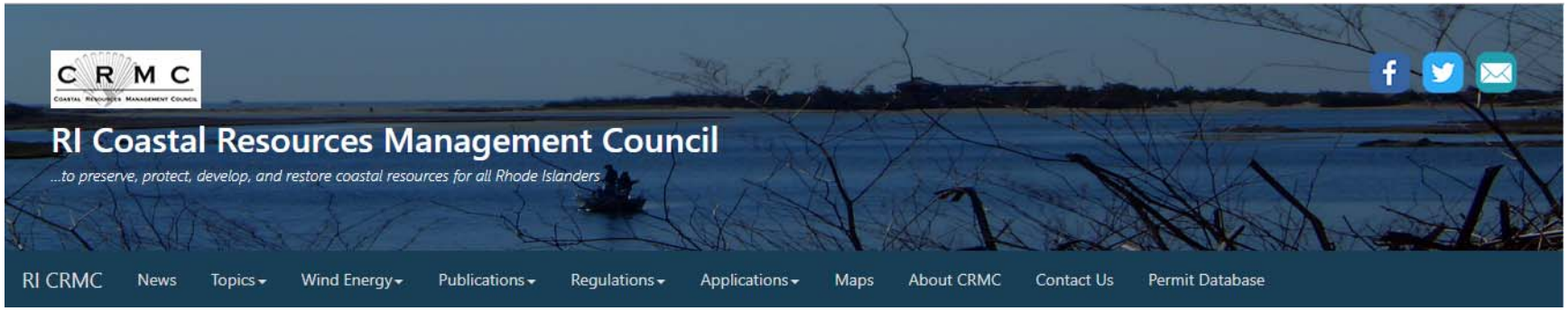
Beach SAMP Risk-Based Permitting System

Rhode Island Flood Mitigation Association
Fidelity Investments, Smithfield, RI
April 30, 2019

CRMC Coastal Resources Management Council

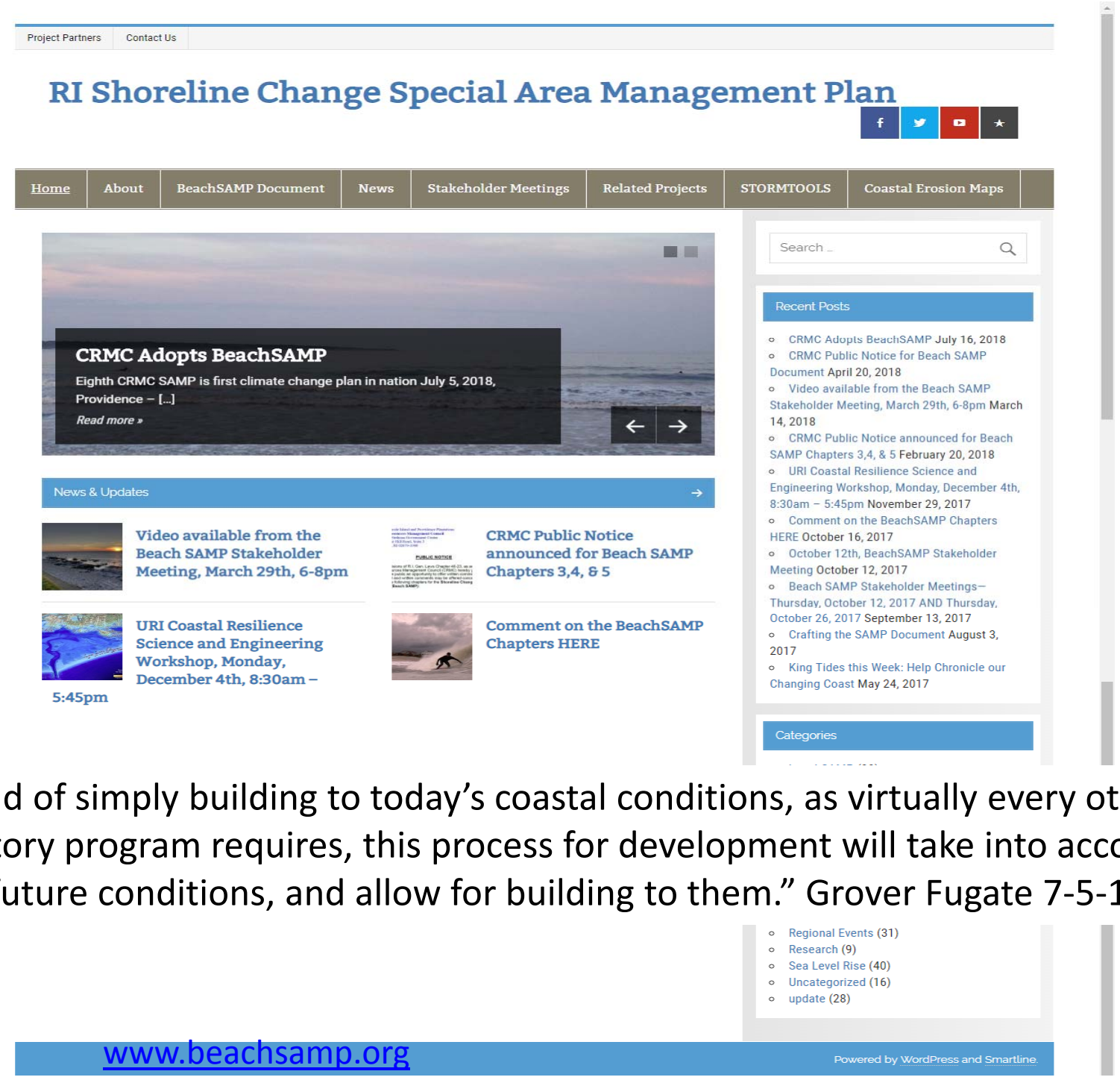
The University of Rhode Island Graduate School of Oceanography | Coastal Resources Center



