# HRPDC RESILIENT DESIGN GUIDELINES

Urban Stormwater/Climate Resiliency Workgroup Joint Meeting
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Performance standards such as design storms are based on risk.

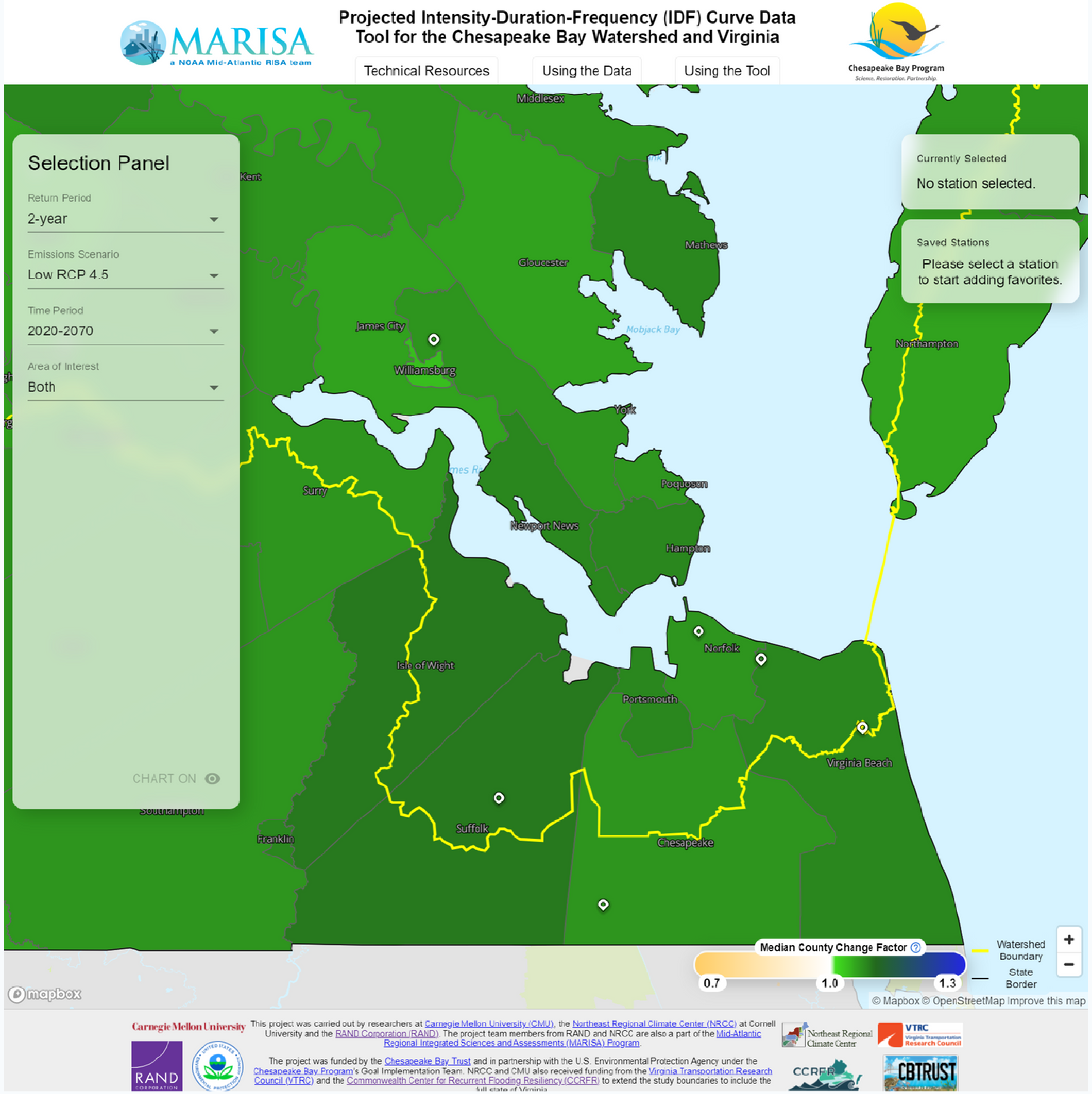
Risk is a function of the probability of an occurrence and its consequences.

