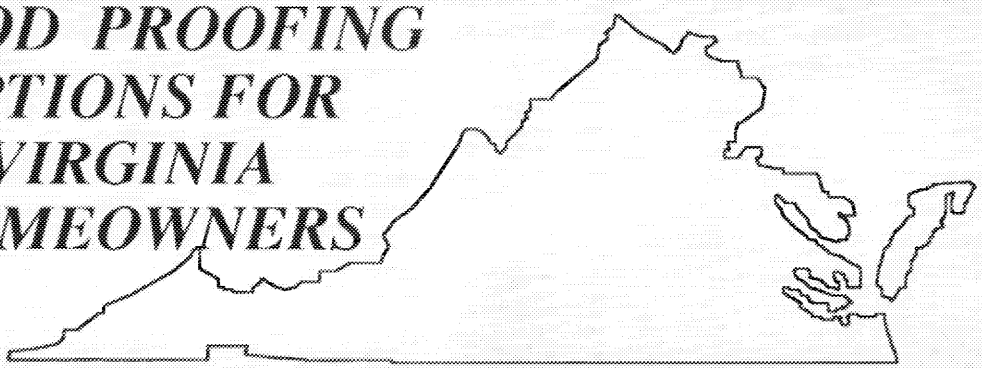
FLOOD PROOFING OPTIONS FOR VIRGINIA HOMEOWNERS



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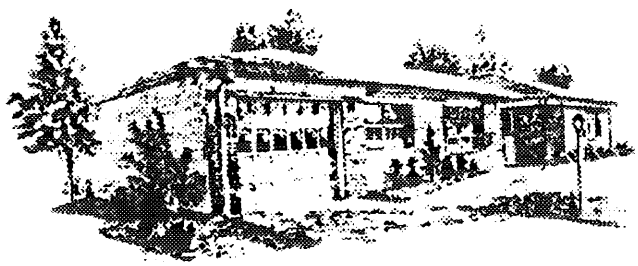

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PREFACE

If you own a home in an area subject to flooding, you owe it to yourself and your family to be as knowledgeable as possible with respect to the dangers from flooding. This manual presents some flood proofing options which are available to help you minimize the impacts from flooding. Advantages, disadvantages, costs, and benefits of various flood proofing options are provided to help you make a decision. After reading through the following pages, you may find that some of the options will fit your specific situation better than others. You may choose to investigate these options in more detail. Sources of additional information, including telephone numbers and addresses, are provided to help you do this.

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INTRODUCTION

Flood damage occurs annually in Virginia with Presidential Disaster Declarations occurring about every 2 years. There have been 12 declarations since 1969. Flood damages in these declarations averaged $169 million per declaration. Flood insurance claims totalling $59 million have been paid since 1978. Behind these numbers are people who live and work in floodprone areas that suddenly find their lives in turmoil.

If you live in a home that has been flooded, you know that complete recovery from a flood is almost impossible. The onslaught of mud, the cleaning, the damage, the repairs are all hardships you don't want repeated. Add to these cleanup problems health risks, personal and family safety hazards, and the emotional cost of being the victim of flooding, and it becomes clear that many residents in floodprone areas who have not experienced a flood have little perception of how disrupting the experience can be.

Flood waters impinging on homes

To determine what your flood hazard is, call your local zoning administrator/building official/town clerk and ask if your property is in a floodplain.

Each homeowner who lives in a floodprone area has an alternative. It is called "flood proofing" and is defined as any combination of structural changes and/or adjustments incorporated in the design and/or construction and alteration of individual buildings, structures, or properties primarily for the reduction of flood damages.

Flood proofing requires adjustments to homes and often to contents as well. It may involve keeping water out or reducing the effects of water entry. Such adjustments can be applied by the individual or as part of collective action either when homes are under construction or during remodeling or expansion.

There are three general approaches to flood proofing which will be discussed in the subsequent chapters in this manual:

- Raise or move your home.
- Construct barriers to stop flood water from entering your home.
- Modify the home and relocate contents to minimize flood damage.

This manual has been prepared to serve as a quick reference and guide for homeowners to convey flood proofing concepts. It contains many flood proofing techniques to prevent or reduce flood damages but is not intended to contain everything a homeowner would need to

Post flood cleanup

Child meanders through rubble Photo courtesy of Roanoke Times and World News

carry out a flood proofing project. Instead, the intent is to show the homeowner what he or she can do to reduce or prevent flood damages. Detailed designs must be prepared by qualified individuals such as architects or engineers. Needed permits must be obtained from local authorities before work begins. A qualified contractor should do the work.

Appendix A contains a self assessment and worksheet, information on selecting architects/engineers and contractors, and lists sources of assistance for the homeowner. A fact sheet to assist the homeowner in preparing for a flood is contained in appendix B. It also discusses what to do after a flood in the event you have not yet accomplished what this manual is proposing (flood proofing). Appendix C discusses roof reinforcement and appendix D lists our sources of information.

Threat to human life evidenced by rescue scene in western Virginia Photo courtesy of Roanoke Times and World News

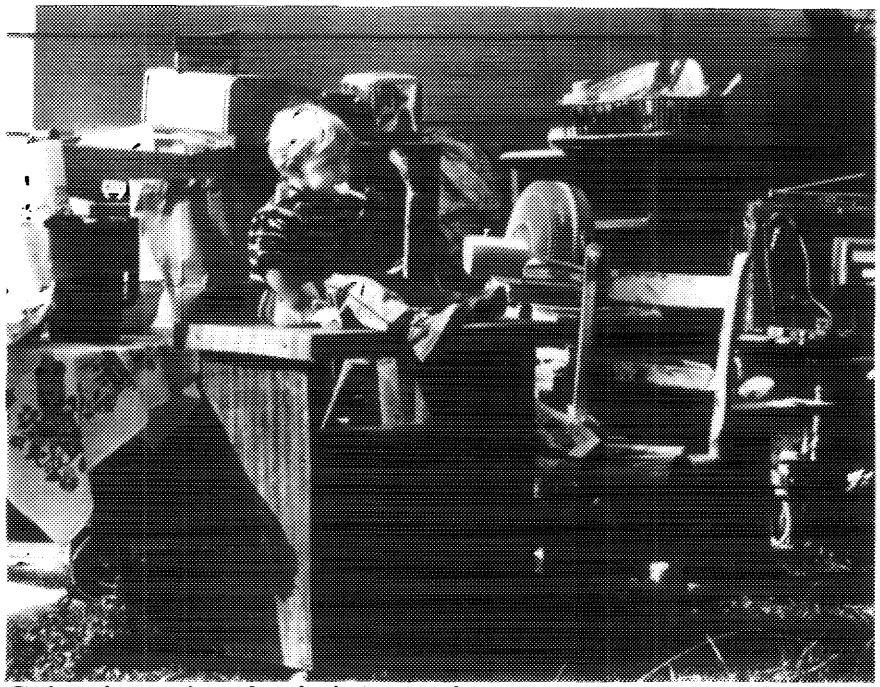
SELF ASSESSMENT FOR FLOOD PROOFING NEEDS

In order to identify the potential of damage and disruption to your home, you must view your home through a perspective as if you have just returned to it following a flood. Imagine that it has been flooded to a level of 3 feet above the first floor. Walk in the front door and look at everything lower than 3 feet. It is not only wet but also packed full of silt and mud. Carpets, stuffed furniture, walls, cabinets, floors, books, mattresses, clothing, most everything is damaged beyond repair. You open an old trunk of keepsakes and find, instead of family photos and memorabilia, a muddy, wet mess. They are irreplaceable, gone. You see some bugs crawling around. You wonder if there may be a snake or other threatening critters lurking within.

Now consider how you would feel faced with the prospects of having to take on recovery. What are your physical limitations? Many deaths occur during flooding events not as a result of drowning

Homeowner sorting through belongings in the aftermath of flooding Photo courtesy of Roanoke Times and World News

accidents but rather from heart attacks or similar complications that set in during the cleanup portion of the flooding. Is your health steady enough to take the risk? How about your emotional health? Will this stress push you to a limit of some sort? Possibly you could handle these conditions, but what about your family, especially youngsters? There are abundant cases of youngsters who suffer emotional anxieties for years after being the victims of floods. The high demand for counselling services following floods attests to the emotional stress placed upon flood victims.



Child sits amidst family's belongings Photo courtesy Roanoke Times & World News

What about your financial resources? Do you have enough cash on hand to pay for recovery? Where is it taken from? Retirement? An education fund? Even if you have flood insurance, there is still the deductible. Remember, flood insurance only provides money to help you recover. It does not eliminate the hardship of the flooding.

To better predict the amount of damage which may occur in your home, you must find out what the 100-year flood elevation is on your site and what the elevation of the ground is. This will tell you how deep the flood waters will be over the ground and, therefore, how deep it will be in your home during a 100-year flood. Your community Building/Zoning Official's Office should be able to provide that important information to you.

In order to understand more about the amount of damage that may occur to your home, refer to the depth-percent damage figures in appendix A for typical structures. A depth-percent damage function is a mathematical relationship between the depth of flood water above or below the first floor of a building and the amount of damage that can be attributed to that water. Depth-percent damage values are based on the assumption that similar properties, constructed, furnished, and maintained alike, and exposed to the same flood stages and force, incur damages in similar magnitudes or in proportion to actual values.

Using the depth-percent damage curves, you can determine an estimate of monetary damages to your structure and contents at various flood levels.

To select the appropriate flood proofing measures for your home, you must carefully consider the nature of the flood hazard, the physical conditions of the site, the function and use of the building, and its structural characteristics. The following list contains many key considerations that must be addressed as you consider flood proofing:

Site Characteristics

- Relief/slope
- Proximity to water
- Stability of soil
- Presence of bedrock
- Construction equipment access
- Aesthetics
- Impact upon adjacent properties
- Coastal/riverine

Flood Characteristics

- Flood water velocity
- Depth
- Rate of flood water rise
- Duration of flooding
- Debris content
- Historic accounts of previous flooding

Building and use characteristics

- Slab or crawl space?
- Structural stability?
- Overall size?
- Strength?
- Access during flooding?
- Utility locations?
- Will people be sleeping in area?
- Can area be converted to storage?
- Is area used primarily for storage?
- Type of construction (concrete, brick, wood, etc.)?
- Building condition (excellent, good, fair, poor)?

After learning all you can about flooding in your community and selecting the most appropriate flood proofing technique to protect your property, you need to assess the expected benefits which would accrue as a result of flood proofing and compare these to expected costs to help you determine if flood proofing measures are feasible.

Before you implement the appropriate flood proofing measure, be sure to plan the project carefully and obtain the expertise of qualified professionals to assist. Also, you should be aware of the extent of any remaining flood risk, since it is impossible to eliminate all risks. Purchase flood insurance for additional protection.

RAISING OR RELOCATING YOUR HOME

Raising or relocating a home so that flood water cannot reach those portions subject to damage are effective flood proofing techniques. Since this method of flood proofing actually incorporates two separate procedures with differing applicability, raising and relocating are discussed separately in the paragraphs that follow. Remember, building/ zoning permits are required.

Building to or above the base flood elevation (BFE) is the best method of flood proofing. What is the BFE? It is the elevation to which you must build to equal or exceed the 1% chance of being flooded in any given year (the 100-year flood). In other words, the 100-year flood is a flood event which has a 1% chance of occurring each year.

