



Section I:

Understanding the Hazards

Satellite picture of Hurricane Andrew taken August 25, 1992



COURTESY OF NASA

Almost every state in the United States has been affected by extreme windstorms such as tornadoes and hurricanes. Virtually every state has been affected by a “considerable” tornado (see the terms in Table I.1). All Atlantic and Gulf of Mexico coastal areas in the United States – including coastal

areas of Puerto Rico and the U.S. Virgin Islands – and coastal areas of Hawaii have been affected by hurricanes. Even in states not normally considered to be susceptible to extreme windstorms there are areas that experience dangerous high winds. These areas are typically near mountain ranges, and include the Pacific Northwest coast.

What Is a Tornado?

Tornadoes are categorized by the Fujita scale (see Table I.1). They typically occur in the spring and summer months, but can occur at any time in any part of the country. Tornadoes are sometimes spawned by hurricanes.



COURTESY OF NOAA NATIONAL SEVERE STORMS LABORATORY (NSSL)

On May 26, 1981, a tornado moved through Dallas, Texas



Table I.1
Typical tornado
damage

Category / Typical Damage



F0 Light: Chimneys are damaged, tree branches are broken, shallow-rooted trees are toppled.



F1 Moderate: Roof surfaces are peeled off, windows are broken, some tree trunks are snapped, unanchored mobile homes are overturned, attached garages may be destroyed.



F2 Considerable: Roof structures are damaged, mobile homes are destroyed, debris becomes airborne (**missiles** are generated), large trees are snapped or uprooted.



F3 Severe: Roofs and some walls are torn from structures, some small buildings are destroyed, non-reinforced masonry buildings are destroyed, most trees in forest are uprooted.



F4 Devastating: Well-constructed houses are destroyed, some structures are lifted from foundations and blown some distance, cars are blown some distance, large debris becomes airborne.



F5 Incredible: Strong frame houses are lifted from foundations, reinforced concrete structures are damaged, automobile-sized missiles become airborne, trees are completely debarked.

F0, F1, AND F2 IMAGES COURTESY OF ANDREW DEVANAS, FLORIDA DIVISION OF EMERGENCY MANAGEMENT
F3, F4, AND F5 IMAGES COURTESY OF NOAA, NATIONAL SEVERE STORMS LABORATORY (NSSL)



