

Jersey City, NJ

# Resilient Design Handbook

2018



**C**ITY JERSEY MAKE IT  
*GREEN*

# CONTENTS



## 04

### FLOODING IN JERSEY CITY

What is a flood zone?	04
Am I in a flood zone?	06
If you are in a flood zone	06
If you are not in a flood zone	07



## 08

### WHAT IS GREEN INFRASTRUCTURE?

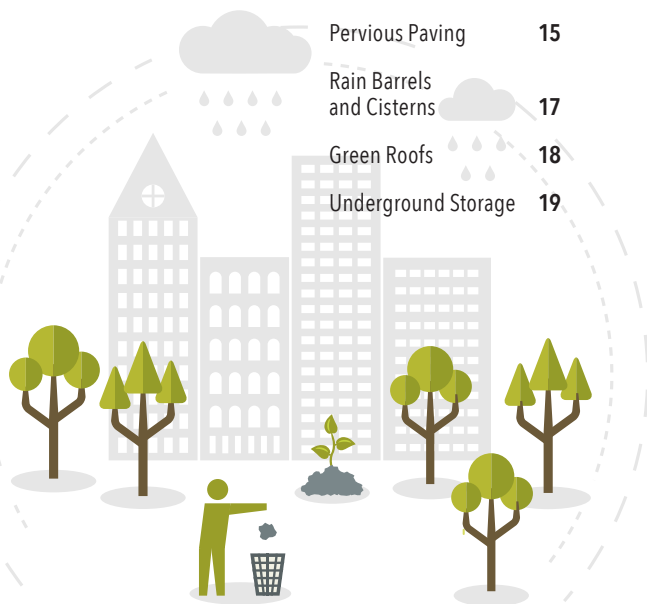
Trees	10
Stormwater Planters and Rain Gardens	12
Eco-friendly Landscaping	14
Pervious Paving	15
Rain Barrels and Cisterns	17
Green Roofs	18
Underground Storage	19



## 21

### RESILIENT BUILDING DESIGN STRATEGIES

Elevation of Critical Systems	21
Floodproofing	22
Façade Design	26



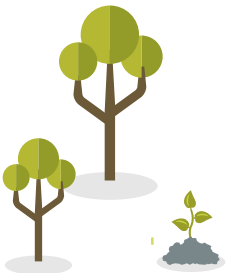
# INTRODUCTION

**THIS DOCUMENT** serves as a tool to assist residents and business owners in making Jersey City greener and more resilient. It provides basic information about flooding in Jersey City as well as recommendations and best practices for Green Infrastructure and Resilient Building Design Strategies.

As the City responds to the effects of stormwater and anticipates a future with rising sea levels, it is increasingly clear that the design of the City must be modified in order to improve Jersey City's ability to manage flooding and stormwater.

While major infrastructure investments are necessary, smaller changes can make big differences as well. Eco-friendly landscaping choices, the installation of green roofs, the addition of vegetation to streetscapes, and other "greening" solutions can, when applied to properties citywide, significantly minimize flooding and increase Jersey City's resiliency. Not only will these green solutions improve water management, but they will provide important secondary benefits such as air and water quality improvements and a more beautiful city.

At the same time, because much of Jersey City lies within flood zones, buildings themselves will need to be built to withstand possible water inundation. The design challenges imposed by this threat are significant, but creative solutions do exist and must be employed in order to retain the active, pedestrian nature that Jersey City is known for, to ensure the safety of residents, and to protect businesses and the economic role that they play in the success of the City.



# FLOODING IN JERSEY CITY

In 2012, Superstorm Sandy hit Jersey City, inundating over thirty-nine percent (39%) of the City's land area and causing tens of millions of dollars in damage. Extreme weather events are becoming more frequent and can result in infrastructure failure. Extreme weather events are not the only types of flooding Jersey City faces. On a regular basis, the City experiences 3 different types of flooding: Coastal, Surface Water or Pluvial, and CSO (Combined Sewer Overflow) flooding.

Depending on where you live in the City, you may have experienced one or more of these types of flooding in your neighborhood.

## Coastal flooding

Occurs around open bodies of water, like the rivers surrounding Jersey City. Coastal flooding is typically the result of extreme tidal conditions caused by severe weather and storm surge when high winds push water onshore, overwhelming low-lying land.

## Surface water, or pluvial flooding

Occurs during heavy rainfall on impervious surfaces, limiting the places where the excess water can go. This type of flooding does not require proximity to a water body or a low elevation.

## CSO flooding

Related to pluvial flooding is CSO flooding. Also typically a result of heavy rain or snow storms, CSO flooding results in combined sewers receiving higher than normal flows causing the treatment plants to get overwhelmed and untreated water to be discharged into the waterways.

While any one of these three types of floods can be problematic, it is not uncommon for them to occur simultaneously.

## What is a flood zone?

A flood zone is an area with a certain likelihood of flooding during a storm event. The type of flooding that has a one percent chance of happening every year is typically called a "100-year flood" or "base flood".

The National Flood Insurance Program defines any area with a one percent chance of flooding in any given year as a Special Flood Hazard Area (SFHA). Within the Special Flood Hazard Area are several specific flood zones (such as zones AE and VE) that experience different levels and types of flooding.



# DID YOU KNOW?

Over 37% of the city lies within the FEMA Special Flood Hazard Area.



A healthy urban tree can intercept up to 760 gallons of storm water per year

More than 6,515 properties experienced storm surge flooding during Hurricane Sandy in 2012

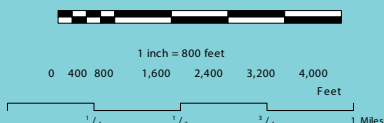
53% of Jersey City is covered by impervious surfaces

Jersey City has 21.7 miles of waterfront along the Hackensack River, Newark Bay, Hudson River, and Upper New York Bay

## LEGEND

-  **Zone VE** - Special Flood Hazard Areas Subject to Inundation by the 1% Annual Chance Flood with Coastal Velocity Hazard (aka Wave Action)
-  **Zone AE** - Special Flood Hazard Areas Subject to Inundation by the 1% Annual Chance Flood

Source: FEMA 2006 FIRM



Over thirty seven percent (37%) of Jersey City lies within the Special Flood Hazard Area. These areas tend to lie along the coastlines of the Hudson and Hackensack Rivers. When predicted sea level rise of 1.2 feet by the year 2050 is factored in, it is estimated that flooding from a future storm event could reach 7.1 feet in some areas of Jersey City.

