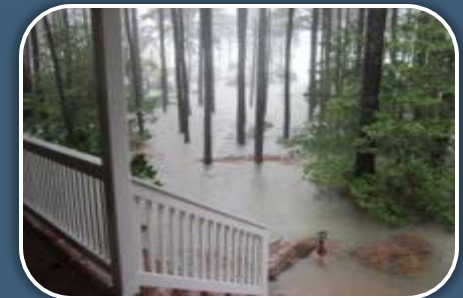


Eastern Shore of Virginia Transportation Infrastructure Inundation Vulnerability Assessment (TIIVA)

Curt Smith

Director of Planning

Accomack-Northampton Planning District Commission



Purpose



To utilize best-available data in order to assess the long-term vulnerability of inundation on regional transportation infrastructure.

Answering key long-term planning questions:

- Where? → VDOT Road Centerline data & NOAA Sea Level Rise/Coastal Flooding Model (uses high-resolution LiDAR)
 - How is access to communities impacted?
- When? → VA sea-level projections (*VIMS Recurrent Flooding Study, 2013*)

Study conducted in partnership with VDOT

First regional study of its kind in Virginia

Methods



Where will inundation occur?

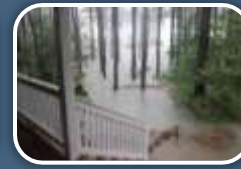
VDOT Road Centerline Data

- Road network divided into segments from intersection to intersection
- Segments checked by ANPDC staff to verify accuracy compared to LiDAR data
- Separate datasets utilized during consideration of bridges and culverts

NOAA Sea Level Rise Model

- Inundation levels from 0-6 feet in one foot increments
- Inundation levels measured above MHHW for 1983-2001
- Does not consider:
 - Astronomical or meteorological tides
 - Stormwater back-flooding
 - Storm surge
 - Groundwater conditions
 - Erosion/accretion
 - Land subsidence
 - Assumes no construction

Methods

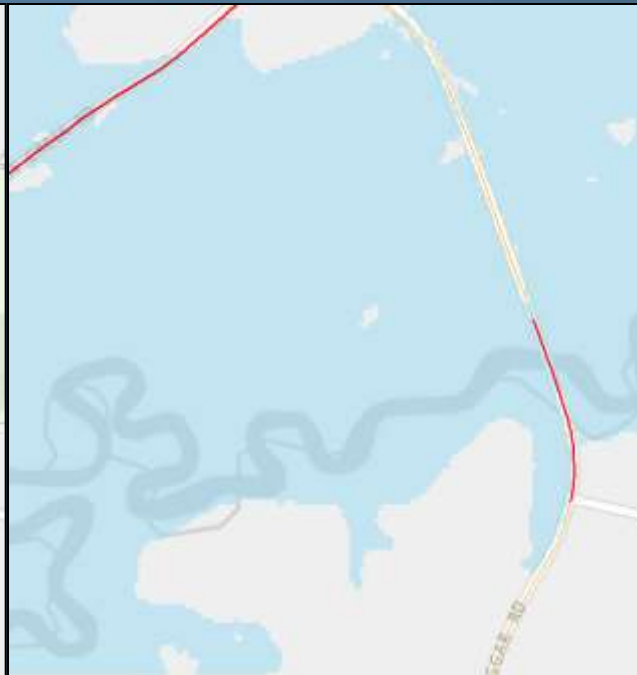


Where will inundation occur?



0 ft.

- Current MHHW conditions (light green)
- No segments inundated
- Bridge segment post-processed by ANPDC staff



1 ft.

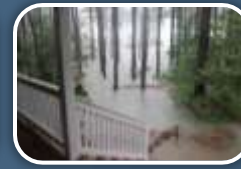
- 2 segments inundated (highlighted red)
- Segment north of bridge initially shown as inundated prior to post-processing by ANPDC staff



2 ft.

- Same 2 segments from 1 ft. scenario inundated (red)
- 2 new segments inundated (green)

Methods



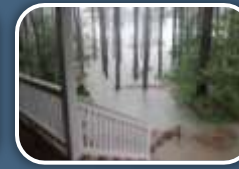
How is access to communities impacted?

A-NPDC Staff:

1. Worked with County staff to develop list of communities and critical facilities to be assessed
2. Identified number of access routes
3. Assessed accessibility under inundation scenarios from 1-6 ft.:
 - Not Impacted
 - Access to Community Limited (at least one access route inundated) and <50% of roads in community inundated)
 - Disconnected/Inaccessible (all access routes inundated and <50% of roads in community inundated)
 - Majority of Roads Inundated (>50% of roads in community inundated)



Methods

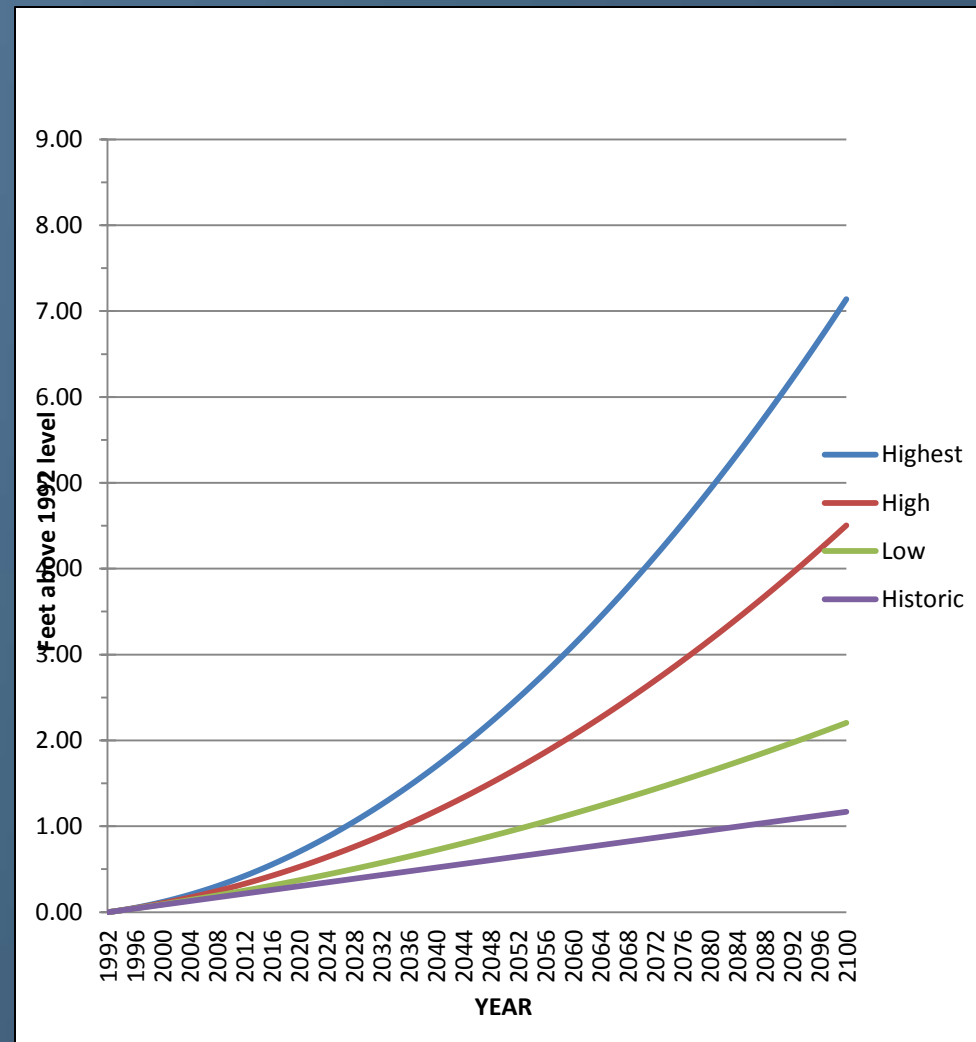


When is this projected to occur?

