

RESILIENT DESIGN GUIDELINES UPDATE

HRPDC Coastal Resiliency Committee

March 26, 2021

Resilient Design Guidelines for Floodplain Management

FLOODPLAIN MAPPING

Maps of projected future floodplains based on sea level rise projections

DESIGN TAILWATER ELEVATIONS

Watershed-based stormwater management standards

DESIGN FLOOD ELEVATIONS

Building requirements that incorporate sea level rise



FUTURE FLOODPLAIN MAPPING

Goals

Future floodplain maps incorporating regional sea level rise planning scenarios

GIS layers for riverine base flood elevations and other recurrence intervals

Integration of coastal and riverine layers to align with existing floodplain maps

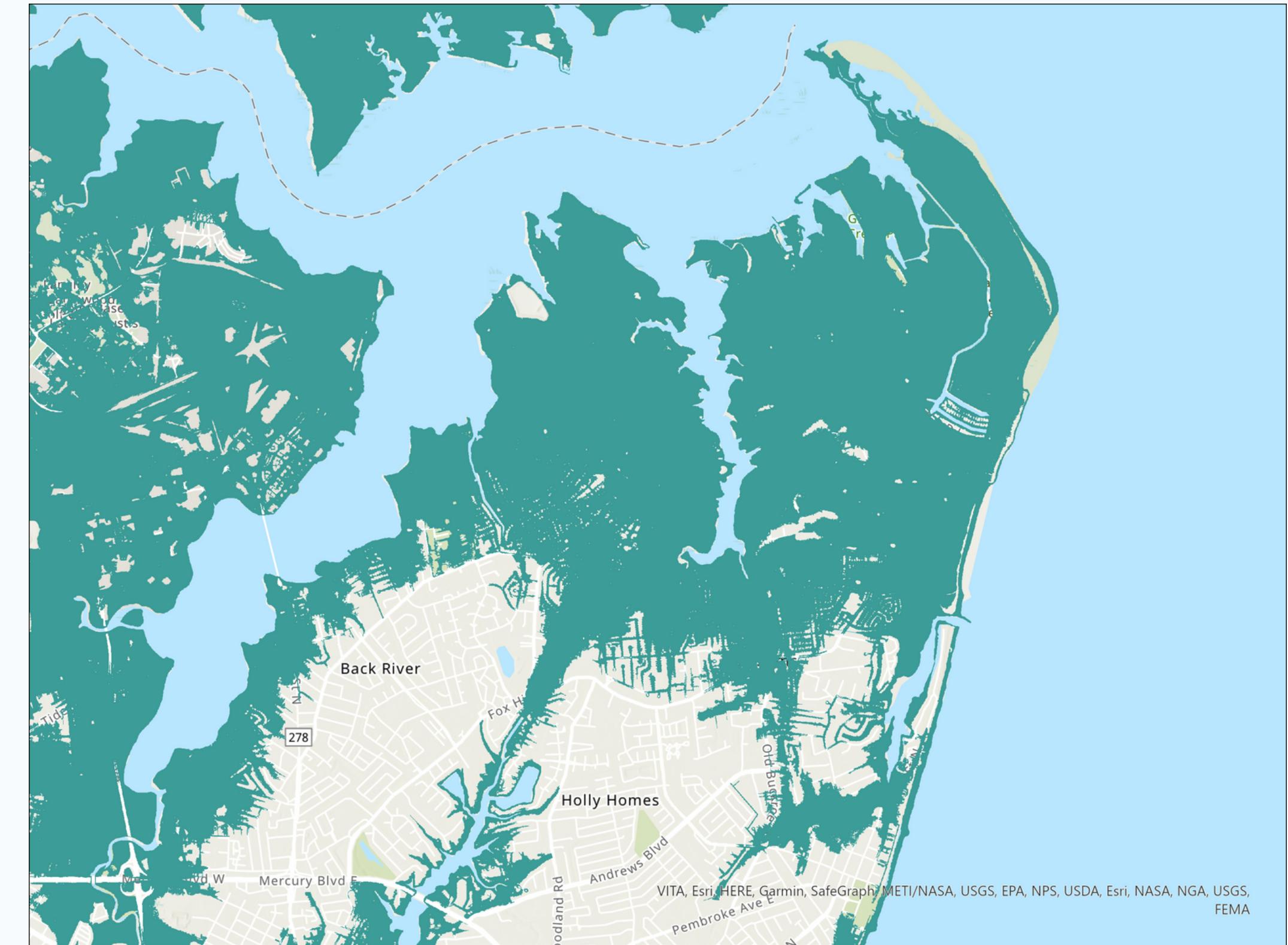
Status: In Development

Future Floodplain Mapping

Hampton, VA

1% Annual Chance
Floodplain

No sea level rise

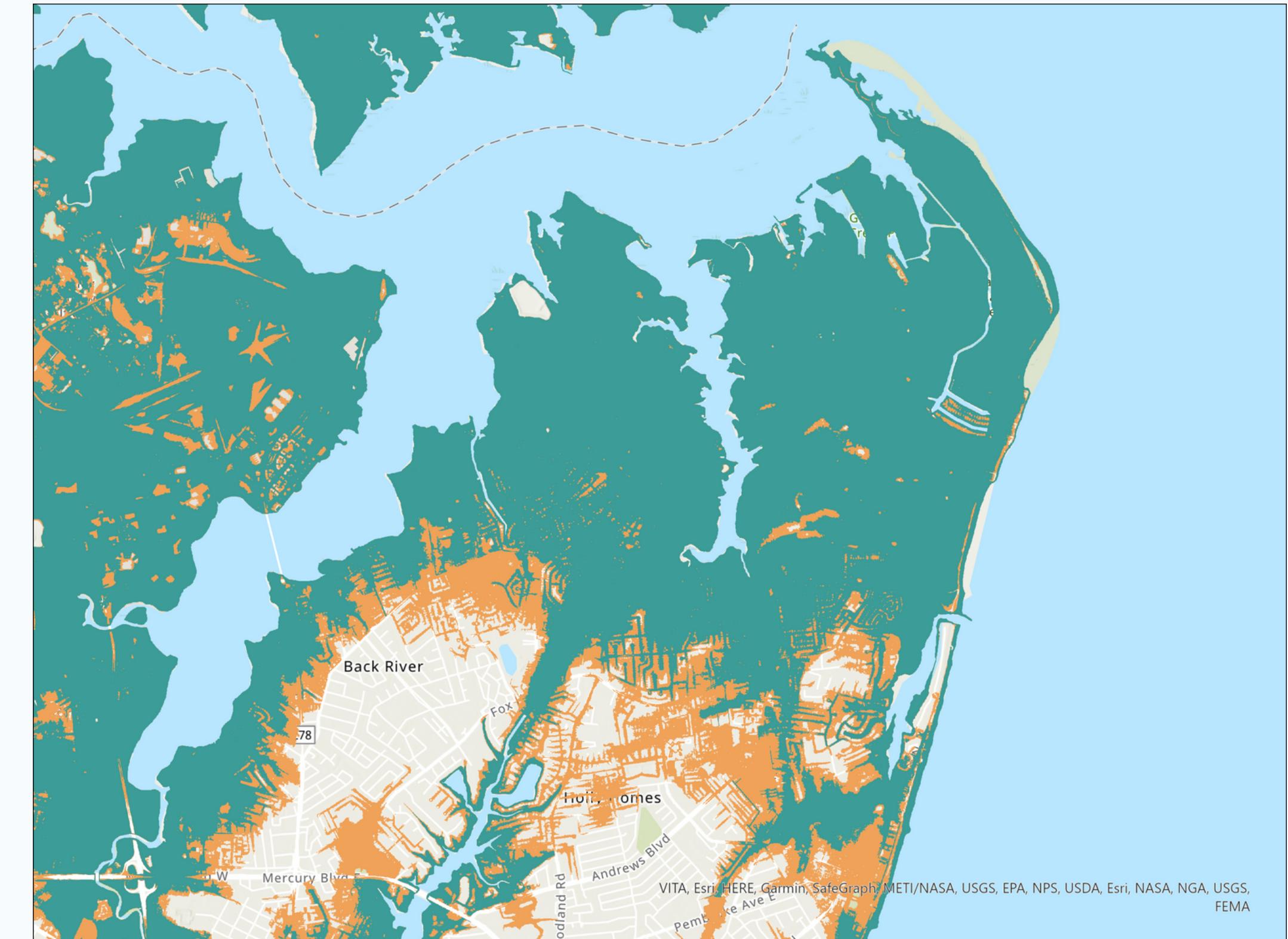


Future Floodplain Mapping

Hampton, VA

1% Annual Chance
Floodplain

1.5' sea level rise

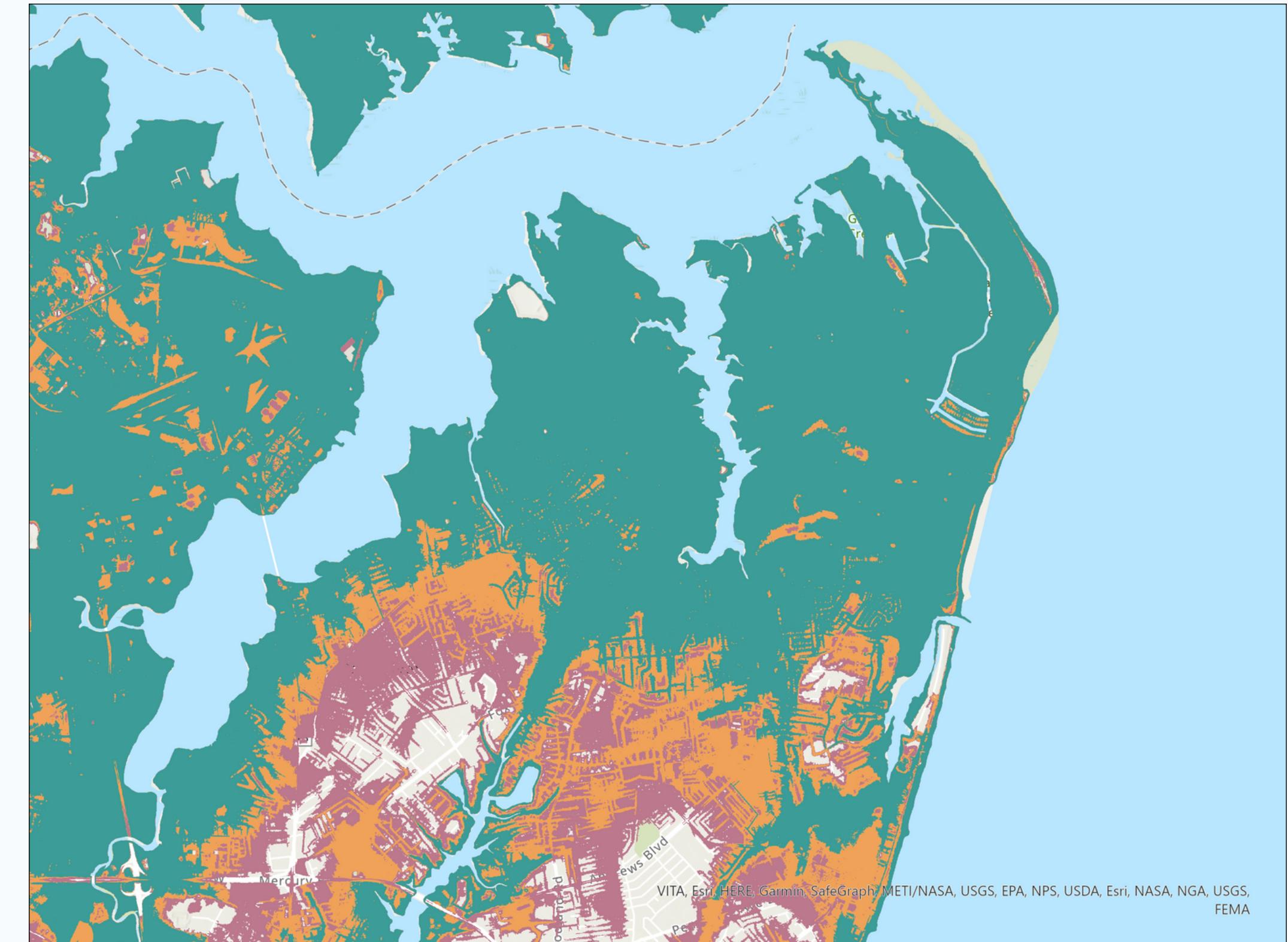


