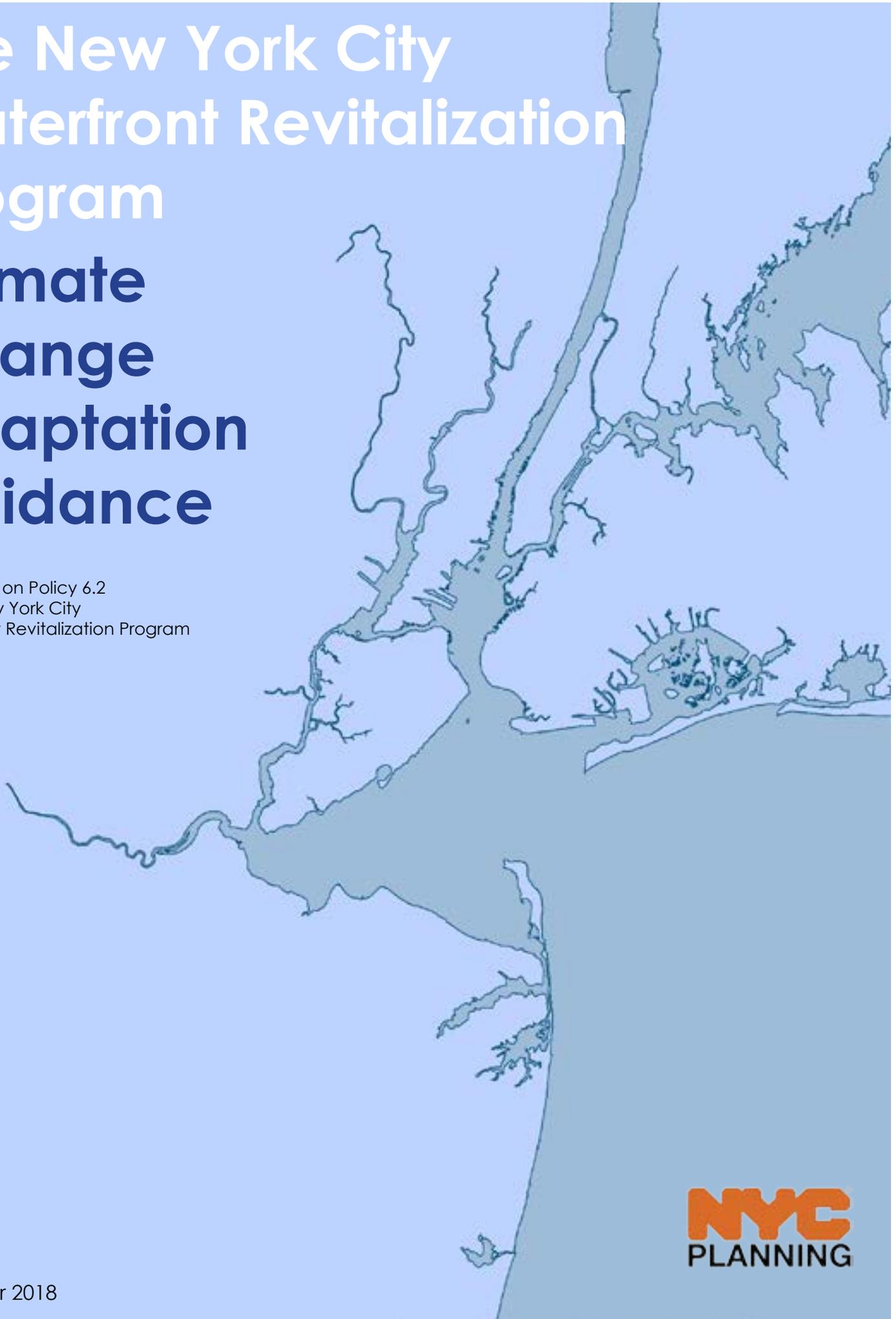


# The New York City Waterfront Revitalization Program

## Climate Change Adaptation Guidance

Guidance on Policy 6.2  
of the New York City  
Waterfront Revitalization Program



## ABOUT

The New York City Waterfront Revitalization Program (WRP) is the City’s principal Coastal Zone Management tool. It establishes the City’s policies for development and use of the waterfront and coastal areas. In October 2013, the City Council approved a revised version of the WRP. The intent of these revisions was to update the policies based on new information and to reflect the City’s objectives for waterfront revitalization, as embodied in *Vision 2020, the NYC Comprehensive Waterfront Plan*, released in 2011. In 2016, the revised version was approved by New York State Secretary of State with the concurrence of the U.S. Secretary of Commerce.

One of the most significant revisions to the policies was to incorporate the consideration of climate change projections for coastal flooding and sea level rise into the design and review of projects. The new Policy 6.2 is to “Integrate consideration of the latest New York City projections of climate change and sea level rise (as published by the New York City Panel on Climate Change, or any successor thereof) into the planning and design of projects in the city’s Coastal Zone.” This policy requires all projects, except for maintenance and in-kind replacement of existing facilities, to identify potential vulnerabilities to and consequences of sea level rise and coastal flooding over their lifespan and to identify and incorporate design techniques to address these risks.

This document provides guidance to applicants and agencies reviewing projects for their consistency with the WRP on how to assess if a proposed project or action advances or hinders the achievement of this policy. These guidelines aim to provide relevant information, best practices, and a methodology for how to consider future flood risks in the planning and design of projects in order to promote sound decision-making and to advance the City’s goals for enhancing coastal climate resiliency.

## WHEN TO USE THIS GUIDE

Use this guide to assist in completing a WRP Consistency Assessment Form (CAF) for discretionary actions within New York City’s Coastal Zone, including:

- A local discretionary action, such as a City Planning Commission action or a City capital project, subject to City Environmental Quality Review.
- State agency actions and programs subject to State Environmental Quality Review.
- Federal agency permits/authorizations, funding, or direct actions.

This guide is not necessary if:

- The discretionary action only includes maintenance activities or the in-kind, in-place replacement of existing structure or facilities.
- The discretionary action only affects areas outside the 1% Annual Chance Floodplain over the lifespan of the project, given 90th percentile projections of sea level rise. If there is no applicable lifespan, refer to the 2050s 1% Annual Chance Floodplain.
- The discretionary action only includes temporary activities of less than 5 years.

The full text of Policy 6.2 as well as the other policies of the WRP are available at [www.nyc.gov/wrp](http://www.nyc.gov/wrp).

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There are three basic steps to assessing an action’s consistency with Policy 6.2 of the Waterfront Revitalization Program.

- 1 Identify vulnerabilities and consequences**

What are the site’s and project’s potential vulnerabilities to coastal hazards, such as flooding, wave action, and erosion?

How will these vulnerabilities change given projected sea level rise over the project’s lifespan?

What would be the general consequences of this project being affected by coastal hazards?
- 2 Identify adaptive strategies**

How is the project designed to address the potential vulnerabilities and consequences identified?

How does the project allow for the incorporation of any future adaptive techniques?
- 3 Assess policy consistency**

Does the project advance or hinder Policy 6.2 of the Waterfront Revitalization Program?

**KEY TERMS**

The following terms apply to the assessment of a project’s vulnerability to coastal hazards:



**Vulnerable Features**

Project features that have the potential to incur significant damage if flooded.

Examples include any form of enclosed space within a building, including residential, commercial, industrial, or community facility land uses; enclosed parking structures; storage areas; enclosed recreational facilities; and bulkheads, revetments, piers, platforms, and other in-water infrastructure elements.



**Critical Features**

Project features that if damaged would have severe impacts on the project and its ability to function as designed.

