



# **HURRICANES**

## **on the Texas Coast**

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**Survival**  
**and Recovery** 

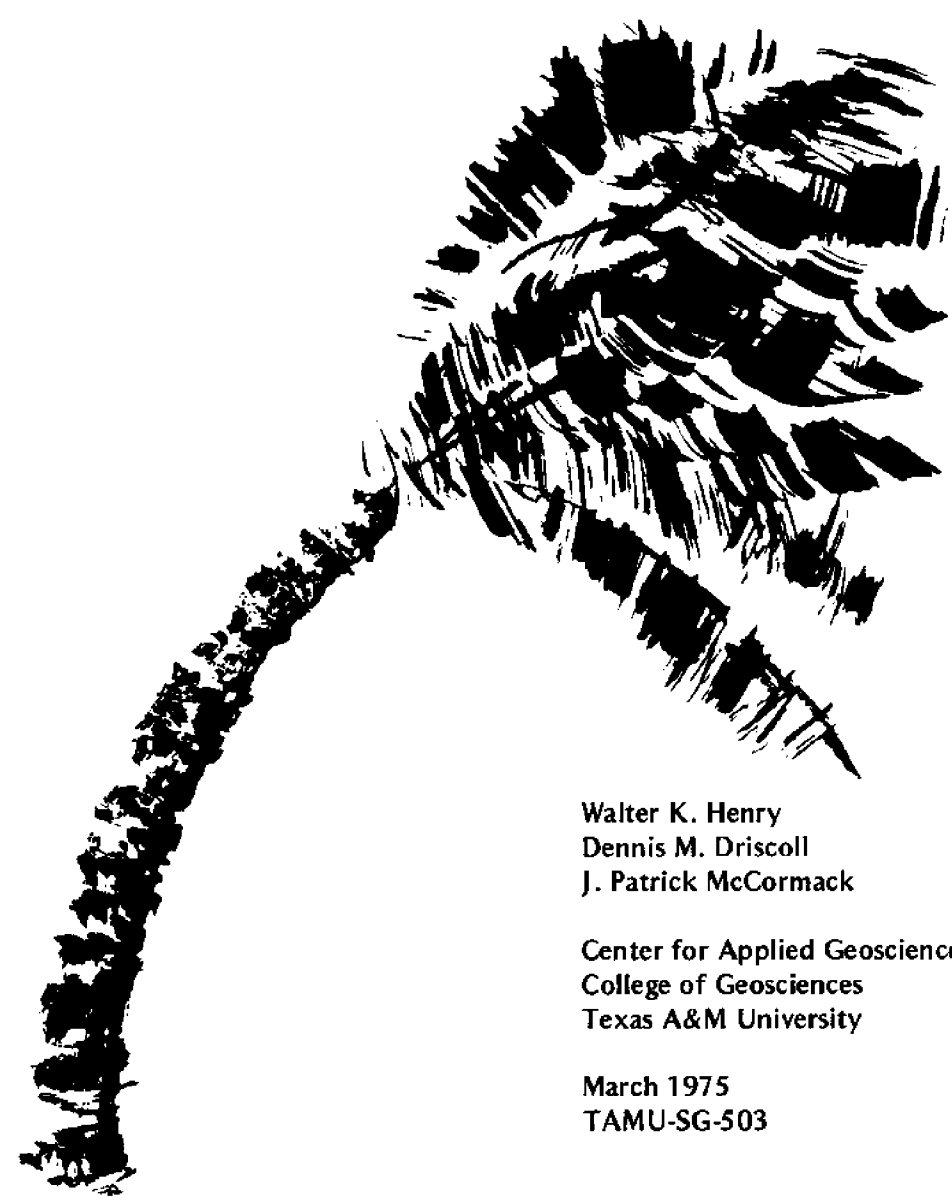
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Walter K. Henry  
Dennis M. Driscoll  
J. Patrick McCormack

Center for Applied Geosciences  
College of Geosciences  
Texas A&M University

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## I. FOREWORD

The destructive ferocity of a hurricane is almost beyond comprehension. In one 24-hour period a hurricane can generate heat energy equal to 400 20-megaton hydrogen bombs and can circulate almost one trillion tons of air carrying 17 billion tons of water vapor. Cost of damages can exceed \$1 billion.

This booklet is the last and probably most important volume in a three-part series concerned with the destructive potential of tropical storms and hurricanes that affect the Texas coast. This volume, which provides information to aid coastal residents in saving lives, describes what federal, state, and local agencies do before, during, and after a hurricane. Since the key element in survival and recovery is *preparation*, each individual should plan to protect himself and his family and to minimize property damage. Actions that individuals should take when a hurricane threatens are listed. Perhaps the most important parts of this volume are personal checklists in Appendix II, which individuals are urged to use and to share with friends.

Volume I, which deals with description and climatology, presents facts and figures about frequencies of occurrence, storm tracks, and major physical features of hurricanes. Volume II, using as examples Texas' three most devastating hurricanes of the last 15 years, explains how hurricane damage is caused.

## II. ACKNOWLEDGMENTS

We extend our most sincere appreciation to Mr. Marion P. Bowden, State Coordinator of the Division of Disaster Emergency Services, Department of Public Safety, Austin, Texas, for his comments and assistance on the final draft of this booklet. We wish to thank Mr. J. A. Riley, Chief of the Meteorological Service Division, National Weather Service, Fort Worth, Texas, and Mr. Davis Benton, Meteorologist-in-Charge, Galveston, Texas, for information about functions of the local National Weather Service Offices. Thanks also are given to Dr. James R. Scoggins, Director of the Center for Applied Geosciences, Texas A&M University, for his continued guidance and support throughout this project. Also, we would like to acknowledge the help of Mr. Joseph Pelissier of the National Hurricane Center, who furnished background information, and Ms. Teena Conklin of the Texas Highway Department for assistance in obtaining many photographs used in this study. The State Office of the Soil Conservation Service, United States Department of Agriculture, Temple, Texas, was most cooperative in supplying information. Special thanks are extended to Ms. Polly Luther for her professional typing of the many drafts.



*Fig. 1. A National Guardsman stands watch at a roadblock in Corpus Christi as Hurricane Carla approaches, September 1961. (Photo courtesy of the Texas State Highway Department.)*

## III. TYPES OF HURRICANE DAMAGE

Great strides have been made in forecasting the paths of tropical storms and hurricanes. In fact, the 12-hour forecast error on landfall averages less than 40 nautical miles. Nevertheless, much remains to be learned from continuing research. One significant question to be answered is, "What type of destruction will a particular hurricane bring when it strikes the coast?" Will the damage occur through storm surge, high winds, tornadoes, heavy rainfall, or a combination of these? Discussed in more detail in Volume II, these terms are defined in the glossary (Appendix I) of this booklet.

When a hurricane is expected to strike the Texas coast, the point of landfall and maximum wind speeds are forecast. Sometimes unexpected changes take place in the hurricane's structure or movement within a short period of time. Hurricane Celia's explosive intensification just prior to landfall and Hurricane Beulah's recurvature to the southwest after hitting the coast are examples. The only way to prepare effectively for a hurricane is to consider all types of potential damage!

