2.0 Introduction to Retrofitting

Every year, flooding causes an average of over 90 percent of the disaster-related property damage in the United States and accounts for an average of over 75 percent of all Presidential Disaster Declarations. In fact, between 2003 and 2013, the NFIP paid an average of over $3.5 billion a year in flood claims. In 2012, the year of Hurricane Sandy, the NFIP paid over $8 billion in flood claims.

Although recent improvements in construction practices and regulations have made new homes less prone to flood damage, many existing homes continue to be repetitively damaged by flooding. In fact, repetitive loss records account for approximately 30 percent of all claim payments made in the history of the NFIP. Between 1978 and 2014, over 186,000 homes were flooded more than once. These homes alone accounted for approximately $15 billion in flood damages, subjecting the owners to a cycle of flooding and repairing.

The good news is that this cycle of repetitive flood damage can be broken. Homeowners across the country have protected their homes from flooding using the techniques described in this guide. One example can be found in New Orleans, where many residential neighborhoods were inundated by Hurricane Katrina in 2005 (Figures 2-1 and 2-2).

Figure 2-1. This home in New Orleans was inundated by 4 feet of water during Hurricane Katrina.

Figure 2-2. This home, from Figure 2-1, was elevated in a manner that added to both its appearance and its value. As a result of its elevation, the home avoided major damage from Hurricane Isaac in 2012.

One family decided to take action after their home flooded during Hurricane Katrina. They hired a contractor to elevate their home on concrete piers so that it would be above the level of future, similar floods (Figure 2-2).

At the outset of the project, the homeowners were concerned about how the home would look after it was elevated. But once construction was complete, their concerns were alleviated. Access to the front door is now provided by a well-designed double staircase that also serves as an architectural focal point. In addition to providing protection from future floods, elevating the home created a space below that could be used for parking and storage.

In other areas where flooding has caused repeated damage, entire homes have been relocated outside the flood hazard area or protected by floodwalls and levees designed as attractive landscaping features. As you read this guide, you will see that it is possible to protect your home from flooding while preserving or even enhancing its attractiveness and value.

NOTE

Any retrofitting project you undertake must meet the legal requirements of your community, including the floodplain management ordinances your community adopted to participate in the NFIP. By enforcing these ordinances, your community helps reduce future flood damages. As explained later in this chapter, the ordinances are based on the 1-percent-annual-chance flood, also referred to as the "base flood." Remember this term; you will encounter it many times as you read this guide. For more information, see Section 2.3.3.

2.1 What Is Retrofitting?

You may be wondering, "What is retrofitting and why is it necessary?" Retrofitting is making changes to an existing building to protect it from flooding or other hazards, such as high winds and earthquakes. You have already seen one example of retrofitting, and you'll learn about more in the following chapters.

Construction technologies, including both methods and materials, continue to improve, as does our knowledge of hazards and their effects on buildings. Many existing homes were built when little was known about where and how often floods and other hazardous events would occur or how buildings should be protected. As a result, retrofitting has become a necessary and important tool in **hazard mitigation**.

DEFINITION

Hazard mitigation is sustained action taken to reduce or eliminate long-term risk to people and property from hazards such as floods, hurricanes, earthquakes, and fires.

In addition to any retrofit completed on your home, updated Flood Insurance Rate Maps (FIRMs) and new legislation may have implications for your insurance premiums. Before making any changes to your home, FEMA strongly recommends that you discuss retrofit options with your insurance agent and work closely with design professionals and State and local officials.

2.2 Types of Flooding

This guide focuses primarily on retrofitting for flood protection. If you decide to retrofit your home, you'll need to be aware of other potential hazards as well, such as high winds and earthquakes. They are discussed later, but first you must understand flooding—where and how it occurs, the nature of the threat it poses, and how it can affect your home.

Most of the flooding that occurs in the United States is either riverine or coastal flooding, although flooding also occurs around lakes and ponds, and in areas where storm drainage systems are not adequate. Riverine flooding, as its name implies, occurs when rivers and streams overflow their banks (Figure 2-3). Riverine floodwaters can move quite rapidly, as in a **flash flood**, or very slowly, as they often do where the land is gently sloping or flat. The primary causes of riverine flooding are rainfall and rapidly melting snow (and sometimes a combination of both). Water from rain and rapidly melting snow eventually finds its way into stream channels. When the amount of water being carried by a stream exceeds the capacity of the stream channel, it spreads out into the area along the stream, commonly referred to as the floodplain. Usually, the homes and other buildings at greatest risk from riverine flooding are those near the stream channel, where the depths and speed of floodwaters are often greatest.

DEFINITION

Flash flood: A flood caused by heavy or excessive rainfall in a short period of time, generally less than 6 hours. A flash flood rises and falls very quickly and is usually characterized by high flow velocities.

Figure 2-3. These homes in Gays Mills, WI, were inundated by riverine flooding during the Midwest floods of 2008.

Figure 2-4. The extreme impact of large, fast-moving waves, combined with the removal of supporting soil by erosion and scour, can have devastating effects on buildings exposed to coastal flooding. Hurricane Floyd destroyed this home along the coast of North Carolina in 1999.

Coastal flooding, which is caused by **storm surge** and **wave action**, primarily affects coastal areas, especially those along the beachfront, but it can also affect areas around bays and can back up along rivers and streams that empty into bays. Coastal flooding is most dangerous, and causes the most severe damage, where large waves are driven inland by the wind (Figure 2-4). These wind-driven waves occur primarily along the open coast, where they can destroy homes, wash away protective dunes, and erode the soil, often to the extent that the ground surface is lowered several feet. But they can also move inland where the land is flat and there are no large dunes or other obstacles to break them. In these areas, the level of damage can rival that along the open coast.

DEFINITION

Storm surge is the rise in the level of the ocean that results primarily from strong winds associated with hurricanes and other storms. Decreased atmospheric pressure from these storms also makes a small contribution to storm surge.

Coastal flooding can also move inland into low-lying areas beyond the limit of wave action. The danger in these areas is primarily from inundation due to storm surge but, even here, fast-moving floodwaters can result in **scour** and **erosion** around building foundations.

Another cause of flooding, which can affect homes outside identified floodplains, is the limited capacity of local drainage systems, including storm sewers, culverts, and drainage ditches. These systems are usually designed to carry a specific amount of water, which is referred to as the "design capacity" of the system. When heavy rainfall over an area causes the design capacity of the system to be exceeded, water will begin to back up and fill low-lying areas near system inlets and along open ditches. Depending on the amount and **intensity of rainfall**, the floodwater may continue to rise and may eventually affect homes.