VA Sea-level Projections:

- Includes measurements from 1992-2009 and projections to 2100
- Based on 2014 National Climate Assessment curves
- Adjusted for the annual local subsidence rate in Wachapreague (1.6 mm/yr) based on Holdahl & Morrison 1974 study
- VIMS recommends using high curve

Ranges of dates for the highest, high, and low curves were used based on consensus recommendation of ESVA Climate Adaptation Working Group.



Regional Maps

Eastern Shore of Virginia Transportation Infrastructure Inundation Vulnerability Assessment



Potential Inundation

- █ 1 Foot (≈2025-2050)
 - █ 2 Feet (≈2045-2090)
 - █ 3 Feet (>2060)
 - █ 4 Feet (>2070)
 - █ 5 Feet (>2080)
 - █ 6 Feet (>2090)
- Railroads
 - Road Centerlines



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Eastern Shore of Virginia Transportation Infrastructure Inundation Vulnerability Assessment



Potential Inundation

- 1 Foot (≈2025-2050)
 - 2 Feet (≈2045-2090)
 - 3 Feet (>2060)
 - 4 Feet (>2070)
 - 5 Feet (>2080)
 - 6 Feet (>2090)
- Railroads
 - Road Centerlines

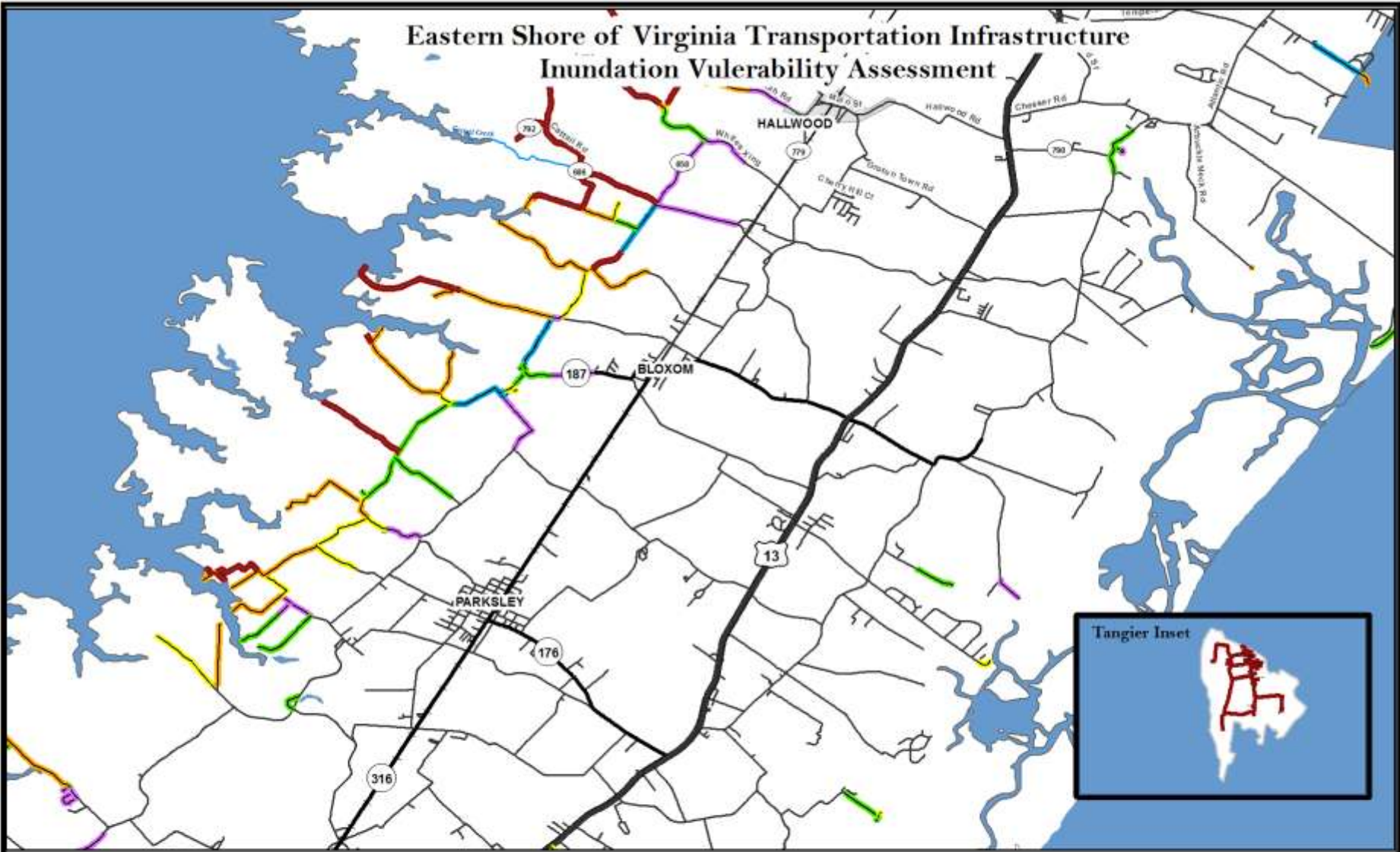


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Eastern Shore of Virginia Transportation Infrastructure Inundation Vulnerability Assessment



Potential Inundation

- █ 1 Foot (≈2025-2050)
 - █ 2 Feet (≈2045-2090)
 - █ 3 Feet (>2060)
 - █ 4 Feet (>2070)
 - █ 5 Feet (>2080)
 - █ 6 Feet (>2090)
- Railroads
 - Road Centerlines

