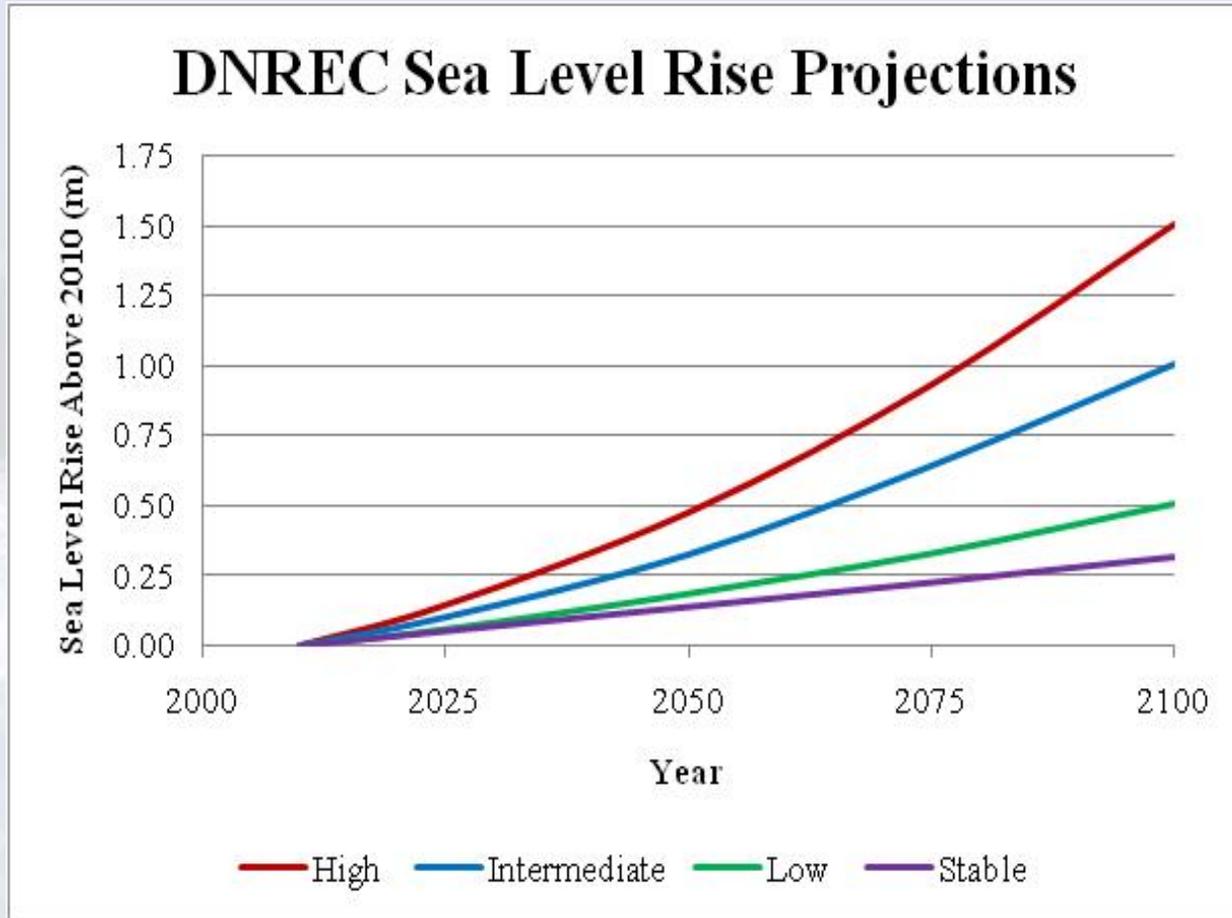


An aerial photograph of a coastal wetland area. A winding waterway, possibly a river or canal, flows through the landscape, which is a mix of brown and green. A road or path runs along the edge of the waterway. The background shows a vast expanse of water under a clear sky.

*Is Habitat Change and Loss in Delaware's
Wetlands a Harbinger of Things to Come?*

David Carter, DNREC's Delaware Coastal Programs

Potential Rates of SLR for Planning



Based on the information from the IPCC AR-4 and CCSP SAP 4.1 reports and the recommendations and guidelines of federal agencies, it has been proposed that DNREC use three planning scenarios for local sea level rise: 0.5, 1.0, and 1.5 meters.

