Maryland Vulnerability Assessments

Maryland Department of Transportation
State Highway Administration

November 6, 2017

MDOT MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

Maryland Overview

Maryland:

- *Atlantic Ocean and Chesapeake Bay*
- *7,719 miles of shoreline*
- *Coastal in the East to Appalachian Mountains in the West*
- *Ranked 42nd in Area (12,407 sq. mi)*
- *Ranked 19th in Population (6,006,401)*
- *Average annual temperature 55.1ºF*
  - *Summer average 80ºF*
  - *Winter average 20ºF*
- *Increases in temperature, precipitation intensity/frequency, and sea level change*

Climate Change/Flood Reduction Groups

Maryland:

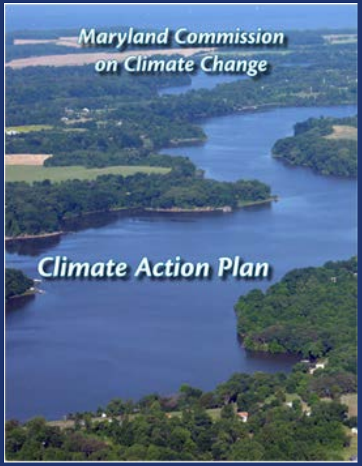
MD Commission on Climate Change Work Groups

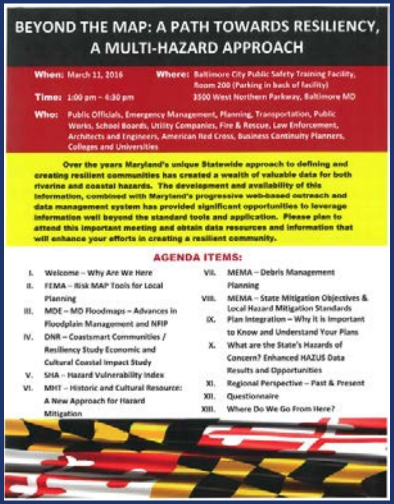
- *Education, Communication, and Outreach*
    - *2015 Report on Education, Communication and Outreach*
- *Greenhouse Gas Mitigation*
    - *2012 Greenhouse Gas Emissions Reduction Plan & 2015 Update*
- *Adaptation and Response*
    - *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change, Phase I: Sea-level rise and coastal storms*
    - *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change, Phase II: building societal, economic, and ecological resilience*
- *Scientific and Technical*
    - *Updating MD's Sea-level Rise Projections Report – 2013*

Silver Jackets – Baltimore - 2010

Coast Smart Council – 2014

Maryland Resiliency Partnership - 2015





BEYOND THE MAP: A PATH TOWARDS RESILIENCY, A MULTI-HAZARD APPROACH

When: March 11, 2016

Time: 1:00 pm – 4:30 pm

Where: Baltimore City Public Safety Training Facility, Room 200 (Parking in back of facility) 3500 West Northern Parkway, Baltimore MD

Who: Public Officials, Emergency Management, Planning, Transportation, Public Works, School Boards, Utility Companies, Fire & Rescue, Law Enforcement, Architects and Engineers, American Red Cross, Business Continuity Planners, Colleges and Universities

Over the years Maryland's unique Statewide approach to defining and creating resilient communities has created a wealth of valuable data for both riverine and coastal hazards. The development and availability of this information, combined with Maryland's progressive web-based outreach and data management system has provided significant opportunities to leverage information well beyond the standard tools and application. Please plan to attend this important meeting and obtain data resources and information that will enhance your efforts in creating a resilient community.

AGENDA ITEMS:

I. Welcome – Why Are We Here
II. FEMA – Risk MAP Tools for Local Planning
III. MDE – MD Floodmaps – Advances in Floodplain Management and NFIP
IV. DNR – Coastsmart Communities / Resiliency Study Economic and Cultural Coastal Impact Study
V. SHA – Hazard Vulnerability Index
VI. MHT – Historic and Cultural Resource: A New Approach for Hazard Mitigation
VII. MEMA – Debris Management Planning
VIII. MEMA – State Mitigation Objectives & Local Hazard Mitigation Standards
IX. Plan Integration – Why It is Important to Know and Understand Your Plans
X. What are the State's Hazards of Concern? Enhanced HAZUS Data Results and Opportunities
XI. Regional Perspective – Past & Present
XII. Questionnaire
XIII. Where Do We Go From Here?

House Bill 514
Maryland Commission on Climate Change

2–1305.

(A) (1) EACH STATE AGENCY SHALL REVIEW ITS PLANNING, REGULATORY, AND FISCAL PROGRAMS TO IDENTIFY AND RECOMMEND ACTIONS TO MORE FULLY INTEGRATE THE CONSIDERATION OF MARYLAND'S GREENHOUSE GAS REDUCTION GOAL AND THE IMPACTS OF CLIMATE CHANGE.

(2) THE REVIEW SHALL INCLUDE THE CONSIDERATION OF:

(I) SEA LEVEL RISE;

(II) STORM SURGES AND FLOODING;

(III) INCREASED PRECIPITATION AND TEMPERATURE; AND

(IV) EXTREME WEATHER EVENTS.

(B) EACH STATE AGENCY SHALL IDENTIFY AND RECOMMEND SPECIFIC POLICY, PLANNING, REGULATORY, AND FISCAL CHANGES TO EXISTING PROGRAMS THAT DO NOT CURRENTLY SUPPORT THE STATE'S GREENHOUSE GAS REDUCTION EFFORTS OR ADDRESS CLIMATE CHANGE.

House Bill 615
Coast Smart Council

(B) (1) THIS SUBSECTION APPLIES TO STATE CAPITAL PROJECTS PLANNED AND BUILT BY UNITS OF STATE GOVERNMENT THAT ARE PARTIALLY OR FULLY FUNDED WITH STATE FUNDS.

(2) BEGINNING JULY 1, 2015, IF A STATE CAPITAL PROJECT INCLUDES THE CONSTRUCTION OF A STRUCTURE OR THE RECONSTRUCTION OF A STRUCTURE WITH SUBSTANTIAL DAMAGE, THE STRUCTURE SHALL BE CONSTRUCTED OR RECONSTRUCTED IN COMPLIANCE WITH SITING AND DESIGN CRITERIA ESTABLISHED UNDER SUBSECTION (C) OF THIS SECTION.

(II) A REQUIREMENT THAT THE LOWEST FLOOR ELEVATION OF EACH STRUCTURE <u>LOCATED WITHIN A SPECIAL FLOOD HAZARD AREA</u> IS BUILT AT AN ELEVATION OF AT LEAST 2 FEET ABOVE THE BASE FLOOD ELEVATION; AND

2014 Climate Resiliency Pilot Study Objectives

- Assess Vulnerability to SHA's Assets
- Develop Approaches to Address Current and Future Risk
- Provide Recommendations for Policy or Process Changes

Floating Debris Lodged in a Bridge during Flood Event at Seneca Creek in Germantown, MD Photo Source: (FEMA/Skolnik 2006)

"Improve Resiliency of Maryland's Transportation System"

Pilot Study Climate Stressors

Sea Level Change	• USACE Procedures Established in Circular No. 1165-2-212 (2013) • Newer LiDAR and Assign Nearest Tidal Station
Storm Surge	HAZUS-MH 2.1 (Category 3 Storm Used) Stillwater Depth Grids Developed
Precipitation	• Micro-scale Data Obtained from C-MIP • Riverine Modeling in HAZUS-MH2.1 (future)

