

# **Preparing our Wetlands for Tomorrow's High Tide**

## ***Recommendations for Adapting to Sea Level Rise in Delaware***

*January 30, 2014*

*Delaware Wetlands Conference*

*Susan Love, Planner IV  
DNREC Delaware Coastal Programs*



# Sea Level Rise is one of the major impacts of global climate change

- Sea level rise is an increase in average tide height over time as a result of:
  - ✓ Thermal Expansion
  - ✓ Melting of glaciers & ice caps
- Influenced locally by *subsidence*



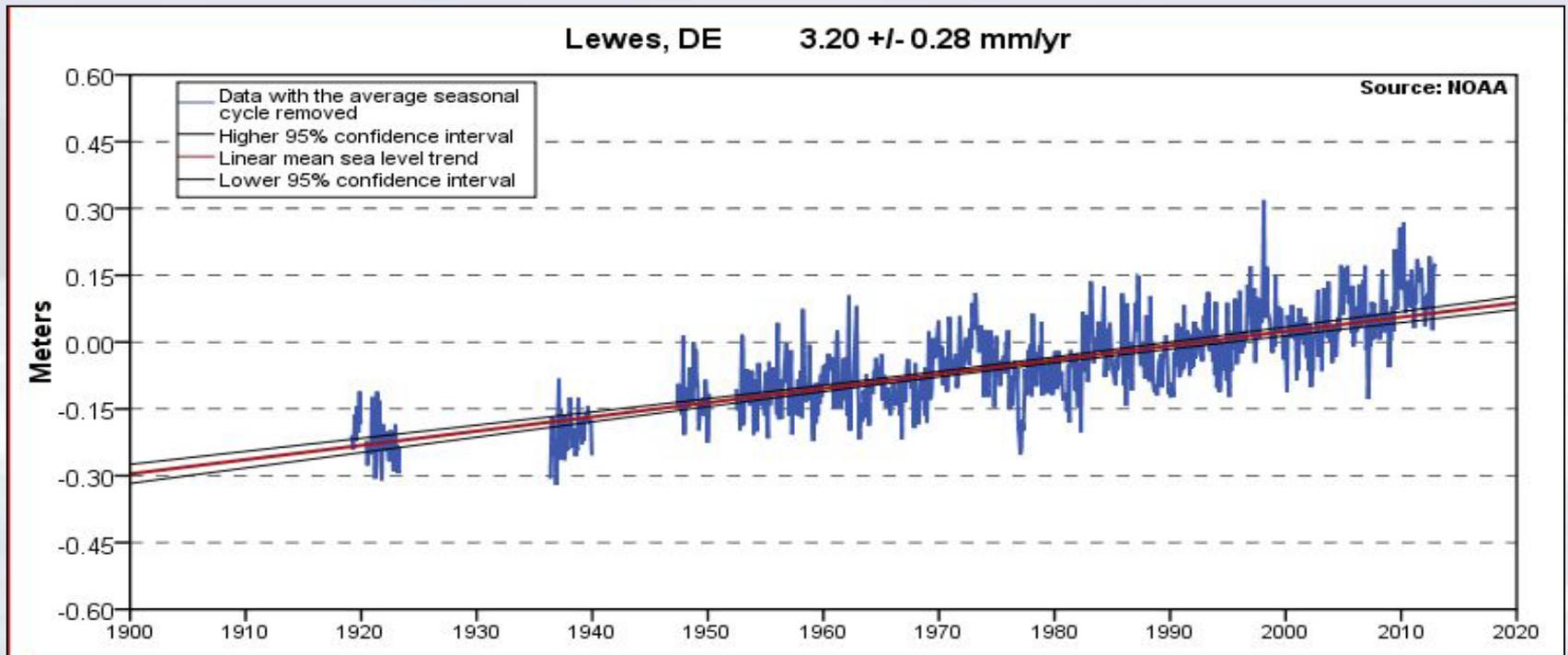
# Potential Impacts of Sea Level Rise

- Increased extent of periodic flooding from storms
- Permanent inundation of coastal areas
  - ✓ Including wetlands
- Saltwater Intrusion
  - ✓ Vegetative and habitat changes
- Rising water tables
  - ✓ More non-tidal wetlands creation?
- Economic & Social Impacts