The storm surge, an abnormal rise in sea level accompanying a hurricane, is a hurricane's greatest killer. Averaged over the years, about nine of 10 people who died during hurricanes drowned due to the storm surge. Hurricane Carla's storm surge reached a maximum height of 21 feet and extended inland more than 10 miles in some

areas. Houses were floated off their foundations and were destroyed by continued wave action superimposed upon the waters of the storm surge. High winds, continual waves, and floating debris made swimming to safety almost impossible for people fleeing from their flooded homes. To obtain maps that show the areas covered by previous storm surges, see Appendix III.

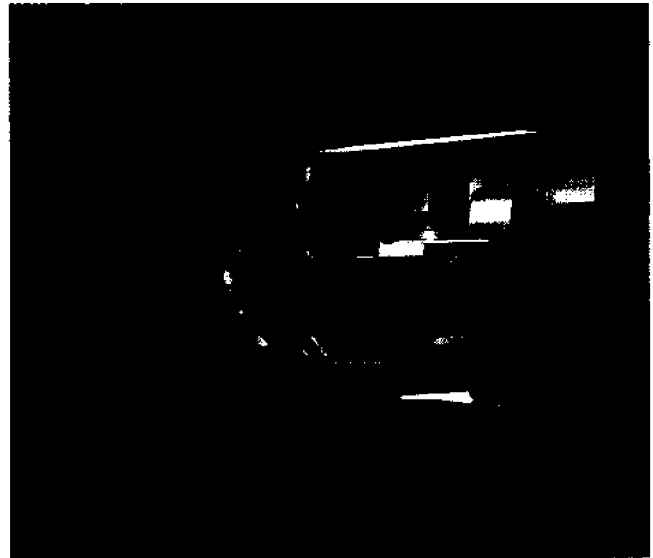
Another aspect of the storm surge, which is less common but more deadly, is the "seiche" (pronounced "sayche"). When the storm surge reaches land, it sometimes forms a series of fast-moving, steep wave fronts (higher than the average storm surge), which can inundate areas rapidly. Survivors have said that a seiche occurred at Galveston during the 1900 hurricane when an estimated 6,000-8,000 people died, and at Corpus Christi in 1919 when 300-600 people lost their lives. During the Great Galveston Hurricane of 1900, a weather observer, Dr. I. M. Cline, reported witnessing a seiche:

The water rose at a steady rate from 3:00 p.m. until about 7:30 p.m., when there was a sudden rise of about 4 feet in as many seconds. I was standing at my front door, which was partly open, watching the water which was flowing with great rapidity from east to west. The water at this time was about 8 inches deep in my residence and the sudden rise of 4 feet brought it above my waist before I could change my position.

The high winds of a hurricane or tropical storm are often strong enough to damage almost any structure. Short wind gusts (less than one minute in duration), which can exceed sustained wind velocities by 50 percent, develop a swinging action in signs, trees, and other bendable structures. Gusty winds cause extensive damage because of this rocking effect, alternately pushing a structure to its limit and allowing it to swing back before the cycle is repeated. Trees and signs are often uprooted or snapped.

Window glass is blown in on the windward side of buildings and out on the downwind side. A device has been developed that is said to protect windows (see Appendix III). Homeowners should board their windows to prevent damage by wind or flying debris. At hurricane speeds airborne debris become lethal projectiles--imagine a 4- x 8-foot sheet of tin roofing sailing through the air at these speeds!

Hurricanes often spawn tornadoes that can cause extensive damage. Smaller than its Great Plains cousin, the hurricane-spawned tornado usually affects an area less than 300 yards wide and a mile long; nevertheless, it is just as deadly. Two Texas hurricanes hold records for the highest number of associated tornadoes. Beulah had more than 100 tornadoes (actual count not known), and Carla is a poor second with 26. Generally, more than 90 percent of tornadoes are found within angles of 10 to 120 degrees to the right of the direction of hurricane movement and between 60 to 240 miles from the eye.



*Fig. 2. A Texas State Highway Department employe maintains radio communications by using an auxiliary generator in Corpus Christi during Hurricane Celia, August 1970. (Photo courtesy of the Texas State Highway Department.)*

Flooding, caused by heavy rains, usually extends farther inland than other types of damage. For example, Hurricane Agnes (1973) made landfall along the Florida coast but caused extensive flooding in Pennsylvania and New Jersey. Appendix IV in Volume II contains a short list of rivers inundated by Beulah (1967), a Texas hurricane that flooded over two million acres. Rainfall accounted for almost three-fourths of Beulah's flooding, and storm surge accounted for the remainder.

#### IV. HELP FROM NATIONAL AGENCIES

When a tropical disturbance is detected (usually by satellite), the National Hurricane Center (NHC) in Miami, Florida, swings into action. The disturbance is monitored continually, and bulletins are issued to the Hurricane Warning Service Network and the news media. Aircraft may fly into the cyclone to gather data and to evaluate the possibility of intensification. If the disturbance matures into a tropical storm, a feminine name is assigned. Appendix IV lists names for tropical storms and hurricanes from 1975 through 1984.

When the disturbance becomes a tropical storm, the NHC calls the hurricane warning system to full alert and issues public advisories. Advisories are numbered consecutively and are issued every six hours at 5 a.m., 11 a.m., 5 p.m., and 11 p.m. Central Daylight Time (CDT). They include information on location, direction, speed of movement, intensity, radius of storm and gale force winds,

and central pressure. When a tropical storm or hurricane approaches land, the Hurricane Warning Office (HWO) in that area issues local warnings. Generally, the HWO prepares advisories if the storm is moving through its area or may progress there within 12 hours. The advisories are issued simultaneously by the National Hurricane Center. Additionally, for the 1975 hurricane season the NHC will initiate the Hurricane Disaster-Potential Scale as an estimate of expected damage. Specifics of the scale are given in Appendix VI.

Meteorologists at the NHC and Hurricane Warning Offices (New Orleans, Washington, D.C., San Francisco, and Honolulu) forecast the movement, development, and storm surge heights of all tropical cyclones that may strike the United States. They also analyze tropical cyclones of the previous season to develop more accurate forecasting methods. In recent years the forecast accuracy for paths of tropical cyclones has increased more than 10 percent; the average 24-hour displacement error is now less than 100 nautical miles.

The National Weather Service Hurricane Warning Office in New Orleans issues hurricane warnings for the Texas coast. Advisories and bulletins (see Appendix I for definitions) issued by that office include:

- Hurricane watch or warning.
- Estimate of storm tide and flood danger in coastal areas.
- Cautionary advice to small craft.
- Gale warnings along the periphery of the cyclone.
- Tornado forecast information.



*Fig. 3. Hurricane Carla in September 1961 left floodwaters that hindered recovery operations. (Photo courtesy of the Texas State Highway Department.)*

Bulletins containing additional information about the tropical cyclone are issued at two-hour intervals, or more often if necessary, as long as the disturbance retains its identity or threatens life and property.

