

Living with Rising Waters in Annapolis



ANNAPOLIS
Maryland



Historical Sites and Buildings

Maritime Industry

America's Sailing Capital

Boat Shows

State Capital

St. John's College

United States Naval Academy

Tourism

Lodging

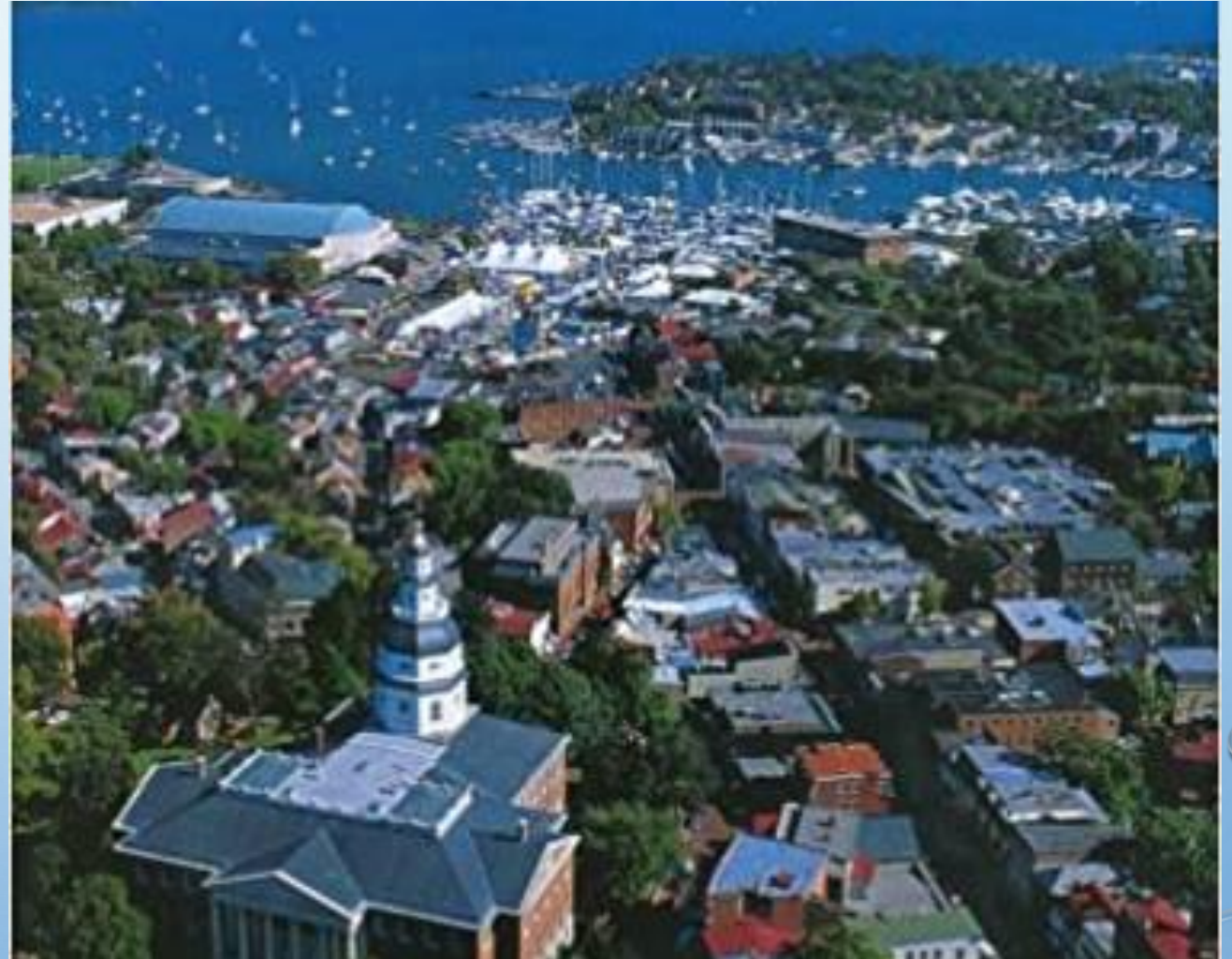
Restaurants

Retail

Home Values

Employment

DOWNTOWN – THE CITY'S ECONOMIC HEARTBEAT



ANNAPOLIS

ONGOING TIDAL FLOODING



- **MORE FREQUENT**
- **MORE INTENSE**
- **FLOOD DAYS PER YEAR**
 - 1969 – 3.8
 - 2013 – 38.5
 - 2019 – 52
 - 2065 365



Hurricane Isabel
September 2003

Annapolis, Maryland

Hurricane Isabel 2003

- 6.4 feet of storm surge
- 60 of 140 properties flooded

If an Isabel equivalent storm surge occurs in 2050 (without mitigation measures in place)

