Planning for Resilience in Northern Chesapeake Bay: Infrastructure System Considerations

Maryland Association of Floodplain and Stormwater Managers - 2019 Conference

Presented by:

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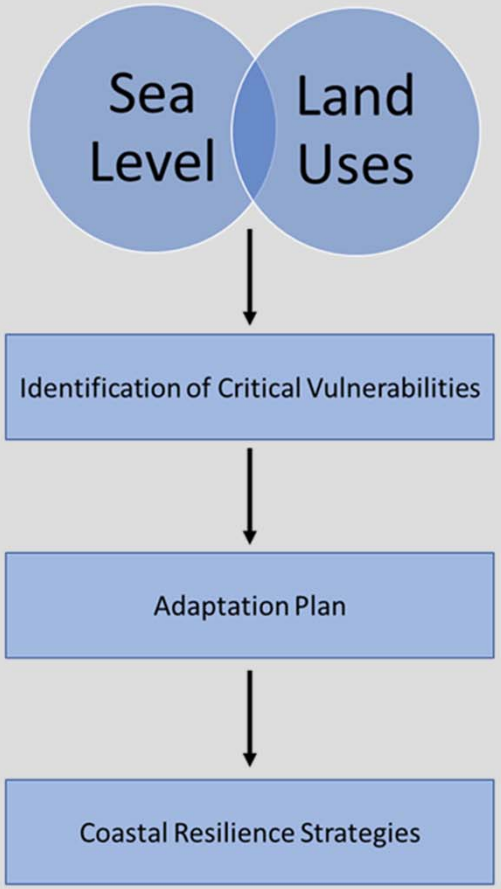
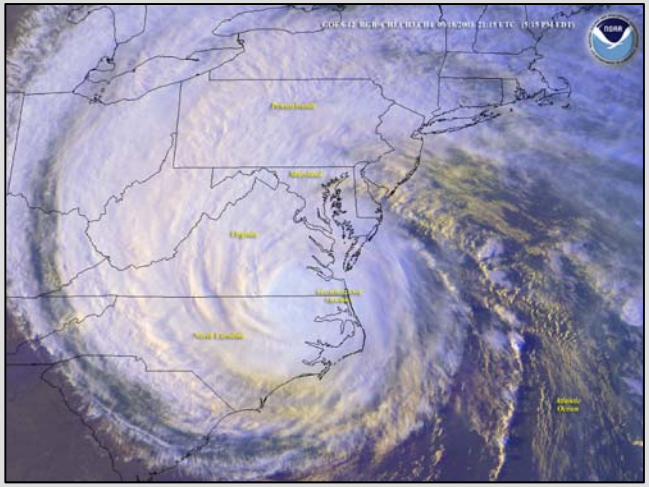
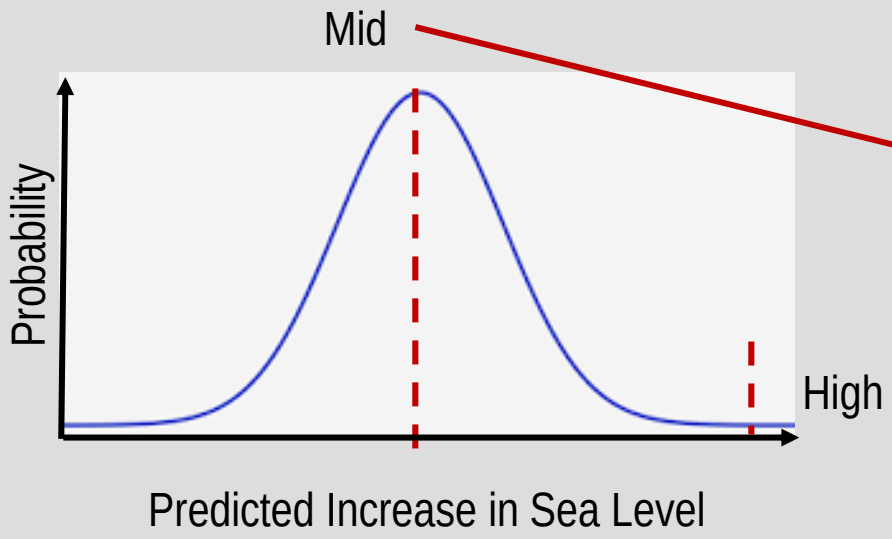
Background and Purpose



- Goal – Framework for management plan to decrease risks from sea level rise and storm events
  - Aberdeen Proving Ground
  - Harford County
  - Cecil County
  - Kent County



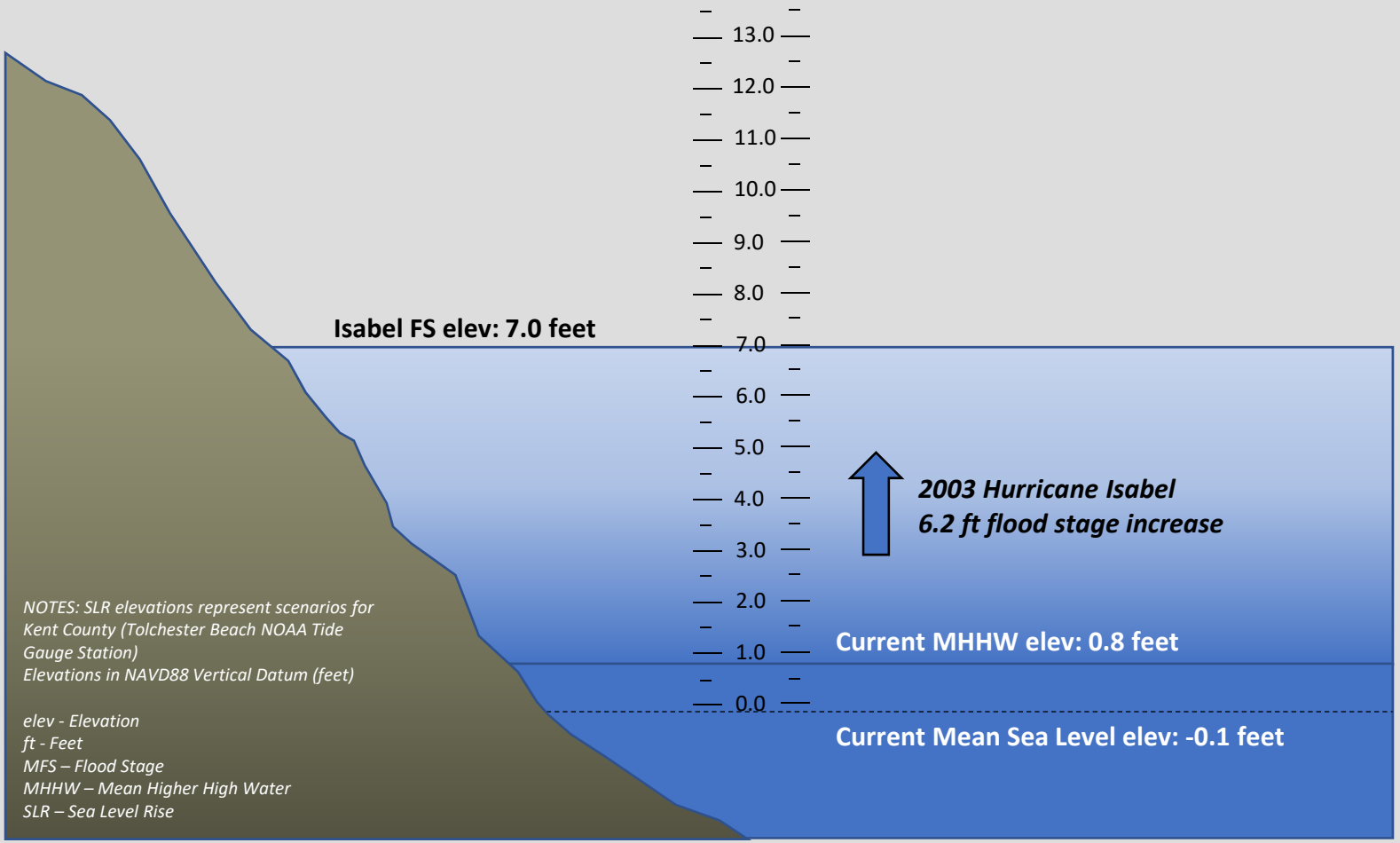
Critical Vulnerabilities and Scenarios



- Mean Higher High Water
- Relative Sea Level Rise from Climate Change
  - Identified from Boesch et al. 2018
  - Mid = 50% probability sea level rise meets or exceeds
  - High = 1% probability sea level rise meets or exceeds
  - For years 2050 and 2100
- Major Flood Stage from Storm Events