Local Weather Service Offices issue Local Action Statements at two- or three-hour intervals, or more frequently if conditions warrant, when tropical cyclones threaten the Texas coast. These statements, which amplify releases from the Hurricane Warning Office, specify:

- Coastal and bay areas or counties where warnings apply.
- Detailed recommendations for evacuation and suggested completion times.
- Places and times of storm surge, including times when critical roads or escape routes are expected to be flooded.
- Other emergency actions and the times for completion.
- Tide readings, wind conditions, rainfall measurements, and areas of possible flooding from excessive rainfall.

Weather Service Offices in the coastal region of Texas are located at Port Arthur, Galveston, Houston, Victoria, Corpus Christi, and Brownsville. These offices have direct communications with disaster preparedness officials and the media via telephone, teletype, and radio.

The U.S. Army Corps of Engineers also plays an important role in minimizing hurricane damage. The Corps has made extensive surveys of damage caused by past hurricanes. These surveys provide background information needed for construction of sea walls to reduce storm surge damage, and levees and improved drainage to minimize flooding by rivers. Some of these protective structures have been completed along the Texas coast.

The American Red Cross and the Salvation Army are two of the many agencies involved in natural disaster recovery operation. In cooperation with state and local officials, the Red Cross plans in advance to operate relief centers and shelters and to supply vital services, food, and clothing. The Salvation Army assists in solving individual and family problems.

## V. PLANS OF STATE AND LOCAL ORGANIZATIONS

At all levels of government, preparations for recovery from man-made and natural disasters are reflected in laws and emergency operating plans. The Texas Disaster Act of 1973, S. B. No. 786, provides state and local governments with the general authority for coordinating and implementing emergency actions when a hurricane threatens.

The state Emergency Operations Center (EOC) is located in the Department of Public Safety Building in Austin. The state Director of Defense and Disaster Relief activates the



*Fig. 4. A weary electric power line crewman takes a break during the recovery period from Hurricane Carla, September 1961, at Bay City. (Photo courtesy of the Texas State Highway Department.)*

Center whenever an actual or threatened disaster, such as a tropical cyclone, is reported. The EOC offers advice and dispatches needed materials to affected areas.

Most EOC assistance is in the form of manpower, i.e., members of the Department of Public Safety, the National Guard, and the State Highway Department. Heavy equipment also may be sent by the Center.

Cities and counties have local Emergency Operating Centers. Executive Order DB-8, dated October 1, 1973, states in part:

The Mayor of each incorporated town in this State will be recognized as the Municipal Disaster Coordinator/Director for his jurisdiction.

The County Judge of each county will be recognized as the County Disaster Coordinator/Director for the area of the county outside the corporate limits of the municipalities in the county.

The intent of Executive Order DB-8 is elaborated further on page 4 of *Disaster Planning—A Manual For Local Governments*.

In either case, these officials may appoint or select by court order or city ordinance a coordinator of disaster services to administer the local program. Such coordinator will be responsible to the county judge or mayor, as the case may be.

If a city and county concur in such an arrangement,

it is authorized under the Disaster Act of 1973 to have a joint disaster program and organization with one coordinator appointed and authorized by both the city and the county. Some of the outstanding disaster programs in the State are joint city-county efforts.

It is desirable for the county judge or his appointed disaster coordinator to appoint a disaster coordinator for each unincorporated town or community in the county. Many of the unincorporated towns in Texas have volunteer fire departments as one of the few organized community efforts for providing a community service and the local leadership might be found in such an organization.

The local EOC of a coastal community should have plans to deal with hurricane problems. These plans should include:

- Communication systems—local, state, and national.
- Methods of warning citizens.
- Dissemination of evacuation and shelter information.
- Operation of shelters in cooperation with the American Red Cross.
- Provisions for police and fire protection.
- Maintenance of public health systems.
- Operation of utilities.
- Plans adopted for the specific needs of the individual community.

During a disaster, local government assumes primary importance because it is the only authority in the affected area. At such times the local EOC has increased authority to take emergency actions, such as:

- Control movement of people.
- Control access to areas and enforce curfews.
- Control supply and rationing of food and supplies.
- Commandeer equipment and vehicles when necessary.
- Operate shelters in cooperation with the American Red Cross.
- Manage the situation as well as possible, suspending civil law if necessary.

## VI. PREPARATION BY CITIZENS

Ultimately, the responsibility for hurricane preparedness lies with you, the individual. When a storm is brewing in the Gulf, local officials are preparing for the emergency and cannot assist you with planning or background information. So know the dangers and be prepared for them before hurricane season begins.

First, determine if you are in a vulnerable area. What is the elevation of your home above sea level? How far are you from the coast? What is the maximum storm surge



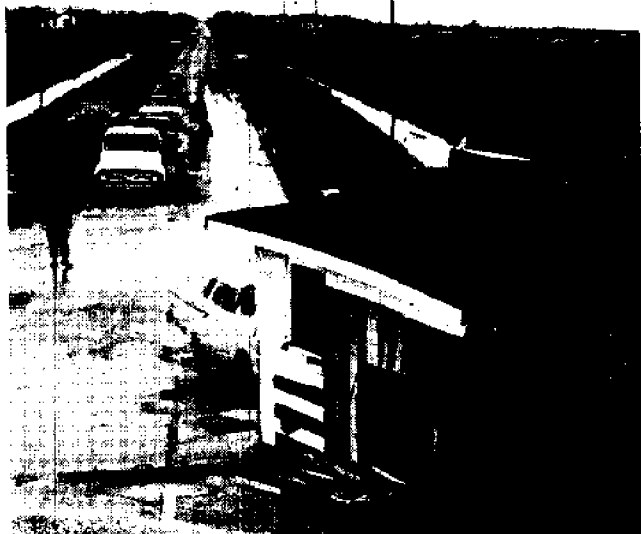
height that could occur in your area? Is your area susceptible to freshwater flooding? The elevation may be included on the construction plan or plat of your house. If you do not know, see Appendix III, Part 4, for instructions. If the elevation of your house is less than 25 feet above mean sea level and you are less than 20 miles from the coast, then you could be highly susceptible to flooding by the storm surge. The nearest National Weather Service Office has estimates of the highest potential storm surge for each point along the coast and the approximate extent of inland flooding. The Office also can supply flood stage information for streams and bayous.

Second, insure your house and possessions. Purchase insurance from a reputable company and request coverage for all types of hurricane damage. In the past, some policies did not cover damage caused by rising or windblown water.

Third, know what to do in and around your house to minimize damage. A few precautions can reduce your losses. Check where to go if you are forced to evacuate and know what to take with you. Local EOC officials can supply this information. Appendix II contains checklists and advice about preparing for a hurricane, remaining at home, and evacuating to safety.

## VII. ENDURING THE STORM

When the storm arrives with its fierce winds and driving rains, everyone must seek protection. If your planning has been thorough, there is not much to do except wait for the storm to pass.



