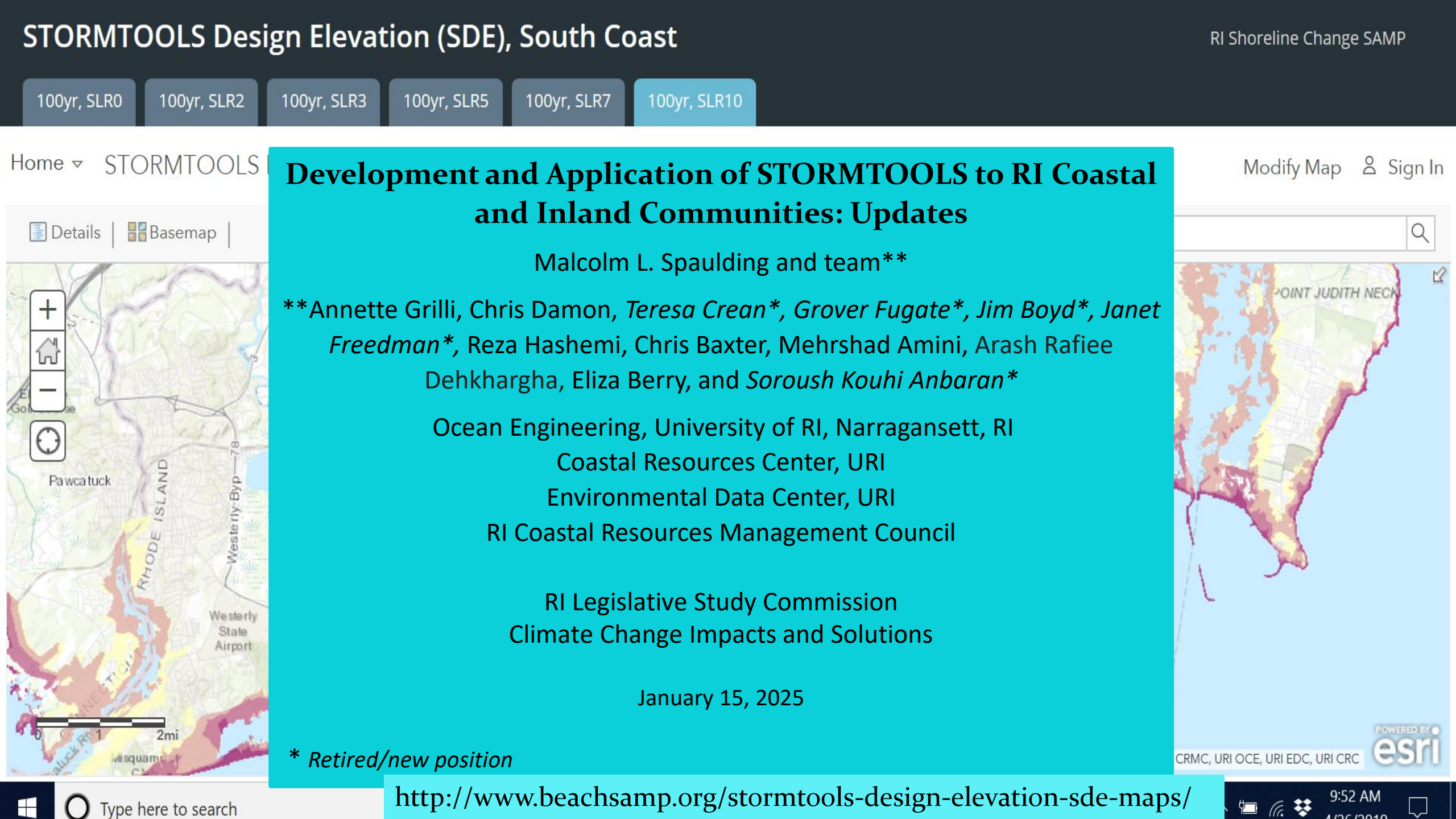


Development and Application of STORMTOOLS to RI Coastal and Inland Communities: Updates

Malcolm L. Spaulding and team**

Annette Grilli, Chris Damon, *Teresa Crean*, Grover Fugate*, Jim Boyd*, Janet Freedman*,* Reza Hashemi, Chris Baxter, Mehrshad Amini, Arash Rafiee Dehkhargha, Eliza Berry, and *Soroush Kouhi Anbaran

Ocean Engineering, University of RI, Narragansett, RI
Coastal Resources Center, URI
Environmental Data Center, URI
RI Coastal Resources Management Council

RI Legislative Study Commission
Climate Change Impacts and Solutions

January 15, 2025

* *Retired/new position*

http://www.beachsamp.org/stormtools-design-elevation-sde-maps/

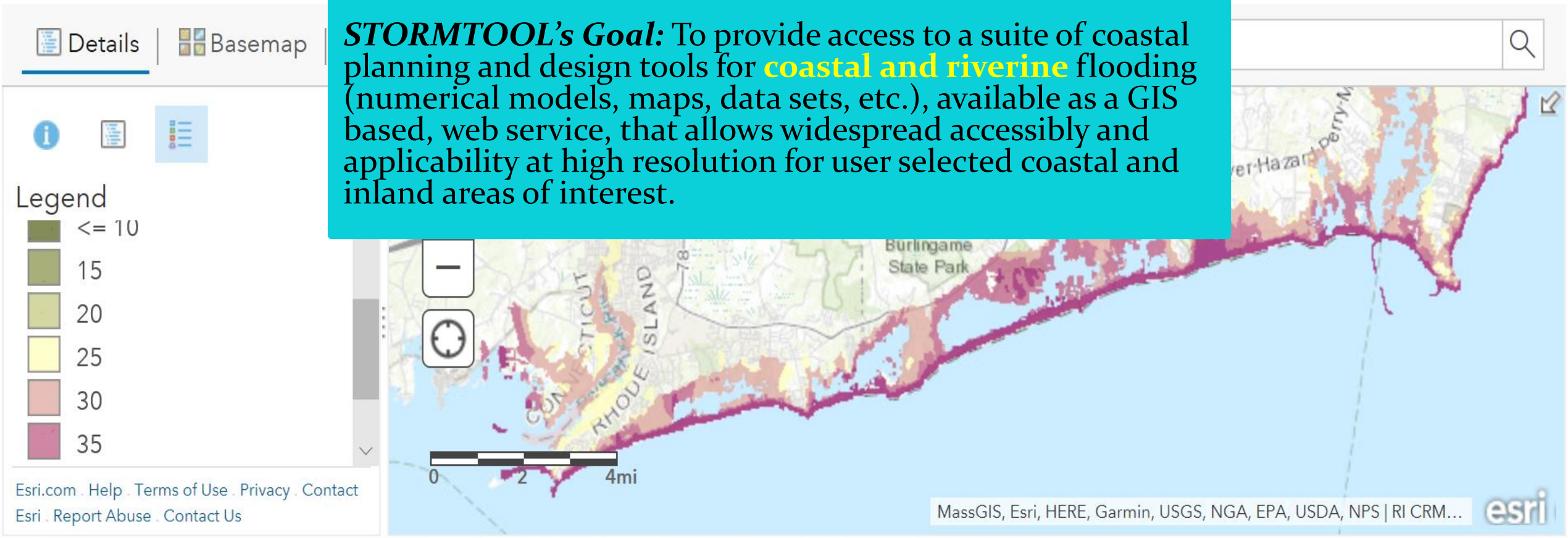
STORMTOOLS Design Elevation (SDE) Review, South Coast

RI Shoreline Change SAMP

100yr, SLR0 | 100yr, SLR2 | 100yr, SLR5 | 100yr, SLR7 | 100yr, SLR10

Home ▾ STORMTOOLS Design Elevation (SDE) Review, South Shore, SLR10 Modify Map Sign In

STORMTOOL's Goal: To provide access to a suite of coastal planning and design tools for **coastal and riverine** flooding (numerical models, maps, data sets, etc.), available as a GIS based, web service, that allows widespread accessibly and applicability at high resolution for user selected coastal and inland areas of interest.



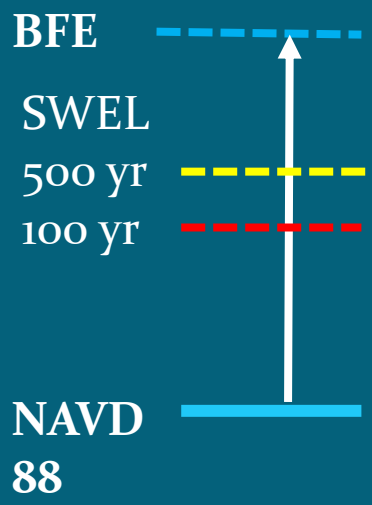
Overarching Objectives

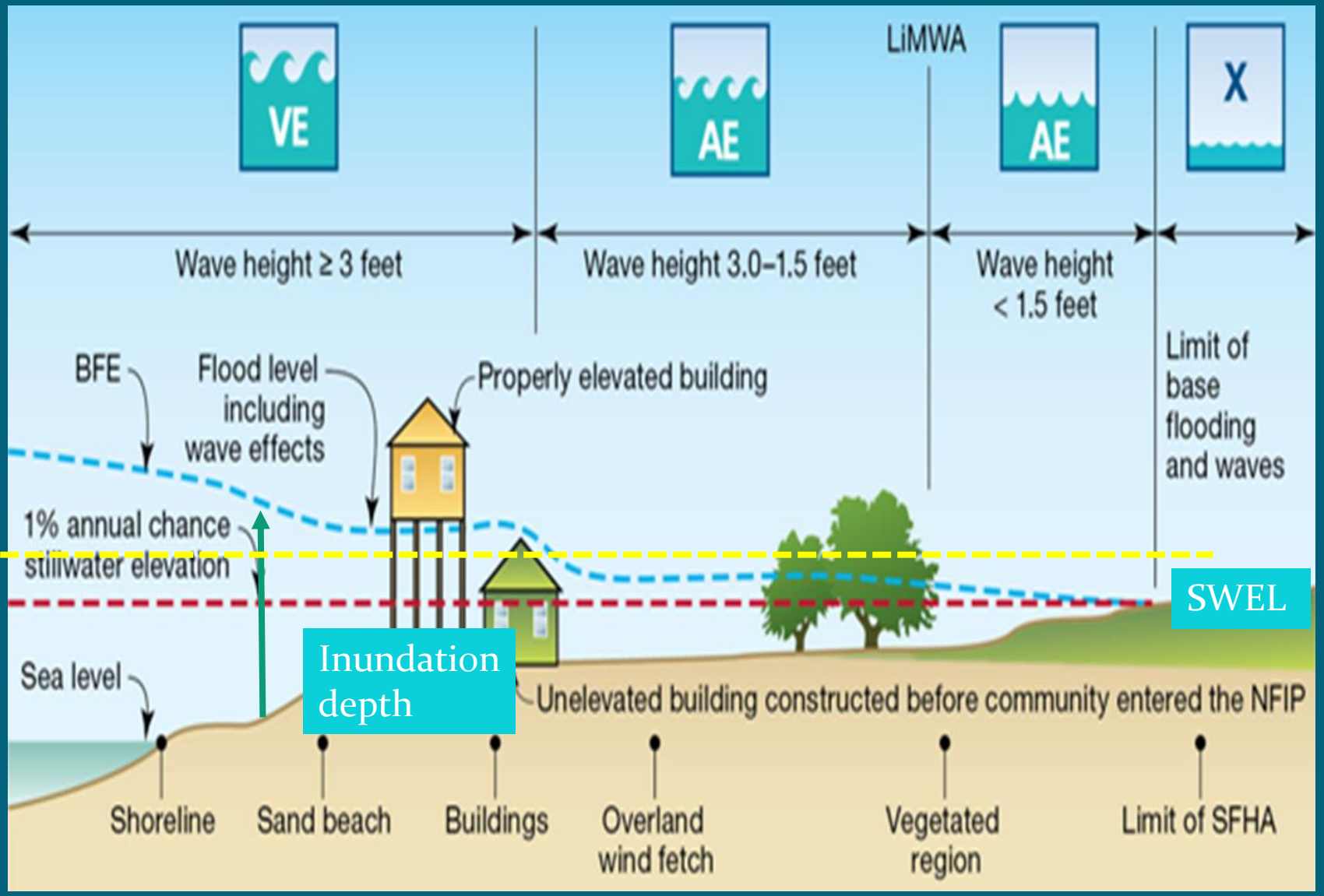
- Seamless **STORMTOOLS** flooding (BFE)/wind and CERI maps for coastal and inland waters of state of RI, that explicitly consider the effects of climate change (sea level rise -coastal and increased precipitation - inland).
- Maps embedded in risk assessment and permitting system for communities and state agencies (RI CRMC, DEM, DOT, etc.) and land use planning that meet current national design standards.
- Maps and tools publicly available, maintained, simple to use and understand, and routinely upgraded.

FEMA flood zones associated water levels and waves

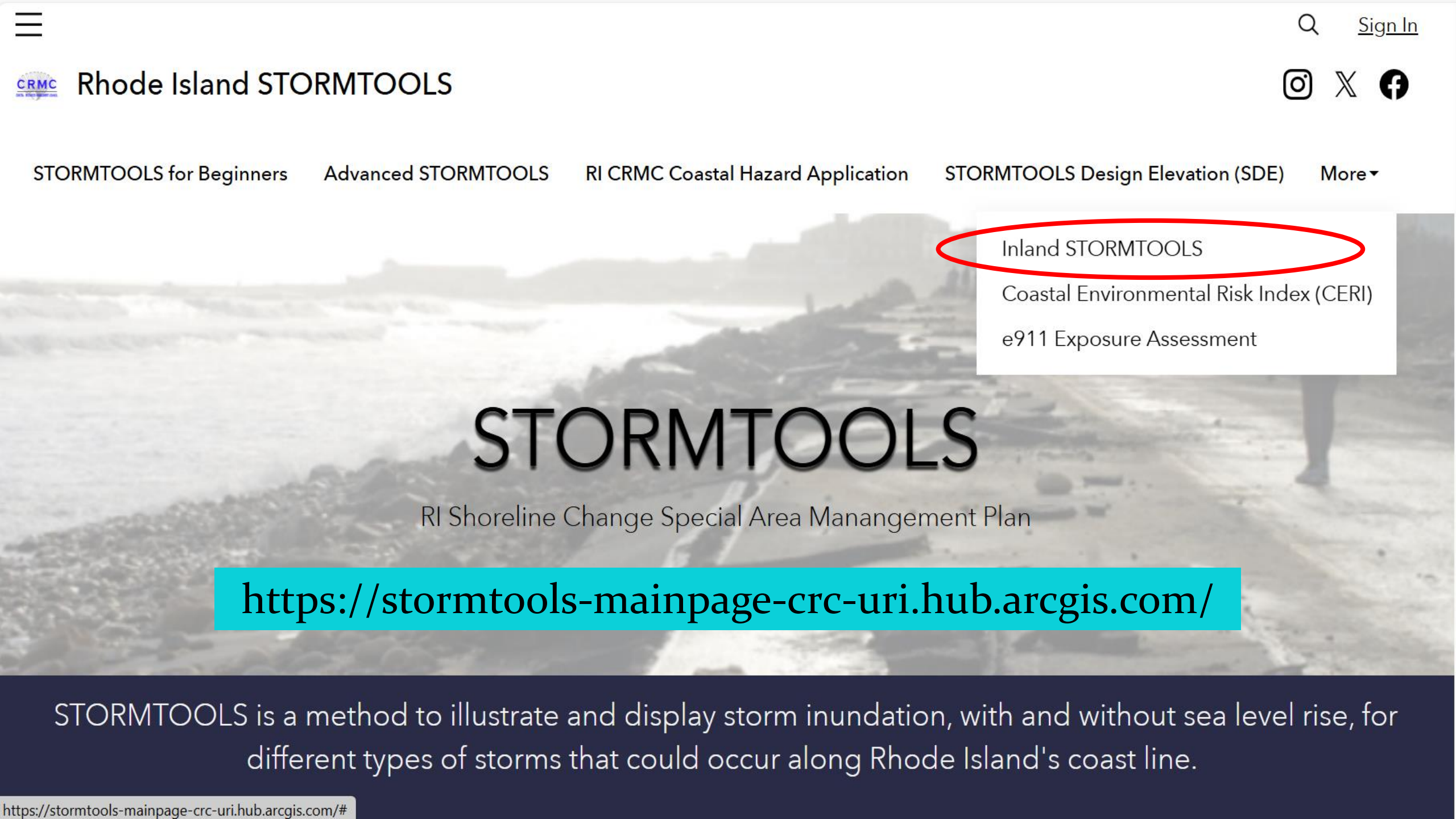
BFE: referenced to NAVD88

Depth of inundation, referenced to grade elevation





FEMA FIRMS 100 and 500 yr events, do not consider sea level rise or change in precipitation.


