



## **Adapting to Climate Change in the Chesapeake Bay: Virginia's Experience**

Skip Stiles  
Executive Director  
Wetlands Watch

STAC Workshop  
March 15, 2011



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

What Do We Know About Climate Change Impact Predictions for Virginia?

**In 100 years we'll see.....**

- **At Least 2.3 feet of sea level rise (as much as 5.2 feet) in next 100 years**
- **3.1 °C increase in average temperature**
- **~11 % increase in rainfall intensity**

**Pyke, et al, 2008, Virginia Climate Change Commission, 2008.**

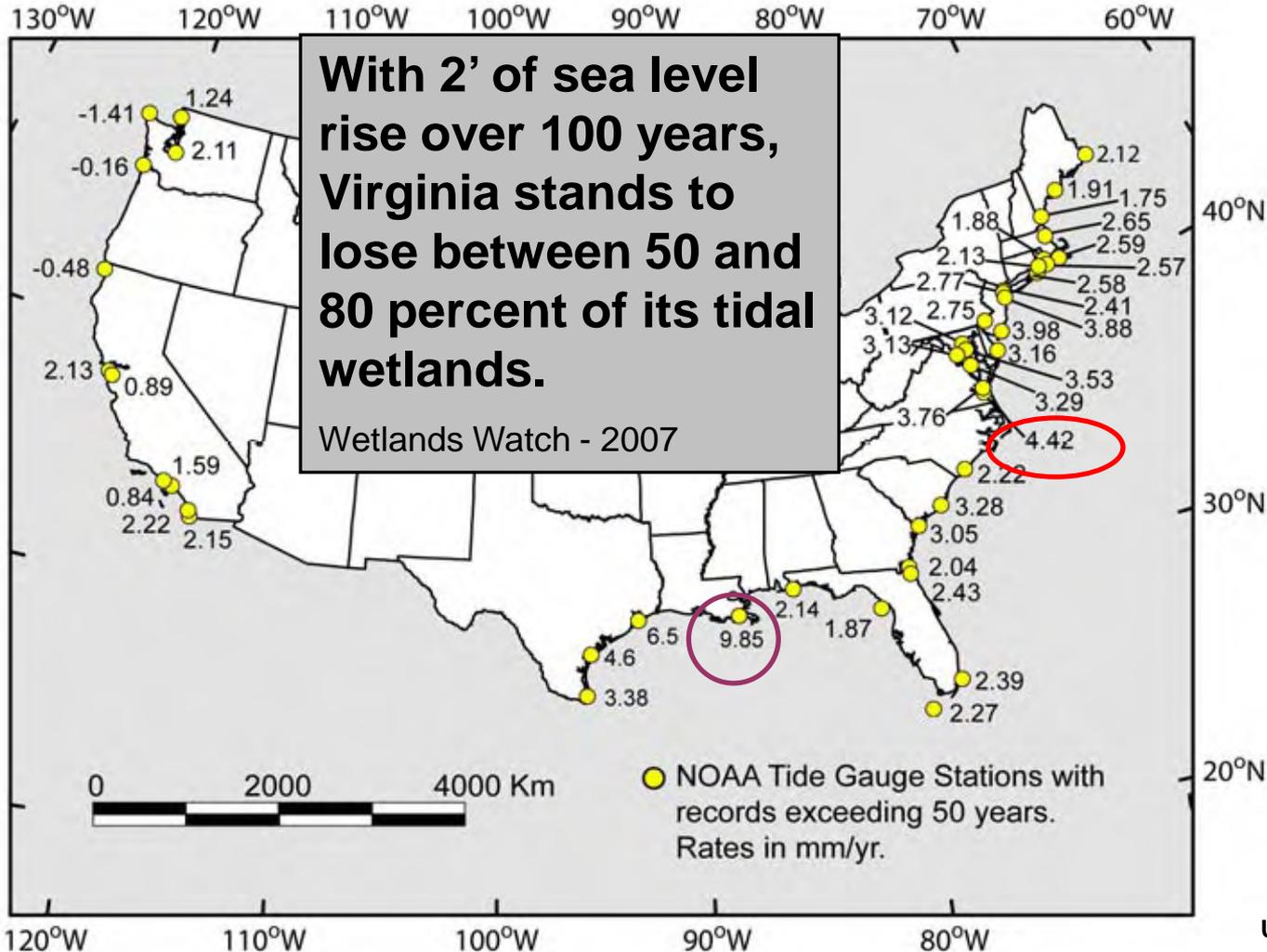


# SEA LEVEL RISE ADAPTATION IN VIRGINIA

These Rates of Sea Level Rise Significantly Threaten the Coastal Ecosystem

**With 2' of sea level rise over 100 years, Virginia stands to lose between 50 and 80 percent of its tidal wetlands.**

Wetlands Watch - 2007

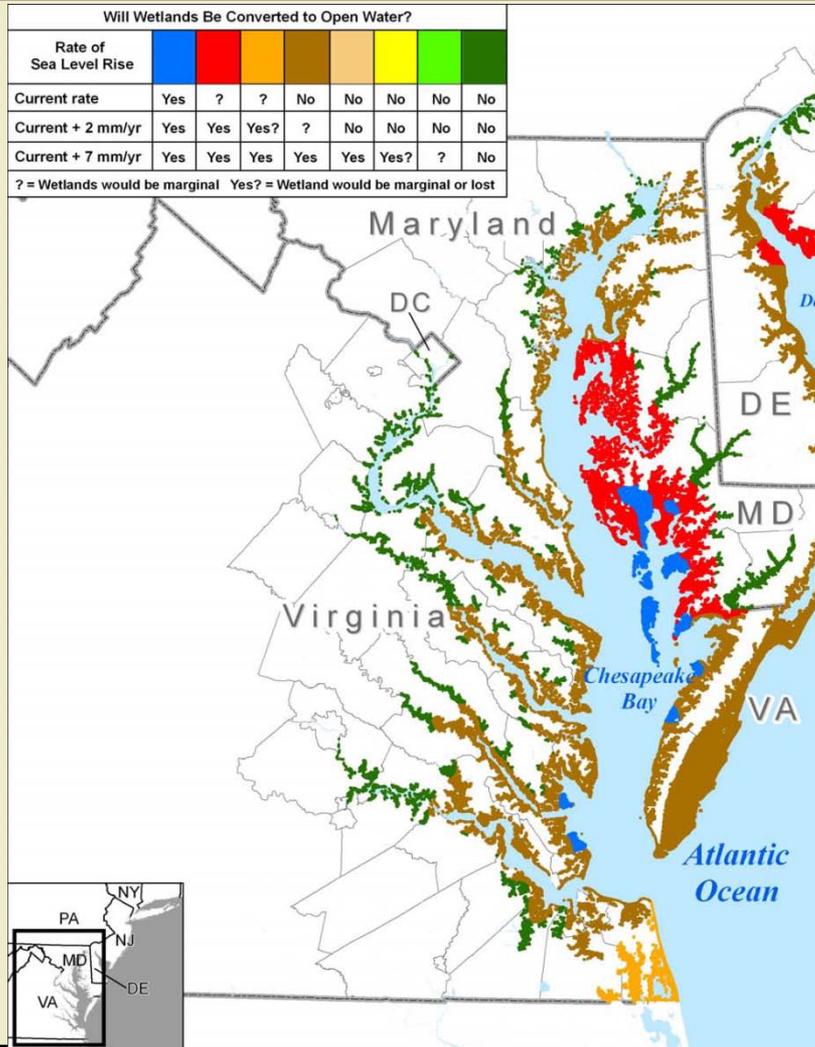


US CCSP SAP 4.1, 2009



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Predicted Rates of Sea Level Rise Will 'Drown' Most of Virginia's Tidal Wetlands



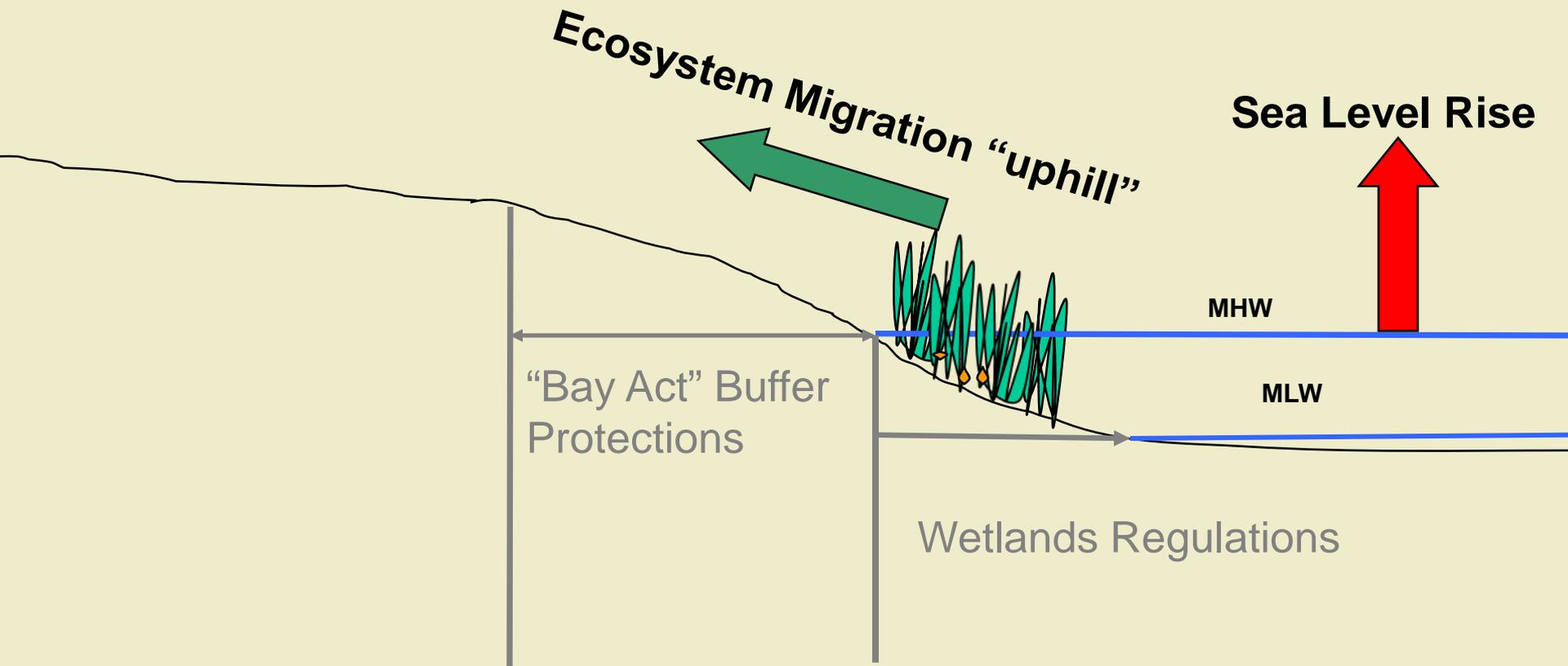
**Blue, Red, Orange, and Brown areas will see wetlands converted to open water at current predicted rates of sea level rise ~ 2-5 feet/100 years**

