Coastal Flood Modeling Issues in Delaware

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Difference between types of flood modeling

- Riverine
- Coastal
- Deterministic
- Probabilistic

Products and applications of flood modeling

- Flood risk mapping
- Design of projects both coastal and non-coastal
- SLOSH and ADCIRC Event forecasting

## Limitations in the modeling commonly used in Delaware

- Lack of resources to run models for individual storms
- Lack of data
- Models often are not robust enough
- Many forecasting models predict output for the Atlantic Ocean or Delaware Bay (not inland bay or barrier island backside locations)

## Coastal management challenges created by insufficient modelling

- Impacts from forecasted events on specific locations very difficult to predict
- Dunes and beaches change seasonally or due to events – risk changes constantly
- Storm parameters which influence impacts complex (storm duration, wind direction, wave heights, wave period, wave direction, inland propagation of surge through inlets and rivermouths, astronomical tide influence, Dune topography,

Where are improvements most needed?

# National Storm Surge Hazard Maps

NOAA/NWS/NHC Storm Surge

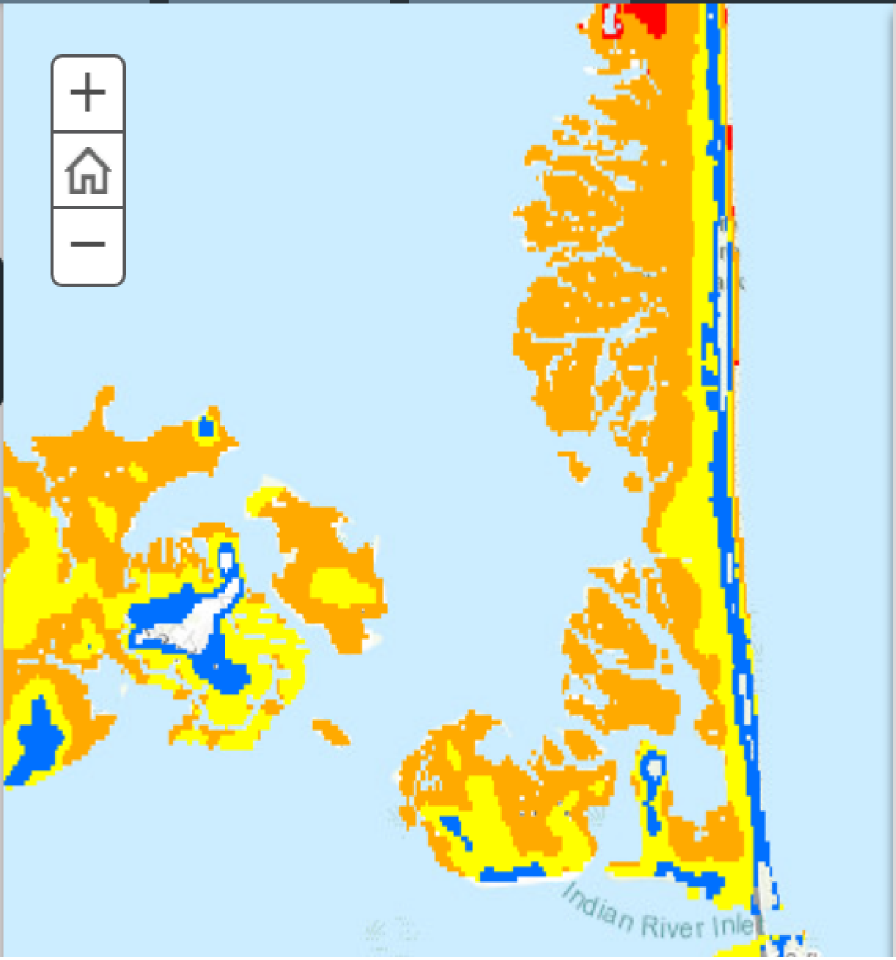
This is not a real-time product. For active tropical cyclones, please see hurricanes.gov and consult local products issued by the National Weather Service

Texas to Maine | Puerto Rico

Category 1 | Category 2 | Category 3 | Category 4 | Category 5

**How this map was created:**

The SLOSH (Sea, Lake, and Overland Surges from Hurricanes) model is a numerical model used by NWS to compute storm surge. Storm surge is defined as the abnormal rise of water generated by a storm, over and above the predicted astronomical tides. Flooding from storm surge depends on many factors, such as the track, intensity, size, and forward speed of the hurricane and the characteristics of the coastline where it comes ashore or passes nearby. For planning purposes, the NHC uses a representative sample of hypothetical storms to estimate the near worst-case scenario of flooding for each hurricane category.