Rhode Island Coastal Resources Management Council is Unique

- Direct permitting agency - make the same land use decisions as municipalities.
- Expertise in areas that a municipality may not have - coastal and ocean engineers, coastal geologist, environmental scientists, and coastal policy specialists
- Work with the Universities to routinely pull the latest science into plans and programs.
- Operate at the state level - all municipalities get put on a level playing field in terms of the training and tools we provide to them.

www.crmc.ri.gov

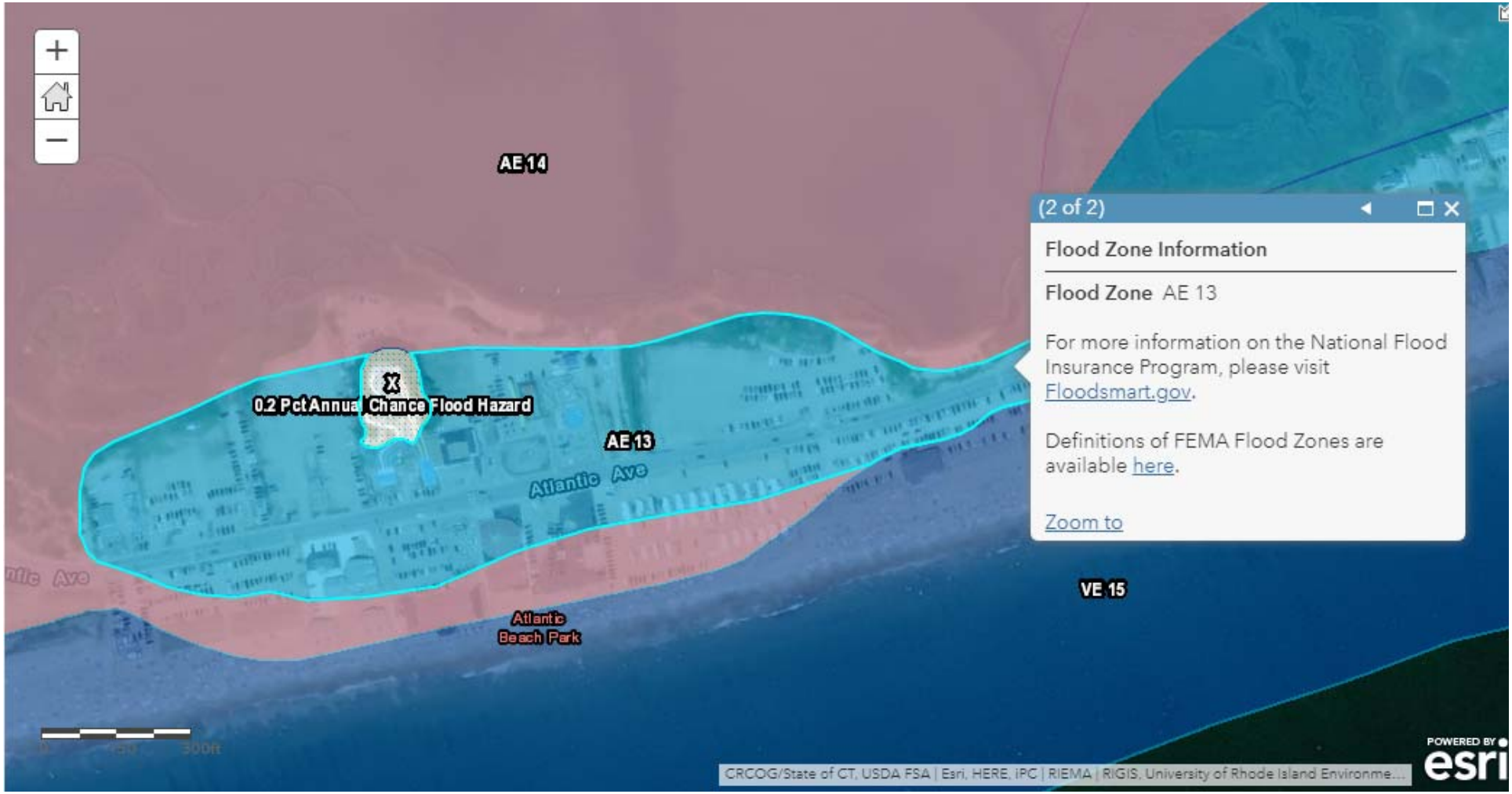


"Instead of simply building to today's coastal conditions, as virtually every other regulatory program requires, this process for development will take into account those future conditions, and allow for building to them." Grover Fugate 7-5-18

GUIDING PRINCIPLES

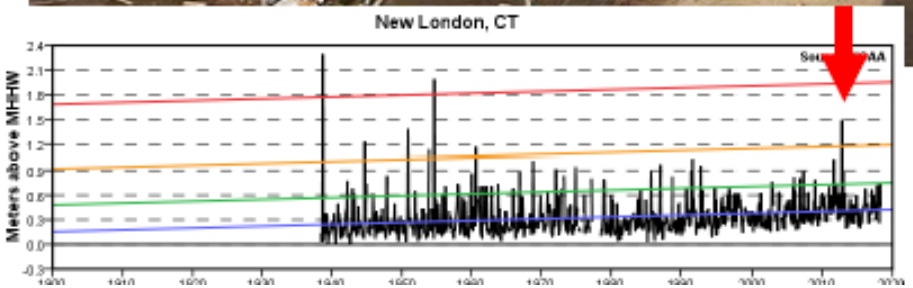
- Guidance Document (incorporated into the Red Book - 650-RICR-20-00-1-1.1.6.I)
- Use best available science
- Long-range combined impacts of SLR, storm surge and coastal erosion
- Risk identification and awareness
- Phasing of adaptation strategies
- Maximize agency coordination
- Public participation
- Transparency