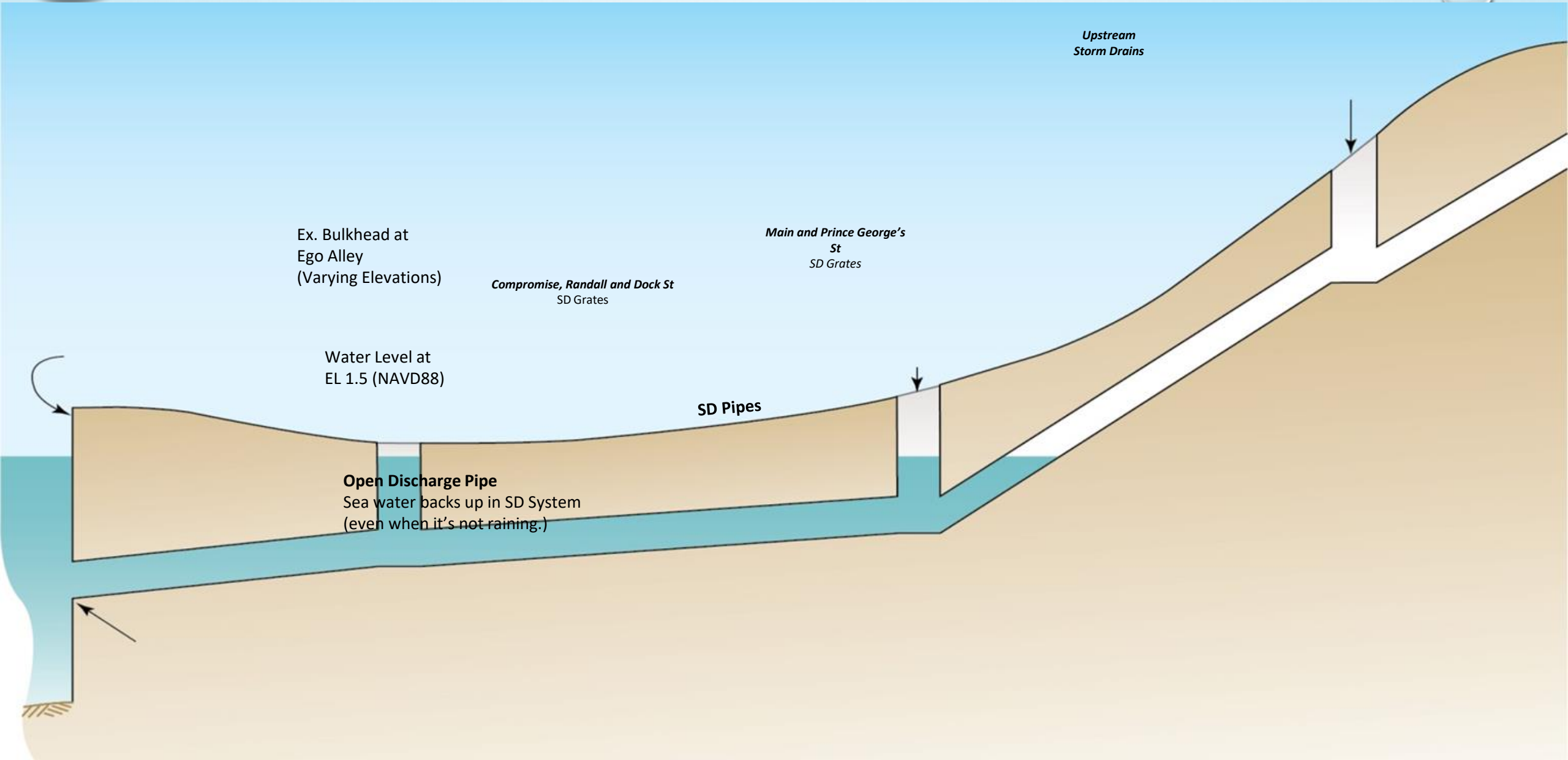
- 95 – 118 (84%) of 140 properties will flood

Hard and Soft Solutions

- ✓ Shore Protection - seawalls, revetments, living shorelines, wetland buffers
- ✓ Flood Protection - permanent (raising sea wall) and deployable (stackable flood walls); scalable solutions that can be increased over time as sea level rises
- ✓ Stormwater Management – pumps, drains, green infrastructure, trees – capture and soak it in!
- ✓ Transportation routes, raising roads and sidewalks
- ✓ Building Codes – resilient, adaptable, elevations, LEED
- ✓ Land Use Planning
- ✓ Environmental Policies – incorporated
- ✓ *Historic preservation concerns and flexibility needed*



EXISTING STORM DRAIN SYSTEM DURING HIGH TIDE



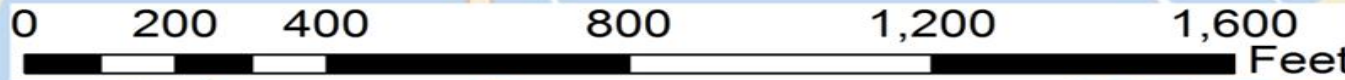


South Pump
Drainage Area
(23 Acres)

North Pump
Drainage Area
(6 Acres)

Annapolis

MARKET SLIP



City Dock-Susan Campbell Park



REIMAGINING CITY DOCK





- K. Dock Street Extended Hardscape Improvements
- L. New Harbormaster Facility
- M. Road/Plaza Connection to Prince George Street
- N. Streetscape Improvements
- O. On Street Parking
- P. Seawall/ Swings/ Seating Features
- Q. Ramp Locations
- R. Shade Tree Plantings - Typical
- S. Water Feature - Splash Pad
- T. Bay Buffer Planting Areas
- U. Stairs (Typical)