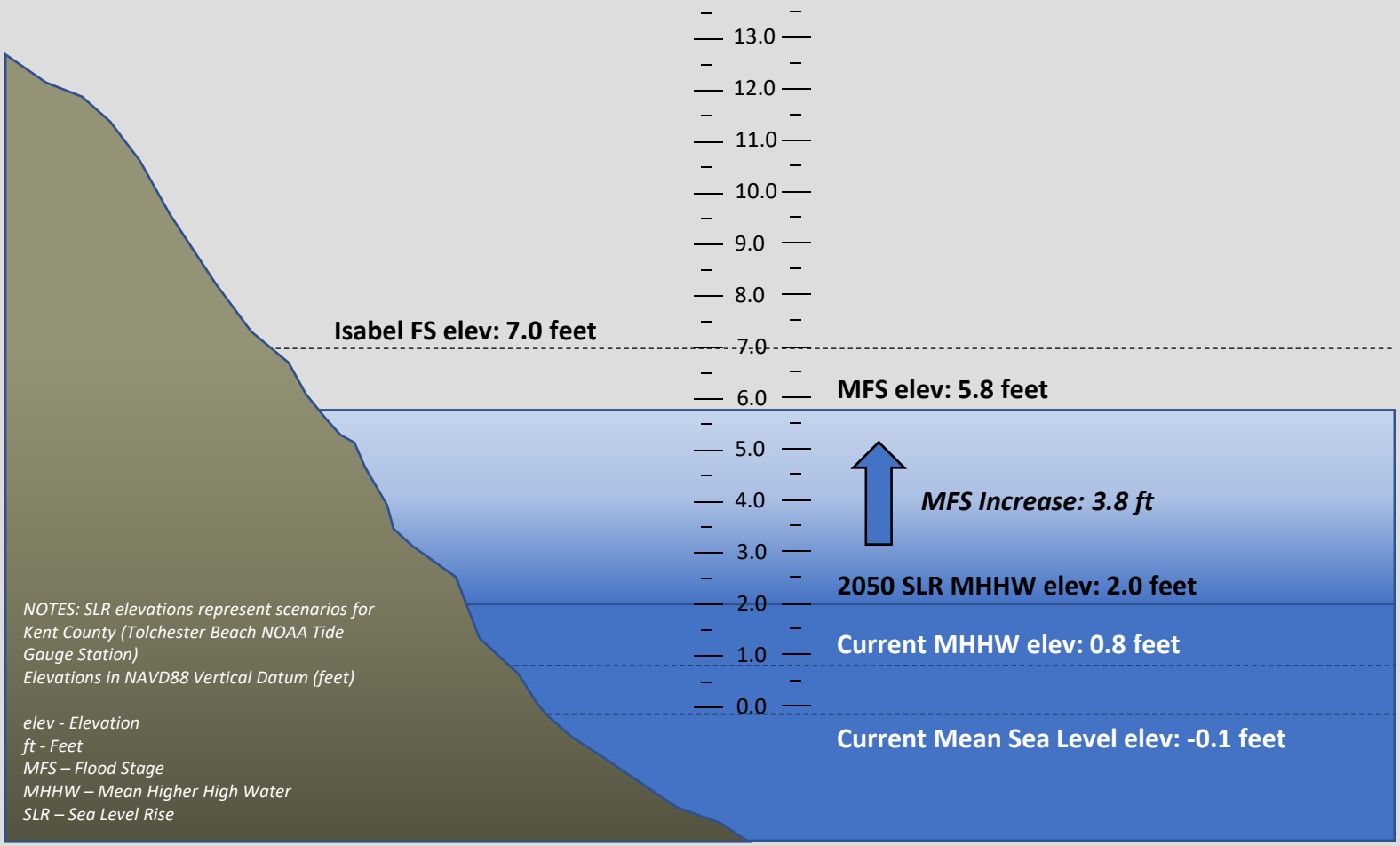
Scenarios

Current Conditions



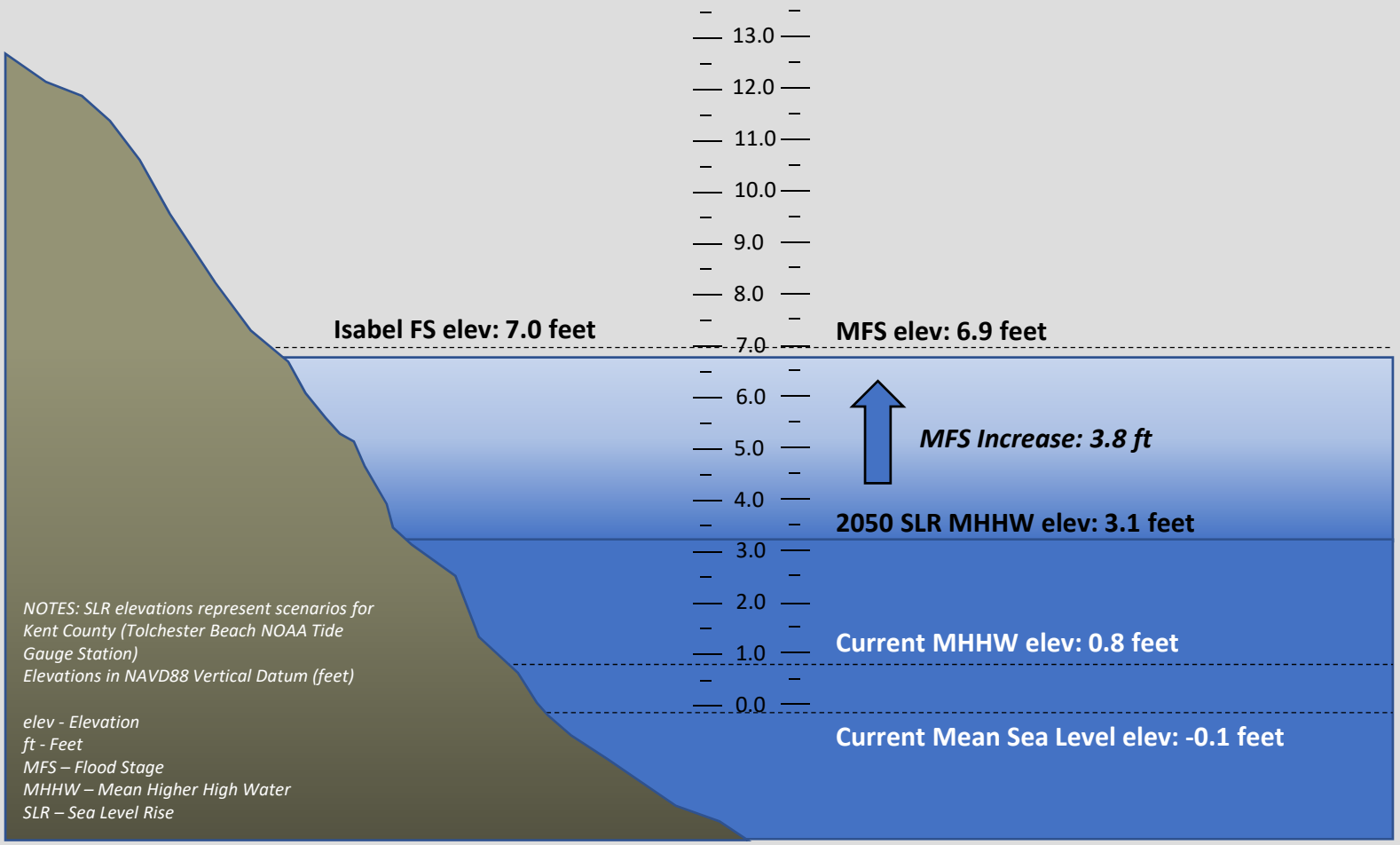
Scenarios

2050 Mid SLR Scenario



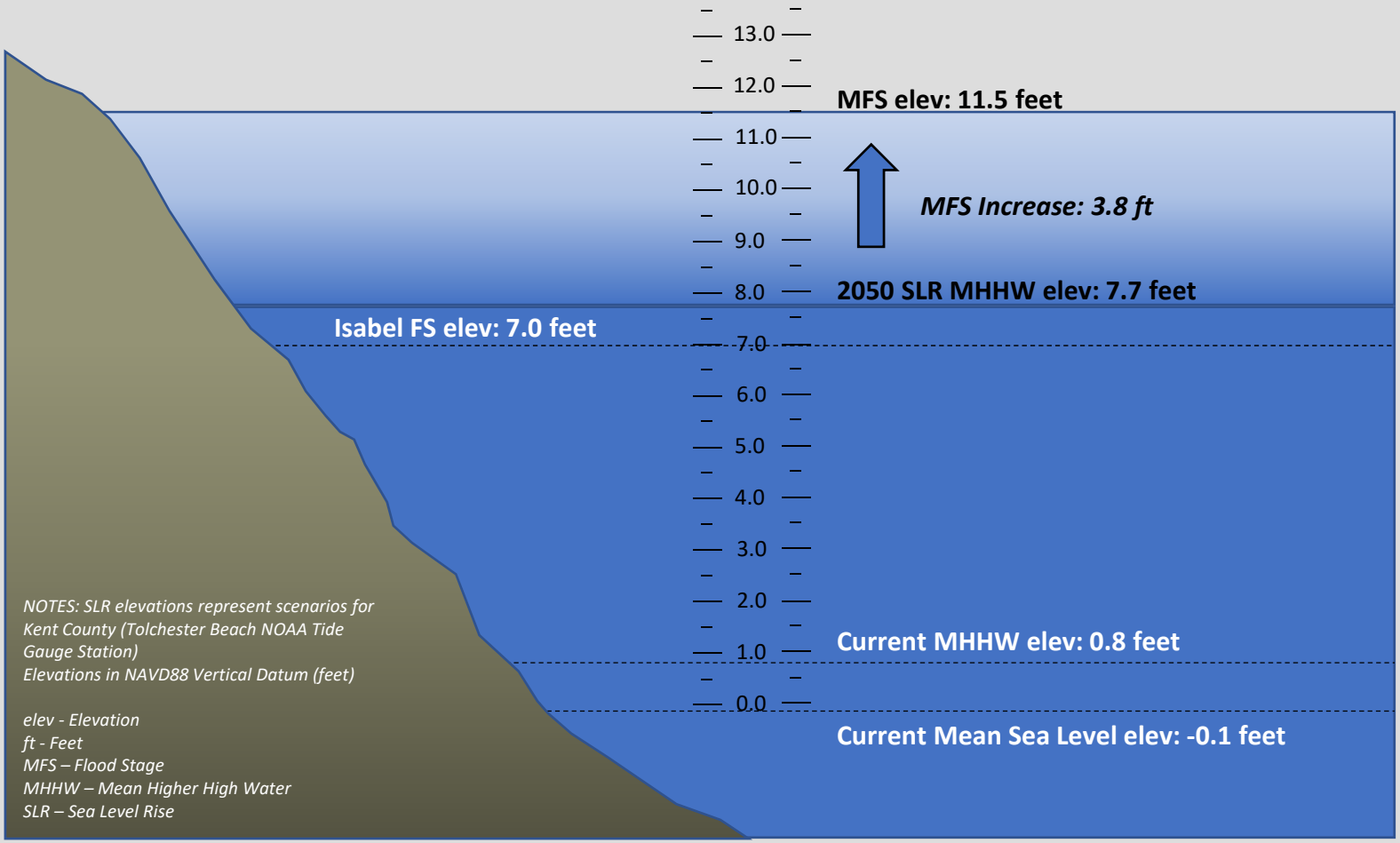
Scenarios

2050 High/2100 Mid SLR Scenario



Scenarios

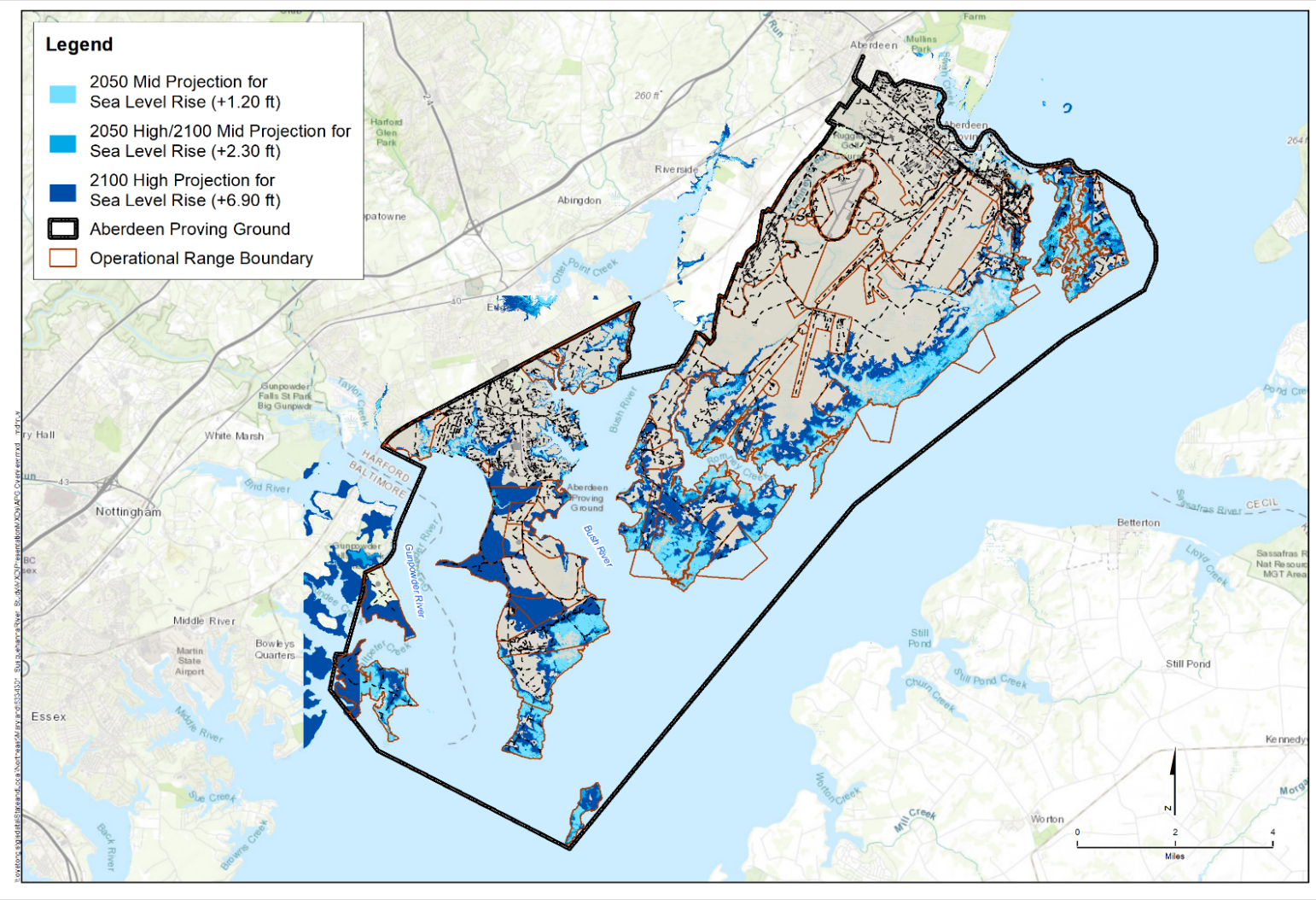
2100 High SLR Scenario



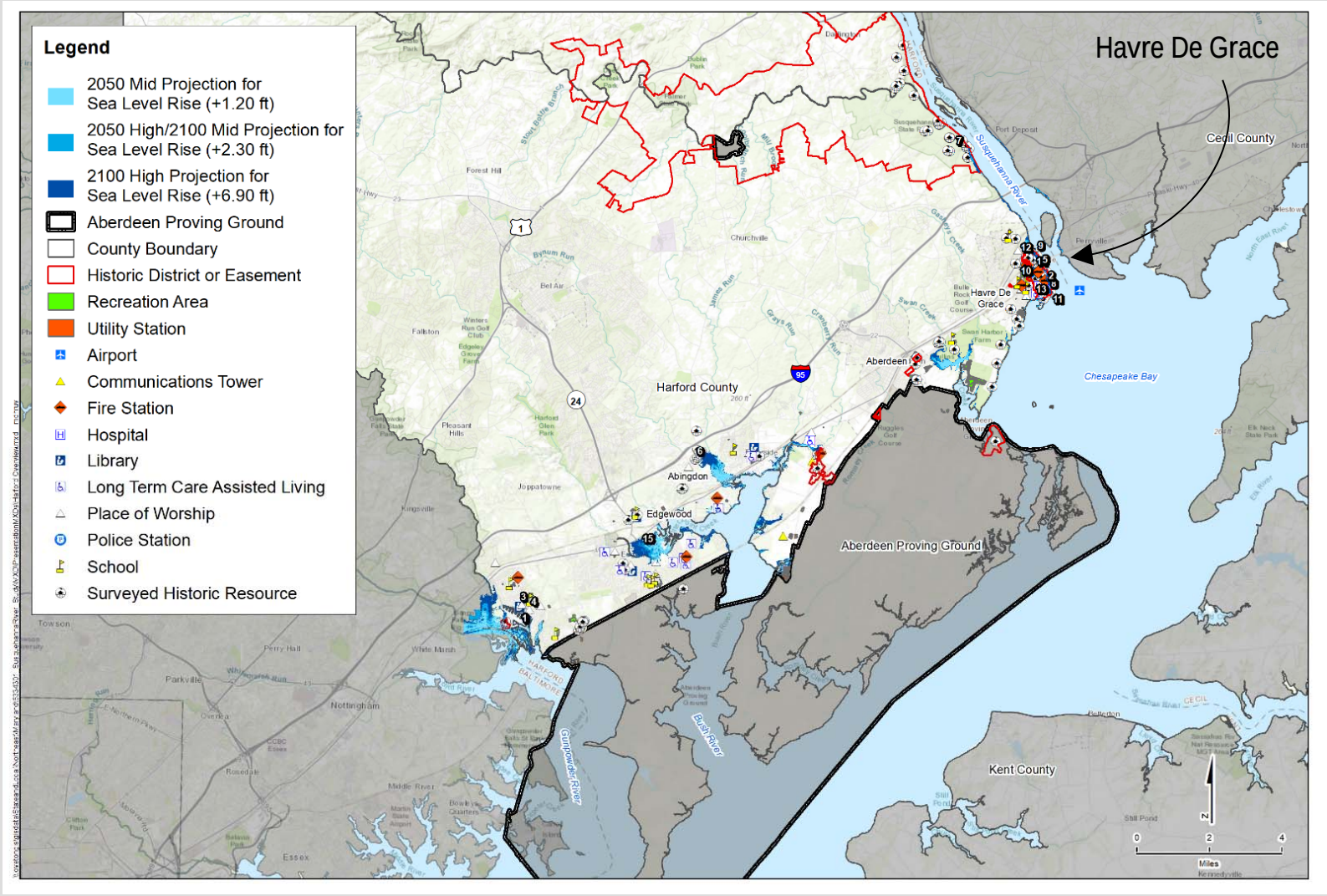
Critical Vulnerabilities

- Infrastructure
  - Utility stations, wastewater treatment plants, distribution and collection system piping, fire stations, SWM facilities, police stations, historic districts and easements and others
- Environments
  - United States Fish and Wildlife Service Wetlands, sensitive species project review area and others