For public policies to work, it's important for expectations align with reality, which means we need to factor in climate change.

Uncertainty in future conditions and climate modeling increases the difficulty in developing and implementing cost-effective public policies.

# Future Precipitation

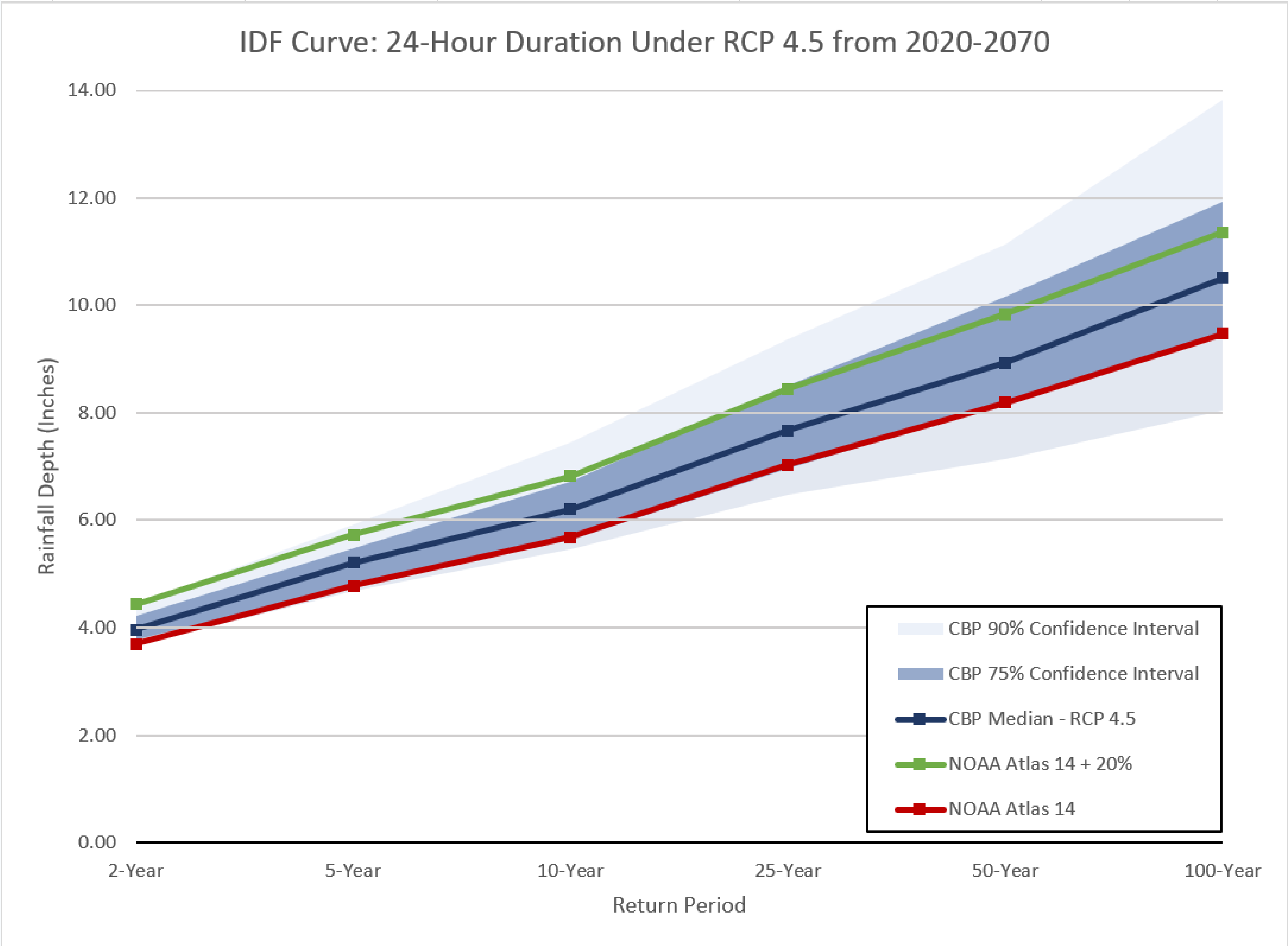
HRPDC is working with its local governments, other regions, and state agencies in Virginia on how to use the RAND/MARISA tool.




https://midatlantic-idf.rcc-acis.org/

# Methodology

Uncertainty in how precipitation will change as a result of climate change is significant. Using the median or mean may not be the best option.