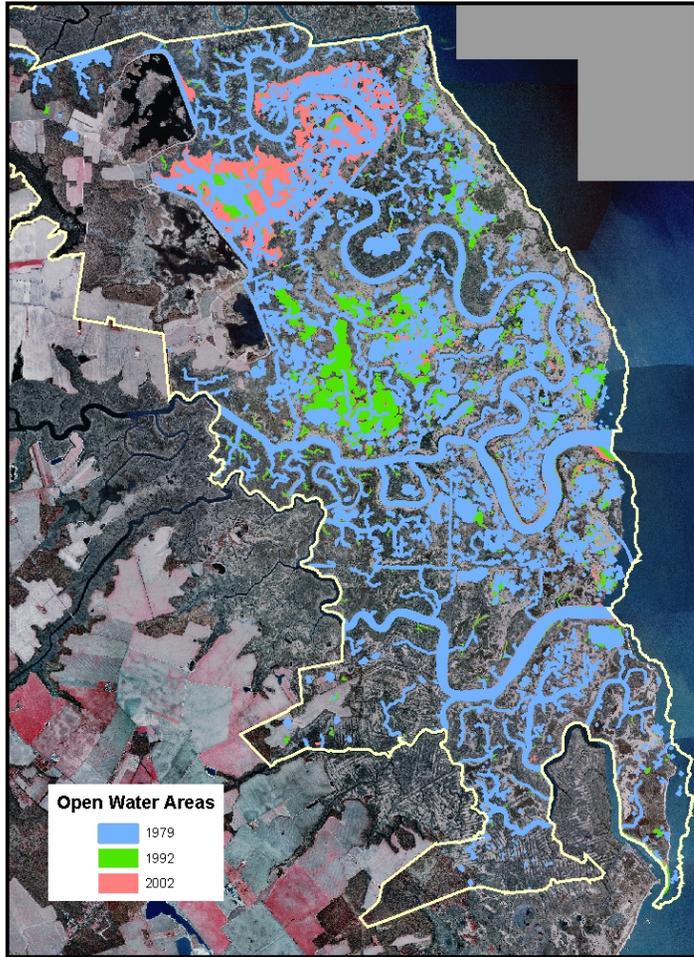


Wetland Habitat Implications

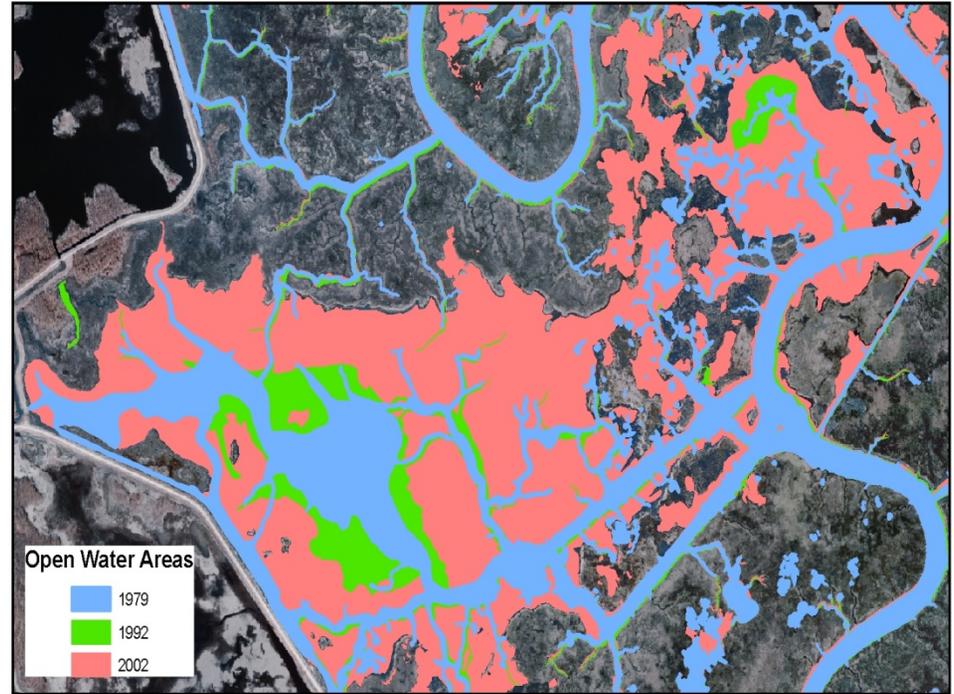
- Sea Level Rise can:
 - ✓ ***Submerge low-lying land***
 - ✓ ***Convert wetlands to open water***
 - ✓ ***Convert uplands to wetlands***
 - ✓ ***Drown Forested wetlands in headwaters areas***
 - ✓ ***Drown Riparian Buffer zones.***
 - ✓ Erode beaches and shorelines
 - ✓ Increase severity of coastal flooding
 - ✓ Increase salinity of Estuaries and Aquifers
 - ✓ Increase invasive species due to their competitive advantage in areas of ecosystem alteration.



Bombay Hook NWR Marsh Loss 1979-2002



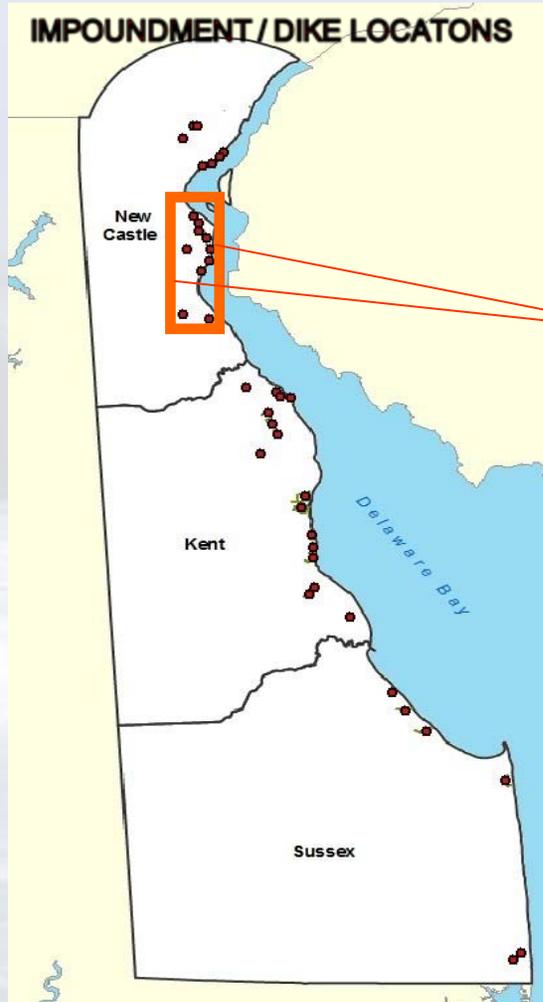
Collins Island - Money Marsh - Leatherbury Flats



Total loss of 1,340 Acres (12%).
~ 58 Acres per year.



