

# Building Resilient Waterfronts and Coastal Communities

Pam Rubinoff  
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RI Sea Grant

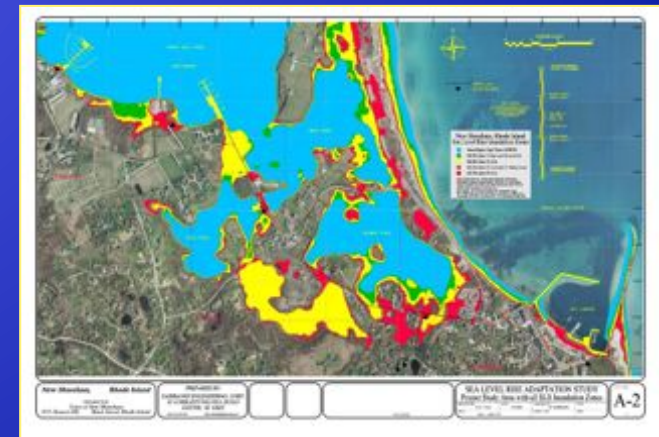


SailNewport

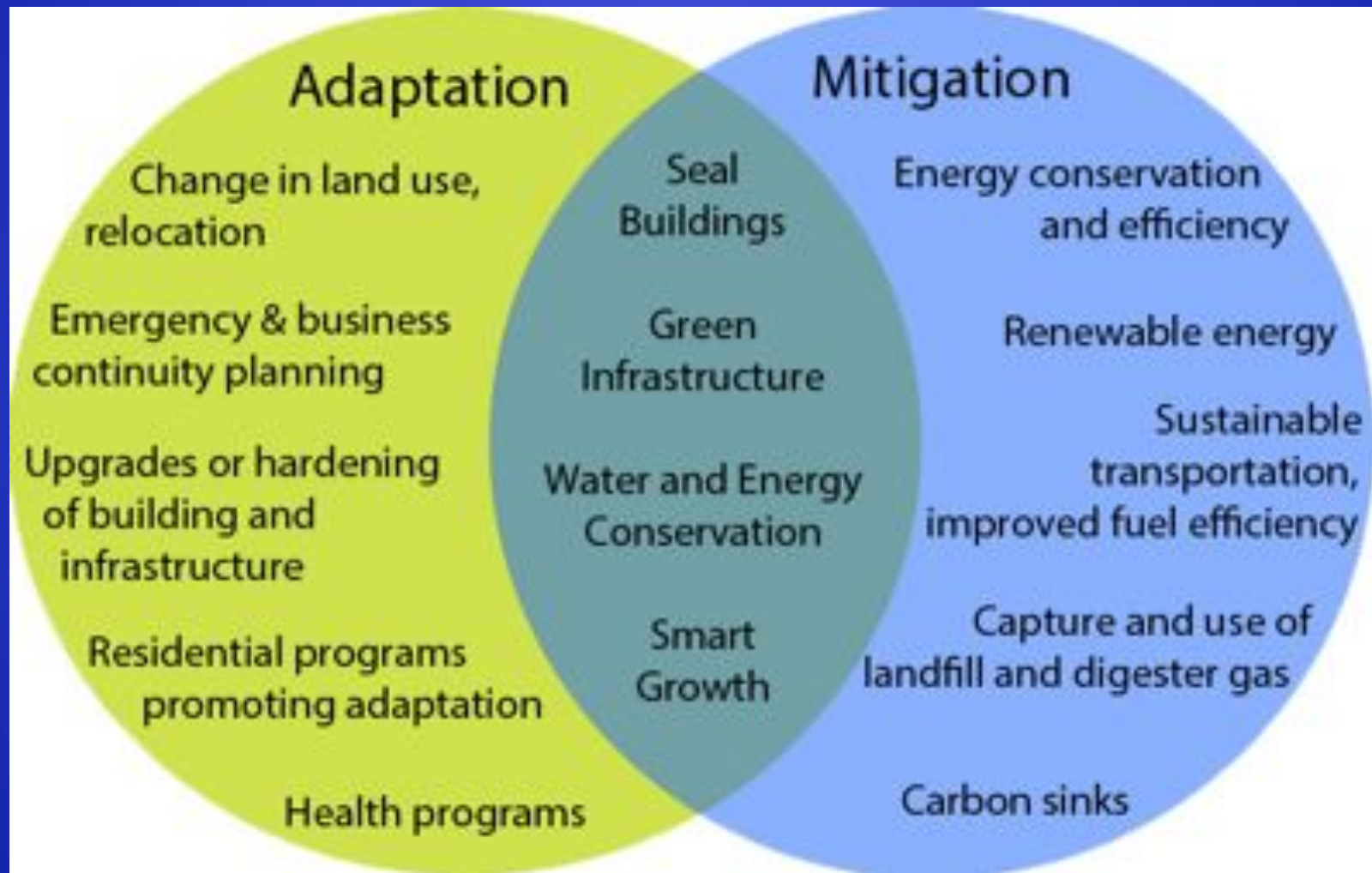


# Outline

- RI Context on marine trades
- SLR and Storms
- Initiatives underway to assess issues and opportunities to build resilience



# Resilience = Both/and



# The RI Context

## The marine trades and recreational boating generate

- \$1.3 billion in direct spending
- 7,100 direct jobs,
- \$327 million in direct wages

## The total economic impact of the maritime trades cluster

- over \$2.2 billion in sales for Rhode Island businesses,
- generates nearly \$118 million in tax and fee revenue for state and local governments



[makeithappenri.com/](http://makeithappenri.com/)

# Ports & Harbors Statewide Inventory (2008 - 2010)



**1,568 Parcels**

**5,562 Acres**

**Approx. 10%  
(42 miles)  
of RI Coastline**



## Rhode Island Ports & Commercial Harbors

A GIS-based Inventory of Current Uses and Infrastructure  
August 2010

Written by:  
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Susan Kennedy (Editor)



The project was supported by the Rhode Island Statewide Planning Program with funding provided by the US Department of Transportation, Federal Highway Administration.



<http://seagrants.gso.uri.edu/coast/>

THE  
UNIVERSITY  
OF RHODE ISLAND

Sea Grant  
Rhode Island

RHODE ISLAND  
STATEWIDE  
PLANNING  
PROGRAM

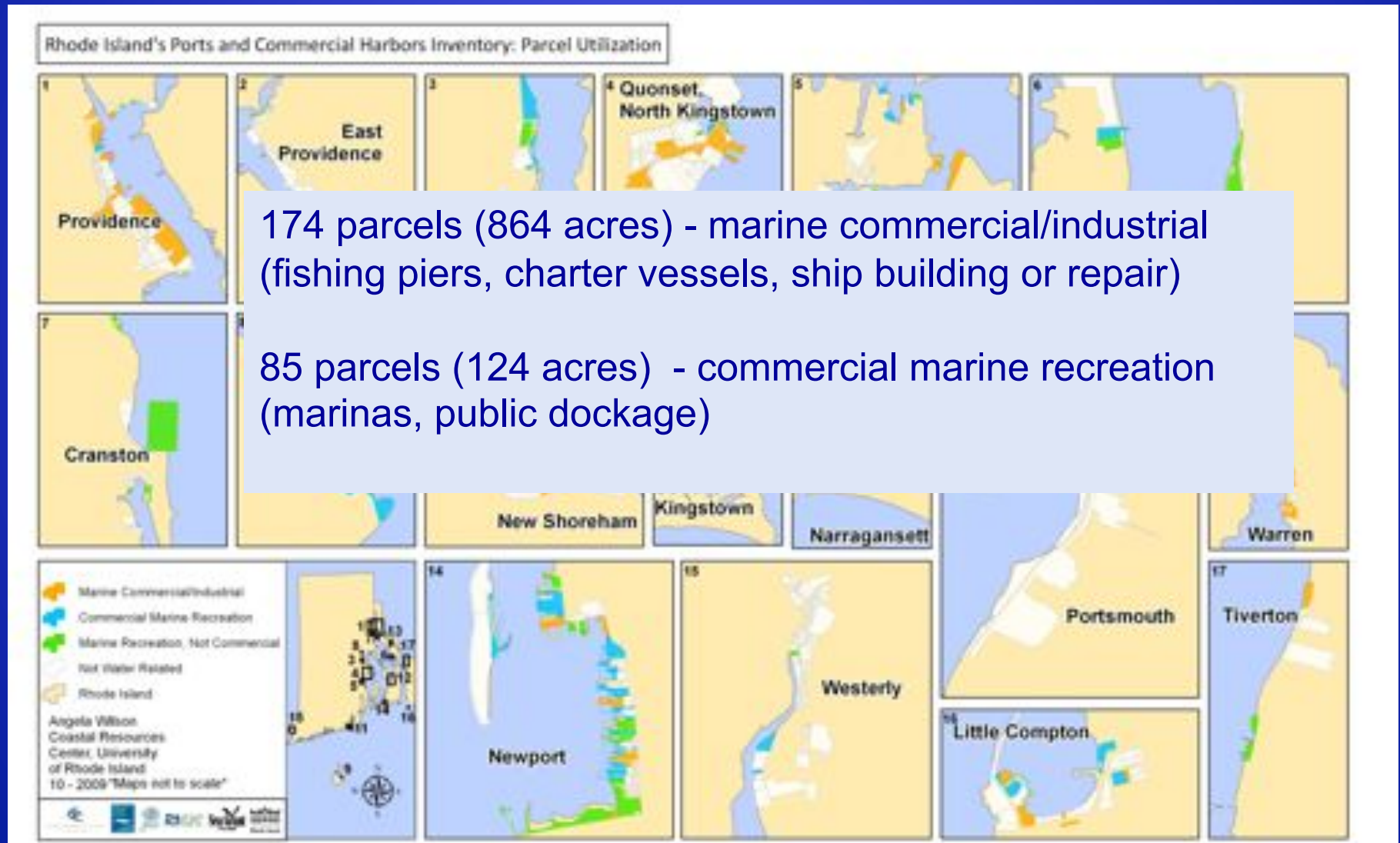
COASTAL  
RESOURCES  
CENTER

U.S. Department of Transportation  
Federal Highway  
Administration

RIGIS

# Areas Zoned for Marine Commercial/industrial Uses

1,028 parcels (3,009 acres, or 66% of study area)



# *Sandy, 2012*



Newport Daily News, 2012



M. Devine, 2012



RIDOT



*Bob  
was  
here*

There's nothing like a boat and the power of the sea. It's a feeling of freedom and adventure, of being out there, of being part of something big. It's a feeling of excitement and discovery, of being part of something new. It's a feeling of joy and happiness, of being part of something special. It's a feeling of love and passion, of being part of something meaningful. It's a feeling of pride and accomplishment, of being part of something great. It's a feeling of hope and optimism, of being part of something bright. It's a feeling of peace and tranquility, of being part of something beautiful. It's a feeling of awe and wonder, of being part of something amazing. It's a feeling of awe and wonder, of being part of something amazing. It's a feeling of awe and wonder, of being part of something amazing.