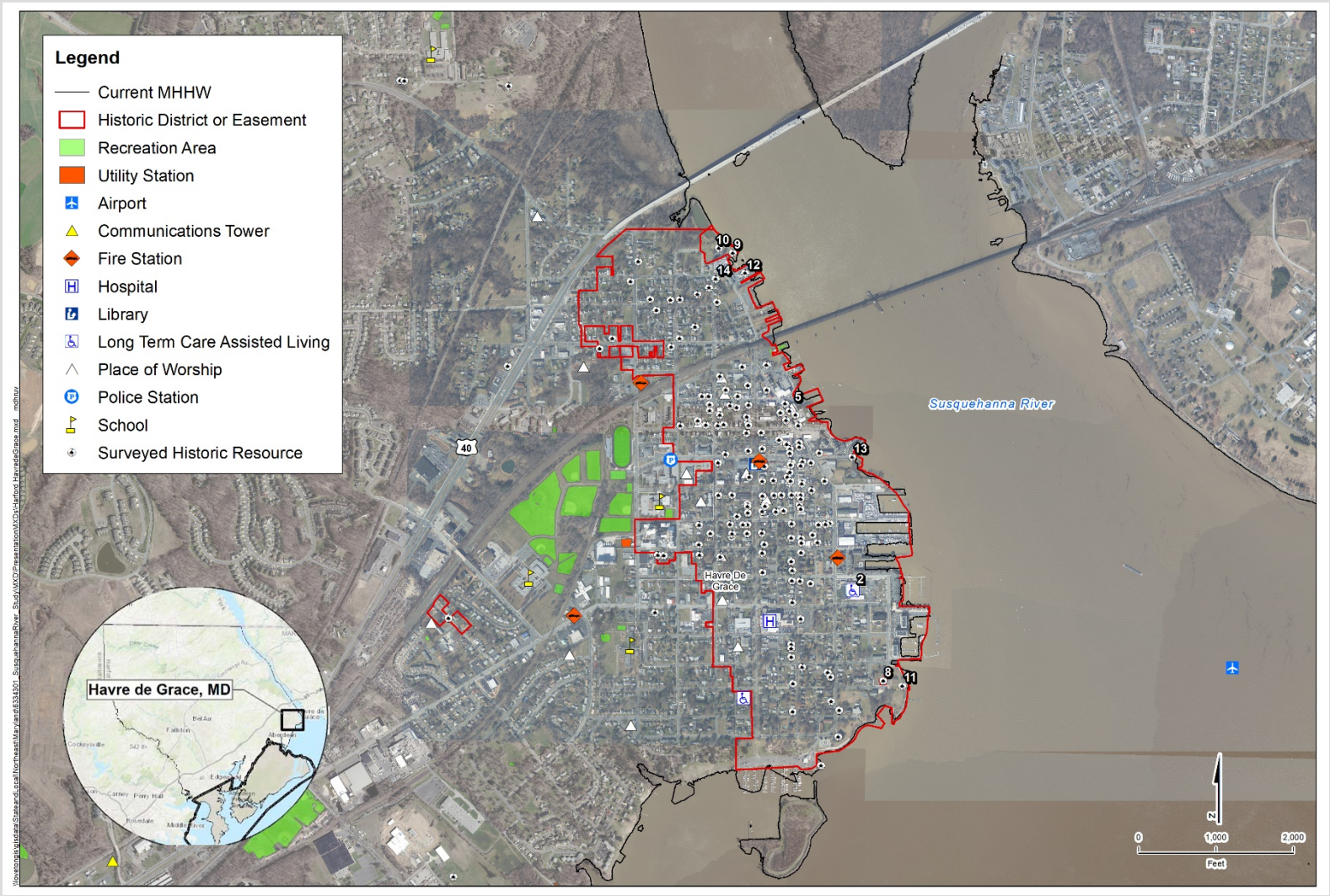
APG - Overview



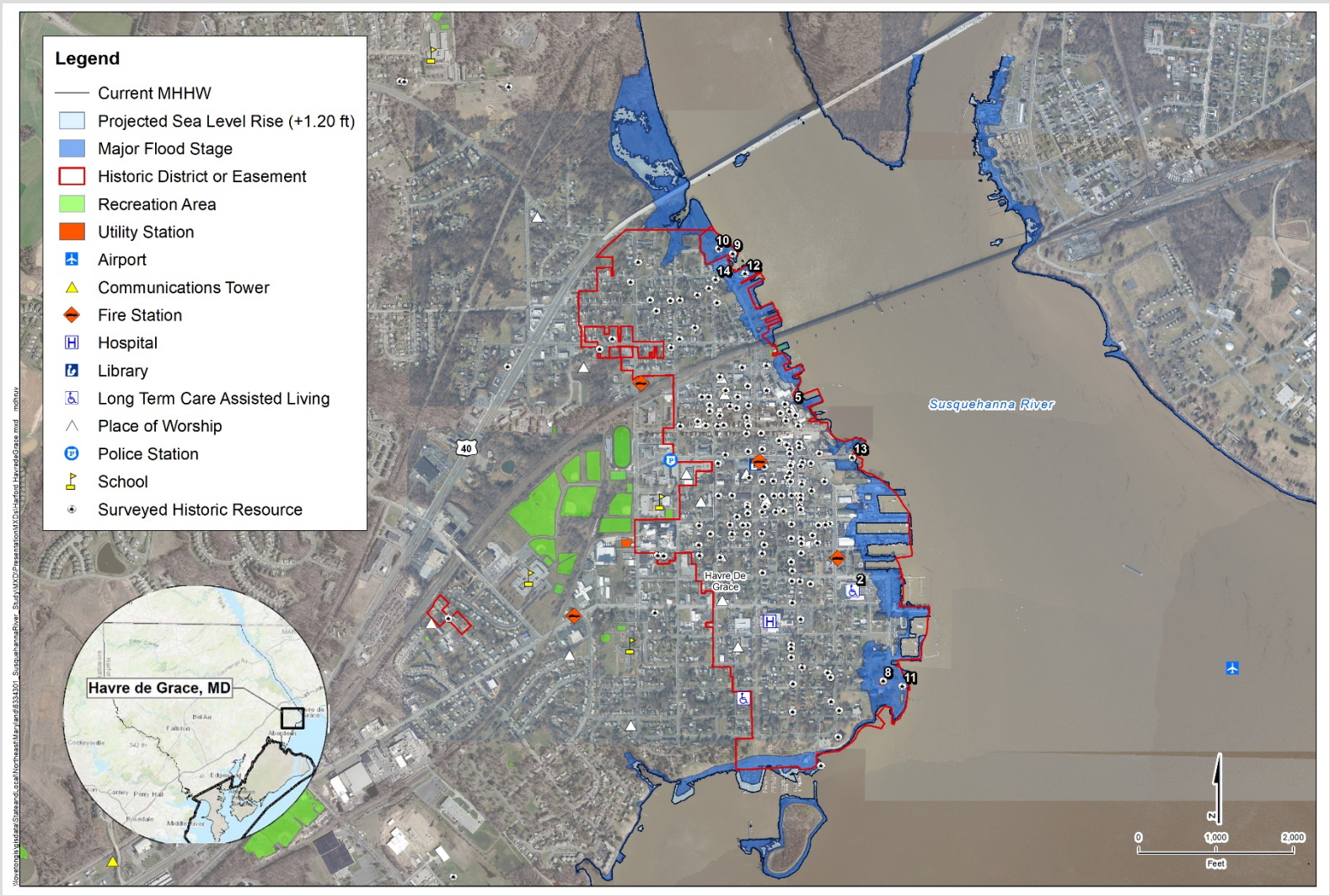
Harford County - Overview



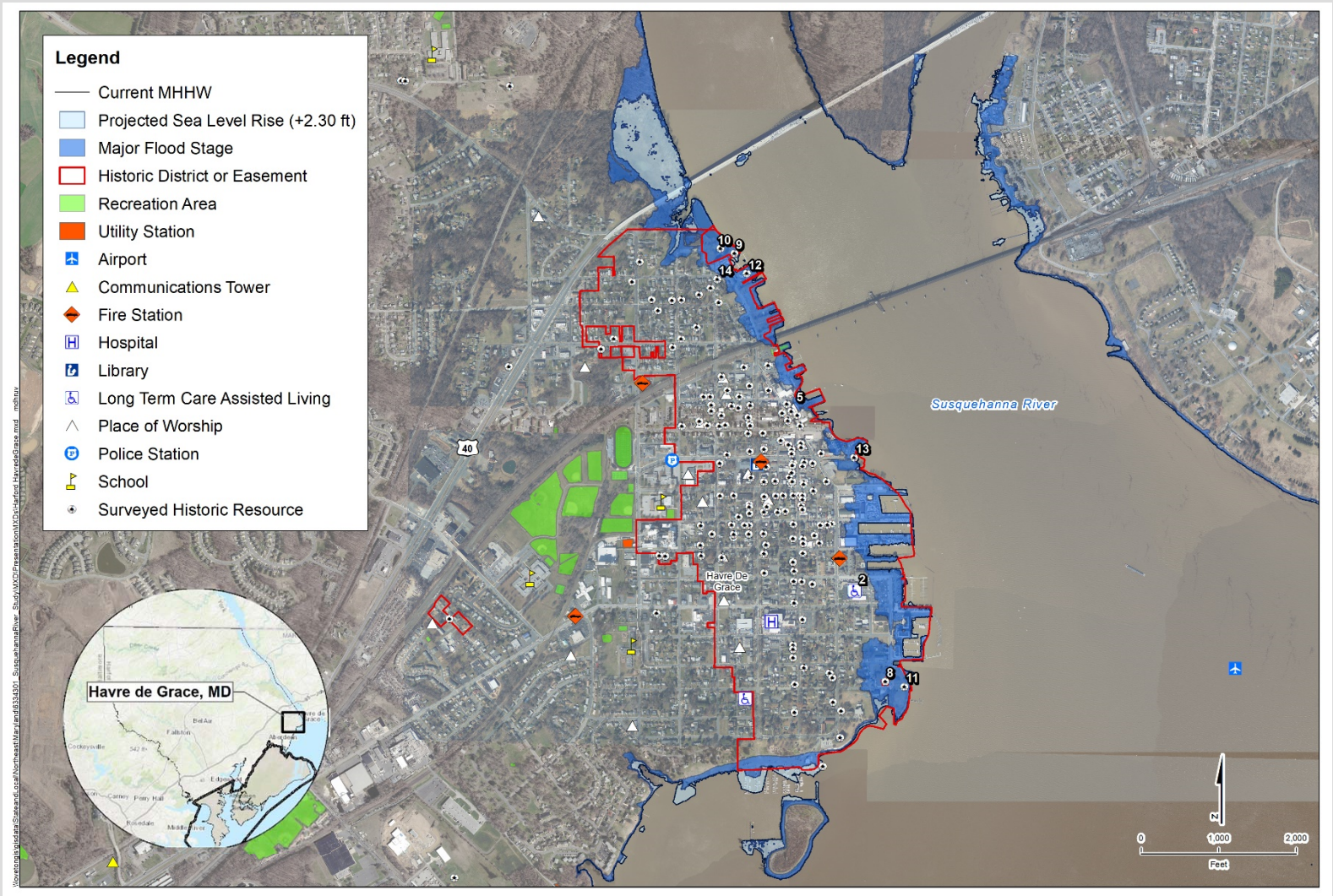
Current Conditions



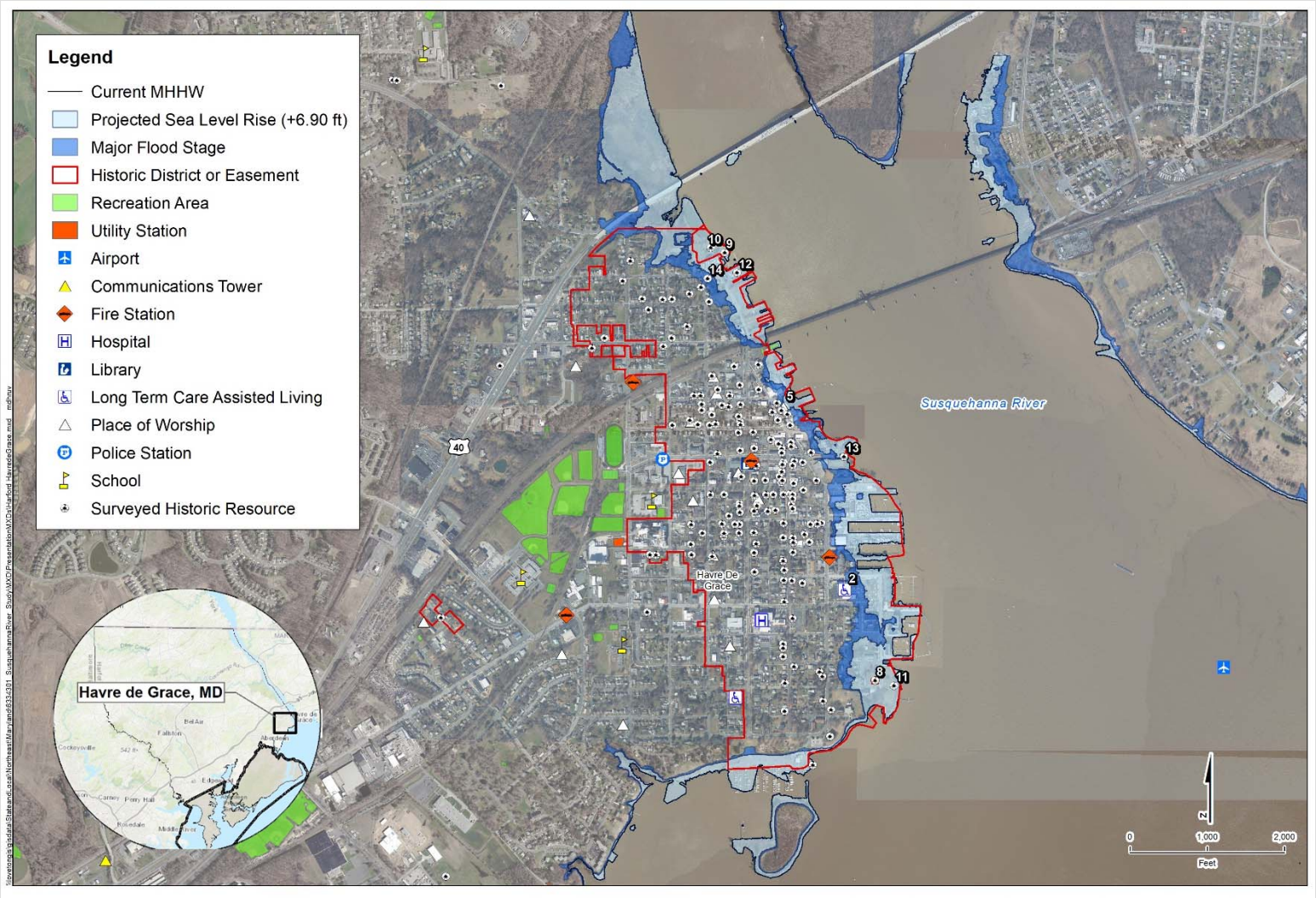
2050 Mid SLR Scenario – 1.2 ft increase



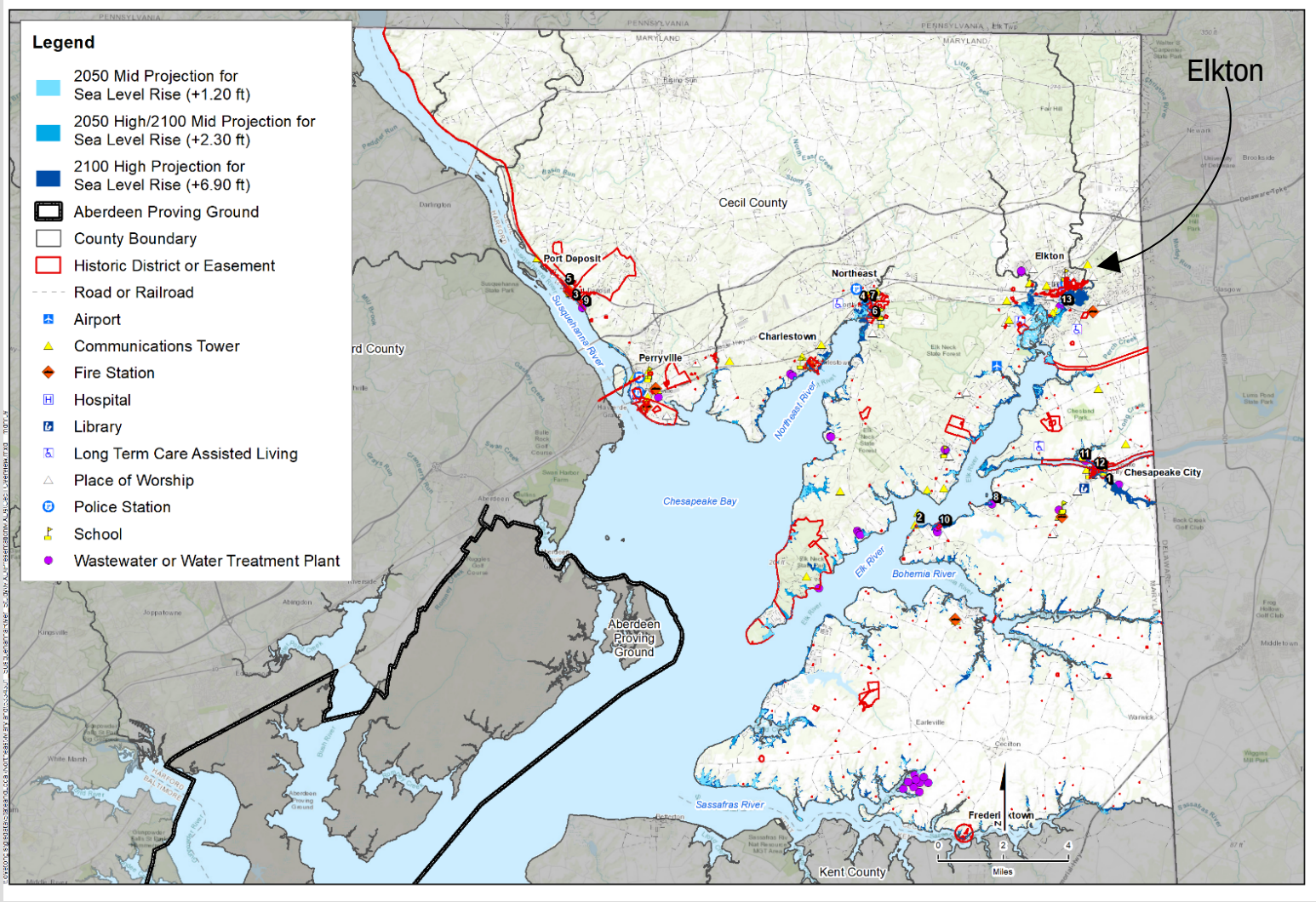
