CITY OF BALTIMORE - CHAP

Commission for Historical & Architectural Preservation

Fells Point Flood Mitigation Guidelines

PURPOSE

Many of Baltimore's historic neighborhoods are vulnerable to flooding, particularly those close to waterfronts like Fells Point. Whether on the roads, sidewalks, or directly impacting buildings, flooding is becoming a more common problem across the City of Baltimore. The historic, attached rowhouse buildings of Fells Point are particularly vulnerable and pose a real challenge for owners seeking to minimize flood damage.

The information presented in this guide is intended to provide information to property owners and tenants on evaluating options to minimize the impact of flooding to their historic rowhouse properties in Fells Point. It should be considered a supplement to consultation with architects and engineers, the Baltimore Floodplain Regulations, the *Baltimore Historic Preservation Design Guidelines,* and the CHAP review process.

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The Department of Planning is available to meet with applicants to review permits required for proposed projects. All applicants proposing exterior flood mitigation measures in Baltimore City Historic Districts and on Baltimore City Landmarks must obtain an Authorization to Proceed from the Commission for Historical and Architectural Preservation (CHAP) permit. Both exterior and interior work may require a Floodplain Permit, in addition to all other necessary City permits prior to proceeding with any work. The Department of Planning's Floodplain Managers is available to provide guidance regarding floodplain regulations.

Reviewing and becoming familiar with these *Guidelines* during the early stages of a project can move a project quickly through the permit approval process, saving both time and money. Staff review of all exterior work is required to ensure proposed work is appropriate to each specific property.

The information presented in this guide is intended to serve as a supplement to the *Baltimore City Historic Preservation Design Guidelines*. (The *Historic Preservation Design Guidelines* are available on CHAP's website.) For more information, to clarify whether a proposed project requires CHAP review, or to obtain a permit application, visit CHAP's website at chap.baltimorecity.gov. Contact CHAP at (410) 396-4866 to schedule a meeting with a CHAP representative. (Refer to *Applicability of Floodplain Management Regulations*, page 5.)

DEFINING TERMS

1% Annual Chance Floodplain (100-year Floodplain): An area that has a 1% chance of flooding in any given year. Properties can experience a "100-year flood" in two consecutive years, just as it is possible for properties to flood even if they are located outside of the floodplain, particularly in a severe weather event such as a hurricane.

0.2% Annual Chance Floodplain (500-year Floodplain): An area that has a 0.2% chance of flooding in any given year.

Adaptation: The process of adjusting to new (climate) conditions in order to reduce risks to valued assets.

ASCE 24: ASCE/SEI 24, American Society of Civil Engineers, "Flood Resistant Design and Construction."

Base Flood Elevation (BFE): The height that water is expected to reach or exceed during the 1% annual chance (100-year) flood event as indicated on FEMA issued Flood Insurance Rate Maps (FIRMs). Flood insurance premiums are determined in part on the relationship between the BFE and the height of the lowest floor of a structure, including the basement.

Basement: Any area of a structure having its floor subgrade (below ground level) on all sides.

Design Flood Elevation (DFE): The design flood elevation is the minimum elevation requirement of ASCE 24, plus freeboard. This is essentially the base flood elevation plus 2-feet. The elevation of the lowest floor of a building must be at or above the design flood elevation. In Baltimore, the DFE is referred to as the Flood Protection Elevation (FPE).

Digital Flood Insurance Rate Maps (DFIRMs): Digitally converted flood insurance maps developed by the Maryland Department of the Environment in conjunction with FEMA.

Elevation Certificate: A certification, in the form and containing the information required by FEMA, of the elevations of a structure and its improvements. An Elevation Certificate may only be prepared and certified by a licensed land surveyor, using Mean Sea Level as established by the North American Vertical Datum of 1988 ("NAVD").

Fill: Materials including gravel, crushed stone, and soil placed in an area to increase ground elevations or change soil characteristics. Per Baltimore City Code, the placement of more than 600 cubic yards or fill per acre in the floodplain is prohibited except by variance.

Flood Insurance Rate Maps (FIRMs): The official map, prepared by FEMA, that depicts the Regulated Flood Hazard Areas. These maps are based upon historical flood information and updated periodically and do not reflect anticipated sea level rise or climate change.

Flood Damage Resistant Materials: Materials identified by FEMA as flood resistant. (Refer to *Use Flood Damage-Resistent Materials in Flood-Prone Locations*, page 8.)

Floodplain: Any land area susceptible to being inundated by water from any source. It includes the floodway and flood-fringe areas.

Floodproofing: Any combination of structural or non-structural adjustments, changes, or actions that reduce or eliminate flood damage to a structure, its contents, and its attendant utilities and equipment.

Floodproofing Certificate: A certification, in the form and containing the information required by FEMA, that a structure has been designed and constructed to be dry floodproofed to the flood protection elevation. A floodproofing certificate may only be prepared and certified by a licensed professional engineer or professional architect. (Refer to *Design Professionals*, page 8.)

Floodproofing, Dry: The floodproofing method that, as specified in ASCE 24, is used to render a structure's envelope substantially impermeable to the entrance of floodwaters. (Refer to page 14.)

Floodproofing, Wet: The floodproofing method that relies on flood-damage-resistant materials and construction techniques to minimize flood damage to areas below the design-flood elevation of a structure. (Refer to page 10.)

Flood Protection Elevation (FPE): In Baltimore City, the flood protection elevation, also known as the design flood elevation, is the minimum elevation requirement of ASCE 24, plus freedboard. This is essentially the base flood elevation plus 2-feet. The 2-feet freeboard standard is applied in the 100 and 500 floodplains, which are both regulated in the City of Baltimore.

Freeboard: A 2-foot increment of elevation added to the minimum elevation specifications of ASCE 24 to be in compliance with the City of Baltimore's floodplain management regulations.

Historic Structure: A structure that is:

1. Individually listed in the National Register of Historic Places or certified or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing in the Register;
2. Individually listed in the Maryland Register of Historic Properties;
3. Individually listed in the Baltimore City Landmark List or that is contributing to a Baltimore City Historic District;
4. Certified or preliminarily determined by the Secretary of the Interior as contributing to the historic significance of an historic district registered with the Secretary.

Integrity: The ability of a property to convey its historic significance.

Lowest Floor: The lowest floor of the lowest enclosed area not including any unfinished or flood-resistant enclosure that is usable solely for parking vehicles, building access, or limited storage, as long as the enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirements of the FEMA, NFIP.

National Flood Insurance Program (NFIP): A program administered by the federal government that enables property owners in participating communities to purchase flood insurance protection against losses from flooding.

Persistent ("Nuisance") Flooding: Minor flooding which typically results in traffic problems, road closures, overwhelmed storm drains, and occasionally infrastructure damage, in addition to public inconvenience and business interruptions.

Pre-FIRM Structures: Buildings constructed or substantially improved prior to the community's initial FIRM are called "pre-FIRM structures" and were likely not built to avoid or reduce flood damage. Buildings constructed or substantially improved after the community's initial FIRM should have been constructed in compliance with the local floodplain ordinance. Most historic buildings are pre-FIRM structures.

Repetitive Loss Property: An NFIP-insured structure that has had at least 2 paid flood losses of more than $1,000 each in any 10-year period since 1978.

Resilience, Flood: The ability to withstand, respond to, and recover from a flooding or storm event.

Sea Level Rise: A result of climate change, refers to the increased average elevation of coastal waters. The increased height of the seas can cause low lying coastal areas, such as those along the Chesapeake Bay and Atlantic Ocean, to experience more frequent flooding.

Severe Repetitive Loss Property: Any building that:

1. Is covered under a Standard Flood Insurance Policy;
2. Has incurred flood damage for which:
   a. 4 or more separate claim payments have been made under a Standard Flood Insurance Policy with the amount of each such claim exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000; or
   b. At least 2 separate claims payments have been made under a Standard Flood Insurance Policy, with the cumulative amount of such claim payments exceed the fair market value of the insured building on the day before each loss.

Special Flood Hazard Area (SFHA): The land in a floodplain subject to a 1% or greater chance of flooding in any given year as designated by FEMA in the Flood Insurance Study and on the FIRM as Zones A, AE, AO, V, and VE.

Subsidence: The lowering of ground plane elevation that results from geological factors and the compression of land mass following the extraction of groundwater from underground aquifers. Subsidence can exacerbate other types of flooding and increase the frequency of tidal flooding in low-lying areas, particularly when coupled with sea level rise.

