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Site-Level Approaches Within an Integrated Adaptation Framework

Johanna Greenspan-Johnston

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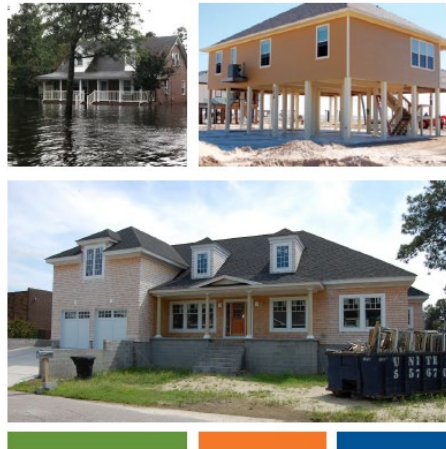


Site-level Approaches within an Integrated Adaptation Framework

Johanna Greenspan-Johnston

Hampton Roads Adaptation Forum | July 31, 2020





Individual Building and Site-Level Flood Risk Reduction Strategies

City of Virginia Beach, Virginia
CIP 7-030, PWCN-15-0014, Work Orders 4A and 17B

Final Draft Report

Date: May 1, 2019

Submitted to: City of Virginia Beach

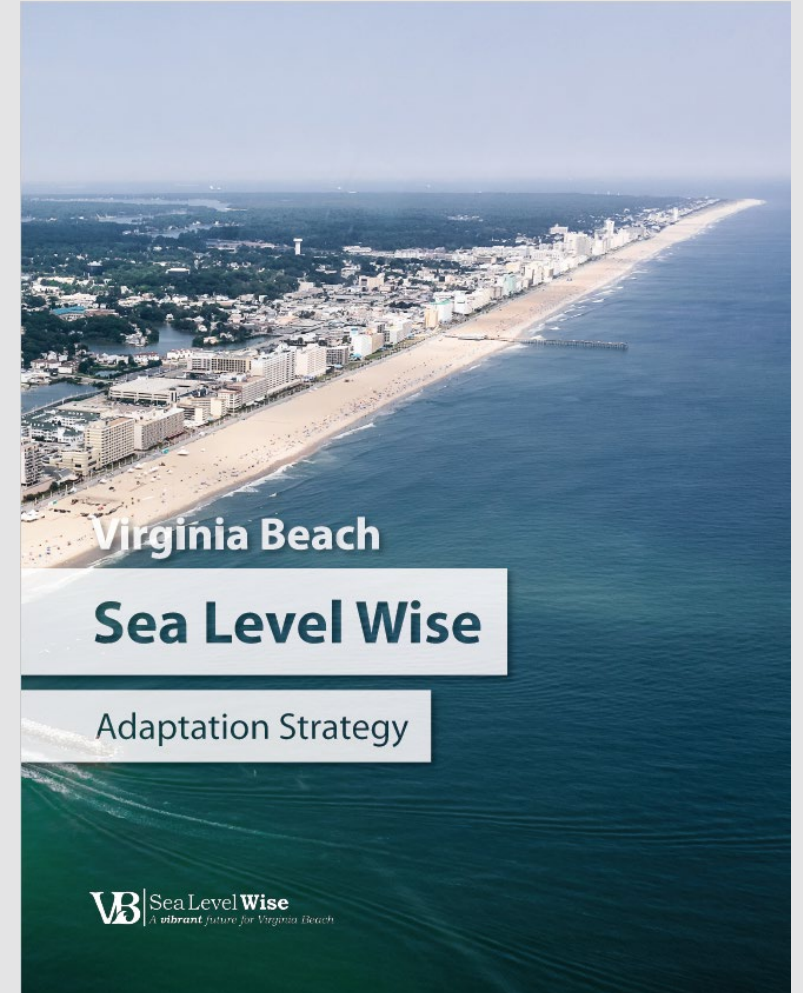
Department of Public Works



Virginia Beach Sea Level Rise Policy Adaptation Report



Draft Working Document | January 10, 2019



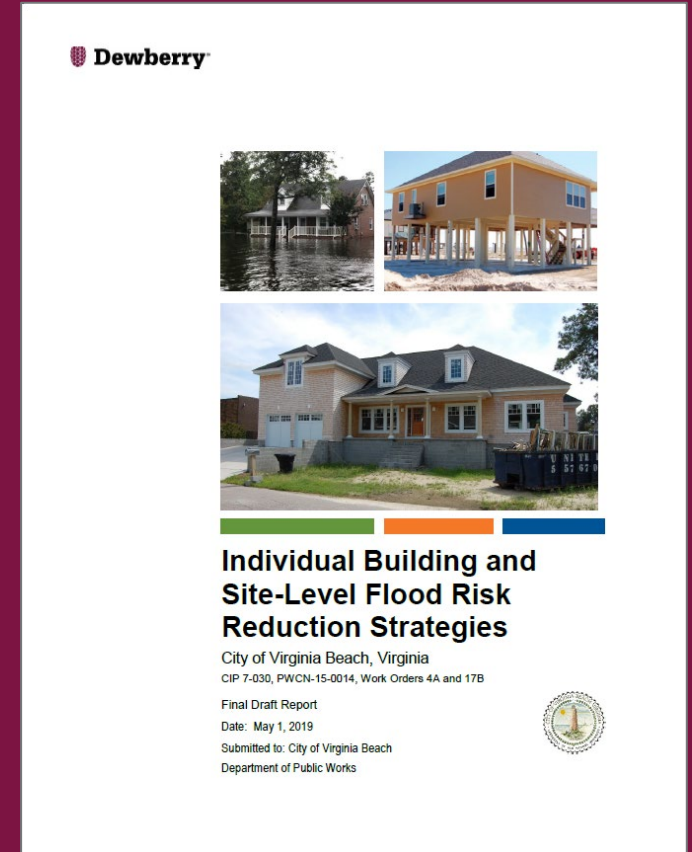
Virginia Beach Sea Level Wise

Adaptation Strategy



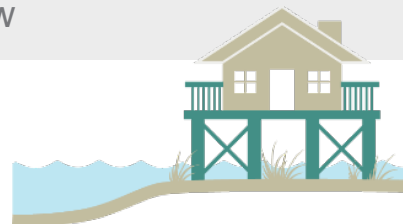
Engineering Approach

Technical engineering analysis of costs and benefits of site-level flood reduction strategies for every parcel in the City of Virginia Beach.



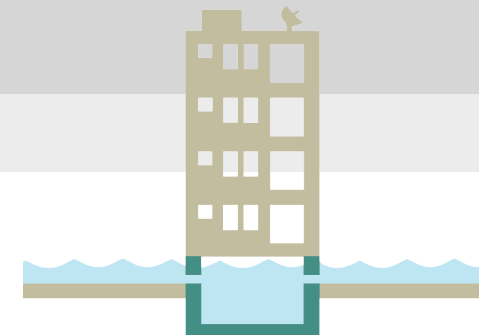
Residential Strategies Considered

	Structure Elevation	Demo/Rebuild	Voluntary Acquisition
Project Description	Existing residence lifted and placed on elevated foundation with lowest floor at BFE + 2 ft (or 3 ft) freeboard	Existing residence demolished and replaced with new structure on same footprint elevated to BFE + 2 ft (or 3 ft) freeboard	Existing parcel purchased by City, structure demolished, site restored to natural condition and deed-restricted
Useful Life	30 years	50 years	100 years
Costs	65-100% of existing building replacement value, depending on existing foundation type	115-145% of existing building replacement value	130% of parcel's current fair market value
FEMA HMP Eligible?	Yes	Yes, but with funding limitations	Yes
Special BCA Requirements	BCA can be waived for projects within the SFHA (or where FFE is below BFE) and cost less than \$175k	BCA cannot be waived	BCA can be waived for projects within the SFHA (or where FFE is below BFE) and cost less than \$276k
Residual Risk	Low	Low	None