*What will  
the future  
look like at  
high tide?*



E. Booth, Oct 2012



H. Hanka, Oct 2012

*1' above  
MHHW*




Jeff Michaelson, June 2012

*Extreme Tides  
2' above  
MHHW*



M. Devine, June, 2012

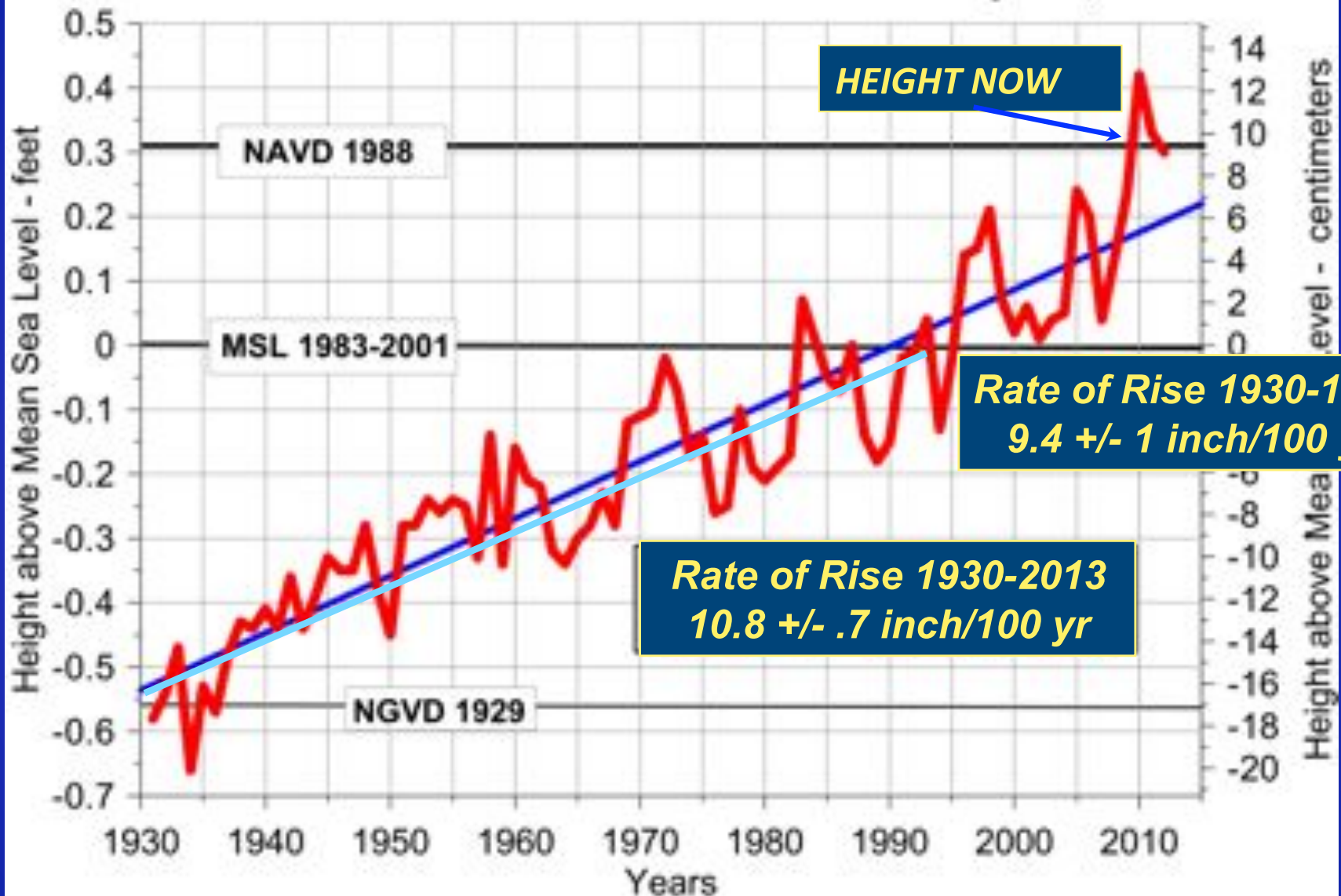


*What will the  
future look at  
high tide?*

*Irene, 2010  
2.7' MHHW*



# HISTORIC SEA-LEVEL RISE - Newport, RI

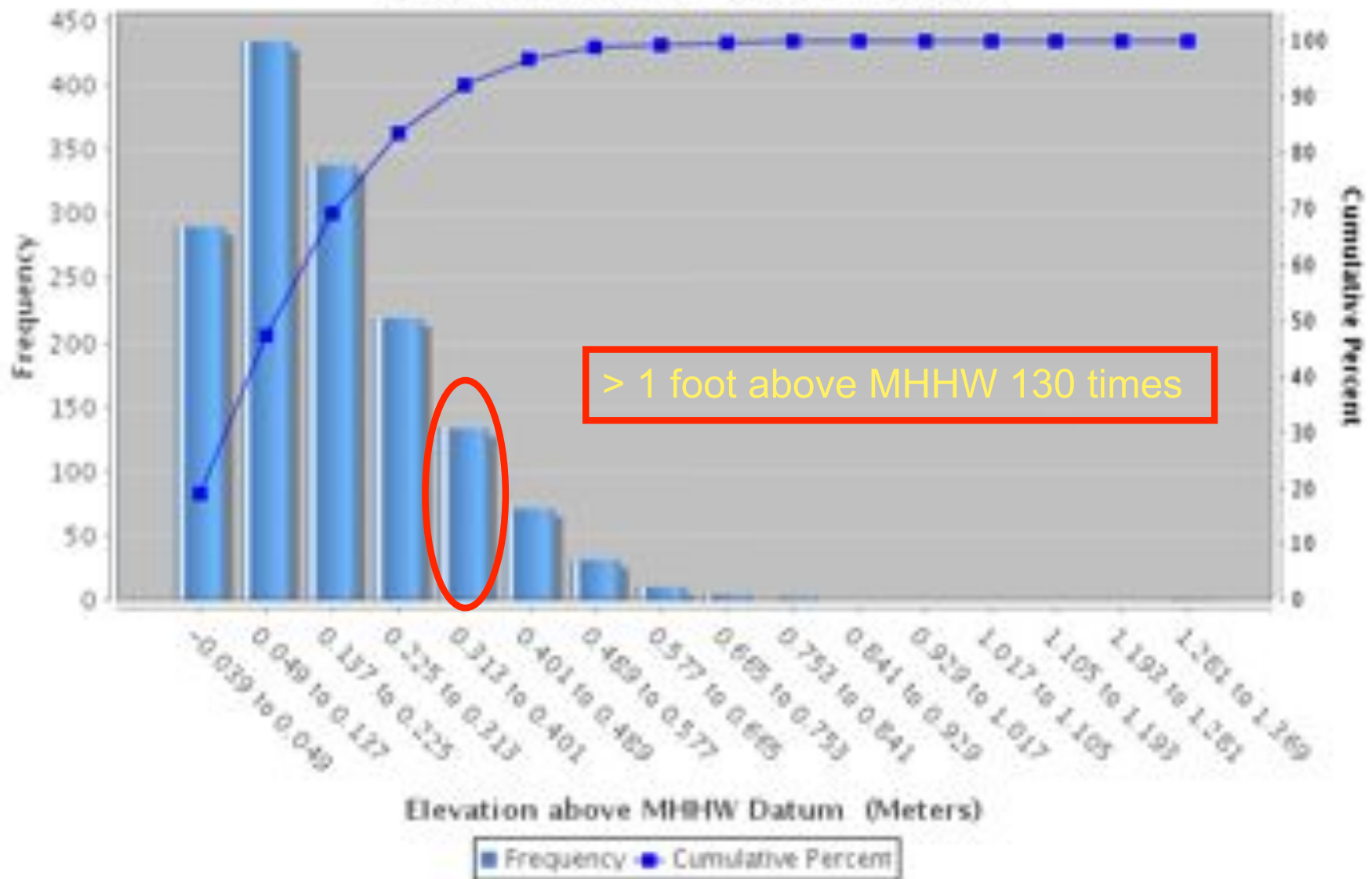


Adapted from:  
[http://tidesandcurrents.noaa.gov/sltrends/sltrends\\_station.shtml?stnid=8452660%20Newport,%20RI](http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=8452660%20Newport,%20RI)



Boothroyd 2013

8452660 Newport RI  
 Frequency of High Water Elevations Relative to MHHW Datum (1.751 Meters)  
 From 2010-01-01 To 2014-01-01



Source: <http://tidesandcurrents.noaa.gov/inundation/>

# What will the future bring in Sea Level?

## US Army Corps of Engineers SLR Curves

USACE Curves computed using criteria in USACE EC 1165-2-212

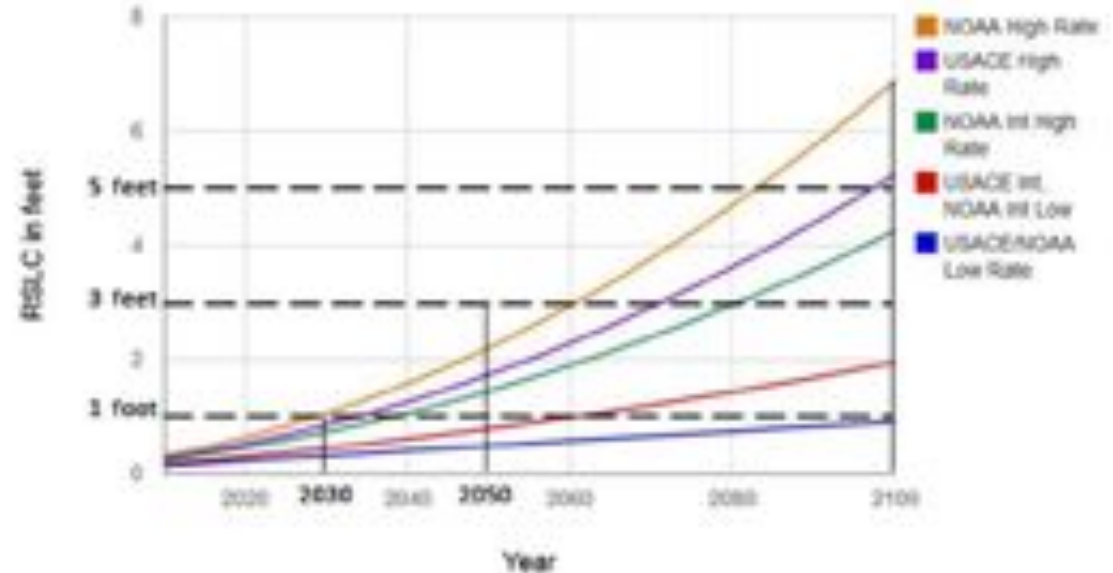
NOAA Curves computed using criteria in NOAA SLR Report 06 Dec 2012

