

# Planning for Climate Change and Sea Level Rise in Hampton Roads

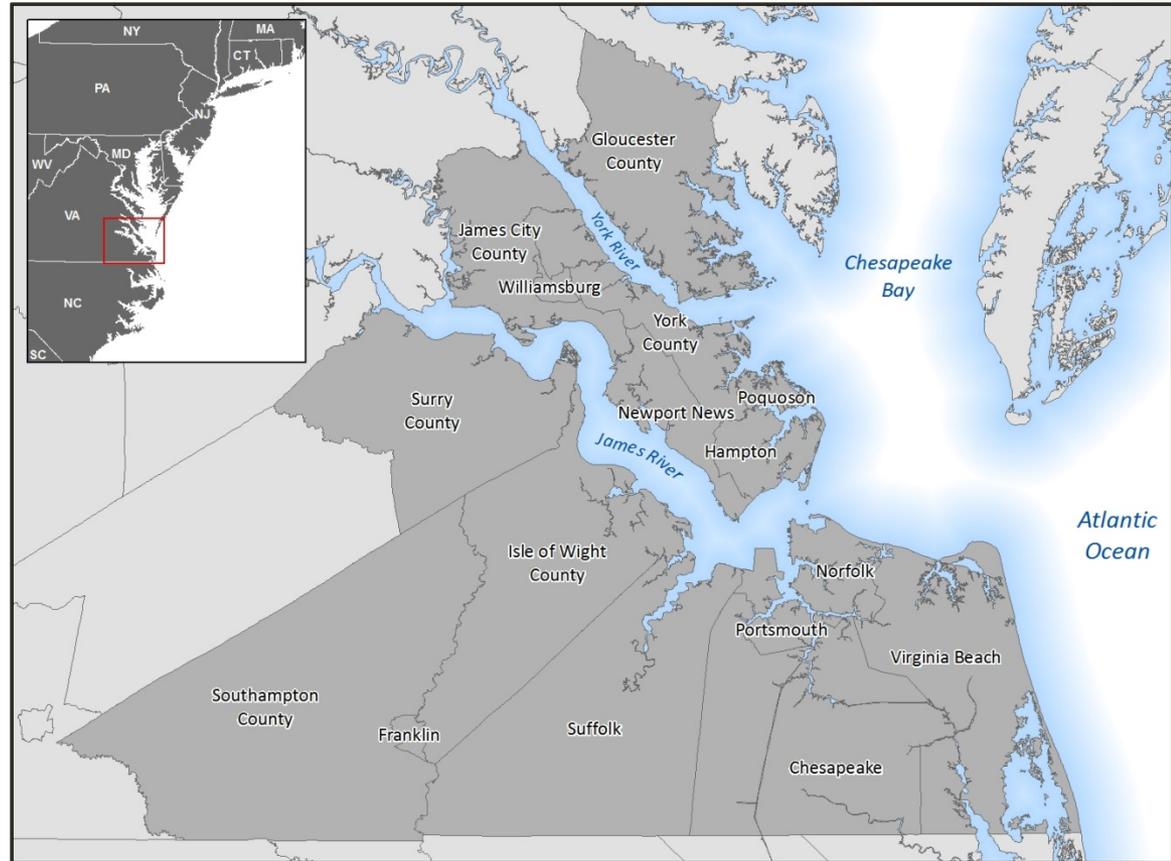
2014 DEQ Environmental Excellence Conference  
March 12, 2014