Values for Chesapeake, Virginia
Data Source: NOAA Atlas 14, MARISA/Chesapeake Bay Program

# Methodology

Sound science does not always make for easy public policy decisions.

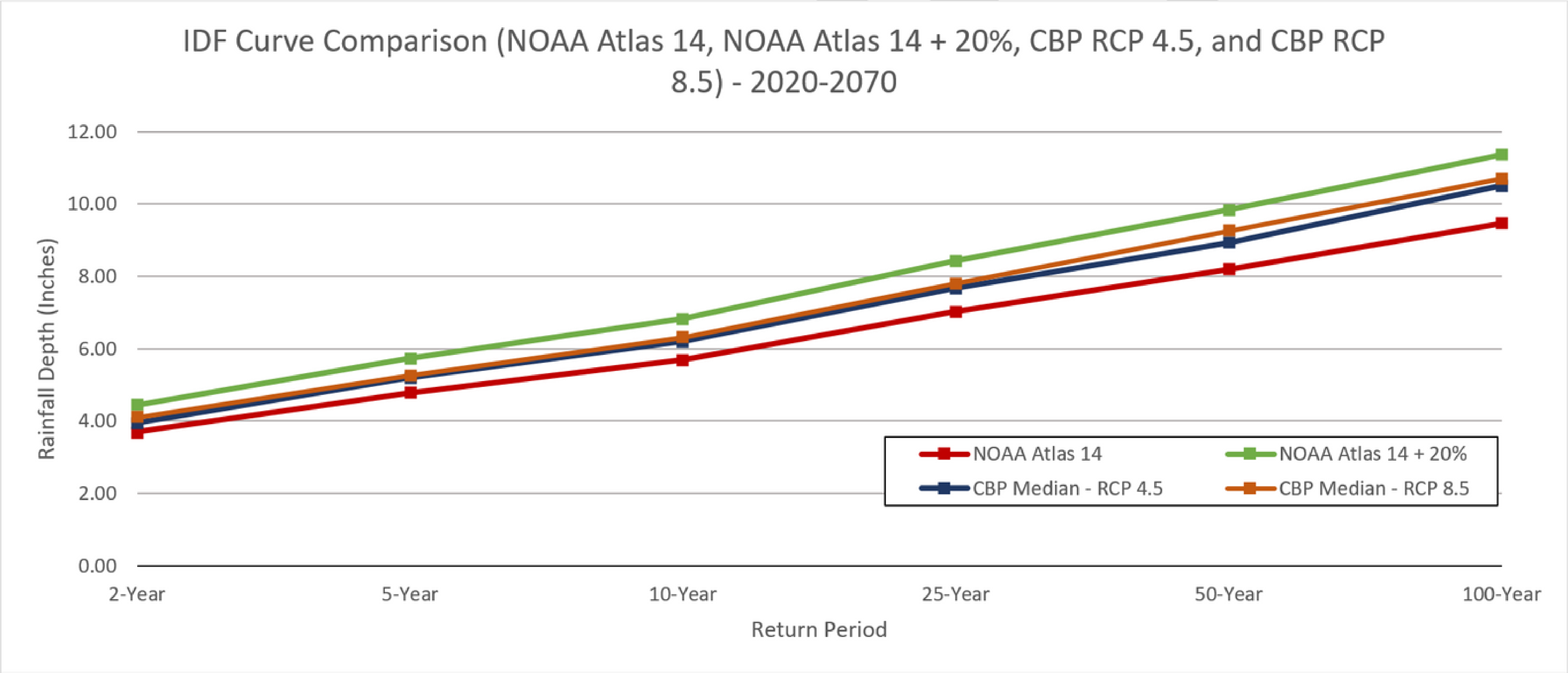
Which climate scenario to use?