Gauge: 8452668, RI, Newport: 77 yrs  
All values are in feet

Year	NOAA Low	USACE Low	NOAA Int Low	USACE Int	NOAA Int High	USACE High	NOAA High
2010	0.16	0.16	0.18	0.18	0.24	0.27	0.32
2015	0.19	0.19	0.24	0.24	0.35	0.39	0.46
2020	0.24	0.24	0.31	0.31	0.48	0.53	0.64
2025	0.28	0.28	0.38	0.38	0.59	0.68	0.84
2030	0.32	0.32	0.45	0.45	0.73	0.86	1.06
2035	0.36	0.36	0.53	0.53	0.89	1.06	1.31
2040	0.41	0.41	0.61	0.61	1.06	1.26	1.58
2045	0.46	0.46	0.70	0.70	1.25	1.49	1.88
2050	0.49	0.49	0.79	0.79	1.45	1.74	2.21
2055	0.53	0.53	0.89	0.89	1.67	2.00	2.56
2060	0.58	0.58	0.99	0.99	1.90	2.29	2.94
2065	0.62	0.62	1.09	1.09	2.14	2.59	3.34
2070	0.66	0.66	1.20	1.20	2.40	2.92	3.77
2075	0.70	0.70	1.32	1.32	2.67	3.26	4.22
2080	0.74	0.74	1.43	1.43	2.96	3.62	4.70
2085	0.79	0.79	1.54	1.54	3.26	3.99	5.21
2090	0.83	0.83	1.68	1.68	3.57	4.39	5.74
2095	0.87	0.87	1.82	1.82	3.90	4.80	6.29
2100	0.91	0.91	1.96	1.96	4.25	5.24	6.87

Ch. 3 Figure B. USACE Online Sea Level Change Curve Calculator ([www.corpsclimate.us/ccaceslcurves.cfm](http://www.corpsclimate.us/ccaceslcurves.cfm))

USACE and NOAA SLR Curves - Gauge: 8452668, RI, Newport: 77 yrs  
USACE Curves computed using criteria in EC 1165-2-212

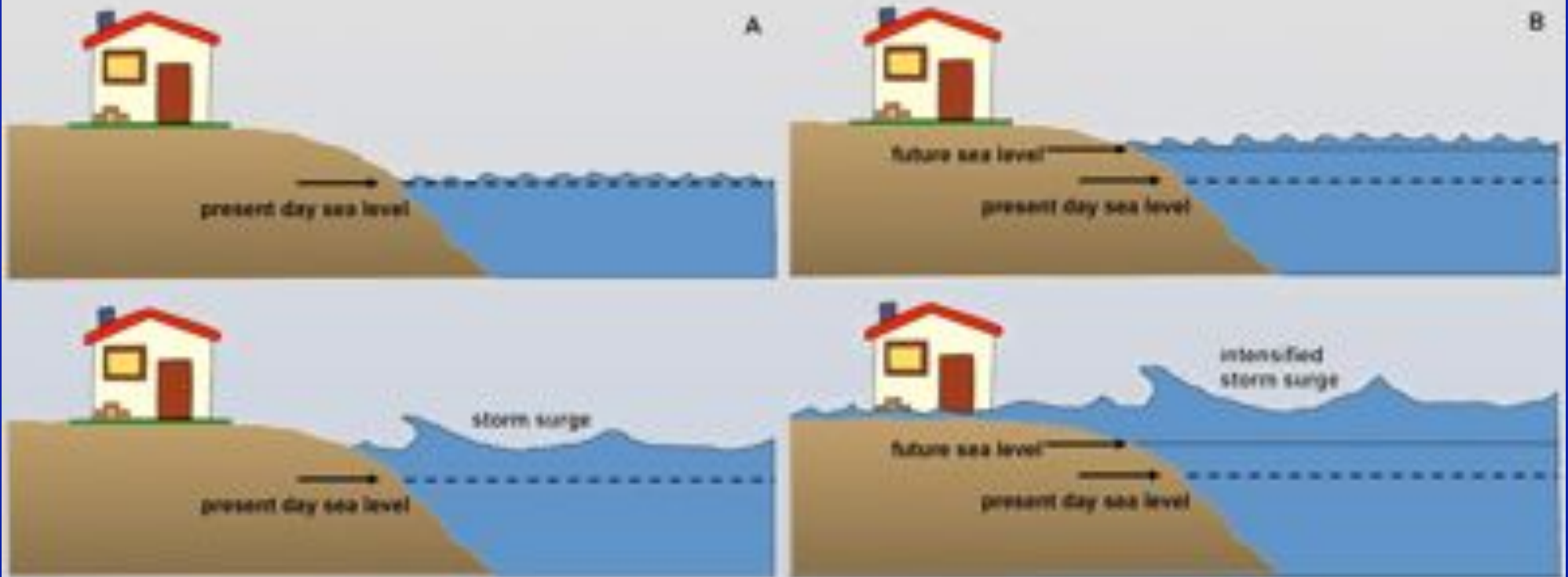


Ch. 3 Figure C. USACE Online Sea Level Change Curve Calculator ([www.corpsclimate.us/ccaceslcurves.cfm](http://www.corpsclimate.us/ccaceslcurves.cfm))

<http://corpsclimate.us/ccaceslcurves.cfm>

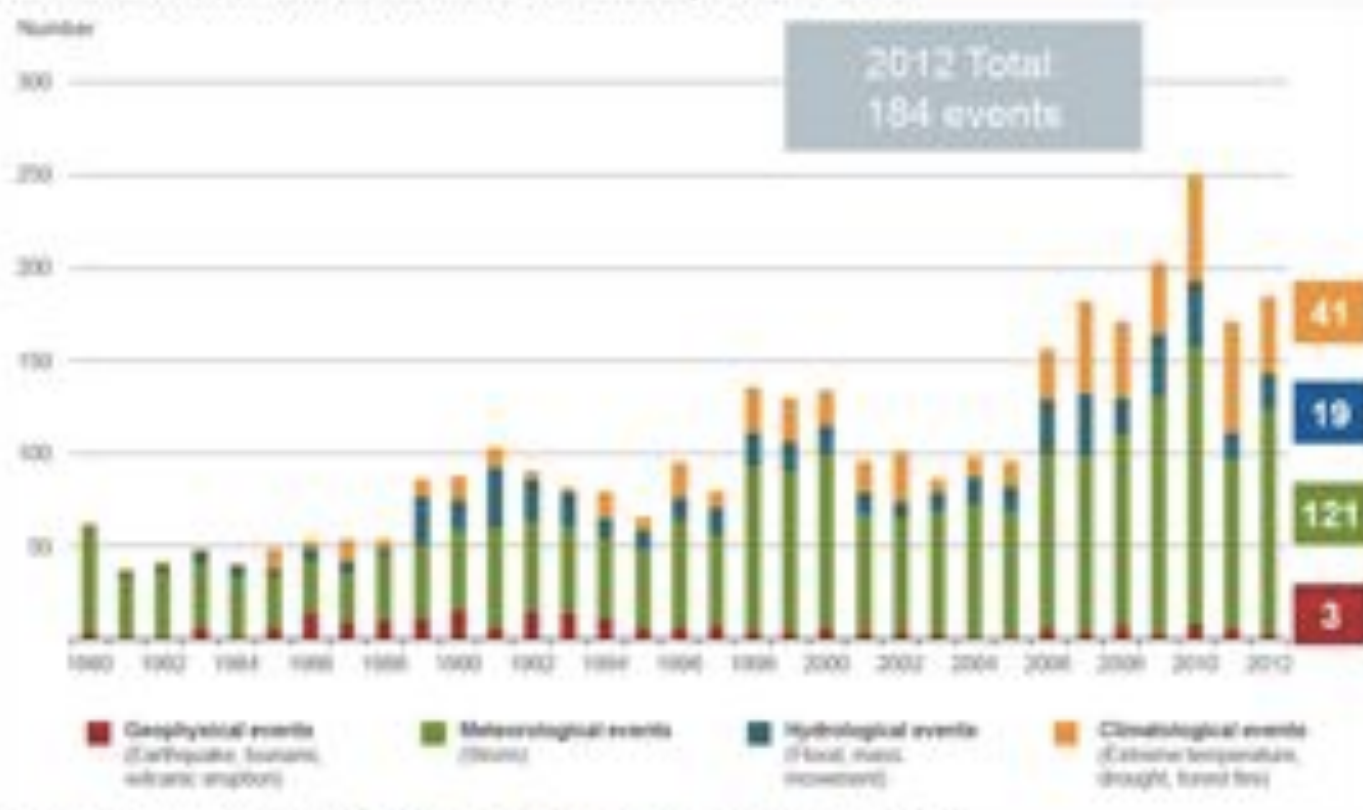
# Increasing sea level & storm surge

Schematic illustrating how sea level and storm surge act in concert under normal conditions (A) and with sea level rise and intensified storms (B).



# Disasters are Increasing in Frequency and Cost

**Natural Disasters in the United States, 1980 - 2012**



Source: © 2013 Munich Re, [NatCatSERVICE](#). As of January 2013.

**Natural Catastrophe Losses in the United States, 1980-2012**  
(Overall and insured losses)



## Rhode Island's Ports and Commercial Harbors Narragansett: Parcel Utilization



# Utilization of Point Judith Waterfront

## Parcels

### Utilization

- Marine Commercial/Industrial
- Commercial Marine Recreation
- Marine Recreation, Not Commercial

July, 2008

## Utilization Parcel (Acres)

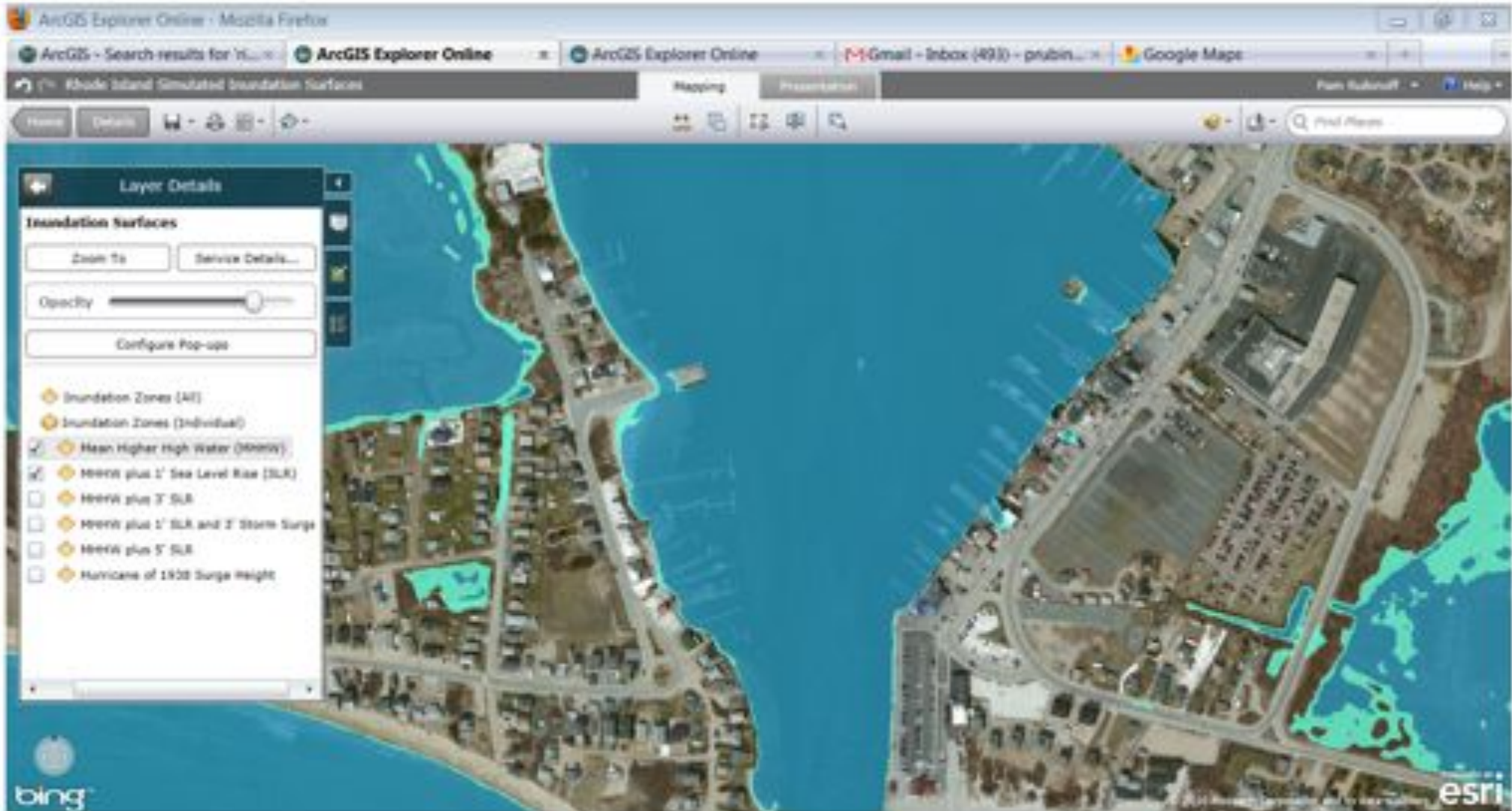
Marine Com/Industrial: 58 (42.86)