## Am I in a flood zone?

To check if you are in a flood zone, you can visit the FEMA Region II Coastal Analysis and Mapping website at [www.region2coastal.com](http://www.region2coastal.com). If you live near the water in Jersey City then you are likely in a flood zone.

## If you are in a flood zone...

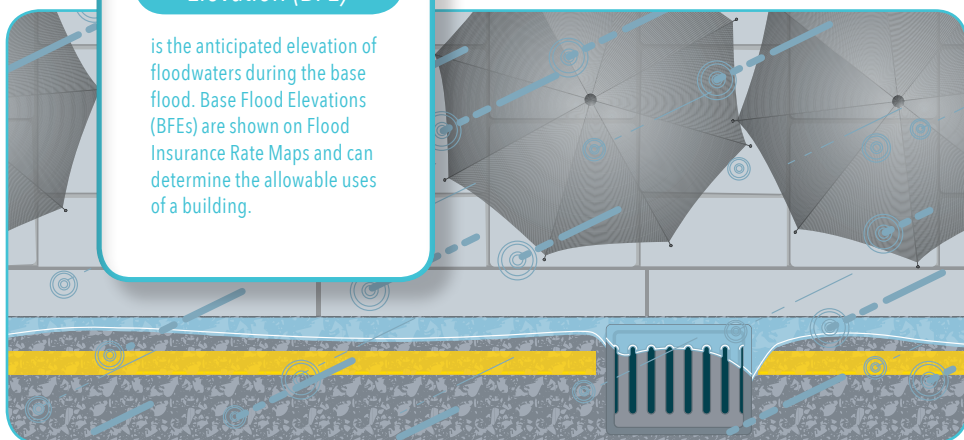
If your home or business is in a flood zone then you may have restrictions on what uses are allowed on your ground floor. For example, new or substantially improved buildings in the 100-year floodplain are not permitted to have living areas below the Base Flood Elevation (BFE) and certain flood damage-resistant materials may be required below the BFE. Property owners can use resilient design techniques like flood-proofing to make sure that their buildings can withstand flooding events. More information about resilient design techniques is on page 21.



### Base Flood Elevation (BFE)

is the anticipated elevation of floodwaters during the base flood. Base Flood Elevations (BFEs) are shown on Flood Insurance Rate Maps and can determine the allowable uses of a building.

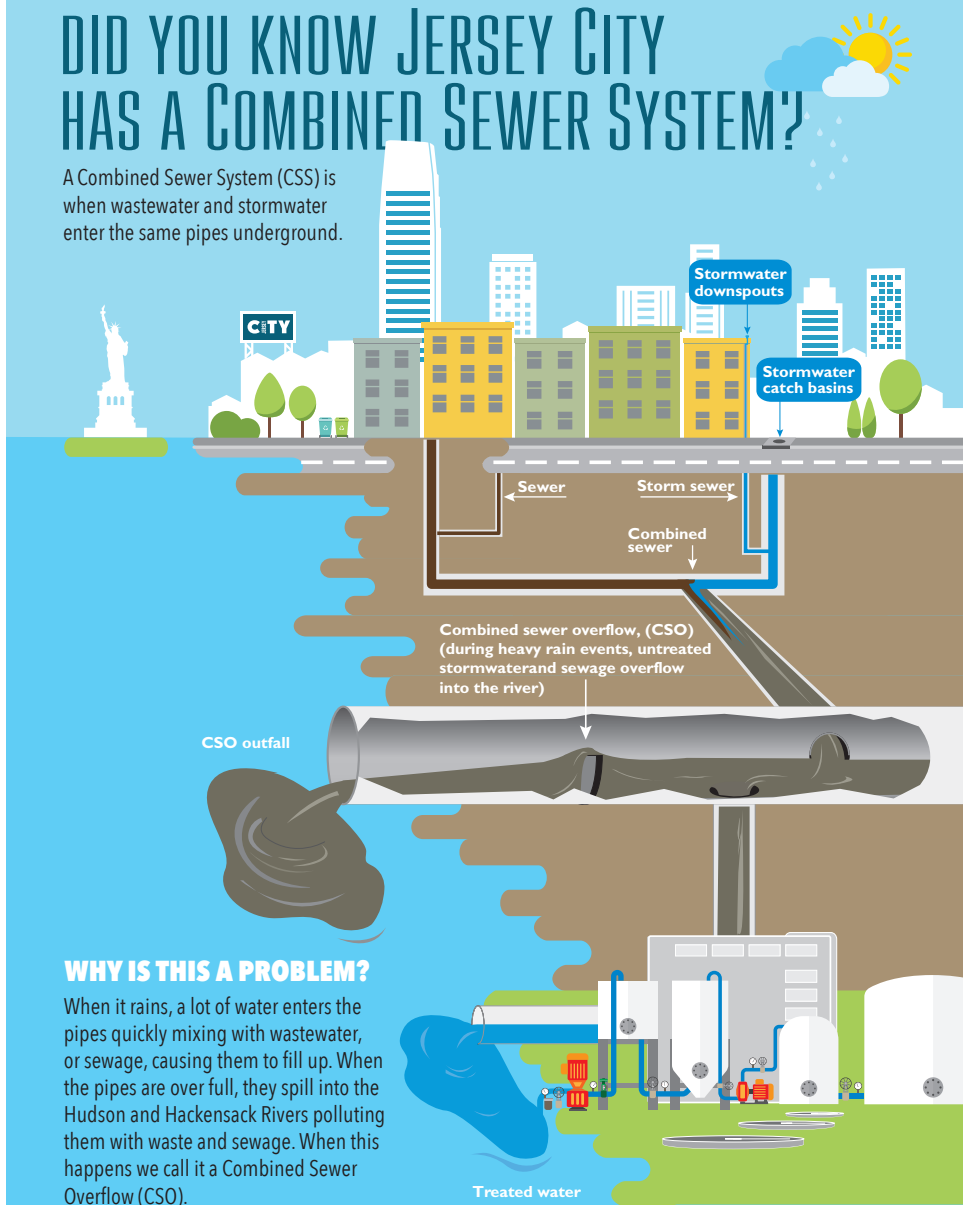
Another way to help prevent flooding in your building and neighborhood is to implement green infrastructure strategies that divert or retain stormwater. Green infrastructure can also help beautify your property. More information on green infrastructure strategies is on page 8.



