Property Owner's Guide to Re-Building for Flood Resiliency

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Property Owners Guide to

Re-Building for Flood Resiliency

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Immediate Aftermath

Your home or business is filled with wet mud! The furniture is every which way, and soaking wet. First question: is it safe to be walking in and around it?! Is it still connected to power, is any propane leaking or spilled oil mixed with the mud?

Make sure someone from the fire department, from the propane and/or electric utility - someone trained in what to look for - makes certain that utilities are disconnected and the building is safe for people to be in.

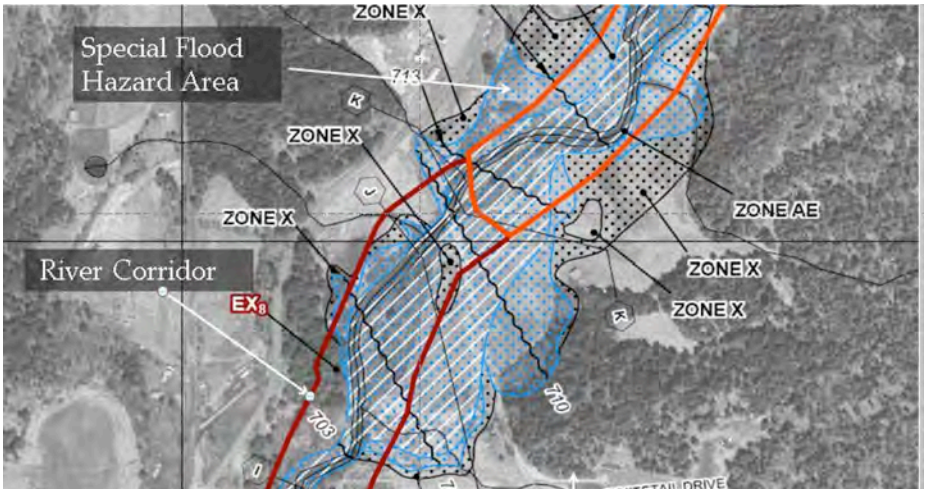
Volunteers often arrive to help – friends, neighbors, family, even complete strangers. You will need a supply of facemasks, latex gloves, shovels, large trash bags, and volunteers making food or delivering drinking water. Hands, feet, noses and mouths need to be protected, since the mud and water can be contaminated with oil or other toxics.

After clearing mud and debris from the building as quickly as possible, mold and mildew will be the next major issue. High-powered generators and heaters are no match for drenched carpet, walls, and furniture. Mold and mildew can set in after only 24 hours. The wet carpet, upholstery, particleboard, fiberglass or cellulose insulation and sheetrock cannot be saved and must be ripped out. Use all creative means to dry out anything that can be dried. This will take weeks. While spraying the damp structural parts remaining with a mildewcide adds to the damp, it is an important precaution.

FEMA.gov offers an extensive library of guides, but the website is not simple to navigate, nor is the information generally applicable to the flash flood river damage experienced most often in inland northern New England. This guide, *Protecting Your Home and Property* at http://www.fema.gov/media-library-data/20130726-1756-25045-8598/protecting_home_book_508compliant.pdf is particularly helpful from day one with

techniques for drying out, addressing mold and mildew, protecting yourself and volunteers, and choosing contractors.

Property Situation

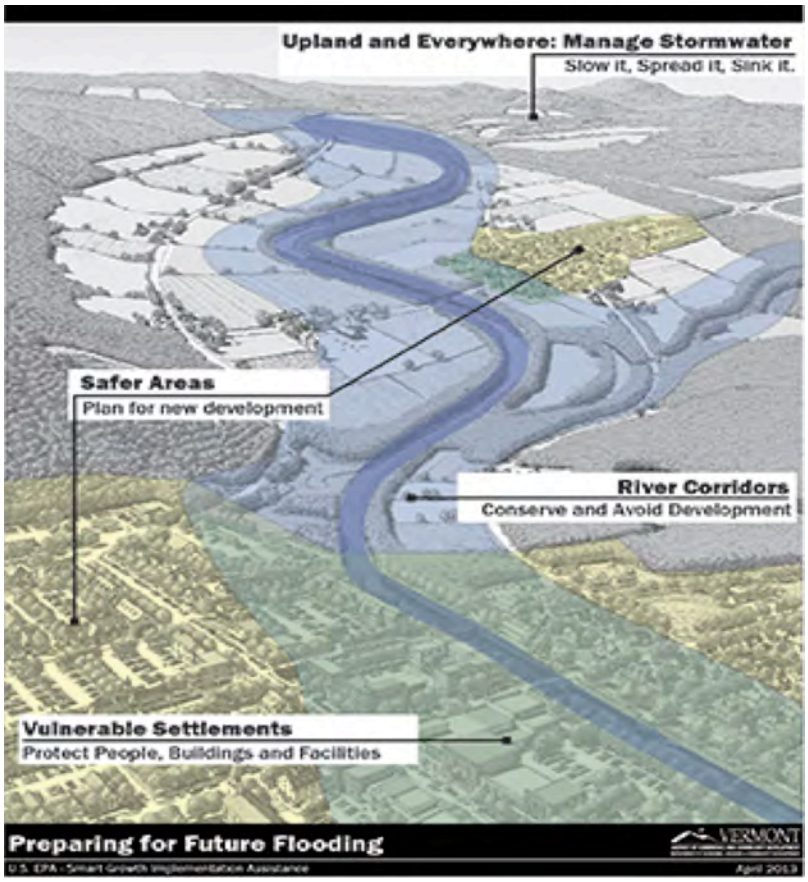


Credit: Vermont Agency of Natural Resources

Is your land located inside the mapped Flood Hazard Area or River Corridor? If you are uncertain, municipal or regional planning commission staff can help you find and interpret the maps available and how they apply to your property. If you have time and interest to access this information yourself, check state websites for background information on the range and meaning of mapping available. Past practice for municipalities, bankers (lenders) and insurers has been to rely on FEMA's Federal Insurance Rate Maps (FIRMs); and these still matter most to insurers and bankers. A library of Fluvial Erosion Hazard maps have been slowly developing as more detailed river corridor work is being completed. The accuracy of these maps, when available, is considered to be much higher. More information and a detailed explanation can be found at http://www.anr.state.vt.us/dec/waterq/rivers/docs/rv_municipalguide.pdf . In Vermont, use the VT Agency of Natural Resources map atlas, http://tinyurl.com/vt-floodmap, to find how your property relates to flood hazard maps, if those maps are available digitally.