2050 High/2100 Mid SLR Scenario – 2.3 ft increase



2100 High SLR Scenario – 6.9 ft increase



Cecil County - Overview



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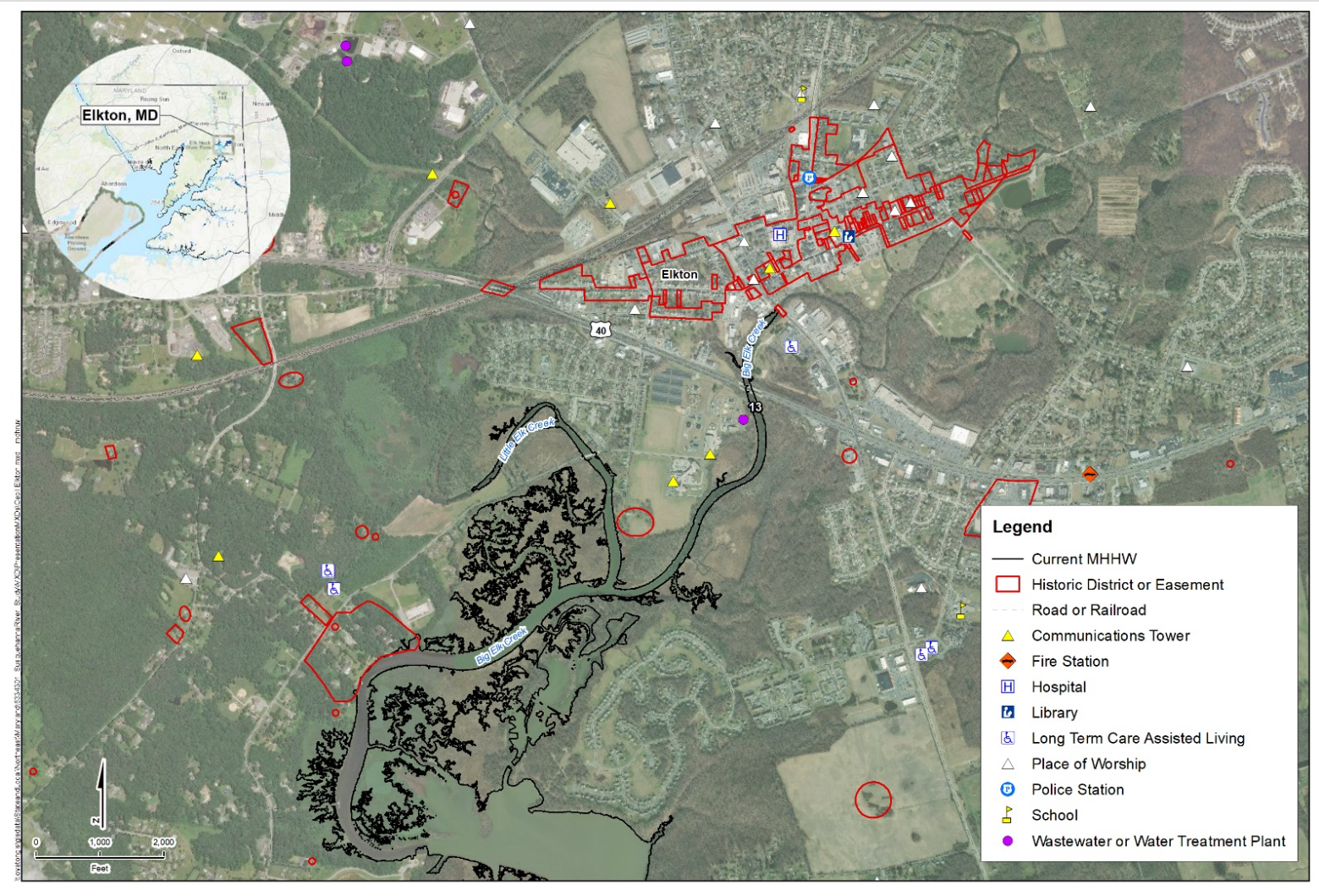

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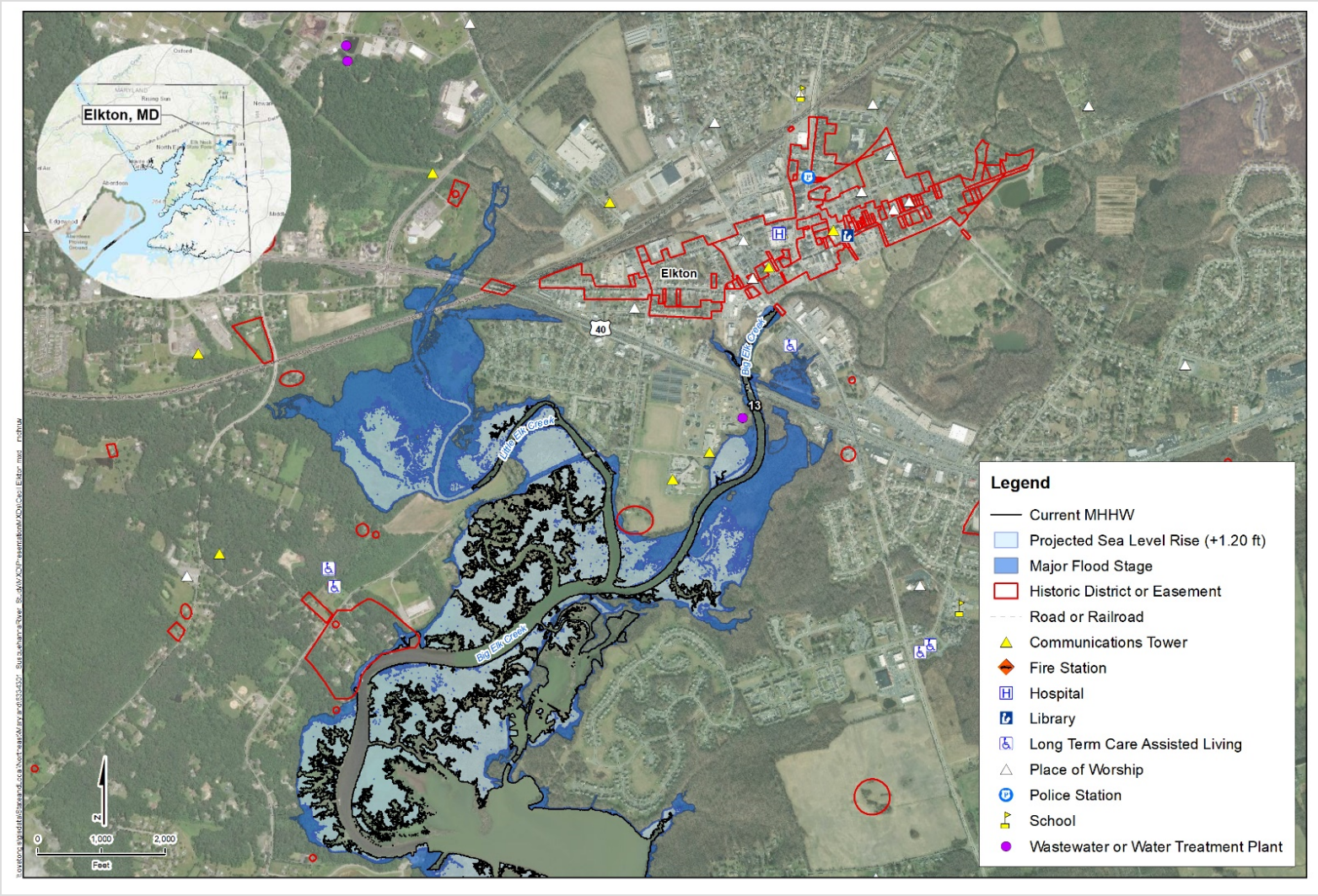