2050 & 2100 Mean Sea Level

Eastern Shore Regional GIS Cooperative – Salisbury University

		2050		2100	
County	Tidal Station	MSL	MHHW	MSL	MHHW
Allegany	None	-	-	-	-
Anne Arundel	Annapolis	2.08	2.79	5.7	6.41
Baltimore	Baltimore	2.01	2.87	5.59	6.45
Baltimore City	Baltimore	2.01	2.87	5.59	6.45
Calvert	Solomons Island	2.1	2.82	5.76	6.48
Caroline	Cambridge	2.11	3.13	5.78	6.8
Carroll	None	-	-	-	-
Cecil	Chesapeake City	1.98	3.63	5.56	7.21
Charles	Washington DC	2.21	3.83	5.78	7.4
Dorchester	Cambridge	2.11	3.13	5.78	6.8
Frederick	None	-	-	-	-
Garrett	None	-	-	-	-
Harford	Baltimore	2.01	2.87	5.59	6.45
Howard	None	-	-	-	-
Kent	Annapolis	2.08	2.79	5.7	6.41
Montgomery	None	-	-	-	-
Prince Georges	Washington DC	2.21	3.83	5.78	7.4
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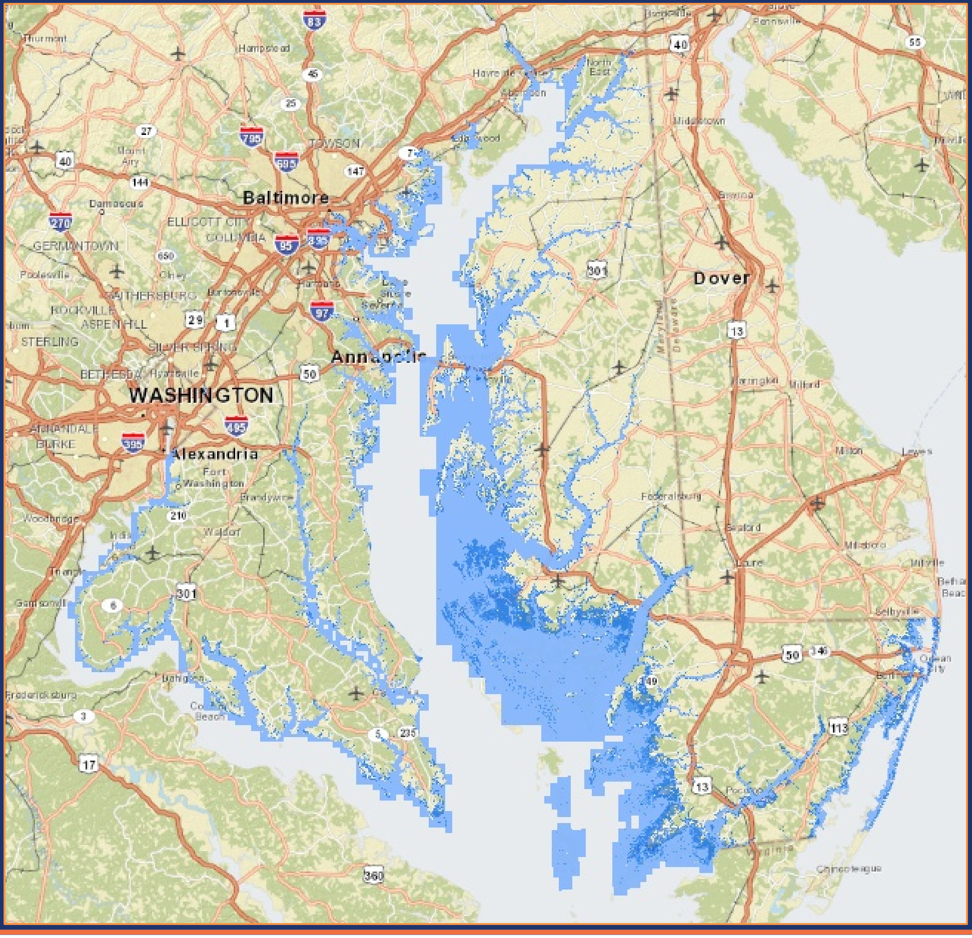
Somerset	Cambridge	2.11	3.13	5.78	6.8
St. Mary's	Solomons Island	2.1	2.82	5.76	6.48
Talbot	Cambridge	2.11	3.13	5.78	6.8
Washington	None	-	-	-	-
Wicomico	Cambridge	2.11	3.13	5.78	6.8
Worcester	Ocean City	2.06	3.25	5.86	7.05

Methodology – USACE: Sea-Level Change Considerations for Civil Works Programs, October 2013



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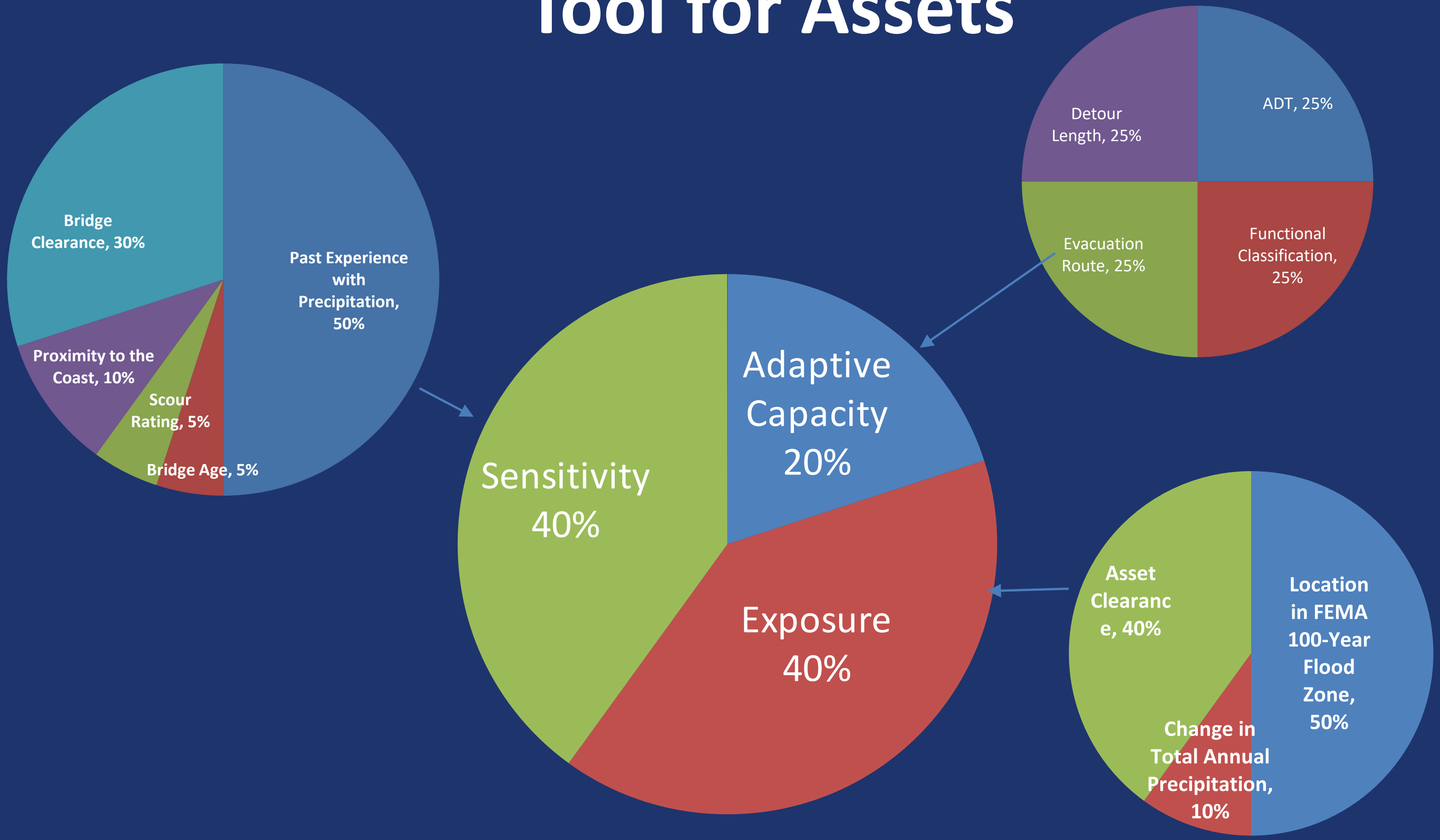
STATE HIGHWAY ADMINISTRATION

FHWA Vulnerability Assessment Scoring Tool for Assets



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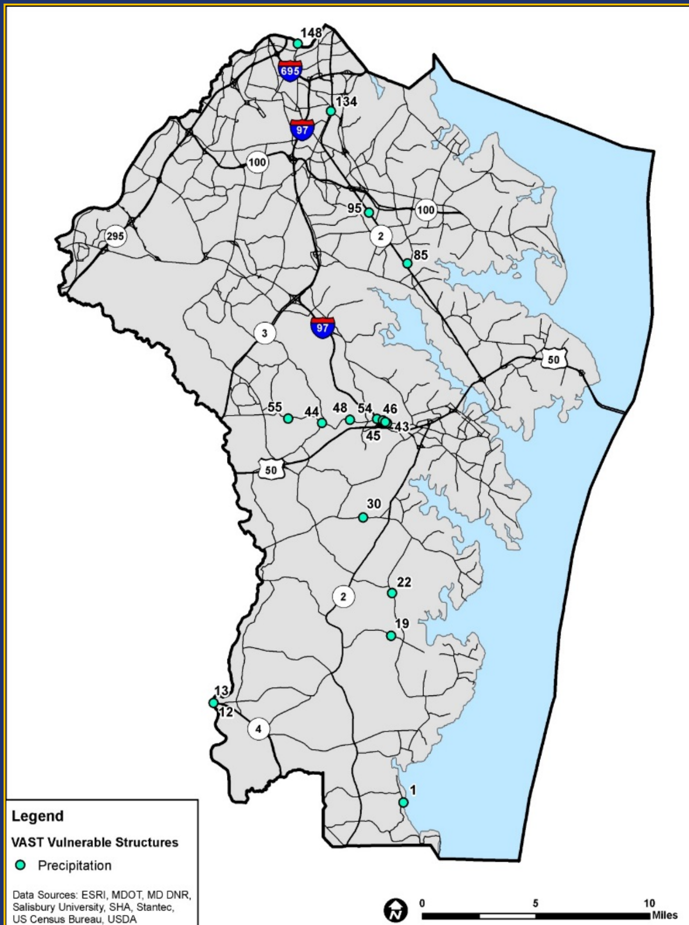
STATE HIGHWAY ADMINISTRATION