Substantial Damage: Damage of any origin sustained by a structure where the cost of restoring the structure to its before-damaged condition would equal or exceed 50% of the market value of the structure before the damage occurred as calculated for cumulative repairs conducted over a 6 year period.

Substantial Improvement: Any combination of repairs, reconstruction, rehabilitation, additions, or other improvements to a structure cumulatively made during the 6-year period immediately preceding a permit application, the aggregate cost of which, together with the cost of the work proposed by the latest permit application, equals or exceeds 50% of the fair market value of the structure before the improvement is started.

COASTAL FLOODING IN BALTIMORE

Historically, much of the flooding in Fells Point is the result of tidal flooding, which can be exacerbated by severe storm events such as tropical storms, hurricanes, and nor'easters. These storms are often accompanied by intense winds, heavy rain, and storm surge inundation. As a result, even storms that do not pass directly over the City can result in flooding.

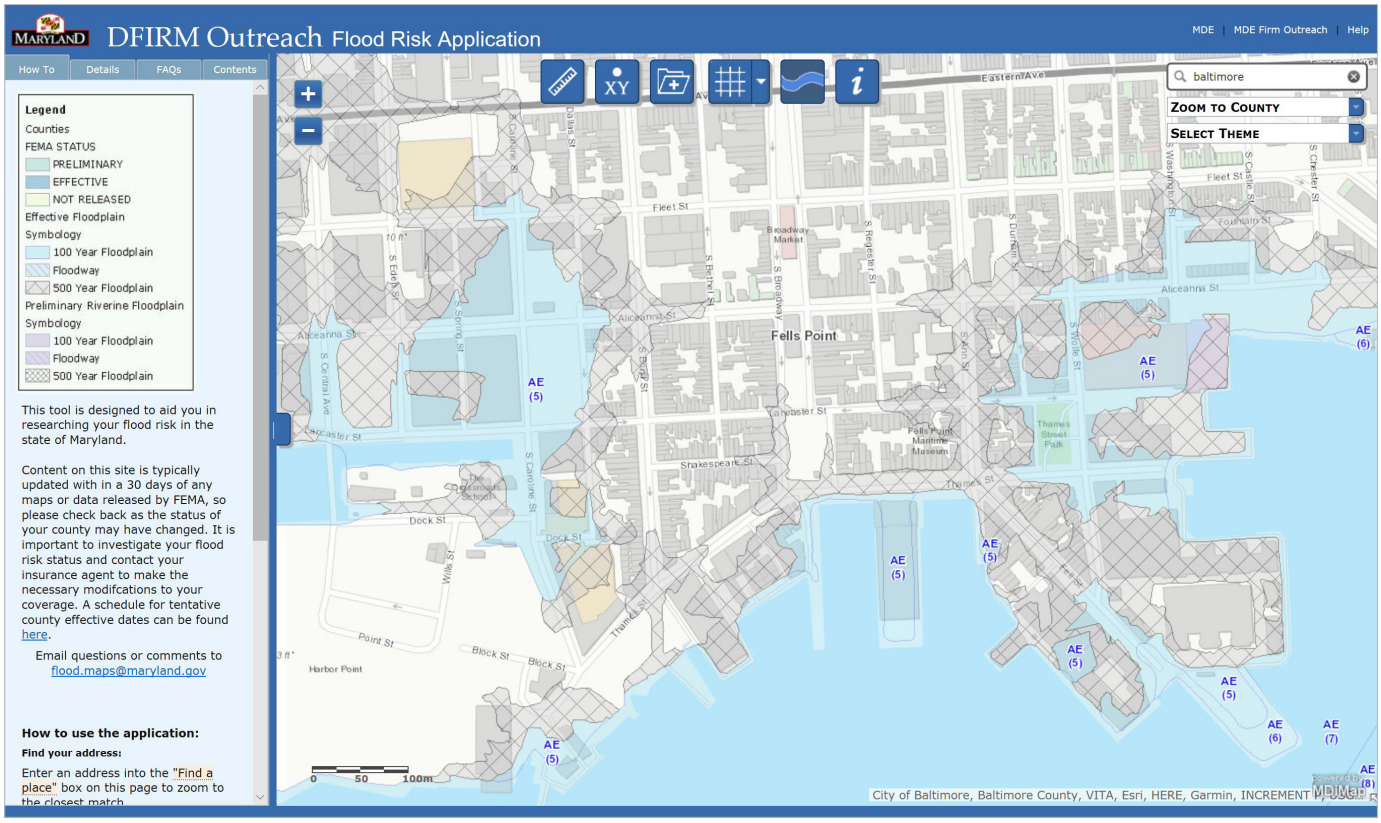
Compounding the effects of storms, sea level rise will increase the impacts of storm-related flooding and persistent tidal flooding. Persistent flooding, also referred to as nuisance flooding, is typically minor flooding which results in traffic problems, road closures and overwhelmed storm drains in addition to public inconvenience and business interruptions. At the beginning, persistent flooding may be associated with exceptionally high tides. With increases in sea level rise and subsidence, "normal" high tides will more frequently cause flooding and the effects of severe storms will intensify.

Henderson's Wharf experienced severe flooding as a result of Hurricane Isabel in 2003. (Source: Baltimore Office of Sustainability.)

FLOODING IN BALTIMORE'S HISTORIC NEIGHBORHOODS

In many cases, the impact of flooding on Baltimore's oldest neighborhoods is more significant than in areas with newer construction. Early European settlements were located close enough to waterways to benefit from ease of transportation as well as access to food and water, while at a sufficient distance to avoid flooding. Streets were laid out and buildings erected based upon past floods, prior to the development of Flood Insurance Rate Maps (FIRMs).

As the rate and intensity of flooding has increased, many of city's oldest buildings have not been substantially altered to reduce the potential impact of flooding. These are known as Pre-FIRM structures. Buildings constructed or substantially improved after Baltimore's initial FIRM should have been constructed in compliance with the local floodplain ordinance of the period, but do not necessarily comply with current floodplain management regulations or building codes.



Flood vulnerability at individual properties can be checked on Maryland's Digital Flood Insurance Rate Map (DFIRM). The DFIRM website includes valuable information and resource links for property owners addressing flood insurance and mitigation as well as a mapping tool that can be searched by street address. (https://mdfloodmaps.net/)

IDENTIFYING FLOOD VULNERABILITY

One of the easiest ways to identify a property's flood vulnerability is to review its proximity to the floodplain. This information can be found on the FIRMs developed by FEMA as well as Maryland's Digital Flood Insurance Rate Maps (DFIRMs) that allow access to floodplain information by property address. The floodplain boundaries on FIRMs and DFIRMs are based upon historical flood data and do not account for climate change or sea level rise.

There are two mapping tools to assist property owners with regard to flooding in the City of Baltimore. The Cityview interactive map is an online tool can provide a quick review of a property's flood vulnerability. (Refer to http://cityview.baltimorecity.gov.) City staff are also available to assist with the Map Information Services (MIS), which can inform residents about basic flood zone information, flood depth data, historical flood information, and natural floodplain functions.

The FIRMs and DFIRMs identify the extent of the 1% floodplain of the ground, also known as the 100-year floodplain, or Special Flood Hazard Area (SFHA), representing the properties at the greatest risk of flooding. Buildings with levels below grade, such as secondary apartments or basements, may be vulnerable to flooding even if they are located outside of floodplain boundaries. In addition, properties outside of designated floodplains may very well experience flooding during major storm events, such as hurricanes, tropical storms, and nor'easters.

The best way to get an accurate flood risk assessment for a specific property is to obtain an Elevation Certificate from a licensed surveyor. The Elevation Certificate will identify the height of the lowest floor relative to the Base Flood Elevation (BFE). The height of the lowest occupied floor can be used to calculate flood insurance rates and determine the height to which the building must be protected to comply with the City's floodplain management regulations. As a benefit, flood insurance may be reduced for properties located within a floodplain whose lowest occupied flood is elevated above the BFE.

FLOOD AND PRESERVATION ACRONYMS

- **ASCE:** American Society of Civil Engineers
- **BFE:** Base Flood Elevation
- **CHAP:** Commission for Historical & Architectural Preservation
- **CRS:** Community Rating System (refer to page 4)
- **DFE:** Design Flood Elevation
- **DFIRM:** Digital Flood Insurance Rate Map
- **FEMA:** Federal Emergency Management Agency
- **FIRM:** Flood Insurance Rate Map
- **FPE:** Flood Protection Elevation
- **MHT:** Maryland Historical Trust
- **NFIP:** National Flood Insurance Program
- **SFHA:** Special Flood Hazard Area

BALTIMORE FLOODPLAIN MANAGEMENT REQUIREMENTS

To provide Baltimore's residents and property owners with increased protection from the impacts of flooding, the City participates in the Community Rating System (CRS). The CRS is a voluntary program that recognizes and encourages community floodplain management activities that exceed National Flood Insurance Protection (NFIP) requirements. The City of Baltimore has achieved a CRS rating of 5. This rating allows property owners to benefit from at 25% reduction in their flood insurance premiums.

