An Advisory Sea Level Rise (SLR) Hazard Map: Building Resiliency in Coastal Communities

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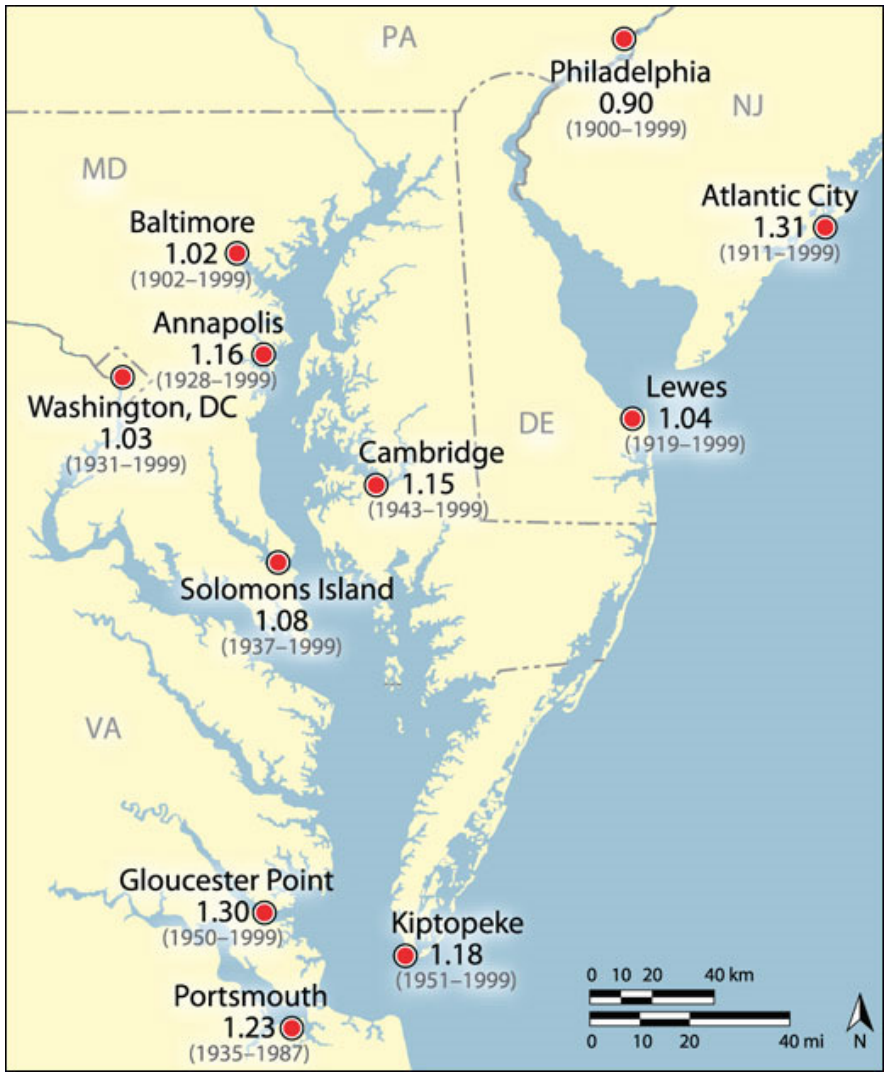
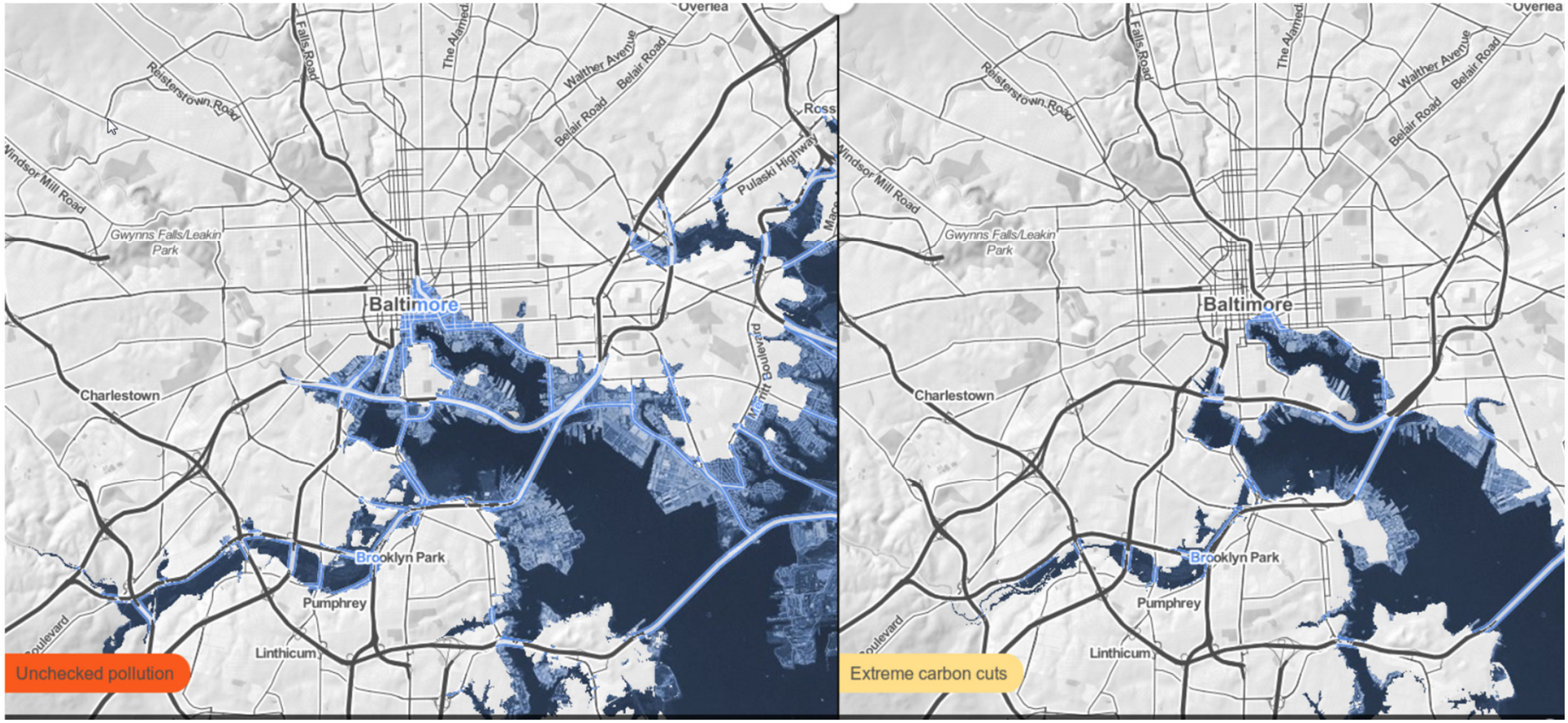
FEMA

Historic Sea Level Rise in the Bay

Report of the Maryland Commission on Climate Change Adaptation and Response Working Group, July 2008.