# UNDERSTANDING THE SEWER SYSTEM

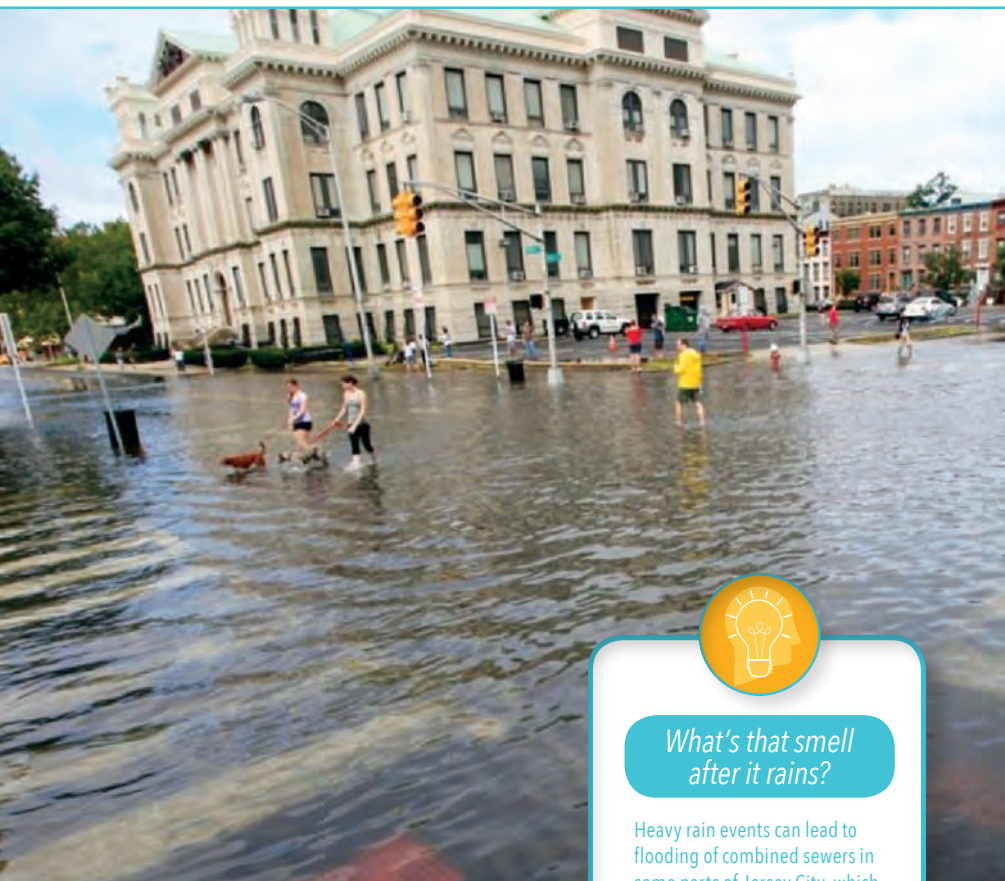
## DID YOU KNOW JERSEY CITY HAS A COMBINED SEWER SYSTEM?

A Combined Sewer System (CSS) is when wastewater and stormwater enter the same pipes underground.



### WHY IS THIS A PROBLEM?

When it rains, a lot of water enters the pipes quickly mixing with wastewater, or sewage, causing them to fill up. When the pipes are over full, they spill into the Hudson and Hackensack Rivers polluting them with waste and sewage. When this happens we call it a Combined Sewer Overflow (CSO).



Jersey City Hall following Hurricane Sandy in 2012

## If you are not in a flood zone...

Even if your home or business is not in a special flood hazard area, you may experience surface water/pluvial or CSO flooding during rain events. You may also experience coastal flooding during an extreme or unprecedented storm event. The use of green infrastructure and resilient design like those outlined in this guide can improve your building's resilience to flooding.

Installing green infrastructure on your property can also help minimize the impact of flooding to nearby flood zone communities by capturing stormwater before it enters the Combined Sewer System.



### *What's that smell after it rains?*

Heavy rain events can lead to flooding of combined sewers in some parts of Jersey City, which may result in noticeable odors coming from CSO catch basins. One way to avoid this is make sure catch basins are kept clear of debris. Residents interested in keeping their neighborhood catch basins clean can adopt one through the Jersey City Adopt A Catch Basin program.

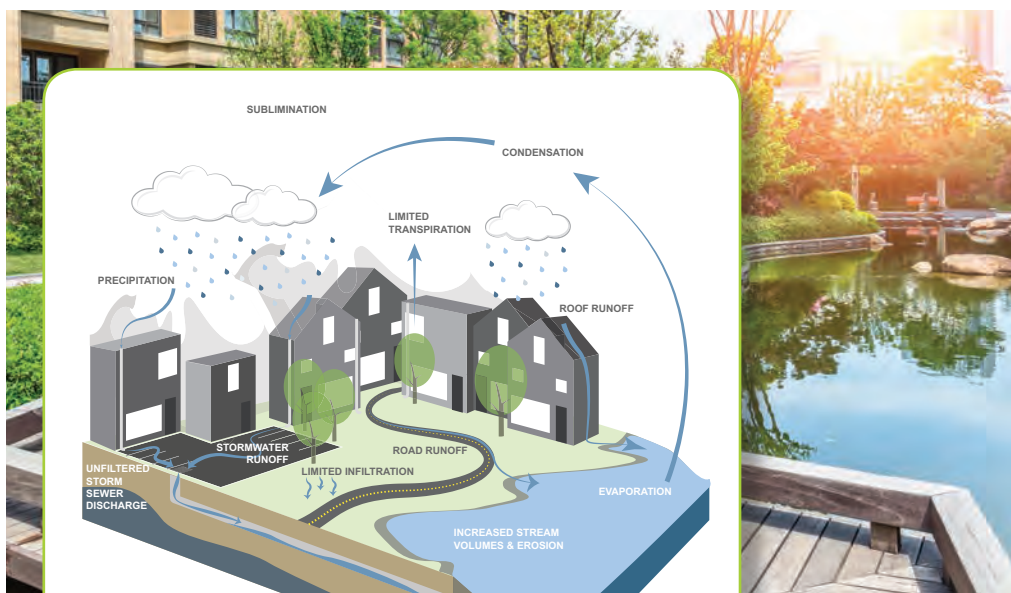
# WHAT IS GREEN INFRASTRUCTURE?

As a nearly built-out environment, Jersey City has miles of impervious surfaces—areas with pavement and rooftops that cannot absorb water. So when it rains, instead of the water being absorbed by the ground or plants, the water runs off the surface and causes flooding. Every paved parking space and building covers up land that would have originally absorbed stormwater.