As part of the City's goal to protect its residents and reduce property damage associated with flooding, Baltimore has established a Flood Protection Elevation (FPE) that is 2 feet above the Base Flood Elevation (BFE). To be compliant with the City's regulations, the lowest floor must be at or above Baltimore's FPE or be dry floodproofed if a non-residential use. Dry floodproofing is not a compliant option for residences within the City's designated floodplains.

Baltimore's FPE, which exceeds the requirements of the NFIP, contribute to the reduced flood insurance rates through the CRS. Those individual properties that meet or exceed the FPE may be eligible for additional flood insurance premium reductions. An Elevation Certificate prepared by a licensed architect or engineer is the most accurate way to determine the height of lowest floor.

Minor flooding can disrupt the ability to move around the city and cause property damage. (Source: Baltimore Office of Sustainability.)

Floodplain management regulations are intended to reduce property damage associated with flooding. (Source: Baltimore Office of Sustainability.)

APPLICABILITY OF FLOODPLAIN MANAGEMENT REGULATIONS

Proposed property improvements within a locally designated floodplain are required to comply with all applicable Baltimore City Code requirements, including Baltimore's floodplain management regulations.

There are many types of work subject to floodplain management regulations within a designated Baltimore floodplain applicable to all properties, including those designated as historic by the City. Examples are:

- Modifying or adding to any building system or equipment, including electrical, plumbing, heating, and air conditioning;
- Installed finishes, doors, and windows;
- Limiting the use of basements to parking, building access and parking;
- Undertaking substantial improvements to existing structures; and
- Constructing additions to existing structures or erecting new buildings.

Depending on the specific circumstances associated with each property and level of flood vulnerability, variances for floodplain management regulations may be available for minor alterations of historic properties.

Property owners considering complex alterations and new construction should contact Baltimore's Office of Sustainability to:

- Determine the floodplain management regulations applicable to a proposed project;
- Complete a Pre-Development Floodplain Application early in the planning phase of a project; and
- Schedule a meeting with a representative of the Office of Sustainability to better understand the permit review process.

The Office of Sustainability maintains helpful information on their website www.baltimoresustainability.org and can be reached at (410) 396-4556 to schedule an appointment.

CHAP'S ROLE

Baltimore's Commission for Historical and Architectural Preservation (CHAP) helps preserve and revitalize neighborhoods, celebrates City history, and promotes historic preservation as a proven economic driver for the City. As established by the Baltimore City Code, CHAP has jurisdiction over all proposed exterior alterations to properties in locally designated historic districts as well as individual City Landmarks. CHAP also maintains jurisdiction over interior alterations on properties that benefit from City Historic Preservation Tax Credits. Proposed improvements to address flood mitigation, either proactively to provide protection, emergency repairs following a flood event, and larger projects to make buildings serviceable, fall within CHAP's jurisdiction.

In its review of flood mitigation measures, CHAP utilizes the same criteria as it does for other types of alterations. This includes proposed additions intended to offset loss of usable space at existing buildings. However, CHAP recognizes that the increased compliance for flood mitigation at the City's most vulnerable properties will likely require greater interventions and more flexibility in the historical review process. The *Baltimore City Historic Preservation Design Guidelines* provide more specific CHAP review criteria for various types of improvements.

As with all projects affecting historically designated properties, CHAP is available to provide assistance to public regarding potential mitigation options. Although specific flood protection measures cannot be recommended, the staff can provide guidance on whether proposed strategies meet CHAP review criteria.

MARYLAND HISTORIC TRUST REVIEW

The Maryland Historical Trust (MHT), the State Historic Preservation Office, reviews proposed flood mitigation and repair measures for historic properties to ensure, to the degree possible, that proposed alterations do not affect the property's historic character, integrity, and eligibility for funding. MHT reviews properties that are:

- Receiving state or federal funding or permits;
- Seeking financial incentives such as tax credits; and
- Protected by easements held by MHT.

Immediately following a flood, MHT encourages stabilization repairs, including the installation of temporary shoring and roof tarps. Quick action has the potential to reduce the potential for additional damage, and secondary damage such as mold. Prior to undertaking any further work, MHT review should be undertaken for properties under their jurisdiction.

The MHT review is not a substitute for CHAP review. In addition, if there are differences of opinion between CHAP and MHT, the more stringent opinion will apply.

The flood vulnerability of all potential building entrances should be evaluated and addressed to minimize potential damage.

FLOOD MITIGATION

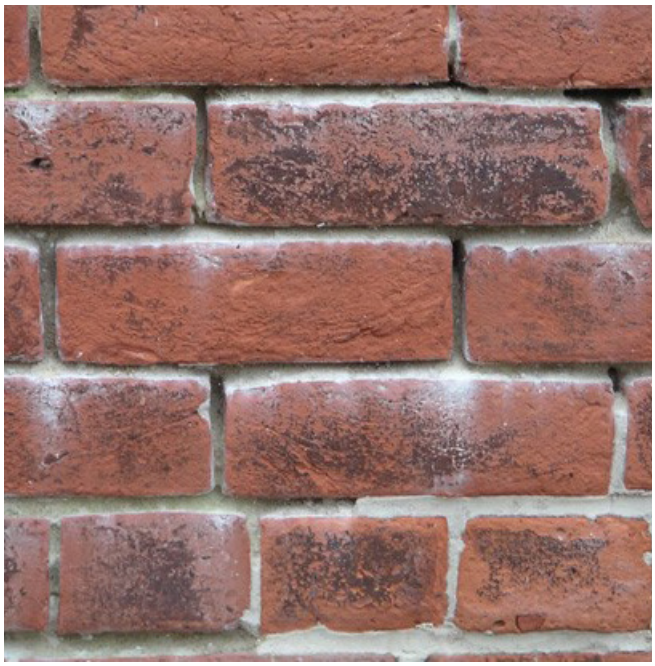
Flood mitigation measures reduce the potential damage to a structure from a flood. The practice of flood mitigation, although intended to protect life and property, is often at odds with historic preservation. Flood mitigation strategies tend to require change, often radical change, that can damage or destroy the integrity or character of historic properties.

In rowhouse communities such as Fells Point, property-specific mitigation options available to improve flood resilience generally fall into one of two categories:

- Basic improvements; and
- Building alterations.

Basic improvements are generally simple, low-impact strategies that are relatively easy and inexpensive to complete. Building alterations are often more complex, likely require the assistance of a design professional, and typically have the greatest impact on the integrity of historic properties.

The entrance door is located below the sidewalk height. As a result, the lower level might be more vulnerable to flooding than what the FIRM may suggest.



Repointing of open joints can reduce interior damage from wind-driven rain and floodwater.

BASIC IMPROVEMENTS

A first step for many property owners is to include basic improvements that are relatively easy to complete and low cost, and typically have a lower impact on historic integrity. Basic improvements can include:

- Maintenance of historic resources and properties;
- Relocation of critical systems and equipment above the flood protection elevation;
- Installation of secondary power sources such as solar collectors and generators to allow electrical independence after a storm; and
- Use of flood damage-resistant materials in flood-prone locations. (Refer to page 9.)

CHAP review is not required for several basic improvements associated with general maintenance or for interior building work. (Refer to the *Baltimore City Historic Preservation Design Guidelines* for a description of CHAP's review jurisdiction.)

Downspouts should be kept clear and the surrounding ground sloped away from the building foundation to minimize potential water damage.