Local SLR Prediction Variations



Climate Central, 10/14/15
(http://www.climatecentral.org/what-we-do/our-programs/sea-level-rise)

Sea Level Rise and the NFIP

SLR is indirectly considered in the NFIP:

- Insurance contingency loadings
- FEMA's Coastal Construction Manual
  - Brief section on SLR
  - Long-term coastal erosion discussed
- NFIP Community Rating System (CRS) gives community credit for mitigation activities
- Insurance rates in V Zones consider generalized effects of long-term coastal erosion

Biggert-Waters Flood Insurance Reform Act of 2012

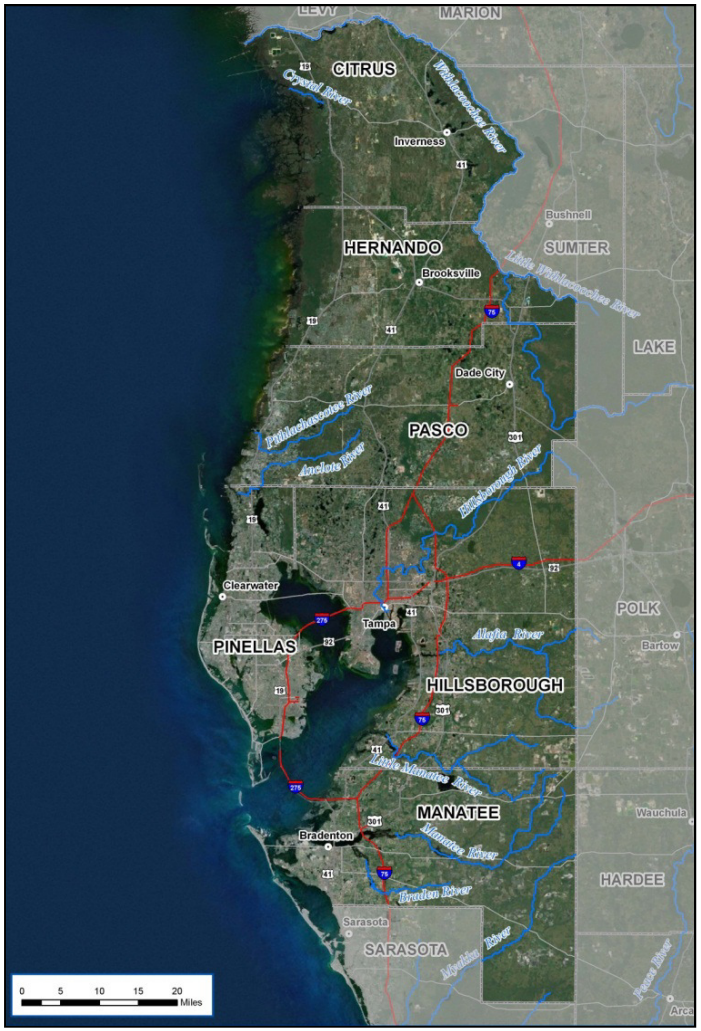
- **Section 100216:**
  - Authorizes FEMA to include climate change information when **updating** FIRMs
  - Inclusion on FIRMs done in coordination with TMAC established in Section 100215

SLR Pilot / Proof-of-Concept Studies

- **FEMA Advisory SLR Study Areas:**
  - Puerto Rico (Caribbean Sea)
  - Hillsborough and Pinellas Counties, FL (Gulf of Mexico)
  - San Francisco County, CA (Pacific Ocean)

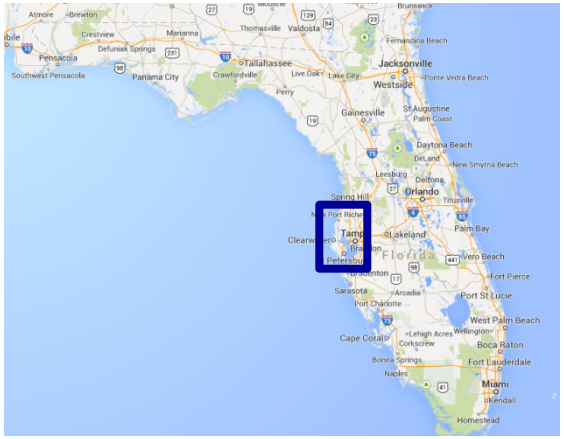
- **Goals:**
  - Work with coastal communities to produce SLR information for advisory purposes
  - Further test whether linear superposition ("bathtub approach") is adequate for NFIP flood-mapping purposes

