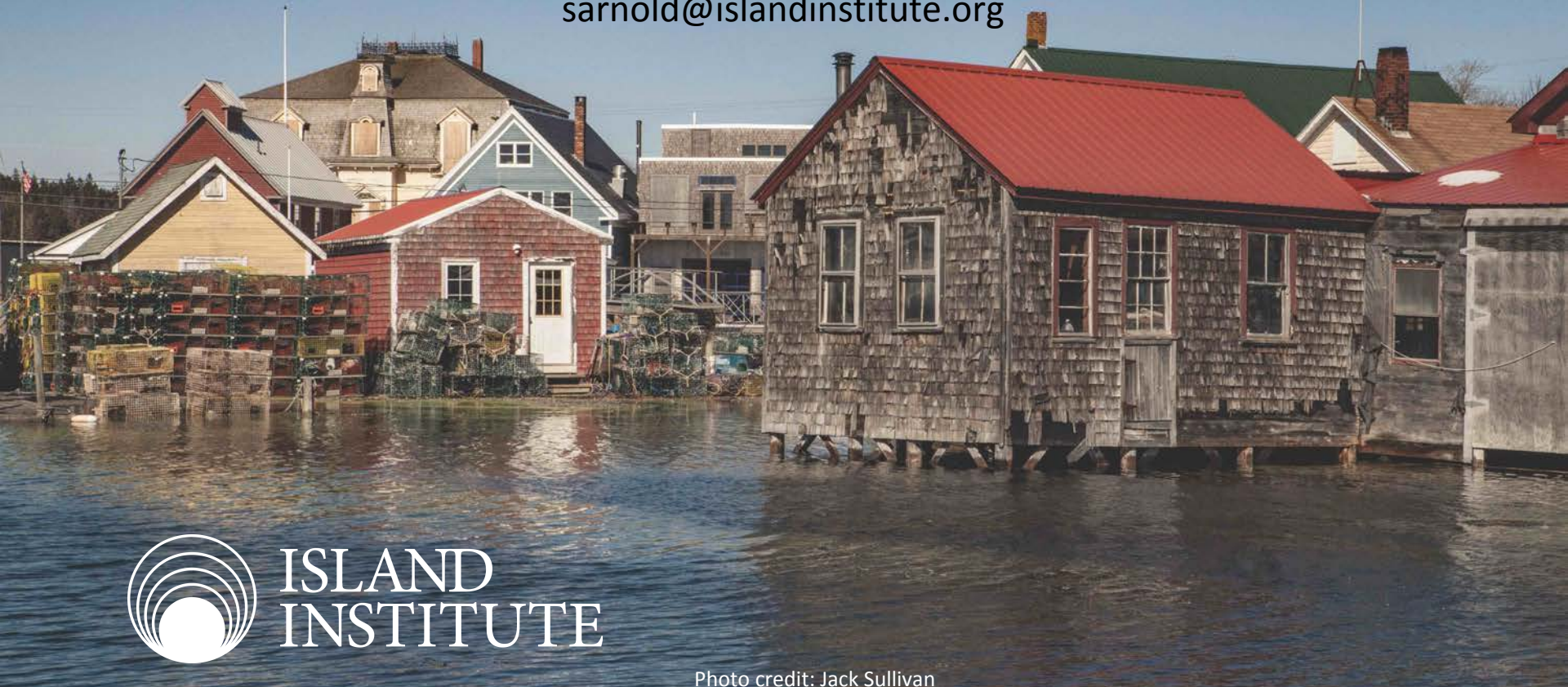


Tackling Sea Level Rise in Maine

Susie Arnold

Marine Scientist, Island Institute

sarnold@islandinstitute.org



ISLAND
INSTITUTE

Photo credit: Jack Sullivan



STRENGTHENING COMMUNITY ECONOMIES



ENHANCING EDUCATION & LEADERSHIP



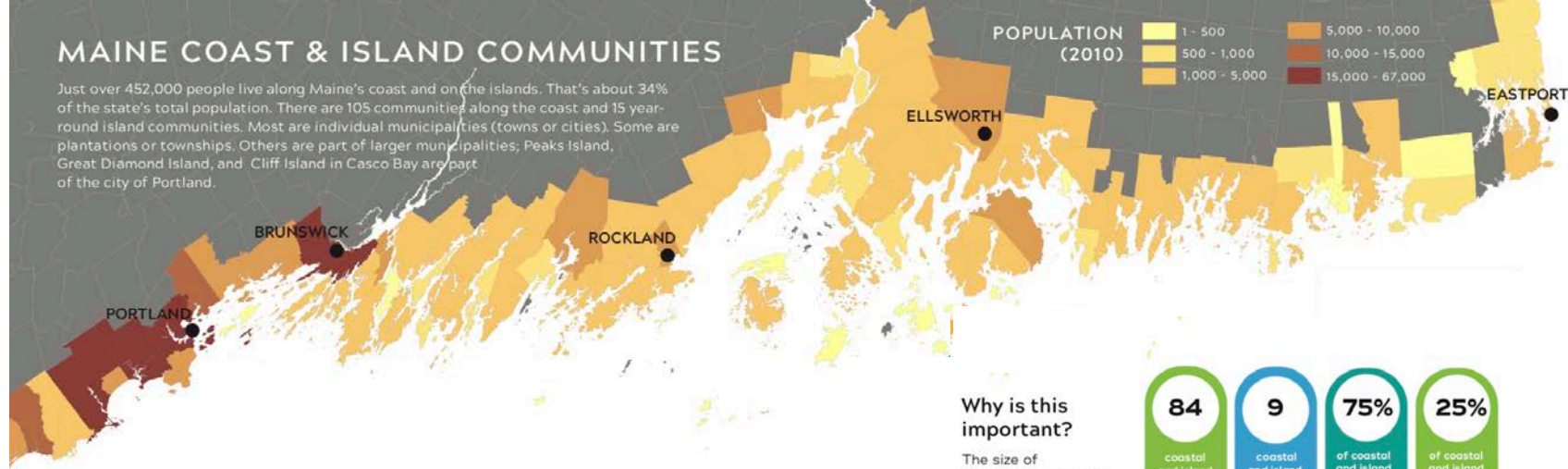
DELIVERING & SHARING SOLUTIONS



MAINE COAST & ISLAND COMMUNITIES

Just over 452,000 people live along Maine's coast and on the islands. That's about 34% of the state's total population. There are 105 communities along the coast and 15 year-round island communities. Most are individual municipalities (towns or cities). Some are plantations or townships. Others are part of larger municipalities; Peaks Island, Great Diamond Island, and Cliff Island in Casco Bay are part of the city of Portland.

POPULATION (2010)



THESE ARE SMALL TOWNS

92.2% of them have fewer than 10,000 residents

compared to 85% of towns in the U.S. overall.



Population estimates are less precise in the smallest communities due to under-sampling.

Why is this important?

The size of communities impacts how well residents are supported in their ability to make a living. Smaller communities have human and financial challenges that can limit investments in local