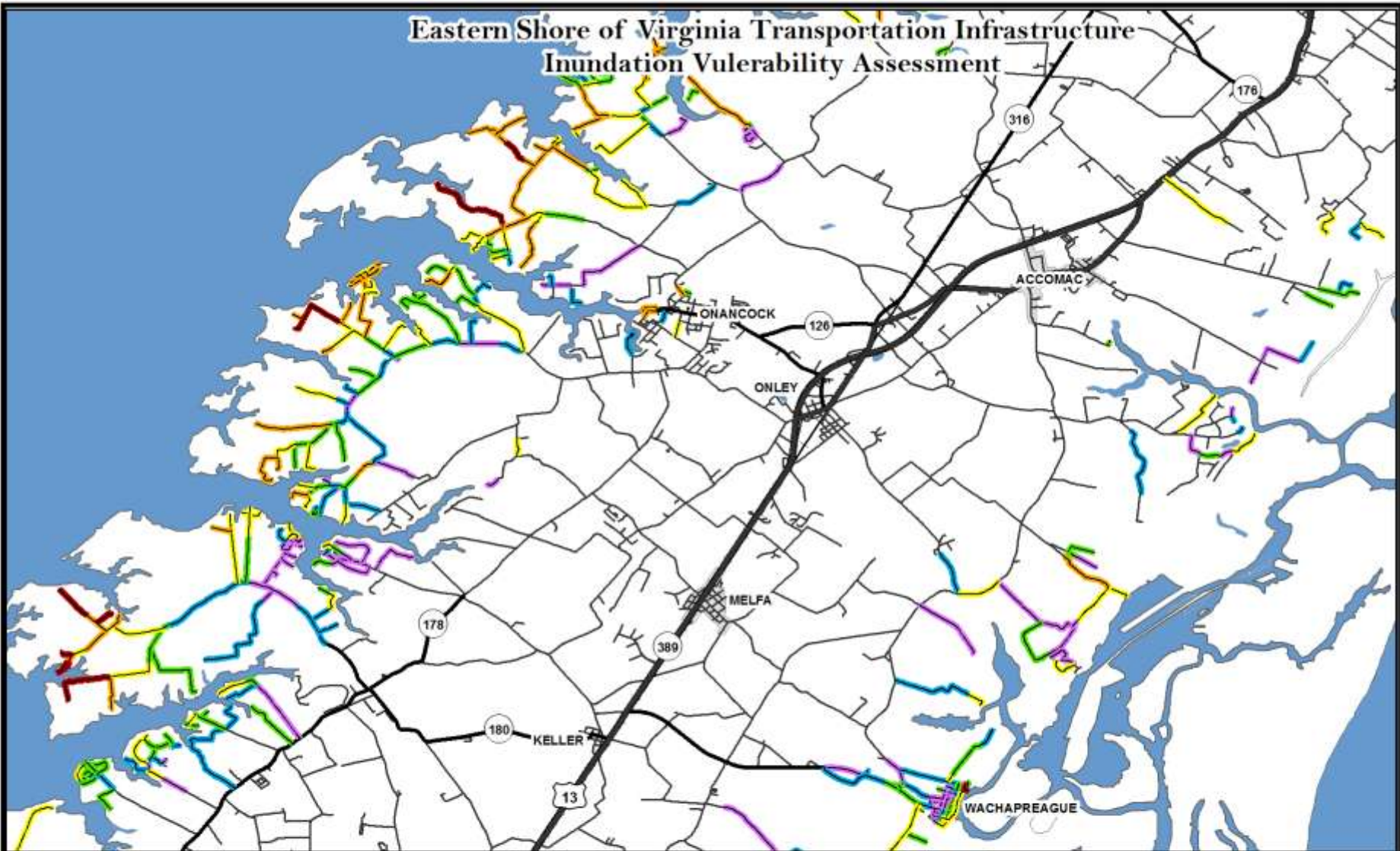


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Eastern Shore of Virginia Transportation Infrastructure Inundation Vulnerability Assessment



Potential Inundation

- 1 Foot (≈2025-2050)
 - 2 Feet (≈2045-2090)
 - 3 Feet (>2060)
 - 4 Feet (>2070)
 - 5 Feet (>2080)
 - 6 Feet (>2090)
- Railroads
 - Road Centerlines



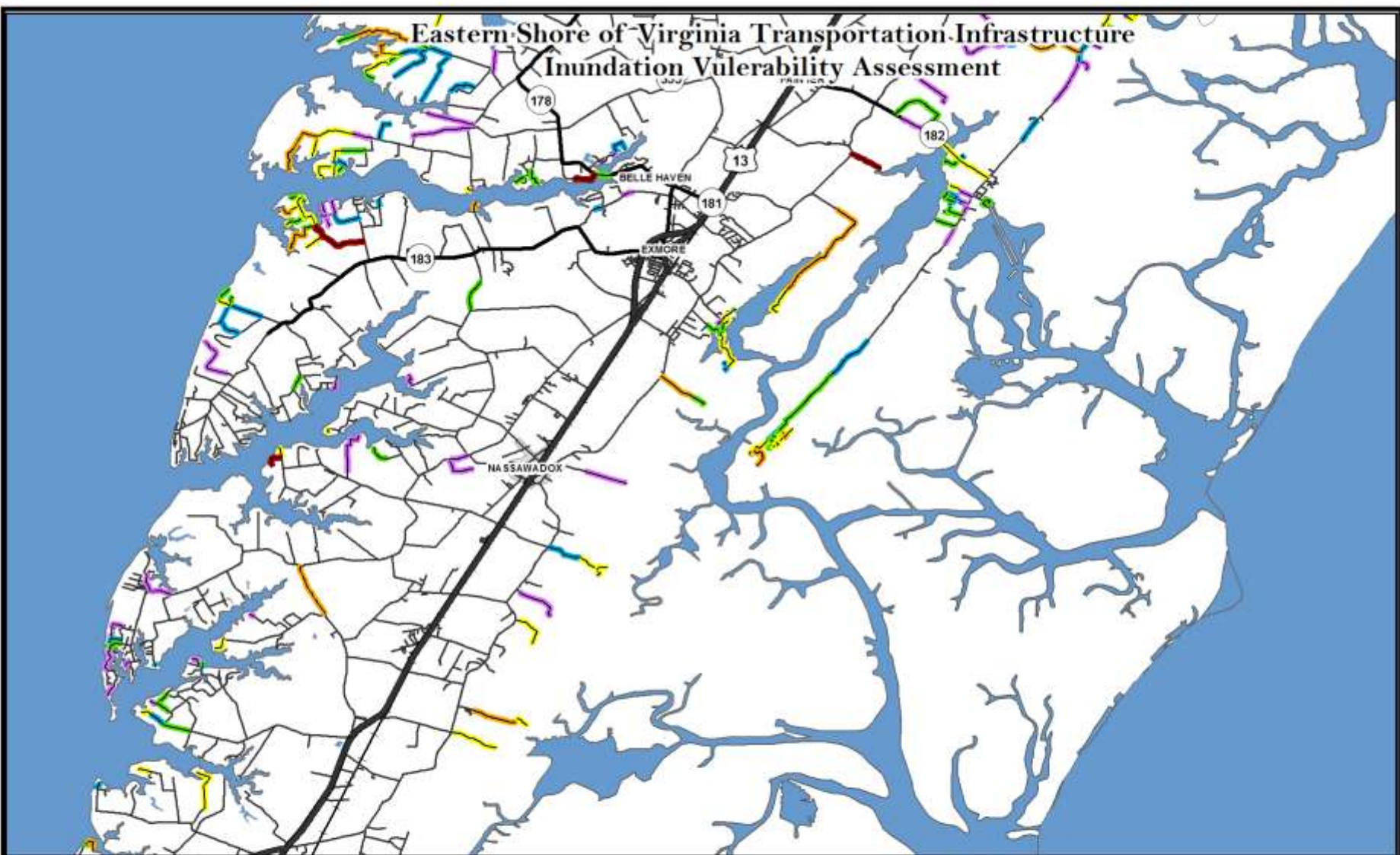
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0 1.5 3 6 Miles



Eastern Shore of Virginia Transportation-Infrastructure Inundation Vulnerability Assessment



Potential Inundation

- █ 1 Foot (≈2025-2050)
 - █ 2 Feet (≈2045-2090)
 - █ 3 Feet (>2060)
 - █ 4 Feet (>2070)
 - █ 5 Feet (>2080)
 - █ 6 Feet (>2090)
- Railroads
 - Road Centerlines