Other Areas of Concern



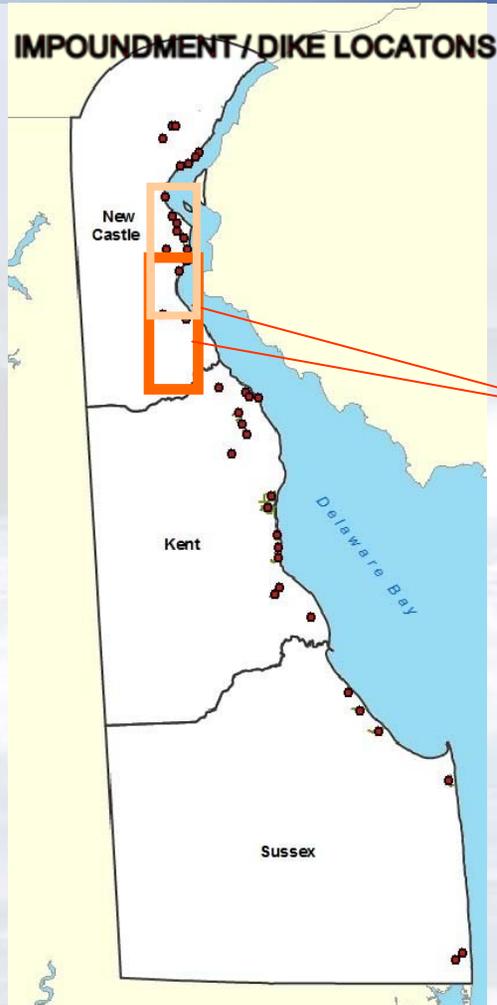
- 1000 Acre Marsh



1000 Acre Marsh



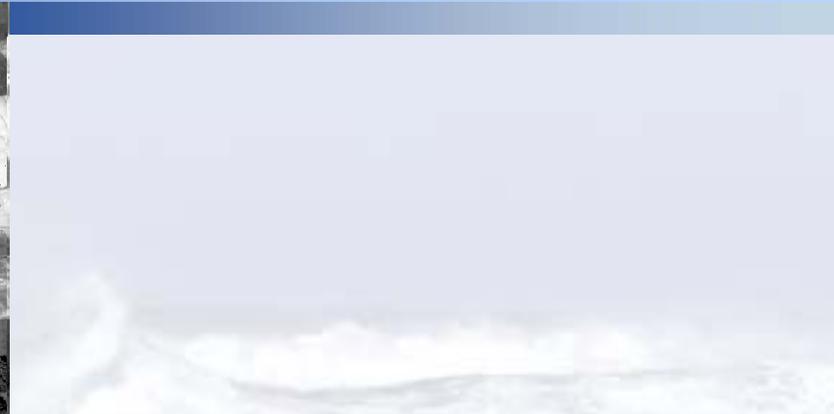
Other Areas of Concern



- 1000 Acre Marsh
- Blackbird Creek



Blackbird Creek



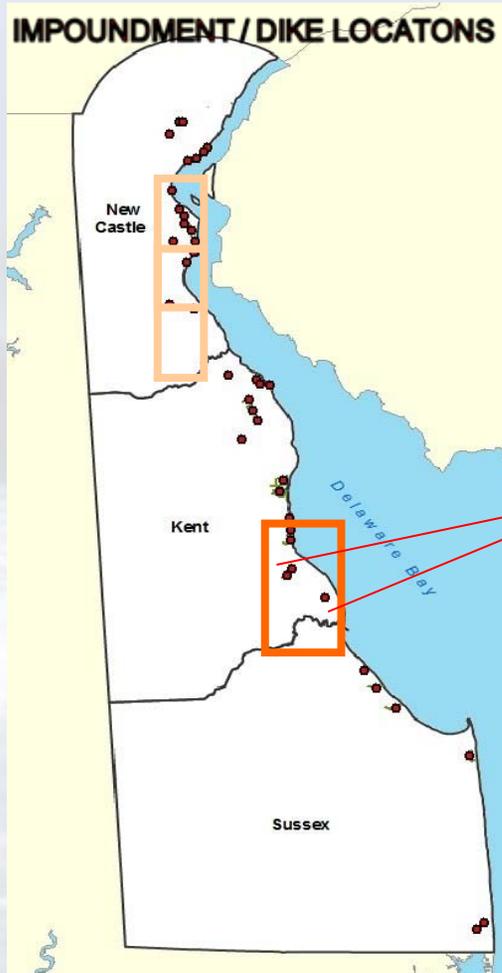
1937



2006



Other Areas of Concern



- 1000 Acre Marsh
- Blackbird Creek
- Milford Neck



Milford Neck



1968



2002



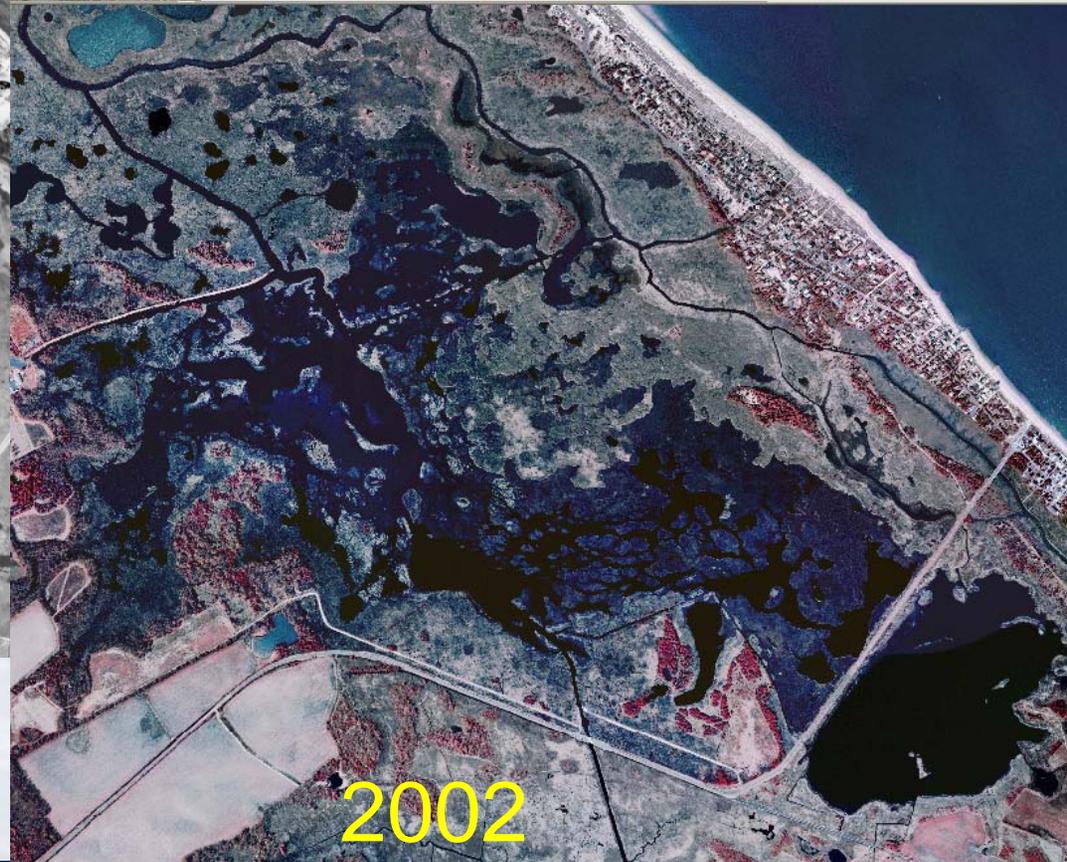
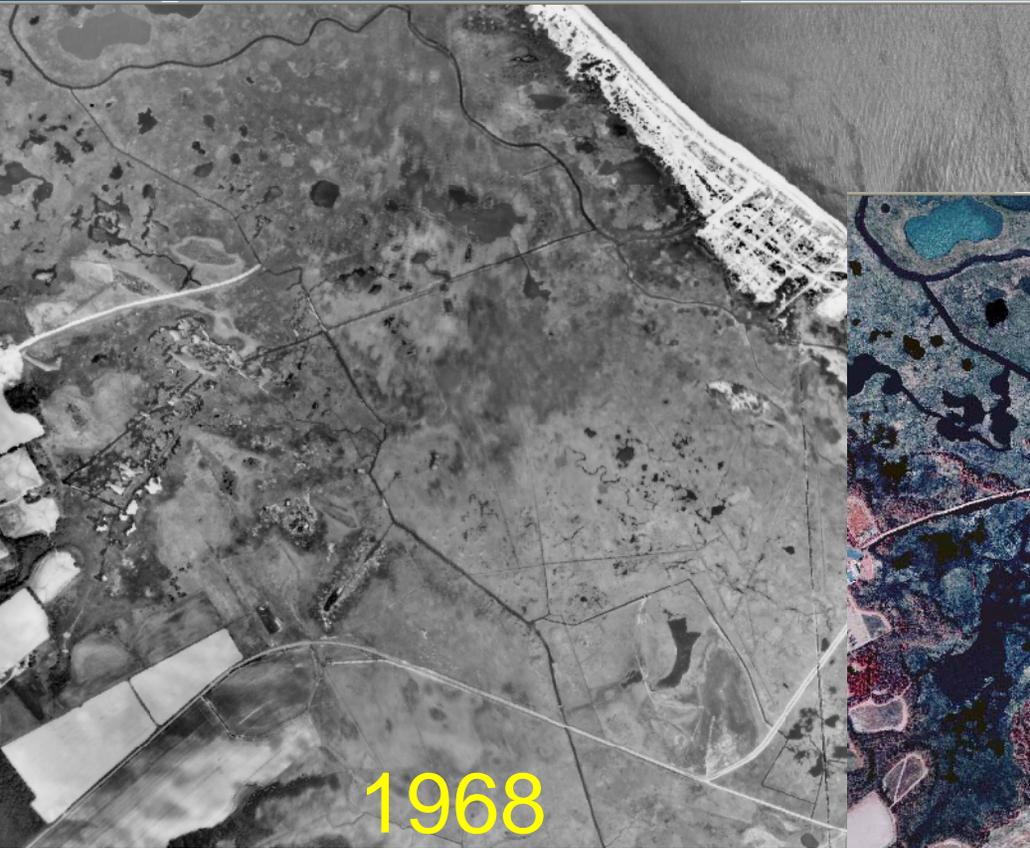
Other Areas of Concern

