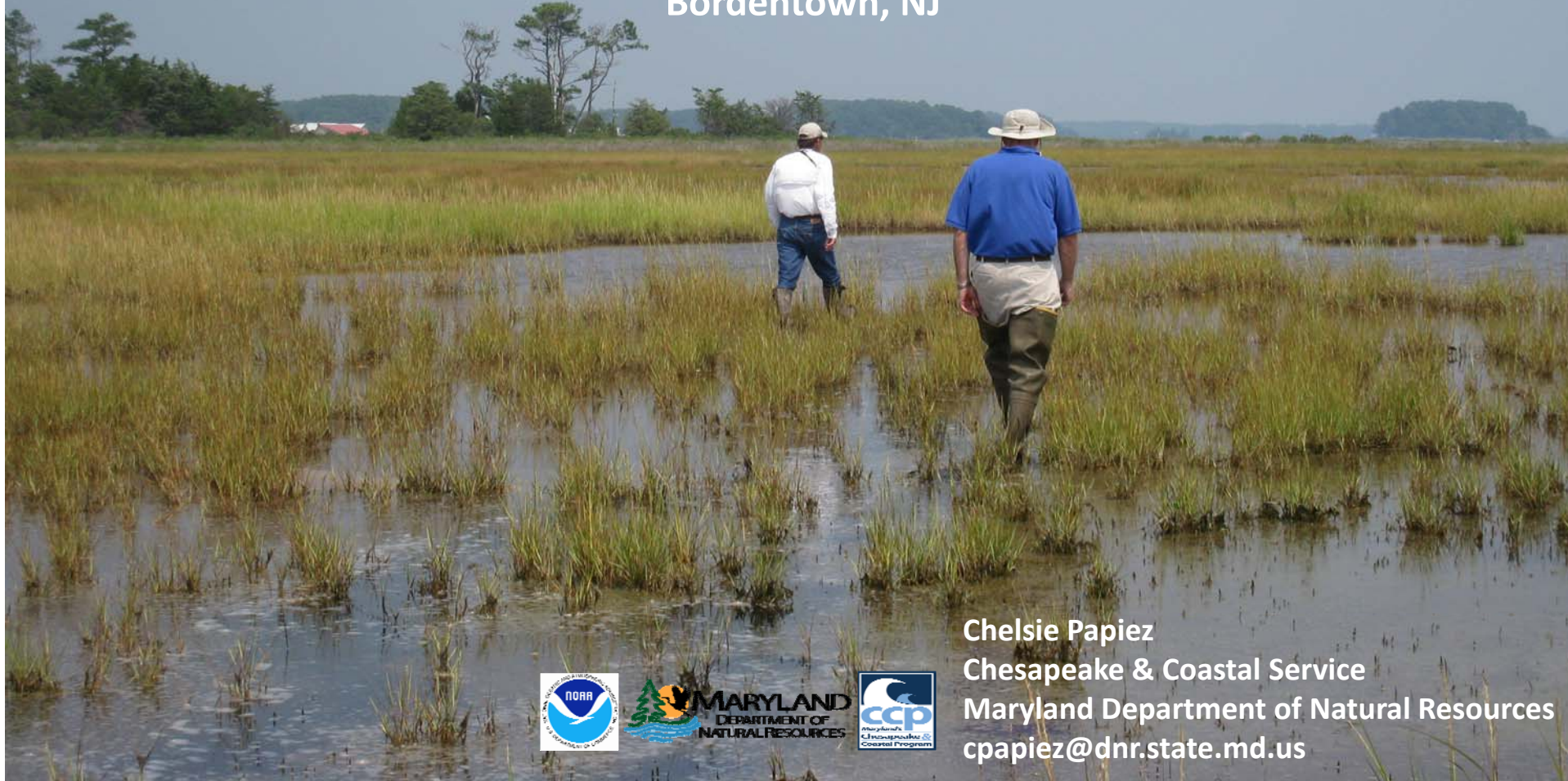


The State of Maryland: A Case Study for Acquisition Targeting and Coastal Marsh Management in the Face of Climate Change and Sea Level Rise

December 12, 2011
Rutgers University
Bordentown, NJ



Chelsie Papiez
Chesapeake & Coastal Service
Maryland Department of Natural Resources
cpapiez@dnr.state.md.us

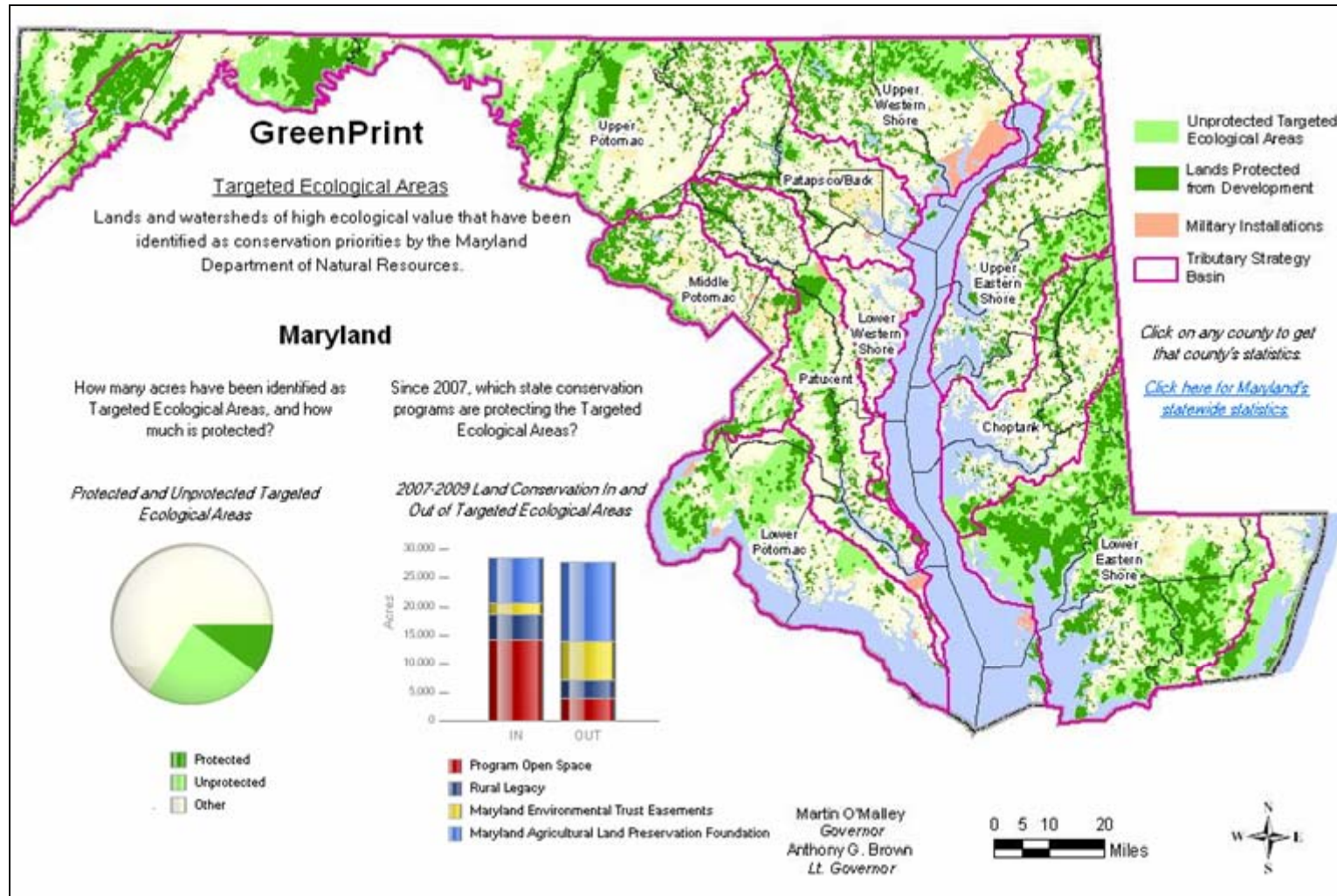


Maryland's Land Conservation Programs



- **Program Open Space** – through State and Local POS funds over 352,000 acres have been protected
- **Rural Legacy Program** – focuses on preserving working farms from development, over 40,000 acres have been protected
- **CREP** – funding for crop or pasture lands along erodible or waterways taken out of production for 10-15 years
- **Maryland Environmental Trust** – over 1,000 conservation easements statewide, protecting 125,000 acres
- **Maryland Agricultural Land Preservation Foundation** – protected 250,000 acres on almost 2,000 farms
- **Coastal and Estuarine Land Conservation Program** – protected over 3,000 acres in 9 different areas