Examples include electrical utilities, building heating and cooling systems, telephone and data connection and distribution rooms, and other supporting and related building technology and utility spaces.



**Potentially Hazardous Features**

Project features that if damaged or made unsecure by flooding could potentially adversely affect the health and safety of the public and the environment.

Examples include hazardous materials, including highly volatile, flammable, explosive, toxic, or water-reactive materials; and materials that have the potential to become waterborne in the event of a flood and would be dangerous to the health and safety of the public and the environment, such as the storage of construction materials, demolition debris, and aggregate materials.



**Other Features**

Other project features include entirely open and unenclosed spaces, except the open storage of potentially hazardous materials. These features may be damaged by flooding, but are not likely to present significant consequences and are more easily repaired.

Examples include open parking lots, natural areas, or unenclosed recreational spaces, such as playgrounds or ballfields.

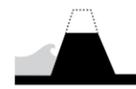
The following terms apply to the assessment of a project’s adaptive design:



### Flood Damage Reduction Elements

Physical elements designed to protect features of the project from flooding, waves, or storm damage.

This includes any element that is part of a wet or dry floodproofing system, such as watertight enclosures, flood panels or barriers, features elevated above flood levels, flood-damage resistant materials, flood vents, bulkheads, seawalls, breakwaters, berms, or floodwalls. Design measures that allow sites or elements of a project to flood without causing critical damage or disruption are also included.



### Adaptive Measures

Planned future actions to protect project features from flooding, waves, or storm damage. While these measures may not be implemented at the time of initial development or construction, the project is designed to accommodate them.

Examples include buildings designed to accommodate flood protection in the future or bulkheads or seawalls designed so that they can be raised to protect against future high tides.

There are many possible approaches to incorporating flood risk and climate adaptation into project design and planning depending on the scale and scope of the project. More information on the basic approaches depicted at the right, refer to the Urban Waterfront Adaptive Strategies, available at [www.nyc.gov/uwas](http://www.nyc.gov/uwas).



## METHODOLOGIES

Depending on the type of action subject to WRP consistency review, two different assessment methodologies—general or detailed—may apply.

### General Methodology

The general methodology should be used for the following types of actions:

- Programmatic, non site-specific actions, such as regulatory actions that address a large geography. For example, an area-wide zoning map change or a citywide zoning text amendment.
- Site-specific actions for projects that are considered lower risk since they do not include new vulnerable, critical, or potentially hazardous features. For example, actions that facilitate open space, parking lots, unenclosed natural areas, or recreational facilities such as ballfields or playgrounds.

### Detailed Methodology

The detailed methodology should be used for site-specific actions for projects that include, or would facilitate the development of, new vulnerable, critical, or potentially hazardous features, such as:

- Development of new vulnerable, critical, or potentially hazardous uses.
- Critical infrastructure or facilities (see Glossary on page 21 for definition).
- Construction of hardened shoreline structures such as bulkheads, piers, docks, wharves, rip-rap, seawalls, levees, breakwaters, or living shorelines with sills.

## COASTAL HAZARDS

As a coastal city, New York City is highly exposed to coastal hazards. With climate change and sea level rise, these hazards are likely to become more frequent and their consequences more severe.

### CLIMATE CHANGE PROJECTIONS

Applicants and reviewers should refer to the climate change projections for sea level rise from the New York City Panel on Climate Change (NPCC). The most recent projections from the NPCC were issued in 2015. The panel’s projections are based on scientific literature and observed climate data and were developed by downscaling global climate models to be applicable to the New York City metropolitan area. The projections use ranges of outcomes from the results of 24 global climate models and two scenarios of future greenhouse gas emissions, organized into percentiles of the distribution of model outcomes. See table below, “Sea level rise projections, relative to the 2000-2004 base period.”

The NPCC has found that sea levels have risen 1.1 feet at the Battery since 1900, and that higher sea levels in the future are “extremely likely.” In addition, the panel found that there have been increases in the number of strong (category 4 and 5) hurricanes in the North Atlantic Basin since the early 1980s, and that the number of intense hurricanes in the region will “more likely than not increase.” However, it is very difficult to evaluate the significance of trends for rare events and the NPCC has not provided quantitative projections for future coastal storms.

For the purposes of assessing a project’s consistency with the WRP, project applicants and reviewers should, when feasible, assess the range of the sea level rise projections appropriate to the project’s timeline and expected useful life, as well as risk tolerance of a specific project. For instance, when the consequences of flooding is very severe, such as for projects that involve critical facilities or potential hazardous materials, higher range projections should be considered.

Projects advanced by New York City agencies should refer to the [Climate Resiliency Design Guidelines](#) developed by the Mayor’s Office of Recovery and Resiliency, which recommend designing for the 50th percentile sea level rise projections over the project’s anticipated useful life, in addition to freeboard.

	Low Estimate	Middle Range			High Estimate
	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile
2020s	+ 2 in.	+ 4 in.	+ 6 in.	+8 in.	+10 in.
2050s	+8 in.	+ 11 in.	+16 in.	+21 in.	+30 in.
2080s	+13 in.	+18 in.	+29 in.	+39 in.	+58 in.
2100	+15 in.	+22 in.	+36 in.	+50 in.	+75 in.

Sea level rise projections, relative to the 2000-2004 base period (NPCC, 2015).

## CHRONIC HAZARDS

Sea level rise is leading to gradual increases in daily and monthly tides. In very low-lying areas, this is likely to result in monthly and eventually daily flooding. In areas with gradual sloping shorelines, such as beaches and marshes, sediments will erode as the high tide line advances landward and some of the intertidal zone will be permanently submerged.

The consequences of these gradual changes in everyday conditions will be felt slowly over time but have the potential to lead to:

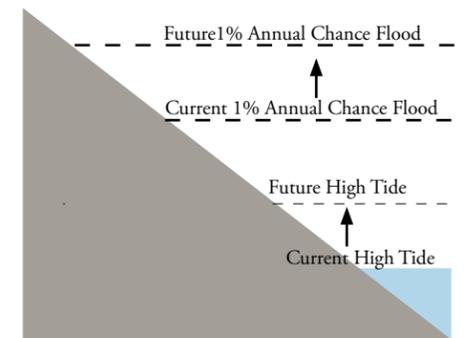
- Development of unsafe living conditions, as affected neighborhoods may be hard to access during emergencies.
- Reduction of quality of life in affected neighborhoods.
- Loss of vegetation due to high saline content in soils.
- Loss of usable land, roadways, and infrastructure.
- Gradual erosion of shorelines, which could lead to loss of habitat and undermine building foundations on developed sites.
- Low-level but regular, even daily, overtopping of shorelines and flooding.
- Decreased functionality of drainage infrastructure.

### EXTREME EVENTS

Climate change is also increasing the frequency and severity of extreme coastal storms, which result in storm surge, wave action and erosion. Storm surge is a rise in coastal water level associated with a hurricane or other coastal storm. With sea level rise, flood elevations associated with annual chances of occurrence, such as the 1% annual chance flood, will be higher, and the area within the floodplain will also increase.

Extreme events occur less frequently, but their consequences are more severe, and could lead to:

- Loss of life and threats to human safety.
- Water and wave damage to structures, and erosion of shorelines and shoreline structures, which could undermine building foundations.
- Inundation of critical facilities and infrastructure that could cause operational and service disruption to residents and businesses.
- Release of sewage and potentially hazardous materials, as well as other secondary impacts on the health and security of residents, particularly vulnerable populations who may not be able to evacuate safely or depend on regular assistance and care.
- Displacement of affected populations.
- Overland flooding and disruptions, such as blocked access to roads and utilities.
- Changes to ecosystems and loss of habitat.



