Manayunk Main Street Historic District Flood Guide

July 2020

PDP
Preservation Design Partnership, LLC

PHMC
Pennsylvania State Historic Preservation Office
Pennsylvania Historical and Museum Commission

FRMTF
Flood Risk Management Task Force
City of Philadelphia

We would like to express our appreciation to the Pennsylvania Historical and Museum Commission and the City of Philadelphia for their support in the completion of this project.

Pennsylvania State Historic Preservation Office
PENNSYLVANIA HISTORICAL AND MUSEUM COMMISSION

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FRMTF
FLOOD RISK MANAGEMENT TASK FORCE
CITY OF PHILADELPHIA

The City of Philadelphia's Flood Risk Management Task Force was convened in 2015 to address the circumstances of flooding as it impacts various Philadelphia neighborhoods, and represents an inter-agency effort to coordinate resources.

The mission of the Task Force is to develop and implement an improved strategy for flood management and mitigation planning. To serve this mission, the City chartered this inter-agency task force to foster collaboration and maximize available resources and expertise within City government.

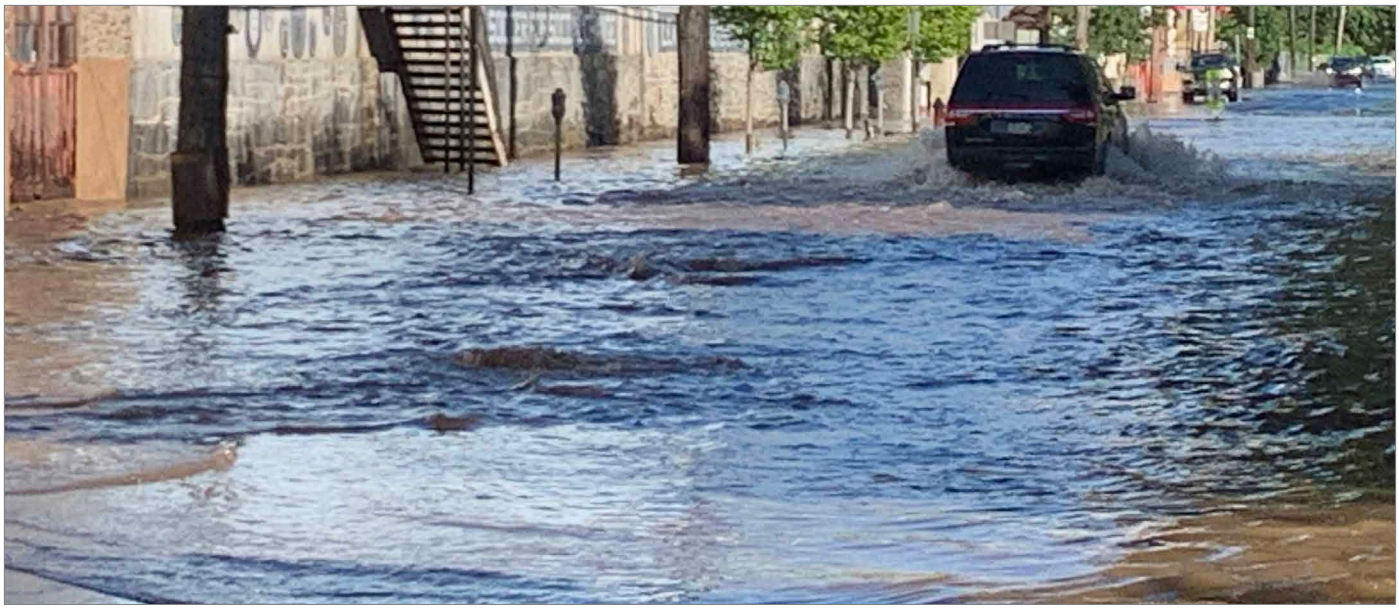
This material is based upon work assisted by a grant from the Department of the Interior, National Park Service. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the Department of the Interior.

All components of the *Manayunk Flood Guide* including all text, graphic design, photography and illustrations unless noted otherwise were prepared by Dominique M. Hawkins, FAIA, LEED AP.

Preservation Design Partnership, LLC
Philadelphia, Pennsylvania
www.pdparchitects.com

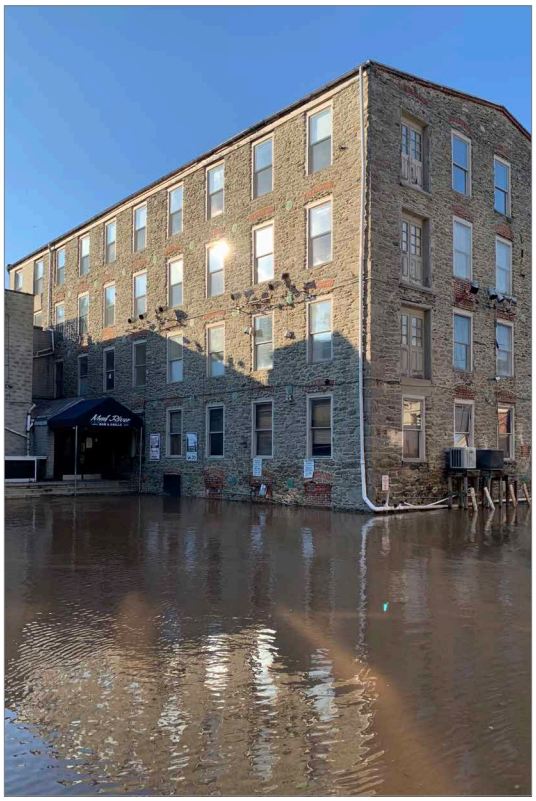
Contents

City agencies are collaborating to address flooding issues through public information, mapping and regulations, flood damage reduction, and flood preparedness. For more information on flooding in Manayunk, visit https://www.phila.gov/documents/manayunk-flood-guide-and-pamphlet/.



Flooding in the Manayunk Main Street Historic District is often caused by the rising Schuylkill River.

Purpose



Exposure to floodwater can be detrimental to historic buildings and features.

Manayunk is a unique and irreplaceable neighborhood in Philadelphia. Main Street, with a collection of current and former industrial buildings, late-19th and early-20th century commercial buildings, servers as Manayunk's spine, with mill worker's housing on side streets to the north and Venice Island separating it from the Schuylkill River to the south. With its distinctive character, the National Park Service and the Philadelphia Historical Commission have each designated the Manayunk Main Street Historic District.

Located along the banks of the Schuylkill River, Manayunk developed into a water-powered, industrial hub in the 19th century that was plagued with flooding so severe that it slowed the construction of the canal. Today, the former industrial, commercial, and residential buildings are located in the narrow floodplain that extends from the river to the properties flanking Main Street. As flooding is becoming increasingly prevalent, property owners and tenants are struggling with how best to protect their investments as well as the unique historic character of the Manyunk Main Street Historic District.

The information presented in this *Guide* is intended to provide information to owners, business owners, and tenants on evaluating options to minimize the impact of flooding on properties in the Manayunk Main Street Historic District. It includes an overview of floodplain management requirements, flood insurance, and the role of the Philadelphia Historical Commission, who is charged with balancing the level of desired protection with the maintenance of the Manayunk Main Street Historic District's character. This *Guide* should be considered as a supplement to consultation with architects and engineers; Philadelphia's Building, Zoning and Floodplain Management Requirements; and the Philadelphia Historical Commission review process.

Key Terms

Base Flood Elevation (BFE) - elevation of flooding, having 1% chance of be equaled or exceeded in a given year.

Basement – that portion of a structure having its lowest floor below ground level on all sides.

Design Flood Elevation (DFE) – elevation of the design flood, relative to the datum specified on the community's flood hazard map – ***In Philadelphia the DFE is the BFE + 18", unless a higher standard applies.***

Dry Floodproofing – floodproofing method used to render a structure envelope substantially impermeable to the entrance of floodwaters.

Enclosure – confined area below DFE, formed by walls on all sides of the enclosed space.

Elevation Certificate - is a form developed by FEMA that verifies the elevation data of a structure on a given property relative to the ground level. The Elevation Certificate is used to ensure compliance with floodplain management ordinances and is also used by insurance agents and companies in the rating of flood insurance policies. The Certificate documents the base flood elevation and the building's construction above that elevation.

Existing Structure – any structure for which the start of construction commenced before the effective date of the first floodplain ordinance, or standard adopted by the authority having jurisdiction.

Fill – material such as soil, gravel, or crushed stone that is placed in an area to increase ground elevations.

Flood-Damage Resistant Material – any construction material capable of withstanding direct and prolonged contact with floodwaters, without sustaining any damage that requires more than cosmetic repair.

Flood Hazard Area – area subject to flooding during the design flood.

Flood Hazard Map – map delineating flood hazard areas adopted by the authority having jurisdiction.

Flood Hazard Study – study that serves as the technical basis for a flood hazard map.

Flood Insurance Rate Map (FIRM) – official map of a community on which the Federal Insurance and Mitigation Administration (FEMA) has delineated both special flood hazard areas and the risk premium zones applicable to the community.

Floodplain – any land area, including watercourse, susceptible to partial or complete inundation by water from any source.

Floodway – channel and that portion of the floodplain reserved to convey the base flood without cumulatively increasing the water surface elevation more than a designated height.

Highest Adjacent Grade – highest elevation of the natural or regraded ground surface, or structural fill, at the location of a structure.

Historic Structure – any structure that meets on of the following criteria: (1) listed individually in the National Register of Historic Places; (2) certified by the Secretary of the Interior as meeting the requirements for individual listing in the National Register; (3) certified or preliminary determination by the Secretary of the Interior as contributing to the historical significance of a register historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district; (4) Individually listed on a state inventory of historic places, in stated with historic preservation programs that have been approved by the Secretary of the Interior; or (5) individually listed on a local inventory of historic places in communities with historic programs certified by an approved state program or by the Secretary of the Interior.

NGVD – North American Vertical Datum.

Nonresidential – any building or structure or portion thereof that is not classified in residential.

Pre-FIRM Structures - In Philadelphia, pre-FIRM structures are those structures constructed or altered before December 31, 1978, the effective date of Philadelphia's initial Flood Insurance Rate Map (FIRM). This is the date on which Philadelphia began regulating floodplain development.

Post-FIRM Structures - A floodplain structure in Philadelphia is considered post-FIRM if it was built (or substantially improved) after December 31, 1978, the effective date of Philadelphia's initial Flood Insurance Rate Map (FIRM). Post-FIRM structures should already be in compliance with floodplain development standards. Any subsequent improvements must maintain compliance with the standards that were in effect when the building was built. Renovations, repairs, or additions to post-FIRM structures are thus regulated through floodplain development standards as new construction.

Residential – (1) buildings and structures and portions thereof where people live or that are used for sleeping purposes on a transient or nontransient basis; (2) residential structures, including but not limited to one- and two-family dwellings, townhouses, condominiums, multifamily dwellings, apartments, congregate residencies, boarding houses, lodging houses, rooming houses, hotels, motels, apartment buildings, convents, monasteries, dormitories, fraternity houses, sorority houses, vacation time-share properties; and (3) institutional facilities where people are cared for or live on a 24-hours basis in a supervised environment, including but not limited to board and care facilities, assisted living facilities, halfway houses, group homes, congregate care facilities, social rehabilitation facilities, alcohol and drug centers, convalescent facilities, hospitals, nursing homes, mental hospitals, detoxification facilities, prisons, jails, reformatories, detention centers, correctional centers, and prerelease center.

Special Flood Hazard Area (SFHA) – land in the floodplain subject to a 1% or greater chance of flooding in an given year; area delineated on the Flood Insurance Rate Map (FIRM) as Zone A, AE, and Floodway.

Structure – any building or other structure, including gas and liquid storage tanks.

Substantial Improvement – any reconstruction, rehabilitation, addition, or other improvement to a structure, the cost of which equals or exceeds 50% of its pre-improvement market value, or equals or exceeds a smaller percentage established by the authority having jurisdiction.

Wet Floodproofing – floodproofing method that relies on the use of flood-damage resistant materials and construction techniques to minimize flood damages to area below the DFE or a structure internally allowed to flood.

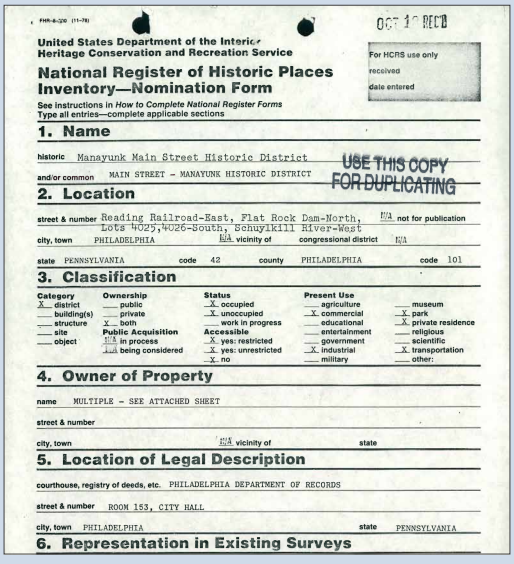
The 1823 completion of the Canal allowed Manayunk's development as an industrial center with mills located on both banks. Commercial buildings dominated the north side of Main Street and worker housing extended up the hill towards Roxborough.

