane Depot.

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

Type of Protection	Pros	Cons
Roll-Down Shutters	Easiest to deploy; best overall protection, especially wind-driven rain	Expensive
Accordion Shutters	Easily deployed; simple manual operation; good overall protection; modest cost	Possible aesthetic issues
Bahama Shutters	Easily deployed; "Islands" decorative flair; provides shade	Blocks some light and view
Colonial Shutters	Easily deployed; "traditional" decorative flair	Cost; requires adequate room for "swing" of shutters
Storm Panels	Removable; inexpensive	Manual deployment required; must be stored when not in use
Stainless Steel Impact Screens	Always in place; provides shade	Some aesthetic impact; egress issues must be considered; less effective for wind-driven rain
Flat Impact Polycarbonate Units	Always in place; minimal aesthetic impact	Egress issues must be considered; care must be taken in cleaning
Fabric Windscreen (Direct Mount)	Inexpensive; easy to handle and store	Manual deployment required; greater shutter deflection than metal systems
Impact-Resistant Windows and Doors	Always in place; many styles and options	Costs vary widely and can be high; glass can still break, requiring expensive replacement
Plywood	Inexpensive; available	Manual deployment is difficult; must be properly stored; doesn't provide impact-resistance for winds > 130 mph

Note: Window protection options were provided by Roll-a-way.



The garage door is a significant weakness during a hurricane due to its large area and the stress it is subject to (Figure 29), and its failure can cause extensive damage to a structure. Garage door options include: (i) replacement with a stronger door, (ii) horizontal bracing, (iii) vertical bracing, or (iv) other types of bracing kits. For many garage doors, vertical bracing is a popular and reasonably priced option.

Double entry doors should have slide bolts at the top header and bottom threshold of the inactive door, a deadbolt with at least 1-inch throw length between each door, and three hinges attaching the door to the frame. Single entry doors should have three hinges and a bolt long enough that it goes into the 2 by 4 framing of the door. Whenever entry doors are fortified, at least two of them must be operable for access and exiting at any time.

4.1.3 TREES

Cutting or trimming trees that overhang your house is an additional measure you can take to protect your property during a hurricane. Even though trees provide a buffer to the full strength of the wind, there is a serious danger if there are large trees or limbs that are close enough to fall on the house. Tree limbs or branches falling onto or impacting your house will cause considerable damage — few roofs are strong enough to withstand a falling 20-inch diameter tree. Figure 30 illustrates the distance from the tree to the house to ensure that falling limbs do not affect the roof.

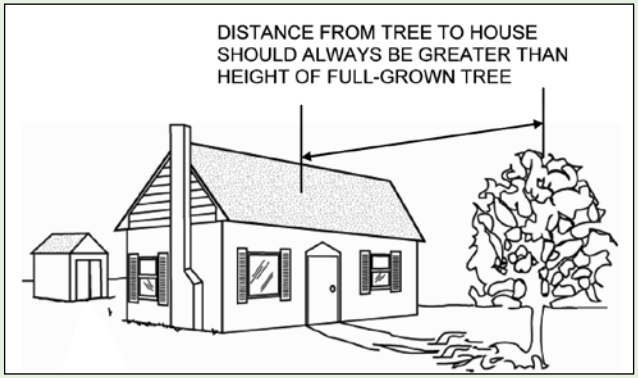


Figure 30. FEMA recommends that the distance between a tree and your house should always be greater than the height of the tree when it is fully grown. This is to prevent a tree from falling on the roof, either at its current size or in the future. Source: FEMA's "Protecting Your Property From Wind."

If it is not possible to remove a tree, you can at least cut off all branches that hang over the roof of the house. Generally, you should hire a licensed tree trimmer to perform this work.

Additional resources from the University of Florida and IFAS Extension:

- http://goo.gl/ZdNLJ ("Give Tips on Preparing Your Trees for Hurricane Season")
- http://goo.gl/50L3H ("Hurricane Damage Reduced in Trees Pruned for Strength")
- http://edis.ifas.ufl.edu/pdffiles/FR/FR17300.pdf (*Trees and Hurricanes*, Chapter 5, "Wind and Trees: Lessons Learned from Hurricanes")

4.1.4 CONCRETE STRUCTURES

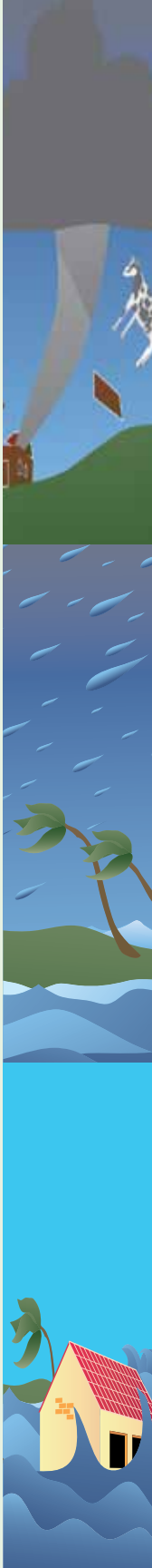
Concrete structures, even for residential units, are becoming much more popular in coastal areas. Concrete homes were some of the few left standing in storm surge zones after Hurricanes Katrina and Ike. Well-built concrete structures can withstand winds in excess of 200 miles per hour. [26]

Concrete may be somewhat more expensive initially than a wood-frame home, but in the long run the thermal properties mean overall lower costs. Concrete by itself does not provide adequate thermal properties, but the advent of insulated concrete forms (ICF) allows for a structurally sound, hurricane-resistant if not hurricane-proof house with excellent insulation. In a coastal surge zone, elevation is still an important factor, even with an ICF structure.

4.1.5 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 build a safe room during original construction of the house. FEMA notes that while construction costs vary nationwide, the cost to build a safe room inside a new house (which can also double as a master closet, bathroom, or utility room) ranges from $2,500 to $6,000.