Most municipalities have adopted flood hazard by-laws in order to be eligible for FEMA assistance when a disaster event occurs. Familiarize yourself with the municipal flood hazard by-law requirements and insurance rate reduction incentives! After checking with municipal officials, you may find additional information from knowledgeable state agency staff in Emergency Management and in Rivers Management. In Vermont, see tinyurl.com/floodresilience. Review your re-building ideas with friendly real estate agents to learn how the changes may affect marketability of the building. FEMA assistance is never enough to cover losses and re-building. While essential for high risk property in flood hazard areas, recent changes to the National Flood Insurance Program may make it very expensive to insure a building, and difficult to sell or mortgage a property, that does not meet FEMA's standards.

If your property is in the hazard area (shown in blue on this graphic) you need to familiarize yourself with municipal and FEMA requirements for re-building in order to comply with municipal bylaws and meet eligibility requirements for national flood insurance. Call 211 for general information on possible assistance, register with FEMA if the event has been decared a federal disaster or, in the case of commercial properties, register with the Small Business Administration for possible loan assistance. If you are eligible for assistance from FEMA after a disaster, don't incur any expenses you hope to have reimbursed until that federal assistance is officially granted. FEMA cannot provide reimbursement for work already completed! Sometimes the disaster declaration will include release of "Individual and Household Assistance". This funding will not reimburse damage to any losses that could have been insured, but can help with costs such as lodging. There will not be significant help in this source -- payments after Irene averaged $6,732 per household! If you have flood insurance be sure to photograph the structure and damage, and schedule an insurance adjuster through your insurance company to document the damage. If you have flood insurance, and are within the hazard area, you may be eligible for funding for "Increased Cost of Compliance" – a rider carried on all insurance policies which can provide up to $30,000 of compensation if the municipality requires the structure to be demolished, elevated or moved.



Credit: VT Dept of Housing & Community Development

If your property is outside of the mapped flood hazard zone, you will not be eligible for FEMA assistance but have more flexibility when re-building. Flood insurance is critical, however, for property that can be affected by erosive stream or river action. While much flood damage does align with the mapped floodplain, **a significant amount of severe flood damage to structures in Vermont occurs outside the mapped flood hazard area.** Flood insurance is critical for property that can be affected by erosive stream or river action, or for property that common sense indicates may be in a flood-prone area despite being outside FEMA's defined flood hazard zone. Some homes, perched high above a river, have been lost to slumping as the river moves and undercuts the steep slope. Many others, not included on the federal FIRM maps, are located adjacent to steep upland streams that become raging torrents in a large rainfall event. A property that has been flooded once is

vulnerable to flooding again, especially as extreme weather events become more frequent and severe. All property in a community that has adopted a flood hazard by-law is eligible for flood insurance – even if the property is located outside the mapped flood hazard area. More information about the National Flood Insurance Program (NFIP) is available from www.floodsmart.gov .

To Raze or Raise...

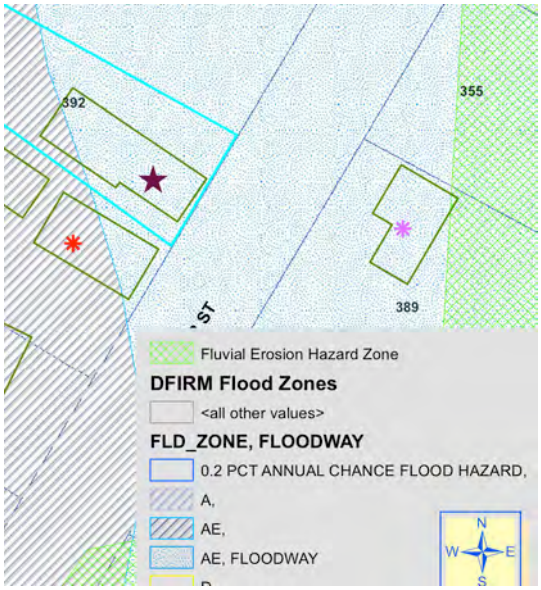
If the building is located in or adjacent to the federally-recognized flood hazard area, the municipality may help you by applying to the FEMA Hazard Mitigation Grant Program (HMGP) for "buy-out" funds, which could provide compensation of 75% of the pre-flood assessed value of the property. Your property then is transferred to the community for demolition of structures and to be re-used as "working floodplain", possibly parkland, with no structures. To be considered for a buy-out, it is critical that no structures be removed from the property prior to the final buy-out application approval -- removing the buildings, even when they have been completely destroyed, before final funding approval is in hand, will make the parcel ineligible for the program! Patience and much fortitude are required, for both owners and creditors, as if those haven't already been taxed, as this option can take two years or more to complete.

If the property is not eligible for a buy-out, a mortgage still exists, and there is no assistance available to pay for demolition or moving the structures, it becomes difficult to consider the raze option. The building-moving option is not often exercised due to the logistics and cost. The FEMA guide previously referenced, *Protecting Your Home and Property From Flood Damage*, has a brief section of advice on this: http://www.fema.gov/media-library-data/20130726-1756-25045-8598/protecting_home_book_508compliant.pdf

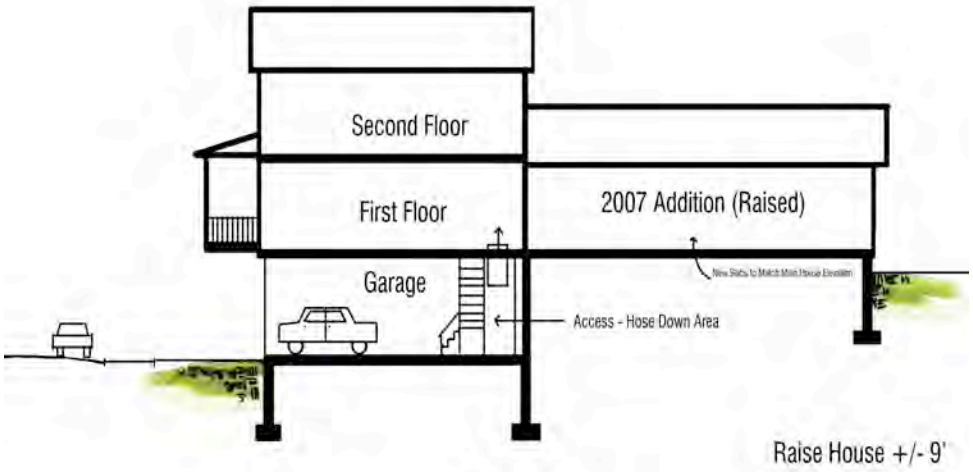
If you're going to stay put and make the place more safe for yourself and future owners, consider a combination of the following to best protect you and yours, as well as help regain some market equity in your property: elevating the structure, landscaping protection, dry - or wet-floodproofing. Again, be sure to consider the National Flood Insurance Program standards as you make decisions, as addressing those parameters will affect the future marketability of the property regardless of the location of the property with respect to the mapped flood hazard area. It should be noted that the official Flood Insurance Rate Maps only use past flood history for their delineations. None of the current maps incorporate the historic flows of 2011 and none anticipate further climate change. Under current flood insurance program rules, if the map changes later the structure will

have premiums that reflect the revised mapped risk when that information changes. This is an important time to think ahead. For every whole foot the bottom floor is elevated above the Base Flood Elevation, the annual flood insurance premium will be reduced.