Future Floodplain Mapping

Hampton, VA

1% Annual Chance
Floodplain

3' sea level rise





DESIGN TAILWATER ELEVATIONS

Goals

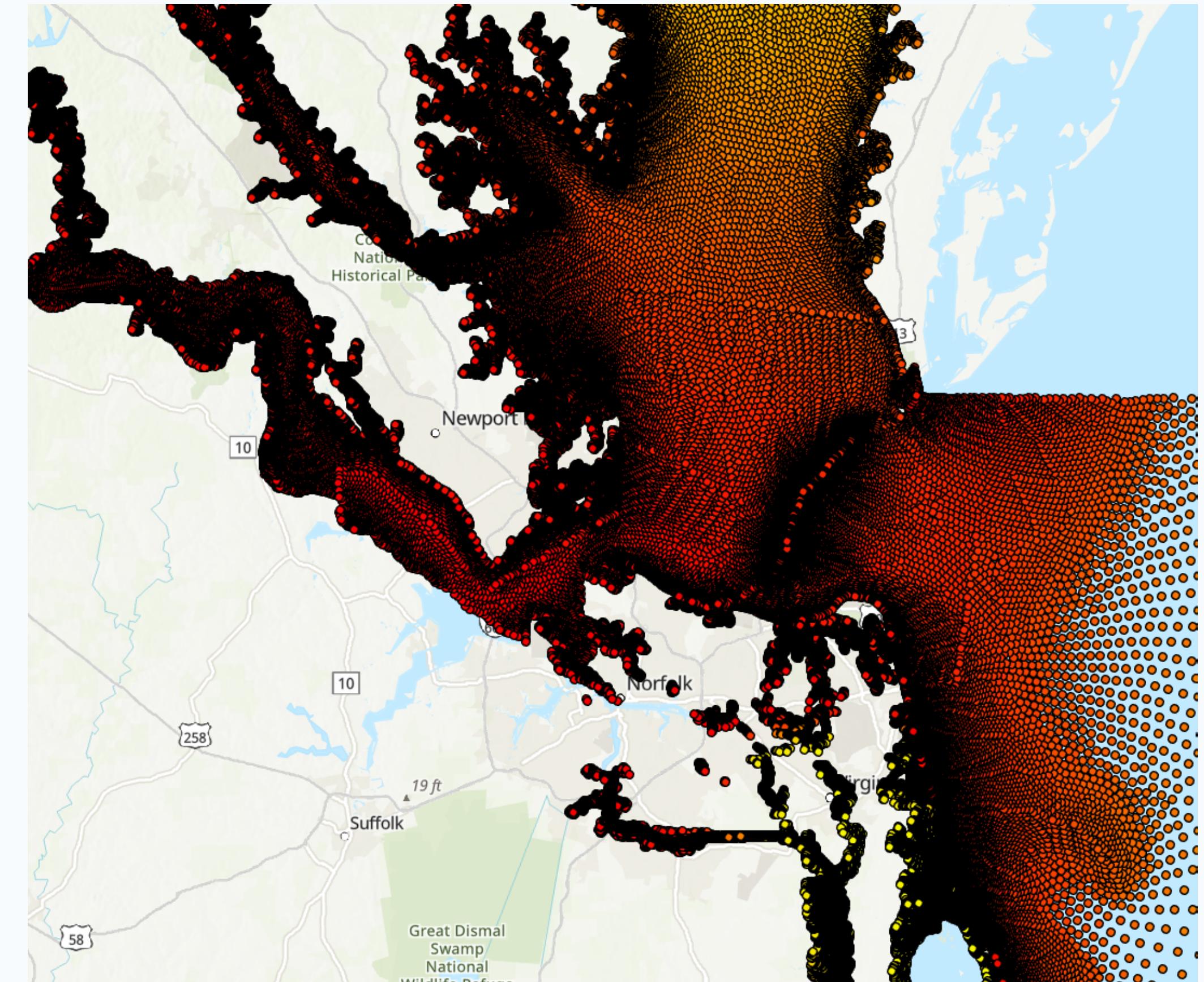
Calculate design tailwater elevations for individual watersheds (HUC10, HUC12) across Hampton Roads for 1-year to 500-year recurrence intervals