Com. Marine Recreation: 5 (.37)

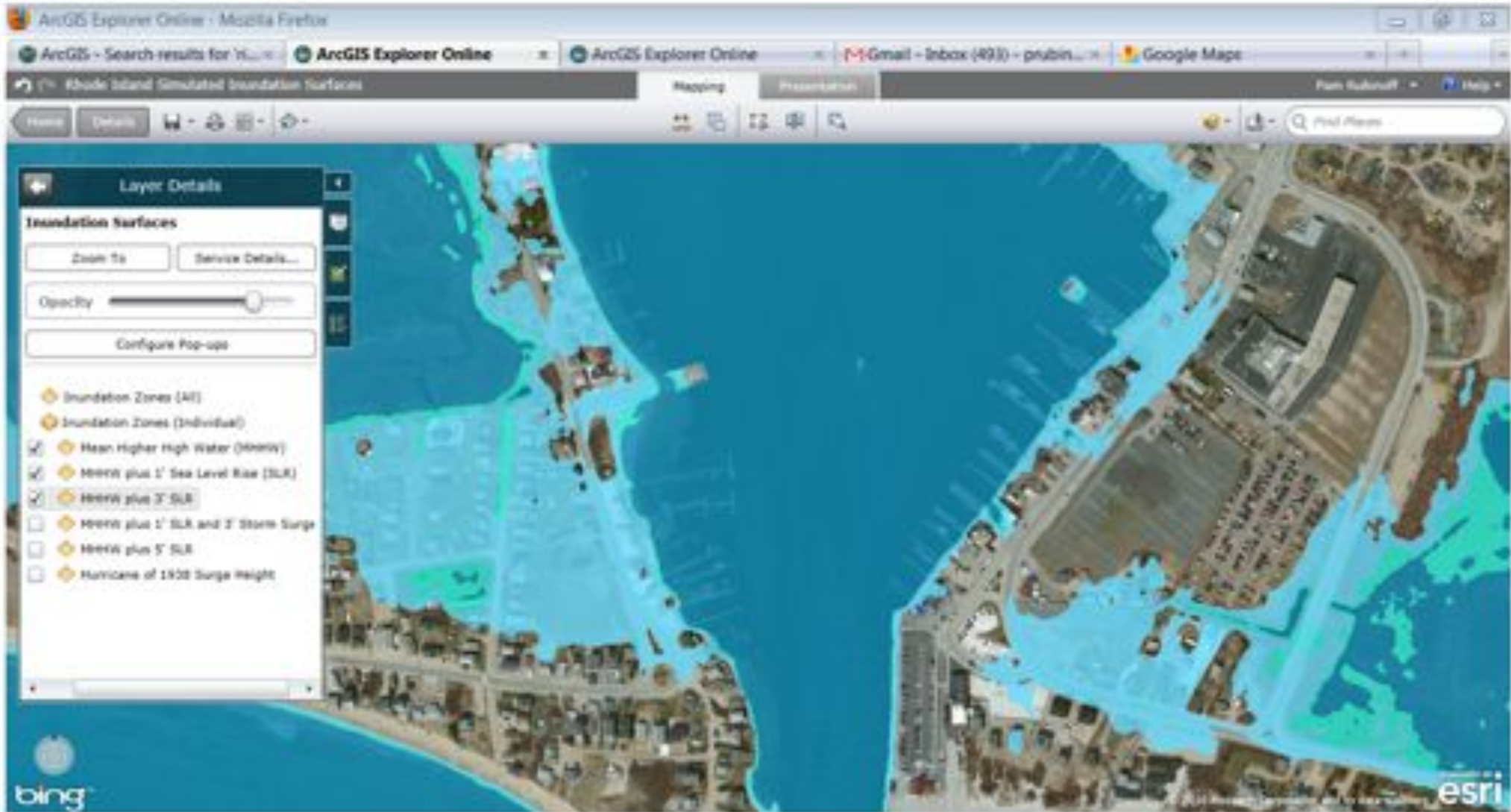
Marine Rec., Not Com.: 3 (19.76)

Not water related: 30 (32.99)

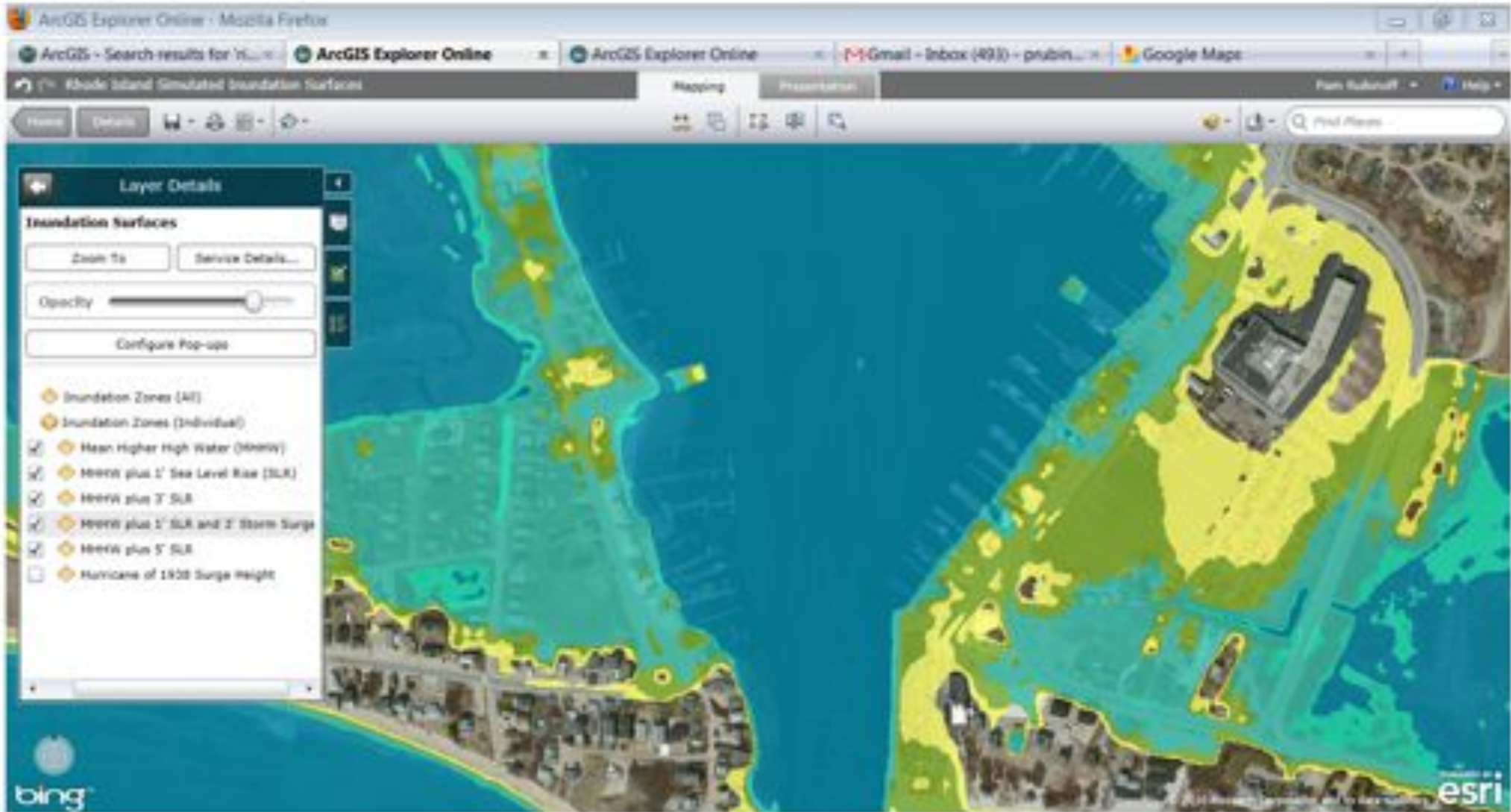
# MHHW +1'