infrastructure or economic development projects. It can be difficult for small communities to change these dynamics themselves and challenging for private sector companies that provide economic development services (e.g., broadband internet) to construct business models that work in small, remote locations.

84

coastal and island communities have fewer than 2,500 residents and are considered "rural" by the U.S. Census.

9

coastal and island communities have populations larger than 10,000 and all are in Southern Maine.

75%

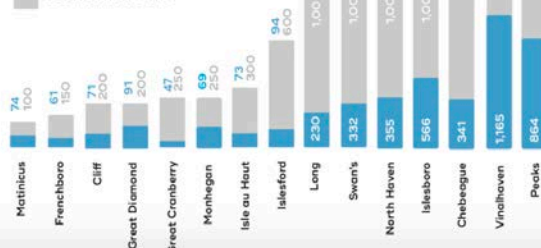
of coastal and island communities have fewer than 3,500 residents.

25%

of coastal and island communities have fewer than 800 residents.

ISLAND POPULATION AT A GLANCE

YEAR-ROUND RESIDENTS
SUMMER RESIDENTS



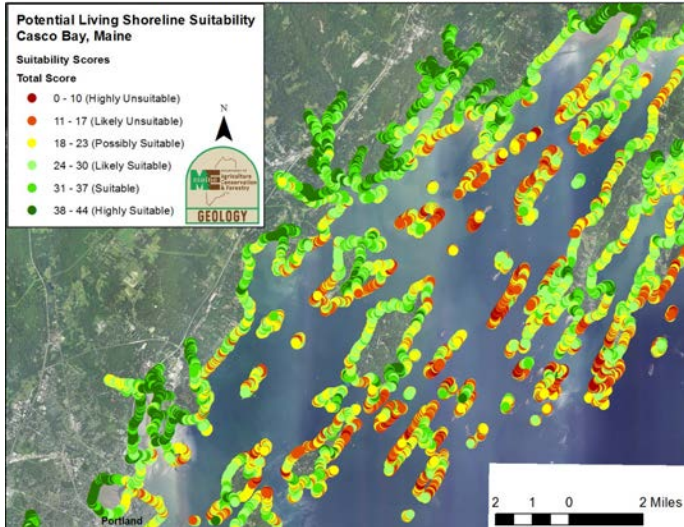
Talk Overview

1. Current impacts of sea level rise in Maine's island and coastal communities



Talk Overview

1. Current impacts of sea level rise in Maine's island and coastal communities
2. Efforts currently in place to improve coastal resilience



Talk Overview

1. Current impacts of sea level rise in Maine's island and coastal communities
2. Efforts currently in place to improve coastal resilience
3. Tools and scenarios being used for planning