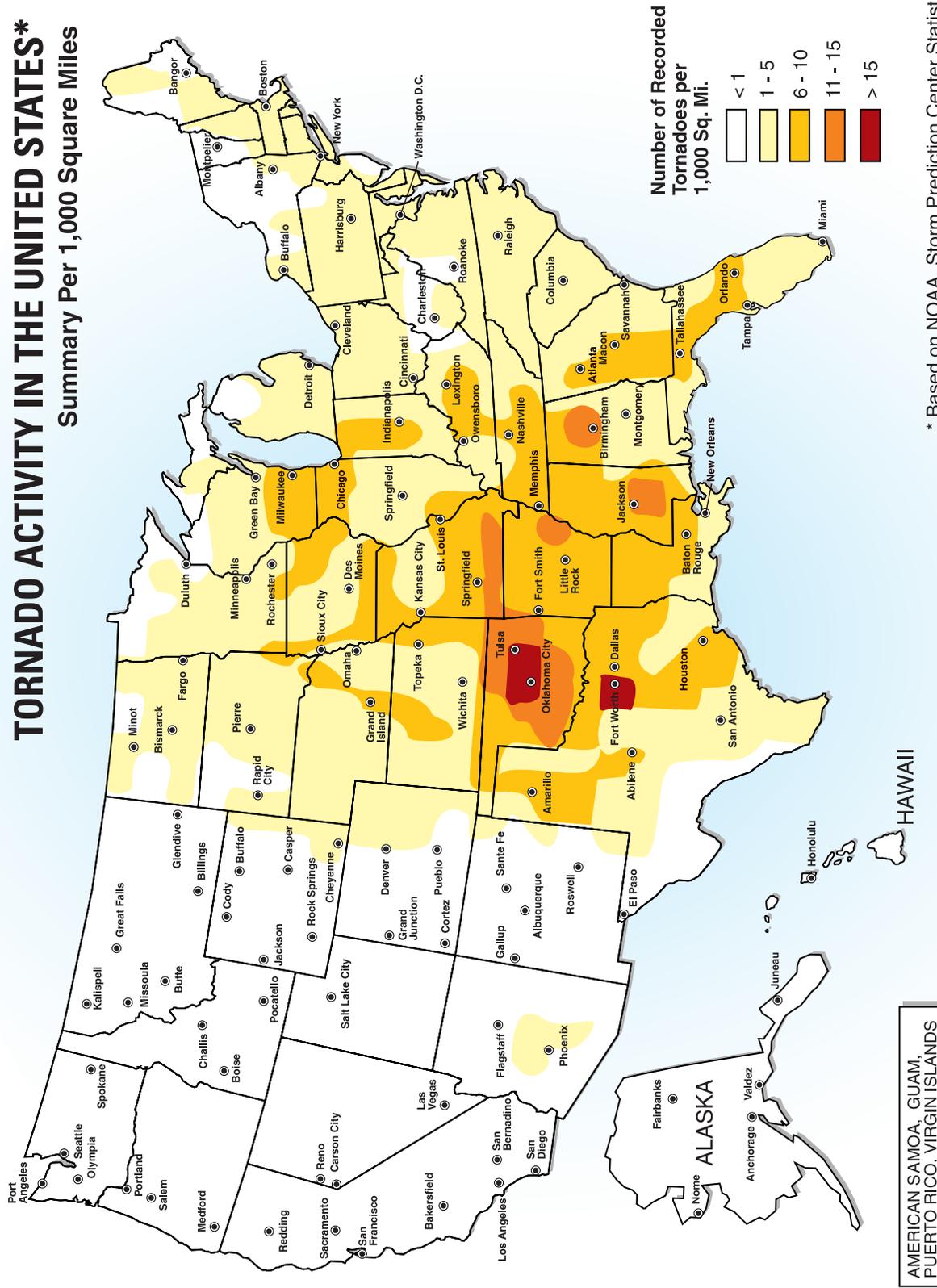
DEFINITION

In this guide, the term **missiles** refers to debris and other objects picked up by the wind and moved with enough force to damage and even penetrate windows, doors, walls, and other parts of a building. In general, the stronger the wind, the larger and heavier the missiles it can carry and the greater the risk of severe damage. But even small stones, branches, and other lighter missiles can easily break glass doors and windows.

Not all parts of each state are at equal risk from tornadoes. For example, while Texas has the highest number of recorded tornadoes, the state's least tornado-prone area—along the Gulf Coast—has been hit by fewer tornadoes than northeastern Arkansas. Comparing the numbers of tornadoes recorded in different areas within a state can give you a better understanding of the potential tornado activity in those areas. Figure I.1 shows the numbers of tornadoes recorded per 1,000 square miles in the United States and its possessions and territories.



TORNADO ACTIVITY IN THE UNITED STATES* Summary Per 1,000 Square Miles



* Based on NOAA, Storm Prediction Center Statistics

Figure I.1 The number of tornadoes recorded per 1,000 square miles



What Is a Hurricane?

Hurricanes are categorized by the Saffir-Simpson scale (see Table I.2).

Table I.2
Typical hurricane
damage

Category / Typical Damage



C1 Minimal: Damage is done primarily to shrubbery and trees, unanchored mobile homes are damaged, some signs are damaged, no real damage is done to structures.



C2 Moderate: Some trees are toppled, some roof coverings are damaged, major damage is done to mobile homes.



C3 Extensive: Large trees are toppled, some structural damage is done to roofs, mobile homes are destroyed, structural damage is done to small homes and utility buildings.



C4 Extreme: Extensive damage is done to roofs, windows, and doors; roof systems on small buildings completely fail; some curtain walls fail.



C5 Catastrophic: Roof damage is considerable and widespread, window and door damage is severe, there are extensive glass failures, some complete buildings fail.

C1, C2, C3, C4 IMAGES: FEMA
C5 IMAGE COURTESY OF NOAA, HISTORICAL DATA COLLECTION

In the United States, 158 hurricanes were recorded to have made landfall between 1900 and 1996. Hurricanes have made landfall in Florida more than in any other state. The second most hurricane-affected state is Texas, but every state on the Gulf Coast and bordering the Atlantic Ocean, as well as U.S. island possessions and territories, are susceptible to damage caused by hurricanes.

In recent years, the U.S. territories of American Samoa and Guam have been seriously affected by numerous tropical cyclones.



Do You Need a Shelter?

On the basis of 40 years of tornado history and more than 100 years of hurricane history, the United States has been divided into four zones that geographically reflect the number and strength of extreme windstorms. Figure I.2 shows these four zones. Zone IV has experienced the most and the strongest tornado activity. Zone III has experienced significant tornado activity and includes coastal areas that are susceptible to hurricanes.

To learn more about the wind history for the area where you live, check with your local building official, meteorologist, emergency management official, or television weather reporter.

Your house is probably built in accordance with local building codes that consider the effects of minimum, “code-approved” design winds in your area. Building codes require that buildings be able to withstand a “*design*” wind event. A tornado or extreme hurricane can cause winds much greater than those on which local code requirements are based. Having a house built to “code” does not mean that your house can withstand wind from any event, no matter how extreme. The shelter designs in this booklet provide a place to seek safe shelter during these extreme wind events.