FEMA Flood Insurance Rate Map effective 10-16-13



http://www.riema.ri.gov/

MISQUAMICUT (WESTERLY), RI



STORMTOOLS Design Elevation (SDE), South Coast

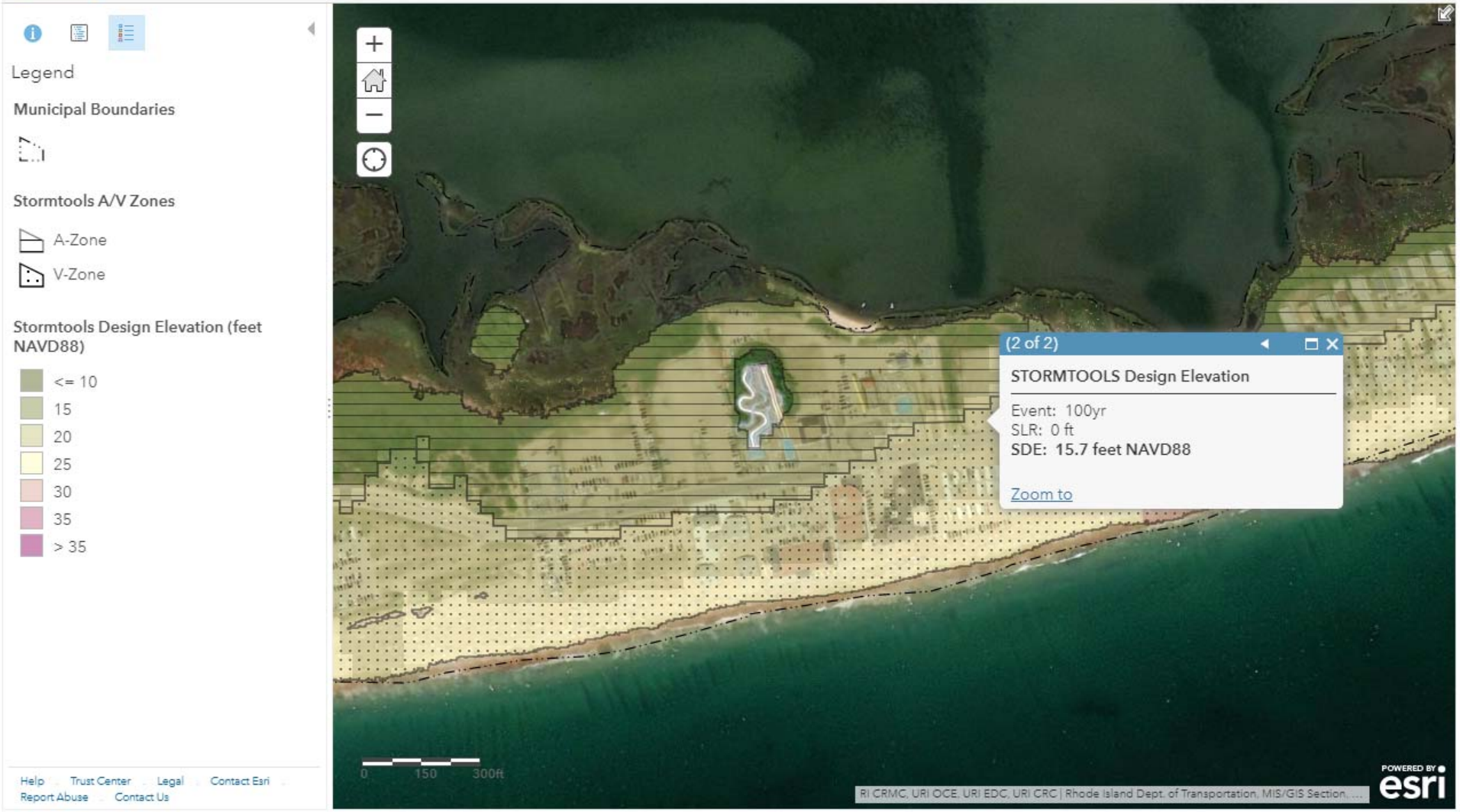
RI Shoreline Change SAMP

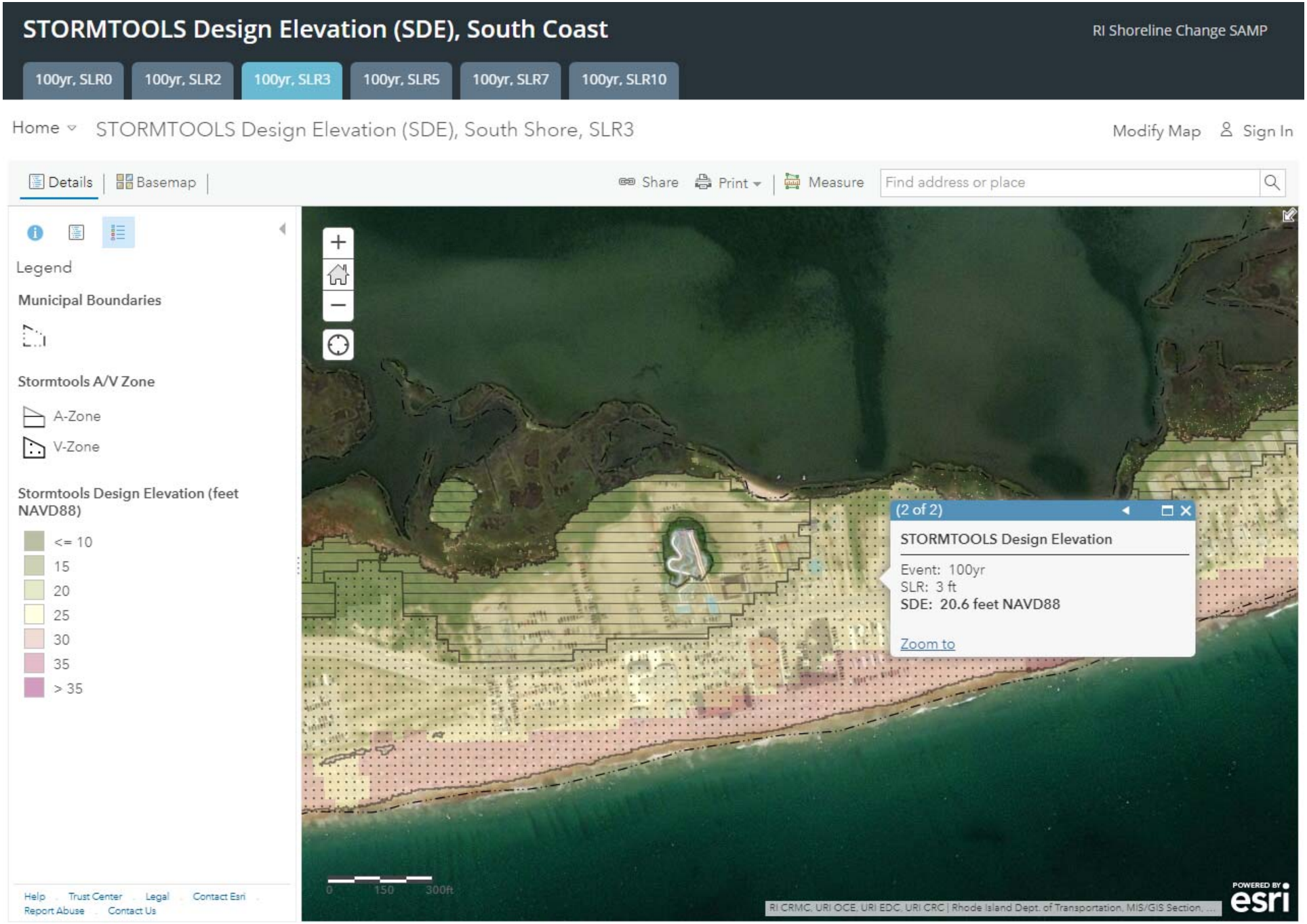
100yr, SLR0 | 100yr, SLR2 | 100yr, SLR3 | 100yr, SLR5 | 100yr, SLR7 | 100yr, SLR10

Home ▾ STORMTOOLS Design Elevation (SDE), South Shore, SLR0

Modify Map | Sign In

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




STORMTOOLS Design Elevation (SDE), South Coast
RI Shoreline Change SAMP
100yr, SLR0
100yr, SLR2
100yr, SLR3
100yr, SLR5
100yr, SLR7
100yr, SLR10
Home