Sign In
Rhode Island STORMTOOLS
STORMTOOLS for Beginners
Advanced STORMTOOLS
RI CRMC Coastal Hazard Application
STORMTOOLS Design Elevation (SDE)
More
Inland STORMTOOLS
Coastal Environmental Risk Index (CERI)
e911 Exposure Assessment
STORMTOOLS
RI Shoreline Change Special Area Manangement Plan
https://stormtools-mainpage-crc-uri.hub.arcgis.com/
STORMTOOLS is a method to illustrate and display storm inundation, with and without sea level rise, for different types of storms that could occur along Rhode Island's coast line.
https://stormtools-mainpage-crc-uri.hub.arcgis.com/#

ArcGIS ▾ STORMTOOLS for Beginners

Sea Level Rise

Open in Map Viewer | Modify Map | Sign In

Details | Basemap | Share | Print ▾ | Measure | Find address or place

Legend

Will 1-FOOT of SEA LEVEL RISE affect my property?

Will 2-FEET of SEA LEVEL RISE affect my property?

Will 3-FEET of SEA LEVEL RISE affect my property?

Will 5-FEET of SEA LEVEL RISE affect my property?

Will 7-FEET of SEA LEVEL RISE affect my property?

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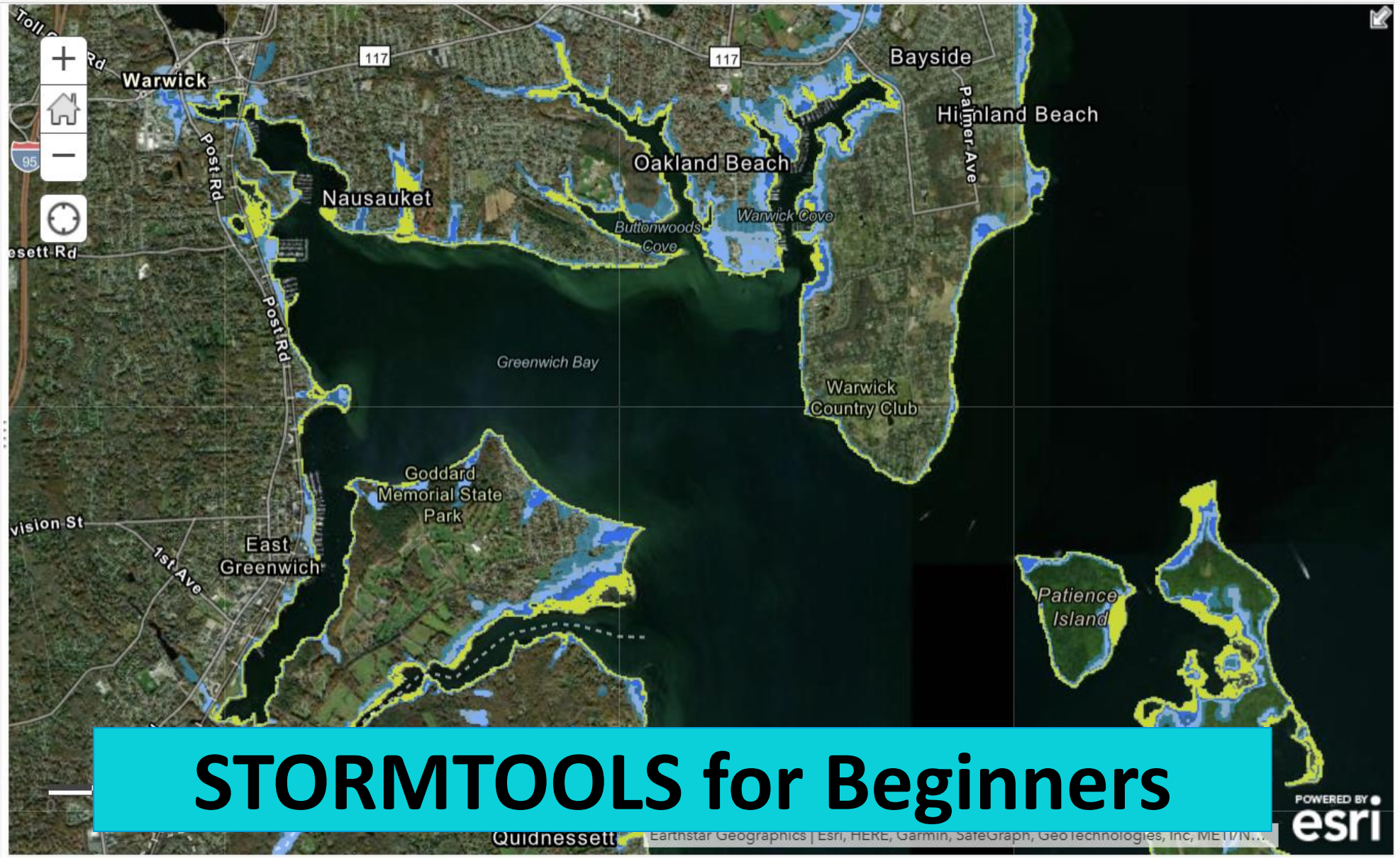


STORMTOOLS for Beginners

RI CRMC COASTAL HAZARD APPLICATION: Risk assessment tool, embedded in permitting system

RI Coastal Resources Management Council

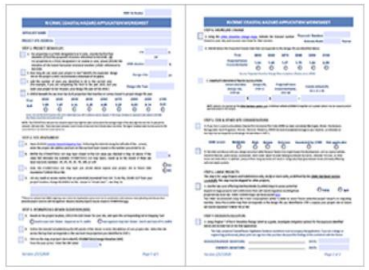
...to preserve, protect, develop, and restore coastal resources for all Rhode Islanders

RI CRMC | News | Topics | Wind Energy | Aquaculture | Publications | Regulations | Applications | Maps | About CRMC | Contact Us | Permit Database

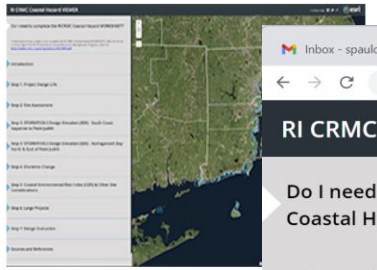
Coastal Hazard Application

Welcome to the RICRMC Coastal Hazard Application WORKSHEET and ONLINE VIEWER!

Please download and print the **RICRMC Coastal Hazard Application WORKSHEET from the link below**, and use the **ONLINE VIEWER** to access the maps and other information required for completion of the **WORKSHEET**.



Coastal Hazards Application Interactive Worksheet (PDF)



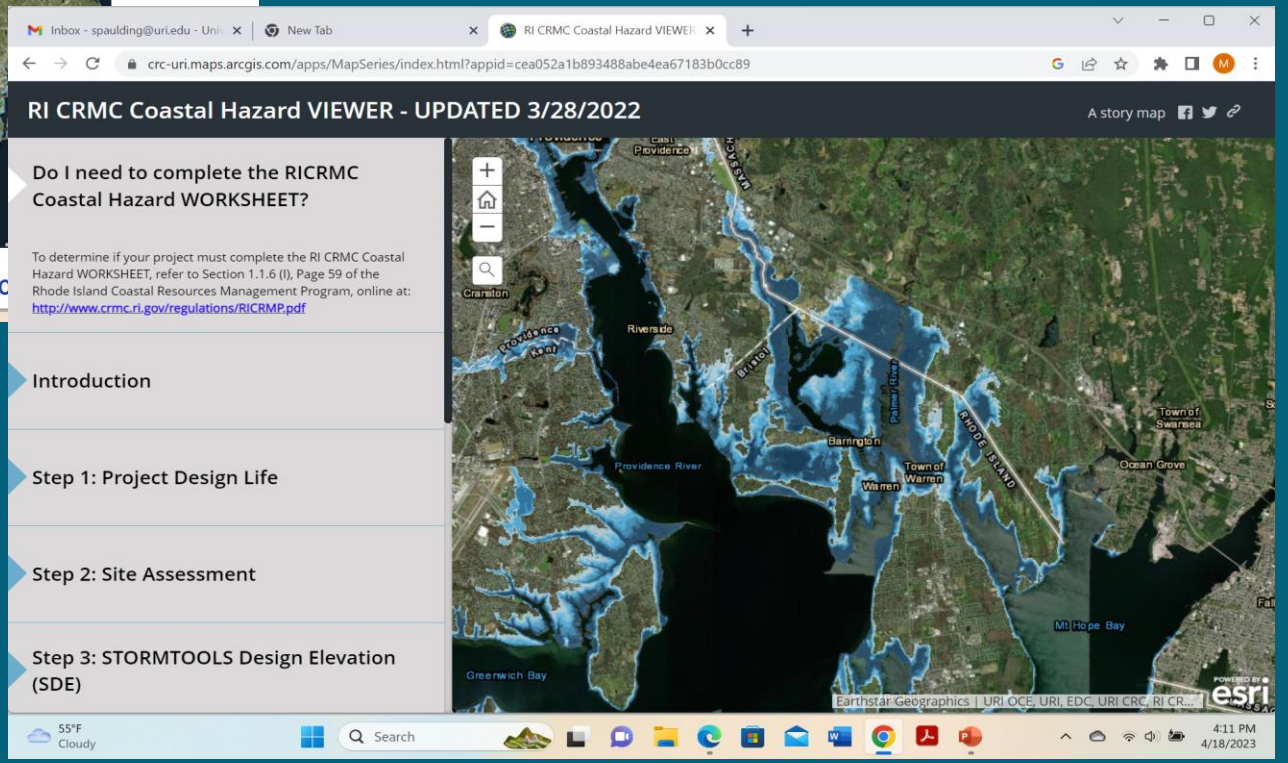
Coastal Hazards Application C

Year	2030	2040	2050	2060	2070	2080	2090	2100
SLR	0.71	1.11	1.60	2.29	3.17	4.19	5.35	6.47

Source: Sea Level Rise (SLR) Projections (Feb. 2022). NOAA High Curve, Newport, RI Tide Gauge. All values are expressed in feet relative to NAVD88. https://sealevel.nasa.gov/task-force-scenario-tool?psmsl_id=351

NOTE: The present National Tidal Datum Epoch (NTDE) is 1983 through 2001. The NOAA 2017 data use a baseline starting at 2000, and the NOAA 2022 data use a baseline starting at 2020. Between 1991 and 2020 there was an annual average of 4.03 mm/year of sea level rise at the Newport (8452660) tide station based on the trends data from the Permanent Service for Mean Sea Level (https://www.psmsl.org/products/trends/). Because the PSMSL trends are based on a minimum 30 years of data we will assume a similar trend applies to the shorter 20 year period of 2000 to 2020. Thus, there was approximately 8.06 cm (3.39 inches) of sea level rise during the period 2000 to 2020. Accordingly, the MHHW elevation of 3.85 feet at the Newport station (Epoch 1983-2001) would be adjusted an additional 3.39 inches to 4.13 feet MHHW. For reference, NAVD88 at Newport is 2.04 feet.

http://www.crmc.ri.gov/coastalhazardapp.html



STORMTOOLS Design Elevation (SDE)

BFE Maps, with Sea Level Rise (SLR)

RI Shoreline Change SAMP

100yr, SLR0 | 100yr, SLR2 | 100yr, SLR3 | 100yr, SLR5 | 100yr, SLR7 | 100yr, SLR10

Home ▾ STORMTOOLS Design Elevation (SDE), SLR0

Open in Map Viewer | Modify Map | Sign In

Details | Basemap | Share | Print ▾ | Measure | Find address or place

Legend

Municipal Boundaries

Stormtools Design Elevation (feet NAVD88)

- <= 10
- 15
- 20
- 25
- 30
- 35
- > 35

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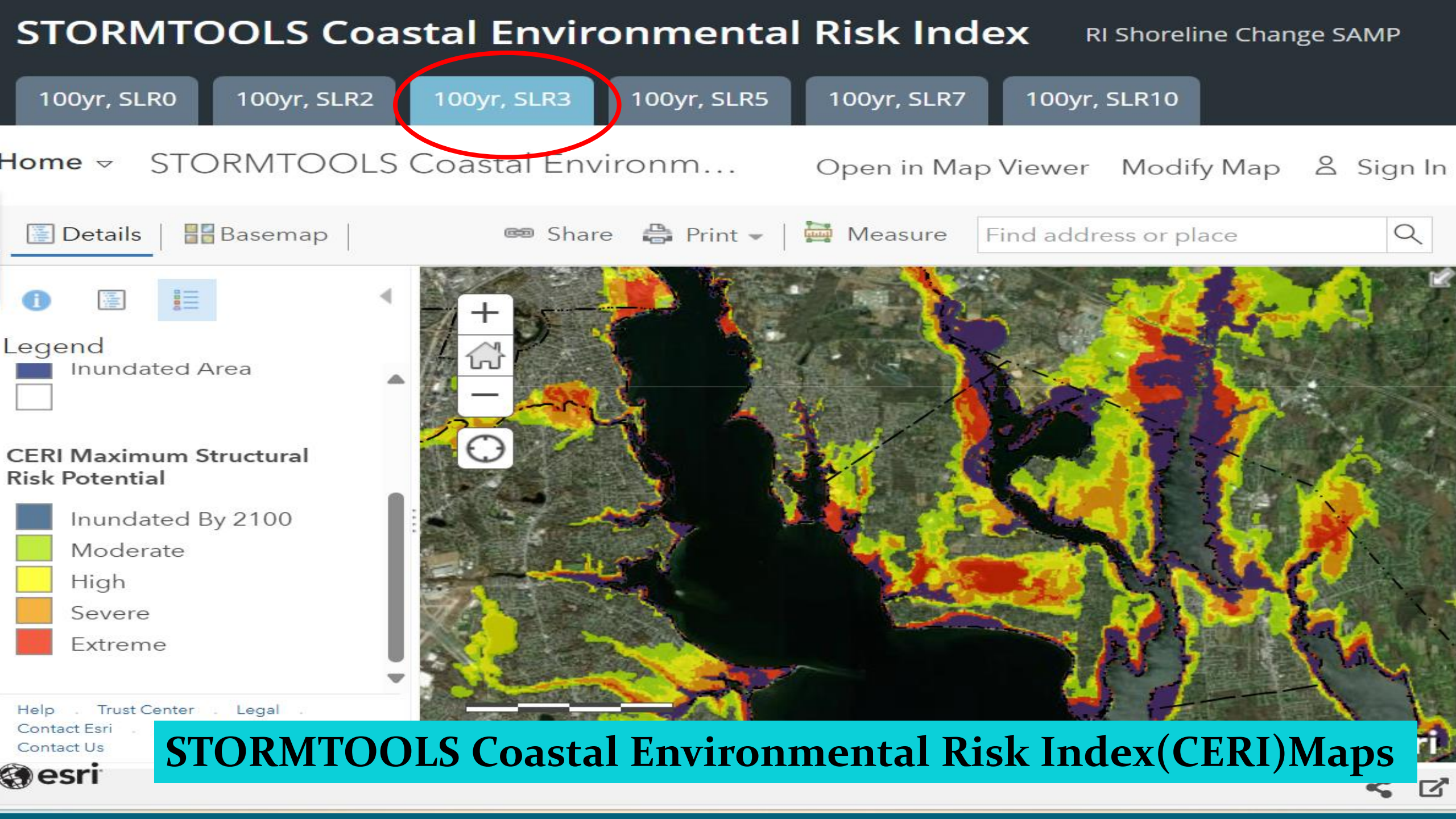
STORMTOOLS Design Elevation(SDE) Maps