The worksheet on pages 7 and 8 will help you determine your level of risk from these extreme events and will assist you in your consideration of a shelter. If you decide that you need a shelter, Section II will help you and your builder/contractor plan your shelter.



DEFINITION

In this guide, the term **storm surge** refers to the rise in the level of the ocean that results from the effects of wind and the drop in atmospheric pressure associated with hurricanes and other storms.



WARNING

A shelter designed to protect you and your family from a hurricane should not be built in an area expected to be flooded during a hurricane. Residents of these hazardous coastal areas should abide by the warnings of their local emergency services personnel and evacuate to safer ground. The protection from wind provided by safe rooms and shelters is quickly negated when stranded homeowners find themselves trapped by flood waters.

If you do not know whether your house is in a **storm surge** area or other area subject to flooding, check the community service section of your local phone book for storm surge evacuation information or ask your local emergency management or floodplain management official.



WIND ZONES IN THE UNITED STATES*

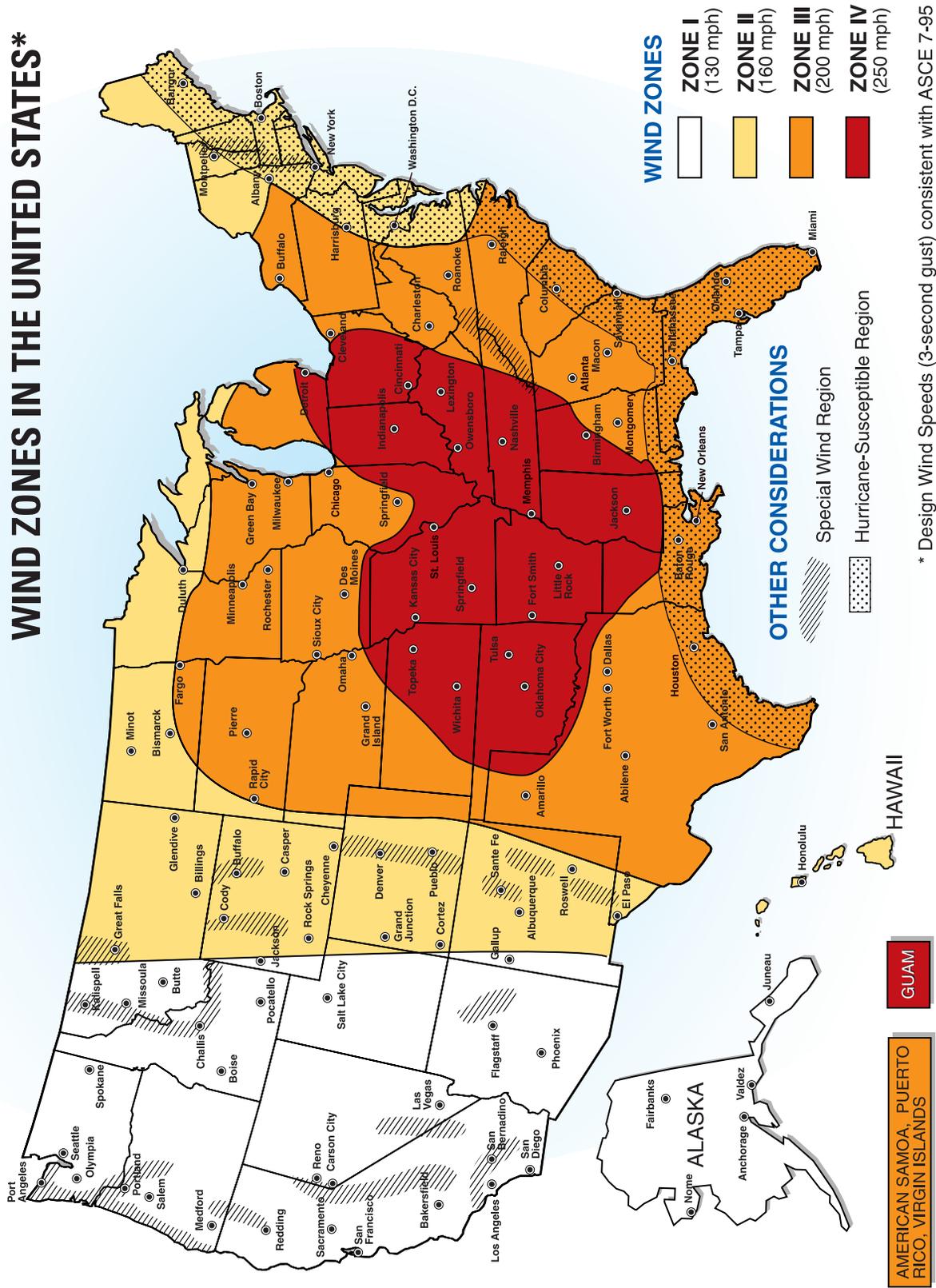


Figure 1.2 Wind zones in the United States