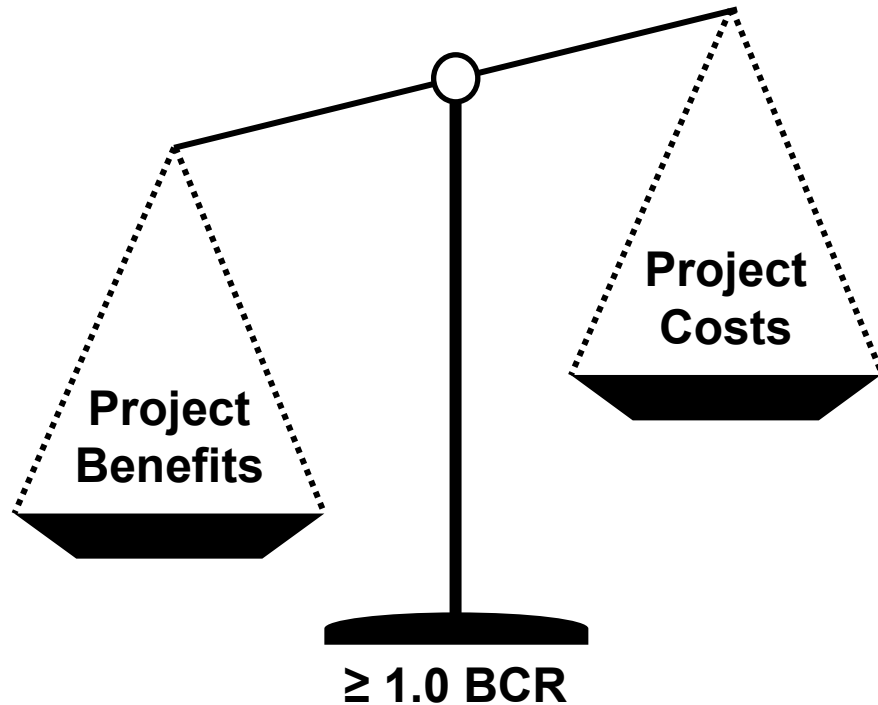


Non-Residential Strategies Considered

	Dry Floodproofing	Wet Floodproofing
Project Description	Reinforce walls, flood shields, and install drainage pumps to make substantially impermeable to floodwater entry	Hydrostatic openings, flood damage-resistant materials, and key equipment/ contents elevated to reduce damages
Useful Life	20 years	20 years
Costs	Costs \$10/SF of building foot for each 1 foot of protection above grade	Costs \$7/SF of building foot for each 1 foot of protection above grade
FEMA HMP Eligible?	Yes	Yes
Special BCA Requirements	None	None
Residual Risk	High	Moderate



Benefit-Cost Analysis (BCA) Framework

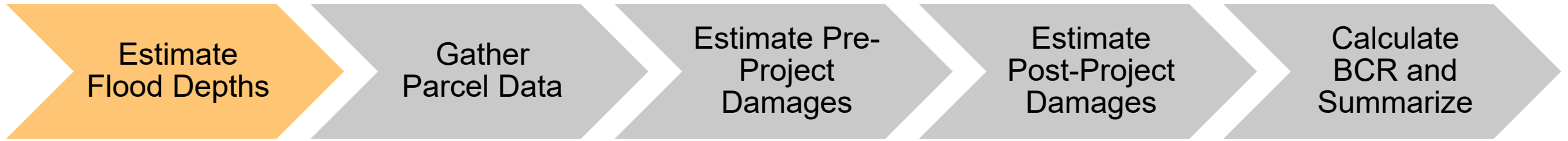


$$\frac{\$ \text{ Benefits}}{\$ \text{ Costs}} = \text{BCR}$$

$$\frac{\text{Pre-project Event Damage} - \text{Post-Project Event Damages}}{\$ \text{ Benefits}}$$

\$ Benefits

BCA Process



- BCA was calculated for current and 3 ft sea level rise conditions
- Flood elevations evaluated for two return periods:
 - 10-year storm (i.e. nor'easter)
 - 100-year storm (i.e. hurricane)
- Wave heights and flood depths calculated using USGS LiDAR topography

BCA Process



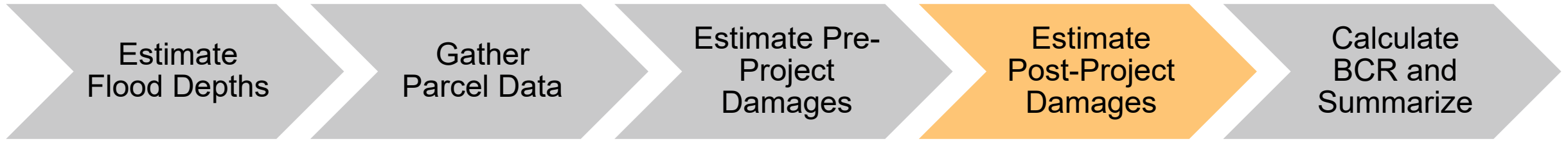
- Parcel data from City of Virginia Beach’s tax database used to estimate type and size of structure on each parcel:
 - Building label
 - Occupancy class
 - Number of stories

BCA Process



- For each flooded building, three types of damages were estimated:
 - Structure damage
 - Contents damage
 - Displacement/loss of function