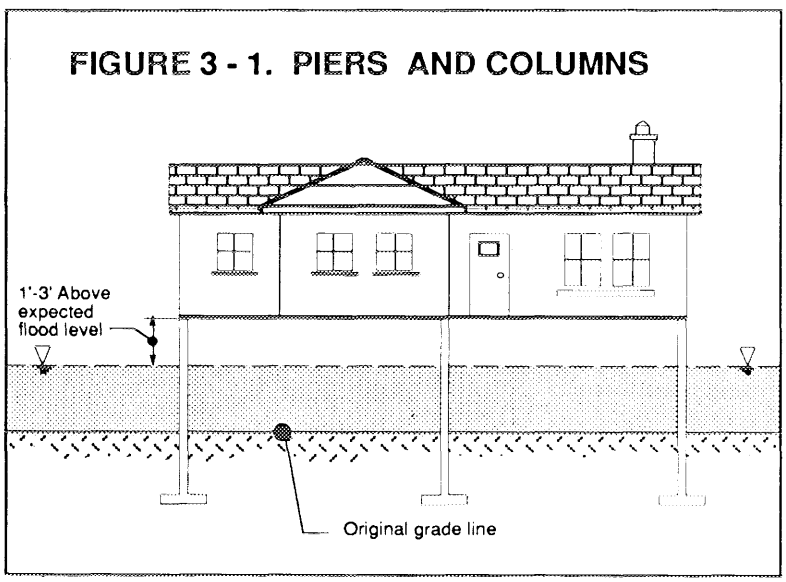
In 30 years, the life of a typical mortgage, there is a 26% chance of being flooded if the home is located at the 100-year flood level. The chance will be less if the structure is elevated above the 100-year flood.

RAISING YOUR HOME

Raising your home has the most widespread applicability for reducing flood damage problems. It may reduce the cost of flood insurance, possibly by hundreds of dollars. For Virginia contractors, it represents an untapped market for home improvement jobs. Unlike relocation, a new site is not needed. And unlike some of the types of flood proofing discussed later, it has the potential to provide almost guaranteed protection, depending on how high the home will be elevated.

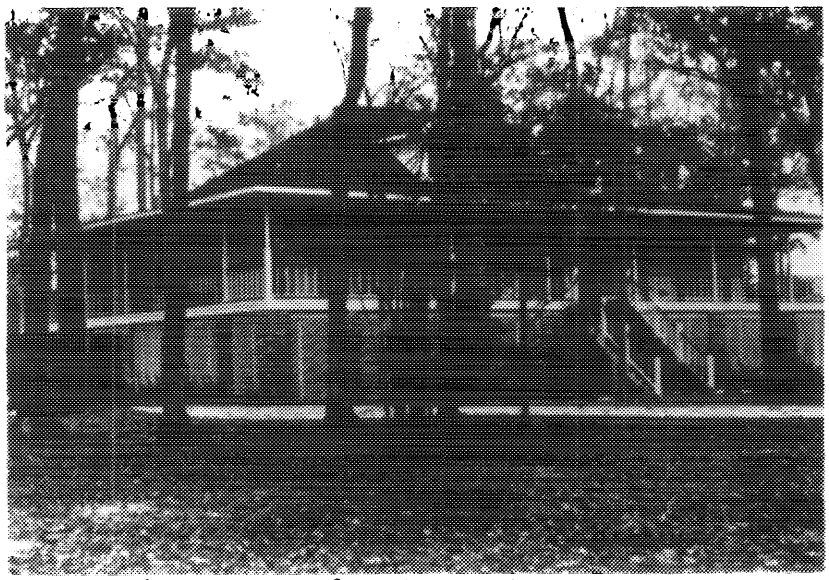
Raising a home or livable area can be done in several ways. The most common technique entails placing jacks and lifting beams below the structural members of the home, detaching the home and its utilities from its foundation, jacking it up to the desired height (typically above the 100-year flood elevation), building up the foundation to meet the new level of the home, and attaching the home to the new foundation. Homes can be elevated on piles or columns, on extended foundation walls, or on fill (although fill may require moving the home aside to construct a properly engineered soil foundation which adds to the cost).

FIGURE 3 - 1. PIERS AND COLUMNS

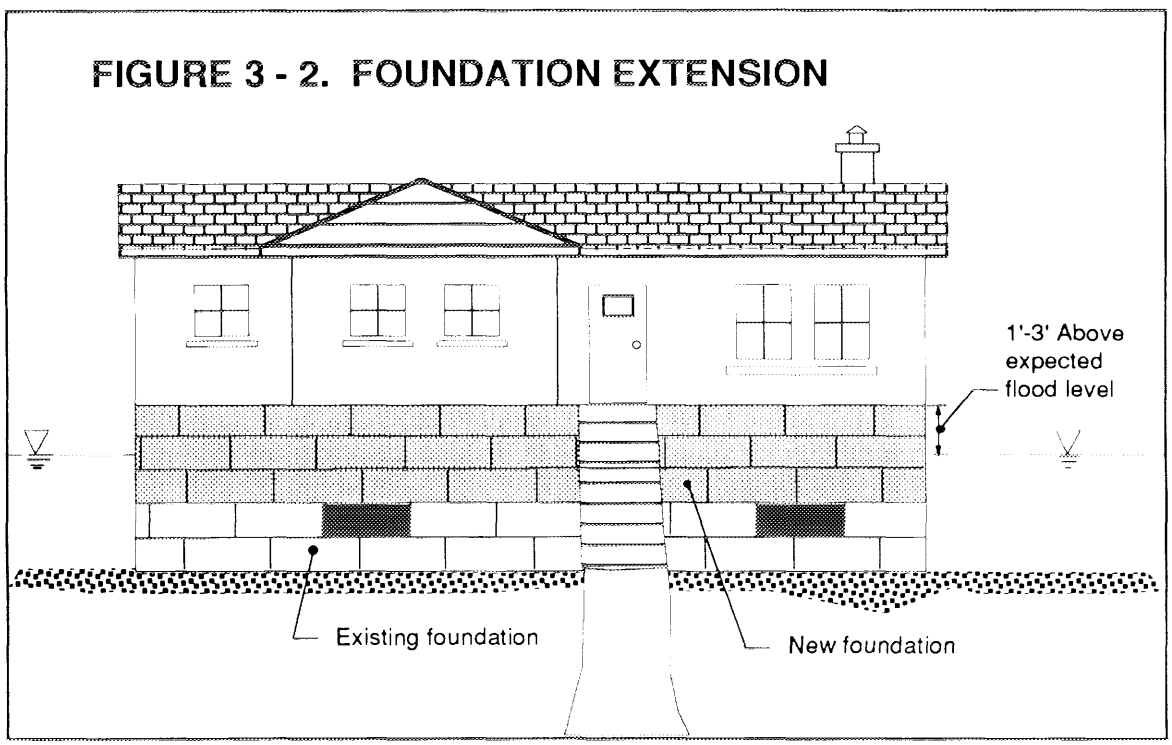


Why Raise?

Raising homes is adaptable to any floodplain environment, coastal or riverine. The raising of homes on engineered fill provides the most assured protection from flooding through elevation because the height of the fill keeps flood waters away from the home. Elevation on fill may increase flood heights upon other properties and may not be allowed under local zoning regulations and National Flood Insurance Program (discussed in chapter 6)



An attractive example of an elevated home



regulations. Homes constructed on fill are not allowed in special flood hazard areas along coasts subject to inundation by the 100-year flood that have the additional hazards associated with storm waves (V-zones).

Advantages of Raising a Structure

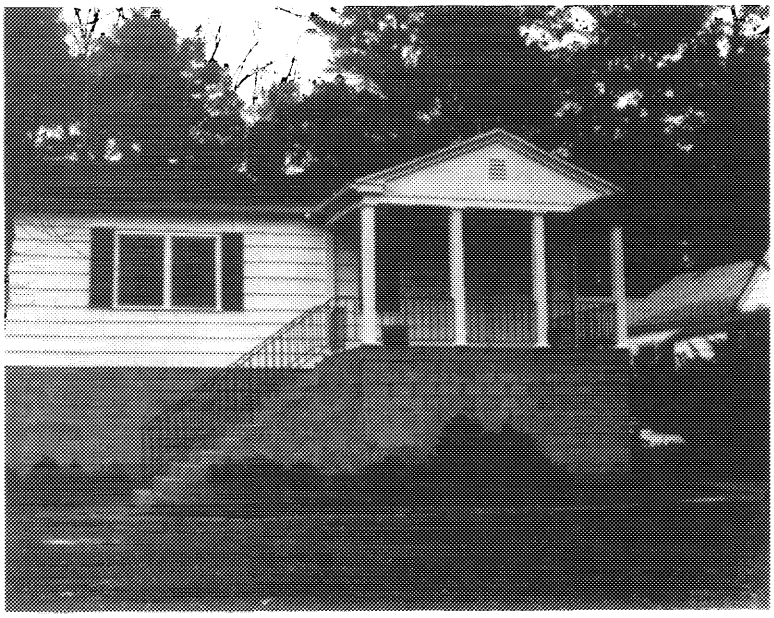
- Reduces or eliminates flood damage to homes and contents.
- Flood insurance premiums can be significantly reduced, possibly eliminated in the case of raising on fill as long as there is no basement.
- Allows use of a desirable, but floodprone site.

Disadvantages of Raising a Structure

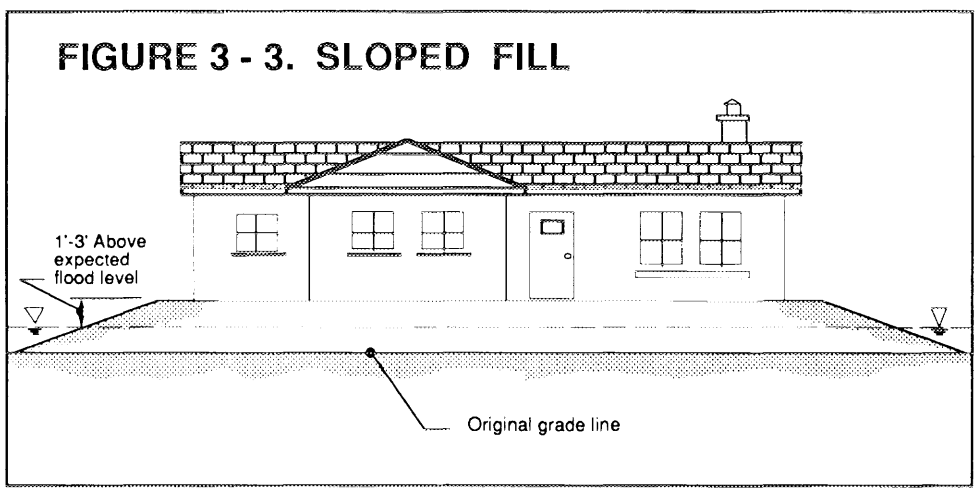
- Cost can be beyond the means of an average homeowner without special budgeting or a home improvement loan.
- May lose basement storage capacity.
- Evacuation during a flood is still necessary.