STORMTOOLS Coastal Environmental Risk Index
RI Shoreline Change SAMP
100yr, SLR0
100yr, SLR2
100yr, SLR3
100yr, SLR5
100yr, SLR7
100yr, SLR10
Home
STORMTOOLS Coastal Environm...
Open in Map Viewer
Modify Map
Sign In
Details
Basemap
Share
Print
Measure
Find address or place
Legend
Inundated Area
CERI Maximum Structural Risk Potential
Inundated By 2100
Moderate
High
Severe
Extreme
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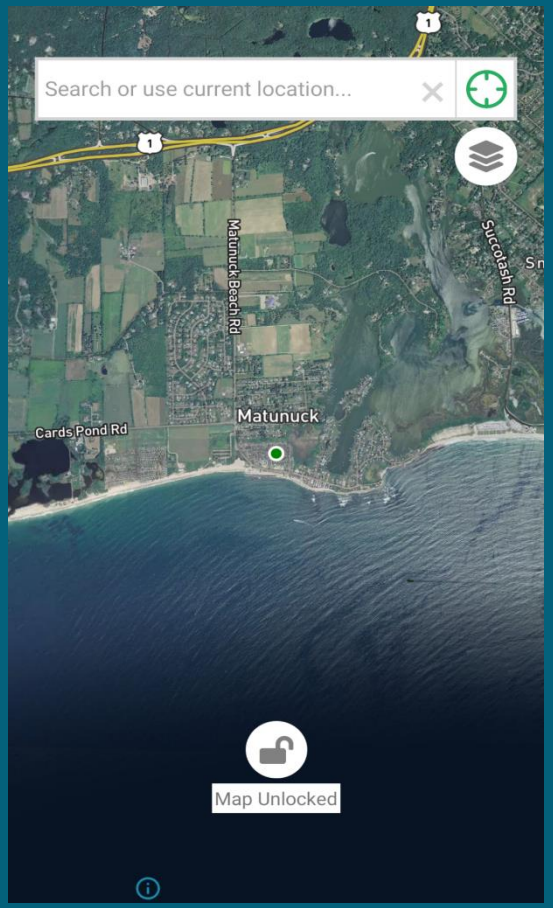
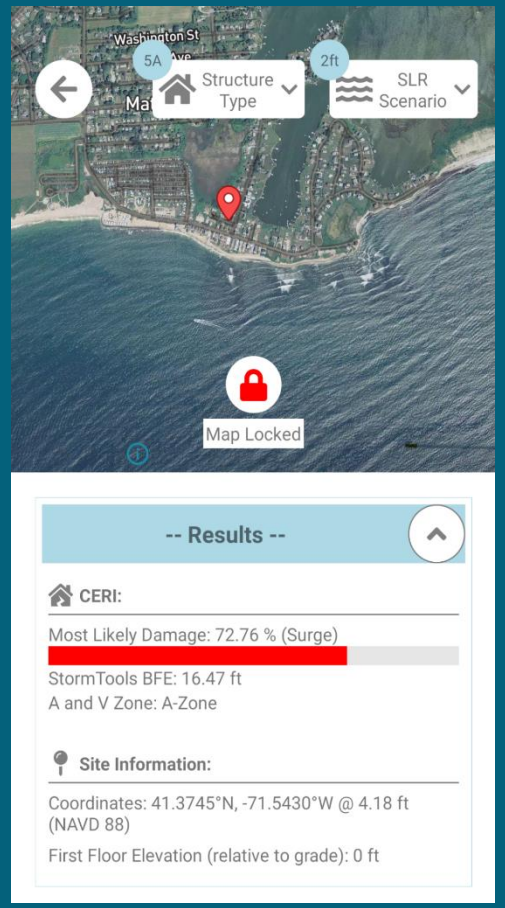
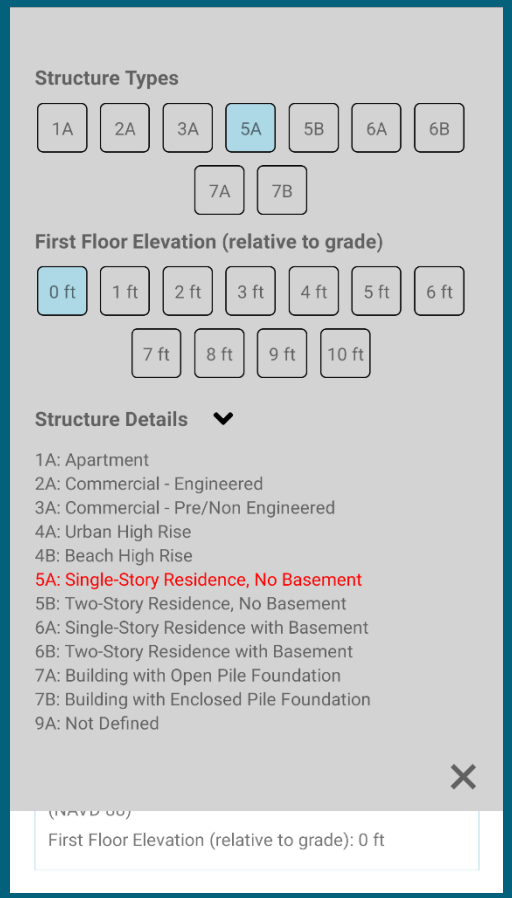
STORMTOOLS Coastal Environmental Risk Index(CERI)Maps

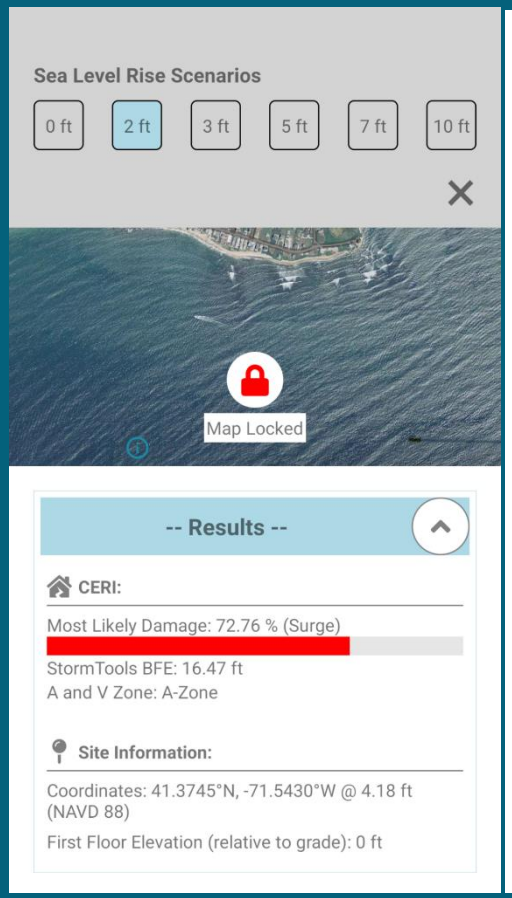
STORMTOOLS CERI Flood Risk and Damage App

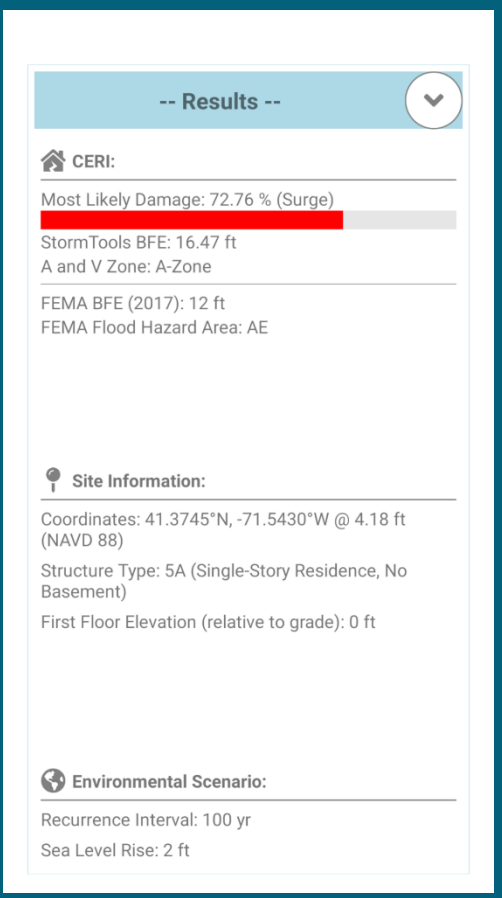
Goal: Develop an app that will provide access to coastal flood risk and associated damages for a user selected structure in RI.







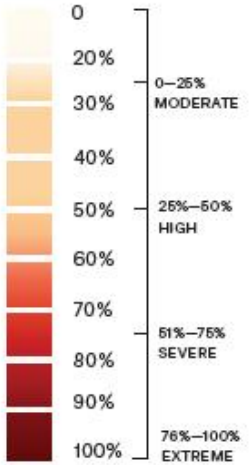




Town of Warren, RI

Waste Treatment

100-year storm | 0 feet sea level rise



Structure Risk Index
Data provided by RI STORMTOOLS Coastal Environmental Risk Index.

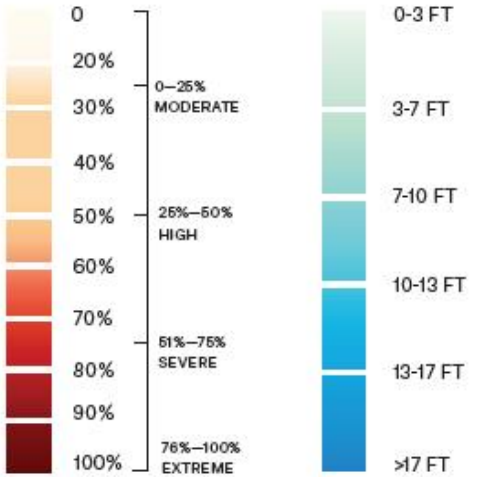
Water Depth at ground elevation
100-year storm + sea level rise inundation depth. Data provided by RI STORMTOOLS Coastal Environmental Risk Index.

THE UNIVERSITY OF RHODE ISLAND DEPARTMENT OF MARINE AFFAIRS · COASTAL INSTITUTE · Sea Grant Rhode Island · CRMC Coastal Resources Management Council

Town of Warren, RI

Waste Treatment

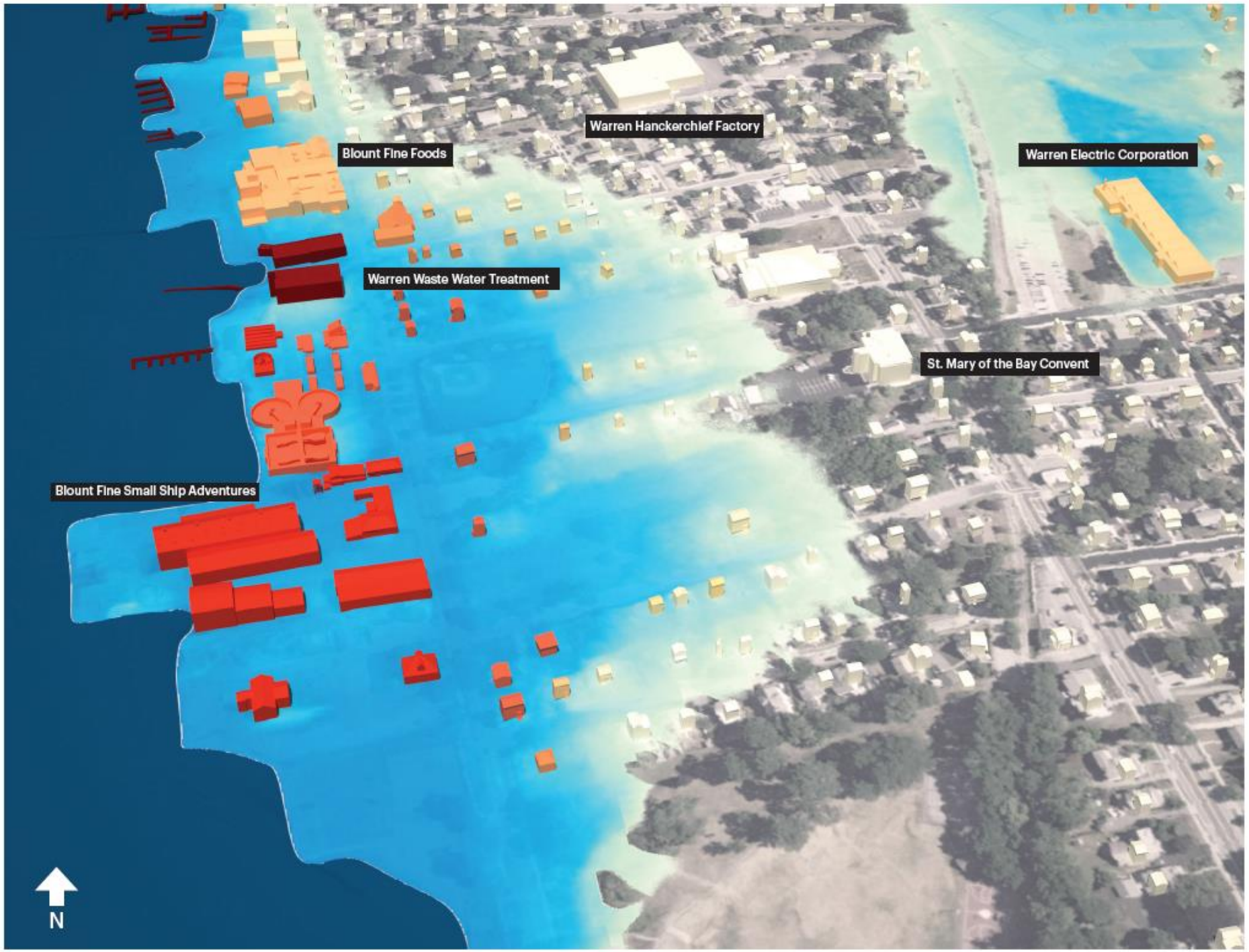
100-year storm | +2 feet sea level rise



Structure Risk Index
Data provided by RI STORMTOOLS Coastal Environmental Risk Index.

Water Depth at ground elevation
100-year storm + sea level rise inundation depth. Data provided by RI STORMTOOLS Coastal Environmental Risk Index.

THE UNIVERSITY OF RHODE ISLAND DEPARTMENT OF MARINE AFFAIRS
COASTAL INSTITUTE
Sea Grant Rhode Island
CRMC COASTAL RESOURCES MANAGEMENT COUNCIL



Town of Warren, RI

Waste Treatment

100-year storm | +5 feet sea level rise

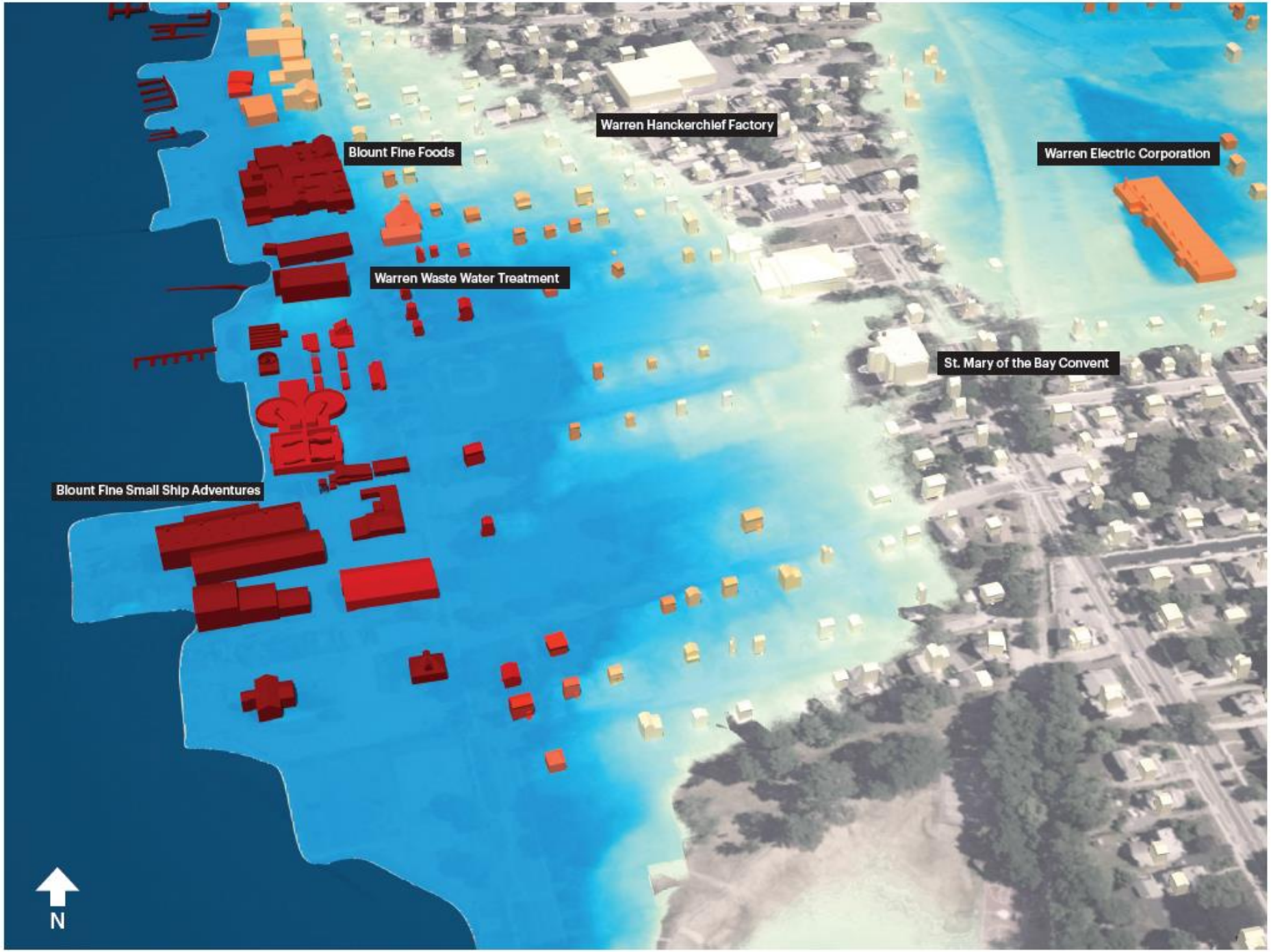
0
20%
30%
40%
50%
60%
70%
80%
90%
100%

0–25% MODERATE
25%–50% HIGH
51%–75% SEVERE
76%–100% EXTREME

0-3 FT
3-7 FT
7-10 FT
10-13 FT
13-17 FT
>17 FT

Structure Risk Index
Data provided by RI STORMTOOLS Coastal Environmental Risk Index.