# Annual Rate of Sea Level Rise

**Average annual rate in DE = 3.35 mm/yr  
(13 Inches/100 years)**



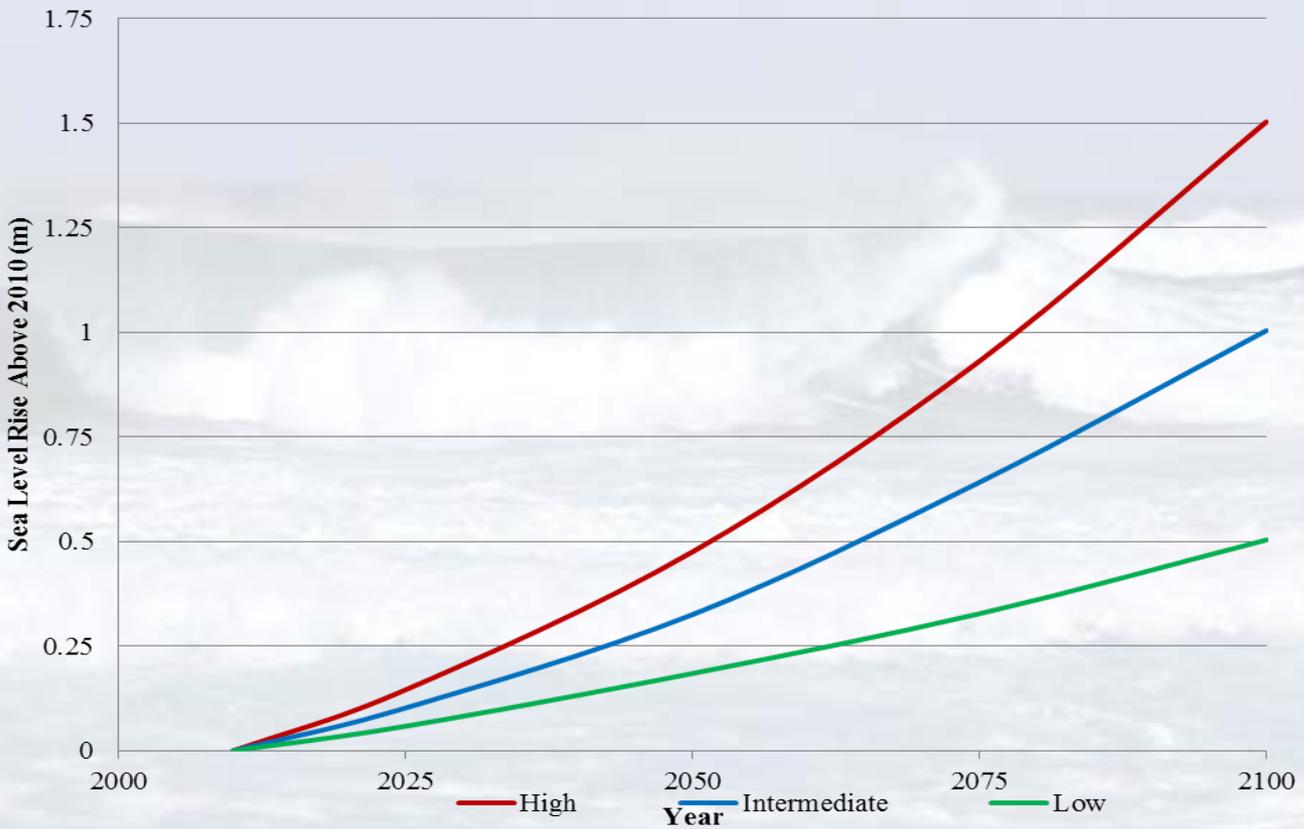
**Global rate = 1.7 mm/yr**



# Rates of SLR are very likely to accelerate in the future



### DNREC Sea Level Rise Scenarios



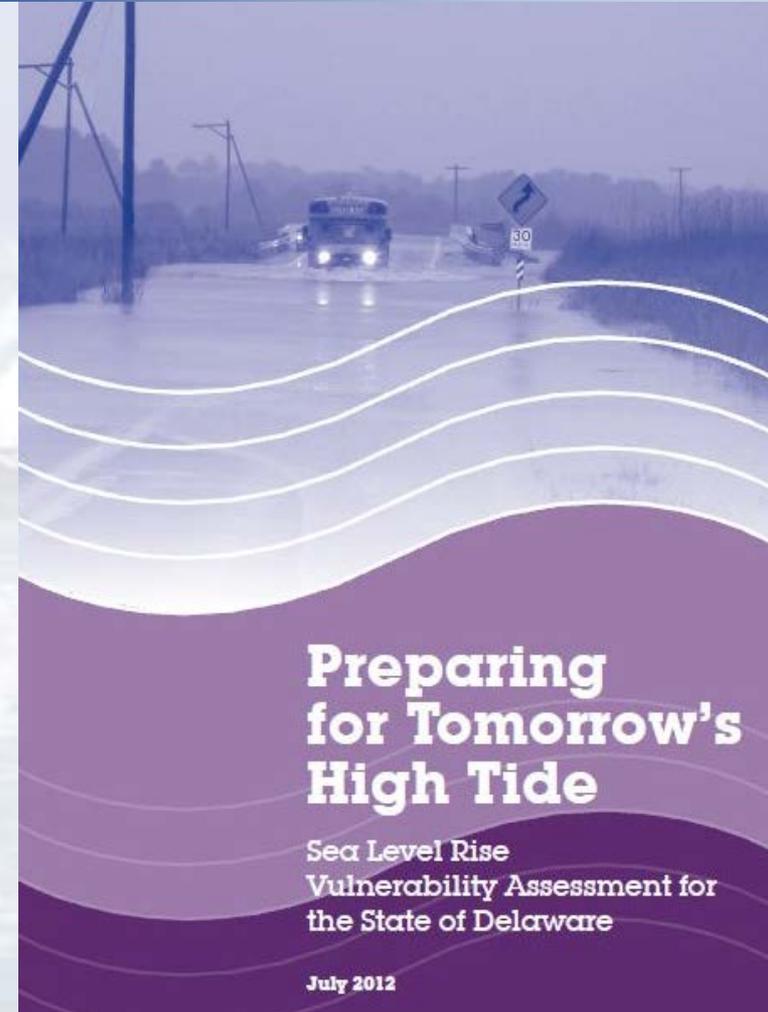
# Delaware's Sea Level Rise Advisory Committee

*The goal of the Sea Level Rise Advisory Committee is to assess Delaware's vulnerability to current and future inundation problems that may be exacerbated by sea level rise and to develop a set of recommendations for state agencies, local governments, businesses and citizens to enable them to adapt programs, policies, business practices and make informed decisions.*