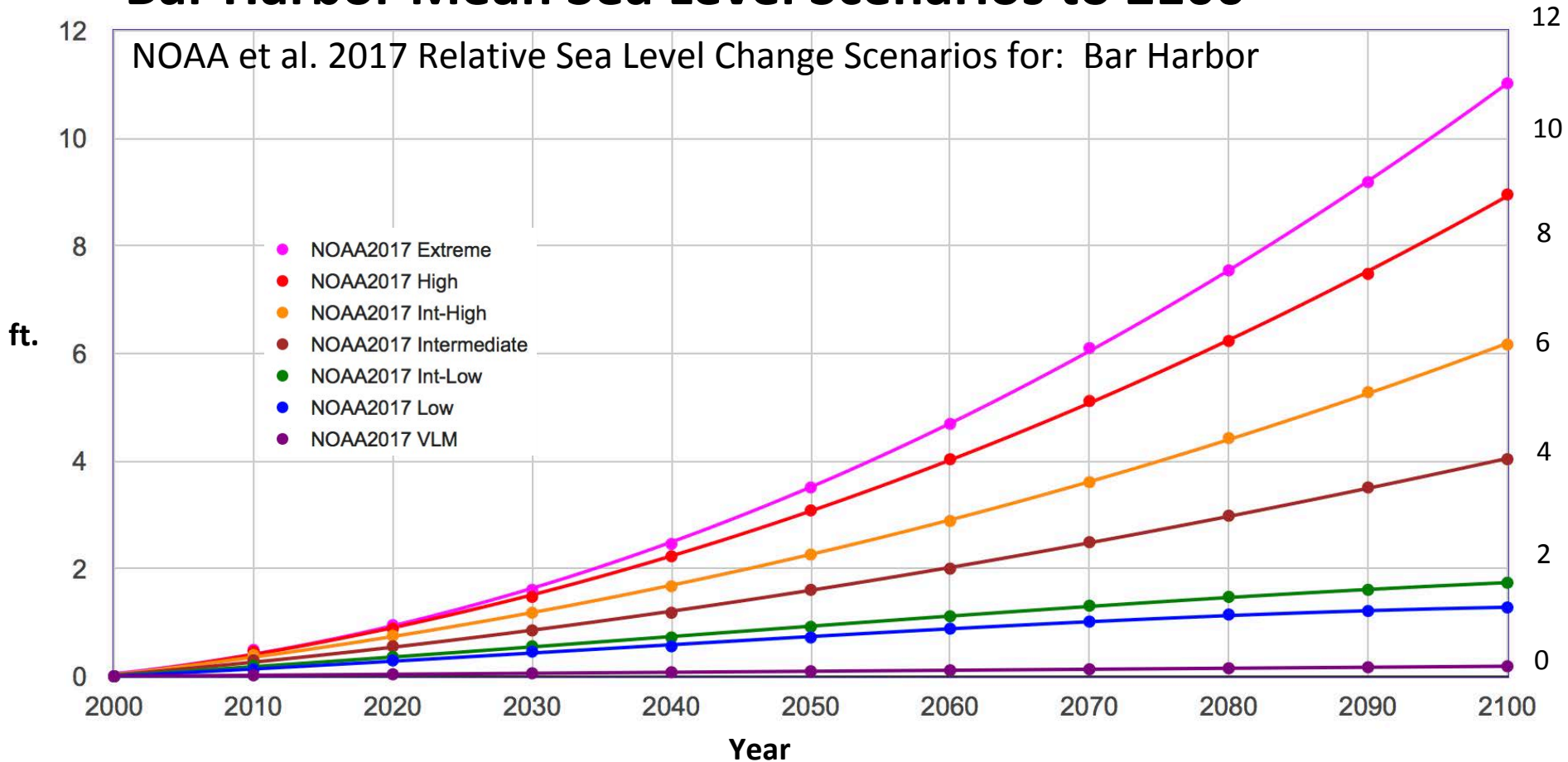


Talk Overview

1. Current impacts of sea level rise in Maine's island and coastal communities
2. Efforts currently in place to improve coastal resilience
3. Tools and scenarios being used for planning
4. Best strategies to increase community awareness and facilitate adaptation