Elevation

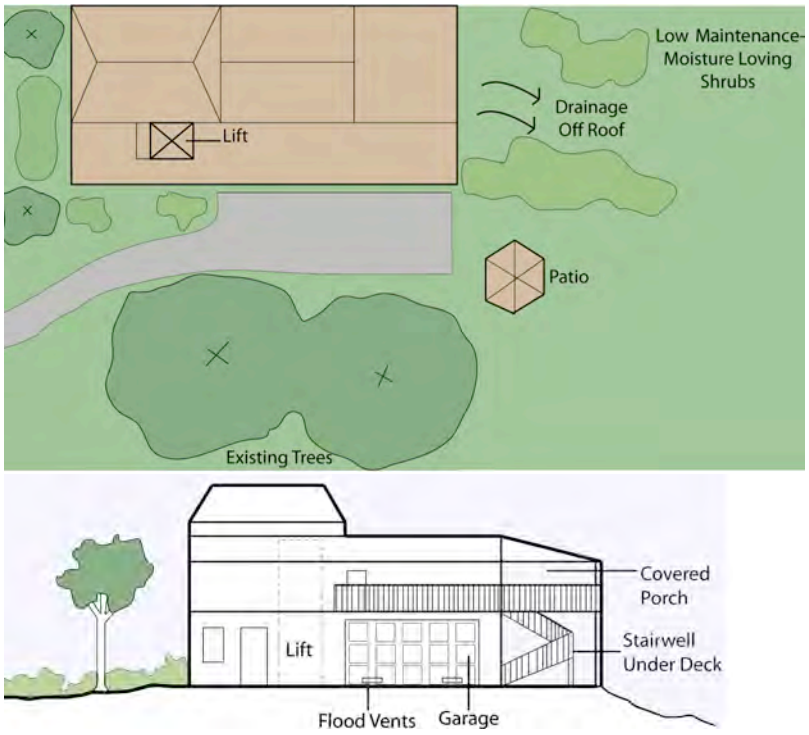


Since Tropical Storm Irene, the historic Water Street neighborhood of Northfield, Vermont has been undergoing major transformation. Applications to the FEMA Hazard Mitigation Grant Program were successful for buying out many of the impacted homes to go through the buyout process to be razed, and the resulting new riverside area will become a park. Other property owners decided to stay. Some of those have gained FEMA HMGP assistance to elevate their homes. For those who carry NFIP insurance, it is important to check into the "Increased Cost of Compliance" (ICC) standard rider on those insurance policies, as this may help cover a portion of the costs for elevating a structure located within a mapped flood hazard zone. One of the most challenging structures has a rear addition, built on a slab foundation with radiant heat in 2007. The larger original structure was built in the 1800's, and is located in the mapped floodway – a dangerous place to be. To further complicate the challenges, one of the household members is handicapped.



Credit: Katherine Anderson, Norwich University, '14

Raising this home offers the opportunity for a garage to be located under the living quarters, as shown in the graphic below. An elevator, also on the graphic, is also eligible under FEMA assistance. A handicap-accessible ramp, which would be helpful considering the danger of inundation in the garage and power outages, is not feasible due to the height of the living floors.



Credit: Jade Burkart, Norwich University, '15

Since the garage is located well below base flood elevation (BFE), it should be constructed and finished with materials easily hosed down to remove mud and debris after future flooding events, such as concrete. In addition, FEMA requires that enclosed areas below the BFE be used only for building access, storage and parking as these area will be flooded again.

Another concept for the same home is shown in the graphic on the left, with the garage to the side rather than front. Careful landscaping will help the elevated home fit into the neighborhood and help absorb stormwater in a low-lying part of the property.

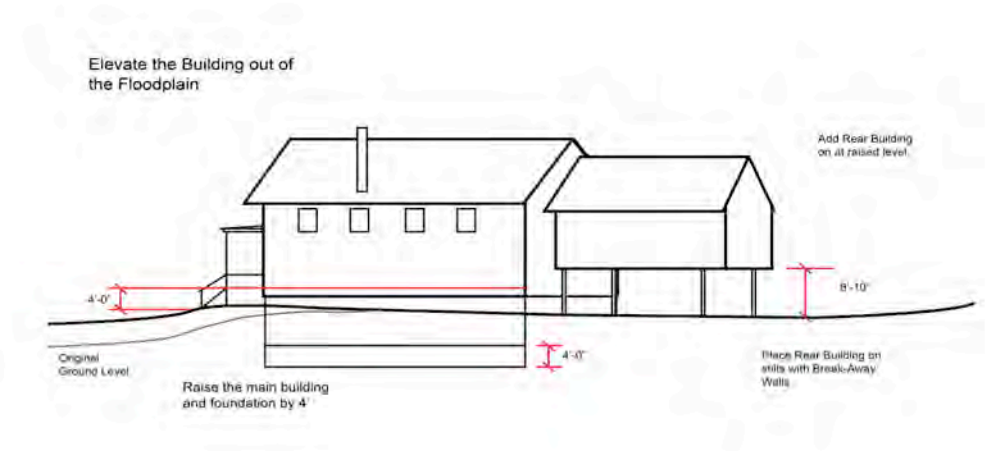
FEMA provides a number of guides that address elevating a home but much of the information is geared to warmer or coastal areas. The Vermont experience is proving, however, that old New England homes on stone foundations can go through the elevation transformation successfully.

Above the Flood: Elevating Your Floodprone House; FEMA P-347 CD July 2008 6pp tri-fold brochure www.**fema**.gov/media-library-data/20130726-1723-25045.../**p**_20.pdf
Elevated Residential Structures; FEMA-54; March 1984 www.**fema**.gov/media-library/assets/documents/3289?id=1670
Protecting Manufactured Homes from Floods and Other Hazards; FEMA P-85CD; November 2009 www.**fema**.gov/media-library/assets/documents/2574?id=1577

Vermont saw very few elevated structures before 2011, but after the ravages of Tropical Storm Irene, many have been. While the FEMA standard is to elevate the living floor at least one foot above base flood elevation (BFE), the common advice is to raise the building at least two feet above BFE, to prepare for extreme events.

