Sea Level Rise in Coastal Virginia: Risk and Response

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Sea Grant Virginia

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Resilience Collaborative

Sea Level Rise in the News

Business

In Norfolk, evidence c change is in the stree

Norfolk wrestles with rising waters, sinking options

Rising oceans threaten bases: report

By: Meghann Myers, July 29, 2016 *(Photo Credit: U.S. Coas*

No special permits needed for Sandbridge rental homes under bill awaiting signature

By MECHELLE HANKERSON | *The Virginian-Pilot*

VIRGINIA BEACH

As the city grapples with how to regulate vacation rental homes, the state wants to make one thing clear: Sandbridge should get special treatment.

For decades, rental housing has been a key part of the neighborhood's economy, drawing visitors to the city's southernmost beach.

A bill passed by the General Assembly and awaiting Gov. Ralph Northam's signature would prevent the city from requiring conditional-use permits for rentals in Sandbridge – even if it decides to do so for other areas.

The proposal was tacked on to HB824, which primarily deals with the city of Lexington's short-term

See RENTALS, PAGE 6

at issue

Permit advocates say they would protect neighborhoods and help them retain their character. Others say permits would threaten Sandbridge's rental economy and some homeowners' income.

L. TODD SPENCER | THE VIRGINIAN-PILOT

The Virginian-Pilot

Tuesday | Our 153rd year | 03.13.18 | PILOTONLINE.COM | $1 in Hampton Roads; $1.50 in outlying areas

REPORT

Sea level rise is accelerating in Hampton Roads

By Dave Mayfield
The Virginian-Pilot

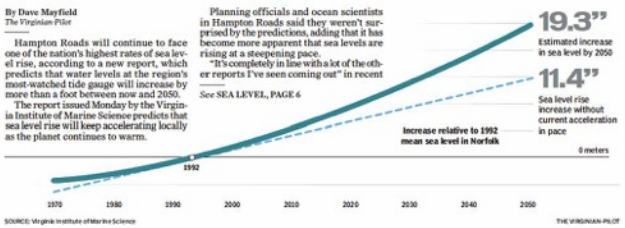
Hampton Roads will continue to face one of the nation's highest rates of sea level rise, according to a new report, which predicts that water levels at the region's most-watched tide gauge will increase by more than a foot between now and 2050.

The report issued Monday by the Virginia Institute of Marine Science predicts that sea level rise will keep accelerating locally as the planet continues to warm.

Planning officials and ocean scientists in Hampton Roads said they weren't surprised by the predictions, adding that it has become more apparent that sea levels are rising at a steepening pace.

"It's completely in line with a lot of the other reports I've seen coming out" in recent

See SEA LEVEL, PAGE 6



SOURCE: Virginia Institute of Marine Science

THE VIRGINIAN-PILOT

hey, that guy looks familiar...

A Norfolk woman said she thought she knew a robber on TV - from a dating app.

PAGE 3

Anthem to cut support for breast pumps nearly in half

breastfeeding advocates angered

Starting April 1 in Virginia and 14 other states, Anthem will pay suppliers about 45 percent less for each breast pump. Doctors and advocates argue it could lead some women to give up breastfeeding, a practice that reduces moms' and babies' disease risks.

By Katherine Hafner
The Virginian-Pilot

Anthem plans to nearly halve what it spends on electric breast pumps, a move advocates fear will lead to inferior equipment and deter new mothers from breastfeeding.

The insurer will pay suppliers about 45 percent less for each pump, dropping from $169 to $95, starting April 1. Customers were not notified of the change, which affects Virginia and 14 other states.

Anthem spokesman Scott Golden said in an email the decision "will not impact the ability of any new mother to access a high-quality, standard double electric breast pump from our nationally contracted medical suppliers." Company officials declined to be interviewed.

See PUMPS, PAGE 7

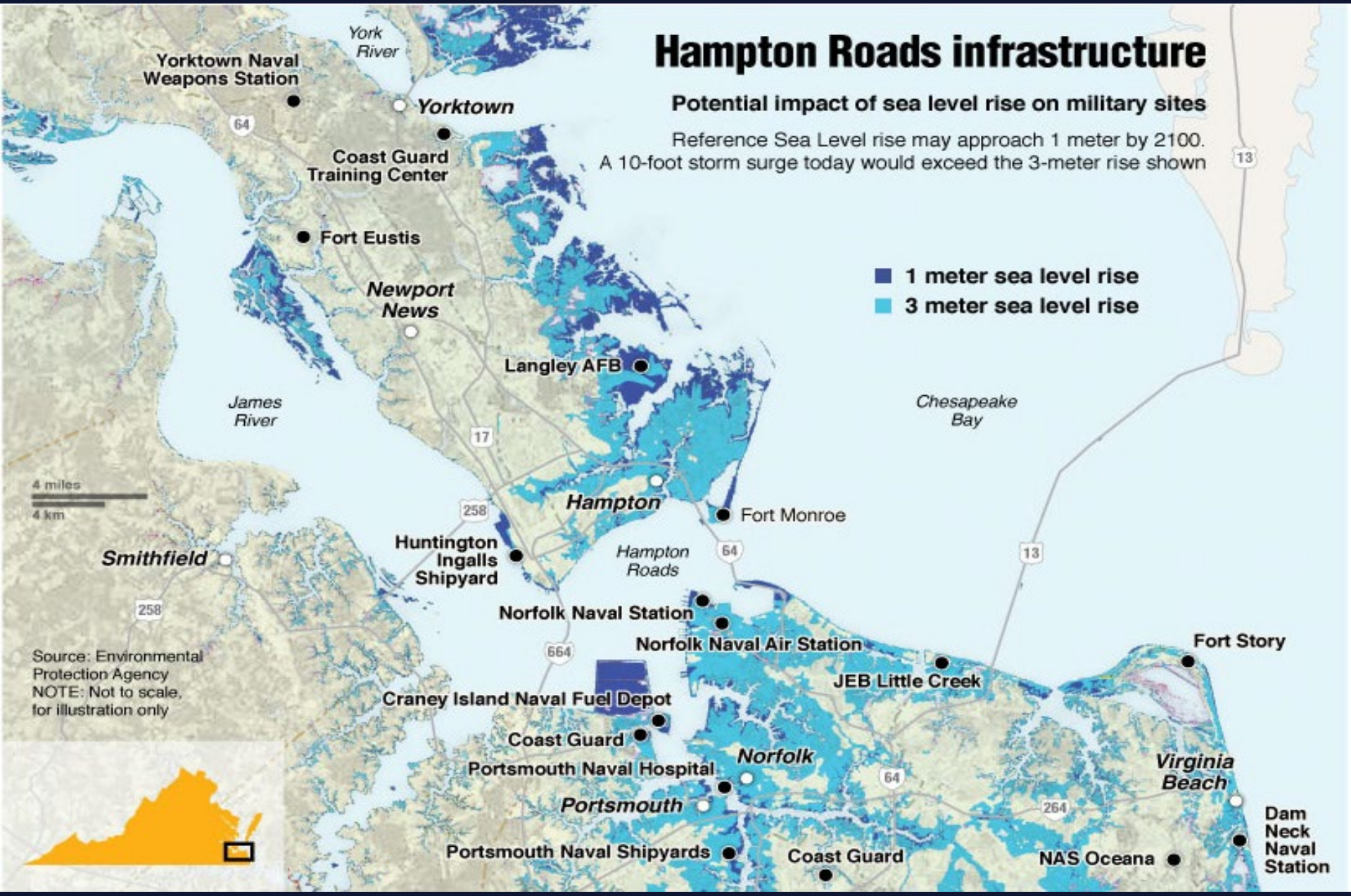
partly sunny

Highs around 60.

ea-level rise

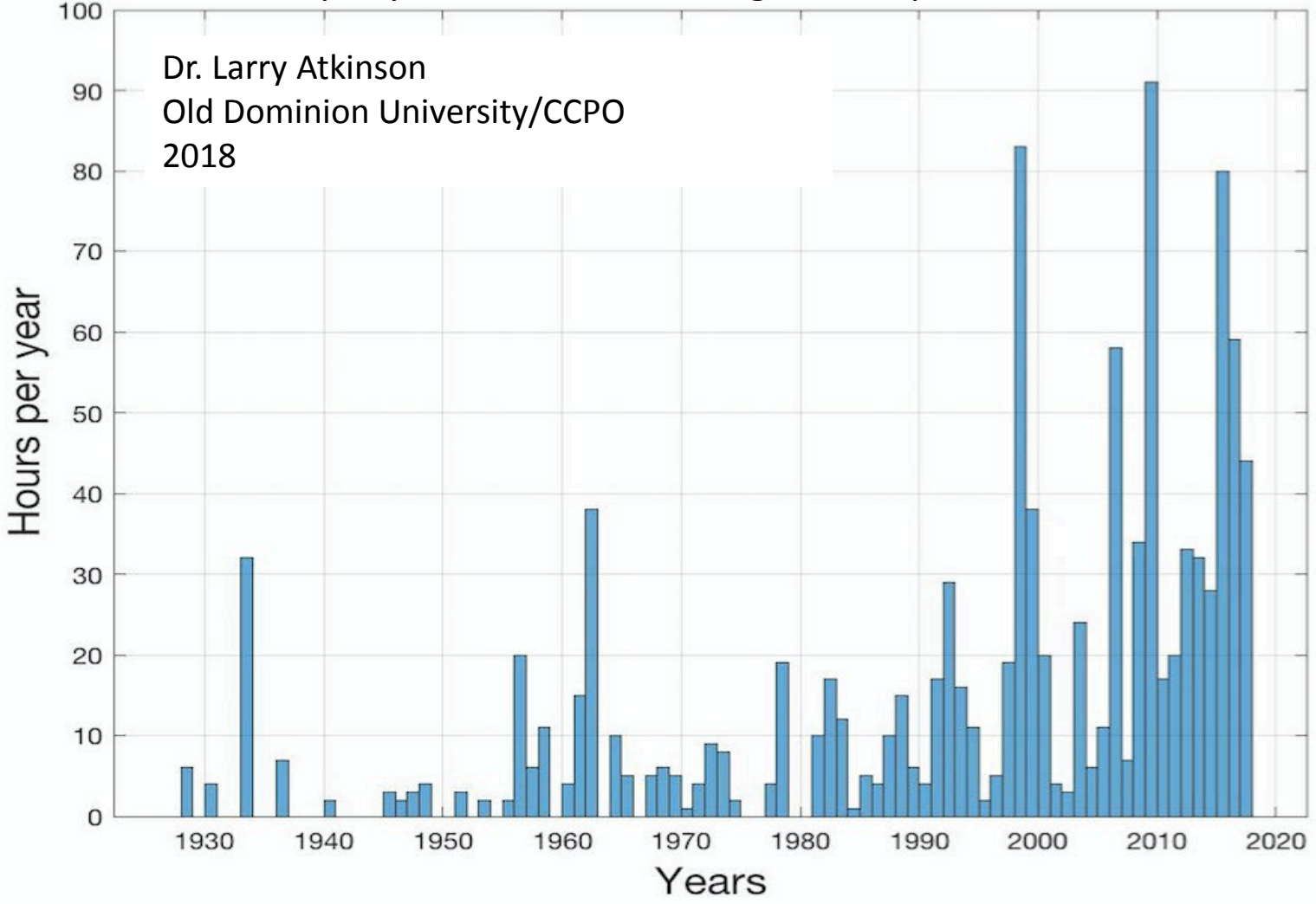
series

Comment


Hampton Roads infrastructure
Potential impact of sea level rise on military sites
Reference Sea Level rise may approach 1 meter by 2100.
A 10-foot storm surge today would exceed the 3-meter rise shown
1 meter sea level rise
3 meter sea level rise
York River
Yorktown Naval Weapons Station
Yorktown
Coast Guard Training Center
Fort Eustis
Newport News
Langley AFB
James River
Chesapeake Bay
Hampton
Fort Monroe
Huntington Ingalls Shipyard
Hampton Roads
Smithfield
Norfolk Naval Station
Norfolk Naval Air Station
Fort Story
JEB Little Creek
Craney Island Naval Fuel Depot
Coast Guard
Norfolk
Portsmouth Naval Hospital
Virginia Beach
Portsmouth
Dam Neck Naval Station
Portsmouth Naval Shipyards
Coast Guard
NAS Oceana
4 miles
4 km
Source: Environmental Protection Agency
NOTE: Not to scale, for illustration only
64
17
258
664
13
264