Bar Harbor Mean Sea Level Scenarios to 2100



1) Current impacts of sea level rise in Maine's island and coastal communities

BDN BUSINESS

Rising seas swallowed \$70 million in Maine home values, study says

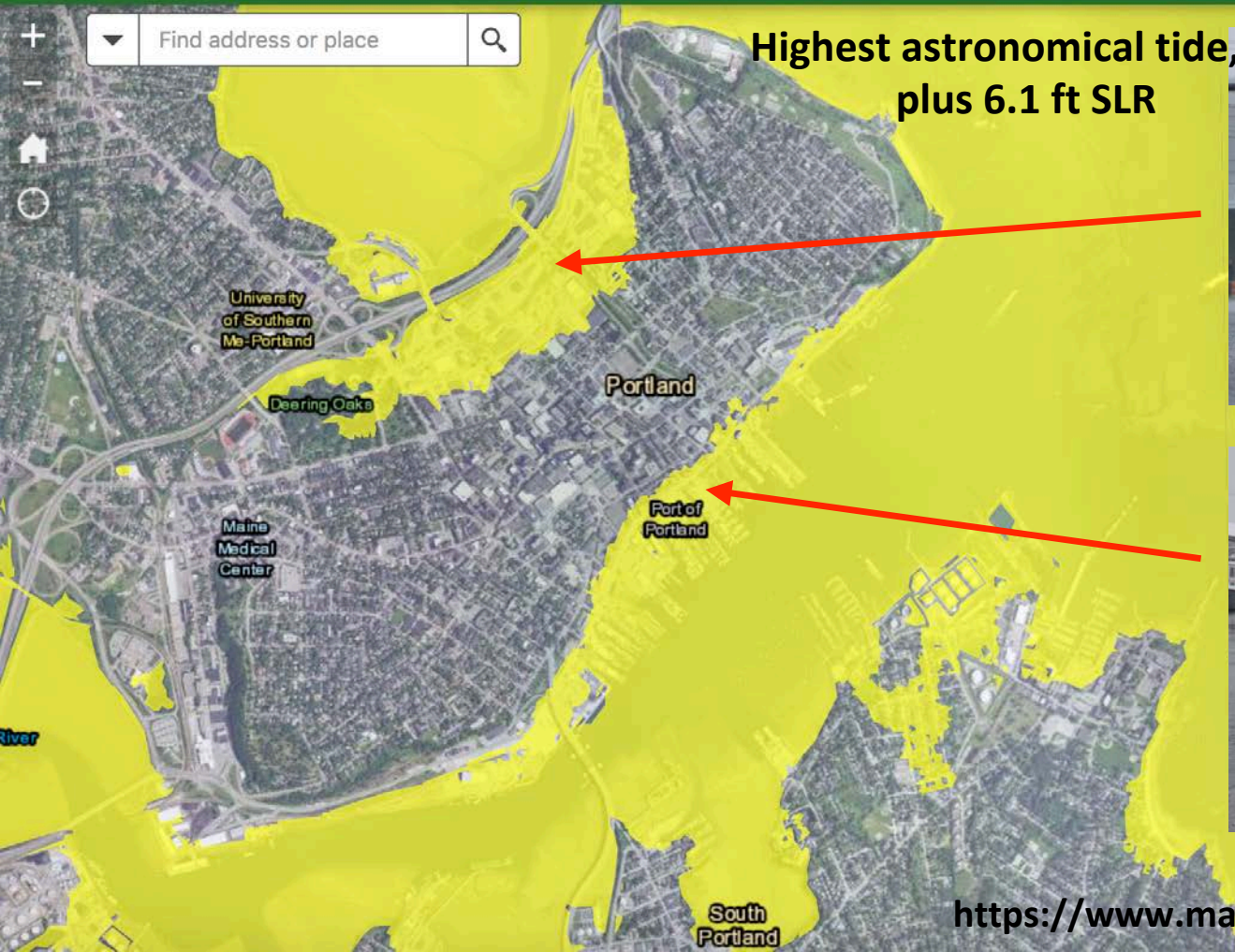


CBS 13 | BDN

An astronomical high tide in Portland reached 13.1 feet, the 12th highest ever for the city, CBS 13 Chief Meteorologist Charlie Lopresti reported March 2, 2018.

By Lori Valigra, BDN Staff • January 22, 2019 6:24 am
Updated: January 22, 2019 10:02 am