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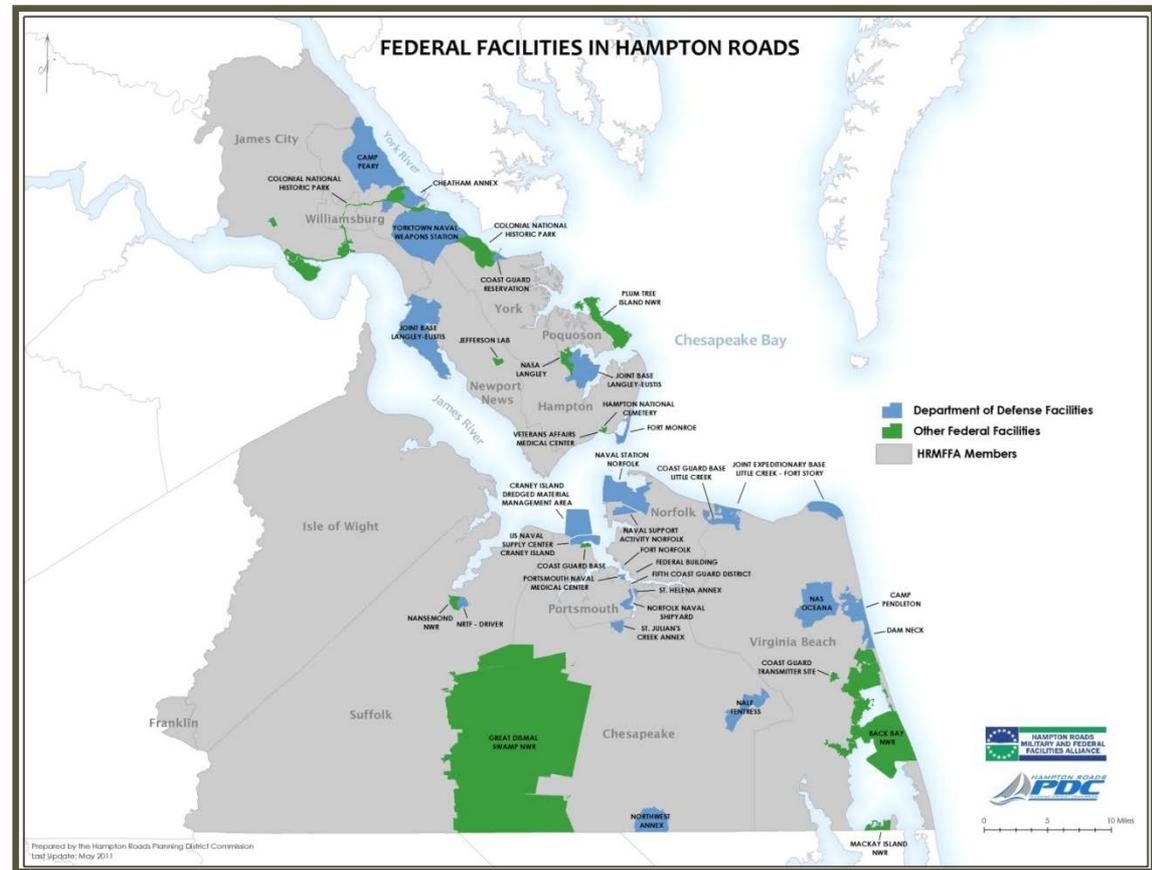
# Hampton Roads, Virginia

- 10 Independent Cities
- 6 Counties
- 1.7 million people
- Strategic location for foreign trade, military facilities, and tourism



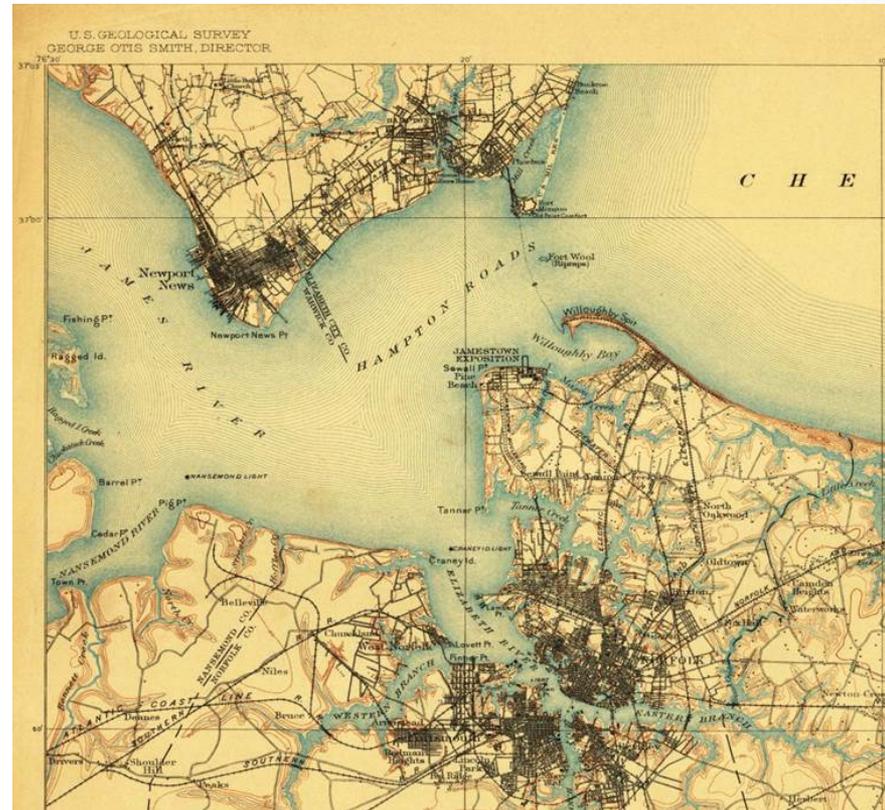
# Hampton Roads, Virginia

- Major Coastal Facilities
  - Newport News Shipbuilding
  - Naval Station Norfolk
  - Langley AFB
  - Port of Virginia
  - Virginia Beach Oceanfront