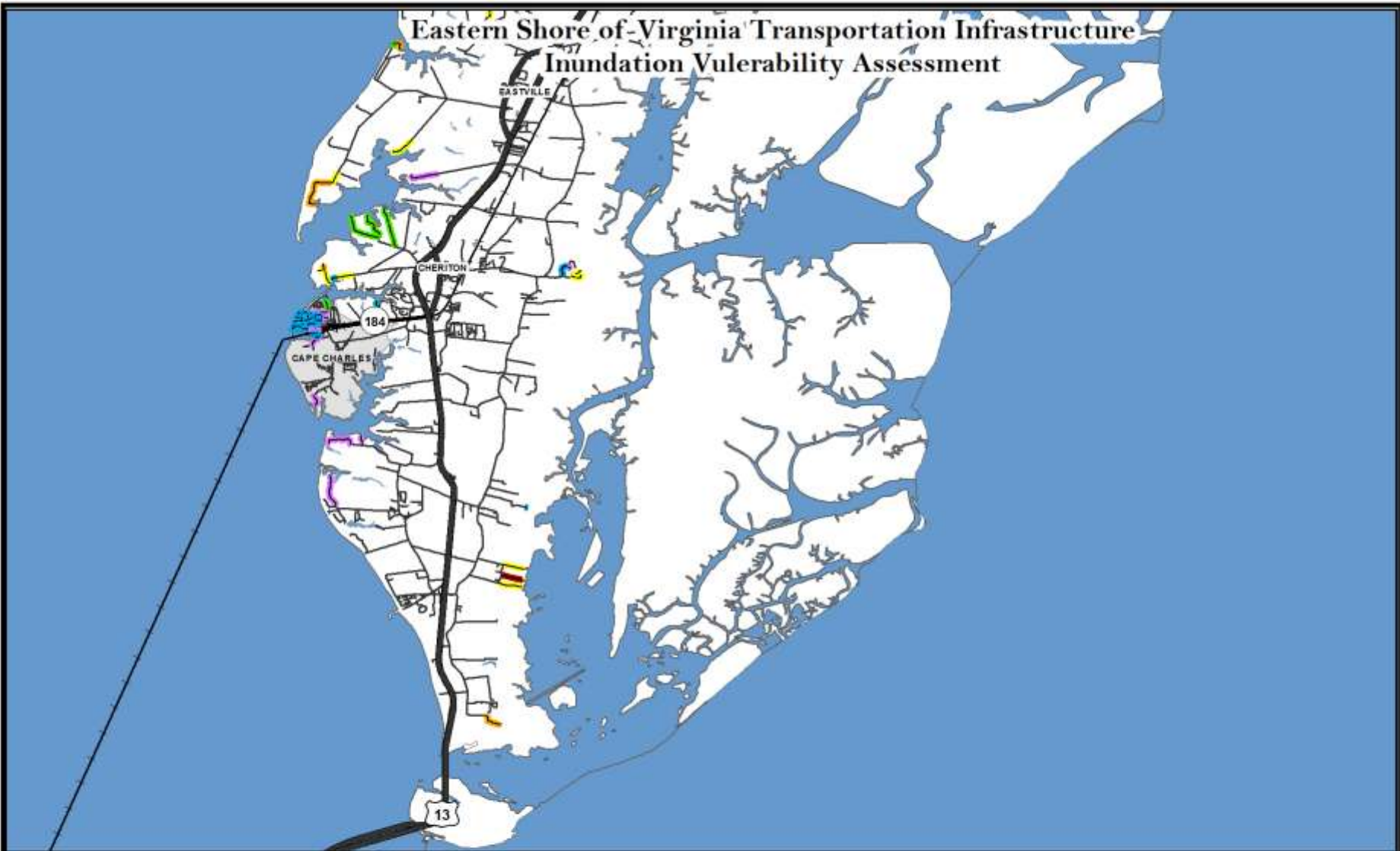


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Eastern Shore of Virginia Transportation Infrastructure Inundation Vulnerability Assessment



Potential Inundation

- █ 1 Foot (≈2025-2050)
 - █ 2 Feet (≈2045-2090)
 - █ 3 Feet (>2060)
 - █ 4 Feet (>2070)
 - █ 5 Feet (>2080)
 - █ 6 Feet (>2090)
- Railroads
 - Road Centerlines



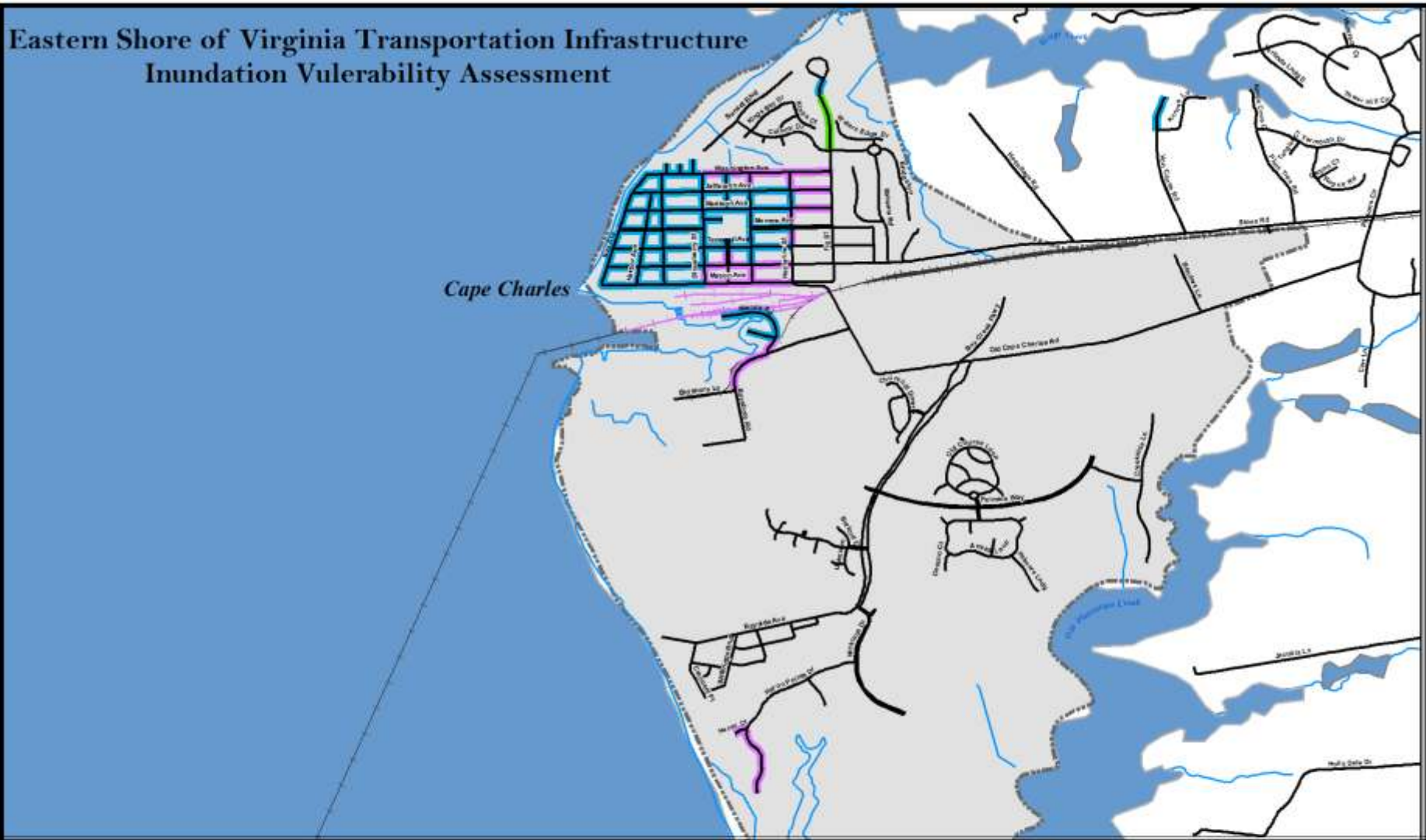
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Town Maps

Eastern Shore of Virginia Transportation Infrastructure Inundation Vulnerability Assessment



Potential Inundation

- █ 1 Foot (≈2025-2050)
 - █ 2 Feet (≈2045-2090)
 - █ 3 Feet (>2060)
 - █ 4 Feet (>2070)
 - █ 5 Feet (>2080)
 - █ 6 Feet (>2090)
- Railroads
 - Inundated Railroads (6 Feet)
 - Road Centerlines
 - Town Boundary



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0 0.4 0.8

1.6 Miles



Accomack-Northampton Sea Level Rise Vulnerability



Potential Inundation

- █ 1 Foot (≈2025-2040)
- █ 2 Feet (≈2040-2070)
- █ 3 Feet (≈2055-2100)
- █ 4 Feet (> 2065)
- █ 5 Feet (> 2075)
- █ 6 Feet (> 2085)
- Railroads
- Road Centerlines