*Fig. 5. National Guardsmen control the entrance into a disaster area at Palacios after Hurricane Carla, September 1961. These houses were floated onto the highway by high waters. (Photo courtesy of the Texas State Highway Department.)*

During passage of the storm, help may not be able to reach the stricken area. People in public shelters or private homes will have to care for themselves. Here are some precautions and suggestions:

- Someone should stay awake at all times to monitor radio broadcasts and serve as guard against fire, snakes, and other hazards.
- Keep a window partially open on the downwind side of the house to stabilize pressure inside the house. This will help reduce the risk of windows or doors being blown out due to large pressure differences caused by the storm.
- Remain inside until the storm passes; do not venture outside during passage of the eye except for necessary repairs that can be accomplished quickly. Remember, the calm winds associated with the eye seldom last more than 20 minutes.
- Several people should know where emergency supplies and equipment are stored.

## VIII. PICKING UP THE PIECES

While a hurricane is in progress, excitement, apprehension, fear, and thoughts of survival leave little time for despondency. After the hurricane passes, however, the extent of property damage can cause widespread shock.

Buildings may be leveled, and areas may remain flooded for days or weeks. Roads, bridges, and highways may be impassable. Communications, utility, and public sewage systems may be disrupted severely. Health hazards abound. Private wells and municipal waterworks can be contaminated, and drinking water may not be available. Without electricity for refrigeration, foods may be inedible.

United States Public Law 93-288 provides for immediate federal assistance to hurricane-damaged areas that have been declared a "major disaster area" by the President. This declaration is made at the request of the state Governor, who is advised by county EOC officials. The Federal Disaster Assistance Administration, in the Department of Housing and Urban Development, can allot federal funds for repairing property and minimizing health hazards, including removal of debris. Manpower supplied by the military services and heavy equipment such as bulldozers can be provided. The U.S. Corps of Engineers may be summoned if local resources are exhausted.

In cooperation with state and local health officials, federal food and drug teams survey the health situation in affected areas. Contaminated foods and drugs must be destroyed. The National Disaster Control Agency and the U.S. Public Health Service assess the danger of infectious diseases and possible epidemics. Drinking water is checked by laboratory tests, and vaccines are distributed to prevent typhoid, diphtheria, and other communicable diseases.

The U.S. Department of Agriculture, through service organizations and state welfare departments, provides surplus foods for families and emergency supplies for livestock feeding. The American Red Cross gives grants, based on need (not loss), to assist families during the disaster period. In addition, the Red Cross and the Texas Division of the Salvation Army distribute food and materials from mobile canteens during and immediately after hurricanes. Funds and other assistance also may come from charitable foundations, churches, clubs, and private citizens.

The Texas National Guard, the Texas State Guard, and units of the United States Army, Navy, Air Force, and Coast Guard may aid affected communities. After a severe storm, Guard units maintain civil order, direct traffic, establish roadblocks, provide manpower for transportation, and distribute food, clothing, and other supplies. Regular military units, which also assist in these tasks, are requested when authorities feel that local resources are inadequate.

Insurance companies usually send extra adjusters to a disaster area to help process insurance claims. Many insurance companies will make an advance payment on proof of loss of identified items without requiring final adjustment. This partial payment allows time to determine total loss and to make a suitable settlement under less hectic conditions.

The primary responsibility for recovery and rehabilitation of hurricane-stricken areas, however, lies with the

state governmental chain extending from the Governor through the Defense and Disaster Relief Council to local civil authorities. County-level agencies can request assistance from state and federal agencies when local resources are inadequate.

County or municipal organizations are expected to arrange for the disposition of dead animals, clearing of debris, and repair of water and sewage systems, roads, bridges, and public buildings. Local civil authorities help coordinate state, federal, private, and military efforts. Restoration of public utilities is handled by local repair crews, but utility companies outside the disaster area are called if needed. The record of these companies in quickly restoring such vital services as electricity, natural gas, and telephone lines is commendable.

## IX. IT'S YOUR RESPONSIBILITY!

Hurricanes and tropical storms will continue to hit the Texas coast, and each one is a potential killer. Even with increased standards of construction, some degree of damage must be expected. However, good planning and preparation are the surest means of reducing the number of casualties and the amount of property damage. State, federal, military, and civilian agencies or organizations will be able to provide help during natural disasters, but the ultimate responsibility for your survival and for your family's survival lies with *you*.

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## APPENDIX I: HURRICANE GLOSSARY

**Bulletin:** A public release from a Weather Service Hurricane Warning Office issued at times other than those when advisories are required. A bulletin is similar in form to an advisory but includes additional general newsworthy information.

**Cautionary Advice to Small Craft:** When a hurricane is within a few hundred miles of a coastline, small craft operators are warned to take precautions and to avoid entering the open sea.

**Cyclone:** A closed system of cyclonic (counterclockwise direction) circulation characterized by low pressure and inclement weather.

**Extreme Hurricane:** A tropical cyclone with maximum winds of 136 m.p.h. (118 knots) or higher and minimum central pressure of 28.00 inches Hg (711.20 mm Hg or 948.19 mb) or less.

**Eye:** The roughly circular area of comparatively light winds and fair weather at the center of a hurricane.

**Gale Warning:** A notice added to small craft advisories when winds of 38-55 m.p.h. are expected.

**Hurricane:** A tropical cyclone with sustained winds of 74 m.p.h. (64 knots) or greater.

**Hurricane Warning:** A warning that within 24 hours or less a specified coastal area may be subject to (a) sustained winds of 74 m.p.h. (64 knots) or higher and/or (b) dangerously high water or a combination of dangerously high water and exceptionally high waves, even though winds expected may be less than hurricane force.

**Hurricane Watch:** The first alert when a hurricane poses a possible, but as yet uncertain, threat to a certain

coastal area, or when a tropical storm threatens the watch area and has a 50-50 chance of intensifying into a hurricane. Small craft advisories are issued as part of a hurricane watch advisory.

**Land Subsidence:** The sinking of the land, caused mainly by the withdrawal of underground water from wells supplying cities and industries. This phenomenon may cause coastal areas to become more vulnerable to flooding.

**Local Action Statement:** A public release prepared by a Weather Service Office in or near a threatened area giving specific details for its area of responsibility on weather conditions, evacuation notices, and other precautions necessary to protect life and property.

**Major Hurricane:** A tropical cyclone with maximum winds of 101 m.p.h. to 135 m.p.h. (88 to 117 knots) and a minimum central pressure of 28.01 to 29.00 inches Hg (711.45 to 736.60 mm Hg or 948.53 to 982.05 mb).

**Seiche:** A series of fast-moving waves that sometimes are superimposed upon the storm surge. This phenomenon may cause total destruction and great loss of life.

**Storm Surge:** An abnormal rise in the level of the sea produced by the hurricane. This inundation is usually responsible for the greatest loss of life and destruction of property.

**Storm Warning:** A notice added to small craft advisories when winds of 56-73 m.p.h. are expected. Both gale and storm warnings indicate the coastal area to be affected and the expected intensity of the disturbance.

**Tornado:** A violently rotating column of air, nearly always observable as a funnel cloud.

**Tornado Forecast Information:** An advisory stating that conditions are such that tornadoes may occur.

**Tornado Warning:** An advisory stating that a tornado actually has been sighted by human eye or indicated by radar.

**Tropical Cyclone:** A general term for the nearly circular cyclones that originate over tropical oceans. It includes tropical depressions, tropical storms, and all types of hurricanes.

