MASFM 2015

Utilizing Floodplain Management to Enhance Resiliency in Baltimore City

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Baltimore Office of Sustainability
People · Planet · Prosperity

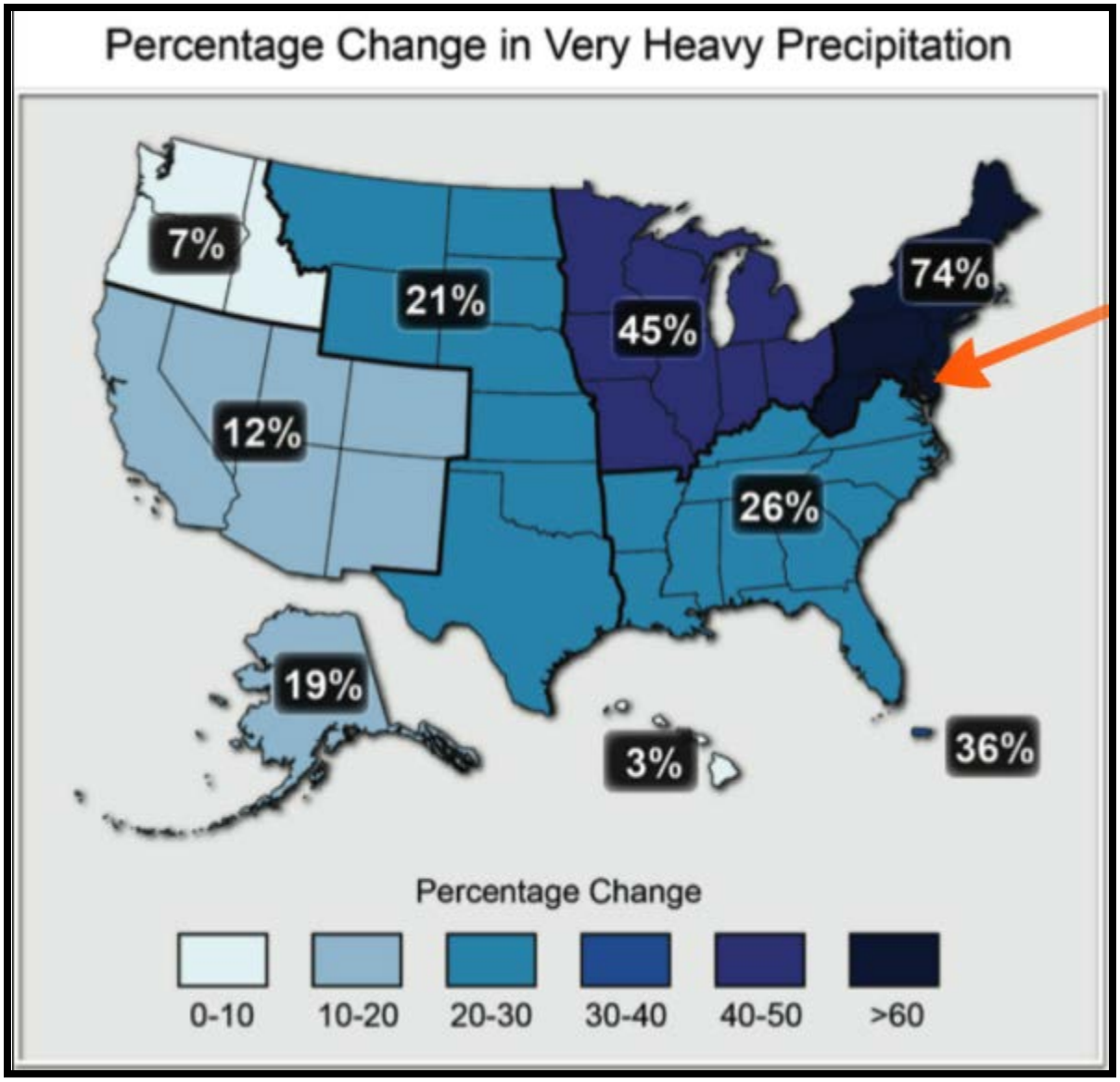
Overview

- Climate Change
- Hazards
- DP3 Development
- Floodplain
- Our Projects
- Preparedness

Quick Review of Hazards

Coastal Storms	more severe
Floods	more extensive
Severe Thunderstorms	more severe
Wind	increase intensity
Winter Storms	less snow, more flooding
Extreme Heat/Drought	more severe and intense
Sea Level Rise	increased threat
Air Quality	lower quality and increase risk

Precipitation Variability



Coastal Storms

There has been a substantial increase in hurricane activity in the Atlantic since the 1970's.