Maintenance

The *Baltimore City Historic Preservation Design Guidelines* provide more specific CHAP review criteria for various types of improvements, including maintenance. Examples of simple maintenance that reduce the vulnerability of historic properties to natural hazards include:

- Grading land to promote positive drainage away from historic buildings (City approval should be sought for proposed sidewalk modifications);
- Trimming overhanging tree limbs that might crash through a roof or take down electric and telephone lines in a storm;
- Clearing site debris that might become waterborne or airborne (if high winds accompany the flood), clog storm drains, provide fuel for a fire, and harbor pests or cause damage to the historic building or surrounding buildings;
- Ensuring oil and propane tanks, including barbeque grills, and associated connections are well maintained and anchored to prevent flotation;
- Removing clutter and unnecessary storage in a building, particularly if items are hazardous, highly flammable, or located in a flood-prone area, such as basements;
- Maintaining roofing, flashing, gutters, and downspouts to direct stormwater away from buildings;
- Reinforcing roof framing to support wind and snow loads;
- Repointing masonry, including chimneys, walls, foundations, and piers, to prevent collapse and stormwater infiltration;
- Replacing or securing missing or dislodged siding to prevent stormwater infiltration and potential windborne debris;
- Replacing cracked window glass that can shatter in a wind storm and allow water infiltration;
- Maintaining shutters in an operational condition to protect windows from airborne debris in a wind storm;
- Replacing cracked pipes to prevent plumbing leaks or sewer failure; and
- Replacing batteries in smoke and carbon monoxide detectors to provide notification of a fire or gas leak.

Maintenance includes the removal of vegetation that can damage building materials, obscure openings, or trap debris.

The systems and equipment are located at the rear of the building to minimize their visibility. The mechanical and electrical equipment located at or near the ground, including electric meters, junction boxes, and air conditioner equipment, are vulnerable to damage from floodwater. To reduce vulnerability, all systems and equipment should be located above the FPE, in a similar manner as the air conditioner equipment located on the raised platform.

Relocation of Critical Systems and Equipment

Damage to building systems and equipment can be a potentially costly effect of flooding. Traditionally, building systems and equipment are often located in a basement, on the first floor, or at exterior grade. Even short-term exposure to floodwater can permanently damage any of these systems, making them useless in the flood recovery process. The types of systems and equipment that could be impacted include:

- Heating;
- Hot water;
- Air conditioning;
- Electrical / Security / Communications; and
- Appliances.

Two options to address building systems and equipment are protection in place or relocation to an area that will not be affected by floodwater. When equipment is located just below the FPE, it may be possible to protect it in place using dry floodproofing. Dry floodproofing of equipment requires the construction of perimeter floodwalls with secondary drainage such as a sump pump to remove any water seepage. The height to which the dry floodproofing of the equipment will be effective will largely depend on the wall materials and its construction, but it is likely limited to 2- to 3-feet. (Refer to *Dry Floodproofing*, page 14.) **However, dry floodproofing is not permitted by the City on a residential structure when substantial damage or improvement has been triggered. In addition, the City Code requires the elevation of the utilities or making them watertight when the improvement triggers less than substantial improvement.** (Refer to City Code, Section 3-10 Electrical, Mechanical, and Plumbing Systems.)

Relocation will often require raising the systems and equipment to higher levels, at a minimum to the FPE. This includes not only major equipment but raising secondary elements such as electrical outlets, junction boxes and switches. Relocated equipment should be installed in a manner that meets both manufacturers' and local code requirements including clearances, access, and ventilation. At the interior of a building, the relocation of equipment to upper floors can result in the loss of habitable space, which is typically not subject to CHAP review.

Relocation of exterior equipment may require mounting on roofs, walls, and platforms. CHAP's jurisdiction includes evaluating the potential visual impact of all building systems and equipment. Every effort should be used to minimize the visibility of all equipment.

The equipment and systems in this garage are wall mounted above the anticipated flood elevation. A floor-mounted grate connected to a sump pump can be used to drain any standing water or seepage. A secondary power source is needed to allow the sump pump to remain operational in the event of a flood-related power outage.

Installation of Secondary Power Sources

Loss of power often occurs as the result of flooding. This could be property specific – loss of power at a building – or impact multiple properties – downed electrical lines for a neighborhood. An independent power source, such as solar collectors or a generator, can provide a means of facilitating recovery after a flood, allowing equipment such as sump pumps and fans to remain operational, speeding up a return by occupants.

Like the relocation of critical systems, every effort should be made to minimize the visibility of secondary power sources. Refer to the *Baltimore City Preservation Design Guidelines* for the review of solar panels and similar secondary power sources.

Although brick has an acceptable flood resistance, deteriorated brick and the lack of mortar can significantly reduce the resistance level.

Use of Flood Damage-Resistant Materials in Flood-Prone Locations

Certain materials are less affected by being submerged in water than others. FEMA categorizes building materials in one of five levels to rank their potential resistance to flood, ranging from those that require a constant dry environment to those that can withstand high flood exposure. Several interior materials popularized during the mid-20th century that appear to be water resistant are also rated "unacceptable" for flood resistance including ceramic and linoleum tile.

Brick, which is the most common exterior building material in Fells Point, is classified as having an "Acceptable" flood resistance without the application of any coatings. It should be noted that although individual bricks may be acceptable, brick walls can only provide protection if well maintained. This includes ensuring that mortar joints are repointed and joints are sealed. CHAP review is required for the modification of all exterior materials, including repointing, and interior materials under their jurisdiction.

Flood Resistant Materials

Materials identified by FEMA as flood resistant and available in the following documents:

- FEMA Technical Bulletin 2: "*Flood Damage-Resistant Material Requirements for Buildings Located in Special Flood Hazard Areas in accordance with the National Flood Insurance Program*"
- FEMA Technical Bulletin 7: "*Wet Floodproofing Requirements for Structures Located in Special Flood Hazard Areas in accordance with the National Flood Insurance Program*"

BUILDING ALTERATIONS

Building alterations to address flood mitigation are often complex, costly, and have an impact on the historic character of a building. They are generally initiated by owners seeking to:

- Reduce flood insurance premiums;
- Reduce potential damage from flooding; or
- Improve resilience after a flood.

Where buildings are freestanding, its elevation above the FPE is an effective protection approach. In Fells Point, where rowhouses are the predominant building type, building alterations for flood mitigation are generally limited to two options: wet floodproofing and dry floodproofing.

Flood vents are a key element of wet floodproofing. By painting it to match the adjacent wall color, this flood opening is less visually obtrusive.

DESIGN PROFESSIONALS

The National Flood Insurance Program (NFIP) and the City of Baltimore have established specific compliance requirements for wet floodproofing and dry floodproofing. In addition to complying with Building Code and CHAP standards, alterations at buildings located within locally designated floodplains in Baltimore must also comply with the City's floodplain management regulations.

The review process for wet and dry floodproofing typically requires the preparation of drawings by an architect or structural engineer. Improperly installed or constructed wet or dry floodproofing alterations can result in significant damage to an existing building and prevent owners from benefiting from reduced flood insurance rates. Consultation with a licensed structural architect or engineer who has specific experience with flood mitigation alterations and CHAP requirements is highly recommended.

To allow non-residential property owners to take advantage of potential reductions in flood insurance rates, a licensed architect or engineers is also required to prepare a Floodproofing Certificate.

Wet floodproofing is one of the most effective options to protect residential buildings from floodwater damage. If completed in accordance with the National Flood Insurance Program requirements, it also has the potential to reduce flood insurance premiums.

WET FLOODPROOFING

Wet floodproofing is a flood mitigation alternative that can comply with Baltimore's floodplain management requirements for residential, commercial, and institutional buildings. Wet floodproofing allows floodwaters to enter an enclosed area of a building and rise at the same rate, and to the same levels, as floodwaters outside of the building. The unimpeded transfer of floodwater through flood openings equalizes the lateral and buoyancy forces, significantly lessening strain on the building's structure.

To be compliant with the NFIP, wet floodproofing relies on automatic passage of floodwater in and out of a building. In addition, spaces located below the flood protection elevation should be considered "wet," use of these spaces should be limited to non-living functions, and materials used should be moisture tolerant. (Refer to *Flood Resistant Materials*, page 9.) In addition, building systems and equipment should be located above the flood protection elevation. (Refer to *Relocation of Critical Systems and Equipment*, page 8.) These criteria apply to all wet floodproofed floor levels, including lower level apartments and basements.

Wet floodproofing may be the best alternative for buildings that are required to comply with NFIP design criteria and are technically difficult to elevate or relocate. This can include very large or complex buildings, or buildings that share party walls, such as the rowhouses of Fells Point. To meet wet floodproofing requirements, it may be necessary to abandon or limit the use of a portion of a building.

Flood Openings

Flood openings allow the passage of floodwater in and out of a building without mechanical intervention such as sump pumps. They must be of sufficient size, number, and location to be able to quickly equalize interior and exterior water levels. They will typically be located around the perimeter of a building or foundation, close to the adjacent exterior grade height, and may also be needed between adjacent, enclosed spaces, such as in interior foundation walls. In the case of a filled or abandoned basement, the installation of flood vents and drainage through the basement slab may be required.