BCA Process



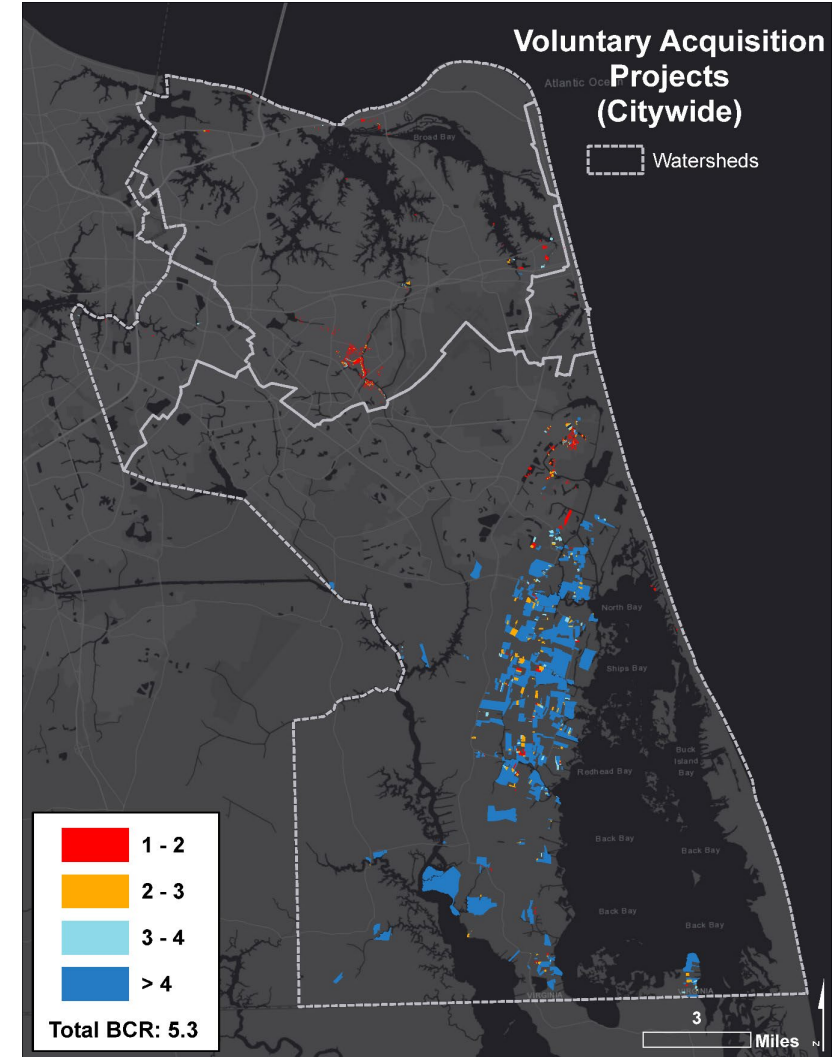
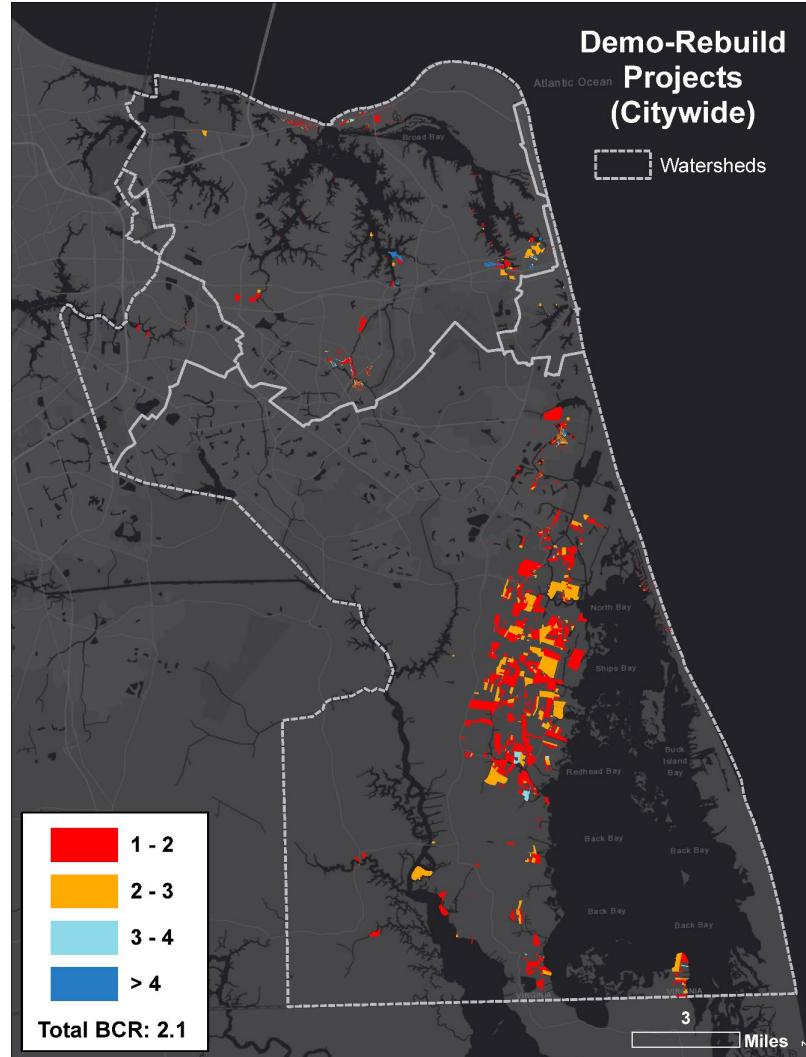
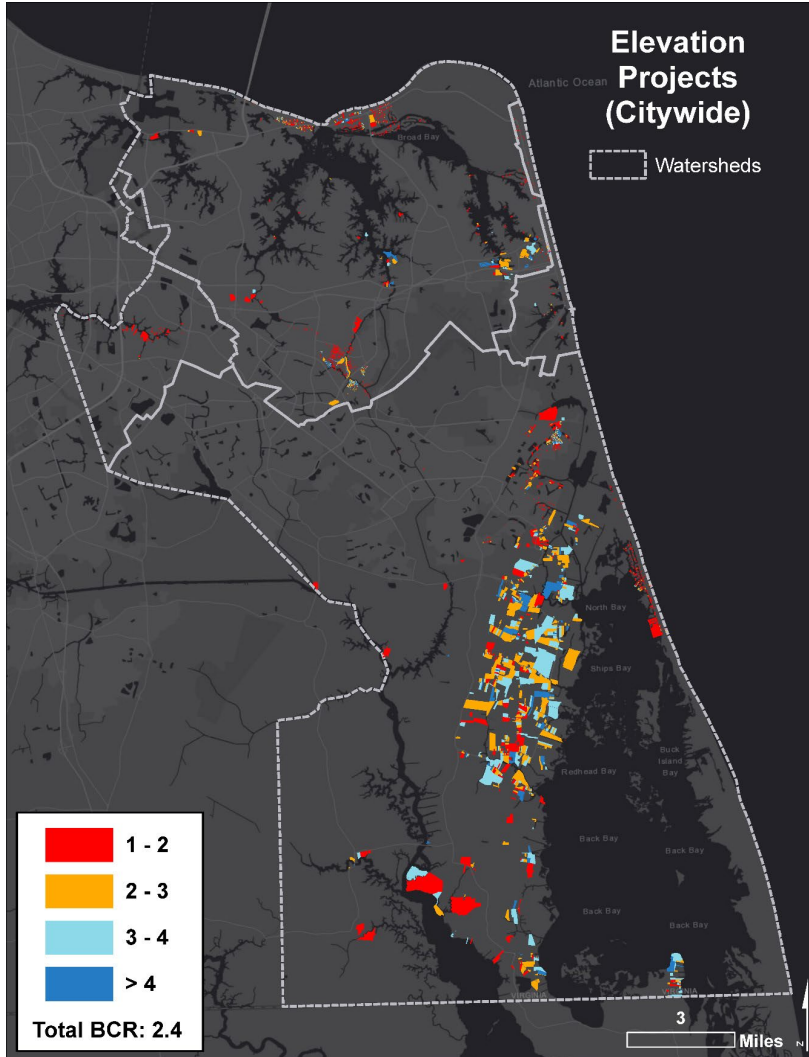
- Costs and post-construction losses were estimated for:
 - Residential Structure Elevation (with 2 and 3 ft freeboard)
 - Residential Demo-Rebuild (Mitigation Reconstruction)
 - Residential Voluntary Property Acquisition
 - Non-Residential Dry Floodproofing
 - Non-Residential Wet Floodproofing