STORMTOOLS Design Elevation (SDE), South Shore, SLR3
Modify Map
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Details
Basemap
Share
Print
Measure
Find address or place
Legend
Municipal Boundaries
Stormtools A/V Zone
A-Zone
V-Zone
Stormtools Design Elevation (feet NAVD88)
<= 10
15
20
25
30
35
> 35
(2 of 2)
STORMTOOLS Design Elevation
Event: 100yr
SLR: 3 ft
SDE: 20.6 feet NAVD88
Zoom to
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150
300ft
RI CRMC, URI OCE, URI EDC, URI CRC | Rhode Island Dept. of Transportation, MIS/GIS Section, ...
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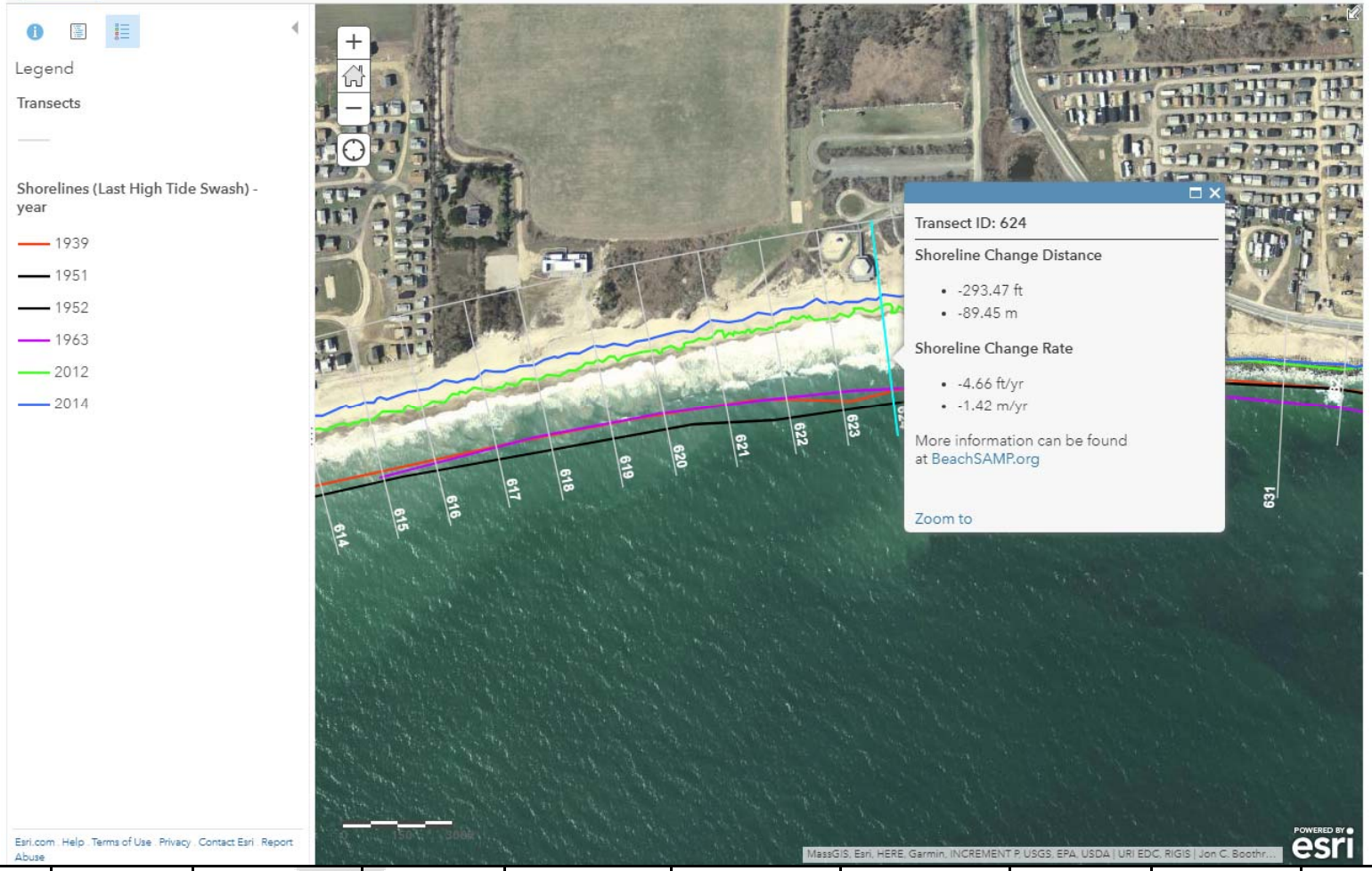
Shoreline Change Setbacks



