



# 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

A blue-toned sketch of a suburban neighborhood. In the foreground, there's a river or stream with reeds and some small birds. A path or road runs along the water. On the left, there are several houses of varying sizes, some with solar panels on their roofs. Tall, thin trees are scattered throughout the scene. In the background, more houses and trees are visible, along with a few birds flying in the sky. The entire image is overlaid with a semi-transparent blue rectangle.

# **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**



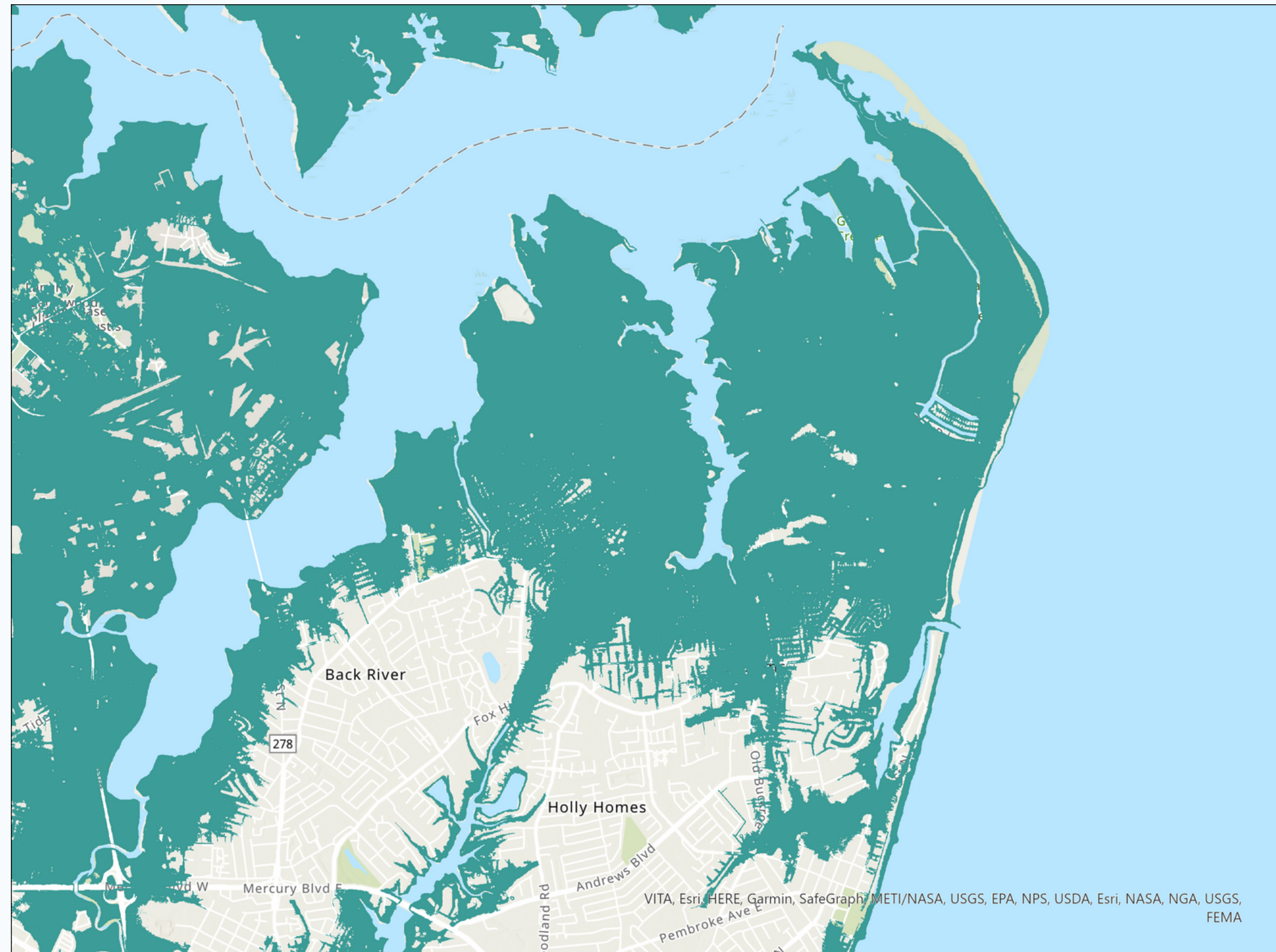
# Future Floodplain Mapping

---

Hampton, VA

1% Annual Chance  
Floodplain

No sea level rise



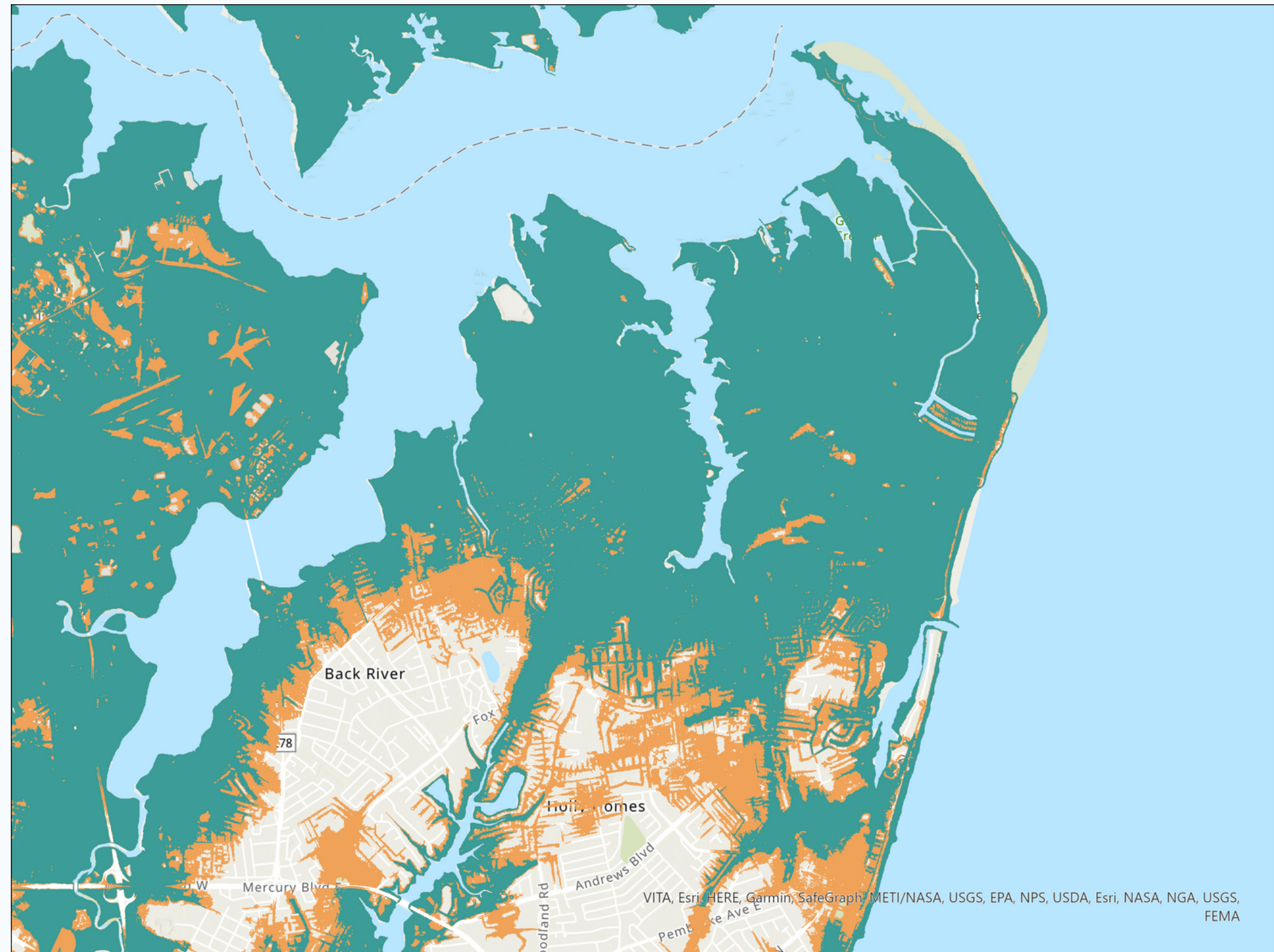
# Future Floodplain Mapping

---

Hampton, VA

1% Annual Chance  