Costs

Raising structures can be costly. Cost depends on the type, shape, and size of home being raised and the required increase in elevation. Cost will be lower if the home is light enough to be elevated with ordinary home-moving jacks, if there is at least 18 inches of access under the first floor for the placement of beams and jacks, and the home is small enough to be lifted without partitioning. Given the above conditions, a small frame house of about 1,000 square feet could be raised several feet for about $10,000, while a 2,000-square-foot home could cost as much as $40,000 to raise. Generally, the additional cost to raise a structure an additional foot or so is small compared to the initial set-up cost. Due to the complexity of the operation and the number of variables involved, the services of a professional engineer would be required.

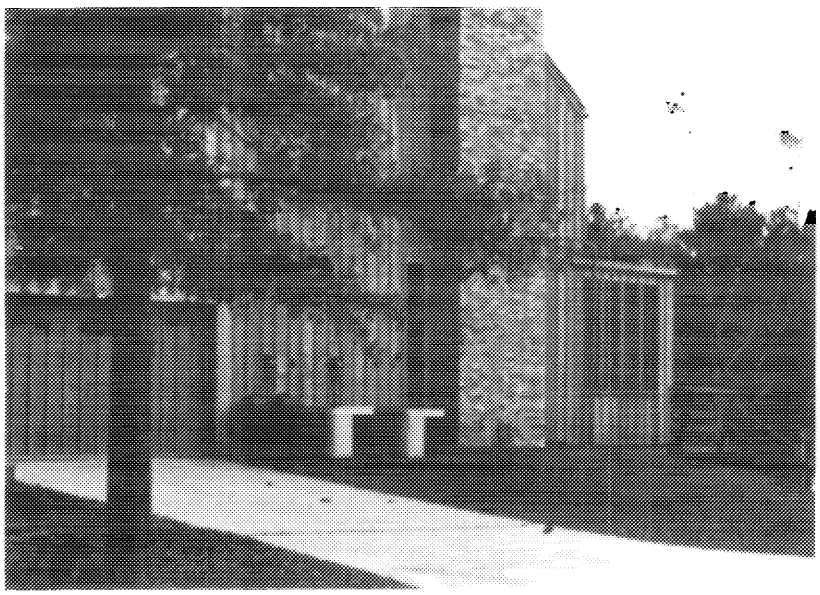


An example of an extended foundation



Conclusions

Elevating a house on site should be seriously considered by any homeowner living in a flood risk area. Utilizing the services of a reputable house-moving company will make this option more attractive. The peace of mind alone is of considerable value. Remember, even if you have flood insurance you will have a deductible to pay and quite likely your claim will not cover all of your losses, particularly personal possessions. The best way to recover from a flood on your lot is to have no damage to your home or possessions at all. Wouldn't you like to say after a flood, "The water didn't reach us." Think about it. No damage. No hassles. Life back to normal when the water recedes.



Flood protection provided by sloped fill

RELOCATING YOUR HOME

Relocating your home away from the flood risk area will provide the greatest possible protection from flooding. You would then have peace of mind, no flood damage, and no threats to your family's safety. But there are drawbacks. It is the most expensive approach, ranging upward from $20,000. Relocation entails placing lifting beams and hydraulic jacks under a home, having a new site prepared and ready, raising the home, positioning it on a trailer for transporting, transporting the home, positioning it upon its new site, then settling it down on its new location. Although this involves many steps, it has been done many times.

Why Relocate?

There are several compelling reasons for a homeowner to relocate his or her home. The availability of high ground on the existing lot or a nearby lot, a feeling of attachment to a home or neighborhood, and an expectation of remaining in the home for many years are convincing reasons to choose relocation.

Advantages of Relocating

- Flood damage and loss of personal possessions due to flooding are eliminated.
- Family's safety is increased by not living in a floodprone home.
- Periodic outlay of time and money for cleanup is eliminated.
- Your family will not have to stay in shelters, motels, or friends' homes during floods.
- Homes may be left during trips without fear of flooding.
- Flood insurance premiums typically are eliminated.
- Being out of the flood risk area would provide peace of mind.

- Your vacated lot may be deeded to your community as open space parkland.

Disadvantages of Relocating

- Initial expense is high compared with other flood proofing measures.
- You still own a floodprone lot which may require maintenance and associated costs (such as taxes).
- Aesthetic advantages of being near the water may be lost.
- You may have to move out of your neighborhood.

Costs

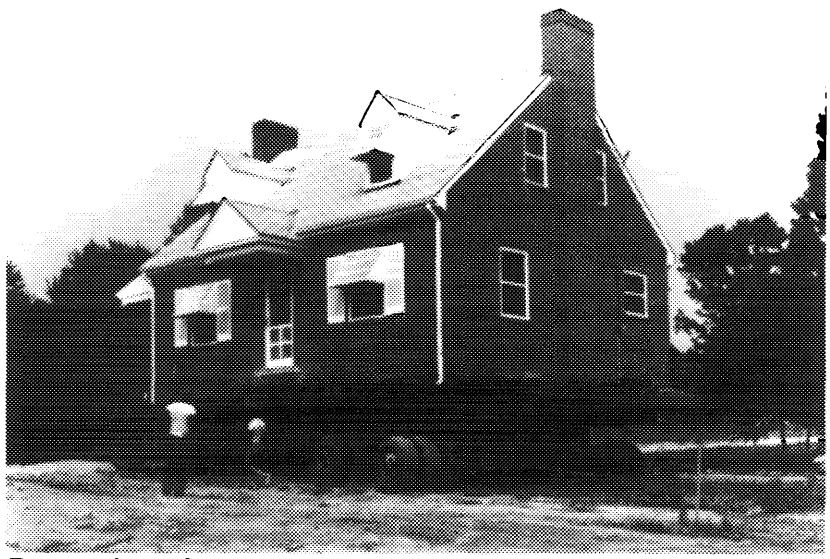
Let's face the high cost of relocation head on. It has high initial cost for a long-term benefit.

Relocation is the most costly flood protection measure. Although most types and sizes of homes including brick or concrete can be relocated, some are much more difficult and therefore more expensive to move. The easiest to move are wood frame homes that are located over a crawl space or basement that provides easy access to floor joists, are light enough to be lifted with ordinary house-moving equipment, and small enough to be moved without partitioning. Houses of brick or concrete that are over crawl spaces or basements are also movable if excessive cracking can be prevented. Sometimes it is less costly to remove brick facing, move the house frame, and install new facing at the new site.

Slab structures present special problems in relocation; however, technologies have been developed that now make relocation feasible. The costs of preparing a house for relocation, moving, and setting up vary greatly and can easily exceed $20,000. Key variables which impact costs are size and type of home, and cost of the new site and needed improvements.

Conclusions

Practically speaking, moving a home appears overwhelming. Many logistical details need to be resolved. But it can be done. Relocation is particularly successful when several homes are moved as part of a major project. A good example would be the case where a community is willing to provide good buildable upland lots to floodplain homeowners in exchange for taking ownership of the floodplain lots to be used for a river park site.



Relocation of home

CONSTRUCTION OF BARRIERS

There are two techniques employed in the construction of barriers: installation of free-standing barriers such as berms, levees, and floodwalls that are not attached to the structure and the incorporation of "dry flood proofing" techniques. Dry flood proofing would include installation of sewer check valves to keep sewer water from backing up through the system and the coating of the lower portions of exterior walls with an impermeable sealant. The BFE plus an additional safety factor should be taken into consideration.

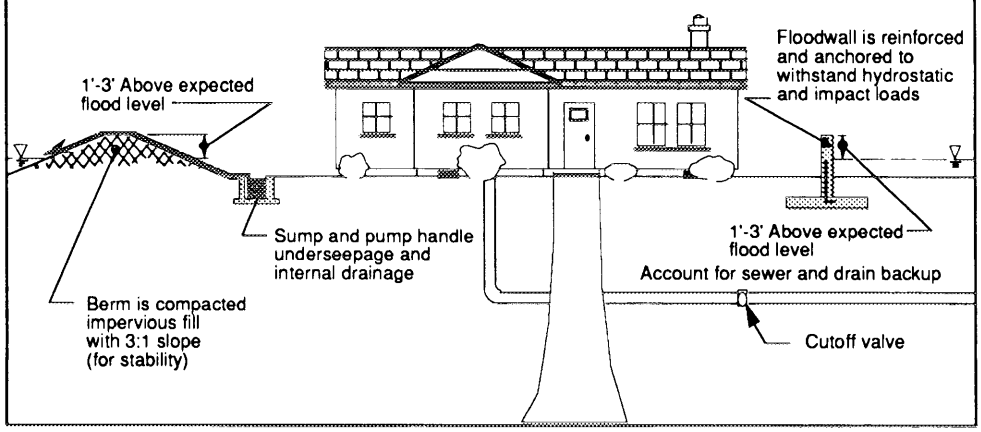
FREE-STANDING BARRIERS

The primary free-standing barriers used to reduce flood damages are berms, levees, and floodwalls. These measures should be designed by an engineer and constructed in accordance with design specifications. Permits will be required. A berm is an earthen structure constructed between a watercourse and building that stops flood waters from reaching the structure. Berms must be constructed with impermeable materials with correct side slopes. Levees, which are similar to berms, are also earthen structures of compacted local fill. Levees are usually constructed along riverbanks to prevent the flood water from spilling over and flooding structures. The levee in Scottsville, Virginia along the James River is a good example. Berms, on the other hand, serve the same purpose but usually are constructed closer to the homes themselves and often protect individual buildings. It could be said that levees and floodwalls protect many buildings while berms keep water away from one or two structures. Floodwalls are usually constructed with reinforced concrete, brick, or stone, and are anchored into the ground.

Why Barriers?

Many people prefer berms, levees and floodwalls because they require no change to the building. The appropriateness of using berms or levees becomes increasingly questionable with deeper flood waters. Deeper waters pose greater pressures against these barriers. If they fail, the forces of the flood water would do more flood damage than if the structures were flooded naturally. Both berms and levees are generally appropriate for flood proofing a structure where flood water is less than 6 feet deep. Levees can be constructed in areas where flood water exceeds 6 feet, but the cost and the land area required for these levees usually make them impractical for the average homeowner. Floodwalls, because of their greater cost, would normally be considered only on lots that are too small to have room

FIGURE 4 - 1. BERMS, LEVEES, AND FLOODWALLS



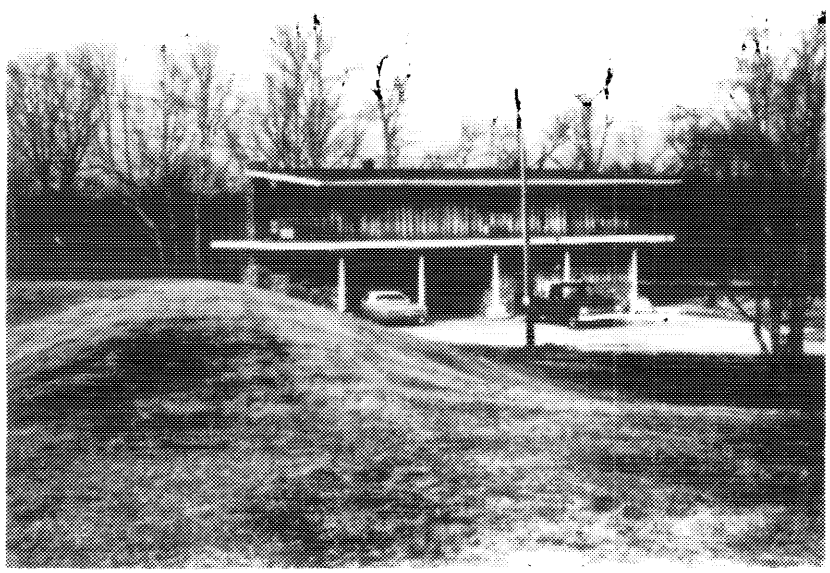
for berms or levees or where flood velocities may erode earthen berms or levees. Berms, levees, and floodwalls may not be appropriate for homes with basements since they are more susceptible to underseepage.