Many manufactured flood openings are metal louvers or vents. Some flood openings are designed to be more in keeping with the architectural character of historic buildings. They should be selected and installed to allow the free flow of water and to prevent animal and insect infestation.

In addition to providing openings for flood water, it is important to ensure that all building spaces are well ventilated after a flood. Secondary damage after a flood such as mold and rot can be reduced with adequate ventilation. Operable windows can typically be used to ventilate inhabited spaces, while ventilation of abandoned basements or areas below raised finished floors can be more challenging. Some flood vents are designed to allow ventilation and can eliminate the need for additional vents.

NFIP FLOOD OPENING REQUIREMENTS

The minimum requirements for flood openings as established by the National Flood Insurance program (NFIP) are as follows:

- "A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding,
- The bottom of all openings shall be no higher than one foot above grade. Garage doors do not meet the National Flood Insurance Program (NFIP) minimum requirements for openings."

Flood water must be able to freely flow in and out of all enclosed areas without requiring electrical, mechanical, or manual operation. This includes exterior walls as well as interior walls separating enclosed spaces. To allow the free flow of water, a minimum of two flood openings are required and they must be located on different walls. Any modification to or covering of flood openings such as louvers, screens, or netting, should be installed in a manner that does not impede the free flow of flood water.

Flood openings must remain clear to be effective. The application of screening for aesthetic purposes, such as bricks, can trap debris rendering the flood opening ineffective.

The front elevation (at left) of this wet floodproofed rowhouse maintains its historic character. At the time of renovation, it was missing its rear wall, providing a unique opportunity for substantial alterations. The contemporary rear elevation (at right), includes a roof deck, balcony, and garage door openings. The basement has been infilled and first floor uses limited to an entrance, garage, and storage space.

Uses Below Flood Protection Elevation

To be considered wet floodproofed, the allowable uses of enclosed space below the flood protection elevation should be limited to minimize potential flood damage. (Refer to *Relocation of Critical Systems and Equipment*, page 8.) Uses that are permitted include building entrances, storage, and parking. To be considered floodproofed, all building systems must be located above the flood protection elevation. In the case of existing buildings, modification and/or abandonment of the lowest floor levels to comply with Baltimore's floodplain management regulations can include the following options:

Potential Basement Modifications

- **Abandon the use of the basement.** The basement may need to be capable of draining and partially or fully infilled with a water permeable fill material like gravel to provide sufficient resistance against the lateral forces of floodwater.
- **Allow floodwater to freely enter and leave the building.** This might include adding flood openings in the walls and providing openings for floodwater to infiltrate the soil through the floor slab. In addition, a sump pump with a secondary power supply above the flood protection-elevation should be considered to expel residual water during and after an event.
- **Modify basement window and door openings.** Depending on their location, basement windows and doors might require modification to allow drainage or ventilation to facilitate drying after a flood.

Potential First Floor Modifications

- **Raise the floor.** If sufficient first floor ceiling height is available, raise the floor level above the flood protection elevation. This may require the interior modification of stairs, adjustment of interior doors, and may potentially alter the relationship between the floor height and the windows.
- **Limit first floor use.** If the floor level is below the flood protection elevation and sufficient floor to ceiling height is not available to raise the floor, the use of the first floor may be limited to a building entrance, parking, and storage. This may require reconfiguration of upper building floors to accommodate formerly first floor public spaces, such as living rooms or kitchens.

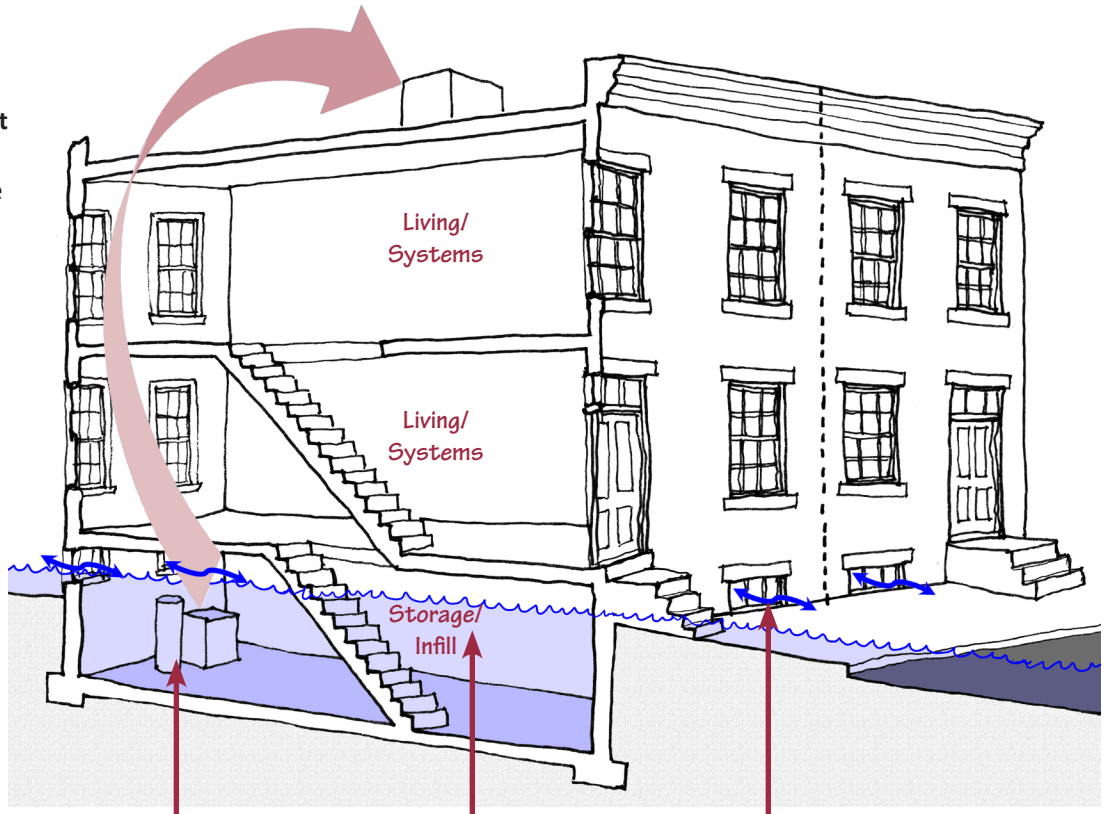
Refer to diagrams on the following pages for examples of wet floodproofing.

Screening obscures the interior storage at the first floor at the wet floodproofed rowhouse pictured above. The former basement has been infilled with gravel that has been visually obscured through the lower window opening.

Wet Floodproofing Options: The following diagrams indicate wet floodproofing strategies for a residential rowhouse.

Flood Protection Elevation (FPE) Below Existing First Floor Height

Limit use of floor below FPE to storage and remove all critical systems and equipment.



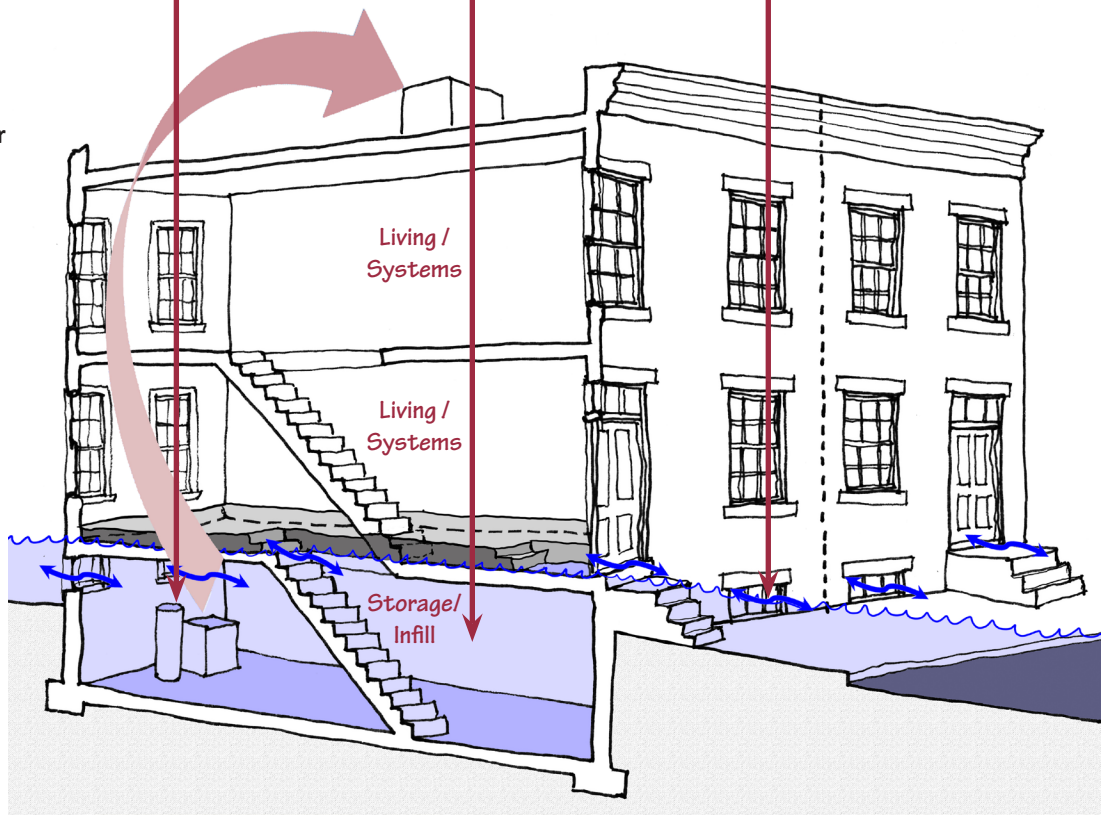
Relocate building systems and equipment above the FPE.

