GEOGRAPHY

Dr. Anamaria Bukvic
Assistant Professor ▪ Department of Geography

Coastal Flooding and Adaptation: Lessons Learned from Hampton Roads

Unnamed storm brings a foot of rain to parts of North Carolina, heads north

The disturbance caused flash flooding, tornado warnings and washed-out roadways as it neared the Carolinas.

https://www.nbcnews.com/news/us-news/unnamed-storm-brings-1-foot-rain-parts-north-carolina-heads-north-rcna171398

"If we stick to former paradigms we are bound to be defeated in every battle. The point is not to prepare plans and tools to avoid surprise, but to be prepared to be surprised."

- Patrick Lagadec, 2008

Photos credit: Wetlands Watch 2019

EPISODIC FLOODING ▪ MAJOR DISASTERS

CHRONIC, NUISANCE, OR RECURRENT FLOODING

https://sealevelrise.org/states/virginia/

DRAINAGE UNDER NORMAL TIDAL CONDITIONS

DRAINAGE WITH HIGH TIDE / SEA LEVEL RISE

Courtesy of Wetlands Watch, Norfolk

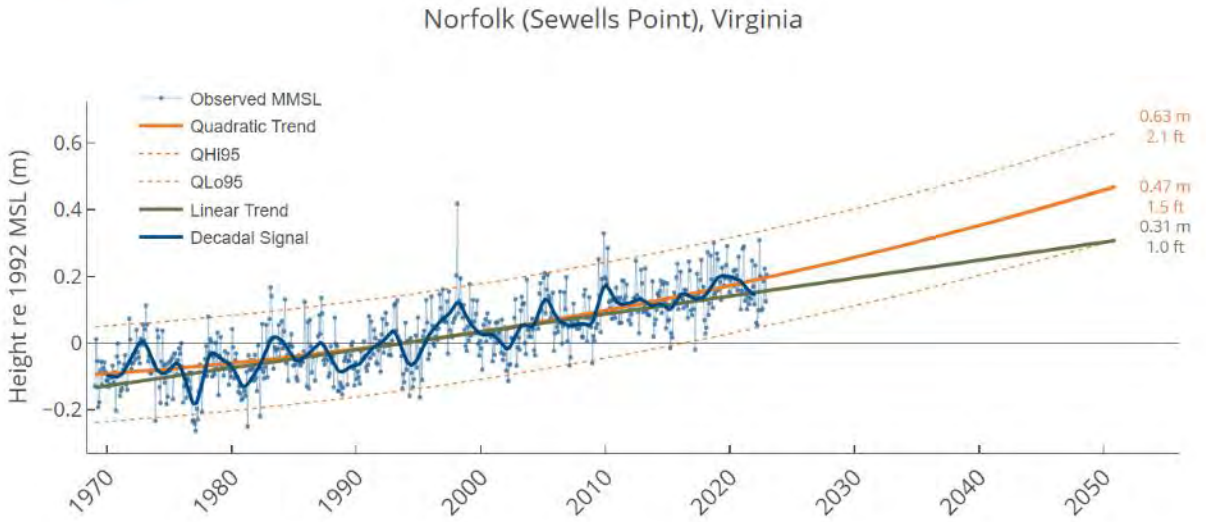
CATEGORY 2 HURRICANE STORM SURGE

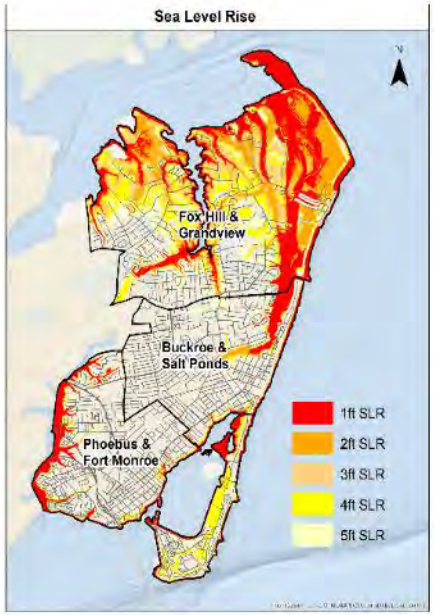
Norfolk, Virginia

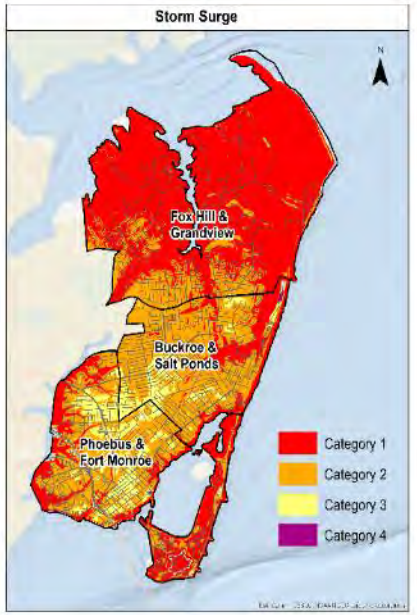
Sea-Level Report Card

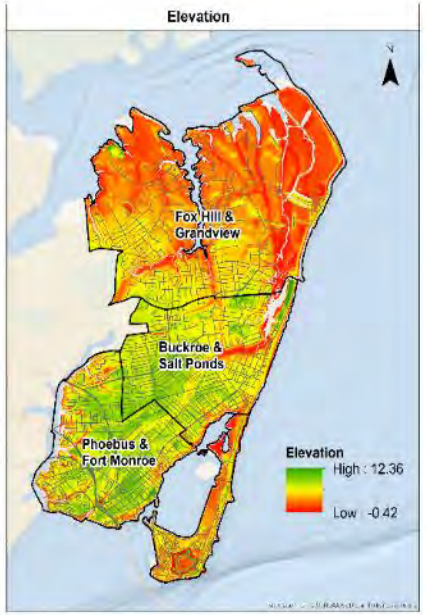
VIMS VIRGINIA INSTITUTE OF MARINE SCIENCE