# Why do we need to adapt?

- Hampton Roads is a low-lying coastal community with a long-settled, urbanized shoreline
- Major industries located on or near the shore:
  - Tourism
  - Military
  - Ship building and repair
- Storms have caused and continue to cause significant impacts residents and assets



USGS, 1907

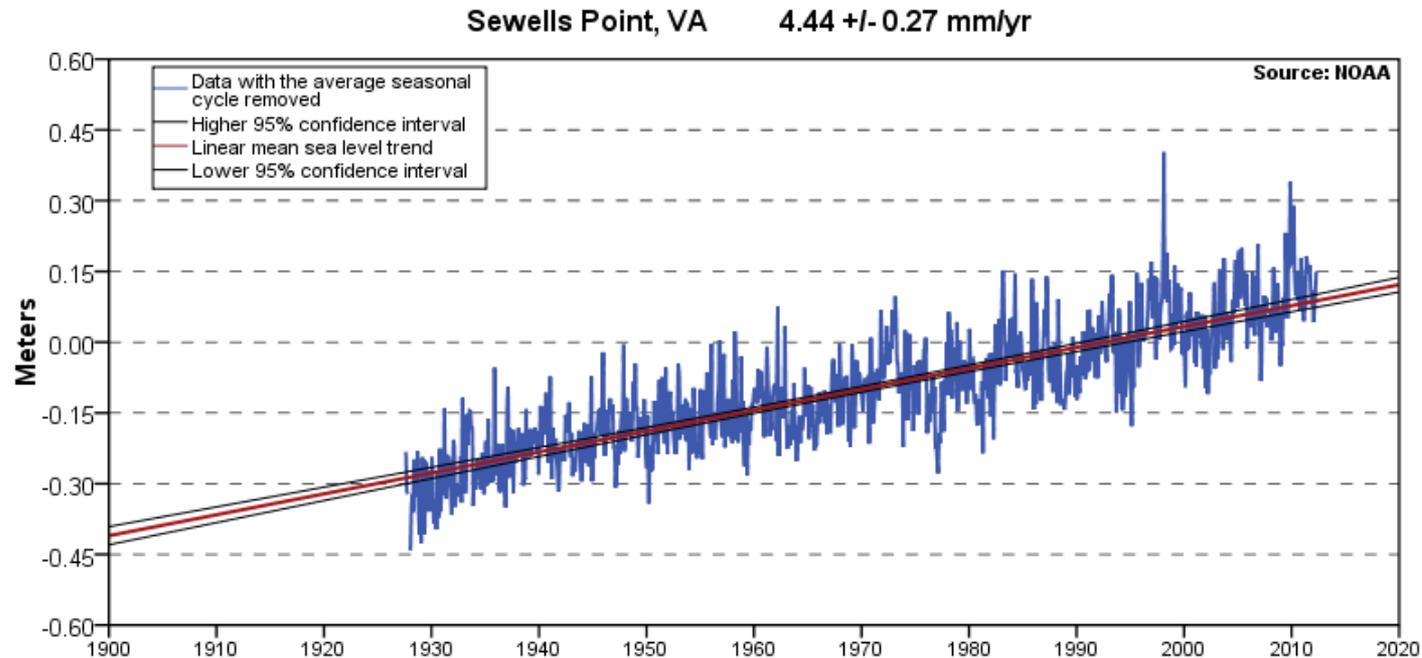


Credit: City of Norfolk



Credit: City of Hampton

# Why do we need to adapt?

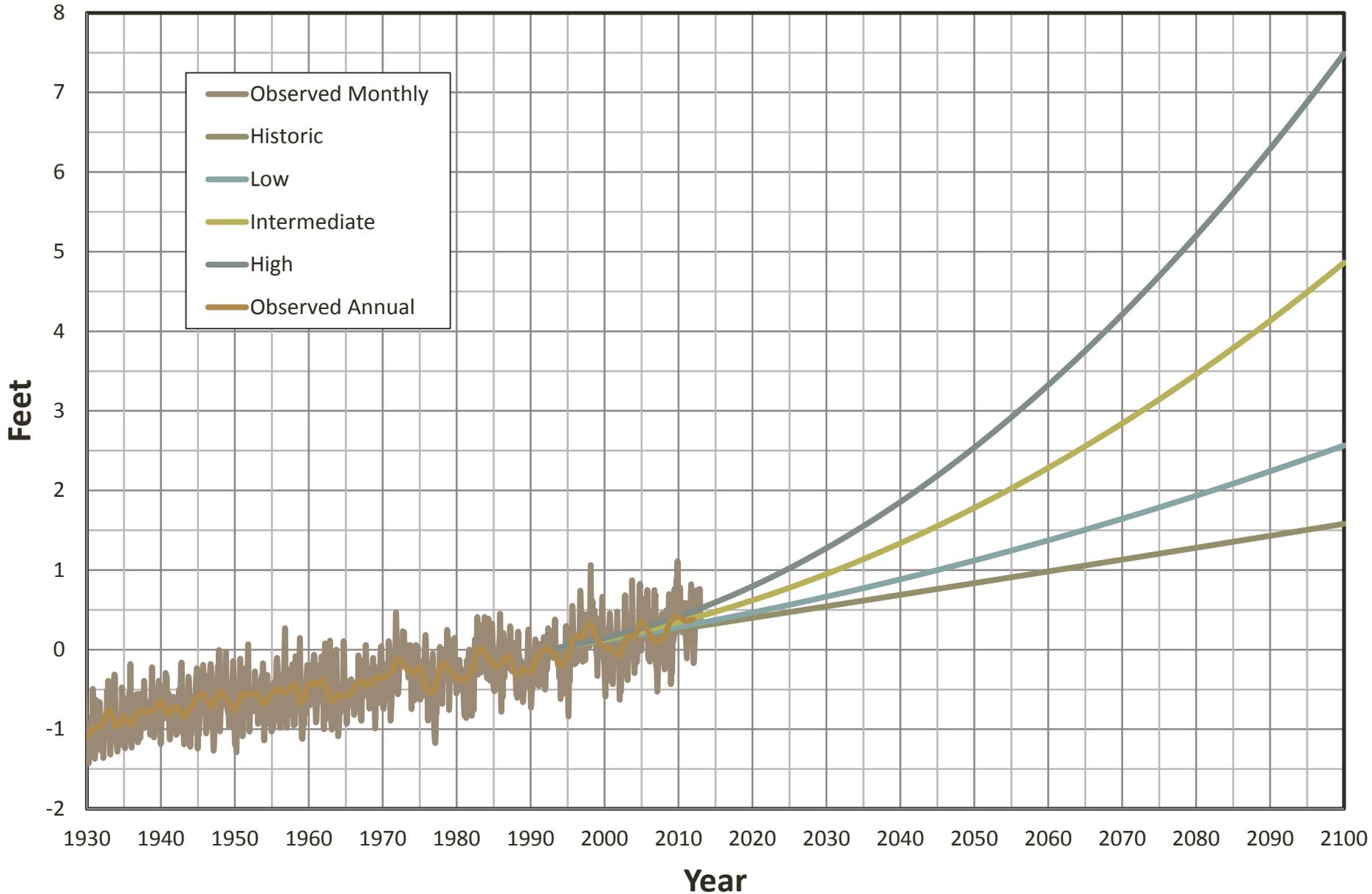


- Historic sea level rise has resulted in more frequent and widespread flooding
- Climate change is projected to accelerate the rate of sea level rise, putting more people and assets at risk