The additional cost can 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.

More information regarding design and construction of safe rooms can be found in FEMA Publication 361, *Design and Construction Guidance for Community Safe Rooms*, and FEMA Publication 320, *Taking Shelter from the Storm*, available from http://www.FEMA.gov.

4.2 ELECTRICAL AND POWER ISSUES

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. 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. GFCIs could prevent over two-thirds of electrocutions.[27] 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 do not have them, consider having them installed by a licensed electrician.[28]

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 energize the water, potentially posing a lethal trap.[29]

Flooded Areas

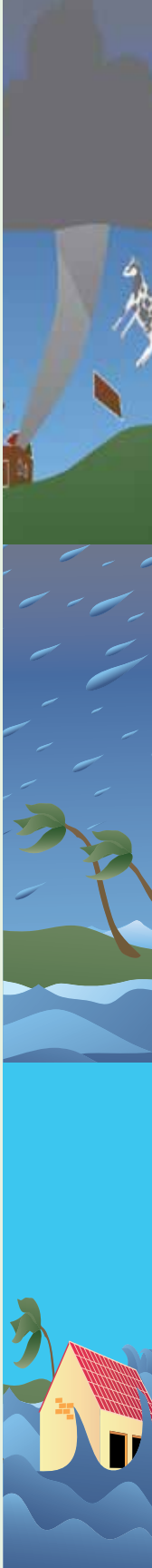
Wet Electrical Equipment: Do not use electrical appliances that have been wet. Water can damage the motors in electrical appliances such as furnaces, freezers, refrigerators, washing machines, and dryers.[30] For more information, the National Electrical Manufacturers Association (NEMA) has produced a brochure, *Guidelines for Handling Water Damaged Electrical Equipment*, 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 or 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, electronic products including signaling, protection, communication systems, industrial controls and cable trays.[31] The NEMA brochure can be downloaded free of charge at http://www.nema.org/.[32]

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:[33]

- If you see a downed power line, 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.
- 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 use another object such as a broom or stick to move a downed power line or anything in contact with the line. Even nonconductive 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.

Figure 31. Downed or damaged power lines in a residential area can pose a serious danger to public safety. Source: EPA.



- 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.

4.2.1 ALTERNATE POWER SOURCES

Before discussing alternate power sources during an emergency, one general suggestion is to make your house as energy efficient as possible as you replace equipment and appliances in your house at the end of their normal life. For example, if the lights, television, or refrigerator need replacing, consider products with the U.S. Environmental Protection Agency's (EPA) Energy Star label (Figure 32). These products may cost slightly more, but over their lifetime, the energy savings will far outweigh the small initial cost increase.

Figure 32. Items with the EPA'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 will be especially useful during an emergency, when you may be on alternative forms of power with limited supply. 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 for about 8-9 hours with the same light output. 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.

4.2.2 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. Some medicine such as insulin, which is stored 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 cannot get by without the refrigerator, or there are other critical power needs for medical or other purposes, then you may want to consider a portable generator.

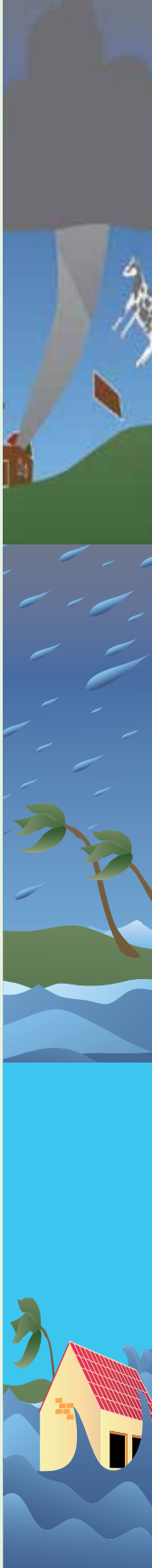
Take special care with portable electric generators that can provide a good source of power, but if improperly installed or operated, can become deadly. Do not connect generators directly to household wiring. Power from generators can backfeed along power lines and electrocute anyone coming in contact with them, including line workers making repairs. A qualified, licensed electrician should install your generator to ensure that it meets local electrical codes.[34]

Other generator-related tips include:

- Make sure your generator is properly grounded.
- Keep the generator dry.
- Plug appliances directly into the generator.
- Make sure extension cords used with generators are rated for the load, and are free of cuts or worn insulation and have three-pronged plugs.
- Do not overload the generator.
- Use a ground fault circuit interrupter (GFCI) to help prevent electrocutions and electrical shock injuries. Portable GFCIs require no tools to install and are available at prices ranging from $12 to $30.

Most importantly, never run a generator indoors or in your garage because of the possibility of carbon monoxide gas accumulation, which cannot be detected by smell. Good ventilation is required. Operate your generator outside and away from open windows. Do not hook up a generator to your house power supply without a licensed electrician.

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 40 degrees in the refrigerator compartment and 0 degrees in the freezer. Open the refrigerator door as little as possible.

4.2.3 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 form part of your stock of emergency supplies and 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 could 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 within the phone system.

4.2.4 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 use power tools in an emergency and the power is out. The inverter will drain your car battery, but look for inverters that have a low battery shutdown feature to prevent total battery drain. You should not run an inverter with the car running unless the manufacturer provides specific instructions with safety guidelines. In addition, the car should not be run in a garage, but rather in a well-ventilated area, if the manufacturer approves of such procedures.

4.2.5 BATTERY CHARGERS

Your car battery can be an important source of DC and AC power with an inverter. To keep the car battery charged, you should consider a battery charger as part of your emergency supplies. The charger only works when

there is household power or backup power through a generator, but it can recharge your car battery if it is needed. 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.