# Vulnerability Assessment: Results

- All of Delaware is impacted!
- Of 79 resources assessed, wetland related resources were among the most vulnerable:
  - ✓ Tidal Wetlands
  - ✓ Freshwater Tidal Wetlands
  - ✓ Coastal Impoundments
  - ✓ USFWS Refuges
  - ✓ Protected Lands Statewide



# SLR will affect all of Delaware

## ■ Urban Areas in Northern Delaware:

- ✓ Transportation Networks
- ✓ Neighborhoods
- ✓ Economic Development Zones
- ✓ Contaminated soils
- ✓ Public Safety Facilities
- ✓ Sewer Capacity



South Wilmington and Surrounding Areas with 0.5, 1.0 and 1.5 meters of SLR to 2100

# Sea Level Rise will affect all of Delaware

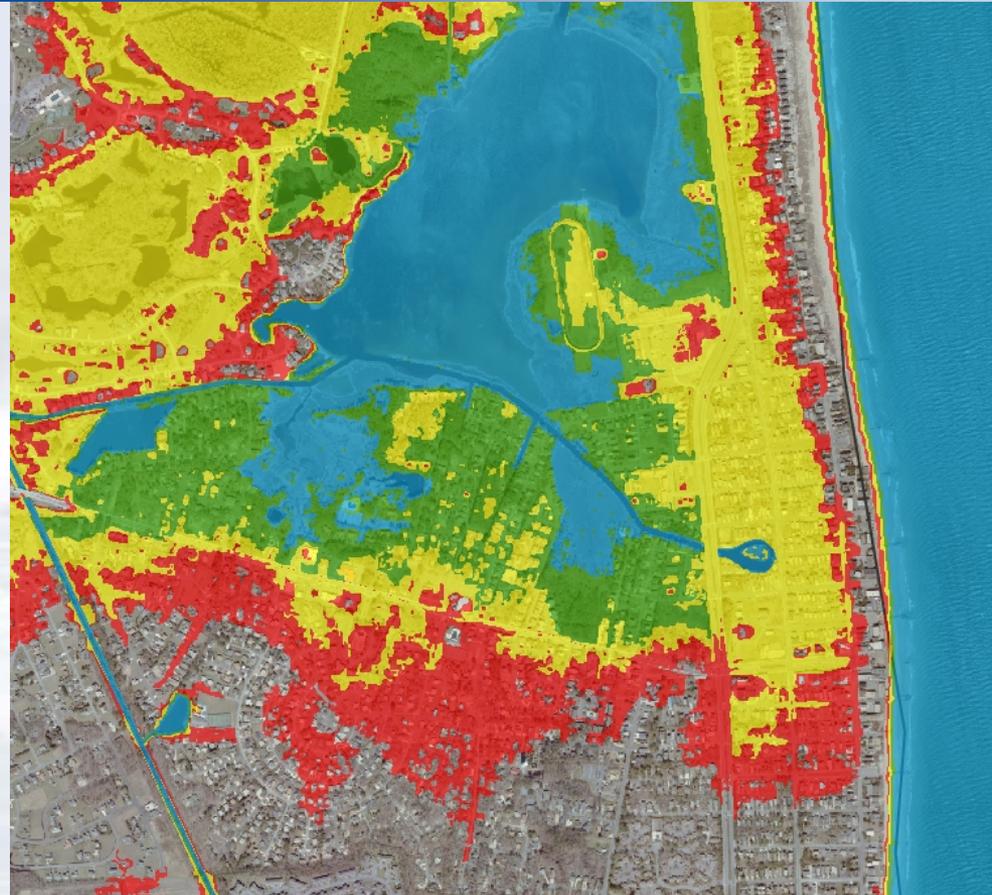
- At risk in Coastal Kent County:
  - ✓ Commercial/Recreational Fishing Docks
  - ✓ Residences
  - ✓ Habitat
    - **Wetlands**
    - **Shorebirds**
    - **Horseshoe Crabs**
  - ✓ Way of Life