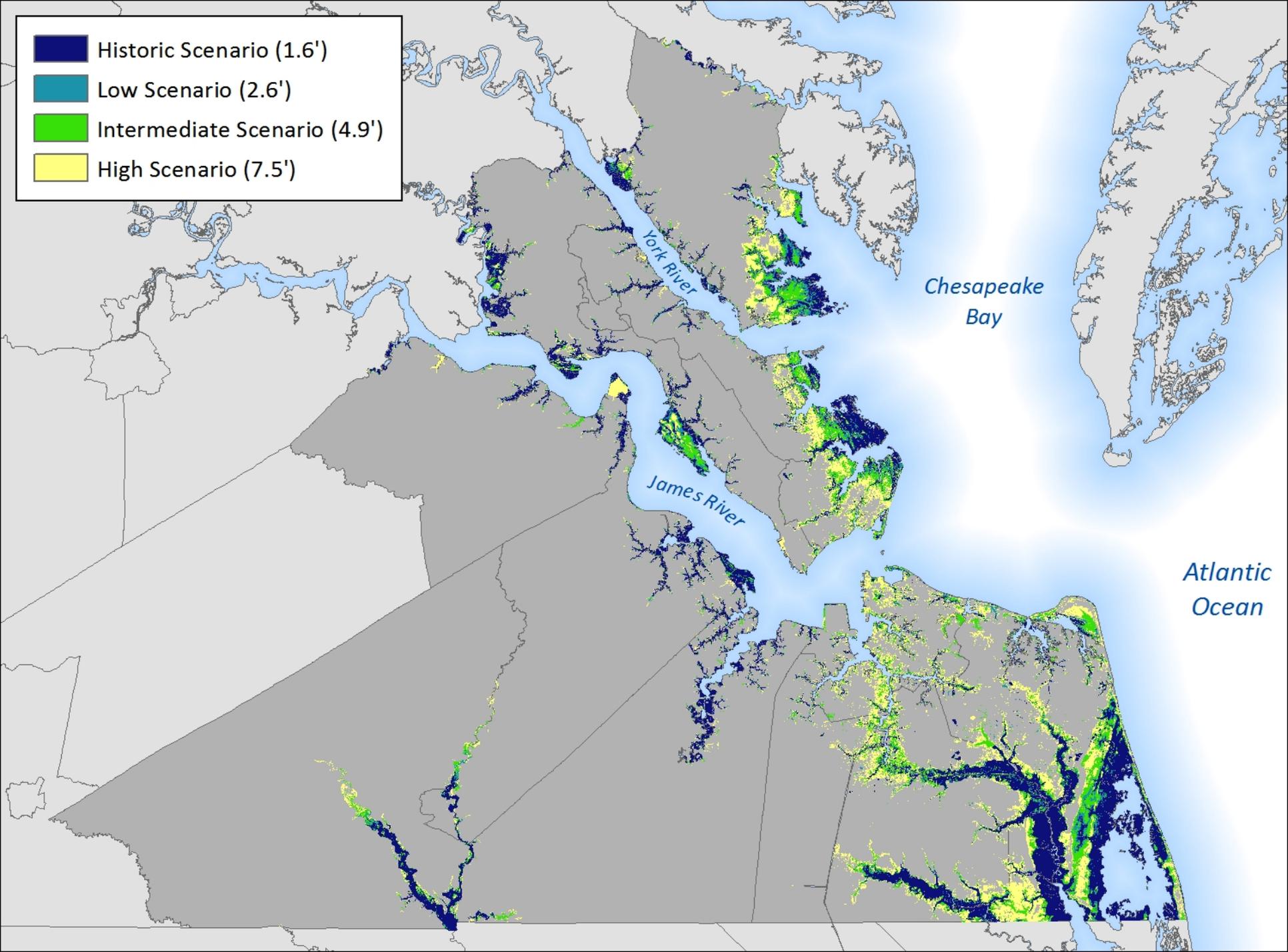
# Sea Level Rise in Hampton Roads

- Global sea level rise occurs as a result of ice melt and thermal expansion of the oceans
- Local or relative sea level rise includes local influences:
  - Ground subsidence (or uplift)
    - Glacial isostasy
    - Groundwater withdrawals
  - Changes in ocean currents
- In Hampton Roads, about half of the observed sea level rise is due to global sea level rise and half is due to subsidence

# Observed and Projected Relative Sea Level Change at Sewells Point Tide Gauge, Norfolk, VA (1930-2100)



- Historic Scenario (1.6')
- Low Scenario (2.6')
- Intermediate Scenario (4.9')
- High Scenario (7.5')

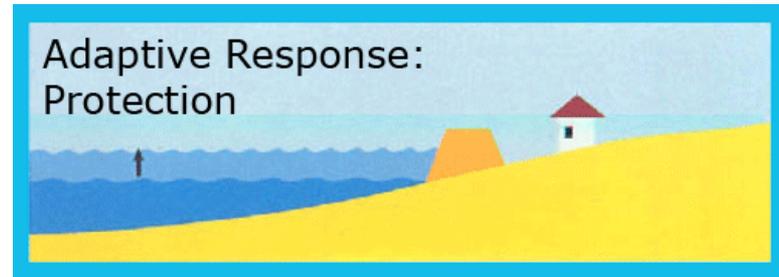




Legend  
Green  
Blue  
Yellow

# Adapting to Sea Level Rise

1. Protection



2. Accommodation



3. Retreat



IPCC, 1990

# Adapting to Sea Level Rise - Protection

- Large, structural improvements designed to keep water out and land dry (sea walls, flood gates, levees, etc.)