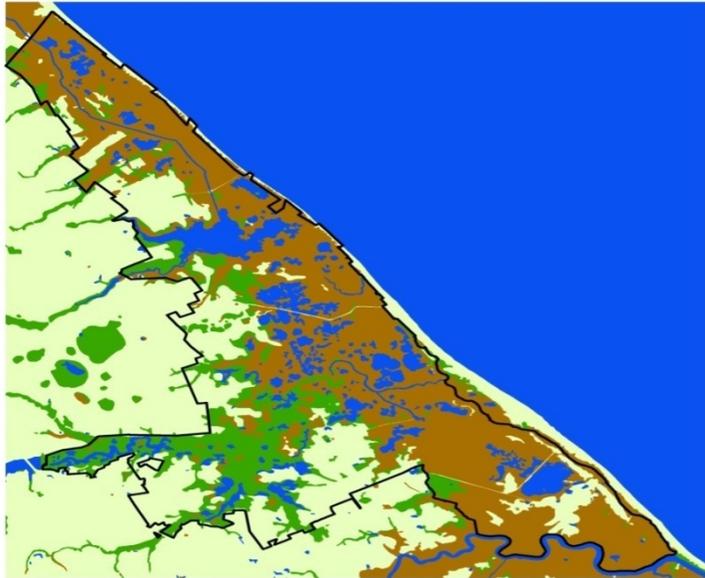


- 1000 Acre Marsh
- Blackbird Creek
- Milford Neck
- Prime Hook / Broadkill Beach



Prime Hook / Broadkill Beach



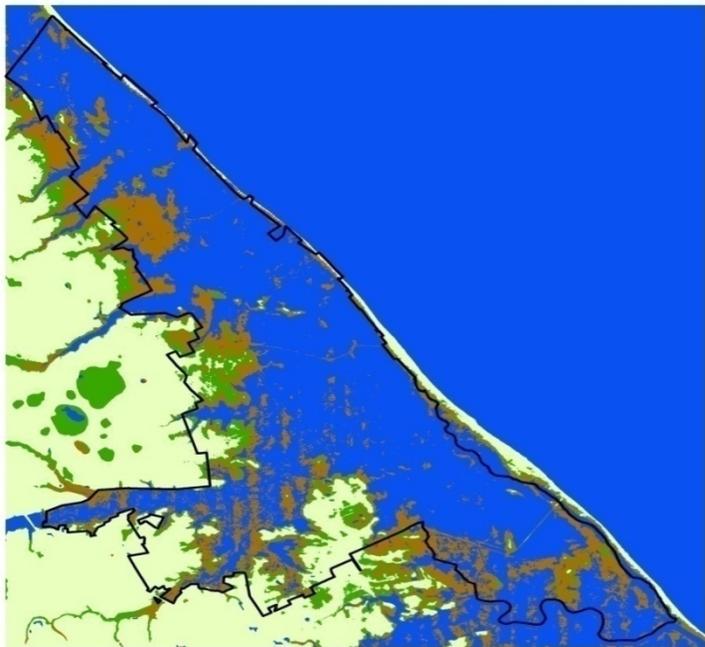


Prime Hook NWR SLAMM Output

Year = 2007
SLR Scenario = A1B
Sea Level Rise = 0.00 meter

Accretion Rate = 3.1 mm/yr
Inland Tide = 50% Coastal Tide

- NWR Boundary
- Uplands
- Forested Wetlands/Scrub Shrub
- Marsh
- Open Water/Tidal Mud Flats



Prime Hook NWR SLAMM Output

Year = 2100
SLR Scenario = A1B
Sea Level Rise = 0.50 meter

Accretion Rate = 3.1 mm/yr
Inland Tide = 50% Coastal Tide

- NWR Boundary
- Uplands
- Forested Wetlands/Scrub Shrub
- Marsh
- Open Water/Tidal Mud Flats



**Scenario: A1B SLR, Inland Tide = 50%
Coastal Tide, Accretion Rate = 3.1 mm/yr**

Year	Land Cover				Water & TMF (%)
	SLR (meter)	Upland (%)	FW&SS (%)	Marsh (%)	
2007	0.00	22%	16%	47%	15%
2025	0.07	14%	25%	29%	32%
2050	0.20	12%	7%	42%	39%
2075	0.35	10%	7%	28%	55%
2100	0.50	9%	5%	21%	65%

•A1B Scenario = A Conservative Estimate of International Panel on Climate Change (IPCC) of about 1.6 ft.