Floodplain

1.5' sea level rise





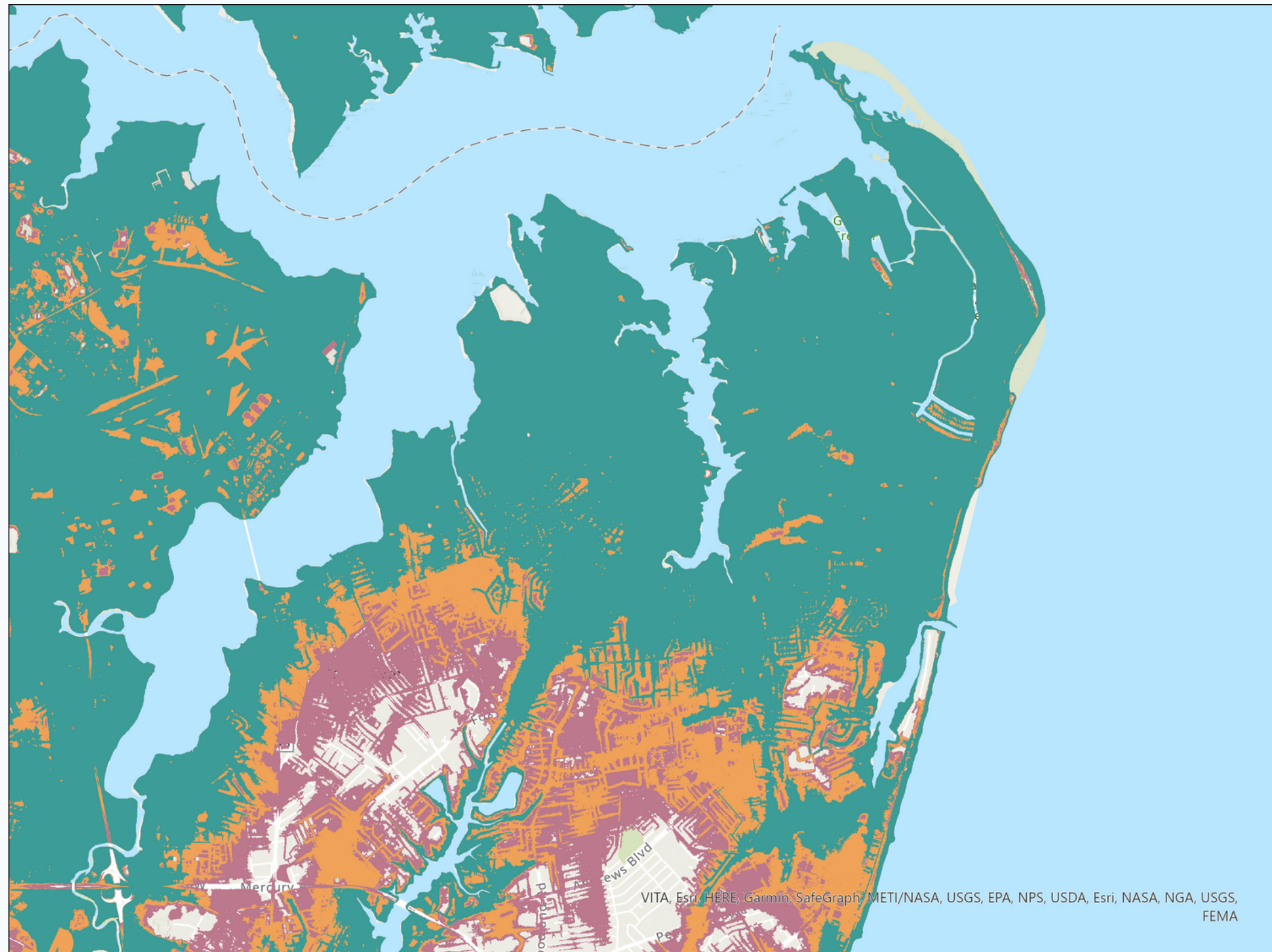
# Future Floodplain Mapping


---

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

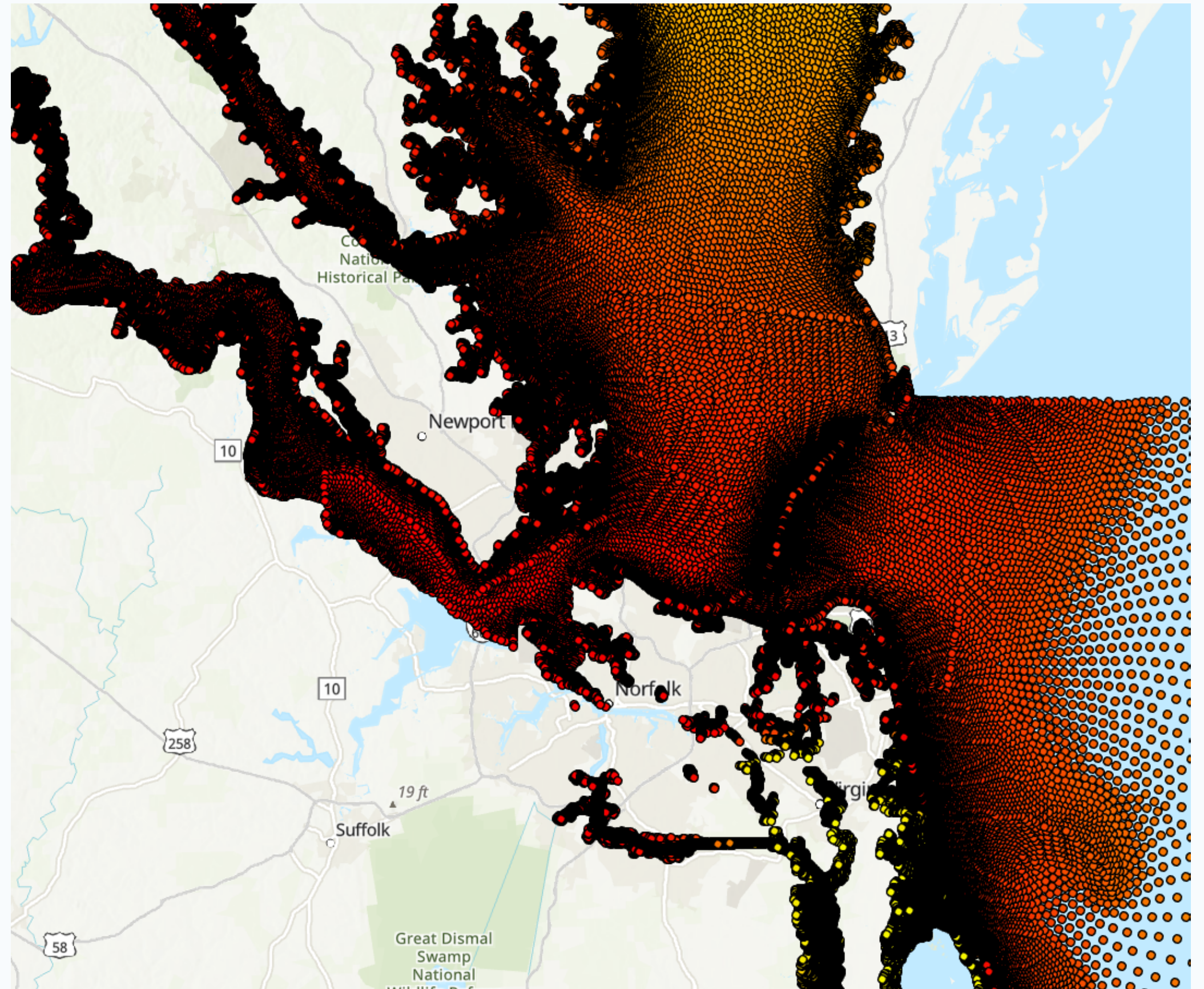
Calculate tailwaters that include regional sea level rise planning scenarios