GreenPrint: Land Conservation Ecological Targeting

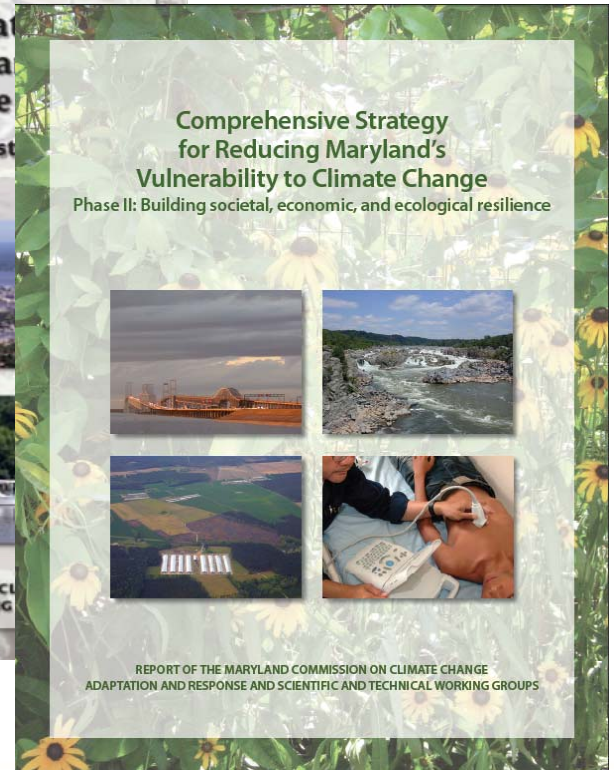
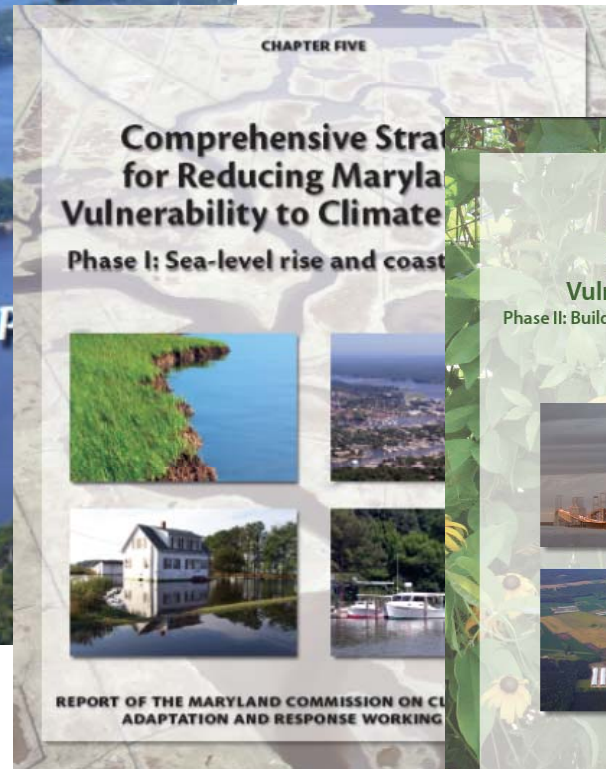
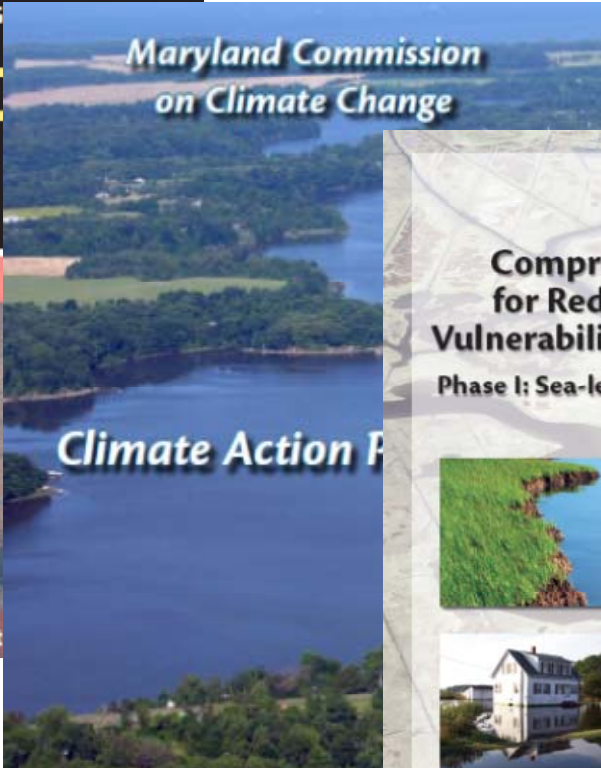
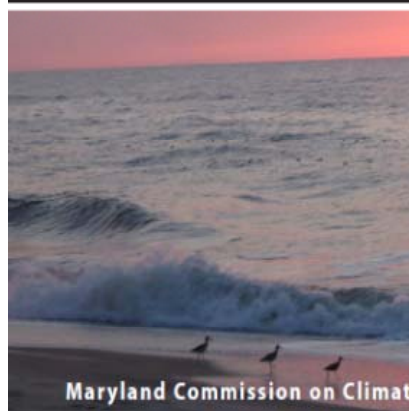




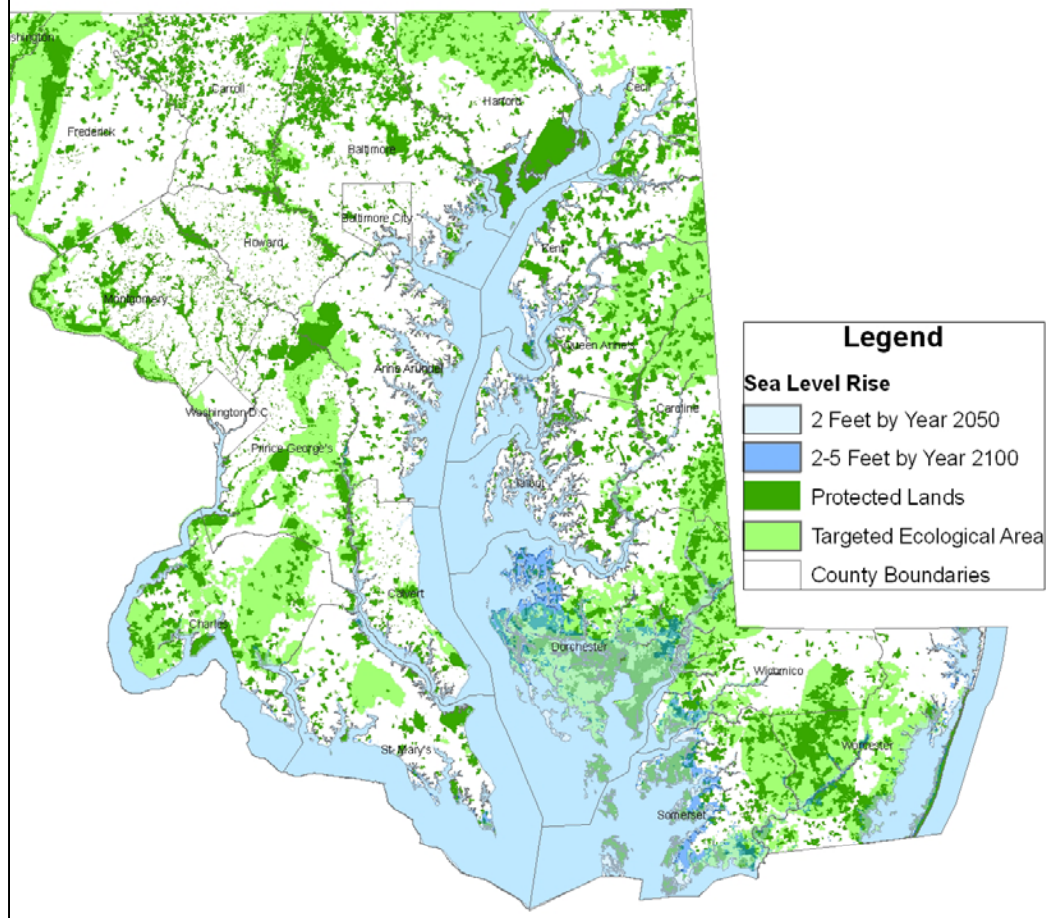
Global Climate Change = Real Consequences

- ✓ Sea Level Rise:
+ 3- 4 feet (1 to 1.5 meters)
- ✓ Temperature: + 4 - 7 degrees F
 - ✓ Annual Precipitation:
-10% to +20%
 - ✓ Spring Runoff: Higher
 - ✓ Summer Runoff: Lower

Climate Change Adaptation Planning



Maryland's Targeted Ecological Areas for Land Conservation



Vulnerability of TEAs

Targeted Ecological Areas (TEAs) are identified as the most ecologically valuable areas in the State and are preferred for conservation funding through Stateside Program Open Space.



New DNR Climate Change Policy

Signed October 12, 2010

A. New Land Investments

Practice: The Department shall proactively seek the protection of lands that enhance the resilience of bay, aquatic and terrestrial ecosystems and/or mitigate the impacts of climate change through on-site carbon sequestration.

Procedure: DNR's Land Acquisition and Planning Unit shall review all proposed land acquisitions and conservation easements to: (1) assess potential impacts of climate change and sea level rise; and (2) identify landscape or site-level characteristics that support ecosystem resilience. Limitations on future use of the site and opportunities to increase resiliency and/or mitigate adverse impacts shall be considered in combination with other existing land conservation evaluation criteria.

Implementation Guidance: The Department shall develop specific land conservation-climate change evaluation criteria within 12 months of the effective date of this policy.

Drivers for the Project

– Climate Action Plan –

Phase I Report: Protect and restore the State's natural shoreline and its resources, including its tidal wetlands and marshes, vegetated buffers, and Bay Islands, that inherently shield MD's shoreline and interior.

– Narrowed Focus on Wetlands –

Advisory Workshop Top Priority: Facilitate landward movement of high priority coastal ecosystems subject to dislocation by sea level rise.



Project Components

**Landscape-Level
Targeting**

**Marsh Migration
Model**

**Parcel-Level
Scoring**

**Ecological-Based
Evaluation Criteria**

Facilitate landward movement of high priority coastal ecosystems subject to dislocation by sea level rise.