Bowers Beach and Surrounding Areas with 0.5, 1.0 and 1.5 meters of SLR to 2100

# Sea Level Rise will affect all of Delaware

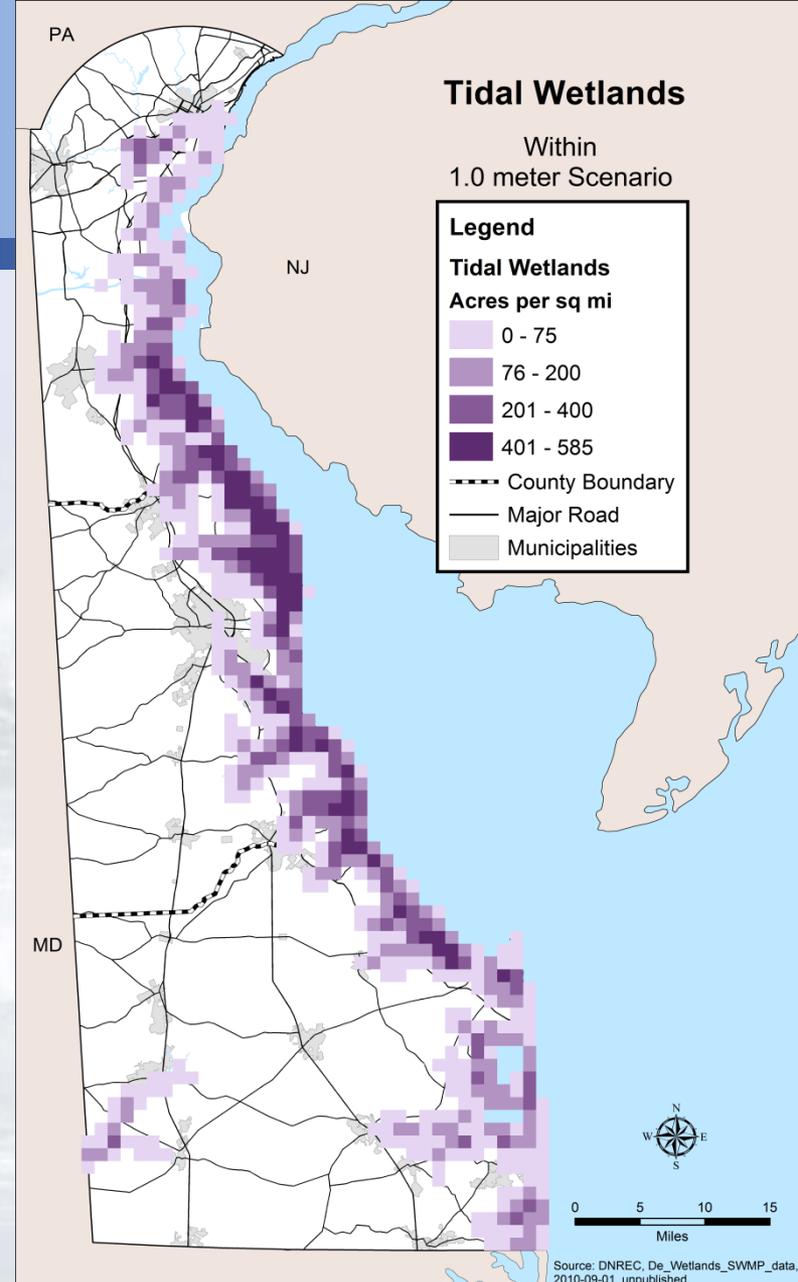
- At risk in the Sussex Coastal Area:
  - ✓ Homeowners
    - **Bayfront and Oceanfront**
    - **Septic Systems**
  - ✓ Tidal Wetlands and riparian areas
    - **Habitat**
    - **Flood Attenuation**
    - **Water Quality**
  - ✓ Transportation Networks
  - ✓ DE National Guard