Maeslantkering Storm Surge  
Barrier, Netherlands  
Wired Magazine, 2008

# Adapting to Sea Level Rise - Accommodation

- Structural and behavioral improvements that allow for “living with water” (raising houses, flood-proofing ground floors, moving cars to high ground at high tides, etc.)



## Above the Flood: Elevating Your Floodprone House

FEMA 347 / May 2000



FEMA

# Adapting to Sea Level Rise - Retreat

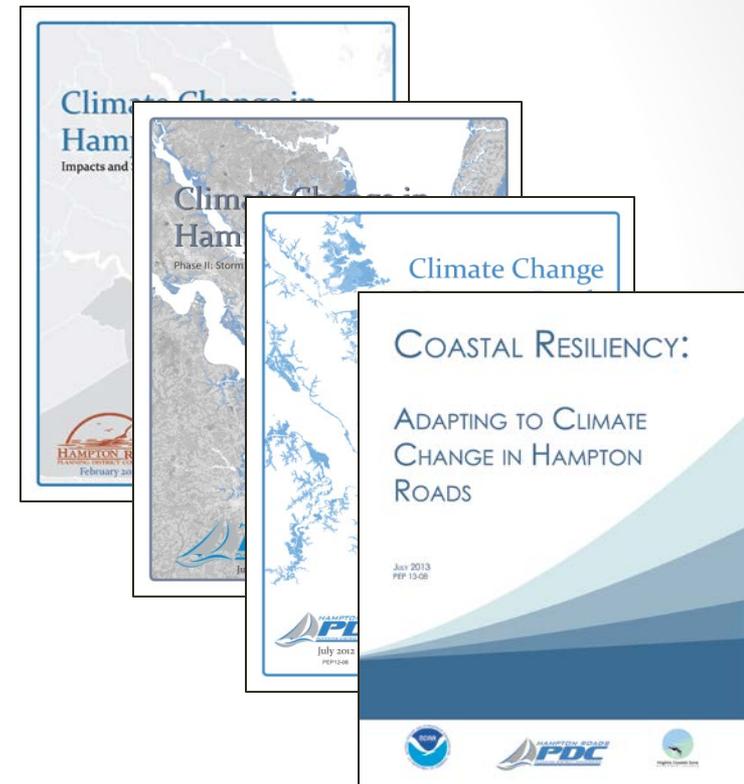
- Moving out of or not building in vulnerable areas (property buy-outs, transfer of development rights, etc.)



Georgetown Climate Center, 2011

# Regional Efforts

- Planning grants from the Virginia Coastal Zone Management Program, 2008-present
  - Mapping and GIS analysis
  - Policy research
  - Outreach and education
  - Government coordination
- Partnerships with other stakeholders
  - Research
  - Hampton Roads Adaptation Forum

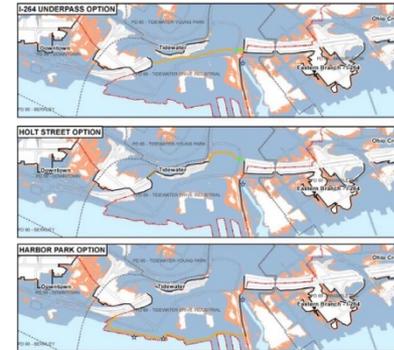


# Local Efforts – Newport News

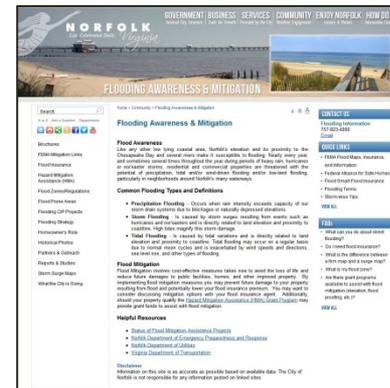
- Flood Assistance Program
  - The FAP is a program that funds the acquisition, relocation, or elevation of structures located in the floodplain.
  - Voluntary
  - Dependent on funding
  - Three eligibility criteria:
    - Located in the 100-year floodplain
    - Finished flood below the 100-year Base Flood Elevation
    - Under construction before December 31, 1974
  - Multiple benefits:
    - Hazard mitigation
    - Emergency response
    - Water quality