A similar problem occurs when drainage system inlets are plugged or obstructed by mud or other debris and when drainage system outlets are submerged by water during riverine or coastal floods. In the latter situation, water can flow backwards in the system and reach areas that otherwise might not have flooded.

DEFINITION

Wave action refers to the characteristics and effects of waves that move inland from an ocean, bay, or other large body of water. Large, fast-moving waves can cause extreme erosion and scour, and their impact on buildings can cause severe damage. During hurricanes and other high-wind events, storm surge and wind increase the destructiveness of waves and cause them to reach higher elevations and penetrate further inland.

Scour refers to a localized loss of soil, often around a foundation element.

Erosion refers to a general lowering of the ground surface over a wide area.

Intensity of rainfall refers to the amount of rain that falls during a given amount of time. It is usually expressed in inches of rainfall per hour. The higher the number of inches per hour, the greater the intensity.

2.3 How Flooding Can Damage Your Home

To understand how flooding can damage your home, you need to know about six important flood characteristics: depth/elevation, flow velocity, frequency, rates of rise and fall, duration, and debris impact. Most of these characteristics apply to both riverine and coastal flooding, and they can vary—sometimes greatly—from one place to another. The flood conditions at a particular site, such as the location of your home, are determined largely by the combination of these characteristics. The following paragraphs explain these characteristics. Section 2.3 and Chapter 4 explain how you can determine the flood conditions at your home.

DEFINITION

An elevation **datum** is an arbitrary surface that serves as a common reference for the elevations of points above or below it. Elevations are expressed in terms of feet, meters, or other units of measure and are identified as negative or positive, depending on whether they are above or below the datum. Three common elevation datums are mean sea level (msl), NGVD, and NAVD.

2.3.1 Depth/Elevation of Flooding

The depth and elevation of flooding are so closely related that, for the purposes of this discussion, they can be viewed as a single characteristic. Flood depth is the height of the floodwater above the surface of the ground or other feature at a specific point. Flood elevation is the height of the floodwater above an established reference **datum**. The standard datums used by

most Federal agencies and many State and local agencies are the National Geodetic Vertical Datum (NGVD) and the North American Vertical Datum (NAVD); however, other datums are also in use. The use of other datums is important because elevations of the ground, floodwaters, and other features cannot be meaningfully compared with one another unless they reference the same datum. If a survey has established a **benchmark**, this point can be used to determine the flood depth and elevation. When the elevation of the ground (or another surface such as the **lowest floor** of your home) and the elevation of the floodwaters both use the same datum or benchmark, the flood depth at any point is equal to the flood elevation at that point minus the elevation of the ground (or other surface) at that point. Figure 2-5 illustrates this relationship. Ground elevations are established by surveys; flood elevations may be calculated or they may be known from water marks left by past floods.

The depth of flooding at your home is important primarily because floodwaters, even when they are not moving, exert pressure on structural components such as walls and concrete floor slabs. The pressure exerted by still water is called "hydrostatic pressure." It is caused by the weight of the water, so it increases as the depth of the water increases. As shown in Figure 2-6, floodwater, including water that has saturated the soil under the home, pushes in on walls and up on floors. The upward force on floors is called "**buoyancy.**"

DEFINITION

A **benchmark** is a reference point established by a survey with a precisely known relationship to a datum.

Under the NFIP, the **lowest floor** of a building is the floor of the lowest enclosed area within the building, *including the basement*. The only exception is an enclosed area below an elevated building, but only when the enclosed area is used solely for parking, building access, or storage and is compliant with relevant regulations. The elevation of the lowest floor can be very important in retrofitting, as you will see in later chapters.

Buoyancy refers to the upward hydrostatic force that floodwater exerts on the floors of homes with enclosed spaces below the flood level.

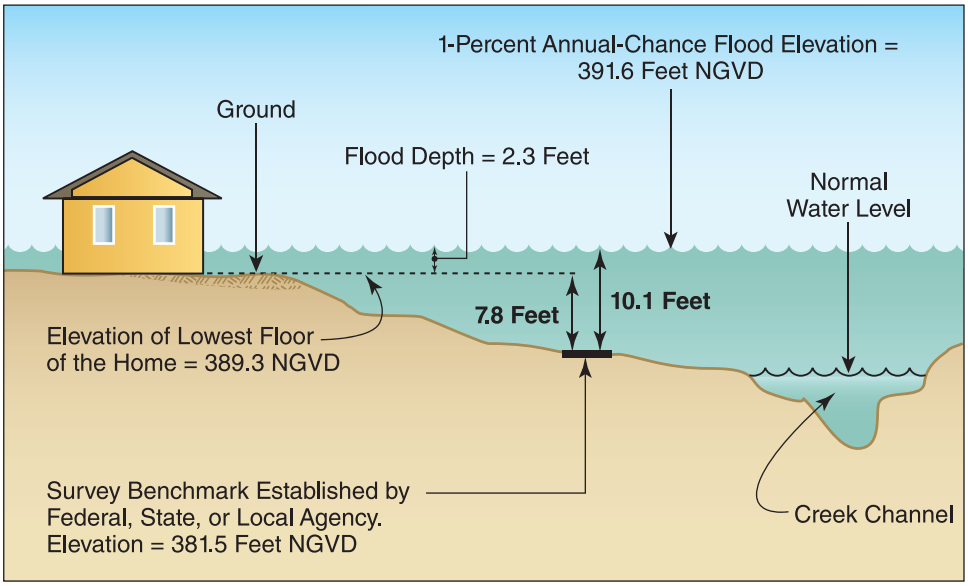

Figure 2-5. In this example, the 1-percent-annual-chance flood elevation is 391.6 feet (10.1 feet above the benchmark elevation of 381.5 feet), and the elevation of the lowest floor of the home is 389.3 feet (7.8 feet above the same benchmark). The flood depth above the lowest floor is therefore equal to 391.6 feet – 389.3 feet, or 2.3 feet during the 1-percent-annual-chance flood.

As shown in Figure 2-6b, water that has saturated the soil poses a special hazard for basement walls. Because hydrostatic pressure increases with the depth of the water, the pressure on **basement** walls is greater than the pressure on the walls of the upper floor, as indicated by the arrows in the figure. This pressure is made even greater by the weight of the saturated soil that surrounds the basement.