West Florida Surge Study



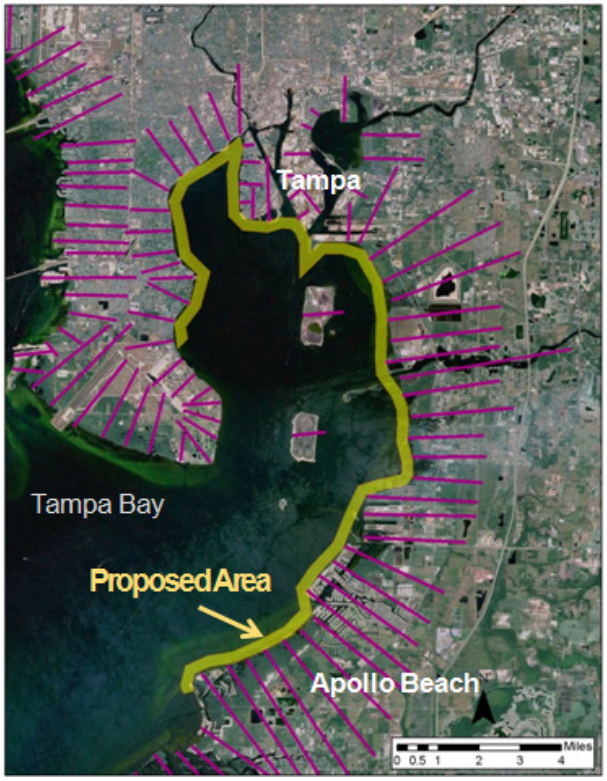
- **FY12 WFL Surge Study Area**
  - Citrus, Hernando, Pasco, Pinellas, Hillsborough, and Manatee Counties
- **SLR: Pinellas and Hillsborough**
- **Counties selected because:**
  - Enthusiasm for SLR advisory products
  - Opportunity to test different coastal environments (other than PR and CA)
  - Leverage ongoing coastal flood studies

Pilot Study Areas



Pinellas

Hillsborough



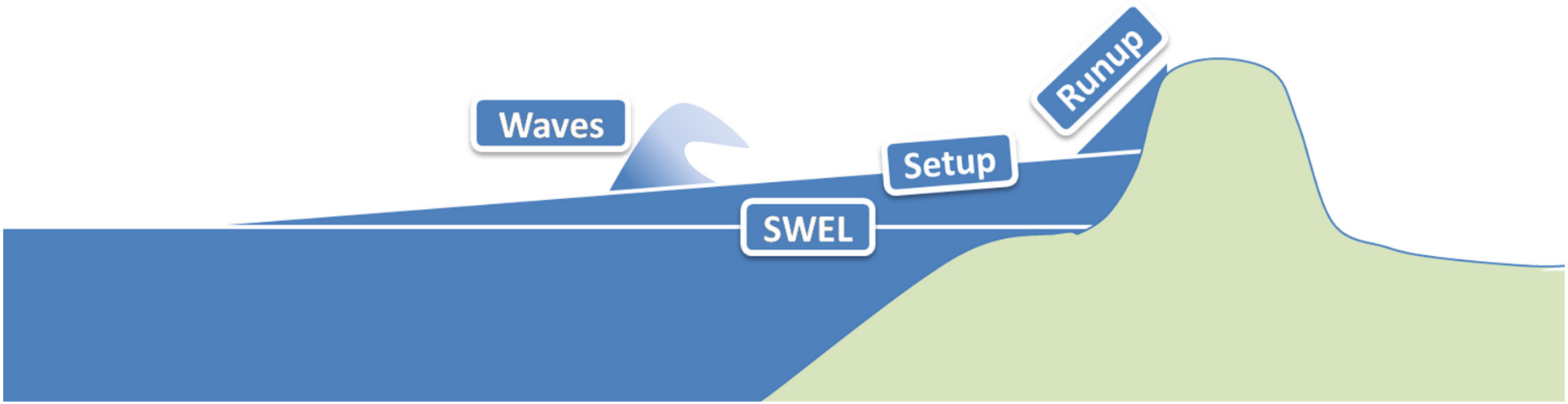
Hillsborough/Pinellas SLR Scope

- **SLR scenarios identified: Using the high scenario**
- **Comparatively evaluate changes to wave and surge**
  - Detailed method: FIS-level numerical modeling
    - 2D-Advanced CIRC and Simulating Waves Nearshore models
    - JPM-OS statistical model
    - FIS erosion assessment
    - WHAFIS and Runup 2.0
  - Approximate method: linear superposition method applied with empirical techniques
- **Produce report and FIRM-like products with BFEs**
  - Summary of statistical variance between approximate and detailed

Detailed Modeling

Challenge: Cost-effective and more accurate products

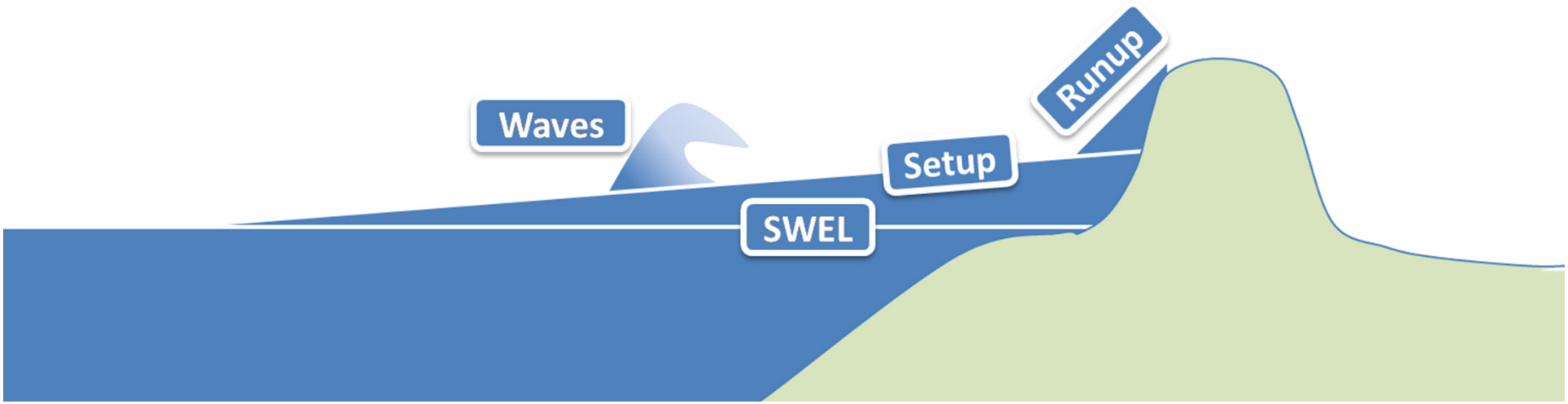
- **BFE on the FIRM includes 4 components:**
  - Storm Surge
  - Wave Setup
  - Overland Waves
  - Wave Runup