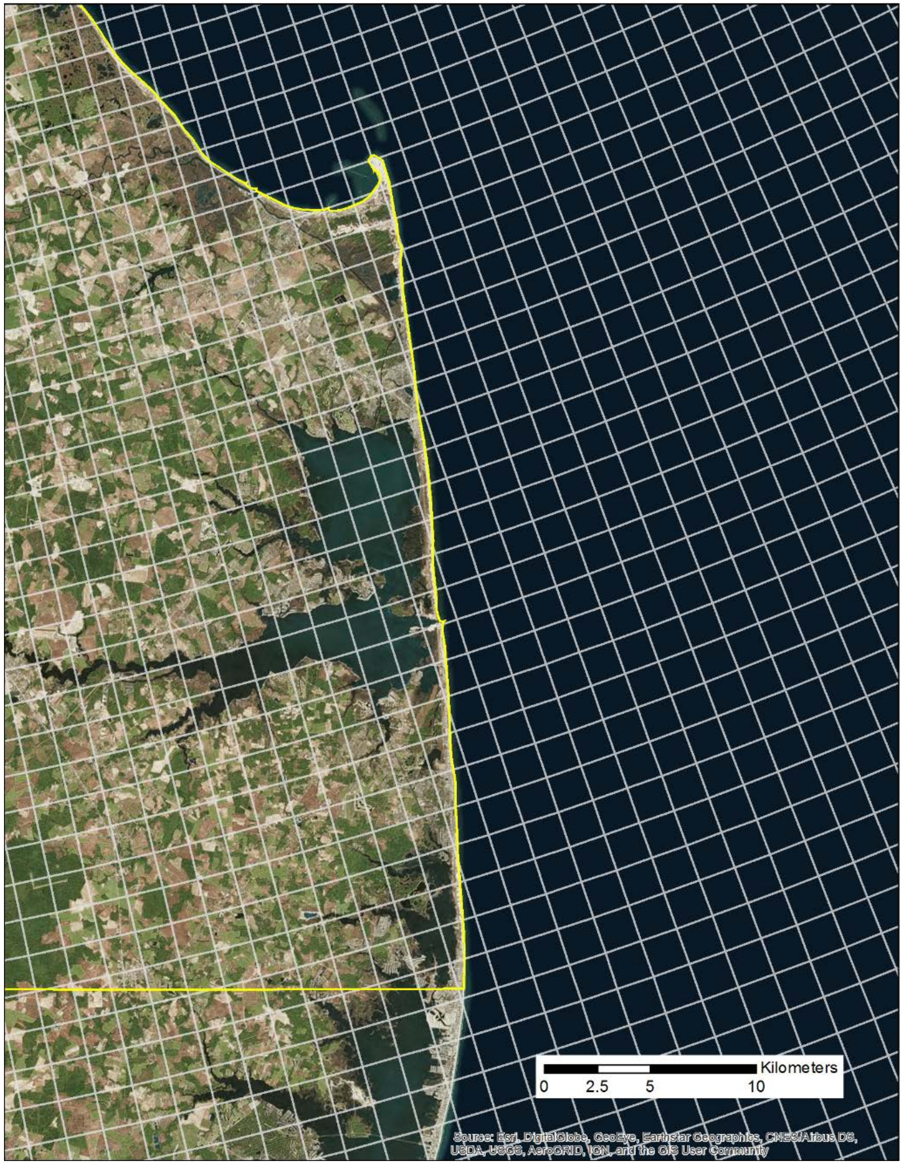

LEGEND

**Category 2 (SLOSH MOMs) Storm Surge Inundation**

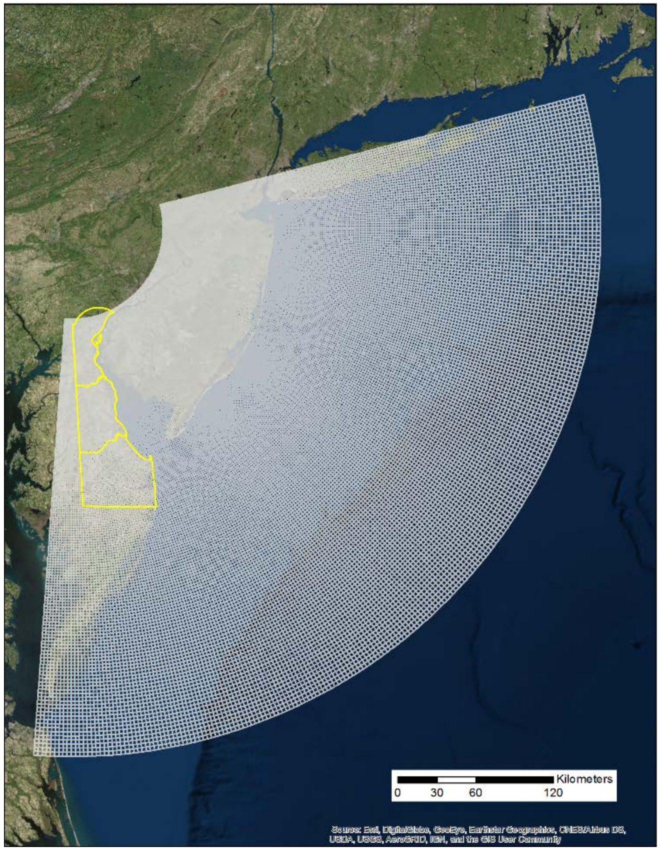
Inundation Height

- Up to 3 feet above ground
- Greater than 3 feet above ground
- Greater than 6 feet above ground
- Greater than 9 feet above ground