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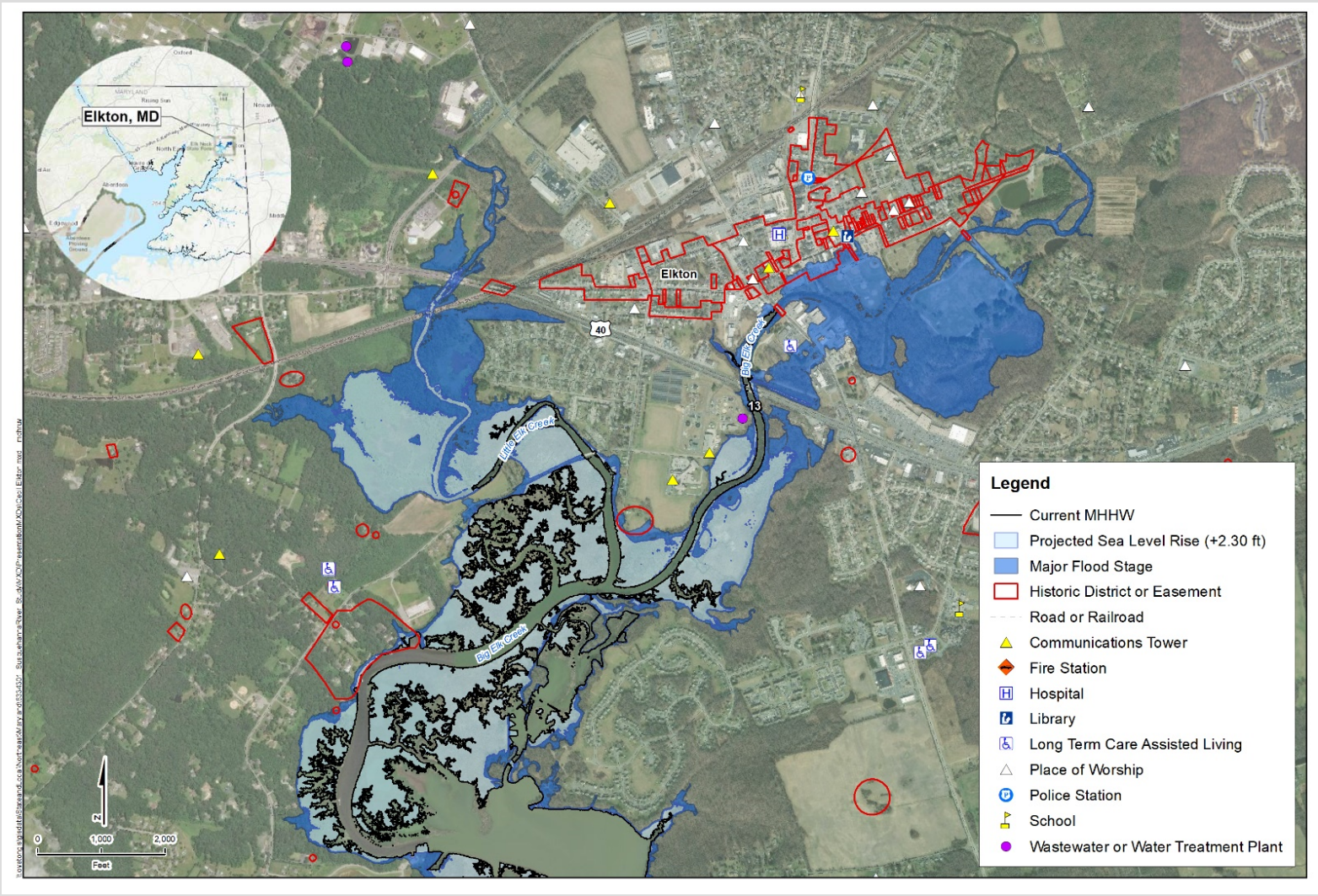

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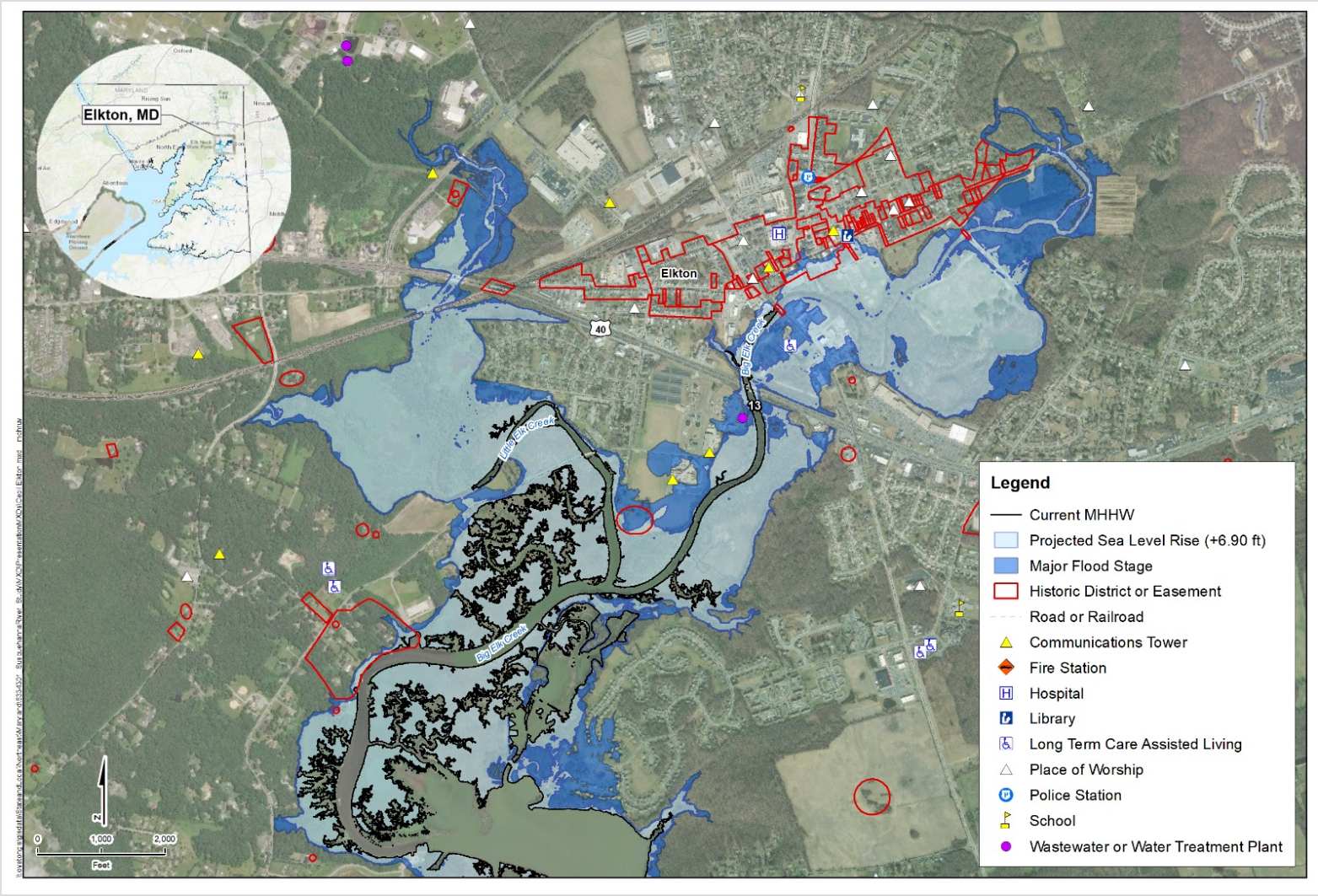


W/WW Vulnerabilities

Elevation generally more conducive to higher protection of W/WW Infrastructure in the northern Bay then in southern portion

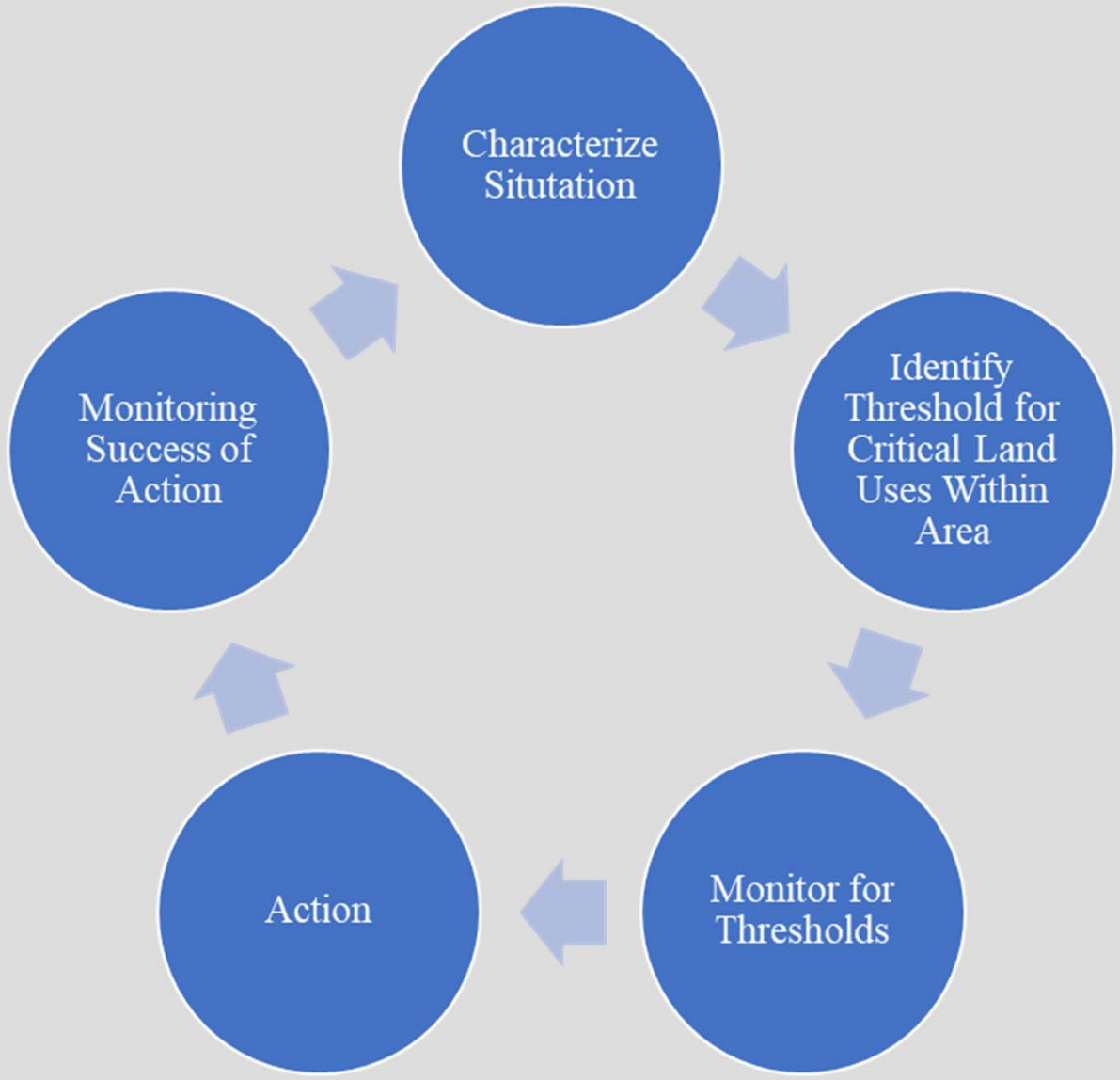
- **WWTP – Many are in lower lying areas but only a few were found to be in a critical zone up to year 2100 - Port Deposit, Harbor View, Elkton**