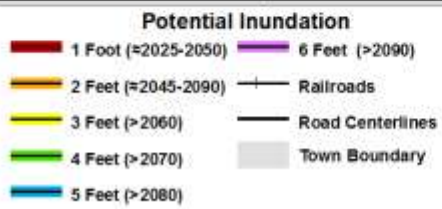
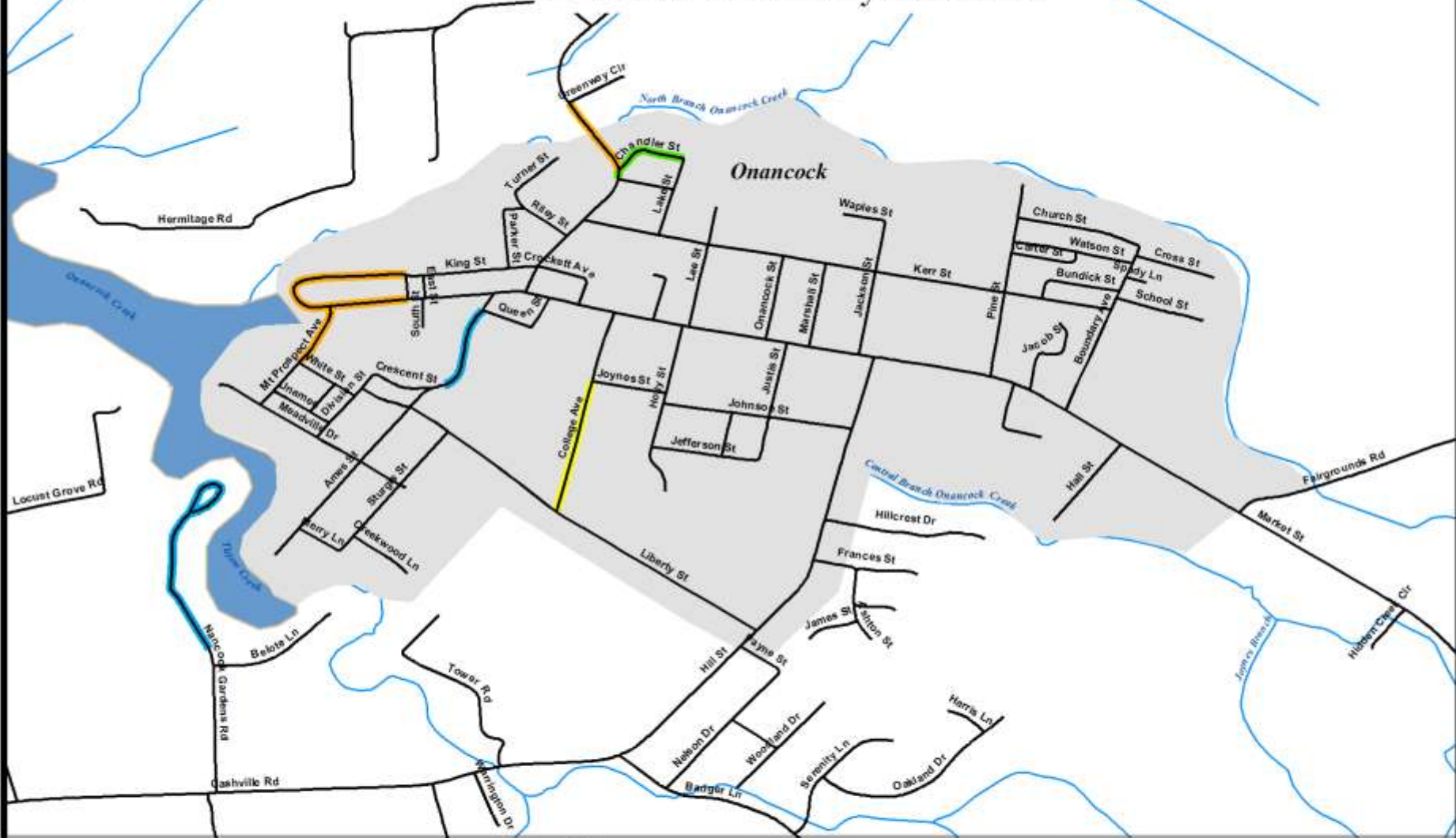


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Eastern Shore of Virginia Transportation Infrastructure Inundation Vulnerability Assessment

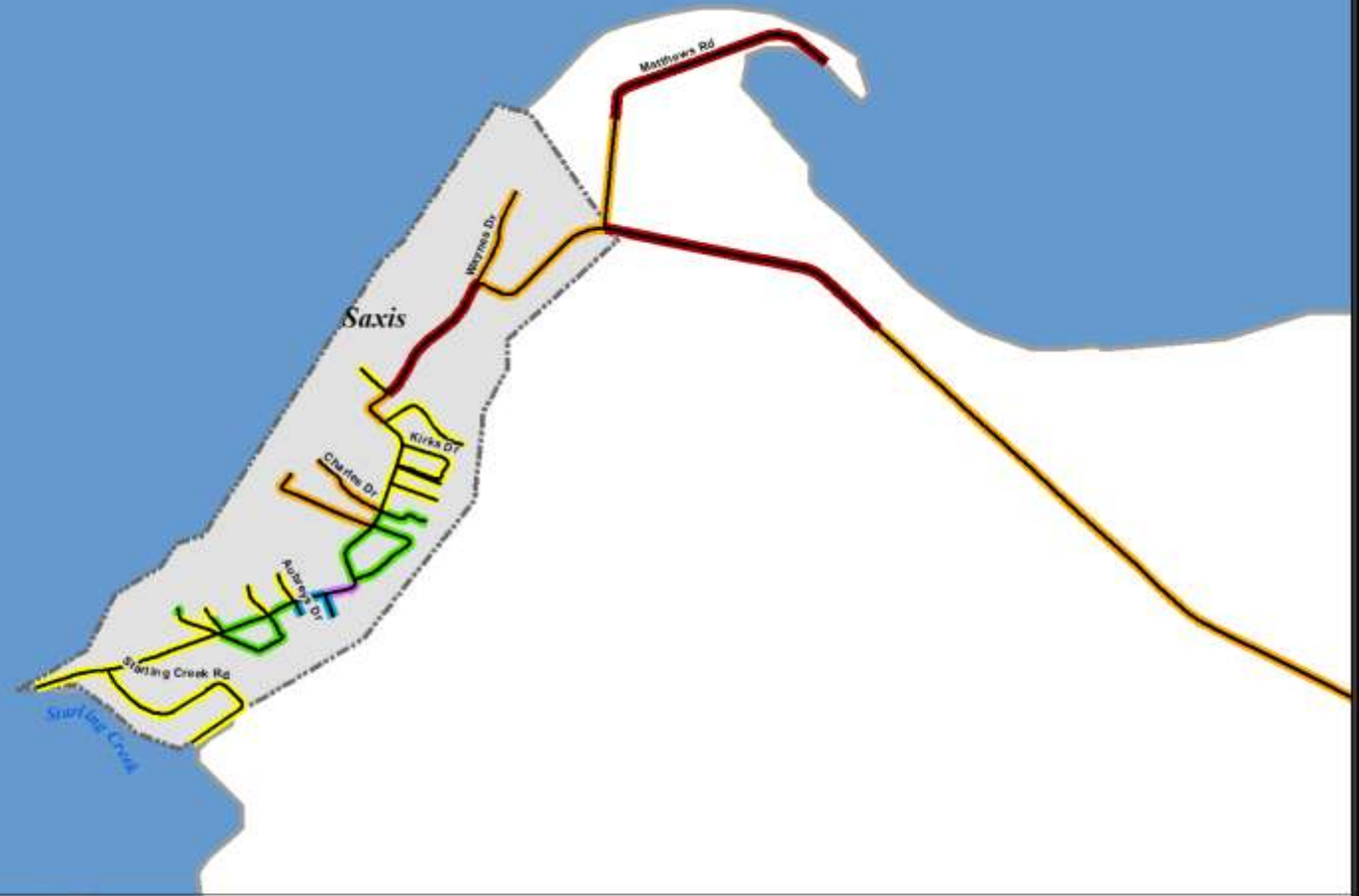


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Eastern Shore of Virginia Transportation Infrastructure Inundation Vulnerability Assessment



Potential Inundation

- █ 1 Foot (≈2025-2050)
 - █ 2 Feet (≈2045-2090)
 - █ 3 Feet (>2060)
 - █ 4 Feet (>2070)
 - █ 5 Feet (>2080)
 - █ 6 Feet (>2090)
- Railroads
 - Road Centerlines
 - Town Boundary