- Ability to sustain coastal ecosystem structure and function through restoration and protection activities to ensure that ecosystems can migrate and adapt; and/or

- Ability to sustain coastal ecosystem services that include maintaining healthy Bay water quality and coastal community protection such as flood control and storm-surge protection

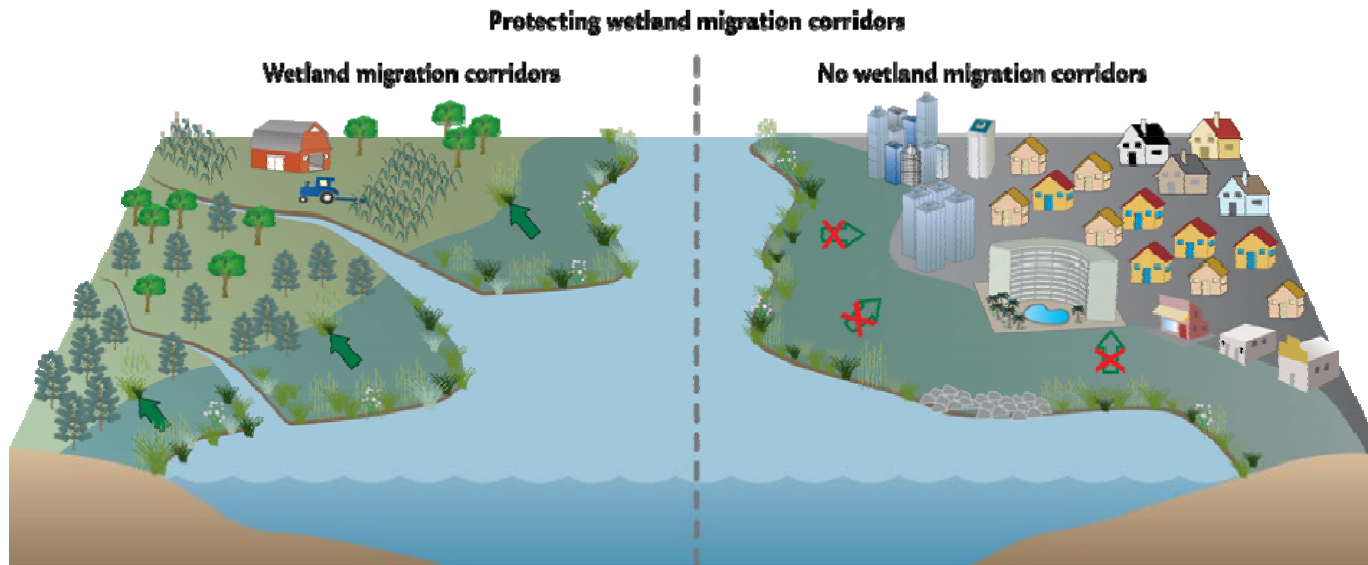





Figure 14. As sea level rises, wetlands may migrate  into open spaces such as forests  and fields . However, wetlands cannot migrate  into areas with man-made barriers such as hardened shorelines  and heavy development such as urban , commercial , and residential areas .

Coastal Land Criteria

- Shoreline Structures
 - Potential barrier to inland migration of ecosystems



Coastal Land Criteria

- Intact Coastal Wetlands
 - Intact coastal wetlands may help facilitate accretion and recruitment inland



Limiting Harden Shorelines

Potential Barriers to Inland Migration

- Armored shorelines
- Heavy development
- Impervious surfaces
- Steep slopes/ cliffs



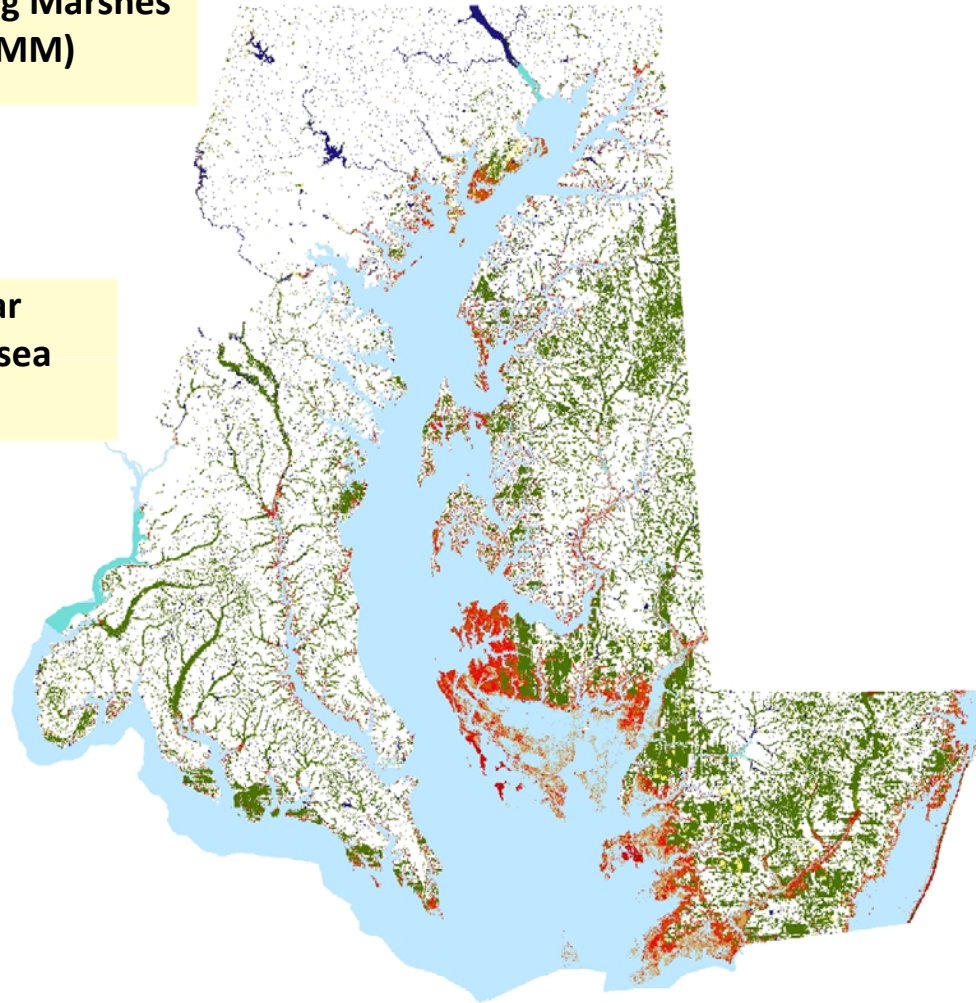
Living Shoreline Protection Act (2008)

- Requires non-structural shore protection practices unless proven infeasible




Priority Setting Using Marsh Modeling

**Sea Level Affecting Marshes
Model (SLAMM)**

**Projection for year
2100 with 3.4 ft of sea
level rise**

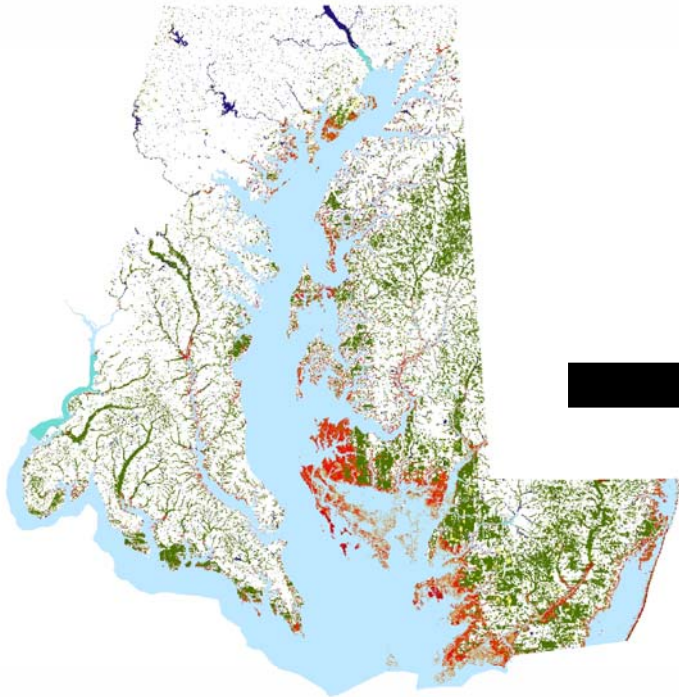


Wetland Classes

-  Swamp
-  Cypress Swamp
-  Inland Freshwater Marsh
-  Tidal Freshwater Marsh
-  Transitional Salt Marsh
-  Regularly Flooded Marsh
-  Estuarine Beach
-  Tidal Flat
-  Ocean Beach
-  Rocky Intertidal
-  Inland Open Water
-  Riverine Tidal Open Water
-  Estuarine Open Water
-  Tidal Creek
-  Irregularly Flooded Marsh
-  Inland Shoreline
-  Tidal Freshwater Swamp
-  Blank

Setting Wetland Priorities with SLAMM & Additional Data

Statewide Marsh Modeling

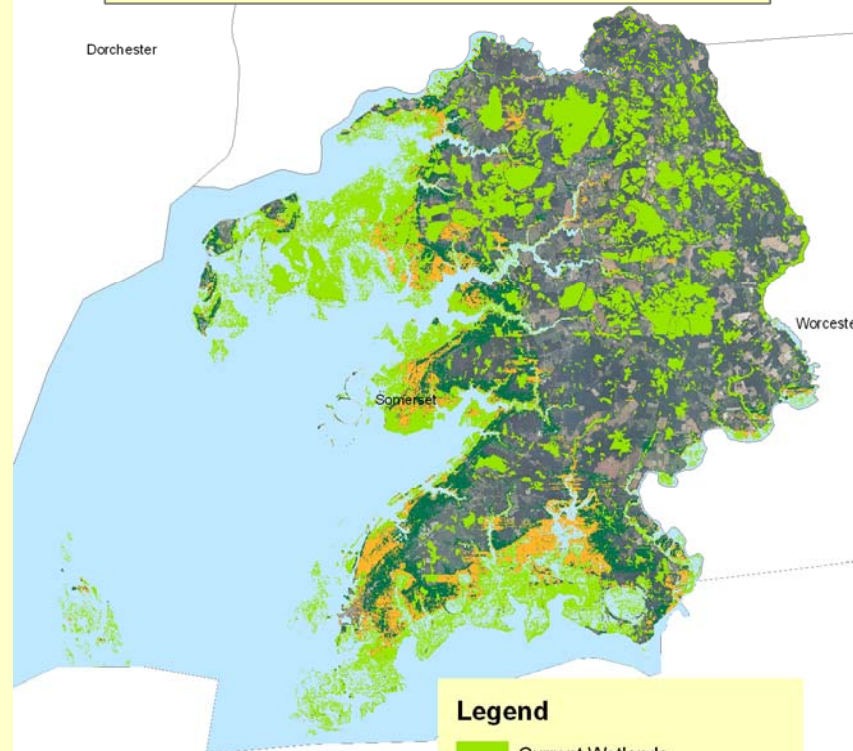


- All Future Wetlands under SLR
- Large Intact Wetlands
- New Wetland Areas
- Maintain Diversity of Wetlands
- Wildlife Habitat: Breeding Birds
- Wildlife Habitat: High Marsh
- Suitable Hydric Soils
- Future Wetlands within GI Network
- Future Wetlands within BI Watershed