- A. Existing Market Building
- B. Existing Burtis House
- C. Existing Alex Haley Memorial
- D. Pump House/Restroom Facility

- E. Dock Street Parking
- F. New Park/Event Lawn
- G. Bus Drop - Off Plaza Area
- H. The Deck Lounge/Gathering Space -

- Focal Shade, Tables, Chairs, Games, Lighting, Landscape
- I. New Raised Promenade (to 6')
- J. On Street Parallel Parking

\$\$\$ FINANCING \$\$\$

- City Capital Improvement Projects – budgeted
- Grants
- Federal and State appropriations
- Anne Arundel County contributions
- Concession payment from operators of new garage
- Resilience Authority of Annapolis & Anne Arundel County
- *But, what about private property?*

Private Property- Creative Approaches and Financing Needed

Example: Eastport

Approximately 2500 residents

Surrounded on three sides by water – Spa Creek and Annapolis Harbor, Back Creek and the Severn River

City owns very little land – small street end parks

Very low-lying land

Residential, retail, maritime businesses, restaurants, lodging, housing authority properties

Let it go? Who pays for protection? Off-shore and On-shore infrastructure?



Community Rating National Flood Insurance Program Federal Emergency Management Agency

- Annapolis achieved a rating of 7 (out of 10) = 15% reduction on flood insurance for property owners
- Savings on average = \$115 (based on average \$771 cost of flood insurance)
- Qualified through voluntary City efforts to prevent property damage
- FEMA identified additional actions to take during a Community Assistance Visit
- Discounts available from 5% to 45% (depending on rating)



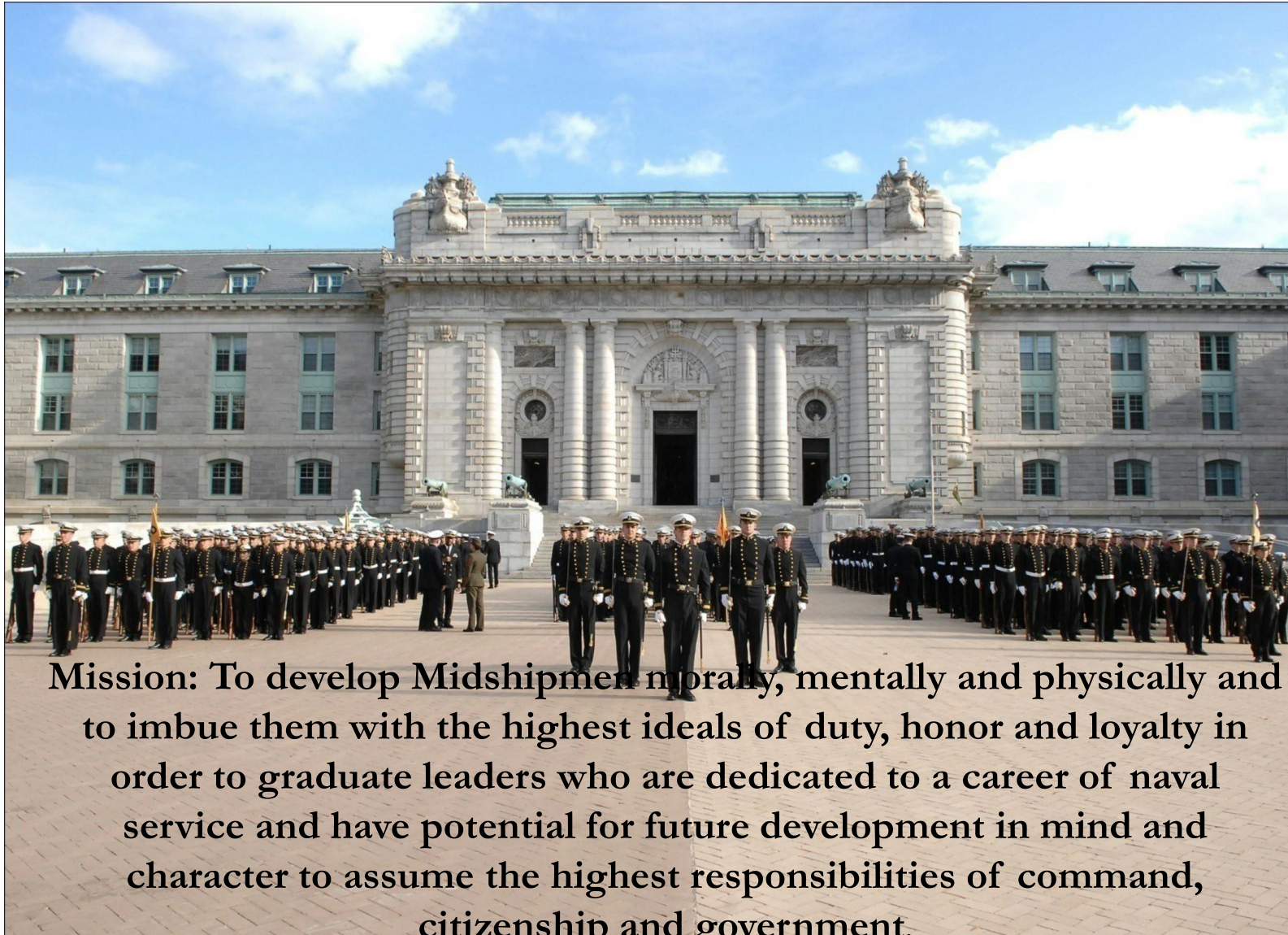
*Living with Rising Water:
Military Installation Resilience & Community Planning*

*Zoë P. Johnson, Community Planning Liaison
NSA Annapolis/U.S. Naval Academy*

September 12, 2023



The United States Naval Academy



Mission: To develop Midshipmen morally, mentally and physically and to imbue them with the highest ideals of duty, honor and loyalty in order to graduate leaders who are dedicated to a career of naval service and have potential for future development in mind and character to assume the highest responsibilities of command, citizenship and government.