Elevation isn't simple – there will be complications. This old house, built in 1805, had the White River rage through it both during Tropical Storm Irene and in the 1927 flood. Although not in the mapped flood hazard area, the property owner did have federal flood insurance. The elevating of the home involved stabilizing two old chimneys. One survived the raising, the other had a rotted base and needed full replacement – and removal of the old brick fireplace. Other rotten sills and beams were discovered and replaced. The damage caused by inserting steel beams through the structure seemed more extreme than the flood damage, but made the most sense for a building on questionable sills with an already-stripped-to-the-studs first floor. The old stone foundation was knocked out to the sides, to be used as the rubble behind a stone breakwater wall (described under the Landscaping section of this guide).

The West Hartford Village Store has already undergone extensive re-building and re-modeling without any elevating of the structure. Although an unlikely strategy for the owner, the following is a possible design for elevating the structure:

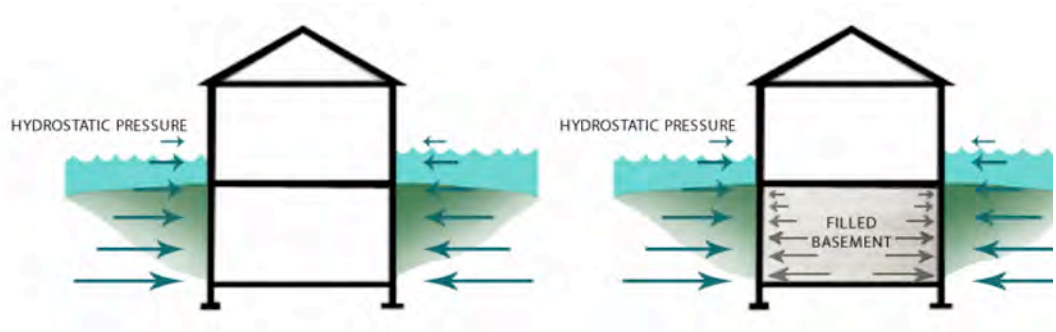


credit: Sam Waite, Norwich University, '14

Basement options

FEMA guides and Certified Floodplain Managers are adamant that basements below BFE are a liability, and should be filled with sand and gravel or flowable fill that can be pumped with a concrete truck. More information on flowable fill is at http://www.nrmca.org/aboutconcrete/cips/17p.pdf, http://www.nrmca.org/members/concreteinfocus/promotion%20library/cif-july-aug-08-

flowable-fill.pdf and
http://www.fema.gov/media-library-data/20130726-1622-20490-2266/fema_d671.pdf.
Hydrostatic pressure is the reason for concern. If the basement becomes surrounded by water pressing in from the outside and has only air inside, the basement foundation for the house may collapse.



Credit: FEMA guides and Katherine Anderson, Norwich University, '14

FEMA guidance, initially designed for southern and coastal regions, has been to build a structure on pilings or to insert louvers in the foundation walls, to allow floodwater to flow through. The idea of a flow-thru basement under a home in a northern climate, subject to flooding from an ice jam event, is unnerving – leading property owners to choose the filled basement approach.

The owner of this lovely old home shown flooded here, invested in elevating

the structure 7' higher than its original elevation, placing a deep foundation beneath, providing flow-through openings (flood vents) in the foundation walls and then filling that foundation with gravel below the slab floor.

There is 4" of waterproof foam insulation under the slab. The utilities, such as the furnace, are located on the first floor, and wall-mounted to be elevated above the floor.
The owner's flood insurance has been very significantly reduced, as the structure was elevated 1.5 feet above the BFE.

Flood vents have been used in garages, and are a success story for the Waterbury (Vermont) Fire Station. This makes good sense for buildings readily hosed out after muddy flood water flows through. More information is provided below, under "Wet Floodproofing".

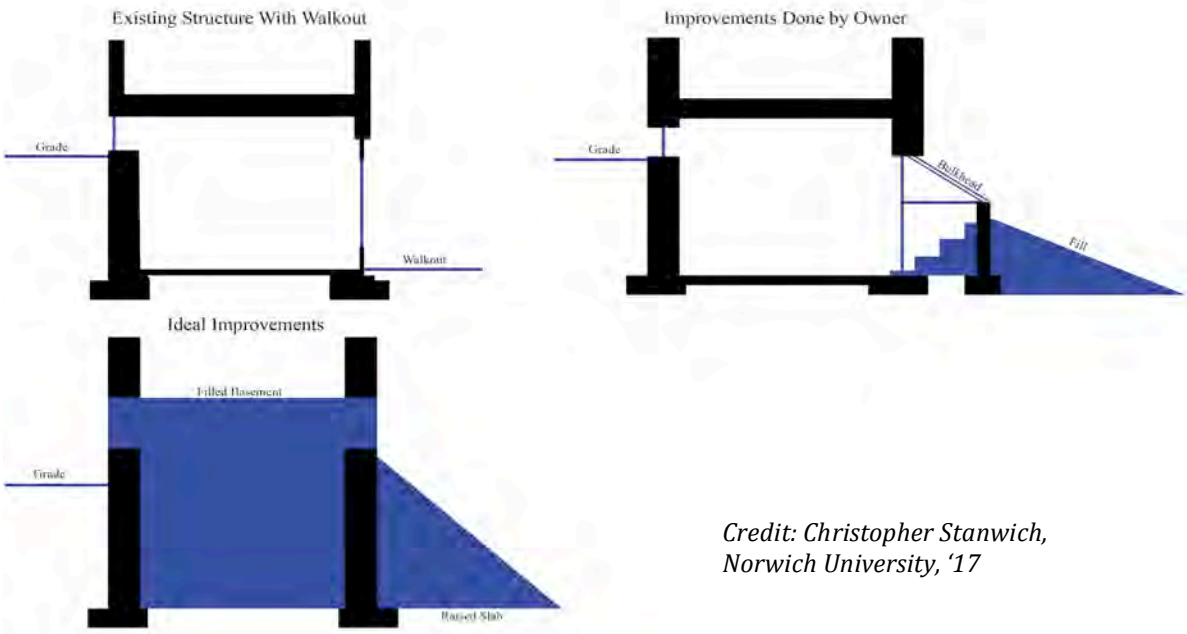
Another option is to place shields over windows and doors to block water from entering. Examples in Vermont that worked very well during the Irene event, include the Children's Theater in Brattleboro and the Burnham Hall library in Lincoln (shown right). Both were installed with FEMA HMGP funds after previous flooding events caused major community losses. For more information, see http://vtstrong.vermont.gov/Home/CommunityCaseStudy/BurnhamHall.aspx

Credit: Vermont Strong

There are a number of examples of structures re-built after Irene, which were not in mapped flood hazard areas, requiring the design of protective strategies without much guidance or financial assistance. Most often, if only the basement received the floodwaters, re-building after clean-out has, at a minimum, included raising utilities and appliances well off the floor, and placing the water storage tank against the basement ceiling. Others have attempted to add protection via concrete abutments or re-grading to send stormwater away from the structure.