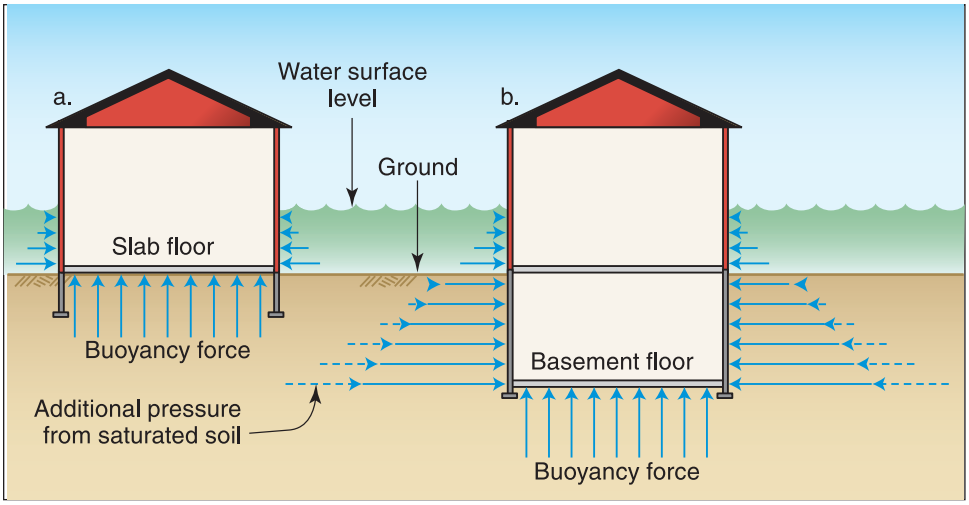

Figure 2-6. Hydrostatic pressure acts on walls and concrete slab floors. The weight of saturated soils adds to the pressure on basement walls. Figure 2-6a shows a home with a concrete slab floor. Figure 2-6b shows a home with a basement.

The walls of homes built using standard wood-frame or masonry construction are not designed to resist this pressure. If the pressure exceeds the strength of the walls (including basement walls), it can push them in or out (Figure 2-7), cause extensive structural damage, and possibly cause the home to collapse. In some areas, the buoyant force of hydrostatic pressure on basement floors has pushed homes entirely out of the ground.

If water is allowed to enter, the hydrostatic pressures on both sides of the walls and floor become the same, or equalized (Figure 2-8), and the walls are much less likely to fail. As discussed in Chapters 3, 5, 7, and 8, this is an important consideration in some types of retrofitting methods.

DEFINITION

The NFIP regulations define a **basement** as "any area of the building having its floor subgrade on all sides." Note that the NFIP definition of basement does not include what is typically referred to as a "walkout-on-grade" basement, whose floor would be at or above the surface of the ground that touches the outside walls of the building on at least one side (see Section 3.1.2). This ground surface is referred to as the "adjacent grade."

Figure 2-7. The walls of this basement in Wisconsin failed because of the pressure exerted by water and saturated soil.

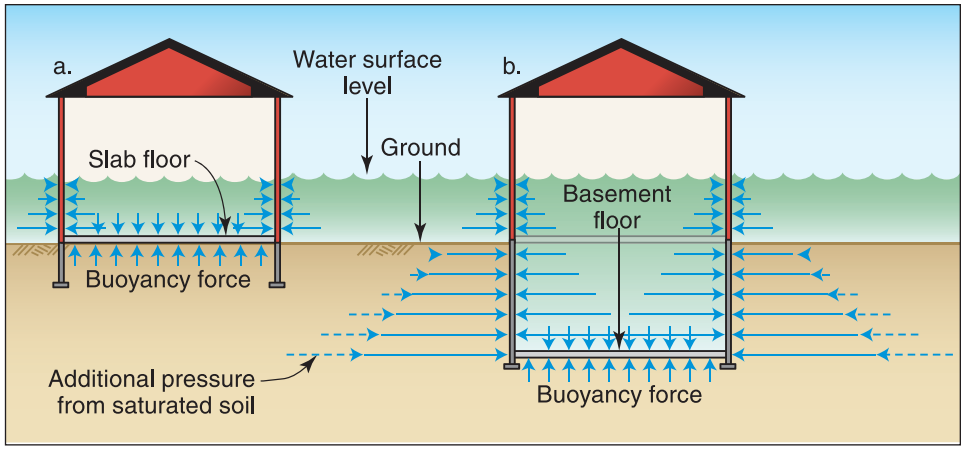

Figure 2-8. Once water enters the home, hydrostatic pressure is equalized. Figure 2-8a shows a home with a concrete slab floor. Figure 2-8b shows a home with a basement.

2.3.2 Flow Velocity

Flow velocity is the speed at which floodwaters move. It is usually measured in feet per second (fps). Flow velocities during riverine floods can easily reach 5 to 10 fps and, in some situations, may be even greater. Expressing velocities in fps is common in floodplain studies and engineering analyses. It may be helpful to relate fps to a more familiar unit of measure. For example, 10 fps is roughly equal to 7 miles per hour (mph).

The velocity of riverine floodwaters depends on a number of factors; one of the most important is the slope of the stream channel and floodplain. As you might expect, floodwaters will generally move much faster along streams in steep mountainous areas than streams in flatter areas. However, even within the same floodplain, flow velocity can still vary. As water flows over the ground, its velocity depends largely on the roughness of the ground surface. For example, water will flow more swiftly over parking lots, roads, and other paved surfaces, and will flow more slowly over ground covered with large rocks, trees, dense vegetation, or other obstacles. Also, flow velocities in the floodplain will usually be higher nearer the stream channel than at the outermost fringes of the floodplain, where water may flow very slowly or not at all. In areas subject to coastal flooding, velocities depend largely on the speed of the wind and, like riverine flow velocities, on the slope and roughness of the ground surface.

If your home is in an area where floodwaters are flowing, especially if they are moving more than about 5 fps, the flow velocity is important for several reasons. Flowing water pushes harder on the walls of a building than still water. So instead of just the hydrostatic pressure caused by the weight of the floodwater resting against the walls of your home, you have the additional pressure of moving water, referred to as "hydrodynamic pressure" (Figure 2-9). As water flows around your home, it pushes against the side of the home that faces the flow (the upstream side). As it flows past the sides of the home, it creates friction that can tear at wall coverings, such as siding. On the side of the home that faces away from the flow (the downstream side), the water creates a suction that pulls on walls. In some situations, the combination of these forces can destroy one or more walls (Figure 2-10), cause the home to shift on its foundation, or even sweep the home away.

Flowing water can also cause erosion and scour. As previously discussed, erosion refers to a general lowering of the ground surface over a wide area. Scour refers to a localized loss of soil, often around a foundation element. Both erosion and scour can weaken the structure of a home by removing supporting soil and undermining the foundation. In general, the extent and depth of erosion and scour increase as the flow velocity and size of the home increase. Also, keep in mind that any objects being carried by floodwaters will be moving at roughly the same speed as the water. The dangers associated with these objects are discussed in Section 2.3.6.