Sea level rise will increase the height and horizontal extent of both high tide and the 1% annual chance flood. See maps on next page for 2050s projections. More maps area available at the NYC Flood Hazard Mapper ([www.nyc.gov/floodhazardmapper](http://www.nyc.gov/floodhazardmapper)).

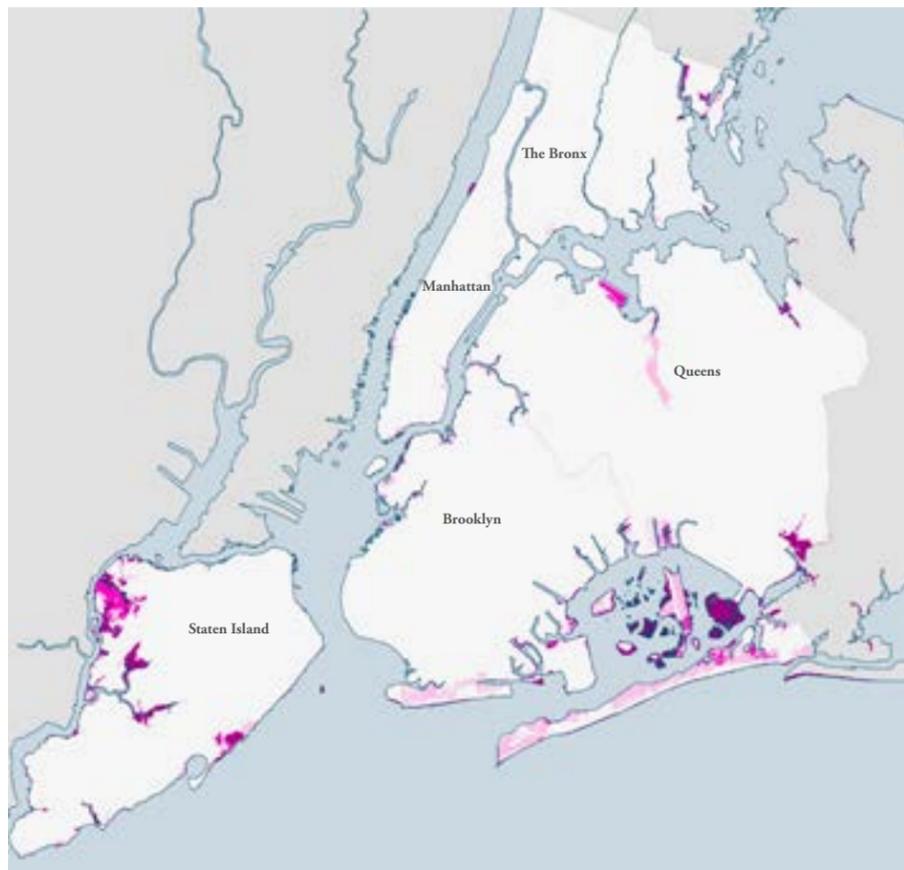
**Effects of Sea Level Rise on the 1% Annual Chance Floodplain**

- 1% Annual Chance Floodplain (2015 PFIRM)
- 2050s 1% Annual Chance Floodplain (90th percentile)



**Areas Affected by Future High Tides**

- 2020s Mean Higher High Water (90th percentile)
- 2050s Mean Higher High Water (90th percentile)
- 2080s Mean Higher High Water (90th percentile)



**KEY RESOURCES**

The following resources should be consulted for either the general or detailed methodology.

**NYC Flood Hazard Mapper**

NYC Department of City Planning

[www.nyc.gov/floodhazardmapper](http://www.nyc.gov/floodhazardmapper)

A web-based tool showing a range of flood hazard layers, including current and future floodplains as well as future Mean Higher High Water.

**Preliminary Flood Insurance Rate Maps**

FEMA

[www.region2coastal.com](http://www.region2coastal.com)

The 2015 Preliminary Flood Insurance Rate Maps are currently the best available data for planning purposes. FEMA's website provides GIS files as well as an online map. The Preliminary Flood Insurance Study (FIS) report available on this site provides 0.2% annual chance flood elevations for transects throughout the city.

**Tides and Currents**

NOAA

[www.tidesandcurrents.noaa.gov](http://www.tidesandcurrents.noaa.gov)

Information on current tide elevations can be found on NOAA's website.

**Building the Knowledge Base for Climate Resiliency: New York City Panel on Climate Change 2015 Report**

Volume 1336, of the Annals of the New York Academy of Sciences, January 2015

<http://onlinelibrary.wiley.com/doi/10.1111/nyas.2015.1336.issue-1/issuetoc>

**Flood-Resistant Construction**

NYC Department of Buildings

[www.nyc.gov/buildings](http://www.nyc.gov/buildings)

Appendix G of NYC's Building Code contains requirements for construction within the floodplain.

**NYC Open Data Portal**

[www.nyc.gov/opendata](http://www.nyc.gov/opendata)

GIS files for future Mean Higher High Water, future 1% Annual Chance Floodplain, and a Digital Elevation Model of NYC are available.

**New York City Waterfront Revitalization Program**

NYC Department of City Planning

[www.nyc.gov/wrp](http://www.nyc.gov/wrp)

Additional information on the Waterfront Revitalization Program.

**NYC Climate Risk Design Guidelines**

Mayor's Office of Recovery and Resiliency

[https://www1.nyc.gov/assets/ort/pdf/NYC\\_Climate\\_Resiliency\\_Design\\_Guidelines\\_v2-0.pdf](https://www1.nyc.gov/assets/ort/pdf/NYC_Climate_Resiliency_Design_Guidelines_v2-0.pdf)

Guidance on incorporating projected impacts from climate change into the planning, engineering, construction, and renovation of City facilities.

**DCP Climate Resiliency Initiatives**

NYC Department of City Planning

[www.nyc.gov/resilientneighborhoods](http://www.nyc.gov/resilientneighborhoods)

Additional materials and guidance on potential flood damage reduction elements and adaptive strategies.

**OneNYC**

Mayor's Office of Recovery and Resiliency

[www.nyc.gov/resiliency](http://www.nyc.gov/resiliency)

Information on the City's resiliency planning goals and efforts.

## GENERAL METHODOLOGY

The following steps outline the methodology for assessing the consistency of programmatic, non site-specific actions, or site-specific actions that are considered lower risk since they do not include new vulnerable, critical, or potentially hazardous features. If there is not a specified construction timeline or defined project lifespan at the time of proposal, these steps should be based on the 2050s 90th percentile sea level rise projections as an appropriate planning horizon for current projects. A narrative describing each step should be provided as an attachment to the WRP Consistency Assessment Form (CAF).

### 1 Identify Vulnerabilities and Consequences

The goal of the first step is to assess the project's vulnerabilities to future coastal hazards and what the potential consequences may be.

#### (a) Assess the project area's exposure to current and future flood risk.

- If the project area or affected geography is outside the 2050s 1% Annual Chance Floodplain, no further analysis is necessary. Policy 6.2 should be marked "not applicable" on the CAF.
- If the project area or affected geography is within (or touches the boundary of) the current 1% annual chance floodplain, provide a map of the project area in relation to the floodplain.
- Identify the current Flood Zones and Base Flood Elevations within the project site or affected geography, and note if there are any V or Coastal A zones present.
- Describe the range of ground elevations relative to NAVD88 and the range of Base Flood Elevations (both relative to NAVD88).
- If the project area is outside the current 1% annual chance floodplain, but is within (or touches the boundary of) the 2050s 1% Annual Chance Floodplain, provide a map of the project area in relation to 2050s 1% Annual Chance Floodplain.
- If the site is located on the shoreline, identify if any portion of the site would be flooded by the 2050s Mean Higher High Water.