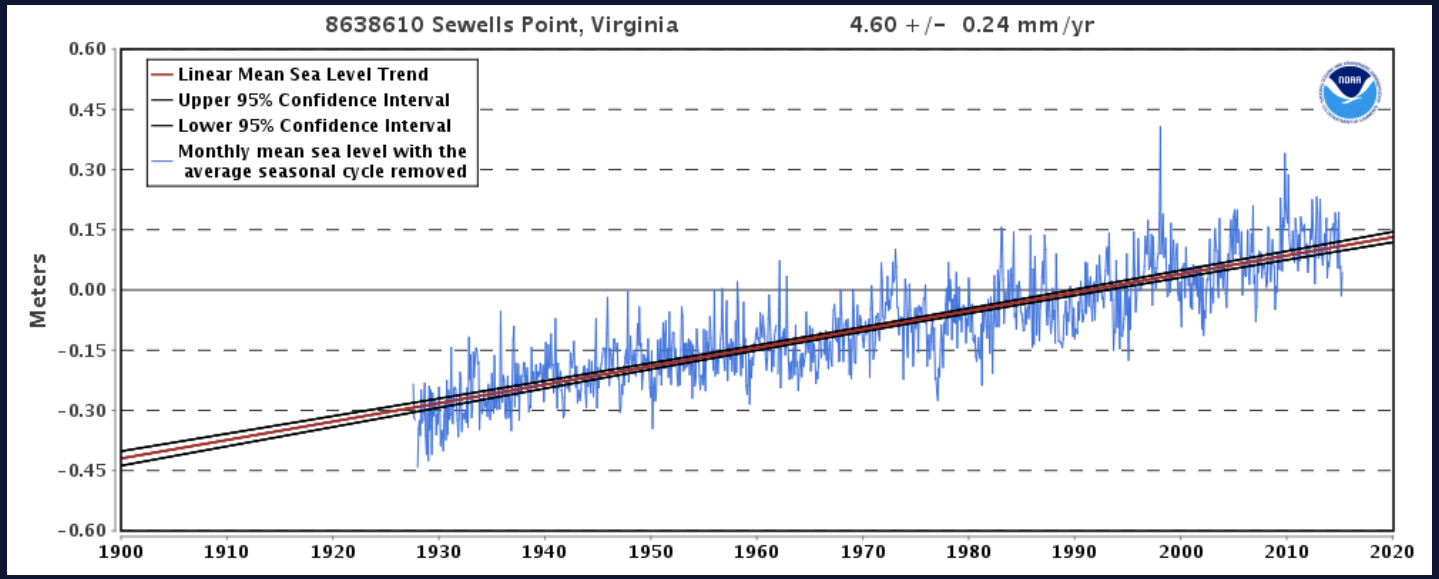
Minor (Nuisance) Flooding

Hours per year nuisance flooding on Hampton Blvd.

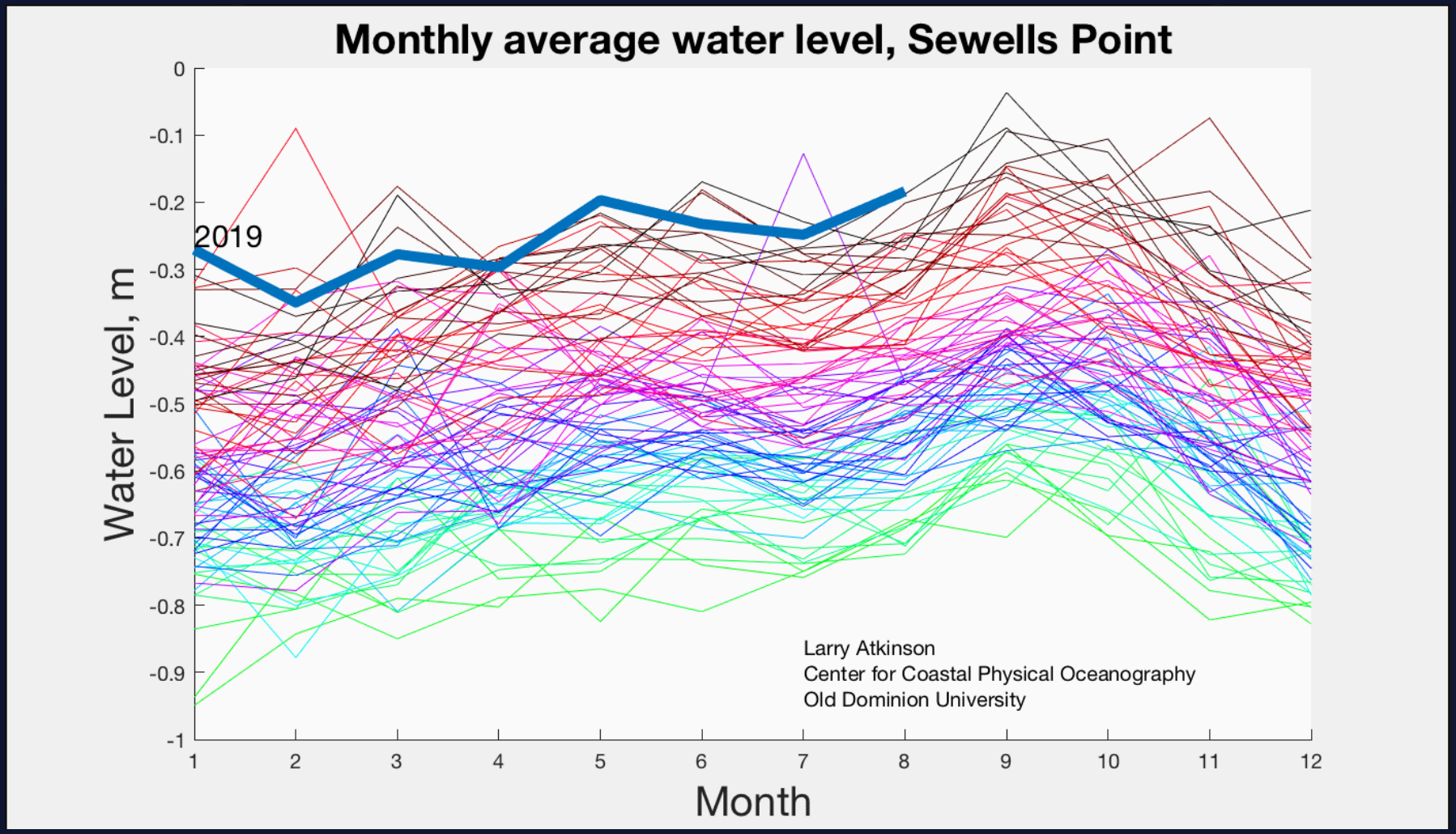


Measuring Sea Level Rise

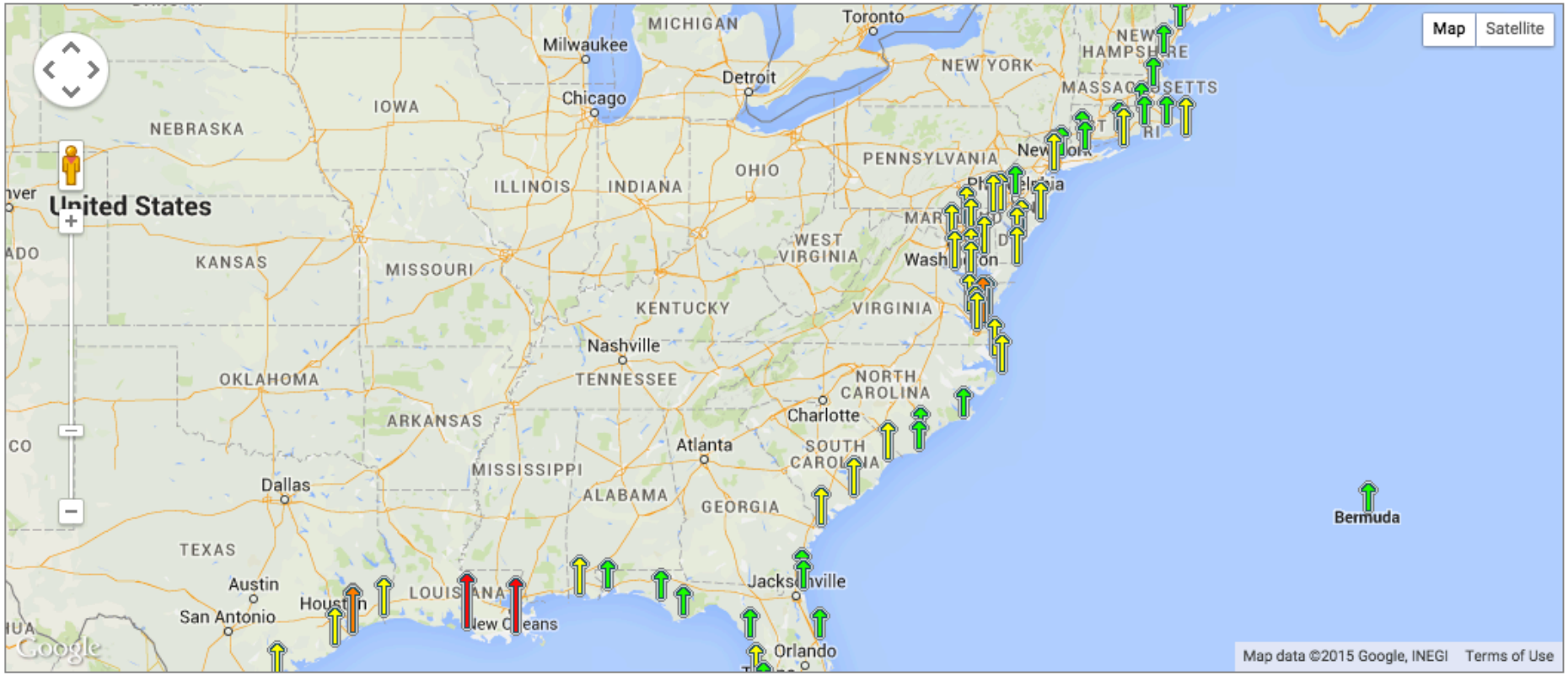
Sewell's Point Tide Gauge



Measuring Sea Level Rise



Measuring Sea Level Rise



The map above illustrates regional trends in sea level, with arrows representing the direction and magnitude of change. Click on an arrow to access additional information about that station.