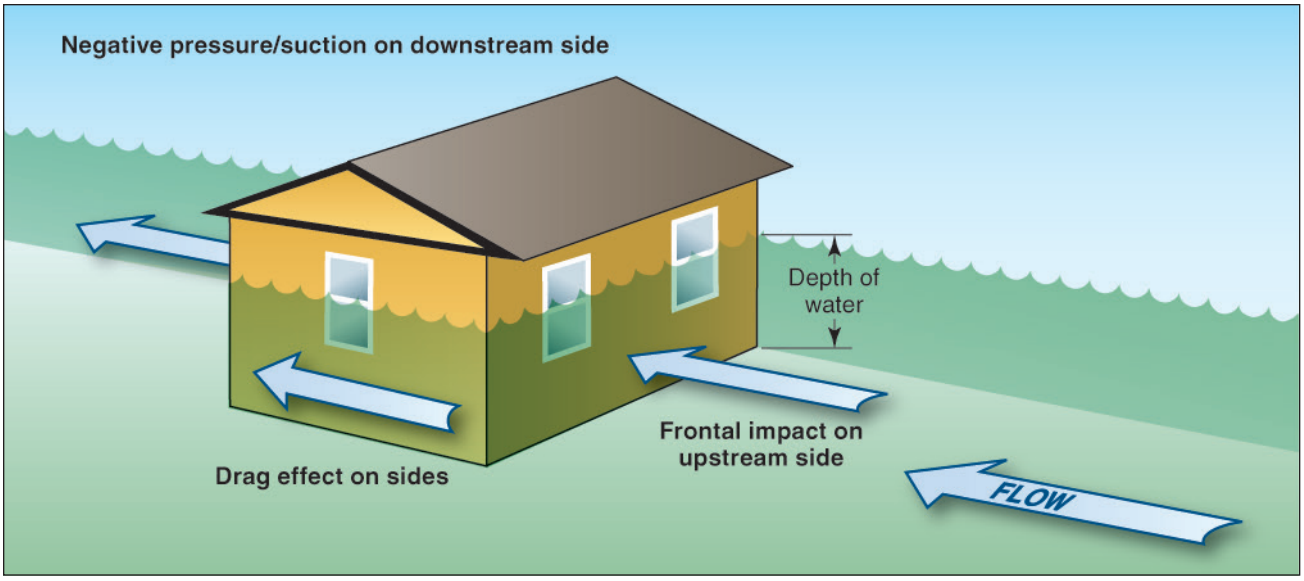

Figure 2-9. Moving water acts on the front, sides, and back of a home.

Figure 2-10. Water moving at high velocity destroyed the wall of this home and caused the building to shift on its foundation.

2.3.3 Flood Frequency

You may have been told that your home is in "the 100-year" floodplain, or you may have heard that term used to describe a specific flood. You may also have heard similar terms used, such as "50-year flood" or "500-year flood." These terms can be misleading. Flood frequencies are usually determined through statistics and engineering analyses performed by floodplain management agencies and other organizations responsible for implementation of flood control programs and floodplain regulation. The results of those analyses define the probability, expressed as a percentage, that a flood of a specific size on a specific stream will be *equaled or exceeded* in any year.

For example, the flood that has a 1 percent probability (1 in 100) of being equaled or exceeded in any year is sometimes referred to as the 100-year flood. This term is simply a convenient way to express probability. It should not be interpreted to mean a flood that happens exactly once every 100 years. Nor does it imply that once a

100-year flood occurs there is little risk of another 100-year flood occurring in the near future. To the contrary, changes in climatic conditions, such as those caused by El Niño, often result in clusters of floods that occur over relatively short times at the same location. In this publication, the term 1-percent-annual-chance flood is used to describe the 100-year flood.

For most homeowners, the value of these terms is that they indicate relative frequencies and sizes. Over time, a 1-percent-annual-chance (100-year) flood is expected to occur less often than a 2-percent-annual-chance (50-year) flood and more often than a 0.2-percent-annual-chance (500-year) flood. In addition, a 1-percent-annual-chance flood will be more severe than a 2-percent-annual-chance flood and less severe than a 0.2-percent-annual-chance flood. For example, if your home is in the 1-percent-annual-chance floodplain of a nearby stream or river, the 1-percent-annual-chance flood elevation at your home will be lower than the 0.2-percent-annual-chance flood elevation, and the water from a 2-percent-annual-chance flood might not even reach your home.

The 1-percent-annual-chance flood is particularly important for homeowners because it is the basis of NFIP flood insurance rates and regulatory floodplain management requirements. These requirements are discussed in detail in Section 2.5. In the NFIP, the 1-percent-annual-chance flood is referred to as the "base flood." The elevation associated with the base flood is referred to as the "base flood elevation" (BFE), and the floodplain associated with the base flood is referred to as the "special flood hazard area" (SFHA). Other Federal agencies, such as the U.S. Army Corps of Engineers (USACE), use the 1-percent-annual-chance flood for planning and engineering design, as do many State and local agencies. These agencies often have their own names for the 1-percent-annual-chance flood.

2.3.4 Rates of Rise and Fall

You may not have heard these terms before, but they describe important characteristics of flooding: how rapidly the elevation (and therefore the depth) of water increases and decreases during a flood. These rates are usually expressed in terms of feet or inches per hour. Floodwaters with high flow velocities, such as those in areas of steep terrain, and water released by the failure of a dam or levee, usually rise and fall more rapidly than slower-moving floodwaters, such as those in more gently sloping floodplains.

Rate of rise is important because it affects how much warning you will have of an impending flood. For example, homeowners in the floodplains of large rivers like the Mississippi and Missouri may know days in advance that flooding is occurring upstream and will eventually reach their homes. But in the floodplains of streams with rapid rates of rise, homeowners may have only a few hours' notice of a coming flood or perhaps none at all. With adequate warning, you will be better prepared to take steps to protect yourself and your property. Warning time is particularly important for flood protection methods that depend on action you must take. Chapters 3, 4, 7, and 8 further discuss this issue.

Rates of rise and fall are important also because of their effect on hydrostatic pressure. As explained in the discussion of flood depth/elevation, hydrostatic pressure is most dangerous for a home when the internal and external pressures are not equalized. This situation occurs when the level of water inside the home is significantly higher or lower than the level outside. When floodwaters rise rapidly, water may not be able to flow into a home quickly enough for the level inside the home to rise as rapidly as the level outside. Conversely, when floodwaters fall rapidly, water that has filled a home may not be able to flow out quickly enough, and the level inside will be higher than the level outside. In either situation, the unequalized hydrostatic pressures can cause serious structural damage, possibly to the extent that the home collapses.