(Atlas of the City of Philadelphia, 1910 ; Published by G.W. Bromley and Co.; Obtained through http://www.philaathenaeum.org/.)

A Manayunk & Flooding

MANAYUNK MAIN STREET HISTORIC DISTRICT

The 1982 Manayunk Main Street Historic District National Register Nomination provided the basis for the designation on both the National Register of Historic Places and the Philadelphia Register of Historic Places. *(https://catalog.archives.gov/id/71996932)*



United States Department of the Interior
Heritage Conservation and Recreation Service

National Register of Historic Places Inventory—Nomination Form

See instructions in *How to Complete National Register Forms*
Type all entries—complete applicable sections

For HCRS use only
received
date entered

1. Name

historic Manayunk Main Street Historic District

and/or common MAIN STREET - MANAYUNK HISTORIC DISTRICT

USE THIS COPY FOR DUPLICATING

2. Location

street & number Reading Railroad-East, Flat Rock Dam-North, Lots #029,#026-South, Schuylkill River-West — N/A not for publication

city, town PHILADELPHIA — N/A vicinity of — congressional district N/A

state PENNSYLVANIA — code 42 — county PHILADELPHIA — code 101

3. Classification

Category	Ownership	Status	Present Use
X district	___ public	X occupied	___ agriculture
___ building(s)	___ private	X unoccupied	X commercial
___ structure	X both	___ work in progress	___ educational
___ site	Public Acquisition	Accessible	___ entertainment
___ object	N/A in process	X yes: restricted	___ government
	___ being considered	X yes: unrestricted	X industrial
		X no	___ military

___ museum	
X park	
X private residence	
___ religious	
___ scientific	
X transportation	
___ other:	

4. Owner of Property

name MULTIPLE - SEE ATTACHED SHEET

street & number

city, town N/A vicinity of — state

5. Location of Legal Description

courthouse, registry of deeds, etc. PHILADELPHIA DEPARTMENT OF RECORDS

street & number ROOM 153, CITY HALL

city, town PHILADELPHIA — state PENNSYLVANIA

6. Representation in Existing Surveys

MANAYUNK HISTORIC OVERVIEW

Originally settled by the Lenape Indians, the Manayunk Main Street Historic District is nestled between the Schuylkill River and steep slope leading up to Ridge Avenue in Roxborough. Venice Island, formed when the Manayunk Canal was completed in 1823, housed industrial buildings that used water power to operate the mills which manufactured diverse products including cotton, paper, wool, soap, and drugs were prevelent. Over time, the mills expanded their operations over the canal to the south side of Main Street, with bridges connecting some of the industrial buildings. Although most of the industrial buildings on Venice Island have been demolished, several of the expansions on the north side of the canal remain.

While the Manayunk Canal and Schuylkill River provided water transportation for materials and goods, Main Street was the vehicular link to the City and provided support for the industrial mills. In addition to mill expansions, the south side of Main Street housed mill offices and warehouses. By contrast, the north side of Main Street primarily included commercial uses, initially supporting industrial buildings and later the expanding worker's population housed in two- to three-story row homes off of Main Street. Commercial uses included banks, offices, hotels, and mixed use commercial ground floors with residential above. In the late-19th century, the commercial uses expanded to include retail stores and entertainment, and in the 20th century to service the growing residential community. Many of the mills closed during the Depression and the buildings were later re-purposed for contemporary storage before the late-20th century conversion of Manayunk's Main Street into a center for night life and Venice Island as a recreational amenity for the City and center for recent residential development.

MANAYUNK FLOODING TYPES

Flooding in the Manayunk Main Street Historic District is most often associated with the rising Schuylkill River, known as riverine flooding, which can be exacerbated by severe storms. Infrastructure-related flooding has greatly decreased with recent investment by the City in supply, storm water, and sewer piping s well as the Venice Island storage tank.

RIVERINE FLOODING

The Schuylkill River is approximately 135 miles in length, flowing from the west towards Philadelphia, where it discharges into the Delaware River at the former Navy Ship Yard, now known as the Philadelphia Naval Business Center. The Schuylkill River watershed, the area of land that drains into the river on both sides, is approximately 2,000 square miles and includes Roxborough and Lower Merion. When there is an excess amount of water that flows from the watershed into the river, the height of the river can rise to the point that it overflows its banks, also known as riverine flooding. Riverine flooding is the most common type of flooding in Manayunk. The additional water that increases the height of the river can be caused by the following:

- Excessive rainwater in the watershed that is unable to soak into the ground and instead washes into the river; or
- Quick melting snow or ice washes water into the river.

The additional volume of water in the river causes it to rise and flow faster. The fast-flowing water can be dangerous to pedestrians and moving vehicles, and can cause unsecured objects to become floating projectiles. Although riverine flooding can be devastating, there is often sufficient notice to allow property owners, residents, tenants, and visitors to protect their property and safely relocate to higher ground.

SEVERE STORMS

Severe storms with significant rainfall can also result in flooding. The types of storms resulting in flooding can be the remnants of anticipated storms such as hurricanes, tropical storms, or Nor'easters, or an unpredictable intense rainfall, known as a flash flood, where there can be a sudden rise in the river. While anticipated storms can provide vulnerable property owners with time to prepare, flash floods occur with little to no notice.

As development in the watershed has increased, more of the ground is covered with buildings, asphalt, and concrete, with limited areas of landscape remaining to absorb rainwater. This is particularly true of the area between Ridge Avenue and Main Street. ***When there is a heavy storm, the rainwater can overwhelm storm sewers and will wash down the hill towards Main Street and the river. The extra water volume can cause the river to overflow its banks, resulting in flooding.***

INFRASTRUCTURE

Buildings in the Manayunk Main Street Historic District have a history of infrastructure-related flooding. Past infrastructure-related flooding was often due to water flowing backwards in storm drains, floor drains, sewers, and water supply piping. The Philadelphia Water Department recently completed many stormwater improvements to Venice Island, greatly alleviating infrastructure-related flooding and the associated damage.

Floodwater heights from past flood events are marked inside the Manayunk Brewing Company. Three of the four markers identify hurricane-related flooding.

ACRONYMS

DFE: Design Flood Elevation

FEMA: Federal Emergency Management Agency

FIRM: Flood Insurance Rate Map

GIS: Geographic Information System

NFIP: National Flood Insurance Program

NOAA: National Oceanic and Atmospheric Administration

NPS: National Park Service

OEM: Office of Emergency Management

PA SHPO: Pennsylvania State Historic Preservation Office

SFHA: Special Flood Hazard Area

USACE: United States Army Corps of Engineers

MANAYUNK FLOODING MYTHS

The United States Army Corps of Engineers (USACE) has evaluated the Manayunk Main Street Historic District and found the following factors do not increase the likelihood of flooding:

- The presence of the canal
- The width of the Schuylkill River along the length of Main Street
- The accumulation of silt at the bottom of the Schuylkill River
- Releases of water from dams upriver

Unlike larger sections of the city with combined sewers that handle both storm and sanitary discharges, the Manayunk neighborhood has separate storm sewers and sanitary sewers. ***Property owners or tenants experiencing water in their basement who believe the source may be connected to their drainage system or water supply should contact the Philadelphia Water Department.***

The storage tank at Venice Island, located underneath the new recreation center and parking lot, was built to capture excess infiltration and inflow of Philadelphia stormwater into the separate sanitary sewer system. The tank captures and holds this excess inflow so that the City's sanitary sewer system maintains capacity during wet weather. The main tank has a volume of 4.02 million gallons. It has effectively eliminated discharges from the Upper Schuylkill East Side interceptor during large rain events.

CHRONOLOGY OF VENICE ISLAND FLOODS

The following information was obtained through the Manayunk Neighborhood Council *www.manayunkcouncil.org* through 1999 and does not include recent flood events.

1822 - Flooding causes damage in Manayunk.

1839 - Flooding from a storm destroys the Flat Rock Bridge, which must be rebuilt.

1841 - January flooding causes a local paper to write; "the distress produced will be great."

1850 - A September flood washes away 2 local dams. The Flat Rock Bridge is swept away and is not rebuilt.

1869 - Manayunk experiences its worst recorded flood on October 4, surpassing floods of 1822, 1839, and 1850. The Schuylkill River and the Canal join as one and water reaches the underside of the Green Lane bridge, which is destroyed as a boat is torn from its moorings and crashes into it. The bridge is later rebuilt. All mills in the Wissahickon Valley are demolished when the Fairmount Park Commission buys up the area to protect water quality in the Schuylkill River.

1889 - Flooding in the upper reaches of the Schuylkill River causes the Philadelphia Times to report: "There have not been many buildings in the town carried off, but there are few that have not been damaged. There is mourning everywhere for the dead. There are hundreds utterly destitute. They have lost all they had and have no hope of employment for the future."

1894 - Another flood batters Manayunk.

1902 - After a long rain, the Schuylkill River rises on February 28 and crests on March 1. River Road is flooded to the eaves of one-story buildings, matching the height of 1869 floodwaters. As the water recedes, everything is covered with a foul smelling mud that takes days of shoveling to remove. No lives are lost.

1933 - Portions of Manayunk are once again inundated.

1935 - In July, the Schuylkill River basin floods again.

1936 - Heavy snow during the winter of 1935-1936 and an early warm spell in February cause rapid melting and statewide flooding.

1942 - In May, the Schuylkill River once again experiences flooding.

1948 - The Manayunk area experiences another flood.

1955 - The Delaware River swells into one of its biggest recorded floods in history when the area is hit by Hurricane Connie and then Hurricane Diane five days later in mid-August. The Schuylkill River is not as severely affected, but does once again rise to cover sections of Manayunk, including all of Venice Island and portions of Main Street.

1972 - Hurricane Agnes rips through the area in June and causes major damage in Manayunk. Agnes is described as the worst natural disaster experienced in Pennsylvania. Flooding in Philadelphia is considered minimal compared to the upper reaches of the Schuylkill River, where evacuations are ordered in Pottstown and Norristown just north of Manayunk. Philadelphia joins the National Flood Insurance Program, committing itself to maintain the floodplain management regulations of the Federal Emergency Management Agency.

1996 - A heavy snow in January, followed by sudden rains and high temperatures, causes major flooding that covers Venice Island and fills Manayunk's Main Street.

1999 - September, Hurricane Floyd, downgraded to Tropical Storm by the time it hits the Schuylkill River valley, once again floods Manayunk.

This composite map of Manayunk includes the approximate boundaries of the Manayunk Main Street Historic District (green) and the Special Flood Hazard Area (SFHA) (dark purple) as defined in 2007. The SFHA (also known as the 1% annual chance flood, 100-year flood and base flood zone), has historically been subject to a 1% chance of flooding during any given year. In this case, the SFHA is defined as Zone AE, in which the base flood elevations are determined. The portions in light purple represent areas of historically 0.2% annual chance flood (also known as the 500-year flood zone). Areas without purple were determined in 2007 to be outside of the historically 0.2% annual chance floodplain. It is important to highlight that it is anticipated that the floodplain boundaries will be updated within the next few years and the flood risk delineations do not include future conditions due to climate change or other factors. (Map obtained through the Pennsylvania Historic Preservation Office and the boundaries are approximate for both the Historic District and areas of flood risk.)

FLOOD INSURANCE COVERAGE

Flood insurance is available for tenants and property owners from the National Flood Insurance Program (NFIP) for buildings and contents at qualified properties in the following coverage amounts:

	Commercial	Residential
Building	$500,000	$250,000
Contents	$500,000	$100,000

Flood insurance is also available from private companies, although amounts may vary.

PRESIDENTIAL DISASTER DECLARATION FUNDING

The federal government provides financial assistance only in the event of a Presidential Disaster Declaration. ***However, most incidents of flooding do not warrant the declaration and even with a disaster declaration, not every impacted property will qualify for assistance. In both cases the property owner would be financially responsible for necessary repairs through flood insurance or other means.***

The following federal funding is available following a Presidential Disaster Declaration:

- **Individuals and Households Program (IHP):** Administered by FEMA, IHP provides financial and direct services to eligible individuals and households affected by a disaster who have uninsured or under insured necessary expenses and serious needs. In 2018, the IHP program grant limit was increased to $34,900. *(www.fema.gov.)*
- **U.S. Small Business Administration (SBA):** The SBA makes long-term, low-interest loans for both residential and commercial use through its Disaster Loan Assistance program to address both physical and economic damage from a declared disaster.
- **U.S. Department of Housing and Urban Development (HUD):** HUD can provide funding through its Community Development Block Grant Disaster Recovery (CDBG-DR) Program. To be eligible for funding, the proposed project must be a CDBG eligible activity and meet a CDBG national objective. *(www.hudexchange.info/programs/cdbg-dr/.)*

NATIONAL FLOOD INSURANCE PROGRAM

Established in 1968, the National Flood Insurance Program (NFIP) offers repair assistance for flood-damaged properties; provides maps of floodplain areas, delineating zones of risk; and makes flood insurance available to property owners.

The intent of the NFIP was to:

- Allow property owners to purchase flood insurance from the Federal government where private insurance was unavailable or cost prohibitive;
- Provide a national insurance funding pool to distribute the risk across a larger geographic area, thus reducing premium costs; and
- Provide incentives for flood risk management, thus reducing the overall costs of flooding.