**Tropical Cyclone/Hurricane Advisories:** Messages issued simultaneously by the Hurricane Warning Offices and the National Hurricane Center in Miami every six hours

describing the storm, its position, anticipated movement, and prospective threat.

**Tropical Depression:** A tropical cyclone with sustained winds of less than 39 m.p.h. (34 knots).

**Tropical Storm:** A tropical cyclone with sustained winds of 39 to 73 m.p.h. (34 to 63 knots).

## APPENDIX II

Presented here are three hurricane-safety checklists for evaluating home safety, deciding whether or not to remain at home, and evacuating the area. Individuals are urged to use these checklists now, to review them periodically, and to share them with friends. Extra copies that may be torn out are included in the back of this booklet.

To keep these lists available, it is convenient to specify one location, such as the inside of a closet door, as the emergency center of the house. A framework can be installed to hold a first-aid kit, snake-bite kit, flashlight, candles, waterproof match box, and booklets on first aid, civil defense, tornado safety, and hurricane preparedness. A fire extinguisher is recommended. Emergency phone numbers should be listed on the door in large letters that can be read in poor light and without glasses.

### A. Checklist for Evaluating Home Hurricane Safety

YES/NO

- \_\_\_\_\_ 1. Is your home within 20 miles of the coast?
- \_\_\_\_\_ 2. Is your home less than 25 feet above mean sea level?
- \_\_\_\_\_ 3. Is your home in an area susceptible to flash floods or river system floods?
- \_\_\_\_\_ 4. Do you live in a mobile home within 50 miles of the coast? If your answer is "yes," plan to evacuate your home and proceed to the evaluation checklist.

If you have answered "yes" to any questions above, complete Checklist A. Then proceed to the checklist applicable to your plans for weathering a hurricane--remaining at home or evacuating the area.

- \_\_\_\_\_ 5. Is your insurance coverage suitable?
- \_\_\_\_\_ 6. Have you stored your valuable papers, jewelry, keepsakes, etc. in a bank vault or secure place that will be safe from storms, fires, or looters?

**B. Checklist for Remaining at Home during a Hurricane**

YES/NO

- \_\_\_\_\_ 1. Are you aware that mobile homes are more susceptible to damage by high winds than other types of housing? Your mobile home should be tied at all times. When a hurricane approaches, *leave* for more substantial shelter.
- \_\_\_\_\_ 2. If you own a boat, is it moored securely? Do not attempt to ride out a storm on your boat or to return to check its moorings after the storm has arrived. Small boats can be tied close to the house and filled with water to keep them from being blown away.
- \_\_\_\_\_ 3. Do you have a full tank of gasoline in your car? Authorities may advise you to evacuate if conditions worsen and your home is no longer safe. If electric power is off, filling stations may not be able to operate pumps for several days.
- \_\_\_\_\_ 4. Have you stored or secured outdoor objects that could be blown away or uprooted? Garbage cans, garden tools, awnings, TV antennas, signs, outdoor furniture, and toys can become lethal projectiles in hurricane-force winds.
- \_\_\_\_\_ 5. Are windows boarded or shutters in place? (Use good lumber and make sure it is fastened securely. Makeshift boarding or plywood may come apart when wet and do more damage than not having taken any precautions.)
- \_\_\_\_\_ 6. Do you have strong bracing for outside doors?
- \_\_\_\_\_ 7. Are flashlights and/or emergency lights working? Do you have extra batteries?
- \_\_\_\_\_ 8. Do you have a sufficient supply of drinking water on hand? Since city water service may be interrupted, you should sterilize the bathtub, jugs, bottles, pots and pans, then fill them with water. Water in the hot water tank may be used for drinking. A supply of water purification tablets is recommended.
- \_\_\_\_\_ 9. Have you stocked non-perishable food that does not need refrigeration and can be eaten without cooking or with little preparation? Remember that electric power may be off and you may be without refrigerator or

stove. For assistance, see Appendix VII.

- \_\_\_\_\_ 10. Do you have sufficient medication and prescription drugs?
- \_\_\_\_\_ 11. Do you have a portable radio in working condition so that you can listen to local stations for storm watches and warnings and for instructions from the local EOC?
- \_\_\_\_\_ 12. Do you have an axe and wrecking bar immediately available? If the house shifts or falls, these tools may be needed to open doors or to rescue trapped individuals.
- \_\_\_\_\_ 13. Have you moved furniture away from exposed windows and doors? Tape windows to reduce the possibility of flying glass.
- \_\_\_\_\_ 14. Do you know that it is *extremely* important to stay inside during the storm and not to go out during the lull while the eye is passing?
- \_\_\_\_\_ 15. Do you know how to shut off the main gas valve and to pull the main power switch if the house starts to flood? Flooding will extinguish pilot lights and gas may leak. High water can cause shorting of electric lines, which could start fires. It is unlikely that help will be available to control or extinguish fires.
- \_\_\_\_\_ 16. Are you aware of the dangers (flying debris) of opening a door or window on the windward side of the house? Exit on the downwind side if possible.
- \_\_\_\_\_ 17. Are you prepared to evacuate if required? Take only necessary clothing. (It is advisable to have a suitcase packed.) See Appendix III, Part 5.
- \_\_\_\_\_ 18. If you have to evacuate at the last minute, do you know which evacuation route to use? Keep up-to-date on the best route by listening to the radio in your area.
  - a. Use route \_\_\_\_\_ to \_\_\_\_\_.
  - b. Use route \_\_\_\_\_ to \_\_\_\_\_.
  - c. Use route \_\_\_\_\_ to \_\_\_\_\_.
- \_\_\_\_\_ 19. Do you have the location and telephone number of the nearest Red Cross shelter posted in your house? Information will be

given over radio concerning *available* shelters. Remember that the list may not include the shelter closest to your home.

a. Address \_\_\_\_\_ Phone \_\_\_\_\_

b. Address \_\_\_\_\_ Phone \_\_\_\_\_

c. Address \_\_\_\_\_ Phone \_\_\_\_\_

\_\_\_\_\_ 20. Do you know that downed electric power lines are *extremely* dangerous? Do not move or touch them.

### C. Checklist for Evacuating the Area

If you decide to evacuate, try to leave during daylight hours well in advance of the storm. Heavy rains and high winds usually precede the storm by six hours.

YES/NO

\_\_\_\_\_ 1. Have you tied down your mobile home?  
See Appendix VIII.

\_\_\_\_\_ 2. Is a car with a full tank of gasoline ready if needed? Walk to shelter when possible to help alleviate traffic congestion.

\_\_\_\_\_ 3. If you own a boat, is it moored securely?  
(Do not attempt to ride out a storm on your boat or to return to check its moorings after the storm arrives.) Small boats can be tied next to the house and filled with water to keep them from being blown away.

\_\_\_\_\_ 4. Have you stored or secured outdoor objects that might be blown away? Garbage cans, garden tools, awnings, TV antennas, signs, outdoor furniture, and toys can become lethal projectiles in hurricane-force winds.

\_\_\_\_\_ 5. Are windows boarded or shutters in place?  
Taping windows helps to reduce flying glass.

\_\_\_\_\_ 6. Do you have strong bracing for outside doors?