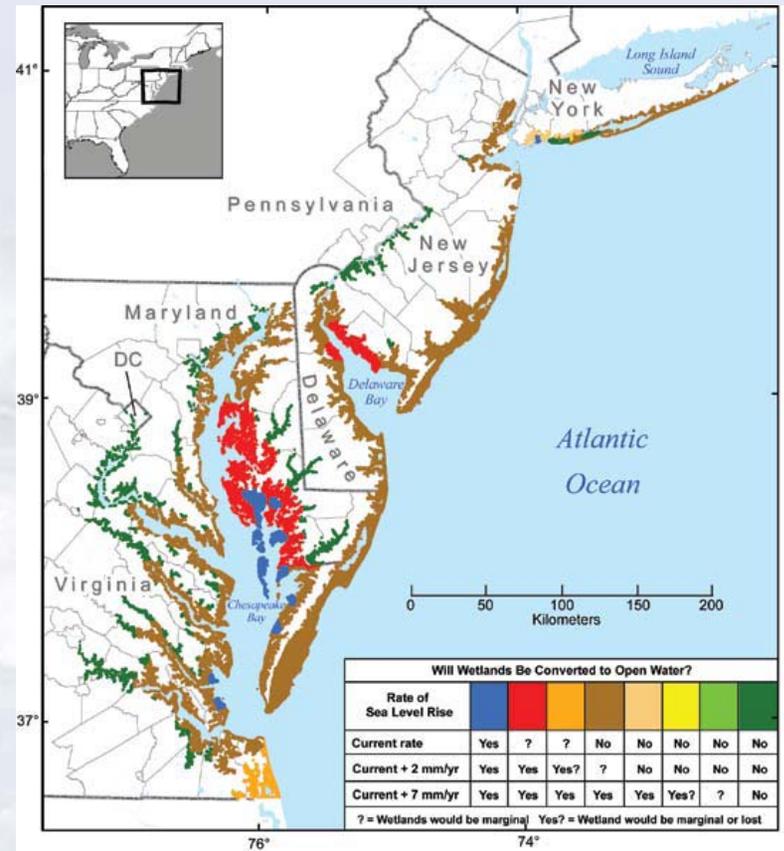
Responding to Sea Level Rise

■ Options for Adapting

- ✓ Retreat & Avoid
- ✓ Elevate
- ✓ Armor

■ Proactive Decisions

- ✓ What is at risk?
- ✓ What can be protected? At what cost?
- ✓ Where can we let nature take its course?



Building the Foundation for SLR Adaptation

- SLR Initiative has four key components
 - ✓ Implementation Actions (Pilot Projects)
 - ✓ Scientific – Technical and Support Actions
 - ✓ Communication, Training, and Public Involvement Actions
 - ✓ Coordinated SLR Policy Development



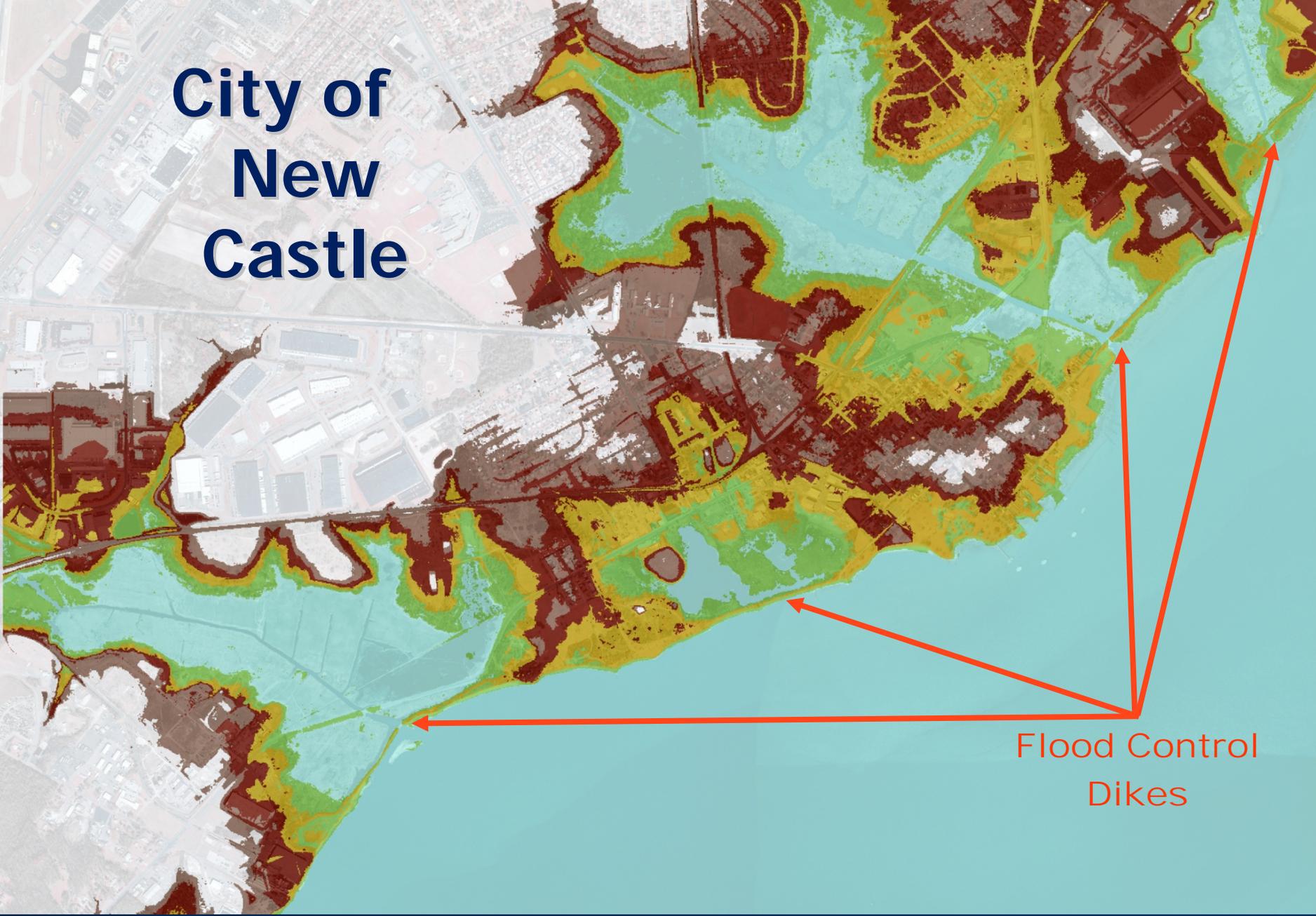
Building the Foundation for SLR Adaptation