BCA Process

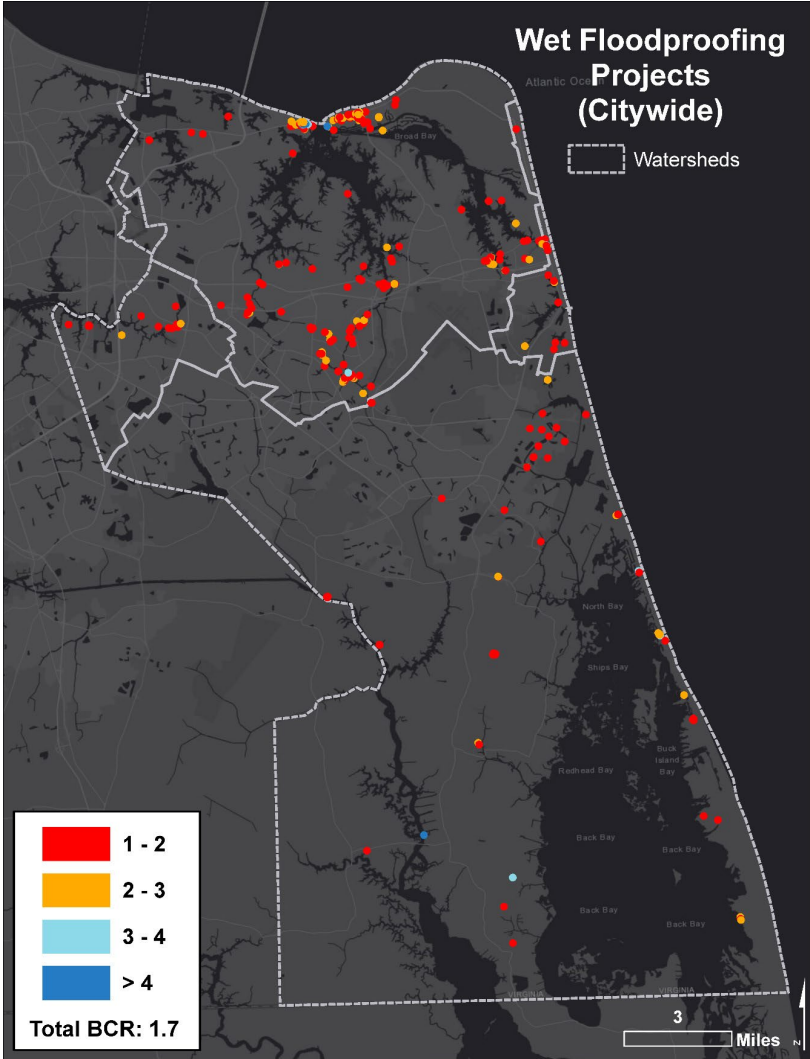
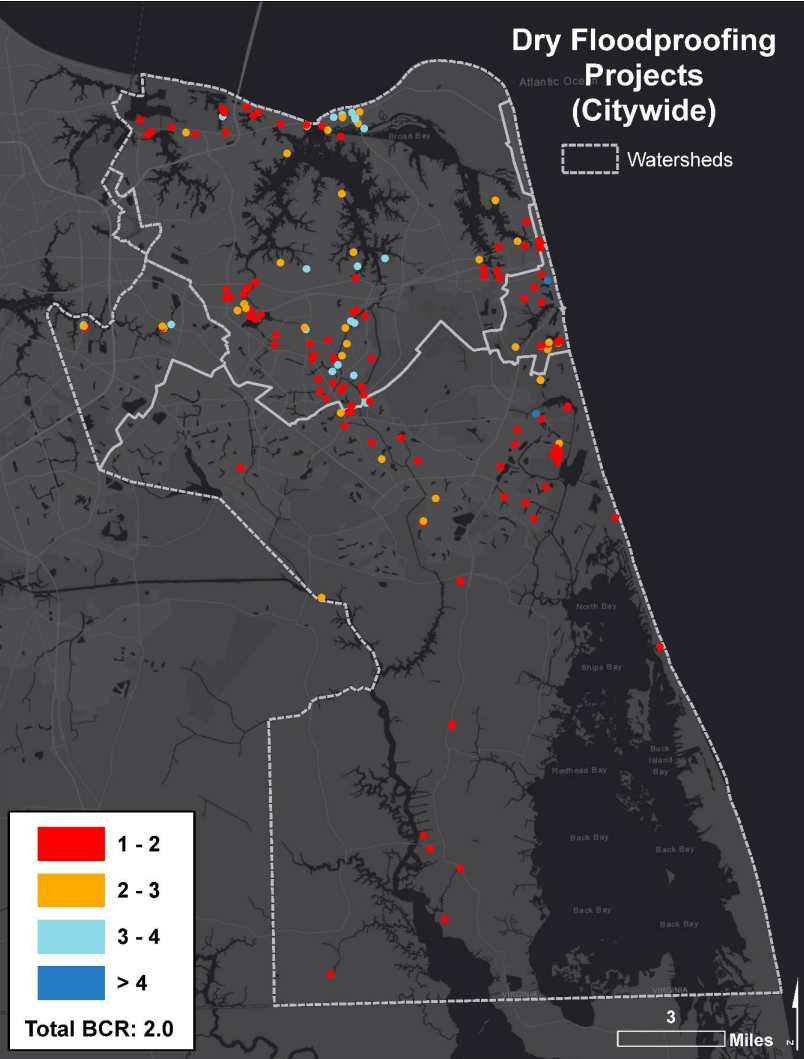


- The ultimate Benefit-Cost Ratio was determined based on:
 - Base Benefit-Cost Ratio (avoided damages / costs)
 - Social Benefits (mental stress and anxiety, loss of productivity)
 - Environmental Benefits (ecosystem services)