2050 Projection

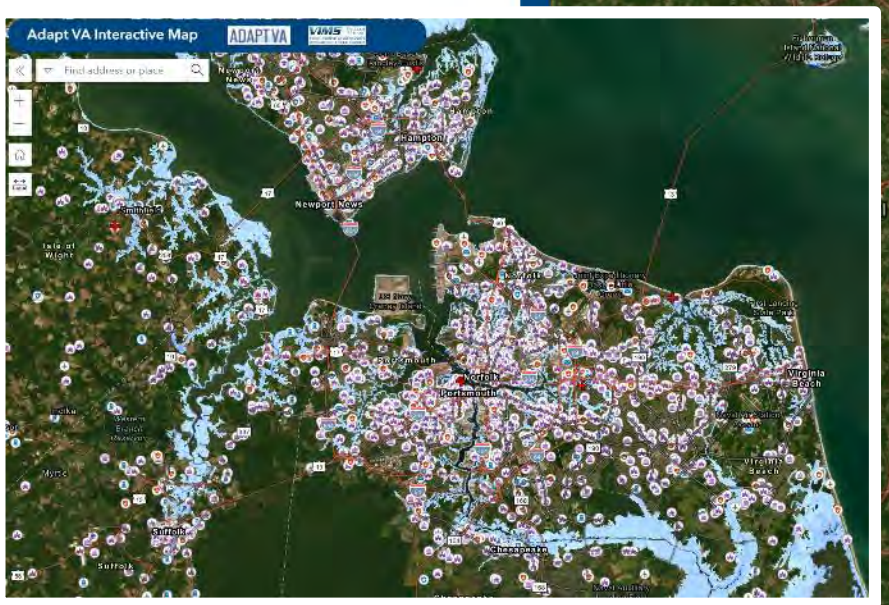








- Protection/Restoration
- Infrastructure
- Shoreline Management
- Natural Resources
- Sea Level Rise/Flooding/Storm Surge
- Vulnerability/Risk



Adapt VA Interactive Map | ADAPT VA | VIMS

Find address or place

Lake Anna

Rappahannock River Valley National Wildlife Refuge

Chincoteague National Wildlife Refuge

Tuckahoe

Richmond

Chesapeake Bay

Colonial National Historical Park

Hampton

Newport News

Portsmouth

Virginia Beach

Suffolk

Great Dismal Swamp National Wildlife Refuge

Int-High SLR scenario 2040

2010 2020 2030 2040 2050 2060 2070 2080 2090 2100

Earthstar Geographics | VGIN, Esri, TomTom, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, USFWS

VIRGINIA COASTAL RESILIENCE WEB EXPLORER Ver 1.0

The collected projects represented here provide an initial sample of the substantial resilience project needs within the Commonwealth. Projects were collected through a survey call issued to localities and PDCs. Future CRMP efforts will seek to extend the coverage of this database while moving to a more comprehensive capture of needs across the Commonwealth.

Select Area of Interest:

Commonwealth | Virginia

Filters:

Category: All

Hazard Addressed: All

Project Class: All

Reset All Filters & Map

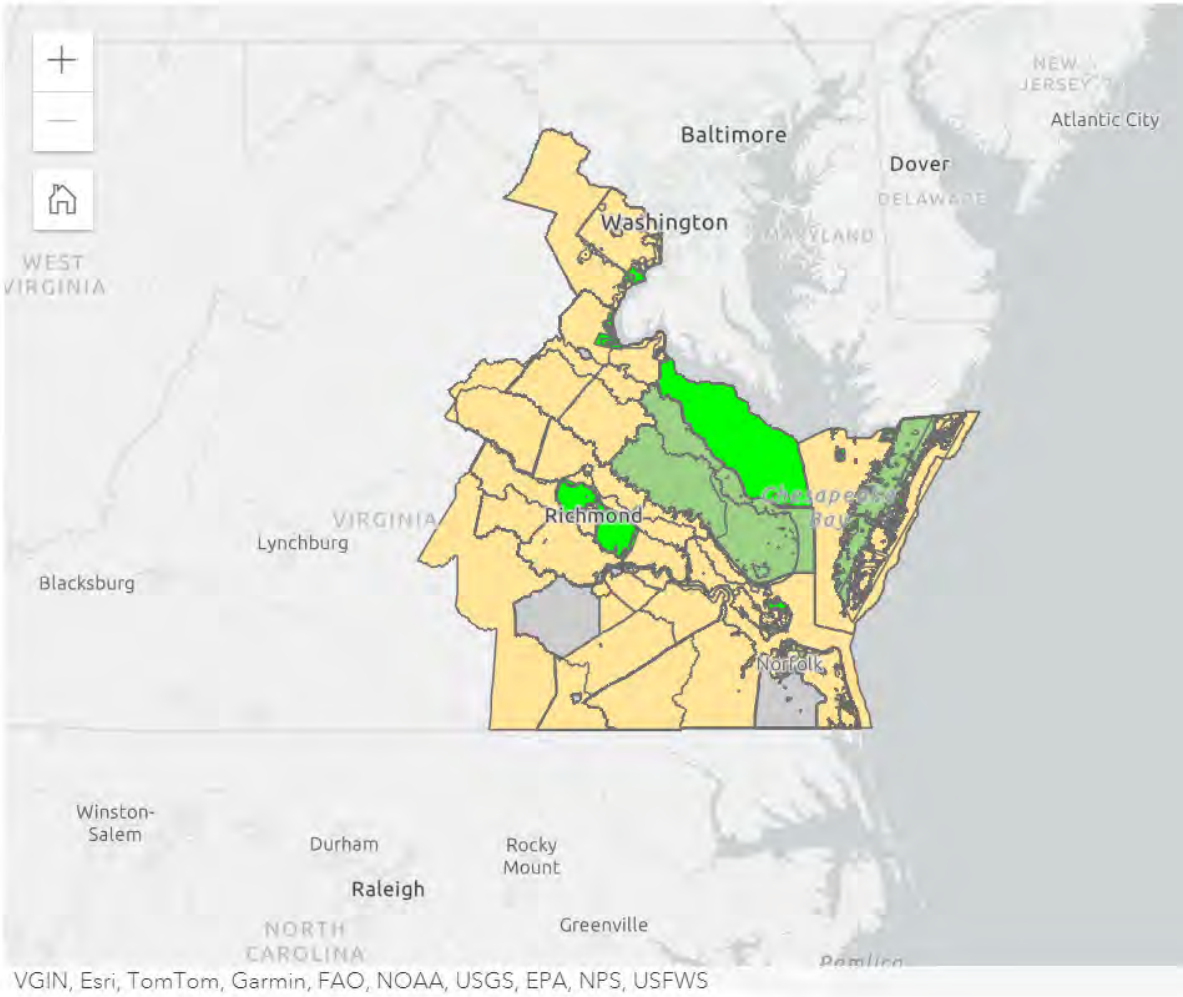
Additional Map Layers: Clear Map Layers

- Coastal Floodplains +
- Community Resource Impact Areas +
- Critical Sector Impact Areas +
- Natural Infrastructure Impact Areas +
- Coastal Hazard and Social Vulnerability +

Search: Clear

Projects and Initiatives (Features: 946, Selected: 0)

Name
100 Governor St (District 6)
10500 Cherokee Rd (District 4)
1200 Blk W Franklin St at Birch St (District 2)
1605 Wentbridge Rd (District 2)
18th Street Drainage Improvements
1. Crow's Nest Peninsula and Estuary Conservation
200 Blk Poplar Ln (District 1)
2019 FMA
2300 Blk Carrington St (District 7)
2854 Bicknell Rd (District 4)
3000 Blk Monument Ave @ N Belmont Ave | District 2
300 Blk N 11th St @ Marshall St (District 6)
300 Blk S 4th St at E Byrd St (District 6)