Implementation Actions (Pilot Projects)

- **Pilot Coastal Resiliency Planning Projects (Bowers Beach, City of New Castle)**
- **Early Warning System**
- **Prime Hook & Bombay Hook NWR SLR impacts on habitat/long range planning.**



City of New Castle



Flood Control
Dikes





Delaware's Sea Level Rise Initiative



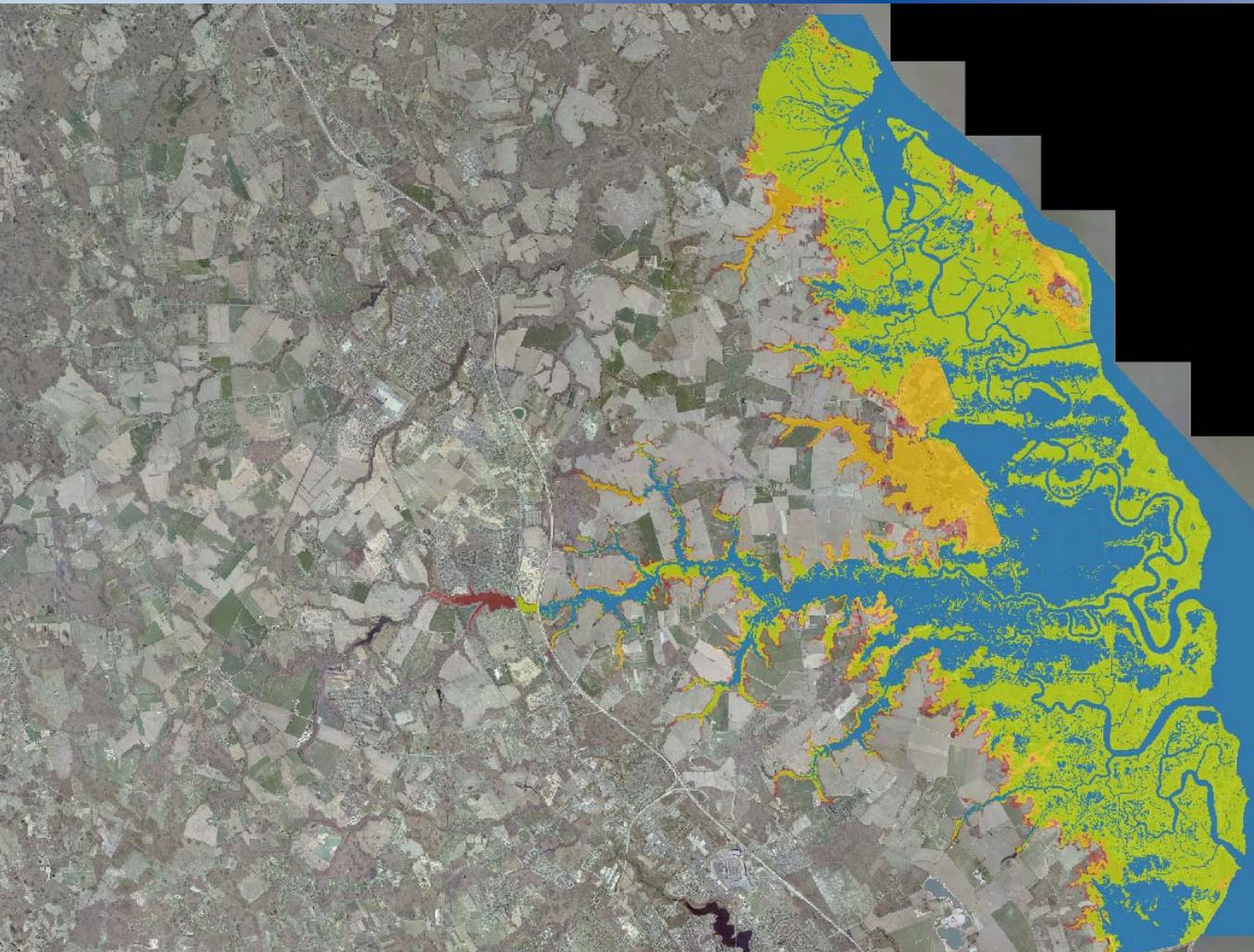
Building the Foundation for SLR Adaptation

Scientific – Technical and Support Actions

- **Development of Coastal Inundation Maps**
- **Marsh Vulnerability Index Development**
- **Coastal Monitoring Gap Analysis**