FHWA Vulnerability Assessment Scoring Tool Results



Vulnerability to Precipitation		
Structure ID	VAST Score	Evacuation Route
134	3.1	Yes
44	2.8	No
30	2.8	No
43	2.8	No
45	2.8	No
46	2.8	No
1	2.6	No
22	2.6	No
95	2.5	Yes

Hazard Vulnerability Index (HVI)

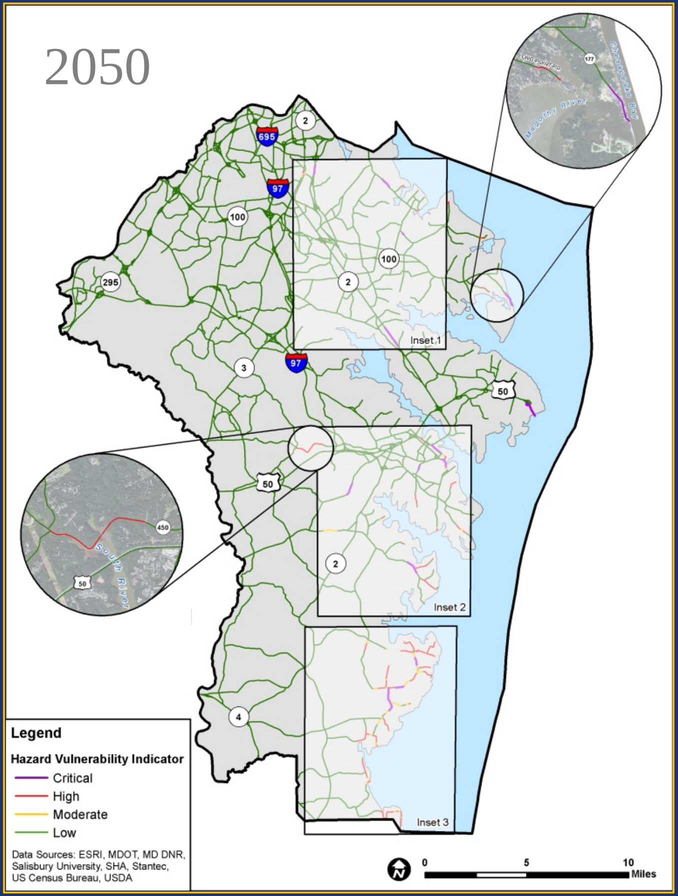
(Evacuation Code*0.5+1) + (Flood Depth Code+0.01)/4 + (0.7/Functional Classification)

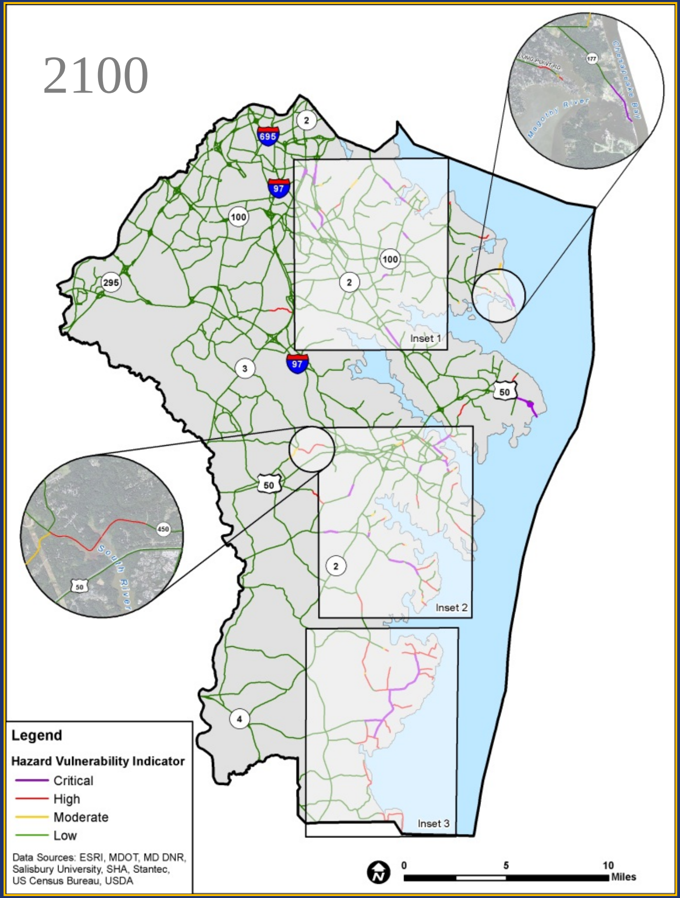
Evacuation	Code
No	0
Yes	1

Flood Depth (Feet)	Code
No Flood	0
0 – 0.5	1
0.5 - 1	2
1 - 2	3
>2	4

Value	SHA Functional Class
1	Interstate
2	Principal Arterial – Other Freeways and Expressways
3	Principal Arterial – Other
4	Minor Arterial
5	Major Collector
6	Minor Collector
7	Local

HVI for Anne Arundel County





MDOT SHA Vulnerability Studies

Completed Coastal Vulnerability Study:

- *Mapping of Sea Level Change for 2050 and 2100*
- *Mapping of modeled storm events (10%, 4%, 2%, 1% and 0.2%) for years 2015, 2050 and 2100*
- *Hazard Vulnerability Index (HVI) for State Roads*
- *Flood Depth for Local Roads*

2050 & 2100 Sea Level Change

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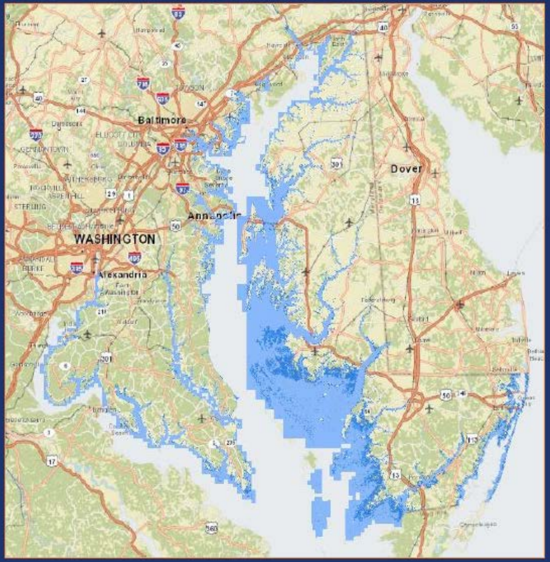

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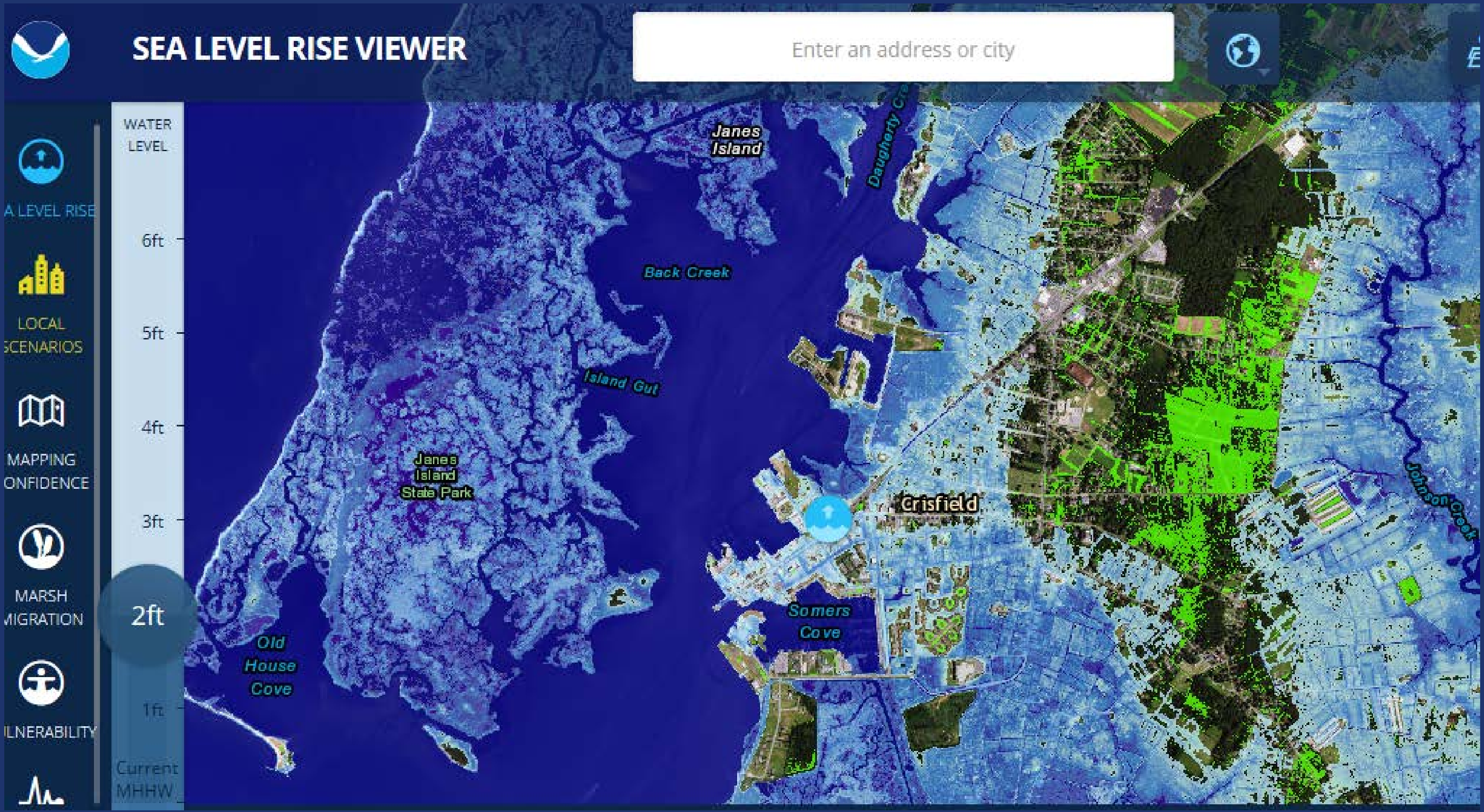
Crisfield 2050
2 ft. of sea level rise