History

Present • U.S. Naval Academy • 4,400 midshipmen
• 338 acres of land • 1600+ Faculty and Staff

1845

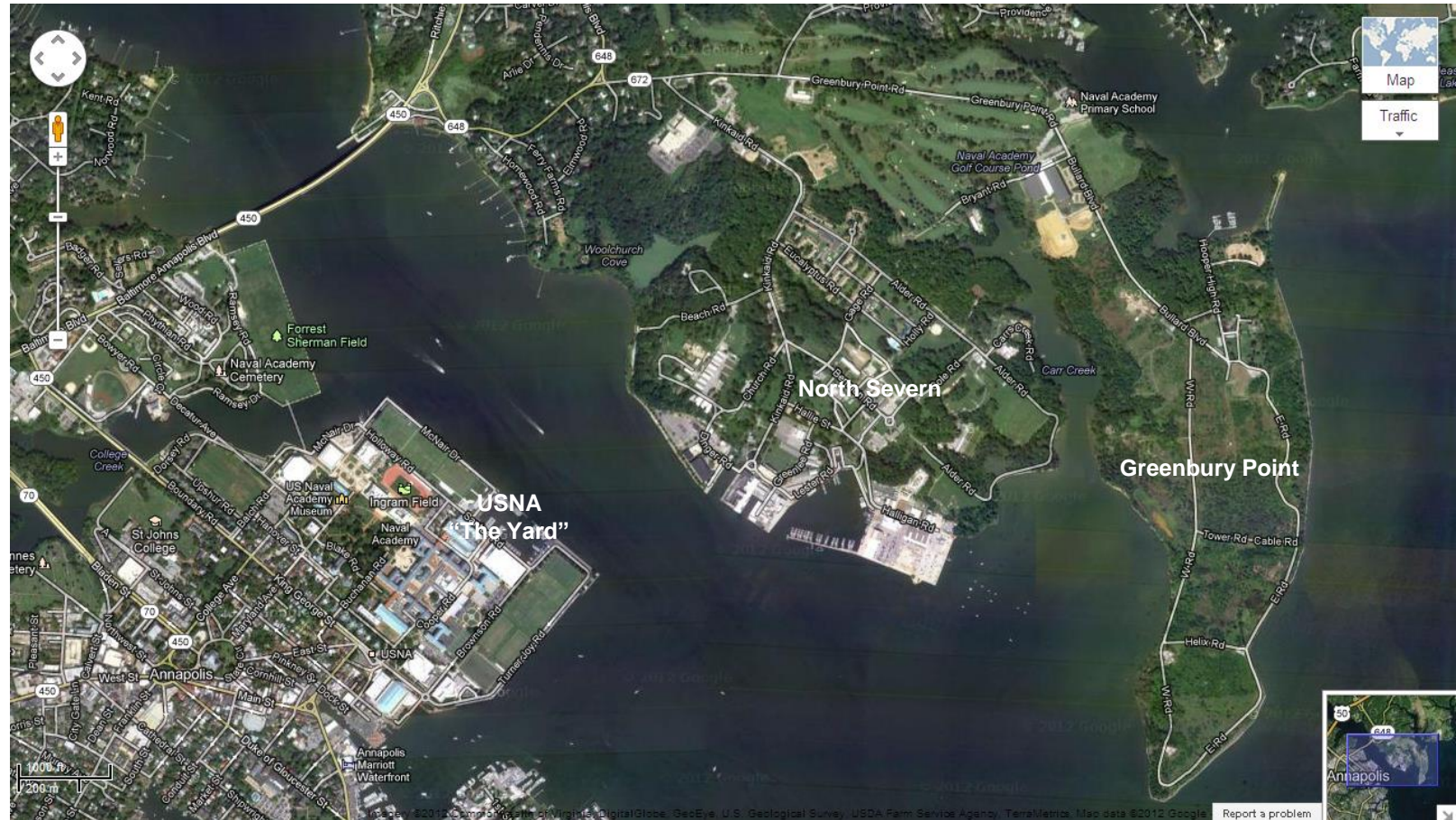
• Fort Severn
• 9 acres of land
• 50 midshipmen
• 7 Professors





Naval Support Activity Annapolis Overview

- NSA Annapolis provides base operating support services to the United States Naval Academy.
- NSA Annapolis is committed to providing effective and efficient shore installation management that supports its tenants and promotes the professional development of the Brigade of Midshipmen.