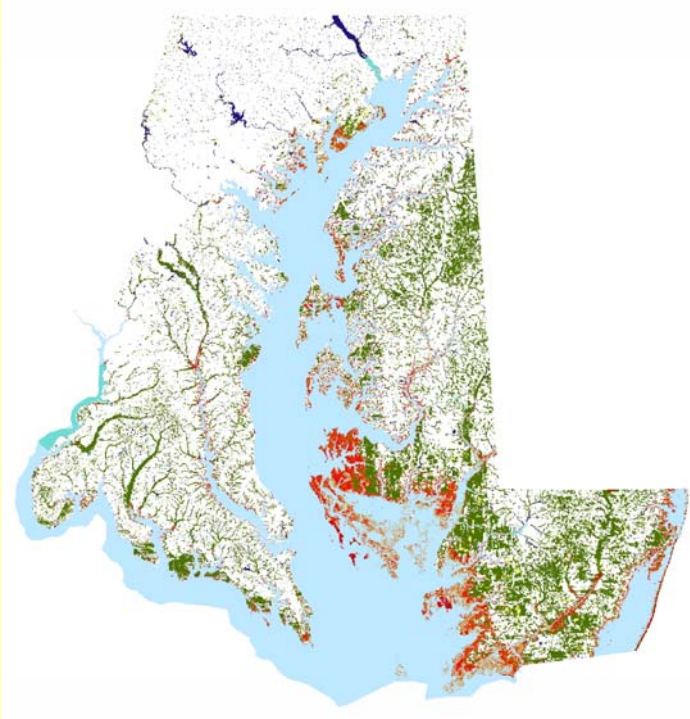
New Wetland Areas: Planning Horizons

- New Wetland Areas projected by SLAMM
- Maintaining migration corridors for inland movement

Somerset County New Wetland Areas Sea Level Rise



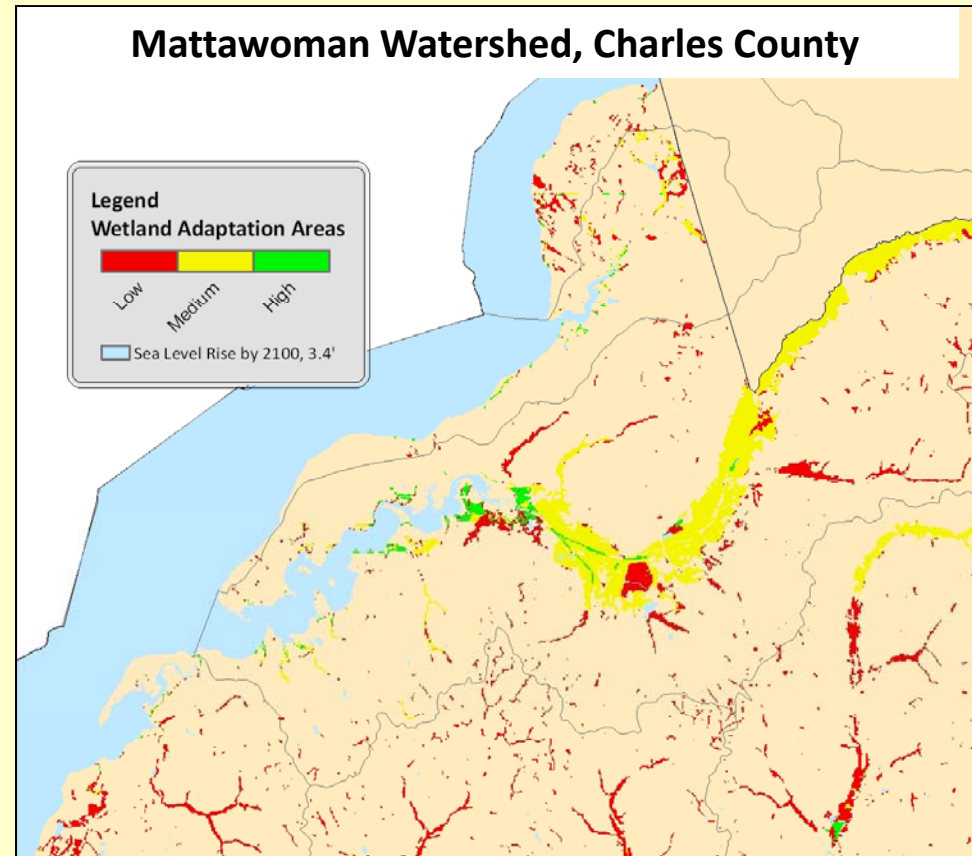
Statewide Marsh Modeling



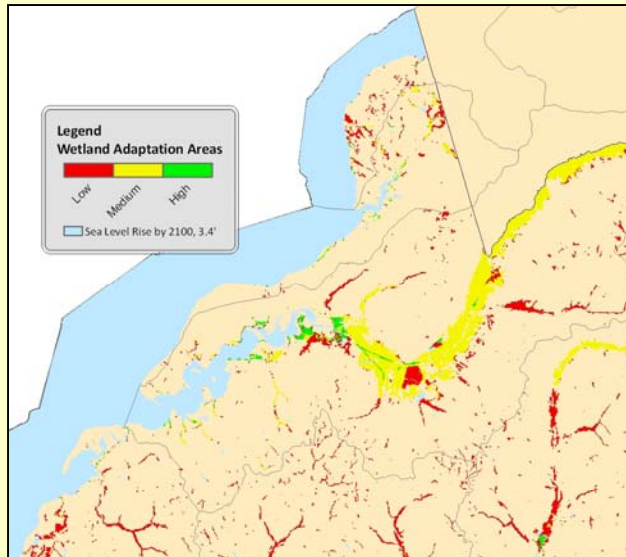
- All Future Wetlands under SLR (5 pts)
- Large Intact Wetlands (5-25pts)
- New Wetland Areas (20 pts)
- Future Wetlands within BI Watersheds (10 pts)
- Maintain Diversity of Wetlands (5-20 pts)
- Suitable Hydric Soils (5-15 pts)
- Future Wetlands within GI Network (10 pts)
- Wildlife Habitat: Breeding Birds (10 pts)
- Wildlife Habitat: High Marsh (15 pts)

Wetland Adaptation Areas

- Priority is a 3-tier breakout
- Adaptation Planning for a 3.4 ft of Sea-Level Rise by year 2100
- Data is available for every coastal county and Baltimore City