# SLOSH grid in Delaware

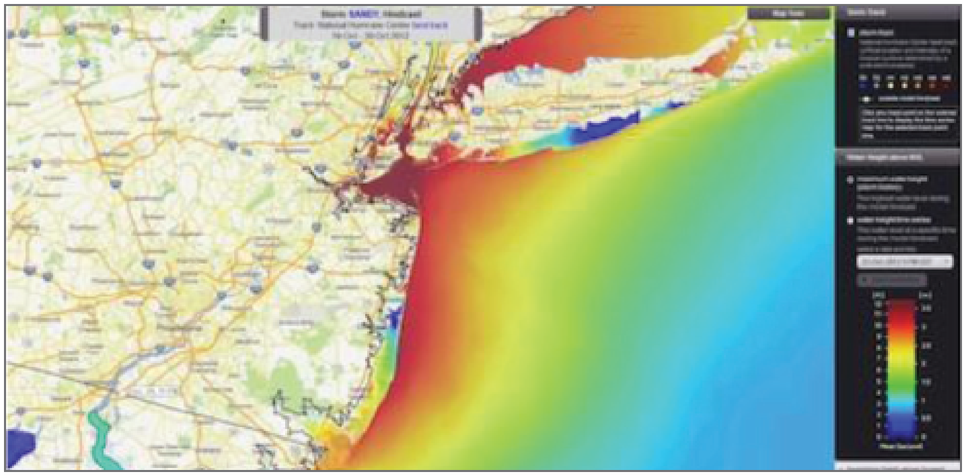



- 1.5 $km^2$ elements at Cape Henlopen
- 1.7 $km^2$ elements at Fenwick Island



## ADCIRC Predicts Floods

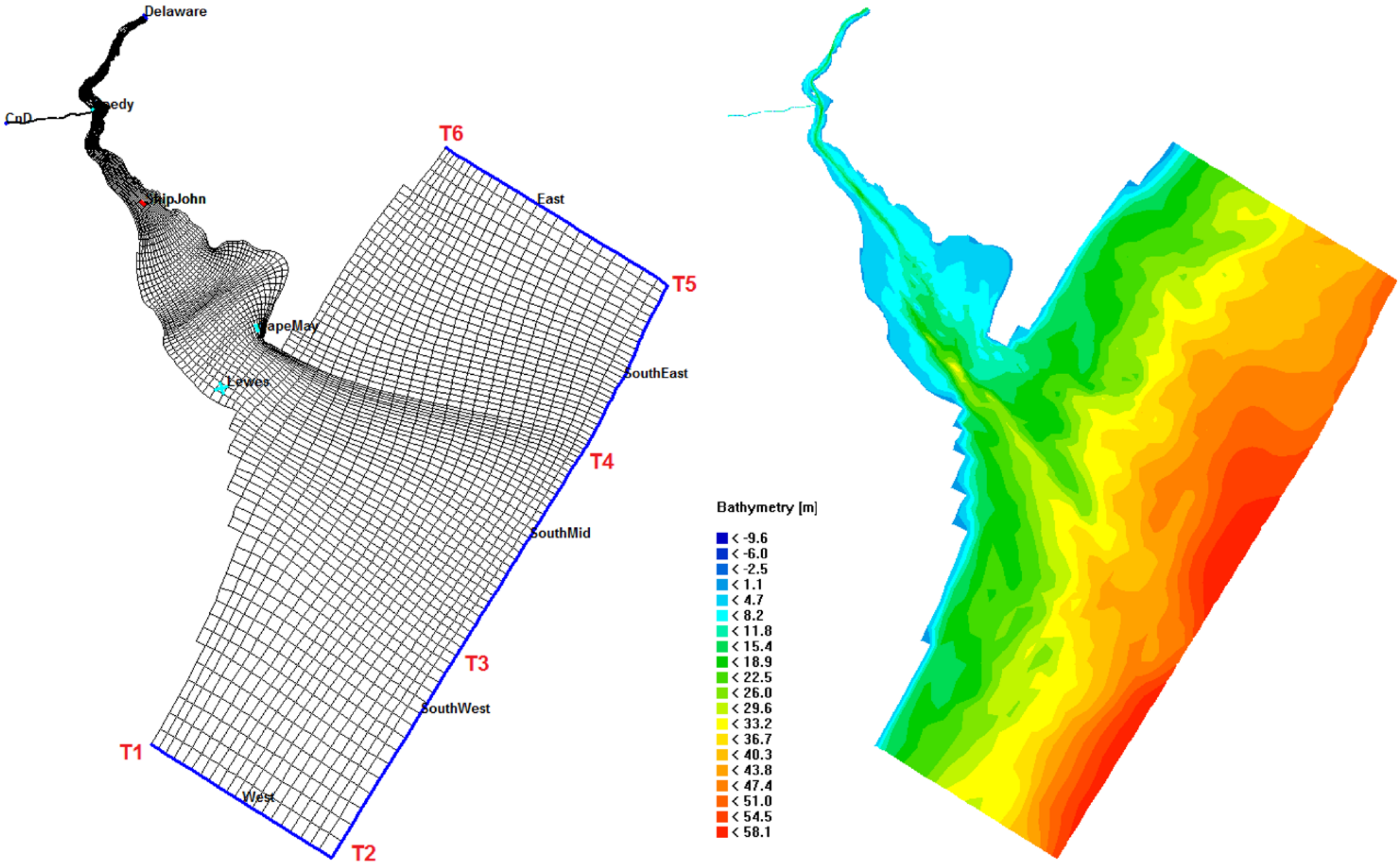
The **ADvanced CIRCulation (ADCIRC) storm surge model**[*] combines rain, atmospheric pressure, and wind forecasts to predict when, where, and to what extent flooding will inundate a coastal community with greater precision than other available models. This enables decision-makers to identify which locations to evacuate as a storm approaches and to plan for mitigation and response before severe storms occur.



*Maximum Water Inundation Forecast, Hurricane Sandy, Oct. 22, 2012, 8:00pm EDT*

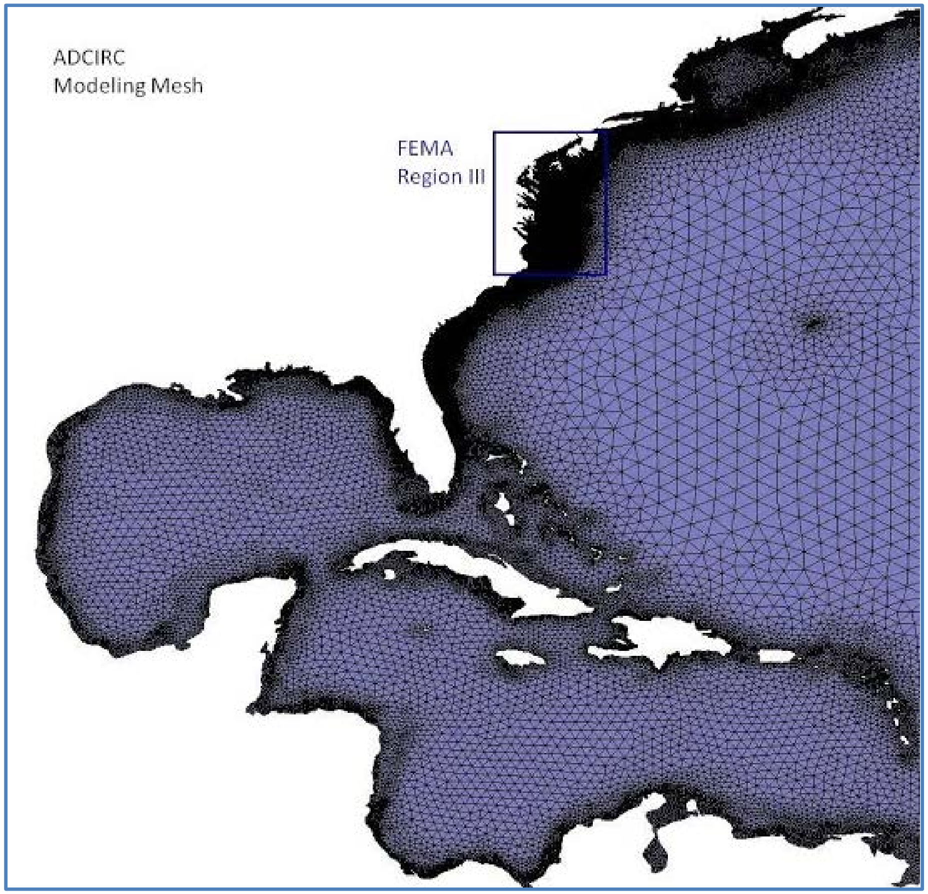
## The ADCIRC Model is Used to:

- Inform nearshore marine operations
- Predict hurricane storm surge and flooding
- Model oil spill movement in nearshore areas
- Model tides and wind-driven water circulation
- Model the impact of potential sea level rise on coastal communities



Delaware
CnD
T6
East
T5
SouthEast
Lewes
T4
SouthMid
T3
SouthWest
T1
West
T2
Bathymetry [m]
< -9.6
< -6.0
< -2.5
< 1.1
< 4.7
< 8.2
< 11.8
< 15.4
< 18.9
< 22.5
< 26.0
< 29.6
< 33.2
< 36.7
< 40.3
< 43.8
< 47.4
< 51.0
< 54.5
< 58.1