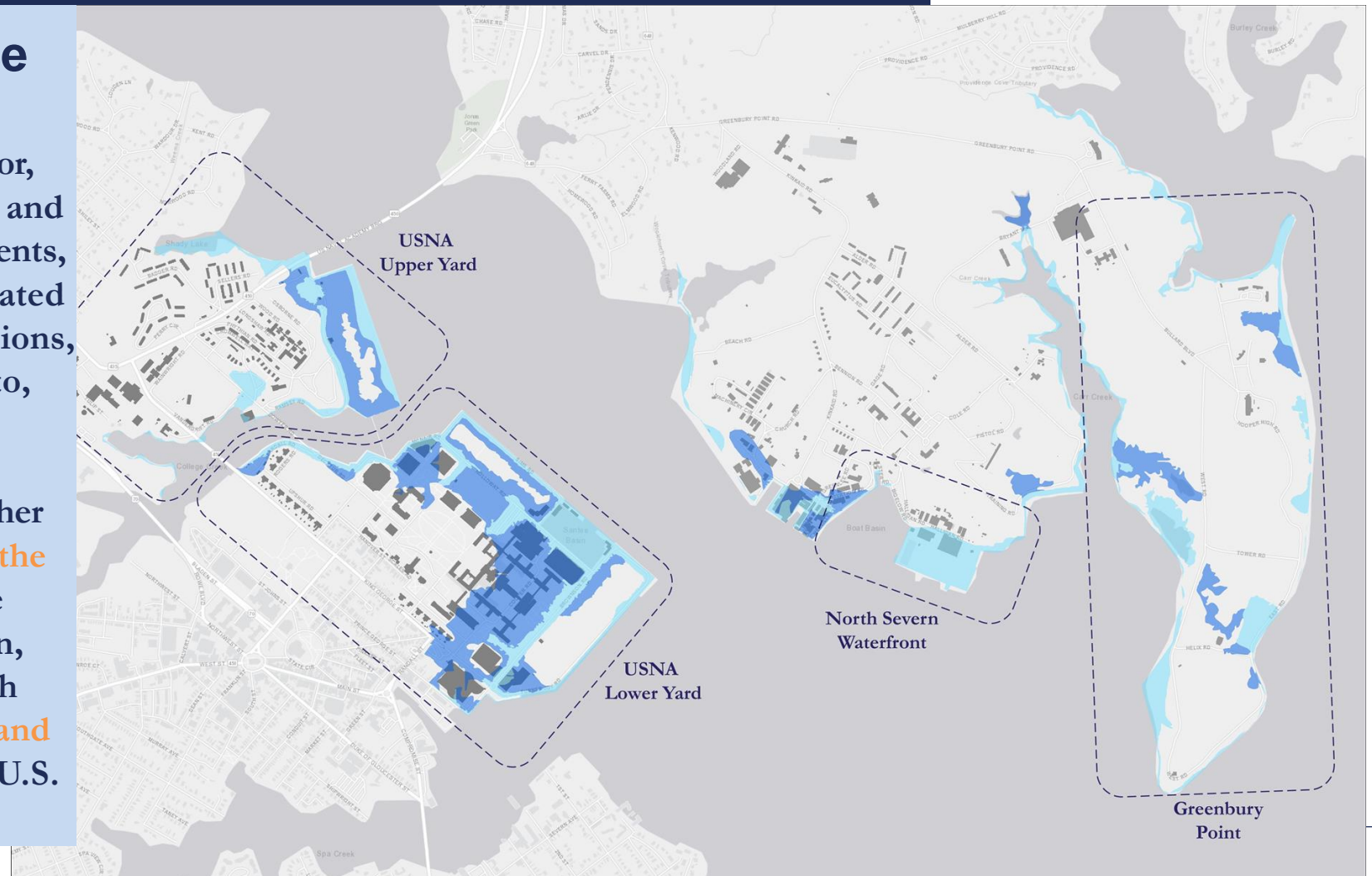


Charge

Develop a comprehensive plan, project portfolio, and year-to-year execution strategy to cohesively address and mitigate the combined effects of flooding caused by land subsidence, sea level rise, storm surge, and changes in groundwater elevations.

Installation Resilience

The capability of a military installation to avoid, prepare for, minimize the effect of, adapt to, and recover from extreme weather events, or from anticipated or unanticipated changes in environmental conditions, that do, or have the potential to, **adversely affect the military installation** or essential transportation, logistical, or other necessary resources **outside of the military installation** that are necessary in order to maintain, improve, or rapidly reestablish **installation mission assurance and mission-essential functions** (10 U.S. Code §101).