4.3 HAZARD MITIGATION ASSISTANCE PROGRAM

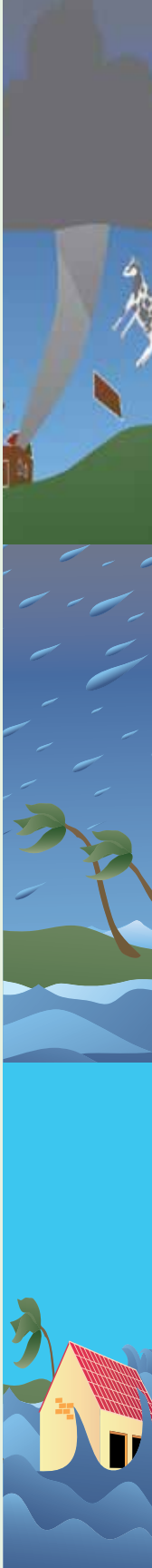
FEMA's Hazard Mitigation Assistance (HMA) Programs provide funding for eligible mitigation activities that reduce property damage and protect life from potential disasters. At the state level, the Texas Division of Emergency Management (TDEM) and the Texas Water Development Board (TWDB) administer the HMA grant programs and coordinate the State Emergency Management Program to ensure the state and its local governments respond to emergencies and disasters while lessening their lasting impacts. The two agencies encourage local communities to take advantage of funding provided by HMA programs in both the pre- and post-disaster timeframes. Any community wanting to apply for a federal grant must have a FEMA-approved hazard mitigation plan. Brief descriptions of the HMA grant programs can be found below.

Hazard Mitigation Grant Program (HMGP) assists in implementing long-term hazard mitigation measures following Presidential disaster declarations. Funding is available to implement projects in accordance with state, tribal, and local priorities, and is only available following a Presidentially declared disaster.

Pre-Disaster Mitigation (PDM) provides funds on an annual basis for hazard mitigation planning and the implementation of mitigation projects prior to a disaster.

Flood Mitigation Assistance (FMA) provides funds on an annual basis so that measures can be taken to reduce or eliminate risk of flood damage to buildings insured under the NFIP.

Repetitive Flood Claims (RFC) provides funds on an annual basis to reduce the risk of flood damage to individual properties insured under the NFIP that have had one or more claim payments for flood damages. RFC provides up to 100% federal funding for projects in communities that meet the reduced capacity requirements.



Severe Repetitive Loss (SRL) provides funds on an annual basis to reduce the risk of flood damage to residential structures insured under the NFIP that are qualified as severe repetitive loss structures. SRL provides up to 90% federal funding for eligible projects.

Among other things, these programs can provide funds to states to assist homeowners in implementing mitigation measures to existing structures. Some of the project types that have been approved by FEMA for use 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 the natural floodplain functions.
- **Property Acquisition and Structure Relocation:** The physical relocation of an existing structure to an area outside of a hazard-prone area or regulatory erosion zone 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 the natural floodplain functions.
- **Structure Elevation:** Physically raising an existing structure to an elevation at or above the Base Flood Elevation or higher if required by FEMA or local ordinance. Structure elevation may be achieved through a variety of methods, including elevation on continuous foundation walls; elevating on open foundations, such as piles, piers, posts, or columns; and elevating on fill. Foundations must be designed to properly address all loads and be appropriately connected to the floor structure above, and utilities must be properly elevated as well. 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.

Funding under HMA programs is subject to the availability of appropriations and, for HMGP funds, to 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.

4.4 RETROFITTING AN EXISTING HOME

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

1) Roof-to-wall and wall-to-foundation connections,

2) Hurricane clips only without additional foundation connection, or

3) Stronger connectors than those required in the current building code.

4.4.1 ROOF-TO-WALL CONNECTION

Concepts regarding the roof-to-wall connection were covered in Part 4.1. A properly selected hurricane clip is required for each rafter. In addition, the rafters at gable end eaves should be strapped down. Exterior beams supported by corner columns also require strap down. For houses with post and beam roof construction, fasteners should be for roof rafter to roof beams, top of post to horizontal ridge beam, and post to beam connections located at the exterior wall (see Figures 33 and 34).

Figure 33. 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.

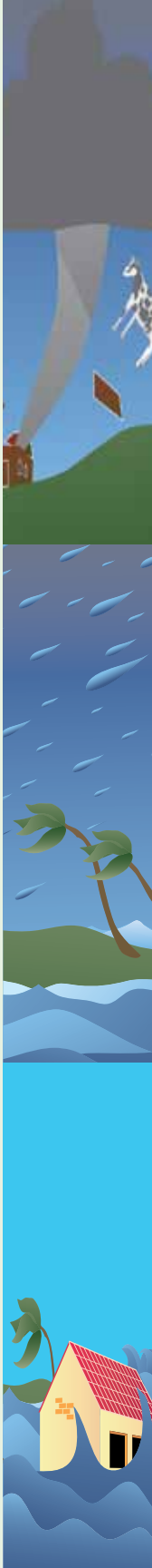


Figure 34. In some retrofit examples, it is possible to tie a portion of the house to the foundation. Here, a metal strap connects the vertical post to the foundation, which finishes the continuous load path connection from roof to the foundation. Source: Hurricane Protection Services.

You should seek a licensed structural engineer or architect to select the proper connectors and nails for your house. You can then do either all or part of this work yourself, or hire a licensed contractor.