Water Depth at ground elevation
100-year storm + sea level rise inundation depth. Data provided by RI STORMTOOLS Coastal Environmental Risk Index.



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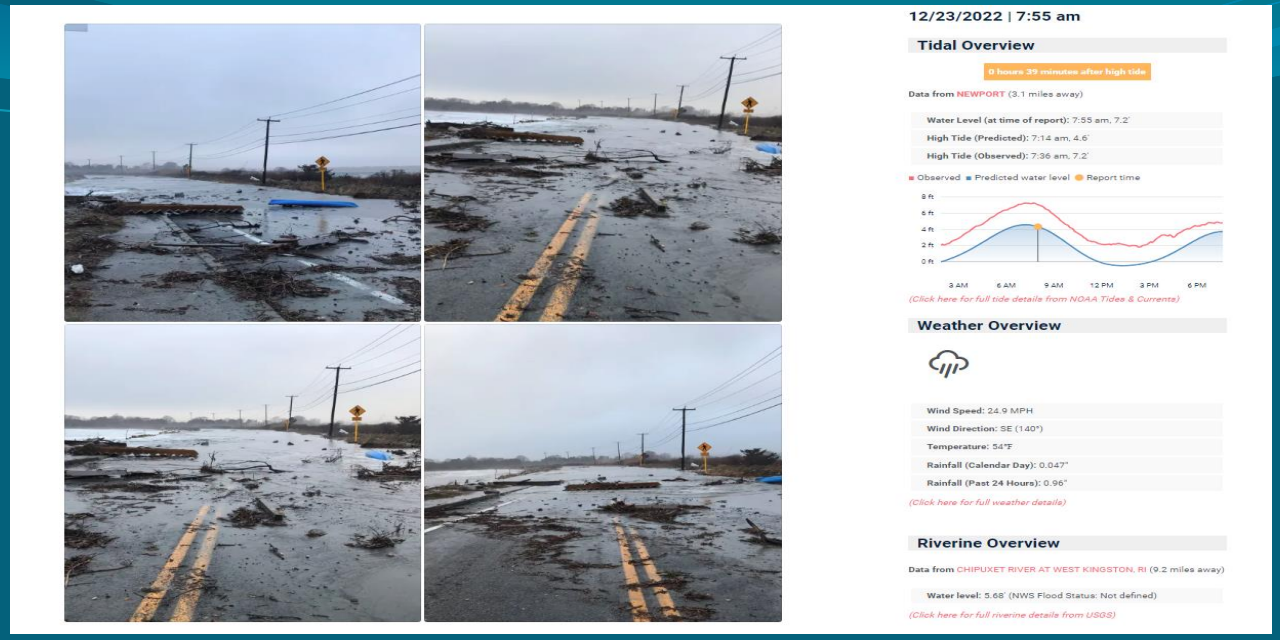
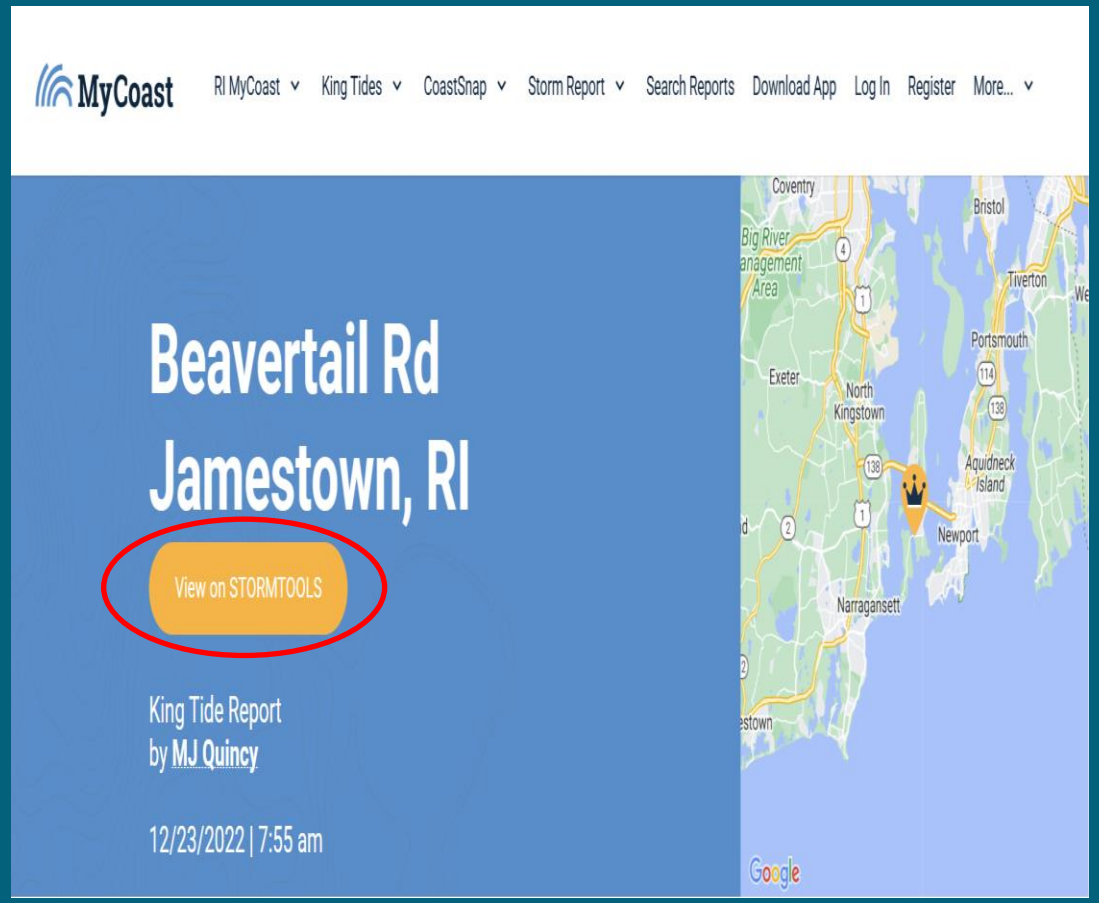
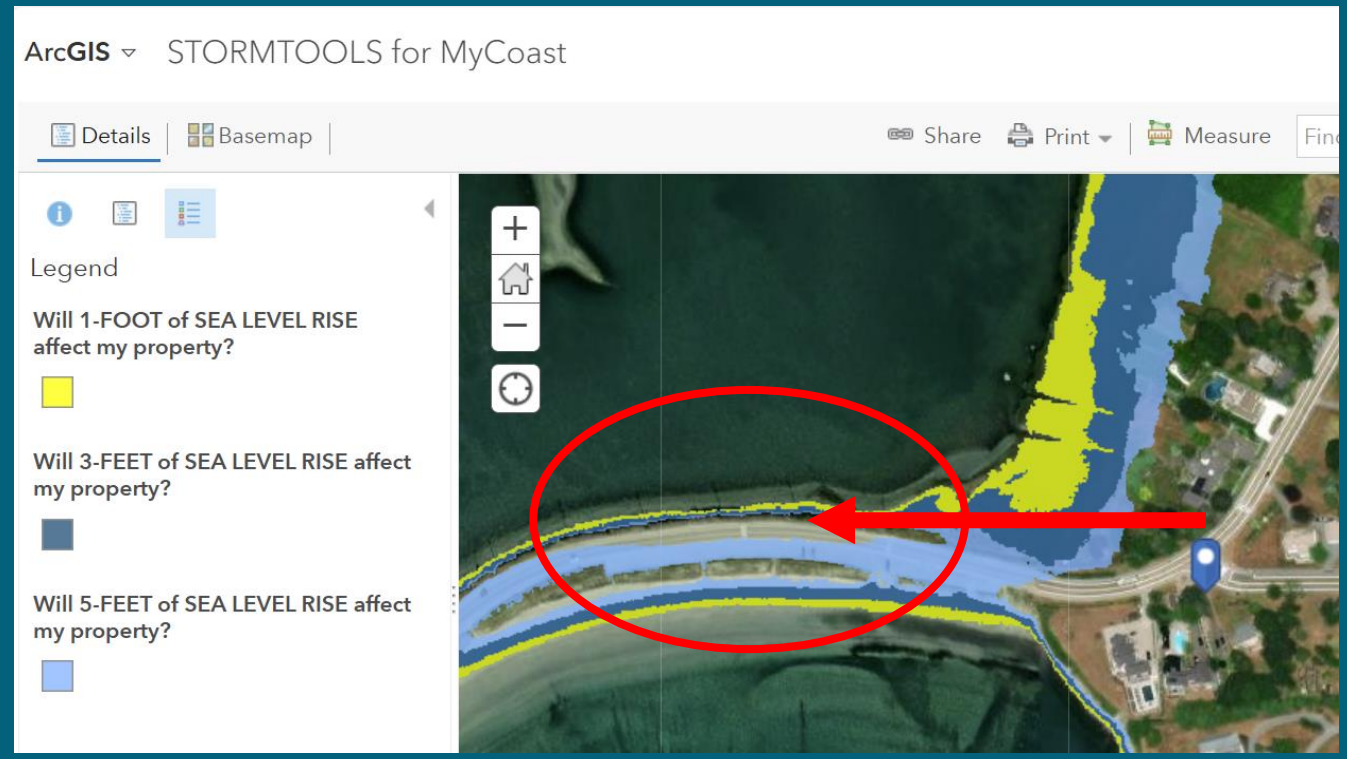
COASTAL INSTITUTE
Sea Grant Rhode Island
CRMC Coastal Resources Management Council

Link: My Coast to STORMTOOLS







ASCE 7-22 Flood Standards Updated (May 2023)

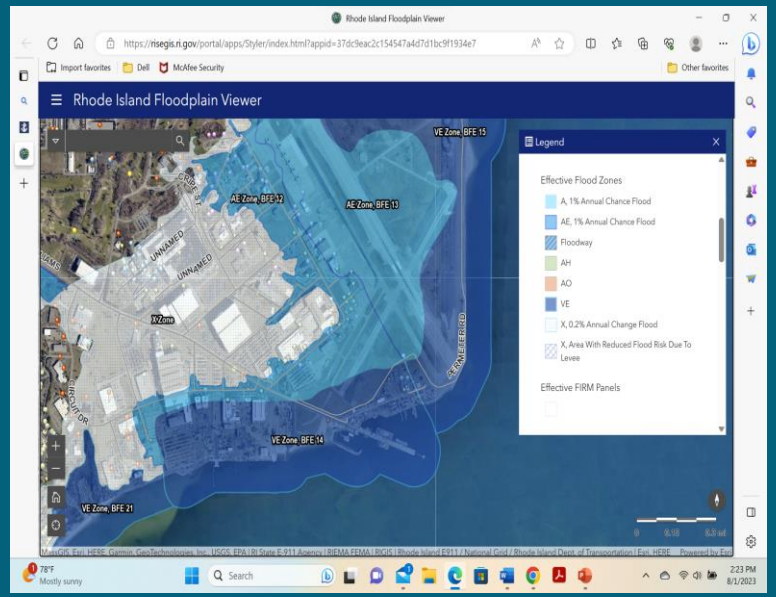
New flood standard requires ASCE 7-22 class II (residential homes) to use 500 yr FEMA FIRM flood maps (for class (I, III, & IV) structures, mean return intervals(MRI) are 100, 750, and 1000 yr, respectively) and to consider sea level rise(SLR) over the design life of the structure. WWTF, AST(?) - Class III - 750 yr.

Updated ASCE 7-22 standard now available | ASCE

New ASCE 7-22 supplement on flood loads now available as free download | ASCE

Impact of updates (May 2023) to ASCE 7-22 on hazard analysis

- New standard for flooding is 500 yr (0.2%, X event) for Class II (residential structures), including adjustment for sea level rise (SLR). For other classes: Class I (warehouse), III (apartment bldg.), and IV(hospital) - 100, 750, and 1000 yr, respectively. WWTF and AST qualify as Class III.
- Current FEMA flooding maps show 1 and 0.2%, (X zones) but don't provide BFEs for 0.2% or higher return periods case, just show surge levels. Need to add SLR and determine wave conditions.
- X zone values are available from FEMA Flood Insurance Studies(FIS) but show significant spatial inconsistencies in Narragansett Bay
- Work in progress to generate SDE maps 500 and 750 yr with SLR for state. (FEMA BRIC 2024 funded).



FEMA Policy: Federal Flood Risk Management Standard (FFRMS)
FEMA Policy 206-24-005 (effective: Sep 9, 2024)

C. DETERMINATION OF THE FFRMS FLOODPLAIN

Outcome: Explain how FEMA determines the appropriate vertical flood elevation and corresponding horizontal FFRMS floodplain under this policy.

FFRMS flood elevations and corresponding FFRMS floodplains are determined using one of the three different approaches described below:

a. ***Climate-Informed Science Approach (CISA):*** The elevation and corresponding horizontal floodplain that result from using the best-available, actionable hydrologic and hydraulic data and methods that integrate current and future changes in flooding based on climate science.

STORMTOOLS

b. ***Freeboard Value Approach (FVA):*** The elevation and corresponding horizontal floodplain that result from using the freeboard value, reached by adding 2 feet to the base flood elevation (BFE) for non-critical actions (+2' FVA) and from adding 3 feet to the BFE for critical actions (+3' FVA).

c. ***0.2-Percent-Annual-Chance Flood Approach (0.2PFA):*** The area subject to flooding by the 0.2% AC flood.

https://www.fema.gov/floodplain-management/intergovernmental/federal-flood-risk-management-standard?utm_campaign=GR-2024-7-12-TWiW%20Email%20Short&utm_medium=email&utm_source=Eloqua

STORMTOOLS Development (2022 - present)

- 2023 – 2026 Inland STORMTOOLS, enhanced rainfall rates (1 yr progress presentation, Dec 11, 2024).
- 2024-2027 Extension of STORMTOOLs to include compound flooding and wind damage in Bristol and Newport Counties.
- 2024-2026 Update SDE maps to 500 yr flooding level with sea level rise in compliance to updated ASCE 7-22 flood design standards.

FEMA BRIC funding(3 projects): 2022 -2023: $976,488

Inland STORMTOOLS requested by RI DEM & CRMC (2022).