US CCSP SAP 4.1, 2009



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

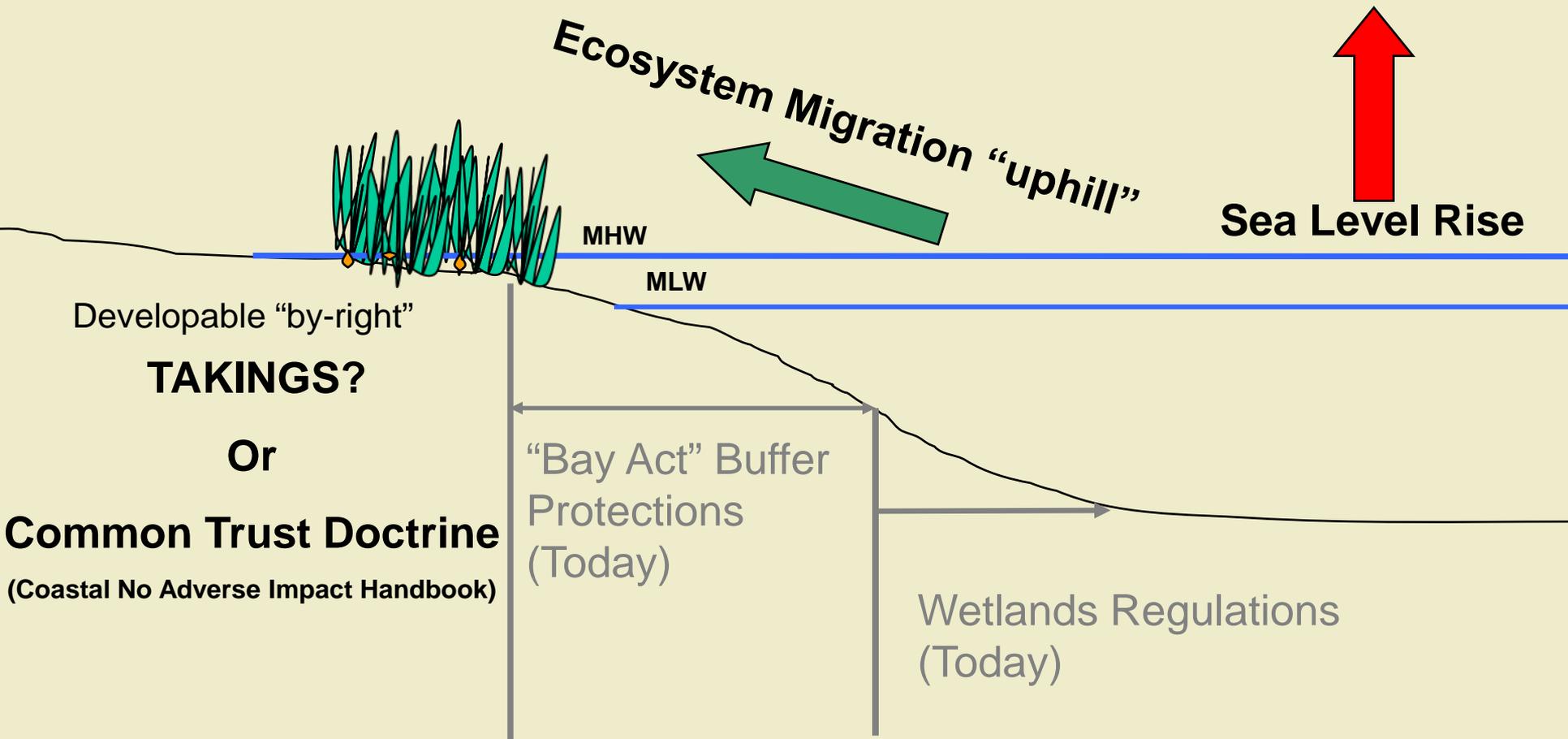
Sea Level Rise Will Move Shoreline Beyond Today's Environmental Jurisdictions





# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Sea Level Rise Will Move Shoreline "Uphill" – Eventually onto "Nonjurisdictional" Land with Development Rights





# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Local Government Adaptation Campaign –  
“Save the Coastal Ecosystem from Climate Change Impacts”

**85 % of Virginia’s Shoreline is Privately Owned**

**Keeping the Tidal Shoreline Open and Resilient is Key = limit development, limit shoreline hardening**

**All Private Land Use Decisions, Occupancy Permits, Business Permits, Many Environmental Decisions are Made by Local Government**

**State Law Requires Local Governments to Review Long Range Land Use Plans Every 5 Years**

Can we...



**...Get Local Governments to Include Climate Change and Shoreline Ecosystem Adaptation in Long Range Plans?**



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Who Are Adaptation Partners and What Are Their Tools?

Chesapeake Bay vulnerability to sea-level rise

## TOOLS

State and federal wetlands laws

Chesapeake Bay Preservation Act

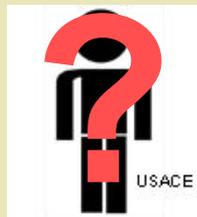
Easements, transfer and purchase of development rights

Local land use regulations

**GOAL: PROTECT WETLANDS AND SHORELINE BUFFERS**



## ADAPTATION PARTNERS





# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Challenges Facing Shoreline Ecosystem Adaptation in Virginia

**Virginia is a “Low Water” State with Private Property Ownership to Low Tide Line**

**Virginia Law Limits Local Government Powers**

**Virginia is a Strong Property Rights State**

**Virginia is 50<sup>th</sup> in US for Per-Capita Spending on Natural Resources**

**Virginia HAS NEVER MET its 2000 “No Net Loss” Wetlands Regulatory Goal for Tidal Wetlands** (DEQ 305b Water Quality Report)

**Virginia’s Tidal Wetlands Inventory Hasn’t been Updated in 30 Years**  
(VIMS/CCRM 2010)

**Virginia Has No Data Base to Track its Wetlands Restoration Efforts**  
(2008 Annual Chesapeake Bay Implementation Report)

# SEA LEVEL RISE ADAPTATION IN VIRGINIA

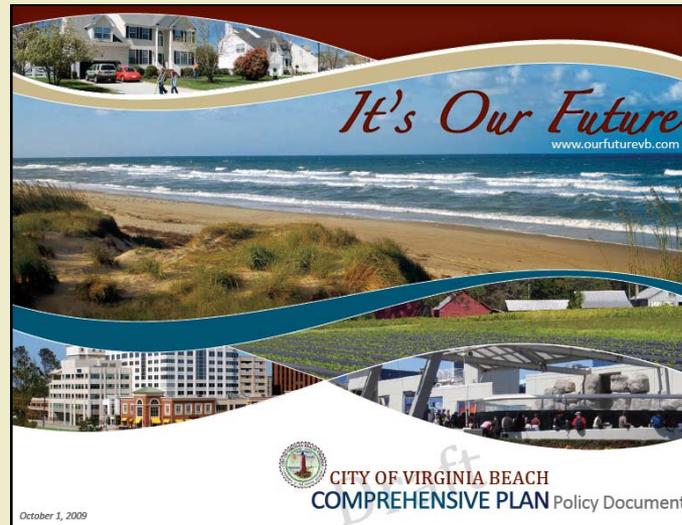
Some Progress in Getting Climate Change in Long-Range Local Government Plans