# ADCIRC grid – FEMA modeling




- Unstructured mesh
- Refined near area of interest and around areas of changing topobathy

# ADCIRC grid – FEMA modeling

- Nominal 50-100m minimum resolution
- Static topobathy
- No validation in Delaware Inland Bays

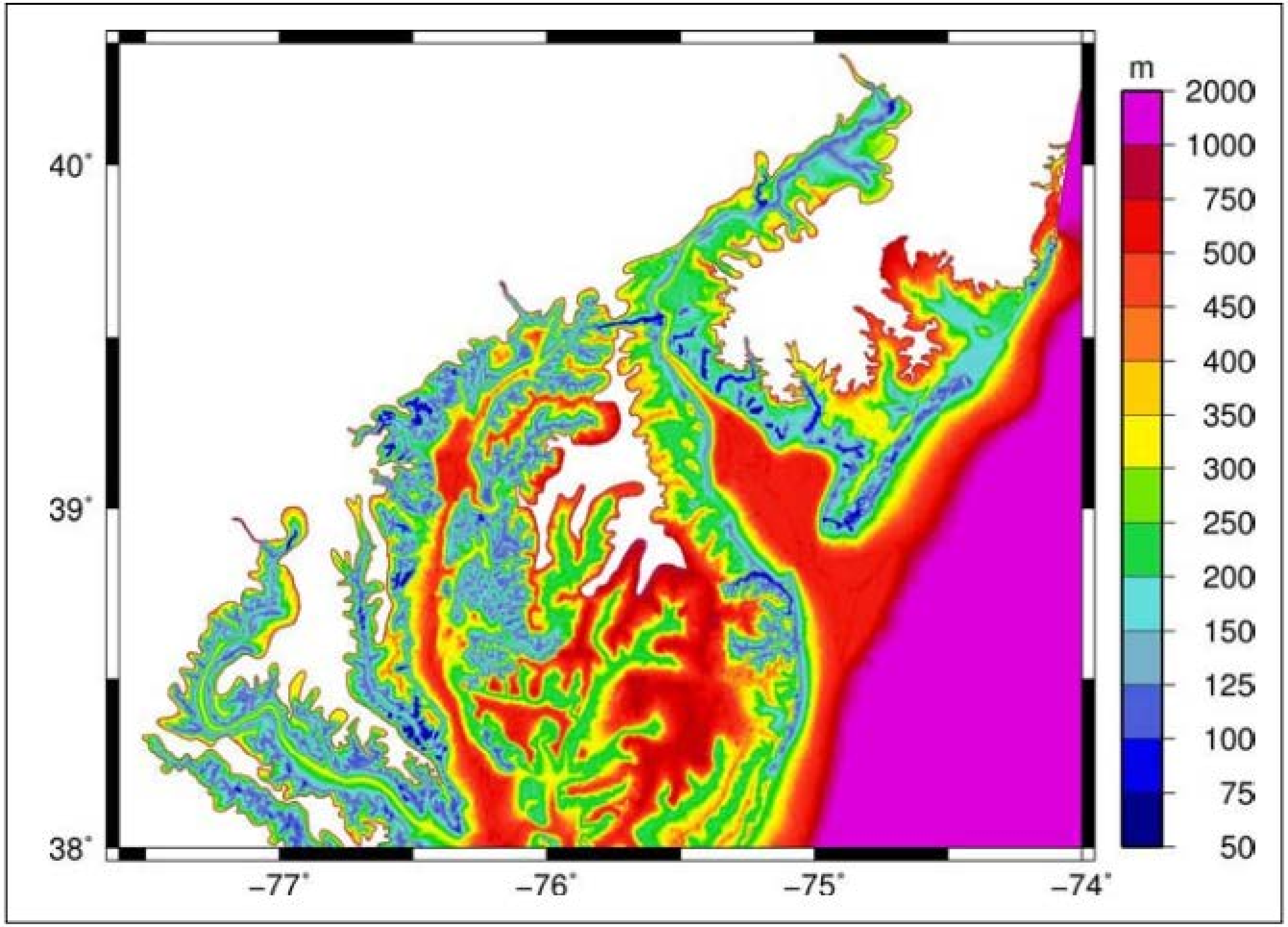
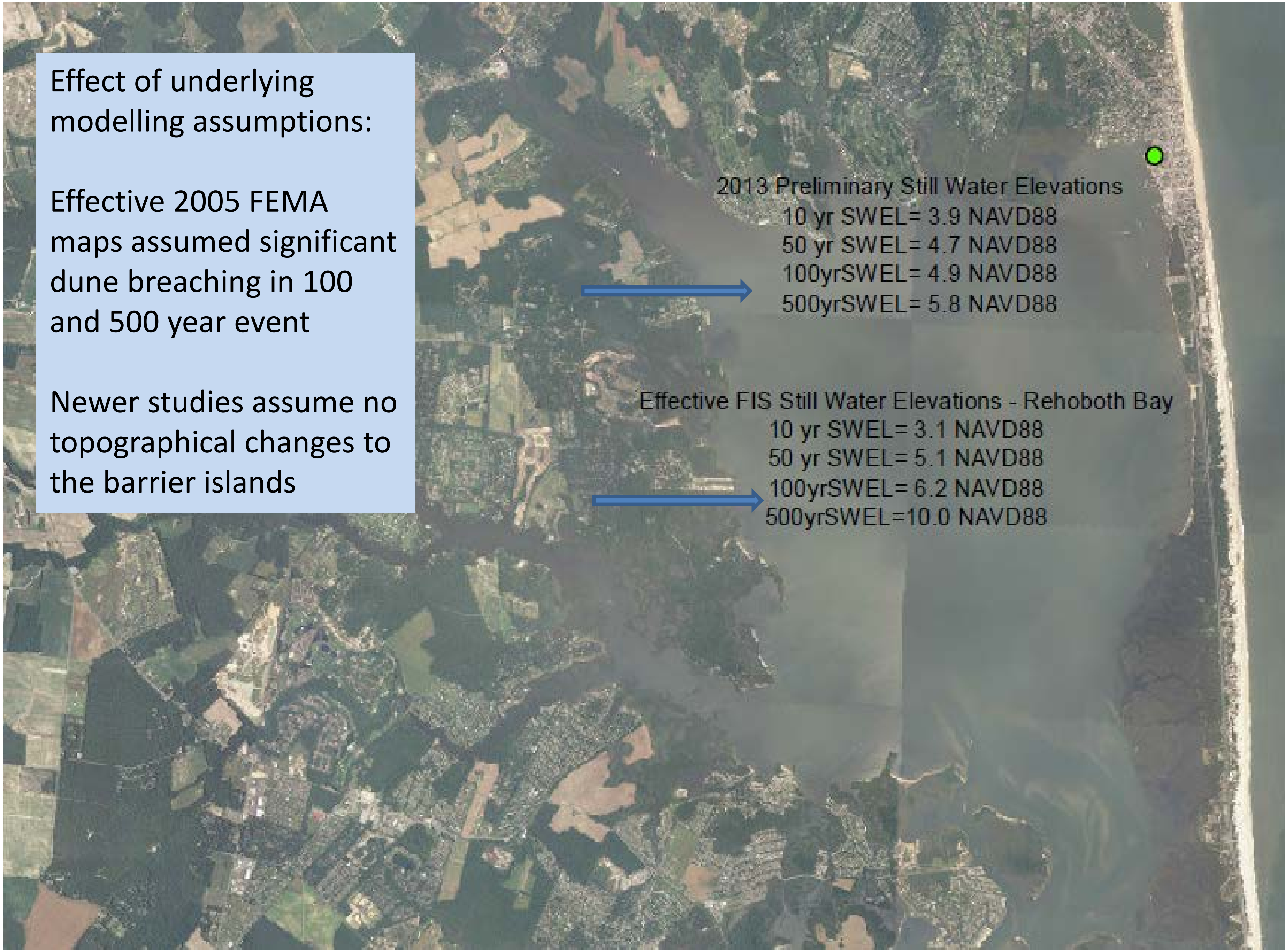