\_\_\_\_\_ 7. Have you moved furniture away from exposed windows and doors?

\_\_\_\_\_ 8. Do you have sufficient prescription drugs or medicines?

\_\_\_\_\_ 9. Have you taken only necessary clothing?

See Appendix III, Part 5.

\_\_\_\_\_ 10. Have you shut off the main gas valve and pulled the main power switch before leaving?

\_\_\_\_\_ 11. Do you know that downed electric power lines are extremely dangerous? Do not move or touch them.

\_\_\_\_\_ 12. Are you familiar with the best evacuation route to use?

a. Use route \_\_\_\_\_ to \_\_\_\_\_.

b. Use route \_\_\_\_\_ to \_\_\_\_\_.

c. Use route \_\_\_\_\_ to \_\_\_\_\_.

\_\_\_\_\_ 13. If you are marooned, do you know the location and telephone number of your nearest Civil Defense or Red Cross shelters?

a. Address \_\_\_\_\_ Phone \_\_\_\_\_

b. Address \_\_\_\_\_ Phone \_\_\_\_\_

c. Address \_\_\_\_\_ Phone \_\_\_\_\_

### APPENDIX III

General information that may be useful in preparing for a hurricane is presented here.

1. *Device for protecting windows.* Scientists at Texas A&M University have designed a protective device for windows. This 10-inch aluminum disc, when clamped onto windows with an aluminum bar, is said to enable windows to withstand winds up to 240 miles per hour. This device is better protection than boards or shutters and is easier to install. It is recommended for upper-story windows, which are affected less by flying debris. Ground-level windows should be boarded. For further information about this disc, write to Dr. John Reading, Physics Department, Texas A&M University, College Station, TX 77843

2. *Tiedown for mobile homes.* If you live in a mobile home, you should be prepared to evacuate. However, your mobile home should be tied throughout the year. A booklet entitled "Protecting Mobile Homes from High Winds" can be obtained from your local Civil Defense office or by writing the U.S. Army AG Publications Center, Civil Defense Branch, 2800 Eastern Blvd., Baltimore, MD 21220. Appendix VIII contains an excerpt from this booklet.

3. *Maps of areas covered by storm surges of previous hurricanes.* "Hurricane Awareness Program Materials" may be obtained from the Texas Coastal and Marine Council, P.O. Box 13407, Austin, TX 78711. Included in these materials are maps showing the extent of storm surge flooding from past hurricanes. Storm evacuation maps may be obtained from the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Survey, Distribution Division, C44, Riverdale, MD 20840. These maps, \$2 each, are large scale and cover a small area in great detail. Specify the location for the map requested. Maps are available at this time for the following areas:

Alvin	Beaumont	Galveston	Refugio
Anahuac	Corpus Christi	Houston	Rockport
Aransas Pass	Freeport	Port Arthur	Winnie

4. *Information on land elevation.* The local city engineer should be able to tell you the land elevation of an area. The engineering office in a Drainage District also has the information. The U.S. Department of Agriculture-Soil Conservation Service (USDA-SCS) can supply the information for rural as well as urban areas. There are SCS offices in the following cities:

Anahuac	Edna	Port Lavaca	San Benito
Angleton	Harlingen	Raymondville	Sinton
Bay City	Houston	Refugio	Victoria
Beaumont	Kountze	Robstown	Wharton
Edinburg	Liberty	Rosenberg	

5. *Possessions to take when evacuating.* A hurricane shelter will be the most suitable building in the area, such as a school, church, or courthouse. Rooms and halls will be lined with folding cots. Foods will be simple and rationed. Privacy will be minimal, and all refugees must help to maintain public health and sanitation. With *good humor* and *cooperation* everyone can endure, and many lasting friendships may begin under such conditions. Expect to remain in the shelter one to three days. When evacuating to a shelter, take:

- One change of durable clothing (heavy shoes, work clothes, etc.).
- Special medicine the family needs.
- Special food any family member requires.
- Special clothes for babies, especially disposable diapers.
- Extra eye glasses if needed.
- Minimal toilet articles.
- Paper towels, kleenex, etc.
- Bedding, if time and space permit.

Do not take:

- Alcoholic beverages.

- Firearms, other weapons, or fireworks.
- Family pets. (Do not leave pets tied or confined. However, if you do not wish to leave your pet to fend for itself, evacuate from the area and place the animal in commercial facilities.)

When evacuating to a known place (i.e., the home of a relative or friend), take:

- Medication the family requires.
- Extra eyeglasses if needed.
- Durable work clothes for returning to the disaster area to make house repairs.

When returning to the disaster area, leave young children and pets behind, if possible, until utilities and public services (drinking water, etc.) are restored and until home repairs and cleanup have been completed.

6. *Evacuation vehicle.* Take a vehicle in good mechanical condition since repairs and services may not be available. A larger car is preferable because it will drive through deeper water, will not be blown off the road as easily as a smaller car, and will carry more people and items. Do not overload, however. Water on the road may cause brakes to malfunction and the engine to stall. Traffic may be bumper-to-bumper so demonstrate your best driving skill and judgment on the evacuation trip. A motorcycle should be used only as a last resort.

## APPENDIX IV

Listed here are names of Atlantic hurricanes and tropical storms for the period 1975-1984. Each set of names is repeated every 10 years. In the event of an extremely damaging hurricane, that name is retired permanently and a new name is substituted.

1975--Amy, Blanche, Caroline, Doris, Eloise, Faye, Gladys, Hallie, Ingrid, Julia, Kitty, Lilly, Mabel, Niki, Opal, Peggy, Ruby, Sheila, Tilda, Vicky, Winnie.

1976--Anna, Belle, Candice, Dottie, Emmy, Frances, Gloria, Holly, Inga, Jill, Kay, Lillas, Maria, Nola, Orpha, Pamela, Ruth, Shirley, Trixie, Vilda, Wynne.

1977--Anita, Babe, Clara, Dorothy, Evelyn, Frieda, Grace, Hannah, Ida, Jodie, Kristina, Lois, Mary, Nora, Odel, Penny, Raquel, Sophia, Trudy, Virginia, Willene.

1978--Amelia, Bess, Cora, Debra, Ella, Flossie, Greta, Hope, Irma, Juliet, Kendra, Louise, Martha, Noreen, Ora, Paula, Rosalie, Susan, Tanya, Vanessa, Wanda.

1979--Angie, Barbara, Cindy, Dot, Eve, Franny, Gwyn, Hedda, Iris, Judy, Karen, Lana, Molly, Nita, Ophelia, Patty, Roberta, Sherry, Tess, Vesta, Wenda.

1980--Abby, Bertha, Candy, Dinah, Elsie, Felicia, Georgia, Hedy, Isabel, June, Kim, Lucy, Millie, Nina, Olive, Phyllis, Rosie, Suzy, Theda, Violet, Willette.

1981--Arlene, Beth, Chloe, Doria, Edith, Fern, Ginger, Heidi, Irene, Janice, Kristy, Laura, Margo, Nona, Orchid, Portia, Rachel, Sandra, Terese, Verna, Wallis.