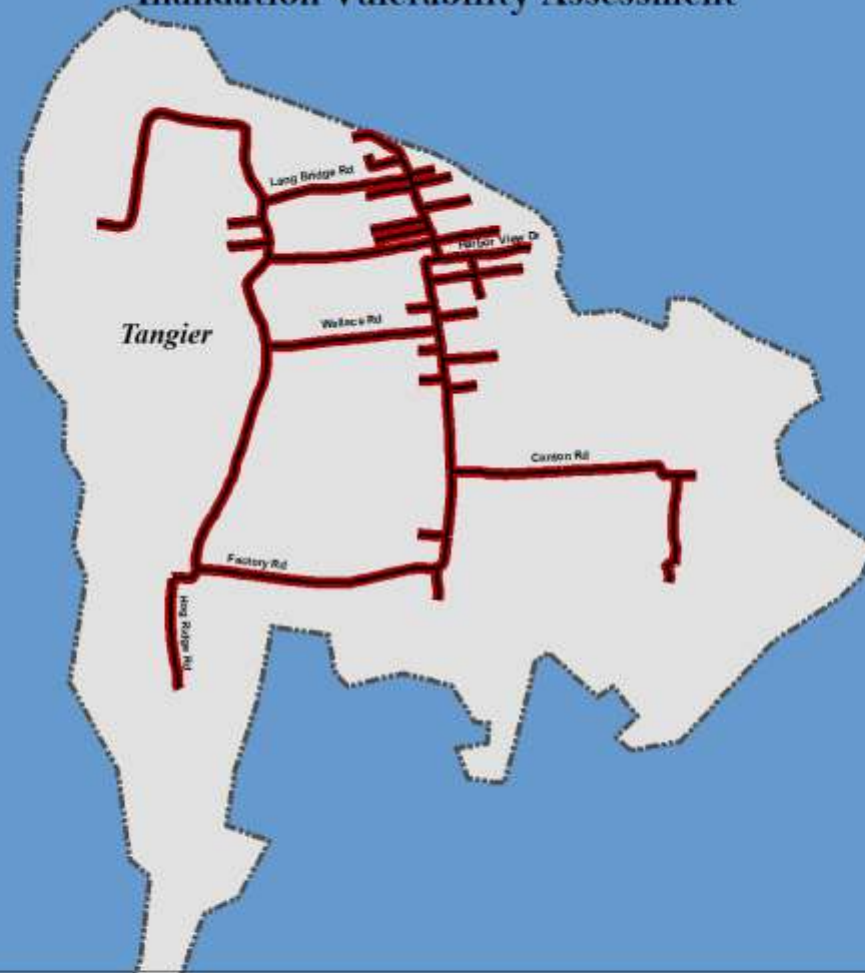
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0 0.25 0.5 1 Miles



Eastern Shore of Virginia Transportation Infrastructure Inundation Vulnerability Assessment



Potential Inundation

- █ 1 Foot (≈2025-2050)
 - █ 2 Feet (≈2045-2090)
 - █ 3 Feet (>2060)
 - █ 4 Feet (>2070)
 - █ 5 Feet (>2080)
 - █ 6 Feet (>2090)
- Railroads
 - Road Centerlines
 - Town Boundary

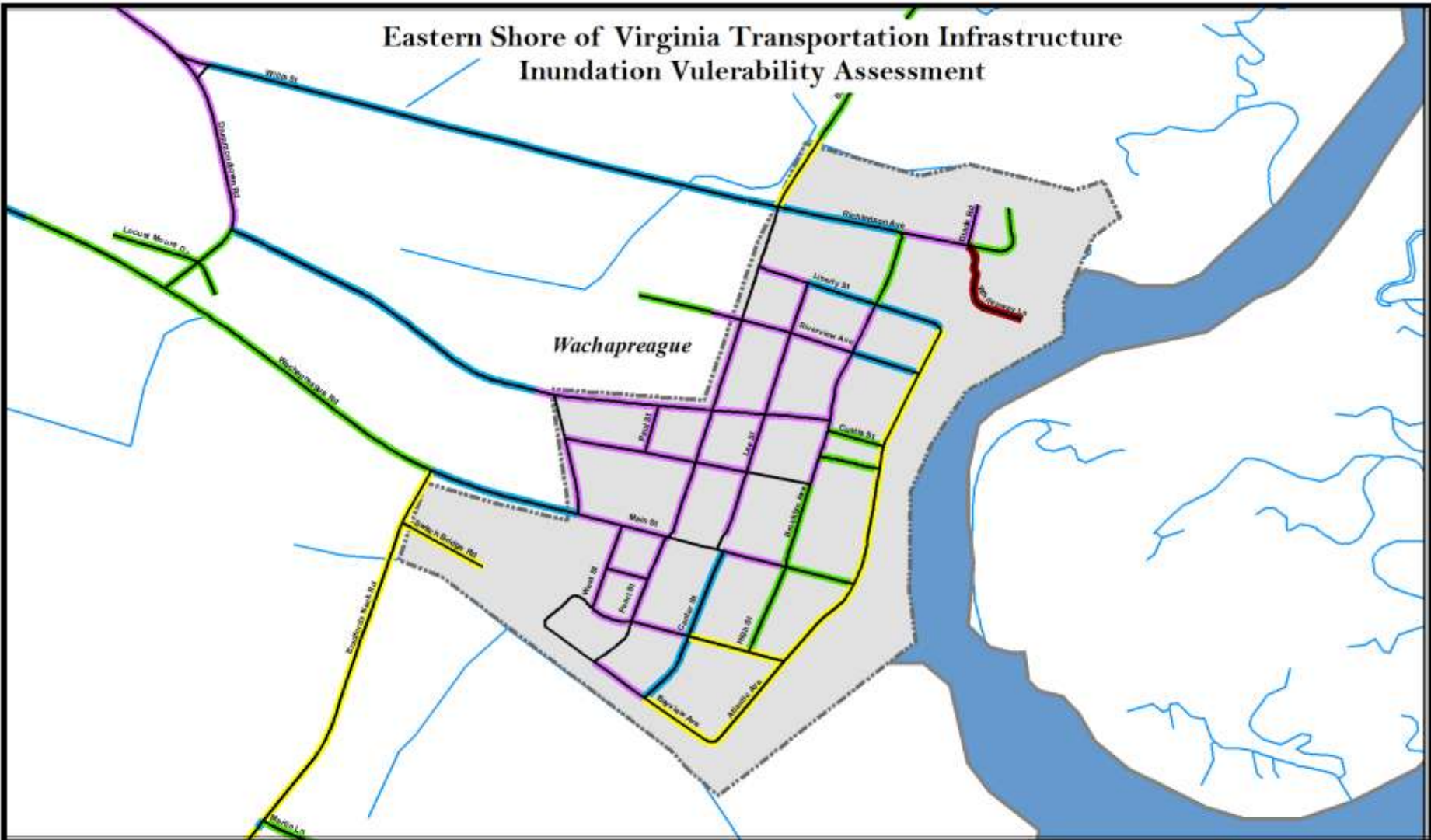


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Eastern Shore of Virginia Transportation Infrastructure Inundation Vulnerability Assessment



Potential Inundation

- █ 1 Foot (≈2025-2050)
 - █ 2 Feet (≈2045-2090)
 - █ 3 Feet (>2060)
 - █ 4 Feet (>2070)
 - █ 5 Feet (>2080)
 - █ 6 Feet (>2090)
- Railroads
 - Road Centerlines
 - Town Boundary