This property owner is addressing extreme flash flood events with raging impact on the scale of Irene that last only a few hours, rather than prolonged inundation. The intention is to have the storage benefit (recognizing anything there could be flooded) of the new basement for years of safety between events while holding onto the building when a massive event does occur. No windows or doors were installed on the upstream side of the basement, and extra rebar reinforcement in the upstream basement wall and the floor was requested. The former French door that the river had burst through was replaced with a solid wall and the one remaining window on the upstream side was raised. Only two basement windows exist (slightly below Irene flood level) and will have rudimentary shields. The bulkhead (at Irene level) will be enclosed in a shed building designed to allow better sandbagging. Again, this building is currently not subject to FEMA requirements, as it is located outside a mapped flood hazard area, but the owner does want to address possible future flood insurance and property marketing issues, as well as make the home safer from future flooding events.

Another example of the problems posed by a bulkhead is addressed in the graphic series below. The first diagram is of a walkout basement door, for a basement fully flooded during Irene. The owner, whose property is outside the mapped flood hazard area, made the "improvements" illustrated in the picture to the right: bringing in fill and a bulkhead in hopes of protecting the basement from future flooding. Engineers with expertise in re-building for greater flood protection are adamant that the graphic in the lower corner is the ideal – fill the basement to support its structure.

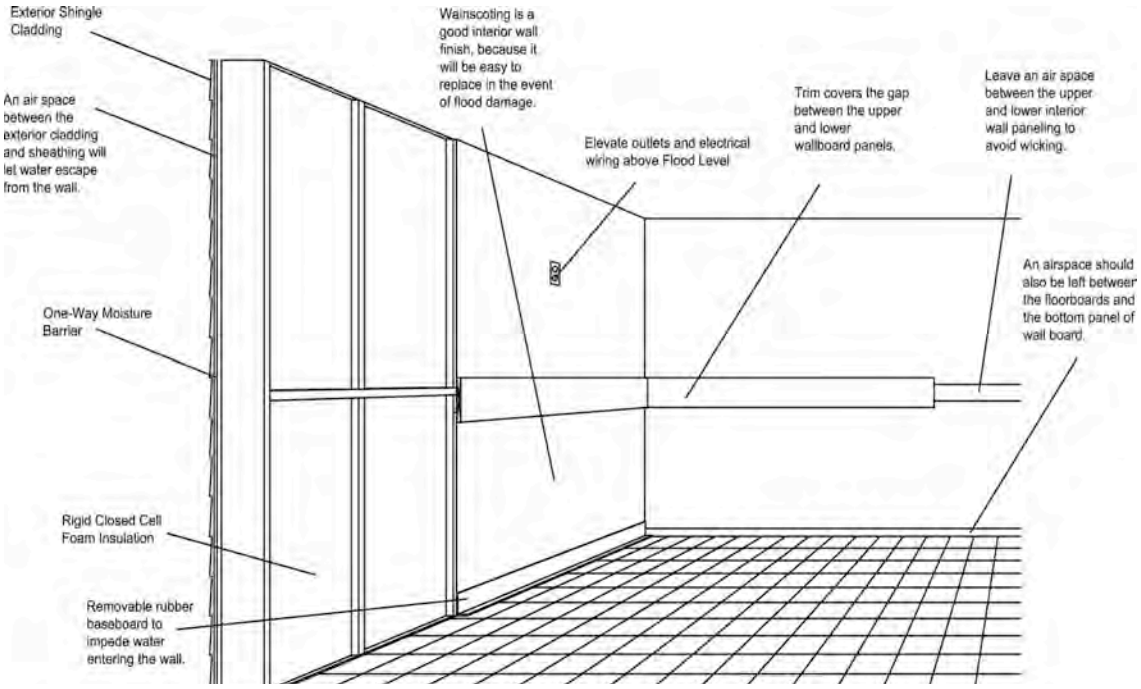


Credit: Christopher Stanwich, Norwich University, '17

Dry Floodproofing

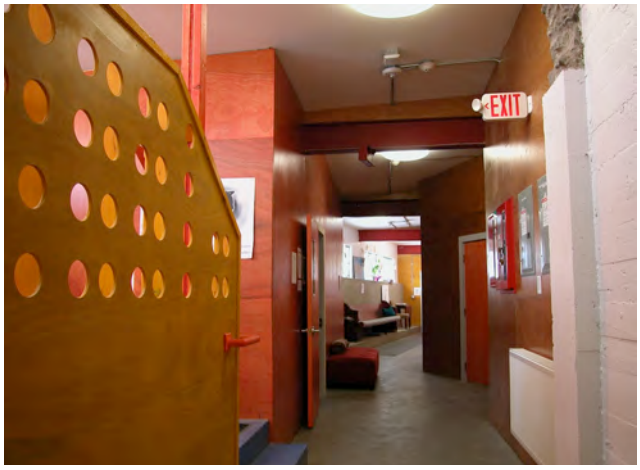
After a flooding event, property owners will work to devise solutions that might make their buildings watertight. Water under high pressure will find any openings, however, and hydrostatic pressure is difficult to guard against. The expense of extreme dry floodproofing rises dramatically, so most often these measures are reserved for public buildings. Keeping all water out is virtually impossible. FEMA guides provide ideas on dryproofing (see: http://www.fema.gov/media-library-data/20130726-1608-20490-9182/fema_551_ch_07.pdf) including the door and window shields used in Burnham Hall (Lincoln, Vermont's, public library) above and/or installing impermeable membrane along basements. Dry floodproofing may not be used to bring a substantially damaged or substantially improved residential structure into compliance with the community's floodplain management ordinance or law. For most property owners, completely dry proofing should be thought of as a nice concept that cannot be realistically achieved.

credit: Sam Waite, Norwich University, '14



Wet Floodproofing

These re-building strategies are aimed at learning to live with getting wet again, and recovering with the least damage, loss and inconvenience. A wonderful, short guide can be found at http://www.lsuagcenter.com/en/family_home/hazards_and_threats/publications/Wet+Floodproofing.htm. The basics are borrowed in this graphic and include installing the wiring and outlets high on the wall, and sheetrock only on the upper half, with easily removed and replaced wainscoting on the lower portion. The tile floors and rigid foam wall insulation are more easily hosed off and dried.