What confidence level?

Which time frame?

Chesapeake – 24-Hour Design Precipitation Depths (Inches)

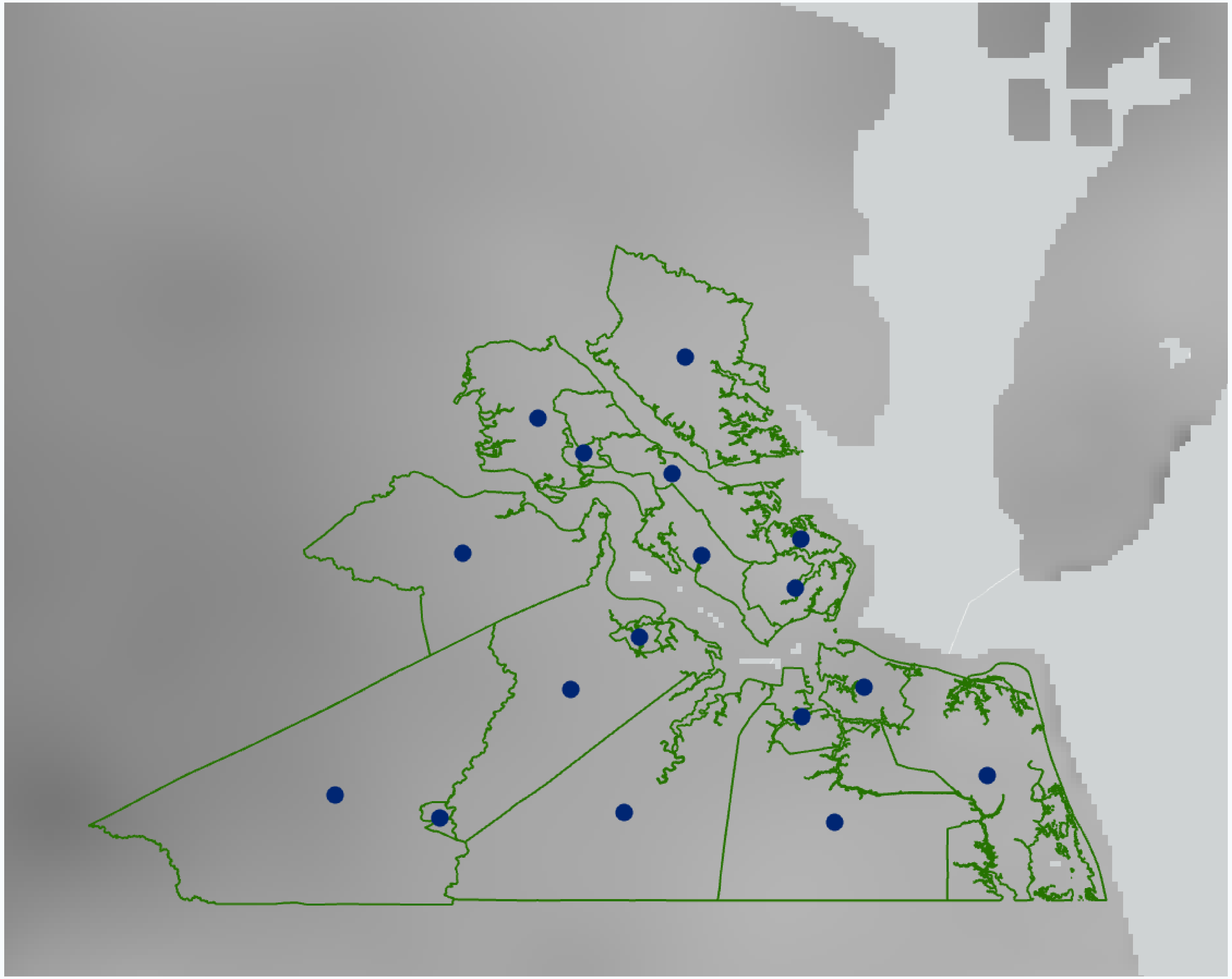
| Return Period | Atlas 14 | Atlas 14 + 20% | RCP 4.5 10th | RCP 4.5 25th | RCP 4.5 50th | RCP 4.5 75th | RCP 4.5 90th | RCP 8.5 10th | RCP 8.5 25th | RCP 8.5 50th | RCP 8.5 75th | RCP 8.5 90th |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2-Year | 3.70 | 4.44 | 3.66 | 3.77 | 3.96 | 4.22 | 4.44 | 3.63 | 3.85 | 4.11 | 4.25 | 4.40 |
| 5-Year | 4.78 | 5.73 | 4.68 | 4.78 | 5.20 | 5.49 | 5.92 | 4.63 | 4.97 | 5.25 | 5.63 | 5.97 |
| 10-Year | 5.69 | 6.83 | 5.46 | 5.63 | 6.20 | 6.71 | 7.45 | 5.52 | 5.92 | 6.31 | 6.83 | 7.28 |
| 25-Year | 7.04 | 8.44 | 6.47 | 6.96 | 7.67 | 8.51 | 9.36 | 6.47 | 7.32 | 7.81 | 8.65 | 9.22 |
| 50-Year | 8.19 | 9.83 | 7.13 | 8.19 | 8.93 | 10.16 | 11.14 | 7.29 | 8.44 | 9.26 | 10.41 | 11.06 |
| 100-Year | 9.47 | 11.36 | 8.05 | 9.47 | 10.51 | 11.93 | 13.82 | 8.24 | 9.66 | 10.70 | 12.12 | 13.16 |




