Capitol Hill Briefing

Climate Resilience Planning:

Baltimore's Combined All Hazards Mitigation and Climate Adaptation Process

Baltimore Office of Sustainability
People · Planet · Prosperity

Kristin Baja
Climate and Resilience Planner
City of Baltimore, Office of Sustainability

Overview

- Recent Events
- Plan Development
- Implementation
- Communication





Recent Events

Non-Tidal Flooding







Non-Tidal Flooding







Tidal Flooding

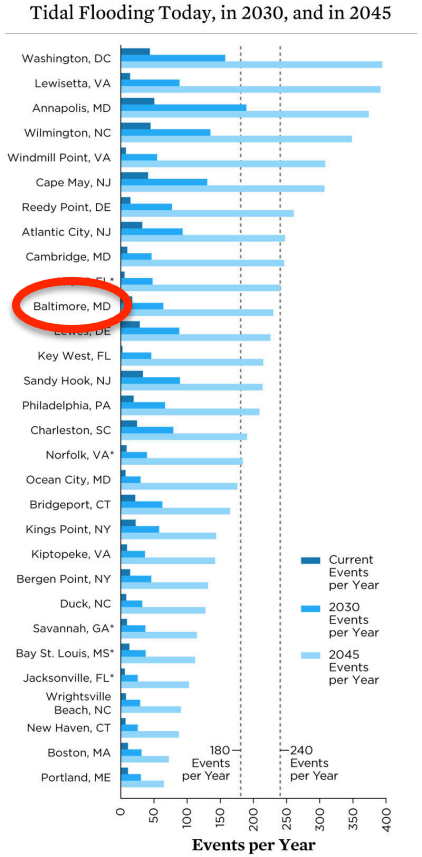
The mid-Atlantic coast is expected to see some of the greatest increases in flood frequency.