Recent Tropical Storms/Hurricanes impacting Baltimore:

2013 Hurricane Sandy

2011 Tropical Storm Lee

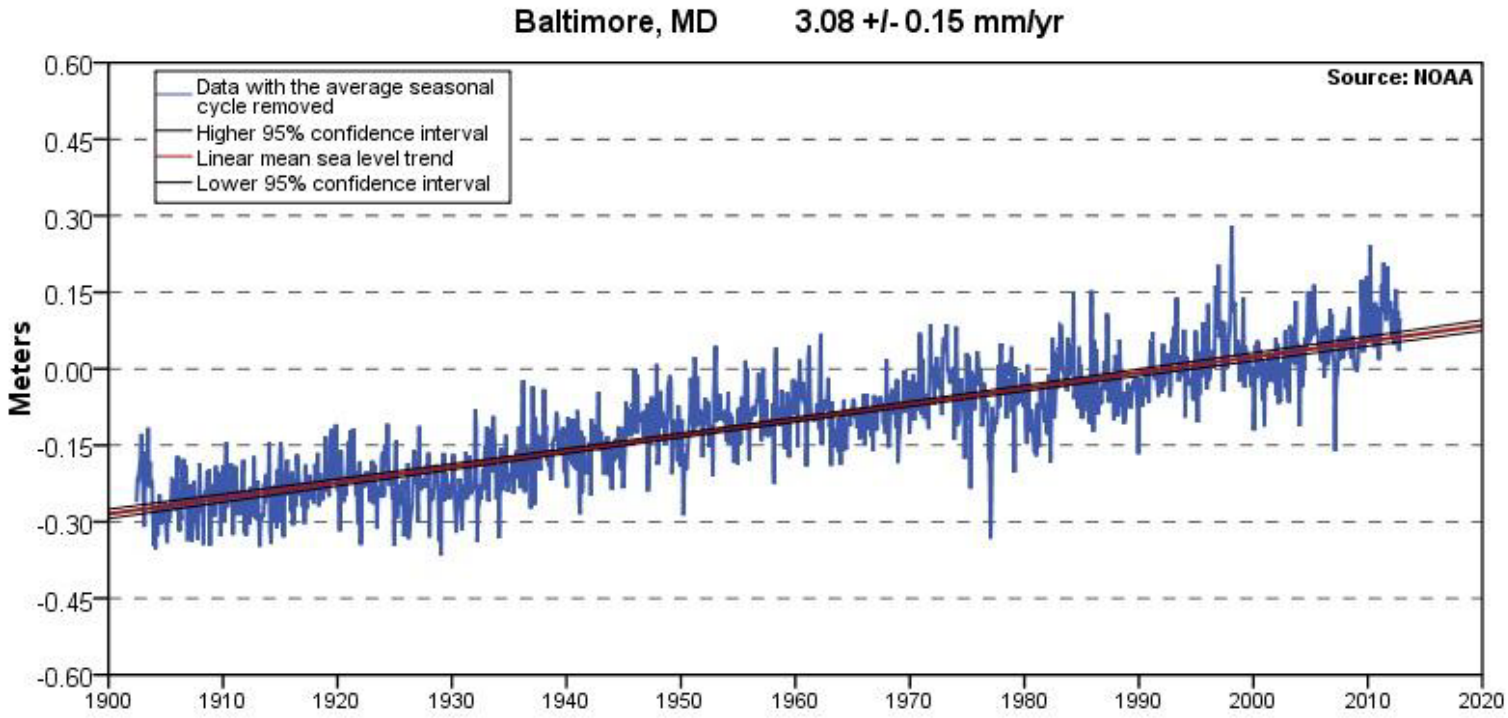
2011 Hurricane Irene

2006 Tropical Storm Ernesto

2003 Hurricane Isabel

Sea Level and Tidal

- Baltimore is expected to experience 1.5 to 3 feet (conservative numbers) of additional sea level rise in the next 50 years.
- We are expected to go from 17 tidal flooding events per year to 227 tidal flooding events per year by 2045



Baltimore's Unique Approach

All Hazard Mitigation Plan
(Current and Historical Hazards)

\+ = Resilience

Climate Adaptation Plan
(Adapt to new and predicted climate conditions)

Process

Risk Assessment

Hazard Identification

- Hazard Identification
- Review Historical Impacts
- Conduct an Asset Inventory

Vulnerability Assessment

- Determine likelihood
- Determine economic, social, legal & environmental consequence

Impacts Assessment

- HAZUS Modeling
- Integrate projected climate conditions
- Identify weaknesses

Plan Development

- Vision, Goals, Strategies, Actions
- Prioritization
- Integration
- Plan for implementation & monitoring

Structure

Infrastructure

- Energy
- Liquid Gas
- Communication
- Transportation
- Waterfront
- Wastewater
- Stormwater
- Solid Waste
- Policy

Buildings

- City Codes
- Structural
- Non-Structural

Natural Systems

- Urban Parks & Forests
- Water Supply and Management

Public Services

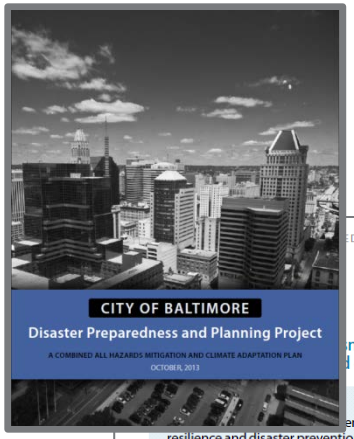
- Emergency Preparedness & Response
- Health
- Education & Outreach
- Food System

Community Engagement

Small Staff Trainings and Community Meetings

Large Town Halls and Interactive Community Meetings

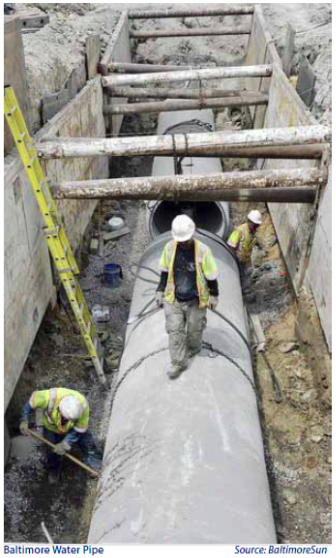
Disaster Preparedness Plan



Adopted unanimously in October, 2013

ment that evaluates and improves all pipes' ability to withstand
l cold

em is dated and in need of upgrades. It is important to build extreme weather resilience and disaster prevention into water and wastewater systems by using both adaptation and mitigation actions. Additionally, structural and infrastructural upgrades must be made to reduce loss of water supply from the distribution system.