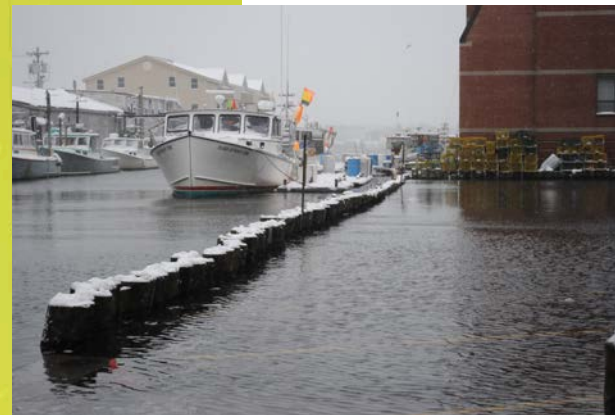




**Highest astronomical tide,
plus 6.1 ft SLR**



Photo from Portland Press Herald

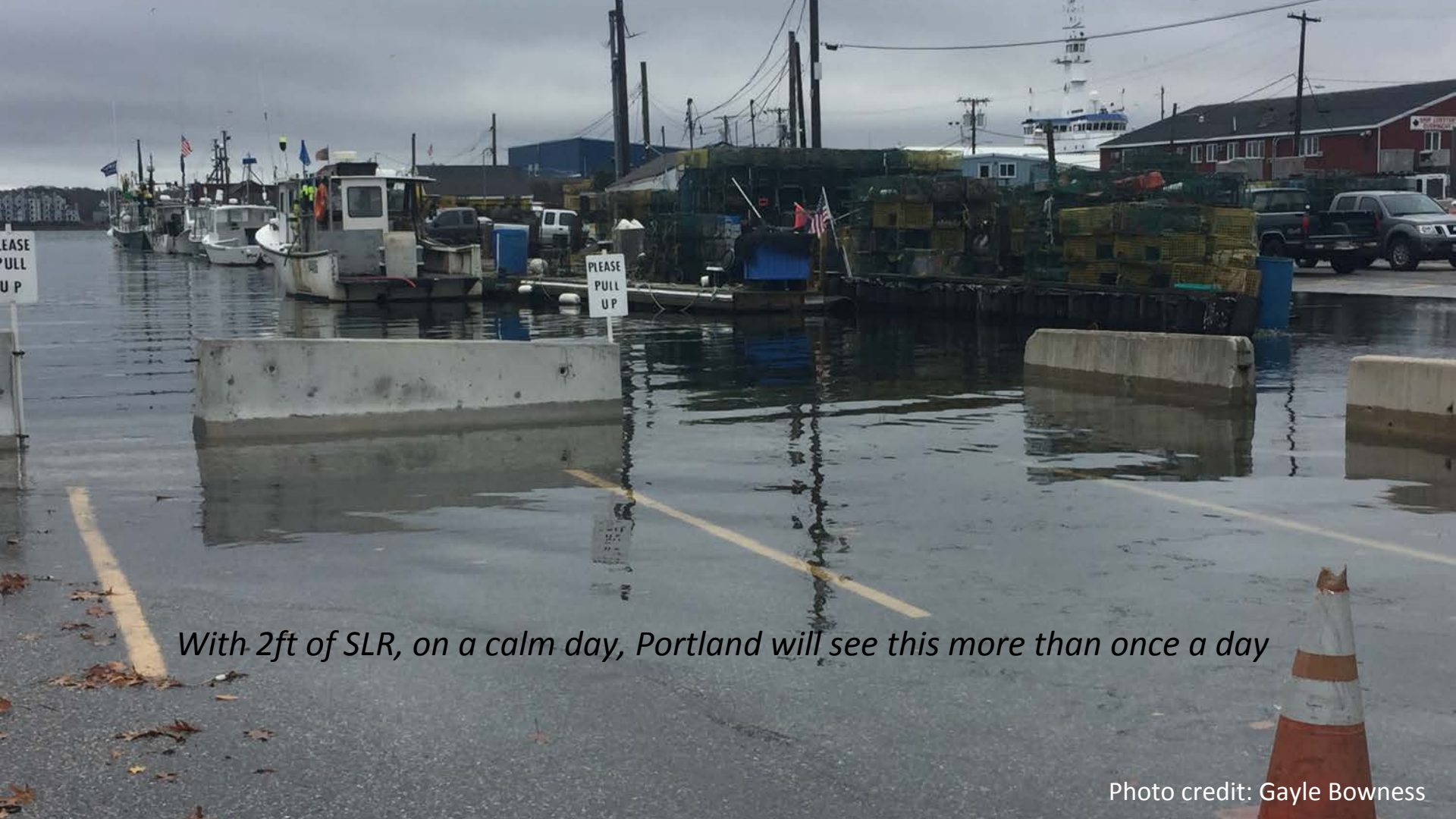


Changes in Annual Flooding Frequency in Portland with SLR (using 2006-2016 Average)

Scenario	Flood Stage (ft, MLLW)	# times per year	% of high tides
Existing	12	9.8	1.3%
+1 ft SLR	11	98	13.5%
+2 ft SLR	10	461	63.3%

Based on this, there could potentially be a ***tenfold increase in the frequency of flooding in Portland*** with **1 foot of sea level rise**.