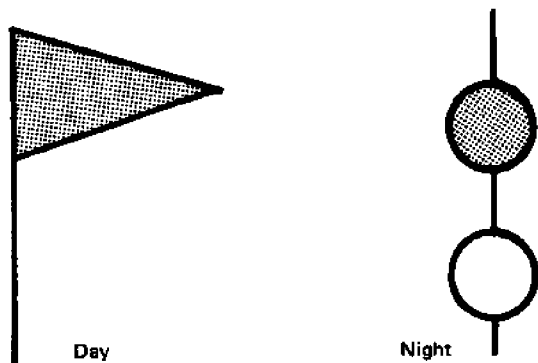
1982--Agnes, Betty, Carrie, Dawn, Edna, Felice, Gerda, Harriet, Illene, Jane, Kara, Lucile, Mae, Nadine, Odette, Polly, Rita, Sarah, Tina, Velma, Wendy.

1983--Alice, Brenda, Christine, Delia, Ellen, Fran, Gilda, Helen, Imogene, Joy, Kate, Loretta, Madge, Nancy, Ona, Patsy, Rose, Sally, Tam, Vera, Wilda.

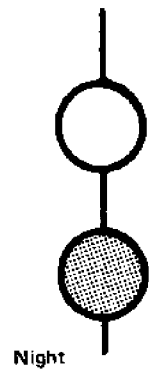
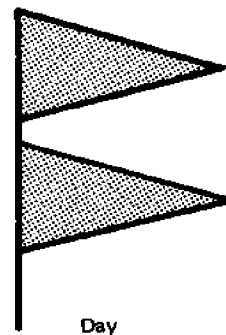
1984--Alma, Becky, Carmen, Dolly, Elaine, Fifi, Gertrude, Hester, Ivy, Justine, Kathy, Linda, Marsha, Nelly, Olga, Pearl, Roxanne, Sabrina, Thelma, Viola, Wilma.

## APPENDIX V

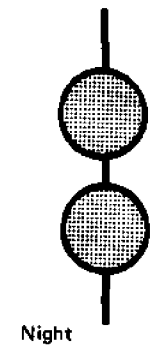
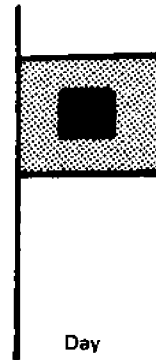
Colored pennants and lights are displayed in some ports and areas of the Texas coast to warn of hazardous sea conditions. Modern technology, however, has reduced the number of flag stations needed along the coast. Now emphasis is placed on continuous marine broadcasts transmitted at 162.55 MHz.



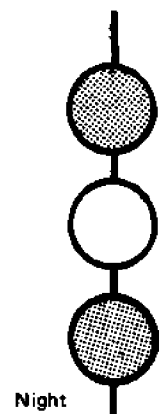
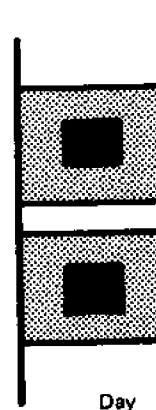
**Small Craft Advisory.** One RED pennant displayed by day and a RED light over a WHITE light at night to indicate the winds and seas, or sea conditions alone, considered dangerous to small craft operations are forecast. Winds may range as high as 38 m.p.h. (33 knots.)



**Gale Warning.** Two RED pennants displayed by day and a WHITE light above a RED light at night to indicate winds within the range 39 to 54 m.p.h. (34 to 47 knots) are forecast for the area.



**Storm Warning.** A single square RED flag with a BLACK center displayed during daytime and two RED lights at night to indicate winds within the range 55 to 73 m.p.h. (48 to 63 knots) are forecast for the area.



**Hurricane Warning.** Two square RED flags with BLACK center displayed during the day and WHITE light between two RED lights at night to indicate that winds 74 m.p.h. (64 knots) and above are forecast for that area.

## APPENDIX VI

The following excerpt is reprinted from *NOAA Magazine*, Volume 4, Number 3, July 1974.

### Hurricane Disaster-Potential Scale:\*

The hurricane disaster-potential scale is an experimental effort by the National Weather Service to give public safety officials a continuing assessment of the potential for wind and storm-surge damage from a hurricane after it reaches a point where it could be a threat to their coastal populations.

Scale numbers are made available to public-safety officials when a hurricane is within 72 hours of landfall.

Scale numbers range from 1 to 5--with Scale No. 1 having at least the threshold windspeed of a hurricane of 74 miles per hour, or a storm surge 4 to 5 feet above normal water level--and Scale No. 5 having a windspeed of 155 miles per hour or more, or a storm surge more than 18 feet above normal.

The Weather Service emphasizes that the disaster-potential numbers are not forecasts, but will be based on observed conditions at a given time in a hurricane's lifespan. They represent an estimate of what the storm would do to a coastal area if it were to strike without change in destructive power. Scale assessments will be revised regularly as new observations are made, and public-safety organizations will be continually advised of new estimates of the hurricane's disaster potential.

The Disaster-Potential Scale gives probable property damage and evacuation recommendations as follows:

**Scale No. 1**--Winds of 74 to 95 miles per hour. Damage primarily to shrubbery, trees, foliage and unanchored mobile homes. No real damage to other structures. Some damage to poorly constructed signs. **Or:** storm surge 4 to 5 feet above normal. Low-lying coastal roads inundated, minor pier damage, some small craft in exposed anchorages torn from moorings.

**Scale No. 2**--Winds of 96 to 110 miles per hour. Considerable damage to shrubbery and tree foliage, some trees blown down. Major damage to exposed mobile homes. Extensive damage to poorly constructed signs. Some damage to roofing materials of buildings; some window and door damage. No major damage to buildings. **Or:** storm surge 6 to 8 feet above normal. Coastal roads and low-lying escape routes inland cut by rising water 2 to 4 hours before arrival of hurricane center. Considerable damage to piers. Marinas flooded. Small craft in unprotected anchorages torn from moorings. Evacuation of some shoreline residences and low-lying island areas required.

**Scale No. 3**--Winds of 111 to 130 miles per hour. Foliage torn from trees, large trees blown down. Practically all poorly constructed signs blown down. Some damage to roofing materials of buildings; some window and door damage. Some structural damage to small buildings. Mobile homes destroyed. **Or:** storm surge 9 to 12 feet above normal. Serious flooding at coast and many smaller structures near coast destroyed; larger structures near coast damaged by battering waves and floating debris. Low-lying escape routes inland cut by rising water 3 to 5 hours before hurricane center arrives. Flat terrain 5 feet or less above sea level flooded inland 8 miles or more. Evacuation of low-lying residences within several blocks of shoreline possibly required.