Pilot Goal

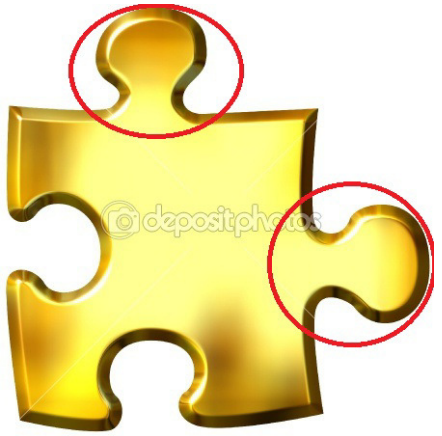
Goal: Find approximate, empirical, or geospatial modeling techniques

- Approach: Evaluate change to hazards through the FIS process
- Scaling: Use developing understanding
  - ✓ Find a multiplier to existing hazard data to capture non-linearities

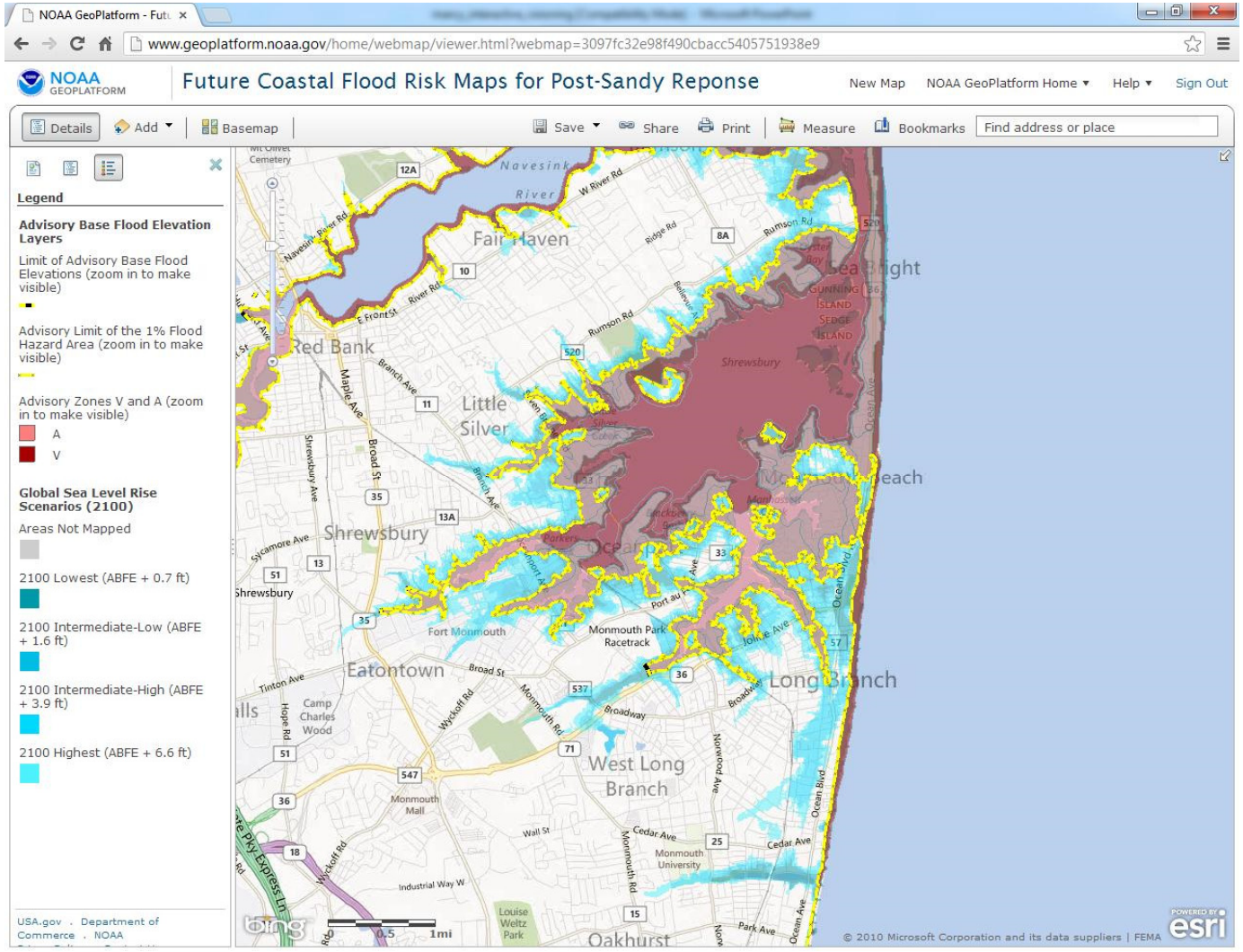


Example Sea Level Rise Tool

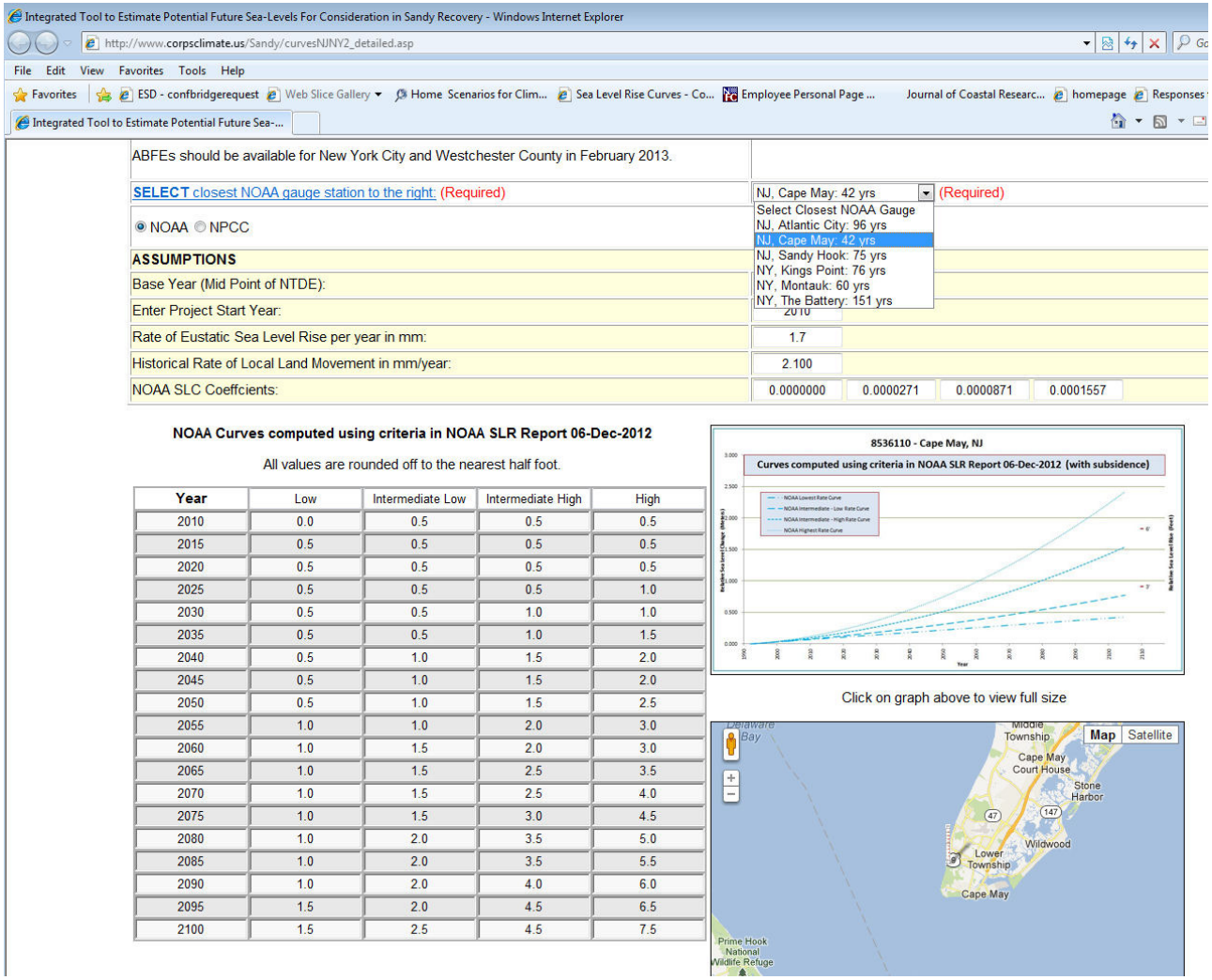
- **Two sources for SLR projections were used in the tool:**
  - NOAA-led interagency report (2012), *Global Sea Level Rise Scenarios for the United States National Climate Assessment*
  - New York City Panel on Climate Change report, *Climate Risk Information 2013: Observations, Climate Change Projections, and Maps*
- **Tool used: simplified linear superposition**
- **Tool consists of two components:**
  - ARC-GIS SLR map developed by NOAA's CSC
  - SLR Calculator developed by USACE