**Figure 2.11 ADCIRC mesh element resolution in meters in the northern portion of the FEMA Region III domain. Brown lines denote mesh boundaries.**

Effect of underlying modelling assumptions:

Effective 2005 FEMA maps assumed significant dune breaching in 100 and 500 year event

Newer studies assume no topographical changes to the barrier islands



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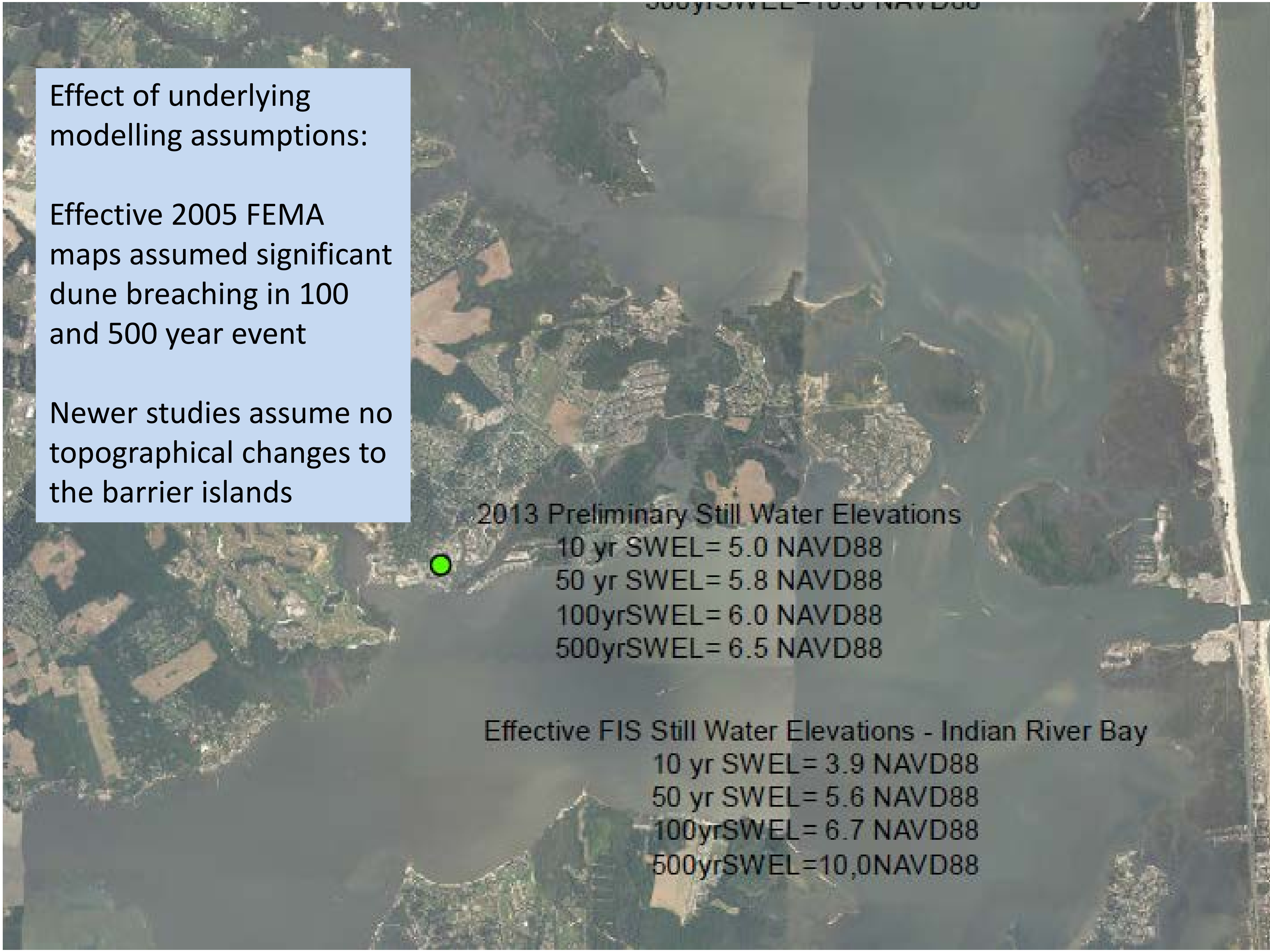