Seamless Flood Risk Mapping Tools for Coastal and Inland Waters of RI in a Changing Climate: Inland STORMTOOLS

Project Team:

Dr. Reza Hashemi (PI)
Dr. Malcolm Spaulding (Senior Advisor)
Dr. Chris Baxter (Co-PI)
Chris Damon (EDC)
Arash Rafiee (Ph.D. Student)

Stakeholder Outreach and Engagement:

Eliza Berry (CRC)
Pam Rubinoff (CRC)

Contact:

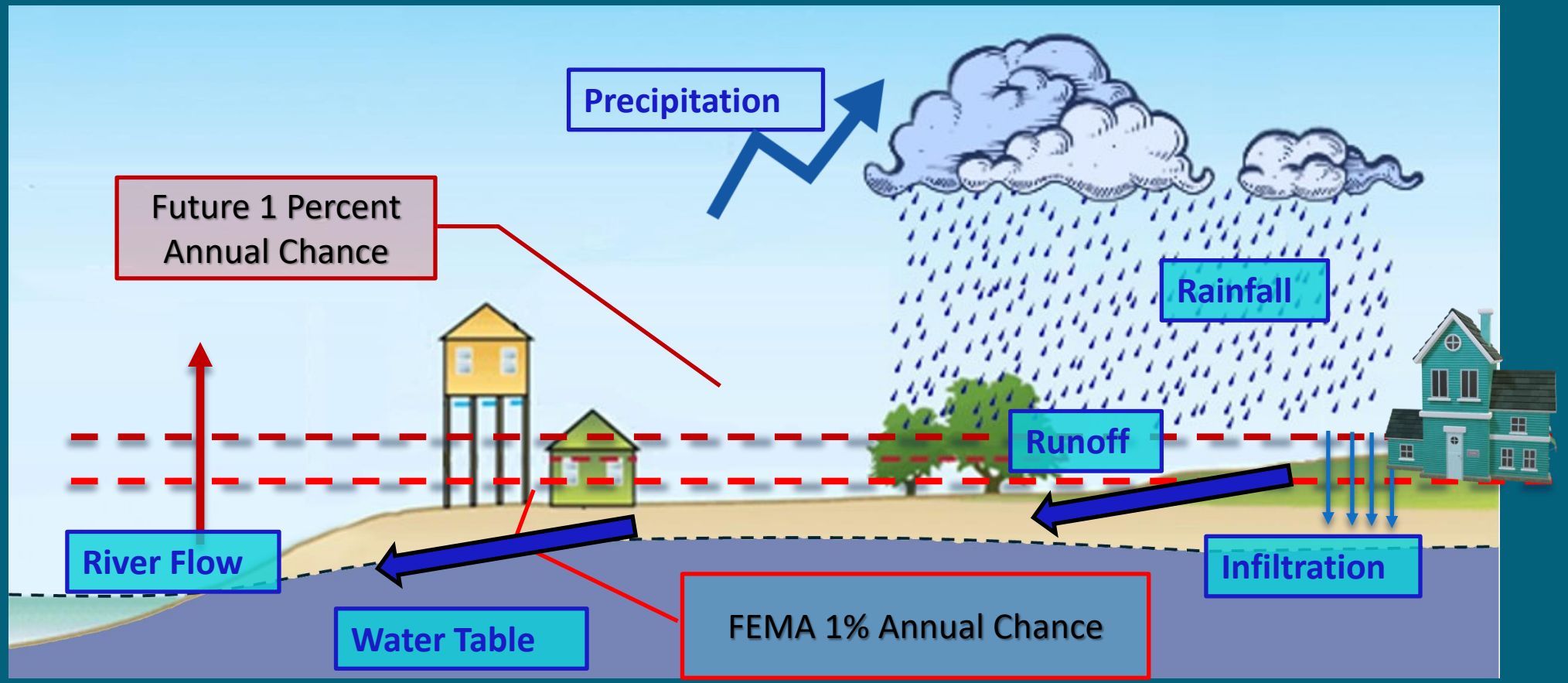
reza_hashemi@uri.edu (Reza Hashemi)
eliza.berry@uri.edu (Eliza Berry)

Thanks to

- **Rae-Anne T. Culp**
  Mitigation Planning Supervisor & State Hazard Mitigation Officer at the Rhode Island Emergency Management Agency.
- **Gardner Bent**
  USGS-New England Water Science Center.
- **Dr. Mehrshad Amini**
  Assistant Professor at the University of Rhode Island
- **RI Coastal Resources Management Council (RI CRMC)**
- **State of Rhode Island, Department of Environmental Management (RIDEM)**

https://stormtools-mainpage-crc-uri.hub.arcgis.com/pages/inland-stormtools

How does a change in rainfall with a 100/500-year return period affect the FEMA flood zone maps?



Inland Flood Modeling Framework

HEC-HMS

Hydrologic Process

Change in Precipitation

Change in River Flow Rate

HEC-RAS

Hydraulic Process

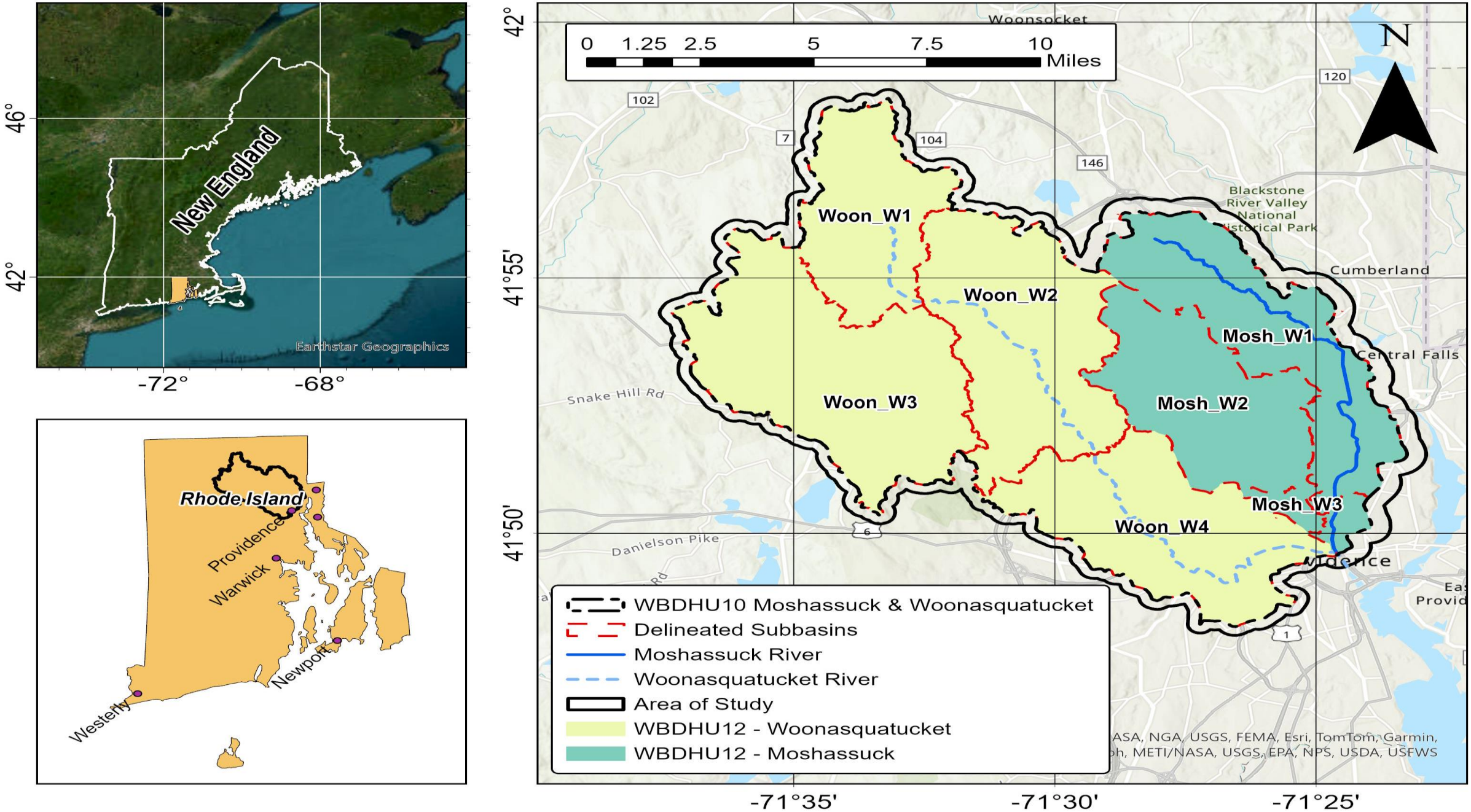
Change in River Flowrate

Change in Flood Elevation

GIS-STORMTOOLs

Change in Flood Elevation

New Flood Zone

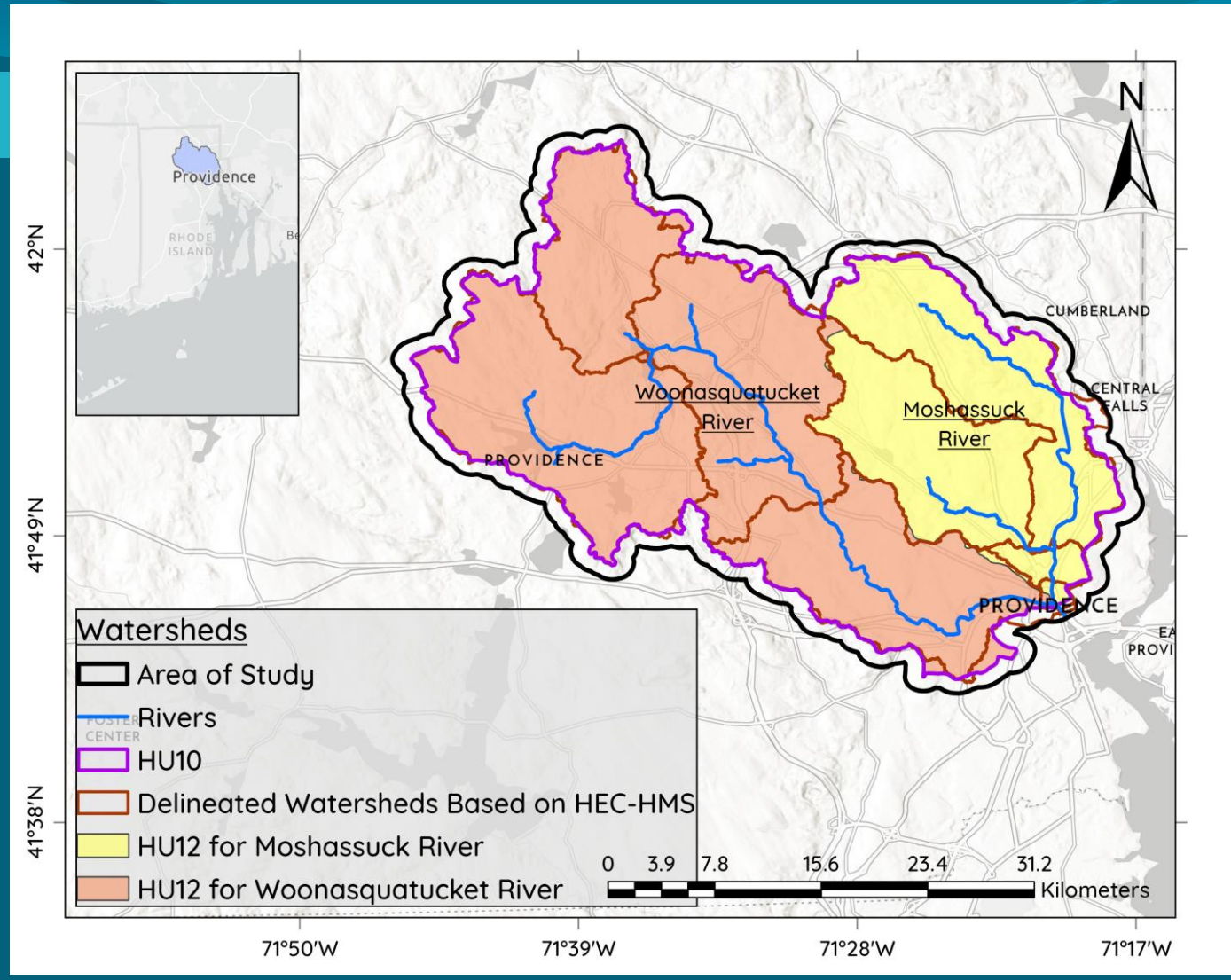

New England
Earthstar Geographics
46°
42°
-72°
-68°
Rhode Island
Providence
Warwick
Newport
Westerly
0 1.25 2.5 5 7.5 10
Miles
N
Woonsocket
Blackstone River Valley National Historical Park
Cumberland
Central Falls
Snake Hill Rd
Danielson Pike
Woon_W1
Woon_W2
Woon_W3
Woon_W4
Mosh_W1
Mosh_W2
Mosh_W3
WBDHU10 Moshassuck & Woonasquatucket
Delineated Subbasins
Moshassuck River
Woonasquatucket River
Area of Study
WBDHU12 - Woonasquatucket
WBDHU12 - Moshassuck
42°
41°55'
41°50'
-71°35'
-71°30'
-71°25'

Data Source

- USGS-National Watershed Boundary Dataset (WBD)

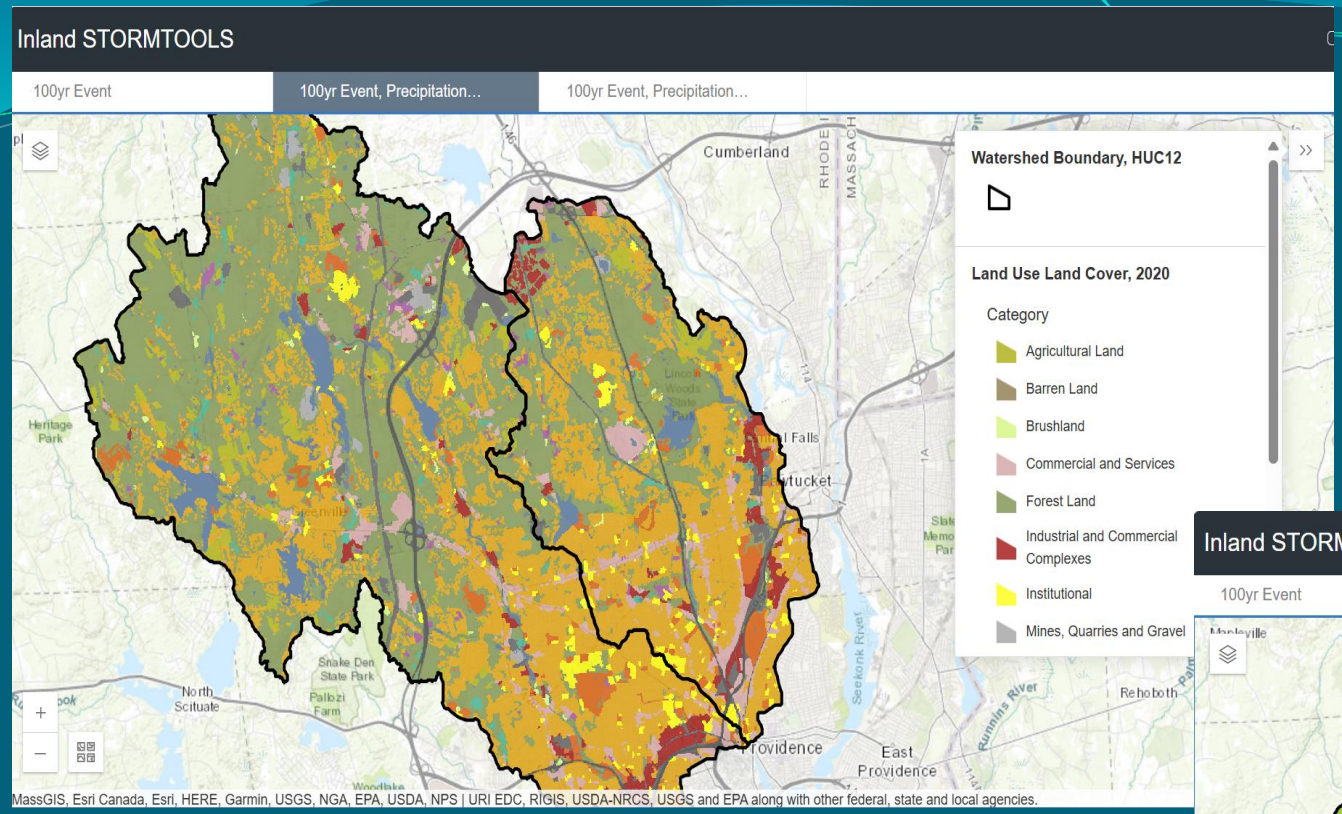
Watershed	Area Based on HU12
Woonasquatucket River	$132.5\ km^2$ **-50 smi**
Moshassuck River	$59.7\ km^2$**- 23 smi**

		Peak Flowrate Percentage Increase		
Period	Precipitation Increase	Hydrologic Model	Previous Work	Theoretical Analysis
2010-2039	26.9 %	37.0 %	45.0 %	42.0 %
2040-2069	34.3 %	50.0 %	50.0 %	47.0 %
2070-2099	45.2 %	65.0 %	55.0 %	75.0 %