In many ways, flood insurance works like other types of insurance. In exchange for the payment of a premium, the insurance provider guarantees compensation or partial compensation for a covered loss. The cost of premiums varies with risk; for example, less flood-prone properties will have lower premiums than those in more vulnerable locations. With flood insurance, a property owner or tenant is eligible to receive funds for recovery following a flood event. Flood insurance is typically available to covers damage to both the property (i.e., commercial and residential buildings) and contents (i.e., merchandise, furnishings, and objects).

NFIP insurance is currently available to all owners of eligible residential and commercial properties throughout Philadelphia, regardless of the property's flood risk. ***Flood insurance is required for some properties, such as mortgaged properties located within high-risk areas, but it should be considered by owners of all properties at risk for flooding. In cases where flood insurance is not required, each property owner must assess their property's level of risk and their ability to financially recover from a flood event when considering forgoing coverage. In the event of a flood, any flood-related damage not covered by insurance is largely the responsibility of the owner and/or tenant.***

Unfortunately, alterations required to protect a property from flooding (e.g., wet floodproofing or dry floodproofing) and to achieve lower insurance premiums can sometimes be at odds with best practices for historic preservation. *(Refer to Wet Floodproofing, page 23, and Dry Floodproofing, page 29.)* Alterations can jeopardize the historic character and integrity of a building, property, and setting. If the changes cause the building to no longer meet the definition of a "Historic Structure," full floodplain management requirements must be met. All contributing properties in the Manayunk Main Street Historic District meet the criteria of "Historic Structures" under the NFIP. *(Refer to Floodplain Management, page 10, and Historic Preservation Review, page 13.)*

"Although you as a property owner may elect to forgo flood insurance if you own your property outright, when triggered, compliance with regulations always applies."

Because the City of Philadelphia participates in the NFIP, compliance is mandatory everywhere to prevent surcharges for owners with NFIP insurance or loss of disaster assistance to name a few.

Flood vulnerability is largely based upon a building's location. Although the basements are all vulnerable, the building at the bottom of a hill will be more vulnerable than a similar one at the top of the hill.

IDENTIFYING FLOOD RISK

Low-lying, flood prone areas located adjacent to or near waterways, also known as floodplains, are mapped by the Federal Emergency Management Agency (FEMA). Information regarding a property's flood vulnerability can be found on FEMA's Flood Insurance Rate Maps (FIRMs) as well as Digital Flood Insurance Rate Maps (DFIRMs) available online through ***FEMA's Flood Map Service Center***, is searchable by street address. *(https://mcs.fema.gov/portal/home.)* FIRMs serve as the basis for floodplain regulation and management, as well as a tool for determining flood insurance premiums. ***However, both FIRMs and DFIRMs are based upon historical or current flood data and do not address future threats such as increased development, subsidence, or increased precipitation from climate change.*** Flooding threat from infrastructure is often sudden and unpredictable and is not included on FIRMs.

The FIRMs and DFIRMs identify the extent of the 1% floodplain of the ground, formerly known as the 100-year floodplain, or Special Flood Hazard Area (SFHA), identifying properties at the greatest risk of flooding. They also include the 0.2% floodplain of the ground, formerly known as the 500-year floodplain, identifying properties with a more moderate risk of flooding. Buildings outside of the SFHA with levels below grade, such as basements, may be equally vulnerable to flooding. In addition, properties outside of designated floodplains often experience flooding during major storm events, such as hurricanes, tropical storms, Nor'easters, and sudden storms. The best way to obtain an accurate flood risk assessment for a specific property is to acquire an Elevation Certificate from a licensed surveyor, architect, or engineer, typically sought for buildings in SFHAs. *(Refer to Elevation Certificate, page A.10.)*

This restaurant's owner monitors the height of the water relative to the underside of the deck. When floodwater is within about 18" of the deck, the staff relocates all furnishings and equipment to higher ground.

FLOODSMART

FloodSmart, administered by FEMA, is the official website of the National Flood Insurance Program (NFIP). It is valuable resource for property owners and includes information regarding flood risk, flood insurance, and reducing flood risk. *(www.floodsmart.gov/.)*

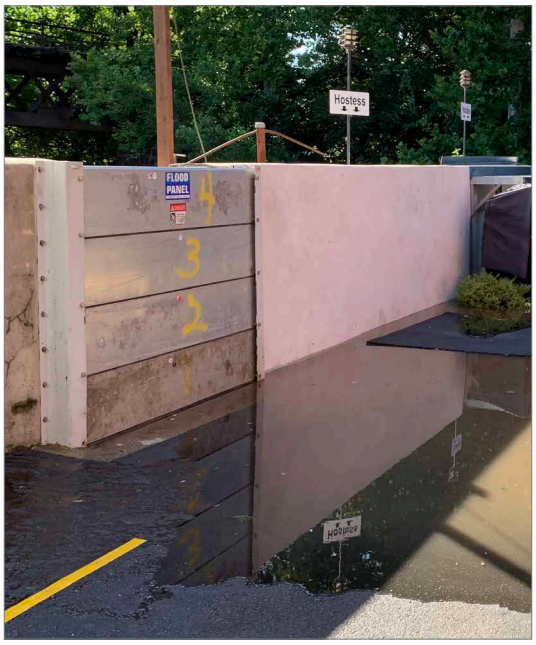
DFIRM

Digital Flood Insurance Rate Maps (DFIRMs) are developed in conjunction with FEMA and available through the FloodSmart web portal. Like FIRMs, DFIRMs indicate Special Flood Hazard Areas (SFHAs) and areas that have a 0.2% chance of flooding in any given year. *(hwww.floodsmart.gov/.)*

FIRM REVISIONS

FIRM's are periodically updated to reflect known flood risk based upon historical data and the development impacting flood vulnerability. ***It is anticipated that the FIRM map for Manayunk will be updated in the next few years. This may result in a boundary change or even a rise in base flood elevations that may change a property's designation from being outside of the Special Flood Hazard Area (SFHA).***

Property alterations typically require a City Building Permit. A review for floodplain requirements will be triggered when any permits are applied for when a structure/parcel is located within a SFHA.



Flood gates can provide temporary protection from rising floodwater. The panels must be engineered by design professionals and installed prior to flooding. Water seepage can be reduced by maintaining gaskets. *(Refer to Barriers & Sheilds - Windows & Doors, page 32.)*

DESIGN PROFESSIONALS

The City of Philadelphia has established specific compliance requirements for mitigation projects. ***In addition to complying with Philadelphia building codes and Historical Commission requirements, alterations to buildings located within locally designated floodplains must also comply with the floodplain management regulations.***

With the exception of building permit applications with a construction value that is less than $25,000, a design professional licensed in the Commonwealth of Pennsylvania must sign and seal all of Philadelphia's Flood Protection Forms. Structural plans must be signed and sealed by a professional engineer.

To expedite the review process, consultation with an architect or structural engineer who has specific experience with flood mitigation alterations and Philadelphia Historical Commission requirements is highly recommended.

A licensed architect, engineer, or surveyor is also required to prepare an Elevation Certificate. *(Refer to Elevation Certificate, page 12.)*

FLOOD MITIGATION

Flood mitigation entails actions taken by communities and individuals that decrease the negative effects of flooding, with the primary aim of protecting of human life and property. ***Mitigation projects are sometimes undertaken as protective measures, in anticipation of a potential flooding, but they are more likely as a reaction to flooding, during or immediately following the recovery process.***

When considering mitigation after a flood, there is a tendency to strive to return to "normal" pre-flood conditions. Although an emotionally comfortable response, reinstating a condition that is known to be prone to flood damage is not necessarily in a community's or property owner's best long-term interest. However, the careful selection of mitigation options allows both a community and its constituents to be forward-thinking, particularly in considering increasing flood vulnerability associated with increased precipitation and development in the floodplain.

There is a wide range of mitigation measures that can be implemented to address flooding of various types and extents. ***Community-wide mitigation options tend to be larger and beneficial to an extended area, such as the storm water improvements at Venice Island, and may alleviate the need for individual property mitigation. By contrast, property-specific mitigation options are initiated by an owner or tenant and are typically limited to reducing flood impact at a single parcel.***

Property-specific mitigation options are determined by individual owners or tenants within the requirements of local zoning, floodplain, and building code, including the Philadelphia Historical Commission, and may have the added benefit of reducing property flood insurance rates if compliant with the National Flood Insurance Program (NFIP). ***Basic improvements are generally simple, low-impact strategies that are relatively easy and inexpensive to complete, and in some instances, do not require the services of a design professional.***

In former industrial communities such as the Manyunk Main Street Historic District, which is dominated by former mills and rowhouses, property-specific mitigation options available to improve flood resilience generally fall into one of three categories: basic improvements; wet flooproofing, and dry floodproofing. *(Refer to pages 15, 23, and 29.)* Building alterations, such as wet floodproofing and dry floodproofing, are often more complex, will require the assistance of a design professional, and typically have the greatest impact on the integrity of historic properties. *(Refer to Design Professionals, at left.)* Improperly installed or constructed wet floodproofing or dry floodproofing alterations can result in significant damage to an existing building and prevent owners from benefiting from reduced flood insurance rates.

It is important to keep in mind that the practice of flood mitigation has not traditionally taken a building's historic character into account. Flood mitigation strategies tend to require change, often radical change, that can damage or destroy the integrity or character of historic properties. When selecting flood mitigation options, every effort should be made to minimize the impacts on the building's historic integrity. *(Refer to Historic Preservation Review, page 13.)*

FLOODPLAIN MANAGEMENT

Floodplain management requirements are intended to reduce the risk to human life, property, and building contents related to flooding. Compliance with Philadelphia's floodplain management requirements for a property located in or close to the SFHA can reduce the time required to obtain a permit and expedite recovery in the event of a future flood.

Although property owners are encouraged to implement floodplain management requirements pro-actively and as part of minor construction and repair projects, there are some construction activities that require compliance. ***Proposed property improvements within a SFHA, including portions of the Manayunk Main Street Historic District, are required to comply with all applicable Philadelphia City Code requirements, including Philadelphia's floodplain management regulations, found in the City of Philadelphia Zoning Code and adopted Building Codes.***

Within a designated Philadelphia floodplain, there are many types of work subject to floodplain management regulations that are applicable to all properties, including those designated as historic by the City. Examples include, but are not limited to:

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

Property owners considering complex alterations and new construction should contact the Department of Licenses and Inspections to:

- Determine the floodplain management regulations applicable to a proposed project (refer to *atlas.phila.gov/*, an online, digital map, searchable by property address that includes floodplain management regulations under the Zoning tab);
- Schedule a floodplain scoping meeting, mandatory for project scopes is over $50,000 *(www.phila.gov/media/20200527101801/PG_002_INF_Floodplain-scoping-meeting-Information-Sheet-v.1.pdf)*
- Schedule a training or see the training document here from the City's Floodplain Manager *(www.phila.gov/documents/floodplain-training-presentation/)*
- Complete a Flood Protection Form early in the planning phase of a project; and
- Schedule a meeting with the Philadelphia Floodplain Manager to better understand the permit review process.

Philadelphia's Flood Risk Management Task Force can assist property owners considering property improvements in a floodplain. In addition, there are numerous helpful resources available from the City and the Federal resources. *(Refer to Resources, page 35.)*

CONSTRUCTION APPROVAL IN THE FLOODPLAIN (SFHA)

The Department of Licenses and Inspections has a website dedicated to guiding applicants through the floodplain management approval process. The website includes floodplain information and links to Philadelphia Flood Protection Forms and FEMA information.

(www.phila.gov/services/permits-violations-licenses/apply-for-a-permit/building-and-repair/get-approval-for-construction-in-the-floodplain/.)

FLOODPROOFING CERTIFICATE

A Floodproofing Certificate is required for commercial and/or mixed-use structures being dry floodproofed prior to the issuance of a Certificate of Occupancy. Dry floodproofing does not provide relief from flood insurance rates for residential property owners. (*Refer to Dry Floodproofing, page 29.)*

> *Documentation of certification by a registered professional engineer or architect that the design and methods of construction of a nonresidential building are in accordance with accepted practices for meeting the floodproofing requirements in the community's floodplain management ordinance. This documentation is required for both floodplain management requirements and insurance rating purposes.*
>
> *For insurance rating purposes, a building's floodproofed design elevation must be at least (18" - Philadelphia) above the Base Flood Elevation (BFE) to receive full rating credit for the floodproofing. If the building is floodproofed only to the BFE, the flood insurance rates will be considerably higher.*
>
> (- FEMA)

FLOOD ROLES IN PHILADELPHIA

There are a number of City Departments, Offices, agencies, and entities who provide information and assistance to property owners and tenants addressing flooding. *(Refer to the Flood Roles in Philadelphia chart, page 34.)*

Mitigation projects should minimize the impact on the building's historic character and features.

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.

The Department of Licenses and Inspections (L&I) is responsible for making substantially damaged determinations.

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.
(- FEMA)

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.* (- FEMA)

SUBSTANTIAL IMPROVEMENT

Any reconstruction, rehabilitation, addition, or other improvement to a structure, the cost of which equals or exceeds 50% of its pre-improvement market value, or equals or exceeds a smaller percentage established by the authority having jurisdiction. (- City of Philadelphia)

Any proposed improvements to a property that are determined to be a Substantial Improvement are subject to full compliance with the Floodplain Management Ordinance. The calculation of Substantial Improvement requires a valuation of the existing structure, not the property (land value), as well as the estimated cost of construction.