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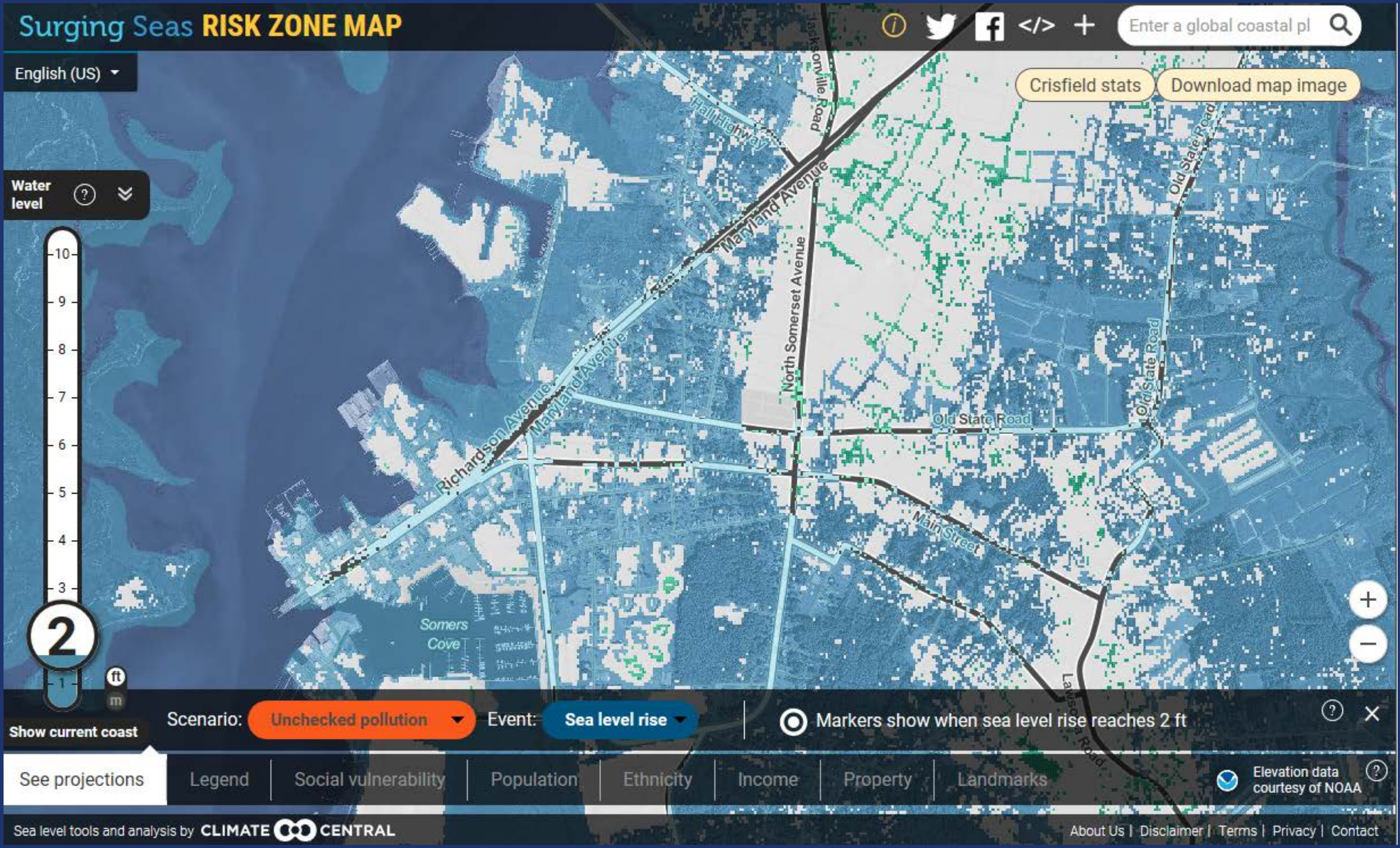
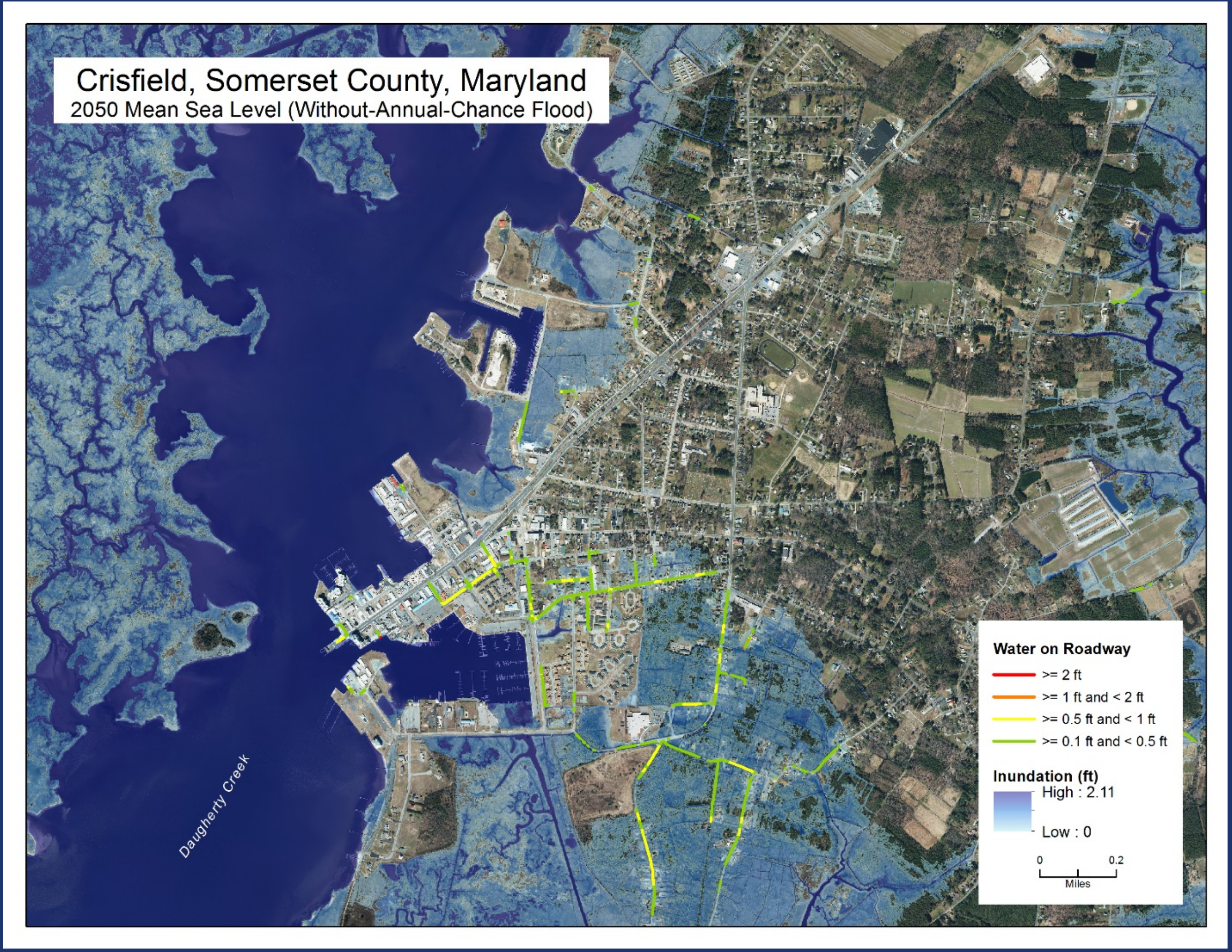
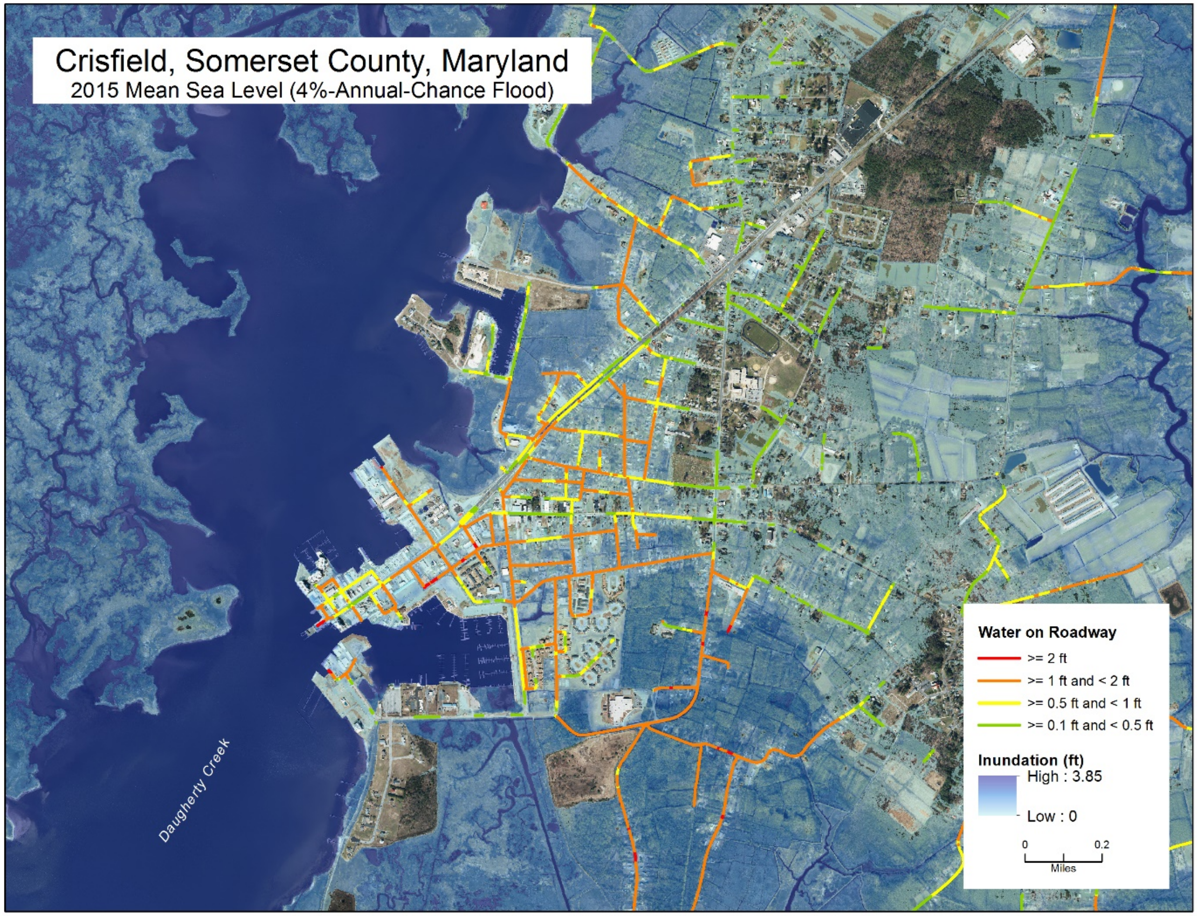