2.3.5 Duration

Duration is how long a flood lasts, or how long it takes for the creek, river, bay, or ocean to return to its normal level. As a homeowner, you may be more interested in how long floodwaters remain in or around your home or perhaps how long they block nearby streets. In many floodplains, duration is related to rates of rise and fall. Generally, water that rises and falls rapidly will recede more rapidly, and water that rises and falls slowly will recede more slowly. An example of this relationship is the extensive flooding that occurred in the broad, flat floodplains of the Midwest in 2008. In those areas, floodwaters rose slowly and remained high for many weeks or longer.

If your home is flooded, duration is important because it determines how long the structural members (such as the foundation, floor joists, and wall studs), interior finishes (such as drywall and paneling), service equipment (such as furnaces and hot water heaters), and building contents will be affected by floodwaters. Long periods of inundation are more likely to cause greater damage than short periods. Duration can also determine how long your home remains uninhabitable.

2.3.6 Debris Impact

Floodwaters can pick up and carry objects of all types—from small to large, from light to heavy—including trees, portions of flood-damaged buildings, automobiles, boats, storage tanks, mobile homes, and even entire homes. In cold climates, wintertime floods can also carry large pieces of ice. Dirt and other substances, such as oil, gasoline, sewage, and various chemicals, can also be carried by floodwaters. All of these types of debris add to the dangers of flooding. Even when flow velocity is relatively low, large objects carried by floodwaters can easily damage windows, doors, walls, and, more importantly, critical structural components of your home. As velocity increases, so does the danger of damage from debris. If floodwaters carrying large amounts of dirt or hazardous substances enter your home, damages may be greater. In addition, your cleanup costs are likely to be higher and your cleanup time longer.

As you read the remaining sections of this guide, keep these flood characteristics and their effects in mind. Section 2.3 and Chapter 4 explain how you can find out more about flooding in your area, including flood elevations near your home.

2.4 Other Hazards

Two more hazards you should be aware of are high winds (including hurricanes) and earthquakes. For homes in areas subject to these hazards, some retrofitting methods are more appropriate than others. Chapters 3 and 4 further discuss this issue. But, regardless of the method you choose, if your home is in a high-wind or earthquake hazard area, your design professional or contractor must ensure that all structural changes made can withstand not only the expected flood forces, but the expected forces of winds or earthquakes as well.

Wind is similar to flowing water in that it pushes against the side of the home that faces the wind and pulls on the side that faces away (Figure 2-11). Wind passing over a home can exert a lifting force on the home. The combination of push, pull, and lift acts on the home, including the foundation, and can result in extensive damage if the structural system and **building envelope** are not adequately designed and constructed.

DEFINITION

The **building envelope** is the entire exterior surface of a building (including walls, doors, and windows) that encloses or envelopes the space within.

The ability of the wind to damage a building is increased if the wind or windborne debris breaches the building envelope by breaking windows, collapsing doors, or puncturing walls. Once the envelope is breached, wind will enter the building and the pressure on the walls and roof will increase, as shown in Figure 2-11. Wind and flood forces can combine in different ways, depending on the directions of the wind and flood flow. When the wind and flood flow direction are the same, the load on the home is greater than the load from either wind or flood alone.

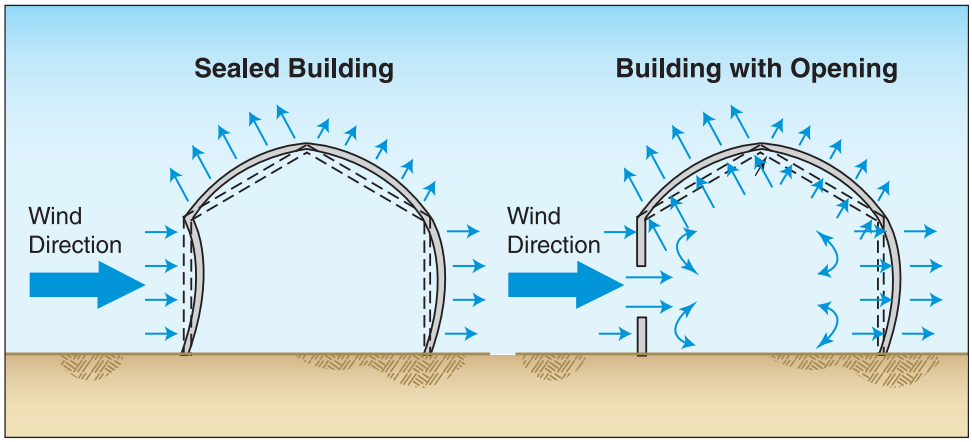

Figure 2-11. Wind forces on a sealed building are less than wind forces on a building with an opening.

The movement of the ground during an earthquake can place large horizontal and vertical loads on a home (Figure 2-12). Like the loads that result from flood flow and wind, earthquake loads can cause extensive damage to a home if they have not been accounted for in the structural design.

High-wind and earthquake hazards vary throughout the United States. In Chapter 4, you will find maps that show the areas where these hazards are greatest. For more information on retrofitting for wind refer to FEMA P-804, *Wind Retrofit Guide for Residential Buildings* (FEMA.2010c), and for more information on retrofitting for earthquakes refer to FEMA 232, *Homebuilders' Guide to Earthquake-Resistant Design and Construction* (FEMA. 2006).

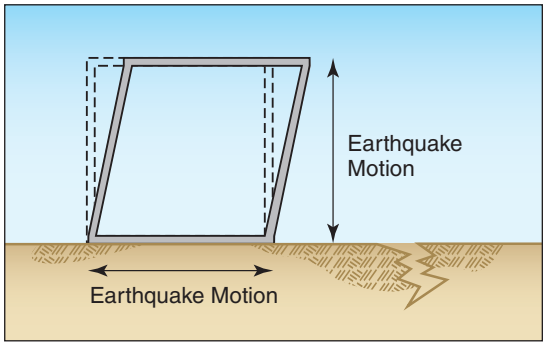

Figure 2-12. Earthquake forces act in both horizontal and vertical directions.

2.5 Federal, State, and Local Regulations

In most communities throughout the United States, construction in floodplains is governed by combinations of Federal, State, and local regulations; however, floodplain development can also be regulated wholly, or in part, by the International Codes (I-Codes). The I-Codes are a comprehensive, consensus-based set of model building codes that are often adopted at the State or local level. At the Federal level, FEMA administers the NFIP. Congress created the NFIP in 1968 when it passed the National Flood Insurance Act (NFIA). The NFIP is a voluntary program for communities. Its goal is to reduce the loss of life and the damage caused by flooding, to help the victims of floods, and to lower the costs of flood damage borne by the taxpayer. Communities participate in the NFIP in several ways:

- Guiding future development away from flood hazard areas
- Requiring that new buildings, **Substantially Improved** existing buildings, and repair of **Substantially Damaged** existing buildings in the SFHA be constructed in compliance with floodplain management ordinance, regulation, or provisions of the building code intended to reduce flood damage

- Providing floodplain residents with financial assistance after floods
- Transferring the cost of flood losses from the taxpayer to the owners of flood-prone buildings by requiring the purchase of flood insurance for buildings in the SFHA

The NFIP operates through a partnership between the Federal Government, the States, and individual communities such as counties and incorporated cities, towns, and villages.