*Respecting the Past, Creating the Future:*

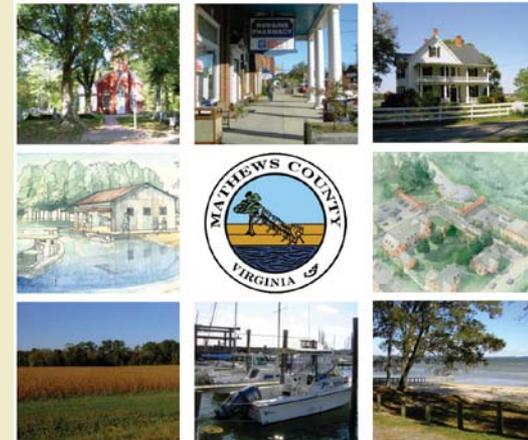
## Accomack County Comprehensive Plan



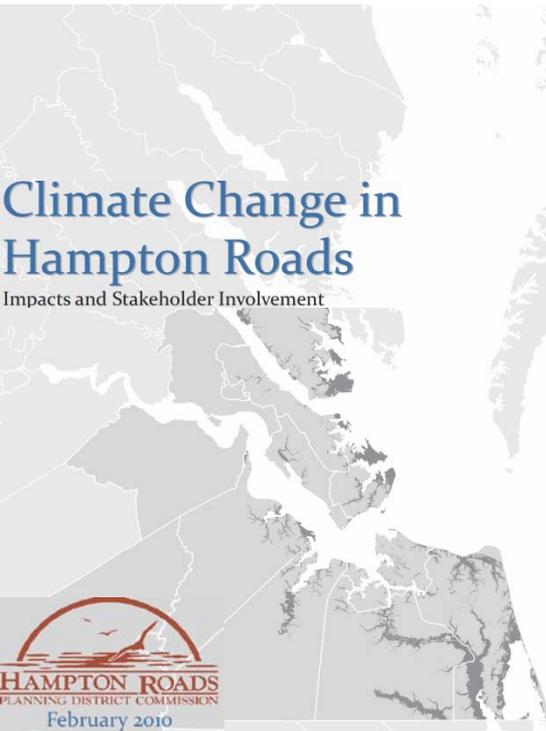
Adopted May 14, 2008



## Mathews County Comprehensive Plan 2030 *Preserving and Sustaining the Pearl of the Chesapeake*



Draft 12-30-2009



## Middle Peninsula Climate Change Adaptation

An assessment of potential Anthropogenic and Ecological Impacts of Climate Change on the Middle Peninsula

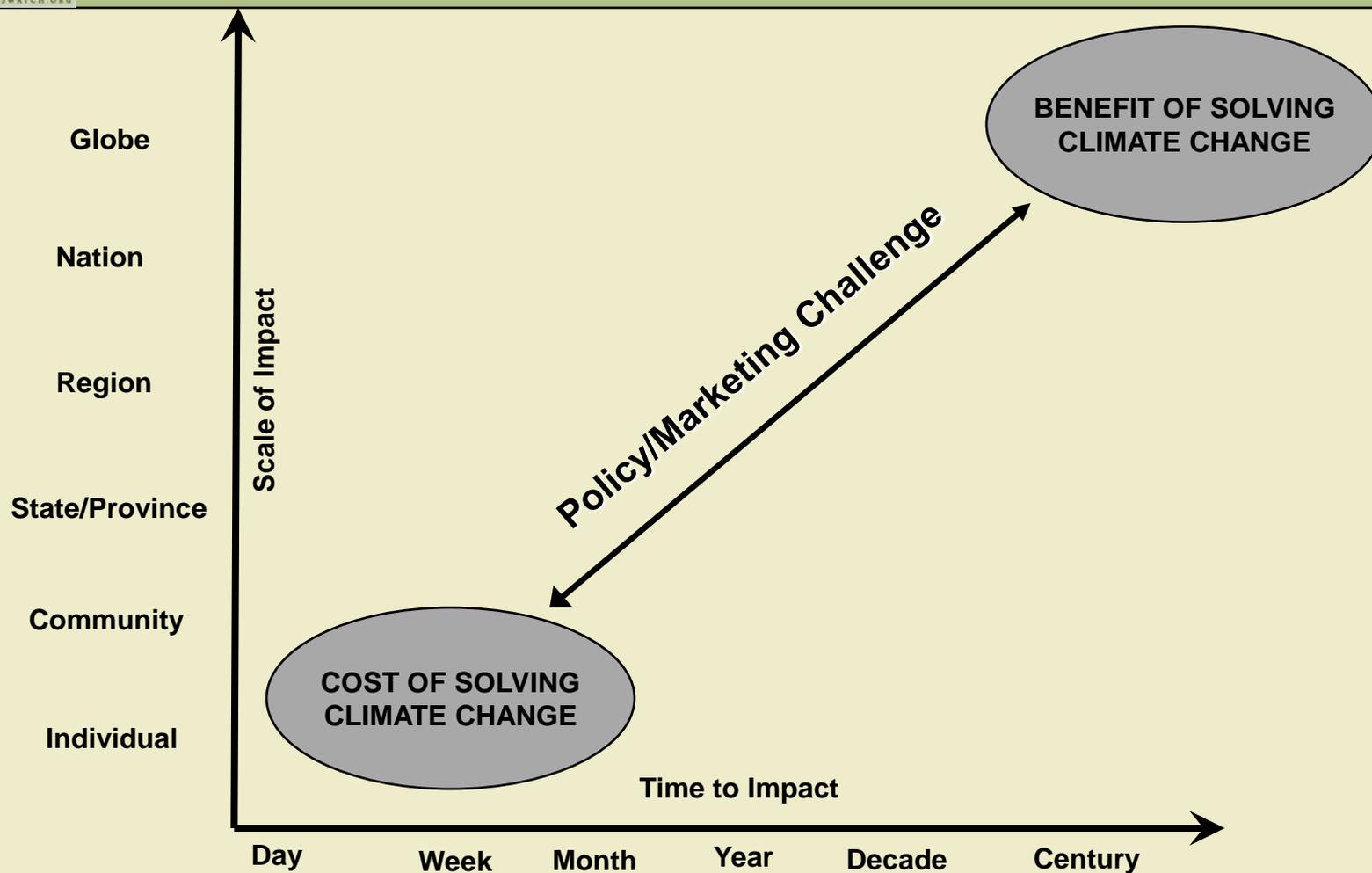


This project was funded by the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant FY2008 NA08NOS4190466 Task 12.04 of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, under the Coastal Zone Management Act of 1972, as amended. The views expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Department of Commerce, NOAA, or any of its sub agencies.



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

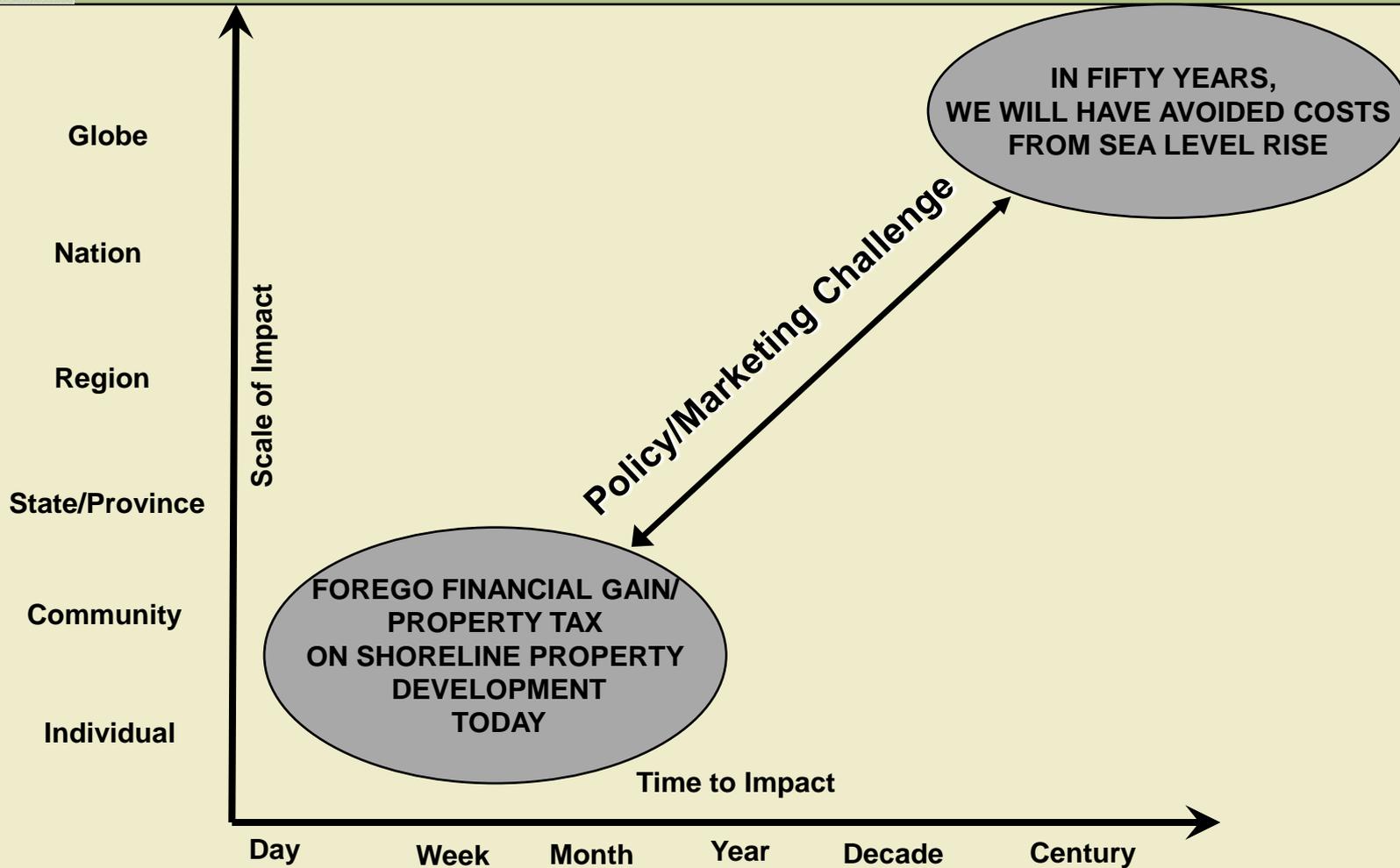
Social Marketing Challenges Are Difficult...How do we Bridge the Gap?





# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Social Marketing Challenges Are Difficult...How do we Bridge the Gap?





# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Social Marketing Challenges Range from Indifference to Resistance

**"It's the greenhouse effect, the greedy capitalists, and I'm not going to let them ruin my life. I'm not going to be swept away. I'm just going to sit on my porch and watch the sunset."**

*Baltimore Sun July 30, 2004*

**"To say we can't build on the water because we think in 100 years the water is going to be 2 feet higher, that's not realistic," Chuck Miller, owner of Miller Custom Homes in Virginia Beach, said Friday. "It's not the builder who decides where people are going to live. It's the people who decide."**

*Virginian Pilot February 3, 2007*

**(Head of Tidewater Builders Association Green Building Council!)**

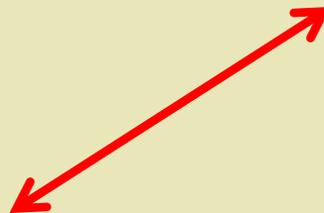


# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Focus on Saving Coastal Ecosystem Using Climate Change Argument Does Not Work

Chesapeake Bay vulnerability to sea-level rise

**GOAL: PROTECT WETLANDS AND SHORELINE BUFFERS**



**WE NEED:**

- More Tools and More Partners**
- More Compelling Arguments**
- Less Mention of Climate Change**

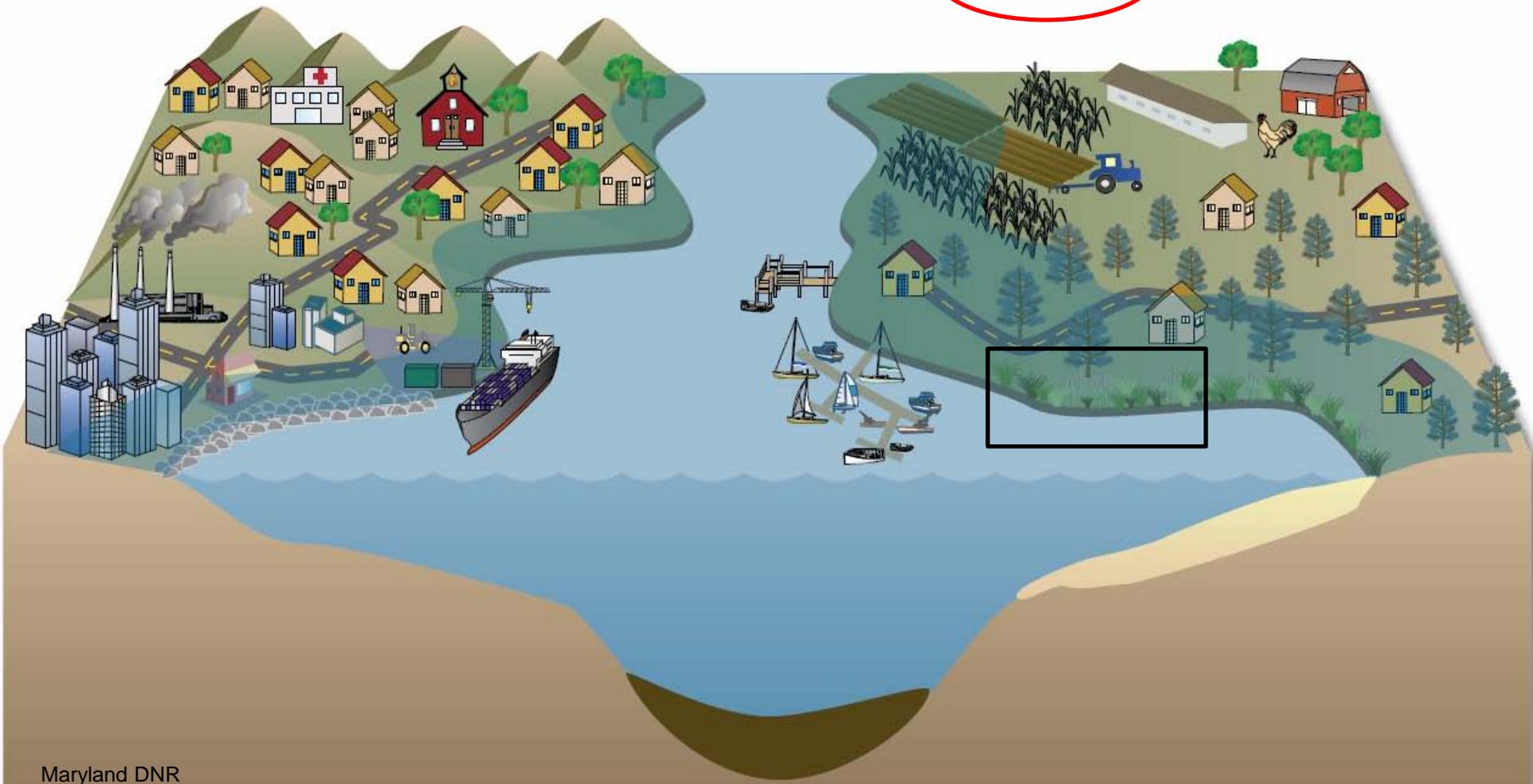


WETLANDS  
WATCH  
WETLANDSWATCH.ORG

# SEA LEVEL RISE ADAPTATION IN VIRGINIA

The Bigger Picture of Sea Level Rise Impacts along Tidal Shorelines

Chesapeake Bay vulnerability to sea-level rise and storm surge

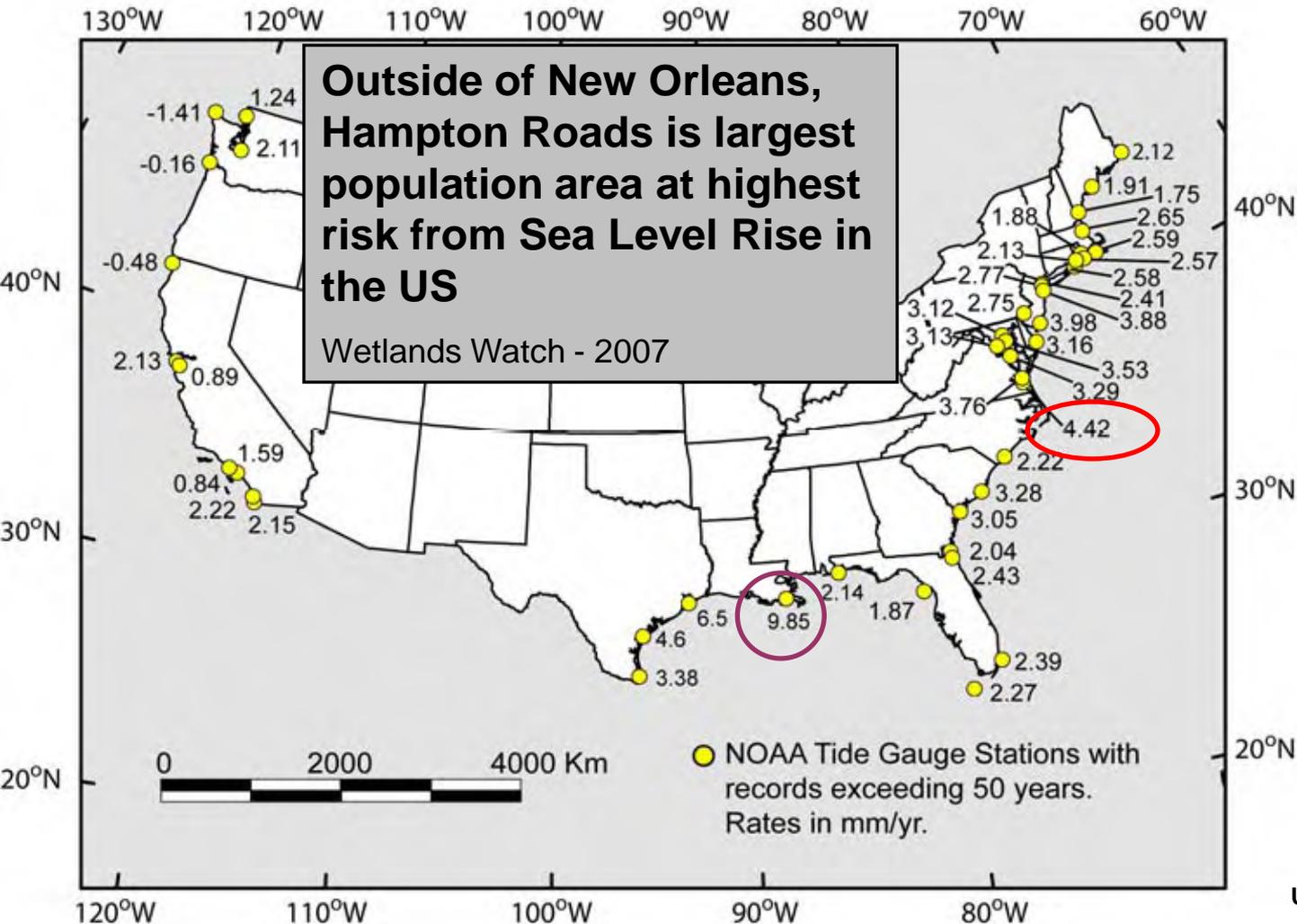


Maryland DNR



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Message Needs to Engage a Wider Segments of Society



US CCSP SAP 4.1, 2009



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Impacts Need to be on the Same Personal, Time, and Geographic Scale = More Compelling

**What Will Sea Level Rise Do in My Children's/Grandchildren's Life?**

**What Is Sea Level Rise Already Doing to my Community/To Me?**

- \* How Many Times Have I Had to Change My Commute in the Last Year?**
- \* Why is My House Insurance Getting More Expensive?**