BCA Results for Residential Structures

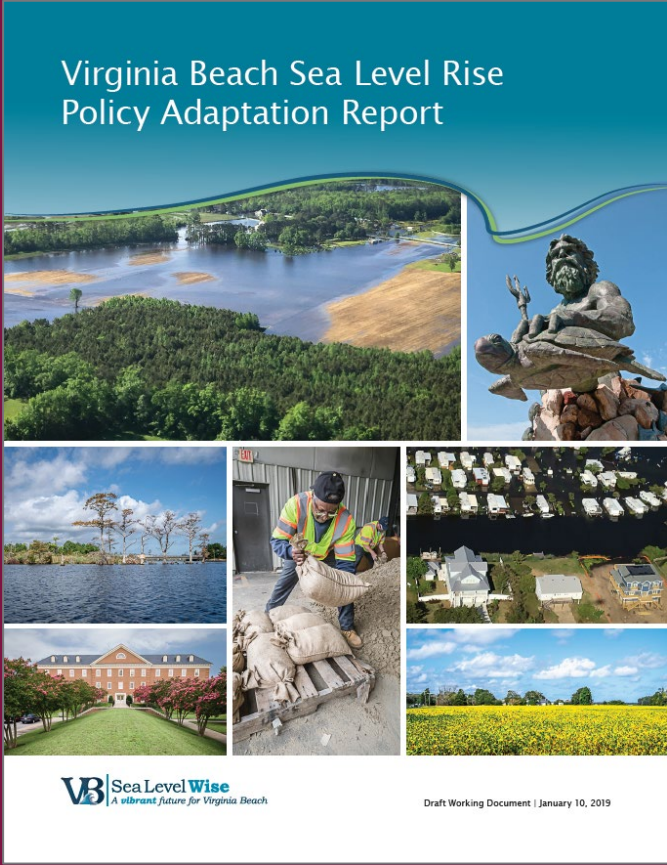


BCA Results for Commercial Structures

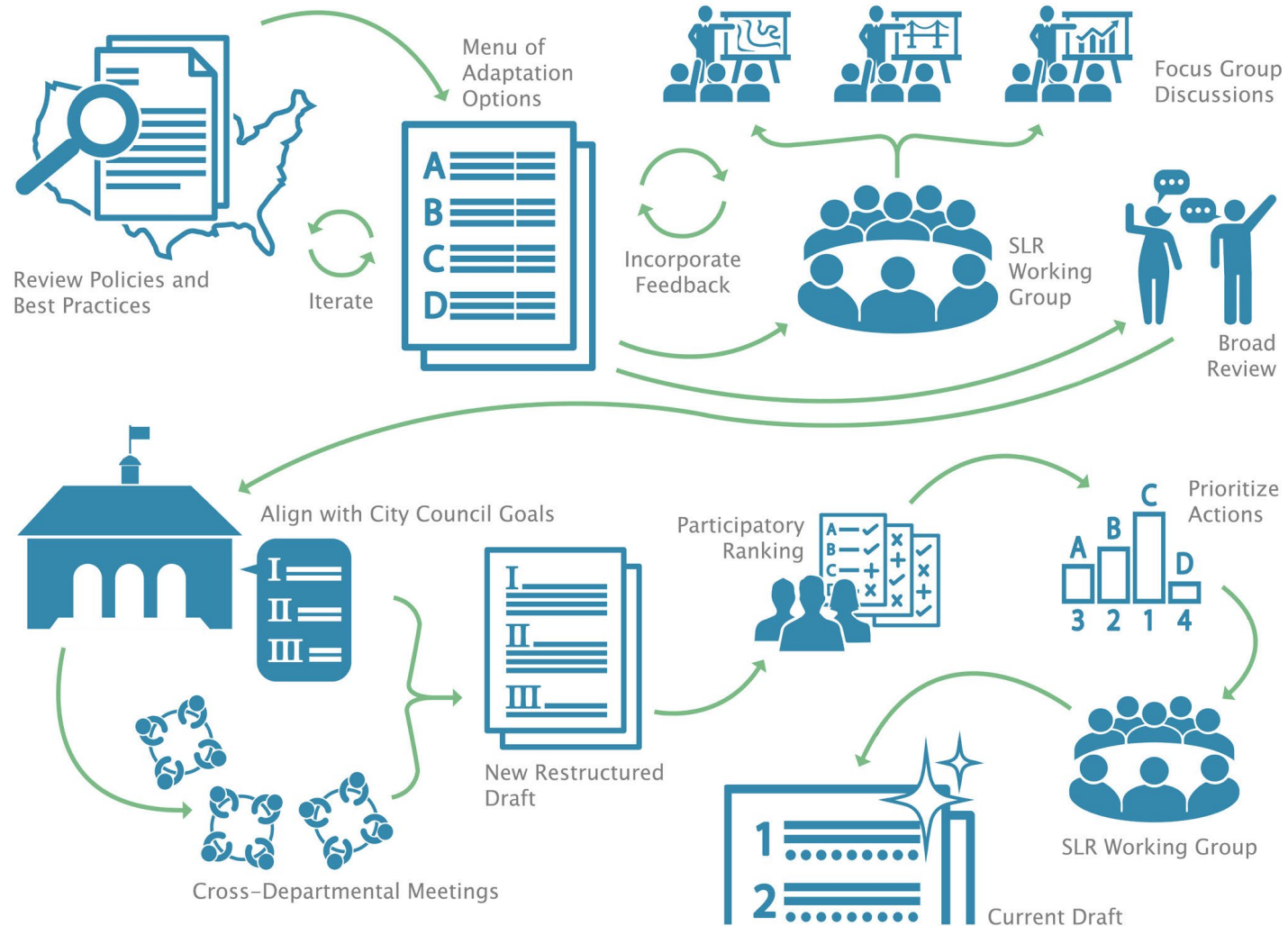


Policy Approach

Assessment of planning, policy, and programmatic options to address sea level rise and recurrent flooding issues.



Development Process



Policies Supporting Site-Level Adaptation

Voluntary Acquisition

Restart the voluntary acquisition and buyout programs (Open Space Program and Agricultural Reserve Program) to allow for acquisitions to also enhance the City's flood resilience, including allowing for acquisition of: repetitive loss properties, undeveloped parcels in the 100-year floodplain, and wetlands and natural floodplains. (See Objective 5.3)

Wet Floodproofing

Require mechanical and electrical systems to be elevated to design flood elevation (with additional freeboard).

Demo-Rebuild and Elevation

Encourage mitigation reconstruction, second story conversion, first floor abandonment, and elevation of highly vulnerable properties through FEMA grant programs and other alternative funding mechanisms.

Commercial Retrofits

Provide financial assistance through tax incentives and/or low interest loans to encourage owners of commercial and industrial properties to undertake flood retrofits (including elevation, floodproofing, mitigation-reconstruction, stormwater management and green infrastructure retrofits).

Residential Retrofits

Provide financial assistance to private property owners to support flood retrofits including elevation (for residential structures), floodproofing (for non-residential structures), mitigation-reconstruction, stormwater management, and green infrastructure retrofits.

Policies Supporting Site-Level Adaptation

Living Shorelines

Provide technical assistance, grants, loans, or tax incentives to private landowners to assist in the removal of hardened shorelines and the design and construction of living shorelines, such as through participation in the Commonwealth's living shoreline loan program.²⁷

Green Infrastructure

Provide specific example mitigation measures that developers could incorporate into the project design to reduce flood risks to the project (e.g., green stormwater management practices, floodproofing measures, preservation of natural flood buffers, back-up power or microgrids).

Developer Guidance

Provide specific guidance to developers on the sea level rise and precipitation projections that should be considered to assess the flood risks to the project. Flood risk should be considered in terms of the project's design life, density, and permitted uses (with requirements to consider more precautionary scenarios for denser projects or project with more intense uses).