A participating community adopts and enforces a floodplain management ordinance, regulation, or provisions of the building code to regulate development within that floodplain, including new construction, Substantial Improvement of existing buildings, and repair of Substantially Damaged buildings. In return, federally backed flood insurance is made available to property owners and renters who live in the community.

A participating community's floodplain management ordinance, regulation, or provisions of the building code must, at a minimum, meet the requirements of the NFIP regulations, but each community is free to establish additional or more stringent requirements to provide additional protection. For example, the regulatory floodplain defined by a community must include the entire SFHA, but it may also include other flood hazard areas within the community. Additionally, some States require communities to adopt and enforce floodplain management requirements that exceed the minimum requirements of the NFIP.

DEFINITION

Under the NFIP, an improvement of a building (such as reconstruction, rehabilitation, or an addition) is considered a **Substantial Improvement** if its cost equals or exceeds 50 percent of the market value of the building before the start of construction of the improvement.

Similarly, damage to a building, regardless of the cause, is considered **Substantial Damage** if the cost of restoring the building to its before-damage condition would equal or exceed 50 percent of the market value of the building before the damage occurred. Consult your local officials about determining the value of your home.

For more information, consult your local officials, or refer to FEMA P-758, *Substantial Improvement/Substantial Damage Desk Reference* (2010).

These points are particularly important because of their potential effect on your retrofitting project. In this guide, you will find many references to requirements included within your community's floodplain management ordinance, regulation, or provisions of the building code. These are the *minimum* requirements that all communities must adopt and enforce in their floodplain management ordinance, regulation, or provisions of the building code to be compliant with the NFIP regulations. Remember that you must comply with *your community's* requirements, which may be more stringent.

Usually, communities enforce other requirements that affect construction, both inside and outside of the regulatory floodplain. These requirements include those associated with building codes and land use regulations, such as zoning and subdivision ordinances.

2.5.1 The Community Rating System

The NFIP Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management actions that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reward community actions that meet the three goals of the CRS. The three goals of the CRS are to:

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

When communities participate in the CRS, flood insurance rates for insured property owners and renters are discounted in increments of 5 percent to a maximum discount of 45 percent, based on 18 creditable activities. The activities are organized under four categories:

- Public information (e.g., offering references on flood insurance and flood protection at the public library)
- Mapping and regulations (e.g., guaranteeing that a portion of currently vacant floodplain will be kept free from development)
- Flood damage reduction (e.g., acquiring, elevating, and/or relocating flood-prone buildings so that they are out of the floodplain)
- Flood preparedness (e.g., providing early flood warnings to the public)

To apply for CRS participation, a community submits documentation of its floodplain management activities to the Insurance Services Office, which works on behalf of FEMA and the insurance companies. Specific information about CRS and the application process can be found at the CRS online resource center at http://training.fema.gov/EMIWeb/CRS/.

2.5.2 Flood Insurance Rate Maps

To provide communities with the information they need to enact and enforce floodplain management ordinance, regulation, or provisions of the building code, FEMA conducts floodplain studies for communities throughout the United States and publishes the results in Flood Insurance Studies (FISs) and FIRMs (Figure 2-13). The FIS for your community provides information about the names and locations of flood sources; historical flood data; flood elevations of varying frequency, including BFEs; areas inundated by the various magnitudes of flooding; and boundaries of the SFHA and **floodway**. This information is presented on FIRMs, which are used by FEMA and local communities to establish flood insurance rates.

DEFINITION

The regulatory **floodway** is the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height (44 CFR §59.1).

More simply put, the floodway is the portion of the SFHA where new development is strictly regulated to prevent flood elevations from increasing. The flood hazard is usually greater in the floodway than in the surrounding areas of the SFHA, referred to as the "floodway fringe." Floodwaters in the floodway fringe are typically shallower and have less velocity.

NFIP regulations do not prohibit development in all portions of the SFHA. Instead, the regulations require that residential buildings in the SFHA be elevated to or above the community's BFE. But floodplain development can reduce the amount of space available to pass floodwaters, which can increase flood elevations. For this reason, the NFIP and local communities prohibit Substantial Improvement and new construction in the floodway.

