WHAT ARE FLOODS?

Causes of flooding include dam and levee failures. Dam failures may follow excessive rainfall or melted snow. Earthquakes can weaken or cause dams to collapse. Dam breaks occur more commonly than is often recognized and are a hazard that has been estimated to threaten more lives than nuclear reactor accidents. Only 6500 of the nearly 75,000 dams have safety Emergency Action Plans in effect. Examples of major dam breaks have been the Buffalo Creek, West Virginia, dam break in 1972, in which 11 people were killed and 3000 were left homeless; the Kelly Barnes Dam break in Georgia in 1977, which killed 37 people; and the damage to more than 230 dams in Georgia after Tropical Storm Alberto in 1994.

Volcanic eruptions that fill reservoirs with mud and debris, engineering or construction mistakes, inadequate maintenance, or a combination of any of these factors can also cause dam failure. Levees are most commonly weakened by burrowing animals and slippage. Regardless of the cause, when a dam or levee fails, huge quantities of water rush downstream with great destructive force.

Floods are one of the leading causes of death in natural disasters in the United States. Most commonly deaths have been associated with alcohol consumption and with persons trying to drive through floodwaters or flash floods.

Landslides are one of the major consequences of heavy rainfall and flooding. These occur most frequently in California, often following forest fires that have stripped the soil of vegetation and support. Earthquakes can also precipitate landslides. On average landslides result in about two federal disaster declarations each year. The average cost from landslides to the United States is $1 to $2 billion. Major landslides followed the 1964 earthquake in Alaska (60% of damage was due to landslides); the eruption of Mt. St. Helens in Washington (30% of damage was due to landslides); and extensive rainfall and storms in California in 1998. Table 7-1 shows the different types of landslides.

Table 7-1 Types of landslides

Type	Examples
Slides	Slides of soil or rock move downward along one or more failure surfaces
Flows	Flows are similar to slides but have a high water content; loose soil, rocks, and debris form a slurry that descends with great speed and destructive force
Lateral spreads	Can occur either very slowly in rocks or very rapidly in fine clay soils; in lateral spreads material is displaced laterally
Falls and topples	Falls occur when masses of rock or other material detach from a steep slope and fall; toppling occurs when the material falls forward

Types of floods

There are several functional definitions are important to understand because these are used for

floodplain prediction, for disaster declaration, and most important, for property owners to determine what their floodplain rating actually means to them so that they can take appropriate mitigation measures. Table 7-2 summarizes several ways to describe floods.

Table 7-2 Types of floods

Type	Description
Riverine	Flows over bank
Flash	Water rises and flows rapidly, often associated with the movement of lots of debris
Alluvial fans	Usually occur in dry areas that experience periodic flooding; rain causes the mountainside to slide, creating tracks for future movement of rocks and soil; very dangerous
Ice jams	Can cause floods upstream from the jam, but more frequently cause flooding as the ice jam is released and a large amount of water suddenly flows downstream
Dam breaks	Can be brought on by poor maintenance, faulty construction, earthquakes, or overfilling of a dam
Local drainage/ high groundwater	Ground becomes saturated after prolonged rains, snowmelt, and other hydrologic phenomena
Fluctuating lake levels	Levels rise after prolonged or short-term excessive rainfall, snowmelt, or other hydrologic phenomena

From Federal Emergency Management Agency: *Multi-hazard identification and risk assessment: a cornerstone of the national mitigation strategy,* Washington, DC, 1997, FEMA.

Flooding occurs in two ways: flash and cresting floods. Flash floods follow heavy rainfalls in low-lying and drainage areas and in areas where irrigation is not adequate. Flash flooding commonly occurs where rivers merge. Flash floods also occur after dam and levee failures. Flash floods often pose the greatest immediate threat to animals and people because they can be trapped and drown.

Cresting floods usually arrive with several days' or weeks' warning. Cresting floods often rise slowly, trapping animals on islands without feed and with a threat of drowning. Slow rising floods are a common problem in low-lying coastal areas, where overflowing rivers cannot drain into the sea. All flooding can result in displacement of livestock and other animals and their owners.