Bethany Beach and Surrounding Areas with 0.5, 1.0 and 1.5 meters of SLR to 2100

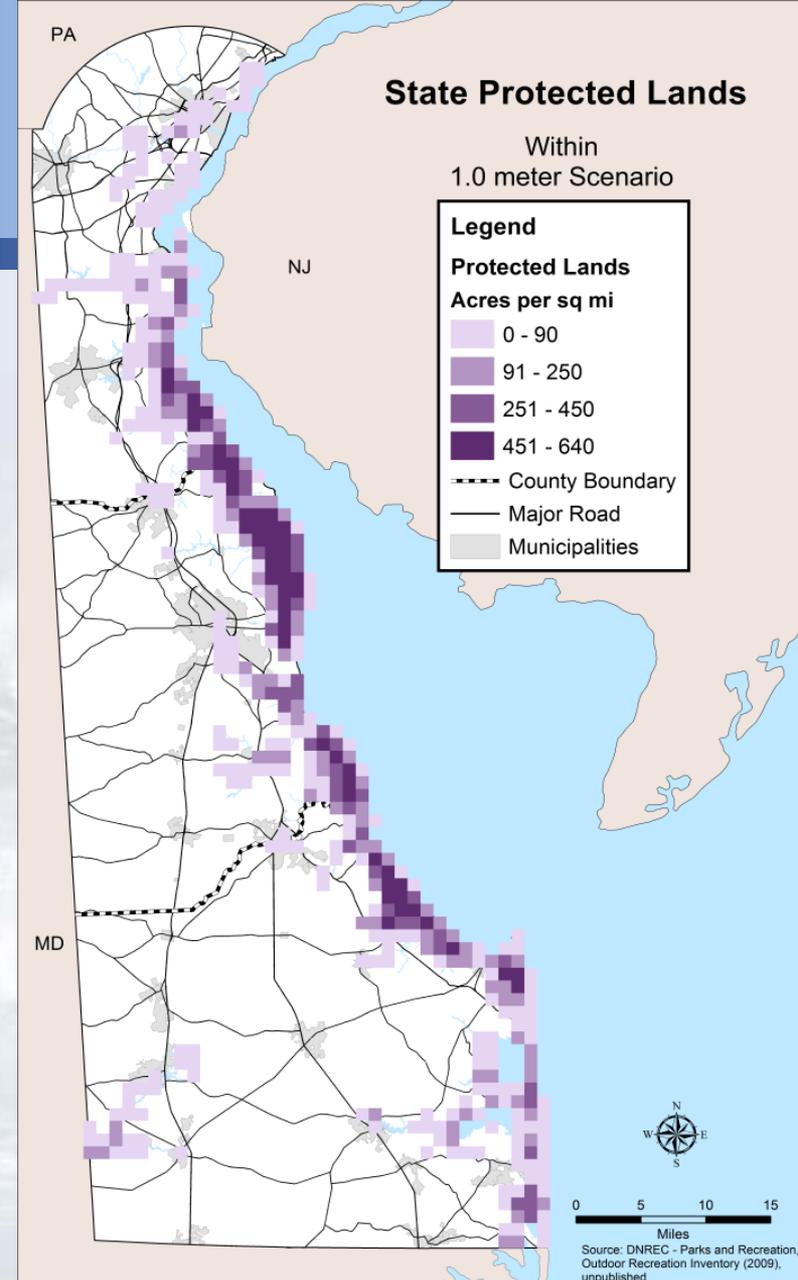
# Tidal & Freshwater Tidal Wetlands

- Tidal
  - ✓ 97% to 99% of 73,000 acres potentially inundated
- Freshwater Tidal
  - ✓ 84% to 98% of 11,000 acres potentially inundated
- Conversion to open water
- Future salinity changes potential issue for tidal fresh
- Ranked as high



# Protected Lands Statewide

- 37% to 44% statewide potentially inundated
- Includes
  - ✓ State owned lands
  - ✓ federal refuges
  - ✓ municipal holdings
  - ✓ public and private conservation easements
- Represent a variety of habitat types and outdoor recreation opportunities



# Adapting to sea level rise means changing our status quo



Protect



Retreat



Accommodate



Avoid

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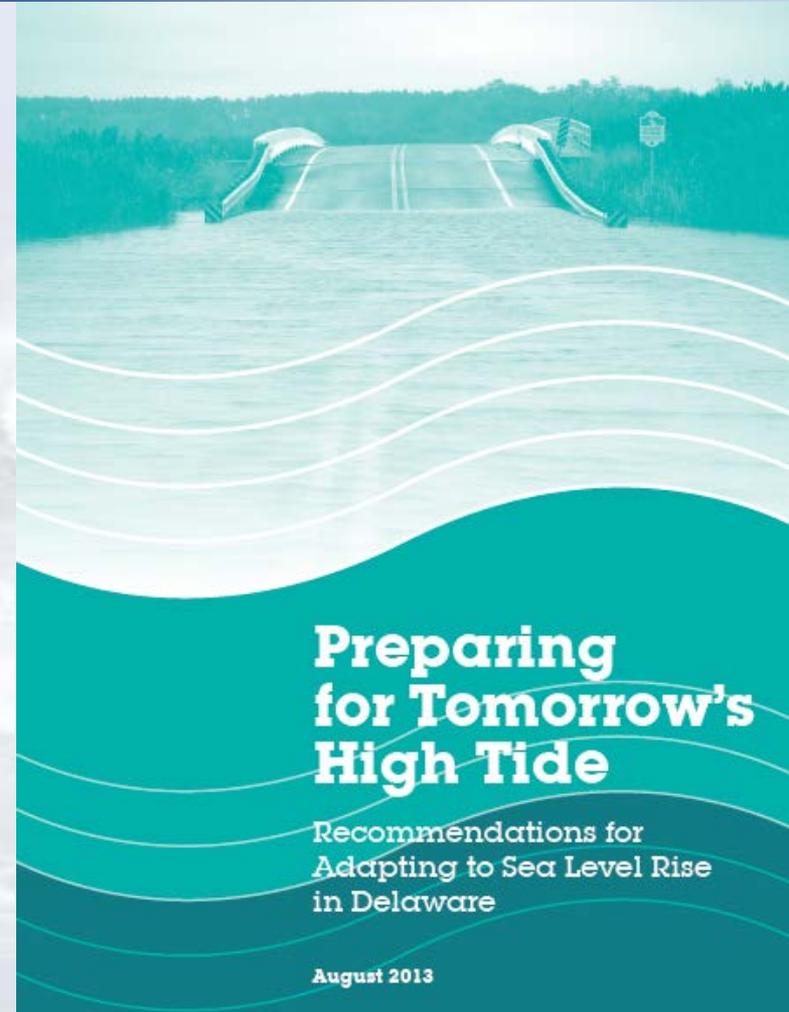


Avoid

These are the most likely adaptation strategies for managing and conserving Delaware's tidal wetlands, but much work remains before a comprehensive strategy will emerge.

# Recommendations for Adapting to Sea Level Rise in Delaware

- A call to action
- Explains and guides adaptation responses
  - ✓ Guiding Principles
  - ✓ Case Studies
  - ✓ Resources and Assistance
- 55 approved recommendations for “*building adaptive capacity*”
  - ✓ 36 are associated with wetlands



# Executive Order-Palooza!

- Governor Markell's Executive Order 41 "Preparing DE for Emerging Climate Impacts..." (September, 2013)
- President Obama's Executive Order on Climate Preparedness (November, 2013)

Photo: Delawareonline.com



*President Obama and Governor Markell agree that sea level rise is no laughing matter*

# Adaptation Objectives

- Improve Coordination and Communication...
- Provide Increased Regulatory Flexibility...
- Provide Consistent Policies for Future Growth...
- Increase Public Awareness...
- Improve Sea Level Rise Data...
- Provide Technical Assistance...
- Expand Funding Opportunities



Bowers Beach, November 2009

# Adaptation Recommendation Highlights

- Create new partnerships for innovative projects
- Incorporate SLR into long range and comp plans
- Create regulatory incentives for adaptation projects
- Create an E.O. for state agencies (check!)