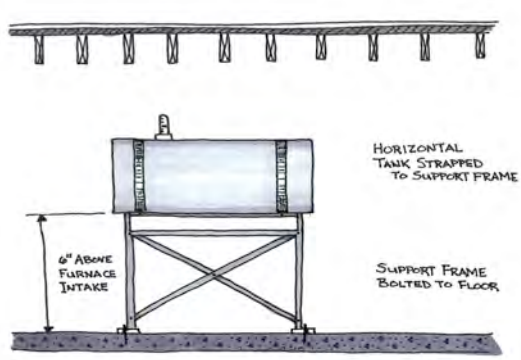


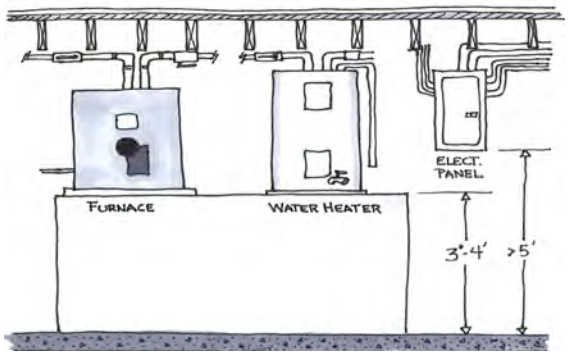
Credit: Daniel Johnson

Another good example is the Watershed Design Studio, an architecture office in White River Junction, Vermont, which was inundated on its basement level during Irene. After being hosed out by the Fire Department, the architects re-designed the basement as space that is both attractive

and also readily able to be hosed out in the future. The use of concrete figures prominently in the ability to minimize damage from both flooding and the subsequent hosing to clean out the space.

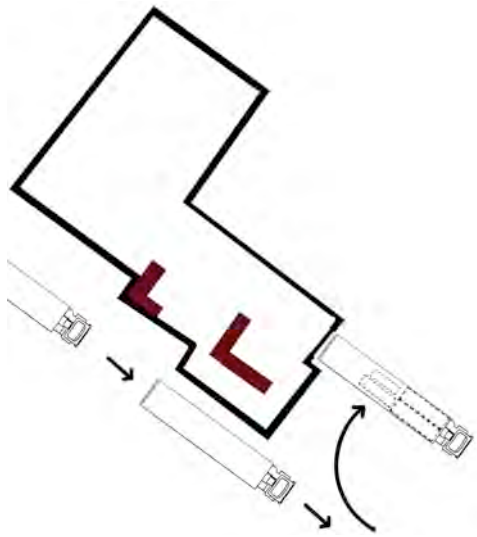
For many properties, flooding primarily affects basements. FEMAs new guidelines for rebuilding are more stringent regarding placement of appliances, water heaters, heating equipment and other key utilities above base flood elevation. Oil tanks need to be securely anchored, to prevent them from floating and leaking. The sewer pipe outlet needs a valve to prevent backflow.





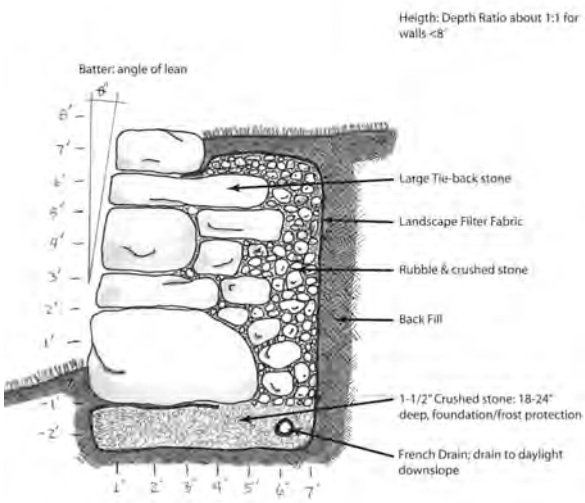
Credit: Stephen Joslyn MArch '14

While some commercial properties may have a gorgeous and prime riverfront location for recreational uses that bring them customers the vast majority of time, the building is in the wrong place when the river overflows its banks. The following example addresses a building containing a mixture of uses by the covered bridge in Waitsfield village. The suggestion for the most vulnerable use, a small ice cream parlor and bakery, is to place the appliances and display cases on casters and creatively conceal a truck loading door. When severe flooding is imminent, as seen during Tropical Storm Irene, simply rent a truck, pull it up to the loading door and remove those appliances and store furnishings to higher ground until it's safe to return them.