Advantages of the Construction of Barriers

- Not dependent upon the size, type, or condition of structure being protected.
- Protects property located outside a structure such as sheds, outbuildings, garages, etc.
- Can be aesthetically pleasing and provide privacy and security in addition to flood protection.

Disadvantages of the Construction of Barriers

- Levees, berms, and floodwalls can fail or be overtopped by large floods and would pose a significant hazard if not properly engineered and constructed.
- Maintenance is required and internal drainage must be handled.
- Local drainage can be affected, possibly resulting in water problems for others.
- Flood insurance rates usually are not reduced.
- The need to evacuate is still present.
- May require access openings that must be closed during a flood which could require warning time.
- May violate local, state, or federal floodplain ordinances. Consult community officials.



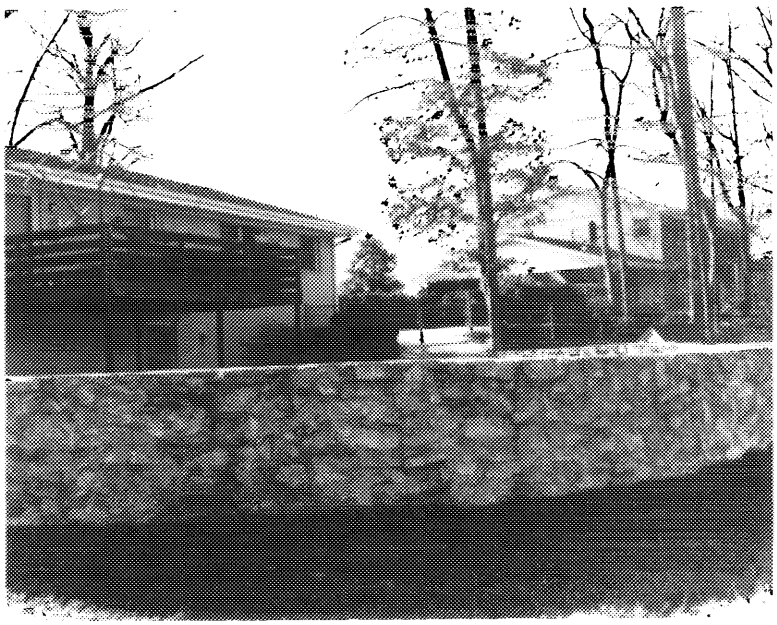
Home protected by berm

Costs

Costs depend on initial design fees, height, length, availability of construction materials, labor, access closures, drainage for the enclosed area, and protection against sewer backup. Depending upon specific site requirements, costs may also be incurred for relandscaping; maintenance to insure a watertight condition; levee and berm erosion protection; power used for pumping; and removal and replacement of walkways, driveways, or patios to accommodate a berm, levee, or floodwall. A berm or levee can be constructed for minimum costs if the owner provides the labor and the appropriate fill is available on site. If several floodprone houses are located next to each other, the cost can be reduced significantly through joint ventures and merging with existing high ground. Due to the number of variables involved, construction costs could range from a few hundred dollars to $15,000 or more.

Conclusions

Like relocation, the choice of using berms, levees, and floodwalls may depend upon your unique site characteristics. For the average home in a subdivision or urban neighborhood setting, the use of these approaches may be limited. However, if this is the flood proofing technique of choice, it is strongly recommended that these options be designed and constructed under the supervision of qualified professional engineers since berms, levees, and floodwalls can fail because of poor design, improper material and/or construction practices, poor maintenance, or inadequate pumping facilities. A proposed berm site may not be located in a floodway. Floodway regulations stipulate that no development can occur which would increase the 100-year flood elevation. A property owner should ask the local Zoning or Building Official about special zoning requirements and permit requirements before constructing any berms.



Home protected by floodwall

DRY FLOOD PROOFING

All flood proofing techniques discussed thus far in this manual would keep flood waters away from the home and, therefore, provide a significant degree of protection. But for some homeowners, these techniques are simply too expensive. A second flood proofing technique that can be used to construct a barrier against flood water is known as "dry flood proofing."

For frequent, low-level (3' or less) flooding, dry flood proofing, if properly designed and constructed, can be just as effective as any other method in preventing flood damages. With this technique, a home is sealed so that flood waters cannot get inside. All areas below the flood protection level are made watertight. Openings such as doors, windows, sewer lines, and vents are closed with permanent closures or removable shields, sandbags, valves, etc. Walls are coated with waterproofing compounds or impermeable sheeting. A sewer "check valve" or one-way flap is installed in the sewer line to permit outgoing sewage to flow during non-flooding conditions. During flooding conditions the pressure of the water will hold the flap shut and will prohibit the flow of incoming flood waters and other debris. Examples of "dry flood proofing" techniques are shown in illustrations and photographs which follow.

Why Dry Flood Proof?

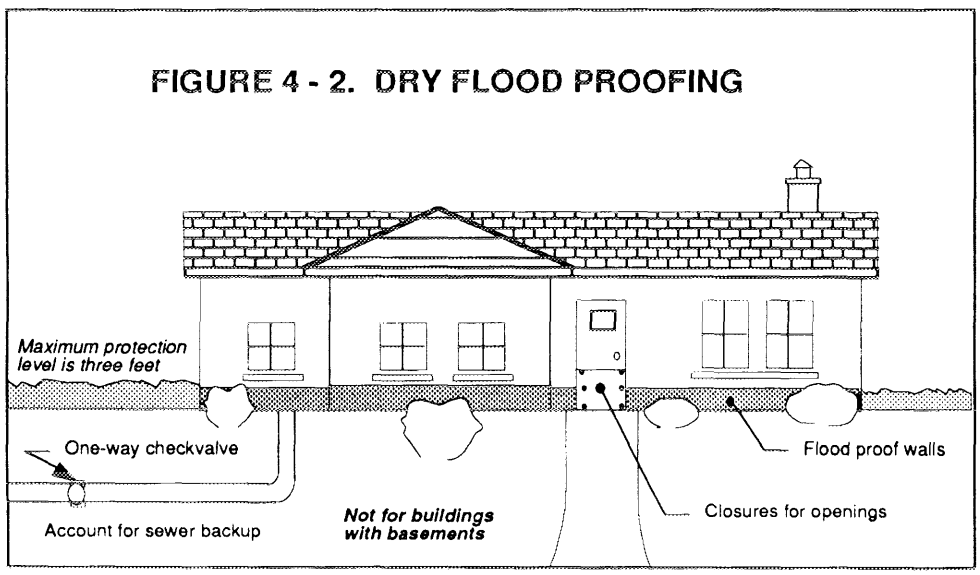
Dry flood proofing has limitations based upon the construction style and condition of your home. Is it of brick construction with a somewhat impermeable exterior or clapboard or siding through which small amounts of water may flow? These

flood proofing techniques are only appropriate where flood waters are less than about 3 feet since most walls and floors in houses will collapse under higher water levels. The technique is not usually as successful on homes with basements since those homes are difficult to protect from underseepage.

Advantages of Dry Flood Proofing

- Homeowners can get started to do something to protect themselves, thereby reducing the potential damage and providing some sense of control and direction over their predicament.

Opening protected by permanent closure



- Flood proofing may be done on a selective basis to only those openings through which water enters and only to the height desired.

Disadvantages of Dry Flood Proofing

- Water seepage through sealed surfaces may occur when flooding conditions are prolonged or the sealants are not maintained.

- Contents of the home are kept dry if the design flood heights are not exceeded.

- Dry flood proofing can be simple and less costly than berms, levees, or floodwalls, especially for flood depths of 3 feet or less.

- It is not acceptable for flood depths deeper than about 3 feet without evaluation by a structural engineer.

- There will be no reduction in flood insurance premiums. Elevation and relocation are the only

techniques that will reduce premiums.

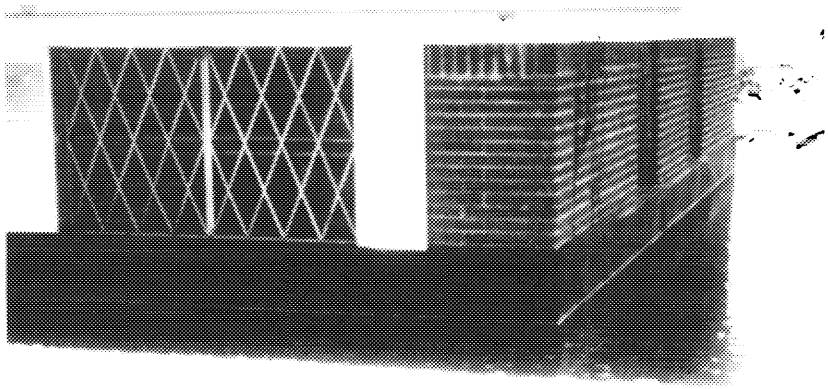
- Human intervention necessary to close some openings will require adequate warning.
- It may create a false sense of security and induce people to stay in their home longer than they should.
- Dry flood proofing measures can fail or be exceeded by larger floods.
- Some damage to the exterior of the home is still likely and damage to landscaping and other property is not reduced.
- The need to evacuate is still present.

Costs

Sometimes dry flood proofing requires no more than the cost of buying and applying tar, heavy plastic, and plywood. More expensive techniques include window wells, outside wall coverings, and electric pumps. Costs vary considerably depending on the type and depth of flooding and the size and strength of your home.

Conclusions

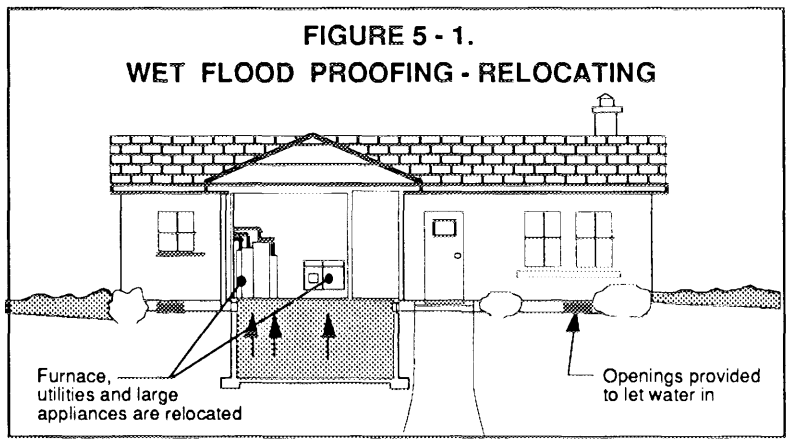
If you expect to spend much money dry flood proofing your home, you should give careful consideration to advancing up the scale of flood proofing options and choose to raise your home. But if dry flood proofing is your only option, keep in mind several rules of thumb: 1) Holding flood waters at bay produces tremendous loads. Make sure your home can withstand these loads. Otherwise collapse and gushing water could spell disaster. Do not consider dry flood proofing for depths greater than 3 feet. Use a professional engineer or at least seek guidance from your community building official. 2) Remember, you must flood proof up to certain elevations all around the home. It will do nothing for you to beautifully flood proof your doorways and provide nothing for your sliding glass patio door. 3) Finally, in your determination to protect your home with these innovative techniques, don't linger around as flood waters rise. Your welfare and the concern for you by others is far more important than getting that seal just right.