The most straight-forward manner of documenting a property's value is through Philadelphia's Office of Property Assessment (OPA) where assessment values can be searched by address. *(www.phila.gov/OPA/Pages/default.aspx.)* On the OPA's web site, the value of the structure is the "taxable improvement value." Applicants also maintain the right to appeal the OPA's valuation.

As an alternative, applicants can engage an appraiser to provide an independent assessment. However, property owners should be cautioned that the assessment requirements for a substantial improvement determination vary from and are more detailed than typical property assessments. Standard property assessments will not be accepted by the City for substantial improvement determinations.

In addition to property valuation, the determination of Substantial Improvement requires property owners to provide estimated costs of construction. It the anticipated cost of construction is over 30% of the assessment value, detailed documentation is required including:

- A description of the proposed work;
- Detailed costs estimates of the proposed improvements; and if the applicant believes the property is not subject to the floodplain requirements
- An Elevation Certificate or survey. *(Refer to Elevation Certificate, page A.10.)*

In assessing the value of construction, the City can review the aggregate total of all recent permit applications at a property. If the City determines the aggregate total of recent and proposed work exceeds 50% of the property value, the owner can be required to fully comply with floodplain regulations if they chose to proceed with the work.

Proposed work that does not meet the threshold of a substantial improvement should not lessen the ability of the property to resist flood damage. This includes the installation of mechanical equipment at grade within the floodplain and sealing and modification of basement or crawlspace openings. *(Refer to Relocation of Critical Systems & Equipment, page 18, and Fenestration Modification, page 33.)*

Main Street slopes down to a low point near Shurs Lane. Properties close to the corner are some of the most vulnerable in the Manayunk Main Street Historic District. The Manayunk Brewing Company, located in the lower level of the red brick building, has been significantly flooded several times.

ELEVATION CERTIFICATE

A certification, in the form and containing the information required by FEMA, of the elevation of a structure and its improvements. An Elevation Certificate may only be prepared and certified by a licensed land surveyor, architect, or engineer using Mean Sea Level as established by the National Geodetic Vertical Datum of 1929 (NGVD-29). ***When constructing a new building or an addition to an existing building, Elevation Certificates are required for design application submission as part of the building permit package, upon the completion of the lowest floor, which may be the basement, and prior to the issuance of a Certificate of Occupancy. They can also be commissioned for properties to potentially take advantage of flood insurance rate reduction.***

CITY DATUM

Although the industry's standard practice it to use NAVD 88, the FIRMs for Philadelphia utilize NGVD 29, which differs from the City Datum. Plans prepared using a City Datum must be converted to NGVD-29 for floodplain management review. The City has 7 survey districts with varying conversion factors. Plans submitted for review must indicate which conversion factor was utilized in determining elevations. (A chart showing the conversion from the City Datum is available at *www.phila.gov/documents/flood-protection-forms/*.)

LOWEST FLOOR

The lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for the parking of vehicles, building access or storage in an area other than a basement is not considered a building's lowest floor provided that such enclosure is not built so to render the structure in violation of other applicable non-elevation design requirements of 44 CFR Section 60.3. (- NFIP)

FLOODPLAIN MANAGEMENT FOR HISTORIC PROPERTIES

Historic properties in Philadelphia are NOT exempt from floodplain regulation. *(Refer to NFIP Provisions for Historic Properties, page 14.)* Property owners considering projects at an existing building are required to submit a Flood Protection Form - Existing Buildings (FP-EX) prior to commencing work.

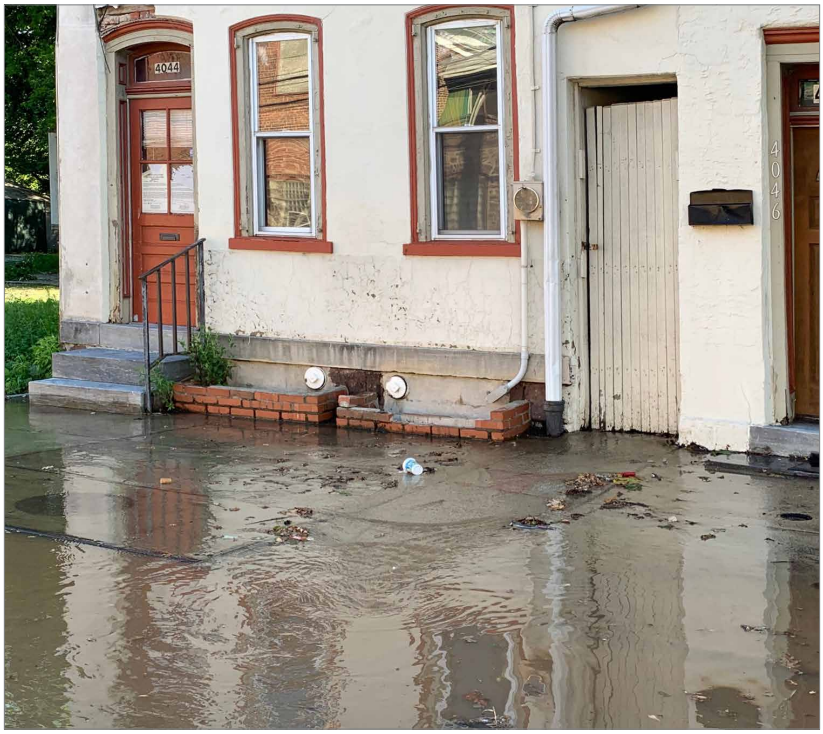
If the building is designated as a contributing resource to the Manayunk Main Street Historic District and compliance with floodplain management requirements would cause the building to loose its designation, a flood protection variance can be sought. The variance application must include an analysis by an architect indicating that compliance with building elevation or floodproofing requirements would impact its integrity to the extent it would no longer be eligible for historic designation. Completed variance applications are considered by the Board of Building Standards.

To minimize future costs of flood recovery for all buildings, including those granted a variance, it is recommended that mechanical equipment and systems be located at least 18" above the Base Flood Elevation (BFE). In addition, flood damage-resistent materials should be used in areas up to 18" above BFE.

GUIDELINES FOR FLOOD ADAPTATION FOR REHABILITATING HISTORIC BUILDINGS

In November 2019, the National Park Service released the *Guidelines for Flood Adaptation for Rehabilitating Historic Buildings*, providing further direction for communities, property owners and tenants considering the impact of flood mitigation projects. *(www.nps.gov/tps/standards/rehabilitation/flood-adaptation.htm.)*

The *Guidelines* identify the appropriateness of various treatments in a "Recommended" and "Non-Recommended" format.



Historic preservation review balances resilience and maintaining the character of historic properties.

HISTORIC PRESERVATION REVIEW

Historic preservation review for flood mitigation is generally only applicable to those properties that would otherwise be subject to review. The goal of historic preservation review is to improve the resilience to flood hazards while minimizing the impact on historic materials, features, and finishes.

PHILADELPHIA HISTORICAL COMMISSION

The Philadelphia's Historical Commission helps preserve and revitalize neighborhoods, celebrates City history, and promotes historic preservation as a proven economic driver for the City. As established by the Philadelphia City Code, the Historical Commission has jurisdiction over all proposed exterior alterations to properties that are visible from a public way in locally designated historic districts as well as individually designated properties. Proposed visible exterior improvements to address flood mitigation, whether proactively to provide protection, emergency repairs following a flood event, or larger projects to make buildings serviceable, fall within the Commission's jurisdiction.

In its review of flood mitigation measures, the Historical Commission utilizes the same criteria as it does for other types of alterations. Their goal is to maintain integrity, or the ability of a property to convey its historic significance. This includes proposed additions intended to offset loss of usable space at existing buildings. However, the Historical Commission 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.

Although activities such as mud clean-up are not subject to review, compliance with historic preservation review requirements is required for building and property alterations.

As with all projects affecting historically designated properties, the Historical Commission 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 the Commission's review criteria.

PA STATE HISTORIC PRESERVATION OFFICE

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

- Receiving state and/or federal tax credits;
- Receiving state or federal funding;
- Receiving state or federal permits; and potentially
- Protected by easements.

Immediately following a flood, PA SHPO encourages stabilization repairs, including the installation of temporary shoring and roof tarps. Quick action has the potential to reduce additional damage and secondary damage such as mold. ***Prior to undertaking any further work, PA SHPO should be contacted to review properties under their jurisdiction. PA SHPO review is not a substitute for Philadelphia Historical Commission review. If there are differences of opinion between the Commission and PHMC review, the more stringent option will typically apply.***

NFIP PROVISIONS FOR HISTORIC PROPERTIES

Although the NFIP provides provisions for historic properties, all properties in the City of Philadelphia are subject to Philadelphia's floodplain regulations, including historic properties. It should be noted that any variance for floodplain compliance:

- Leaves buildings vulnerable to flooding and damage;
- Does not otherwise relieve property owners from obtaining flood insurance if otherwise required; and
- May foster a false belief that the flood risk is somehow reduced or eliminated.

The NFIP floodplain management requirements contain two provisions that are intended to provide relief for "historic structures" located in Special Flood Hazard Areas:

(1) The definition of "substantial improvement" at 44 CFR 59.1 includes the following exclusion for historic structures,

Any alteration of a "historic structure", provided that the alteration will not preclude the structure's continued designation as an "historic structure".

The same exemption also applies to "historic structures" that have been "substantially damaged".

This provision exempts historic structures from the substantial improvement and substantial damage requirements of the NFIP.

(2) The other provision of the NFIP floodplain management regulations that provides relief for "historic structures" is the variance criteria at 44 CFR 60.6(a). This provision states:

Variances may be issued for the repair or rehabilitation of historic structures upon a determination that the proposed repair or rehabilitation will not preclude the structure's continued designation as a historic structure and the variance is the minimum necessary to preserve the historic character and design of the structure.

Rear portions of buildings on Main Street are at lower elevations and would particularly benefit from regular, consistent maintenance.

B Basic Improvements

BASIC IMPROVEMENTS

Potential Preservation Benefits:

- Maintenance of historic buildings, structures, and properties can improve their long-term preservation and increase flood resilience
- Landscape improvements that remove large parking lots can provide a more natural setting

Potential Preservation Challenges:

- Relocation of exterior building systems and equipment can increase their visibility; interior relocation can result in loss of habitable space at higher floor levels
- Secondary power systems, such as solar power and generators, are located at the exterior and locating them in a manner that limits visibility often requires screening
- Replacement of historic materials with flood-damage resistent materials may impact the historic integrity of historic spaces

Whether or not building wet or dry floodproofing is anticipated, there are several relatively low-cost basic improvements that can be undertaken by property owners or tenants to improve flood resilience and recovery.

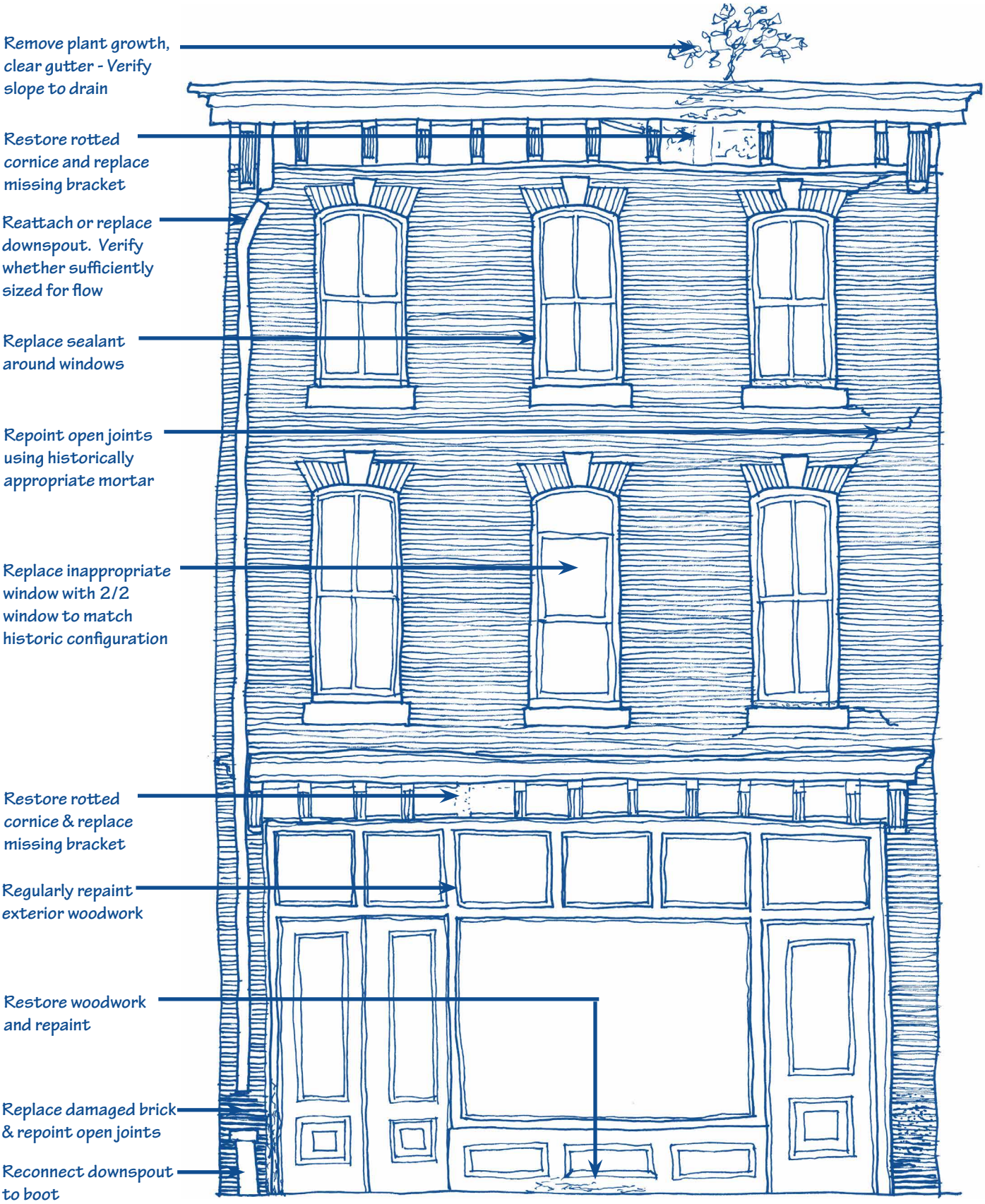
Basic improvements can include:

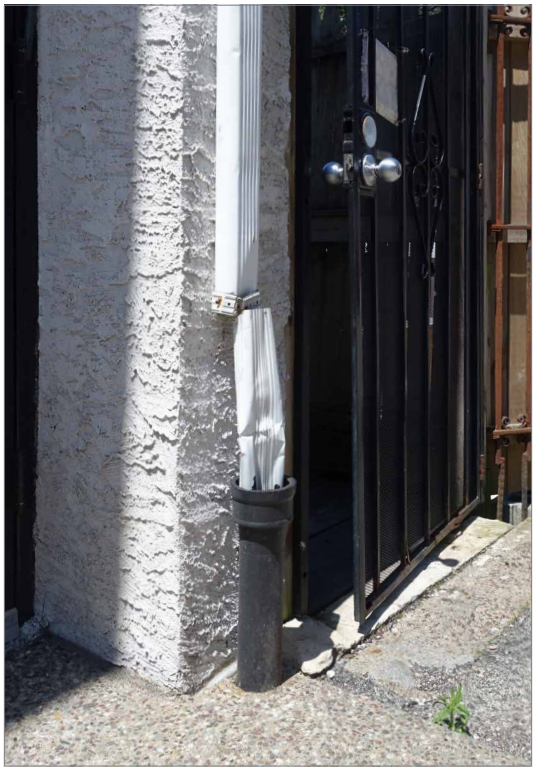
- Maintenance of historic resources and properties;
- Relocation of critical systems and equipment to 18" above the Base Flood Elevation (BFE);
- Installation of secondary power sources such as solar collectors and generators 18" above the Base Flood Elevation (BFE) to allow electrical independence in the aftermath of a flood event;
- Use of flood damage-resistant materials in flood-prone locations;
- Minimizing damage to furnishing and storage; and
- Landscape improvements to improve stormwater absorption and to divert water from flowing towards structures.

These basic improvements are relatively easy to complete and do not require significant modification of historic buildings, thereby limiting the impact on historic integrity. The completion of basic improvements can also be integrated into building alteration, improving their resiliency and probability of ultimate success.

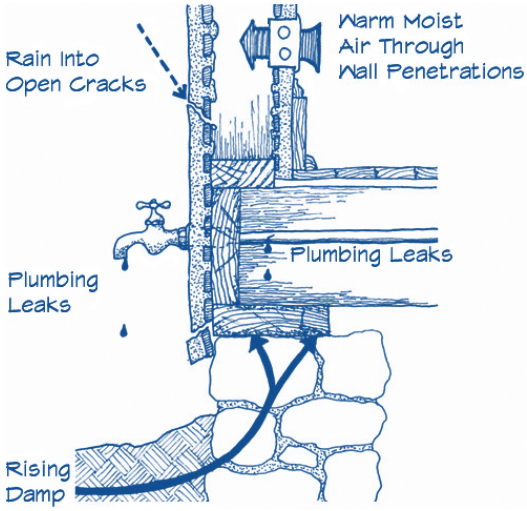
The Philadelphia Historical Commission and Department of Licenses and Inspections (L&I) review requirements of basic improvements will vary. However, the Philadelphia Historical Commission typically does not review maintenance projects and alterations that are not visible from a public way. *(Refer to Historic Preservation Review, page 13.)*

TYPICAL MAINTENANCE NEEDS





Downspouts should be maintained to direct storm water away from a building.



Building maintenance should include special attention in managing water sources to reduce wood rot and loss of mortar at brick and stone.

MAINTENANCE

Regular maintenance helps to:

- Preserve buildings, structures, and properties;
- Protect real estate values and the investment;
- Protect buildings, structures, and properties from flood damage; and
- Keep Manayunk an attractive place to live, work, and visit.

Flooding is often accompanied by secondary factors, such as high winds, and followed by fire. There are simple maintenance measures that can reduce the vulnerability of historic properties to primary and secondary hazards that should be completed at all vulnerable properties, including:

- Grading land to promote positive drainage away from historic buildings (City approval should be sought for potential impact on neighboring properties, sidewalks, or roadways as required);
- Trimming overhanging tree limbs that might crash through a roof or take down electric and telephone lines in a wind 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 and repairing stucco, 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 wind-borne debris;
- Replacing cracked window glass that can shatter in a wind storm and allow water infiltration;
- Sealing openings between building components or around penetrations such as hose bibs;
- 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.

A poorly maintained building, particularly one that is structurally compromised, is a poor candidate for floodproofing because the floodwater can further destabilize its structure.

Interior drywall was removed and electrical outlets and plumbing connections were raised following a flood.

RELOCATION OF CRITICAL SYSTEMS & EQUIPMENT

Damage to building systems and equipment can be a potentially costly effect of flooding, although their impact on historic features and integrity is typically minimal. 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 relocation equipment to a higher elevation level may limit an environmental hazard by preventing gas, oil, and chemicals from mixing with flood water, in addition, reduce the chance of electrification.

The types of systems and equipment that could be impacted include:

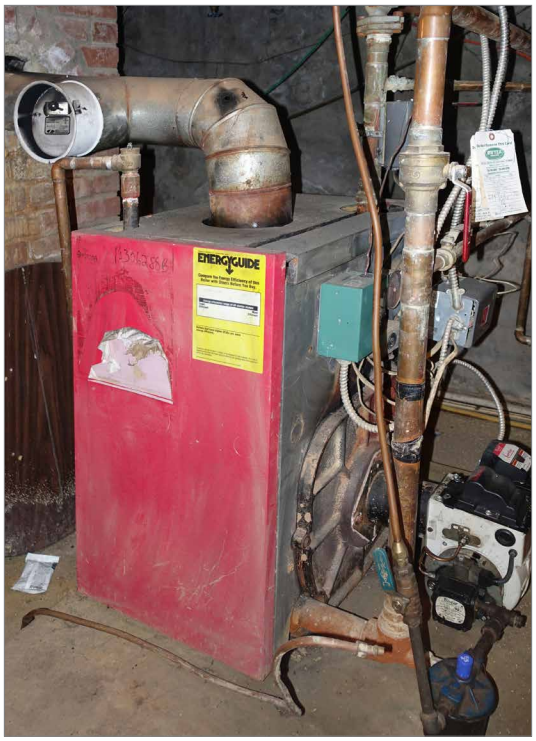
- Heating / Air Conditioning;
- Hot Water;
- Electrical / Generators / Transformers;
- Security / Communications; and
- Appliances.

To be compliant with Philadelphia's floodplain management regulations, relocation will require raising the systems and equipment to 18" above the Base Flood Elevation (BFE). This includes not only major equipment but raising secondary elements such as electrical outlets, junction boxes, switches, disconnects, panels, and meters. Depending on their location, it may also be appropriate to install backflow prevention valves at plumbing fixtures and floor drains to prevent sewage from backing up into buildings.

All relocated equipment should be installed in a manner that meets both manufacturers' and Philadelphia 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, although typically not subject to the Philadelphia Historical Commission's review. This can include boilers, water heaters, electrical panels, refrigerators, kitchen equipment, washers, and dryers.

Relocation of exterior equipment may require mounting on roofs, freestanding platforms, or walls. The Philadelphia Historical Commission's jurisdiction typically includes evaluating the potential visual impact of all building systems and equipment that is visible from the public way. Every effort should be made to minimize the prominence of all equipment by selecting a visually inconspicuous location and screening materials such as shrubs and fencing.

Elevating mechanical equipment at least 18" above the BFE or placing it on a rooftop can help protect it from damage from floodwater. Every effort should be made to minimize equipment visibility.



Building systems and equipment are often located in basements where they are highly susceptible to flood damage, necessitating costly replacement.

PROTECTING BUILDING SYSTEMS

FEMA Publication P-348, Edition 2, *Protecting Building Utility Systems From Flood Damage Principles and Practices for the Design and Construction of Flood Resistant Building Utility Systems* (February 2017) provides guidance on the protection of residential systems and equipment.

Solar panels can provide an alternative source of electricity after a flood to power sump pumps and fans.

Tile flooring can be easily cleaned and disinfected if in contact with floodwater.

FLOOD-RESISTANT MATERIALS

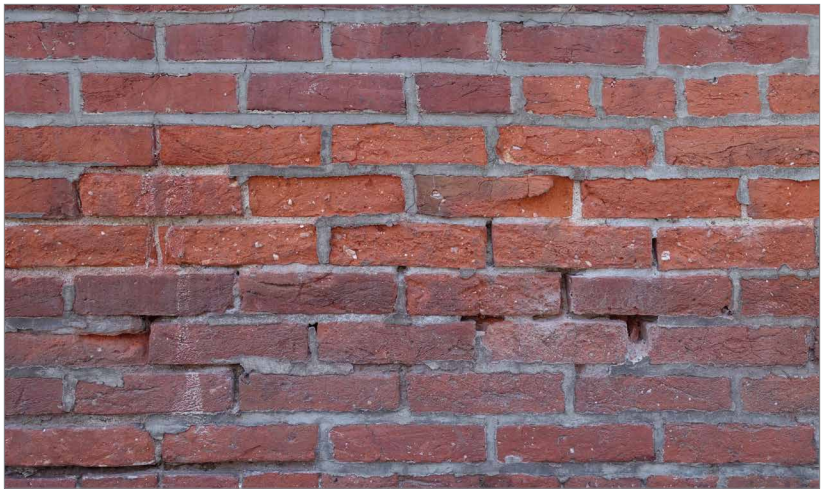
Materials identified by FEMA as flood resistant and available in the following documents:

- **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"* (2008)
- **FEMA Technical Bulletin 7:** *"Wet Floodproofing Requirements for Structures Located in Special Flood Hazard Areas in accordance with the National Flood Insurance Program"* (1993)

Compliance with NFIP non-structural elevation wet floodproofing requirements may necessitate replacement of historic materials with alternative flood damage resistant materials below the BFE/DFE.

INSTALLATION OF SECONDARY POWER SOURCES

Loss of power often occurs as the result of flooding, particularly when accompanied by high winds. This could be property specific – loss of power at a building – or impact multiple properties – downed electrical lines in 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, thus, 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.



Delaminated bricks and open joints in a brick wall can provide a pathway for floodwater into the building. Regular maintenance can preserve the wall and improve its long-term performance.

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 a common exterior material for Manayunk's historic buildings, is classified as having an "acceptable" flood resistance without the application of any coatings. It should be noted that FEMA's material ratings are for individual materials rather than wall and floor assemblies. Therefore, each component in an assembly should be evaluated for flood resistance. For example, although individual bricks may be acceptable, brick walls can only provide protection if all components of the wall assembly are acceptable and well maintained. This includes ensuring that mortar joints are repointed and that openings around penetrations are sealed. Philadelphia Historical Commission review is required for the modification of all exterior materials, including repointing.

The ovens and stoves are on wheels and have quick-release gas valves to facilitate relocation to higher ground in preparation for a flood. In addition, there is no storage on the lower shelves and the floor surface can be easily cleaned.

FURNISHINGS & STORAGE

Businesses that are vulnerable to flooding should consider selecting interior furnishings and display merchandizing that can be easily moved or cleaned and disinfected if touched by floodwater.

For restaurants, this could include:

- Kitchen equipment on wheels to allow relocation to higher ground;
- Quick release valves for gas connections;
- Easily cleaned, lightweight chairs for stacking on tables; and
- Concrete or other solid surface bars and banquettes.

For retail stores, this could include:

- Metal and/or plastic wall and free-standing merchandise displays.

In all instances, one of the best ways to reduce the impact of the flood water is to provide for storage above the anticipated height of the floodwater. This can include:

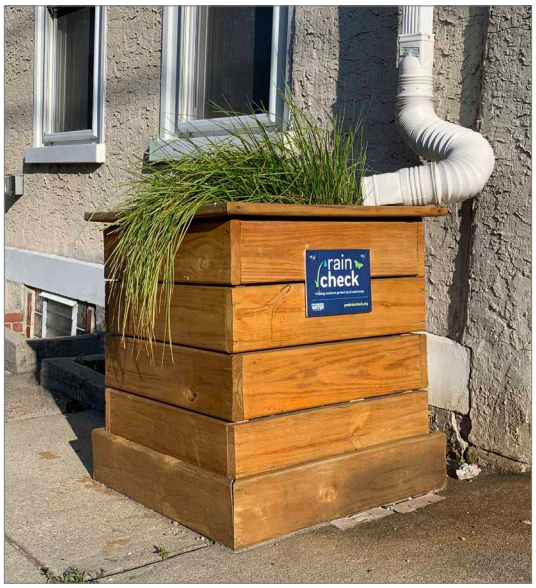
- Limiting storage and equipment in flood-vulnerable areas, particularly appliance such as kitchen equipment and retail merchandise; and
- If flood-vulnerable storage is the only option, elevate items above floor on shelves or raised surfaces and store in plastic bins.