**Status: DRAFT completed**

# Methodology

---

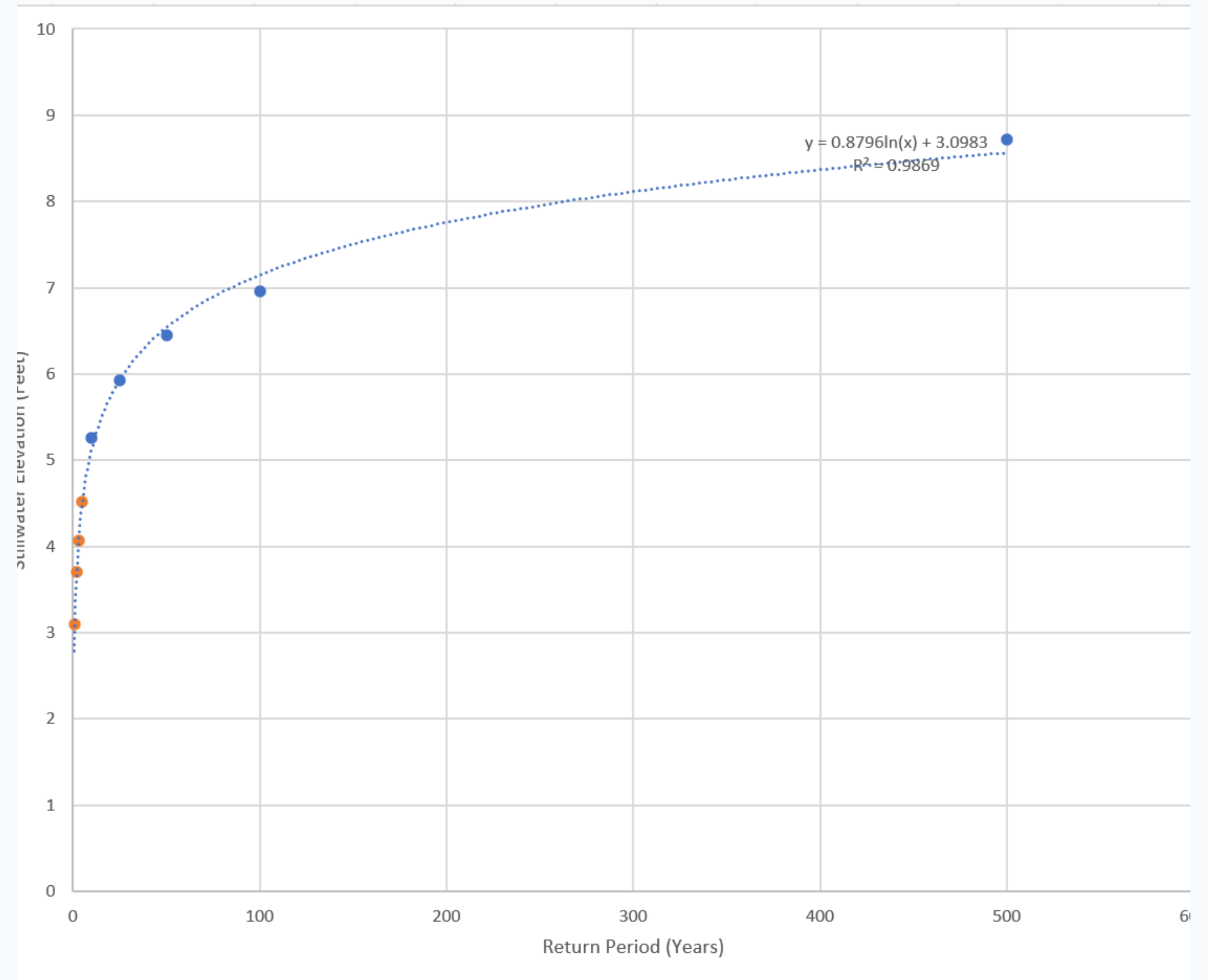
FEMA Region III  
Storm Surge Study  
ADCIRC grid  
contains values for  
**10-year, 25-year,  
50-year, 100-year,  
and 500-year** storm  
surge stillwater  
elevations



# 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

$$\text{Design Flood Elevation} = \text{Base Flood Elevation} + \text{Freeboard} + \text{Sea Level Rise}$$

# 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

A blue-toned architectural sketch of a suburban neighborhood. In the foreground, a river flows from left to right, with tall reeds and grasses along its banks. Several ducks are swimming in the water. On the left bank, there are several houses of varying sizes, some with solar panels on their roofs. Tall, slender trees stand behind the houses. In the background, more houses and trees are visible, along with rolling hills under a sky with a few birds flying. The overall style is a detailed line drawing with a monochromatic blue color scheme.

# **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

---

Ben McFarlane  
Senior Regional Planner  
Hampton Roads PDC  
[bmcfarlane@hrpdcva.gov](mailto:bmcfarlane@hrpdcva.gov)