4.4.2 ROOFING

The wind from a hurricane attacks any weaknesses in the roof. Once a weakness is exposed, adjacent areas can be more easily damaged and peeled away. Thus, strengthening the roof is important and it should be considered for new construction and when a roof is replaced after

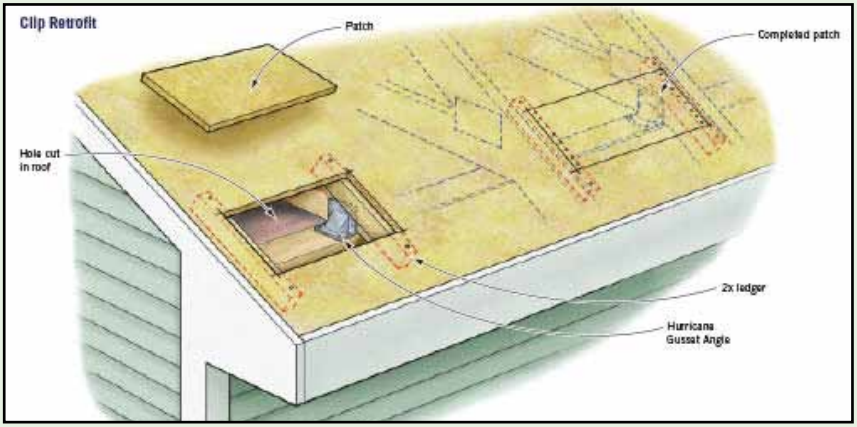


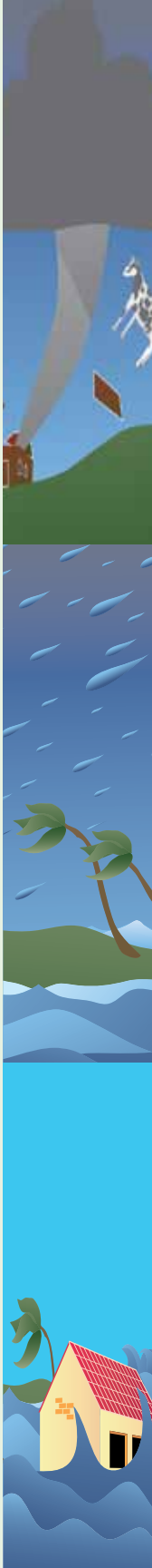
Figure 35. To install connectors with minimal demolition, cut rectangular holes between pairs of trusses. A connector can be attached to a truss on each side of the hole, allowing four trusses to be attached with just two holes. Holes are patched by resting the patch on scabs nailed to the sides of the trusses. Source: Coastal Contractors Online.

its expected life. The roofing option involves installing a continuous structural sheathing (for example, plywood where it is missing or damaged). Additional fasteners and a secondary waterproof membrane are required. You should seek a licensed roofing contractor to do this work.

As a side note, there are small things you can do to strengthen the roof even if is relatively new. For example, if you climb in your attic and see nails that are supposed to attach the plywood sheathing to the truss have missed the truss, then you have found what could be a structural weakness. The joint can be strengthened with a wood epoxy or the application of closed cell foam insulation.

4.4.3 FOUNDATION UPLIFT STRENGTHENING RESTRAINT

Strengthening the foundation to resist uplift will generally require the removal of interior finishes. The installation of uplift connections should be planned by a licensed structural engineer and only after they have inspected the home to understand materials and methods used to construct the home and have calculated the uplift requirements.



Part 5
Protecting Your Property with Insurance

One of the most important ways to protect yourself and your assets from natural hazards is insurance coverage. Wind and flood insurance provides resources to aid recovery in the event of property damage and is essential for all residents living in coastal flood zones or other areas subject to periodic flooding or tornado activity.

5.1 WIND INSURANCE

When purchasing property in an area prone to hurricanes or floods, it is important to have sufficient coverage to protect your investment from considerable damage. Wind and hail insurance will protect against wind, wind gusts, hail, rain, tornadoes, or cyclones, including those caused by a hurricane. These disasters may result in direct physical loss or damage to property.

The Texas Windstorm Insurance Association (TWIA) is the state's only insurer of last resort for wind and hail coverage in the 14 coastal counties and parts of Harris County (east of Highway 146). TWIA provides wind and hail coverage when insurance companies exclude it from homeowner and other property policies sold to coastal residents. To qualify for TWIA coverage, a homeowner's residence must meet windstorm-resistant building standards by passing a windstorm inspection.

Texas Windstorm Insurance Association

Check with an insurance agent about the specific requirements for TWIA, the availability of discount programs from private insurance companies, and the specific requirements needed to qualify for them. Each program and company differs.

Figure 36. Hurricane tips from the Texas Windstorm Insurance Association. This document is available online at http://www.twia.org/Portals/0/Documents/PolicyholderBroch_TWIA_Flat.pdf.

Ten Tips for Hurricane Preparedness

TWIA

1. Be sure you have BOTH flood and windstorm insurance coverages. Flood insurance does not cover wind damage and windstorm insurance does not cover flood/storm surge damage.
2. At least once a year, take an inventory of your property. Consider videotaping a "tour" of your belongings. Keep all property records in a location away from your home or business.
3. Insure your home or business for what it will cost to REPLACE the buildings and contents rather than basing coverage on the current market values. Deductibles vary; be sure you have chosen deductibles that you can afford should you have a loss.
4. Schedule an insurance "check-up" with your agent at least once a year well ahead of hurricane season.
5. If changes to your insurance coverage are needed, plan ahead. New policies and changes to current policies may not be accepted immediately prior to a hurricane. Also, since your mortgage company must be listed on checks for any loss payments, be sure TWIA has the correct name and address for your mortgage company.
6. Be sure you know how to report an insurance claim. Keep your agent's contact information and policy numbers for your flood and TWIA policies with you at all times.
7. Read your insurance policies and know what is covered and what is not covered. If you are not sure, talk with your agent.
8. Take the time NOW to ensure that you and your family will be prepared when the next storm strikes.
9. Protect your home by keeping up with routine home maintenance.
10. You may be able to lessen wind damage to your home by making some simple structural upgrades.

Cut along dotted line.