**What Will Sea Level Rise Cost Me Over my Lifetime/Over my Business Horizon/During the time I Own My House?**

## CLOSING ARGUMENTS



Virginian Pilot Dec 5, 2010



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

## Storm Surge History at Sewell's Point (Norfolk, VA)

DATE	STORM TYPE	ABOVE MHHW
August 23, 1933	Hurricane	6.27 feet
September 18, 2003	Hurricane Isabel	5.12 feet
March 7, 1962	Ash Wednesday Storm	5.05 feet
November 12, 2009	Veterans Day nor'easter	4.99 feet
September 18, 1936	Hurricane	4.92 feet
September 16, 1933	Hurricane	4.36 feet
November 22, 2006	Thanksgiving nor'easter	3.96 feet
October 6, 2006	Columbus Day nor'easter	3.76 feet
January 28, 1998	Twin nor'easters (#1)	3.26 feet
September 16, 1999	Hurricane Floyd	3.21 feet
February 5, 1998	Twin nor'easters (#2)	3.12 feet

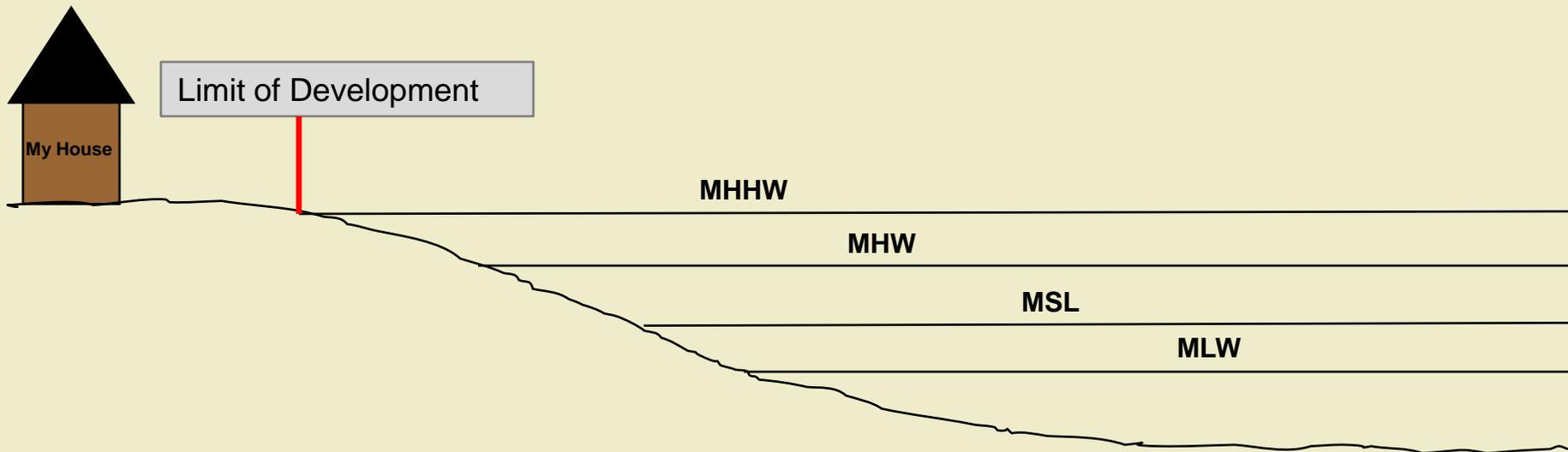
NOAA



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Why “Mean Higher High Water” Benchmark?

Mean Higher High Water = where the “spring tide” comes twice a month = lower limit of development





# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Recent Storms Make it Real to People

DATE	STORM TYPE	ABOVE MHHW
August 23, 1933	Hurricane	6.27 feet
September 18, 2003	Hurricane Isabel	5.12 feet
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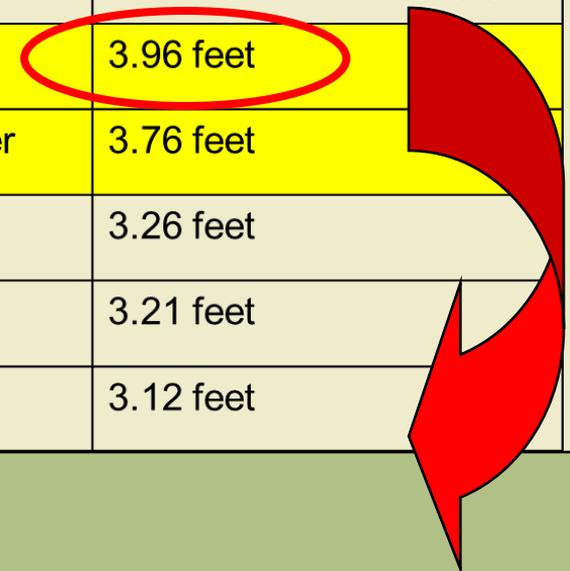


# SEA LEVEL RISE ADAPTATION IN VIRGINIA

What if These Storms Hit 100 Years Ago?

DATE	STORM TYPE	ABOVE MHHW
August 23, 1933	Hurricane	6.27 feet
September 18, 2003	Hurricane Isabel	5.12 feet
March 7, 1962	Ash Wednesday Storm	5.05 feet
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**- 1.45 feet  
in 1906**





# SEA LEVEL RISE ADAPTATION IN VIRGINIA

What Happens 100 Years from Now?

DATE	STORM TYPE	ABOVE MHHW
August 23, 1933	Hurricane	6.27 feet
September 18, 2003	Hurricane Isabel	5.12 feet
March 7, 1962	Ash Wednesday Storm	5.05 feet
November 12, 2009	Veterans Day nor'easter	4.99 feet
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**+2.3 feet  
in 2106**



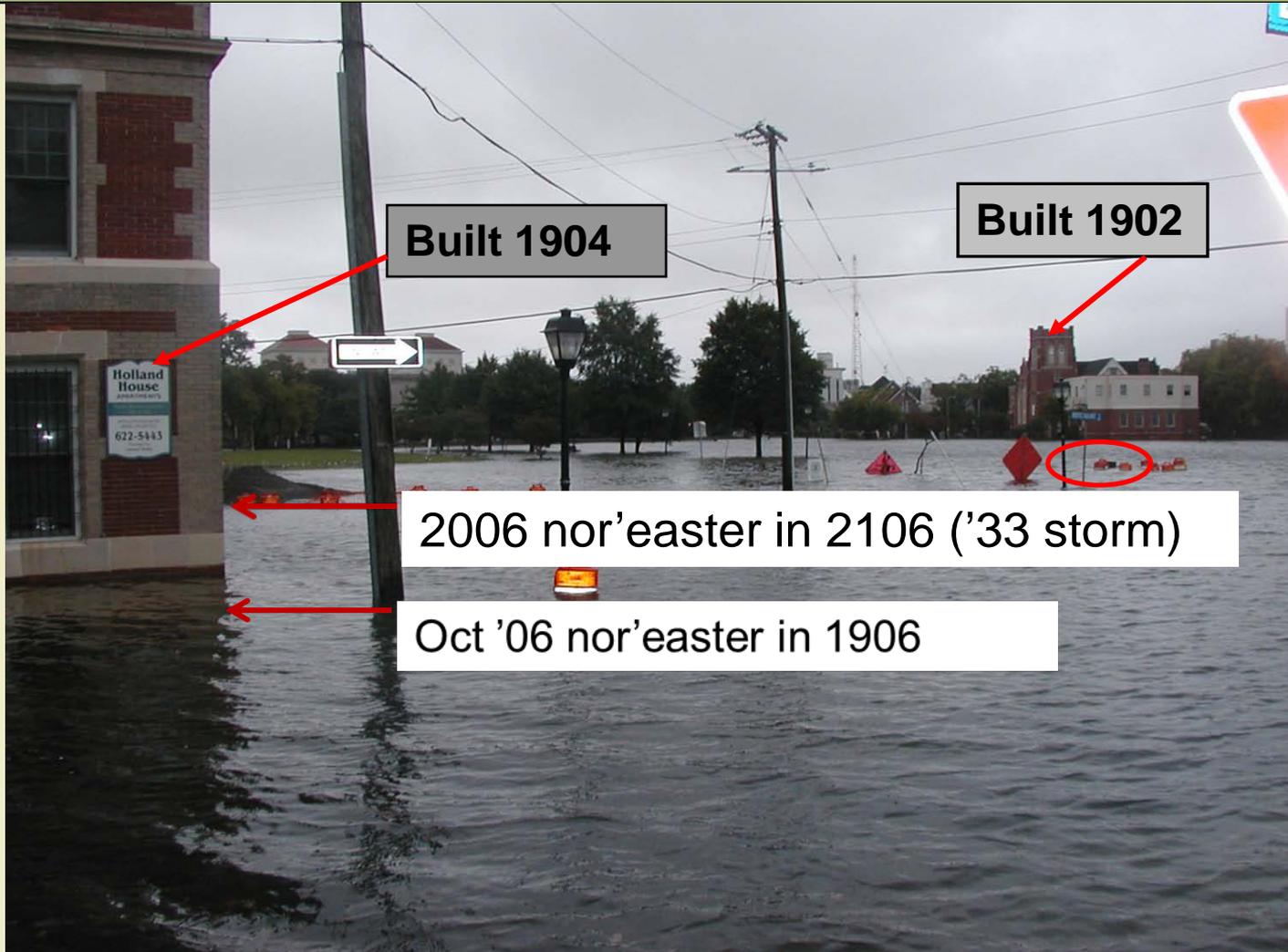
# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Norfolk on a Dry Day (watch the trash can in the circle)