# Local Efforts – Norfolk

- Flood Mitigation
  - Vulnerability analysis
  - Coastal flood modeling
  - Project development
  - Floodplain Management Ordinance Updates
- Flood Awareness
  - Comprehensive website and outreach program
- Planning for Resilience



City of Norfolk/Moffatt & Nichol



City of Norfolk



# Local Efforts – Virginia Beach

- Floodplain Management Ordinance Updates
  - Freeboard now BFE + 2'
- Comprehensive assessment of city policies related to flooding and sea level rise
- HRPDC/City effort to develop a Sea Level Rise Adaptation Plan
  - Ordinance review
  - Case study research
  - Mapping of sea level rise and storm surge
  - Public outreach/education strategy

# Federal Efforts – Department of Defense

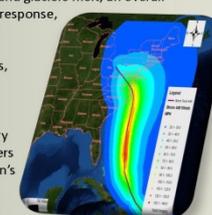
- SERDP-funded study of NAVSTA Norfolk’s vulnerability to sea level rise:
  - “Risk Quantification for Sustaining Coastal Military Installation Assets and Mission Capabilities”



## Risk Quantification for Sustaining Coastal Military Installation Assets and Mission Capabilities (SERDP RC-1701)

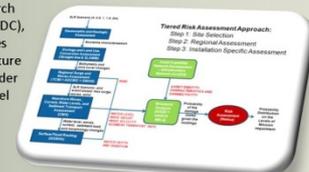
**Problem**

The best available scientific evidence indicates that climate change is occurring at an unprecedented rate. As the oceans warm and glaciers melt, an overall increase in ocean volume will be realized. In response, tropical storms will increase in frequency and intensity, erosion and shoreline change will accelerate, saltwater will intrude into aquifers, water tables will rise, and tidal prisms will change. These effects will act as hazards to coastal military installation assets and capabilities, and as such pose a non-stationary risk to our nation’s security. While commanders may be situationally aware of their installation’s vulnerabilities, demonstrable risk-based assessments are needed to proactively adapt military systems, processes, and protocols in the face of sea level rise. What the military needs is a **robust, scientifically defensible approach** that quantifies risks of climate change to mission sustainability in a transparent, meaningful, and actionable manner.

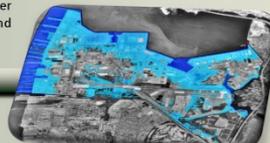


**Study Description**

With funding from the *Strategic Environmental Research and Development Program (SERDP)*, and using advanced technology developed by scientists from the US Army Engineer Research and Development Center (ERDC), the *RC-1701 project* examines the risks to critical infrastructure and mission performance under a prescribed series of sea level rise scenarios (0,0.5, 1,1.5, & 2m) in combination with tropical and extra-tropical storms (1, 10, 50 & 100-yr).



In essence, the RC-1701 has developed an **effective coastal hazard risk assessment framework** that manages sea level rise uncertainties and communicates the risk of mission impairment to end-users and policymakers in a meaningful manner that supports mission adaptation and sustainability into the long-term.



**For More Details Contact:**

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August 2011

# Federal Efforts – U.S. Army Corps of Engineers

- Engineer Circular EC 1165-2-212 – “Sea-Level Change Considerations for Civil Works Programs”
- North Atlantic Coast Comprehensive Study – Scoping Charrette and Visioning Session for Norfolk

DEPARTMENT OF THE ARMY  
U.S. Army Corps of Engineers  
Washington, DC 20314-1000