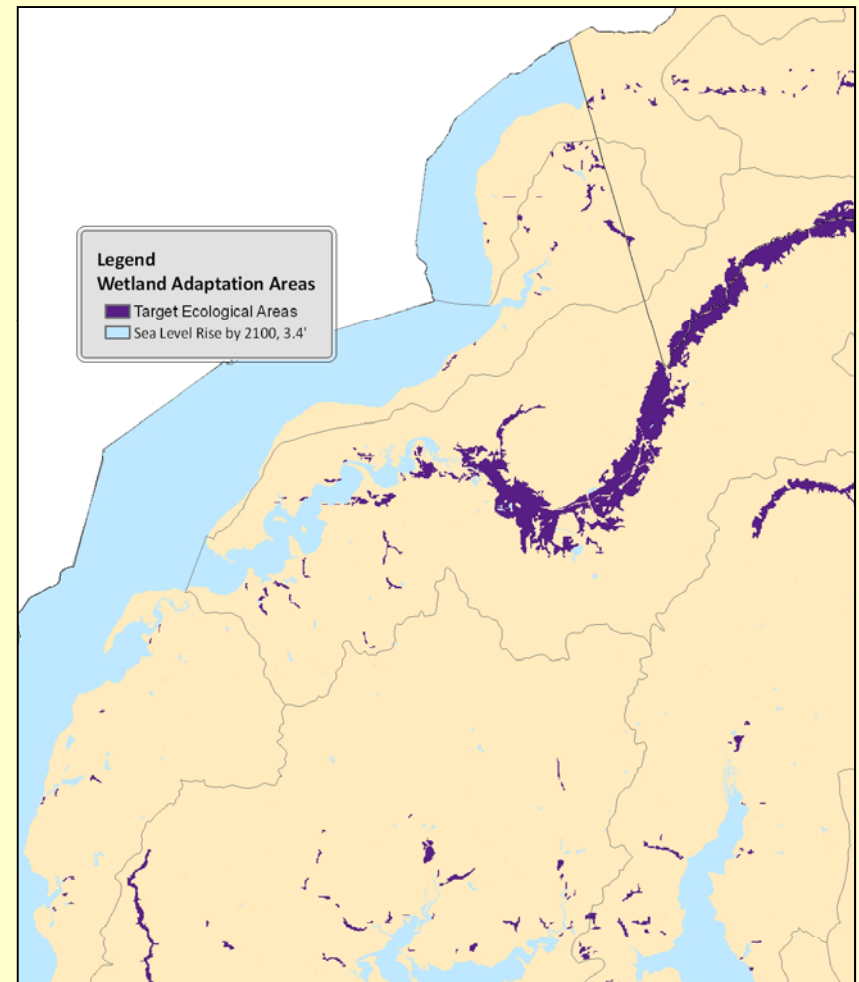
Wetland Adaptation Priority Areas



Top two tiers

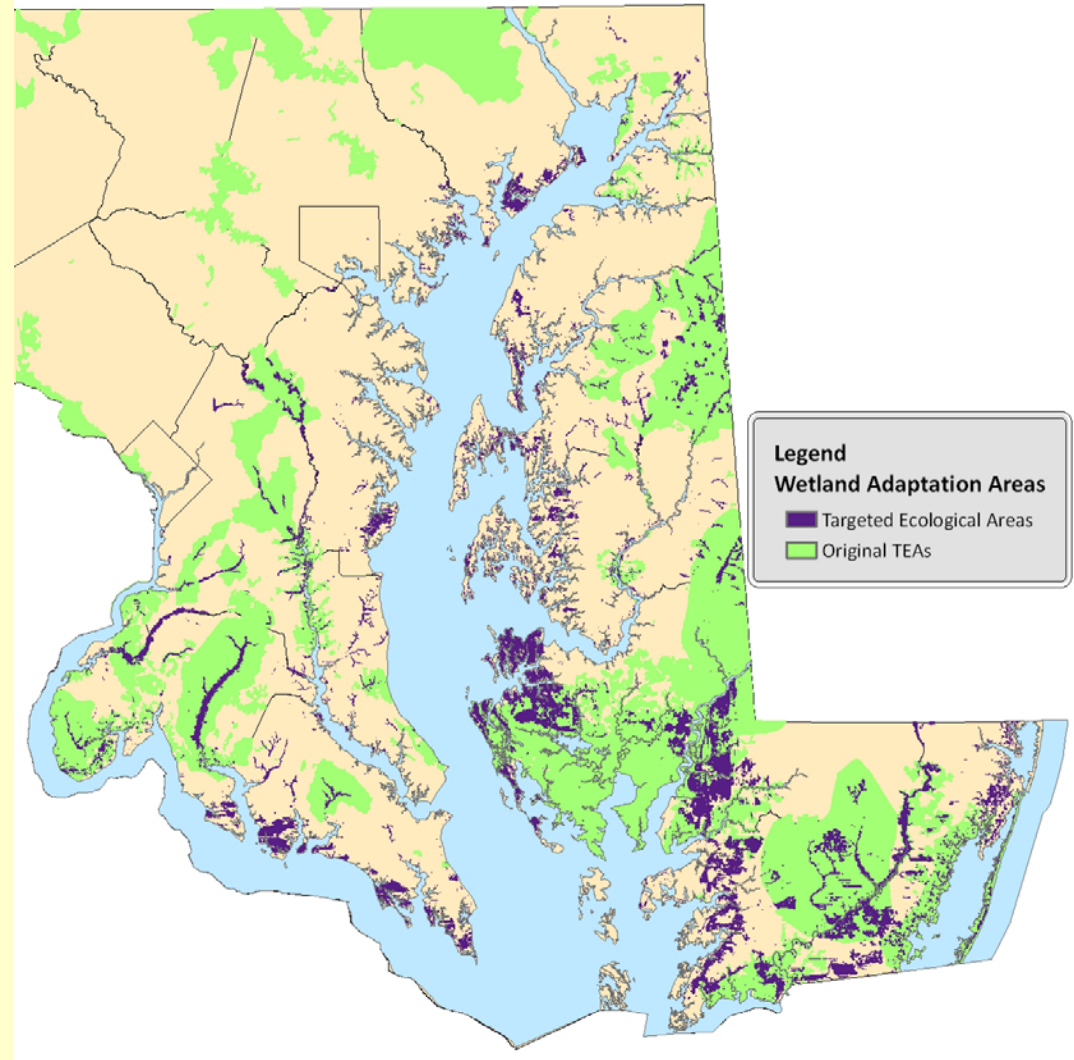


Targeted Ecological Areas

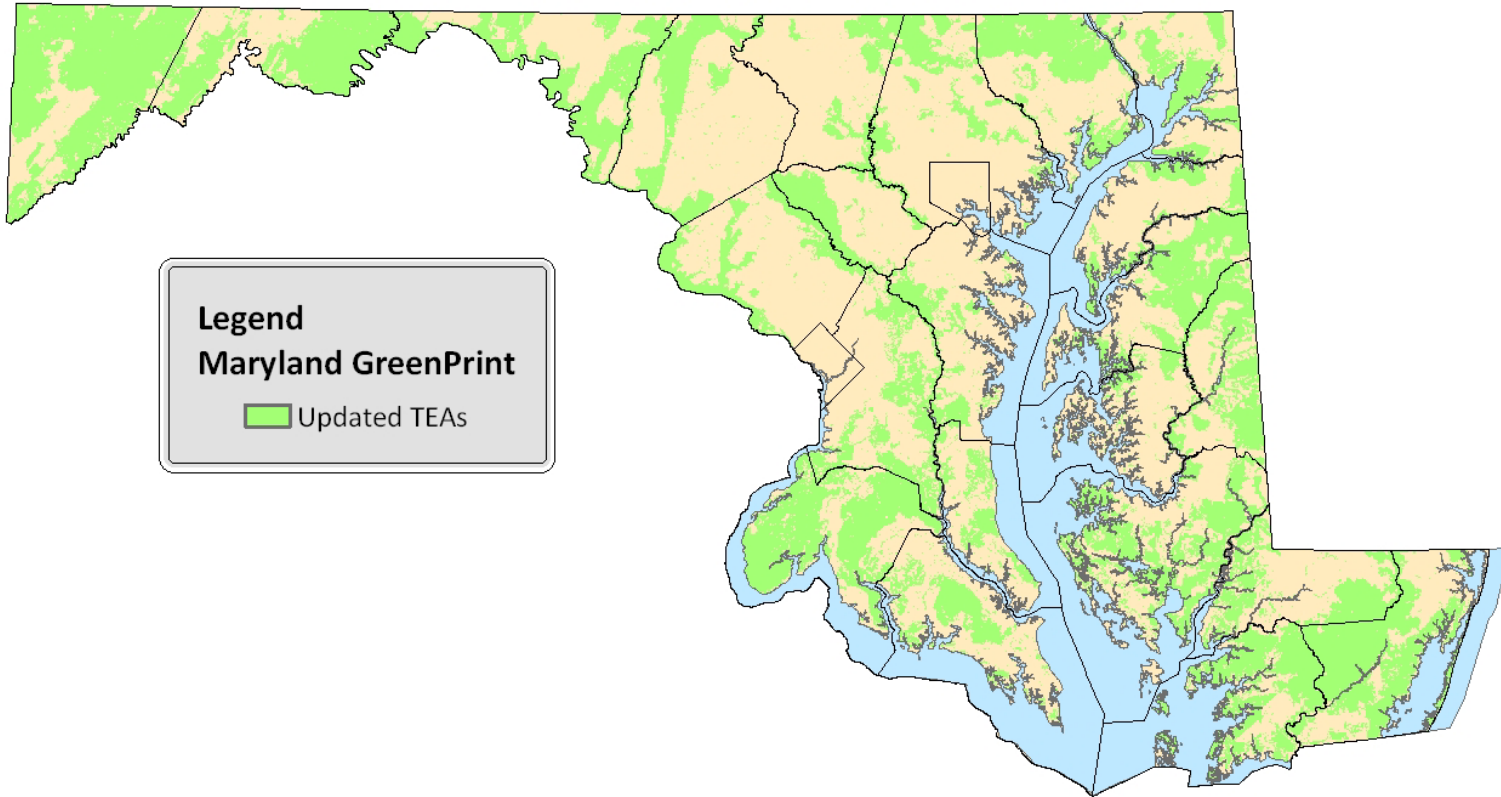


Targeted Ecological Areas for Wetland Adaptation Areas

- Top two tiers of county-level priority Wetland Adaptation Model
- New wetland priority areas will be added to GreenPrint Targeted Ecological Areas for land conservation

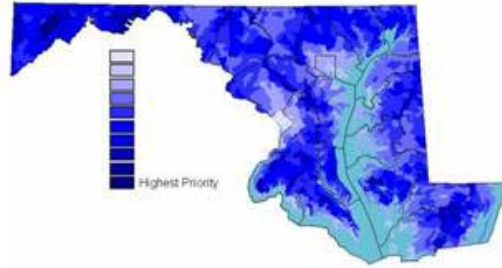


Updated vs. Original Target Ecological Areas

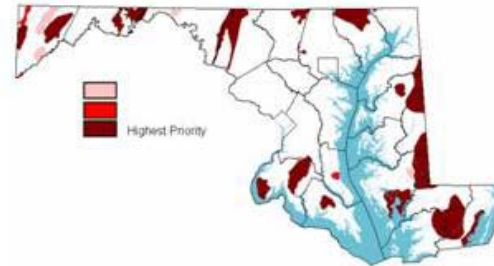


New GreenPrint “Targeted Ecological Areas”

Water Quality Protection



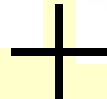
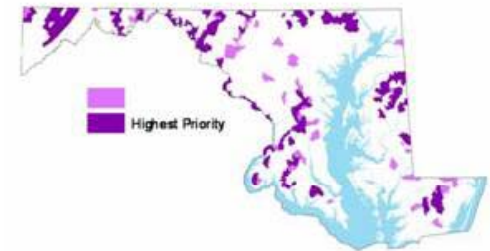
Rare Species Habitats



Green Infrastructure



Aquatic Life Hotspots



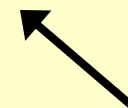
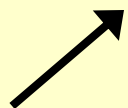
Targeted Ecological Areas



Blue Infrastructure Priorities



Wetland Adaptation Areas



Project Components

Landscape-Level Targeting

Marsh Migration
Model

Parcel-Level Scoring


Ecological-Based
Evaluation Criteria

Training for Land Trusts: Incorporating Climate Change into Land Conservation Decisions



MARYLAND'S COMPANION DATA GUIDE FOR CONSERVATION: DRAFT
Climate Change Data Layers for Parcel Level Evaluations


COASTAL ATLAS:
SHORELINES ONLINE MAP DATA SELECTION (www.dnr.state.md.us/ccp/coastalatlus/)



* Data is available through the use of Coastal Atlas Shoreline Map, downloadable in ArcGIS format from the MD iMAP server (www.imap.state.md.us/) or the Geospatial Data Center (<http://dnrweb.dnr.state.md.us/gis/data/>)

*Sections I-VI: Use the parcels data layer to determine

- I. Sea Level Rise Vulnerability
 - i. Sea Level Rise Vulnerability layer 0-2 feet
 - ii. Sea Level Rise Vulnerability layer 2-5 feet
- II. Wetland Transition Potential
 - i. Sea Level Rise Vulnerability layer, 0-2 feet (current wetlands layer turned on)
 - ii. Sea Level Rise Vulnerability layer, 2-5 feet (current wetlands layer turned on)
 - iii. Land Use/Land Cover layer (view the legend)
 - iv. Living Shoreline Suitability layer (currently Somerset and Calvert Counties)
- III. Restoration Potential
 - i. Imagery layer (turn off Shoreline and Street description)
 - ii. Imagery and Sea Level Rise Vulnerability layer
 - a. Sea Level Rise Vulnerability 2-5 Shoreline and Street Map layers



MARYLAND'S CRITERIA FOR COASTAL LAND CONSERVATION DRAFT
In Response to Climate Change Impacts of Sea Level Rise


Climate Change Evaluation Criteria
Projected impacts are based on the best available science for the Mid-Atlantic Region. Relative sea-level rise projections for the Maryland range between 1-1.3 feet by 2050 and 2.7-3.4 feet by 2100. Please refer to the companion guide that identifies the supporting data for this evaluation.