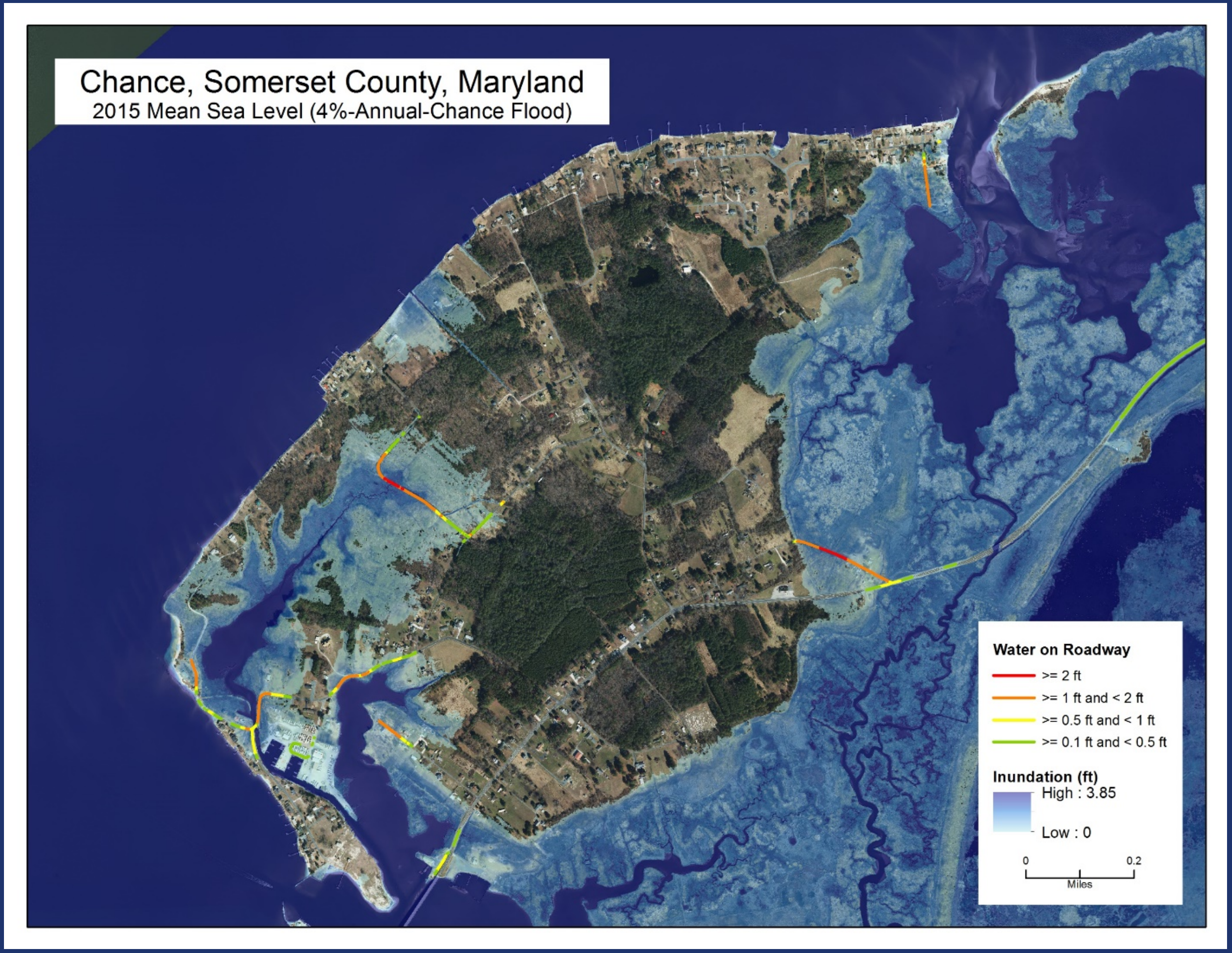
Crisfield 2050
2.11 ft. of sea level rise