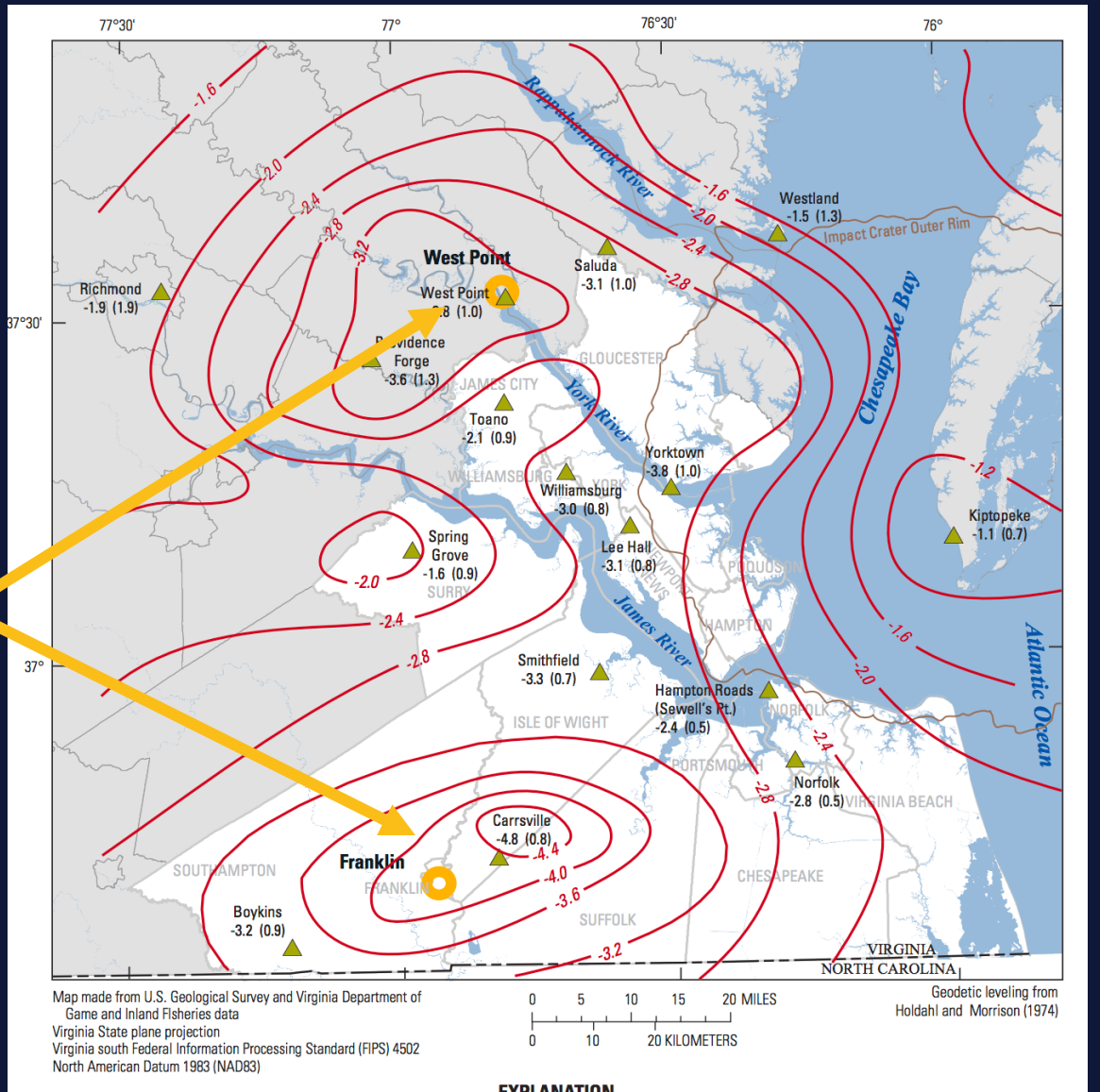
Sea Level Trends
mm/yr (feet/century)

15 to 21 (5 to 7)	6 to 9 (2 to 3)	-3 to 0 (-1 to 0)	-12 to -9 (-4 to -3)
12 to 15 (4 to 5)	3 to 6 (1 to 2)	-6 to -3 (-2 to -1)	-15 to -12 (-5 to -4)
9 to 12 (3 to 4)	0 to 3 (0 to 1)	-9 to -6 (-3 to -2)	-18 to -15 (-6 to -5)