Calculate tailwaters that include regional sea level rise planning scenarios

Status: DRAFT completed

Methodology

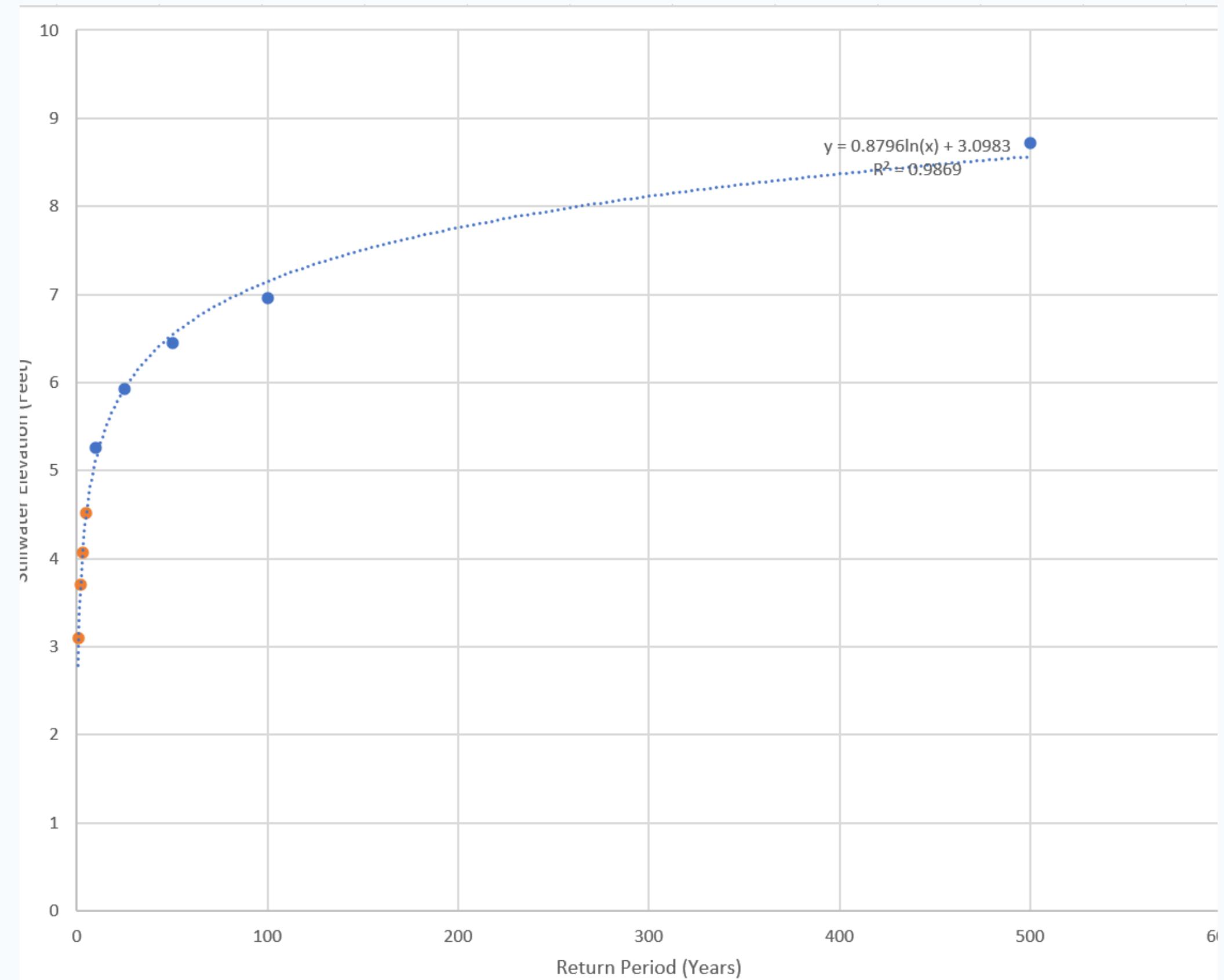
FEMA Region III
Storm Surge Study
ADCIRC grid
contains values for
**10-year, 25-year,
50-year, 100-year,
and 500-year** storm
surge stillwater
elevations