Credit: Katherine Anderson, Norwich University, '14

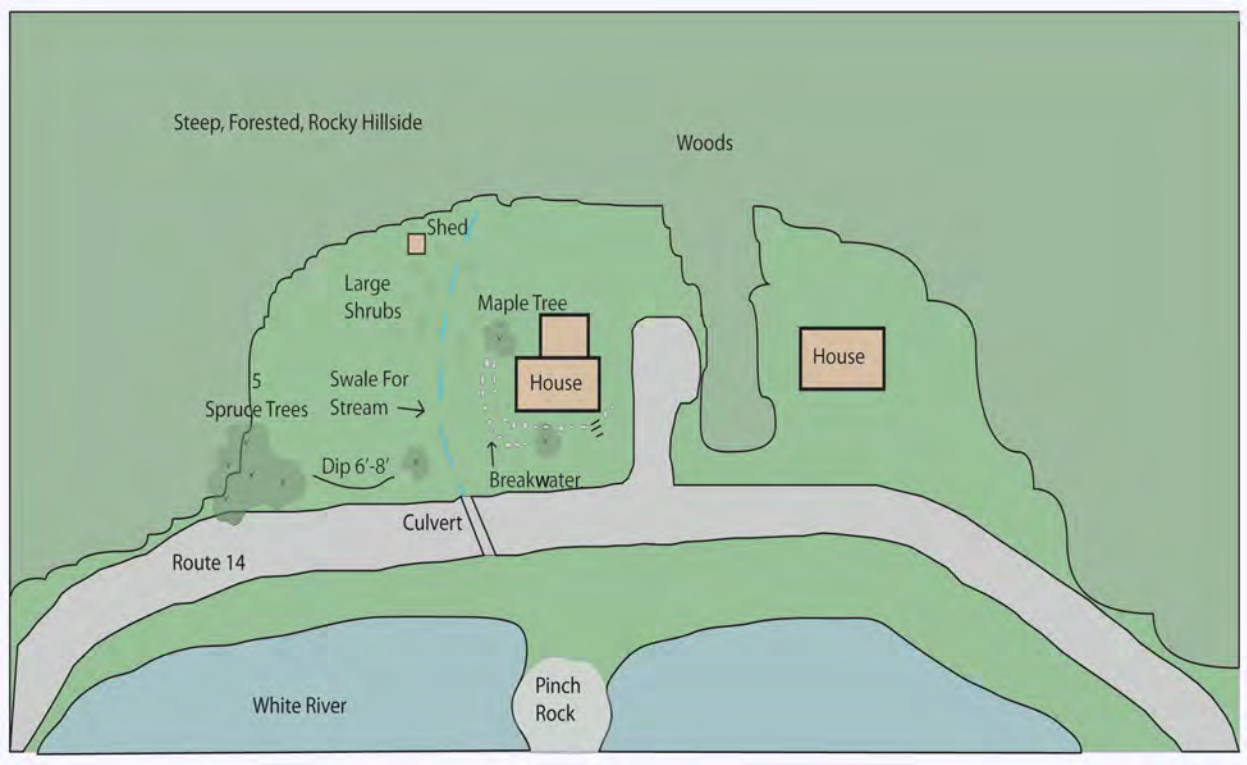
There are a number of creative strategies that can be implemented via landscaping that are both artful and protective. If the property is located within the mapped flood hazard area, these strategies are more limited, as adding fill in a flood hazard area requires a special exemption. The "breakwater wall" in this photo helps this newly-elevated historic Cape fit its site and provides for an attractive garden setting, and also helps protect the structure during future floods by deflecting the flow of the river away from the home. The old maple tree in the forefront is also a protective feature of note. A large tree stump was caught in its branches, preventing it from hitting the house like a cannonball, during Tropical Storm Irene.



Credit: Stephen Joslyn MArch '14 and Ben Canonica, Stone Mason

The wall is constructed as a breakwater, and is much more than just a stonewall. It is constructed to withstand the raging force of the White River, blasting out of its banks in a future flood. The largest rock anchors the base of the wall and is partially buried in the ground.

This property includes multiple landscaping strategies, located in the long sideyard that faces the river upstream. All of the features are aimed to slow and absorb floodwater energy. The features include a six foot dip and cluster of blue spruce that will help disperse the flow of the river when it overflows the state highway and enters the yard. Next, any storm flow will have an uphill climb before meeting a filter of large shrubs, trees and another swale, as well as the breakwater immediately defending the house. The next graphic map provides a map of these features.

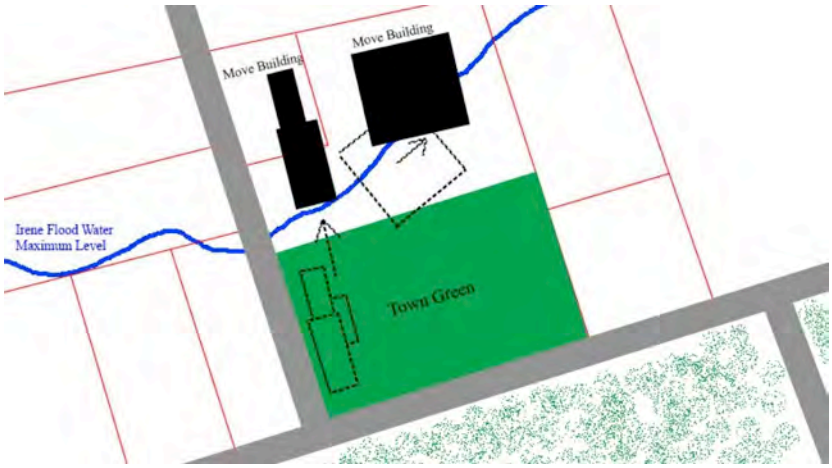


Credit: Jade Burkart, Norwich University, '15

Regardless of whether a site is within or outside of the mapped flood hazard boundaries, a variety of techniques can be used to help the site absorb stormwater or slow it down. Ben Falk, founder and director of the Whole Systems Design firm, speaks to resilient and holistic design of a site. His site designs feature the capture and retention of stormwater along the contours of a hillside, which is an important design feature for the steep slopes that surround us. This concept slows down and captures stormwater in vegetated swales, with a large capacity to absorb excess water. He has numerous videos to explain this concept, including: https://vimeo.com/57208305 or http://www.youtube.com/watch?v=3s5GiPNAbl4