VIRGINIA COASTAL RESILIENCE MASTER PLANNING FRAMEWORK

Principles and Strategies for Coastal Flood Protection and Adaptation

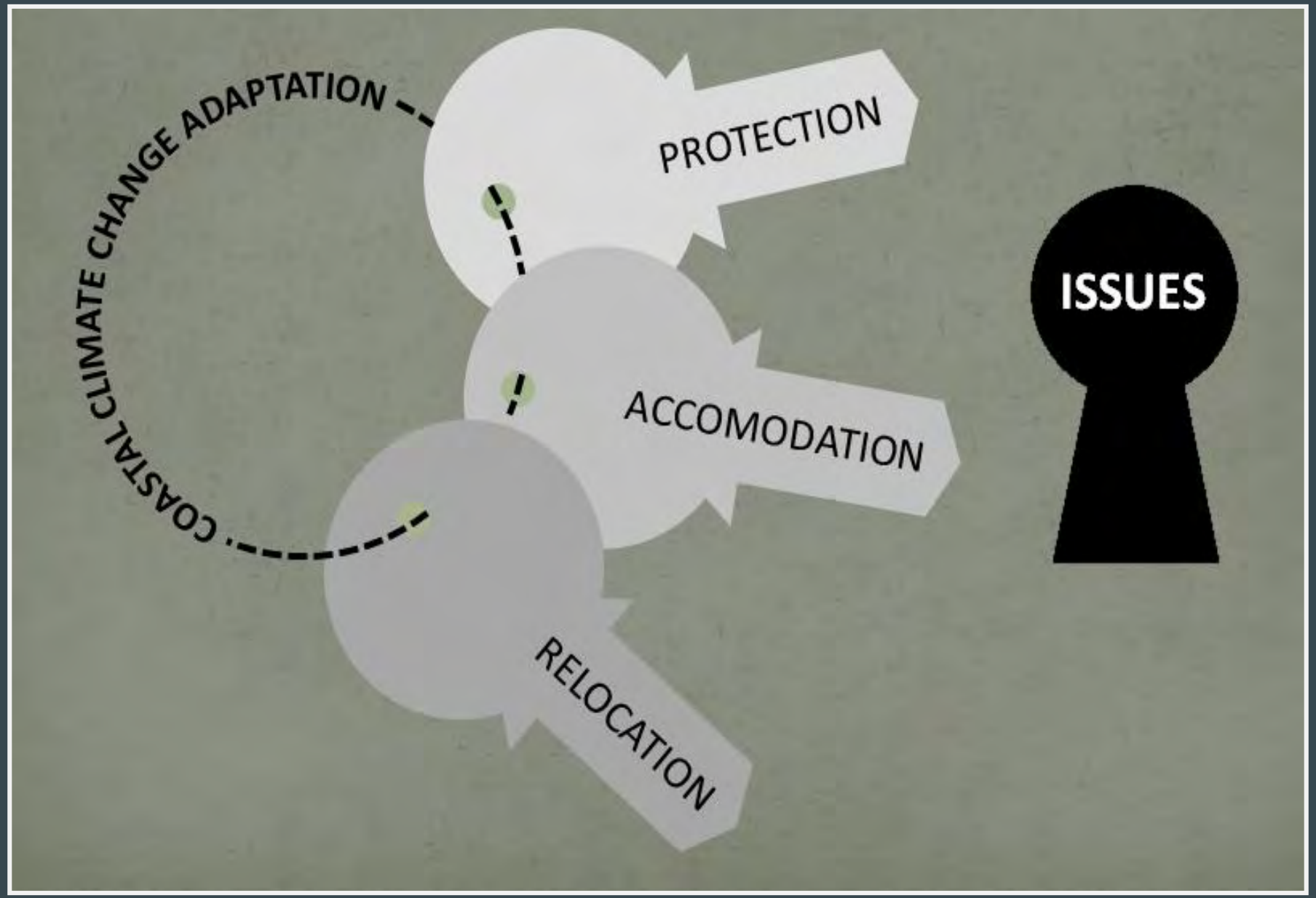
OFFICE OF GOVERNOR RALPH S. NORTHAM
COMMONWEALTH OF VIRGINIA
OCTOBER 2020

VIRGINIA COASTAL RESILIENCE MASTER PLAN

PHASE 1
DECEMBER 2021

Office of Governor Ralph S. Northam
Commonwealth of Virginia

DCR


COASTAL CLIMATE CHANGE ADAPTATION
PROTECTION
ACCOMODATION
RELOCATION
ISSUES

WHAT WE KNOW SO FAR

- Many projects are being implemented but not in a cohesive manner
- Unequal distribution of risks and investments in solutions

  "*We have ….. Of all places, we should be saved first*"
- Lack of resources and financial mechanisms to address emerging issues
- Policy cycle – implementation and monitoring are lagging behind
- Simplification of adaptation strategies due to convenience, pressure to do something with limited information, and lack of integrated approach
- Lack of political will and actors willing to advocate for adaptive measures

PROTECTION

NOT EVERYTHING CAN BE PROTECTED

"Unfortunately, 80% of high- or very high-risk levees were found to have one or more levee performance concerns that would likely result in a breach prior to overtopping."

Seawall Failure Across Different Coastal Environments

Seawall Failure Series

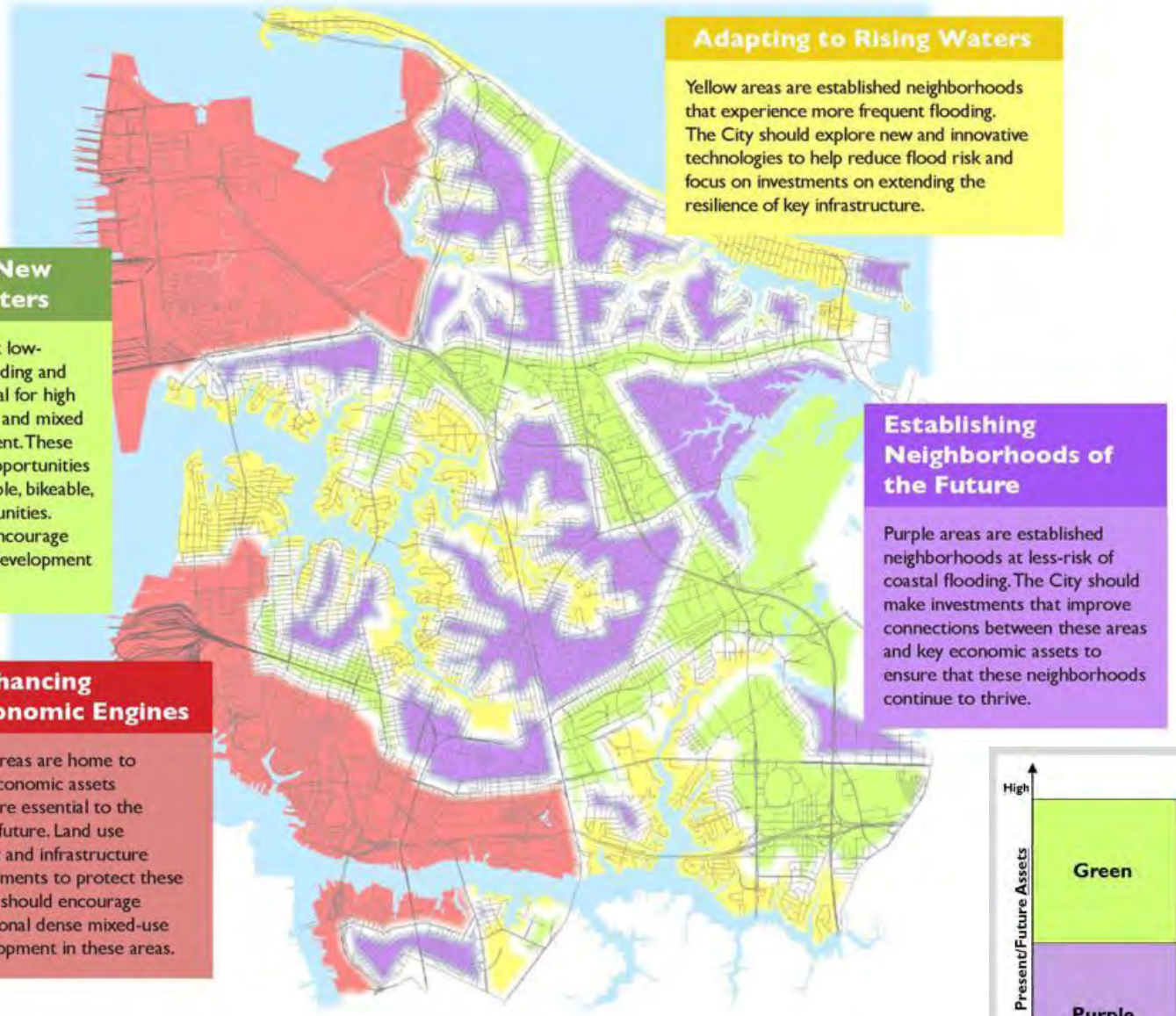
https://infrastructurereportcard.org/cat-item/levees-infrastr
https://thebulletin.org/2022/05/why-cities-should-ditch-seawalls-and-let-the-water-in/