Baltimore Water Pipe *Source: BaltimoreSun*

1. Replace old and malfunctioning pipes with new pipes or retrofit existing pipes with new lining

   Pipes that have already begun experiencing problems, or older pipes which are more vulnerable to the impacts of hazards, should be upgraded using the best available technology.

2. Evaluate and utilize new technology that allows for greater flexibility in pipes as they are replaced

   It is essential to prepare for future changes in hazard events and proactively upgrade pipe systems to prevent cracking and bursting.

IMPLEMENTATION GUIDELINES	
Lead Agency	DPW
Stakeholders	DOT, DPW, Water and Wastewater Utilities
Alignment with Goals	Goal 3
Connection with Existing Efforts	CAP; CRS; MD DNR; ESF-3; ESF-4
Timeframe	

STORMWATER

IN-16 Enhance and expand stormwater infrastructure and systems

Future changes in precipitation frequency and intensity may require reconsideration of the design of existing stormwater infrastructure systems.

Increase resiliency and disaster prevention measures related to stormwater systems by enhancing drainage systems in stream corridors and improving and repairing stormwater conveyance popes and outfalls.

1. Implement the requirements of Baltimore's MS4 (separate stormwater and sewer system) permit (S)

   The City of Baltimore operates under a Municipal Separate Stormwater and Sewer System (MS4) permit, which protects water-quality and requires that Baltimore prevents pollution as much as possible. It is critical that the requirements of these permits are fully met.

2. Prioritize storm drain upgrades and replacement in areas with reoccurring flooding (S)

   While proximity to a floodplain or floodway can increase vulnerability to flooding, certain measures can reduce this vulnerability. Inadequate or older pipes, which cannot accommodate the excessive amounts of stormwater, should be upgraded so as to handle extreme rainfall and storm surge events.

3. Install backflow-prevention devices or other appropriate technology along waterfront to reduce flood risk (M-L)

   Backflow-prevention devices are used to ensure that water does not flow back through drainage infrastructure. Through the installation of backflow-prevention devices, the City can improve the performance of the drainage network and prevent risk of flooding impact along the waterfront.

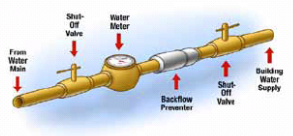
4. Preserve and protect natural drainage corridors (S)

   It is important to utilize natural drainage corridors and green infrastructure to capture more stormwater runoff and enhance the ability of the existing infrastructure to cope with environmental changes.

5. Review and revise storm drain design on a continuous basis, to accommodate projected changes in intense rainfall (O)

   The City's storm drains will require continual revision to incorporate new and projected changes in intense rainfall. This will ensure that the storm drains maintain adequate capacity.

IMPLEMENTATION GUIDELINES	
Lead Agency	DPW
Stakeholders	Community Groups, DOT, DPW, MOEM, MDNR, NGOs, Private Developers, Stormwater Utility
Alignment with Goals	Goals 1, 3, and 6
Connection with Existing Efforts	CRS; MD DNR
Timeframe	



Backflow Preventer *Source: DemarPlumbingNYC*


Floodplain

Floodplain

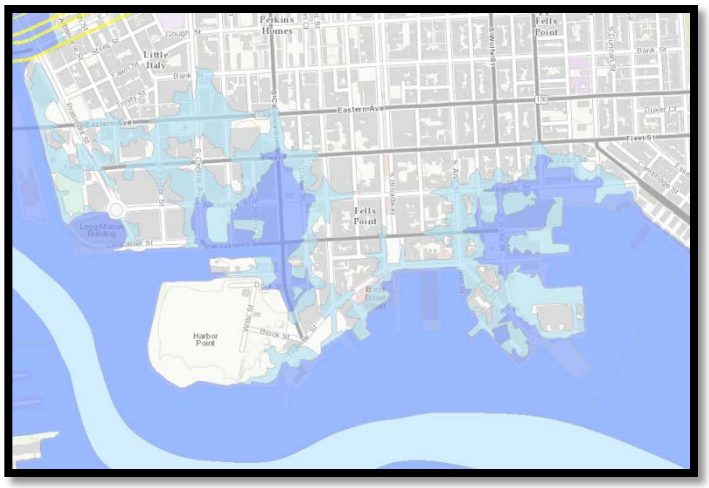
National Flood Insurance Program (NFIP)

The U.S. Congress established the NFIP on August 1, 1968, with the passage of the National Flood Insurance Act of 1968. This program:

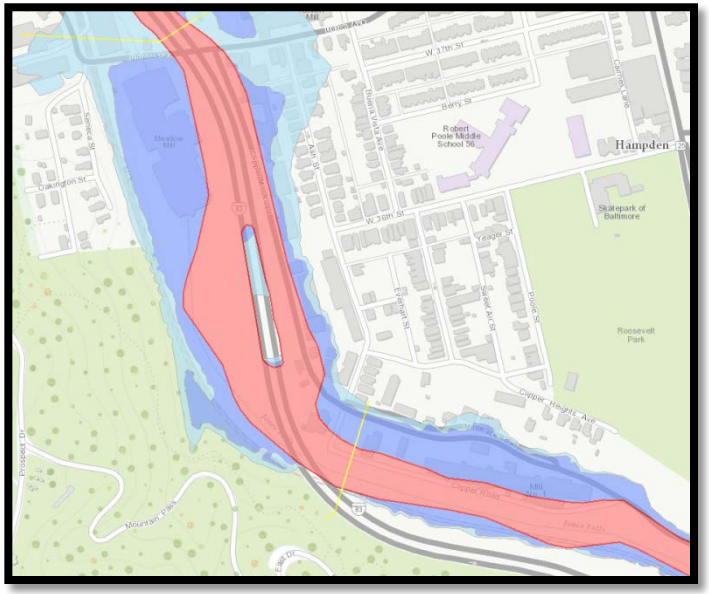
- Aims to reduce the impact of flooding on private and public structures.
- Provides affordable insurance by encouraging communities to adopt and enforce floodplain management regulations.
- Utilizes floodplain management regulations to reduce the socio-economic impacts of flooding

Types of Flooding in Baltimore

Tidal (Coastal)
Flooding issues related to coastal storms, hurricanes, tropical storms, and storm surge.



Non-Tidal (Riverine)
Flooding issues related to heavy precipitation events. Flash flooding is major concern.



DP3 Flood-Related Goals & Strategies

Goal 6- Become a Community Rating System (CRS) classified community

IN-17: Modify urban landscaping requirements and increase permeable surfaces to reduce stormwater runoff

BL-2: Enhance City building codes that regulate building within a floodplain or near waterfront

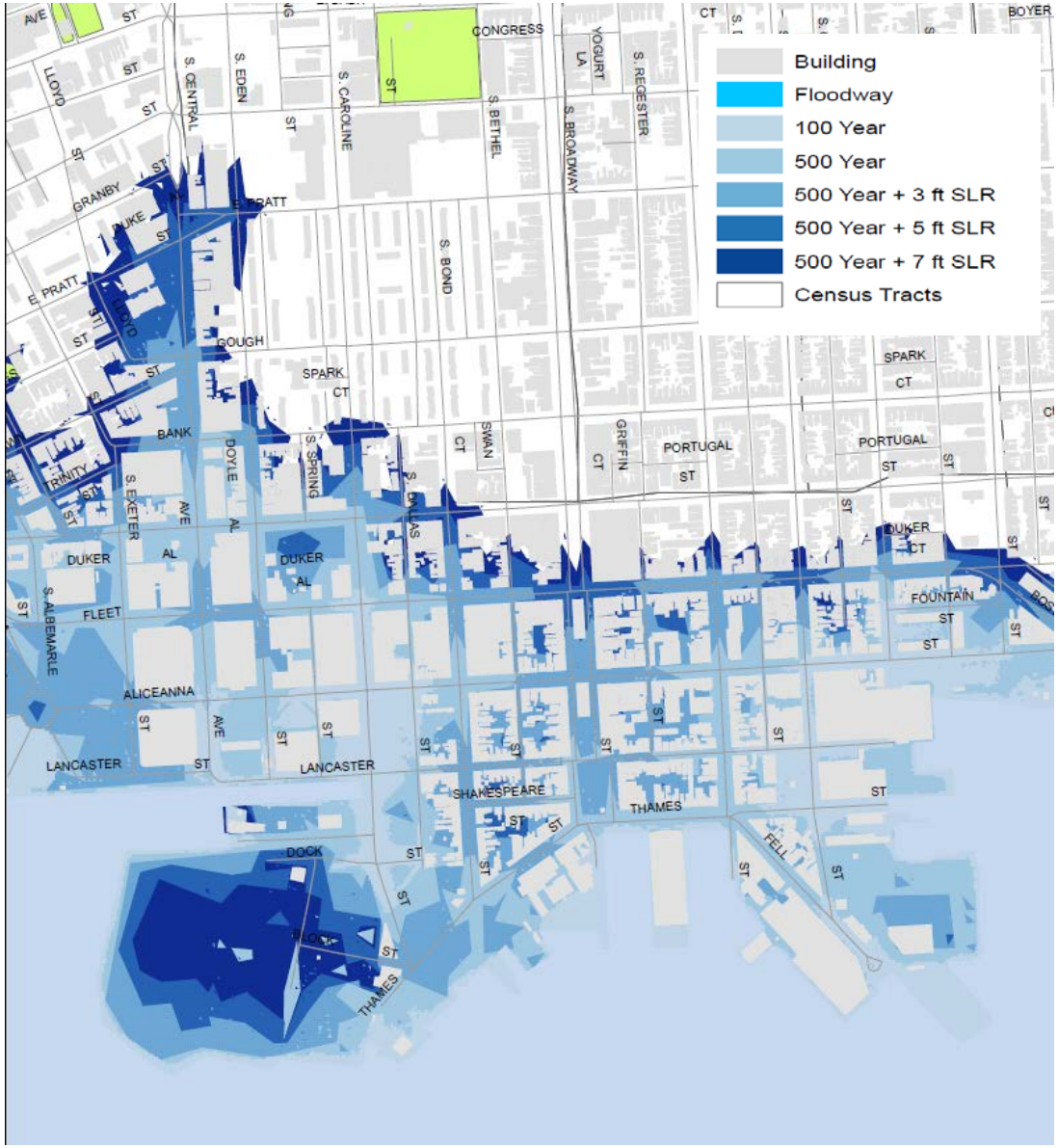
BL-3: Strengthen City zoning floodplain and construction codes to integrate anticipated changes in climate