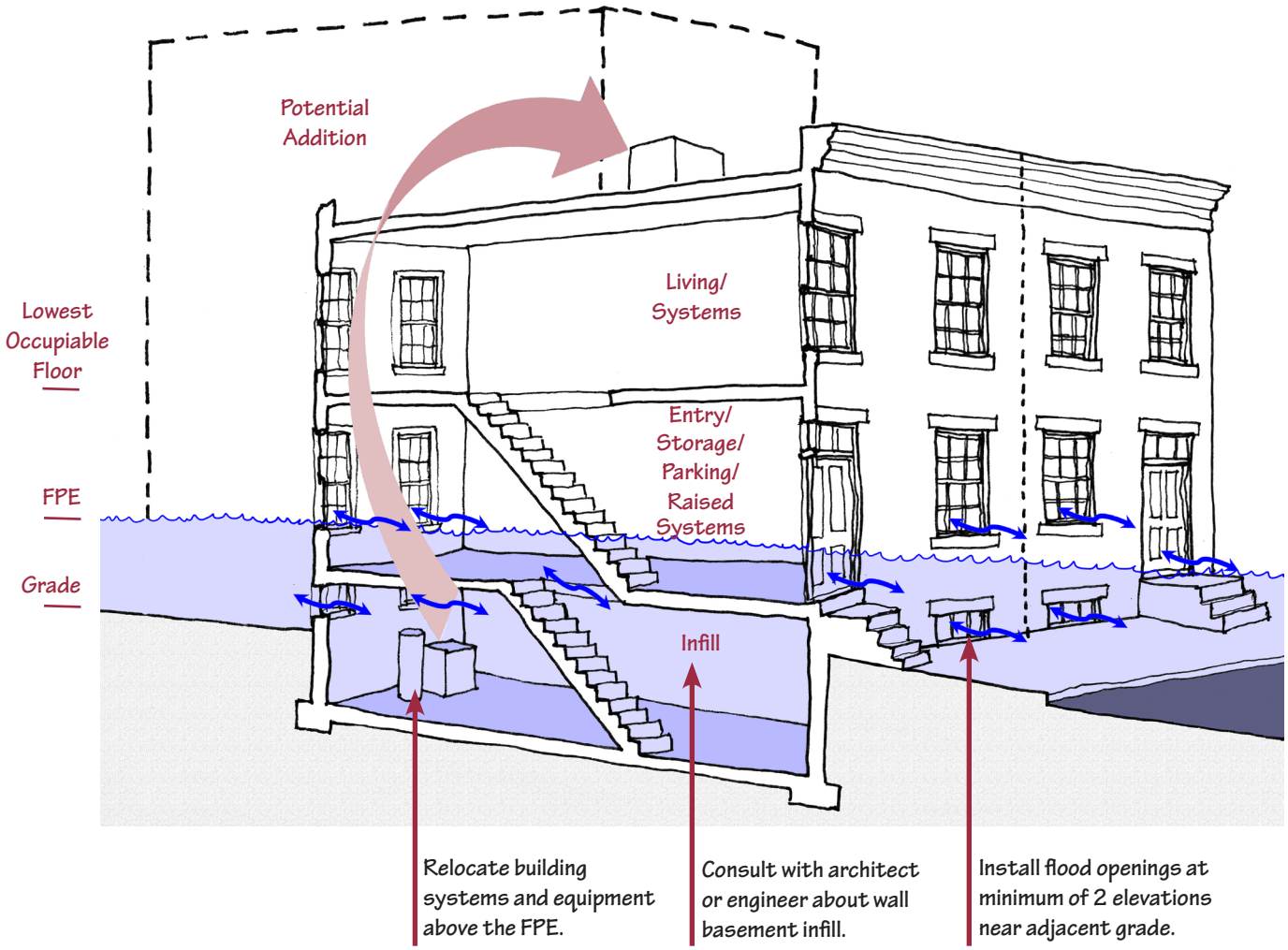
Consult with architect or engineer about potential wall stabilization / basement infill.

Install flood openings at minimum of 2 elevations near adjacent grade.

Flood Protection Elevation (FPE) Slightly Above Existing First Floor Height

Overbuild (raise) first floor height above FPE. Limit use of floor below FPE to storage and remove all critical systems and equipment.





Flood Protection Elevation (FPE) Above Existing First Floor Height

Relocate all systems and equipment from abandoned basement and former first floor level to above the FPE. Limit use of former first floor to entry, storage, and potentially parking. Relocate living spaces including the kitchen and living room to an upper floor.

Consult with CHAP regarding the potential installation of a garage door at the rear elevation and an addition to compensate for lost living space.

CHAP WET FLOODPROOFING REVIEW

In its review of proposed wet floodproofing applications, CHAP recommends the following:

- Referring to the *Baltimore City Historic Preservation Design Guidelines* when developing your flood mitigation project.
- Consulting with CHAP and the Office of Stainability early regarding any proposed wet floodproofing measures.
- Maintaining the historic configuration of window and door openings whenever possible. (Refer to *Fenestration Modification*, page 17.)
- Considering the potential impact on the façade and window openings of raised first floor level.
- Locating garage doors on secondary elevations.
- Maintaining principal exterior building access features, including stairs, stoops, and porches whenever possible.
- Obscuring street-facing glazing to minimize visibility of first floor storage areas and garages.
- Using metal louvers and vents that are compatible in color to minimize the visual impact.
- Converting first floor level below the flood protection elevation to commercial use, if permitted by zoning, and implementing required flood protections, which may include dry floodproofing. (Refer to Dry Floodproofing, page 14).
- Constructing additions that comply with floodplain management requirements in an unobtrusive manner to compensate for lost interior space.

The Sagamore Pendry Hotel, located at the former Fells Point Recreation Pier, is an example of dry flooproofing. The project included:

- *Installing waterproofed concrete flood walls to the 11-foot base flood elevation for the new addition, both at the exterior and within the courtyard, and flood doors at all grade locations - inspecting waterproofing 3 times by a third party reviewer during installation as part of the permitting process*
- *Raising the interior first floor height 3.5-feet above the 100-year floodplain, while maintaining the original window height dimensions - installing tempered glazing to address code concerns related to floor-level proximity*
- *Locating all mechanical equipment on the roof, running systems primarily along the ceilings, minimizing and waterproofing penetrations of the first floor slab, installing all electrical receptacles and devices at higher elevations*
- *Multiple hearings and approvals were required related to building within the 100-year floodplain, the historic designation, and the preservation tax credits*

The developer is aware that recovery from a flood has the potential to be very expensive regardless of steps to prevent damage.

DRY FLOODPROOFING

Although any property owner can employ dry floodproofing techniques to protect their property, **dry floodproofing at residential buildings does not comply with Baltimore's floodplain ordinance or the NFIP**. As a result, owners of residential properties that are located in the floodplain and employ dry floodproofing techniques will not benefit from reduced flood insurance premiums, although they may reduce their potential flooding vulnerability.

To be effective, dry floodproofing must keep all, or almost all, water out of a building. Essentially, it provides a "wetsuit" at the exterior of the flood-prone areas of the building to prevent infiltration through:

- Wall surfaces;
- Floor slabs;
- Window and door openings; and
- Joints and gaps at pipe penetrations and between different materials.