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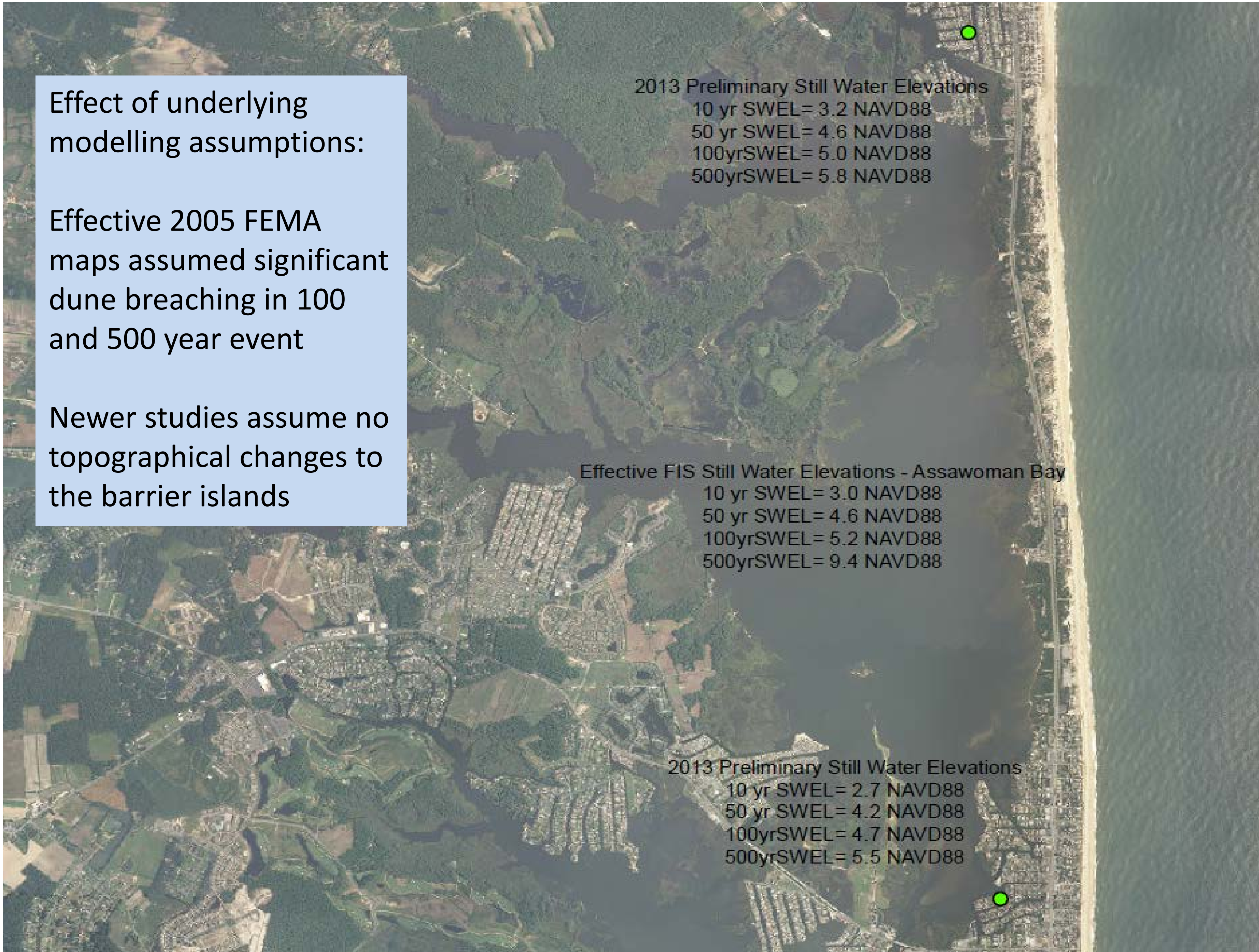