#### (b) Identify if the project or action would facilitate the development of any vulnerable, critical, or potentially hazardous features, as defined under "Key Terms" above, within areas exposed to flooding from Mean Higher High Water or 1% Annual Chance Flood by the 2050s under the 90th percentile of sea level rise projections.

- If not, provide a narrative stating that while the project is within the current or future floodplain, it would not facilitate the development of any vulnerable, critical, or potentially hazardous features in areas exposed to current or future flood hazards, and would therefore advance Policy 6.2.
- If yes, provide a narrative description of all vulnerable, critical, or potentially hazardous features that may be introduced in areas exposed to current or future flood hazards as a result of the action, and describe the general consequences of exposing those features to chronic coastal hazards or extreme flood events.

### 2 Identify Adaptive Strategies

The goal of Step 2 is to assess how the vulnerabilities and consequences identified in Step 1 are addressed through the project's design and planning.

Assess how applicable codes and regulations, planned flood damage reduction elements and adaptive measures, or likely future infrastructure investments (beyond the scope of the proposed project), would or would not reduce potential flood damage for any proposed vulnerable, critical, or potentially hazardous features.

- If public infrastructure or coastal protection projects are planned that may reduce future flood risk, a description should be provided along with references to reports and plans.
- For an area-wide rezoning, describe Building Code requirements that would be applicable to any new development facilitated by the proposed action. See example that follows the methodologies.
- For the funding of a project that has not yet been designed, describe any applicable codes, standards or policies relating to flood protection levels or sea level rise projections.
- Provide relevant supporting materials (see list at right).

### 3 Assess Policy Consistency

The final step is to assess whether the project is consistent with Policy 6.2 of the Waterfront Revitalization Program.

A project or action would advance the policy when:

- No new vulnerable, critical, or potentially hazardous features would be located within area flooded by current or future high tide, or current or future 1% annual chance storm, or
- All new vulnerable, critical or potentially hazardous features would be protected through flood damage reduction elements or future adaptive measures.

A project or action would hinder the policy when:

- New vulnerable, critical, or potentially hazardous features would be introduced in areas that will be flooded by high tide in 2050s where other adaptive actions are not feasible,\*
- Industrial development would not be protected from 2050s high tides or current 1% annual chance flood, or
- Critical infrastructure would not be protected to the 1% annual chance flood elevation over its lifespan.

If a potential policy hindrance is found, the Detailed Methodology should be conducted to further examine the project's consistency with Policy 6.2.

\*For land use actions, this includes projects that would increase the allowable density of residential uses or would introduce uses likely to include vulnerable populations not able to easily evacuate (such as a nursing homes or senior-care facilities), and critical facilities.

## SUPPORTING MATERIALS

The following materials should be provided as supporting information:

- A map of the project site in relation to the current 1% annual chance floodplain as shown on FEMA's 2015 Preliminary Flood Insurance Rate Maps.
- A map of the project site in relation to the 2050s 1% annual chance floodplain.
- If located on the shoreline, a map of the project site in relation to the 2050s Mean Higher High Water.

## DETAILED METHODOLOGY

The following steps outline the methodology for assessing the consistency of site-specific actions for projects that include, or would facilitate the development of, new vulnerable, critical, or potential hazardous features or uses. A narrative describing each step should be provided as an attachment to the Consistency Assessment Form, along with the Flood Elevation Worksheet. Both are available online at [www.nyc.gov/wrp](http://www.nyc.gov/wrp).

### 1 Identify Vulnerabilities and Consequences

The goal of the first step is to assess the project's vulnerabilities to future coastal hazards and identify what the potential consequences may be.

- (a)** Complete the Flood Elevation Worksheet to identify current and future flood elevations in relation to the elevations of the site and project features.
- Download the Flood Elevation Worksheet and follow the directions for completing the worksheet on the following page. Refer to the resulting flood elevation charts to complete the next steps.
- (b)** Identify any project features that may be located below the elevation of the 1% floodplain over the lifespan of the project under any sea level rise scenario. For each feature identified, describe the following:
- Under which future sea level rise scenario would the elevation of the feature be below the elevation of the 1% floodplain? For instance, the high, high-mid, low-mid, or low for the 2020s, 2050s, 2080s, or 2100.
  - What would be the general effects on the feature from flooding? Consider how flooding would impact the project's ability to function, what damages and disruptions may occur, and what other consequences may result. For instance, what are potential consequences to the surrounding area if the feature is flooded, such as dispersal of materials stored on the site? Is the project likely to contain occupants who may not be sufficiently mobile to avoid the loss of life or injury during flood and storm events?
- (c)** Identify any vulnerable, critical, or potentially hazardous features that may be located below the elevation of Mean Higher High Water over the lifespan of the project under any sea level rise scenario. For each feature identified, describe the following:
- Under which future sea level rise scenario would the elevation of the feature be below the elevation of Mean Higher High Water? For instance, the high, high-mid, low-mid, or low for the 2020s, 2050s, 2080s, or 2100.
  - What would be the general effects on the feature of daily inundation? Consider how flooding would impact the project's ability to function, what damages and disruptions may occur, and what other consequences may result. For instance, what are potential consequences to the surrounding area if the feature is flooded, such as dispersal of materials stored on the site or cutting off key access points? Is the project likely to contain occupants who may not be sufficiently mobile to avoid the loss of life or injury during high tides?
- (d)** Describe how any additional coastal hazards are likely to affect the project, both currently and in the future, such as waves, high winds, or debris.
- Is the project located within a Coastal A or V Zone?
  - Does the project contain any materials or substances that if made insecure from wind, water, or debris would result in a threat to public health or the environment?

#### SUPPORTING MATERIALS

Refer to the list of resources on page 11 for additional information.

The following materials should be provided:

- Completed Flood Elevation Worksheet.
- A project site plan showing the current 1% annual chance floodplain as shown on FEMA's 2015 Preliminary Flood Insurance Rate Maps.
- A project site plan showing the range of potential future 1% annual chance floodplains over the project's lifespan.
- A project site plan showing the range of potential future Mean Higher High Water over the project's lifespan.
- Sectional drawings showing project features with the elevation of the current and future 1% annual chance floodplain, and current and future Mean Higher High Water, over the project's lifespan.

### 2 Identify Adaptive Strategies

The goal of Step 2 is to assess how the vulnerabilities and consequences identified in Step 1 are addressed through the project's design and planning.

- (a)** For any features identified in Step 1(b), describe the following:
- How would any flood damage reduction elements incorporated into the project, or any natural elevation on the site, provide any additional protection? For instance, is the project feature located behind a seawall or floodwall? Or is the feature sufficiently surrounded by higher elevation to prevent future inundation? Or is the feature designed with flood-damage resistant materials and vents to allow the feature to flood without experiencing significant damage?
  - How would any planned adaptive measures protect the feature in the future from flooding? For instance, could the feature be elevated or moved inland by the time the floodplain elevation increases, and is the project being designed to allow such modification in the future? Describe why the actions are not being implemented at this time.
- (b)** For any features identified in Step 1(c), describe the following:
- How would any flood damage reduction elements incorporated into the project, or any natural elevation on the site, provide any additional protection? For instance, is the project feature located behind a seawall or floodwall? Or is the feature sufficiently surrounded by higher elevation to prevent future inundation? Or is the feature designed to be inundated at high tide?
  - How would any planned adaptive measures protect the feature in the future from flooding? For instance, could the feature be elevated or moved inland by the time sea levels increase, and is the project being designed to allow such modification in the future? Or could a bulkhead be elevated in the future to protect the site from high tides? Describe why the actions are not being implemented at this time.
- (c)** Describe any additional measures being taken to protect the project from additional coastal hazards such as waves, high winds, or debris.
- (d)** Describe how the project would affect the flood protection of adjacent sites, if relevant. How would the project lead to increased flooding on adjacent sites? How would the project protect upland sites from coastal hazards? Does the project complement or conflict with planned, adjacent flood protection projects?