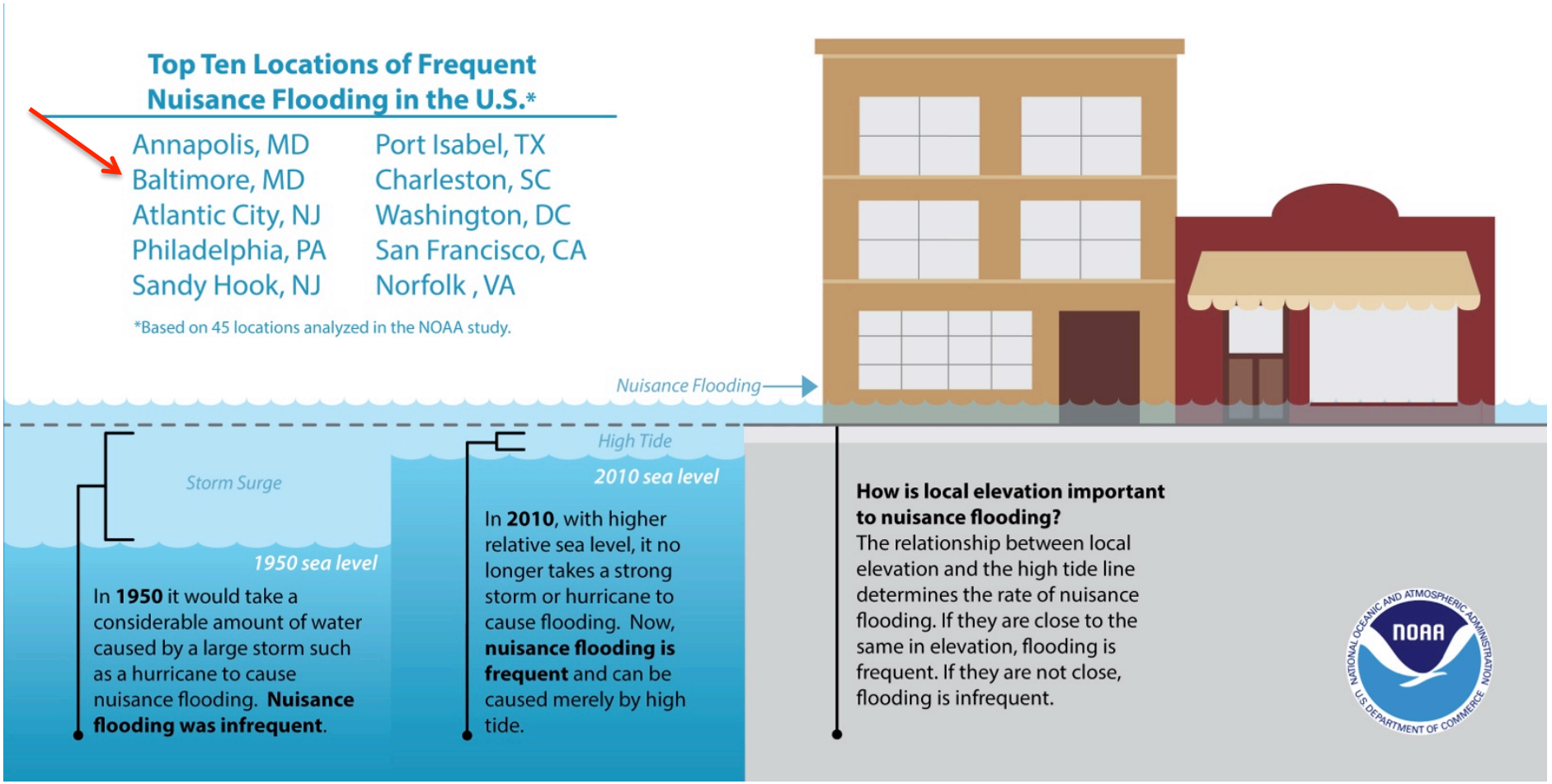






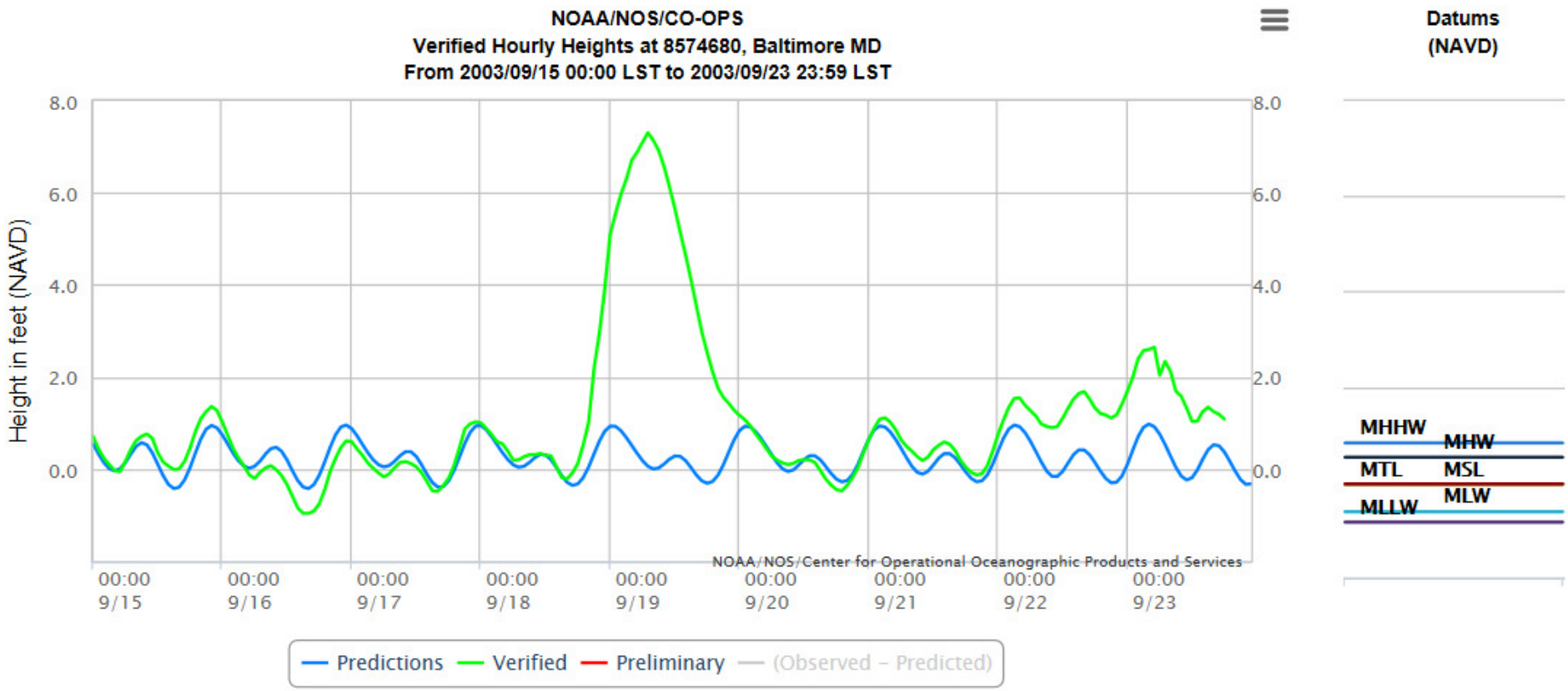
Of the 52 locations we examined, 30 (shown here) can expect at least two dozen tidal floods per year by 2030. (Note that some communities, such as Broad Channel in Jamaica Bay, NY, see roughly this much flooding today; however, this flooding is not captured by the closest tide gauge.) And tidal flooding will occur even more often in many locations. By 2045, one-third of the locations we analyzed can