With 2ft of SLR, on a calm day, Portland will see this more than once a day

Photo credit: Gayle Bowness

Winter Storm Greyson- Jan 4, 2018



Photo credit: Parker Poole



Brown's Boatyard, North Haven

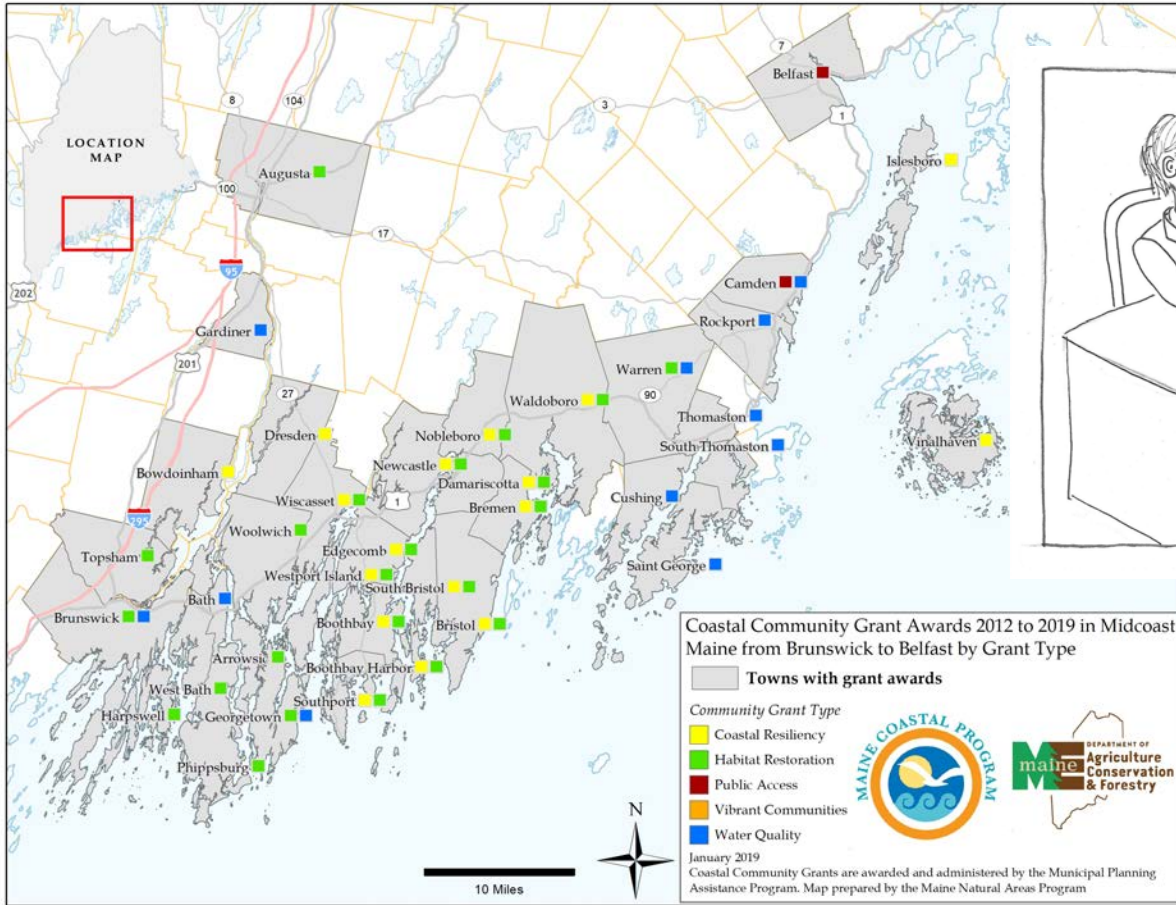
Winter Storm Greyson- Jan 4, 2018



Monhegan Island- Freshwater Drinking Supply



2) Efforts currently in place to improve coastal resilience

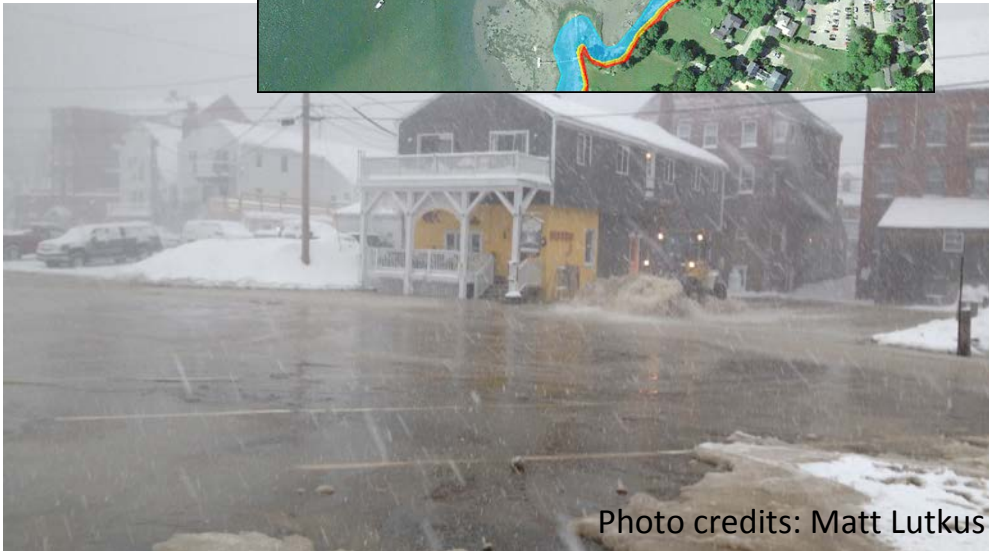


Ex) CCG- Damariscotta Downtown



VE zone
AE zone

1ft SLR
3ft SLR



**ADAPTATION PLANNING STUDY
DOWNTOWN WATERFRONT AREA
DAMARISCOTTA, MAINE**



Option 2