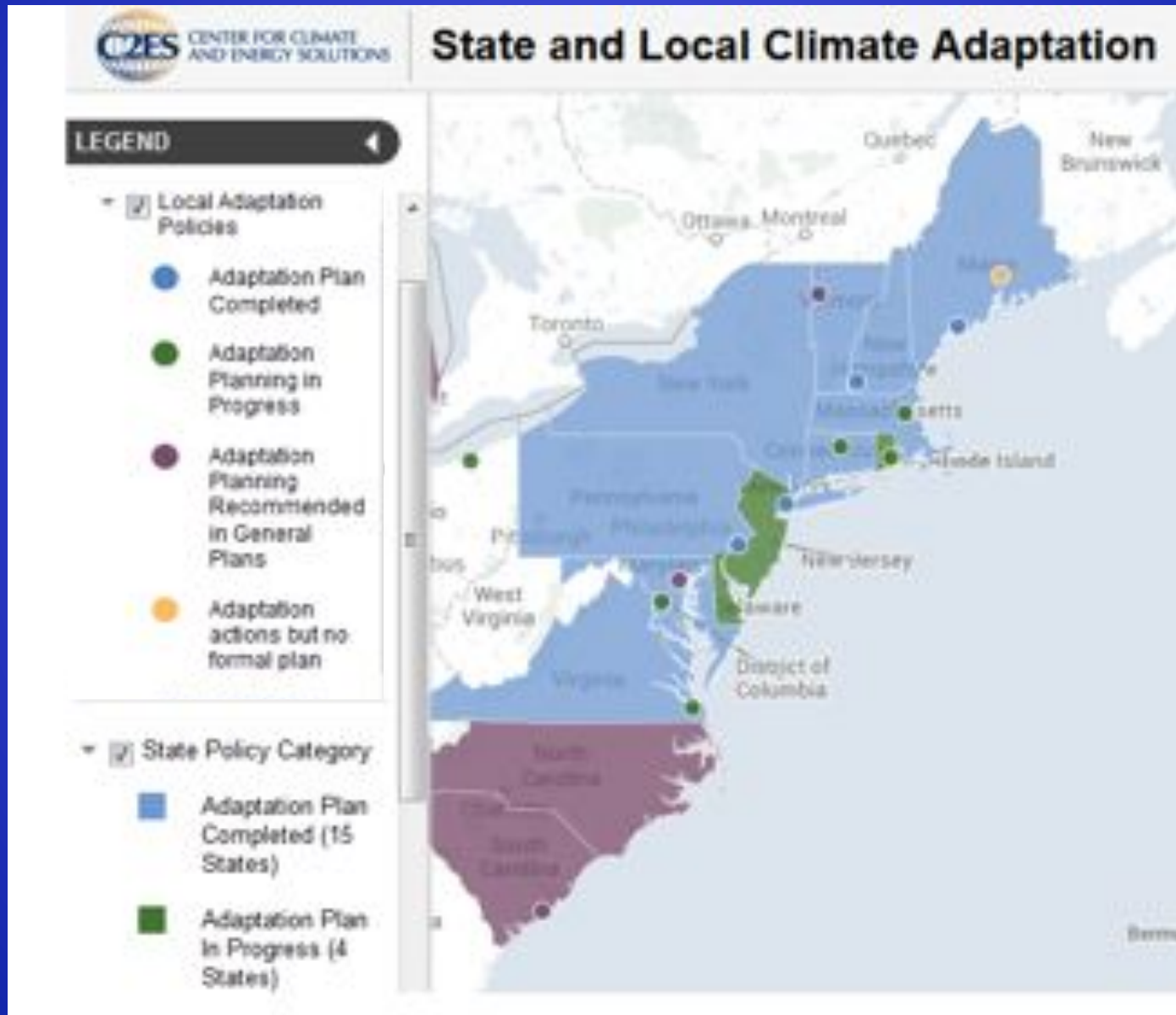
# MHHW +3'



# MHHW +5'



# What Can We Do?

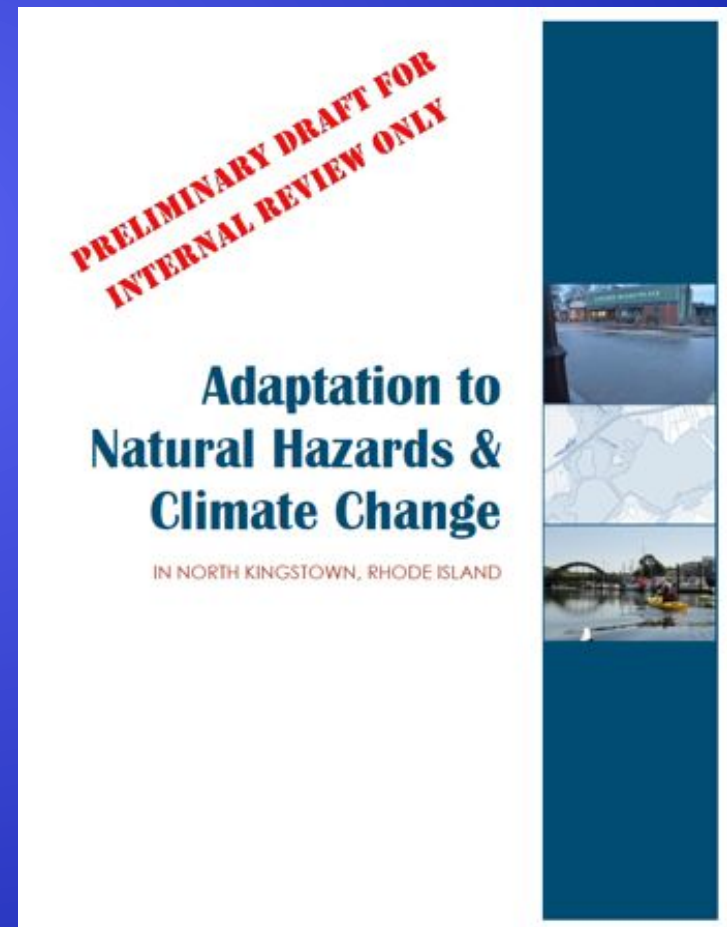
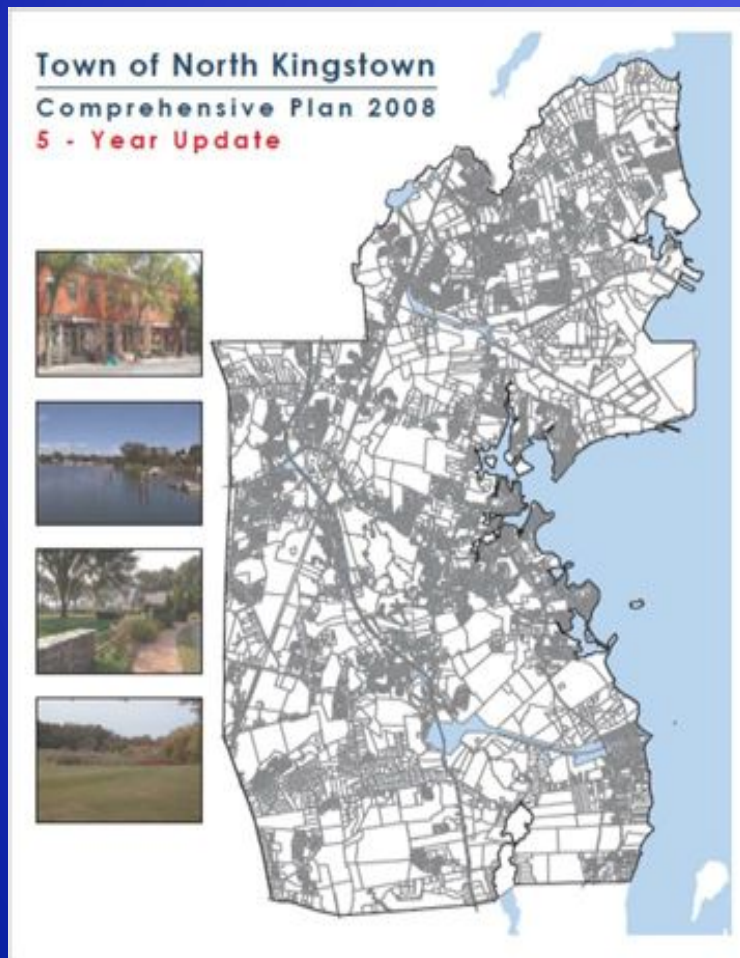


# State Planning & Policies

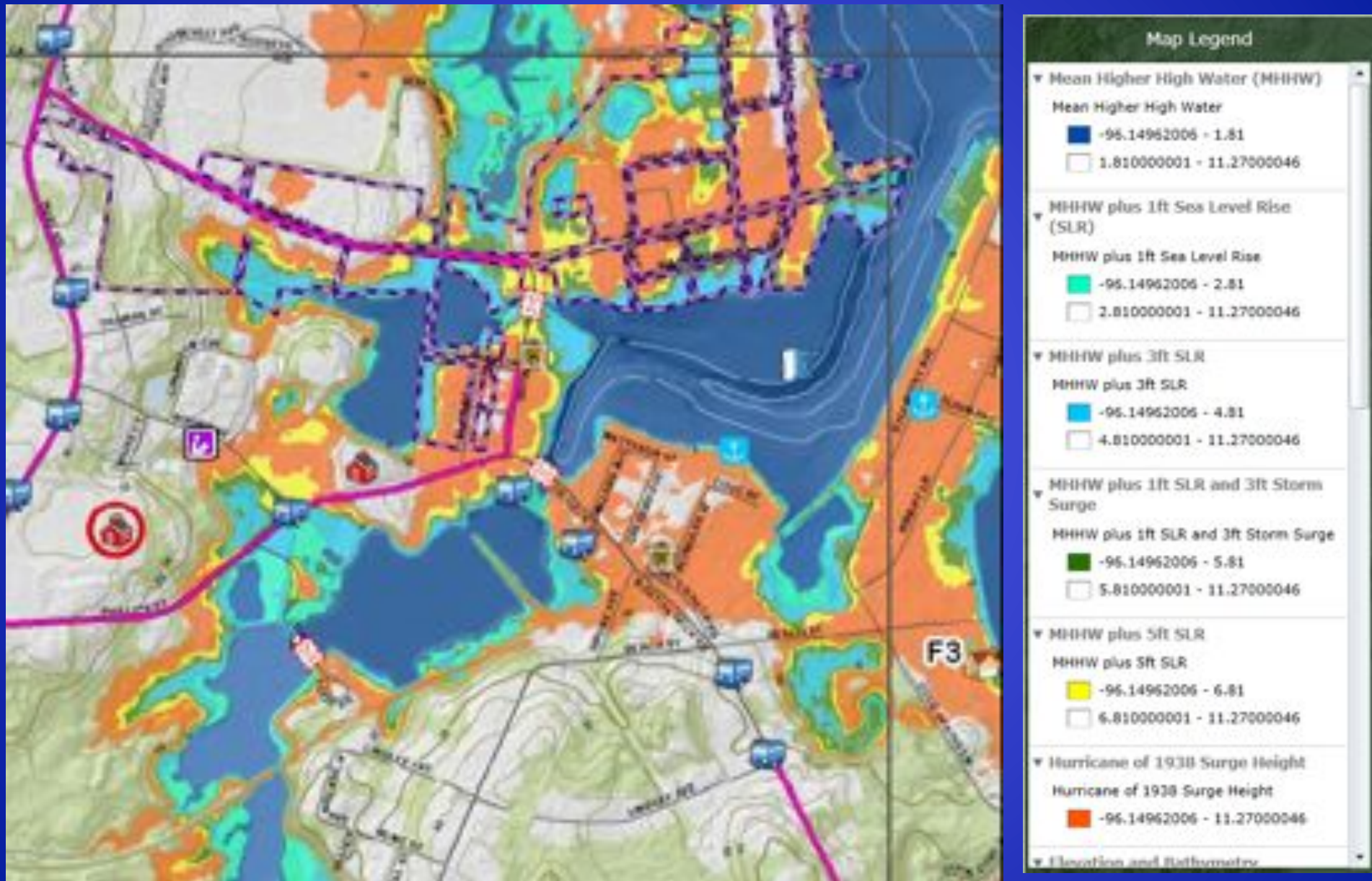
- Sea Level Rise Policy
- Executive Council on Climate Change
- Vulnerability maps informing permitting & decision making
- State Infrastructure Planning
  - Roads
  - Wastewater
  - Drinking water
- Open space acquisition – ID/prioritize lands for protection, salt marsh creation
- Low Impact Design – storm water and green infrastructure
- Shoreline Change SAMP