Exterior furnishings, including tables, chairs, and umbrellas should be light enough to be moved for storage and secured to prevent flotation. Ideally, the storage location should be above the anticipated floodwater height.

Interior and exterior furniture should be lightweight and easy to move.

The concrete banquette and floor can be easily cleaned if in contact with floodwater. The chairs are lightweight for easy stacking.

Storage in vulnerable areas should be elevated and stored in plastic bins whenever possible.



The Philadelphia Water Department provides rain barrels to divert water from roof downspouts from storm water drains into storage containers that can be used to water plants and gardens.

Rain gardens on Venice Island collect stormwater from the parking lot and then slowly alow it to be absorbed into an underground storage tank.

LANDSCAPE IMPROVEMENTS

Landscape improvements can be relatively low impact, inexpensive to implement, and integrated into a designed landscape, particularly at new areas of development. Manayunk has very little land area that is not covered by buildings, roadways, sidewalks, and asphalt paving. As a result, the opportunity to improve flood resilience with landscape improvements in this urban setting is very limited, and generally relies on capturing stormwater on site to prevent it from running into a drain or downhill towards the canal or river.

- **Reduction of impervious surfaces and introduction of permeable surfaces** provides a means of increasing infiltration and decreasing stormwater runoff. Impervious surfaces include roofed buildings and structures, roadways, parking areas, and paved surfaces. Any rainfall or other form of water that hits these impervious surfaces becomes runoff, increasing the propensity for flooding downstream. Because of their limited absorption, impervious surfaces have the added effect of reducing infiltration into the ground, thus reducing the replenishment of aquifers. As another strategy to reduce the impact of runoff, roadways, and paved surfaces can be sloped towards drainage ditches in lieu of curbed asphalt that discharges into a stormwater system. This strategy can be implemented for parking lots of larger properties when rain gardens are not desired.
- **Rain gardens** are gardens located in depressed areas of land, often near paved surfaces, that collect stormwater runoff and promote infiltration; they often incorporate native plants. Rain gardens provide a decorative boarder to the sidewalks on Venice Island.
- **Native plants** absorb water to a greater degree than non-native plants, require less maintenance, and can tolerate the range of extremes from very wet to very dry soil.
- **Rain barrels** are located at the base of buildings to collect stormwater discharged from roof surfaces through downspouts. These are a property-specific mitigation measure. The Philadelphia Water Department offers free rain barrels to property owners. They should not be located in the right-of-way where may block the pedestrian flow on sidewalks, and to the extent possible, in manner that limits their visibility from the public way.

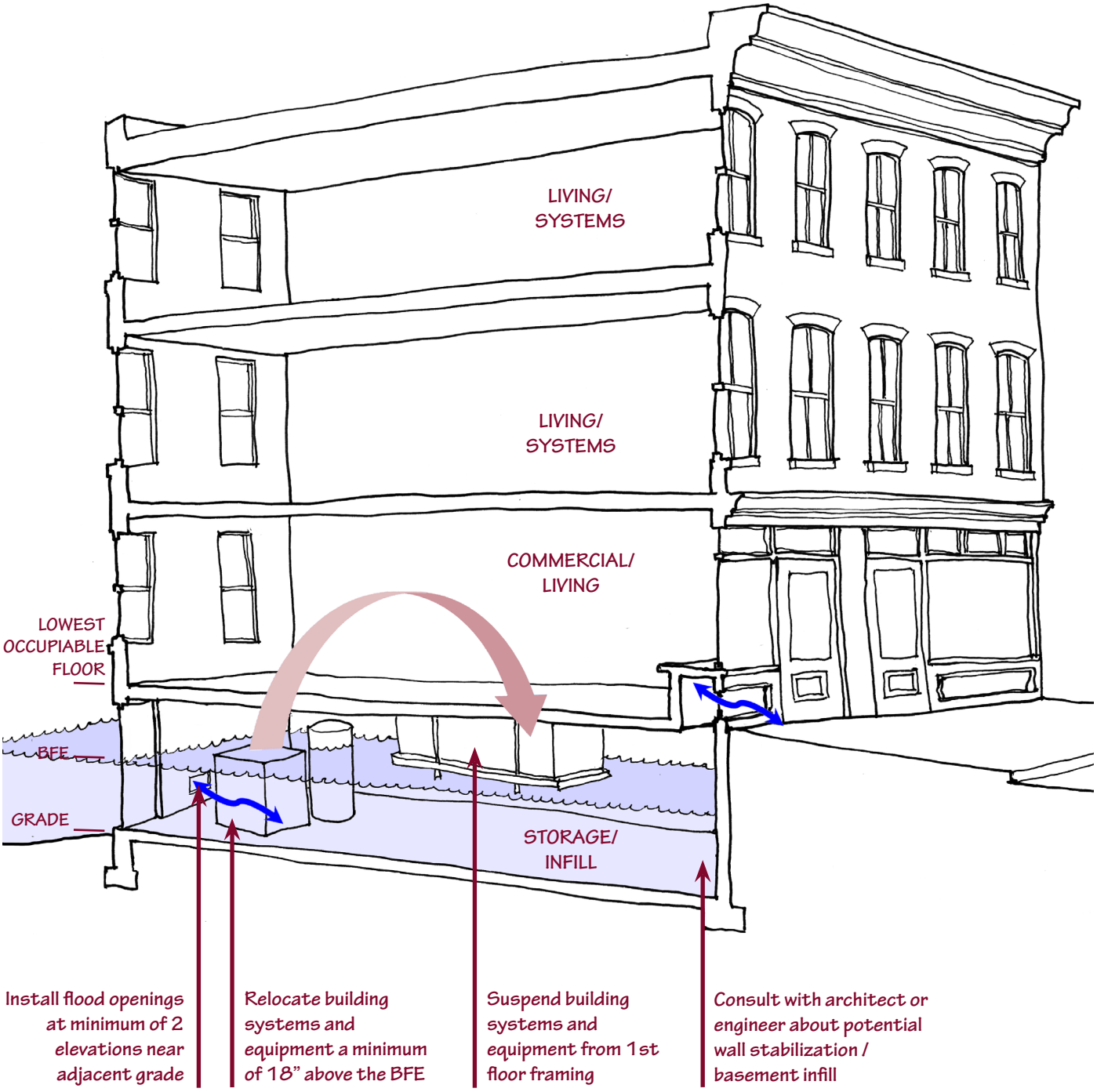
Asphalt surfaces do not absorb storm water. Instead, stormwater is directed towards the river.

WET FLOODPROOFING OPTION:

The following diagram indicate wet floodproofing strategies for an attached commercial or residential building. In Philadelphia, wet floodproofing is only allowed for structures without an enclosure below grade on all four sides

BASE FLOOD ELEVATION (BFE) BELOW EXISTING FIRST FLOOR HEIGHT

Limit use of floor below BFE to storage and remove all critical systems and equipment. To maintain use of upper floors, suspend equipment from first floor framing a minimum of 18" above the BFE. Limit basement storage to non-essential items and locate above BFE.



The first floor of this office has been raised at the interior of the building, while maintaining the height of the door and storefront window.

C Wet Floodproofing

WET FLOODPROOFING

Potential Preservation Benefits:

- Historic buildings can remain at original location and elevation
- It might be possible to minimize exterior alterations, retaining the exterior integrity
- Typically, abandonment of a basement level will not significantly impact historic integrity

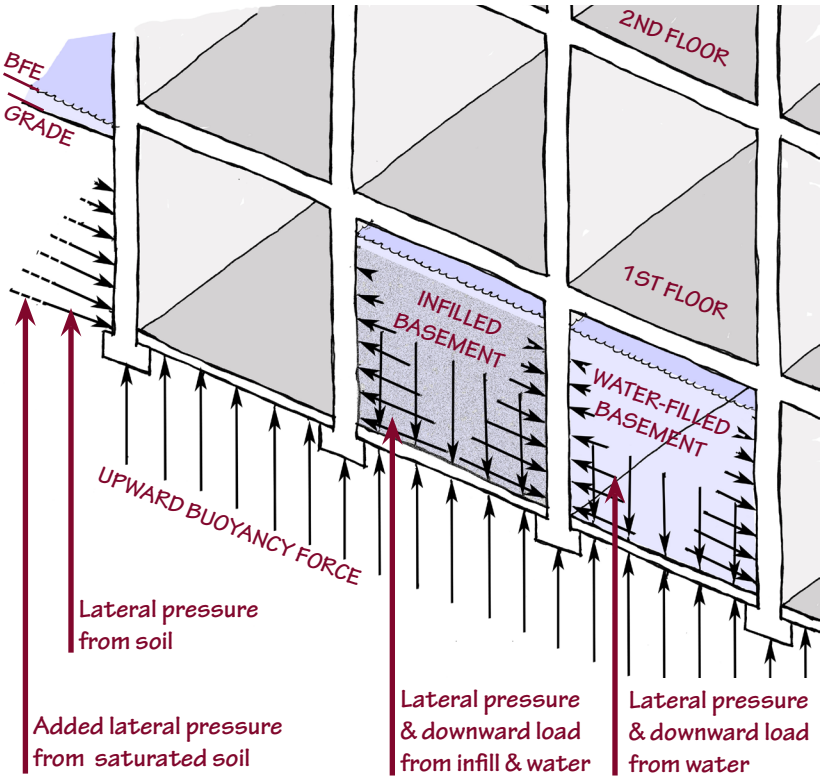
Potential Preservation Challenges:

- Interior spaces must be altered to allow for inundation, potential contamination, draining, cleaning, and drying possibly necessitating replacement of historic materials.
- Abandonment or re-configuration of a first floor often involves modification to windows and doors, significantly altering the integrity of the interior and potentially the exterior
- Flood openings must be sensitively designed for compatibility as should openings and mechanisms to promote ventilation
- Loss of space may necessitate construction of an addition

Wet floodproofing is a flood mitigation alternative that can comply with Philadelphia's floodplain management requirements for residential and non-residential buildings that does not have an enclosure below grade on all four sides. ***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. *(Refer to diagram, page 24.)*

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 flood damage-resistant materials utilized. Potential uses include parking, building access including stairs and elevators, and incidental, low-value storage.*** *(Refer to Use of Flood Damage-Resistant Materials in Flood-Prone Locations, page 19.)* In addition, building systems and equipment should be located above the Design Flood Elevation (DFE). *(Refer to Relocation of Critical Systems and Equipment, page 18.)* 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 -ptechnically difficult to elevate or relocate. This can include very large or complex buildings, or buildings that share party walls, such as the rowhouses and former mill buildings in Manayunk. To meet wet floodproofing requirements, it may be necessary to abandon or limit the use of a portion of a building. Any addition to replace abandoned space must comply with floodplain management requirements and is subject to Philadelphia Historical Commission review.



Lateral and buoyancy forces from saturated soils as well as gravel infill and water-filled basements can put pressure on unsupported basement walls. Keeping the water out of the left basement places significant pressure on the walls and floors that can lead to structural failure including wall collapse and slab heaving. Penetrations in the basement slab may be required to prevent heaving of the basement floor.

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. 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. ***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.

Flood vents, such as those located along the foundation, allow the free passage of water in and out of a closed foundation or building.