**Scale No. 4**--Winds of 131 to 155 miles per hour. Shrubs and trees blown down, all signs down. Extensive damage to roofing materials, windows and doors. Complete failure of roofs on many small residences. Complete destruction of mobile homes. **Or:** storm surge 13 to 18 feet above normal. Flat terrain 10 feet or less above sea level flooded inland as far as 6 miles. Major damage to lower floors of structures near shore due to flooding and battering by waves and floating debris. Low-lying escape routes inland cut by rising water 3 to 5 hours before

### Definition of the Scale

Category	Central Pressure (millibars)	Winds (mph)	Surge (ft)	Example
1	> 980	74-95	4-5	Agnes 1972 (Fla. coast)
2	965-979	96-110	6-8	Cleo 1964
3	945-964	111-130	9-12	Betsy 1965
4	920-944	131-155	13-18	Donna 1960 Fla., Carla 1961 Tex.
5	< 920	> 155	> 18	1935 Storm on Fla. Keys

\*Developed by Herbert Saffir, Dade County consulting engineer, and Dr. Robert H. Simpson, former National Hurricane Center Director



hurricane center arrives. Major erosion of beaches. Massive evacuation of all residences within 500 yards of shore possibly required, and of single-story residences on low ground within 2 miles of shore.

**Scale No. 5—Winds greater than 155 miles per hour.** Shrubs and trees blown down, considerable damage to roofs of buildings; all signs down. Very severe and extensive damage to windows and doors. Complete failure of roofs on many residences and industrial buildings. Extensive shattering of glass in windows and doors. Some complete building failures. Small buildings overturned or blown away. Complete destruction of mobile homes. Or: storm surge greater than 18 feet above normal. Major damage to lower floors of all structures less than 15 feet above sea level within 500 yards of shore. Low-lying escape routes inland cut by rising water 3 to 5 hours before hurricane center arrives. Massive evacuation of residential areas on low ground within 5 to 10 miles of shore possibly required.

## APPENDIX VII

Food is an important item for survival and must be obtained before the disaster strikes. The food selected must meet several requirements, such as nourishment, taste, and easy preparation, perhaps without heat or refrigeration. One listing of a disaster diet has been published by the Government Printing Office. When ordering from the Public Documents Distribution Center, Pueblo, CO 81009, include the publication numbers from the following information:

*28J DISASTER DIET.* This folder describes a Disaster Diet Kit and tells how it should be designed to provide nourishment for a family isolated from normal food sources for several days by hurricanes, floods, winter storms, etc. 1974. 8 p. \$.25  
C 55.2:D 63/2 S/N 0317-00236

Another food list for disaster diets is being published by the Home Extension Service of Texas A&M University. Copies of this pamphlet will be available before the 1976 hurricane season and may be obtained at the county agent's office or by writing the Agricultural Extension Service, Texas A&M University, College Station, TX 77843.

## APPENDIX VIII

The following excerpt is taken from *Protecting Mobile Homes From High Winds*, a 1974 publication that includes detailed information about and drawings of piers and footings, ties, and anchors for mobile homes. Specify

publication TR-75 when ordering this booklet from your local Civil Defense office or from the U.S. Army AG Publications Center, Civil Defense Branch, 2800 Eastern Blvd, Baltimore, MD 21220.

## Tiedown Mobile Homes for Safety

Tiedowns offer the most consistent and effective means for minimizing mobile home damage from high winds. Two types of ties are needed: (1) the "over-the-top" tie, and (2) the frame tie. The first keeps the unit from overturning, and the second prevents it from being blown off the supports.

Frame ties can also reduce the chance of overturn, but many mobile homes do not have enough internal strength to transmit high wind loads to the supporting steel frame. Thus, installation solely of frame ties will secure the frame, but the unit resting on the frame may blow away. Therefore, the Defense Civil Preparedness Agency recommends use of both over-the-top ties and frame ties to secure 10-, 12-, and 14-ft.-wide mobile homes. Double units 24 ft. in width are quite stable, and do not require use of over-the-top ties—only frame ties.

Ties are made of wire rope or rust-resistant steel strap which "tie" the mobile home and its steel frame to anchors embedded in the ground. The cable or strap is secured to the anchor with a yoke-type fastener and tensioning device, or with clamps and turnbuckles.

Commercially available ties, consisting of galvanized steel strapping (1 ¼" x .035"), with a minimum breaking strength of more than 4,750 lb., or galvanized steel cable (7/32" 7x7, or ¼" 7 x 19), with a breaking strength of more than 4,800 lb., are acceptable.

The over-the-top tie is secured to an anchor on each side of the mobile home. Frame ties connect the steel beam supporting the unit to the anchors. Several of each type of tie, with connections and anchors, must be used for an effective tiedown of the whole unit.

Over-the-top ties should be located within 2 feet of each end of the mobile home, and others as needed at intervals between, at stud locations. Commercially available adapters or wood blocks should be used to prevent sharp bends in over-the-top ties, and to keep them from cutting into the unit when tension is applied.

Manufacturers of mobile homes increasingly are including concealed tiedown straps under the skin in new units. The homes are thus more attractive than when exposed tiedowns must be used. The concealed straps still must be secured to ground anchors, and frame ties must also be installed.

Tiedowns should be installed by ALL mobile home owners. If your unit is in a mobile home park and your neighbors don't tie theirs down, other units could be blown into yours in a severe storm.

## REFERENCES

- ESSA Technical Memorandum WBTM SR-50, A Reassessment of the Hurricane Prediction Problem.* U.S. Department of Commerce, Environmental Science Services Administration, Washington, D. C. February 1970.
- Disaster Planning--A Manual for Local Governments.* The State of Texas Department of Public Safety Division of Disaster Emergency Services, Austin, Texas. 1974.
- Grice, G. K. *An Investigation of the Tornadoes Associated with Hurricane Beulah.* Unpublished thesis. Texas A&M University, College Station, Texas. August 1968.
- Hope, J. R. and C. J. Neumann. *NOAA Technical Memorandum NWS SR-55, Digitized Atlantic Tropical Cyclone Tracks.* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Washington, D. C. July 1971.
- The Homeport Story: An Imaginary City Gets Ready for a Hurricane.* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Washington, D. C. 1971.
- Hurricane Awareness Briefings 1974.* Texas Coastal and Marine Council, P. O. Box 13407, Austin, Texas. 1974.
- Hurricane, The Greatest Storm on Earth.* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Washington, D. C. 1971.
- Hurricane Information and Atlantic Tracking Chart.* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Washington, D. C. 1971.
- Hurricane Safety Rules.* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Washington, D. C. 1970.
- Hurricanes.* WTVT Weather Service, Tampa, Florida. 1973.
- Neumann, C. J. *NOAA Technical Memorandum NWS SR-62, An Alternate to the Hurrant (Hurricane Analog) Tropical Cyclone Forecast System.* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Washington, D. C. January 1972.
- Neumann, C. J. et al. *NOAA Technical Memorandum NWS SR-63, A Statistical Method of Combining Synoptic and Empirical Tropical Cyclone Prediction Systems.* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Washington, D. C. May 1972.
- Neumann, C. J. and M. B. Lawrence. *NOAA Technical Memorandum NWS SR-69, Statistical-Dynamical Prediction of Tropical Cyclone Motion (NHC 73).* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Washington, D. C. April 1973.
- NOAA Technical Memorandum NWS TM SR-53, The Decision Process in Hurricane Forecasting.* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Washington, D. C. January 1971.
- Survival in a Hurricane.* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Washington, D. C. 1970.
- Tannehill, I. R. *Hurricanes.* Princeton University Press, Princeton, New Jersey. 1945.