Methodology

Log-linear extrapolation can be used to generate values for more frequent return periods **(1-year, 2-year, 3-year, 5-year)**

Tailwater values calculated for each return period based on the 95th-percentile for a given geography



Results

Tailwater values calculated for each return period based on the 95th-percentile for a given geography for various combinations of sea level rise and storm recurrence intervals

Design Tidal Elevations for Chesapeake

All elevations in feet relative to the North American Vertical Datum (NAVD) of 1988

HUC12	Watershed	Design Level	1-Year	2-Year	3-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
020802080201	New Mill Creek-Southern Branch Elizabeth River	Existing Condition	3.9	4.5	4.8	5.2	5.8	6.6	7.2	7.8	9.2
		1.5 ft SLR	5.4	6.0	6.3	6.7	7.3	8.1	8.7	9.3	10.7
		3.0 ft SLR	6.8	7.4	7.7	8.1	8.7	9.5	10.1	10.7	12.1
		4.5 ft SLR	8.3	8.9	9.2	9.6	10.2	11.0	11.6	12.2	13.6
020802080203	Deep Creek-Southern Branch Elizabeth River	Existing Condition	3.4	4.1	4.5	5.1	5.9	6.7	7.3	8.0	10.0
		1.5 ft SLR	4.9	5.6	6.0	6.6	7.4	8.2	8.8	9.5	11.5
		3.0 ft SLR	6.4	7.1	7.5	8.1	8.9	9.7	10.3	11.0	13.0
		4.5 ft SLR	7.9	8.6	9.0	9.6	10.4	11.2	11.8	12.5	14.5
020802080204	Eastern Branch Elizabeth River	Existing Condition	2.9	3.7	4.2	4.8	5.9	6.6	7.3	8.0	10.4
		1.5 ft SLR	4.4	5.2	5.7	6.3	7.4	8.1	8.8	9.5	11.9
		3.0 ft SLR	6.0	6.8	7.3	7.9	9.1	9.8	10.5	11.2	13.6
		4.5 ft SLR	7.5	8.3	8.9	9.5	10.6	11.3	12.0	12.7	15.2
020802080205	Western Branch Elizabeth River	Existing Condition	3.7	4.5	4.9	5.4	6.1	7.0	7.9	8.6	10.3
		1.5 ft SLR	5.2	6.0	6.4	6.9	7.6	8.5	9.4	10.1	11.8
		3.0 ft SLR	6.9	7.7	8.1	8.6	9.3	10.2	11.2	11.9	13.6
		4.5 ft SLR	8.4	9.2	9.6	10.1	10.9	11.8	12.7	13.4	15.2
030102051104	Indian Creek-Northwest River	Existing Condition	0.1	0.5	0.7	1.0	1.4	2.0	2.4	2.8	3.8
		1.5 ft SLR	1.6	2.0	2.2	2.5	2.9	3.5	3.9	4.3	5.3
		3.0 ft SLR	3.2	3.6	3.8	4.2	4.6	5.2	5.6	6.0	7.1
		4.5 ft SLR	4.8	5.2	5.4	5.7	6.1	6.8	7.2	7.6	8.6
030102051201	Chesapeake Canal	Existing Condition	3.0	3.6	4.0	4.4	5.0	5.8	6.4	7.0	8.4
		1.5 ft SLR	4.5	5.1	5.5	5.9	6.5	7.3	7.9	8.5	9.9
		3.0 ft SLR	6.0	6.6	7.0	7.4	8.0	8.8	9.4	10.0	11.4
		4.5 ft SLR	7.5	8.1	8.5	8.9	9.5	10.3	10.9	11.5	12.9
030102051203	Upper North Landing River	Existing Condition	0.4	0.8	1.0	1.3	1.8	2.2	2.5	3.0	4.0
		1.5 ft SLR	1.9	2.3	2.5	2.8	3.3	3.7	4.0	4.5	5.5
		3.0 ft SLR	3.5	3.9	4.1	4.5	5.0	5.4	5.7	6.2	7.3
		4.5 ft SLR	5.1	5.5	5.7	6.0	6.5	7.0	7.3	7.8	8.8