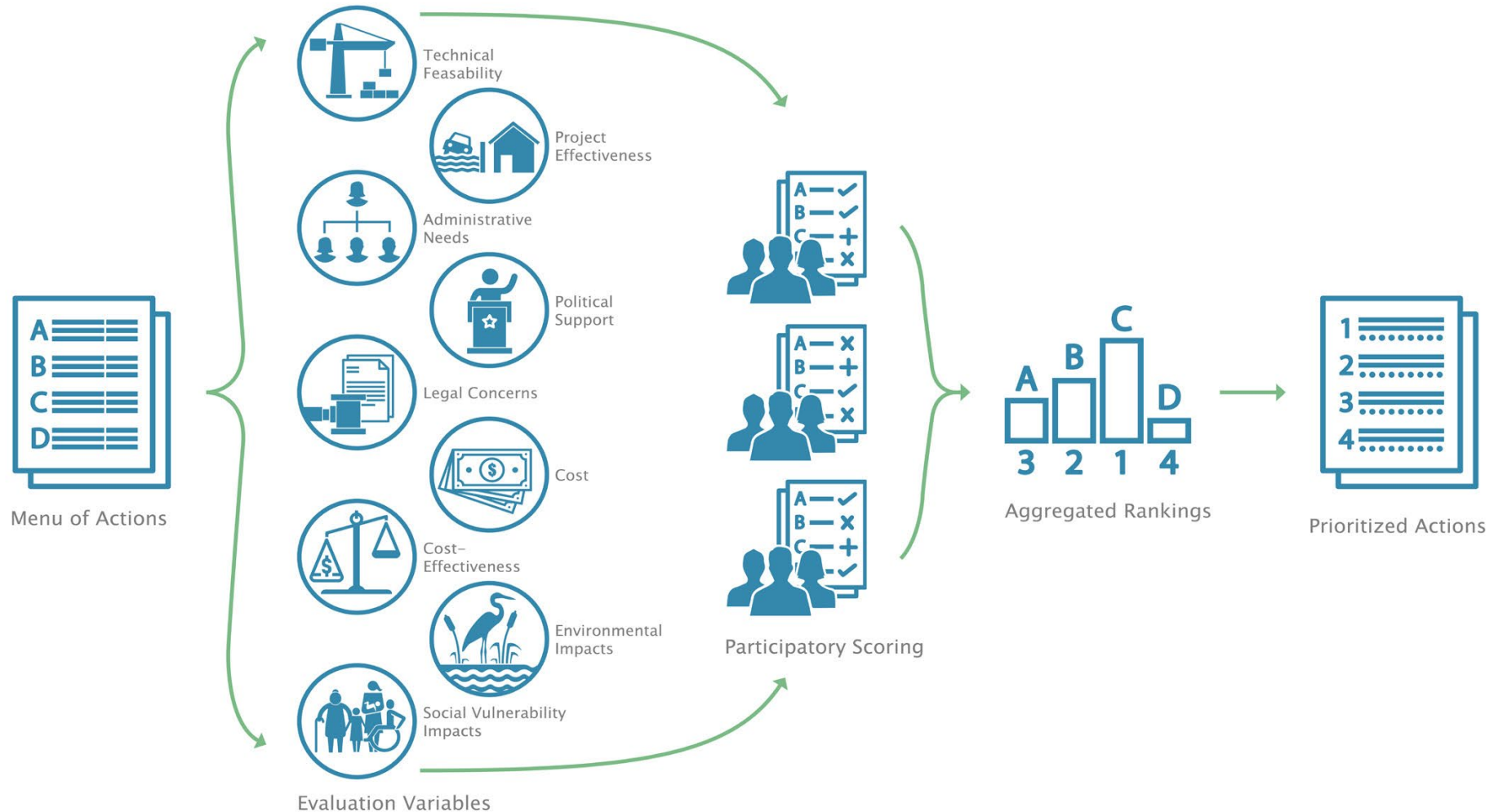
Homeowner Trainings

Provide flood-protection consultations and workshops for homeowners and businesses to disseminate information about different methods for retrofitting structures to reduce flood damage and available financing services and grants.

Historic Preservation

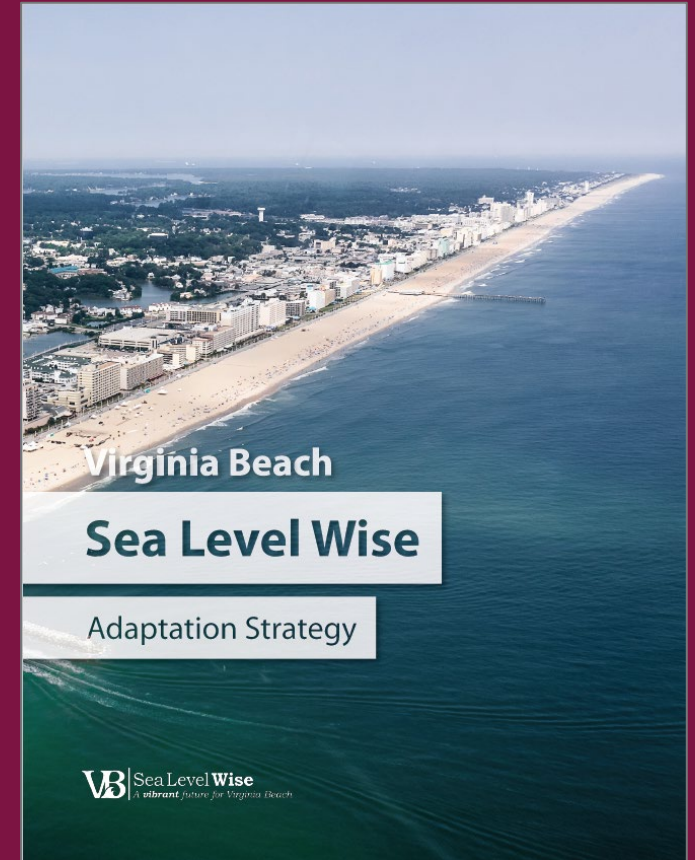
Develop informational materials for property owners and contractors on how to renovate historic properties to enhance flood resilience in ways that are consistent with historic preservation requirements.

Development Process



Integrated Approach

Public-facing document integrating five years of technical research to present a long-term holistic adaptation strategy.



Multiple Layers of Adaptation



• **Natural Mitigations**

Natural and nature-based features both in the water and on land lessen the magnitude and extent of flooding events.

• **Engineered Defenses**

Permanent or deployable structural flood risk reduction elements prevent the passage of floodwater into inhabited areas.

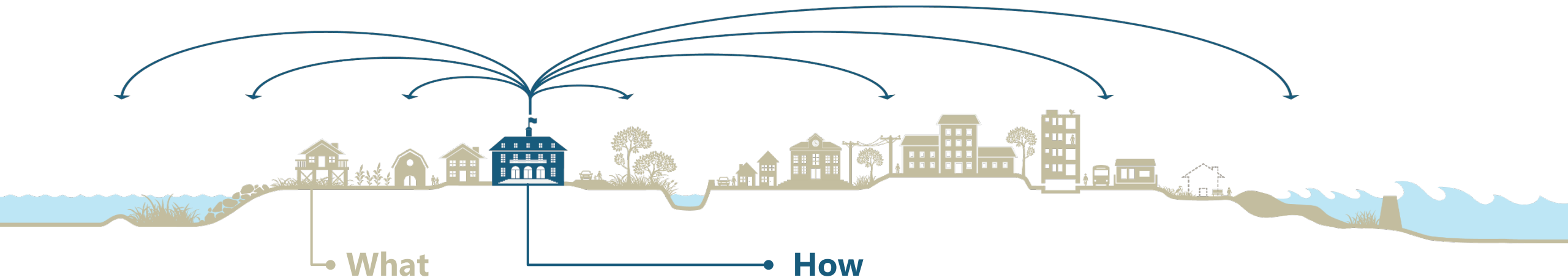
• **Adapted Structures**

Appropriate siting, design, and retrofit techniques and policies limit damage to buildings and infrastructure systems.

• **Prepared Communities**

Educational services and financial planning tools help minimize the social and economic impacts of an experienced flood event.

Integrating Policy and Planning



What

Each layer aims to achieve concrete outcomes that improve Virginia Beach's overall flood resilience.

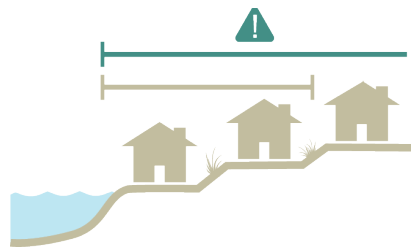
How

In order to achieve those outcomes, the City can employ a number of policy and planning tools:

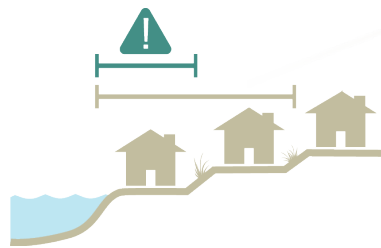
- Comprehensive and strategic planning
- Budgeting and financing
- Community outreach
- Building codes and standards
- Partnerships
- Research and analysis
- Land use planning and zoning
- Incentives and support programs
- Program and project management

Regulate Building & Development

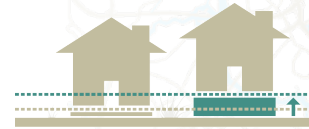
Require responsible siting, design, and construction practices for new and substantial redevelopment that are reflective of the area's current and future flood risks.