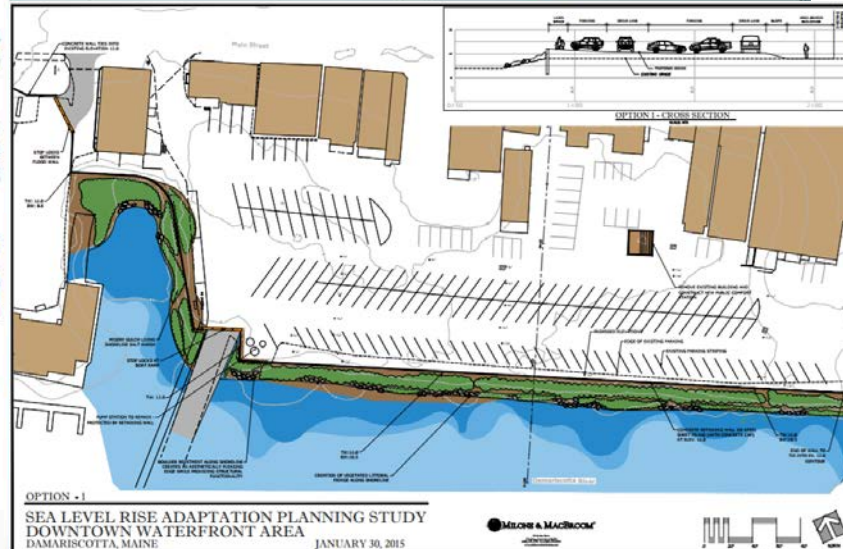
Ground
& Door
elevations

DECEMBER 22, 2014
(REVISED FEBRUARY 2, 2015)

PREPARED FOR:
COASTAL COMMUNITIES GRANT OVERSIGHT COMMITTEE
DAMARISCOTTA, MAINE

PREPARED BY:
MILONE & MACBROOM, INC.
100 COMMERCIAL STREET, SUITE 417
PORTLAND, MAINE 04101

This memorandum was prepared by Milone & MacBroom, Inc. and the Town of Damariscotta under award C2M13N054190045 to the Maine Coastal Program from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration or the Department of Commerce.



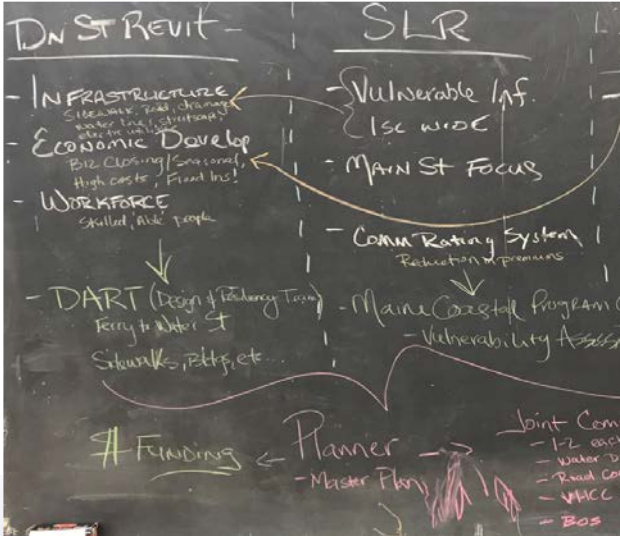
Option 1

Ex) CCG- Vinalhaven “Downstreet”