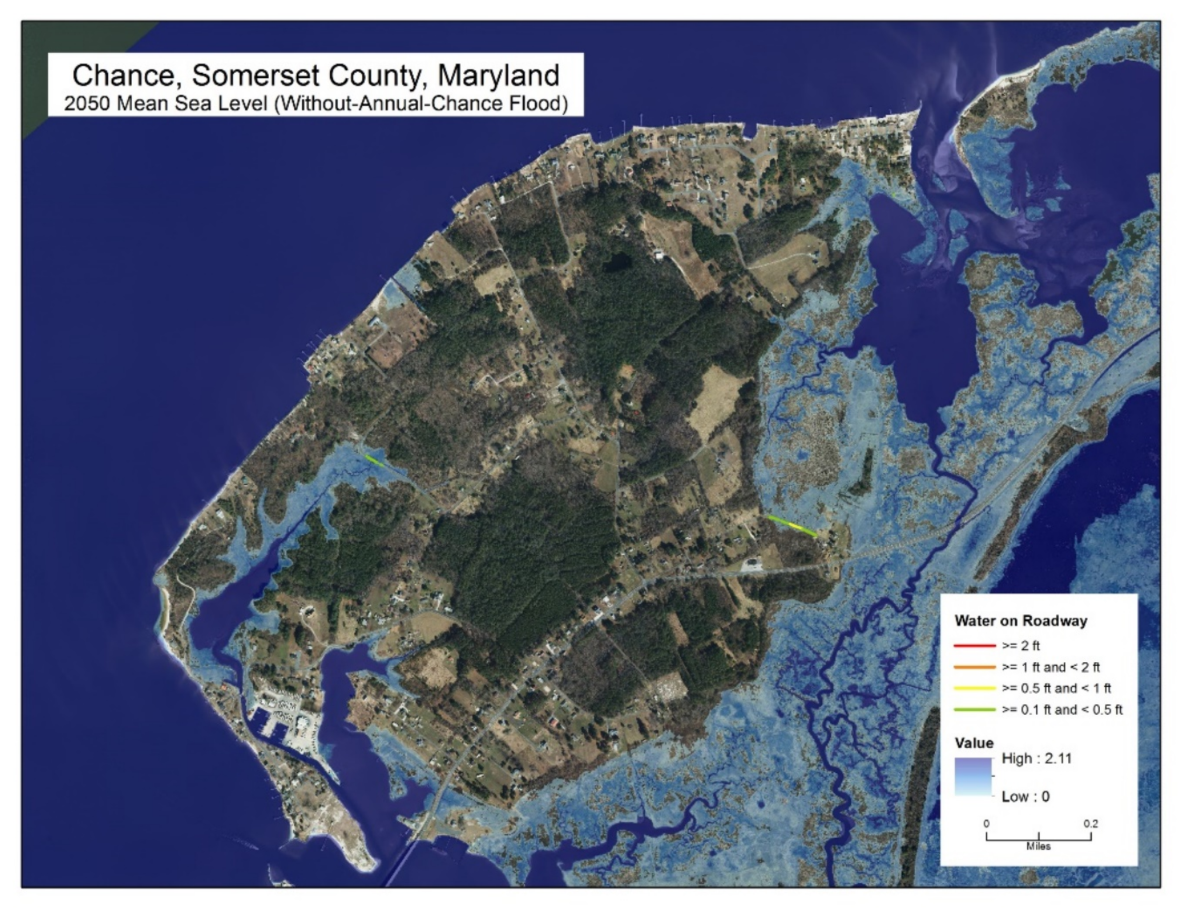
25-Year Storm in 2015
Crisfield



25-Year Storm in 2015 Chance



2050 Mean Sea Level Chance



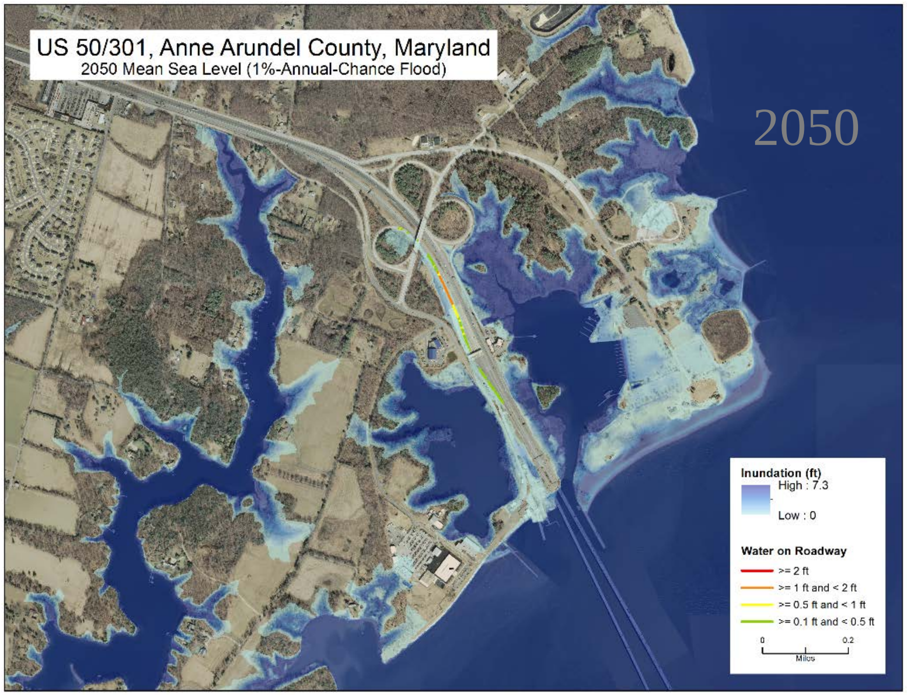
Somerset County Coastal Vulnerability

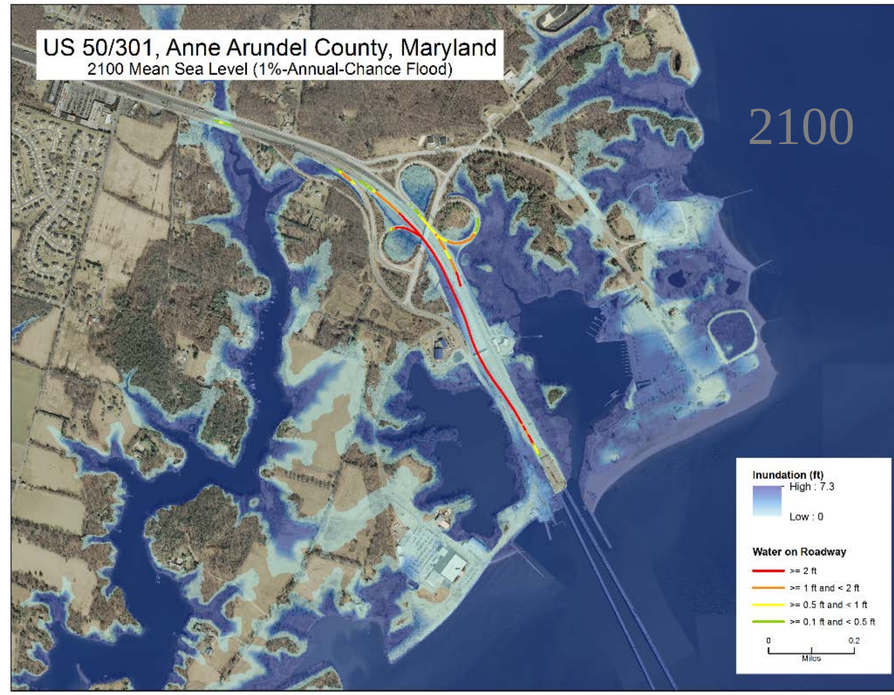
Somerset County Roadway Infrastructure in 2015 at Mean Sea Level						
Water on Roadway	Roadway (ft) (without annual)	% Total Roadway (without annual)	Roadway (ft) (4% annual)	% Total Roadway (4% annual)	Roadway (ft) (1% annual)	% Total Roadway (1% annual)
> 0.1' and <= 0.5'	0	0.0%	117,776	4.4%	56,285	2.1%
> 0.5' and <= 1.0'	0	0.0%	152,521	5.8%	107,631	4.1%
> 1.0' and <= 2.0'	0	0.0%	263,432	10.0%	299,968	11.3%
> 2.0'	0	0.0%	36,476	1.4%	284,381	10.7%

Somerset County Roadway Infrastructure in 2050 at Mean Sea Level						
Water on Roadway	Roadway (ft) (without annual)	% Total Roadway (without annual)	Roadway (ft) (4% annual)	% Total Roadway (4% annual)	Roadway (ft) (1% annual)	% Total Roadway (1% annual)
> 0.1' and <= 0.5'	72,967	2.8%	63,804	2.4%	80,418	3.0%
> 0.5' and <= 1.0'	30,427	1.1%	69,226	2.6%	98,277	3.7%
> 1.0' and <= 2.0'	3,911	0.1%	162,400	6.1%	152,728	5.8%
> 2.0'	64	0.0%	619,603	23.4%	786,228	29.7%