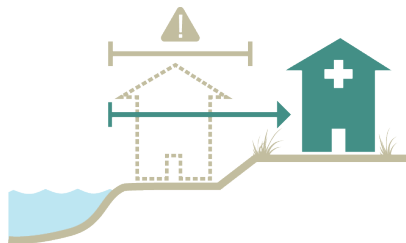
Floodplain Ordinance Update



Coastal Zone Creation



Elevation Requirements



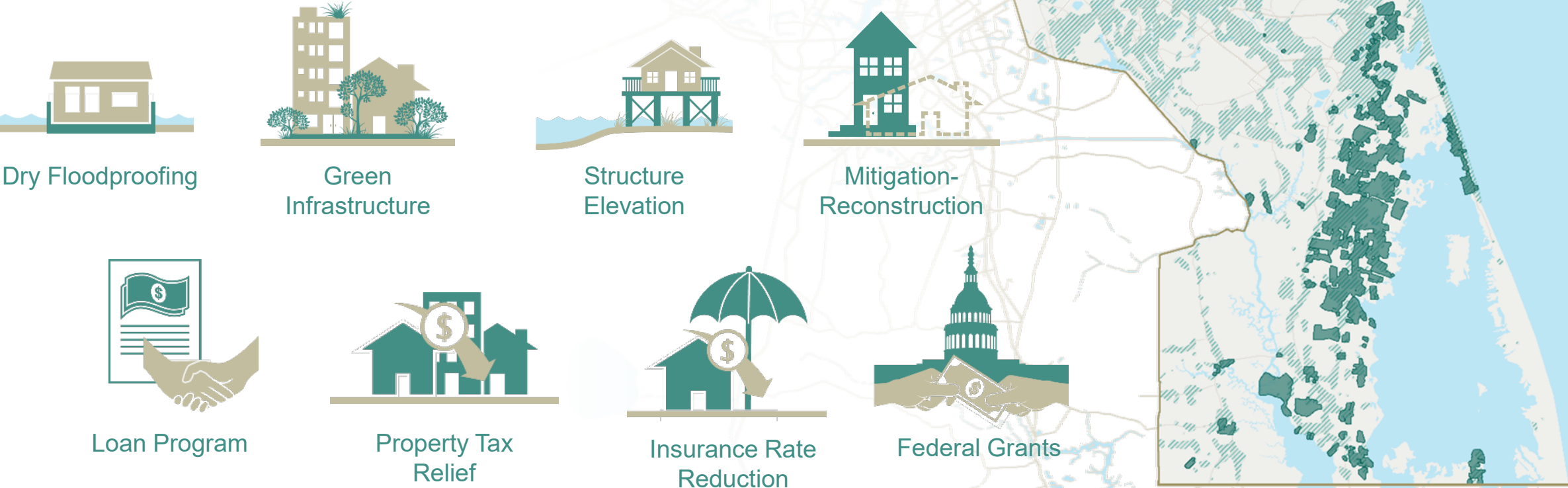
Critical Facility Location



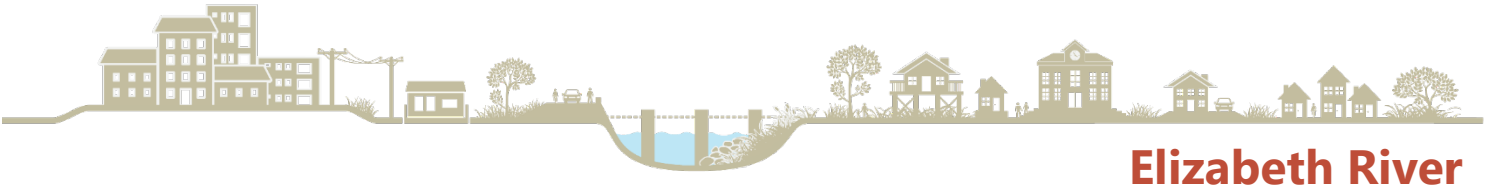
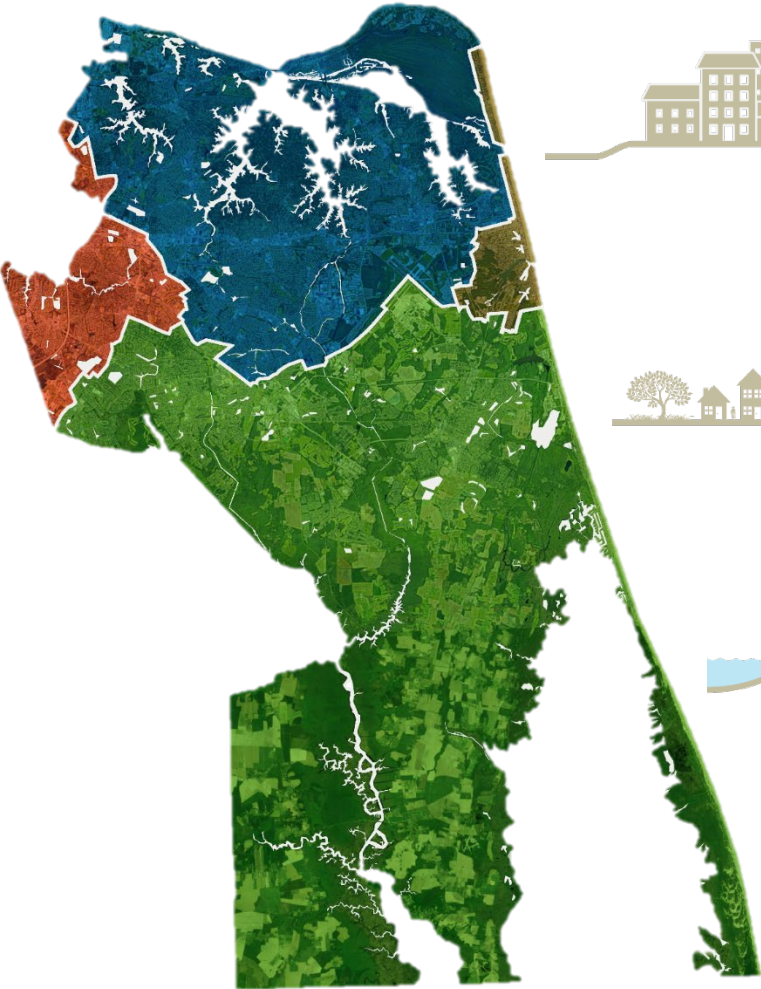
Conditional Permitting