Surface runoff also carries nonpoint source pollution such as litter, pet waste, household chemicals, and oil. As the runoff moves, it picks

up and carries these pollutants to water bodies like the Hudson and Hackensack Rivers.

Additionally, contamination from past industry and land disturbance from development exists in many areas of the City. When rainwater infiltrates in those areas, sediment and contamination can bleed into the rivers, fundamentally changing aquatic habitats. In areas where significant contamination is known, it may be desirable to capture rainwater before it becomes contaminated to reuse in irrigation or directing it straight into the storm sewers.



## URBAN WATER CYCLE

Impervious surfaces decreased the amount of infiltration and transpiration that would take place through the natural water cycle.

**Figure 1**

Source: Green Infrastructure Guidance Manual for New Jersey, produced by the Rutgers Cooperative Extension Water Resources Program.

Where contamination is not a concern, increasing pervious coverage or reducing surface runoff will help water follow its normal course of infiltration or delay infiltration so that the water table can handle the volume which is otherwise limited by the impervious coverage.

Green Infrastructure involves the use of pervious “soft” surfaces such as green roofs, rain gardens, and bioswales that decrease the volume and speed of stormwater runoff. The slowed water seeps into the ground, recharges the water table, and filters out many pollutants and sediment before they arrive in downstream waters.

Green infrastructure helps to supplement traditional public infrastructure such as sewers, storage basins, and treatment facilities by adding stormwater storage capacity throughout the landscape.



### Nonpoint source (NPS) pollution

is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters and ground waters. Source: [www.epa.gov/nps](http://www.epa.gov/nps)

Even small green infrastructure projects like installing a rain barrel or planting a street tree can help reduce localized flooding and stormwater-related pollution. The following section describes a number of green infrastructure practices in further detail.

Check out the Green Infrastructure Guidance Manual for New Jersey, produced by Rutgers Cooperative Extension Water Resources Program, which can be found at: <http://water.rutgers.edu/greeninfrastructureguidancemanual.html>

### GREEN INFRASTRUCTURE CYCLE

Green infrastructure practices are designed to intercept stormwater runoff at the source. By retrofitting these practices into the existing development, they can help restore the natural water cycle. Many green infrastructure practices incorporate vegetation to help treat runoff and promote infiltration and transpiration.

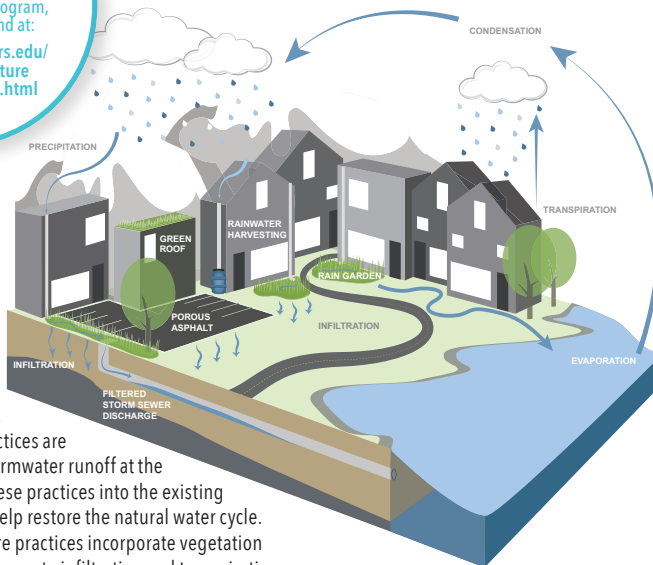


Figure 2

Source: Green Infrastructure Guidance Manual for New Jersey, produced by the Rutgers Cooperative Extension Water Resources Program.



# TREES



Trees have multiple benefits for cities from mitigating flooding and decreasing air pollution and overall city temperatures to increasing your property values and improving the health of the residents. Jersey City has recognized these benefits by creating a goal to plant 5,000 trees by the year 2020.

In a dense urban area like Jersey City there is limited land available for planting trees in yards and parks. That's why street trees, or trees planted along the sidewalk and in road medians, are so important.



## Benefits of Street Trees

- Frame streetscape and make street feel more walkable
- Filter the air through the absorption of Carbon Dioxide and increased Oxygen
- Absorb stormwater
- Provide shade and reduce the urban heat island effect

## "Right Tree, Right Place"

In order to have a successful and healthy tree it must be suitably matched to its environment. Multiple criteria must be considered when choosing the right tree for a location, including growth rate, hardiness, height, and canopy spread. For more information, visit [www.arborday.org/trees/righttreeandplace](http://www.arborday.org/trees/righttreeandplace)

The planting area for the tree, known as the tree pit, must be large enough to allow for plenty of room for the tree to grow and have enough pervious surface area to allow for maximum water filtration to the tree's roots. For more information about tree planting standards within Jersey City, please refer to the Jersey City Forestry Standards, available on the City website.



### Street trees

can raise a home's value up to **15%** and increase the time shoppers spend in stores by **12%**.

Even if you don't have a yard you can enjoy the many benefits of trees by planting or maintaining one along the sidewalk in your neighborhood. Visit the City's website under the Division of Parks and Forestry to fill out a Street Tree Planting Application.

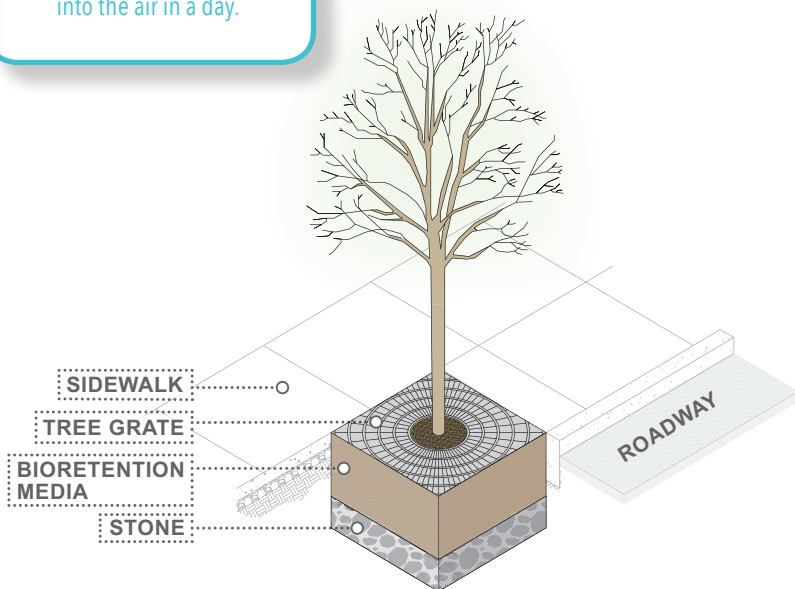
Although planting street trees in standard tree pits is an effective way to use green infrastructure to manage stormwater, even more stormwater can be captured when trees are planted with enhanced tree growth systems, in tree filter boxes or within stormwater planters.