NOAA's Coastal Service Center

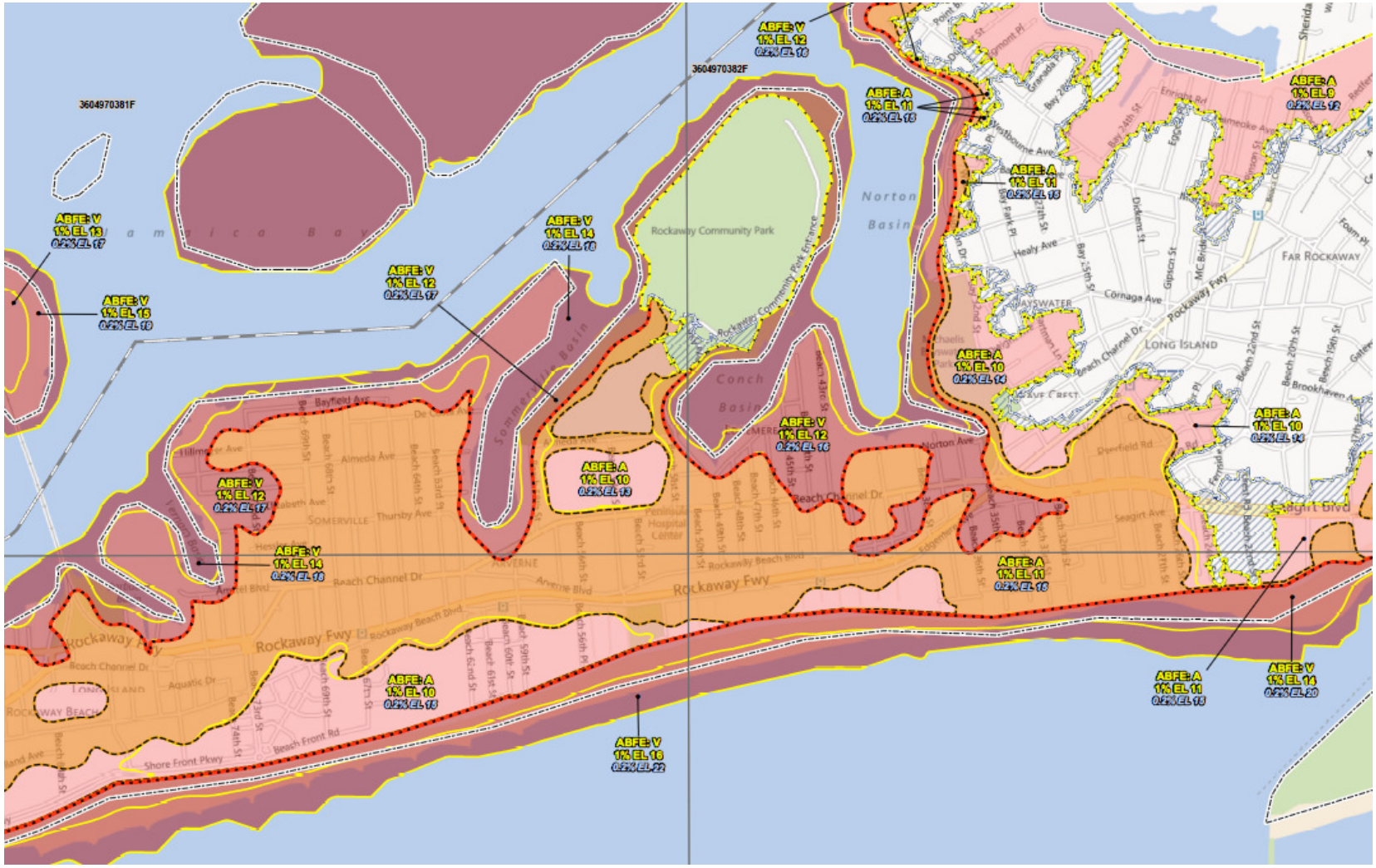


USACE Sea Level Rise Calculator



Year	Low	Intermediate Low	Intermediate High	High
2010	0.0	0.5	0.5	0.5
2015	0.5	0.5	0.5	0.5
2020	0.5	0.5	0.5	0.5
2025	0.5	0.5	0.5	1.0
2030	0.5	0.5	1.0	1.0
2035	0.5	0.5	1.0	1.5
2040	0.5	1.0	1.5	2.0
2045	0.5	1.0	1.5	2.0
2050	0.5	1.0	1.5	2.5
2055	1.0	1.0	2.0	3.0
2060	1.0	1.5	2.0	3.0
2065	1.0	1.5	2.5	3.5
2070	1.0	1.5	2.5	4.0
2075	1.0	1.5	3.0	4.5
2080	1.0	2.0	3.5	5.0
2085	1.0	2.0	3.5	5.5
2090	1.0	2.0	4.0	6.0
2095	1.5	2.0	4.5	6.5
2100	1.5	2.5	4.5	7.5

Envisioned Advisory Product Post-Sandy ABFE



Usefulness of SLR Hazard Layer

- **Existing hazard layer does not account for SLR**
  - Better knowledge supports better planning
  - Increase Communal/Organizational Resilience

What is Resilience?

The Last House Standing After Ike
Photo.Accuweather.com

Traditionally,

Ability …

to resist, absorb, accommodate to and recover from the

effects of a hazard in a timely and efficient manner,

including through the preservation and restoration of its essential basic structures and functions.

United Nations

Office for Disaster Risk Reduction

Resilience Planning Goals

- **Traditional goals:**
  - Look to past events to reduce:
    - Loss of life and injury
    - Displacement and dislocation of occupants
    - Impact on natural resources
    - Building maintenance or replacement
    - Flood insurance premiums
- **Visionary (Big Hairy Audacious) goals:**
  - Renew, Regenerate, Reorganize
    - Consider greater intensity and the What If's
    - Strive for flexibility and speed
    - Transform vs. Regress

Plan Resilience Activities

- **Big Picture: Understand Hazards**
  - Determine SLR Estimates (future scenarios)
  - Model & Map (visual aids)
- **Identify/Assess Vulnerabilities**
  - People (consider disaster behaviors)
  - Infrastructure/built environment (remember security)
  - Natural Resources (safe/livable communities)
- **Consider tolerance for damage/disruption**
- **Adaptive capacity**
  - Flexibility and speed

Solution Examples

- **Non-structural Solutions**
  - Adopt higher floodplain management standards
  - Preserve connected open space
  - Provide sea level rise inundation areas
  - Revisit evacuation routes
  - Reclassify buildings according to identified hazards
  - Encourage floodproofing in new areas
  - Review stormwater mgmt practices
  - Provide window placards

Photo from The Baltimore Sun 2014 article "Get Ready for Disasters, Baltimore Residents Urged"