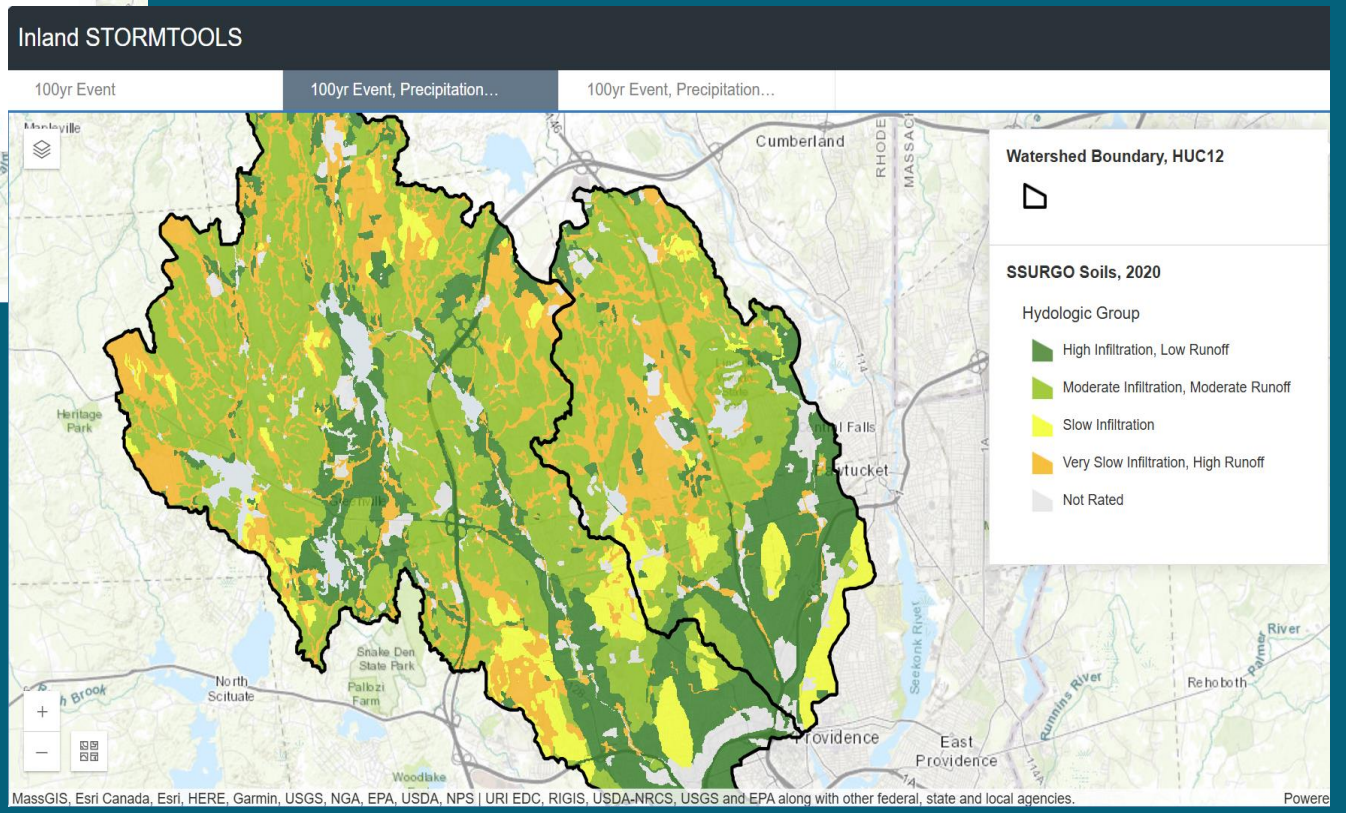
Jones, K.A., Niknami, L.S., Buto, S.G., and Decker, D., 2022, Federal standards and procedures for the national Watershed Boundary Dataset (WBD) (5 ed.): U.S. Geological Survey Techniques and Methods 11-A3, 54 p., https://doi.org/ 10.3133/ tm11A3.

Inland STORMTOOLS (Land use/cover and soils group)

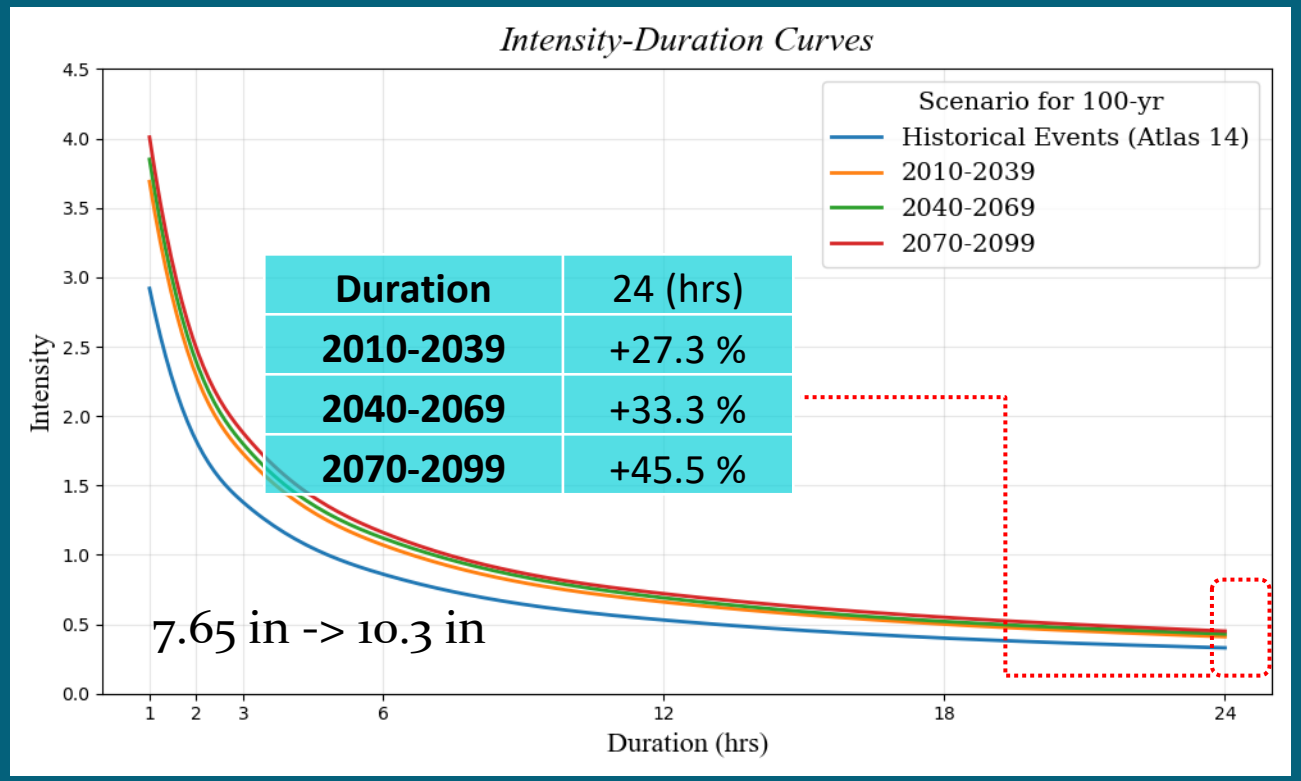


Land use and cover

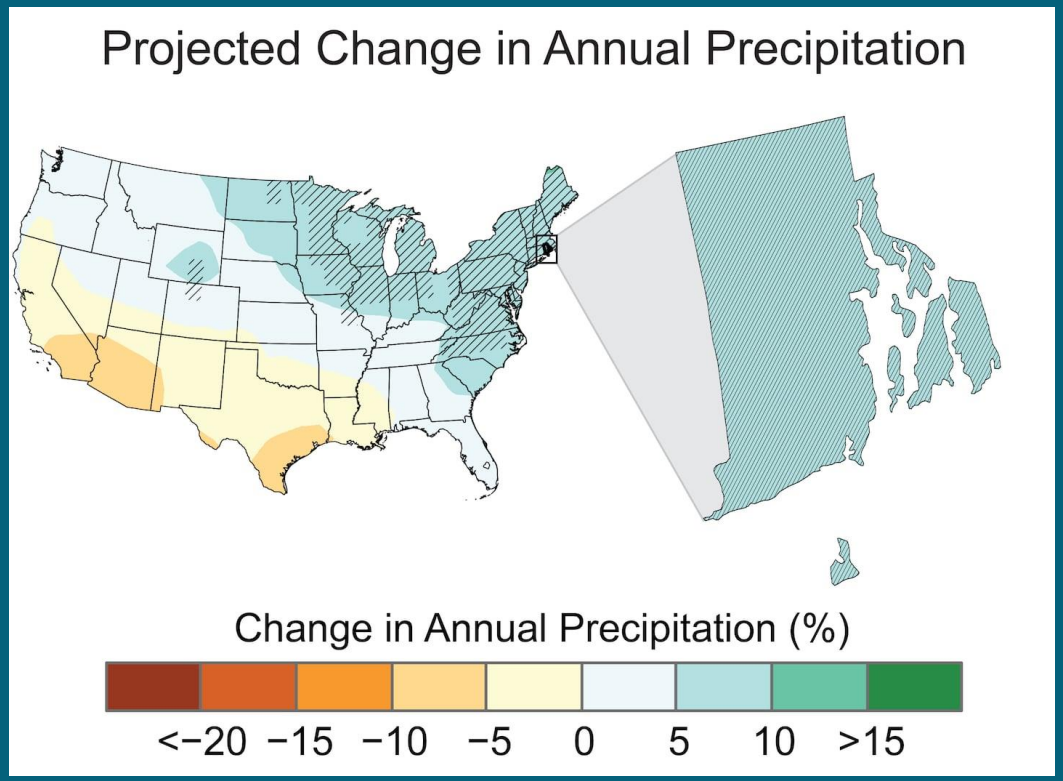
Soil Hydrologic Groups



Rainfall Average and Intensity Increasing



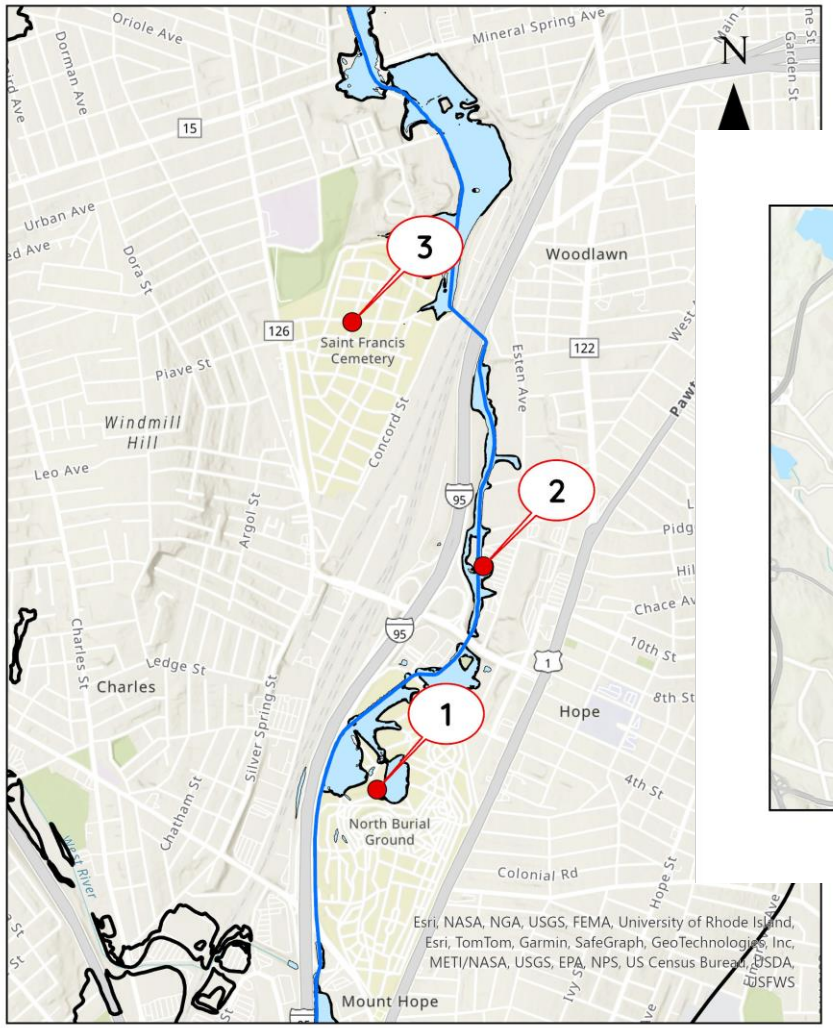
Duration	24 (hrs)
2010-2039	+27.3 %
2040-2069	+33.3 %
2070-2099	+45.5 %

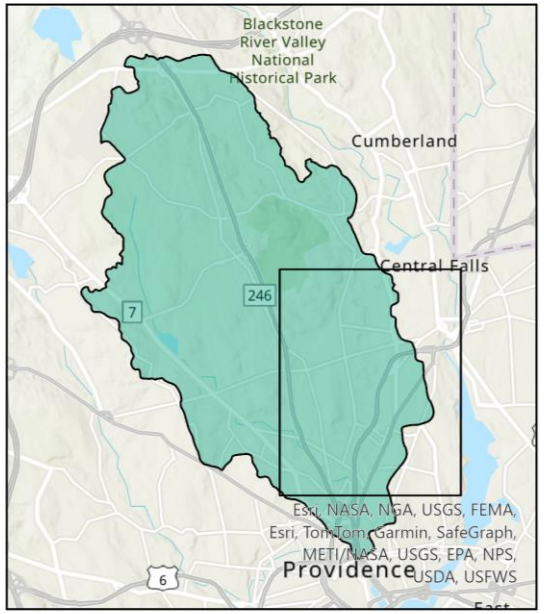


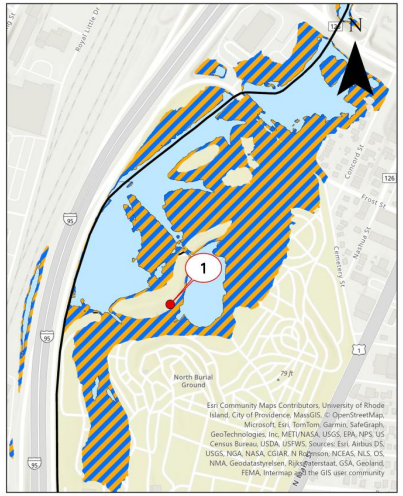
DeGaetano, A. T., Castellano, C. M., & Center, N. R. C. (2015). Downscaled projections of extreme rainfall in New York State. Northeast Regional Climate Center, New York.