Single Value Surface (Bathtub model) SLR Inundation Maps

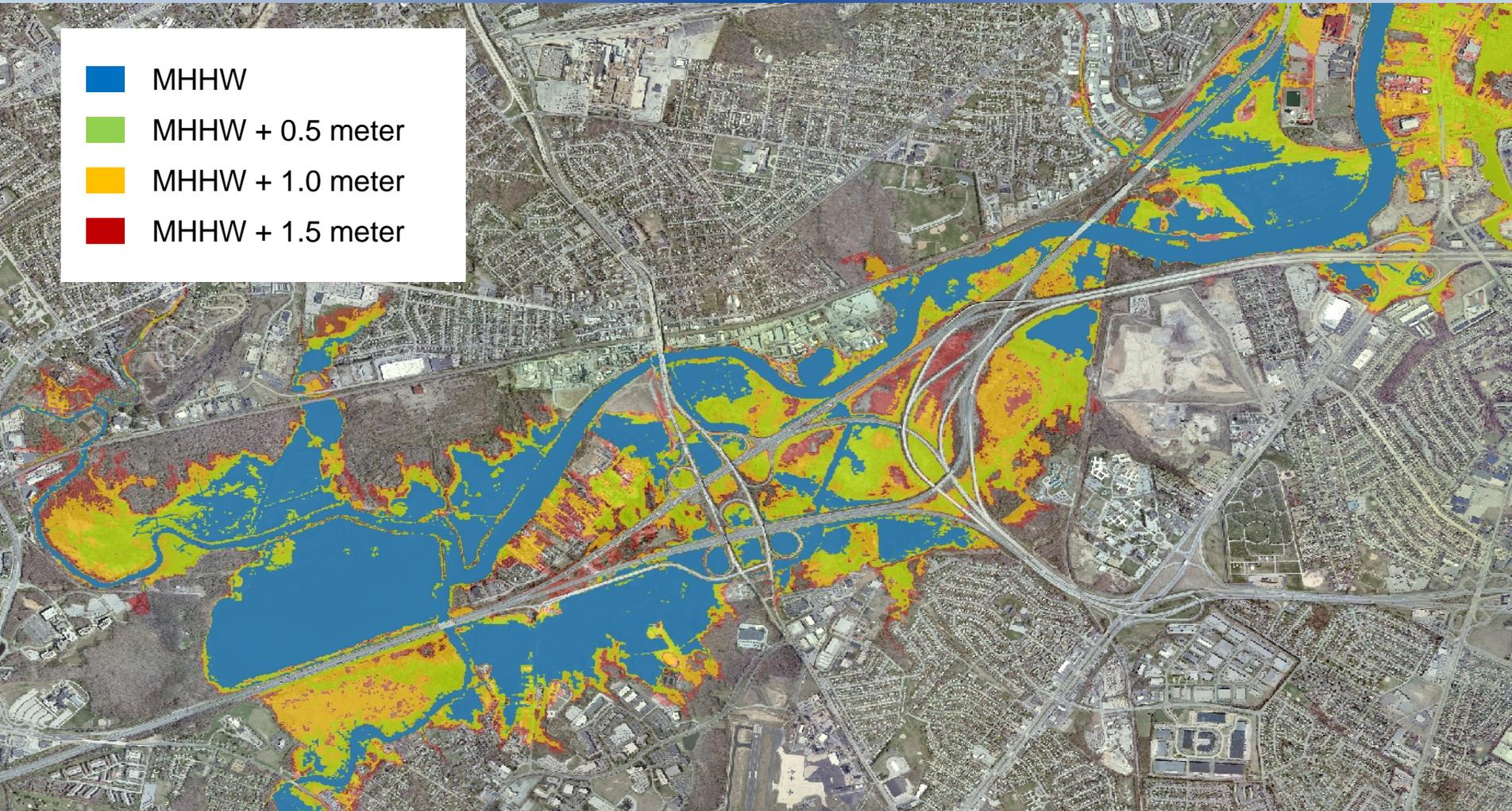


-  MHHW
-  MHHW + 0.5 meter
-  MHHW + 1.0 meter
-  MHHW + 1.5 meter



Single Value Surface (Bathtub model) SLR Inundation Maps

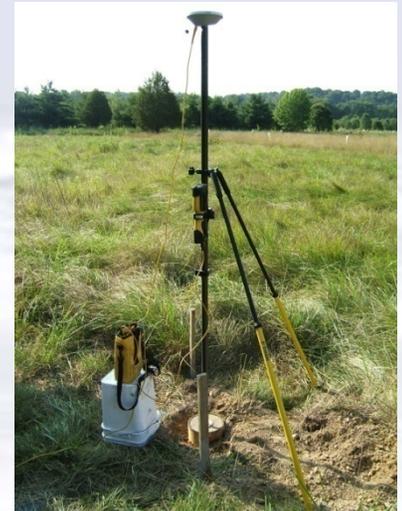
-  MHHW
-  MHHW + 0.5 meter
-  MHHW + 1.0 meter
-  MHHW + 1.5 meter



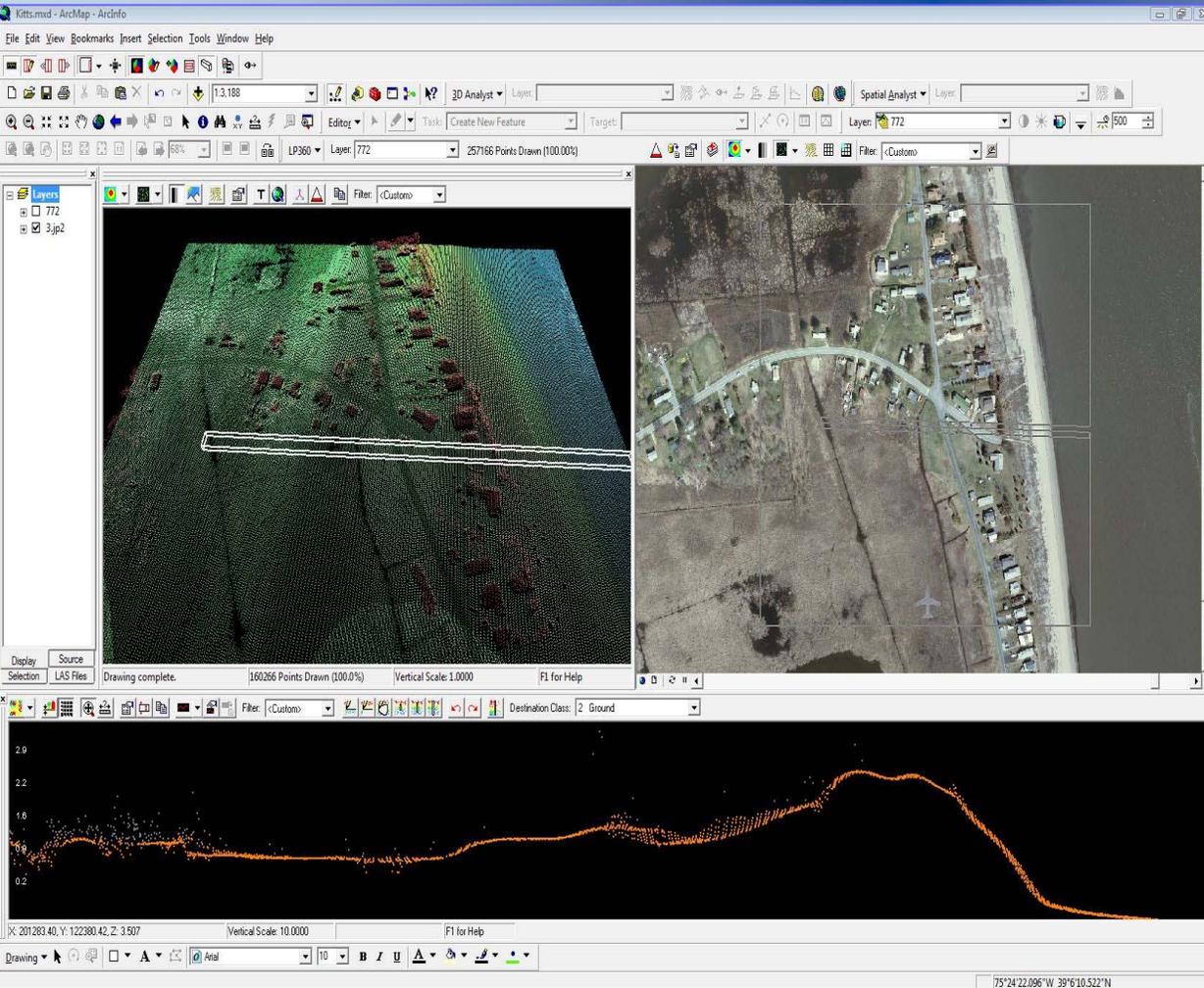
Marsh Vulnerability Index



- Monitor Delaware's marshes response to Sea Level Rise (SLR) and to promote conversation, restoration and monitoring
- Classify healthy, degrading, and severely degrading short-form *Spartina alterniflora* marsh regions based upon correlation
- Based on positive correlation between mean tidal range and elevational growth of tidal wetland plant species
 - ✓ Biomass Sampling
 - ✓ Real-Time Kinematic (RTK) Survey