SLR Inundation Area Plan

- **Plans include a vision for the future**

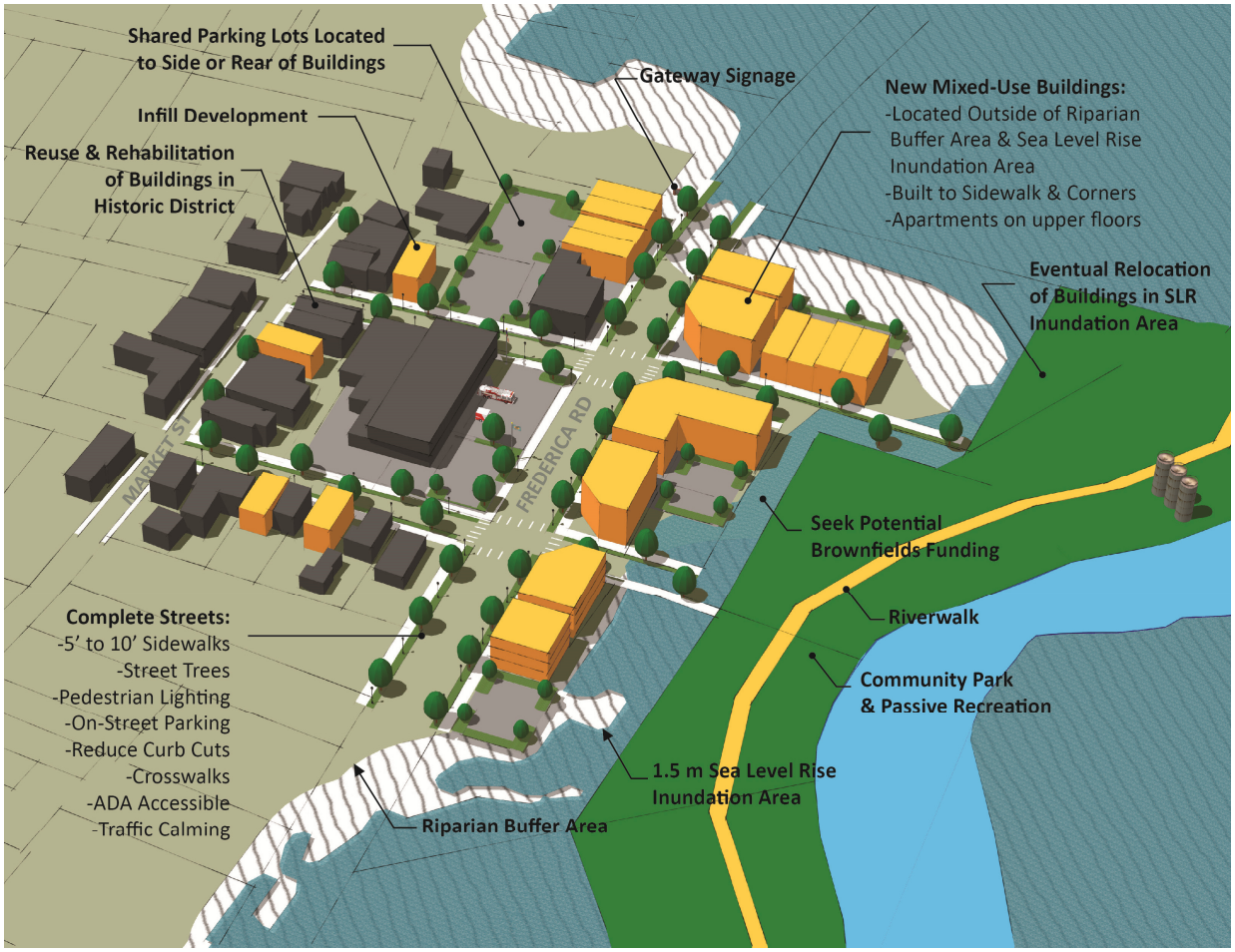
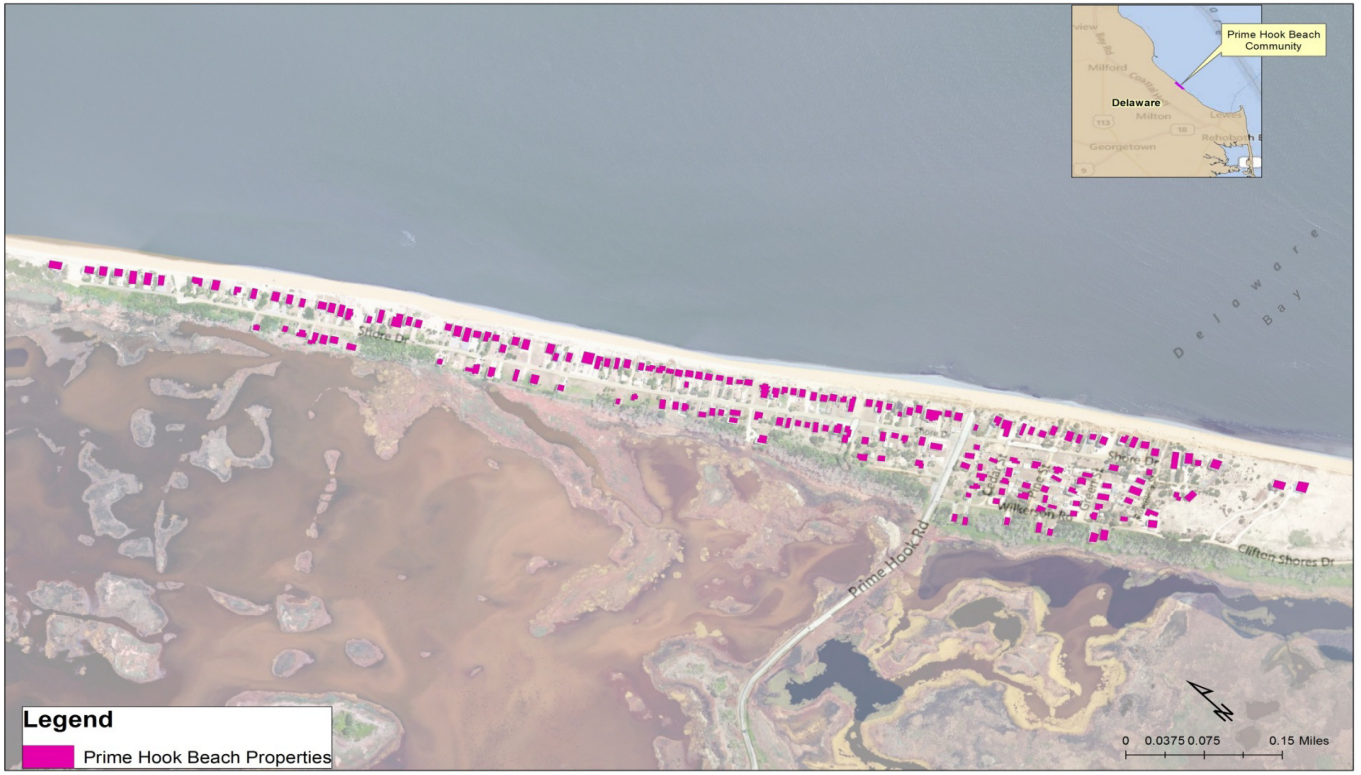