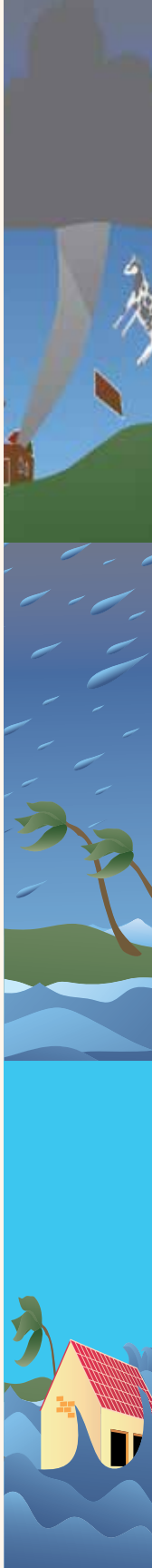
Emergency Contact Wallet Card

Agent's name

Agent's phone

TWIA policy number

1-800-788-8247 | www.twia.org



5.2 FLOOD INSURANCE

Flood insurance will cover inundation or flooding for homes near a river, stream, or along the coastline. In addition, mudflows (*i.e.*, movement of the land by viscous, water-saturated soil) are covered, but landslides (*i.e.*, movement of the land by earthquakes) are not. Consider flood insurance if flooding is a risk; it is recommended for those who live near coastlines, rivers, stream systems, or any other body of water.

Obtaining flood insurance is mandatory if you live within the 100-year floodplain and have a mortgage. Outside this boundary, insurance is not required, but many people along the coast have it because flooding occurs so broadly. In fact, more than 40% of insured flood claims in and around Houston were outside of the floodplain. Please be aware that new and existing flood insurance policies will not be written or modified when a storm nears the Gulf.

Floods are the most common natural disaster in the United States. In 1968, the U.S. Congress enacted the National Flood Insurance Program (NFIP), primarily because flood insurance was nearly unavailable from the private insurance markets following frequent widespread flooding.

NATIONAL FLOOD INSURANCE PROGRAM FloodSmart.gov
The official site of the NFIP

The NFIP is a FEMA-managed federal program that provides flood insurance that is available for purchase through insurance agents in your local community. Consumers can learn more about flood insurance, ascertain their personal relative risk of flood, and take action to protect themselves from financial loss due to flood at http://www.FloodSmart.gov. The NFIP maintains this website, where consumers can perform an address-based risk assessment, locate an insurance agent serving a specified address, and sign up for an email newsletter.

Flood insurance through the NFIP is subsidized by the federal government, but premiums vary according to the location of the property (floodplain vs. X zone, for example). In addition, you may be eligible to receive a discount on your flood insurance premium if your community is

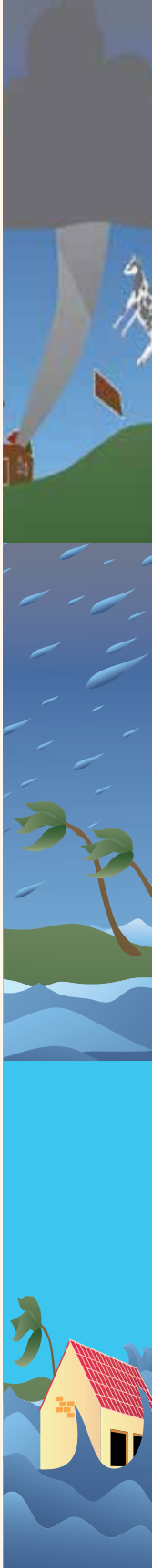
participating in the Community Rating System (CRS), a program that rewards communities for floodplain management activities that exceed the minimum NFIP requirements. (Contact your insurance agent for more information.) Flood insurance premium rates are discounted to reflect the reduced flood risk resulting from community actions meeting the three goals of the CRS:

- Reduce flood damage to insurable property,
- Strengthen and support the insurance aspects of the NFIP, and
- Encourage a comprehensive approach to floodplain management.

What you should know:

- Flood losses are not typically covered under renter and homeowner's insurance policies.
- FEMA manages the National Flood Insurance Program (NFIP), which makes federally backed flood insurance available in communities that agree to adopt and enforce floodplain management ordinances to reduce future flood damage.
- Flood insurance is available in most communities through insurance agents.
- There is a 30-day waiting period before flood insurance goes into effect, so do not delay.
- Flood insurance is available whether the building is in or out of an identified flood-prone area.
- If your property was newly mapped into a high-risk flood zone on or after October 1, 2008, you may be eligible for a low-cost Preferred Risk flood insurance policy as part of the PRP Eligibility Extension program.

The following information on the Preferred Risk Policy (PRP) was obtained from the NFIP website at http://www.floodsmart.gov/floodsmart/pages/flooding_flood_risks/prp_extension_for_property_owners.jsp and is explained in more detail there.



FLOODING & FLOOD RISKS:
PRP Eligibility Extension Program for Property Owners

If your property was newly mapped into a high-risk flood zone on or after October 1, 2008, you still may be eligible for the lower-cost PRP.

Who Is Eligible for PRP?

- To be eligible for the PRP, your building must meet certain loss-history requirements. If there have been two disaster relief payments, or claims for flood losses of $1,000 or more, or three losses of any amount, you cannot obtain a PRP.
- If you are the owner of a building that meets the loss history requirements and was newly mapped into a high-risk flood zone (shown on a flood map as a zone beginning with the letter "A" or "V") since October 1, 2008, you are eligible to purchase or renew a PRP.
- The PRP option will continue until FEMA completes its analysis and implementation of premium rate revisions put in place by the Biggert-Waters Flood Insurance Reform Act of 2012.