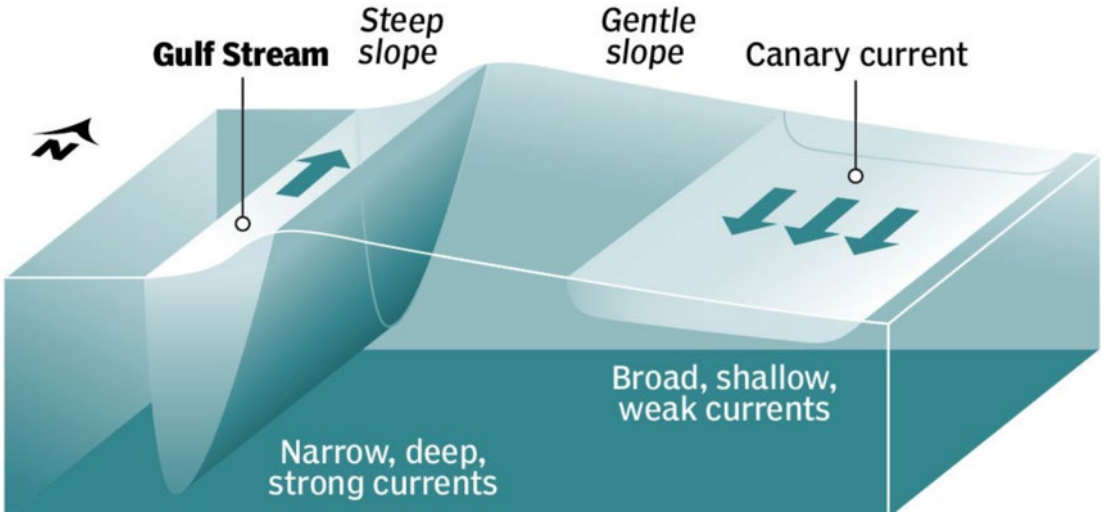
Land subsidence

about 1 ft. per century in Virginia

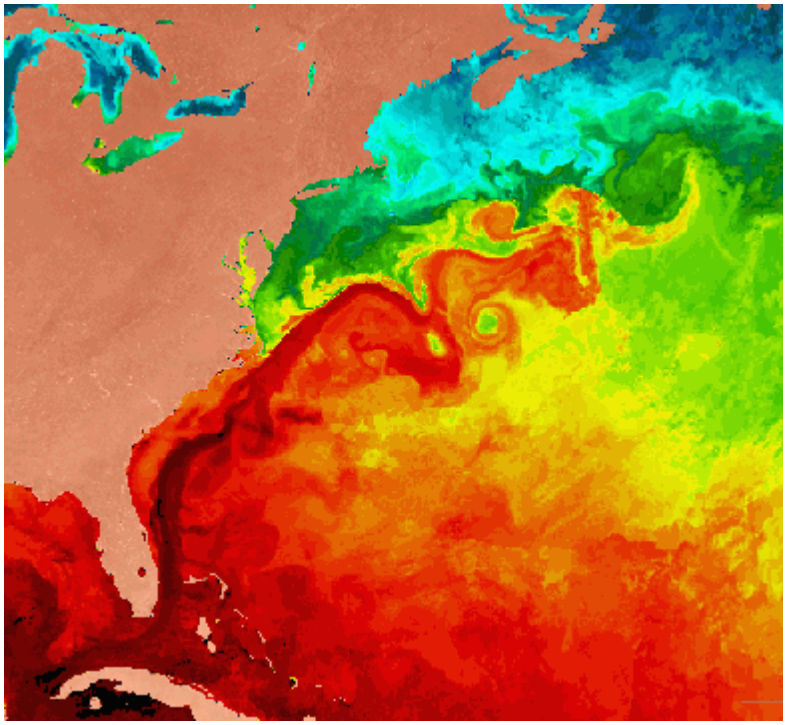
Groundwater pumping



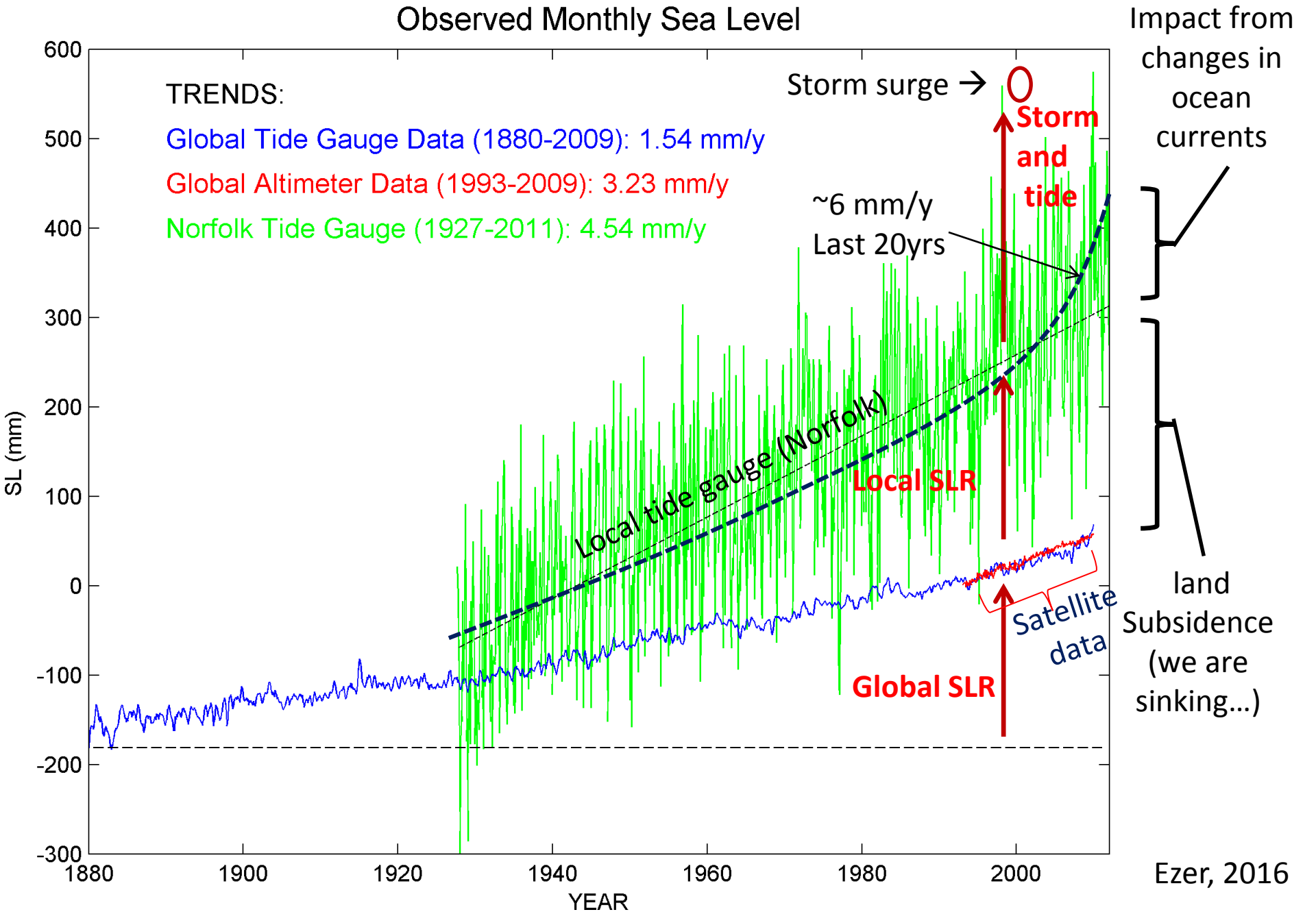
Ocean Currents- Gulf Stream

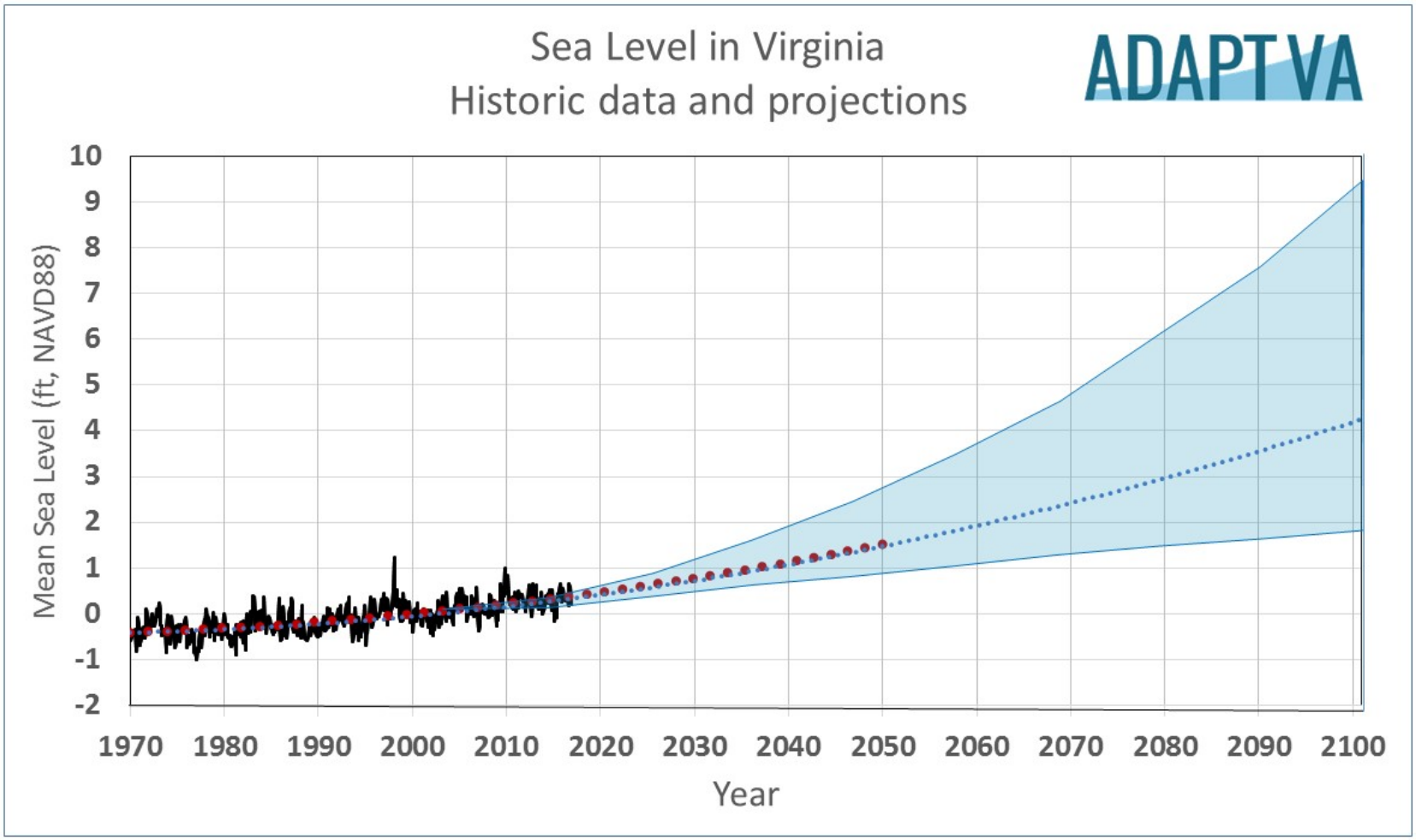


The Virginian Pilot 2018

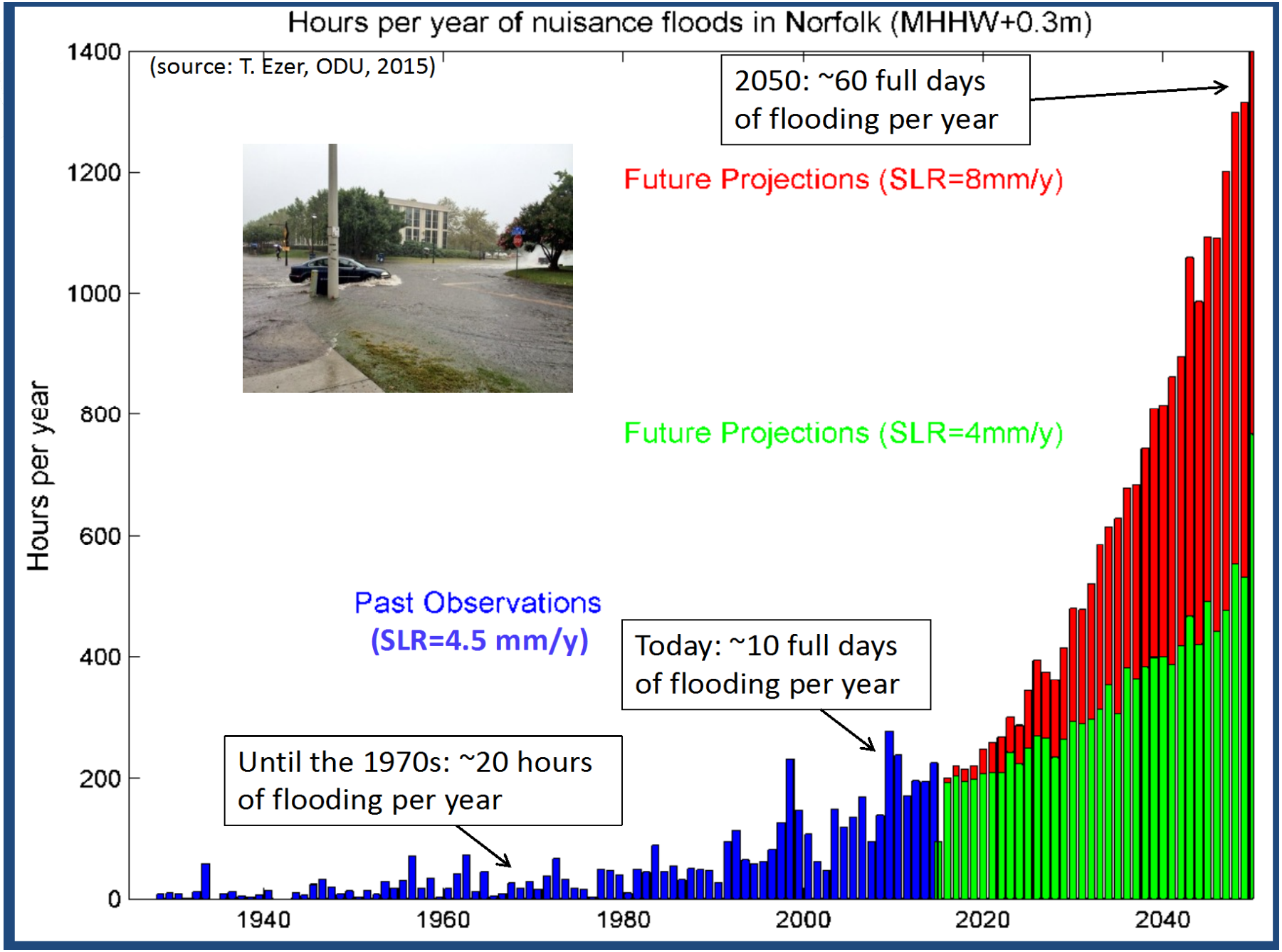


Weather Online


Observed Monthly Sea Level
TRENDS:
Global Tide Gauge Data (1880-2009): 1.54 mm/y
Global Altimeter Data (1993-2009): 3.23 mm/y
Norfolk Tide Gauge (1927-2011): 4.54 mm/y
Storm surge →
Storm and tide
~6 mm/y
Last 20yrs
Local tide gauge (Norfolk)
Local SLR
Satellite data
Global SLR
SL (mm)
YEAR
600
500
400
300
200
100
0
-100
-200
-300
1880
1900
1920
1940
1960
1980
2000
Impact from changes in ocean currents
land Subsidence (we are sinking…)
Ezer, 2016