### 3 Assess Policy Consistency

The final step is to conclude whether the project is consistent with Policy 6.2 of the Waterfront Revitalization Program.

A project or action would advance the policy when:

- No new vulnerable, critical, or potentially hazardous features would be located within area flooded by current or future high tide, or current or future 1% annual chance flood, over the project's lifespan, or
- All new vulnerable, critical or potentially hazardous features would be protected through flood damage reduction elements or future adaptive measures within the timeframe that they would be needed.

A project or action would hinder the policy when:

- Vulnerable, critical or potentially hazardous features would be introduced in areas that will be flooded by high tide during the project's lifespan and adaptive measures are not feasible.
- Industrial development would not be protected from 2050s high tides or the current 1% annual chance flood.
- Critical infrastructure would not be protected to the elevation of the 1% annual chance storm over its lifespan.
- Shoreline structures would not function as intended with increases in sea levels projected over their lifespan.

## FLOOD ELEVATION WORKSHEET

For the detailed methodology, Step 1(a) is to complete the Excel-based Policy 6.2 Flood Elevation Worksheet, available at [www.nyc.gov/wrp](http://www.nyc.gov/wrp).

### TAB 1 - PROJECT BACKGROUND

Begin by identifying the project's name, its scope, including location and scale, and project type. The selected project type(s) inform the steps that follow, by giving priority to particularly relevant and important project features and sea level rise projections. For example, a project with critical infrastructure or facilities, such as a hospital, has greater consequences if flooded and therefore will be assessed differently.

Background Information	
Project Name	
Location	
Type(s)	<input type="checkbox"/> Residential, Commercial, Community Facility <input type="checkbox"/> Parked Over Space, and Natural Area <input type="checkbox"/> Taxi/Bus Stop <input type="checkbox"/> Other Infrastructure Facility <input type="checkbox"/> Industrial Use <input type="checkbox"/> Other water Structures <input type="checkbox"/> Irrigation Structures <input type="checkbox"/> Transportation <input type="checkbox"/> Sewerage Treatment/Storage <input type="checkbox"/> Coastal Protection
Description	
Planned Completion Date	

- 1 For project location, enter address, block and lot, or site boundaries.
- 2 Select from the list of project types. More than one type may be applicable to a single project.
- 3 Enter a short description of the project. Include total site area and other dimensions as appropriate.
- 4 Enter the estimated project completion date.

### TAB 2 - TIDAL AND FLOOD HEIGHT

Identify current tidal and flood heights at the project site. These will serve as the baseline heights for determining future flood elevations with sea level rise projections, while also identifying current vulnerabilities. For large sites with features that have varied tidal heights, select a range of elevation points that comprehensively address flood vulnerabilities. For instance, select a high point, an average elevation point, and the lowest elevation point.

Refer to the list of resources on page 11 for recommended data sources.

Establish current tidal and flood heights.				
	FT (NAVD88)	Feet	Datum	Source
MHHW				
1% flood height				
Design flood elevation				
As relevant:				
0.2% flood height				

Data will be converted based on the following datums:	
Datum	FT (NAVD88)
NAVD88	0.00
NGVD29	1.30
Manhattan Datum	1.63
Bronx Datum	1.53
Brooklyn Datum (Sewer)	0.67
Brooklyn Datum (Highways)	1.43
Queens Datum	1.67
Richmond Datum	2.09

- 1 Enter the elevation in feet of the site's Mean Higher High Water (MHHW) in the highlighted cell and select the corresponding datum from the drop-down menu. Identify the source in the last column.\*
- 2 Enter the elevation in feet of the site's 1% flood height in the highlighted cell and select the corresponding datum from the drop-down menu. Identify the source in the last column. If the site contains multiple flood elevations, choose the flood elevation at the location of the physical features identified. If there are multiple flood elevations that include project features, create separate worksheets for each.\*\*
- 3 For critical infrastructure or facilities, enter in the 0.2% flood height. This elevation can be found in the Preliminary Flood Insurance Study available from FEMA.
- 4 These values are used to convert the elevations entered above to NAVD88 in order to have a consistent measure of elevations for comparison purposes.

\* This data should be provided from a site survey. For projects not located on the waterfront, or if a survey is not available, refer to appendix A for MHHW values and use the values closest to the project site.

\*\* For project's outside the 1% annual chance floodplain, enter to the 1% annual chance flood height of the closest flood zone.

### TAB 3 - PROJECT FEATURES

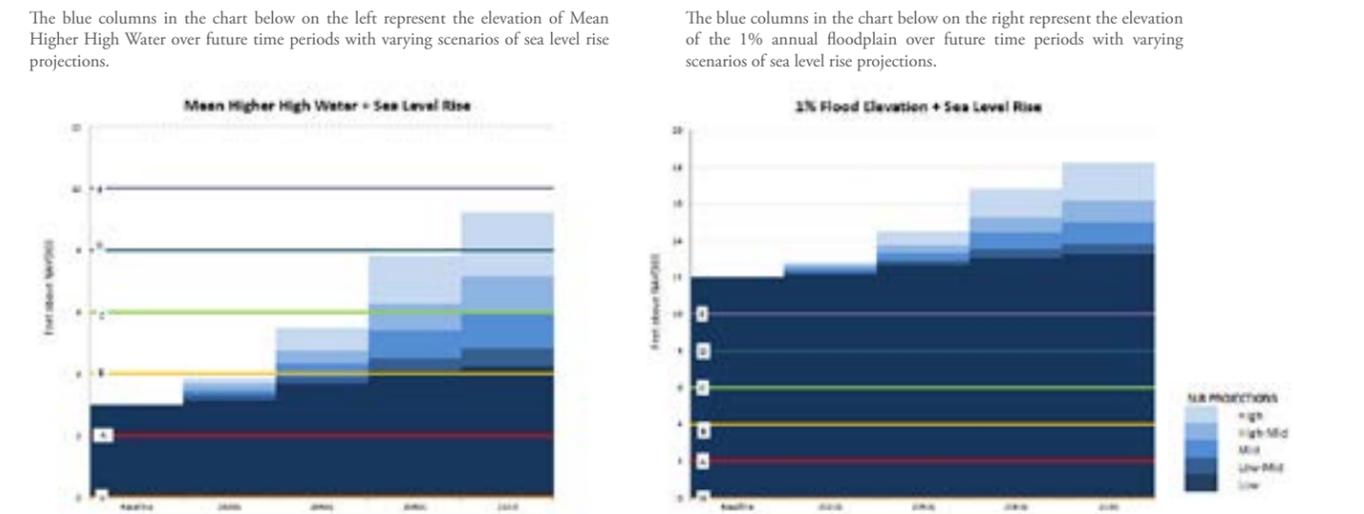
Identify the elevation and lifespan of key project features and provide a description of factors that affect their potential vulnerability to chronic flood hazards and extreme flood events. Select a maximum of 8 features that represent the scope of the project. If more features are necessary, prepare an additional worksheet. Information on the project's lifespan will inform which time horizon of sea level rise to focus on.