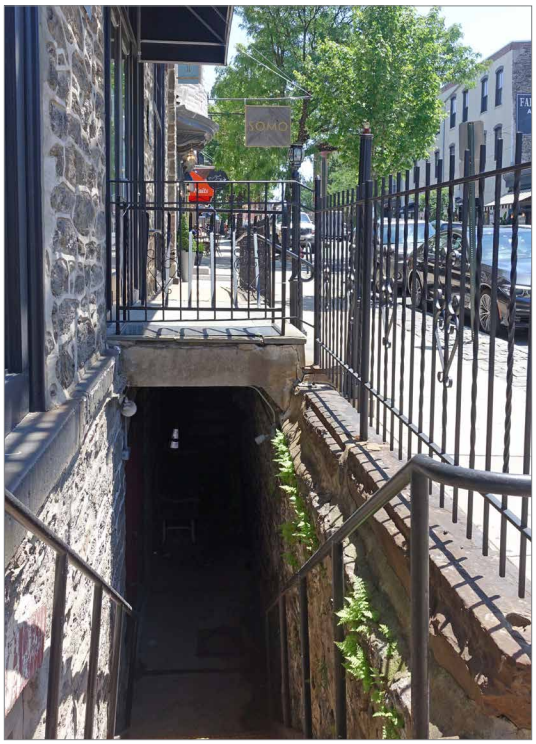
NFIP FLOOD OPENING REQUIREMENTS

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

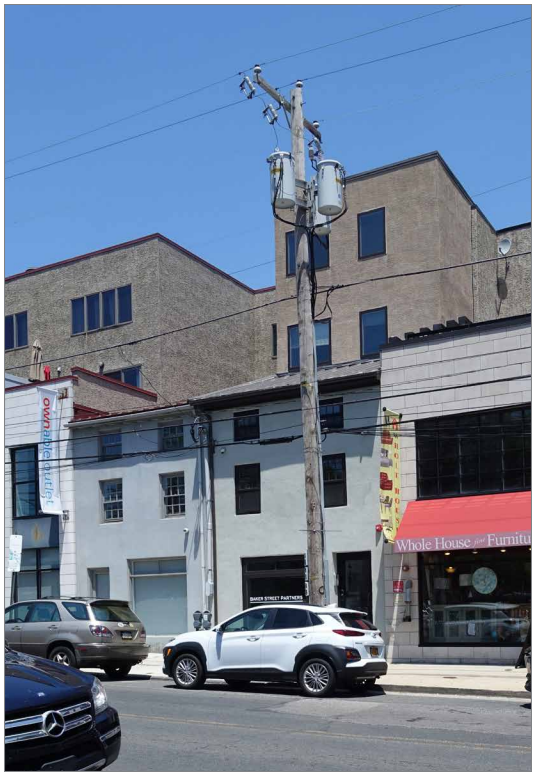
> *A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding.*
>
> *The bottom of all openings shall be no higher than one foot above grade. Garage doors do not meet the National Flood Insurance Program (NFIP) minimum 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 and for room enclosures, at least 2 openings on 2 sides of each space.***

FEMA NFIP Technical Bulletin 1 / March 2020, *Requirements for Flood Openings in Foundation Walls and Walls of Enclosures Below Elevated Buildings in Special Flood Hazard Areas In Accordance with the National Flood Insurance Program. (https://www.fema.gov/media-library-data/1585162441620-bd1b5b0d5cf34eda30d6363c63290d9a/FEMATB1_508_031320_rev.508.pdf)*



Lower levels may need to be abandoned if a building is wet floodproofed.



The loss or limiting of first floors may cause some property owners to consider an elevated addition to recapture lost square footage. In this example, the addition is set back from the street with the intent of limiting is visibility.

USES BELOW DESIGN FLOOD 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 18.)* Uses that are permitted include building entrances, storage, and parking. To be considered wet floodproofed, all building systems must be located above the Design Flood Elevation (DFE). In the case of existing buildings, modification and/or abandonment of the lowest floor levels to comply with Philadelphia's floodplain management requirements can include the following options:

Potential Basement Modifications

- **Abandon the use of the basement.** The basement may need to be partially or fully infilled with a water permeable fill material like gravel to provide sufficient resistance against the lateral forces of floodwater. *(Refer to Basement Infill diagram, page 24.)*
- **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. *(Refer to photograph, page 23, and diagram, page 27.)*
- **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 non-residential uses or if residential to a building entrance, parking, and storage. This may require re-configuration 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.

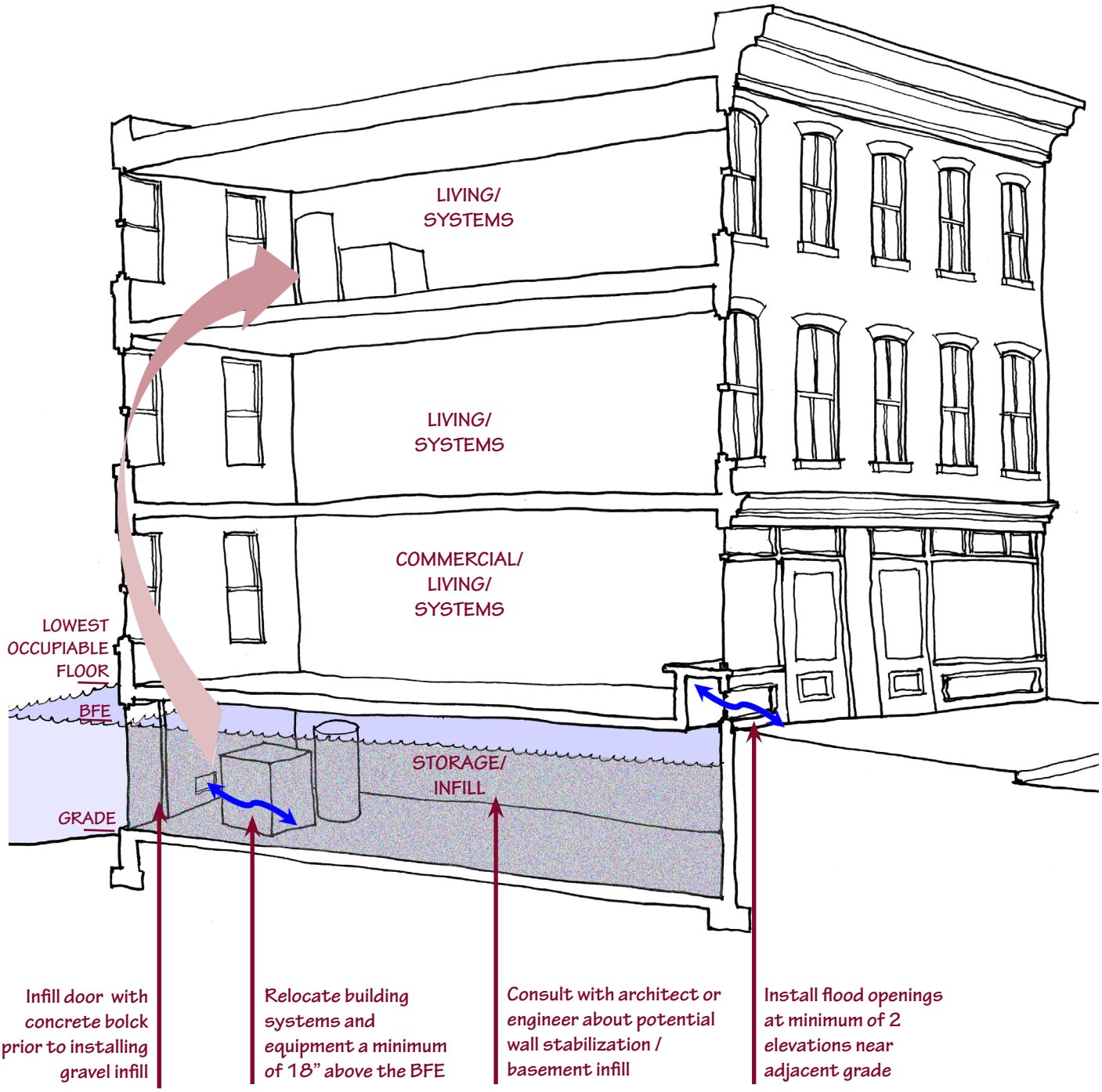
Although storage is permitted in flood-vulnerable areas such as basements that are wet floodproofed, it comes with the risk of loosing merchandise, food, and equipment.

WET FLOODPROOFING OPTIONS:

The following diagrams indicate wet floodproofing strategies for an attached commercial or residential building. In Philadelphia, wet floodproofing is only allowed for structures without an enclosure below grade on all four sides

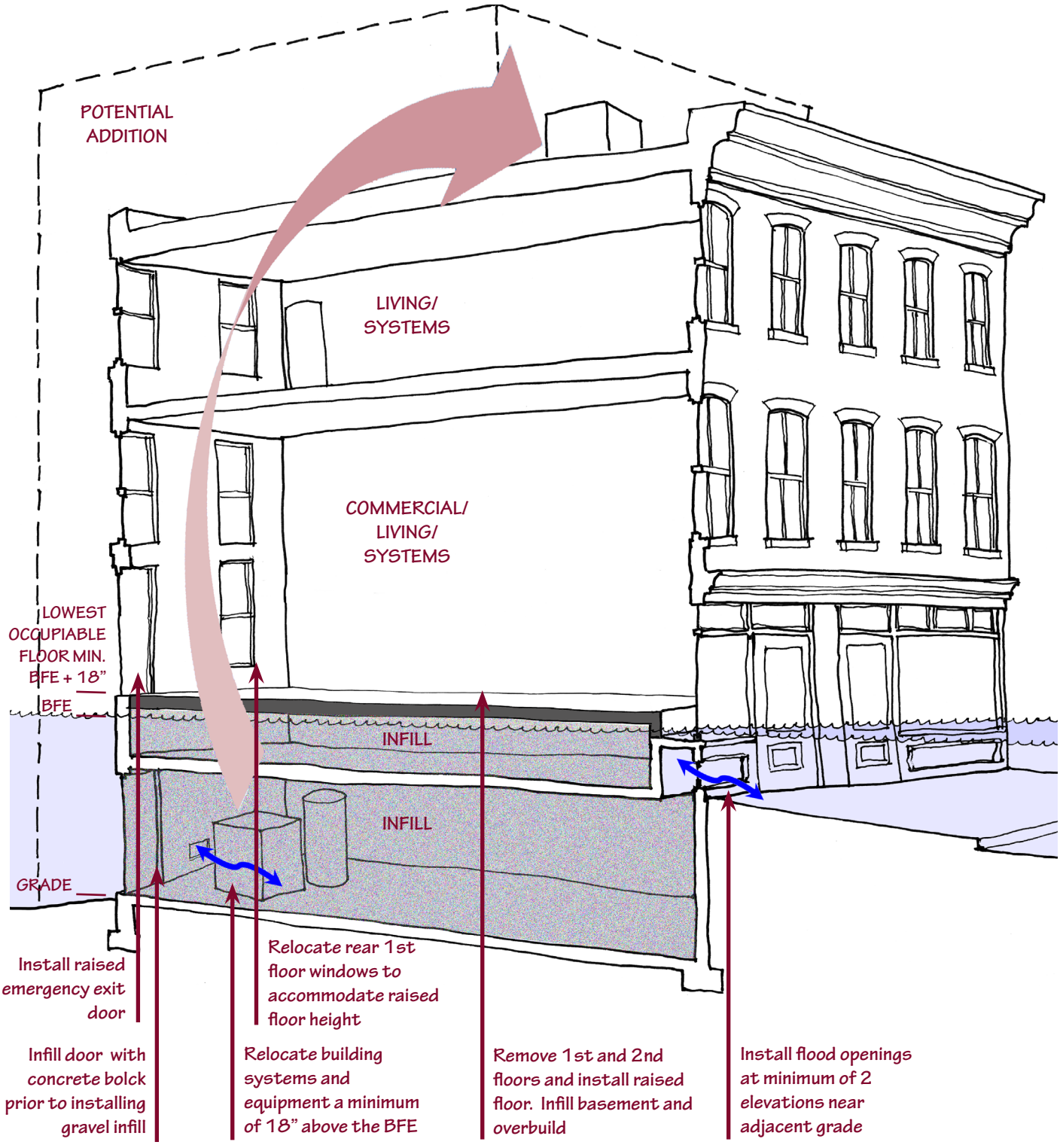
BASE FLOOD ELEVATION (BFE) BELOW EXISTING FIRST FLOOR HEIGHT

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



BASE FLOOD ELEVATION (BFE) ABOVE EXISTING FIRST FLOOR HEIGHT

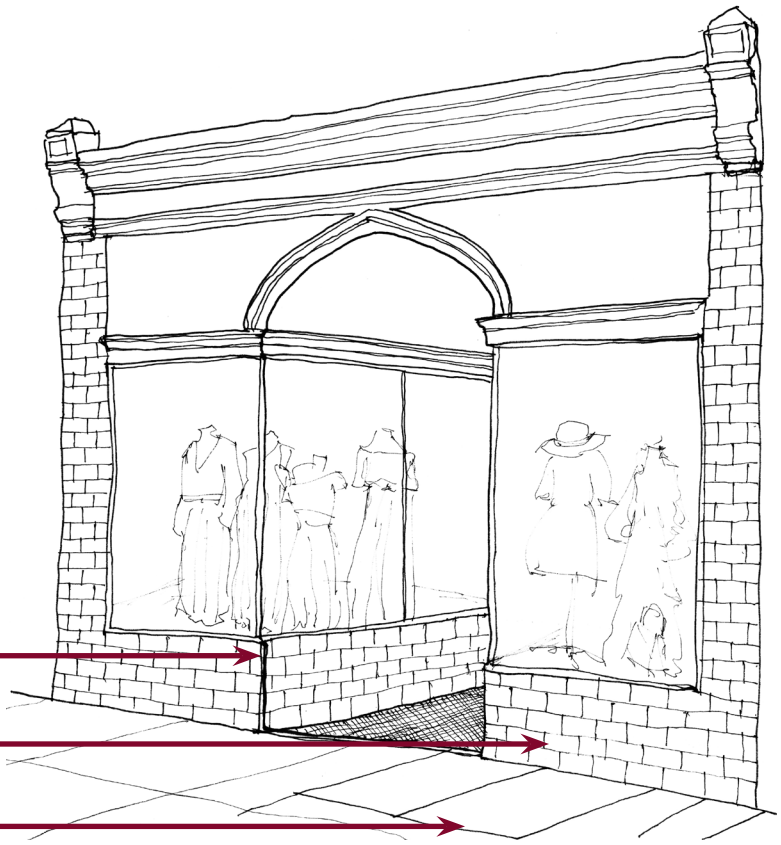
Relocate all systems and equipment from abandoned basement, ground-mounted equipment, and former first floor level to above the BFE. For residential properties, limit use of former first floor for residential use to entry, storage, and potentially parking. For non-residential uses, understand and prepare for potential flood impact. ***A rear addition is prefered to a rooftop addition. Setback of roof addition should limit visibility from the street.***



DRY FLOODPROOFING

BASE FLOOD ELEVATION (BFE) ABOVE EXISTING FIRST FLOOR HEIGHT

Dry floodproofing should be limited to non-residential buildings. Dry floodproofing of residential buildings does not comply with Philadelphia's floodplain management requirements or the NFIP and will not lower flood insurance rates.