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

October 2006 Nor'easter Flooding in Norfolk



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

FEMA Post-Hazard Mitigation Program



**~\$130,000/house**

**\$4.5 million in  
FEMA spending to  
raise houses in  
Norfolk after Isabel**



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

House is Fine...Now About the Street



**\$1.23 Million to Raise One Block 18"**

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

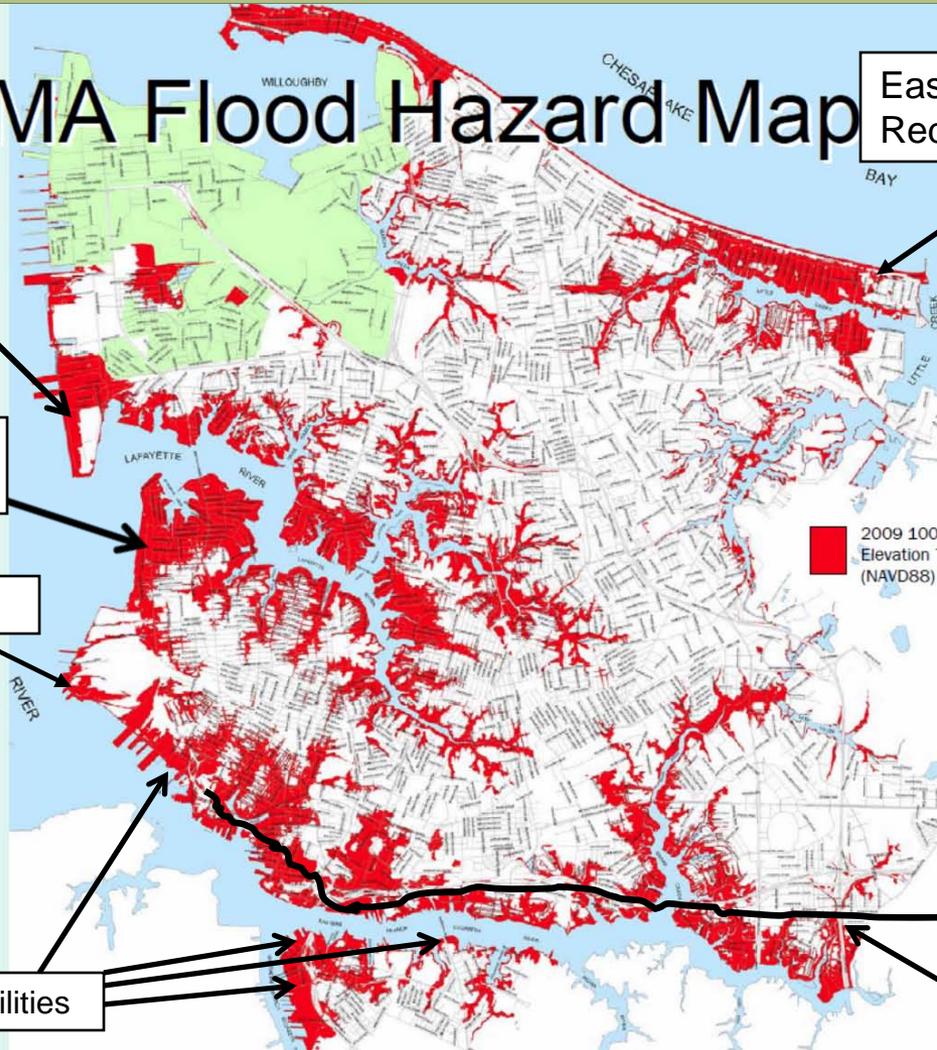
[www.wetlandswatch.org](http://www.wetlandswatch.org)



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

What's at Stake as Flood Zones Shift?

## FEMA Flood Hazard Map



East Ocean View  
Redevelopment

Port of Norfolk

Old Dominion  
University

Norfolk Southern Piers

In 2009 FEMA  
increased Norfolk's  
base flood elevation  
by 0.3 feet over their  
1980 prediction

Ship Repair Facilities

Light Rail (under construction)



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

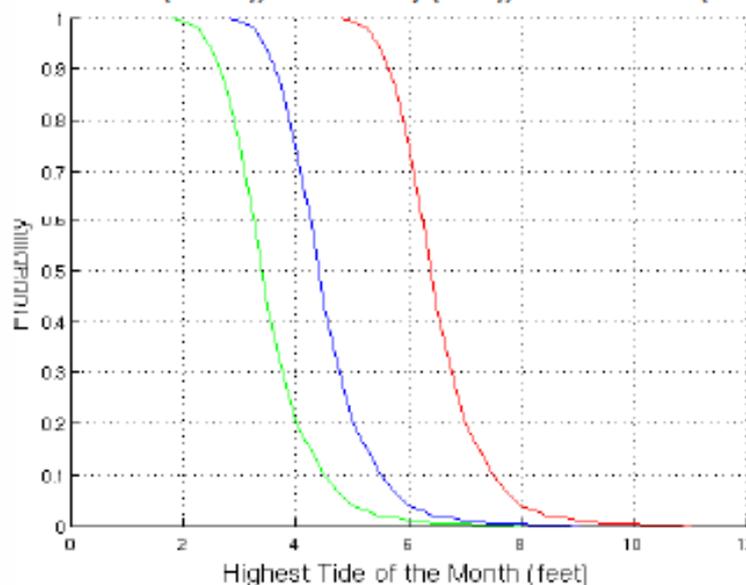
Sea Level Rise Increases Frequency of Flooding Events

Northrop Grumman is Largest Manufacturing Employer in Virginia – Only “Nuclear Capable” Shipyard in the US

**NORTHROP GRUMMAN**

## Sea-Level Rise Notional Scenarios

Probability that Tide at Sewells Pt exceeds:  
Historical (Green), Present Day (Blue), Historical + 3' (Red)



Increasing Sea Level combined with storm surge frequencies alters the risk analysis

Modest levels of rise on the average increase the frequency of extreme events dramatically

Average Number of Years Between Inundation Events					
Event Severity		Sea Level Rise change (Ft)			
Flood Stage	Gauge Level(ft)	Historical	Present	+2'	+3'
Flood	5.00	1.71	0.33	0.10	0.08
Moderate	6.00	7.32	1.71	0.33	0.10
Major	7.00	26.83	7.32	1.71	0.33
Record	8.02	80.50	26.83	7.32	1.71

Sea-level rise reduces the time between (increases the frequency of) record-level inundation events.

Northrop Grumman Proprietary Level I

Colors represent relative risk.

Flood	Flood (Ft)	Historical	Now	+2'	+3'
Record	+8.02	80.5 yrs	26.8 yrs	7.3 yrs	1.7 yrs



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Rural Areas in Virginia are Threatened as Well When the Shoreline Moves

Who's Responsible for this Residence?



4' Erosion/yr

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

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



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Economic Drivers for Adaptation Are Emerging - Globally

LLOYD'S

**360**

DRIVING THE  
DEBATE ON  
EMERGING RISK

## COASTAL COMMUNITIES AND CLIMATE CHANGE

MAINTAINING FUTURE  
INSURABILITY



## **Allstate stopped writing new policies in 19 coastal communities:**

**Accomack, Gloucester, Isle of Wight, King and Queen, Lancaster, Mathews, Middlesex, Northumberland, Northampton, Southampton, Surrey, Sussex, York counties and Chesapeake, Franklin, Hampton, Newport News, Norfolk, Virginia Beach**

## **Nationwide is withdrawing new coastal coverage**

**State Farm will not write new policies within one mile of the ocean shoreline**

**Farmer's will not write a new policy within two miles of ocean shoreline or one mile of tidal Bay**

**USAA – withdrawing new coverage**



**Do These Broader Concerns Bring More People to the Table and Provide More Adaptation Tools?**

**.....YES!**

# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Each Sector of Shoreline Community Brings New Potential Adaptation Partners to the Table

Chesapeake Bay vulnerability to sea-level rise and storm surge



**Water-Dependent Businesses**

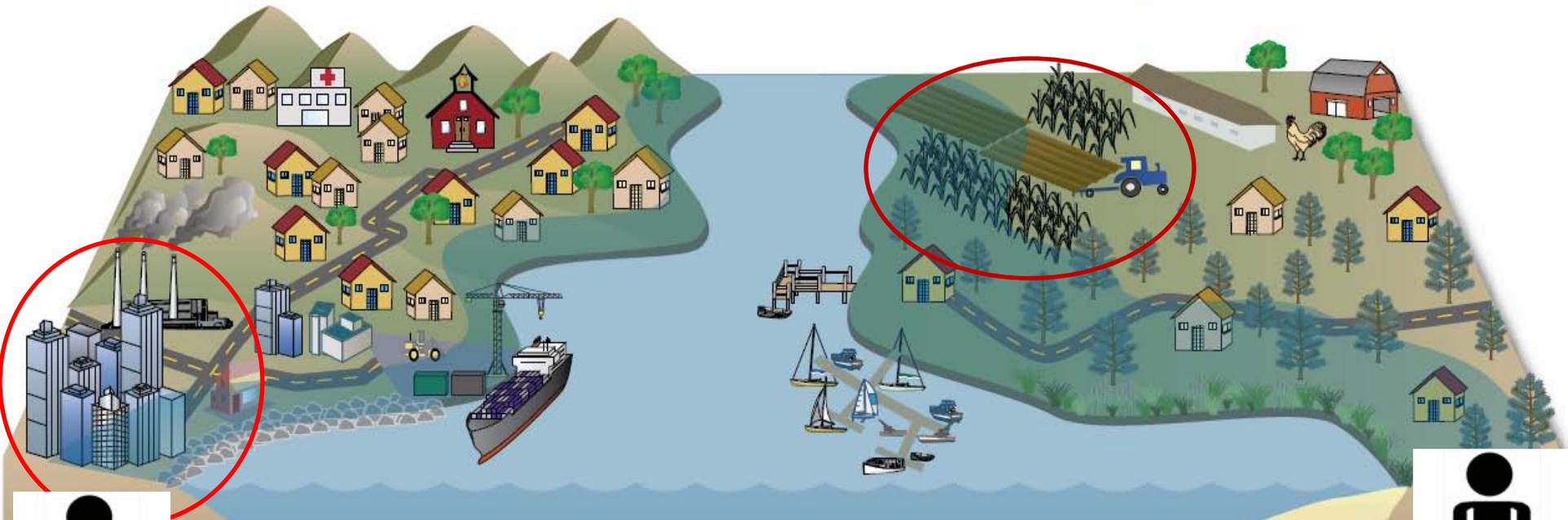


Maryland DNR

# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Each Sector of Shoreline Community Brings New Potential Adaptation Partners to the Table