# Adapting local North Kingstown's Comprehensive Plans



# High Resolution Mapping



[http://seagrants.gso.uri.edu/climate/slr\\_tools.html](http://seagrants.gso.uri.edu/climate/slr_tools.html)



All Parcels  
MHHW +5' SLR

5%  
of total  
assessed property  
values in NK

North Kingstown  
Study Areas

\$80M  
of property in Wickford  
-150 parcels-  
(Study Areas 5 & 6)  
potentially  
impacted by 2100

- 
- 1  
2  
3  
4  
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12

# Local Applications

- **Regulatory** – zoning ordinance, comprehensive plan amendments
- **Hazard Mitigation Plan** – plan and implement actions; reduce rates
- **Incorporate into town GIS** – more accessible information
- **Transportation** – ID roads and infrastructure inundated
- **Transportation Improvement Program (TIP)** – incorporate into future funding program for state priorities
- **Capital Improvement Plan (municipal)** – infrastructure improvements (i.e sewers, dams, roadways, water)
- **Building Code** – apply standards and identify incentives
- **Open space acquisition** – ID/prioritize lands for protection
- **Educating citizens and decision makers** – technical and public

# What are the Maps Telling Us in Wickford?

- Many **properties exposed** with high assessed value
- Ingress/egress barrier @ Main St/ Brown St – **no alternate route** out of the neighborhood
- **Evacuation routes** out of this area are exposed to 3-foot SLR scenario

And we have many question:

- Many **septic systems** were recently upgraded – how do we include SLR assessment in future sewer planning?
- **Historic properties** – what are the options to retain historic listing?



# From Map to Action



- Land Use
- Transportation & Circulation
- Building Stock
- Municipal Properties & Facilities
- Emergency Management Facilities
- Wastewater
- Stormwater Management
- Drinking Water
- Groundwater
- Wetlands
- Historic & cultural Resources
- Open Space, Recreation, Public Access

# Municipal Adaptation Strategies

“Similar to individual bricks that make up a wall, Rhode Island needs to start implementing site-scale solutions in our cities and towns that build incrementally, so our state as a whole is more resilient to coastal hazards.”

Grover Fugate, Executive Director RICRMC

URI Landscape Architecture,  
Junior Studio, 2014



## 4. MUNICIPAL ADAPTATION STRATEGIES BY SECTOR

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### 4.3. BUILDING STOCK

- B1. For parcels identified in the risk assessment as within the sea level rise areas (or Sea Level Rise Overlay Zone, as described in Section 4.1, LU2) at MHHW + 1-foot, +3-feet, and +5-feet, evaluate the long-term viability of properties within the SFHA and projected sea level rise areas, contact the property owners and ensure they are notified of the town-wide sea level rise vulnerability assessment, and establish procedures to apply long-term maintenance plans for their individual properties and related structures. In addition, maintain a separate database of building permits for all properties within the SFHA and the projected sea level rise areas, or flag these properties as part of these zones.
- B2. Building on experience from other Rhode Island municipalities (i.e. Town of Westerly), and state agencies (i.e. CRMC), implement an emergency permit process in North Kingstown to expedite permit approvals for predetermined repairs or reconstruction immediately following a storm event. In addition, work closely with state agency partners to define, evaluate, and communicate rebuilding restrictions in these areas.
- B3. Create incentives for homeowners to elevate their homes and offer clearly defined and enforceable height variances if the elevation of the structure will exceed the local height restriction.
- B4. For new construction throughout North Kingstown, create incentives for builders to design and build structures that are resilient to storm impacts both within and outside of flood zones. Create incentives for developers of new structures to design buildings with freeboard above Base Flood Elevation (BFE). In coordination with private sector stakeholders (Rhode Island Builders Association, private insurers, etc.) explore incentive programs that highlight the tradeoff between increased freeboard in construction projects and savings on insurance premiums.
- B5. For existing structures on parcels in the SFHA and the Sea Level Rise Overlay Zone, define areas that fall within these categories: Protection Zones that may be hardened to prevent or minimize floodwater intrusion, Accommodation Zones that are designed to be temporarily flooded with a high tide or storm event, Retreat Zones that have a master plan for managed retreat of structures and residents permanently out of the area, and Preservation Zones that have an established management plan for natural or cultural resource preservation. [insert citation]

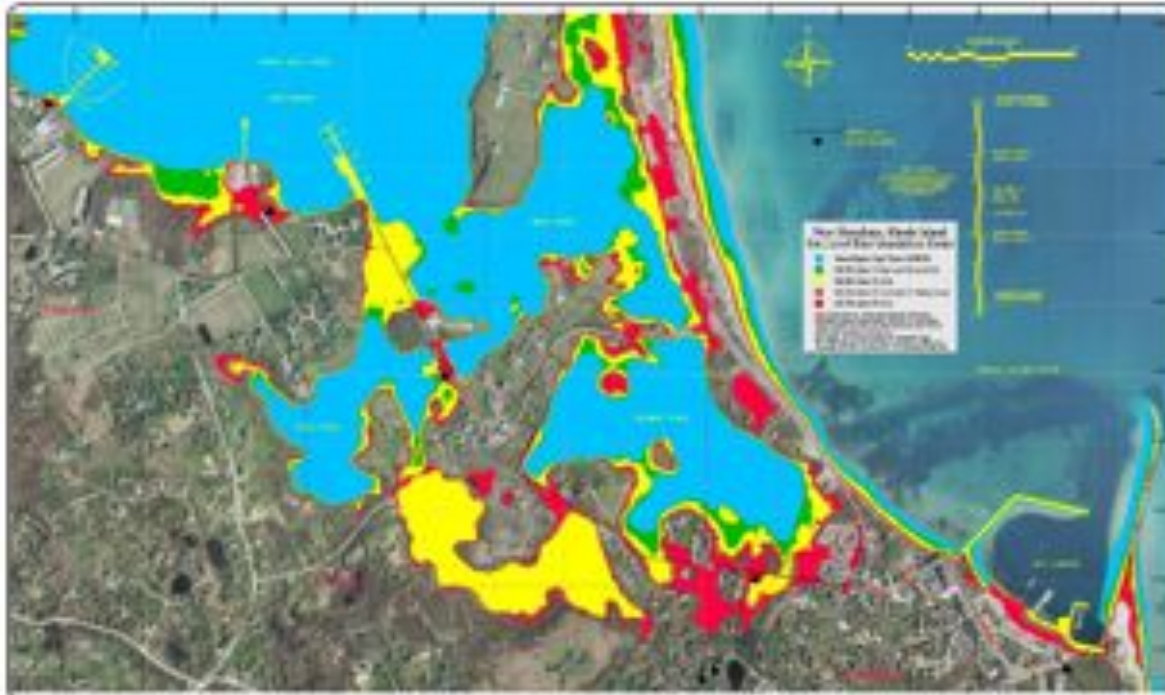
# Block Island: Adapting Transportation Systems

## Engineering Solutions

- Marine Facilities
- Vulnerable Roadways

## Emergency Contingency Planning

- Ferry Operations
- Public Safety/Emergency Response



New Shoreline, Block Island  
SEA LEVEL RISE ADAPTATION ZONES  
Project Info: See official Sea Level Rise Zone  
A-2

## Block Island Harbors Adaptation Study



New England Municipal Coastal Resilience Initiative Grant Program

Gulf of Maine  
Council on the  
Marine Environment



<http://necca.stormsmart.org/municipal-grants/block-island-rhode-island/>

# Building Resilience on the Newport Waterfront

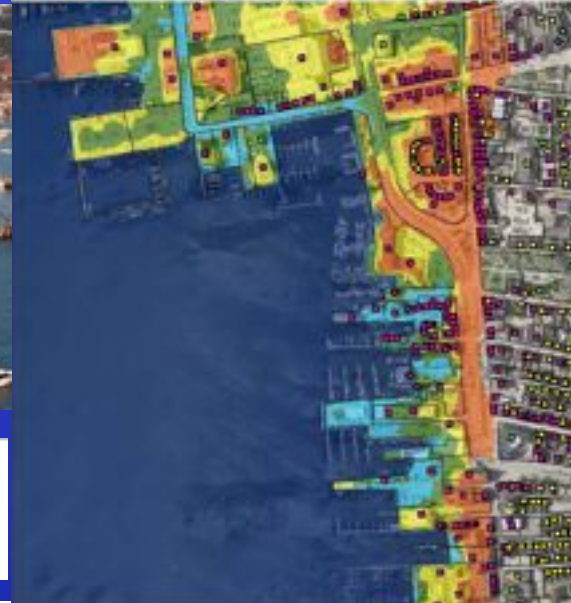
Newport Harbor





# Building upon Other Efforts

- Waterfront Access
- Economic Study
- Ports & Harbor Study
- City planning & outreach
- SLR mapping
- Local “heros” & stories