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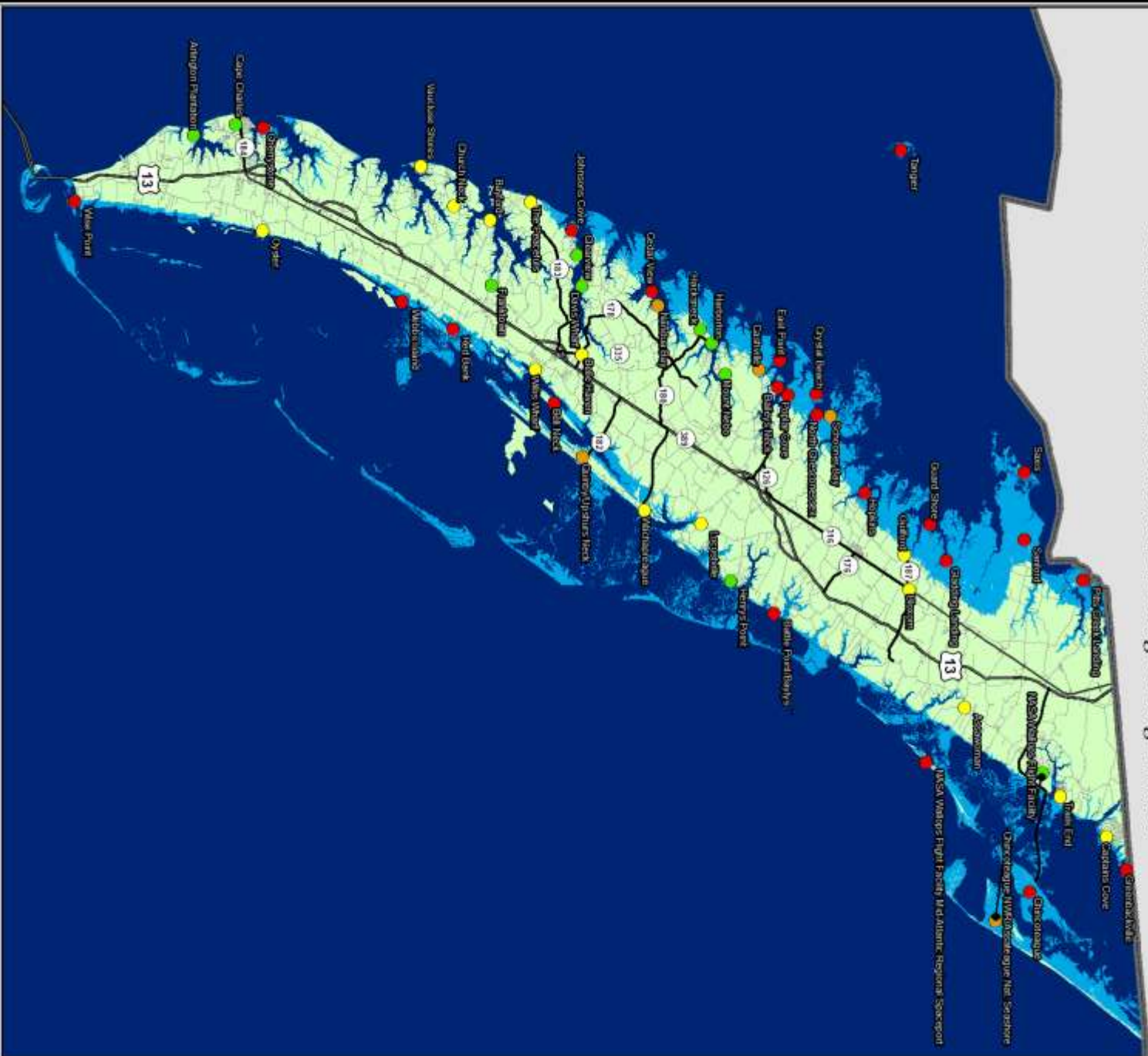
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0 0.125 0.25 0.5 Miles



Community Accessibility Maps

Eastern Shore Projected Community Accessibility Map - 4 Feet Sea Level Rise above Mean Higher High Water



Critical Communities

- Community Access Not Impacted
 - Access to Community Limited
 - The community is inaccessible
 - Majority of roads inundated
- 4 Foot Inundation
 - State Highway
 - US Highway
 - Road Construction
 - Railroad

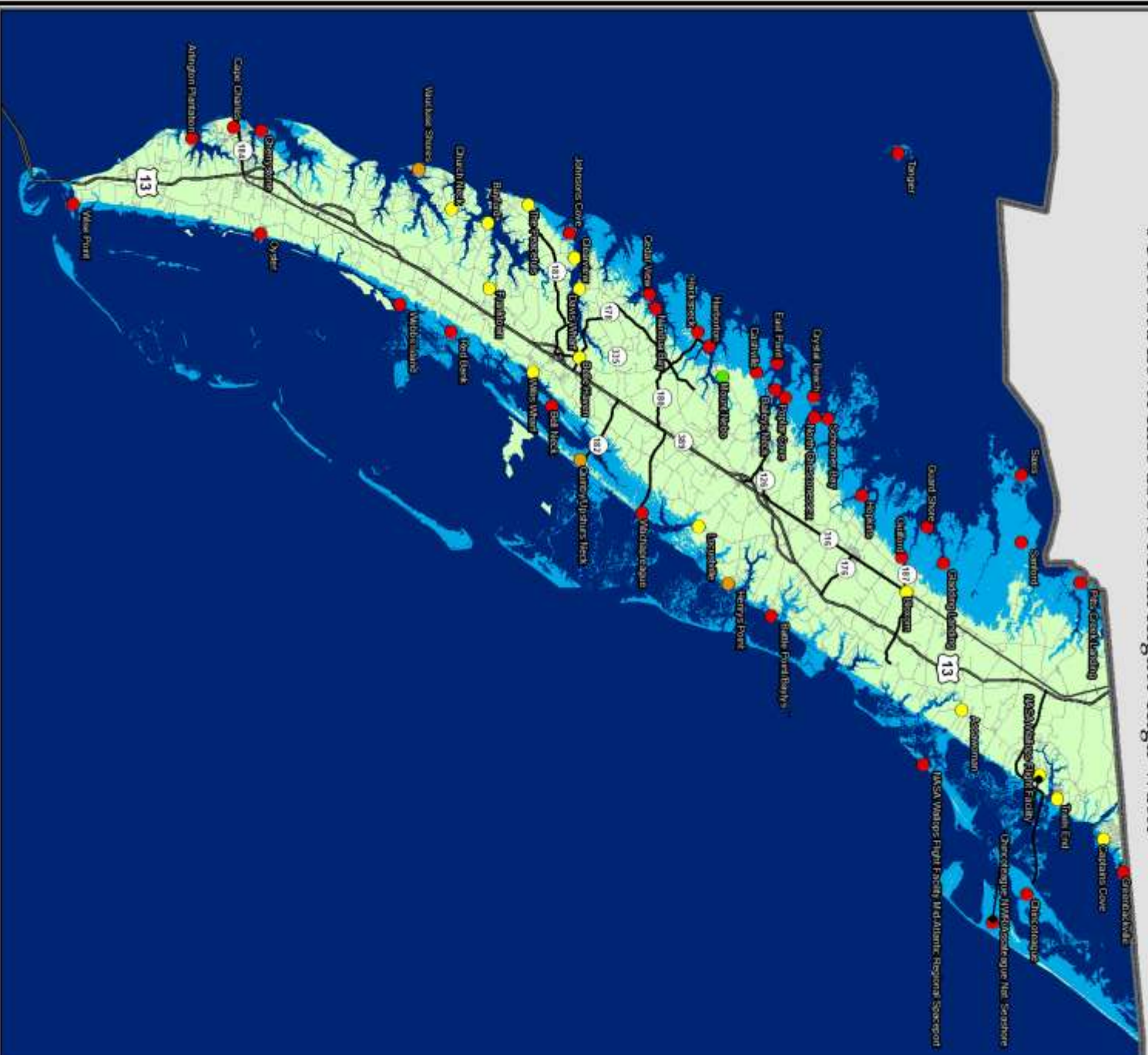


Disclaimer: The content of this map reflects the extent of the Access and Egress Planning District Commission (AEPDC) road files and accessibility refers the official values of positions of the Virginia Department of Transportation (VDOT). This map does not constitute a standard, specification, or regulation and is intended for informational purposes only. Do not attempt to use this map for legal action, easements, or other emergency.

Explanation: The map illustrates accessibility conditions to selected communities and critical facilities at given sea level rise scenarios. The shaded areas represent areas projected to be inundated at a given sea level rise scenario. Sea level rise scenarios are measured above mean higher high water (MHHW). Data obtained in this map are derived from the National Oceanic and Atmospheric Administration (NOAA) Coastal Sea Level Rise Project. This project was funded by the Virginia Coastal Program. Accessibility is determined by the Department of Environmental Quality through the use of the Virginia Coastal Program's Sea Level Rise Assessment Tool (SLRAT) and the Virginia Coastal Program's Sea Level Rise Assessment Tool (SLRAT) as of 2022. An overview of the project can be found at <https://www.deq.virginia.gov/sea-level-rise>.