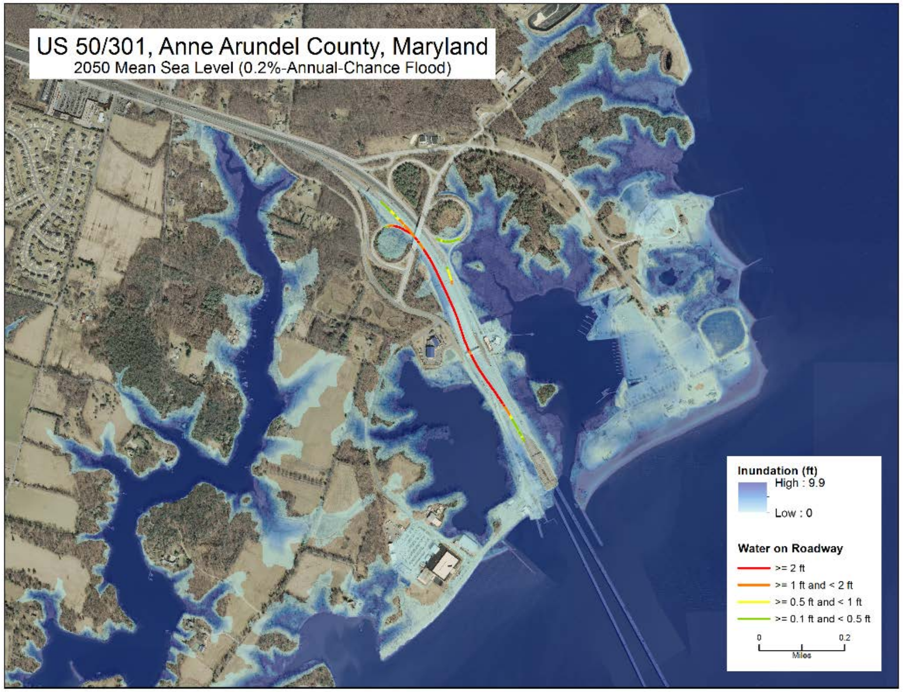
Somerset County Roadway Infrastructure in 2100 at Mean Sea Level						
Water on Roadway	Roadway (ft) (without annual)	% Total Roadway (without annual)	Roadway (ft) (4% annual)	% Total Roadway (4% annual)	Roadway (ft) (1% annual)	% Total Roadway (1% annual)
> 0.1' and <= 0.5'	66,712	2.5%	20,968	0.8%	22,645	0.9%
> 0.5' and <= 1.0'	69,548	2.6%	27,443	1.0%	22,453	0.8%
> 1.0' and <= 2.0'	150,207	5.7%	83,041	3.1%	55,011	2.1%
> 2.0'	638,127	24.1%	1,242,525	46.9%	1,323,710	50.0%

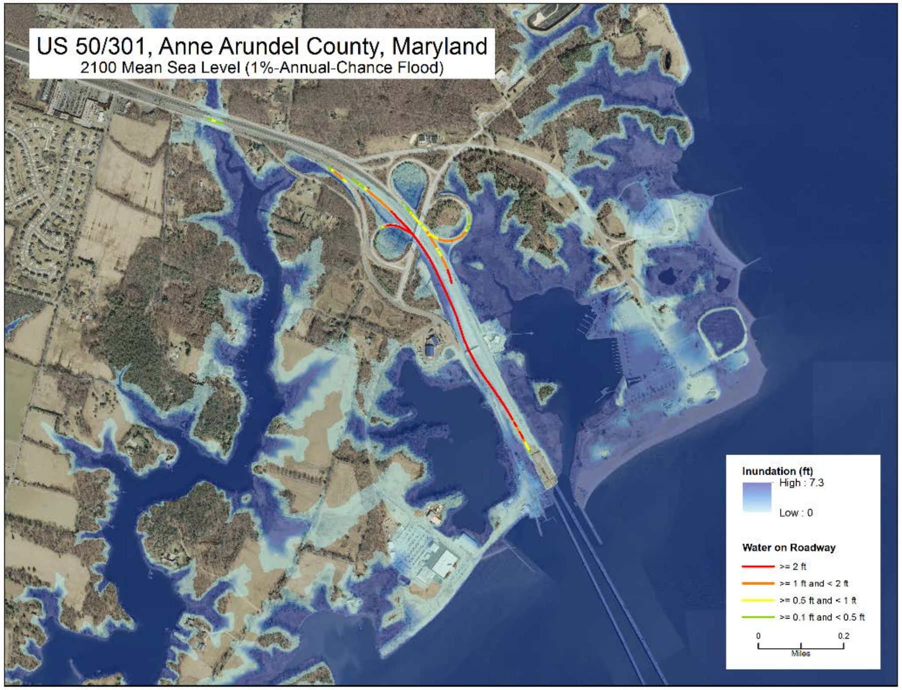
100-Year Storm in 2050 & 2100
Bay Bridge



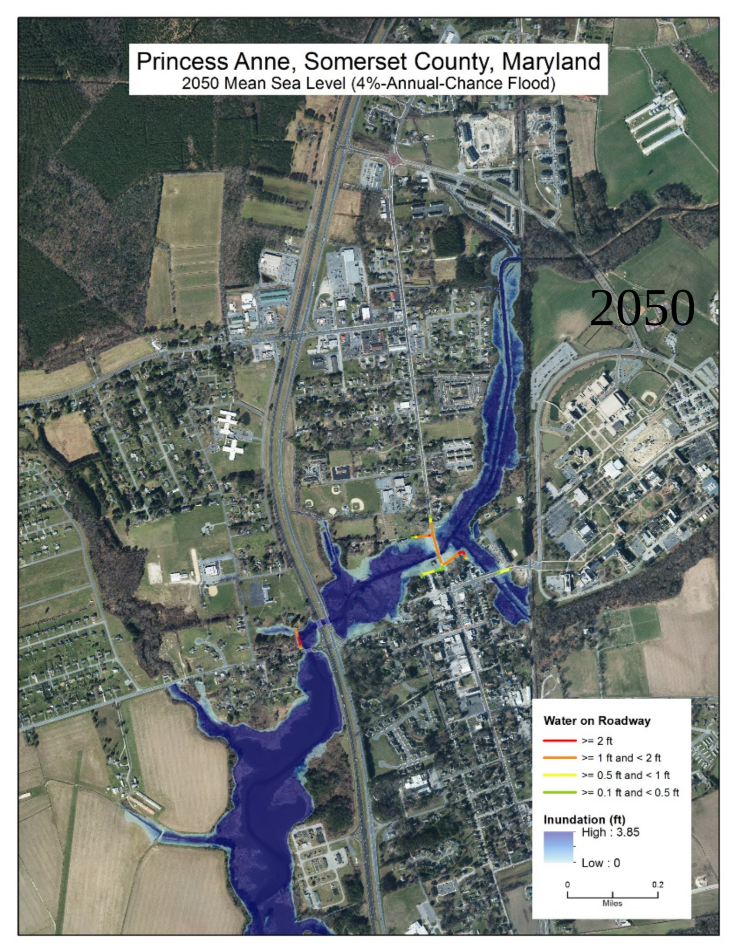


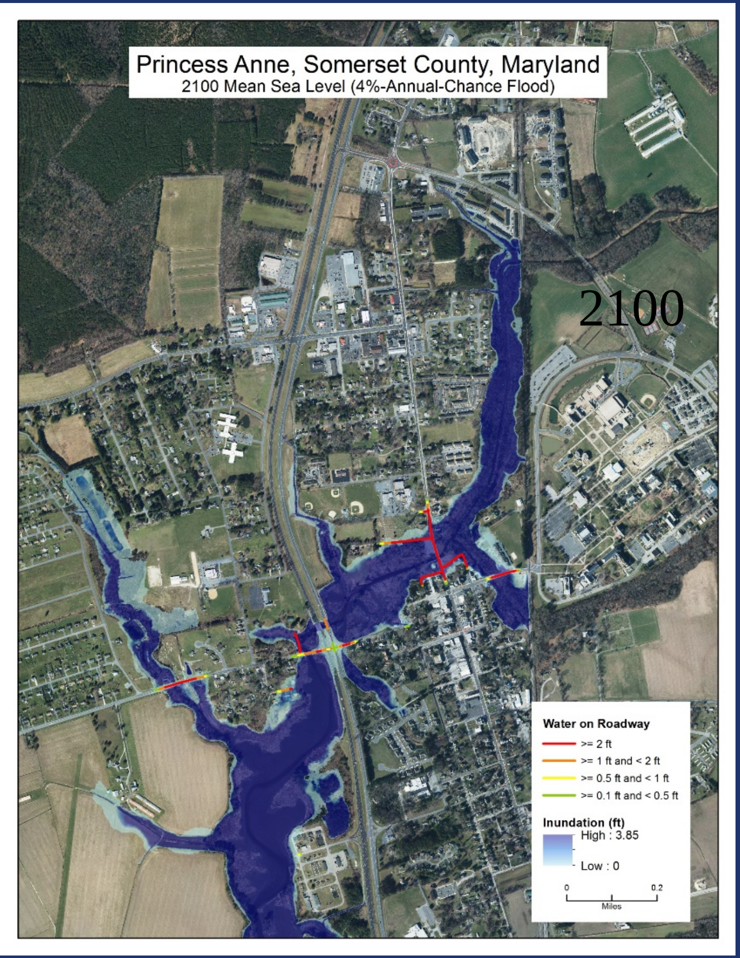
500-Year Storm in 2050 & 100-Year Storm in 2100 at the Bay Bridge