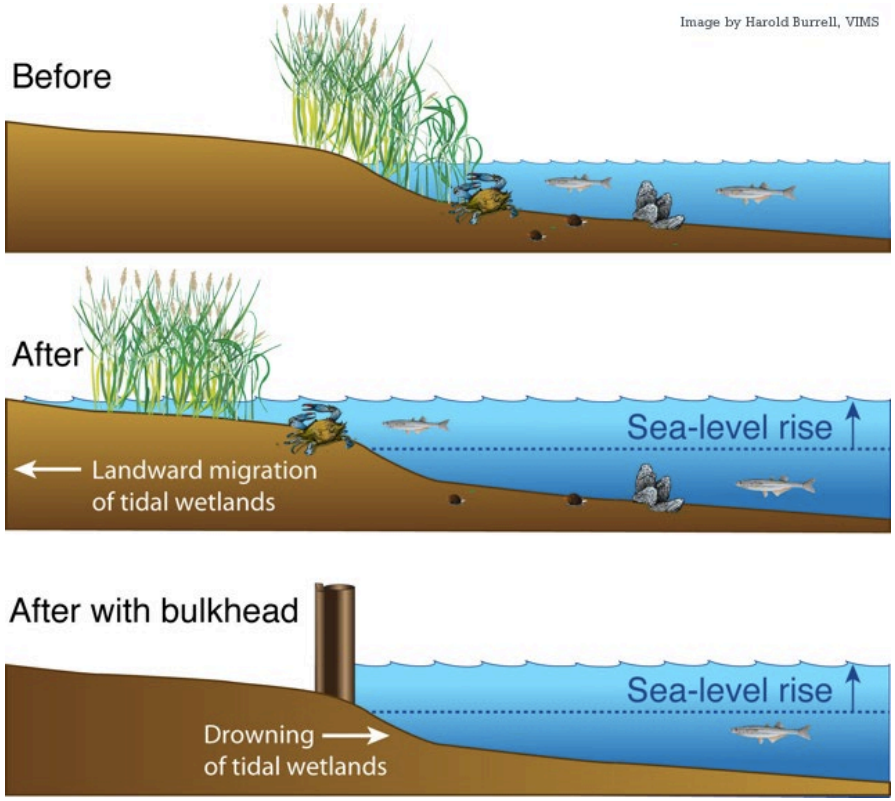
Virginia Institute of Marine Science 2017

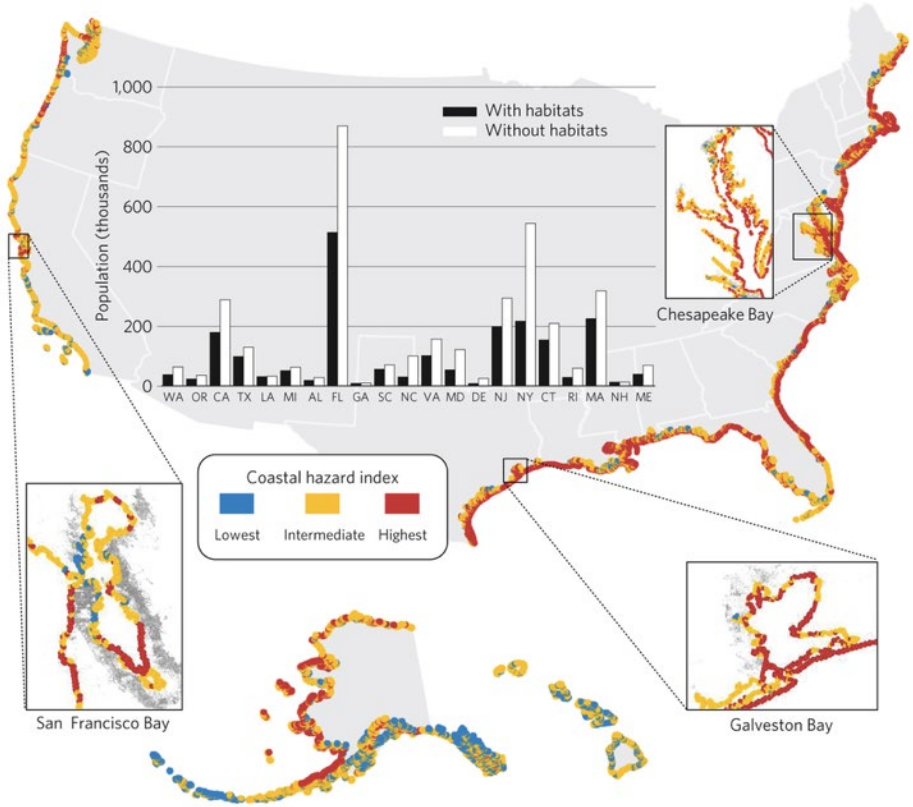

Hours per year of nuisance floods in Norfolk (MHHW+0.3m)
(source: T. Ezer, ODU, 2015)
2050: ~60 full days of flooding per year
Future Projections (SLR=8mm/y)
Future Projections (SLR=4mm/y)
Past Observations (SLR=4.5 mm/y)
Today: ~10 full days of flooding per year
Until the 1970s: ~20 hours of flooding per year
Hours per year
0
200
400
600
800
1000
1200
1400
1940
1960
1980
2000
2020
2040

What is at risk?

- Land inundation and shoreline erosion
- Destruction of wetlands
- Saltwater intrusion
- Increased threat from severe storms
- Difficulty living in the coastal zone
  - Property Insurance
  - Transportation
  - Economic stability