**Enhanced Tree Growth Systems** are soil techniques designed to transfer the load from pavement directly to the subsoil rather than the topsoil media. These systems promote additional soil volume for trees than is otherwise available under conventional pavement systems.

**Tree Filter Boxes**, sometimes also referred to as 'stormwater tree pits', are designed to quickly filter stormwater through the soil and then direct it to the local sewer system. Tree filter boxes resemble typical street tree pits and are well-suited for city streets with limited space for bioretention areas. Stormwater is collected in the pit and then filtered through layers of substrate, including mulch, soil, compost, and the plant root systems, which also retain any pollutants. Treated stormwater can then be discharged into traditional stormwater drainage systems, or infiltrated into the ground where appropriate. Several boxes can also be interconnected with an underdrain in order to handle larger volumes of stormwater. Residents and developers are encouraged to install enhanced tree pits and tree filter boxes along streets and in parking lots, particularly in higher elevation areas of the city.



**One large tree** can absorb up to **100 gallons** of water out of the ground and discharge it into the air in a day.



**Figure 3 - Tree filter boxes**

Source: Green Infrastructure Guidance Manual for New Jersey, produced by the Rutgers Cooperative Extension Water Resources Program, which can be found at <http://water.rutgers.edu/GreenInfrastructureGuidanceManual.html>.



# STORMWATER PLANTERS AND RAIN GARDENS



Both Stormwater Planters and Rain Gardens are bioretention techniques that capture and store stormwater runoff and pass it through a filter bed of soil. Depending on the bioretention method, filtered runoff may be collected and returned to a storm sewer or allowed to infiltrate into the soil.



## Benefits of Stormwater Planters and Rain Gardens

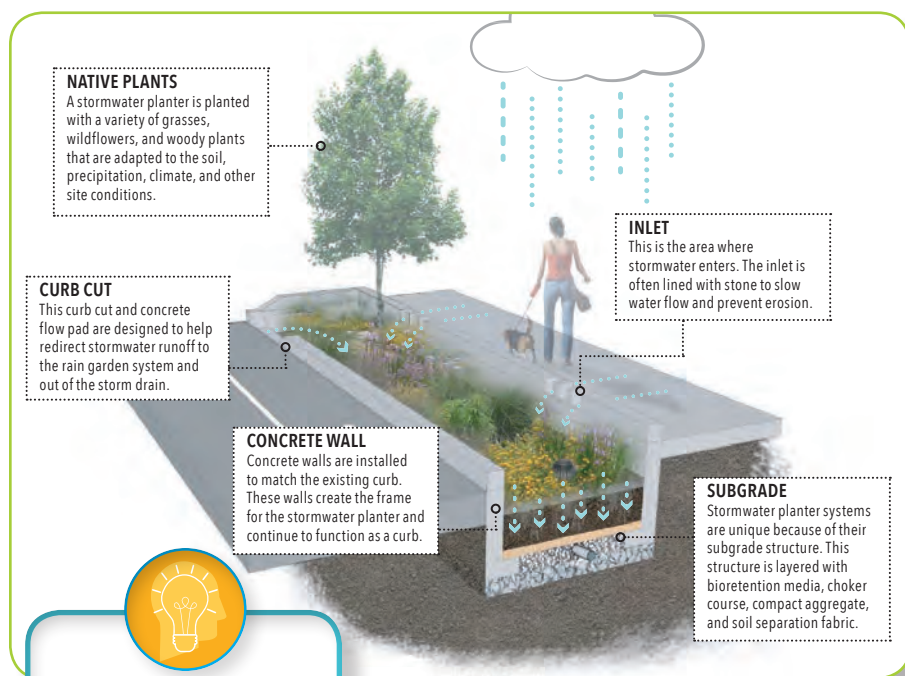
- Water quality improvement
- Helps reduce peak runoff rates
- Can provide natural wildlife habitat

**Rain gardens** are landscaping features that help to slow, collect, and filter stormwater using a depression in the ground and flood-resistant, native plants. If you have the room, rain gardens are an excellent way to manage stormwater in your private yard.

Rain gardens are fed by surrounding impervious surfaces, such as roads, driveways, and roofs, which drain into a naturally low-lying area. Native soils are often utilized, but may be amended with sand or compost to provide adequate water infiltration rates. Rain gardens are vegetated with plants that can withstand flooded/over-saturated or dry conditions, but are not meant to retain large quantities of water for an extended period of time. In parts of Jersey City where infiltration is not desired due to a high water table or where adjacent soils are contaminated, rain garden systems can be designed with an underdrain to move excess water into a conventional storm sewer pipe.



Rain garden at City Hall.



## Stormwater Planters

are specialized planters installed in the sidewalk area that are designed to manage street and sidewalk stormwater runoff.

**Figure 4 - Stormwater Planter**

Source: Green Infrastructure Guidance Manual for New Jersey, produced by the Rutgers Cooperative Extension Water Resources Program, which can be found at <http://water.rutgers.edu/GreenInfrastructureGuidanceManual.html>.

**Stormwater planters**, sometimes also known as tree pit bioswales, are a bioretention technique that intercept stormwater runoff from the roadway or sidewalk. The water can then be filtered directly into the ground or directed to the stormwater sewer.

Stormwater planters often contain trees along with other native plants and they are generally used to remove excess water from large impervious areas, such as streets and parking lots. Curb cuts allow water flowing down a street to be diverted into the bioswale.

Although stormwater planters require considerably more effort to install than ordinary tree pits, they are a good option where piping and drains do not exist on older streets and where water is regularly directed down a street, which is common in Jersey City. If you regularly experience flooding in your home or business from stormwater runoff, then you may want to consider installing a stormwater planter in front of your property.

It is recommended that stormwater tree pits be no less than 5' wide by 10' long.

# ECO-FRIENDLY LANDSCAPING



If you have a yard, one of the simplest ways to integrate green infrastructure practices is to implement eco-friendly landscaping. Eco-friendly landscaping, also known as waterwise landscaping or xeriscaping, helps conserve water and provides natural wildlife habitat.