ENGAGE  NEWPORT

# RI Statewide Ports & Harbors

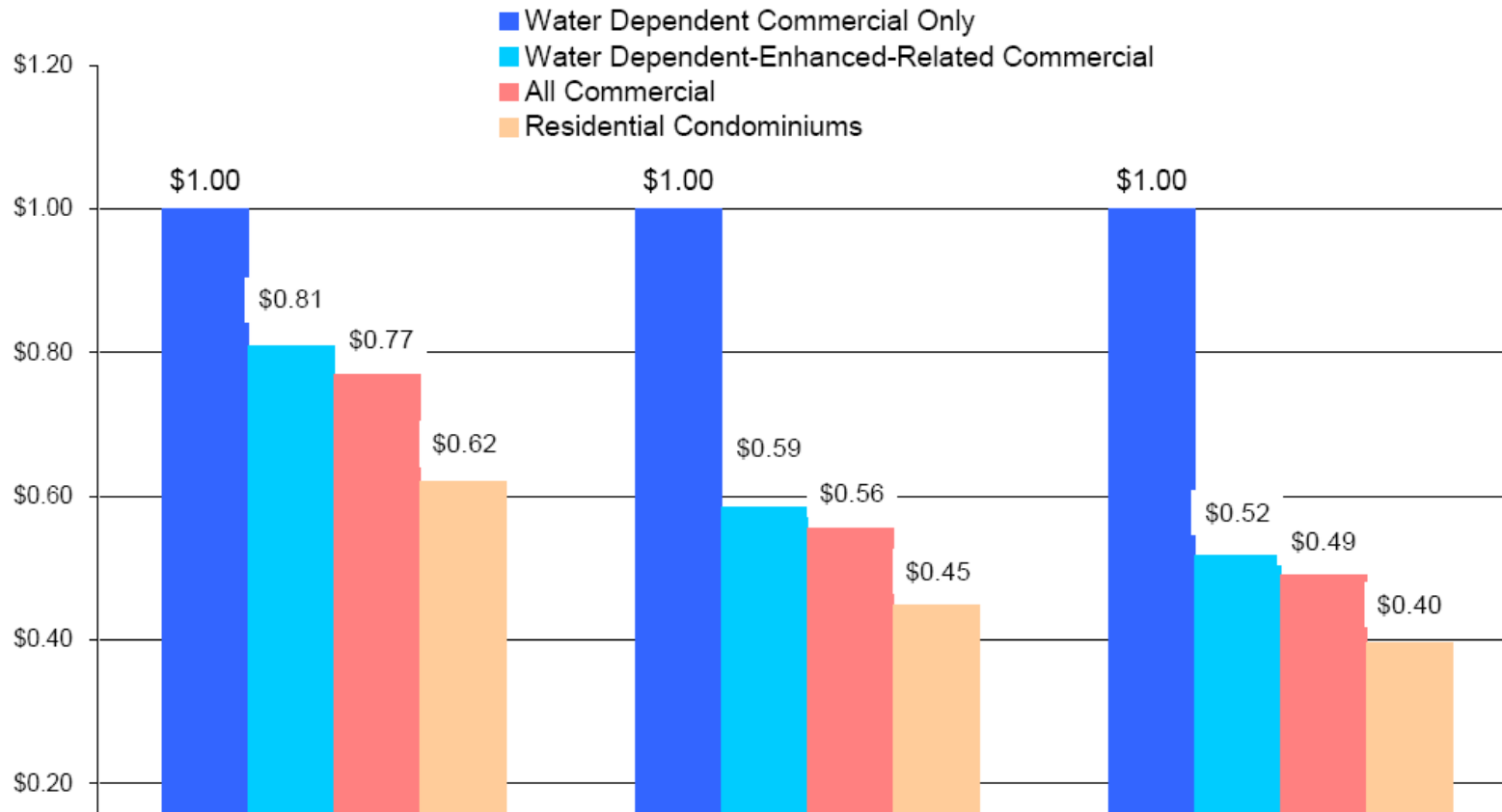


## Water Dependency:

- **Water Dependent** – requires direct access to the water for viable operation
- **Water Related** – provide goods or services associated with water-dependant uses
- **Water Enhanced** – do not require direct access to the water for viable operation, but are enhanced by waterfront location

Figure D

Relative Yield in Municipal Revenues per Acre: Newport Harbor Study Area



Water-dependent land uses in Newport Harbor contribute substantially more to municipal revenues on a per-acre of waterfront land utilized basis than other waterfront area commercial and residential uses.

**Perrotti Park/Newport Visitors Center, Newport, RI  
High Tide (3.8 ft)**



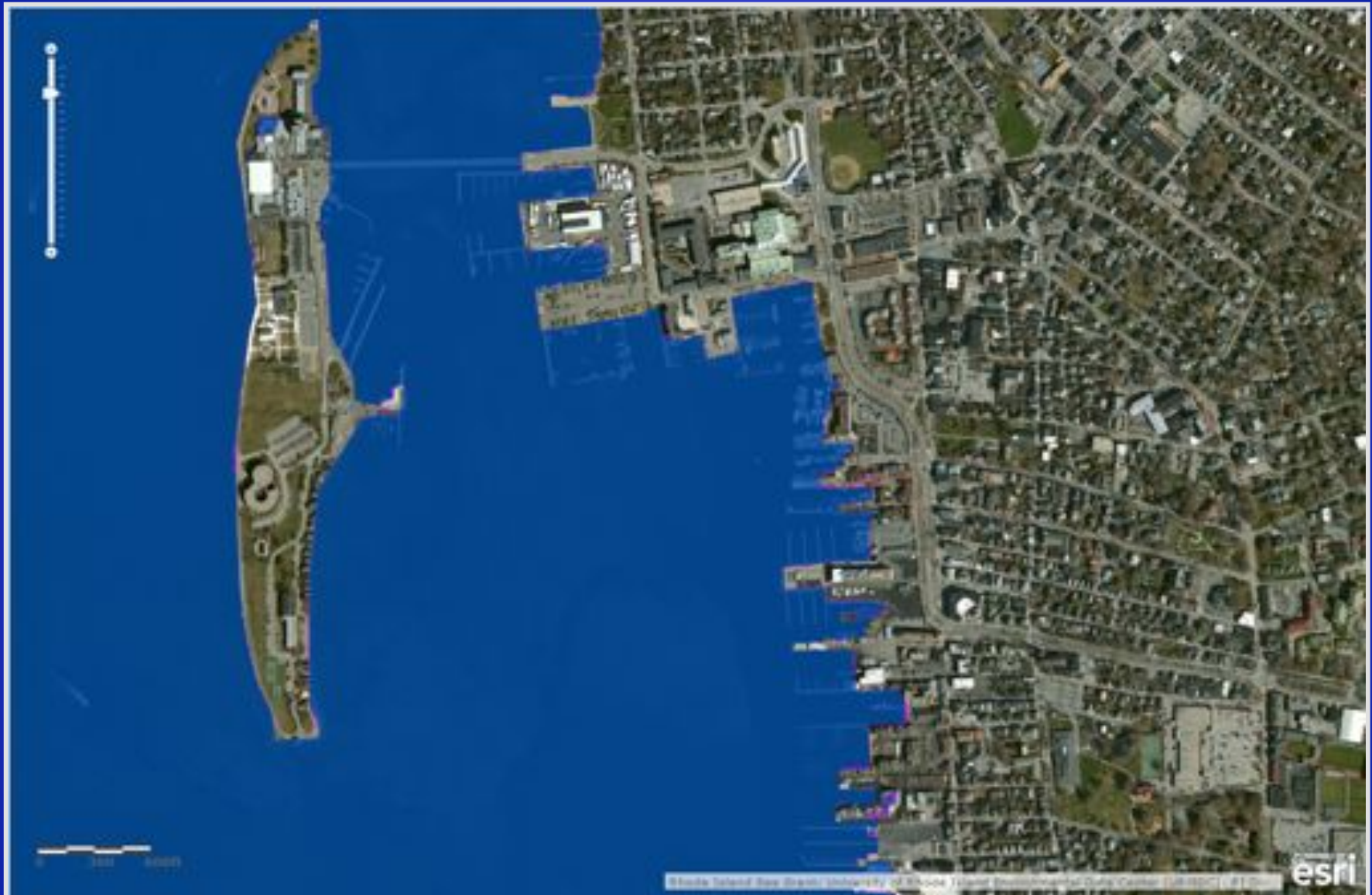
**Perrotti Park/ Newport Visitors Center, Newport, RI  
Average Spring Tide 1997- 2007 (7.03ft)  
plus 3 feet of SLR**