Sea Level Rise Trends and Projections

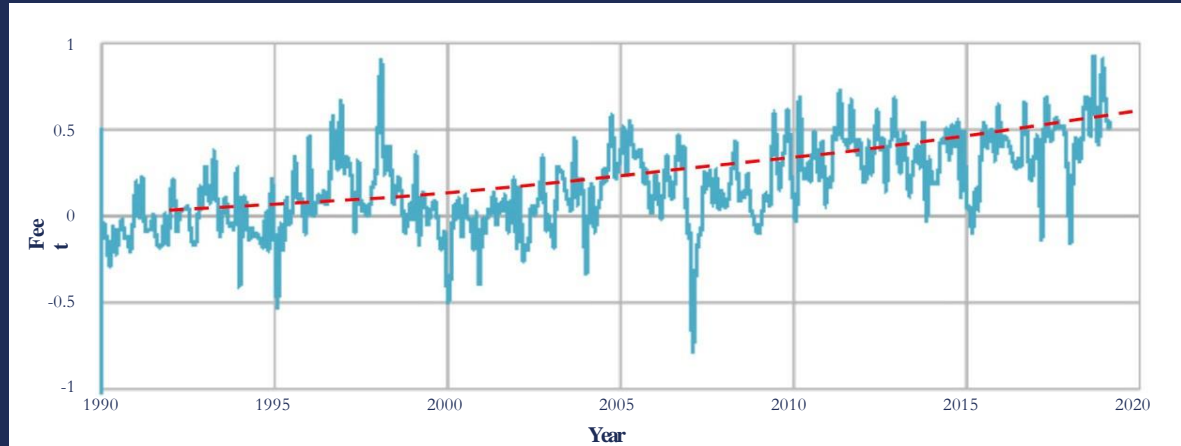
Annual Nuisance/High-Tide Flood Events at USNA



Nuisance or high tide flooding is defined as “flooding that leads to public inconveniences such as road closures (NOAA).” Nuisance flooding is often unrelated to a specific storm but is commonly influenced by sustained wind events, storm systems or astrological phases. Future sea level rise may increase these flood events at USNA: a 6-inch rise will likely result in approximately 90 events/year; and with a 12-inch increase, that number increases to about 340 events/year.

Source: USNA Sea Level Rise Advisory Council

Relative Sea Level Trends (Annapolis, MD)



Monthly mean sea level in Annapolis has risen approximately 0.5 feet in the past 25 years (faster than the long-term linear trend of 1.2 feet per century). This acceleration is consistent with observations of sea level rise at other locations on Chesapeake Bay.

Source: USNA Sea Level Rise Advisory Council

Future Sea Level Rise Induced Flood Levels (feet above NAVD88)

YEAR	MHHW	5-YR	20-YR	50-YR	100-YR
*ARP	N/A	20%	5%	2%	1%
2022	0.7	3.7	4.6	5.6	6.3
2035	2.0	5.0	5.9	6.9	7.6
2050	2.7	5.6	6.6	7.6	8.3
2065	3.3	6.3	7.2	8.2	8.9
2100	5.1	8.1	9.0	10.0	10.7

MHHW =Mean Higher High Water
NAVD88 =North America Vertical Datum of 1988

*Annual Recurrence Probability
Source: DoD Regional Sea Level (DRSL) Database

Integrated Adaptation Framework

Exterior Defense

- Wave Attenuation
- Pier Replacement

Perimeter Protection

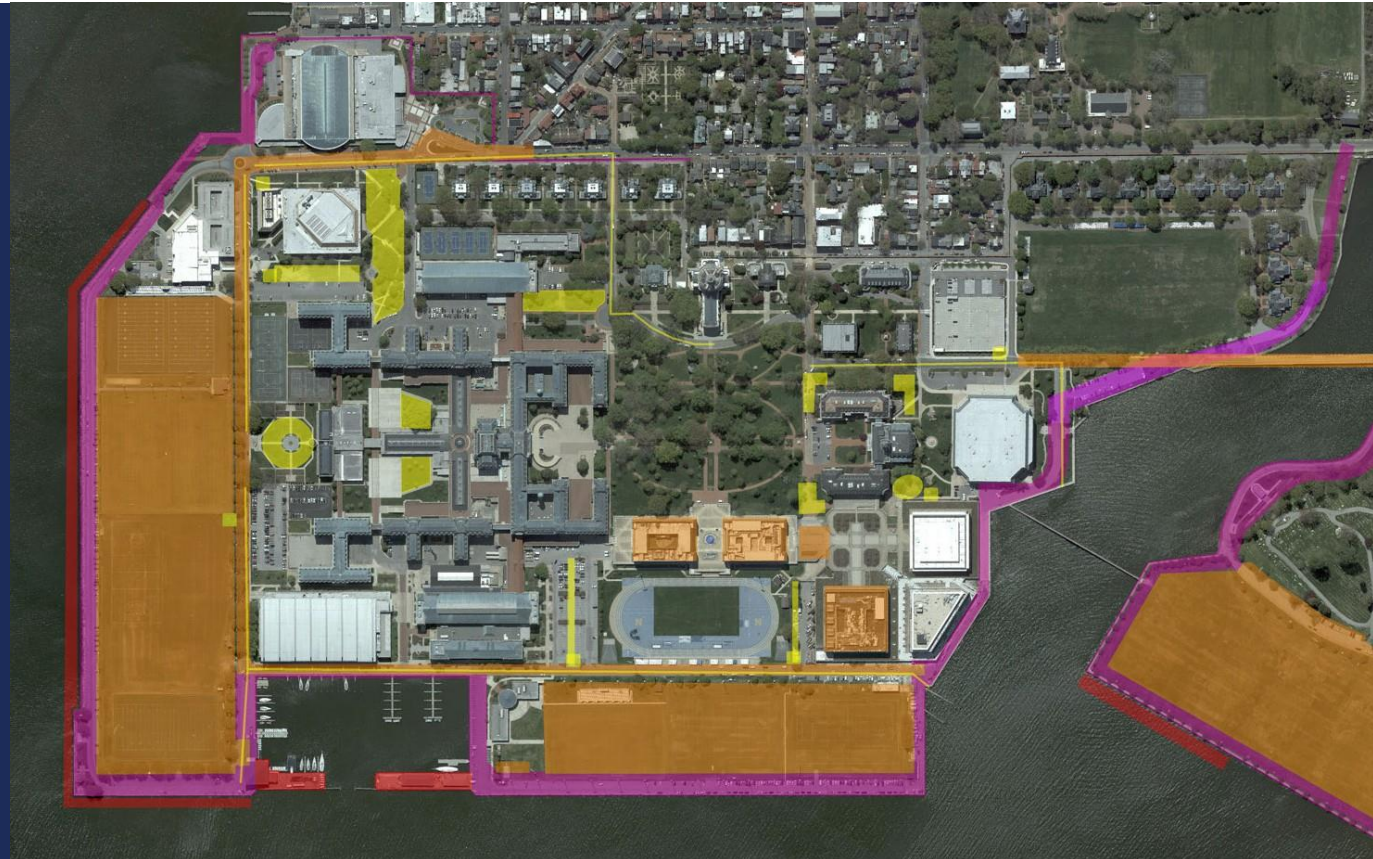
- Raised Bulkheads
- Flood Walls
- Earthen Berms