1

## Planning & Design

A landscape plan ensures that water-conserving techniques are employed.

2

## Soil Improvement

Any inferior soil should be upgraded to drain quickly and store water at the same time.

3

## Appropriate and Regional Plant Selection

A landscape plan ensures that water-conserving techniques are employed.

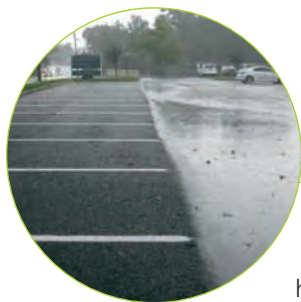
4

## Maintenance

Eco-friendly landscapes require proper irrigation, pruning, weeding, and fertilizing, but the amount of maintenance time required decreases over time as the plants grow and crowd out weeds.

This type of landscaping takes into account the regional and microclimatic conditions of the site, as well as topography, existing vegetation, and zoning of plant materials. After they become established, plants that are native to the region usually require little to no watering. For more information on eco-friendly landscaping in New Jersey, visit [www.JerseyYards.org](http://www.JerseyYards.org).





# PERVIOUS PAVING SYSTEMS

In urban areas such as Jersey City, impervious coverage is generally very high due to the concentration of buildings, roads, driveways, and other hard infrastructure. In a city with 75 percent or more impervious coverage, it is expected that 55 percent of stormwater will become surface runoff, which degrades the watershed and becomes problematic for drainage during heavy rainfall.

In comparison, natural ground cover allows approximately 25 percent shallow infiltration of stormwater and 25 percent deep infiltration, with only 10 percent runoff.

There are two types of pervious pavement systems: those that infiltrate water directly into the soil and those that detain stormwater in order to reduce peak flow. Individual soil conditions will determine which type of system will work best in different parts of Jersey City. Small pervious paving projects such as driveways and patios that infiltrate water directly into the ground are generally applicable throughout the city.



## Benefits of Pervious Paving Systems

- Can provide retention to help improve groundwater recharge Suitable for cold-climate applications
- Reduces or eliminates standing water and black ice
- Maintains traction while wet
- Minimizes the urban heat island effect
- Can minimize the need for land dedicated to stormwater control measures
- Can help minimize the size and length of stormwater pipes and reduce the need for grading

The excellent filtration of pervious pavers makes them the optimal choice of these three options. Of course, any of the three are preferable to standard, impervious materials. Typical homeowners as well as developers can use pervious paving in their projects. Patios are excellent candidates for pervious paving systems.

According to Low Impact Development 2010: Redefining Water in the City, published by the American Society of Civil Engineers, only 12% to 18% of a project's total surface area in pervious pavers is typically required for optimal project drainage and stormwater management.





**Porous pavers**, sometimes called Turf pavers, are generally a grid system filled with dirt, sand, or gravel that provides grass reinforcement, ground stabilization and gravel retention.

**Figure 5**

Porous pavers  
(source: ReadingRock Building Materials and Services)



**Pervious pavers** allow stormwater to percolate through the surface rather than running off into surrounding areas or storm drains. As water runs through, the pavers filter urban pollutants. Pervious pavers have a higher water infiltration rate than that of pervious concrete or permeable pavers.

**Figure 6**

Pervious pavers on plaza (source: [https://en.wikipedia.org/wiki/Permeable\\_paving#/media/File:Permeable\\_paver\\_demonstration.jpg](https://en.wikipedia.org/wiki/Permeable_paving#/media/File:Permeable_paver_demonstration.jpg))



**Permeable pavers** force water to filter through the grout between the pavers and require more maintenance; rainwater passes around the paver opposed to through it.

**Figure 7**

Permeable pavers  
(source: <https://pixabay.com/en/patch-paving-stone-texture-3117242/>)

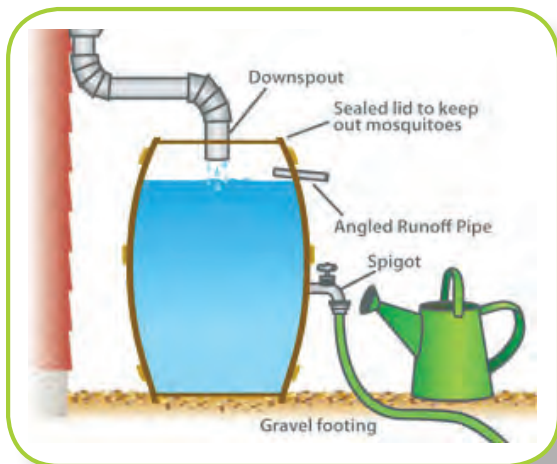


# RAIN BARRELS AND CISTERNS

Some downspouts from roofs drain directly onto paved surfaces or are piped into stormwater inlets, contributing to sewer overflows during storm events.

Downspout disconnection is a recommended adaptation measure in the City's Adaptation Master Plan. Downspout disconnection reconfigures rooftop drainage to instead flow into vegetated areas, or in some cases rain barrels or cisterns.

Using containers like rain barrels to collect roof runoff near downspouts, removes (or "harvests") water that would otherwise saturate the ground or run into the street and storm drains. Harvested water can be stored and reused for garden irrigation during a dry period. Similarly, cisterns collect rainwater, but with a greater capacity, and can be stored above or below ground.



Rain barrels should be closed containers to prevent children, pets, or mosquitoes from getting in, while also allowing for water to be collected. A spigot on the barrel, which can connect to a hose, allows easy access to use or drain the water at a later time.

Rain barrels, given their size, are mostly useful for on-site reuse, although they can slightly reduce stormwater impacts during rain events. Homeowners, civic and public institutions, and even small businesses should consider adding rain barrels to their property.

**Figure 8**  
Diagram of a rain barrel at a downspout.



## Benefits of Rain Barrels and cisterns

- Easy to install
- Collects and conserves rainwater
- Helps reduce the amount of harmful runoff into the watershed and oceans
- Saves money on water (for gardening, cleaning etc.)

# GREEN ROOFS AND WALLS



Green roofs and roof gardens use soil and plants in place of traditional roof materials in an effort to reduce the rate of stormwater runoff from buildings into the city's water system. In contrast to traditional roofs, green roofs capture, store, absorb and evapotranspire stormwater. Green roofs also provide buildings with thermal insulation and energy efficiency, increased acoustic insulation, reduced heat island effect, and increased durability and lifespan of roofs. Green roofs may be used in new construction or retrofitted to existing structures. They are applicable to residential, commercial, and industrial buildings and are constructed on roofs with up to a 20 percent slope.