Year	2020	2030	2040	2050	2060	2070	2080	2090	2100
Projected Future Erosion Multiplier	1.05	1.14	1.23	1.34	1.45	1.57	1.70	1.84	2.00

Science Gaps

Assessing the Effects of Rising Groundwater from Sea Level Rise on the Service Life of Pavements in Coastal Road Infrastructure

Jayne F. Knott, Mohamed Elshaer, Jo Sias Daniel, Jennifer M. Jacobs, and Paul Kirshen

Coastal communities with road infrastructure close to the shoreline are vulnerable to the effects of sea level rise caused by climate change. The sea level in coastal New Hampshire is projected to rise by 3.9 to 6.6 ft (1.2 to 2.0 m) by 2100. Climate change vulnerability and adaptation studies have focused on surface water flooding caused by sea level rise; however, little attention has been given to the effects of climate change on groundwater. Groundwater is expected to rise with sea level rise and will intersect the unbound layers of coastal road infrastructure, thus reducing the service life of pavement. Vulnerability studies are an essential part of adaptation planning, and pavement engineers are looking for methods to identify roads that may experience premature failure. In this study, a regional groundwater flow model of coastal New Hampshire was used to identify road infrastructure for which rising groundwater will move into the unbound materials during the design life of the pavement. Multilayer elastic theory was used to analyze typical pavement profiles in several functional classifications of roadway to determine the magnitude of fatigue and rutting life reduction expected from four scenarios of sea level rise. All the evaluation sites experienced service life reduction, the magnitude and timing of which depended on the current depth to groundwater, the pavement structure, and the subgrade. The use of this methodology will enable pavement engineers to target coastal road adaptation projects effectively and will result in significant cost savings compared with implementation of broad adaptation projects or the costs of no action.

Coastal areas worldwide are becoming more developed. Roads, constructed to service the built environment along the shore, are increasingly at risk from sea level rise, more intense coastal storms, and storm surge (*1*). Although the shoreline in many locations could be fortified in the future to protect property from coastal storms, access roads in coastal communities are vulnerable to rising groundwater caused by sea level rise. The sea level in coastal New Hampshire is projected to rise by 3.9 to 6.6 ft (1.2 to 2.0 m) by 2100 (*2*). Groundwater is expected to rise with rising sea level not only along the coast but also at significant distances inland (*3*, p. 46). In some locations, rising groundwater caused by sea level rise will intersect the unbound layers of coastal road infrastructure, weakening the pavement structure. Pavement design criteria currently is based on historical information that assumes the environmental parameters are stationary or, on average, not changing with time. Recent advances in climate change science have shown that the climate no longer is stationary. Transportation engineers, concerned that the pavement design criteria of the past are no longer valid, are looking for new guidance for designing and restoring pavement systems. Anticipated changes in groundwater levels will change the frequency, duration, and severity of road failures as well as the time and cost of repair.

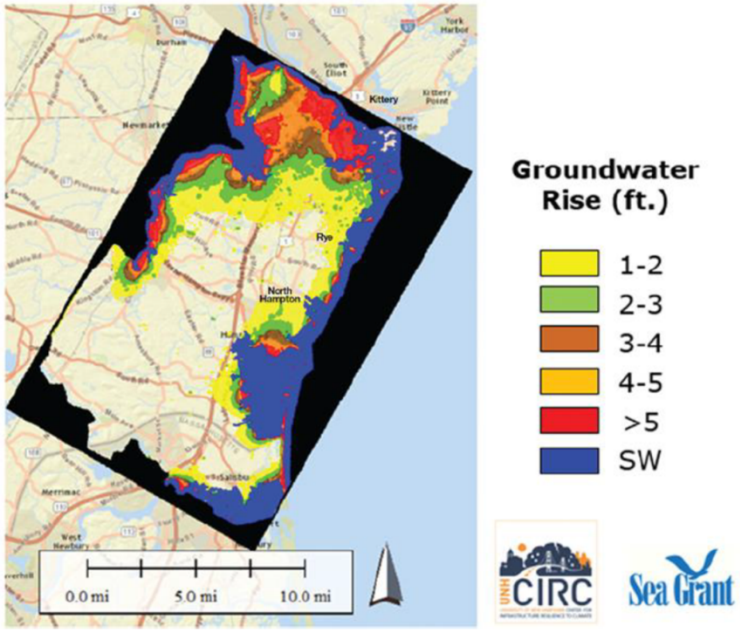
Sea level rise can cause erosion and storm surge damage, flood coastal communities, and damage coastal infrastructure (*4*). The causes of sea level rise are (*a*) thermal expansion of ocean waters, (*b*) water transfer between glaciers and oceans, (*c*) vertical land movement, (*d*) shifts in the Earth's magnetic field, and (*e*) ocean dynamics (*5*). There is uncertainty in projections of sea level rise in part because no one knows how quickly global economies will reduce greenhouse gas emissions and because the ice-loss dynamics of the Greenland and West Antarctica ice sheets are not well understood. A study linking global sea level rise to global-temperature-projected global sea level rise ranging from 2.5 to 6.2 ft (0.76 to 1.9 m) between 1990 and 2100 (*6*). The National Oceanic and Atmospheric Administration (NOAA) assessed several studies of sea level rise and produced scenarios of global mean sea level rise ranging from 0.7 (0.2 m) to 6.6 ft by the end of this century (*5*). The lowest figure is an extrapolation of the historical record, and the highest is based on the Intergovernmental Panel on Climate Change AR4 projections of global sea level rise combined with an estimate of the maximum amount of glacial and ice sheet loss by the end of the century. NOAA recommended that the 6.6-ft scenario be used to design infrastructure where the tolerance for risk is small (*5*). In coastal New Hampshire, the sea level rose 5.3 in. (13.5 cm) between 1927 and 2001, close to the global mean sea level rise. The New Hampshire Hazards and Risks Commission has adopted the NOAA scenarios for coastal adaptation planning (*2*).