DOI: 10.1061/(ASCE)HY.1943-7900.0000498

ACCOMODATION - LIVING WITH WATER

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.



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.

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.

Establishing Neighborhoods of the Future

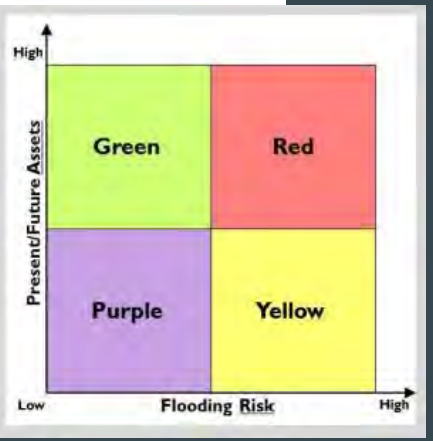
Purple areas are established neighborhoods at less-risk of coastal flooding. The City should make investments that improve connections between these areas and key economic assets to ensure that these neighborhoods continue to thrive.

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



Norfolk 100RC Initiative, 2015: Norfolk: Resilience City. 100 Resilient Cities/The Rockefeller Foundation, Norfolk, VA. http://100resilientcities.org/strategies/ city/norfolk

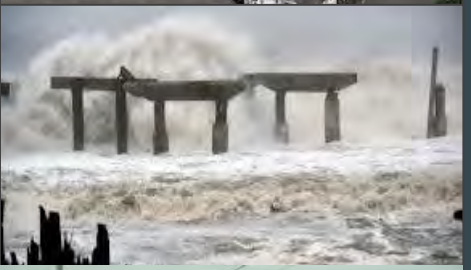
RELOCATION


PIZZA
CHEESE STEAK
Zeppoles
SAUSAGE
FUNNEL CAKE
SUBS
WRAPS
732·830·3330
3 BROTHERS
from Italy

"Up to 50% of the areas with high social vulnerability face the prospect of *unplanned displacement* under 1-4 foot range of projected sea level rise for several key reasons:

- they cannot afford expensive protection measures,
- public expense is not financially justified, or
- there is little social and political support for a more orderly retreat process."

Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2.



WHAT WE KNOW SO FAR

- Relocation is not a new concept and has been extensively used in the past
- We learned a lot from past experiences
- Controversy stems from the social costs and lack of transparency
- Spontaneous relocation is already happening in many coastal areas
- Change is difficult but possible – it is all about proactive planning
- It is all about the rhetoric! Different terms have different meanings