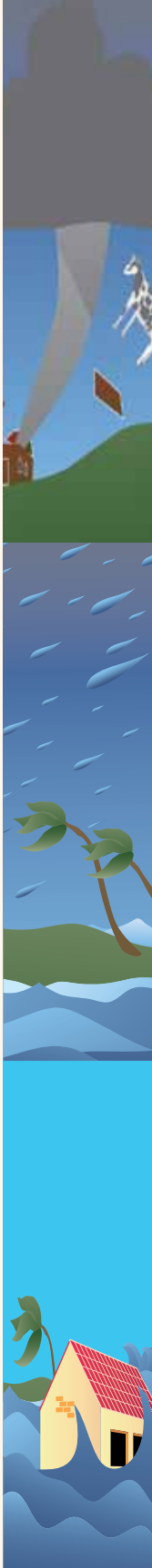
What You Need to Do

Talk to your insurance agent. Previous and current flood zone documentation for your property will be needed to validate your PRP extension eligibility. Historic maps and current effective maps are available through FEMA's Map Service website: http://www.msc.fema.gov. If you have questions or would like more information, you can call the NFIP Help Center at 1-800-427-4661 for assistance.

NFIP Reforms

The United States Congress passed the Biggert-Waters Flood Insurance Reform Act of 2012 with an effective date of July 1, 2012. This legislation is attempting to move the NFIP toward risk-based pricing and therefore removes subsidized rates (pre-Flood Insurance Rate Map rates) for the following classes of structures and allows rates to increase by 25% per year until actuarial rates are achieved:

- Any residential property that is not the primary residence of an individual.
- Any severe repetitive loss property.
- Any property that has incurred flood-related damages that cumulatively exceed the fair market value of the property.
- Any business property.
- Any property that after the date of the Bill has incurred substantial damage or has experienced substantial improvement exceeding 30% of the fair market value of the property.
- Any new policy or lapsed policy, or any policy for a newly purchased property.
- Any policy for which the owner has refused a FEMA mitigation offer under the Hazard Mitigation Grant Program, or for a repetitive loss property or severe repetitive loss property. (Severe repetitive loss means four or more claims payments of more than $5,000 or two claims that exceed the value of the property.)



Appendix A
Emergency Contact Information

Texas Division of Emergency Management
(512) 424-2208
http://dps.texas.gov/dem/index.htm

Texas Department of Transportation
(800) 452-9292 (Travel Information Line)
http://www.txdot.gov/inside-txdot/division/traffic/safety/weather/hurricane.html

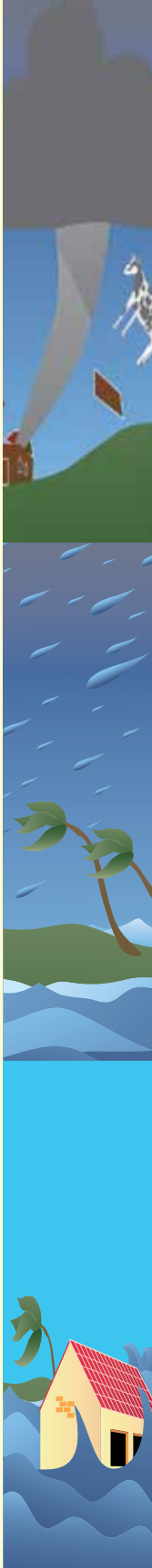
American Red Cross – Central Texas Region
2218 Pershing Drive
Austin, TX 78723
(512) 928-4271
http://www.redcross.org/tx/austin

Federal Emergency Management Agency (FEMA) Region 6
FRC 800 North Loop 288
Denton, TX 76209-3698
800-621-FEMA or 800-621-3362
http://www.fema.gov/region-vi

Texas Water Development Board
Texas Floodplain Manager
1700 North Congress Avenue
P.O. Box 13231
Austin, TX 78711-3231
(512) 463-3509
http://www.twdb.state.tx.us/flood/index.asp

Texas General Land Office
Coastal Management Program
PO Box 12873
Austin, TX 78711
(800) 998-4456 or (512) 463-9212
http://www.glo.texas.gov/what-we-do/caring-for-the-coast/index.html

Texas Sea Grant College Program
Texas A&M University, 4115 TAMU
College Station, TX 77843-4115
(979) 845-3854
http://TexasSeaGrant.org



Appendix B
Websites and Publications

1. Texas.gov Emergency Portal

Hurricane Preparedness

High winds and flooding are serious business. Find out how to protect yourself if a hurricane strikes.

Preparing for a Storm
Before the storm, there are a number of measures you can take to ensure your family's safety. Go to http://emergency.portal.texas.gov/en/Pages/Preparing-for-a-Storm.aspx.

Evacuating to Safety
If the storm gets too dangerous, you will have to evacuate. There are processes in place to help you relocate successfully. Go to http://emergency.portal.texas.gov/en/Pages/Evacuating-to-Safety.aspx.

2. Texas Division of Emergency Management

The Texas Division of Emergency Management's Public Information & Education web page, http://dps.texas.gov/dem/PublicInfo.htm, contains links with useful information on the topics listed below.