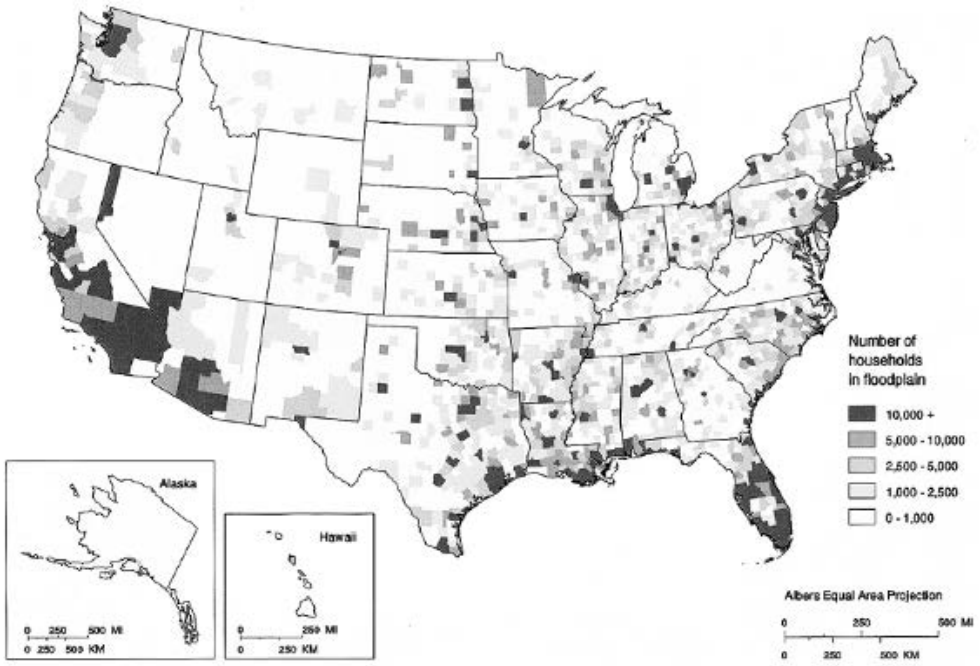

FIG. 7-1 Geographic distribution by county of households in the United States in 100-year floodplains. (From Federal Emergency Management Agency: *Multi-hazard identification and risk assessment: a cornerstone of the national mitigation strategy,* Washington, DC, 1997, FEMA.)

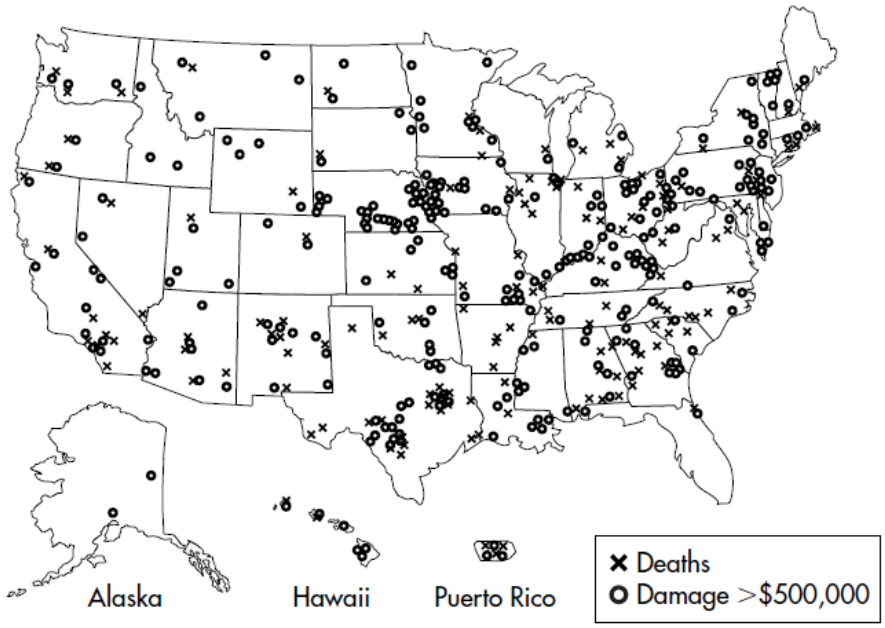

FIG. 7-2 Notable sites of floods and flash floods in the early 1990s. (From the National Weather Service.)