Risk perceptions

Place attachment

Financial resources

Values and coping capacity

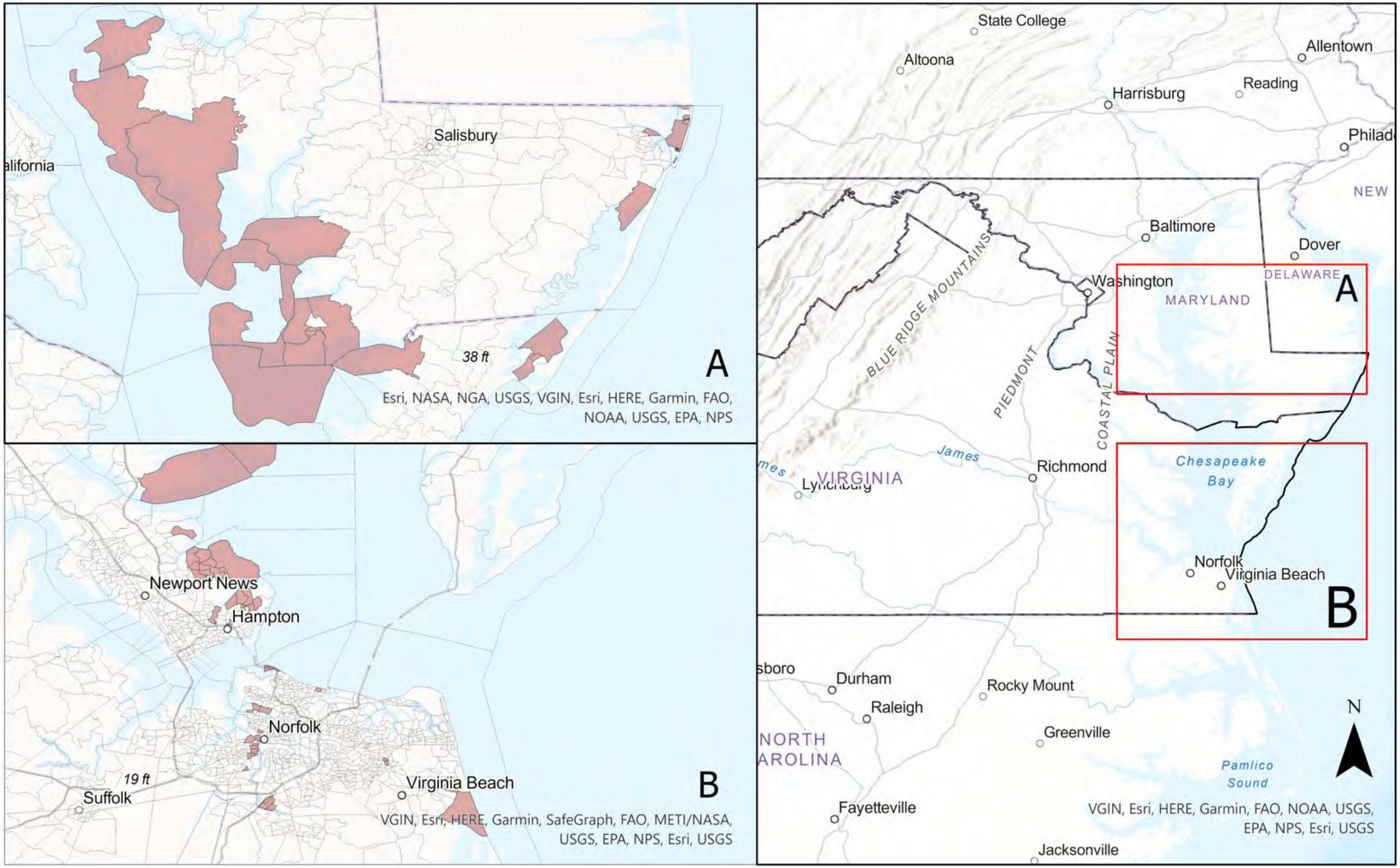
YES

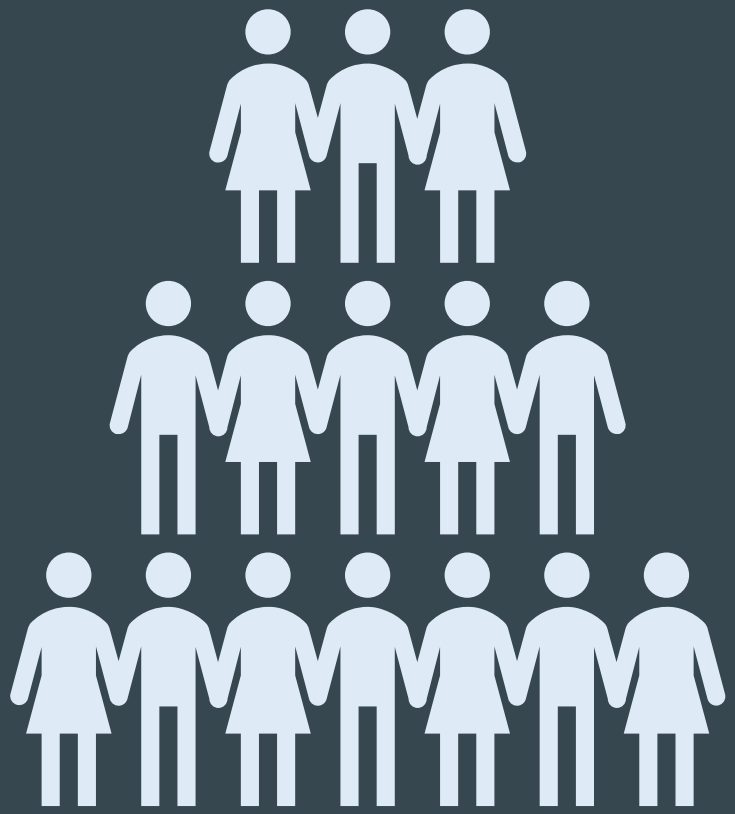
Experience with flooding

Impacts on livelihood

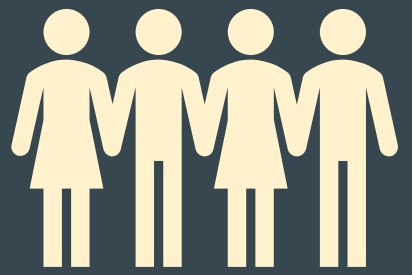
Aspirations and future plans

Confidence in government

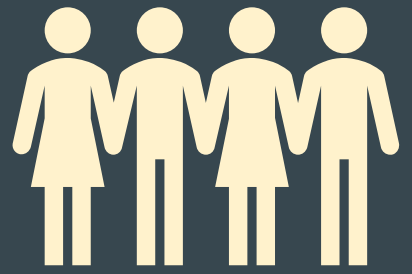

Salisbury
38 ft
A
Esri, NASA, NGA, USGS, VGIN, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS
Newport News
Hampton
Norfolk
19 ft
Suffolk
Virginia Beach
B
VGIN, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, Esri, USGS
State College
Altoona
Harrisburg
Reading
Allentown
Philad
NEW
Baltimore
Dover
Washington
DELAWARE
MARYLAND
A
BLUE RIDGE MOUNTAINS
PIEDMONT
COASTAL PLAIN
James
Richmond
VIRGINIA
Chesapeake Bay
Norfolk
Virginia Beach
B
Durham
Rocky Mount
Raleigh
Greenville
Pamlico Sound
Fayetteville
Jacksonville
N
VGIN, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS, Esri, USGS



NO = 54%