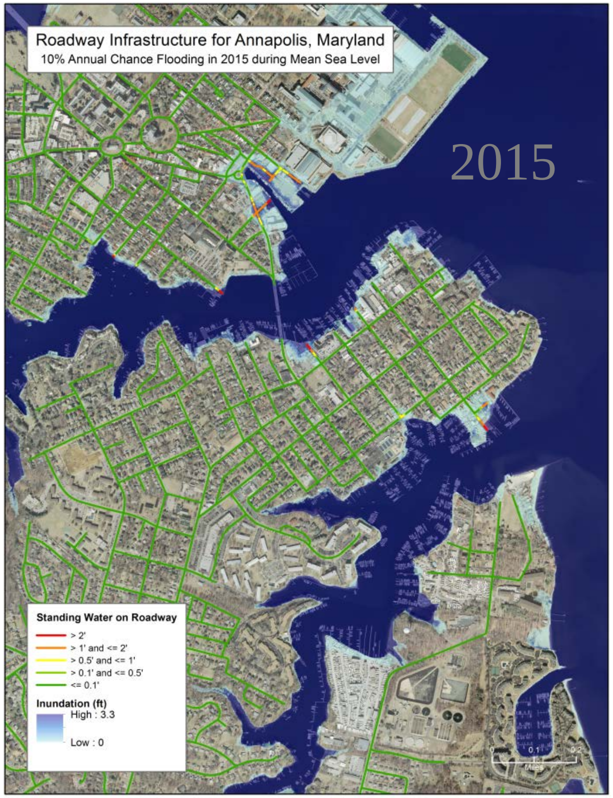


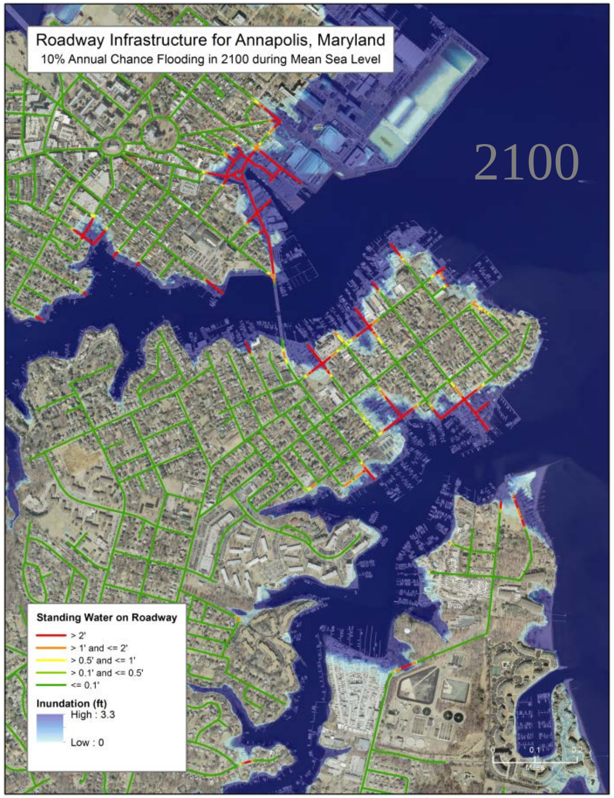
25-Year Storm in 2050 & 2100
Princess Anne





10-Year Storm Inundation
Mean Sea Level





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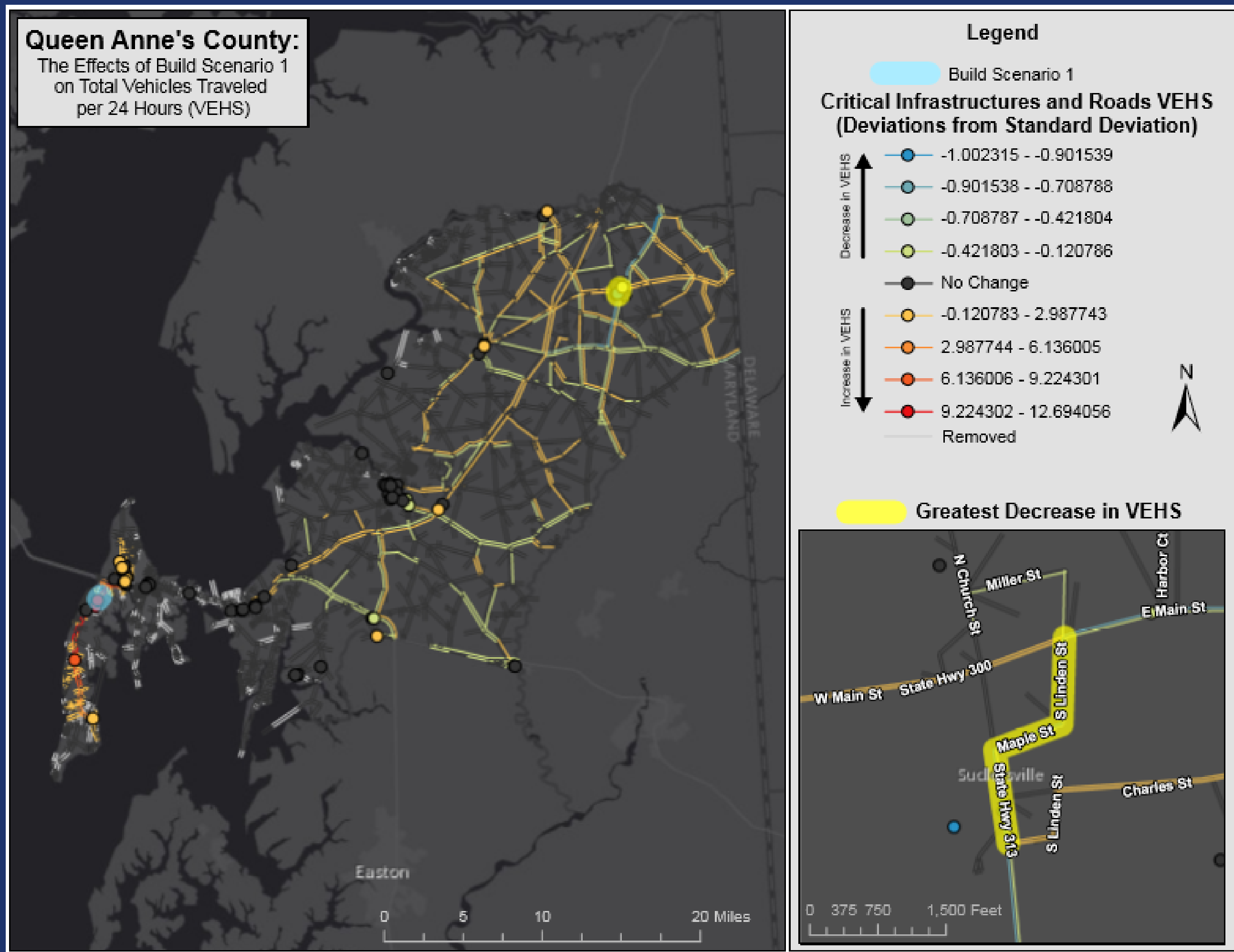
Evaluation of High Scoring HVI Road Segments



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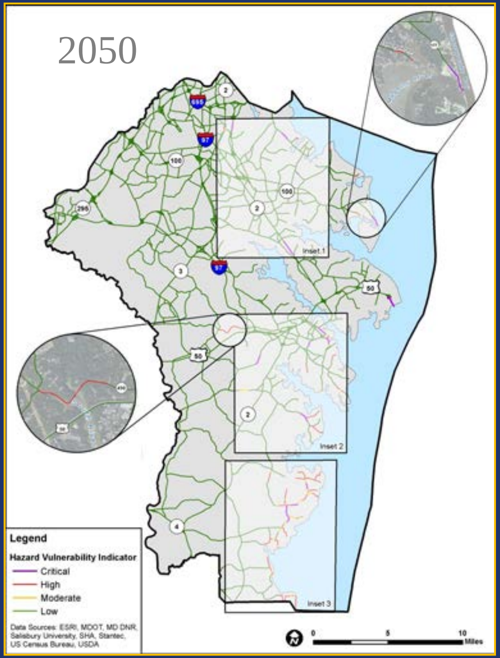
Non-Coastal Vulnerability

Asset Management, Extreme Weather, and Proxy Indicators Pilot 2017
MDOT SHA Objectives

- Develop proxy indicators to identify and address extreme weather and climate-related risks to Maryland’s critical assets
- Integrate climate-related risks and data into the TAMP processes
- Develop and modify existing lifecycle management plans to reflect climate-related data and risks
- Document the new processes



The purpose of MDOT SHA’s proposed project for this pilot is to develop and integrate a repeatable framework for leveraging current and future extreme weather and climate change data with the transportation asset management processes currently in place

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

Questions

Elizabeth Habic
Office of Planning and Preliminary Engineering
ehabic@sha.state.md.us
410-545-8563

Climate Change Adaptation Plan with Detailed Vulnerability Assessment, October 2014

https://www.fhwa.dot.gov/environment/sustainability/resilience/pilots/2013-2015_pilots/maryland/final_report/index.cfm