Nuisance Flooding

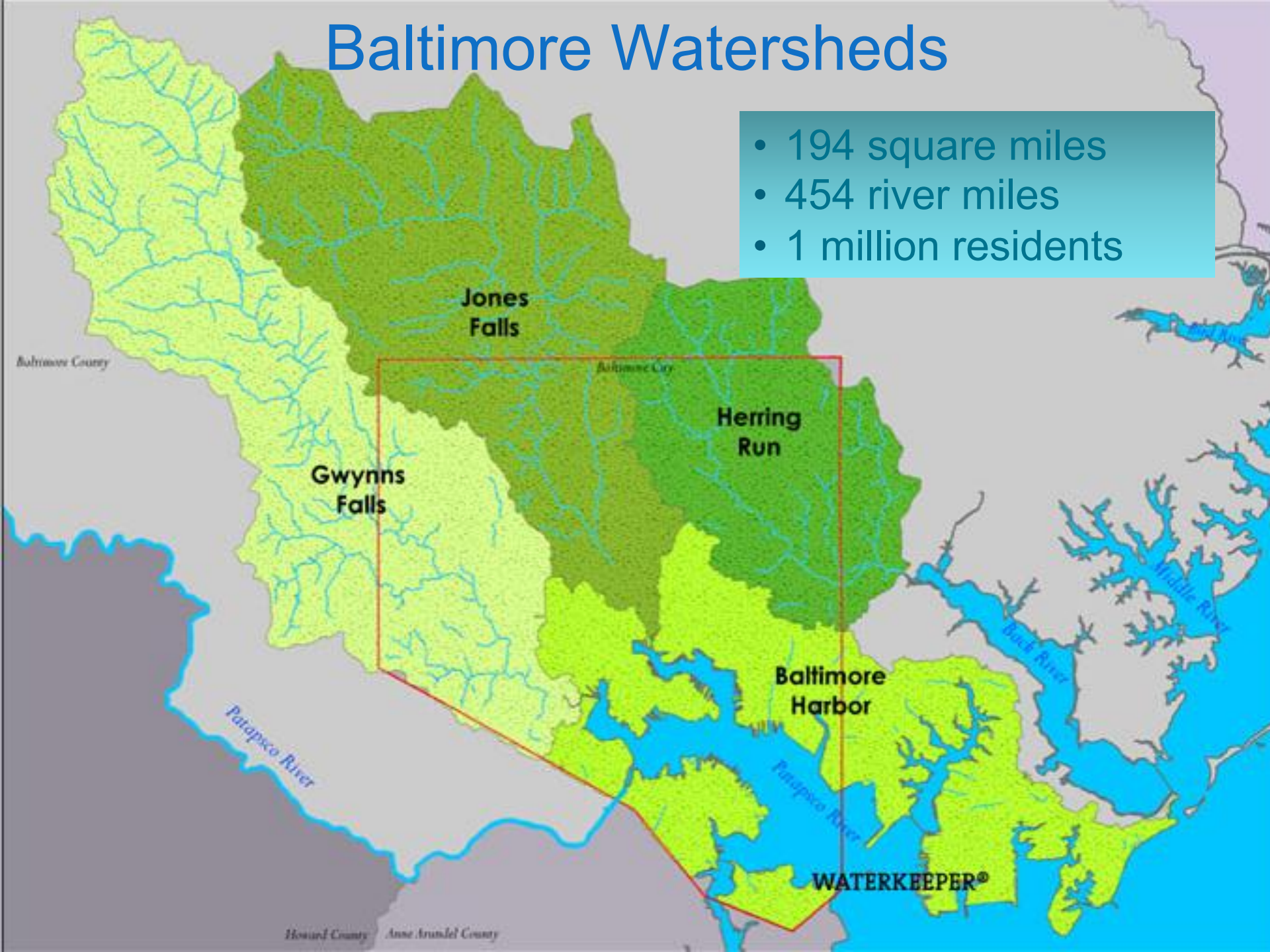


Storm Surge

Hurricane Isabel, 2003



Baltimore Watersheds




Planning

Baltimore's Unique Approach

All Hazard Mitigation Plan

(Current and Historical Hazards)