In considering whether dry floodproofing is a viable option, it is important to understand the potential depth and duration of the flood and the characteristics of the building. In a flood event, standing water and saturated soil exert two types of forces: lateral (side to side) and buoyancy (up and down). There may be additional forces imposed by wave action or debris impact from flowing water. The type and method of construction must be able to withstand the anticipated forces in order for dry floodproofing to be considered a feasible alternative.

Dry floodproofing, that is, keeping floodwater out of a building, is only viable as an option in situations that meet the following criteria:

- The depth of floodwaters is relatively low, typically no higher than to 2- to 3-feet, to limit lateral forces on the building unless significant engineering measures are undertaken;
- The exterior building and foundation walls can withstand the lateral forces, wave action and flood-borne debris impact forces, limiting viable wall materials to load-bearing masonry and concrete;
- The building or basement slab can resist upward buoyancy forces;
- Window and door openings subject to flooding can be effectively sealed to protect against the anticipated lateral force of the floodwater and to prevent infiltration for the flood's duration;
- Minor openings such as pipe penetrations and crevices can be effectively sealed to minimize seepage;
- The duration of flooding is limited since the rate of seepage often increases as materials are exposed to water for longer periods of time; and
- Water seepage can be removed until floodwaters recede, requiring a sump-pump or other mechanical system that will remain operational to remove flood water even with a power failure.

Concrete buildings are generally good candidates for dry floodproofing because of their ability to withstand loads and their smooth surface for the application of sealers.

Dry Floodproofing Considerations

The feasibility of dry floodproofing is site-specific and requires a structural engineer to evaluate the soundness of the building and determine whether it can withstand flood-related forces.

Construction Types

As a general rule, only masonry bearing wall and concrete buildings are potential candidates for dry floodproofing.

- **Masonry buildings** include stone, brick, and block construction, and have walls composed of masonry units bonded with mortar, grout, or sealant. The wall composition tends to be continuous from the roof to the foundation, often providing sufficient structural capacity to withstand the lateral force of water or capable of being reinforced to have sufficient capacity. Conversely, their irregular surface can be difficult to waterproof and they often have openings or voids through which water might pass – either designed, such as weep holes, or openings, which developed over time through deterioration or lack of maintenance.
- **Concrete buildings** and slabs might appear to be waterproof, but concrete is a very porous material and typically allows water seepage. In addition, concrete may be vulnerable to seepage at transitions between structural members or between installation "pours." Because of concrete's relatively smooth surface, the application of a waterproof membrane can often be readily accomplished. The structural capacity of concrete to resist lateral and buoyancy forces is influenced by thickness of the concrete, the size and configuration of reinforcing, and the manner in which the building was constructed.
- **Wood-framed buildings**, typically constructed of wood studs with exterior clapboard, shingles, or siding, are generally porous, with many small holes and crevices that allow water seepage. In addition, wood-framed structures are vulnerable to water penetration at the connection between the foundation and the wall framing. As a result, effective dry floodproofing of wood-framed buildings is typically limited to a continuous masonry or concrete foundation or basement.

Wall and Slab Surface Sealers

To prevent infiltration through masonry and concrete walls and slabs, the surfaces must be sealed. Wall and slab sealants generally fall into two categories, either asphalt-based coatings, that can be brush or spray applied, or heavy-duty, rubber membranes. It is generally most effective to seal a building at the exterior wall, foundation wall, or slab surface to prevent prolonged saturation of building materials during a flood event.

Because the building's "wetsuit" needs to be continuous, or as continuous as possible, this can present challenges at existing buildings in which foundations need to be exposed to apply the protection. Slabs may need to be replaced to allow installation of an underlying sealant barrier. There are different challenges above-ground where building materials or aesthetic considerations, such as historic preservation regulations, may limit options for the application of wall sealant systems. In these cases, it may be necessary to rely on joint sealers to minimize infiltration.

The structural integrity of masonry walls should be verified prior proceeding with dry floodproofing. All sealers should be concealed by soil or historically appropriate material based upon location.

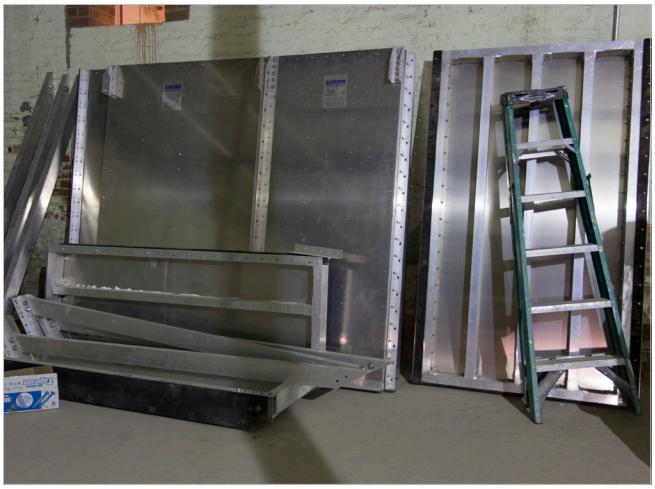
Joint Sealers

Many buildings have joints or gaps at penetrations, where dissimilar materials meet, or where different elements are joined. To improve the effectiveness of dry floodproofing, all crevices and gaps must be sealed to provide a continuous barrier at the wall and slab.

Joint sealers generally come in two categories, sealants and gaskets. Sealant is typically a flexible, putty-like material that adheres to surfaces and forms a watertight seal. Gaskets are generally rubber and are compression fit to form a water-resistant seal between two materials. While sealants adhere to adjacent materials, gaskets can be utilized as a sealer between two joining parts, such as around an operable door or window.

One of the difficulties associated with sealants and gaskets is that they tend to degrade and fail relatively quickly. As they begin to fail, they lose their water tightness, becoming ineffective as a water barrier. As a result, they require frequent replacement, and become a long-term maintenance obligation.

The metal frames flanking the window and door openings are used to hold flood barriers in place.



Metal flood barriers need to be installed in an accessible location to allow quick installation in preceding a flood.

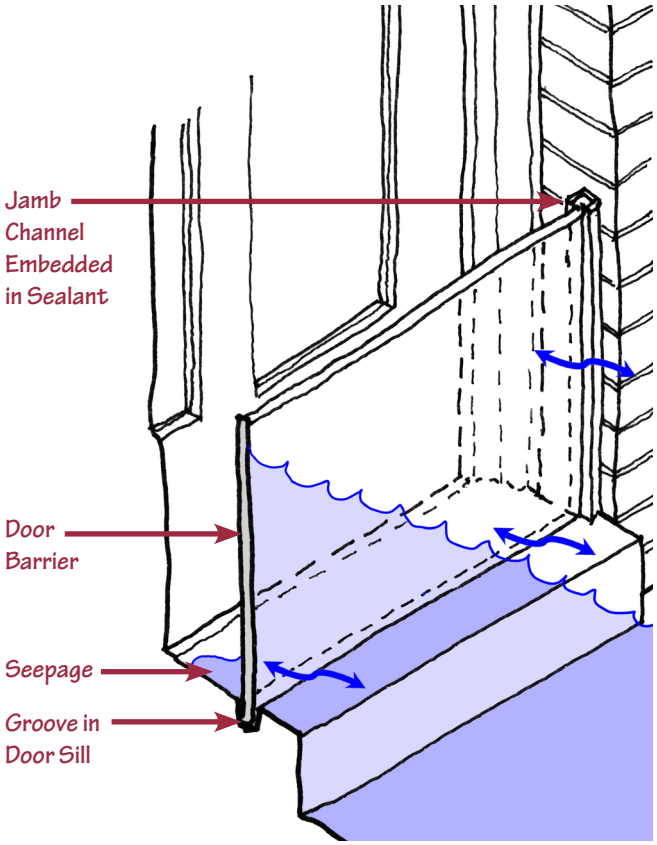
Barriers and Shields – Windows and Doors

Barriers and shields can provide temporary protection against floodwater entering doors and windows and are installed immediately preceding an anticipated flood event. The range of barriers and shields includes sandbags, drop-in or roll-up barriers, shields at door openings, floating barriers and engineered barriers secured to building walls and the ground. With the exception of the engineered barriers, the other forms of protection are typically limited structurally to a maximum of two- to three-feet of floodwater.

Shields and barriers are generally constructed of metal, with heavier gauges for engineered applications. To minimize potential seepage, the shields and barrier systems typically include gaskets at the junction of components and where they meet the building wall or ground surface. Although not necessarily NFIP compliant, the installation of window and door barriers and shields can provide a relatively inexpensive protection from low-level flooding such as persistent tidal flooding, when combined with regular maintenance including repointing and sealing of open joints and crevices.