Eastern Shore Projected Community Accessibility Map - 6 Feet Sea Level Rise above Mean Higher High Water



Critical Communities

- Community Access Not Impacted
- Access to Community Limited
- Inaccessible/Inaccessibility
- Majority of Roads Inaccessible

- 6 Feet Inundation
- State Highway
- US Highway
- Road Construction
- Railroad



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Explanation: The map illustrates accessibility conditions to selected communities and critical facilities at given sea level rise scenarios. The shaded areas represent areas projected to be inundated at high tide under the given sea level rise scenario. Sea level rise scenarios are measured above mean higher high water (MHHW). Data obtained in this map are derived from the National Oceanic and Atmospheric Administration (NOAA) Coastal High and Low Water (CHLW) data. This project was funded by the Virginia Coastal Program. Accessibility is determined based on the Department of Environmental Quality (DEQ) Sea Level Rise (SLR) Scenarios, which are based on the Coastal High and Low Water (CHLW) data. The map is based on the Department of Environmental Quality (DEQ) Sea Level Rise (SLR) Scenarios, which are based on the Coastal High and Low Water (CHLW) data. The map is based on the Department of Environmental Quality (DEQ) Sea Level Rise (SLR) Scenarios, which are based on the Coastal High and Low Water (CHLW) data.



Accomack County

Community/Critical Facility	# of Access Routes	Inundation from Sea Level Rise Above MHHW					
		1 feet (≈2025-2040)	2 feet (≈2040-2070)	3 feet (≈2055-2100)	4 feet (>2065)	5 feet (>2075)	6 feet (>2085)
Assawoman	3	Green	Green	Green	Yellow	Yellow	Yellow
Baileys Neck	1	Green	Yellow	Orange	Red	Red	Red
Battle Point/Baylys Neck	1	Green	Green	Green	Red	Red	Red
Belle Haven	4	Green	Green	Green	Yellow	Yellow	Yellow
Bell Neck	1	Green	Orange	Red	Red	Red	Red
Bloxom	4	Green	Green	Green	Yellow	Yellow	Yellow
Captains Cove	3	Green	Green	Green	Yellow	Yellow	Yellow
Cashville	2	Green	Green	Green	Orange	Red	Red
Cedar View	1	Green	Green	Green	Red	Red	Red
Chincoteague	1	Green	Orange	Red	Red	Red	Red
Chincoteague Nat. Wildlife Refuge	1	Green	Orange	Orange	Yellow	Yellow	Yellow
Crystal Beach	1	Orange	Red	Red	Red	Red	Red
East Point	1	Green	Orange	Red	Red	Red	Red
Davis Wharf	1	Green	Green	Green	Green	Green	Yellow
Deep Creek	1	Green	Red	Red	Red	Red	Red
Gladding Landing	1	Orange	Red	Red	Red	Red	Red
Greenbackville	2	Yellow	Yellow	Orange	Red	Red	Red
Guard Shore	1	Orange	Red	Red	Red	Red	Red
Guilford	3	Green	Green	Yellow	Yellow	Red	Red
Hacksneck	1	Green	Green	Green	Green	Orange	Red
Harborton	1	Green	Green	Green	Green	Red	Red
Hopkins	1	Orange	Red	Red	Red	Red	Red
Henry's Point	1	Green	Green	Green	Green	Green	Yellow
Locustville	2	Green	Green	Yellow	Yellow	Yellow	Yellow
Mount Nebo	3	Green	Green	Green	Yellow	Yellow	Yellow
Nandua Bay	1	Green	Green	Orange	Orange	Red	Red
NASA Wallops Flight Facility - Main Base	2	Green	Green	Green	Green	Green	Yellow
NASA Wallops Flight Facility - Mid-Atlantic Regional Spaceport	1	Green	Green	Green	Red	Red	Red
North Chesconessex	1	Green	Orange	Red	Red	Red	Red
Pitts Creek Landing	1	Orange	Red	Red	Red	Red	Red
Poplar Cove	1	Green	Orange	Red	Red	Red	Red
Sanford	2	Green	Red	Red	Red	Red	Red
Saxis	1	Orange	Orange	Red	Red	Red	Red
Schooner Bay	1	Green	Orange	Red	Yellow	Yellow	Yellow
Tangier	0	Red	Red	Red	Red	Red	Red
Trails End	1	Green	Green	Green	Yellow	Yellow	Yellow
Quinby/Upshurs Neck	3	Green	Yellow	Orange	Orange	Orange	Orange
Wachapreague	4	Green	Green	Green	Yellow	Yellow	Yellow

Legend

Community Access Not Impacted

Access to Community Limited

Disconnected /Inaccessible

Majority of Roads Inundated

Legend

**Community
Access Not
Impacted**

**Access to
Community
Limited**

**Disconnected
/Inaccessible**

**Majority of
Roads
Inundated**

<u>Northampton County</u>							
Community/Critical Facility	# of Access Routes	<i>Inundation from Sea Level Rise Above MHHW</i>					
		1 foot (≈2025-2040)	2 feet (≈2040-2070)	3 feet (≈2055-2100)	4 feet (>2065)	5 feet (>2075)	6 feet (>2085)
Arlington Plantation	1						
Bayford	1						
Cape Charles	2						
Cherrystone	1						
Church Neck	1						
Clearview	1						
Franktown	4						
Johnsons Cove/Old Neck	1						
Oyster	2						
The Peacefuls	2						
Red Bank	1						
Vaucluse Shores	1						
Webbs Island	1						
Willis Wharf	2						
Wise Point Landing - ESVA NWR	1						

Sea Level Scenarios Above Current MHHW													
Jurisdiction	Total Miles of Roads	1 foot (≈2025-2040)		2 feet (≈2040-2070)		3 feet (≈2055-2100)		4 feet (>2065)		5 feet (>2075)		6 feet (>2085)	
		Total Miles Inundated	% of Total in Jurisdiction	Total Miles Inundated	% of Total in Jurisdiction	Total Miles Inundated	% of Total in Jurisdiction	Total Miles Inundated	% of Total in Jurisdiction	Total Miles Inundated	% of Total in Jurisdiction	Total Miles Inundated	% of Total in Jurisdiction
Eastern Shore of Virginia	1516	33	2.2%	131	8.6%	209	13.8%	270	17.8%	319	21.0%	371	24.5%
Accomack County	1014	31	3.1%	115	11.3%	183	18.0%	236	23.3%	275	27.1%	316	31.2%
Town of Belle Haven	7	0	0.0%	0	0.0%	0	0.0%	0.11	1.6%	0.11	1.6%	0.32	4.6%
Town of Chincoteague	60	4	6.7%	38	63.3%	56	93.3%	60	100.0%	60	100.0%	60	100.0%
Town of Onancock	13	0	0.0%	0.43	3.3%	0.79	6.1%	1	7.7%	1	7.7%	1	7.7%
Town of Saxis	4	0.25	6.3%	1	25.0%	2	50.0%	4	100.0%	4	100.0%	4	100.0%
Town of Tangier	4	4	100.0%	4	100.0%	4	100.0%	4	100.0%	4	100.0%	4	100.0%
Town of Wachapreague	5	0.12	2.4%	0.12	2.4%	0.88	17.6%	2	40.0%	2	40.0%	5	100.0%
Northampton County	502	2	0.4%	16	3.2%	26	5.2%	34	6.8%	44	8.8%	55	11.0%
Town of Cape Charles	28	0	0.0%	0	0.0%	0	0.0%	0.2	0.7%	6	21.4%	8	28.6%

Lessons Learned



- VDOT's current engineering and planning horizons do not extend beyond 22 years for roads and 50 years for bridges
- Considering flooding, sea-level rise and inundation is currently not a widely used practice by VDOT
- VDOT has no policy for determining which roads will continue to be maintained based off the number of properties served by a road
- The Eastern Shore will be competing for funding to re-engineer roads with many other localities in Virginia

Next Steps

- Report published February 2015
- Incorporate findings into 6-Year Transportation Plan and Long-Range Transportation Plan
- Continue working with VDOT to identify strategic plan for implementing necessary engineering work to mitigate inundation
- Distribute report and publish maps on VCZM Coastal GEMS portal and TNC's Coastal Resilience portal