Values for Chesapeake, Virginia
Data Source: NOAA Atlas 14, MARISA/Chesapeake Bay Program

# HRPDC Approach

Calculate baseline NOAA Atlas 14 values using NOAA precipitation grid for each return period and locality centroid



Data Source: NOAA Atlas 14, Volume 2

# HRPDC Approach

Use MARISA tool to calculate future precipitation values based on locality centroids and Atlas 14.

## Return Periods

2-, 5-, 10-, 25-, 50-, and 100-year return periods

## Emissions Scenarios

RCP 4.5 (Low)
RCP 8.5 (High)

## Time Period

2020-2070

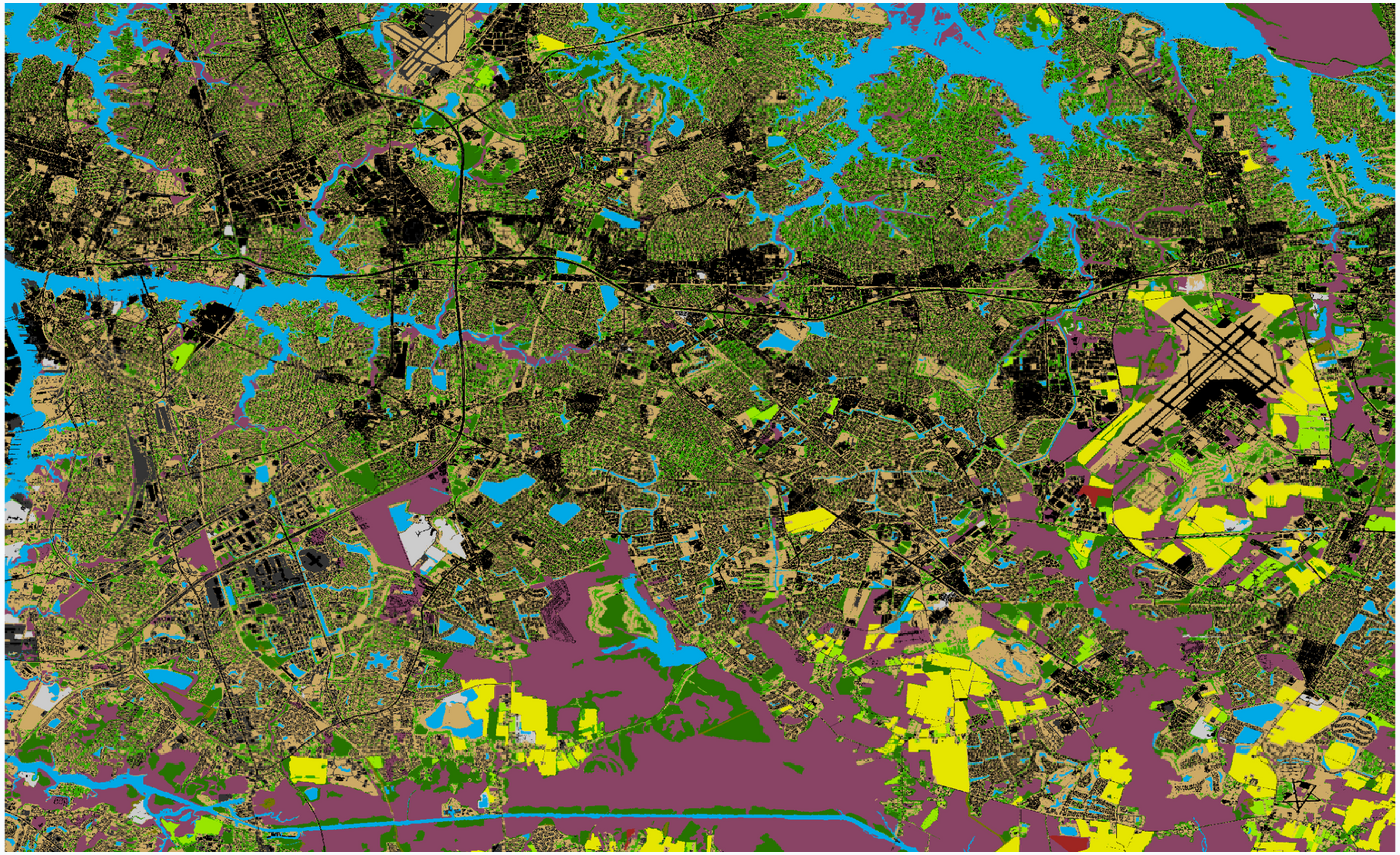
## Confidence Intervals

50th Percentile
75th Percentile

# HRPDC Approach

Impervious cover is used as a proxy for watershed capacity to absorb rainfall.

More impervious cover means potentially higher consequences if rainfall is greater than predicted.



Data Source: Chesapeake Bay High-Resolution Landcover

# HRPDC Approach

Recommend single multiplier for each locality by averaging 2020-2070 values for all return periods and both emissions scenarios

Percentile selected based on local impervious cover*

- < 10% - use 50th
- > 10% - use 75th

| Multiplier | Localities |
|---|---|
| 1.1 | Gloucester County<br>Isle of Wight County<br>Southampton County<br>Surry County |
| 1.15 | James City County<br>Suffolk<br>Williamsburg<br>York County |
| 1.2 | Chesapeake<br>Franklin<br>Hampton<br>Newport News<br>Norfolk<br>Poquoson<br>Portsmouth<br>Smithfield<br>Virginia Beach |

# Other Considerations

It's not just rainfall - we need to account for sea level rise, tides, and compound events.

## Design Tidal Elevations

**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.



## Joint Probability Events

| Design Storm | Tidal Elevation | Rainfall |
|---|---|---|
| **1-Year** | 10-Year | 1-Year |
| **2-Year** | 5-Year | 2-Year |
| **10-Year** | 1-Year | 10-Year |
| **25-Year** | 2-Year | 25-Year |
| **50-Year** | 2-Year | 50-Year |
| **100-Year** | 3-Year | 100-Year |

# Next Steps

Locality review of draft design standards

Recommendation from HRPDC Coastal Resiliency Committee in December 2021

Consideration by HRPDC Board in Q1-Q2 2022

# Questions

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