BL-7: Retrofit existing buildings in the designated Flood Area to increase resiliency

NS-1: Utilize green corridors and parks to help protect surrounding communities from the impacts of hazard events

PS-9: Improve awareness and education about the importance of flood insurance and preparation for citizens

Floodplain Modeling

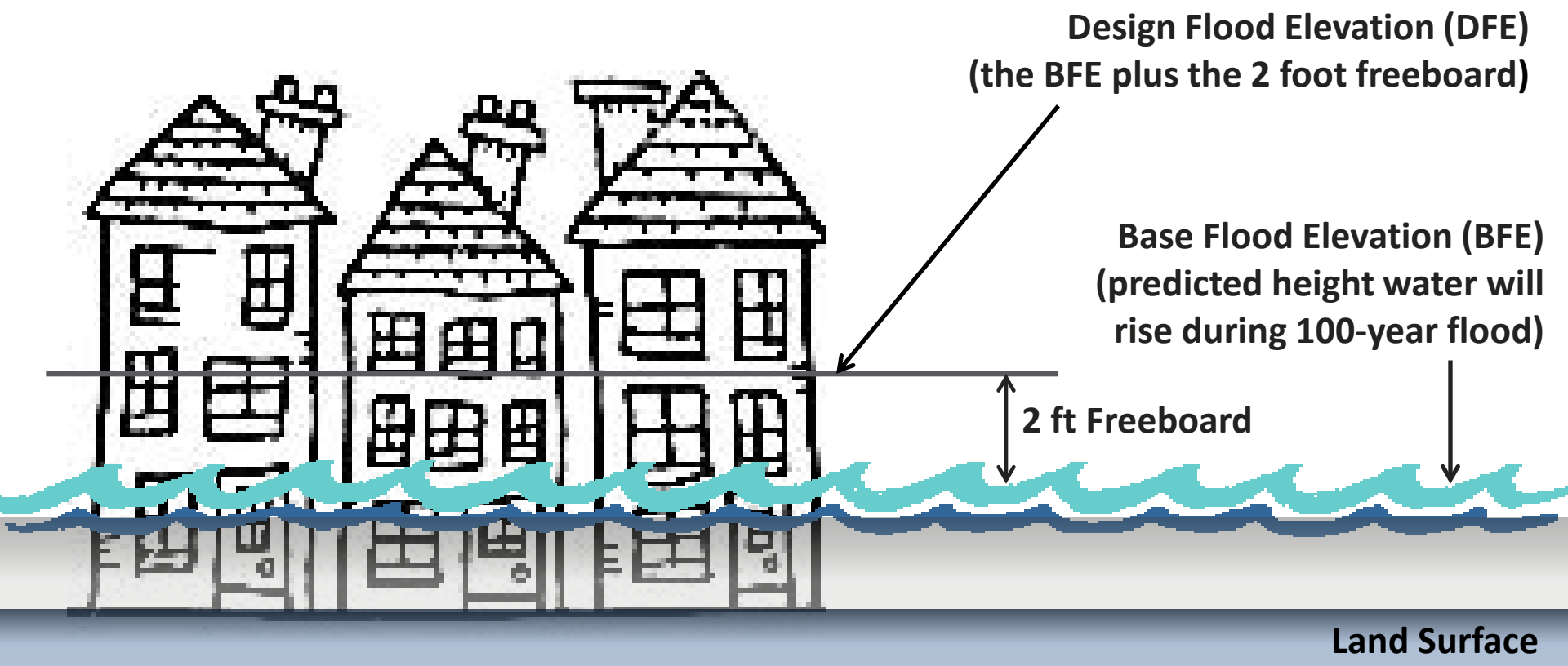


Modeling that looks at the 100-year and 500-year storm with Sea Level Rise

As you can see, our entire waterfront is almost completely inundated

Floodplain Regulation

Understanding Height and Freeboard



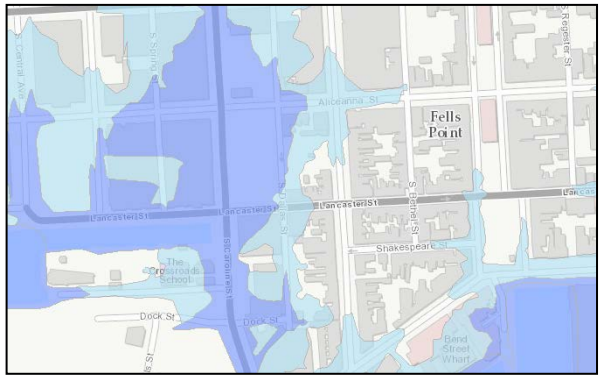
Floodplain Regulation

- The City of Baltimore regulates to the height and extent of the 500-year flood in tidal areas