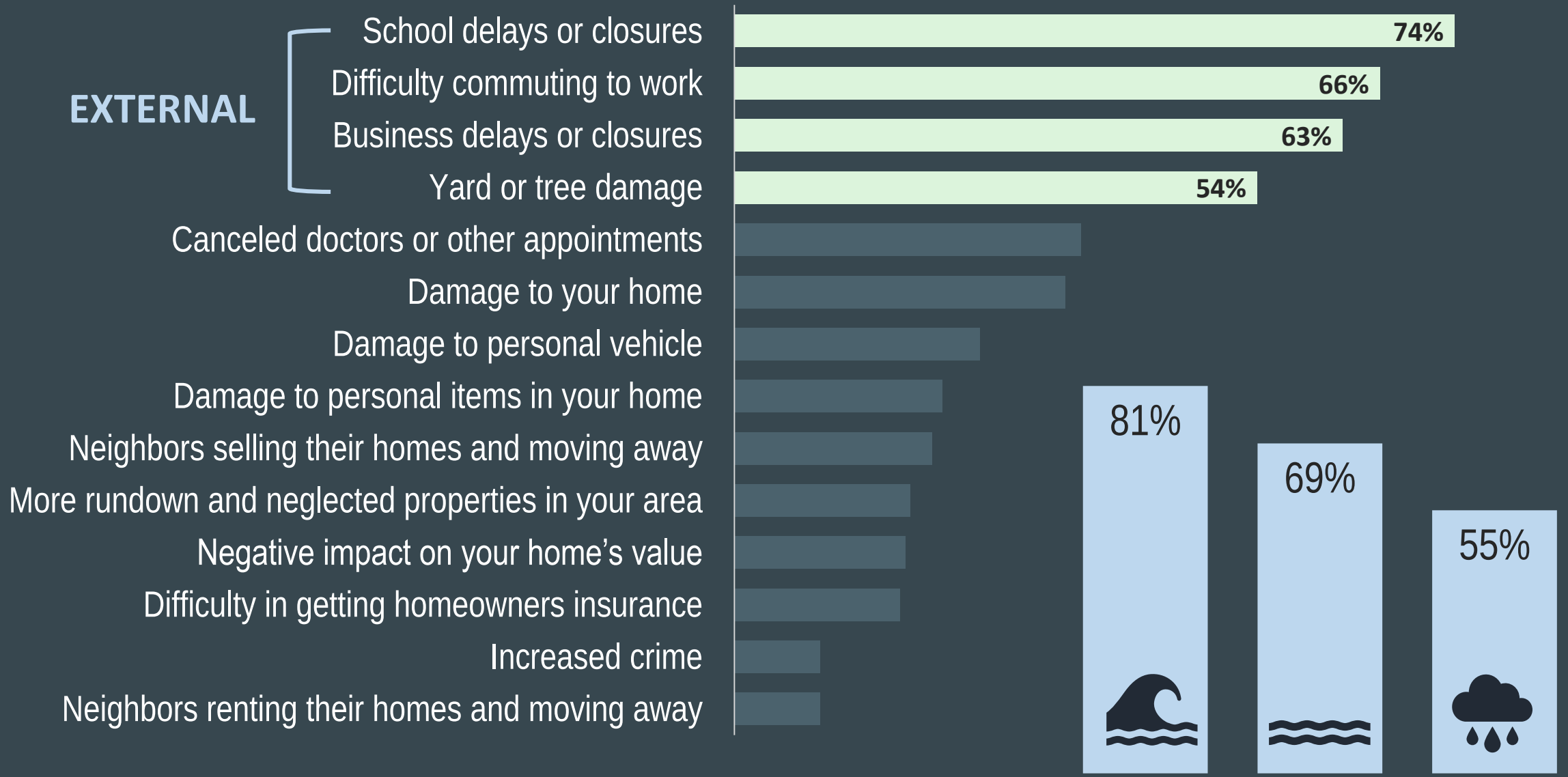


YES = 22%



MAYBE IN THE FUTURE = 24%

N = 182



Tool shed flooded | Power outages | Boating issues | Unpleasant outdoor odor | Pumping sewage | Reparking vehicles

PUSH FACTORS

MOST IMPORTANT

- Disastrous hurricane flooding
- Higher taxes
- Higher costs of living
- Declining property values
- Higher insurance rates
- Damage to your home

LEAST IMPORTANT

- Localized rainfall flooding
- Frequent workplace closures
- Neighbors, friends, and family moving away
- Minor flooding of any type
- Increase in abandoned lots

PULL FACTORS

MOST IMPORTANT

- Low crime rates/public safety
- To be closer to family/friends
- To be closer to better healthcare facilities/services
- To have shorter commute and less traffic congestion

LEAST IMPORTANT

- To be among people with same ethnic, racial, religious or political determination
- To be away form any waterways
- To be closer to better schools

What predicts willingness to relocate due to coastal flooding?