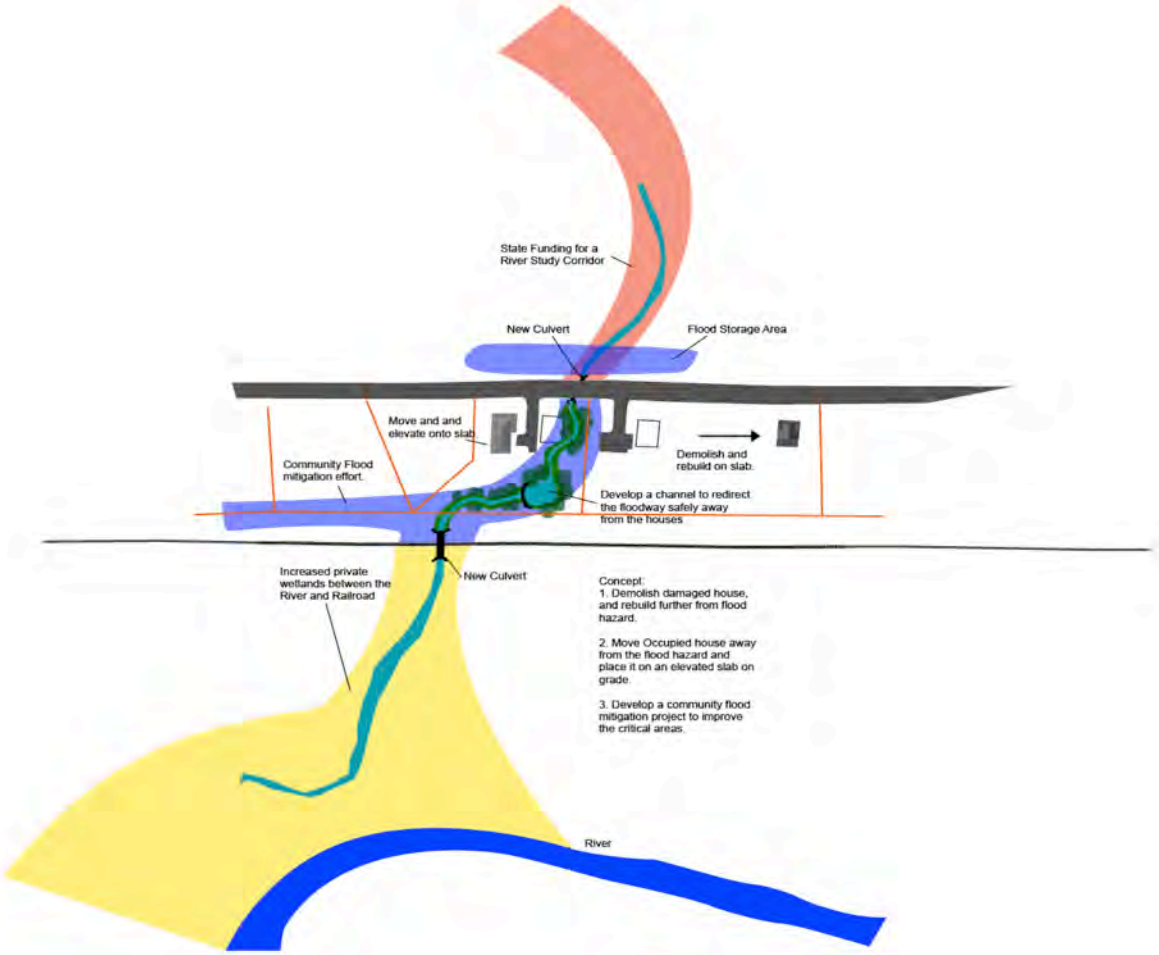
"It Takes a Village"

Some strategies would require a community effort larger than one property owner. The following example is a vision for a general store, pizzeria and post office, central to a small village. The riverfront (at bottom) would include plantings of shrubs and trees to provide a vegetative buffer. The large



Credit: Christopher Stanwich, Norwich University, '17

warehouse buildings in the rear would be removed, through a buyout process such as through Community Development Block Grant (CDBG) funding that would allow re-use of the land. The store could then be moved farther back on the land, out of the immediate hazard area. Its former site could become a village green, making the village center and store into attractive community assets, while adding flood resilience.



credit: Sam Waite, Norwich University, '14

Another conceptual solution, that would require coordinated community effort, involves the scenario above. The steep, wooded stream on the upper side of the graphic overwhelmed the under-sized culvert on the state highway, swept through the two homes shown, and met up with the flood waters from the river at the bottom that had breached the railroad tracks (shown as a black line across the middle). The strategies shown include:

- a stream corridor study to support the project
- a flood storage area on the upper side of the highway,
- a larger culvert under the road,
- moving both homes away from the high velocity stormwater flow
- creating a stormwater sump of water-loving vegetation where the homes were previously located,
- a new culvert under the railroad bed, and
- protection of the wetland storage attributes of the farmland adjacent to the river.

To Sum Up

If your property has been hit hard by flooding, it probably will happen again. Be patient, although there really isn't a choice. Breathe deep and expect that recovery will take 3-5 years, whether you decide to re-build or to work with the town to apply to be bought out. There are many resources listed in this guide to assist you in your decision-making, and those resources will lead you to others. Good luck!

More Resources

Engineering Principles and Practices for Retrofitting Flood-Prone Residential Structures, Third edition, FEMA P-259, January 2012. http://www.fema.gov/library/viewRecord.do?id=1645
(Very detailed and lengthy resource (Table of Contents is 25pp) outlining engineering and design analyses - good reference for design professionals researching a particular strategy)

VT Agency of Natural Resources: *Flood Resilience* website with blog Sharepoint; tinyurl.com/floodresilience

Flood Damage-Resistant Materials Requirements – Technical Bulletin 2 – Aug 2008, FEMA, from eXtension online: How to Select Building Materials That Resist Moisture http://www.extension.org/pages/13870/how-to-select-building-materials-that-resist-moisture...

Floodproofing Non-Residential Structures, FEMA P-102, May 1986. http://www.fema.gov/library/viewRecord.do?id=3581

Homeowner's Guide to Retrofitting, Six Ways to Protect Your Home from Flooding, FEMA P-312, Second Edition, December

2009. http://www.fema.gov/library/viewRecord.do?id=1420

Low Country Rx: Wet Floodproofing; JLC Journal of Light Construction from Coastal Contractor July 2006. http:/www.jlconline.com/coastal-contractor/low-country-rx-wet-floodproofing.aspx?printer… *Short article derived from LSU publication above*

Openings in Foundation Walls and Walls of Enclosures; FEMA/NFIP Technical Bulletin 1-08; August 2008. http://www.fema.gov/media-library-data/20130726-1502-20490-9949/fema_tb_1__1_.pdf

"One man elevates his home with 75 screw jacks and 15 friends"; *Mitigation Best Practices* newsletter; April 2009; FEMA Region VI; 2pp

Protecting Building Utilities From Flood Damage, FEMA P-348, November 1999. http://www.fema.gov/library/viewRecord.do?id=1750

Protecting Manufactured Homes from Floods and Other Hazards, A Multi-Hazard Foundation and Installation Guide, FEMA-85, Second Edition, November 2009. http://www.fema.gov/library/viewRecord.do?id=1577

Sea Bright Mitigation; A Mitigation Success Story -- two homes in Sea Bright, NJ survived Hurricane Sandy with minimal damage after being built with mitigation in mind. Uploaded March 20, 2013; **fema.gov**

Watertight Doors and Floodproofing; Product Sales Website; http://www.presray.com/flood-protection-flood-barriers-overview/

Wet Floodproofing, FEMA, Jul 26, 2013 http://www.fema.gov/media-library-data/20130726-1441-20490-0396/06_fema_p312_chap_6.pdf

Wet Floodproofing Requirements for Structures Located in Special Flood Hazard Areas FEMA publication TB-7/ December 1993 https://www.**fema**.gov/media-library/assets/documents/3503?id=1720

Openings in Foundations Walls and Walls of Enclosures Below Elevated Buildings in Special Flood Hazard Areas FEMA TB-1 August 2008; www.**fema**.gov/media-library-data/20130726…/**fema_tb_1__1**_.pdf