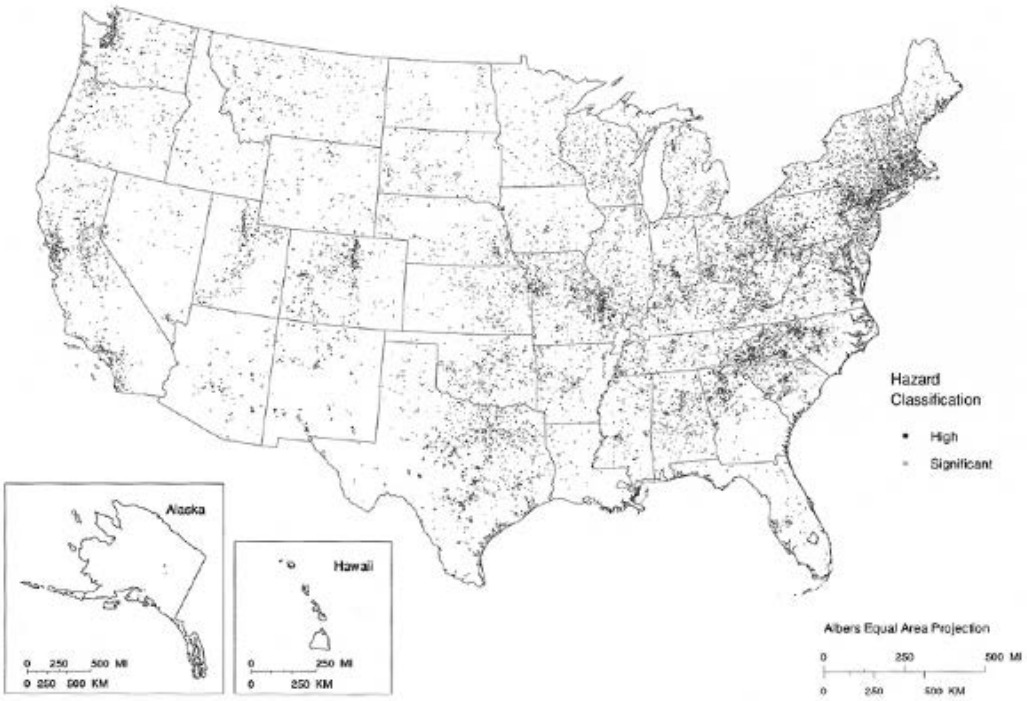

FIG. 7-3 Dams in the National Inventory of Dams classified as having high or significant hazard. (From Federal Emergency Management Agency: *Multi-hazard identification and risk assessment: a cornerstone of the national mitigation strategy,* Washington, DC, 1997, FEMA.)