\+ = Resilience

Climate Adaptation Plan

(Adapt to new and predicted climate conditions)



All 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**

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

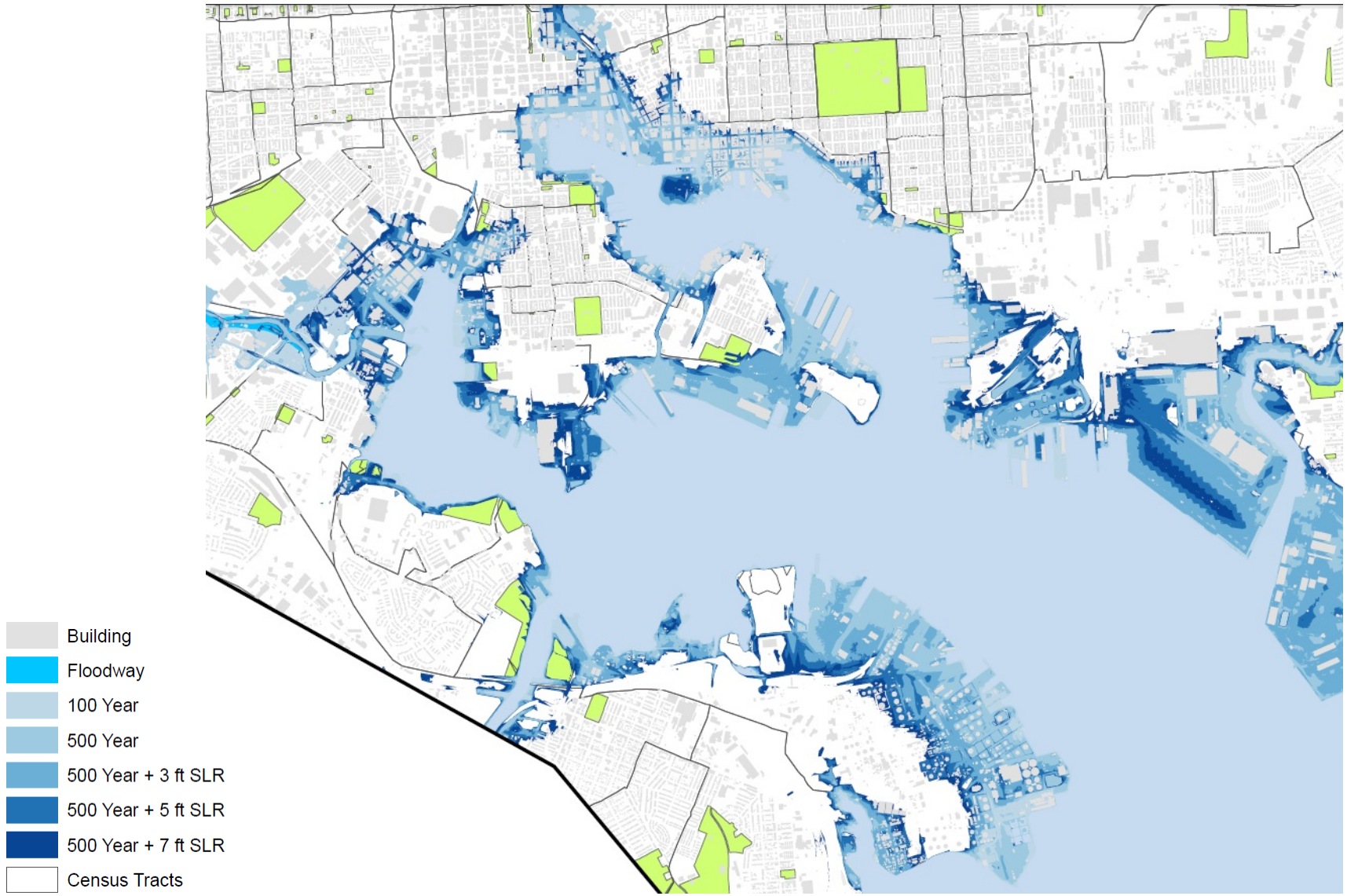
Natural Systems

- Urban Parks & Forests
- Water Supply and Management

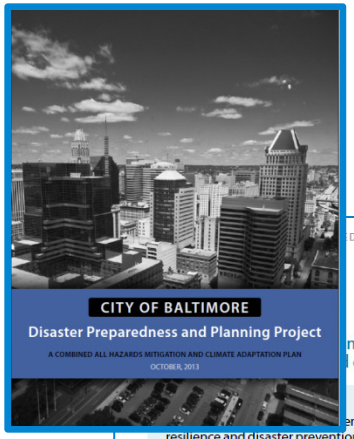
Public Services

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

Modeling


Building
Floodway
100 Year
500 Year
500 Year + 3 ft SLR
500 Year + 5 ft SLR
500 Year + 7 ft SLR
Census Tracts