- **WTP – Havre de Grace**
- **Pump Stations –**

some were identified in each county

- **W/WW Linear Infrastructure – higher erosive forces and I/I in submerged conditions**

Adaptation Plan



Resilience Strategies

- **Accommodate** – Focus on altering existing structures and building new infrastructure that is better able to withstand sea level rise and storm surge

- **Protect** – Engineered solutions to decrease risks for existing structures and areas without changing existing items or features

- **Managed Retreat** – Relocation of existing structures, and areas and limit construction of new infrastructure within areas anticipated to be flooded

❖ Measures are implemented to execute the resilience strategies

Coastal Risk Reduction & Resilience Measures

Measure	Examples
Natural	Barrier islands, dunes, reefs, wetlands, and riparian corridors 
Non-Structural	Structure acquisitions or relocations, flood proofing, implementing flood warning systems, flood preparedness planning, land use regulations, development restrictions within the greatest flood hazard areas, elevated development, managed retreat, evacuation, buyout and leaseback 
Structural	Levees, storm surge barrier gates, seawalls, groins, revetments, and near-shore breakwaters 

USACE 2013

Nature-Based Measures

Dunes and Beaches

Benefits/Processes

Breaking of offshore waves

Attenuation of wave energy

Slow inland water transfer

Performance Factors

Berm height and width

Beach slope

Sediment grain size and supply

Dune height, crest, and width

Presence of vegetation

Vegetated Features

Benefits/Processes

Breaking of offshore waves

Attenuation of wave energy

Slow inland water transfer

Increased infiltration

Performance Factors

Marsh, wetland, or SAV elevation and continuity

Vegetation type and density

Barrier Islands

Benefits/Processes

Wave attenuation and/or dissipation

Sediment stabilization

Performance Factors

Island elevation, length, and width

Land cover

Breach susceptibility

Proximity to mainland shore

Maritime Forests/Shrub Communities

Benefits/Processes

Wave attenuation and/or dissipation

Shoreline erosion stabilization

Soil retention

Performance Factors

Vegetation height and density

Forest dimension

Sediment composition

Platform elevation

USACE 2013

Non-Structural Measures

Floodplain Policy & Management

Benefits/Processes

Improved and controlled floodplain development

Reduced opportunity for damages

Improved natural coast environment

Performance Factors

Wave height

Water level

Storm Duration

Agency Collaboration

Floodproofing and Impact Reduction

Benefits/Processes

Reduced opportunity for damages

Increased community resiliency

Does not increase flood potential elsewhere

Performance Factors

Wave height

Water level

Storm Duration

Relocation

Benefits/Processes

Reduced opportunity for damages

Does not increase flood potential elsewhere

Improved natural coast environment

Performance Factors

Wave height

Water level

Storm Duration

USACE 2013

Structural Measures

GENERAL COASTAL RISK REDUCTION PERFORMANCE FACTORS:
STORM SURGE AND WAVE HEIGHT/PERIOD, WATER LEVEL

Levees

Benefits/Processes

Surge and Wave attenuation and/or dissipation

Reduce Flooding

Risk Reduction for vulnerable areas

Performance Factors

Levee height, crest width, and slope

Wave height and period

Water level

Storm Surge Barriers

Benefits/Processes

Surge and Wave attenuation

Reduced Salinity Intrusion

Performance Factors

Barrier height

Wave height

Wave period

Water level

Seawalls and Revetments

Benefits/Processes

Reduce flooding

Reduce wave overtopping

Shoreline stabilization behind structure

Performance Factors

Wave height

Wave period

Water level

Scour protection

Groins

Benefits/Processes

Shoreline stabilization

Performance Factors

Groin length, height, orientation, permeability and spacing

Depth at seaward end

Wave height

Water level

Longshore transportation rates and distribution

Detached Breakwaters

Benefits/Processes

Shoreline stabilization behind structure

Wave attenuation

Performance Factors

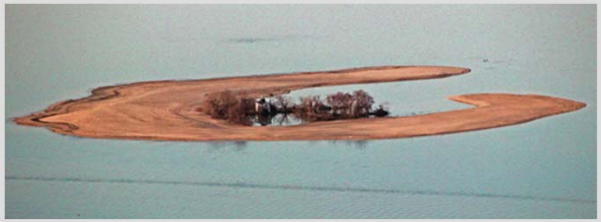
Breakwater height and width.

Breakwater permeability, proximity to shoreline, orientation and spacing

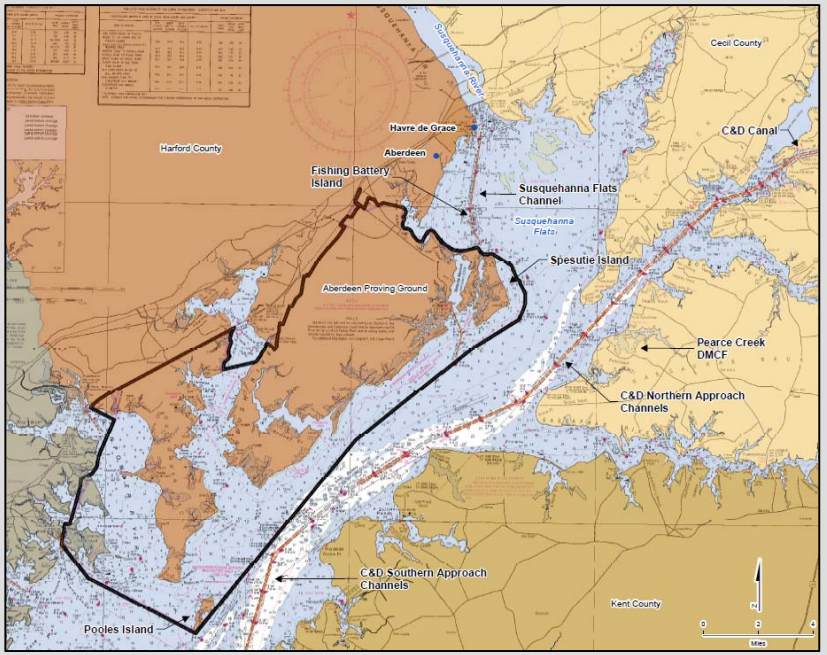
USACE 2013

Dredged Material

- Resilience strategies often require sediment
- Important considerations
  - Collaborate with dredging operations
  - Proximity of dredge operation to site
- Sediment sources within project area
  - Northern Bay channel
    - Includes USACE channel north of Pooles Island
    - Anticipate 1.2M CY of sediment per year
  - Susquehanna Flats
    - Currently dredged every 4 to 5 years
    - 200,000 CY of sediment were used to expand Battery Island