Feature Name	Feature Category	Height	Datum	Units	Elevation	Project Lifespan	End of Useful Life	End of Useful Life	End of Useful Life
Description of Project Use and Materials	<input type="checkbox"/> Healthcare <input type="checkbox"/> Office <input type="checkbox"/> Retail <input type="checkbox"/> Other								
Description of Project Use and Materials	<input type="checkbox"/> Healthcare <input type="checkbox"/> Office <input type="checkbox"/> Retail <input type="checkbox"/> Other								
Description of Project Use and Materials	<input type="checkbox"/> Healthcare <input type="checkbox"/> Office <input type="checkbox"/> Retail <input type="checkbox"/> Other								
Description of Project Use and Materials	<input type="checkbox"/> Healthcare <input type="checkbox"/> Office <input type="checkbox"/> Retail <input type="checkbox"/> Other								
Description of Project Use and Materials	<input type="checkbox"/> Healthcare <input type="checkbox"/> Office <input type="checkbox"/> Retail <input type="checkbox"/> Other								
Description of Project Use and Materials	<input type="checkbox"/> Healthcare <input type="checkbox"/> Office <input type="checkbox"/> Retail <input type="checkbox"/> Other								
Description of Project Use and Materials	<input type="checkbox"/> Healthcare <input type="checkbox"/> Office <input type="checkbox"/> Retail <input type="checkbox"/> Other								
Description of Project Use and Materials	<input type="checkbox"/> Healthcare <input type="checkbox"/> Office <input type="checkbox"/> Retail <input type="checkbox"/> Other								

- 1 Enter a name for each project feature and short descriptions of the planned uses and materials.
- 2 Identify if the feature is vulnerable, critical, or potentially hazardous (see definitions on page 5).
- 3 Enter in the best estimate of when in the future the project will meet the end of its useful life, including ongoing maintenance, such as 2040, 2050, 2080, etc.
- 4 In the highlighted cell, enter the elevation of each feature. Large features with several elevation points should be included as multiple features, with one feature representing the lowest elevation point and another the average elevation. In the drop-down lists, select inches or feet as appropriate and select the datum from which elevation was calculated.
- 5 Elevations entered will be automatically converted to measurements in feet above NAVD88 and feet above tidal and flood elevations entered in Tab 2.

### TAB 4 - SUMMARY CHARTS

The charts in Tab 4 are based on data on the elevation of Mean Higher High Water and the 1% Annual Chance Flood Elevation entered in Tab 2, the elevation of project features entered in Tab 3, and from sea level rise scenarios provided in the worksheet. These charts are intended as a visual tool to help assess the extent to which project features could be exposed to future flooding from either Mean Higher High Water or the 1% Annual Chance Flood over their lifespan, under a range of sea level rise projections. Insert an image of these charts in the narrative response to Policy 6.2.



In both charts, the horizontal lines in each chart (labeled "A" through "D") represent the elevation of the project features in feet about NAVD88.

In both charts, the lightest blue is the high-end projection (the 90th percentile), the darkest blue is the low-end projection (10th percentile), with the high-mid (75th percentile) and low-mid (25th percentile) in between.

## GENERAL METHODOLOGY ILLUSTRATIVE EXAMPLES

### EXAMPLE 1

#### Citywide Zoning Text Amendment

A zoning text amendment is proposed to minimize conflicts between building code requirements for certain safety measures required by Building Code and zoning provisions.

- 1(a): The amendments would apply to residential developments citywide, including the current and future floodplain.
- 1(b): The action would not facilitate the development of any new vulnerable, critical, or potentially hazardous features. The project would advance Policy 6.2, and no further analysis is needed.

### EXAMPLE 2

#### Area-wide Rezoning

A zoning map change is proposed to allow residential and mixed-use developments in an area that is currently zoned for low-density commercial.

- 1(a): The rezoning area includes a portion of the current 1% Annual Chance Floodplain. A portion of the rezoning area is also within the 2050 1% Annual Chance Floodplain given the 90th percentile sea level rise projections. The current Base Flood Elevation throughout the area is 10 feet NAVD, which ranges from 2 to 4 feet above grade. No portion of the project area would be affected by future Mean Higher High Water given the 90th percentile projections for sea level rise.
- 1(b): The action would potentially lead to construction of new residential and commercial buildings that may be affected in the future by severe flood events. Consequences may include building damage, loss of property, and public safety risks.
- 2: Building code requirements for flood-resistant construction, including freeboard, would be required for all new development facilitated by this action within the current 1% Annual Chance Floodplain. New development located outside the current 1% Annual Chance Floodplain but within the 2050s 1% annual chance floodplain, would be able to voluntarily floodproof to such standards without zoning barriers created by the proposal. In the future, if these buildings are within the floodplain, they would be able to retrofit to such standards and would not be impeded by the proposed zoning.
- 3: The project would advance Policy 6.2. No new vulnerable, critical, or potentially hazardous features would be facilitated in areas that would flood from future Mean Higher High Water. New vulnerable features within the future 1% Annual Chance Floodplain would be designed with flood-resistant construction standards. And the project would not inhibit the ability of new vulnerable features located within the future 1% Annual Chance Floodplain to be made resilient through future adaptive actions, like retrofits.



Project Location Map

### EXAMPLE 3

#### Construction of New Neighborhood Park

A city capital project is proposed for a new waterfront park including a playground and seating area. The project does not include any new shoreline infrastructure or enclosed structures.

- 1(a): The project is located within the current and 2050s 1% annual chance floodplain. A small portion of the site may be flooded by 2050s Mean Higher High Water.
- 1(b): The project does not include any vulnerable, critical, or potentially hazardous features. The project would advance Policy 6.2, and no further analysis is needed.

### EXAMPLE 4

#### Federal Funding for Airport Improvements

This federal funding application would provide assistance to the City for an airport improvement project. At the time of the application for funding, the project is not fully designed, although the general scope and program has been established.

- 1(a): Portions of the project site are located within the current 1% annual chance floodplain with a Base Flood Elevation of 11 feet NAVD, which ranges from 1 to 8 feet above grade. A portion of the site is within the Coastal A zone. The entire site is within the 2050s 1% annual chance floodplain. No portions of the site would be flooded by 2050s Mean Higher High Water.
- 1(b): During an extremely large storm event, the runway area may experience inundation from flooding, although an existing seawall reduces the likelihood of this occurring. If the airport were to be flooded, it would lead to property damage and disruption of air travel, with potential impacts on regional economic activity.
- 2: Since the project is federally funded, it would need to adhere to Federal Executive Order 11988, which requires critical infrastructure to be protected from the 500-year flood. In addition, the airport authority has adopted a standard for incorporating sea level rise which will apply to this project. The airport also has a coastal flood risk reduction plan for long term investments, which includes plans to increase the height of the seawall – a future adaptive measure – as well as an emergency operations plan.
- 3: The project would advance Policy 6.2. All new vulnerable, critical or potentially hazardous elements within the current or future 1% Annual Chance Floodplain will be floodproofed to the 0.2 % annual chance floodplain elevation. This elevation, +15 NAVD, is higher than the existing base flood elevation (+12 NAVD) with Sea Level Rise projections for the 90th percentile for the 2050s (+30 inches).

## DETAILED METHODOLOGY ILLUSTRATIVE EXAMPLE

### Mixed-Use Redevelopment Project

This proposal is for a redevelopment of several parcels on the waterfront with residential and retail uses, publicly accessible open space, and parking. The proposed project requires a number of discretionary actions from the City Planning Commission including zoning map and text amendments and special permits for modifications to height, setback, and bulk requirements.