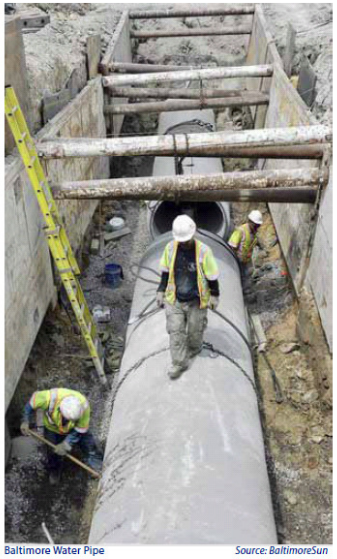
Disaster Preparedness Plan



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.

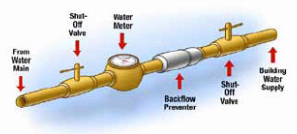
4. Preserve and protect natural drainage corridors (S)

   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	



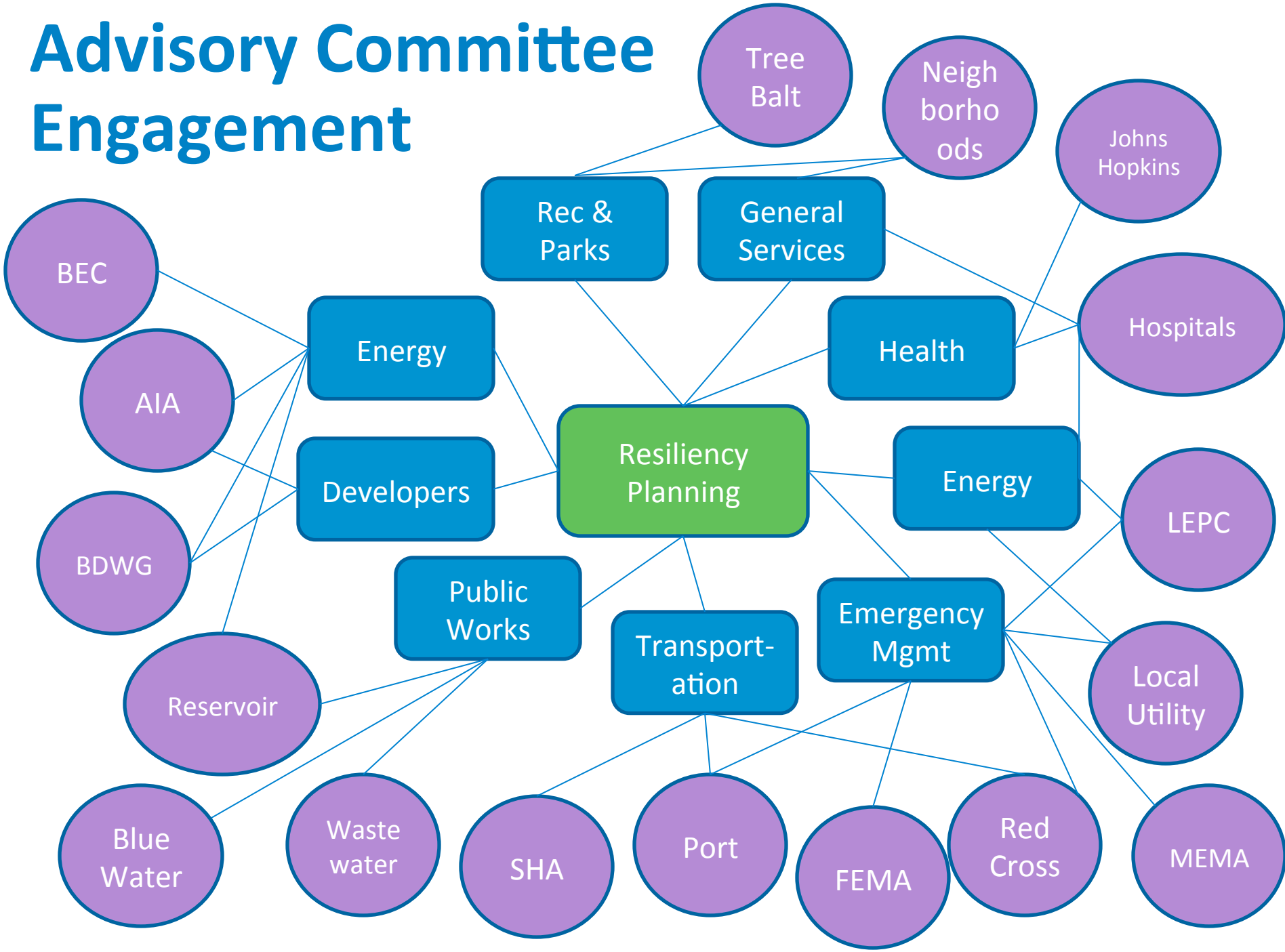
Backflow Preventer *Source: DemarPlumbingNYC*