Property Name: _____ County: _____

Scoring: In interpreting the scale it is assumed that the higher the rating, the greater the capacity of the property to provide resiliency to climate change stressors of sea level rise and storm surge through adaptation and/or mitigation.




I. Sea Level Rise Resiliency
Identifying potential sea level rise vulnerability of a site will help establish a long-term management plan to help increase the resiliency of the site.

Overall Rating: slight low moderate high



Sea Level Rise Resiliency Potential

- i. Is there potential for inundation on the property by 2050?
Yes No
- If yes, roughly how much of the property would be inundated?
 - a. 76-100% slight
 - b. 51-75%
 - c. 26-50%
 - d. 25% or less high
- ii. Is there potential for inundation on the property by 2100?
Yes No
- If yes, roughly how much of the property would be inundated?
 - a. 76-100% slight
 - b. 51-75%
 - c. 26-50%
 - d. 25% or less high

1

Maryland Coastal Atlas: www.dnr.state.md.us/ccp/coastalatlus/

Evaluating for Climate Change Adaptation & Mitigation Benefits



Sea Level Rise Resiliency

- Temporal flooding
- Short term inundation
- Long term inundation

Wetland Migration Potential

- Land use/Land cover
- Living Shoreline
- Elevation or Sea Level Rise

Natural Storm Surge Protection

- Storm surge buffers (vegetated shorelines, wetlands, or beaches)
- Rate of Shoreline Erosion
- Proximity to adjacent protected lands or communities
- Land use/Land cover
- Storm surge data (SLOSH)

Potential Barriers to Habitat Migration

- Hardened shorelines
- Bank cover & height
- Waterway obstructions
- Other Impervious surfaces

Mitigation and Restoration Potential

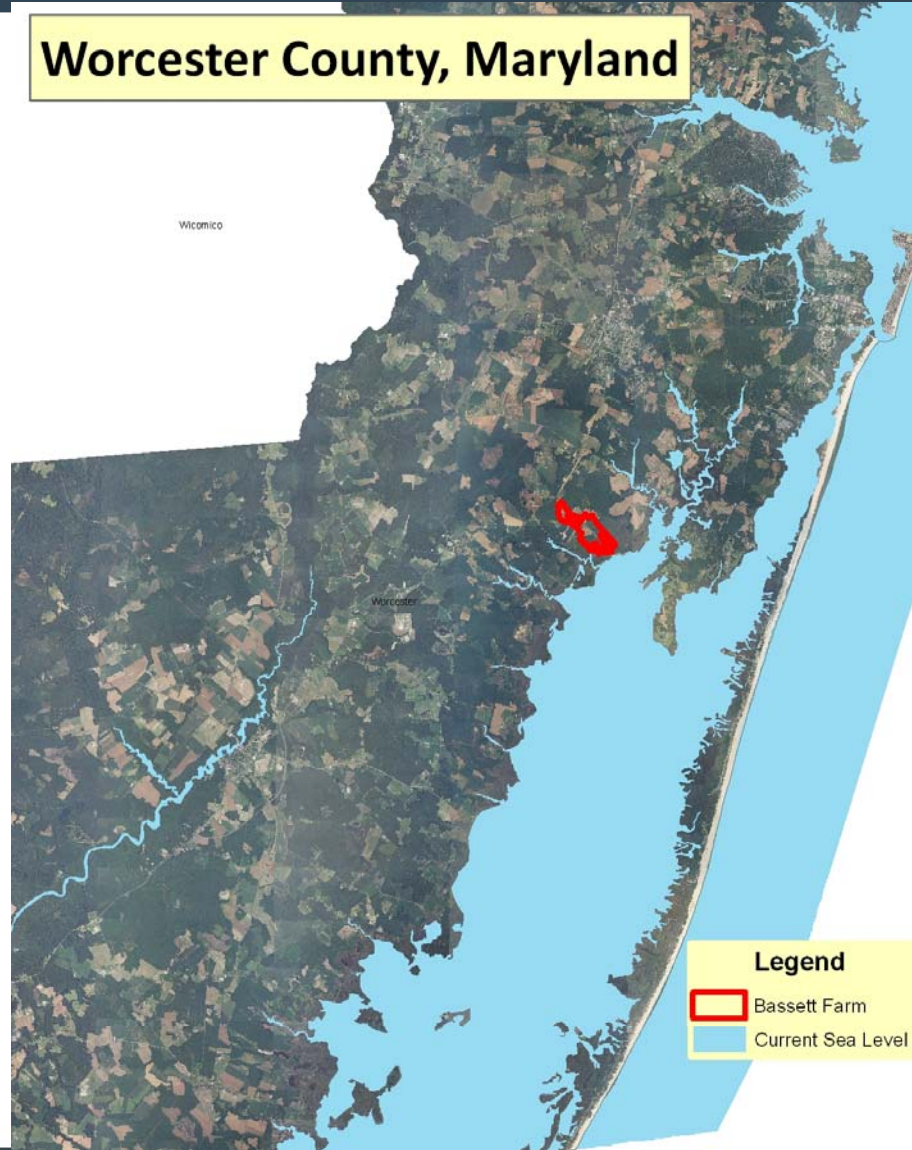
- Carbon sequestration
- Afforestation & Reforestation above inundation zone
- Ditched/Diked wetlands
- Invasive wetland species