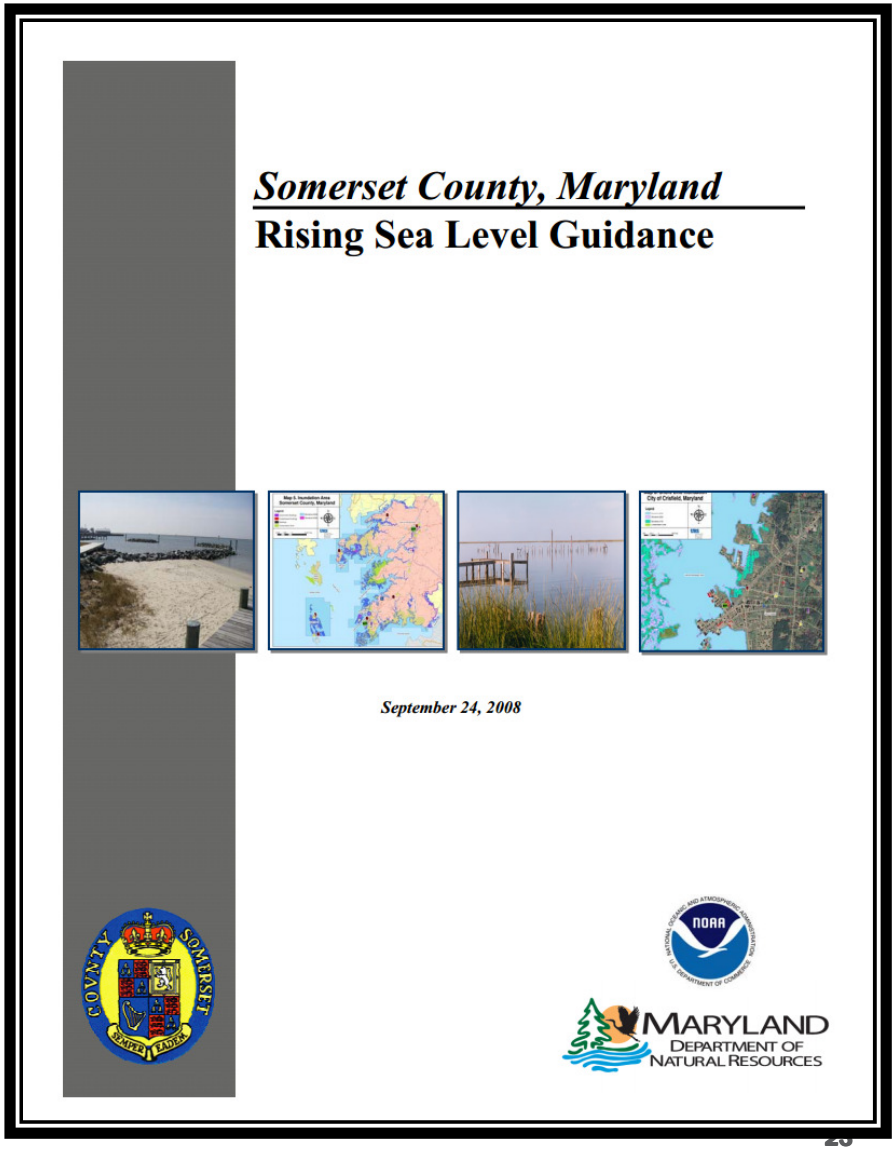
Image: Frederica, DE Development Plan

Evaluate Adaptive Options

- **Prime Hook, DE: 185 properties funded by DNREC**
  - Inventoried flooded homes & performed field visits of most impacted
  - Evaluated adaptation options



Guidance/Planning



- **Funding:**
  - Grant from MD Dept. of Natural Resources
- **Goal:**
  - Assess vulnerability to SLR
  - Develop revisions to plans, codes, and regulations to mitigate impacts
- Method:
  - Estimated 2050 inundation levels
    - Average historical sea level rise rates for area
    - Annual rate of shoreline erosion
    - No surge modeling included in this estimate

Guidance/Planning (cont'd)

- **Example recommendations:**
  - Require 2 foot free board for new/substantially-improved buildings
  - Adopt a floodplain planning zone
  - Recognize wetlands migrate inland, groundwater levels rise, & saltwater intrudes
  - Develop policy to encourage physical relocation of sound buildings and for handling abandoned private buildings and lands
  - Identify roads for elevation or low-water crossings

Solution Examples

- **Mitigation structures**
  - Living Shorelines
  - Beach Nourishment
  - Jetties or Groins
  - Small shoreline protection structures
  - Deployable floodwalls
  - Levees and large floodwalls
  - Storm Surge Barrier Systems

Living Shoreline

- **Use plants, sand, stone, oyster reefs, etc. to develop expanded "living shoreline"**
  - Provide stabilization of the shoreline
  - Creation of an expanded natural habitat

Example before and after shots from NOAA (http://www.habitat.noaa.gov/restoration/techniques/livingshorelines.html)

Small Shoreline Structures

- **Seawalls, revetments, bulkheads**
  - stabilize shoreline and provide erosion control
- **Existing structures**
  - Evaluated
  - Can be raised to provide additional protection

Waterfront retaining wall restoration done by AECOM in Avalon, CA

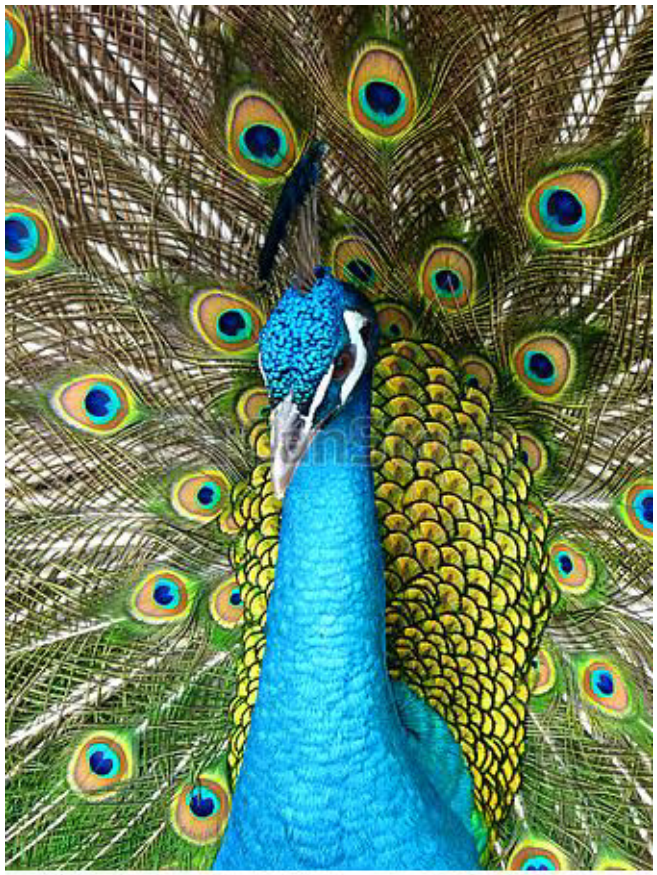
Deployable Floodwall

- **Temporary floodwalls**
  - Less expensive than permanent floodwalls
  - Need to be actively deployed.

FEMA Publication #551 Selecting Appropriate Mitigation Measures for Floodprone Structures (http://www.fema.gov/media-library-data/20130726-1608-20490-6445/fema551_ch_05.pdf)

Summary

- **Good decisions can't be made without facing our challenges**
- **Forward looking data**
  - Facilitates good decisions
- **Think Big Hairy Audacious goals**
  - Be flexible and watch for transformative opportunities
- **Next step is to implement and measure your success**



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Questions

Thank you for your interest!

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