Battery Island
https://www.fws.gov/refuge/susquehanna/



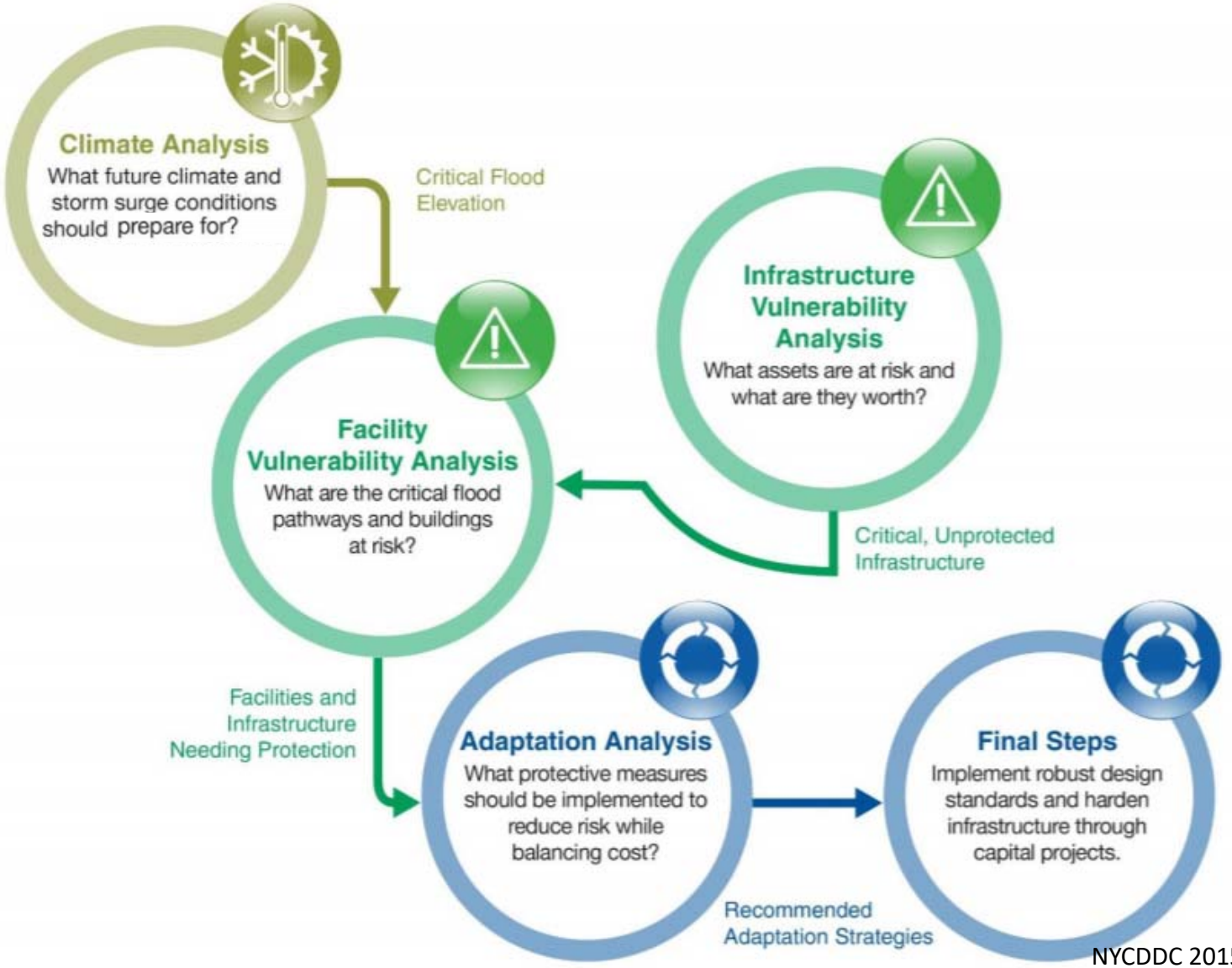
USACE

W/WW Resiliency Strategy

Phase 1
Climate Analysis

Phase 2
Vulnerability Analysis

Phase 3
Adaptation Analysis



NYCDDC 2015

W/WW Resiliency Measures

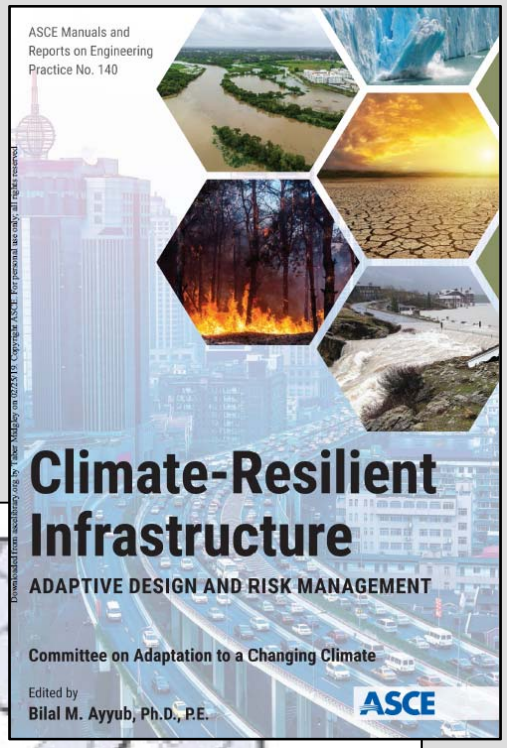
For Existing Infrastructure

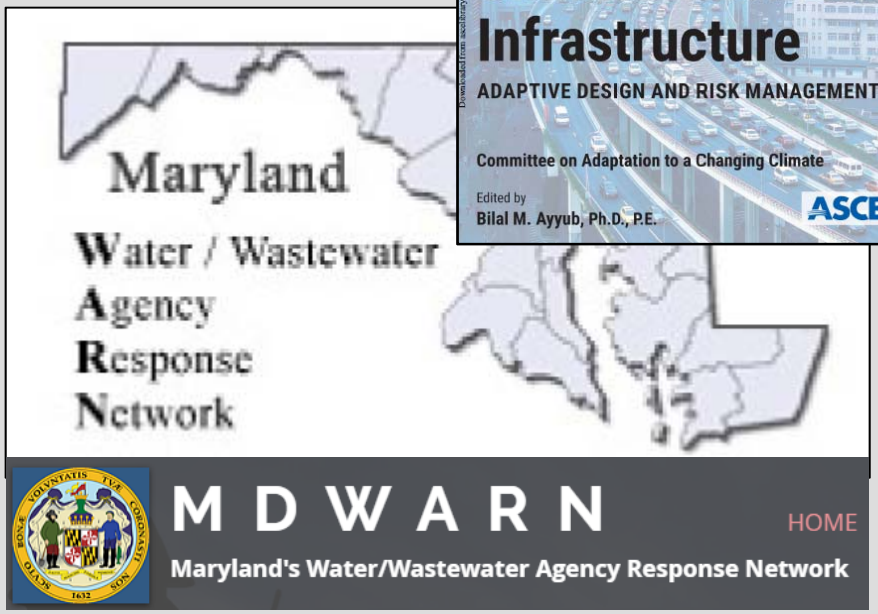
- Elevate Equipment
- Flood-Proof Equipment
- Seal Buildings
- Construct Barriers
- Temporary Measures (ex. sandbag)
- Install Backup Power

❖Emergency Response

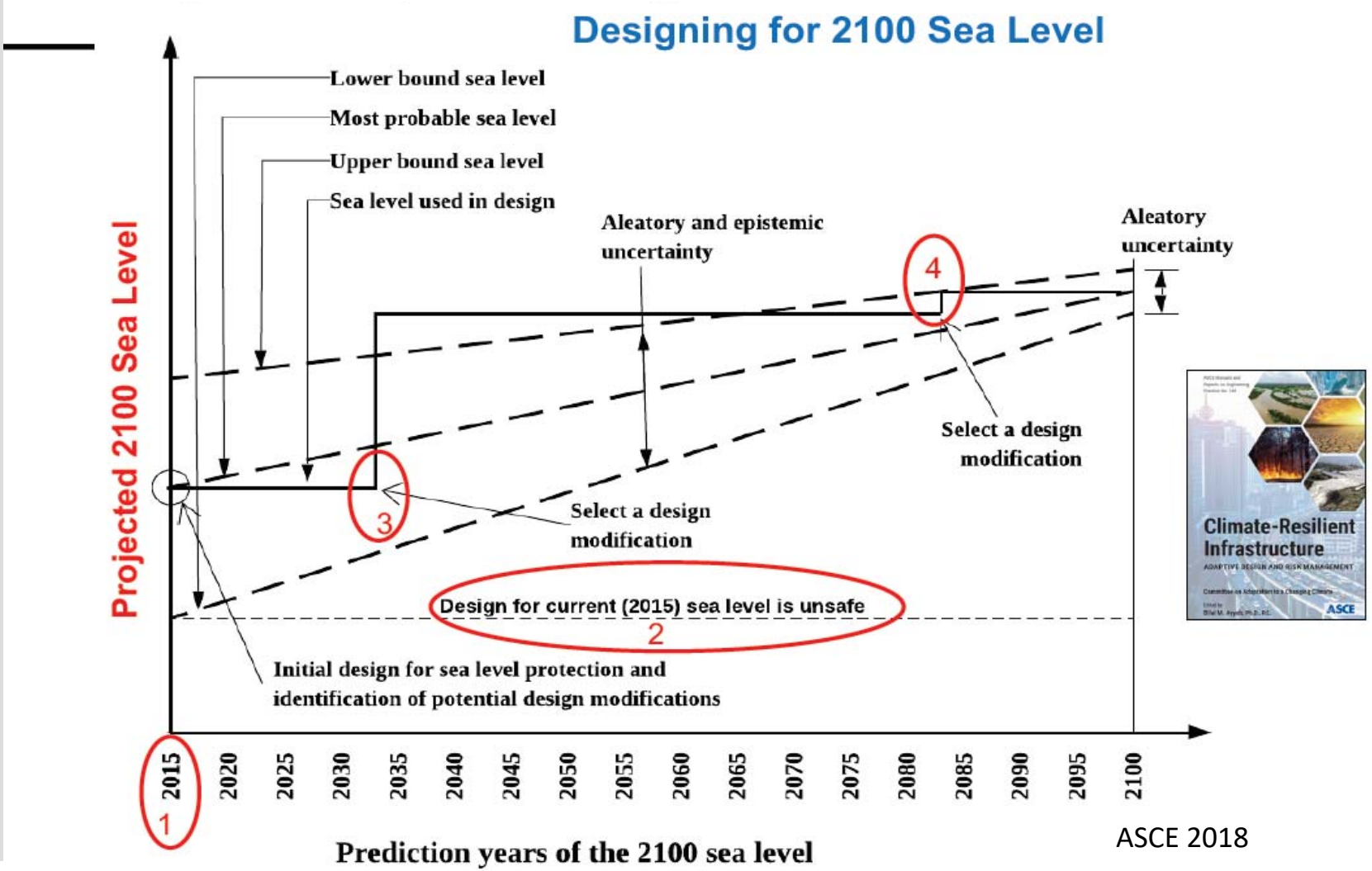
❖Planning for the Future

Adaptive Design





Adaptive Design



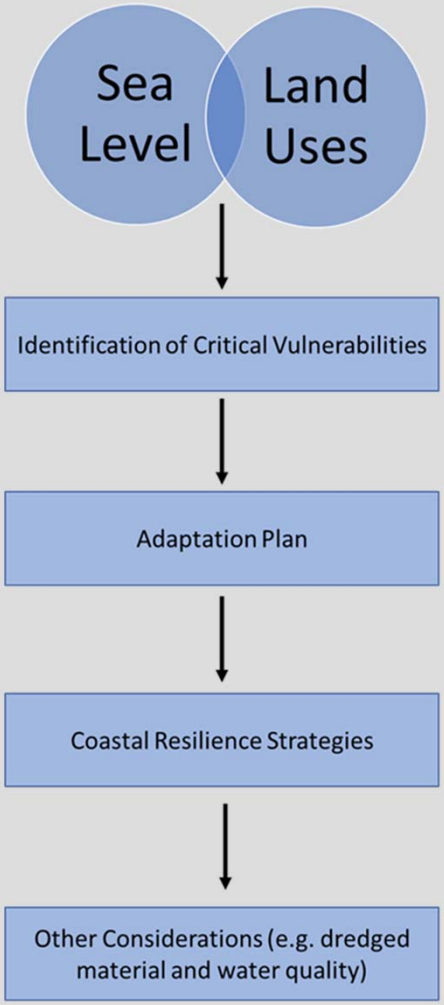
ASCE 2018

W/WW Resiliency Measures

- Prioritization based on criticality of equipment, vulnerability to flooding, and cost of 'do nothing' scenario versus benefits and costs of protective measures
- Number of vulnerable, critical assets increases with increases in sea level rise
- Final adaptation plan is usually a mix of emergency response, hardening assets and operational measures
- Based on time frame

❖ Almost 2,000 assets reviewed for Hunts Point WWTP

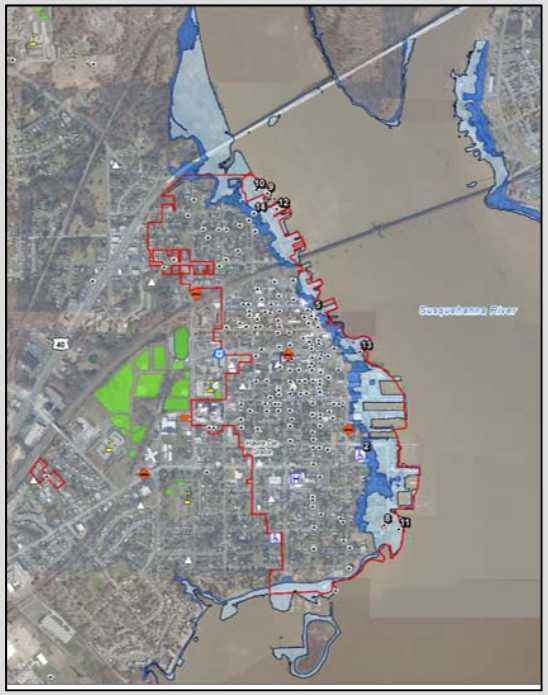
Summary



- **Information gained can be used to develop specific Adaptation plans**

https://apg-chesapeakejlus.com/157/Susquehanna-River-Impact-Accretion-Study

Thank You!



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