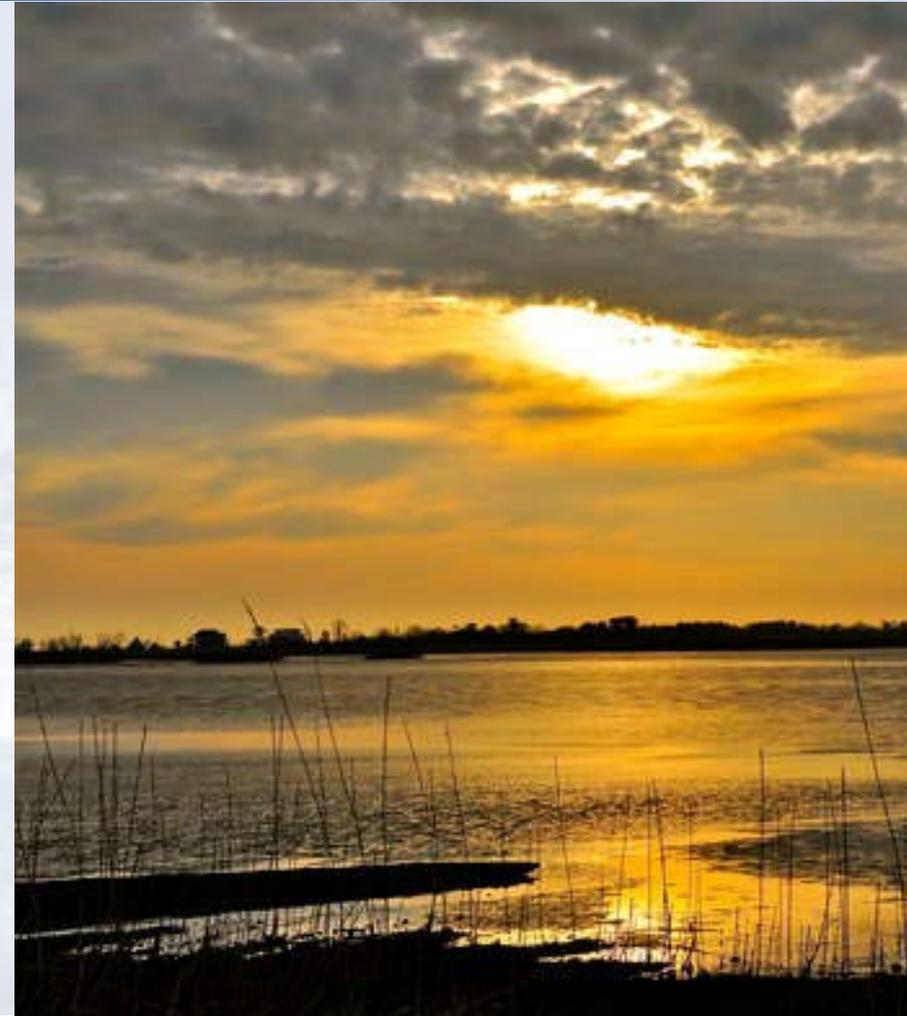
# Adaptation Recommendation Highlights

- Modernize and update Regulatory Tidal Wetlands Maps
- Develop comprehensive wetlands strategy for SLR
  - ✓ \*has research prereqs
- Re-evaluate management strategies for coastal impoundments
- Designate shoreline zones for adaptation strategies



# Adaptation Recommendations specific to improving data

- Expand studies on sediment accretion rates and susceptibility of wetlands
- Develop a model for surface water salinity changes
- Develop a model for ground water salinity changes
- ID areas for wetland migration
- Install add'l water level and salinity recorders



# Adaptation Activities Already Underway!

- State and federal response to EOs
- SLR included in:
  - ✓ State land purchase criteria
  - ✓ UD research agenda
  - ✓ South Wilmington green infrastructure
  - ✓ DE Hazard Mitigation Plan
- Green Infrastructure Projects
  - ✓ Beach Replenishment
  - ✓ South Wilmington Wetland
  - ✓ Pepper Creek Pilot



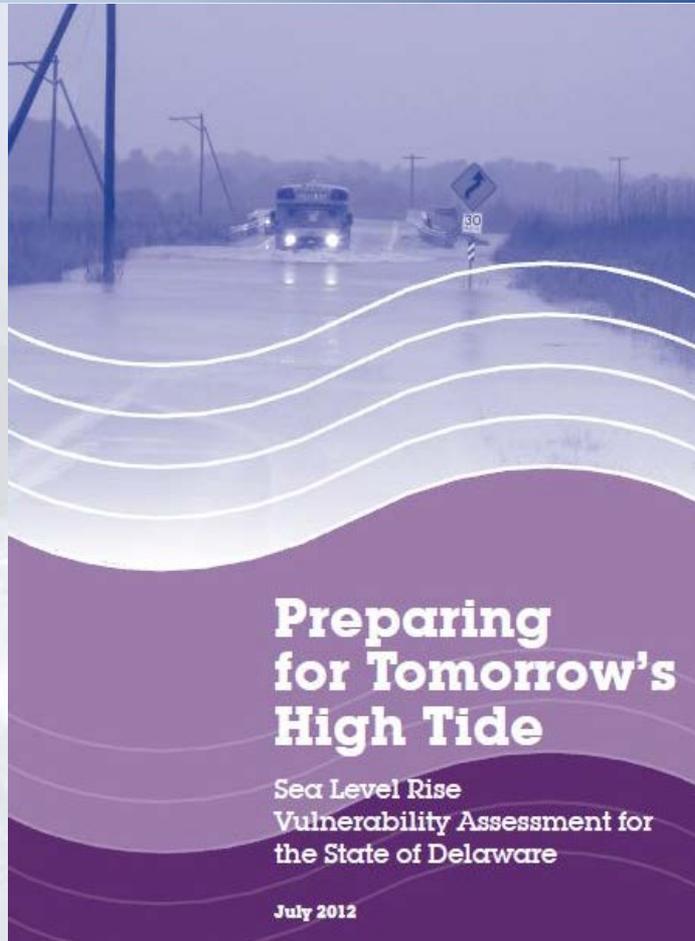
# YOU can play an important role in adaptation