CECW-CE  
Circular  
No. 1165-2-212

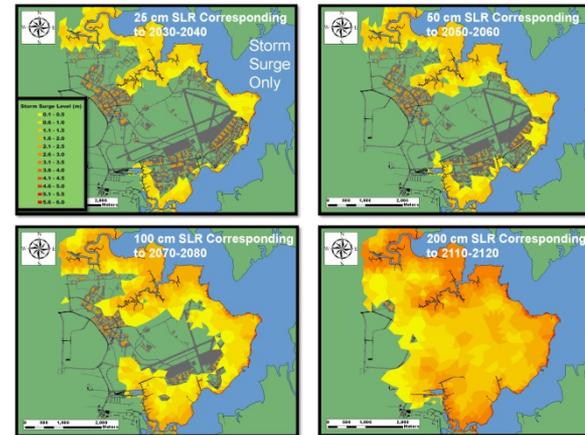
EC 1165-2-212  
1 October 2011

EXPIRES 30 September 2013  
SEA-LEVEL CHANGE CONSIDERATIONS FOR  
CIVIL WORKS PROGRAMS

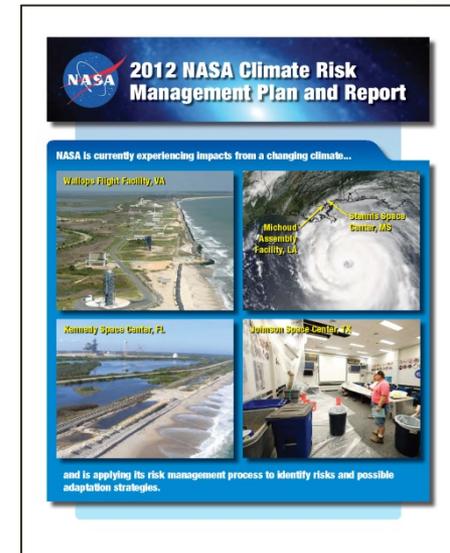
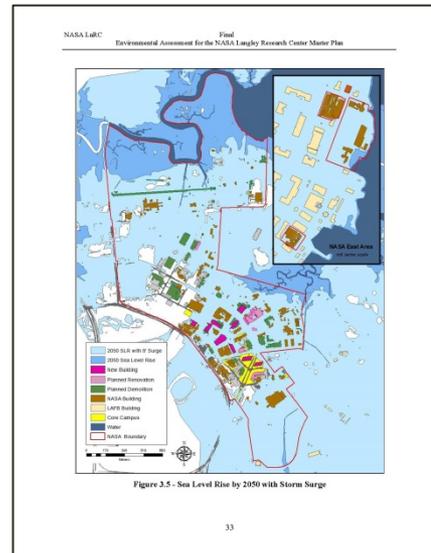
1. **Purpose.** This circular provides United States Army Corps of Engineers (USACE) guidance for incorporating the direct and indirect physical effects of projected future sea-level change across the project life cycle in managing, planning, engineering, designing, constructing, operating, and maintaining USACE projects and systems of projects. Recent climate research by the Intergovernmental Panel on Climate Change (IPCC) predicts continued or accelerated global warming for the 21st Century and possibly beyond, which will cause a continued or accelerated rise in global mean sea-level. Impacts to coastal and estuarine zones caused by sea-level change must be considered in all phases of Civil Works programs.
2. **Applicability.** This Circular applies to all USACE elements having Civil Works responsibilities and is applicable to all USACE Civil Works activities. This guidance is effective immediately, and supersedes all previous guidance on this subject. Districts and Divisions shall inform CECW of any problems with implementing this guidance.
3. **Distribution Statement.** This publication is approved for public release; distribution is unlimited.
4. **References.** Required and related references are at Appendix A. A glossary is included at the end of this document.
5. **Geographic Extent of Applicability.**
  - a. USACE water resources management projects are planned, designed, constructed and operated locally or regionally. For this reason, it is important to distinguish between global mean sea level (GMSL) and local (or “relative”) mean sea level (MSL). At any location, changes in local MSL reflect the integrated effects of GMSL change plus changes of regional geologic, oceanographic, or atmospheric origin as described in Appendix B and the Glossary.
  - b. Potential relative sea-level change must be considered in every USACE coastal activity as far inland as the extent of estimated tidal influence. Fluvial studies (such as flood studies) that include backwater profiling should also include potential relative sea-level change in the starting water surface elevation for such profiles, where appropriate. The base level of potential relative sea-level change is considered the historically recorded changes for the study site. Areas already

# Federal Efforts – NASA Langley/Langley AFB

- NASA Scientific Research and Analysis
  - Partners with City of Poquoson and Langley AFB
- Center Master Plan
- NASA Climate Risk Management Plan and Report



Russell De Young, NASA Langley



# Adaptation – What's being done now?

- Flood adaptation
  - Raising houses and roads
  - Education and outreach
  - Attempts to reduce losses
    - Ex. Parking cars in city garages
  - Engineering studies and plans for flood protection
  - Property buyouts
- Sea Level Rise Adaptation
  - Research and Analysis
  - Planning
    - Ex. Comprehensive Plan updates

# Questions?

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