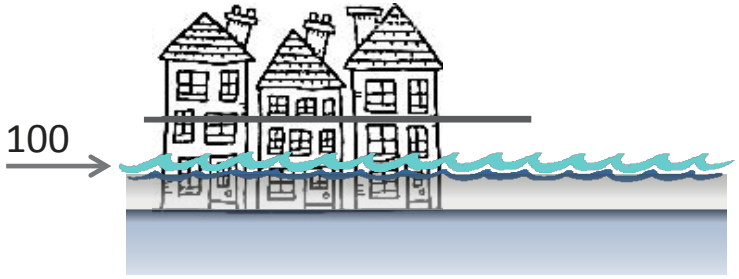
Height

Both 100 and 500

Extent



In non-tidal areas, the City regulates to the height of the 100-year flood and to the extent of the 500-year flood

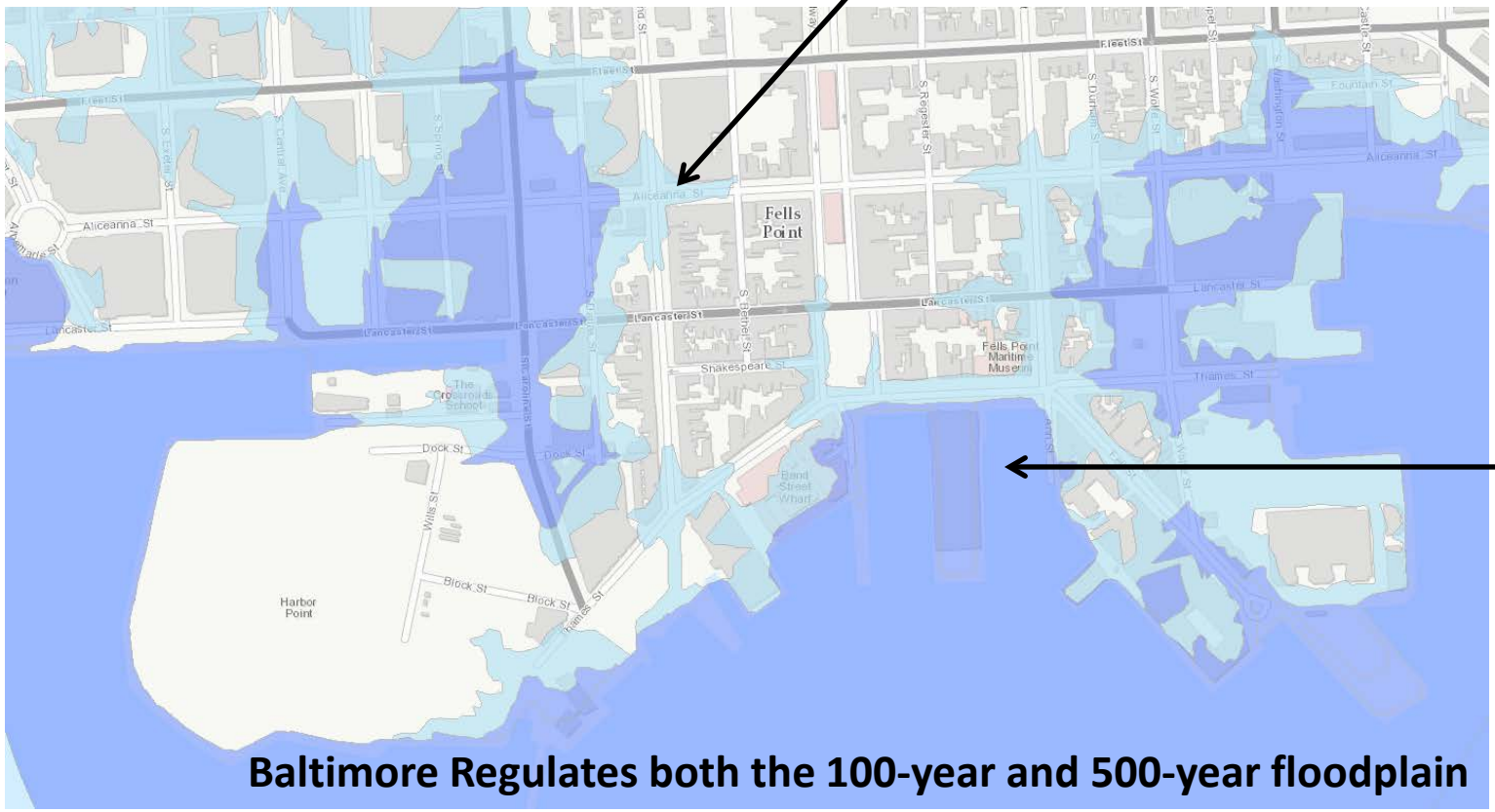


Both 100 and 500

Floodplain Regulation

Understanding Extent of Regulated Floodplain

Light Blue- Flood Resilience Area (FRA)
500 year Floodplain



Dark Blue- 100 year Floodplain

Baltimore Regulates both the 100-year and 500-year floodplain

Flood Resilience Area

Higher of Base Flood Elevation or Stillwater 500

(g) *Flood Resilience Area.*

(1) The Flood Resilience Area comprises those lands within a tidal floodplain that:

(i) due to hurricanes, tropical storms, and the rising Bay are subject to a 0.2% chance of flooding in any given year; and

(ii) lie in areas where detailed study data are available.