In coastal areas, groundwater flows from recharge areas to discharge areas along the shoreline. As sea level rises, the groundwater levels near the coast also rise, until a new equilibrium is established between aquifer recharge and groundwater discharge to the sea.

J. F. Knott, 230 Gregg Hall, and J. M. Jacobs, 240 Gregg Hall, 35 Colovos Road; M. Elshaer, W161 Kingsbury Hall; and J. S. Daniel, W183B Kingsbury Hall, 33 Academic Way, University of New Hampshire, 105 Main Street, Durham, NH 03824. P. Kirshen, 2100 Integrated Science Complex, University of Massachusetts, Boston, 100 Morrissey Boulevard, Boston, MA 02125-3393. Corresponding author: J. F. Knott, jfk1011@wildcats.unh.edu.

Transportation Research Record: Journal of the Transportation Research Board, No. 2639, 2017, pp. 1–10.
http://dx.doi.org/10.3141/2639-01

Projected amount of groundwater rise with 6.6 feet of sea-level rise



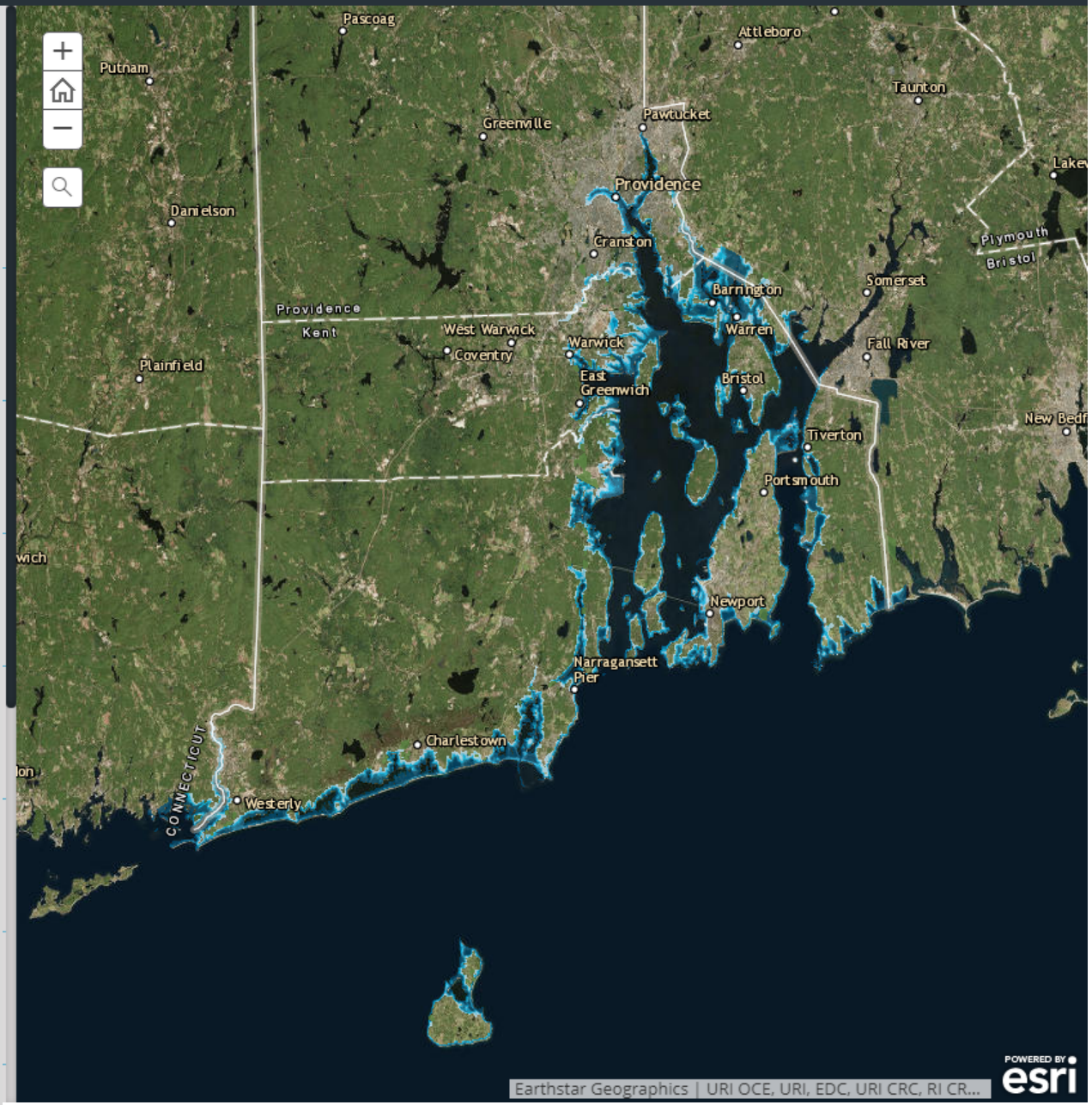
RI CRMC Coastal Hazard VIEWER - UPDATED 4/22/19