Dry floodproofing requires sufficient warning for trained personnel to install the required barriers. This will require regular training of staff members.

Partially sealing the lower portion of the ground floor windows may serve to slow floodwater infiltration from the river and canal.

D Dry Floodproofing

DRY FLOODPROOFING

Potential Preservation Benefits:

- Historic buildings can remain at original location and elevation

Potential Preservation Challenges:

- Installation of waterproofing materials may necessitate modification of historic appearance
- Application of waterproofing membranes, sealers, etc. has potential to trap moisture in historic buildings and building materials during non-flood periods, potentially leading to deterioration
- Attachment or installation locations for barriers and shields can be obtrusive
- Interior structural elements may require reinforcing
- Lower elevation window and door openings may be infilled or modified to achieve waterproofing and provide required lateral resistance to floodwater
- The elevation of exterior building systems and equipment often increases their visibility, screening can be challenging

Although any property owner can employ dry floodproofing techniques to protect their property, ***dry floodproofing at residential buildings does not comply with Philadelphia's floodplain management requirements 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.

The implementation of dry floodproofing mechanisms requires sufficient warning for trained personnel to install the required barriers, necessitating regular training of staff members. 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. *(Refer to Basement Infill Diagram, page 24.)*

Although many of the commercial buildings on Main Street are brick, wood storefronts, like wood framed houses, are poor candidates for dry floodproofing.

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.

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, or between components of a flood gate or barrier. *(Refer to Flood Gate diagram, page 32.)*

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 can become brittle, crack and lose their water tightness, lowering their effectiveness as a water barrier. As a result, they require frequent replacement, and become a long-term maintenance obligation.

Sealing opening around penetrations such as hose bibs is recommended to reduce floodwater seepage.

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.

Concrete buildings are generally good candidates for dry floodproofing because of their ability to withstand loads and their smooth surface facilitates 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 or additions**, 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 & 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. Floor sabs 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.

BARRIERS & SHIELDS – WINDOWS & DOORS

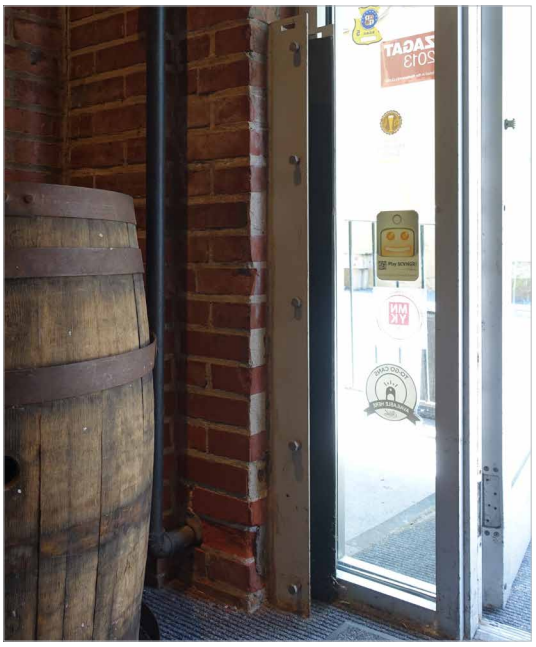
Barriers and shields can provide temporary protection against floodwater entering doors and windows and are installed immediately preceding an anticipated flood event. The range of barriers and shields includes sandbags, drop-in or roll-up barriers, shields at door openings, floating barriers and engineered 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 2- to 3-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 when combined with regular maintenance including repointing and sealing of open joints and crevices.

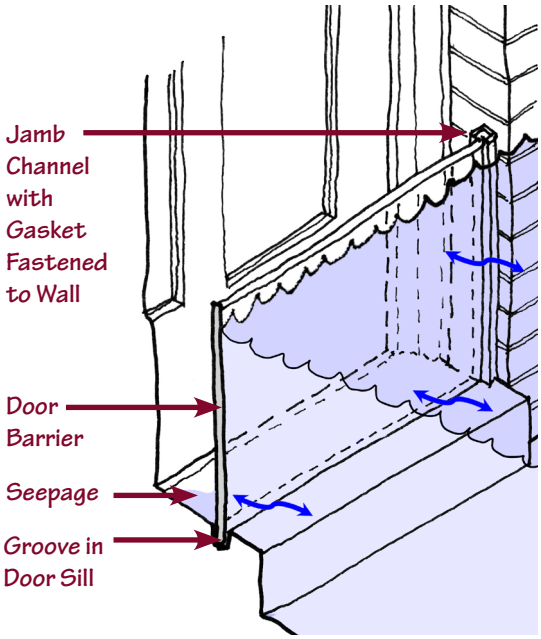
Property owners and planners should consider the following factors when contemplating utilizing barriers and shields at windows and doors:

- ***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. As an alternative, an emergency egress door can be installed a minimum of 18" above the BFE. However, every effort should be made to locate on a secondary elevation and design it in a manner that is compatible with the historic character of the building.
- 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 do not meet the Philadelphia floodplain regulations, require substantial available materials, onsite trained personnel to properly stack bags, and appropriate disposal methods if contaminated by floodwater.

Although barriers such as sandbags may reduce floodwater from entering a building, they do not comply with Philadelphia floodplain regulations.



After persistent flooding, the building owner installed a flood barrier at the inside of the entrance door. When a flood occurs, panels are inserted into the channel and the glass doors are opened to prevent the water pressure from shattering them.



Door barriers can provide temporary protection from rising floodwater. 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.

A curb around a basement window openings can serve as a barrier to floodwater.

For dry floodproofing, basement level windows located at or near the ground will need to be infilled to create a water tight barrier. The repair and repointing of the surrounding brick will also improve the building's flood resilience.

Accumulated flood water is evacuated through floor grates and a sump pump, whose piping is partially concealed by the screen.

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.

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 Philadelphia Historical Commission review.

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 19.)* In addition, building systems should be installed so that they will not be damaged by seepage.

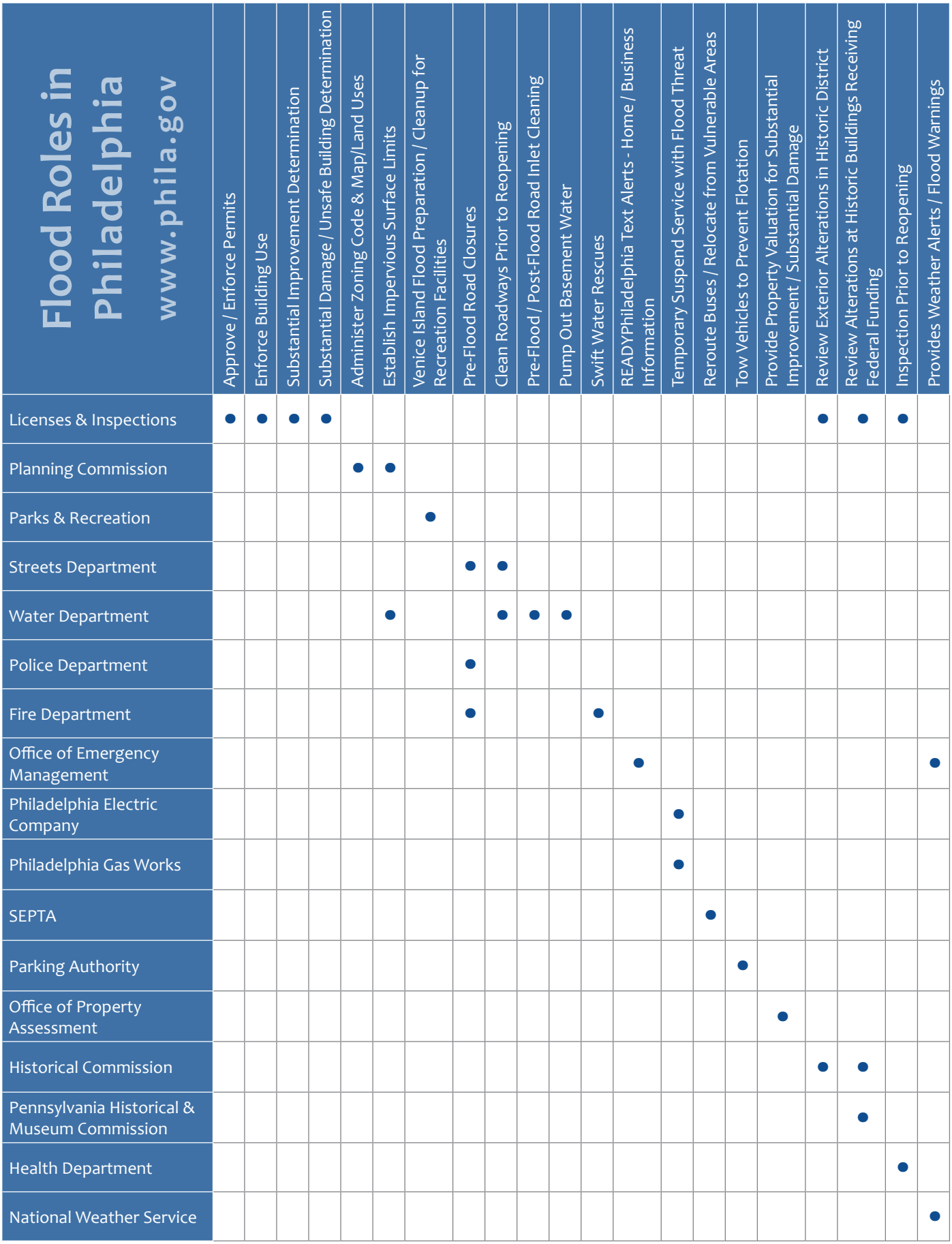
MAINTENANCE

One of the key requirements of a dry floodproofing option is a well-maintained building. *(Refer to Maintenance, page 17.)* 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;
- Flood barriers and gates be inspected and deteriorated gaskets replaced;
- Masonry walls are fully pointed; and
- All joints are properly sealed, including around window and door frames, pipe penetrations, etc.

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 discoloration and 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. The application of visible exterior sealers and waterproofing membranes is subject to review by the Philadelphia Historical Commission.



The above chart, compiled using publicly available information, represents some of the typical responsibilities of the above entities during a flooding event.

E Resources

ADDITIONAL RESOURCES

City of Philadelphia Water Department. *A Guide to Flooding in Philadelphia: What to know: Before it happens. As it happens. After it happens.* *https://www.phila.gov/water/PDF/FloodingGuide.pdf*

U.S. Department of the Interior. National Park Service. *Guidelines on Flood Adaptation for Rehabilitating Historic Buildings*. (2019.) *www.nps.gov/tps/standards/rehabilitation/flood-adaptation.htm*

U.S. Department of the Interior. National Park Service. *The Secretary of the Interior's Standards for the Treatment of Historic Properties*. (2017.) *www.nps.gov/tps/standards.htm*

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*

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*

The Federal Emergency Management Agency (FEMA) has numerous publications available to address construction in flood-prone areas available on their website at *www.fema.gov*. In addition, refer to Philadelphia Zoning Code and adopted Building Codes.

Hurricane Sandy in New Jersey and New York: Mitigation Assessment Team Report - Recovery Advisories and Fact Sheets for Hurricane Sandy

RA3. Restoring Mechanical, Electrical, and Plumbing Systems in Non-Substantially Damaged Residential Buildings (April 2013)

RA6. Protecting Building Fuel Systems from Flood Damage (April 2013)

Fact Sheet 1. Cleaning Flooded Buildings (May 2013)

FEMA Fact Sheets

Historic Structures and The Biggert-Waters Flood Insurance Reform Act of 2012

Historic Preservation and Cultural Resources: Protecting Our Heritage (July 2016)

FEMA Technical Bulletins

Technical Bulletin 0: User's Guide to Technical Bulletins (July 2019)

Technical Bulletin 1: Requirements for Flood Openings in Foundation Walls and Walls of Enclosures Below Elevated Buildings in Special Flood Hazard Areas In Accordance with the National Flood Insurance Program. (2020)

Technical Bulletin 2: Flood Damage-Resistant Materials Requirements (August 2008)

Technical Bulletin 3: Non-Residential Floodproofing - Requirements and Certification (1993)

Technical Bulletin 4: Elevator Installation (November 2010)

Technical Bulletin 5: Free-Of-Obstruction Requirements (August 2008)

Technical Bulletin 6: Below-Grade Parking Requirements (1993)

Technical Bulletin 7: Wet Floodproofing Requirements (1993)

Technical Bulletin 11: Crawlspace Construction (November 2001)

FEMA P-348, Edition 1, Protecting Building Utilities from Flood Damage (2019)

FEMA P-467-2, Floodplain Management Bulletin: Historic Structures (2008)

FEMA P-758 Substantial Improvement/Substantial Damage Desk Reference (2010)

FEMA P-1037 Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (September 2015)


STYLE OF MAN