Environmental Hazards Removal/Mitigation

- Septic system or oil tanks
- Current or past animal feeding operations

Parcel Level Review

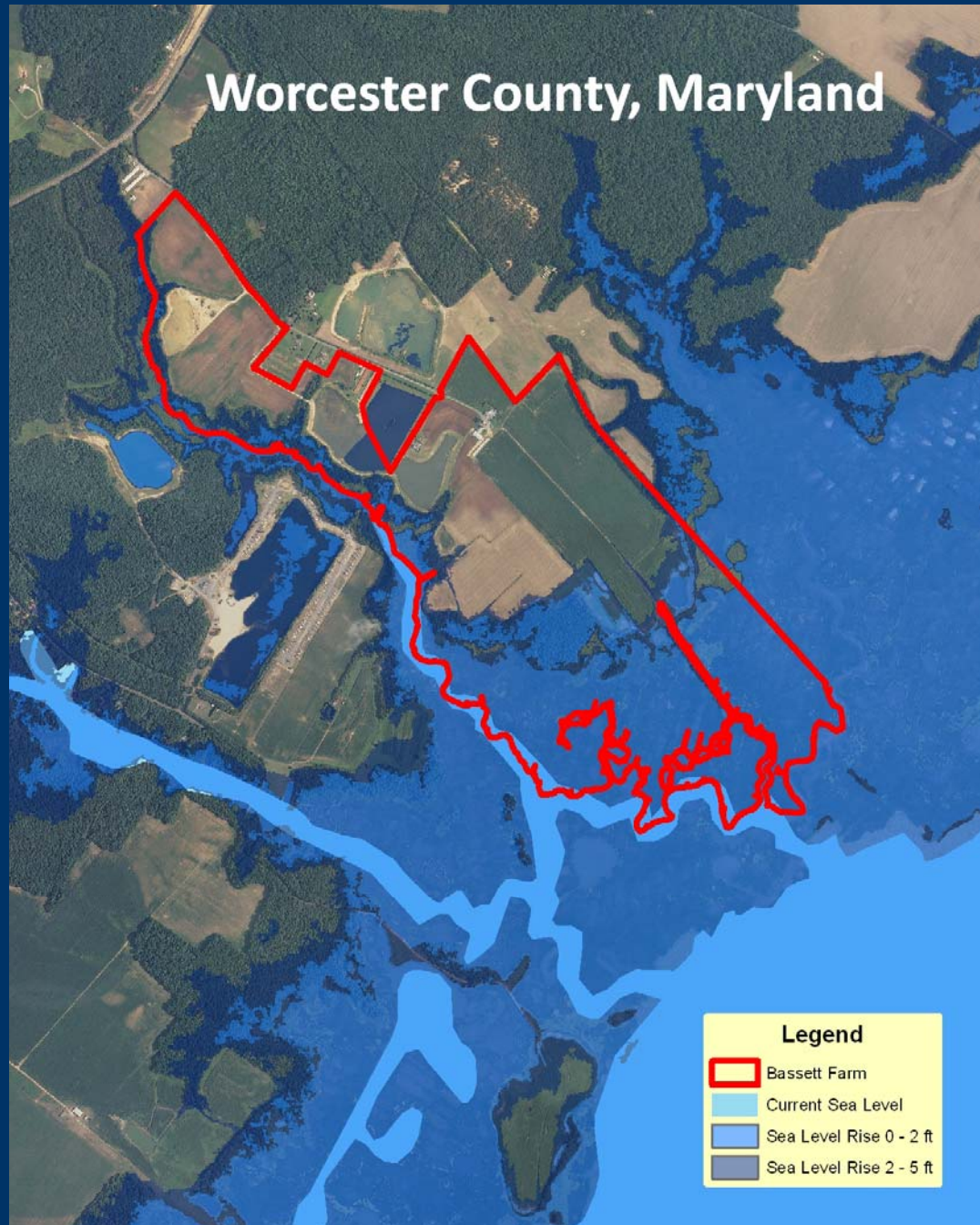
Worcester County, Maryland



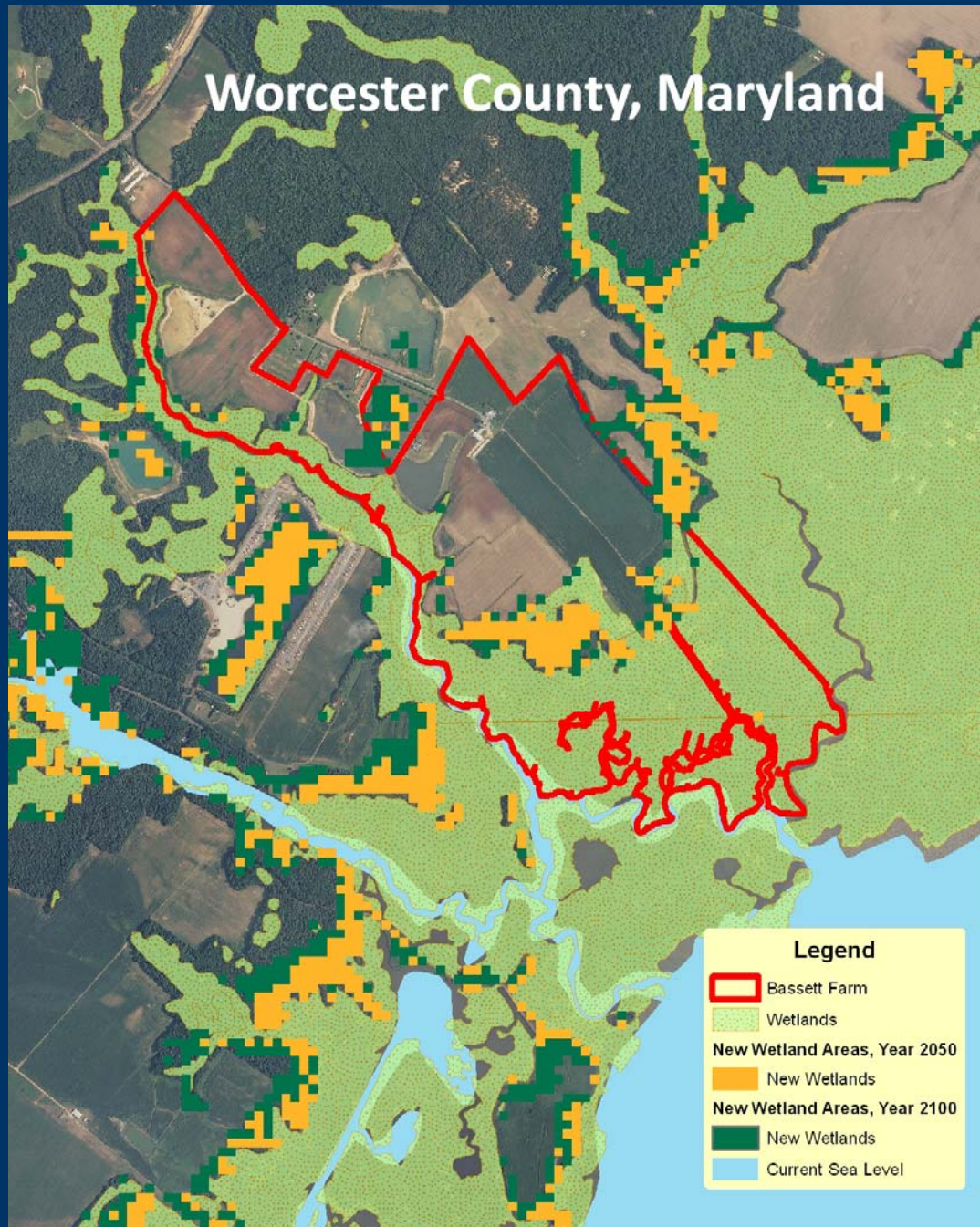
Worcester County, Maryland

Sea Level Rise Scenarios

- 0-2 feet Year 2050
- 2-5 feet Year 2100



Worcester County, Maryland



Sea Level Rise Scenarios

- 0-2 feet Year 2050
- 2-5 feet Year 2100

Wetland Migration Potential

- SLAMM Projections
- New Wetland Areas

Worcester County, MD



Sea Level Rise Scenarios

- 0-2 feet Year 2050
- 2-5 feet Year 2100

Wetland Migration Potential

- SLAMM Projections
- New Wetland Areas

Barriers to Habitat Migration

- Hardened Shorelines
- Bank Slope
- Impervious Surfaces
- Waterway Obstructions

Worcester County, MD

Sea Level Rise Scenarios

- 0-2 feet Year 2050
- 2-5 feet Year 2100

Wetland Migration Potential

- SLAMM Projections
- New Wetland Areas

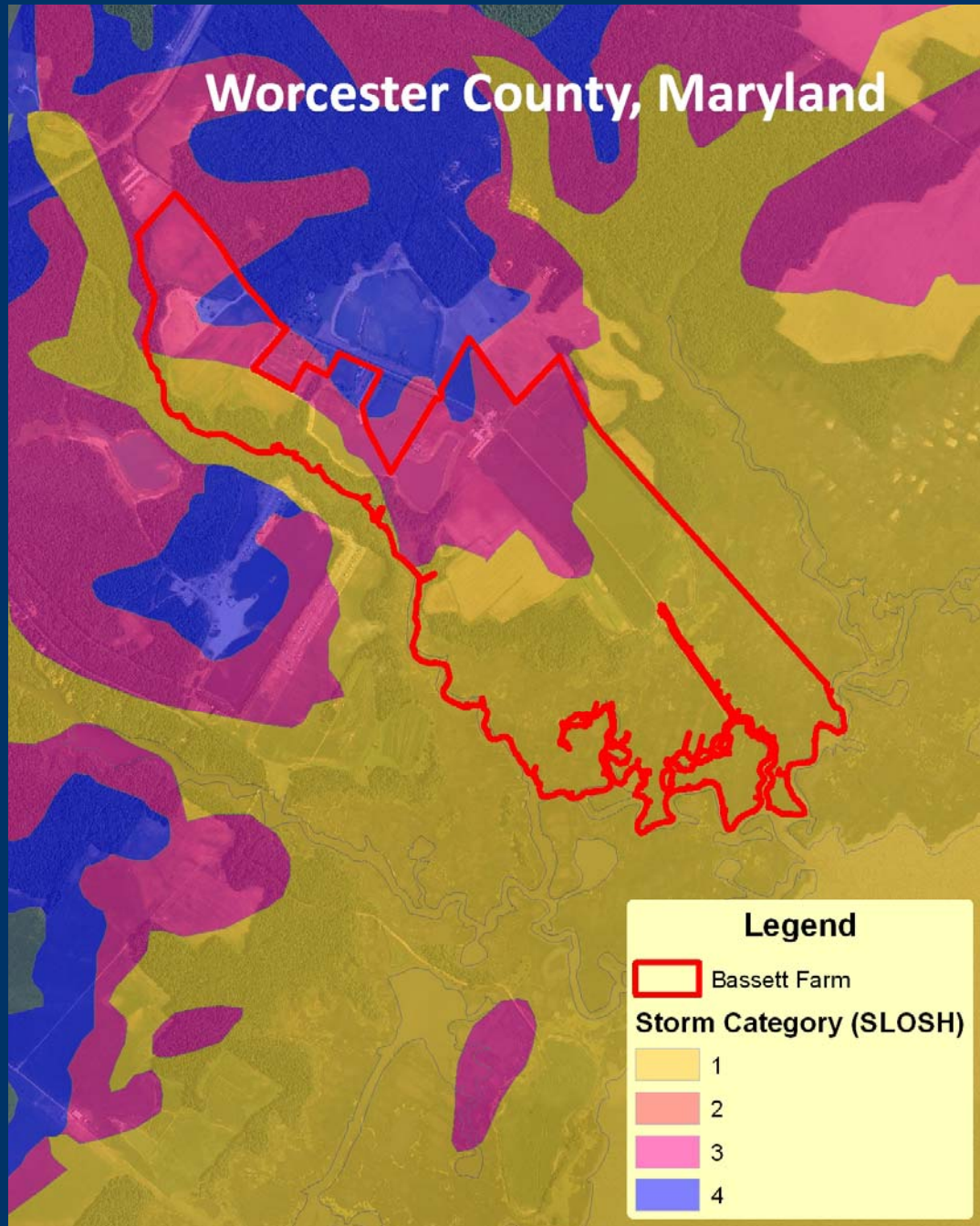
Barriers to Habitat Migration

- Hardened Shorelines
- Bank Slope
- Impervious Surfaces
- Waterway Obstructions

Mitigation/Restoration Potential

- Carbon Sequestration
- Removal of Invasive Species
- Removal of Hazards

Worcester County, Maryland



Sea Level Rise Scenarios

- 0-2 feet Year 2050
- 2-5 feet Year 2100

Wetland Migration Potential

- SLAMM Projections
- New Wetland Areas

Barriers to Habitat Migration

- Hardened Shorelines
- Bank Slope
- Impervious Surfaces
- Waterway Obstructions

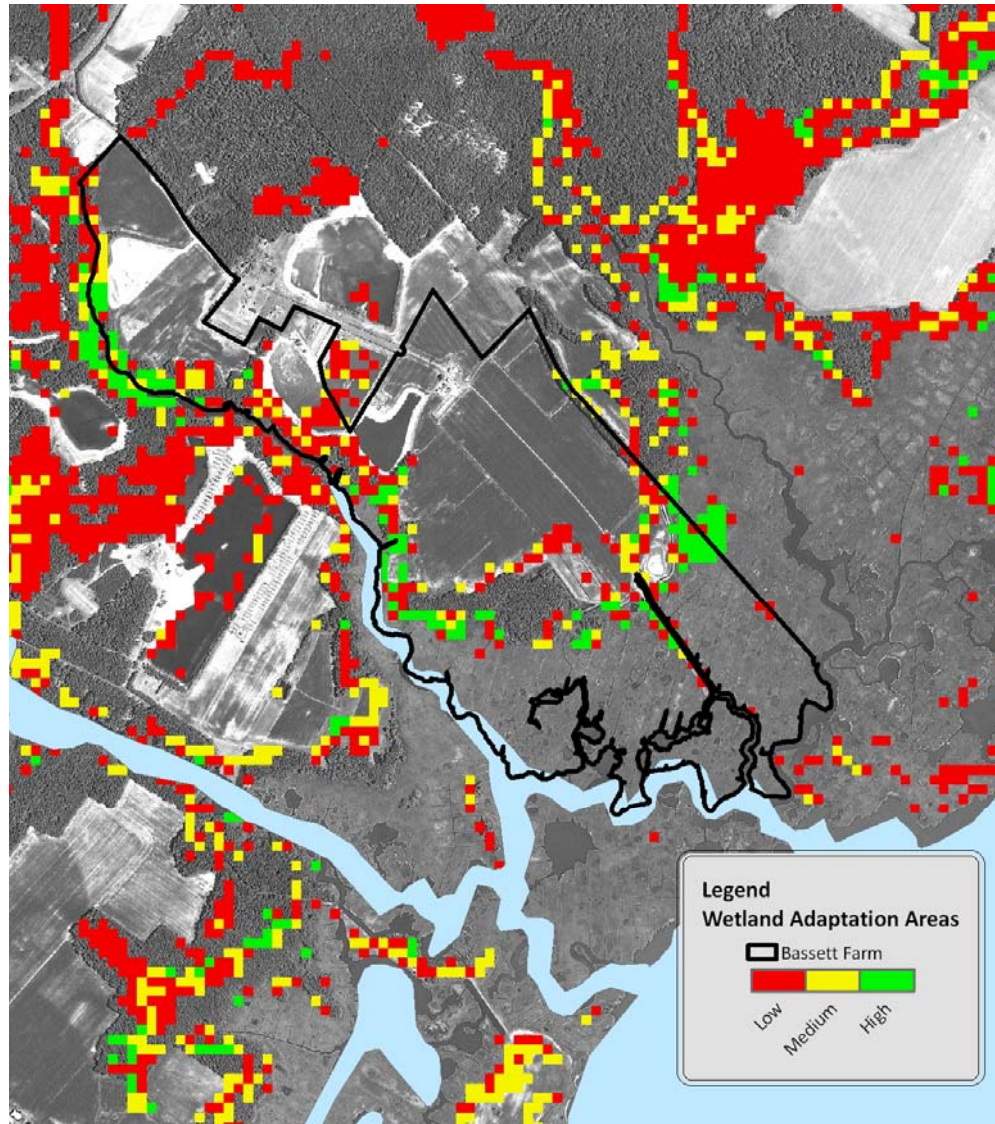
Mitigation/Restoration Potential

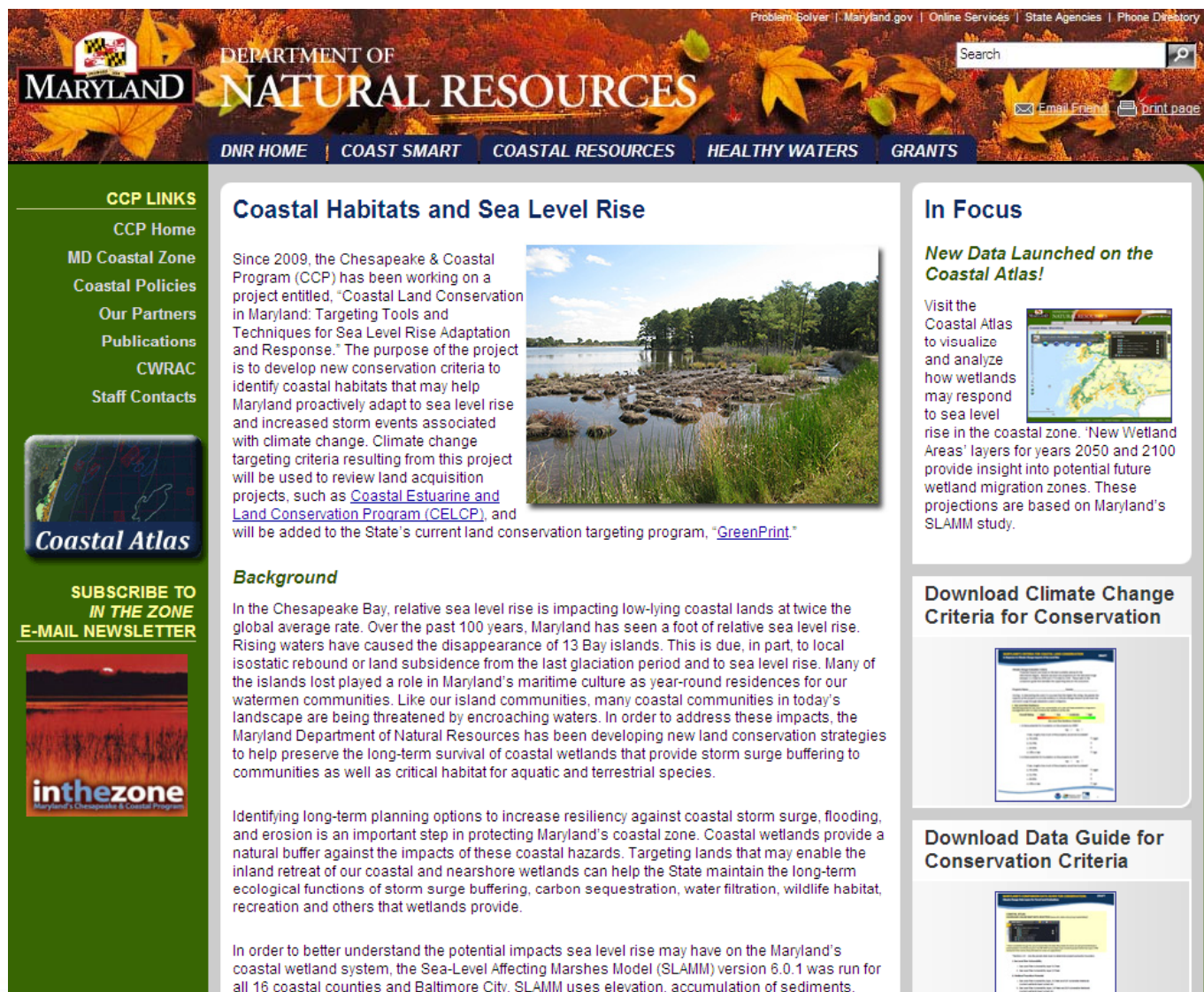
- Carbon Sequestration
- Removal of Invasive Species
- Removal of Hazards

Storm Surge Protection

- Wetlands presence/absence
- Erosion
- Proximity to adjacent protected lands or communities

Wetland Adaptation Areas





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Coastal Atlas

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inthezone
Maryland's Chesapeake & Coastal Program

Coastal Habitats and Sea Level Rise


Since 2009, the Chesapeake & Coastal Program (CCP) has been working on a project entitled, "Coastal Land Conservation in Maryland: Targeting Tools and Techniques for Sea Level Rise Adaptation and Response." The purpose of the project is to develop new conservation criteria to identify coastal habitats that may help Maryland proactively adapt to sea level rise and increased storm events associated with climate change. Climate change targeting criteria resulting from this project will be used to review land acquisition projects, such as [Coastal Estuarine and Land Conservation Program \(CELCP\)](#), and will be added to the State's current land conservation targeting program, "GreenPrint."