#### Step 1

- (a): The completed Flood Elevation Worksheet is shown to the right.
- (b): The analysis below is based on the charts shown in tab 4 of the Flood Elevation Worksheet.

The average elevation of the publicly accessible waterfront is at the elevation of the current 1% annual chance floodplain, and will be below the 1% flood elevation by the 2020s under all sea level rise projections. The low point of the public waterfront is below the elevation of the current 1% annual chance floodplain, and will be for its lifespan under all sea level rise projections. Potential consequences include damage to shoreline structures, paving materials and plantings, and interruption to public access to the waterfront open space.

The lowest residential floor of Building A could be below the elevation of the 1% annual chance flood by the 2050s under the high projections, or by the 2080s under all projections. If it were, there could be damage to property, temporary displacement of residents, and potentially increased flood insurance costs.

Building A's critical systems would be below the elevation of the 1% annual chance flood by the 2080s under the high projections. This could result in loss of building services which could result in damage to property and temporary displacement of residents.

The lowest parking floor in Building A is below the elevation of the current 1% annual floodplain and will be throughout its lifespan under any projection of sea level rise. If flooded, there could be damage to cars and structural damage to the building.

The retail space in Building A would be below the elevation of the 1% annual chance floodplain by the 2050s under the high or high-middle projections, or by the 2080s by the low-middle projections. This could lead to damage to property and loss of inventory.

The lowest residential floor in Building B would be below the elevation of the 1% annual chance floodplain by the 2080s under the high projections. If it were, there could be damage to property and temporary displacement of residents.

- (c): The only feature that would be expected to be below the elevation of Mean Higher High Water at some point over its lifespan is the lowest parking floor in Building A. It would be below the elevation of Mean Higher High Water by the 2050s under the high sea level rise projections or by the 2080s under the high-middle projections. This could result in frequent flooding due to elevated groundwater tables if design measures are not taken into account.

- (d): Coastal storms could bring high winds in addition to the flood hazards described above. The site is not within a Coastal A or V zone.

### FLOOD ELEVATION WORKSHEET

The screenshot shows a form with the following fields:
 

- Project Name: 123 Waterfront Ave
- Location: 123 Waterfront Ave in Boulder, CO
- Description: A proposed redevelopment of several parcels on the waterfront. The project contains two buildings, one with residential and parking on the ground floor, the other with residential and retail on the ground floor.
- Planned Completion Date: 2025

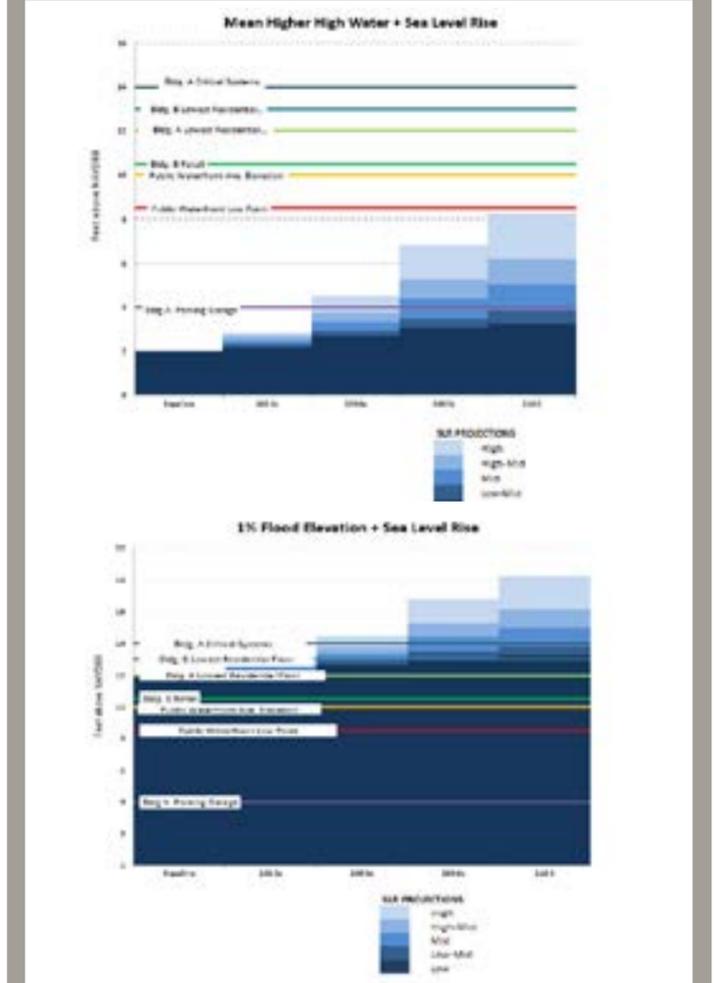
Tab 1

Item	FT NAVD (2006)	Water	Storm	Climate
Water	2.25	2.25	NAVD	Water
1% Flood Height	30.00	30.00	NAVD	30.00

Tab 2

The screenshot shows a table with columns for 'Building Name', 'Floor Type', 'Current Elevation (ft NAVD)', '2050s Projection (ft NAVD)', '2080s Projection (ft NAVD)', '1% Flood Elevation (ft NAVD)', and 'MHHW (ft NAVD)'. It lists various building levels like 'Building A - Retail', 'Building A - Residential', 'Building B - Retail', etc., with their respective elevations and flood projections.

Tab 3



Tab 4

Step 2

(a): The publicly accessible waterfront open space is designed with plants and materials that can withstand saltwater flooding. All electrical systems are elevated or encased in floodproof containers.

Building A is designed to meet NYC Building Code standards for flood resistant construction standards, including dry floodproofed walls, flood barriers at building openings, and a foundation system designed to resist hydrostatic pressure. As a result, the parking will be protected from flooding and the rest of the building will be floodproofed up the elevation of the current 1% annual chance floodplain plus 1 foot of freeboard (11' NAVD 88). If the elevation of the floodplain increases beyond that by the 2050s or 2080s, additional protection could be provided through temporary barriers, or subsequent retrofits to extend dry floodproofed materials to higher elevations.

Building B is outside of the current 1% annual chance floodplain and is not required to meet NYC Building Code requirements for flood resistant construction. The building is not, however, designed with any below grade spaces, and if the floodplain covers the site in the future, additional retrofits could be pursued to wet floodproof and remove dwelling units from the ground floor, or to dry floodproof the exterior and reinforce the foundation.

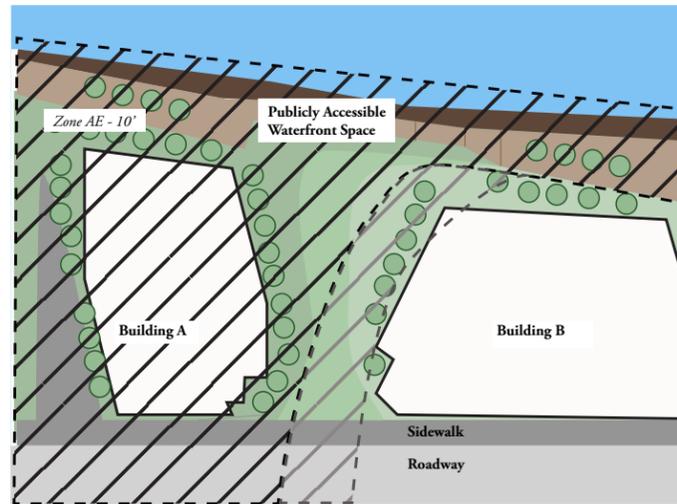
(b): The measures described above would address the potential vulnerability of the parking area to future Mean Higher High Water.

(c): Buildings A and B would be required to meet NYC Building Code standards for wind loading.