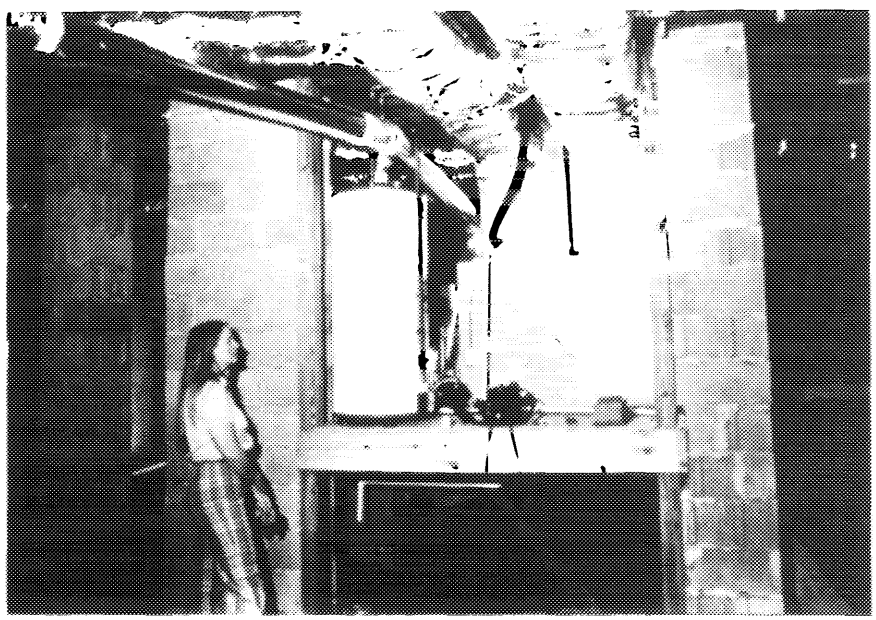
Building protected by impermeable coating

WET FLOOD PROOFING TECHNIQUES

If all of the previously mentioned techniques are not feasible for you either due to cost or the style/ condition of your home, then wet flood proofing may offer some solutions. Wet flood proofing is a technique which includes the modification of a structure and its utilities and contents to allow flood waters to flow inside of the home while ensuring that there is minimal damage to the building and contents. No credit is available from the National Flood Insurance Program to lower flood insurance premiums if this option is chosen. Building permits will be required when relocating gas or electrical utilities.



Care must be taken to raise furniture/ contents above the anticipated flood level. Foodstuffs, paper goods, drugs, clothing, cleaning supplies, hazardous material, and other chemicals should be stored on shelves or on higher floors. Small portable items and lightweight furnishings can be easily moved to higher elevations prior to flooding. Appliances such as refrigerators, ovens, washers and dryers can be raised on pads above shallow flooding depths. A fuse or circuit breaker box located in the basement is particularly dangerous and should be relocated if possible. Electrical outlets should be relocated above expected flood levels, or a separate circuit should be installed whereby power to them can be shut off prior to a flood. Gas should be shut off at the meter prior to flooding.



Water heater elevated on platform

It is also prudent to protect those things in your home which are not possible to move. Furnaces and water heaters can be protected by building small floodwalls around them or raising on elevated platforms. Equipment can be covered with waterproof plastic bags or sheets and taped tightly with duct tape. Another method is to coat the equipment with protective grease.

Why Wet Flood Proofing?

Wet flood proofing is generally appropriate in cases where an

area is available above flood levels to which damageable items can be relocated or temporarily stored, or raised on elevated platforms.

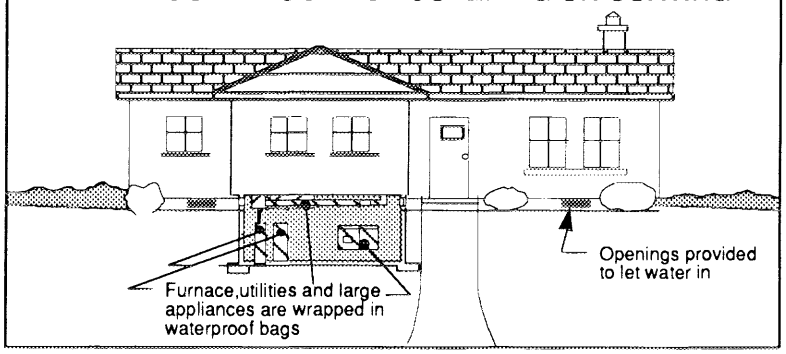
Advantages of Wet Flood Proofing

- No matter how small the effort, some wet flood proofing will reduce flood damage to your home and its contents.
- This technique can be done on a per item basis, thus reducing the cost and allowing selective protection of high-value contents.
- A home can continue to be used at its existing site.
- Loads placed on the walls and floors of your home will be greatly reduced because flood waters will enter the building equalizing the pressure on the walls.
- Costs for relocating or storing property after a flood warning, with the exception of basement property, are covered by flood insurance.

Disadvantages of Wet Flood Proofing

- Those areas flooded will need thorough cleaning to ensure no bacteria or insects have been left by flood waters. This may be minimized by deliberately flooding the area with clean water prior to an imminent flood.
- A potential residual damage to the home and contents not relocated or protected remains.

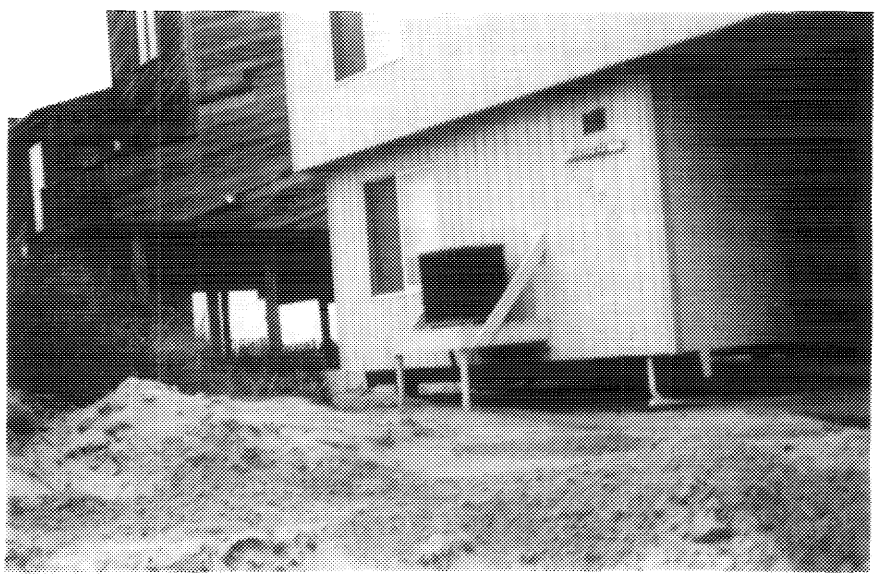
FIGURE 5-2
WET FLOOD PROOFING - COVERING OR COATING



- Flood insurance is still required.
- Evacuation is still necessary.

Costs

Compared with the other flood protection measures previously discussed, wet flood proofing is the least costly. Principal costs include labor and equipment to rearrange utility systems, move items, and cleanup mud and water after a flood. Actual costs can vary greatly depending upon the specific



Air conditioning unit on raised platform

action taken; however, much of the effort required may be accomplished by the homeowner with little or no costs involved.

Conclusions

With wet flood proofing, water still gets into your home and there is still the anxiety of wondering when a flood will occur. The need to monitor conditions and evacuate continues. In short, if flood levels rise to or above the first floor of a home, wet flood proofing should be considered a temporary strategy to reduce damage until enough money can be saved to protect your home. In many cases, wet flood proofing as a realistic approach to alleviating the hazards posed to your household by flooding offers minimal protection. However, wet flood proofing can be effective when flood waters only enter garages, storage areas, workshops, etc.

FLOOD INSURANCE PROGRAM

This manual has thus far presented suggestions to reduce flood damage that involve physical alterations to your home. There is also the insurance option. This does not reduce damage but may provide a claim payment which will assist in paying for cleanup and recovery expenses.

Flood insurance is purchased through your property casualty insurance agent as a separate policy from your homeowner's policy. If your agent has no knowledge of flood insurance, then he or she should contact their regional or corporate office. The insurance is made available through the Federal Government's National Flood Insurance Program (NFIP). Any home can be covered by flood insurance whether it is in a floodplain or outside a floodplain, as long as your city, town, or unincorporated county has joined the NFIP. Almost all Virginia communities have done so. If you want to know if your community participates in the NFIP, call the Department of Conservation and Recreation, Bureau of Rivers and Shores at (804) 371-6095.

The average flood insurance policy in Virginia costs about $350.00 per year for building and contents coverage. Ask your agent for a premium quote. If your home is not located in a floodplain mapped on the NFIP Flood Insurance Rate Maps, then you may purchase a special "Preferred Risk" policy which is less expensive than the standard policy.

With the standard policy, insurance up to $185,000 for your home and up to $60,000 for contents is available. The deductible for this policy is $750 for pre–Flood Insurance Rate Map (FIRM) structures and $500 for post–FIRM structures which is applied separately to buildings and contents. Specific rates and deductibles can be determined by your insurance agent.

Applicable premiums for homes are based on the elevation of the first floor with respect to the 100–year flood elevation (see example below). The 100–year flood is a statistical concept used to measure the risk of flooding and is used as the flood protection level for the National Flood Insurance Program. It is a flood having a 1% chance of being equalled or exceeded in any given year.

EXAMPLE: Standard Policy Premium

To purchase insurance for $80,000 building/ $30,000 contents based on elevation of the lowest floor above or below the Base Flood Elevation, the premiums are listed below:

Elevation	Premium
+2 ft	$208
+1 ft	$250
0 ft	$355
–1 ft	$1029.50

Note: –2 ft must be forwarded to Washington to be rated at actuarial rates.

The Preferred Risk Policy (PRP) is designed for property located outside the Special Flood Hazard Areas where the flood risk is lower (B, C, or X zones on the FIRM). Once a PRP is purchased, continuous coverage is guaranteed even if there is a subsequent change in the FIRM. PRP insurance for buildings ranges from $20,000 to $100,000 and contents range from $5,000 to $25,000. The deductible for this policy is $500 and is applied separately for building and contents coverage. Premiums are flat and vary from $75 to $150 ($25 more if building has a basement). Coverage of $20,000 for a structure and $5,000 for contents can be purchased for an annual premium of $75. Insurance rates change and vary dependent on inflation, new mapping, etc. Quoted figures are as of the date of this publication.

A flood insurance policy only insures against the peril of a flood, defined as a general and temporary condition of partial or complete inundation of normally dry land areas. It will not, for example, cover sewer backup due to high water table where a general condition of flooding is not present. It will not cover rain damage that may be the result of a broken window or roof opening. It will cover, within limits, certain reasonable expenses involved in the removal of contents to a safe place away from the danger of imminent flooding, the placement of sandbags to provide some protection from flooding, and the return of those contents to the insured premises.