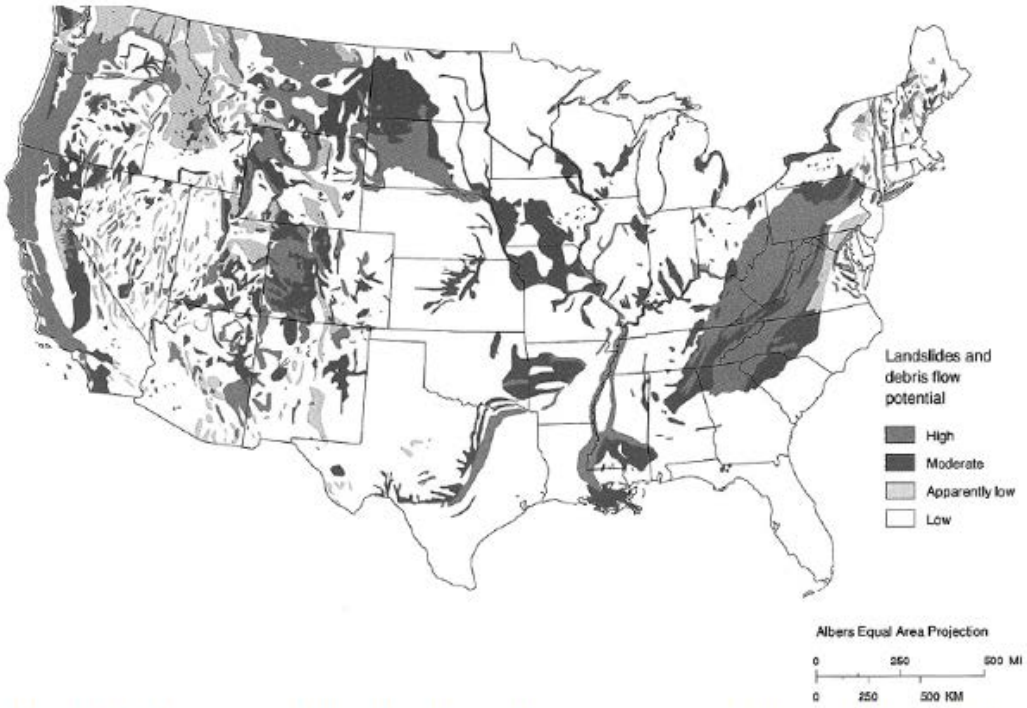

FIG. 7-4 Landslide potential based on adverse formations associated with past landslide activity. (From Federal Emergency Management Agency: *Multi-hazard identification and risk assessment: a cornerstone of the national mitigation strategy,* Washington, DC, 1997, FEMA.)

Government definitions

Floods are defined by the National Flood Insurance Program (NFIP) as occurring when a building is first touched by water associated with general flooding in the area. A general condition of flooding is defined as a general and temporary condition of partial or complete inundation of normally dry land from the overflow of inland or tidal waters or from the unusual and rapid accumulation or runoff of surface waters from any source. The Federal Emergency Management Agency (FEMA) recognizes a flood when one of two conditions has been met: two or more adjacent properties are affected or 2 or more acres on the same property is affected. Adjacent properties must have legally distinct ownership.

Base flood level

Determination of the "base flood level" is accomplished by measuring "discharge" of a river. Discharge is measured as water flow in cubic feet per second. The volume of water flowing in a river is measured at various sites and then calibrated for the cross-sectional area through which the river flows. There is a mathematical relationship between water flow and diameter of river, and therefore a "rating curve" can be constructed for each section of river. Once a rating curve has been calibrated for a particular section of river, simple measurement of water height or speed at predetermined sites is sufficient to determine the amount of discharge of a river.

Floodplains and predictions

Floodplains are determined by averaging recorded heights of rivers and using these values to extrapolate what the probability of a flood would be over the next 100 years. Therefore a

property in a 100-year floodplain has an average chance of flooding in any one year of 1 in 100. For example, this means a home located in a 100-year floodplain has a 30% chance (1 in 3) of being flooded in the time period of a 30-year mortgage. In comparison, the average probability for a house to be burned in a fire is only 1% in a 30-year period. These values are of course only averages and are based on predictions. They cannot take into account unusual events such as changes in global weather patterns or locally occurring flash floods, ice jams, and changes in the lay of the land.

For practical reasons, past data are used to predict future averages. This may or may not be appropriate, depending on whether the period in which the measurement was made is reflective of future periods. The accuracy of this method is judgmental, so owners of property in a floodplain should ask themselves whether the degree of safety expressed in probability (based on the last 30 years of weather) is really likely to predict the next 100 years of weather.

Notification of Pending Floods

Flood warnings are issued by the National Weather Service. Local police, the sheriff, the highway patrol, the county flood control district office, and other local agencies also may issue flood warnings.

Depending on the urgency of the threat of floods, warnings may be issued by sirens, horns, radio, television, or door-to-door canvassing by local emergency personnel. Federal agencies conduct stream flow monitoring to provide advanced warning of a flash flood.

Table 7-3 Announcements of pending floods

Public announcement	Meaning	Action required
Flash flood watch	Flash flooding is possible within the designated watch area	Listen to your radio for flood forecasts and prepare for evacuation with your animals
Flash flood warning	Flash flood has been reported or is imminent	Take necessary precautions immediately
Flood warning	Flood is imminent or is in progress at a certain location or in a certain river basin	Start to relocate animals that are in danger