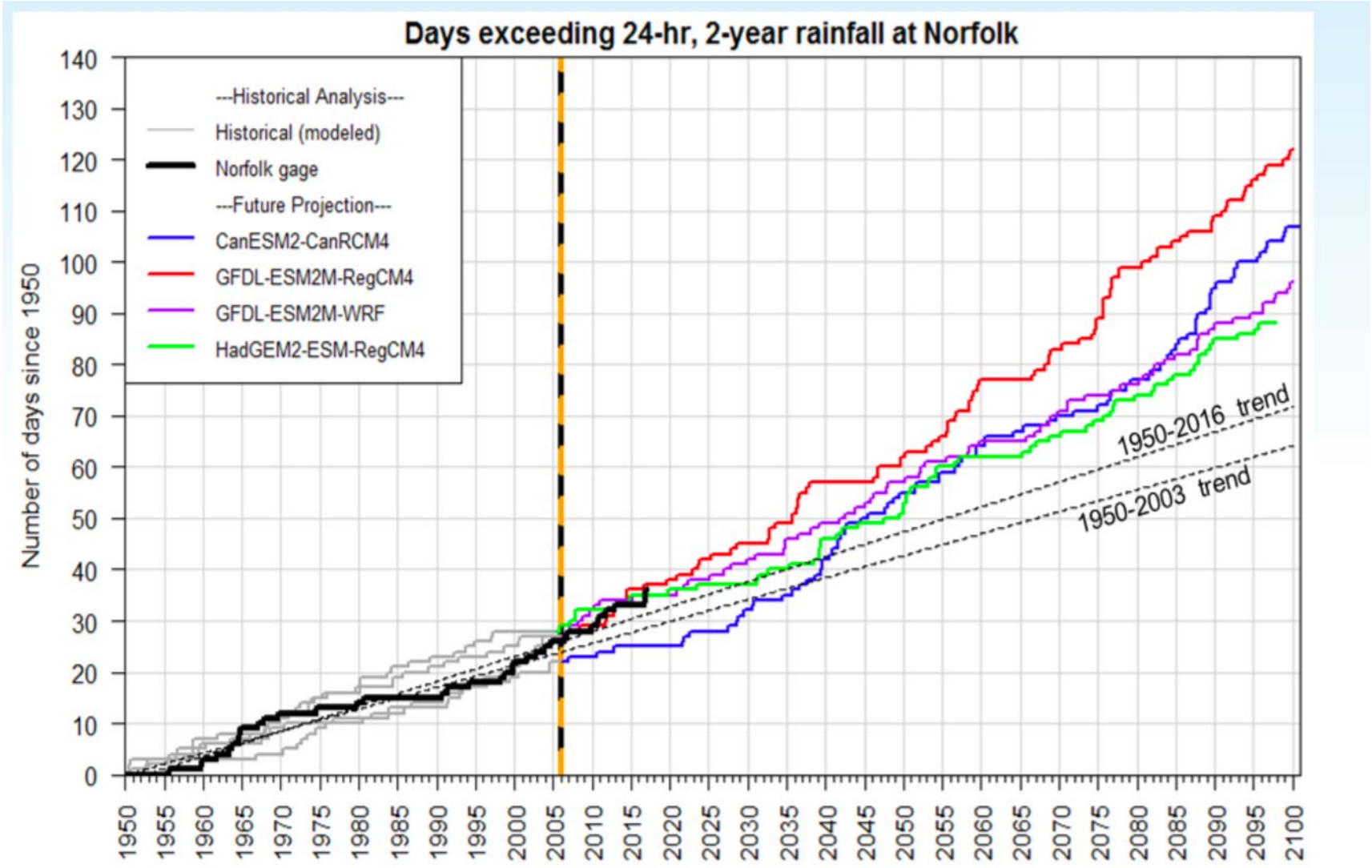
Loss of Wetlands





Arkema, et al., 2013

Rainfall Trend

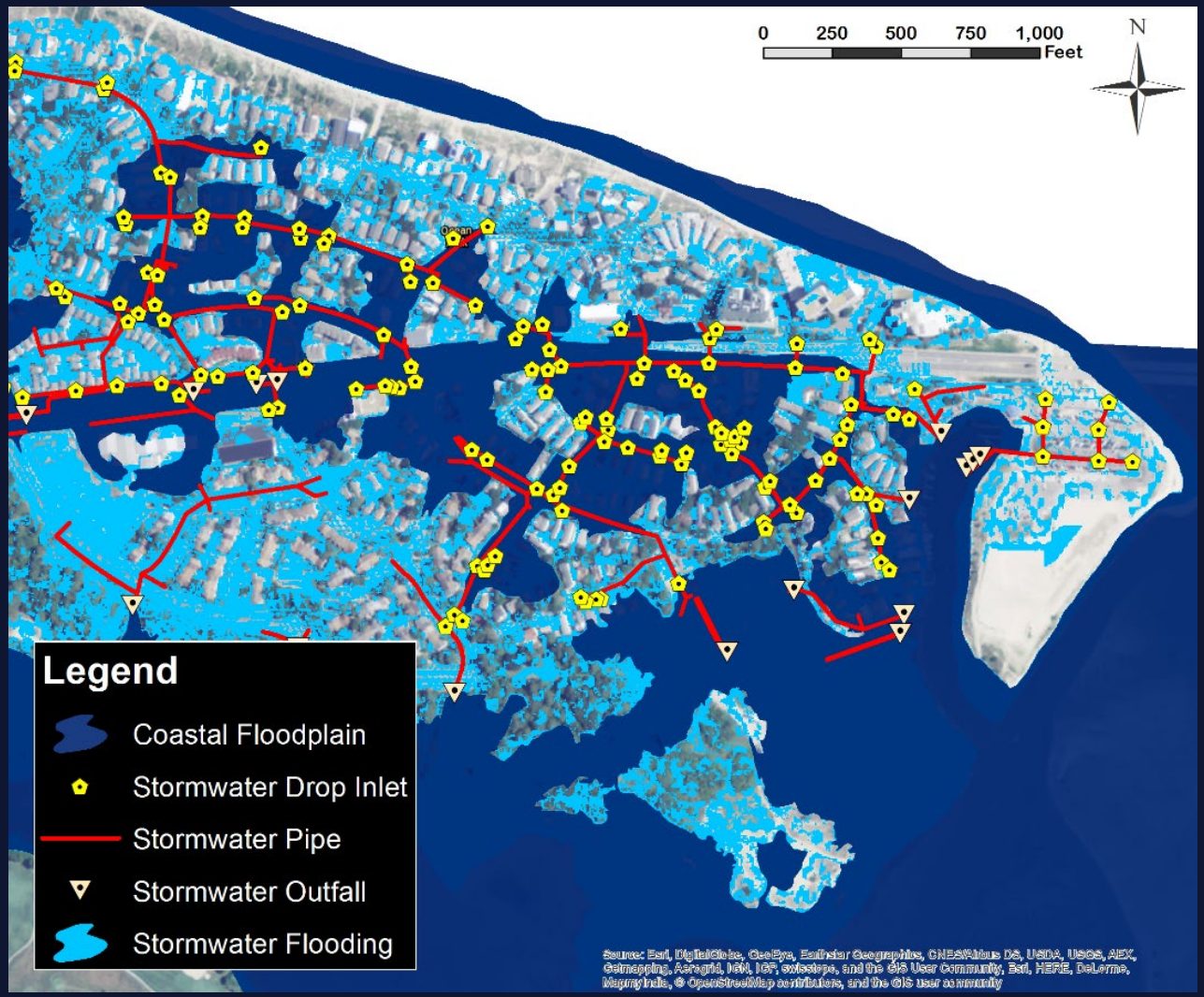


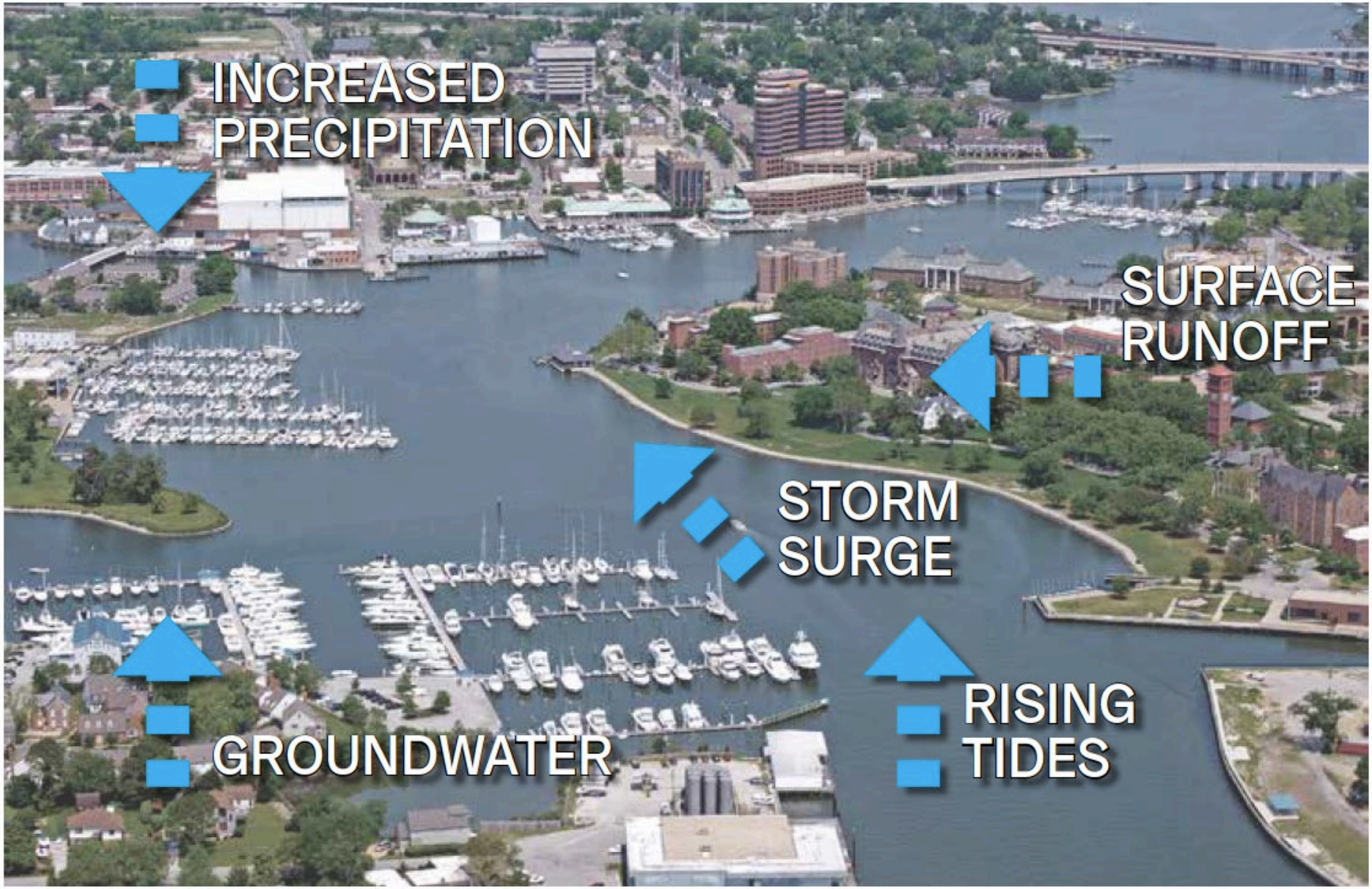
- Upward trend of Annual Maximum Precipitation Series between 3-7% per decade.

Water Infrastructure

Bringing Together

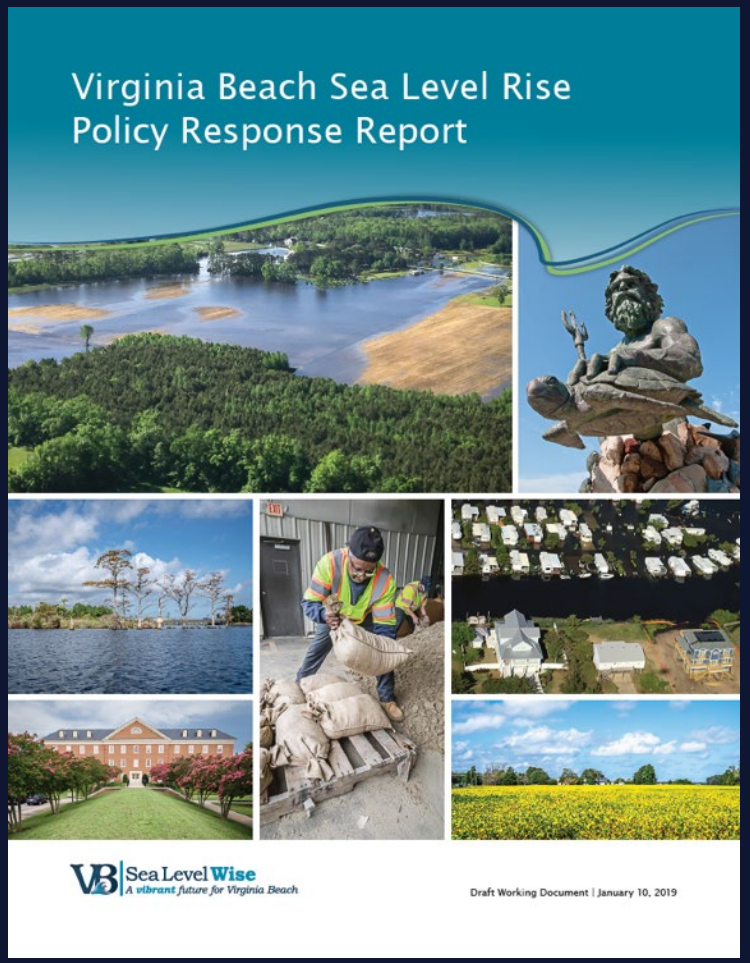
- Coastal Flooding
- Stormwater Conveyance
- Combined Flooding



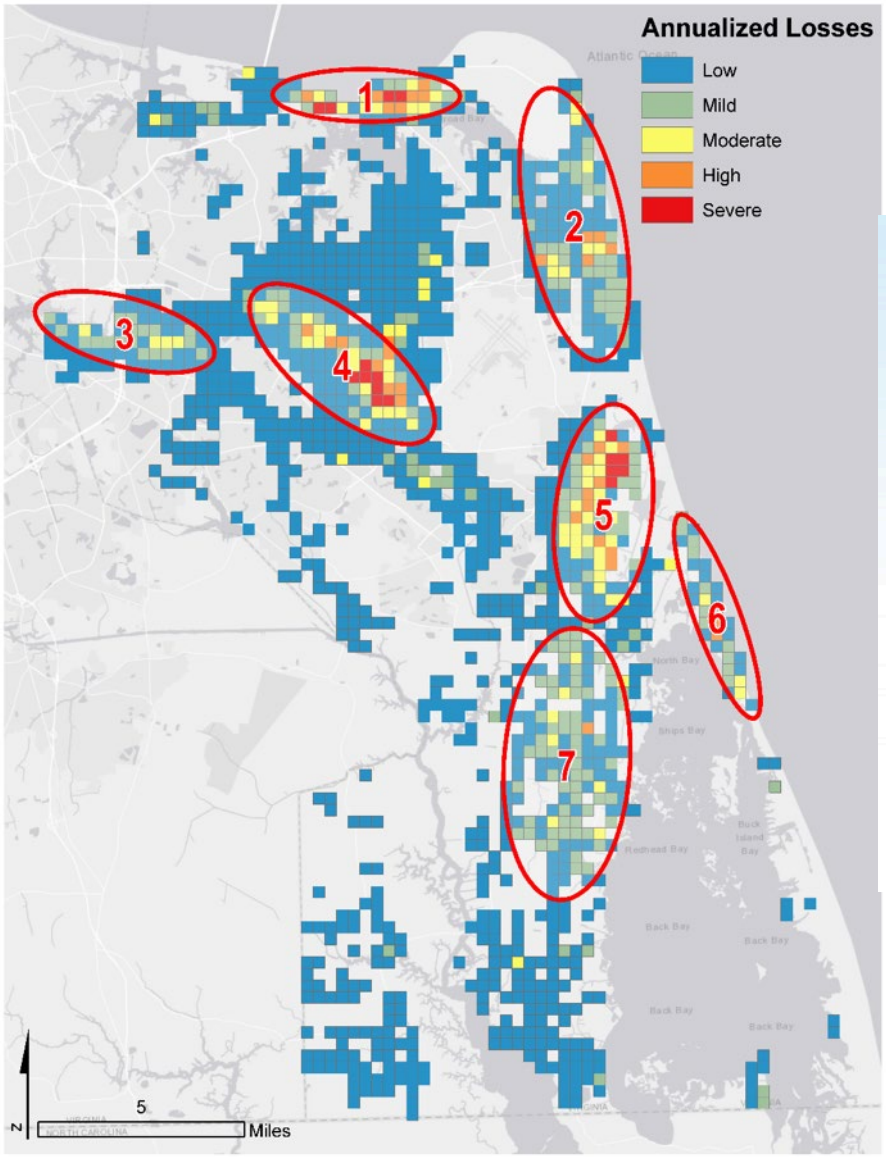

INCREASED
PRECIPITATION
SURFACE
RUNOFF
STORM
SURGE
GROUNDWATER
RISING
TIDES

Adaptation Approaches In Virginia

- Impact Assessment
- Adaptation Strategies
  - Policy and planning
  - Structural protection
  - NNBF and Green infrastructure
- Integration