- 2-1-1 Texas
- Disaster Recovery
- Volunteer in Texas
- Educación e Información Pública

Threat Awareness Campaigns

- Wildfire Awareness
- Severe Weather Awareness
- Flood Safety Awareness
- Hurricane and Post-Storm Preparedness
- Lightning Safety Awareness
- Winter Storm and Ice Storm Preparedness
- West Nile Virus

Disaster Preparedness for People with Functional/Access Needs

- Texans with Functional and Access Needs: Planning (PDF)
- Emergency Supply Kit (PDF)
- Helpful Websites (PDF)
- Accessible Preparedness Videos

General Preparedness and Safety Tips

- Earthquake Preparedness Tips
- Emergency Supply Kits
- Flash Flood Safety Tips
- Food Safety Tips
- Hot Weather Safety Tips
- Hurricane Preparedness Tips
- Hurricane Evacuation Tips
- Lightning Safety Tips
- Power Line Safety Tips
- Tornado Safety Tips
- Tsunami Preparedness Information
- Wildfire Preparedness Tips
- Winter Storm Safety Tips

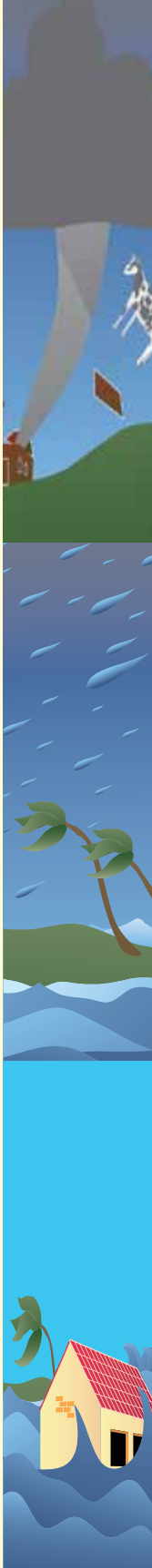
Other Resources

- Joint FEMA/State Disaster Information News Releases
- Texas Emergency Management Online
- Media Center

3. FEMA Publications

Are You Ready?

This FEMA publication (available online at http://www.ready.gov/are-you-ready-guide) provides a step-by-step approach to disaster preparedness by walking the reader through how to get informed about local emergency plans, how to identify hazards that affect their local area, and how to develop and maintain an emergency communications plan and disaster



supplies kit. Other topics covered include evacuation, emergency public shelters, animals in disaster, and information specific to people with access and functional needs.

Are You Ready? is also available in Spanish: *¿Está listo? Una guía completa para la preparación ciudadana* at http://www.ready.gov/sites/default/files/documents/files/estalisto_full_sp.pdf.

Residential Coastal Construction Manual

Investigations conducted by FEMA and other organizations after major coastal disasters have consistently shown that properly sited, well-designed, and well-constructed coastal residential buildings generally perform well. This updated *Residential Coastal Construction Manual*, available online at http://www.fema.gov/residential-coastal-construction, was prepared by FEMA with assistance from other agencies, organizations, and professionals involved in coastal construction and regulation. It is intended to help designers and contractors identify and evaluate practices that will improve the quality of construction in coastal areas and reduce the economic losses associated with coastal disasters.

- FEMA P-55, Coastal Construction Manual
- Coastal Construction Manual Resources
- Contact and Information

Additional Coastal Construction Resources

- NFIP Technical Bulletins
- FEMA P-499 – Home Builder's Guide to Coastal Construction
- FEMA P-550 – Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations
- FEMA P-762 – Local Official's Guide for Coastal Construction
- FEMA P-804 – Wind Retrofit Guide for Residential Buildings
- FEMA P-85 – Protecting Manufactured Homes from Floods and Other Hazards
- Examples of State and Local Erosion Studies and Hazard Maps

After a Flood: The First Steps (L-198)

Tips for staying healthy, cleaning up and repairing, and getting help after a flood. Available online at http://www.fema.gov/library/viewRecord.do?id=1684.

4. American Red Cross Publications

Repairing Your Flooded Home

A booklet about how to enter your home safely, protect your home and belongings from further damage, record damage to support insurance claims and requests for assistance, check for gas or water leaks, and clean up appliances, furniture, floors and other belongings. The booklet is available online at http://www.redcross.org/images/MEDIA_CustomProductCatalog/m4540081_repairingFloodedHome.pdf.

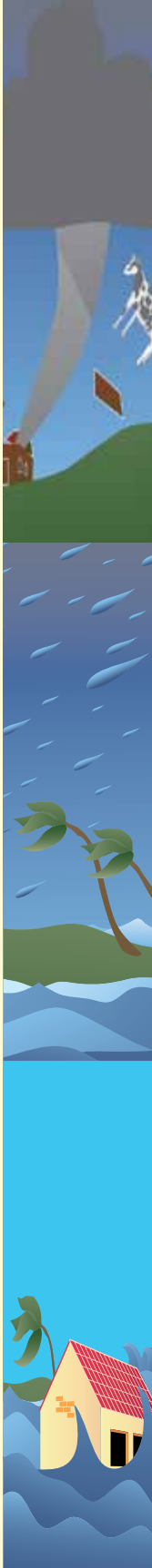
5. National Weather Service Publications

Hurricane Flooding: A Deadly Inland Danger (20052)

Brochure describing the impact of hurricane flooding and precautions to take. Available online at http://www.nws.noaa.gov/om/brochures/InlandFlooding.pdf.

The Hidden Danger: Low Water Crossing (96074E)

Brochure describing the hazards of driving your vehicle in flood conditions. Available online at www.nws.noaa.gov/om/brochures/TheHiddenDangerEnglish.pdf. Also available in Spanish (*El Peligro Oculto: Cruce de Corrientes Poco Profundas* at http://www.nws.noaa.gov/om/brochures/TheHiddenDangerSpanish.pdf.)



Appendix C
Disaster Supplies Checklists

The following list is taken from the FEMA publication *Are You Ready?* and is designed to help you determine what to include in your disaster supplies kit to meet your family's needs.