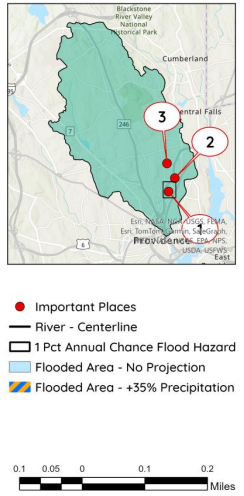
Projected Changes In Total Annual Precipitation
Sources:
NOAA State Climate Summaries
North Carolina Institute for Climate Studies (NCICS). (2024). Rhode Island state climate summary. Retrieved December 8, 202
https://statesummaries.ncics.org/chapter/ri/

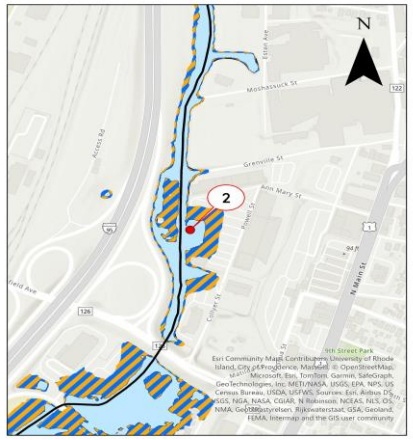
Example: Moshassuck River Results

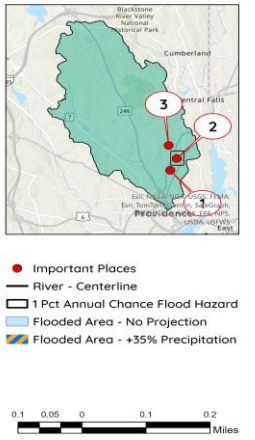












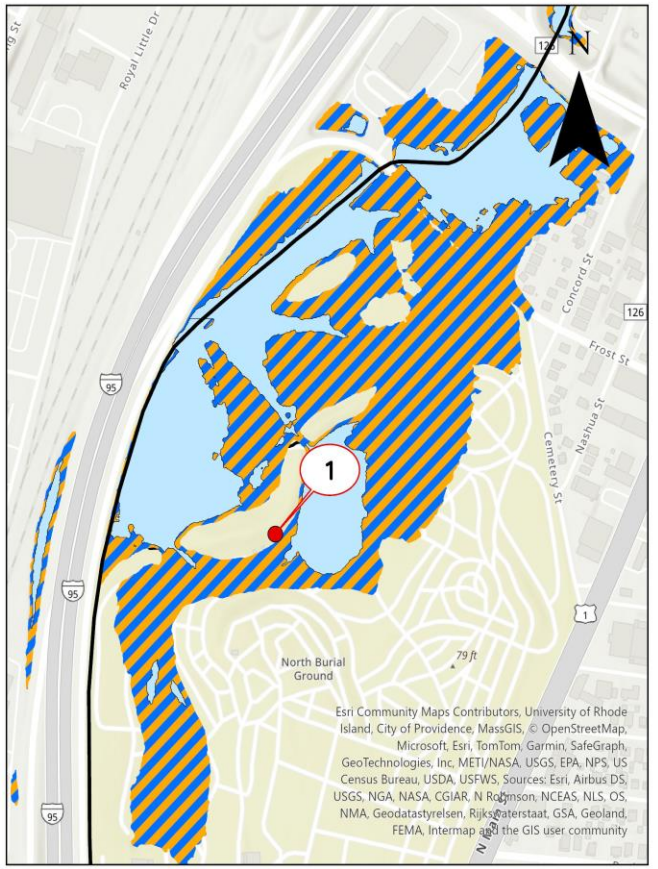
Number	Name	Latitude	Longitude
1	North Burial Ground	41.8499	-71.4081
2	Job lot Parking lot	41.8569	-71.4036
3	ST Francis Cemetery	41.8646	-71.4092

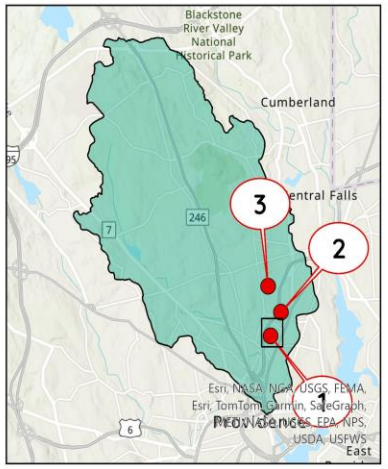
Rhode Island Floodplain Viewer

North Burial Ground, 5

FEMA 100 yr (blue)and 500 yr (X-Zone) flood zones

Inland STORMTOOLS +35% precipitation





- Important Places
- River - Centerline
- 1 Pct Annual Chance Flood Hazard
- Flooded Area - No Projection
- Flooded Area - +35% Precipitation

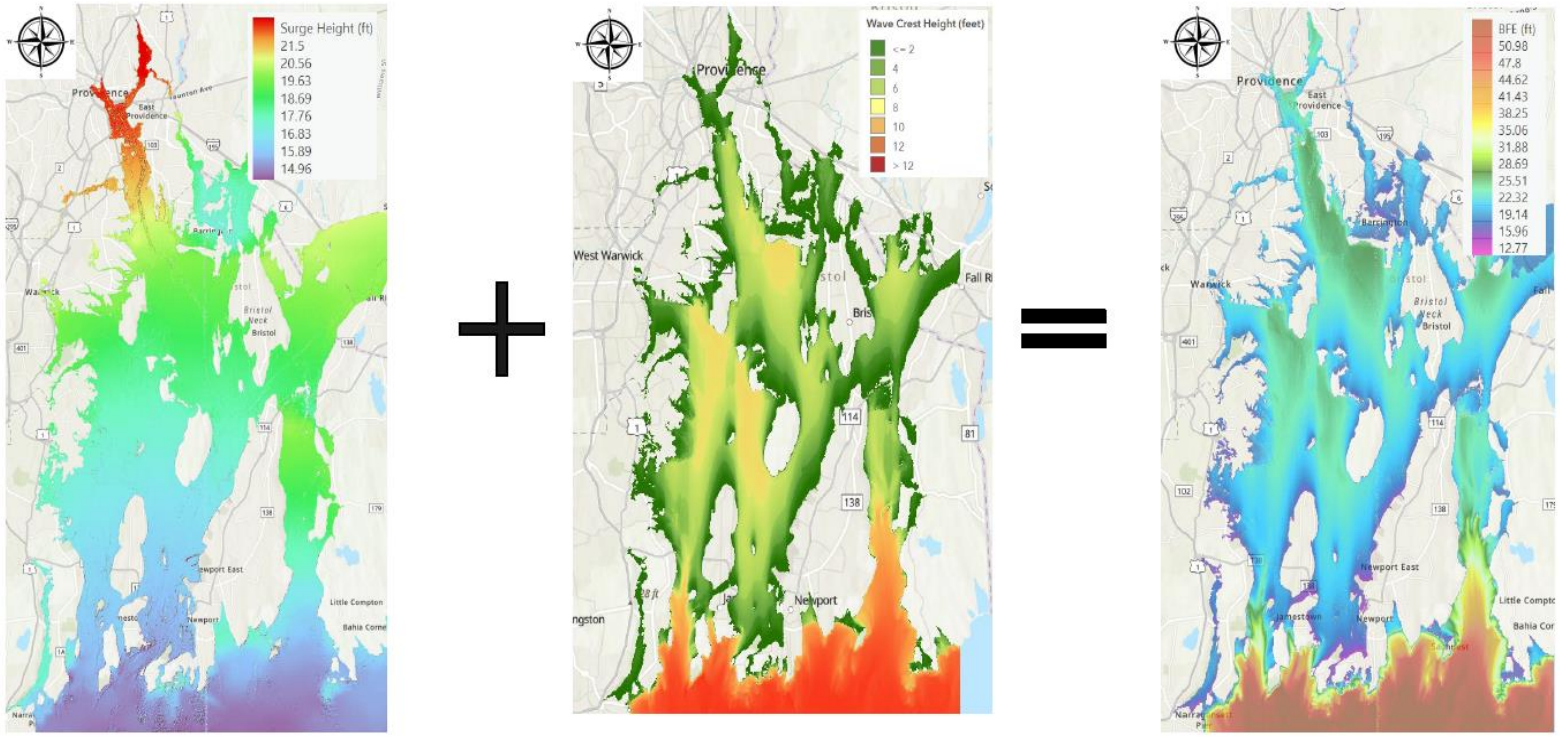
0.1 0.05 0 0.1 0.2 Miles

City of Providence, MassGIS, Esri, HERE, Garmin, GeoTechnologies, Inc., Intermap, USGS, EPA | RI State E-911 Agency | RIEMA FEMA | RIGIS | Rhode Island E911 / National Grid / Rhode Island Dept. of Tran... Powered by Esri

Implementation of ASCE 7-22 500-Year Flood Standard Revisions in Rhode Island (FEMA BRIC 2024, Capstone Students 2023-2025)

- Determine BFE for 500 yr SLR 0

Storm Surge + Wave Crests = BFE



Issues of Concern

1. Support for STORMTOOLS Maintenance Operation

- No support for maintenance, operation, and outreach of STORMTOOLS since 2021. URI bearing burden of keeping system operational, not sustainable.
- Typical expenses: 35- 40 k per yr.
- RI CRMC and RI DEM committed to support operation/maintenance for FEMA BRIC 2022 Inland STORMTOOLS project.
- STORMTOOLS currently operational using ArcGIS API JavaScript. This software will no longer be available in 2025/2026. Need to transition to new system. System will no longer function by Q4 2025/Q1 2026.

2. Flood design standards residential and commercial structures: coastal vs inland: inconsistent, don't meet national/international standards.

- For coastal areas (RI CRMC jurisdiction) STORMTOOLS Design Elevation Maps(SDE), 100 yr with sea level rise(SLR). (500 yr, with SLR maps in progress). No mention of winds.
- SDE/CERI embedded in RI CRMC Coastal Hazard app (risk assessment portion of permitting system) but not in inland permitting system.
- Most communities use FEMA FIRM maps to assess flooding risk for 100 and 500 yr return periods. FEMA FIRMS have ***NO*** provisions for climate change effects: sea level rise and enhanced participation.
- ASCE 7-22 (flood supplement #2, updated May 2023) requires 500 yr for residential structures and adjustments for sea level rise, but not yet adopted by RI Building Commission.
- RI Building Code(RIBC) uses 2018 standards and does not reflect most recent International Building Code (IBC) design standards nor ASCE 7-22 updates.

News

Calendar

Jobs

FAQs

Building Code Appeal Form (PDF)

Building Permits

FEMA Flood Insurance Rate Maps (FIRM)

Inspections

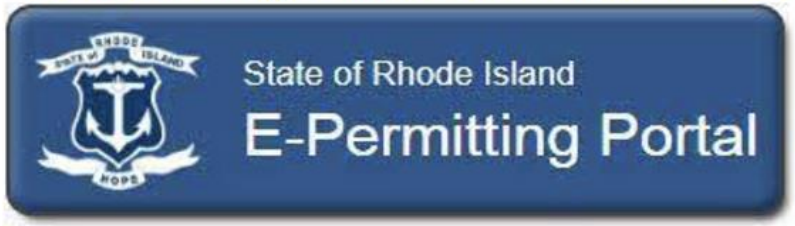
Special Use Permit / Variance Application (PDF)

Superior Court Appeal of Zoning Board Decision

Zoning Enforcement Officer Decision Appeal (PDF)

Building Permits

Click on the image below to access the online E-Permitting Portal



Permit Requirements

- Permit Requirements and Permit Exemptions
- Requirements - Accessory Stuctures
- Requirements - Additions
- Requirements - Alterations
- Requirements - Commercial New, Addition or Renovation
- Requirements-Demolition Permit

Contact Us

Building, Zoning & Code Enforcement

Email

Physical Address
180 High Street
Wakefield, RI 02879

Phone: (401) 789-9331 x1225

Jamie Gorman

Building Official & Zoning Enforcement

Phone: (401) 789-9331

2024 FEMA Building Code Adoption Tracking: FEMA Region 1

RI Score: 0 %
Lower Resistance
Building Code: 2018

2024 Building Code Adoption Tracking: FEMA Region 1

NEW HAMPSHIRE

94.4%

HIGHER RESISTANCE

IBC: State adopts the 2018 edition of the International Building Code (IBC).

IRC: State adopts the 2018 edition of the International Residential Code (IRC).

Note: State is not fully resistant because some jurisdictions with high flood risk do not participate in the NFIP and Portsmouth has introduced local amendments that weaken IRC hurricane resilience with a lower design wind speed (100 mph) in Table R301.2(1) than the model code requirement for Portsmouth based on ASCE 7-17 (115 mph).

MAINE

0.0%

LOWER RESISTANCE

IBC: State adopts the (outdated) 2015 edition of the IBC.
Note that Maine only requires jurisdictions with populations of at least 4,000 to enforce the code.

IRC: State adopts the (outdated) 2015 edition of the IRC.
Note that Maine only requires jurisdictions with populations of at least 4,000 to enforce the code.

MASSACHUSETTS

0.0%

LOWER RESISTANCE

IBC: Commonwealth adopts the (outdated) 2015 IBC and weakens flood resistance by deleting all references to Coastal A Zone Standards as referenced in ASCE 24-14, *Flood Resistant Design and Construction*.

IRC: Commonwealth adopts the (outdated) 2015 IRC and weakens flood resistance by removing the Coastal A Zone freeboard requirements, and weakens hurricane resistance by defining Windborne Debris Region more narrowly in R202 (Definitions).

RHODE ISLAND

0.0%

LOWER RESISTANCE

IBC: State adopts the 2018 IBC but weakens wind resistance by replacing all model code wind figures with Rhode Island Table 1608.1, which specifies design wind speeds for Jamestown that are less conservative than the model code, and which removes Jamestown from the windborne debris region.

IRC: State adopts the 2018 IRC but weakens flood resistance by removing "most restrictive flood hazard area" language from R322.2.1. State weakens hurricane resistance in R301.2.1.1 by allowing old ICC standard SSTD 10, *Hurricane Resistant Construction Standard*, to be used instead of current standard ICC 600, *Standard for Residential Construction in High-Wind Regions*, and by not requiring cold-formed steel structures to conform to American Iron and Steel Institute S230, *Standard for Cold-Formed Steel Framing – Prescriptive Method for One and Two Family Dwellings* in wind-design-required locations. And in R301.2.1.2, state further weakens hurricane resistance: (1) by applying protection of openings to Wind Zone 3 only, rather than the whole windborne debris region, (2) by changing "openings" to "windows," and (3) by excluding garage doors.

VERMONT

0.0%

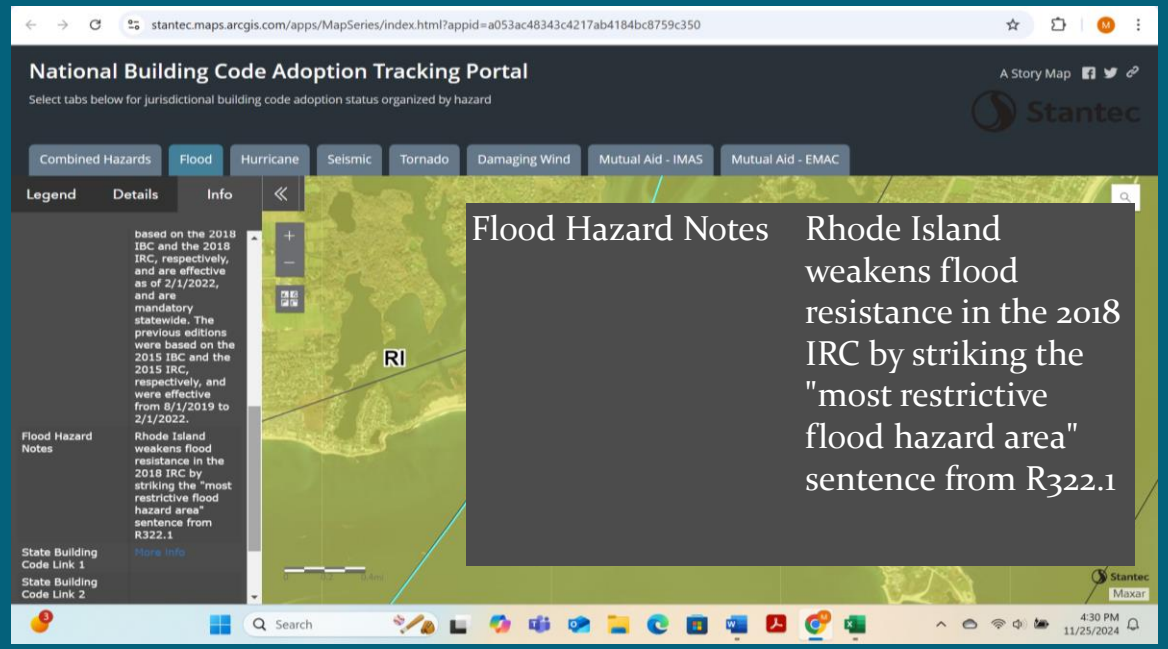
LOWER RESISTANCE

IBC: State adopts the (outdated) 2015 IBC.
Note that Vermont's replacement of IBC Ch. 1 omits several NFIP-related administrative flood provisions.

IRC: No statewide residential code.

Learn more at fema.gov/BCAT

February 2024 3



https://www.fema.gov/sites/default/files/documents/fema_fy24-bcat-region-1-report.pdf

Solutions to Raise the Grade

- Improve multi-modal freight and landside connections to ports to strengthen the entire freight system and reduce congestion that is costly to industries, local governments, and the state's economy when moving goods.
- Increase in-state capacity for electricity generation to improve supply, reduce costs, ease regional market effects, and recoup expenses by supporting renewable power generation with financial incentives, regulations that promote growth, and industrial/logistics resources.
- Continue to support the RhodeWorks plan and its emphasis on reaching a state of good repair for bridges and advocate for additional long-term federal and state funding programs for infrastructure to deliver consistent, reliable funding that is adjusted for inflation.
- Continue to develop infrastructure resiliency plans that address natural disasters and man-made extreme events. Incorporate the impacts of climate variations (sea level rise, extreme storm events) into the design, operation, maintenance, and expansion of all types of infrastructure to improve community resilience – reducing the time and extent that households, businesses, and critical services in Rhode Island are affected during and after natural and man-made disruptions.
- Mainstream tools for data-driven decision-making across all of Rhode Island's infrastructure sectors, including asset management software, life-cycle cost analysis, and affordable rate structuring.
- Pivot new construction, rehabilitation, and post-disaster rebuilds towards the use of consensus-based codes, specifications, and standards.