## Living Green Walls

Are another way to add vegetation to your project and capture stormwater. Green walls are dense pre-engineered vertical vegetative systems consisting of pre-planted panels or modules affixed to a structural wall or frame, and irrigated by harvested stormwater systems that use stored rainwater.



## Benefits of Green Roofs

- Reduces the life cycle cost of roofing
- Reduces the quantity of runoff entering a storm sewer system
- Improves water quality
- Can create additional outdoor open space
- Provides additional thermal insulation and energy efficiency for buildin
- Removes airborne particulate matter and helps reduce acid rain
- Creates wildlife habitat



Developers at all levels should consider the incorporation of green roofs into their projects in Jersey City. Where green roofs are not possible, reflective or "white" roofs are recommended for their ability to lower the urban heat island effect.



### *Evapotranspiration*

The process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants.



Center for Advanced Study, Princeton, NJ (Source: [www.hydrotechusa.com](http://www.hydrotechusa.com))



## UNDERGROUND STORAGE

While landscaping certainly helps reduce stormwater runoff, a more aggressive approach is the installation of underground storage tanks. This will significantly reduce the amount of water immediately entering, and often overwhelming, the City's combined sewer system.

This approach means greater onsite storage of stormwater runoff and slower release to the sewer system. There are numerous models of underground storage, including tanks, gravel beds, chambers, and perforated pipes. A property developer should consider the soil type, contamination, and anticipated runoff volume when evaluating options.



### **Benefits of Underground Storage**

- Does not occupy valuable lot area
- Reduces peak discharge into the combined sewer system
- Allows the city to manage stormwater runoff from new development effectively without financial burden for tanks on private property
- Able to withstand substantial surface loading
- Flexible in design layout, allowing them to be configured in irregular spaces



# RESILIENT BUILDING DESIGN STRATEGIES

While green infrastructure can reduce the impact of stormwater, buildings located in the flood plain should also be designed to stand up to the possibility of future flooding and storm events.

For some buildings that means raising habitable space above Base Flood Elevation (BFE).

Jersey City is a community well-loved for its walkability, dense urban fabric, commercial street life, and historic character. Preserving those qualities is a priority. How can buildings, therefore, withstand possible floodwaters without becoming fortress-like?

This section will illustrate ways to address building facades and details that address these competing needs.



**Find more detailed information on retrofitting buildings for flood resiliency at:**

<https://www1.nyc.gov/site/planning/plans/retrofitting-buildings/retrofitting-buildings.page>



## ELEVATION OF CRITICAL SYSTEMS

It is important that utilities be located (or, as the case may be, relocated) above design flood elevation (DFE) in order to best ensure that any building can withstand a flood event. This is particularly true for buildings which are wet floodproofed and are intended to experience inundation.



### Benefits of Elevating Systems

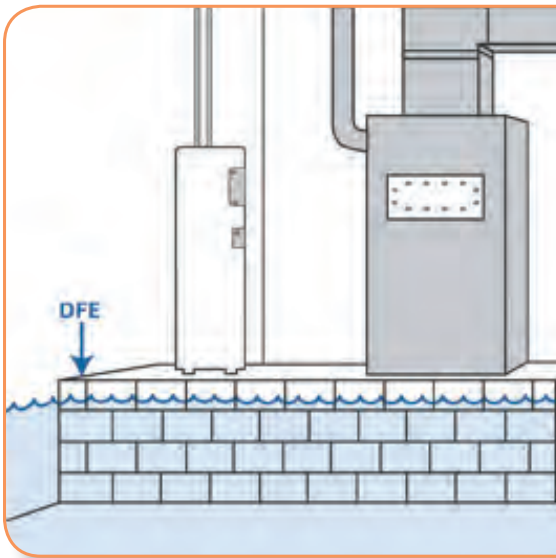
- Reduce cost of repair after flood.
- Reduce time to re-occupy building after flood.
- Usually easy to implement.
- Provides some credit for flood insurance policies.
- Does not require additional land.

### Gas & Electric

It is important to have gas and electric utilities, including meters, raised above flood level. In some cases this requires only a platform, but in more extreme cases the utilities may be required to be raised a full story.

## Elevators

Elevator components located below the flood level should be constructed of flood damage-resistant materials and designed to resist physical damage during flooding, and if an elevator cab is designed to provide access to areas below flood level, it must be equipped with controls that prevent the cab from descending into floodwaters. There are numerous methods by which to accomplish compliance, in accordance with Building Code and FEMA.



### Design Flood Elevation (DFE)

is the level at which a structure's lowest floor must be elevated or floodproofed to be in accordance with state or community floodplain management regulations. DFE is equal to the Base Flood Elevation (BFE) plus any freeboard, or additional amount of height required to ensure safety.

**Figure 9**

Utilities raised above design flood elevation (DFE).  
(Source: A Stronger, More Resilient New York, 2013)



## FLOODPROOFING

As an alternative to elevating structures, floodproofing tactics can be undertaken to prevent or mitigate flood damage to buildings. Floodproofing can be utilized for a variety of lands uses, including residential, commercial, or public properties. There are two options when floodproofing a building: wet floodproofing and dry floodproofing.

## Wet Floodproofing

Wet floodproofing involves retrofitting lower portions of a building to allow water to enter and exit during a flood event and to withstand submergence for a short period of time. A structure with wet floodproofing will incorporate vents or breakaway walls below the DFE that are designed to reduce hydrostatic pressure during a flood event, thereby lowering risk of structural damage.

When utilizing wet floodproofing measures, electrical and mechanical utilities for the building must be protected or elevated/relocated to upper floors that are above the DFE.



### Benefits of Wet Floodproofing

- The load on walls is less compared to a dry floodproofed structure.
- Reduces risk of structural damage from hydrostatic pressure.
- Costs for moving or storing non-basement contents after a flood warning are covered by flood insurance in some circumstances.
- Often less costly than other types of retrofitting.
- Does not require additional land.