In Focus

New Data Launched on the Coastal Atlas!

Visit the Coastal Atlas to visualize and analyze how wetlands may respond to sea level rise in the coastal zone. 'New Wetland Areas' layers for years 2050 and 2100 provide insight into potential future wetland migration zones. These projections are based on Maryland's SLAMM study.




Background

In the Chesapeake Bay, relative sea level rise is impacting low-lying coastal lands at twice the global average rate. Over the past 100 years, Maryland has seen a foot of relative sea level rise. Rising waters have caused the disappearance of 13 Bay islands. This is due, in part, to local isostatic rebound or land subsidence from the last glaciation period and to sea level rise. Many of the islands lost played a role in Maryland's maritime culture as year-round residences for our watermen communities. Like our island communities, many coastal communities in today's landscape are being threatened by encroaching waters. In order to address these impacts, the Maryland Department of Natural Resources has been developing new land conservation strategies to help preserve the long-term survival of coastal wetlands that provide storm surge buffering to communities as well as critical habitat for aquatic and terrestrial species.


Identifying long-term planning options to increase resiliency against coastal storm surge, flooding, and erosion is an important step in protecting Maryland's coastal zone. Coastal wetlands provide a natural buffer against the impacts of these coastal hazards. Targeting lands that may enable the inland retreat of our coastal and nearshore wetlands can help the State maintain the long-term ecological functions of storm surge buffering, carbon sequestration, water filtration, wildlife habitat, recreation and others that wetlands provide.

In order to better understand the potential impacts sea level rise may have on the Maryland's coastal wetland system, the Sea-Level Affecting Marshes Model (SLAMM) version 6.0.1 was run for all 16 coastal counties and Baltimore City. SLAMM uses elevation, accumulation of sediments,

Download Climate Change Criteria for Conservation



Download Data Guide for Conservation Criteria





Thank You



Chelsie Papiez
Coastal Resources Planner
Chesapeake & Coastal Service
cpapiez@dnr.state.md.us

<http://www.dnr.state.md.us/ccp>