- Conduct a SLR/CC vulnerability assessment and adaptation plan
  - ✓ For facilities, land-holdings
- Incorporate SLR into your long-range and strategic plans
- Spearhead on-the-ground innovative pilot projects
- Participate in Executive Order meetings/surveys
- Talk about it!

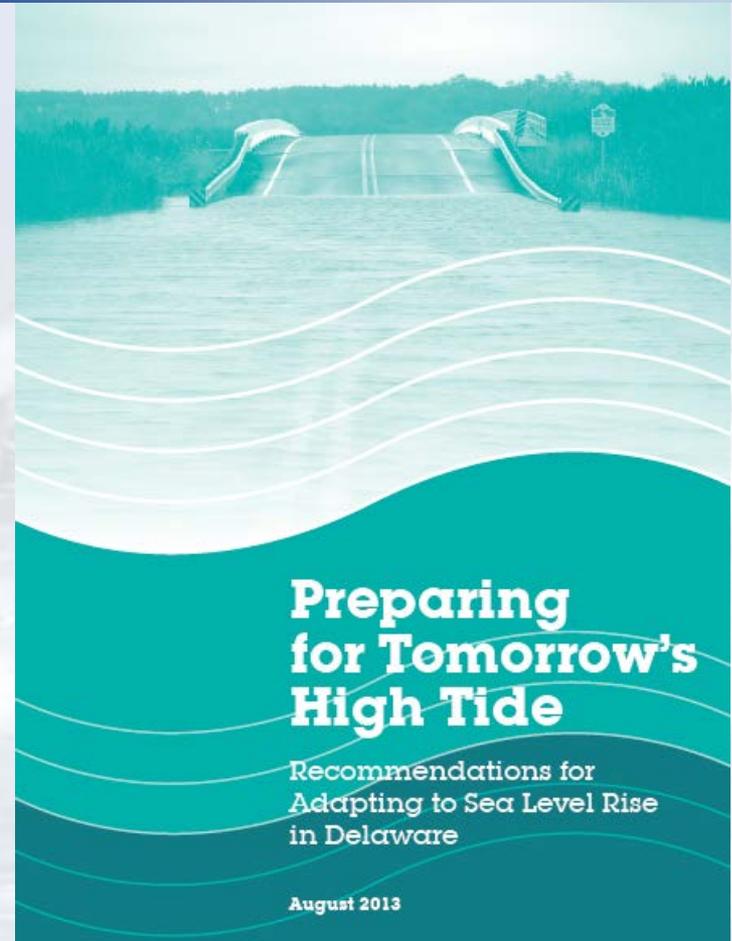


Are you ready to put on your adaptation shoes?

# Getting Started – Excellent Background Reading...



<http://de.gov/slrva>



<http://de.gov/slradaptplan>



*Delaware's Sea Level Rise Initiative*



# Mapping Tools

## Delaware SLR Maps

**Sea Level Rise Inundation Maps**

The rising and spreading of water over normally dry land is referred to as inundation. Scientists from Delaware Coastal Programs used a simple model to develop maps to show the possible impacts of inundation based on various Sea Level Rise scenarios for Delaware's watersheds and the land that surrounds them (watersheds). These maps reflect the filling of these watersheds at constant elevations also referred to as "Bath Tub" modeling. In other words, the maps show the water levels rising in the watersheds similar to the "filling of a bathtub". For more information click [here](#).

**1.0 m sea level rise scenario**

The map illustrates the scale of potential inundation with a 1.0 meter (3.28 feet) increase to sea level rise, 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 higher tide (Mean Higher High Water). Rising sea levels will cause daily high tides to reach farther inland.

These maps are a representation of inundation based on local Mean Higher High Water (MHHW) which is the average highest high tide line in tidal areas. Inundation is assumed to occur at a constant elevation and no other factors other than tidal elevation are used to determine water levels. The land surface elevations are based on data with an average accuracy of 15 cm (6 inches); however, areas of heavy vegetation may have errors exceeding that amount. The Delaware Coastal Programs makes no warranty and promotes no other use of these maps other than as a preliminary planning tool.

There are various uses for these maps including:

- Accession and planning land use and zoning ordinances to protect community resources while protecting

[de.gov/slrmmap](http://de.gov/slrmmap)

## NOAA Digital Coasts

**Sea Level Rise and Coastal Flooding Impacts**

Sea Level Rise Confidence Marsh

Vulnerability Flood Frequency

Marsh Impacts/Migration

3 ft SLR

Advanced Options

Accretion Rate

No Low Mid High

100 years

Legends

Overview

Understanding The Map

Additional Information

Frequently Asked Questions about the Tool (PDF)

Mapping Methodology

Land Cover Data

Sea Level Rise Information

IPCC Projections (PDF)