First Aid Supplies

- Adhesive bandages, various sizes
- 5" x 9" sterile dressing
- Conforming roller gauze bandage
- Triangular bandages
- 3" x 3" sterile gauze pads
- 4" x 4" sterile gauze pads
- Roll of 3" cohesive bandage
- Germicidal hand wipes or waterless, alcohol-based hand sanitizer
- Antiseptic wipes
- Pairs of large, medical-grade, non-latex gloves
- Tongue depressor blades
- Adhesive tape, 2" width
- Antibacterial ointment
- Cold pack
- Scissors (small, personal)
- Tweezers
- Assorted sizes of safety pins
- Cotton balls
- Thermometer
- Tube of petroleum jelly or other lubricant
- Sunscreen
- CPR breathing barrier, such as a face shield
- First aid manual

Non-Prescription and Prescription Medicine Kit Supplies

- Aspirin and non-aspirin pain reliever
- Anti-diarrhea medication
- Antacid (for stomach upset)
- Laxative
- Vitamins
- Prescriptions
- Extra eyeglasses/contact lenses

Sanitation and Hygiene Supplies

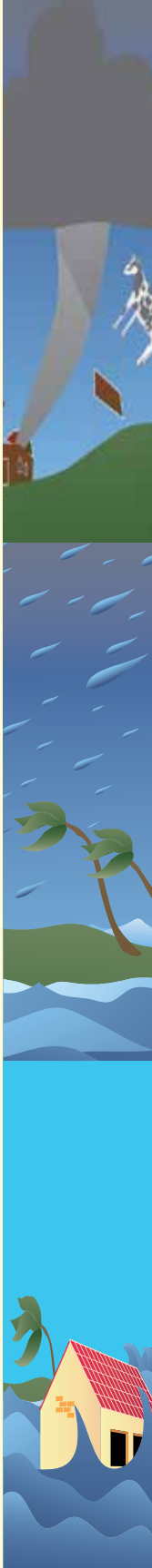
- Washcloth and towel
- Heavy-duty plastic garbage bags and ties for personal sanitation uses
- Towelettes, soap, hand sanitizer
- Medium-sized plastic bucket with tight lid
- Toothpaste and toothbrushes
- Disinfectant and household chlorine bleach
- Shampoo, comb, brush
- Small shovel for digging a latrine
- Deodorants, sunscreen
- Toilet paper
- Razor, shaving cream
- Lip balm, insect repellent
- Contact lens solutions
- Mirror
- Feminine supplies

Equipment and Tools

- Portable, battery-powered radio or television and extra batteries
- NOAA Weather Radio, if appropriate for your area
- Flashlight and extra batteries
- Signal flare
- Matches in a waterproof container (or waterproof matches)
- Shut-off wrench, pliers, shovel, and other tools
- Duct tape and scissors
- Plastic sheeting
- Whistle
- Small canister, ABC-type fire extinguisher
- Tube tent
- Compass
- Work gloves
- Paper, pens, pencils
- Needles and thread
- Battery-operated travel alarm clock
- Gas for a portable generator

Kitchen Items

- Manual can opener
- Mess kits or paper cups, plates, and plastic utensils
- All-purpose knife
- Household liquid bleach to treat drinking water
- Sugar, salt, pepper
- Aluminum foil and plastic wrap
- Resealable plastic bags
- Small cooking stove and a can of cooking fuel (if food must be cooked)



Comfort Items

- Games
- Cards
- Books
- Toys for kids
- Foods

Food and Water Supplies

- Water
- Ready-to-eat meats, fruits, and vegetables
- Canned or boxed juices, milk, and soup
- High-energy foods such as peanut butter, jelly, low-sodium crackers, granola bars, and trail mix
- Vitamins
- Special foods for infants or persons on special diets
- Cookies, hard candy
- Instant coffee
- Cereals
- Powdered milk

Clothes and Bedding Supplies

- Complete change of clothes
- Sturdy shoes or boots
- Rain gear
- Hat and gloves
- Extra socks
- Extra underwear
- Thermal underwear
- Sunglasses
- Blankets/sleeping bags and pillows

Documents and Keys

(Make sure you keep these items in a watertight container)

- Personal identification
- Cash and coins
- Credit cards
- Extra set of house keys and car keys
- Copies of the following:
  - Birth certificate
  - Marriage certificate
  - Driver's license
  - Social Security cards
  - Passports
  - Wills
  - Deeds
  - Inventory of household goods
  - Insurance papers
  - Immunization records
  - Bank and credit card account numbers
  - Stocks and bonds
  - Emergency contact list and phone numbers
  - Map of the area and phone numbers of places you could go

End Notes

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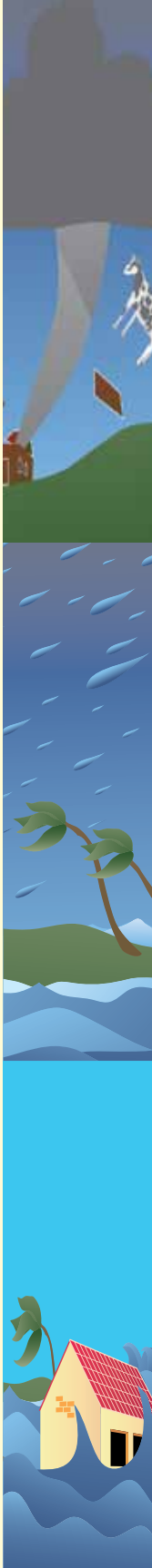

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NOW THAT YOU KNOW HOW TO PREPARE YOUR HOME, HERE'S HOW TO PREPARE YOUR COMMUNITY

StormSmart Coasts
Connect. Communicate. Collaborate.

StormSmart Coasts Website
http://tx.stormsmart.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 Texas, the Gulf of Mexico and the nation are doing to address their risks
- Find others working to protect their communities

TEXAS COASTAL WATERSHED PROGRAM

Texas Coastal Watershed Program
http://tcwp.tamu.edu/community

Additional tools and resources, and information on community planning, sustainable development and land use, are available from the Texas Coastal Watershed Program (TCWP), a partnership of the Texas Sea Grant College Program and Texas A&M AgriLife Extension Service. TCWP provides education and outreach to local governments and citizens on the impacts of land use on watershed health and water quality.

TORNADOES

HURRICANES

FLOODS