Lidar Correction in Wetlands, Sedimentation Rate Data Supplemented by MVI



Building the Foundation for SLR Adaptation

Communication, Training, & Public Involvement

- **Statewide SLR Public Opinion Survey**
- **Comprehensive Public Outreach Strategy for Sea Level Rise**
- **Visualization Tools, Google KML, etc.**





SEA LEVEL RISE IMPACTS FOR WILMINGTON, DELAWARE



This map shows potential flooding, or inundation, caused by sea level rise. Use the slider bar to view the extent.

The map illustrates the scale of potential flooding, not the exact location, and does not account for erosion, subsidence, or future construction. Water levels are shown as they would appear during an average high tide (mean high water). Rising sea levels will cause daily high tides to reach farther inland.

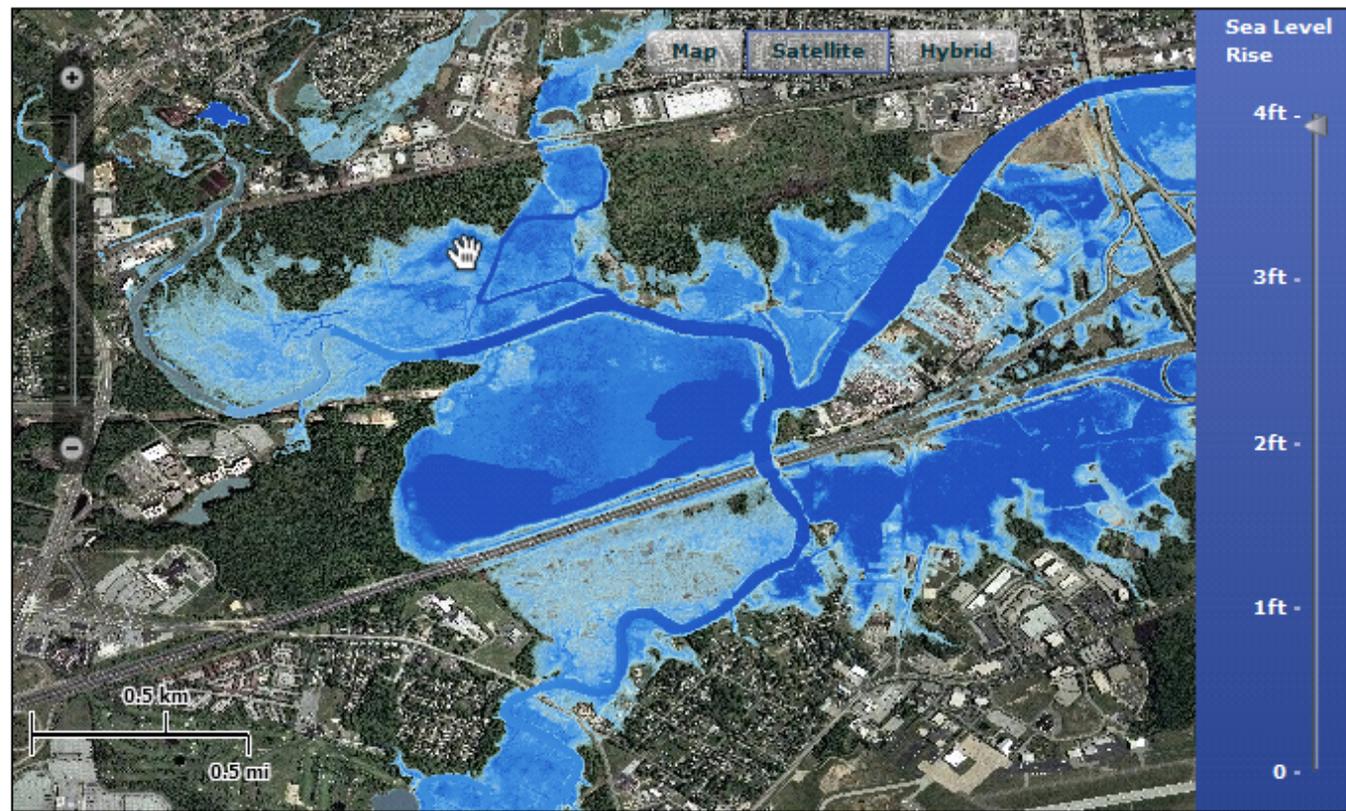
Places of interest vulnerable to sea level rise.

Note: Flood layers may take a moment to load.

View the [Flood Frequency Predictions](#)



SEA LEVEL RISE IMPACTS FOR WILMINGTON, DELAWARE



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 Places of interest vulnerable to sea level rise.

Note: Flood layers may take a moment to load.

View the [Flood Frequency Predictions](#)

Coordinated SLR Policy Development

- **Statewide Sea Level Rise Adaptation Plan**
- **Sustainable Coastal Communities Project**
- **Mid-Atlantic Regional Council on Oceans**
- **DNREC SLR Policy Development**



Sea Level Rise and Climate Change Resources

- Delaware Sea Level Rise Adaptation
 - ✓ Updated info on the Sea Level Rise Initiative
 - ✓ <http://www.swc.dnrec.delaware.gov/coastal/Pages/SeaLevelRiseAdaptation.aspx>
- Climate Change Adaptation
 - ✓ An interactive forum and library of info
 - ✓ <http://community.csc.noaa.gov/climateadaptation/>
- US Climate Change Science Program
 - ✓ <http://www.globalchange.gov>
- Digital Coast/Inundation Toolkit
 - ✓ Tools and training
 - ✓ <http://www.csc.noaa.gov/digitalcoast/>