If you choose not to purchase flood insurance and your home is subject to basement flooding due to sewer backup during conditions other than general flooding, then consider adding a sewer backup rider to your homeowner's policy.

TECHNICAL APPENDIX

SELF ASSESSMENT

How to Estimate Potential Flood Damages. As part of the process for assessing one's need for flood protection, a homeowner must have an understanding of the potential magnitude of damage that may result from a given flood. In this regard, the use of depth-percent damage functions is a relatively simple method for the homeowner to estimate such losses. The depth-percent damage relationship is a mathematical relationship between the depth of flood waters above or below the first floor of a structure and the amount of damage that can be attributed to that water. In the following curves, referenced as figures A-1 through A-7, the first floor elevation is equivalent to zero and negative numbers indicate heights in feet below the first floor and positive numbers indicate heights in feet above the first floor. Curves are shown separately for structure and contents.

The curves represent damage incurred from flooding conditions that do not have high-velocity waters associated with the flood. These curves would therefore underestimate the damage of a flash flood or coastal storm with high-energy, storm-driven waves. The curves show structure damage as a percentage of structure value and content damage as a percent of content value for each foot of inundation. These curves can be an important tool in estimating the potential flood damages to your home and contents. It should be noted, however, that the curves shown were developed by the Federal Emergency Management Agency (FEMA) and represent averages computed from a number of actual flooding situations and, therefore, represent approximations of the range of potential flood damages that may occur to any specific home.

To illustrate how the curves are used, assume a one-story house without a basement with a current value (replacement cost of structure) of $100,000 and contents valued at $30,000 is flooded to a depth of 3 feet over the first floor. From the curves for a one-story house without a basement, the damage to the structure is estimated at about 28% or $28,000 and damage to contents is estimated at about 35% or $10,500. Therefore, for a flood of this height you could expect total flood damages in the neighborhood of $38,500 if you took no flood proofing measures to reduce your losses. To further facilitate use of the curves and estimating damages, a fill-in-the-blank worksheet has been included as figure A-8.

Decision to Flood Proof. There are a number of factors residential property owners should consider prior to making a decision to flood proof. Some factors will be more important than others depending on the financial situation and lifestyle of the homeowner and severity of the flooding problem. Following is a brief description of some of the more pertinent factors which should be considered.

• Flood proofing assistance. This is perhaps the most important of all the factors to be considered. Due to its importance, a separate section has been devoted to its treatment. The section entitled "Sources of Assistance" begins on page A-8 of this technical appendix.

• Building codes. Before property owners commit a significant investment of time and money in flood proofing, they should contact the local building inspector or city engineer for requirements and for information on obtaining necessary permits.

• Cost estimates. Before making a commitment to do any flood proofing work, the property owner should get a rough estimate of the cost of the flood proofing measure to assist in deciding whether further consideration is worthwhile.

Figure A - 1
Percent Damage to Structure and Contents Value
ONE STORY, NO BASEMENT

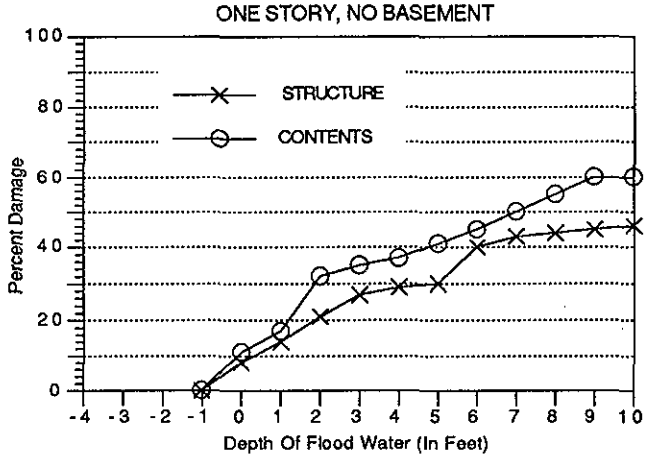


Figure A - 2
Percent Damage to Structure and Contents Value
ONE STORY, WITH BASEMENT

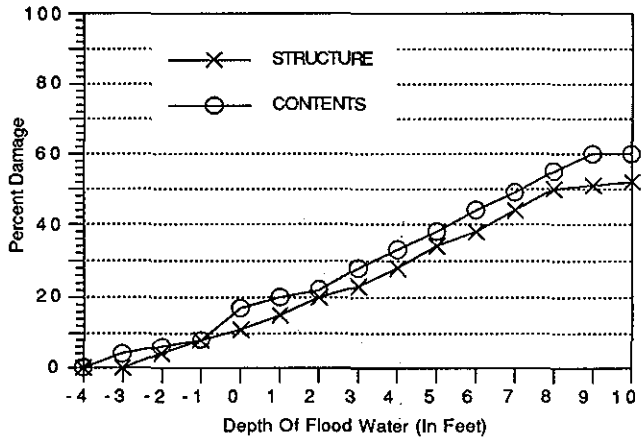


Figure A - 3
Percent Damage to Structure and Contents Value
SPLIT LEVEL, NO BASEMENT

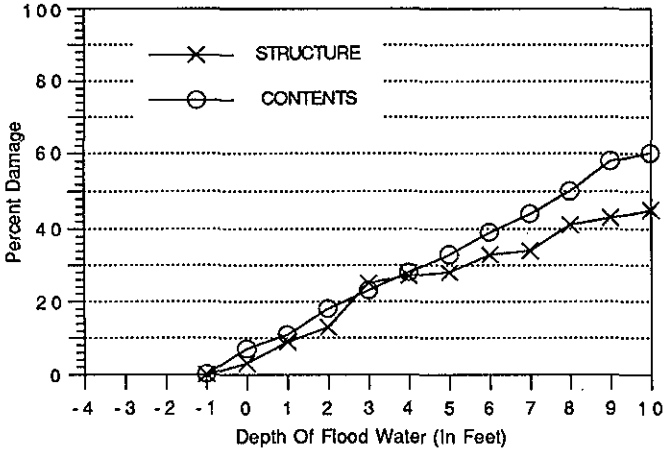


Figure A - 4
Percent Damage to Structure and Contents Value
SPLIT LEVEL, WITH BASEMENT

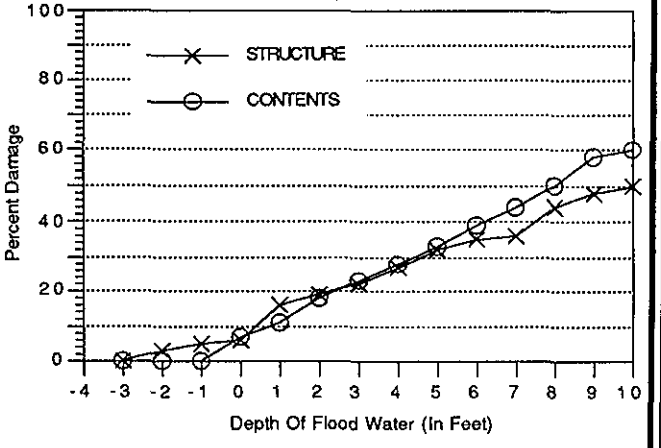


Figure A - 5
Percent Damage to Structure and Contents Value
TWO OR MORE STORIES, NO BASEMENT

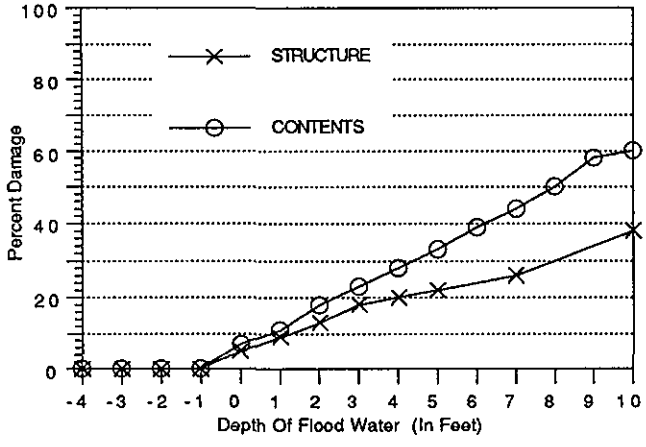


Figure A - 6
Percent Damage to Structure and Contents Value
TWO OR MORE STORIES, WITH BASEMENT

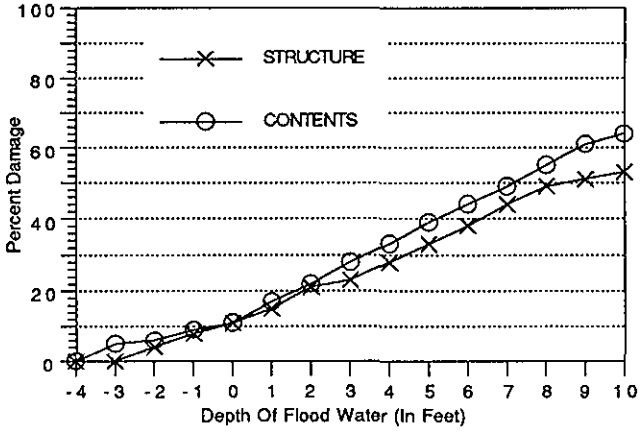


Figure A - 7
Percent Damage to Structure and Contents Value
MANUFACTURED HOME

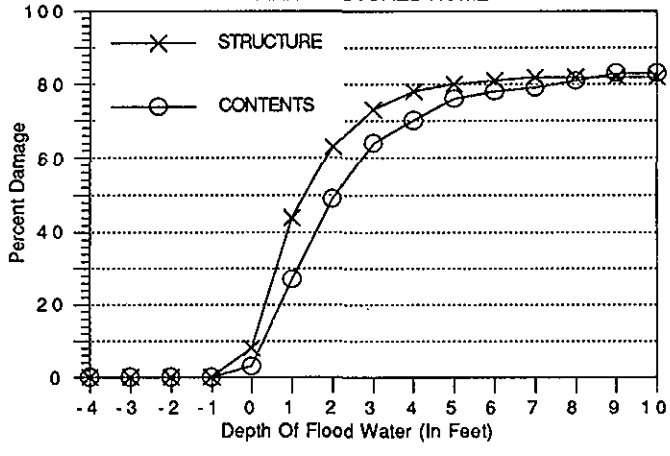


FIGURE A-8. ESTIMATING RESIDENTIAL FLOOD DAMAGES

WORKSHEET

1. Current estimated replacment cost of residential structure (exclude value of land) $_____

2. Current estimated replacement cost of contents in residence $_____

3. Type of residential structure (check one):

   a. One story, no basement (figure A-1) _____
   b. One story, with basement (figure A-2) _____
   c. Split level, no basement (figure A-3) _____
   d. Split level, with basement (figure A-4) _____
   e. Two or more stories, no basement (figure A-5) _____
   f. Two or more stories, with basement (figure A-6) _____
   g. Manufactured home (figure A-7) _____

4. Estimated flood damage to residential structure:

   a. Assume depth of flood on first floor (in feet) _____ft.

   b. Go to figure for corresponing structure type referenced in item 3. and record the percent structural damage for the appropriate depth of flooding (figs. are located on p. A-2 & 3) _____%

   c. Multiply value in 1. by 4b. and divide by 100 $_____

5. Estimated flood damage to residential contents:

   a. Record depth of flood from item 4a. _____ft.

   b. Go to same figure as in 4b. and record the percent content damage for the appropriate depth of flooding _____%

   c. Multiply value in 1. by 5b. and divide by 100 $_____

6. Total estimated residential flood damages, add 4c. and 5c. $_____

• Benefits. The most obvious benefit to consider is the potential reduction in flood damages. However, other less obvious benefits may include the avoidance of the expense and inconvenience of staying in a motel, loss of time from work while cleaning and repairing the flooded structure, and the preservation or extension of the life of the structure by reducing repeated floodings.