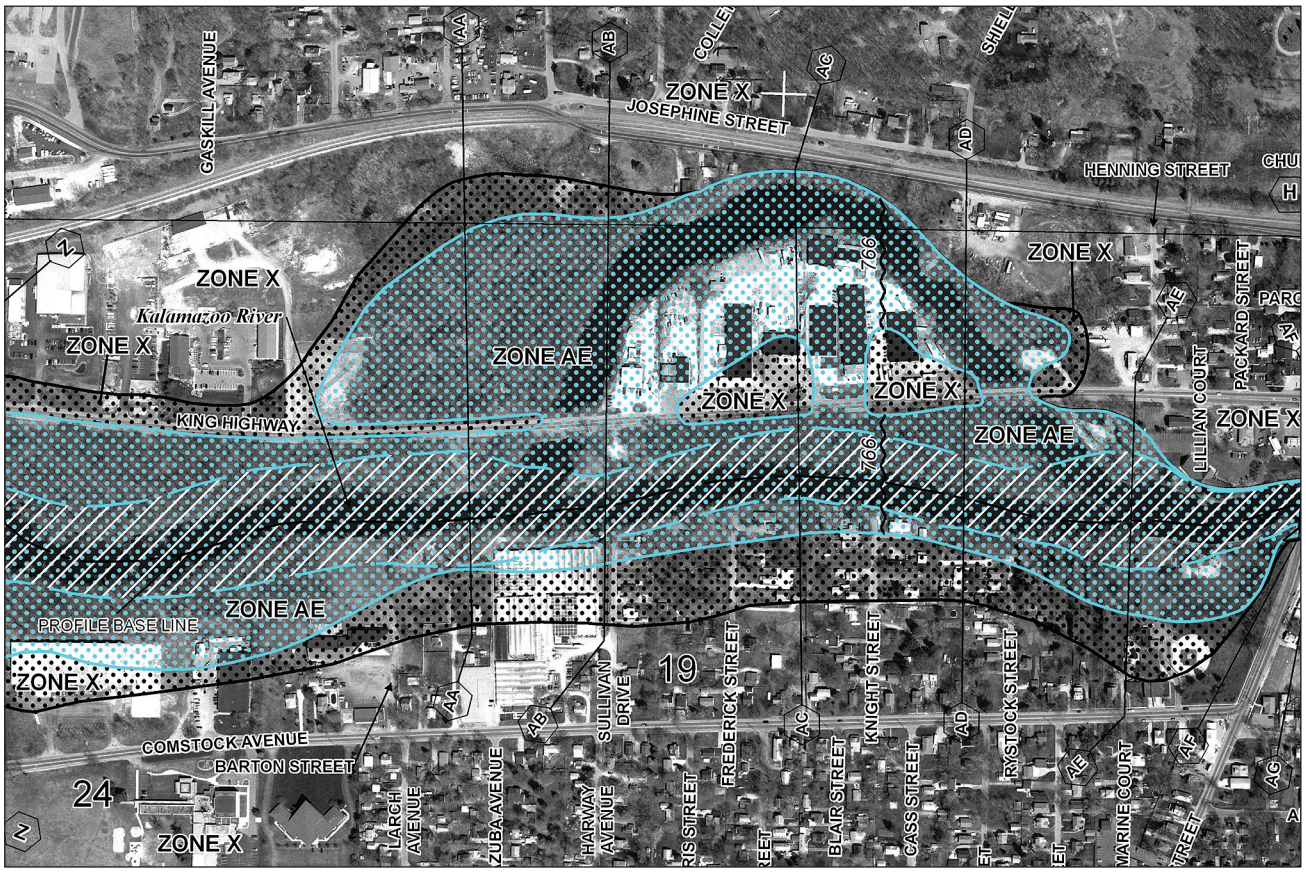

Figure 2-13. This FIRM for riverine flooding shows the SFHA (Zone AE), floodway (hatch-marked Zone AE along centerline of river channel), and areas outside the SFHA (Zone X). The area between the limits of the base flood and 0.2-percent-annual-chance flood are delineated by shaded Zone X. Areas above the 0.2-percent-annual-chance flood are delineated by unshaded Zone X.

FIRMs are available online at FEMA's Map Service Center (MSC): http://www.msc.fema.gov. The site allows you to search for your flood map in one of four ways:

- Searching for your address
- Using the catalog, which allows you to select your State, county, community, and flood map from a list
- Using a map search, which allows you to zoom into your community from a map of the United States
- Searching for a map panel by ID Number

Once you find your FIRM, you can create a printable FIRMette using the MSC Viewer. A FIRMette is a full-scale section of a FEMA FIRM that you create for yourself online. There is no cost for making a FIRMette. FIRMettes are used by many different parties such as community officials, mortgage lenders, real estate agents, design professionals, insurers, land developers, engineers, and surveyors.

The MSC Viewer allows you to zoom to the area you want to be included in your FIRMette and format your printable map. You can save your FIRMette either as an Adobe PDF file or as a TIFF file. The Map Service Center offers a step-by-step tutorial on creating FIRMettes.

Other Federal agencies, such as the USACE, U.S. Geological Survey, and Natural Resources Conservation Service (formerly U.S. Soil Conservation Service), also publish flood information, as do some State and local agencies. This information is often useful as a supplement to FISs and FIRMs. But, because it is developed to meet other needs, it is not used for the NFIP unless it has been reviewed and approved by FEMA.

If you have questions about flood hazards in your community, including the limits of the regulatory floodplain, flood elevations, or sizes and frequencies of past floods, check with your local officials. Usually, they will have copies of the FIS and FIRM for your community. They can also help you determine whether your home is in the regulatory floodplain and advise you about flood protection methods, including those described in this guide. Local officials can also advise you about floodplain management requirements, building codes, and other requirements that may determine the types of changes you can make to your home. See Chapter 4 for more information about working with local officials. You can also get help from your FEMA Regional Office (Appendix C) and the office of your NFIP State Coordinator (Appendix D).

2.6 Financial Assistance for Retrofitting

2.6.1 Federal Programs

FEMA and other Federal agencies have an array of financial assistance programs that assist States, communities, and individual property owners mitigate the negative effects of flood hazards. You may be eligible to receive financial assistance through one or more of these programs that will help pay for some of the retrofitting projects documented in this guide. Check with your local officials, the FEMA Regional Office for your State (Appendix C), your NFIP State Coordinator (Appendix D), or your State Historic Preservation Office (SHPO) (Appendix E).

If a Presidential Major Disaster Declaration has been issued for your area, you may want to seek information from FEMA and the State and local government representatives supporting the post-disaster recovery of your community. Keep in mind that funding for assistance programs is limited; often not everyone's needs can be met. Many Federal assistance programs provide grants to State and local governments, who must then set priorities for the use of the grant funds, including any potential use by individual property owners. Additionally, not all methods of retrofitting are eligible for funding.

NOTE

This section is not meant to be an all-inclusive description of Federal assistance. Following a Presidential Major Disaster Declaration, State and local officials will be briefed on the available types of post-disaster assistance.

Help from FEMA

Increased Cost of Compliance

One of the benefits provided by the NFIP is Increased Cost of Compliance (ICC) coverage. If your home is covered by a Standard Flood Insurance Policy (SFIP), is in an SFHA, and has been declared by your community to be Substantially Damaged or repetitively damaged by flood, ICC will help pay for certain types of retrofitting. ICC coverage is available for most SFIPs.

NOTE

If a flood in your area is a federally declared disaster, you must register with FEMA to obtain assistance. The directions at http://www.fema.gov will walk you through the application process.

If your home sustains a flood loss and the community has declared it Substantially Damaged or repetitively damaged, ICC will help pay the cost (up to $30,000 effective May, 2011) for the following retrofitting methods:

- Elevation: This raises your home to or above your community's adopted design flood elevation (DFE) (see Chapters 3 and 5).
- Relocation: This includes moving your home to another floodplain location on your lot and elevating it or moving it completely out of the regulatory floodplain (see Chapters 3 and 6).
- Demolition: This razes your home and restores the original property (see Chapters 3 and 6).

As noted earlier, your community's floodplain management ordinance, regulation, or provisions of the building code must include a requirement for Substantial Damage. Substantial Damage as defined in Section 2.5.

Some communities may have adopted a cumulative Substantial Damage or repetitive loss provision so that repetitively damaged buildings can qualify for an ICC claim payment. In order for buildings to qualify for a claim payment under ICC coverage as a "repetitive loss structure" the building must be covered by a contract for flood insurance and incur flood-related damages on two occasions during a 10-year period ending on the date of the event for which the second claim is made, in which the costs of repairing the flood damage, on the average, equaled or exceeded 25 percent of the market value of the building at the time of each such event. Note that ICC availability under this provision applies only if the community has adopted a cumulative Substantial Damage or repetitive loss provision in the floodplain management ordinance, regulation, or provisions of the building code. Also, note that under the NFIP, communities are not required to adopt a repetitive loss provision in their floodplain management ordinance, regulation, or provisions of the building code.