A story map

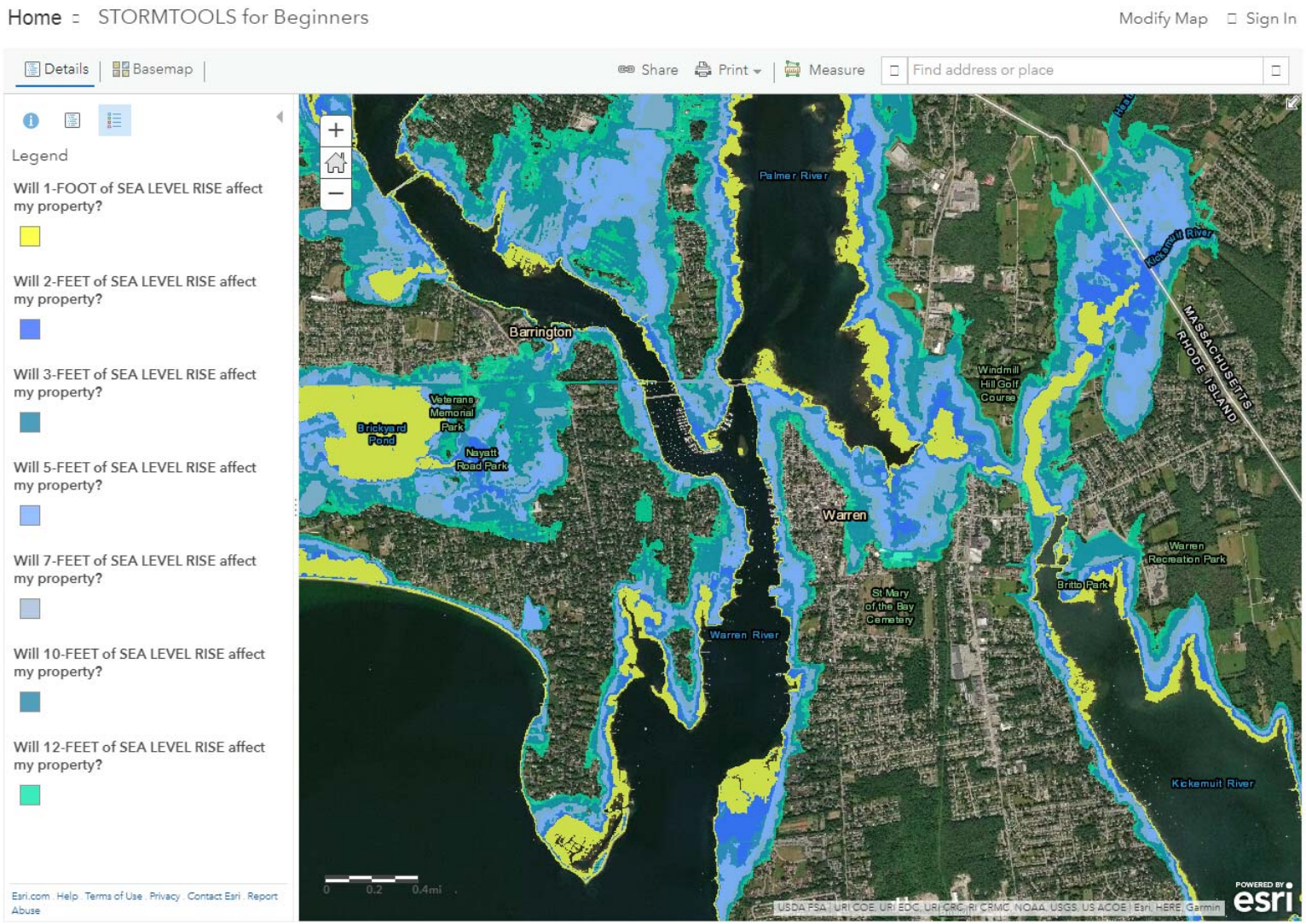
Do I need to complete the RICRMC Coastal Hazard WORKSHEET?

To determine if your project must complete the RI CRMC Coast Hazard WORKSHEET, refer to Section 1.1.6 (I), Page 59 of the Rhode Island Coastal Resources Management Program, online http://www.crmc.ri.gov/regulations/RICRMP.pdf

- Introduction
- Step 1: Project Design Life
- Step 2: Site Assessment
- Step 3: STORMTOOLS Design Elevation (SDE) - South Coast: Napatree to Point Judith
- Step 3: STORMTOOLS Design Elevation (SDE) - Narragansett Bay: North & East of Point Judith
- Step 4: Shoreline Change
- Step 5: Coastal Environmental Risk Index (CERI) & Other Site Consideratio
- Step 6: Large Projects
- Step 7: Design Evaluation
- Sources and References
- Contact Info



STORMTOOLS


Home = STORMTOOLS for Beginners
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?
Will 10-FEET of SEA LEVEL RISE affect my property?
Will 12-FEET of SEA LEVEL RISE affect my property?
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Palmer River
Barrington
Veterans Memorial Park
Brickyard Pond
Nayatt Road Park
Warren
Warren River
St Mary of the Bay Cemetery
Windmill Hill Golf Course
MASSACHUSETTS
RHODE ISLAND
Warren Recreation Park
Britto Park
Kickemuit River
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USDA FSA, URI COE, URI EDC, URI CRC, RI CRMC, NOAA, USGS, US ACOE | Esri, HERE, Garmin
POWERED BY esri

Home = STORMTOOLS for Beginners

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?