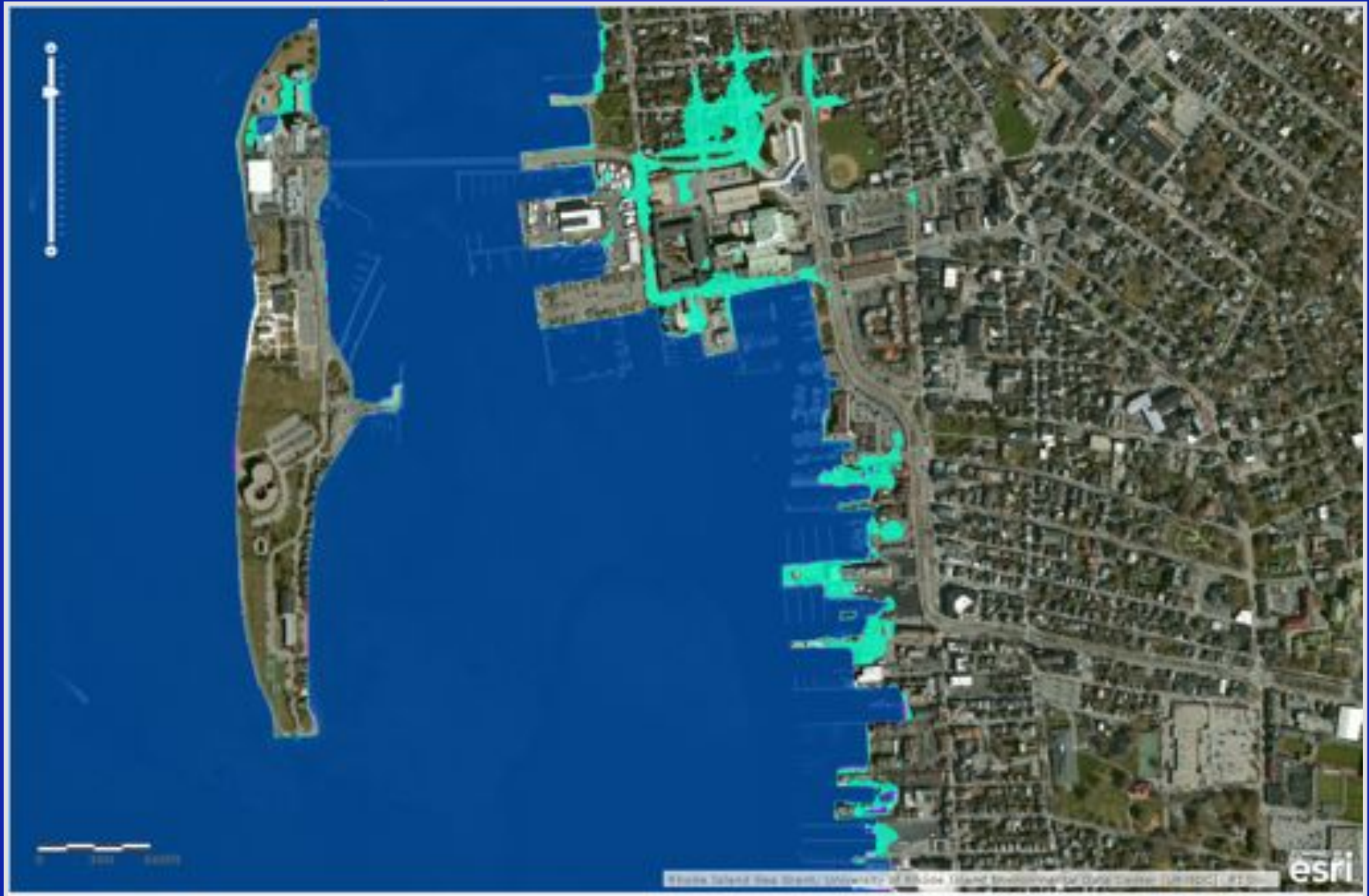
# Newport MHHW



# Newport MHHW + 1'

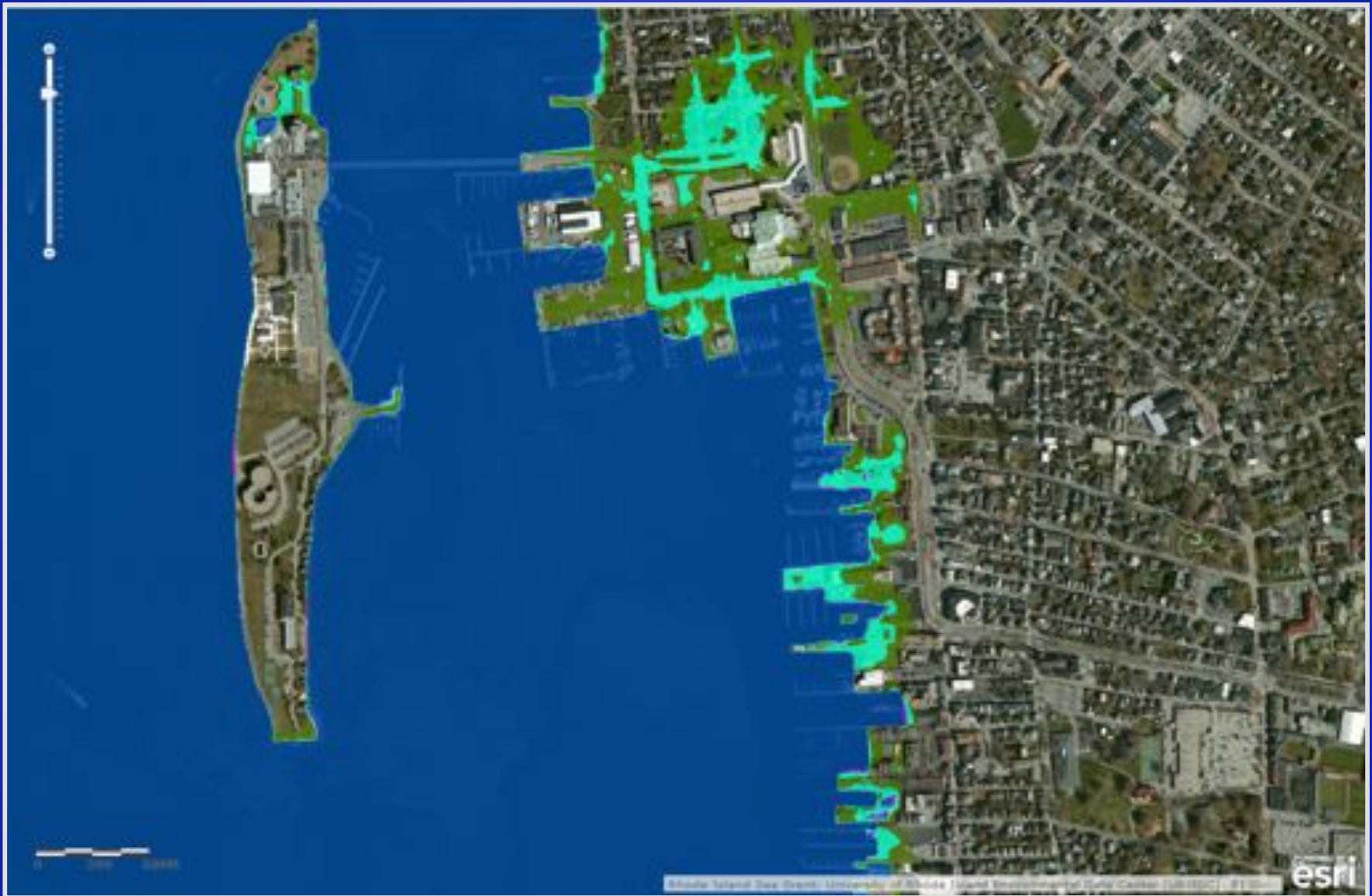


# Newport MHHW + 3'

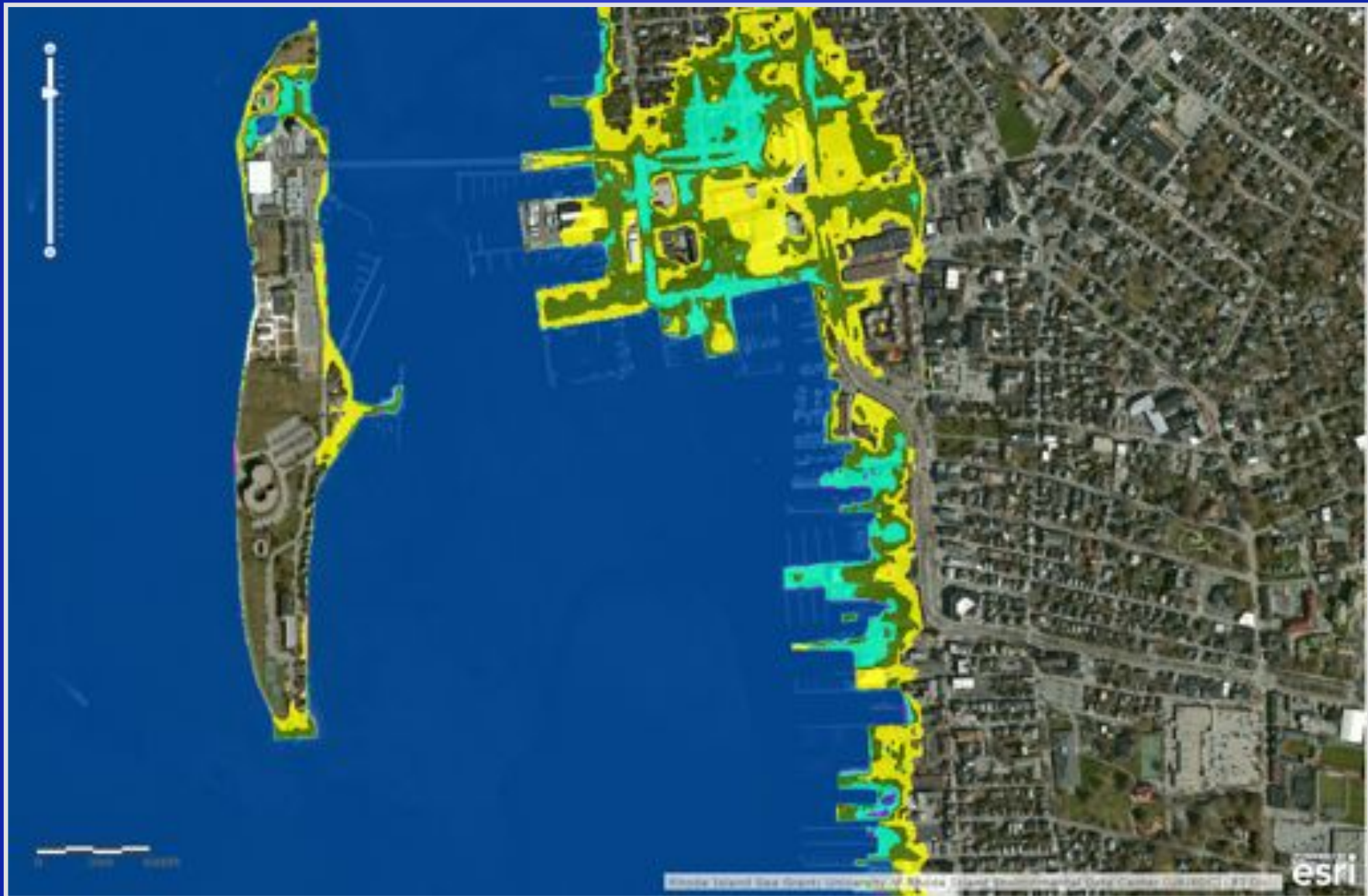




# Newport MHHW + 4'



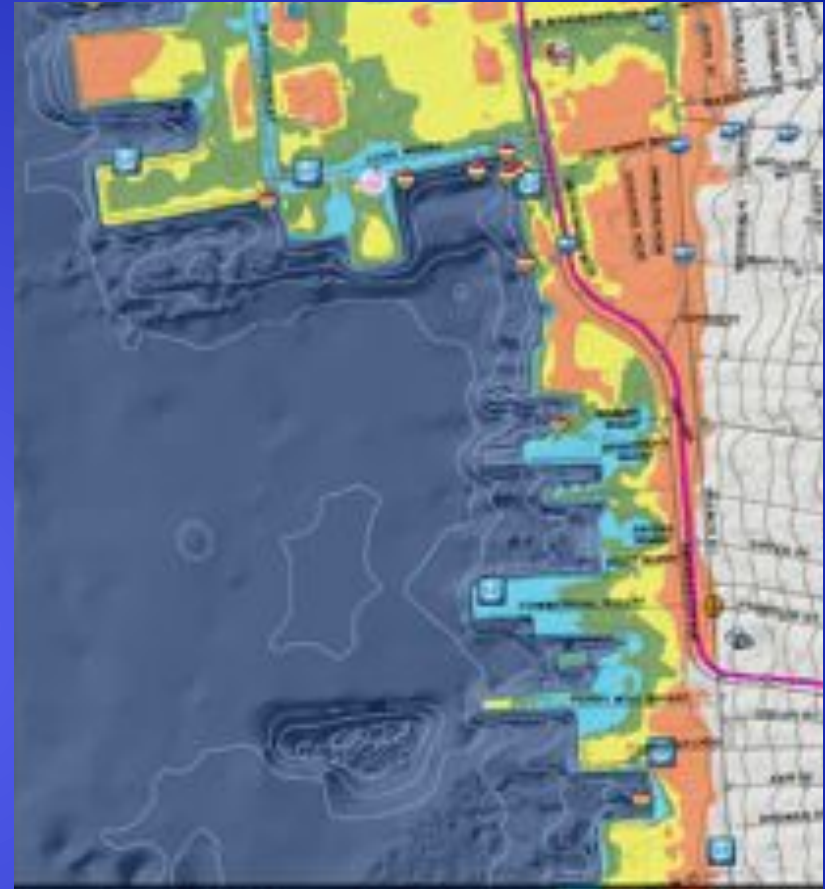
# Newport MHHW + 5'



# Newport MHHW + 1938



# Exposed Real Property & Infrastructure



## Inundation Zones

- Mean Higher High Water (MHHW)
- MHHW plus 1' Sea Level Rise (SLR)
- MHHW plus 3' SLR
- MHHW plus 1' SLR and 3' Storm Surge
- MHHW plus 5' SLR
- Hurricane 1938 Flood Level

## Real Property

- Commercial Property
- Public/Government Building
- Residential Property
- Parcel Boundary\*

## Infrastructure

- Pump Station
- Storm Water Discharge\*
- Storm Water Manhole\*
- Tidegate/Wier
- Wastewater Treatment\*

## Public Safety

- Fire Station
- Mobile Communication
- Police Station
- Police Station, State
- Emergency Shelter

## Facilities

- Library
- Marina
- Commercial/Recreational Port or Harbor
- School
- Senior Center
- Town Hall

## Transportation

- Bridge
- RIPTA Bus Stop
- RIPTA Park-n-Ride

# Towards Resilience

*Engage waterfront businesses to explore strategies and actions to increase resilience to sea level rise & storms*

- Identify relevant issues and stakeholder interests
- Learn current actions and needs
- Conduct a study tour / charrette
- Summarize best practices
- Identify early actions



# Experience from Near and Far

CLEAN & RESILIENT  
MARINA GUIDEBOOK  
VOLUME I



Blue-Systems, Inc.   
www.blue-systems.com



# Be Informed...Get Involved



<http://seagrant.gso.uri.edu/climate>



[www.beachsamp.org](http://www.beachsamp.org)



# Putting all the Pieces in Place





Disaster Resilience  
Coastal Community Development



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[www.crc.uri.edu](http://www.crc.uri.edu)