Notes:

1. Sea level rise scenarios are based on HRPDC Sea Level Rise Planning Policy and Approach (2018).
2. All elevations sourced from statistical analysis of the distribution of water elevations in each watershed from the FEMA Region III Storm Surge Study conducted by the U.S. Army Corps of Engineers Engineer Research and Development Center (2013).
3. Conditions related to the 3-ft and 4.5-ft sea level rise design levels include non-linear increases derived from numerical modeling completed by the U.S. Army Corps of Engineers as part of the North Atlantic Coast Comprehensive Study.



DESIGN FLOOD ELEVATIONS

Goals

Develop design flood elevations incorporating flood risk and sea level rise based on location, expected lifespan, and criticality

Status: In Development

Methodology

Use SLR planning scenarios
to develop Design Flood
Elevations

BFE based on type of
construction and location

Freeboard based on
criticality

Sea level rise scenario based
on projected lifespan and
adaptive capacity

$$\begin{array}{lll} \text{Design} & \text{Base} & \text{Sea} \\ \text{Flood} & = & \text{Flood} + \text{Freeboard} + \text{Level} \\ \text{Elevation} & \text{Elevation} & \text{Rise} \end{array}$$

Elevation-based Development Standards

Zone	Approx. Land Elev. (NAVD)	Allowable Development Density	Allowable Foundation Types	Fill Allowed	Potential Stormwater BMPs
Wet Zone	0 – 6'	None	N/A	No	Living Shorelines/Buffers
Ecological Zone	6 – 10'	Limited (Single)	Elevated	Roadways Only	Promote Buffers/Open Systems/Space/Storage Only
Transition Zone	10 – 15'	Moderate	Elevated/ Limited Slab on Grade	Limited	Closed Systems/ Open Space/Storage and Green Infrastructure/ Infiltration
Community Zone	> 15'	Moderate to Urban	Mix	Limited to Moderate	Green Infrastructure/ Infiltration and Limited Closed Systems

"Elevation Zones" from *Dutch Dialogues Charleston Final Report*, p. 80



PRECIPITATION STANDARDS

Goals

Develop Intensity-Duration-Frequency curves or similar products that account for future climate projections

Status: In Development

Related Efforts

Virginia Beach

NOAA Atlas 14 + 20%

Public Works Design

Standards Manual 2020

VDOT Structure and Bridge Division

NOAA Atlas 14 + 20%

Consideration of Climate

Change and Coastal Storms

Chesapeake Bay Program

Downscaled Climate
Projections

Questions

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