About ASCE-Rhode Island

The Rhode Island Section of ASCE was established in 1920 with the mission to advance the science and profession of civil engineering in a manner consistent with the American Society of Civil Engineers. Our membership consists of civil engineers at all career stages and in all sectors and disciplines.

With our commitment to serve the public in mind, the Report Card released by RI ASCE is a public, voluntary service to citizens and policy makers to inform them of infrastructure needs in their communities.

BRIDGES	D-
DRINKING WATER	C+
ENERGY	C+
PORTS	C
RAIL	B-
ROADS	D
WASTEWATER	C

CONTACT US

reportcard@asce.org

Infrastructure Matters

Good infrastructure is among the key elements that contributes to a high quality of life. From our roads, bridges, ports, and rail, which impact our ability to move people and cargo; to our drinking water and wastewater, which impact the health of our residents and businesses; to our energy sources, which power our daily lives - Rhode Island's infrastructure is essential to supporting the needs of those who call it home or are welcomed to its shores. While many Rhode Islanders might not think about infrastructure every day, Rhode Island's civil engineers do! We work hard to build and maintain our infrastructure systems for the public's health, safety, and welfare.

As a state with a significant coast line, Rhode Island must adequately invest in its critical infrastructure, such as wastewater facilities, drinking water systems, and port structures, to ensure they can protect the natural environment and withstand sea level rise and impacts from extreme weather events. In addition, Rhode Island has been challenged by underinvestment in roads and bridges, leading to structural deficiencies. However, leaders in the state are addressing these challenges head on, by prioritizing investment in roads and bridges to improve safety and reliability. Beyond mitigation, Rhode Island looks to the future by proactively improving its rail systems and maintaining its leadership in the growing renewable energy industry.

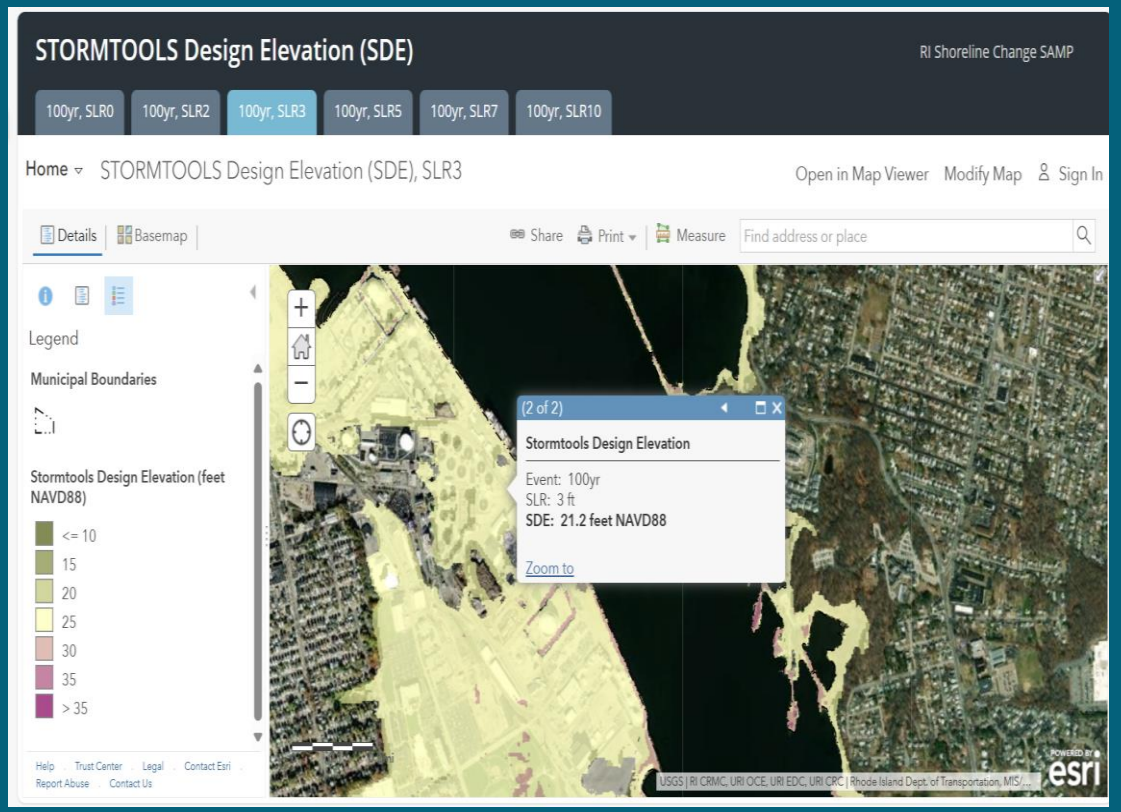
ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

www.infrastructurereportcard.org/RhodeIsland

chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.infrastructurereportcard.org/wp-content/uploads/2016/10/RI-Infrastructure-Report-Card-Brochure-2020.pdf

Design Standards for Infrastructure: WWTF

- RI DEM 100 yr FEMA FIRM plus SLR, 2 and 3 ft offset, Noncritical/critical component.
  (NEIWPCC 2016 guidance standards)
- ASCE 7-22 Risk Category II, 500 yr plus SLR
  Risk Category III, 750 yr plus SLR



Example: NBC Facility Fields Point:

FEMA 100 yr - *12 ft* BFE,

SDE 100 yr - 18 ft BFE

ASCE: FEMA 500 yr - *19 ft* surge only

SDE: 500 yr - 21.2 ft BFE

SDE: 750 yr – *22.6 ft* surge only

Design Standards: Above Ground Storage Tanks

- RI DEM — ***No*** flooding standards, containment of 110% of content for largest tank in the field, no monitoring of berm structures.

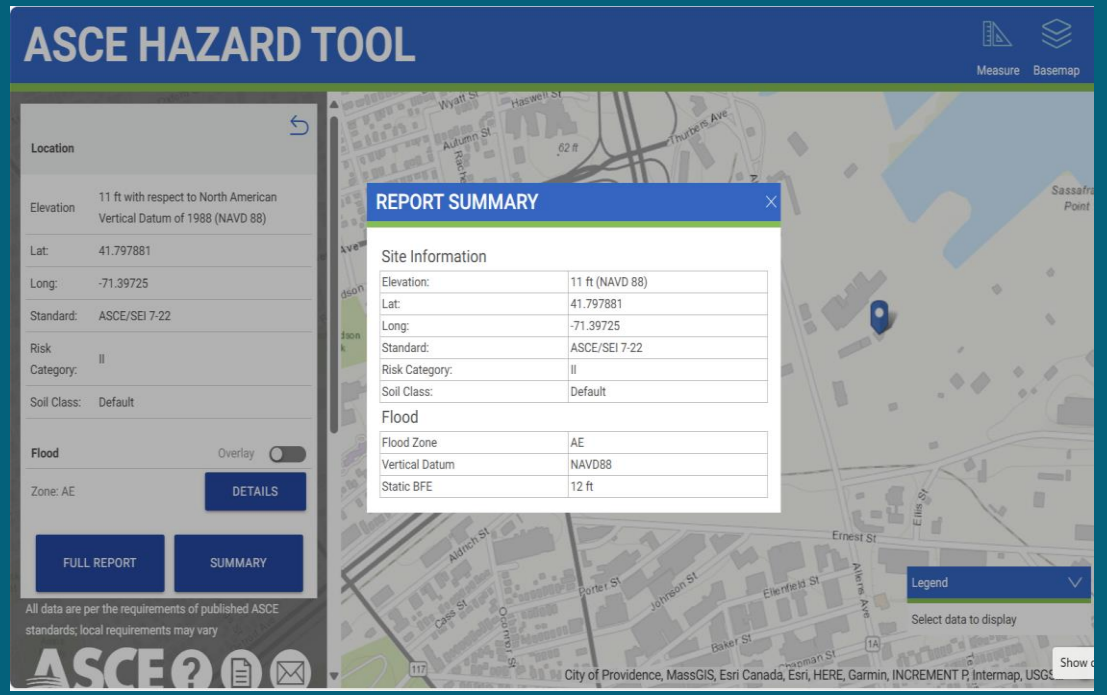
- ASCE 7-22 Risk Category II, 500 yr plus SLR
  Risk Category III, 750 yr plus SLR

Example: Port of Providence, Fields Point

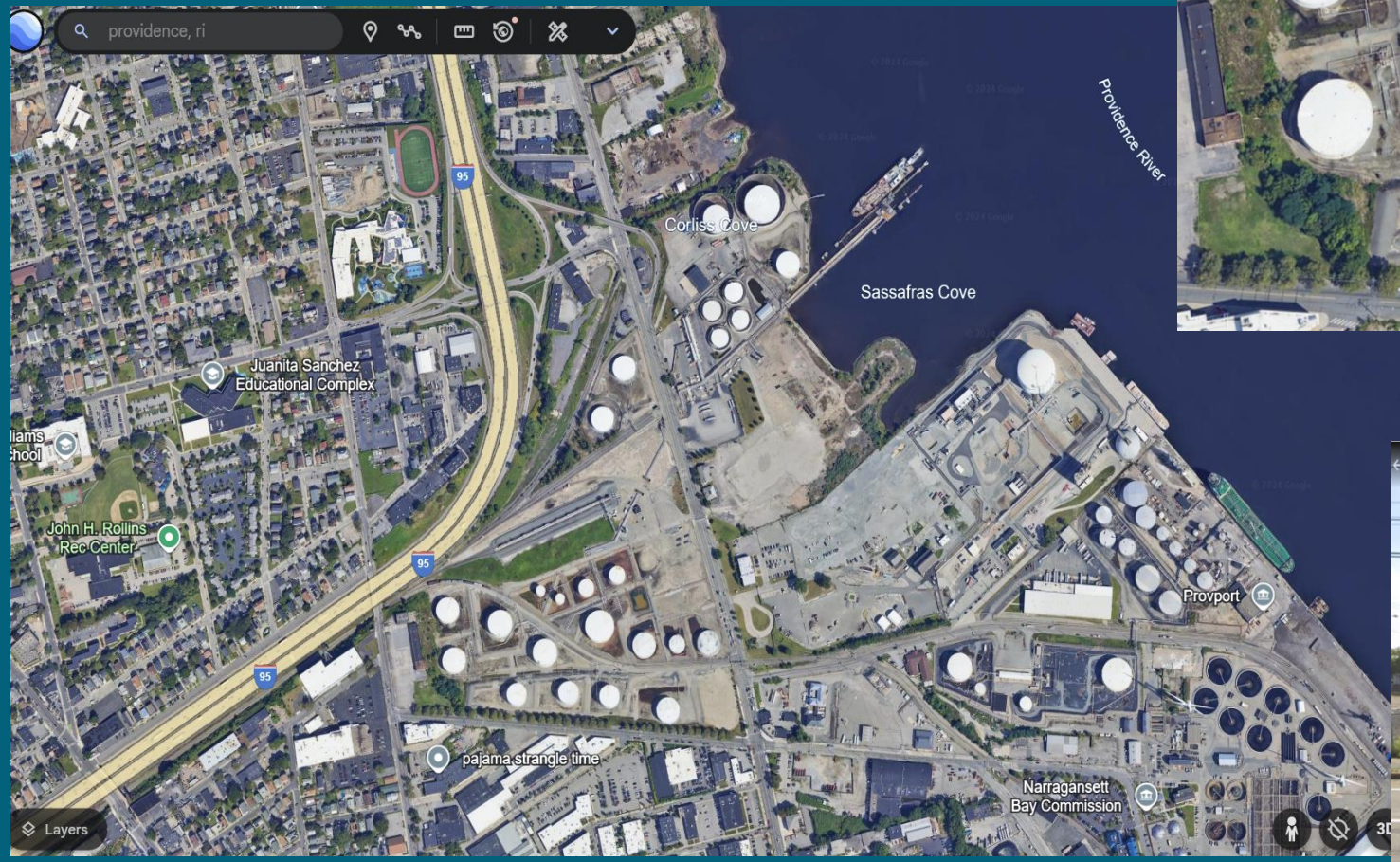
FEMA FIRM 500 yr – 19 ft surge only

SDE: 500 yr - 21.2 ft BFE

SDE: 750 yr – 22.6 ft surge only



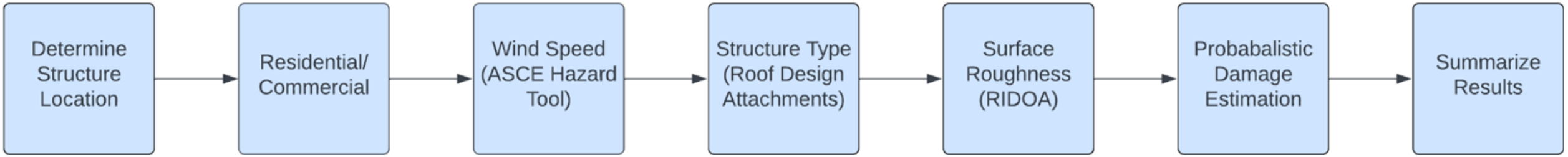
AST Fields Point

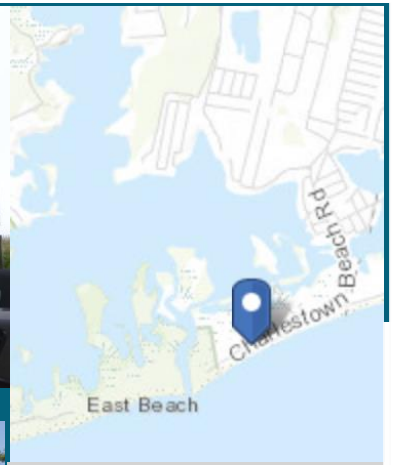


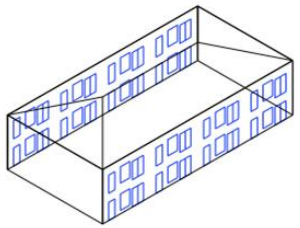
3. **Lack of consideration for wind in CRMC Coastal Hazard App risk assessment.**

- Storm winds ranked as second highest environmental risk in RI.
- RI CRMC Coastal Hazard App does not include any mention of wind risk.
- ASCE Hazard tool available for US and shows estimate of wind design speed for structures and infrastructure. Residential structures: Risk Category II and infrastructure Risk Category III. Doesn't provide estimates of damage by structure type.
- Ocean Engineering capstone students completed method to assess wind damage to structures and infrastructure using FEMA HAZUS based methods under CERI framework.
- Method has been applied to selected locations in RI. Maps covering the entire state will be available by mid 2025.

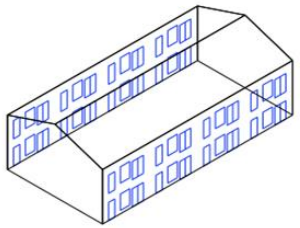
Extension of CERI to Wind Damage: Flow Chart



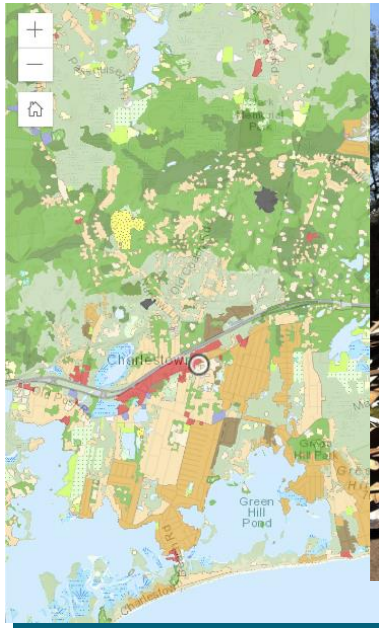




Hip Roof



Gable Roof



- Location
- Risk category
- Wind speed
- Structure Density
- Probability of each damage state
- Best estimate of damage

(https://rirestoration.com/storm-damage/)

2023-2024 capstone class

DEPARTMENT OF OCEAN ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Summary

1. Need support for operation and maintenance of STORMTOOLS.
2. Flood design standards/risk assessment for residential and commercial structures: coastal vs inland: inconsistent, don't meet current national/international standards.
3. Lack of consideration for wind in CRMC Coastal Hazard App risk assessment.