• Inconvenience. Associated with most flooding is a significant amount of personal inconvenience. In many cases, the house cannot be occupied until cleanup and repairs have been completed. The owner may also have to file insurance claims and disaster assistance applications. Damaged household and personal items such as clothes, furniture, and appliances will have to be cleaned or replaced. Utilities must be restored. Also, irreplaceable items, such as photographs or family heirlooms, may be destroyed by a flood.

• Health and Safety. When a home is flooded, occupants are exposed to a variety of health hazards. Sewer lines to the building may back up and flood the building. Rats and snakes may also temporarily inhabit the flood-damaged building. The water supply could become contaminated. Food, medicine, and cosmetics that have been touched by flood waters will be spoiled. Also, when attempting to reenter a building after a flood, occupants may be exposed to electrical shock from outlets or appliances. Flood waters may cause cracks in gas lines in the building, resulting in gas leaks and possibly fires. In addition, the aftermath of coping with a flood can cause considerable stress. Property owners and their families may suffer loss of sleep or fatigue. Many of the hazards associated with entering and occupying a flood-damaged building can be avoided by flood proofing the building.

• Architectural Aesthetics. The homeowner may wonder, "How will my house look if I flood proof? Will it look strange?" This is an important consideration. With the help of an architect, flood proofing can be integrated with the design of the home to create a pleasing appearance. In some cases, the beauty of a home can even be enhanced.

Another consideration regarding appearance occurs after the flood has subsided. If the home is not flood proofed, the property owner must repair and restore it, as described previously. During this period, which can be quite lengthy, the home will be a mess. On the other hand, if the home is flood proofed, the cleanup work after a flood will likely involve only landscaping repairs to the damaged yard. A flood proofed home can usually be restored to its pre-flood condition fairly quickly at a relatively low cost.

• Emergency Measures. If standard flood proofing measures turn out to be impractical, there are other actions that the property owner may take to reduce flood damage. In general, greater reductions in flood damage may be achieved by working with someone experienced or trained in emergency flood protection measures. If there is sufficient warning, prior to a flood, the property owner can relocate items such as electronic equipment, furniture, and personal items from the basement or first floor to a higher level above the expected flood elevations, or they may be transported from the property to a safe location. Also, if there is ample warning the property owner can participate in emergency flood protection measures such as sandbagging around windows and doors or boarding up entrances to the home.

• Flood Insurance. Property owners who do not presently have flood insurance should consider purchasing a flood insurance policy if they are located in a floodplain. This insurance will not reduce damages but it will lower the financial burden to the property owner when damage occurs. To find out if

flood insurance is available in your community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

SELECTING ARCHITECTS/ENGINEERS AND CONTRACTORS

Local building officials may require that plans and specifications for a flood proofing project be prepared by or under the direction of a licensed professional engineer or architect. The homeowner should check with local building officials to determine if this is a requirement before procuring a firm to carry out the project.

The coordination of construction work on a residence can be a difficult, time-consuming, and even frustrating process for the homeowner. It requires considerable knowledge of local building codes and permits, and may also involve hiring a variety of professionals, such as masons, concrete specialists, plumbers, engineers, architects, or landscape architects. Most projects will also involve the legal processes of dealing with contracts. Without proper planning, the inexperienced person attempting this coordination for the first time could face a difficult, financially risky undertaking. There are two general processes a homeowner may follow to simplify this process: obtaining architectural/engineering assistance or hiring a general contractor.

Architectural/Engineering Services. The more complex flood proofing techniques will often require a professional architect or engineer, or some other type of specialized professional service. For example, the construction of a floodwall could require input from a soils engineer to assist in determining soil-bearing capacity, a structural engineer to provide assistance in the structural design of the wall, a civil engineer to provide assistance in sizing drainage structures and sump pumps, and an architect to provide guidance in the placement of the wall to reduce the effect of the flood forces and improve the aesthetics of the finished project.

Some design firms employ professionals having expertise in only one particular area and this could require subcontracting of certain parts of the work. For a more complex project requiring a variety of services, the homeowner may wish to consider using a "full-service" architecture/engineering firm, which would be able to either provide all services in-house or coordinate the various expertise involved. Such a firm would be able to provide one point of contact between the homeowner and the design professionals involved in the project, which would not only provide better coordination of the project and a simpler line of communication, but would also serve to place liability for any problems which may occur with one firm or individual.

In evaluating architect/engineer firms, the homeowner should consider the following:

- Request that the firm provide a listing of projects similar to the one contemplated by the homeowner including former clients and telephone numbers, the dates of performance, and a brief scope of the work performed.

- Insure that the firm has familiarity with the project area including knowledge of contractors available to do the work, and knowledge of costs of various parts of the work.

- Landscape architects can help ensure that flood proofing techniques are provided in a practical and pleasing manner. In addition, they can provide expertise in appropriate plant material, as well as site layout and grading.

- Proximity of the firm to the project site and its ability to respond for consultations on the project.

• Qualifications and background of the firm and specific individuals that would be handling the work including a description of which phases of the work could be provided in-house and any proposed subcontracts which might be included.

• A proposed time schedule for the completion date, realistic deadlines for each phase of the project, and the acquisition of necessary building permits, etc.

Once a firm has been selected, the question of a contract must be addressed. Both the American Institute of Architects and the National Society of Professional Engineers have standard contracts which may be used, or a simple letter of agreement may be sufficient. Homeowners should ensure that the contract includes a detailed scope of work in accordance with their wishes. Professionals suggest that a firm be selected on the basis of capabilities, and then a fee for the work be negotiated with the selected firm. A proposed labor hour breakdown on large projects will assist the homeowner in determining if the fee is in line with the work to be performed.

General Contractors. Contractors are normally also licensed in the state where they do business, and there may be local codes that have additional requirements for certain specialized contractors, such as electricians. Along with price, the criteria for selecting a contractor should be the same as those used for A/E firms. A general contractor will often use subcontractors in the project. This should be specified in advance. Normally, the general contractor's fee will include all payments to subcontractors as well as management of the entire project.

When shopping for a contractor, the homeowner should obtain estimates from two or more contractors on the same project and ask for explanations from each about the differences in price. Since each contractor may operate with different kinds of equipment, different standards of workmanship, and different degrees of experience, the final choice should not be based solely on the lowest bid, but also on the quality of work and the ability to deliver the product within budget and on time.

Homeowners should obtain photos of the contractors' previous projects or details of sites that can be visited to examine their work. They should ask previous customers in particular about the contractor's quality of work, timeliness, and whether the proposed budget was met. A call to the local Better Business Bureau can determine if any complaints have been registered against a particular contractor with the local agency.

Among the questions that should be answered about the contractor are:

• Has the contractor previously done any similar work?

• Does the contractor regularly work on residential structures? Does the contractor thoroughly understand the work and will it be completed as specified?

• Does the contractor intend to employ subcontractors, and are they qualified to do the work?

• Do the contractor and any subcontractors carry liability insurance?

There are various forms of construction contracts used today, but the important items to check for are:

• Detailed Scope of Work

- Basis of Payment
- Period of Performance
- Warranties and Bonding
- Adequate Insurance Coverage

The homeowner should accept work as final only when all provisions of the contract are satisfied. Never sign "completion papers" before the work is completed or make final payment if work is not completed. Before making final payment to the general contractor, the homeowner should insist that the contractor submit a statement that all subcontractors and material suppliers have been paid. If large sums of money are involved, the homeowner should insist that this statement be signed by the major subcontractors involved. If a subcontractor goes unpaid, in most states, that subcontractor has the legal right to place a lien on the home for the amount of payment. This generally means that the subcontractor would have to be paid and the lien removed before the homeowner would be able to sell the house.

Following these general selection and contracting guidelines, the homeowner should be able to enter into a clear client/contractor relationship on a flood proofing project.

SOURCES OF ASSISTANCE

Financial and technical assistance may be available from state, federal, or local governments and community agencies to help property owners flood proof buildings. Property owners should investigate the availability of assistance and utilize free technical and/or financial assistance in their initial flood proofing efforts. The property owner may also need to obtain paid technical assistance from a local architect/engineer firm that has experience in flood proofing individual homes.

Technical assistance may be obtained from the State of Virginia, specifically the Floodplain Programs Section, Department of Conservation and Recreation, Division of Soil and Water Conservation. Assistance is also available from federal agencies, such as the U.S. Army Corps of Engineers (COE), Federal Emergency Management Agency (FEMA), Department of Housing and Urban Development (HUD), Soil Conservation Service (SCS), Tennessee Valley Authority (TVA), and Small Business Administration (SBA), as well as some local agencies. More information on flood proofing assistance programs administered by various agencies and organizations, as well as points of contact for various agencies, are included in the COE National Flood Proofing Committee's document entitled "Flood Proofing Techniques, Programs, and References," as well as many other flood proofing reference documents.

The table on the following page is a listing of addresses and telephone numbers of some of the key agencies from which floodplain and flood proofing information is available.

In addition to these, there are a number of other agencies which may be of specific assistance. These agencies and a brief description of their work follow.

- Local Building Departments

Regulations that affect flood proofing are implemented by local building, zoning, or housing code departments. These offices sometimes provide general information and technical assistance to property owners. Several have developed handbooks on flood proofing for their residents.

Point of contact: Generally, county regulatory departments only operate in unincorporated areas. Municipal departments have jurisdiction in incorporated cities, towns, and villages (check the local

Agency	Address	Phone No.
Department of Conservation & Recreation, Div. of Soil and Water Conservation, Bureau of Rivers & Shores	203 Governor Street Suite 206 Richmond, Va. 23219-2094	804-371-6095
Floodplain Management Services Branch, Planning Division, Norfolk District, U.S. Army Corps of Engineers	803 Front Street Norfolk, Va. 23510-1096	804-441-7779
Federal Emergency Management Agency, Region III	Liberty Square Building 2nd Floor 105 South Seventh Street Philadelphia, Pa. 19106-3316	215-431-5500
Floodplain Management Services, Lower Mississippi Valley Division, U.S. Army Corps of Engineers	P.O. Box 80 Vicksburg, Ms. 39181-0080	601-634-5827

telephone directory). The state NFIP coordinator and FEMA Regional Offices may know of local departments particularly active in flood proofing.

- Local Housing, Community Development, and Planning Agencies

There are many different kinds of city, county, and regional agencies involved in housing, planning, urban renewal, and community development. Community development departments and housing authorities work to improve local housing conditions through both public housing and programs to help low- and moderate-income residents. This work can be in the form of building inspections, technical assistance, and financial assistance.

Other local and regional agencies include regional planning commissions, sanitary districts, and water management districts. Most provide general information to residents and technical assistance to local officials. Some sanitary districts have regulatory authority based on the need to keep flood waters out of sewer lines. Some of these agencies have active technical and financial assistance programs to help property owners flood proof.