Support Risk-Mitigating Interventions

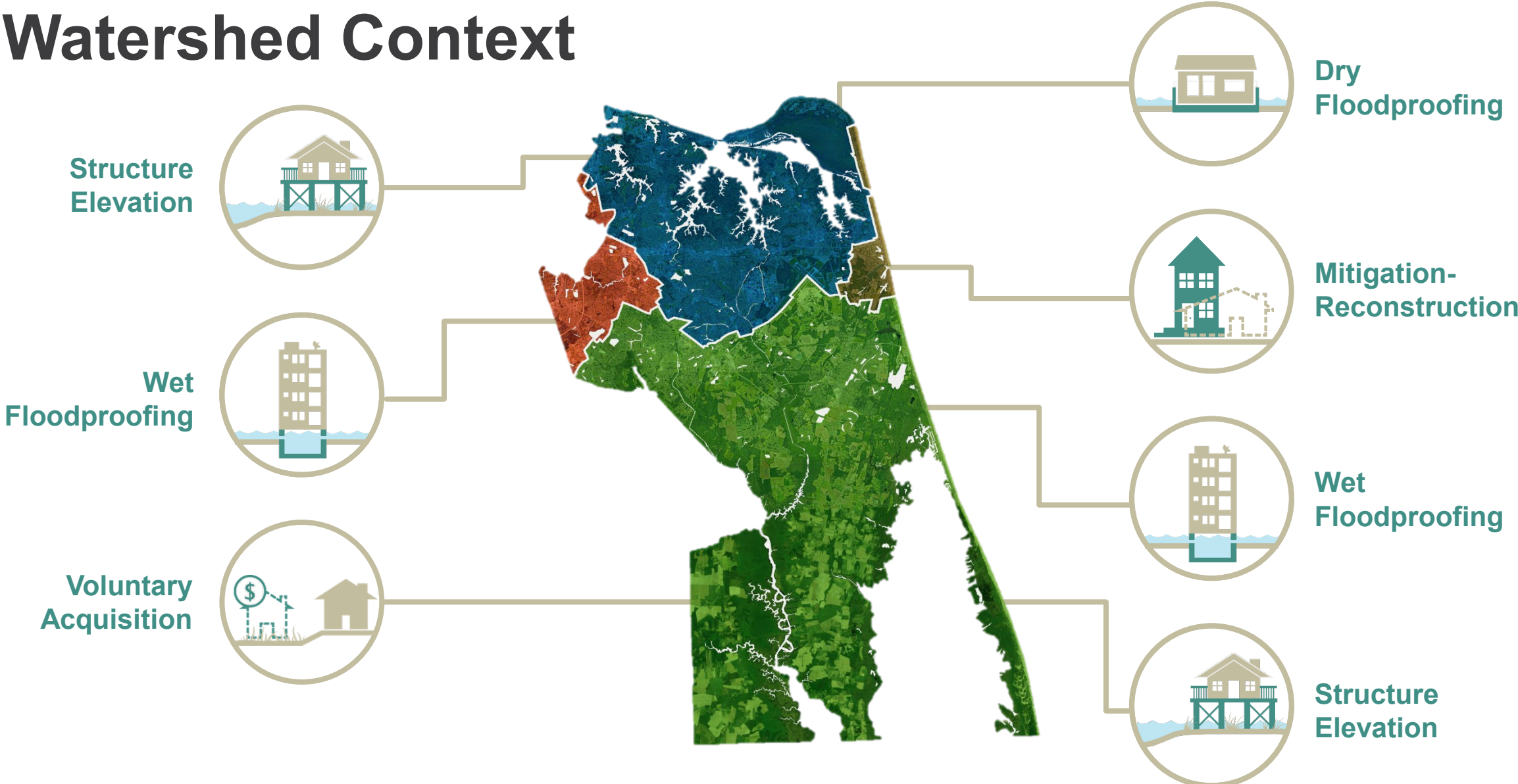
Provide resources and incentives to encourage flood-resilient design or retrofits on residential and commercial properties.



Watershed Context



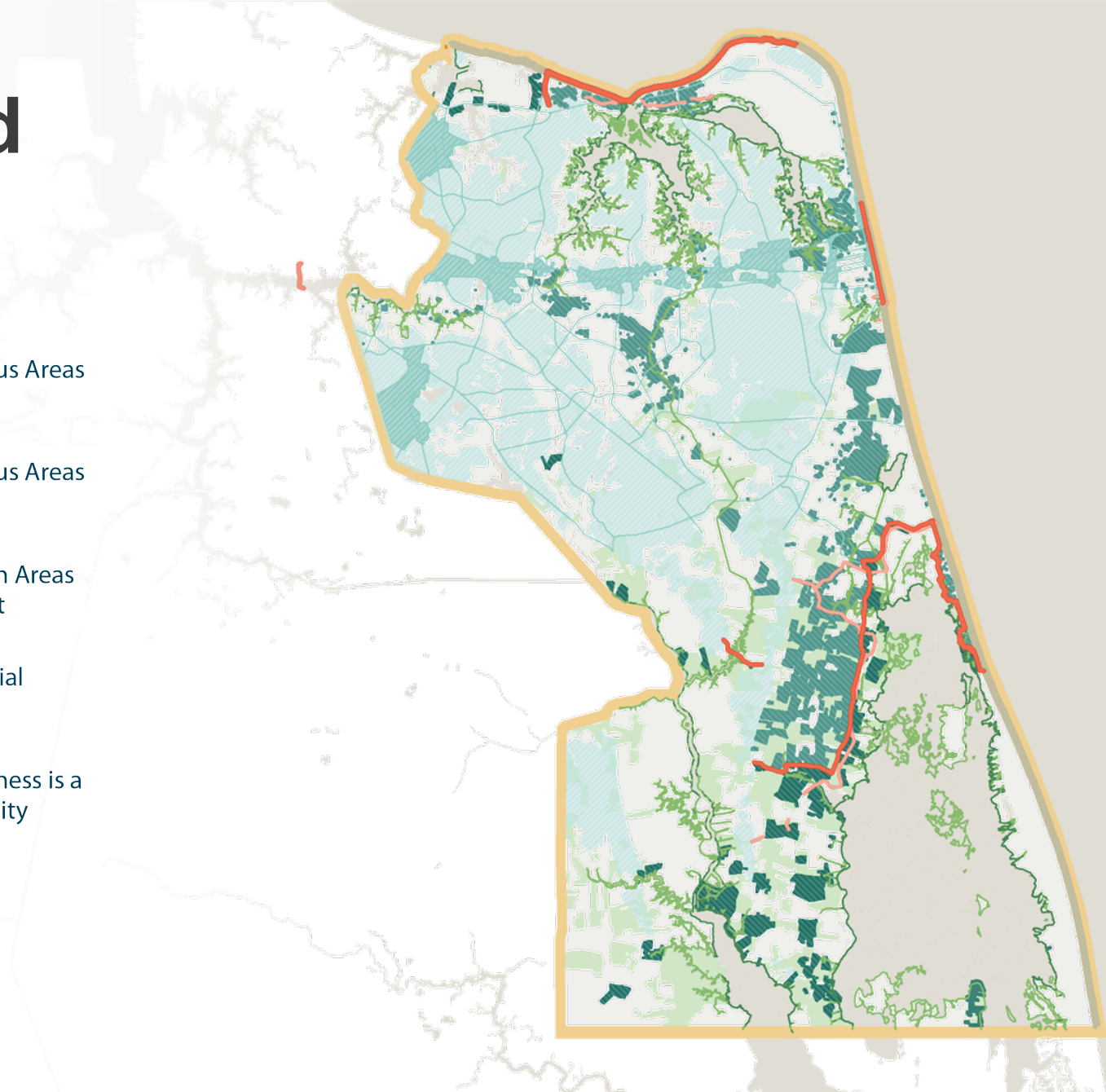
Watershed Context



Envisioning an Adapted Virginia Beach

- Living Shoreline and Enhanced Revetment Areas
- Marsh Restoration Areas
- Land Conservation Focus Areas
- Beach and Dune Renourishment Areas
- Potential Large-scale Engineered Defenses
- Potential Neighborhood-scale Engineered Defenses

- Structure-Level Mitigation Focus Areas Outside Engineered Defenses
- Structure-Level Mitigation Focus Areas Inside Engineered Defenses
- 'High and Dry' Strategic Growth Areas for Concentrated Development
- 'High and Dry' Areas for Potential Adapted Development
- Social and Economic Preparedness is a theme throughout the entire City



Thank You

Johanna Greenspan-Johnston
jgreenspanjohnston@dewberry.com