(2) The Flood Resilience Area appears:

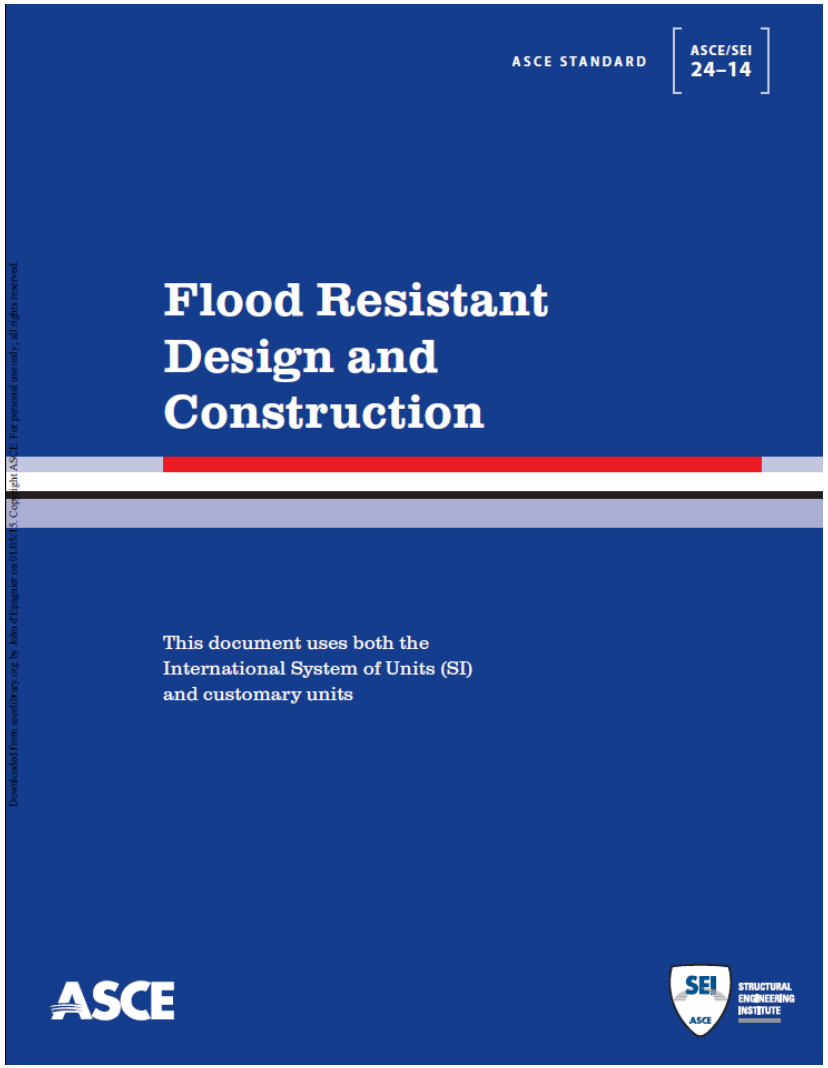
(i) on the Flood Insurance Rate Map, as that part of the tidal floodplain that is designated Zone X ("areas of 0.2% annual chance flood"); and

(ii) in the Flood Insurance Study's Table 4 {"Transect Data"}, under the column heading "0.2% annual chance".

TABLE 5 – TRANSECT DATA

Flood Source	Transect	Starting Wave Conditions for the 1% Annual Chance			Starting Stillwater Elevations (ft NAVD88) and Range of Stillwater Elevations (ft NAVD88)				Zone Designation and BFE (feet NAVD 88)
		Coordinates	Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Patapsco River	1	N 39.240098 W -76.530246	2.7	3.2	4.2	4.8	5.1	7.1	VE 8
Patapsco River	2	N 39.255878 W -76.549812	3.2	3.8	4.2	4.8	5.2	7.2	VE 8
Patapsco River	3	N 39.261362 W -76.556286	3.7	3.9	4.2	4.8	5.2	7.3	VE 8
Patapsco River	4	N 39.260258 W -76.570443	3.5	4.0	4.2	4.8	5.2	7.3	VE 8 AE 8
Northwest Harbor	5	N 39.269903 W -76.569075	2.0	2.9	4.2	4.7	5.2	7.3	VE 7
Northwest Harbor	6	N 39.276766 W -76.573446	1.8	2.9	4.2	4.8	5.2	7.3	AE 7
Northwest Harbor	7	N 39.279871 W -76.580722	1.8	2.7	4.2	4.8	5.2	7.4	AE 8
Northwest Harbor	8	N 39.283239 W -76.586940	1.7	2.7	4.2	4.8	5.2	7.4	AE7 AE 5
Northwest Harbor	9	N 39.280065 W -76.594924	1.4	2.6	4.2	4.8	5.2	7.4	AE 7 AE 5
Northwest Harbor	10	N 39.283499 W -76.605677	1.3	2.2	4.2	4.8	5.2	7.5	AE 7