Point of contact: These agencies may be listed in the local telephone directory. State NFIP coordinators and FEMA Regional Offices may know of

agencies particularly active in flood proofing.

• Soil Conservation Service (SCS)

As part of the U.S. Department of Agriculture, the SCS primarily serves rural areas. SCS staff provides information on land use planning; conservation planning; resource development; water management and flood prevention to farmers, community officials, and land developers. While mostly a general information and technical assistance operation, SCS also funds protection projects that can include flood proofing elements.

Point of contact: The SCS' work is conducted through local soil and water conservation districts. The point of contact is the district conservationist who usually has an office in the county seat (check the local telephone directory) or call the state office in Richmond at 804-771-2457).

• Small Business Administration (SBA)

The SBA administers the federal government's major disaster loan program. In spite of its name, SBA disaster loans are available for any privately owned property, including businesses and residences. The low interest loans are provided to rebuild a damaged building, including the cost of bringing a building up to the building code standards. The loans can pay for code-required flood proofing of substantially damaged buildings and some smaller projects that are not required by code. SBA loans are only available following either a SBA or Presidentially declared disaster.

Point of contact: Disaster Application Centers are established to process applications. The location and hours of these centers are well publicized.

• Department of Housing and Urban Development (HUD)

HUD programs are designed to improve housing conditions, local economies, and neighborhoods. As the nation's housing agency, HUD has been active in protecting both public and privately owned homes from flood damage. HUD's major flood proofing program is the Community Development Block Grant (CDBG), which provides funds directly to larger cities and counties. States handle CDBG funds for smaller communities.

The block grant concept allows states and communities to set their funding priorities as long as the local projects relate to program objectives, i.e., they must benefit low- and moderate-income people, prevent or eliminate slums and blight, or meet other urgent community development needs. Many communities have used CDBG funds to flood proof buildings as a way to provide low-income residents with safe and sanitary housing. Some states have reserved block grant funds for special post-disaster projects that have included flood proofing.

Point of contact: Virginia's HUD Area Office (804-278-4575). State departments of community affairs are also points of contact on the Community Development Block Grant (check the local telephone directory).

• Association of State Floodplain Managers (ASFPM), P.O. Box 2051, Madison, WI 53701-2051

While not a government agency, the ASFPM supports many government flood proofing programs. Its Floodproofing/Retrofitting Committee works on coordinating and publicizing federal, state, and lo-

cal flood proofing activities. The Mitigation Committee focuses on post-disaster activities, especially programs that can provide funding help to property owners.

The Association sponsors a Floodplain Management Resource Center that is both a library and a referral service for floodplain management publications from around the nation. Publication summaries are entered into a computer data base and, by using key words, Center staff can easily and quickly search through the data base for publications that best meet a user's need. Write to:

Natural Hazards Research and Applications Information Center, IBS #6, Campus Box 482, Boulder, CO 80309, Attention: Floodplain Management Resources Center.

FLOOD PROTECTION FACT SHEET

PREPARING FOR A FLOOD

If you live in a floodplain area, there are many things you can do to prepare for the next flood that will save you time, money, or your life. Following is a partial list you can accomplish:

- Determine whether your property is in a floodplain or downstream of a dam. If it is, determine the elevation of the property in relation to nearby streams and other waterways. This information is available from building inspectors/zoning administrators. If below a dam, know the warning system for evacuation in the event of dam failure.
- Learn and practice the safest route from your home or business to high ground.
- Know where community evacuation shelters are located.
- Buy flood insurance and examine claim procedures.
- Itemize personal belongings to facilitate insurance claims.
- Install check or backup valves in building to prevent flood water from backing up sewer lines.
- Prepare an itemized list of personal items you will need if you must evacuate (medicines, prescriptions, clothing, special foods needed for infants, etc.).
- Keep important documents in a flood-free safety deposit box.
- Monitor local radio and television stations for flood warnings.
- Make provisions for pets or livestock.

WHEN FLOODING IS IMMINENT

- Evacuate ASAP if living in a flash flood warning area.
- Elevate or move furniture to a higher floor.
- Fill and anchor tanks to keep them from floating away.
- Grease immovable machinery.
- Turn off electricity, gas, and water at main switch and valves. Label where these are located and teach responsible members of the family where they are located.

- Bring outside possessions inside the house, or tie them down securely.
- Keep gas tank in vehicle(s) at least half full.
- Pack personal evacuation kit.
- If home will not be evacuated or not directly impacted by flood:
  - Draw water and store in air-tight containers.
  - Have a supply of non–perishable food on hand.
  - Have flashlights with spare batteries, portable radio, first aid kit, fire extinguisher, and emergency cooking equipment in working order.

DURING FLOOD CONDITIONS

It is essential to understand that floods are hazardous. The peril is no less if your neighborhood is covered with a foot, or under twelve feet of water.

Things to do include:

- The safety of your family is the most important consideration since flood waters can rise rapidly. Keep the family together so you can evacuate if necessary.
- If evacuation appears necessary, turn off all utilities at the main switch and close the main gas valve. Secure your home before leaving.
- If car stalls in a flooded area, abandon it as soon as possible. Flood waters can rise rapidly and sweep a car (and its occupants) away.
- Listen to radio for information of flood conditions.
- Follow instructions of emergency personnel.
- Keep children out of flood waters (no playing therein).
- Watch out for fallen electrical wires, open manholes, etc.
- Be sensitive to the emotional condition of family members.

- Make plans for recovery.

Things <u>not</u> to do:

- Use foods that have come in contact with flood water.
- Cross a flowing stream where water is above your knees.
- Drive where flood water is extensive over the roads. Parts of the road may be washed out.
- Play or wade in flooded streets.
- Operate electrical equipment in flood water.
- Panic

WHAT TO DO AFTER A FLOOD

When returning to a flooded home or business, one should focus on personal safety, building hazards, cleanup and salvage, and mitigation.

Personal Safety

- Get a tetanus shot. Wear protective gloves and boots. No wading.
- Find out water contamination level and take necessary precautions.
- Look out for "critters" like snakes. Use a stick to lift debris.
- Don't overexert. Many deaths due to flooding occur during cleanup.
- Don't use electrical appliances until cleaned and repaired.
- Don't underestimate emotional stress. Use counselling resources.
- Have children stay out of flooded area.
- Salvage only canned foods and even then exercise extreme care.

Building Hazards

- Contact local official for permission to reoccupy flooded building.
- Make sure gas is turned off and don't light matches until then.
- Make sure electricity is turned off.
- Do not pump basement water all at once. Groundwater pressure against walls may cause them to collapse. Pump over several days.
- Report loose power lines to power company.
- Schedule appointment with insurance agent ASAP.

Cleanup and Salvage - Prioritize cleanup tasks. Store damaged contents on premises for adjuster to inspect.

High Priorities

- Heating and cooling system components must be cleaned and rinsed. Do not operate until inspected by certified technician.
- Open up doors and windows for circulation of air.
- Store valuable papers, works of art, paintings, etc. in cold storage to prevent mildew until they can be restored by an expert.
- Dry books by opening them and standing on end.
- Wooden furniture may warp if dried in direct sunlight. Dry in shade.
- Clean metal ASAP. After dried, wipe with an oiled cloth.

Medium Priorities

- Let wooden floors dry naturally to curtail cracking and splitting.
- Drill hole in wall near floor between studs to drain water.

- Wash with detergent or sanitizing solution (1 or 2 tablespoons of laundry bleach to 1 gallon of water at room temperature.)

- If burners and other motors are to be salvaged, seek guidance from certified technician. Hose down sediment.

Low Priorities

- Shovel and hose down sediment while wet.

- Wash upholstered furniture.

- Clean rugs thoroughly then lay out to dry. Consider professional cleaning.

- Mattresses, pillows and stuffed furniture may be a lost cause.

Mitigation - Steps to be taken to avoid a repeat of flooding devastation.

- Elevate building above flood level on pilings or fill.

- Elevate furnace and utilities above flood level.

- Install flood proofing devices such as "flood shields" across doors.

- Store keepsakes in watertight container or above flood level.

- Install check valves in sewer line and buy sewer backup insurance.

- Relocate structure out of floodplain.

- Buy flood insurance.

ROOF REINFORCEMENT FOR STORM PROOFING

Although roof reinforcement is a subject involving the opposite end of a house from where flooding occurs, it is a pertinent and related topic to discuss under the broad issue of water protection. Hurricanes Hugo and Andrew proved that roofs are highly vulnerable to damage by wind and that typically local building codes may underestimate these forces. The loss of shingles allows water to enter a house causing significant water damage. Once the entire roof is gone, the house is vulnerable to more extensive damage. As a homeowner, there are steps you can take to reduce the vulnerability of your home to roof damage. Typically the weak link in the roof system is where it is connected to the upright walls of a house. As high winds press against a wall in a perpendicular direction, the wind is deflected upward with tremendous upward forces against any overhanging portion of the roof. If the roof is destroyed or damaged by wind forces, a progressive collapse of the structure follows, beginning with the upper portions of the walls down. Additionally the loss of shingles allows water to enter a house causing significant water damage.

The use of hurricane clips or similar metal plate fasteners should be affixed between the rafters and studs. Roof sheathing should be inspected to ensure it is securely nailed down and attached to the rafters. Heavy-weight, self-adhesive type shingles provide more protection than the standard minimally acceptable design. A strong connection from the ridge line of the roof down through the interior stud walls to the floor system and subsequently to the foundation would provide an extremely secure configuration. The ideal time to inspect your roofing system and make necessary upgrades is when it is time for reroofing. This is a perfect opportunity to hire a contractor or roofing specialist to investigate the adequacy of the roof.

BIBLIOGRAPHY

1. Catalog of Residential Depth Damage Functions. U.S. Army Corps of Engineers, IWR Report 92-R-3, Fort Belvoir, Virginia 22060, May 1992.

2. Design Manual for Retrofitting Flood-Prone Residential Structures. Federal Emergency Management Agency, September 1986.

3. Flood Proofing Bibliography. U.S. Army Corps of Engineers, National Flood Proofing Committee, June 1988.

4. Flood Proofing, How to Evaluate Your Options. U.S. Army Corps of Engineers, National Flood Proofing Committee, December 1991.

5. Flood Proofing Regulations. U.S. Army Corps of Engineers, EP 1165-2-314, Washington, D.C. 20314, March 1992.

6. Flood Proofing Systems and Techniques. U.S. Army Corps of Engineers, Washington, D.C. 20314, December 1984.

7. Flood Proofing Techniques, Programs, and References. U.S. Army Corps of Engineers, National Flood Proofing Committee, February 1991.

8. Raising and Moving the Slab-On-Grade. U.S. Army Corps of Engineers, National Flood Proofing Committee, 1990.

9. Report to Stakeholders, Federal Insurance Administration, 1991.

10. Federal Emergency Management Agency Information/Guidance Concerning Elevating Floodprone Structures in Conformance with the National Flood Insurance Program, 1993.

11. Repairing Your Flooded Home, American Red Cross/Federal Emergency Management Agency, 1992.

12. Retrofitting Floodprone Residential Structures (Brochure), Federal Emergency Management Agency, 1987.

13. Best Build III - Videotape, "Protecting a Floodprone Home," Federal Emergency Management Agency/ National Home Builders Association, 30 minutes, 1989.

14. The Floodplain Management Plan for the Commonwealth of Virginia, Department of Conservation and Recreation, 1991.