Impact Assessment



Consequences of Future Without Action

Compared to Today: ***4x increase*** ***23x increase***

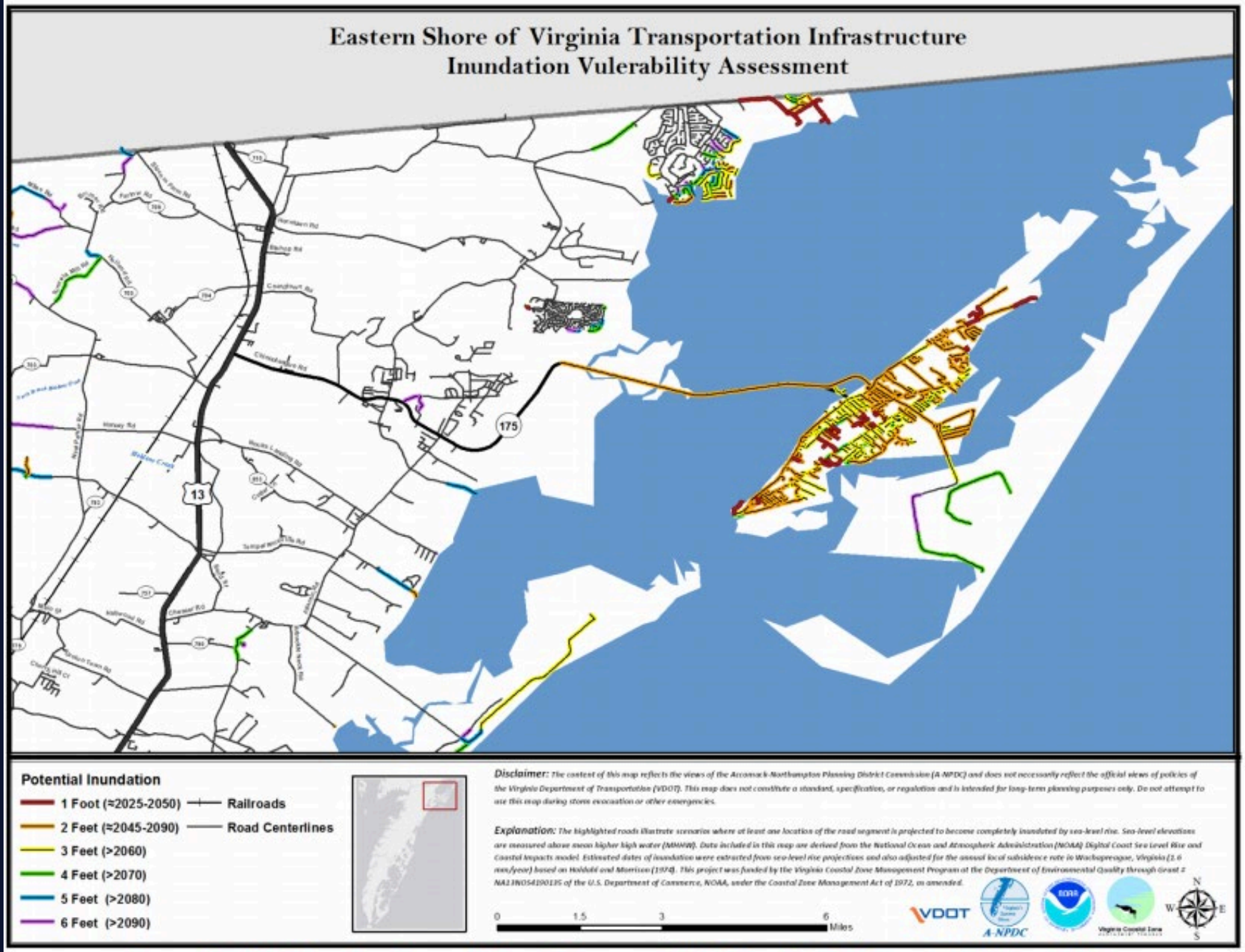


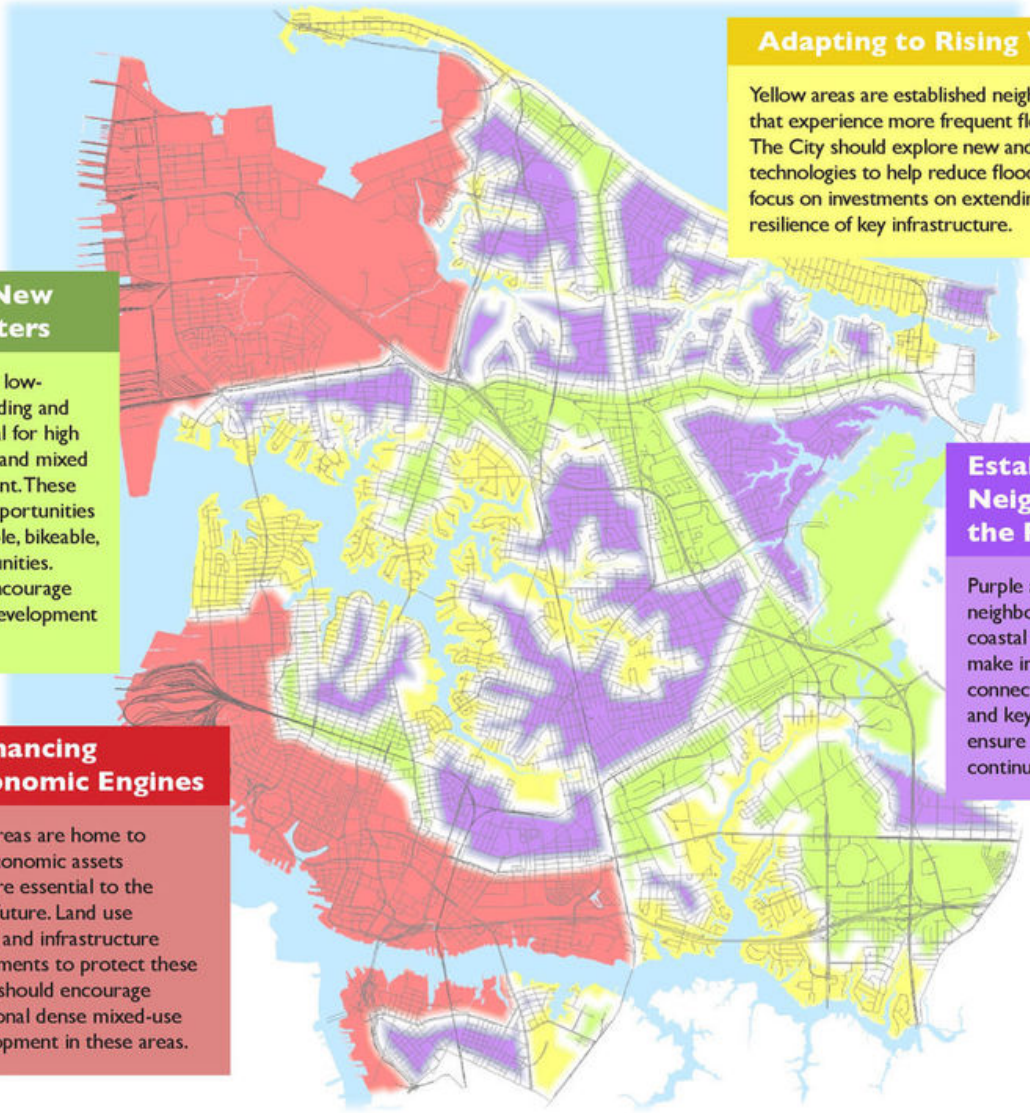
Figure 14 – Northeastern Accomack County Transportation Infrastructure Inundation Vulnerability

Policy Strategies

- Planning (Comprehensive, Haz Mit, Emergency Response, Floodplain)
- Building codes, regulations, set backs & buffers, incentives
- Engaging private sector
- Open space
- State and Federal policy

Designing the Coastal Community of the Future

By working with residents, the City of Norfolk is building a long-term strategy to address the flooding challenges due to sea level rise. How we use land today helps ensure the opportunity that Norfolk will be a dynamic, water-based community into the next century.



Designing New Urban Centers

Green areas are at low-risk of coastal flooding and have great potential for high density, mixed-use and mixed income development. These areas are prime opportunities for creating walkable, bikeable, transit-rich communities. The City should encourage transformational development in these areas.

Adapting to Rising Waters

Yellow areas are established neighborhoods that experience more frequent flooding. The City should explore new and innovative technologies to help reduce flood risk and focus on investments on extending the resilience of key infrastructure.

Establishing Neighborhoods of the Future

Purple areas are established neighborhoods at less-risk of coastal flooding. The City should make investments that improve connections between these areas and key economic assets to ensure that these neighborhoods continue to thrive.

Enhancing Economic Engines

Red areas are home to key economic assets that are essential to the city's future. Land use policy and infrastructure investments to protect these areas should encourage additional dense mixed-use development in these areas.

THE CITY OF NORFOLK

Find more information at www.norfolk.gov/vision2100

Structural Options

Dewberry

Coastal Flood Protection Toolkit

City-Wide Structural Alternatives for Coastal Flood Protection

City of Virginia Beach, Virginia

CIP 7-030, PWCN-15-0014, Work Order 17B

Interim Draft Report

Date: May 24, 2019

Submitted to: City of Virginia Beach

Natural and Nature-Based Features

- INCREASED USE OF LIVING SHORELINES
- EXPLORE BIOGENIC REEFS & OTHER OPTIONS TO MITIGATE SHORELINE EROSION
- BEACH NOURISHMENT AND DUNE STABILIZATION

NORFOLK'S RESILIENCE PARK

A PARK THAT...