Property owners and planners should consider the following factors when contemplating utilizing barriers and shields at windows and doors:

- Most, such as drop-down or roll-up barriers, window and door shields, and engineered barriers, are dependent on people to install them immediately preceding an event (with the exception of floating flood barriers). Sufficient trained manpower must be available and in place for the implementation. Therefore, this approach is most effective when there are a limited number of openings requiring protection, people available to complete the installation, and sufficient advance notice. Consequently, this approach is less effective in locations prone to flash floods.
- Since many exit doors typically swing out, barriers and shields that prevent doors from operating should only be installed after a building has been completely evacuated.
- It is recommended that if using flood barriers, that the National Flood Barrier Testing and Certification Program website be consulted and certified barriers chosen in lieu of untested, non-certified barriers.
- Sandbags require substantial available materials, onsite trained personnel to properly stack bags, and appropriate disposal methods if contaminated by floodwater.



Door barriers can provide temporary protection from rising flood water. Simpler versions can be fabricated with channels permanently mounted in sealant to the door jambs with a groove cut into the sill. The panel, which can be metal or marine grade plywood, slots into the channel and groove. Water seepage can be reduced by a gasket at the perimeter of the panel.

Fenestration Modification

An alternative to installing a barrier or shield at existing window and door openings would be to modify low-lying openings to prevent floodwater infiltration. In the case of very low openings, such as basement windows, this could mean infilling the opening. For windows and unused doors with sill heights vulnerable to flooding, it might mean infilling the lower portion of the opening and raising the sill.

In either case, the infill material must provide a watertight seal and have sufficient structural capacity to withstand the lateral force of floodwater. This generally suggests infilling with masonry or concrete. However, permanent modification of windows and doors can dramatically change the exterior appearance of a building and is subject to CHAP review.

After persistent flooding, the lower sections of the windows were infilled to improve flood resilience. The infilled windows retain their historic sills, and replacement sash are sympathetic to the original configuration.

Secondary Drainage System

No matter how effective a dry floodproofing system is, some water will seep into the building through the walls, joints, and underlying slab. Therefore, it is prudent to have a drainage and under drainage system with a sump pump to evacuate any accumulated water. Pumps may require a secondary power source in the event of flood damage to the power supply. (Refer to *Installation of a Secondary Power Sources*, page 8.) In addition, building systems should be installed so that they will not be damaged by seepage.

Maintenance

One of the key requirements of a dry floodproofing option is a well-maintained building. (Refer to *Maintenance*, page 7.) During a flood event, the force of the water can easily undermine a compromised structural system. In addition, any small gap or opening can provide a path for water seepage. Therefore, for dry floodproofing to be effective it is critical to ensure that:

- Structural framing is sufficient to resist forces;
- Masonry and concrete walls have sufficient lateral load capacity;
- Masonry walls are fully pointed; and
- All joints are properly sealed, including around window and door frames, pipe penetrations, etc.

Open joints around windows and door frames can provide a path for water infiltration. Regular replacement of sealant is required for it to retain its effectiveness to prevent water infiltration.

Cautions

Although dry floodproofing can provide protection from water infiltration during a flood event, the application of permanent or semi-permanent sealers and waterproof membranes can lead to deterioration of building materials by trapping moisture or promoting condensation, both of which can lead to material degradation of masonry, concrete, and wood. In the case of wood, increased moisture can promote rot, mold and insect infestation, such as termites and carpenter ants, in both exterior wall elements and in other parts of the building such as floor framing and interior finishes.

CHAP DRY FLOODPROOFING REVIEW

In its review of proposed dry floodproofing applications, CHAP recommends the following:

- Referencing the *Baltimore City Historic Preservation Design Guidelines.*
- Consulting with CHAP and the Office of Stainability early regarding any proposed dry floodproofing measures.
- Obtaining a FEMA Floodproofing Certificate to potentially benefit from flood insurance premium credits.
- Maintaining the historic configuration of window and door openings.
- Developing a maintenance plan to address any structural issues and openings vulnerable to flooding.
- Working with an engineer or architect for anticipated flood water depths greater than 2- to 3-feet.
- Identifying a convenient location to store door and window barrier panels.
- Conducting periodic drills with on-site personnel on the installation of door and window shields.
- Conducting annual inspections of barrier mounting brackets, hardware, and gaskets.
- Reviewing the potential negative impacts of sealers in terms of visual characteristics and damage to historic materials, including brick.
- Sensitively modifying lower-level window and door openings, such as those found in basements, which can impact the historic integrity of a building, particularly if located at street elevations.

RESOURCES - ORGANIZATIONS

City of Baltimore

City Commission For Historical & Architectural Preservation (CHAP)
417 East Fayette Street, 8th Floor
https://chap.baltimorecity.gov/; (410) 396-4866

Office of Sustainability - 417 East Fayette Street, 8th Floor
www.baltimoresustainability.org/; (410) 396-4556

Department of Planning - City Hall Room 250
https://planning.baltimorecity.gov/; (410) 396-7526

State of Maryland

Maryland Historical Trust
mht.maryland.gov/floodingresources.shtml; (410) 697-9575

Maryland Department of the Environment
Water and Science Administration

- DFIRM Outreach Program
  https://mdfloodmaps.net/home.html; (410) 537-3775
- Maryland Floods and Flood Relief Assistance
  https://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Pages/index.aspx; (410) 537-3000

Federal Government

FloodSmart - National Flood Insurance Program
www.floodsmart.gov

Federal Emergency Management Agency (FEMA)
www.fema.gov

RESOURCES - PUBLICATIONS / WEBSITES

FEMA - www.fema.gov

Homeowner's Guide to Retrofitting: Six Ways to Protect Your Home from Flooding (FEMA P-312)

Protecting Building Utility Systems From Flood Damage (FEMA P-348)

Reducing Flood Risk and Flood Insurance Premiums for Existing Residential Buildings in Zone A (Hurricane Recovery Advisories - RA 7)

Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (FEMA P-1037)

Repairing Your Flooded Home (FEMA P-234)

FEMA Technical Bulletins

- Technical Bulletin 1: *Openings in Foundation Walls and Walls of Enclosures*
- Technical Bulletin 2: *Flood Damage-Resistant Materials Requirements for Buildings Located in Special Flood Hazard Areas in accordance with the National Flood Insurance Program*
- Technical Bulletin 3: *Non-Residential Floodproofing - Requirements and Certification*
- Technical Bulletin 7: *Wet Floodproofing Requirements for Structures Located in Special Flood Hazard Areas in accordance with the National Flood Insurance Program*
- Technical Bulletin 11: *Crawlspace Construction for Buildings Located in Special Flood Hazard Areas*

Maryland Historical Trust

https://mht.maryland.gov/floodingresources.shtm
The Maryland Historical Trust has developed fact sheets to assist property owners/occupants dealing with historic resources damaged by flooding. Their website also includes links to several helpful publications.

- *Attention: Owners of Historic or Older Properties Affected by a Natural Disaster*
- *Selecting a Contractor After a Natural Disaster Strikes*
- *As the Floodwaters Recede — A Checklist of Things to Do*
- *Tips for Drying Out a Water-Damaged Building*
- *Additional Helpful Hints for Historic Properties*
- *Tips for Handling Insurance Claims for Historic Properties Following a Disaster*
- *Landscape Restoration Following a Natural Disaster*
- *Emergency Response and Salvage: Wet Books, Documents & Photographs*

Additional Resources

Historic England. *Flooding and Historic Buildings.*
https://historicengland.org.uk/advice/technical-advice/flooding-and-historic-buildings/

Historic Scotland. *Flood Damage to Traditional Buildings*.
www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=13349883-20bf-48ec-afd9-a59500e9a44e

Livingston, Dennis. *Rebuilding Water-Damaged Homes*
https://ag.purdue.edu/extension/eden/Mold/AFHH-manual.pdf

National Trust for Historic Preservation. *Treatment of Flood Damaged Older and Historic Buildings*. (Information Booklet No. 82, 1993.)
www.ncptt.nps.gov/wp-content/uploads/NTHP-Information-Booklet-82-Flood-Damage-and-Older-Homes.pdf?b5c287

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PREPARATION

All components of the *Fells Point Flood Mitigation Guidelines* including text, graphic design, photography and illustrations, unless otherwise noted, were prepared by:

Dominique M. Hawkins, AIA, LEED AP, NCARB
PRESERVATION DESIGN PARTNERSHIP, LLC
Philadelphia, PA. www.pdparchitects.com

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