Albert G Jamiel Memorial Park

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RI CRMC Coastal Hazard VIEWER - UPDATED 4/22/19

A story map

Step 3: STORMTOOLS Design Elevation (SDE) - South Coast: Napatree to Point Judith

Step 3: STORMTOOLS Design Elevation (SDE) - Narragansett Bay: North & East of Point Judith

- FOR PROPERTIES WITHIN **NARRAGANSETT BAY**: Determine your recommended STORMTOOLS Design Elevation (SDE) using the map to the right.
- Reference State Law Elevation Allowances. ***NOTE: 1-foot of freeboard (elevation) is required, above BFE is required but up to 5-feet of additional freeboard may be provided voluntarily.***
- SDE Maps may be substituted for FEMA FIRM maps, per R.I. Gen. Laws § 45-24-31(12)
- Applicant should coordinate with the design engineer on this issue.

1. Select the Sea Level Rise scenario that matches your WORKSHEET

Step 4: Shoreline Change

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

Please click the map on your desired location to enable the Pop-Up box with the STORMTOOLS Design Elevation for the 100-year return period storm scenario plus 0-feet of sea level rise. Sea level scenarios are relative to 2010, and suggested design elevations are referenced to NAVD 88.

Stormtools Design Elevation (feet NAVD88)

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

Stormtools Design Elevation

Event: 100yr
SLR: 0 ft
SDE: 20.0 feet NAVD88

Apponaug Cove

Mill Cove Beach

OVERVIEW MAP

Microsoft | RI CRMC, URI OCE, URI EDC, URI CRC | Esri, HE...

POWERED BY esri

RI CRMC Coastal Hazard VIEWER - UPDATED 4/22/19

A story map

Step 3: STORMTOOLS Design Elevation (SDE) - South Coast: Napatree to Point Judith

Step 3: STORMTOOLS Design Elevation (SDE) - Narragansett Bay: North & East of Point Judith

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1. Select the Sea Level Rise scenario that matches your WORKSHEET

Step 4: Shoreline Change

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

Please click the map on your desired location to enable the Pop-Up box with the STORMTOOLS Design Elevation for the 100-year return period storm scenario plus 3-feet of sea level rise. Sea level scenarios are relative to 2010, and suggested design elevations are referenced to NAVD 88.

Stormtools Design Elevation (feet NAVD88)

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

Stormtools Design Elevation

Event: 100yr
SLR: 3 ft
SDE: 23.5 feet NAVD88

Apponaug Cove

Mill Cove Beach

OVERVIEW MAP

Microsoft | RI CRMC, URI OCE, URI EDC, URI CRC | Esri, HE...

POWERED BY esri

Chapter 7: Adaptation Strategies and Techniques for Coastal Properties

Some Key Messages

- Adaptation tools and techniques are typically categorized as forms of ***protection***, ***accommodation***, or ***retreat***

- Adaptation strategies can be applied at the scale of an individual ***structure,*** a ***site,*** or an ***entire community***

- Adaptation strategies include ***technical strategies*** and ***planning or policy strategies***

Table 1. Summary table of coastal property adaptation tools and techniques

Strategy	*Existing or New Construction*	*Protection, Accommodation or Retreat*	*Site or Structure*
Site selection	New	Accommodation or Retreat	Site or structure
Distance inland	Existing or new	Retreat	Site or structure
Elevation	Existing or new	Accommodation	Site or structure
Terrain management			
Site grading	New	Accommodation	Site
Site layout	New	Accommodation	Site
Drainage	Existing or new	Accommodation	Site or structure
Natural or nature-based measures			
Coastal bank protection	Existing or new	Protection	Site
Living breakwaters	Existing or new	Protection	Site
Dune restoration	Existing or new	Protection	Site
Beach nourishment	Existing or new	Protection	Site
Coastal wetland or enhancement	Existing or new	Protection	Site

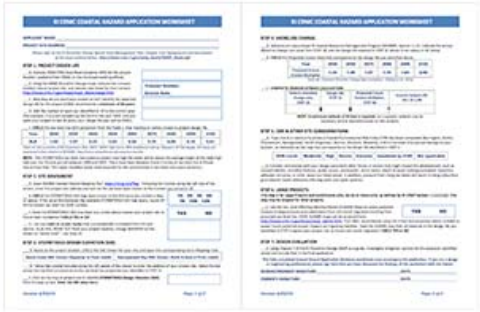
RI Coastal Resources Management Council

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

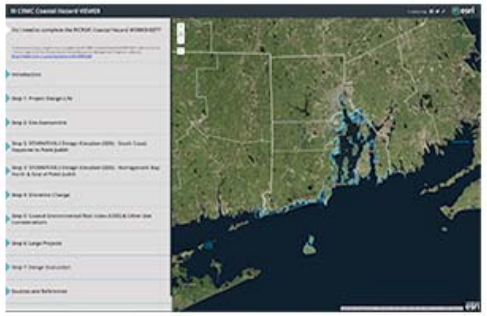
Coastal Ha n

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 Hazard Application Worksheet (PDF)



Coastal Hazards Application Online Viewer

The list of projects below must complete the RICRMC Coastal Hazard Application WORKSHEET to be filed in addition to and with your standard CRMC application (http://www.crmc.ri.gov/applicationforms.html).

Any of the following **new projects**, including tear downs and rebuilds, located on a coastal feature or within the 200-foot contiguous area:

1. construction of new residential buildings as defined in § 1.1.2;
2. construction of new commercial and industrial structures as defined in § 1.1.2;
3. construction of new beach pavilions as defined in § 1.1.2;
4. construction of any new private or public roadway, regardless of length;
5. construction of any new infrastructure project subject to §§ 1.3.1(F), (H), and (M); and
6. construction of any new subdivisions with six (6) or more lots, any portion of which is within 200 feet of a shoreline feature.

Any of the following **modifications to existing projects**, including tear downs and rebuilds, located on a coastal feature or within the 200-foot contiguous area:

1. any expansion of existing commercial structures over tidal waters;

ting residential, commercial, industrial or beach pavilion structures;