Remember, communities with a more restrictive floodplain management ordinance, regulation, or provisions of the building code may require a greater level of protection. If for example, your community requires new and Substantially Improved or Substantially Damaged buildings to be elevated 1 or more feet above the BFE, ICC allows for an ICC claim payment up to the $30,000 limit of coverage.

An ICC claim may also be paid for a combination of retrofitting actions. For example, ICC coverage allows for a claim payment for the cost of demolition and elevation at the same or another site within the SFHA. The ICC payment to demolish and elevate your home is limited to $30,000.

To learn more about ICC coverage, review your SFIP and contact your insurance agent, your community floodplain management official, the FEMA Regional Office that serves your community (Appendix C), or the office of your NFIP State Coordinator (Appendix D). If a Presidential Declaration of Major Disaster has been issued for your area, you can get help from the Mitigation and Insurance Desk at the local DRCs. In many cases, the ICC payments are used to offset the non-Federal cost-share to participate in a disaster assistance program.

Unified Hazard Mitigation Assistance Program

FEMA's Hazard Mitigation Assistance (HMA) grant programs present a critical opportunity to reduce the risk to individuals and property from natural hazards while simultaneously reducing reliance on Federal disaster funds. Hazard mitigation is the only phase of emergency management specifically dedicated to breaking the cycle of damage, reconstruction, and repeated damage. HMA programs provide pre- and post-disaster funding to States, Territories, Indian Tribal governments, local governments, and eligible private non-profits (PNPs) for activities that are consistent with the National Mitigation Framework's Long-term Vulnerability Reduction capability. Qualified private non-profits (PNPs) and *individual homeowners* are also eligible to receive HMA grant funds, but they must apply through a State agency or local government.

The statutory origins of each HMA program differ, but their goals are the same: reduce community vulnerability to disasters, promote individual and community safety and resilience, promote community vitality after an incident, and reduce response and recovery resource requirements in the wake of a disaster. Three grant programs are currently included in the Unified HMA program:

The **Hazard Mitigation Grant Program (HMGP)** is authorized by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended (the Stafford Act), Title 42, United States Code (U.S.C.) 5170c. The key purpose of HMGP is to ensure that the opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not lost during the reconstruction process following a disaster. HMGP is authorized by a Presidential Declaration of Major Disaster. A Governor may request HMGP funding be available throughout the State or only in specific jurisdictions. The amount of HMGP funding available to the Applicant is based upon the estimated total Federal assistance to be provided by FEMA for disaster recovery under the Presidential Declaration of Major Disaster.

The **Pre-Disaster Mitigation (PDM)** program is authorized by Section 203 of the Stafford Act, 42 U.S.C. 5133. The PDM program is designed to assist States, Territories, Indian Tribal governments, and local communities to implement a sustained pre-disaster natural hazard mitigation program to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on Federal funding from future disasters. PDM provides funds on an annual basis.

The **Flood Mitigation Assistance (FMA)** program is authorized by Section 1366 of the NFIA, 42 U.S.C. 4104c, with the goal of reducing or eliminating claims under the NFIP. FMA provides funds on an annual basis.

The National Flood Insurance Fund provides the funding for the FMA program. The PDM and FMA programs are subject to the availability of appropriation funding, as well as any program-specific directive or restriction made with respect to such funds.

Table 2-1 provides a summary of eligible retrofit activities for each of the three programs in the Unified HMA Program. More information about each program can be found on the FEMA HMA Web site at https://www.fema.gov/hazard-mitigation-assistance.

CROSS REFERENCE

The Repetitive Flood Claims (RFC) program and the Severe Repetitive Loss (SRL) program have been eliminated and significant changes have been made to the FMA program. For more information, refer to the *Unified Hazard Mitigation Assistance Guidance*.

Table 2 1. Eligible Retrofit Activities by Program

Elibigle Activities	HMGP	FMA
Acquisition/Demolition (for purposes of open space)	✔	✔
Relocation	✔	✔
Elevation	✔	✔
Dry Floodproofing (historic residential structures)	✔	✔
Mitigation Reconstruction		✔

Help from Other Federal Agencies

Several Federal agencies offer disaster assistance to communities and citizens. For a complete list of Federal assistance programs for which you are eligible, visit http://www.disasterassistance.gov.

Small Business Administration (SBA)

SBA provides low interest disaster loans to homeowners, renters, businesses of all sizes, and PNP organizations to repair or replace real estate, personal property, machinery and equipment, inventory, and business assets that have been damaged or destroyed in a declared disaster. Visit http://www.sba.gov/services/disasterassistance/ for more information.

U.S. Department of Housing and Urban Development (HUD)

HUD provides flexible grants to help cities, counties, and States recover from Presidentially Declared Major Disasters, especially in low-income areas, subject to availability of supplemental appropriations. Visit http://www.hud.gov/ for more information.

U.S. Army Corps of Engineers (USACE)

The USACE has the statutory authority to participate in flood protection projects that may include residential retrofitting (including elevating flood-prone homes and acquiring badly damaged flood-prone homes). Contact the appropriate USACE Division office for further information. You can find more information and contact information for your USACE Division office at http://www.usace.army.mil.

Natural Resources Conservation Service (NRCS), U.S. Department of Agriculture (USDA)

The NRCS has the statutory authority to participate in small watershed flood protection projects that may include residential retrofitting. Contact your local Conservationist for further information. More information is available at http://www.nrcs.usda.gov.

Other Assistance Programs

Other Federal programs intended to protect and improve the environmental quality of floodplains may offer financial assistance.

2.6.2 Non-Federal Help

Programs Sponsored by State and Local Governments

States, local governments, and flood control and drainage districts sometimes develop financial assistance programs to promote flood hazard retrofitting projects. Ask your local officials whether such a program exists in your community.

Voluntary Organizations

After floods and other major disasters, voluntary organizations often offer their services to support the rebuilding of homes. Occasionally, materials are donated and volunteers offer to provide labor that could be used to reduce the cost of a retrofitting project. Check with local officials, local service organizations, and homes of worship for information about such services. Note that you must obtain building permits and comply with all relevant regulations (including Substantial Damage requirements, if they apply), even if you receive assistance from voluntary organizations.

Environmental Interest Organizations, Including Land Trusts and Nature Conservancies

Numerous non-government, non-profit, and quasi-public organizations are dedicated to enhancing the environmental benefits of floodplains. Sometimes these organizations provide funds that can be used in the restoration or protection of the natural beneficial value of the floodplain.