Interior Adaptations

- Elevated Roadways
- Athletic Field Drainage Improvements
- Building Retrofits

Sub-Surface Improvements

- Stormwater Upgrades



Defense in Depth





Land Conservation

Community Preparedness

Open communication with community, city, county and state leaders will enable coordination of resiliency efforts on all levels of local and regional government.



Community Engagement

Military Installation Resiliency Review

City of Annapolis | Anne Arundel County | NSA Annapolis



Project Approach

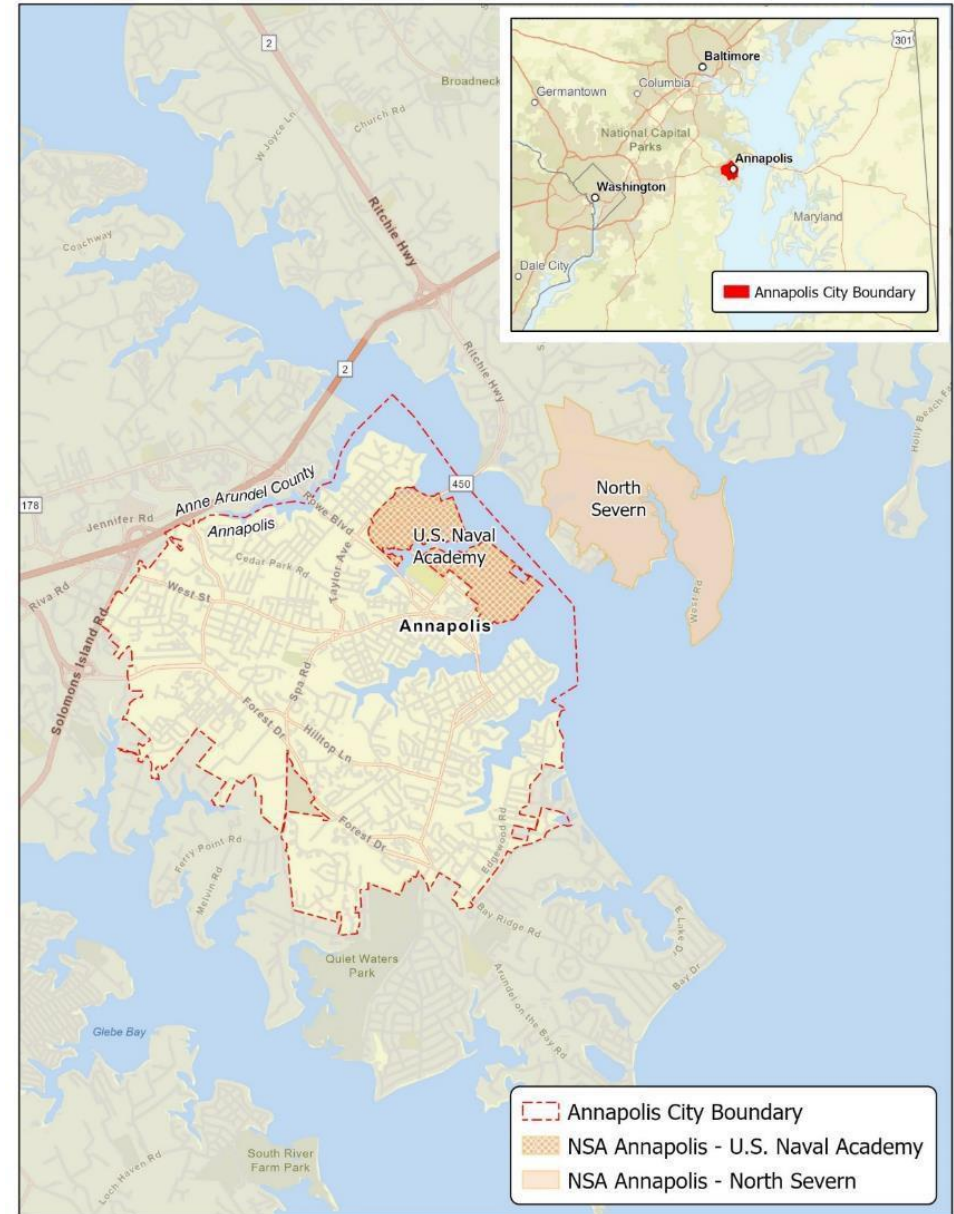
- Resilience is about making our communities and installations stronger, now and in the future, for everyone.
- Develop a resilience planning framework that will enable the region, together with NSA Annapolis, to **assess shared vulnerabilities and risks** with special attention given to **unique resilience requirements for NSA Annapolis**.