Chesapeake Bay vulnerability to sea-level rise and storm surge



“Non-Water Dependent” Businesses



Maryland DNR

# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Each Sector of Shoreline Community Brings New Potential Adaptation Partners to the Table

Chesapeake Bay vulnerability to sea-level rise and storm surge



**Homeowners- Real Estate Industry –  
Insurance Industry – Mortgage Providers**



Maryland DNR



USACE

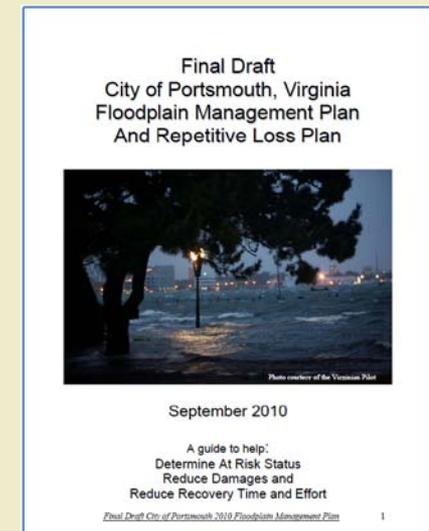
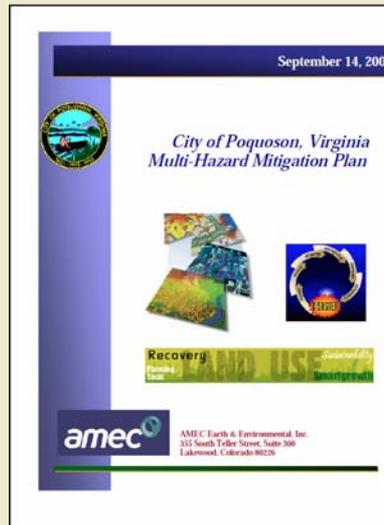
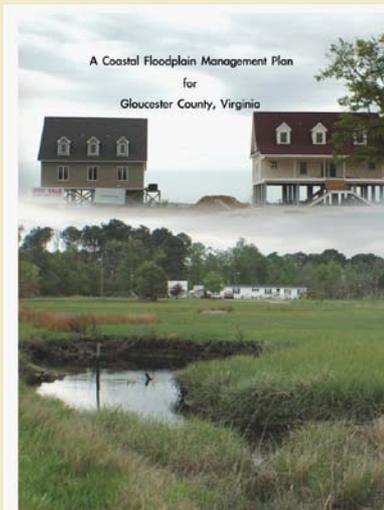


# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Who are the New Partners and  
What are the New Tools?

FEMA requires hazard mitigation plans by states (44 CFR 201.4) and localities (44 CFR 201.5)

National Flood Insurance Program (NFIP) gives reduced rates for publicly developed and regularly updated Floodplain Management Plans (NFIP Community Rating System)



42 U.S.C. § 3162 – Comprehensive Economic Development Strategy – Regional Plan for Sustainable Economic Development  
- Required by US Economic Development Administration



## IV. ANALYSIS OF ECONOMIC DEVELOPMENT PROBLEMS AND OPPORTUNITIES

### Threats

- **Rising Sea Levels and other Potential Impacts of Climate Change**



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Climate Change Showing up in Required US Transportation Plans

Long-Range transportation plan required of each state (23 CFR § 450.206) and region (23 CFR § 450.306) before receiving federal transportation funds.



Virginia's Long-Range Multimodal  
Transportation Plan

## *Climate Change*

**“Climate change poses a serious and growing threat to Virginia’s roads, railways, ports, utility systems, and other critical infrastructure...”**



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

## Other Federal Planning Requirements Can/Are Mentioning Climate Change

US Fish and Wildlife Service requires a “Wildlife Action Plan” prior to receiving funding - 16 U.S.C. § 669e (Virginia and many other states address climate change impacts)

US Forest Service Plans for National Forests -16 U.S.C. § 1604 (Washington/Jefferson Forest Plan will include climate change impacts)

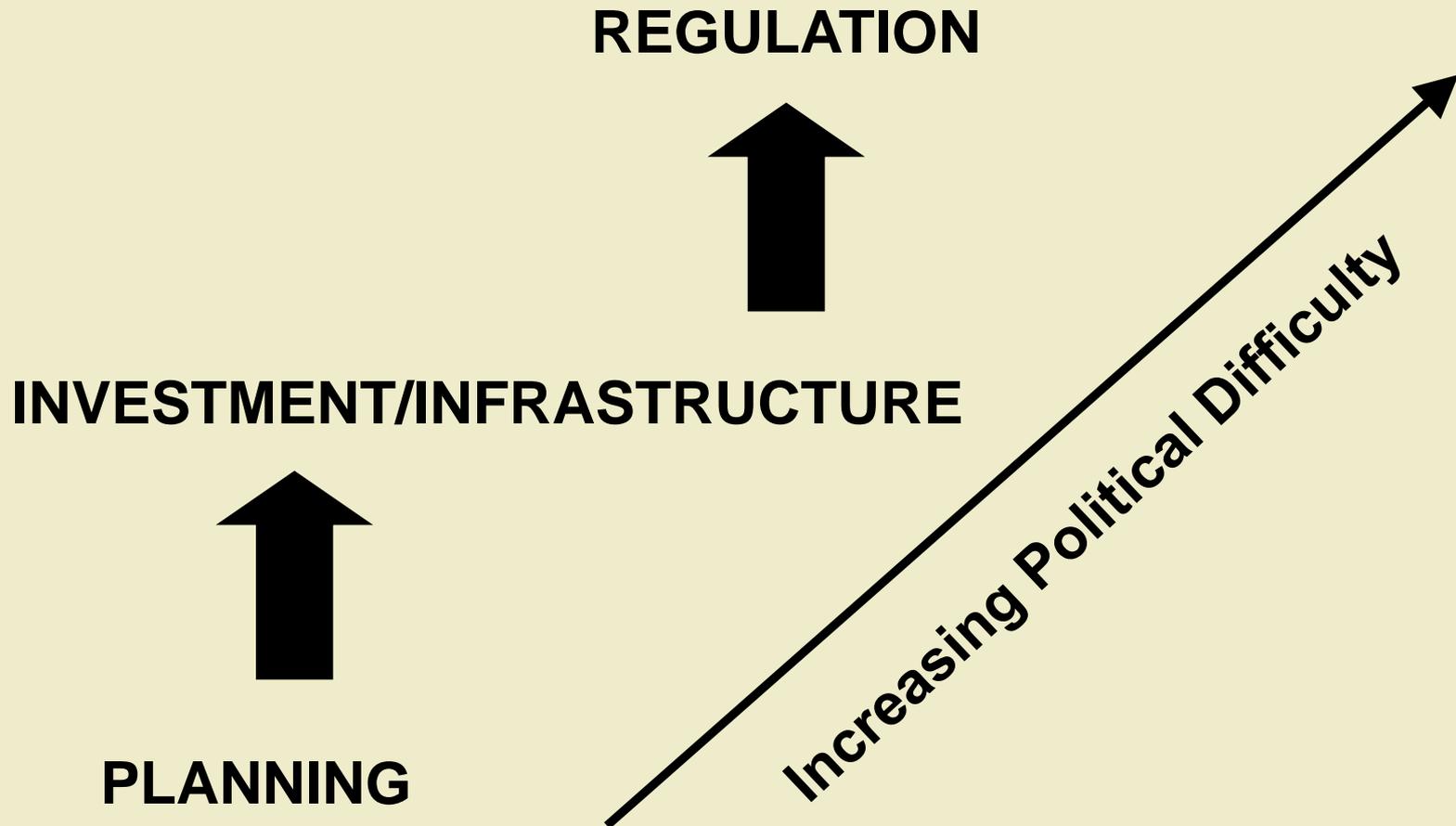
HUD Consolidated Plan required of every locality prior to receiving funding - 24 CFR Part 91.215 (Could include climate change impact on disadvantaged community housing.)