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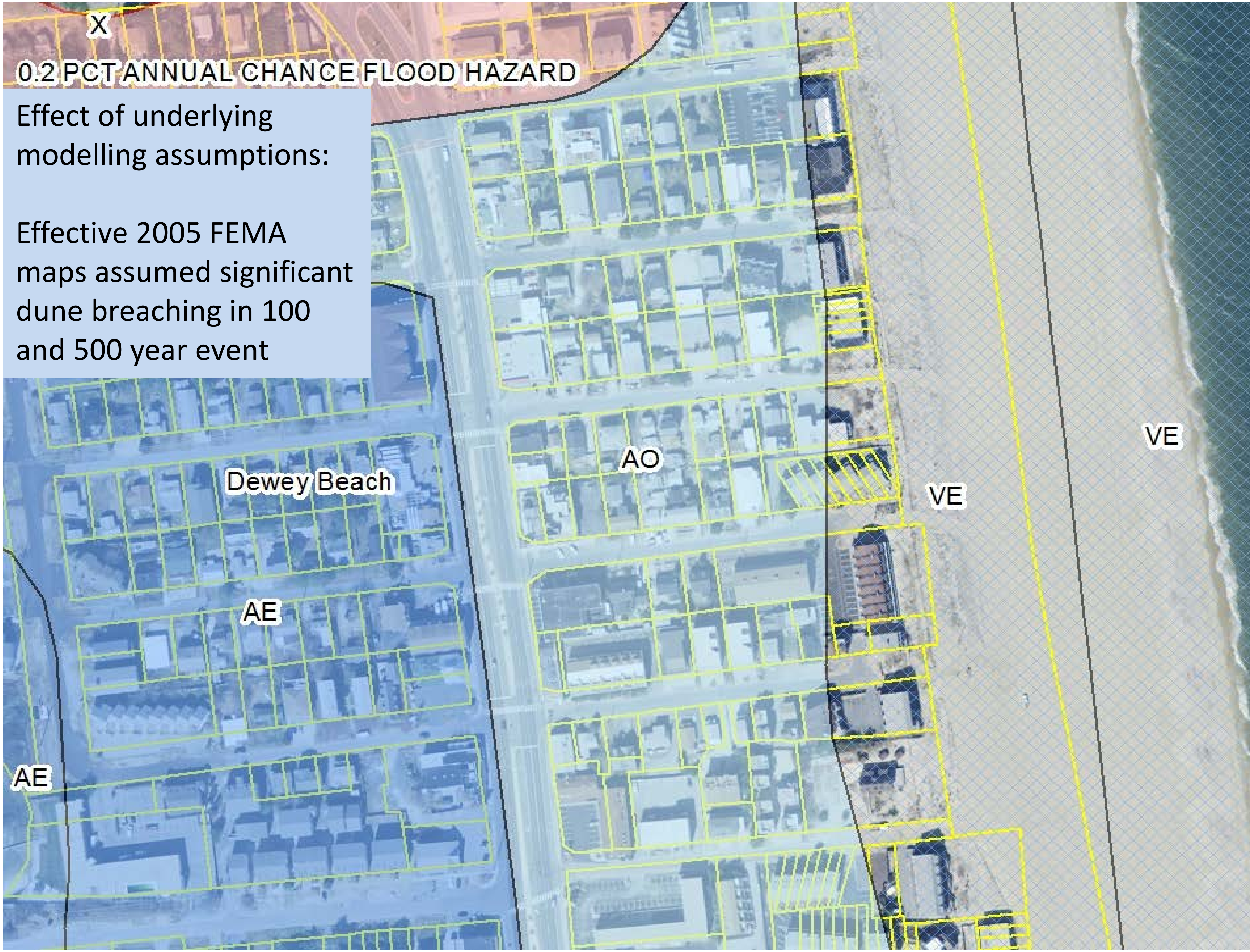
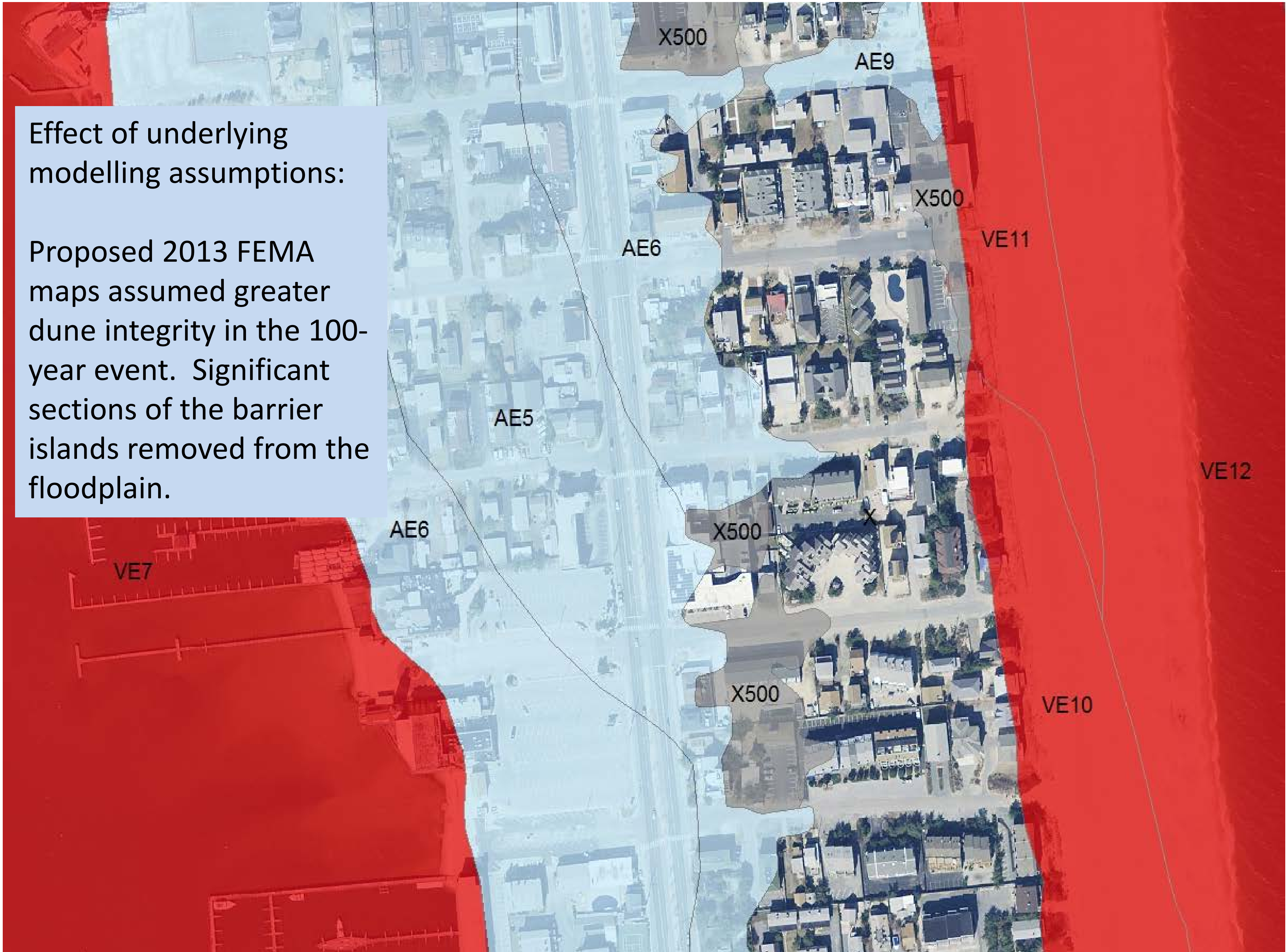
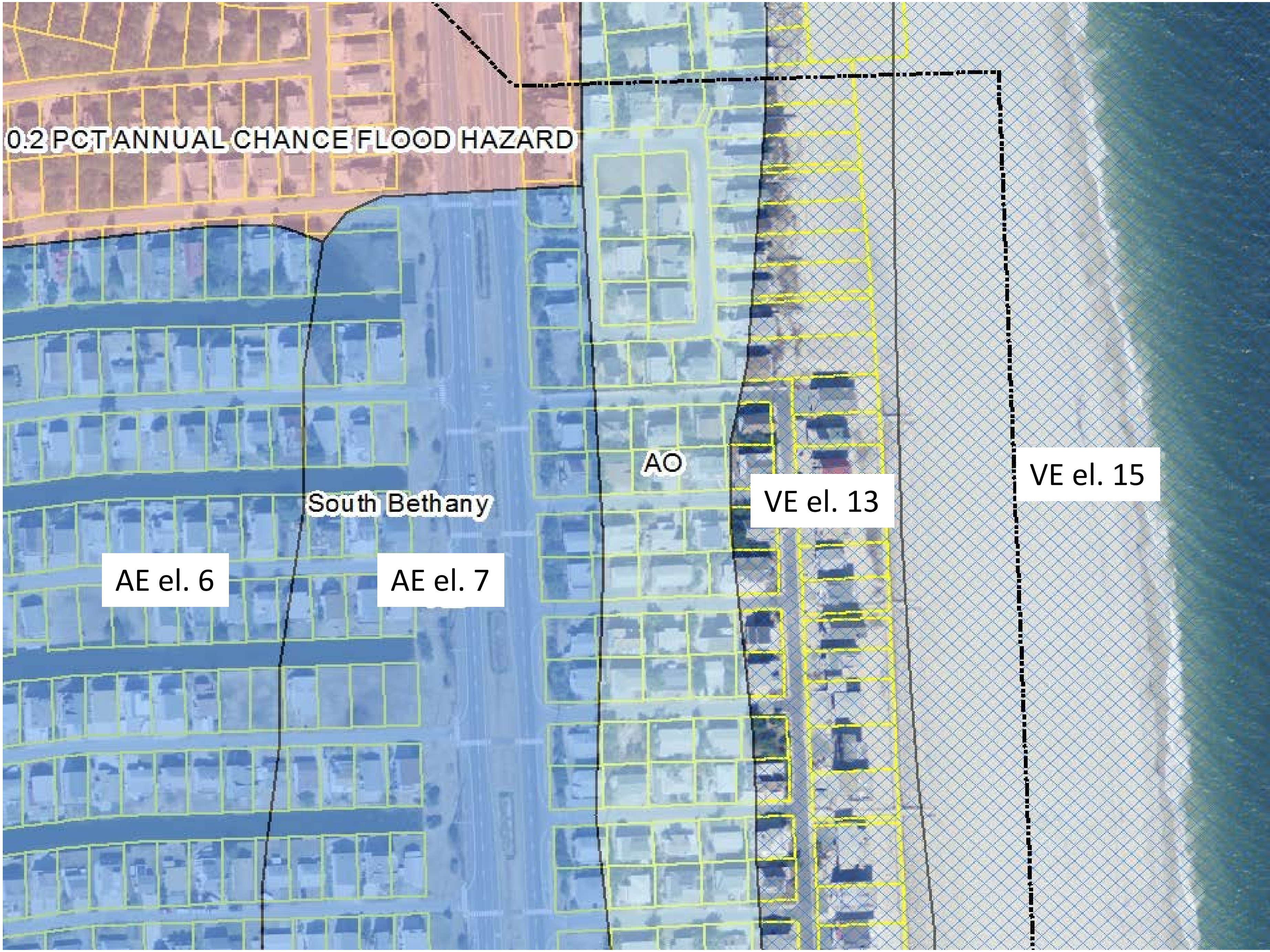
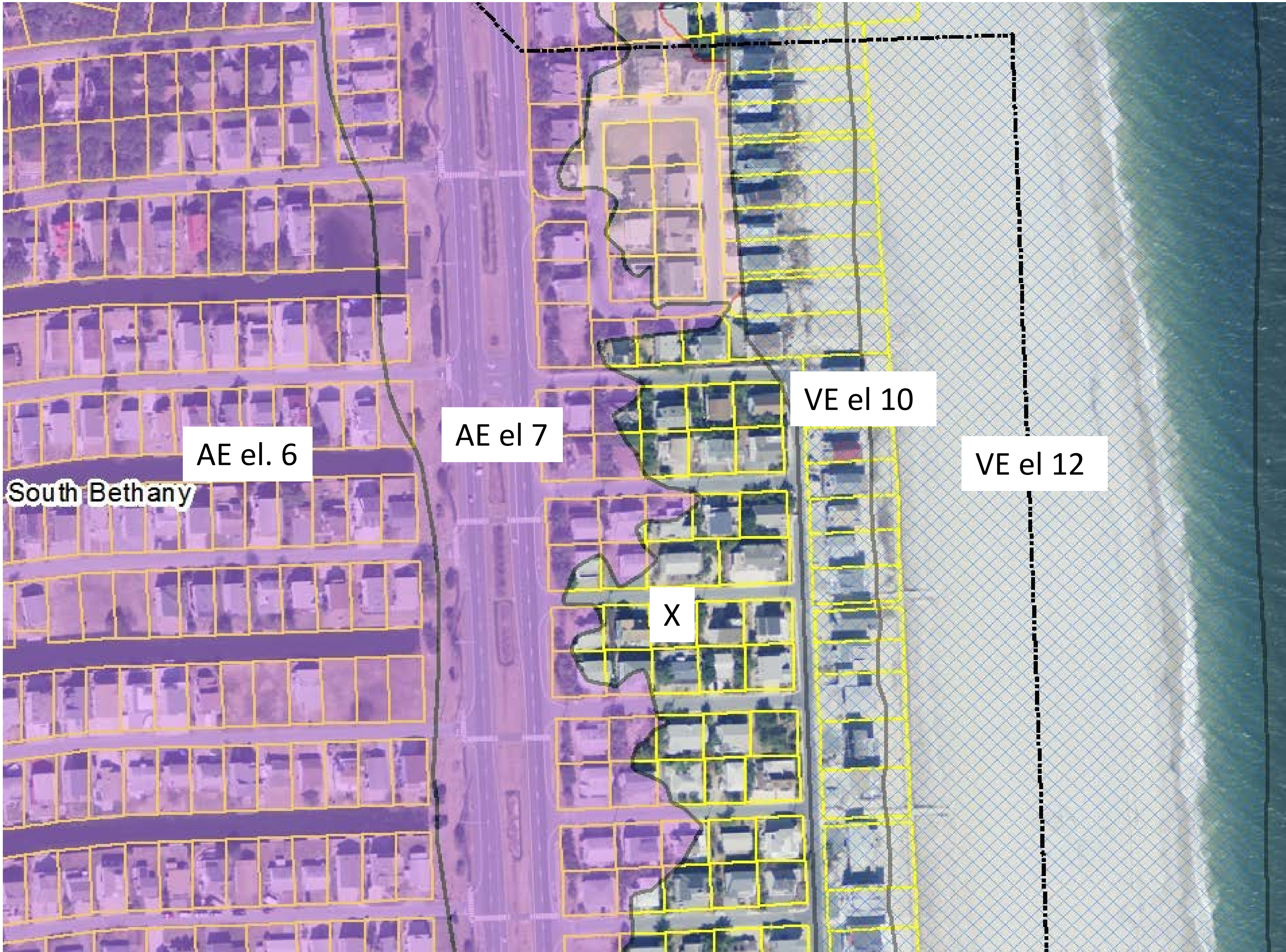


Effect of underlying modelling assumptions:

Proposed 2013 FEMA maps assumed greater dune integrity in the 100-year event. Significant sections of the barrier islands removed from the floodplain.




0.2 PCT ANNUAL CHANCE FLOOD HAZARD
AO
VE el. 15
South Bethany
VE el. 13
AE el. 6
AE el. 7


VE el 10
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VE el 12
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X