Project Goal

- Identify critical assets that are at risk.
- Recommend actions that will increase resilience for NSA Annapolis, City of Annapolis and Anne Arundel County.



View of City Dock Flooding, Photo Provided by Susan Walsh



Community Lifelines



Water: Groundwater, Water/Wastewater Treatment Plants, Distribution



Safety and Security: Public Safety Building



Health and Medical: Hospital, Stormwater Park, Nature-Based Solutions, Health System



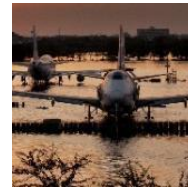
Education: Schools, Colleges, Universities



Energy: Power Grid, Microgrids, Renewables



Communications: Communication Updates



Transportation: Road Elevation, Evacuation Routes

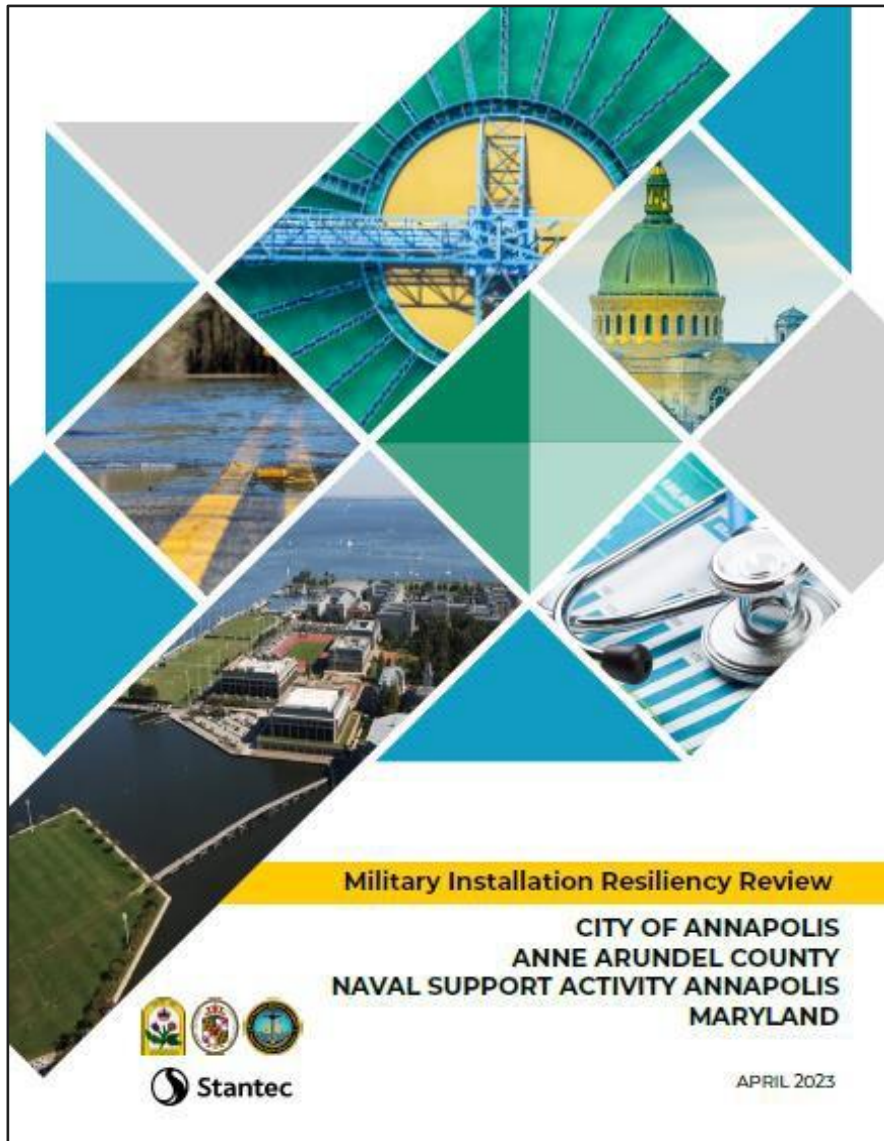


Food, Shelter: Community Housing

Resilience Action Priority Areas

- Coastal Shoreline Boundaries | City Dock
- Installation Access Roads
- Traffic Signal Upgrades
- Energy Supply
- Cybersecurity
- County/City Water Treatment Facilities
- Anne Arundel County Health Department
- Luminis Health Anne Arundel Medical Center





Military Installation Resiliency Review Report

- **Executive Summary**
- **Technical Report**
- **Resilience Action Plan**

Thank you!

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