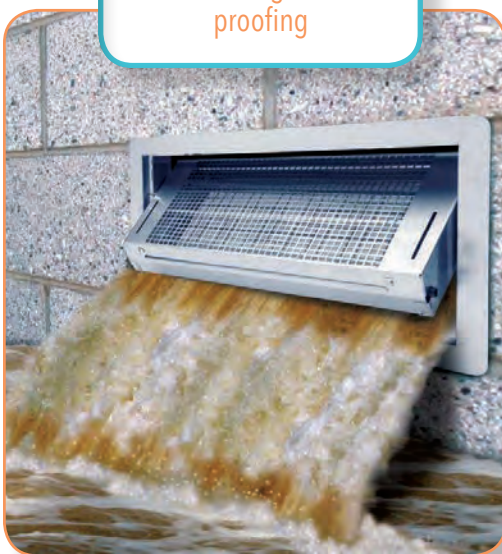


### Limitations of Wet Floodproofing

- Wet floodproofing is considered a band-aid solution and does not lower flood insurance premiums for any building.
- Human intervention and adequate warning time is required to prepare for impending flood.
- Building will get wet inside and may become contaminated by flood waters, necessitating extensive cleanup.
- The structure must not be occupied during a flood and may be uninhabitable for some time after.
- Limited uses of the floodable area (e.g. no residential).



For more information on  
floodproofing, visit  
[www.fema.gov/flood  
proofing](http://www.fema.gov/floodproofing)



**Figure 10**

Flood vent, as those used in wet floodproofing  
(Source: <https://continuingeducation.media.com>)

## Dry Floodproofing

Whereas wet floodproofing permits flood water to flow through the structure, dry floodproofing involves sealing a building to prevent water from entering by utilizing watertight barriers.

One such way of retrofitting a building is by installing flood shield mounts at all vulnerable openings in preparation for a flood.

In addition, it is often necessary to apply waterproof sealants to building walls, structural joints, and openings for utility lines. An interior drainage system may also be needed to handle any leaks through the sealant, requiring a sump pump and emergency power source. The walls themselves may also need to be strengthened and the building anchored to prevent potential collapse.

Other measures for ensuring that dry floodproofing works properly include installing backflow valves for sanitary and storm sewer lines, elevating electrical and mechanical equipment, and anchoring fuel tanks.



**Figure 11**

Modular panel dry floodproofing (Source: <https://www.floodpanel.com/flood-protection-products>)

## Modular Panels

A third method of floodproofing, which is technically also dry floodproofing, is the use of deployable modular panels located around the building or area to be protected. Rather than being adhered to the building itself, modular panels are generally installed in the ground and serve as a wall, holding back any water. Panels can protect entire blocks, if desired. Proposed changes to Jersey City zoning code allow these structures in the public right-of-way for limited periods of time during flood emergencies.



### Benefits of Dry Floodproofing/Modular Panels

- May be less costly than other retrofitting methods and may be eligible for FEMA funding.
- Does not require additional land.
- Easily installed and combined with other measures.
- Some dry floodproofing measures will lower flood insurance premiums for non-residential buildings.



### Limitations of Dry Floodproofing/Modular Panels

- Flood shields are usually only intended for less than a few feet of flooding. Some window and door openings, or lower portions of windows, may be permanently sealed in cases where flooding is expected frequently.
- Ongoing maintenance is required.
- Flood insurance premiums are not reduced for residential structures.
- Human intervention and adequate warning time are required to prepare for impending flood.
- If protective measures fail, the effect on the structure will be the same as if there were no protection at all.
- If design loads are exceeded, more damage could be caused to the structure than if it had been allowed to flood.
- The structure must not be occupied during a flood.
- Flood shields may not be aesthetically pleasing.



**Figure 12**

Modular panels (Source: FEMA, Floodproofing Non-Residential Buildings)

Jersey City recommends that developers and property owners in flood zones contemplate both wet and dry floodproofing. Depending on the use of the property, the character of the block, and the architecture of the building, one or the other may be preferable on a case-by-case basis. Additionally, where historic structures are involved, special attention must be paid to protecting the details of the building and adhering to the Secretary of the Interior's standards for preservation.

In some cases it may be safest to abandon lower floors which are unsafe for habitation due to the cost or frequency of water inundation. In certain zones, it may be possible to retrofit existing first floor spaces from residential to commercial uses which can simply be dry floodproofed. In all cases, the relationship between the building and public sidewalk should be prioritized.

# FAÇADE DESIGN



Buildings in Jersey City, particularly those which have minimal front yard setbacks, have a unique relationship to the public right-of-way. The zone which straddles the public (sidewalk) realm and the private home is critical to the daily interactions in a neighborhood. Similarly, the connection between the street and the interior of a store is integral to pulling customers in and having traffic flow between the storefront and sidewalk. Maintaining this connection is difficult when the base flood elevation is actually above sidewalk grade. The following design recommendations are intended to mitigate those potentially negative consequences of designing habitable space above flood level.

## Residential Design

In order to prevent blank walls at the garden level of residences where units have been vacated, it is recommended that where the level of the lowest occupiable floor is five feet or more above grade, at least one of the following visual mitigation elements be provided. Where the level of the lowest occupiable floor is nine feet or more above grade, at least two of the following visual mitigation elements should be provided:



### Vegetation

Trees, shrubs, or living walls that attain a height of at least three feet shall be provided between the property line and front building walls.



### Stair direction change

Stairs shall be constructed between grade and the lowest occupiable floor or porch, which shall change direction at least 90 degrees.



### Porch

A porch shall have a finished floor, a width at least seventy percent of the building width, a depth of at least five feet, and open railings.

**Figure 13**

Residential techniques to mitigate impacts of blank first floor (Source: Retrofitting Buildings for Flood Risk, NYC Planning).



## Commercial Design

With commercial buildings, engagement with the public realm is critical, and open glazing (i.e. windows) must be a priority even when the interior floor level is higher.

Maximum lengths of blank walls and minimum glazing requirements are detailed in the Jersey City Land Development Ordinance. Where the level of the lowest occupiable floor is three feet or more above grade, it is recommended that at least one of the following visual mitigation elements be provided:

### Vegetation

1

Trees, shrubs or living walls that attain a height of at least three feet shall be provided between the property line and front building walls.

### Second Tier

2

A second tier of outdoor sidewalk or plaza space must be provided along the length of the lot width to provide pedestrian frontage.

### Wet/Dry Hybrid floodproofing

3

Strategies involving elevation of interior space with wet floodproofing at entrances and a shallow area near windows, which can serve as display space.



Second tier of outdoor sidewalk to provide pedestrian frontage (Source: Base <http://www.basenj.com/>)

Commercial interior demonstrating at-grade entry with sales floor raised out of flood zones (Source: Coastal Climate Resilience, Designing for Flood Risk, NY City Planning)





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