PUSH FACTORS***

- Repetitive tidal flooding
- Significant flooding from combination of sources
- Vehicle damage
- Difficulty accessing amenities and services
- Increased anxiety and stress
- Frequent closures of businesses, schools, and workplace
- Neighbors, friends, and family moving away
- Increase in abandoned properties

Multinomial logistic regression
Yes vs No

What predicts willingness to relocate due to coastal flooding?

PULL FACTORS***

- To be outside floodplain, on elevated location, away from waterways
- To be in an area with physical flood protections without prior flooding
- To be closer to amenities like libraries, restaurants, and retail
- To have more social events

ENABLING FACTORS***

- Availability of financial compensation for a home or property buyout
- Free legal and technical advice on options for moving

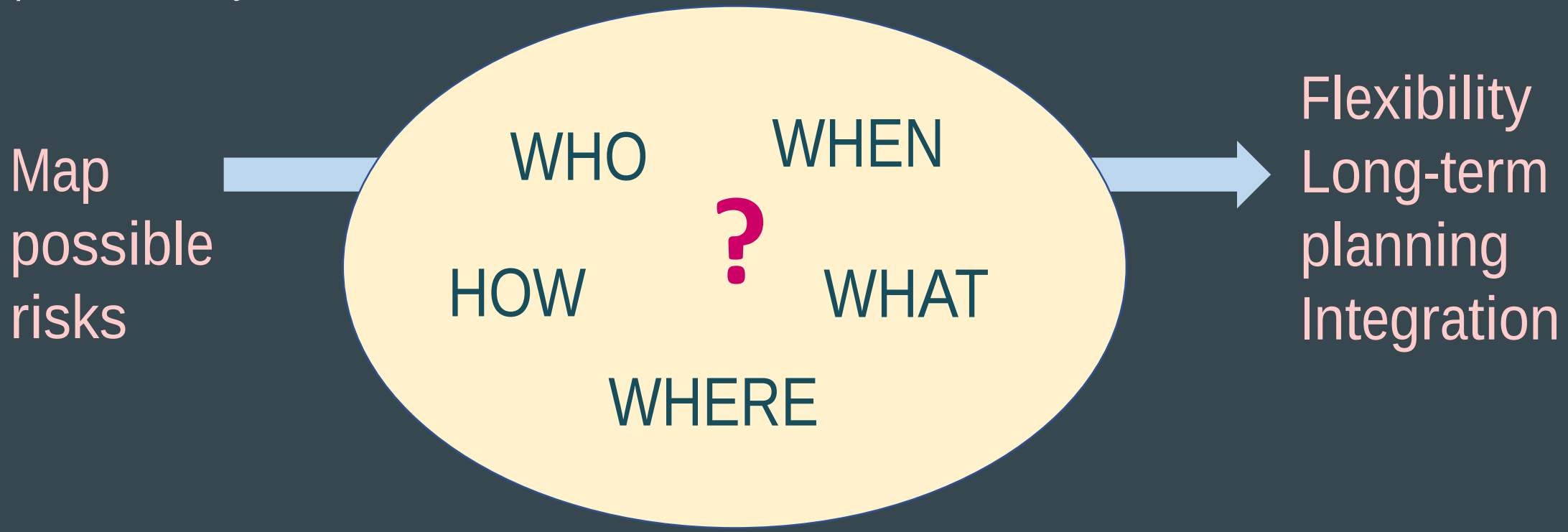
PERSPECTIVES ON FLOOD-DRIVEN RELOCATION

- Financial concerns dominate the push factors and crime rate and proximity to family and friends pull factors
- Moving to a place with effective local leadership is more important than sociopolitical aspects
- Viscous cycle – homeowners putting homes back on the market
- "*The transition from living there to not living there*" will be a difficult process
- Establishing regional consensus on retreat

Bukvic, A. & Harrald, J. (2018). Rural versus urban perspective on coastal flooding: the insights from the U.S. Mid-Atlantic communities. *Climate Risk Management 23, 7-18.*

RISK OF MALADAPTATION

Maladaptation → negative unintentional consequences of adaptative responses that exacerbate or shift vulnerability or exposure of a system.



Reckien, D., Magnan, A.K., Singh, C. *et al.* Navigating the continuum between adaptation and maladaptation. *Nat. Clim. Chang.* **13**, 907–918 (2023).

CONCLUSIONS

"When it is urgent, it is already too late."

- Talleyrand

- The major shifts in attitudes and actions, and the ability to "think the unthinkable"
- More rigorous assessment on what works and what does not
- All hands of deck approach– individual and collective actions need to be synchronized for cumulative benefits

Courtesy of John Reddick, the City of Norfolk

THANK YOU

This material is based upon work supported by the National Science Foundation under Grant No. 1920478. The authors thank the Social Science Research Center at Mississippi State University for collecting data for this study.