PROTECTS

+ captures and store or drain **stormwater**
+ reduces **coastal flooding** through an integrated flood barrier
+ supports **individual resilience** of mind and body

CONNECTS

+ Grandy Village & Chesterfield Heights neighborhoods + The Learning Center
+ people, particularly children, to nature
+ people to the Elizabeth River

ENGAGES

+ creates a **neighborhood destination** and a **place that is uniquely Norfolk**
+ raises **awareness** of regional ecology & hydrology
+ curates an **educational corridor**
+ supports a **resilience** academy

PROGRAM CONCEPT

LOW, WET GROUND

+ [illegible]

NATURAL HIGH ZONES

+ [illegible]

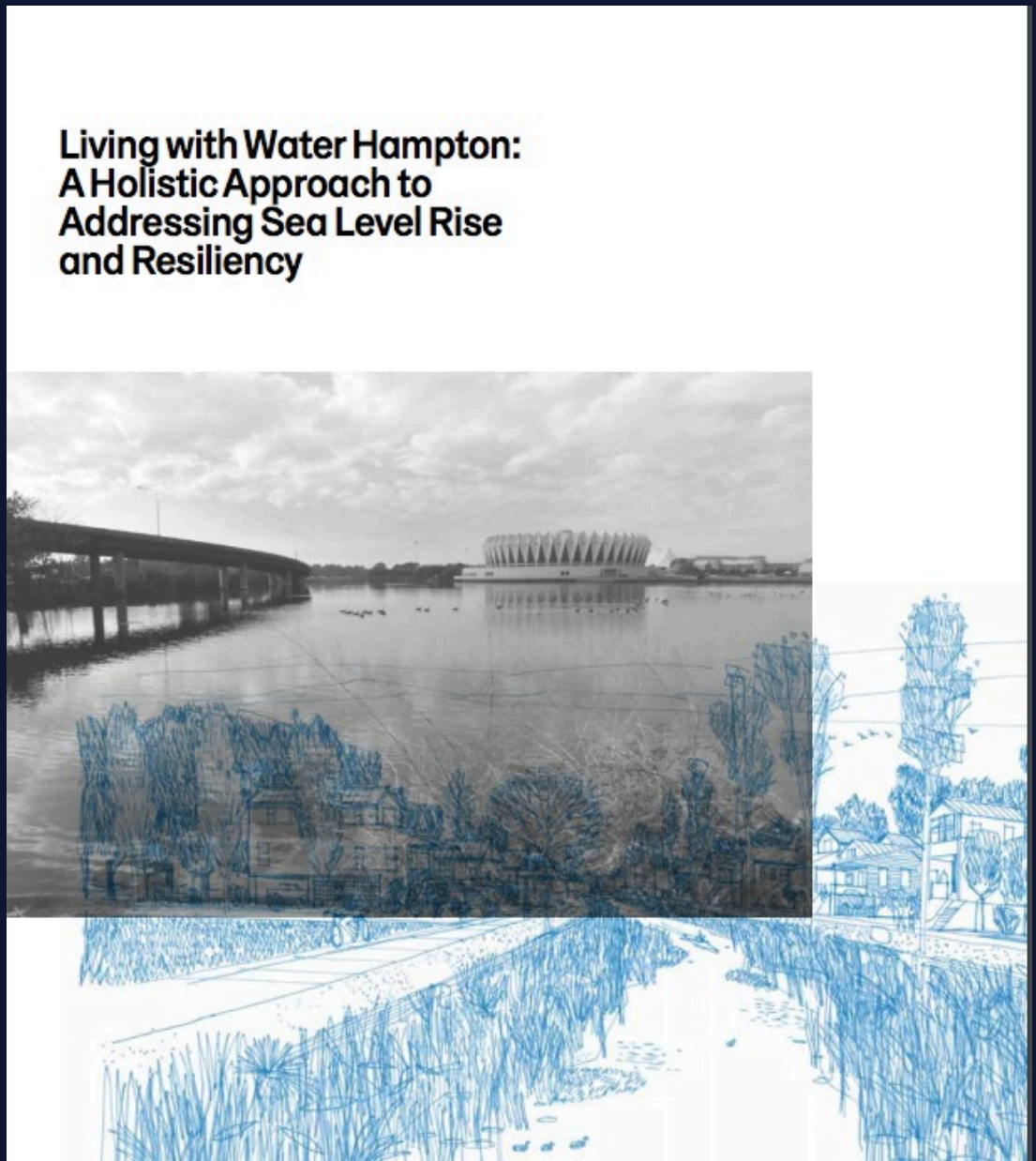
PROGRAMMED HIGH ZONES

+ [illegible]

NDRC OHIO CREEK WATERSHED PROJECT
CITY OF NORFOLK OFFICE OF RESILIENCY

CITY OF NORFOLK ARCADIS SCAPE

Adaptation Approaches in Virginia



Value-Driven Solutions

- Safe
- Equitable
- Natural
- Heritage
- Integrated
- Sufficient
- Nimble
- Innovative

Regional Resilience Efforts

- Regional Coastal Resilience Committee
- Regional Coastal Resilience Working Group
- Joint Land Use Studies

Hampton Roads Sea Level Rise/Flooding Adaptation Forum

University of Virginia Institute for Environmental Negotiation

William & Mary Law School
Virginia Coastal Policy Center

Old Dominion University
Resilience Collaborative

The RAFT

Resilience Adaptation Feasibility Tool

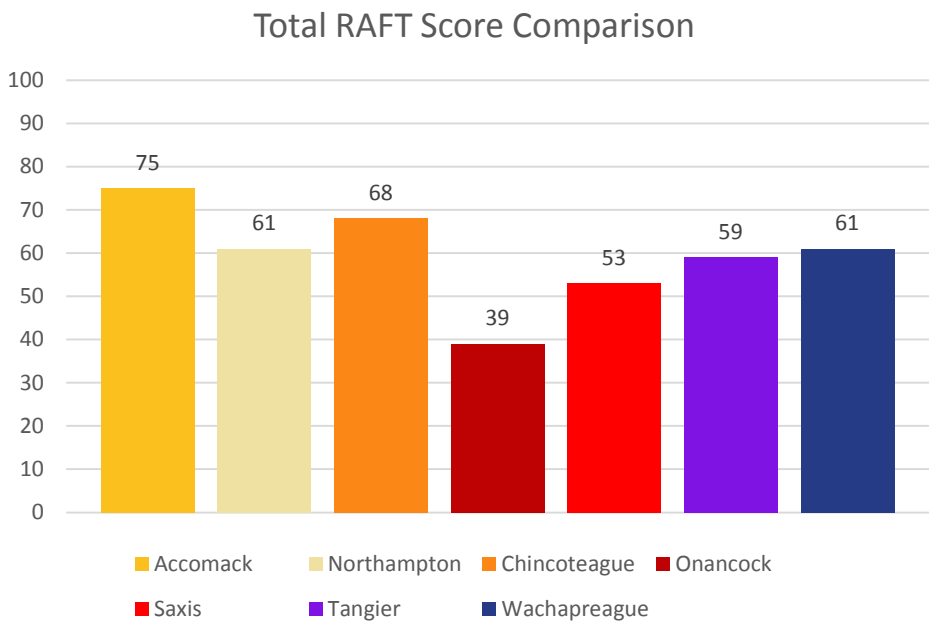
To help Virginia's coastal localities improve resilience to flooding and other coastal storm hazards while remaining economically and socially viable.

raft.ien.virginia.edu

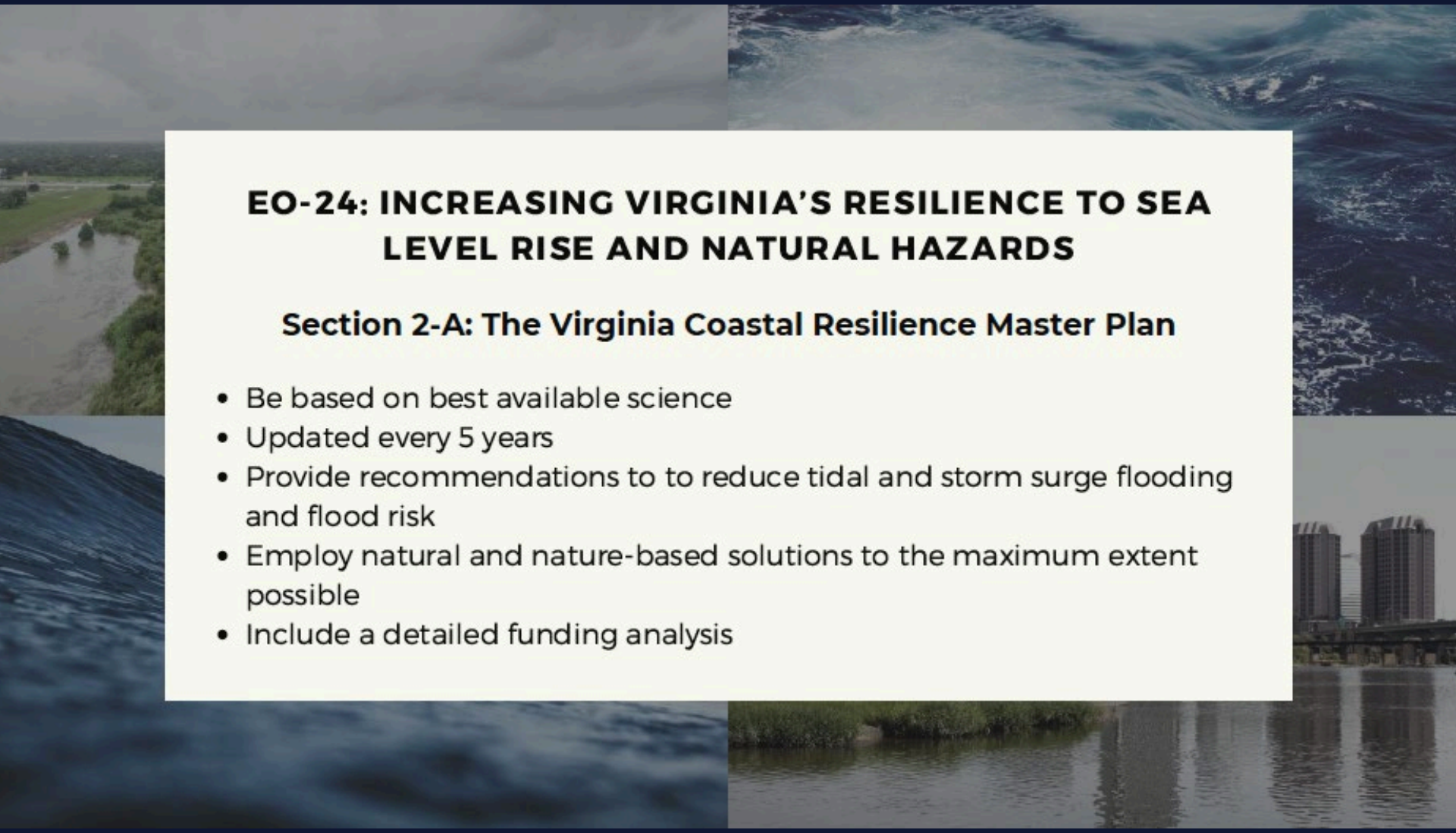
TOTAL SCORES

Category	Score Received	Total Possible Score
1) POLICY, LEADERSHIP, AND COLLABORATION	15	20
2) RISK ASSESSMENT, AND EMERGENCY MANAGEMENT	13	20
3) INFRASTRUCTURE RESILIENCE	10	20
4) PLANNING FOR RESILIENCE	11	20
5) COMMUNITY ENGAGEMENT, HEALTH, AND WELL BEING	12	20
TOTAL SCORES:	**61**	**out of 100 points**

Community Leaders workshop



State Initiatives



EO-24: INCREASING VIRGINIA'S RESILIENCE TO SEA LEVEL RISE AND NATURAL HAZARDS

Section 2-A: The Virginia Coastal Resilience Master Plan

- Be based on best available science
- Updated every 5 years
- Provide recommendations to to reduce tidal and storm surge flooding and flood risk
- Employ natural and nature-based solutions to the maximum extent possible
- Include a detailed funding analysis

Thank you
Questions?