(d): The project would not make flooding on adjacent sites worse, nor would it conflict with other plans for flood protection on adjacent sites.

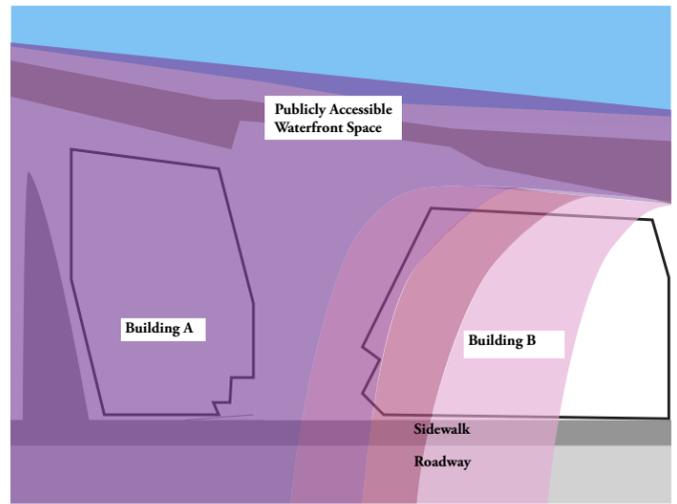
Step 3

The proposed project advances Policy 6.2. All new vulnerable, critical, or potentially hazardous features would be protected through flood damage reduction elements or future adaptive actions.



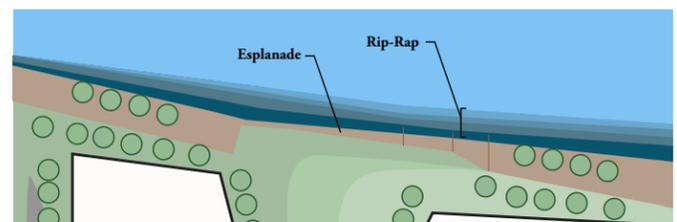
Illustrative Site Plan - Current Floodplain (2015 FEMA PFIRM)

- Current 1% Annual Chance Floodplain
- Current 0.2% Annual Chance Floodplain



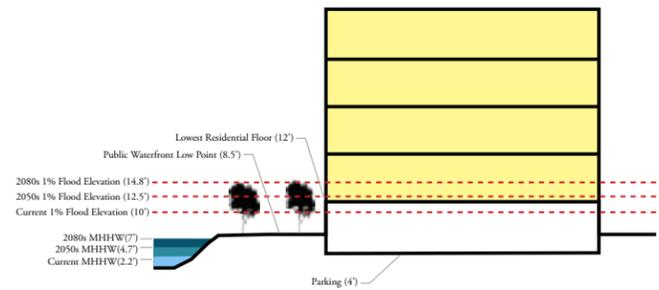
Illustrative Site Plan - Future Floodplain

- 2080s 1% Annual Chance Floodplain (Low Projection)
- 2080s 1% Annual Chance Floodplain (High-Mid Projection)
- 2080s 1% Annual Chance Floodplain (Low-Mid Projection)
- 2080s 1% Annual Chance Floodplain (High Projection)

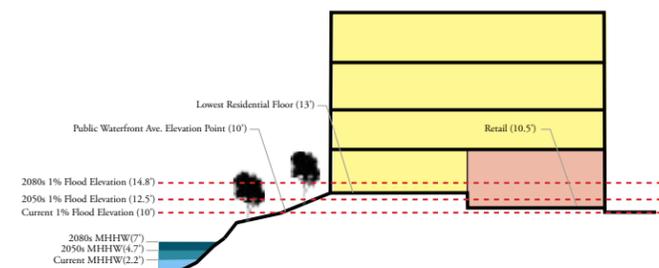


Illustrative Coastal Site Plan - Future Tides

- 2080s Mean Higher High Water (Low Projection)
- 2080s Mean Higher High Water (High-Mid Projection)
- 2080s Mean Higher High Water (Low-Mid Projection)
- 2080s Mean Higher High Water (High Projection)



Building A Section  
(90th percentile SLR projections used. All elevations in NAVD 88.)



Building B Section  
(90th percentile SLR projections used. All elevations in NAVD 88.)

GLOSSARY

0.2% Annual Chance Flood

The flood event projected to have a 0.2% annual chance or greater of being met in any year. Also known as the 500-year flood. Shown on the Flood Insurance Rate Map as the “Shaded X” zone.

1% Annual Chance Flood

The flood event projected to have a 1% annual chance or greater of being met in any year. Also known as the 100-year flood. The 1% annual chance floodplain is shown on the Flood Insurance Rate Map and divided into the following flood zones:

A Zone

An area of the 1% annual chance floodplain that is subject to still-water inundation from the 1% annual chance flood.

Coastal A Zone

A sub-area of the A zone that is subject to moderate wave action between one-and-a-half and three feet.

V Zone

An area of the 1% annual chance floodplain that is subject to high-velocity wave action that can exceed three feet in height

Base Flood Elevation (BFE)

BFE is the expected elevation of flood water during the 1% annual chance flood as shown on FEMA FIRMs.

Critical Infrastructure or Facility

For the purposes of this document, critical infrastructure or facility is defined as uses, facilities or pieces of infrastructure that require a higher standard of flood protection because damage or disruption would have severe detrimental impacts on public health and safety, the environment, and economic security. These include the following:

- Facilities or elements of infrastructure networks, such as energy, telecommunications, transportation, and wastewater.
- Facilities critical to the ability to respond to disasters, such as emergency response services, shelters, communications, and operations centers.
- Facilities such as hospitals, healthcare, facilities, and nursing homes which are likely to contain occupants who may not be sufficiently mobile to avoid the loss of life or injury during flood and storm events.
- Facilities which produce, use, or store highly volatile, flammable, explosive, toxic, or water-reactive materials.

Design Flood Elevation (DFE)

DFE is the elevation of the project’s flood protection. Includes the height of the Base Flood Elevation plus any additional freeboard.

Flood Insurance Rate Map (FIRM)

The maps issued by FEMA that delineate flood zones and elevations. FEMA is in the process of revising the FIRMs for New York City. The most recent maps issued by FEMA as part of the update process are the 2015 Preliminary FIRMs, which are used for building code, planning, and zoning purposes. However, the effective FIRMs issued in 2007 by FEMA are still in use for flood insurance purposes.

Freeboard

Freeboard is an additional height of flood protection for additional safety provided above the base flood elevation.

Mean Higher High Water

The average of the higher high water mark of each tidal day observed over the National Tidal Datum Epoch. The Mean Higher High Water should be determined by a site survey if possible. Alternatively, for non-coastal sites, it may be estimated from the closest tidal station.

Mean Lower Low Water

The average of the lower low water mark of each tidal day observed over the National Tidal Datum Epoch. The Mean Lower Low Water should be determined by a site survey if possible. Alternatively, for non-coastal sites, it may be estimated from the closest tidal station.

North American Vertical Datum of 1988 (NAVD88)

NAVD88 is a vertical control datum of land elevation above sea level established for surveying in North America. Mean sea level varies by location, but by using this datum, which establishes a fixed point of mean sea level, elevations of different locations can be compared to one another.

The New York City Waterfront Revitalization Program Climate Change Adaptation Guidance document was developed by the NYC Department of City Planning. This is a guidance document only and is not intended to serve as a substitute for the actual regulations referenced herein. The City disclaims any liability for errors that may be contained herein and shall not be responsible for any damages, consequential or actual, arising out of or in connection with the use of this information. The City reserves the right to update or correct information in this guidance document at any time and without notice.

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