ASCE-24



Flood Design Class of Buildings and Structures

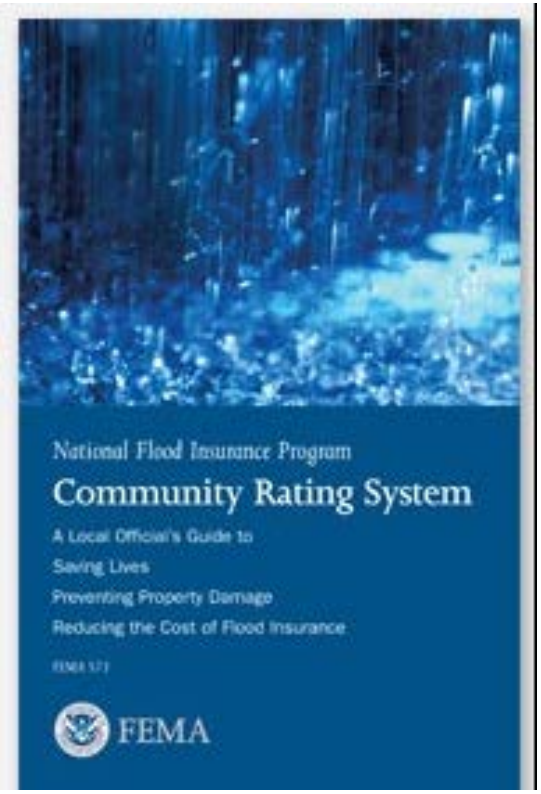
Flood Design Class	Minimum Elevation, Relative to Base Flood Elevation (BFE) or Design Flood Elevation (DFE)
I (Ag, storage, temp)	DFE
II (Non-III, IV)	BFE + 1 ft or DFE, whichever is higher
III (300 people +)	BFE + 1 ft or DFE, whichever is higher
IV (Critical Facilities)	BFE + 2 ft or DFE, or 500-year flood elevation, whichever is higher

Community Rating System

Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements.

By regulating to these higher standards, the City of Baltimore helps support safe and smart development.

Moreover, meeting and exceeding the NFIP standards allows the City of Baltimore to help policy holders receive discounts on their insurance rates.



NFIP/CRS

Program for Public Info

The Program for Public Information (PPI) is a coordinated flood hazard outreach effort to improve communication with stakeholders, and provide information on:

- flood hazard,
- flood safety,
- flood insurance and ways to protect property, and
- natural floodplain functions

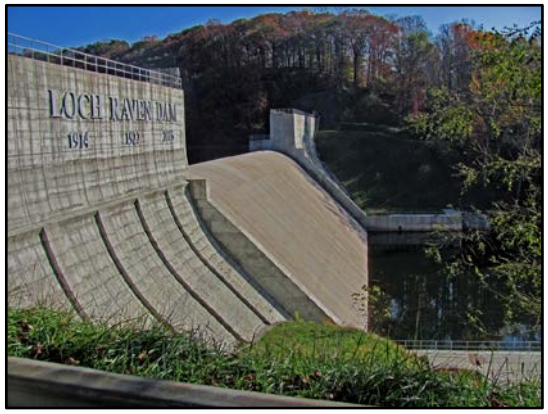
The PPI was developed to identify strategies to targeted audiences and efficiently use resources and improve communications.

NFIP/CRS

Stormwater Management

Resiliency & Restoration

- Stream Restoration
- Stormwater Capture Systems
- Impervious Surface Removal
- Erosion Control
- DAMS
- Wastewater Treatment Plants
- Blue Alley Projects
- Replace and upgrade pipes
- GGI



Large mitigation options

Flood doors and/or gates

Flood walls/barriers

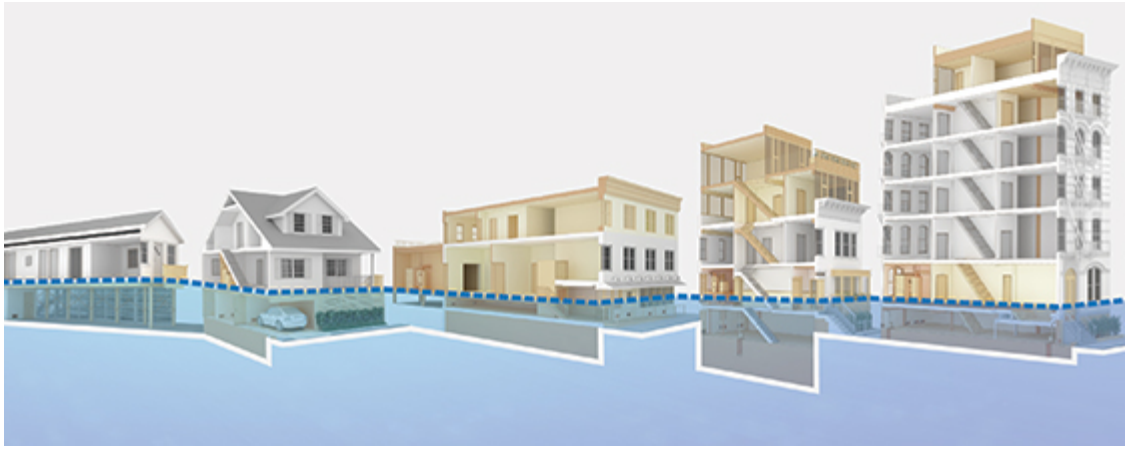
Upcoming projects

Historic Considerations

- Inventory of all historic structures in SFHA
- Develop a guide/toolkit for retrofitting
- Provide mitigation options to developers

Floodplain trainings and design manual

- Urban area focus
- Our housing typology
- Staff and developer trainings



Preparedness: Make a Plan, Build a Kit, Help Each Other

Questions?

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