Crosswalk

- Identify overlaps with existing planning efforts
- Prioritize Strategies and Actions with lead stakeholders

STRATEGY NUMBER	STRATEGY	ACTION	Water a	C1	C2	C3	PP1	PP2	PP3	PP4	PP5	RC1	RC2	RC3	RC4	G1	G2	G3	G4	T1	T2	T3	T4	T5	EA1	EA2	EA3	EA4	GE1	GE2
		Review and revise storm drain design on a continuous basis, to accommodate projected changes in intense rainfall							x				x																	
IN-17	Modify urban landscaping requirements and increase permeable surfaces to reduce stormwater runoff	Support existing stormwater requirements and continue to evaluate and improve Best Management Practices							x				x			x			x										
		Encourage urban landscaping requirements and permeable surfaces into community managed open spaces							x				x			x		x	x										
		Utilize water conservation elements such as green roofs, rain gardens, cisterns, and bioswales on residential, commercial, industrial, and City-owned properties to capture stormwater							x				x			x		x	x										
		Encourage permeable paving on low-use pathways							x				x					x	x										
IN-18	Evaluate and support DPW's stream maintenance program.	Review and improve status of standing maintenance requirements			x				x										x										
		Ensure adequate funding is in place to support stream maintenance			x				x										x										
		Identify opportunities where stream restoration efforts will off-set maintenance costs			x				x										x										
		Identify interdependencies and benefits of stream maintenance with other transportation programs			x				x										x	x	x	x	x	x						
		Clear streams on a regular basis, prioritize dredging the stream beds, and increase inspection and cleaning of culverts and storm drains to prevent flooding		x	x				x										x										
IN-19	Support and increase coordination and information sharing across jurisdictions to better enable mitigation of cross-border impacts on the regions watersheds (e.g., understanding flood conditions upstream in the County)	Partner with local counties to evaluate major tributaries in all watersheds to determine best management practices for capturing run-off and slowly releasing it (stormwater quantity management)							x				x						x										
		Encourage information sharing within the Chesapeake Bay community to assist in developing best management practices							x				x						x										
IN-20	Reevaluate and support a comprehensive debris management plan for hazard events	Investigate best practices for managing and disposing of downed trees, yard waste, building debris, as well as additional household garbage		x	x									x															
		Expand and integrate existing programs to reduce or intercept debris before it gets into the streams and harbor		x	x									x															
		Develop and promote solid waste management actions for citizens to implement before a hazard event		x	x									x															
		Incorporate consideration of hazards and climate adaptation efforts into all plans, systems,		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Advisory Committee Engagement



Community Engagement

Small Staff Trainings and Community Meetings







Large Town Halls and Interactive Community Meetings





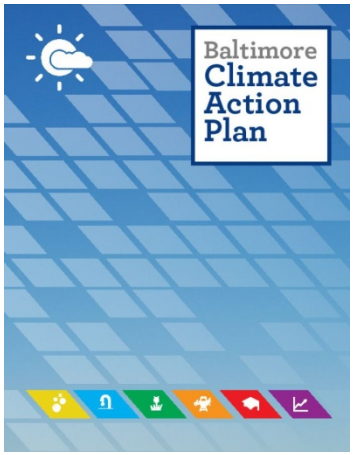




Implementation

Prioritization

MITIGATION



Energy Savings and Supply

Land Use and Transportation

Growing a Green City

RESILIENT + SUSTAINABLE

Drinking water

Renewable Energy

Trees

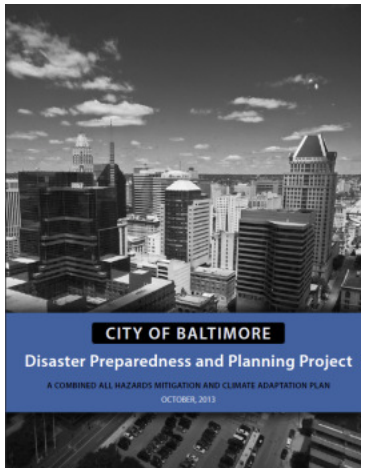
Building Codes

Energy Grid

Energy Efficiency

Transportation Inf.