Rahmsdorf Projections

Global Climate Projections

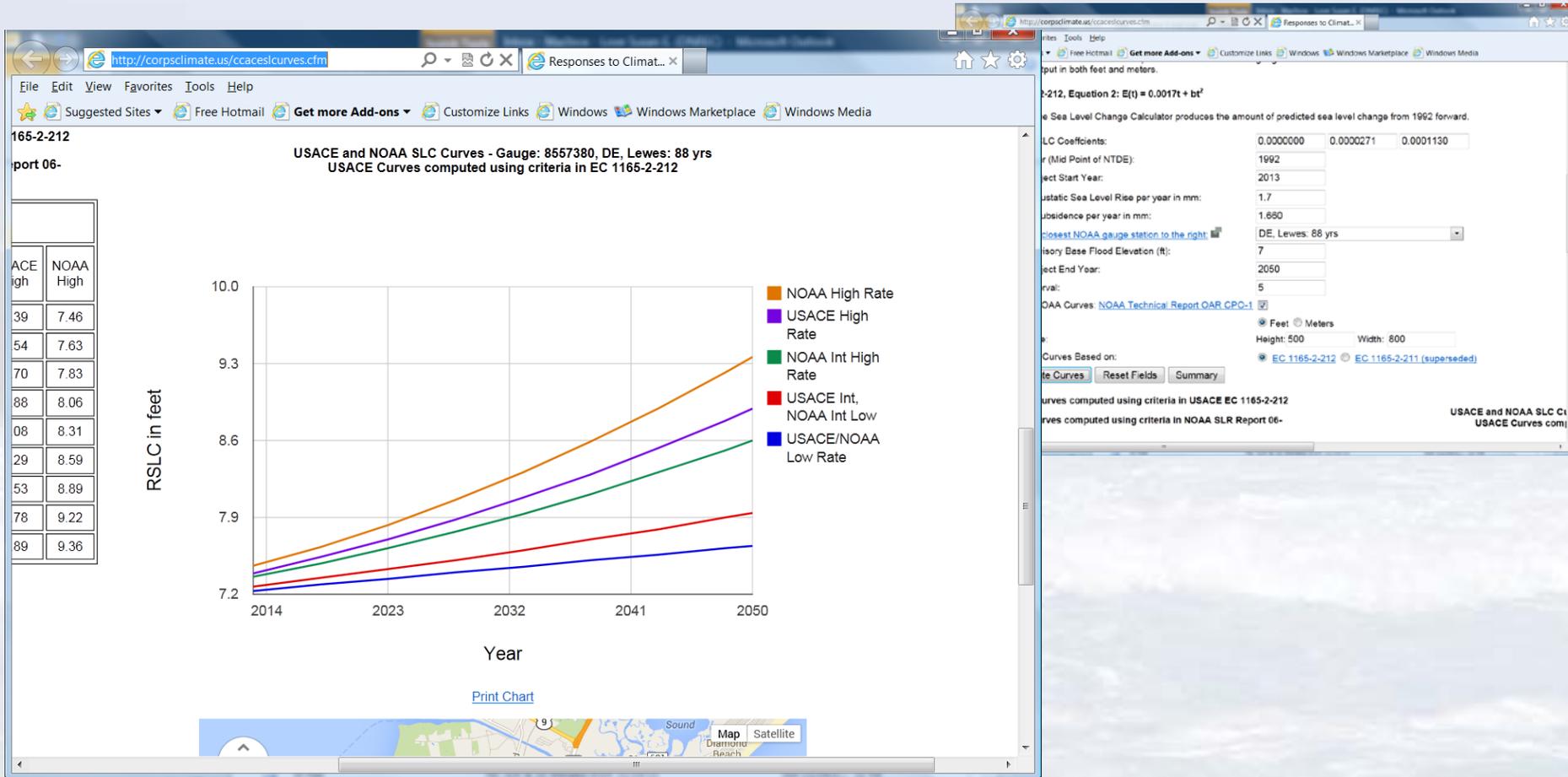
Coastal Sensitivity to Sea Level Rise

NOAA Digital Coast

[csc.noaa.gov/slr/viewer](http://csc.noaa.gov/slr/viewer)



# USACE SLR Rate Calculator



<http://corpsclimate.us/ccaceslcurves.cfm>



Delaware's Sea Level Rise Initiative



# Web-based Adaptation Clearinghouse

The screenshot shows the homepage of the Climate Adaptation Knowledge Exchange (CAKE) website. The browser address bar displays 'www.cakex.org'. The navigation menu includes 'SIGN IN', 'REGISTER', 'MY ACCOUNT', 'ABOUT', and 'DONATE'. The main content area features a featured article titled 'The Costs of Adaptation: Changes in Water Availability and Farmers' Responses in Punakha District, Bhutan' with a corresponding image of a field. A search bar is labeled 'SEARCH CAKE' and includes a world map and a search input field. Below the search bar, there are navigation buttons for 'Case Study', 'Virtual Library', 'Directory', 'Tools', and 'Community'. A 'NEW TO ADAPTATION?' banner with a 'DON'T PANIC!' graphic encourages users to start here. At the bottom, there are sections for 'JOIN & SUBMIT' and 'CONNECT WITH CAKE'.

[www.cakex.org](http://www.cakex.org)



*Delaware's Sea Level Rise Initiative*



# Your helpful friends at DNREC...



# Questions?

## Contact Info:

Susan E. Love, Planner IV  
Delaware Coastal Programs

[Susan.love@state.de.us](mailto:Susan.love@state.de.us)

(302) 739-9283

<http://de.gov/sealevelrise>