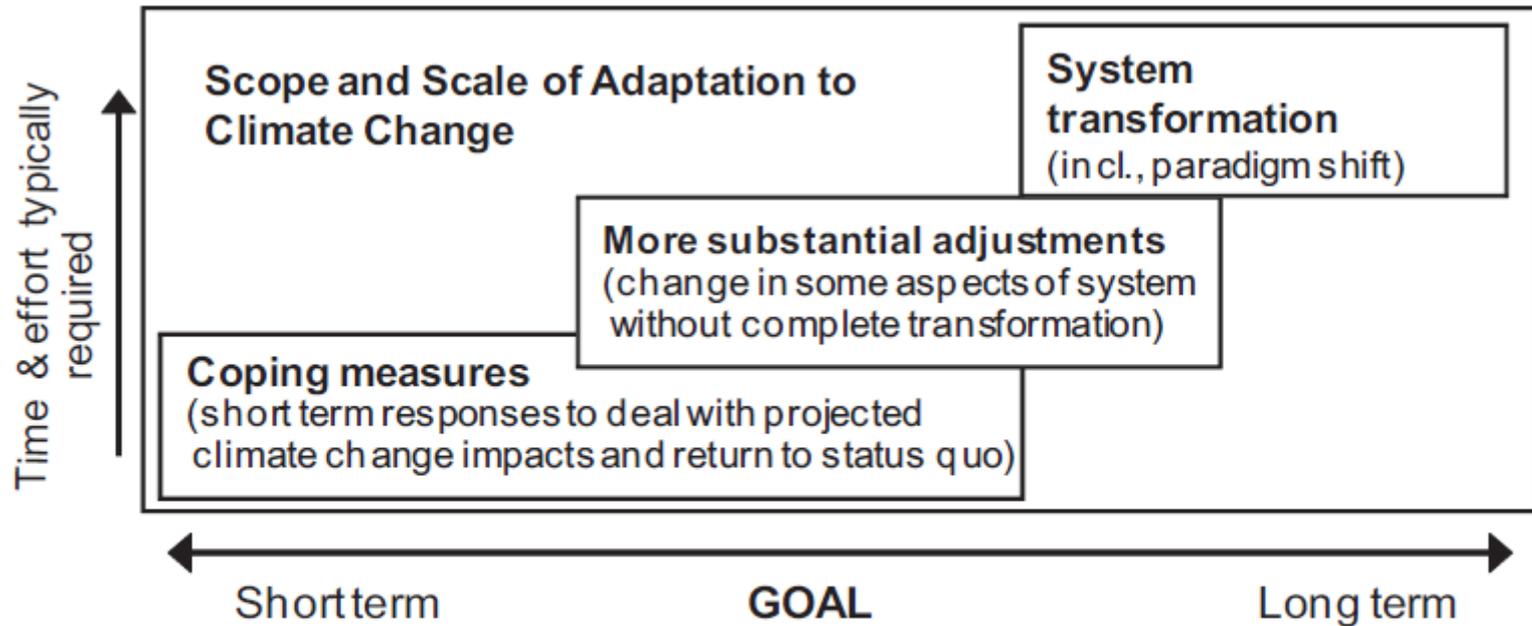
Stormwater planning, Mandatory public involvement and participation – 40 CFR 122.34 (b) 2 (ii) (A place to insert climate change impacts)



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Planning is Just the Start – it Gets Harder as Decisions Change Behavior





**Fig. 1.** Scope and scale of adaptation to climate change [based on an extensive literature review (ref. 14, especially refs. 15–18)].



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Social Marketing Work Must Include a Range of Tactics

“Convincing people that you're right about an issue--say, the scientific consensus about the threat posed by global warming--can seem vitally important, but in the end may be somewhat beside the point.

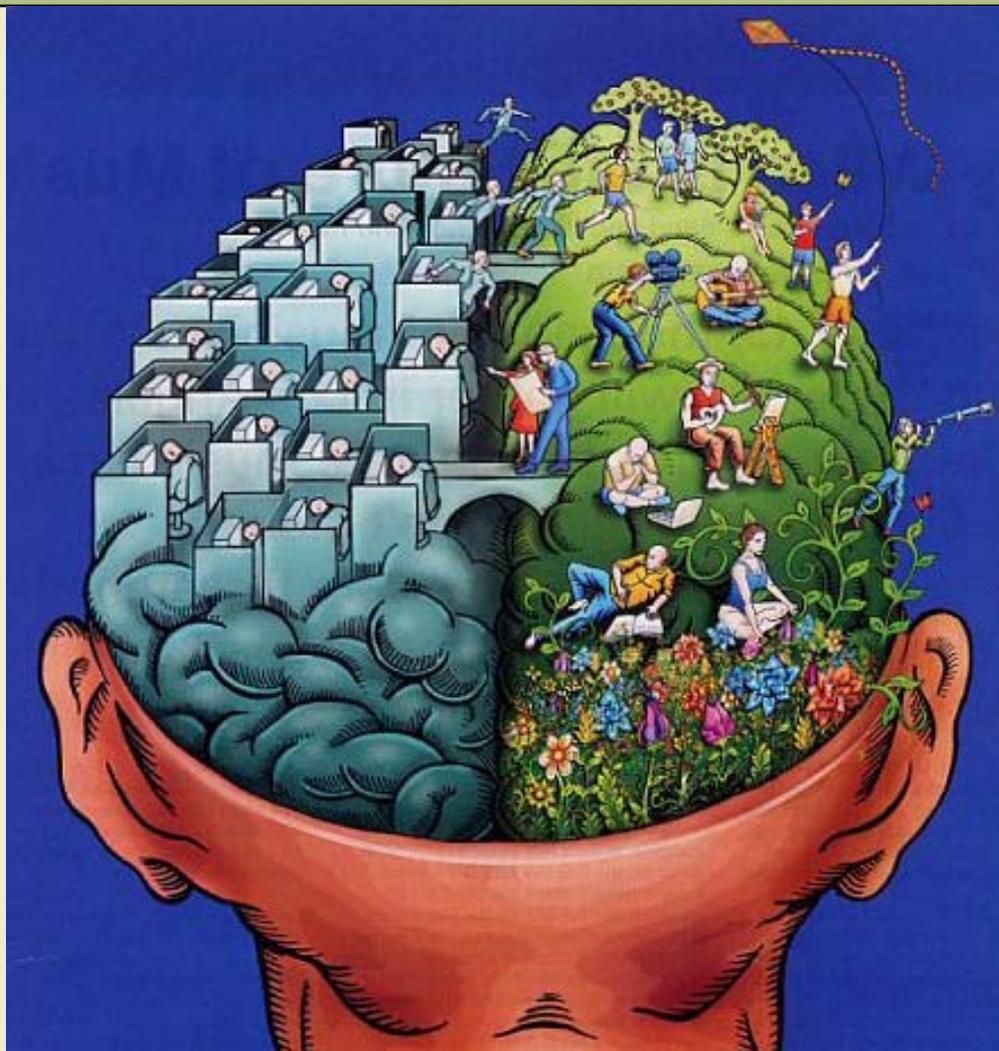
In the long run, you have to move the debate beyond beliefs, and into *incentives*: lining up the economic and social incentives such that the right choices are the easy, natural ones.

To do that, we need smart and effective policies. Appeals to people's reason may help, but rational belief alone won't carry the day.

Clark Williams-Derry, Sightline Institute

# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Change Requires Engaging the Whole Brain



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Role for Visual Arts in Climate Change Debate to Engage the Right Brain



“Melting Men” – Nele Azvedo



## RISING CURRENTS

### PROJECTS FOR NEW YORK'S WATERFRONT





# SEA LEVEL RISE ADAPTATION IN VIRGINIA

## Next Steps – Listening Sessions

### SEA LEVEL RISE IN HAMPTON ROADS

VIRGINIA BEACH LISTENING SESSIONS

A Project of:  
Virginia Sea Grant

Ensuring that Virginia's Coastal Communities are Prepared for Sea Level Rise

[HOME](#) [ABOUT](#) [LISTENING SESSIONS](#) [COMMUNITY SURVEY](#) [NEWS](#) [RESOURCES](#) [OUTCOMES](#) [CONTACT](#)

Project Partners: UVA Institute for Environmental Negotiation (IEN) | Hampton Roads Planning District Commission (HRPDC) | City of Virginia Beach | Wetlands Watch (WW) | Old Dominion University

#### Home



#### Why Do We Need Listening Sessions on Sea Level Rise in Virginia Beach?

Virginia Beach citizens, the built environment, and the natural environment are extremely vulnerable to the combined impacts of **relative sea level rise (sea level rise plus land subsidence)** and natural coastal hazards. The environmental stewardship plan, section 7 of the City's [2009 Comprehensive Plan](#), describes the potential impact of relative sea level rise as follows:

- In the Chesapeake Bay Region, **the projected relative sea level rise is 2.3 to 5.2 feet by 2100** according to the Chesapeake Bay Program's Scientific and Technical Advisory Committee.
- The City of Virginia Beach **could lose about 45,000 acres** from water inundation, assuming 4 foot of relative sea level rise without considering storm surge effects or sea level rise adaptation measures.
- The Virginia Beach-Norfolk Metropolitan Statistical Area **ranks 10th in the world** in value of assets exposed to increased flooding from relative level rise, according to an analysis by RMS (a catastrophe modeling company).
- Hampton Roads is rated **second only to New Orleans as the most vulnerable area** to relative sea level rise in the country.

The high rate of relative sea level rise in Hampton Roads is due to regional land subsidence associated with underlying geology and local land subsidence associated with groundwater withdrawal and/or fill settlement.

#### Current Plans

The City of Virginia Beach [Environmental Stewardship Plan](#) makes recommendations to address vulnerability.

The [Hampton Roads Planning District Commission](#) is conducting a climate change study, an assessment of the regional transportation vulnerability to climate change, and revising the regional hazard mitigation plan to include relative sea level rise.

[Vision Hampton Roads](#), the regional economic development plan, points to the challenges of sea level rise.

#### A Need for Community Response

While local planning agencies have begun to recognize the urgency of the situation, many policymakers and citizens have **questions about what sea level rise means for the community** and what should be done about it.

These four [Virginia Beach Listening Sessions](#) on March 30 and 31 will help answer these questions, and advance the community discussion about what it wants to do.

Results from the sessions will be presented to Virginia Beach City Council, and will inform development of the Virginia Beach Sustainability Plan.

We urge each of you to personally attend and participate in at least one or more listening sessions.

If you have questions or concerns, please don't hesitate to contact the project team:



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For Email Marketing you can trust

#### Register Now!

4 Listening Sessions:  
March 30 and 31, 2011

#### Save the Date:

Presentation to  
Virginia Beach City Council  
April 19, 2011

## Wetlands Watch/UVA/PDC/Virginia Beach Collaboration

## Funded by Virginia Sea Grant

## Leads to pilot projects on adaptation planning



# SEA LEVEL RISE ADAPTATION IN VIRGINIA

Partnerships with “fact based” NGO’s are Essential !

# SEA LEVEL RISE ADAPTATION IN VIRGINIA