ADAPTATION + HAZARD MITIGATION



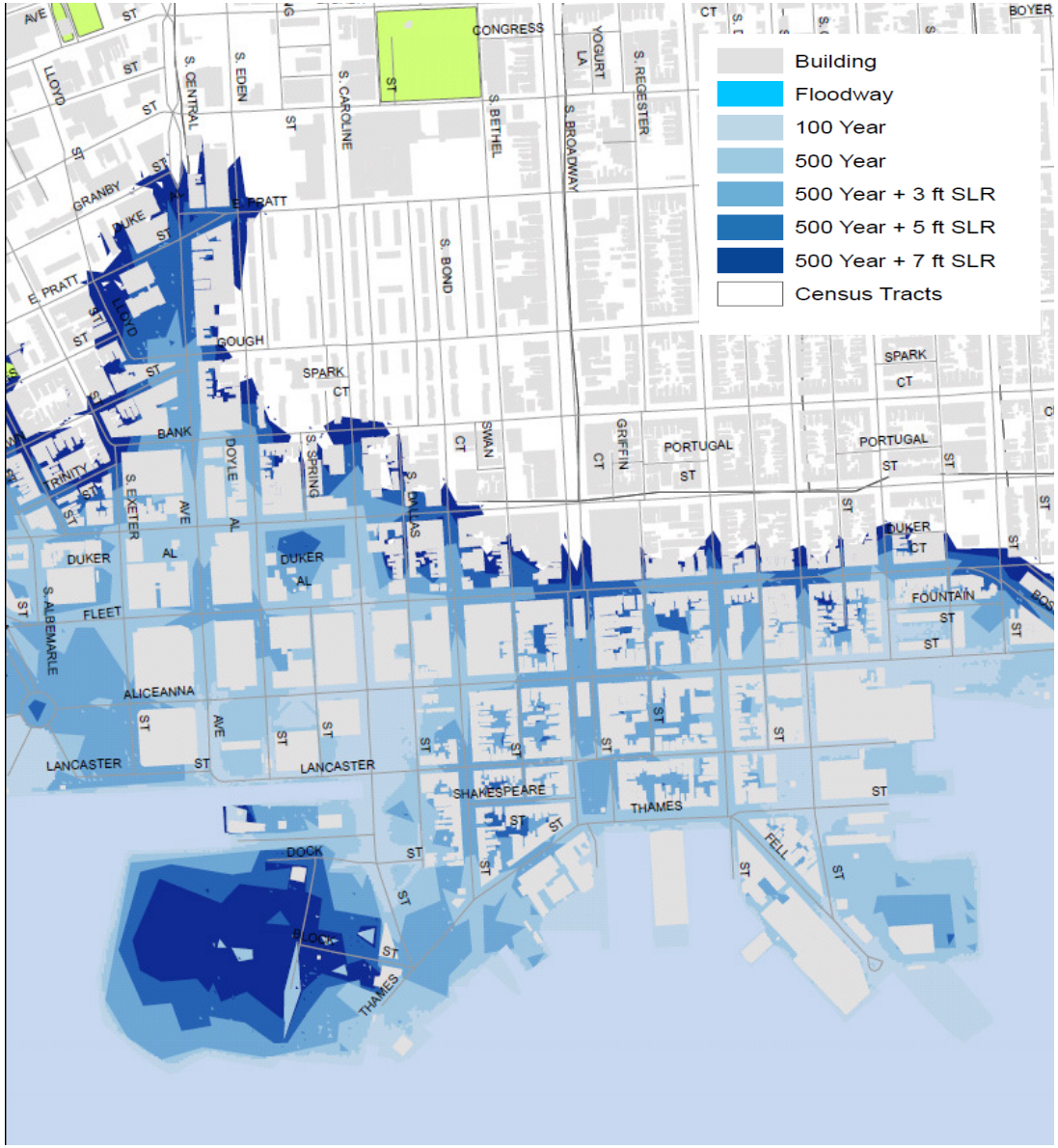
Infrastructure

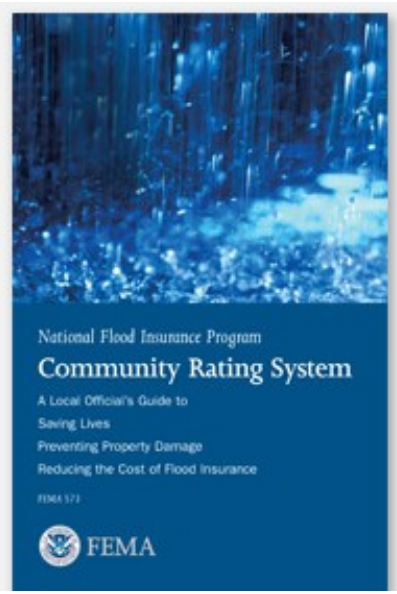
Buildings

Natural Systems

Public Services

Floodplain Ordinance





- Two foot freeboard
- Regulate 500-yr
- CRS
- Local, State, and Federal Partners

Flood Walls







Waterfront Options

Description	Reduce Tidal Flooding?	Reduce Precip. Flooding?	Relative Cost	Relative Long-term O&M Cost
Outfall backflow prevention	yes	no	low	low
Rainfall runoff detention underground in Broadway median	no	yes	med	med
Floodwall along waterfront at elevation +5.0 ft NAVD88**	yes	no	med / high	med
Floodwall along waterfront at elevation +9.5 ft NAVD88**	yes	no	high	med
Floodproofing buildings to +9.5 ft NAVD88	yes	yes	med	low
Storm surge barrier	yes	no	very high	very high

Whole Block Approach

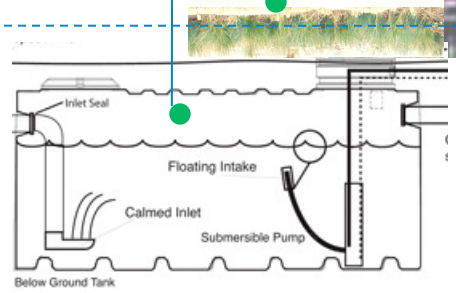
Energy

- Cool Roofs
- Weatherization
- Energy Education

Additional

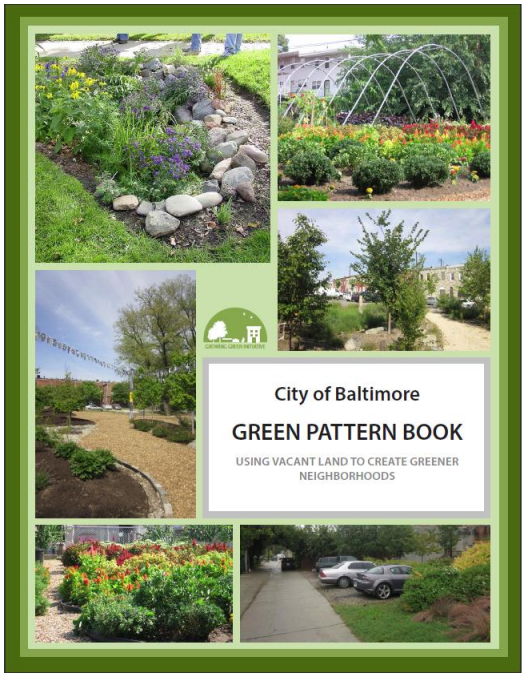
- Trees and Greening
- Renewable Energy
- Stormwater
- Heat sensors





Growing Green

Effort focused on re-using vacant land to green neighborhoods, reduce stormwater runoff, grow food, and create community spaces that mitigate the negative impacts of vacant properties











Communications

Make a Plan, Build a Kit, Help Each Other



















Help/Safe Sign

- Builds Neighborhood assistance capacity

- Lets neighbors know if you need assistance by placing appropriate side in window





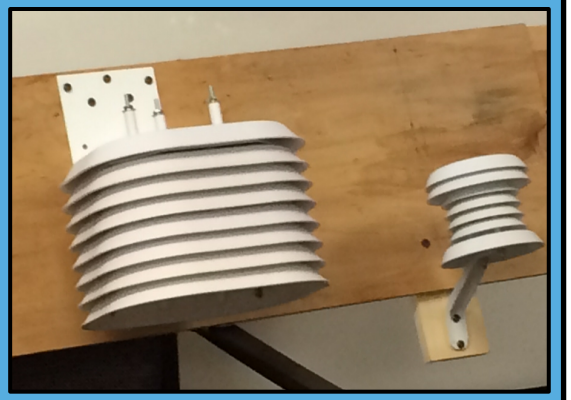
Local Partners

Non-Profits





Universities





Business & Industrial





Capital Improvement

- Department of Planning manages process
- Developed a Resiliency Checklist for projects
- Identify how each project will help reduce risk and improve the City's ability to adapt and respond to natural hazards
- Projects must take into account anticipated impacts from climate change
- Include extreme weather events, adaptation, SLR, floodplain considerations, and mitigation

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THANK YOU!



Kristin Baja
Climate and Resilience Planner
Kristin.baja@baltimorecity.gov