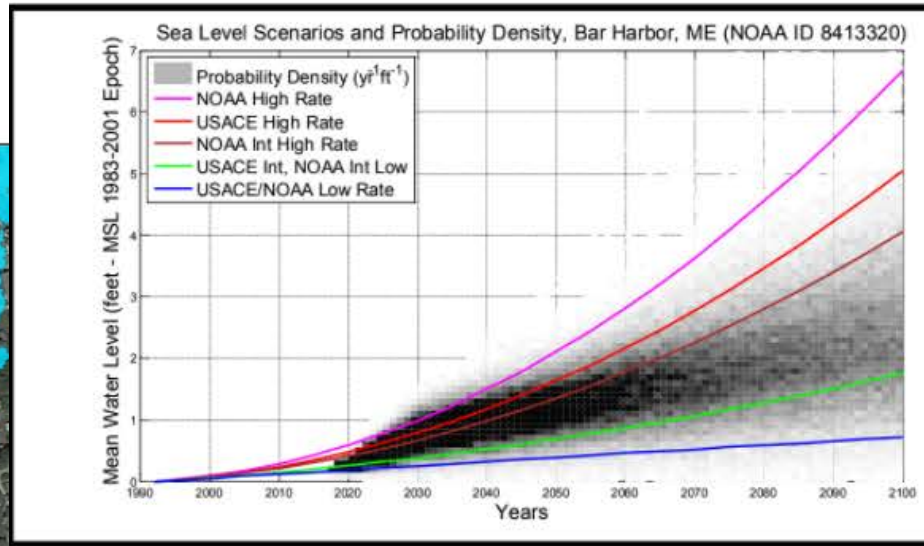
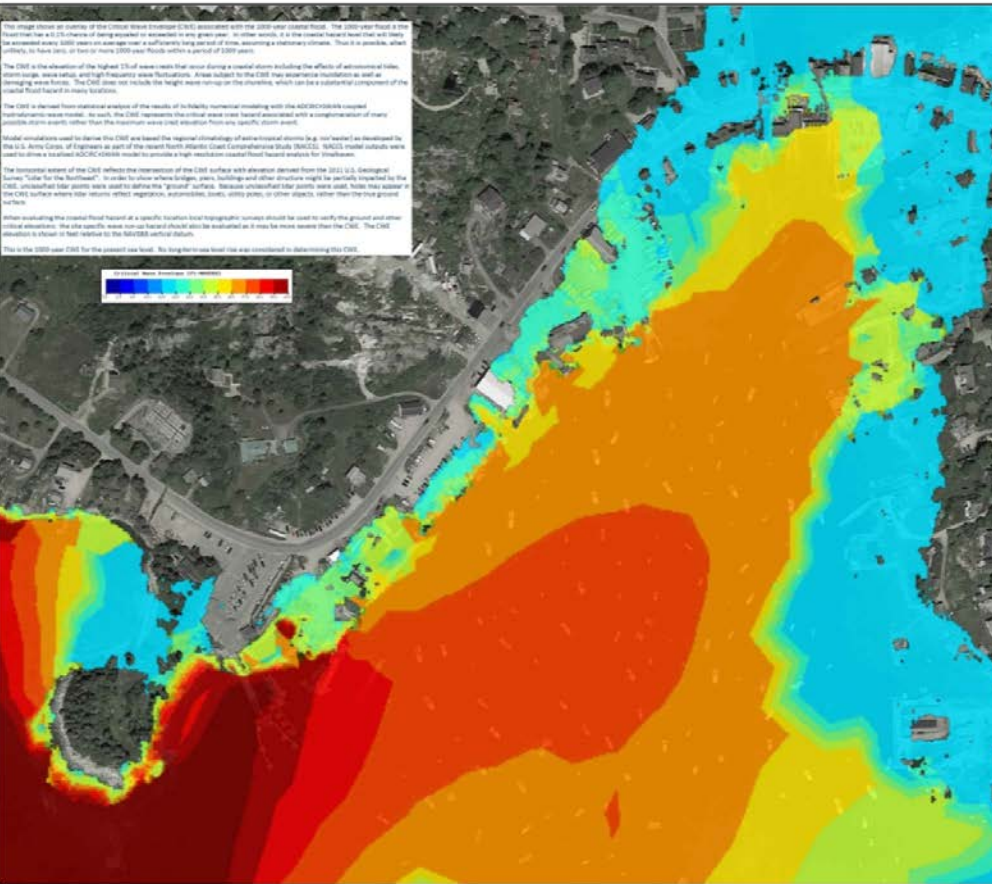


Economic Heartbeat

- 30+ businesses
- \$13 million in RE value
- Emergency Services
- Boatyard
- Lobster Buyers
- Mixed Use



Critical Wave Envelope for the 1000-year storm event



RANSOM CONSULTING ENGINEERS AND SCIENTISTS, INC.

400 Commercial Street, Suite 400
Portland, ME 04101
Tel: 207.771.1000
Fax: 207.771.1001
Email: info@ransom-engineers.com

1000-YEAR CRITICAL WAVE ENVELOPE

Project No.	1000-YEAR CRITICAL WAVE ENVELOPE
Client	
Location	
Date	08/15/17
By	08/15/17
Check By	08/15/17
Scale	1" = 100'

C-100

Page 1 of 1

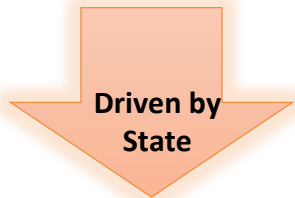


Recommendations

- ☐ **Complete the Maine Flood Resilience Checklist.**
- ☐ Update hazard information to include possible impacts from tropical storms and hurricanes, and purely tidal events.
- ☐ **Evaluate the feasibility of elevating low-lying areas of Main Street.**
- ☐ **Provide property owners with educational tools and resources to evaluate the feasibility of elevating their buildings. Consider retreat as a possible option in certain cases, especially for residential buildings and/or properties with low value.**
- ☐ Evaluate the feasibility of installing a flood gate at the Carvers Pond inlet.
- ☐ Evaluate the vulnerability of Ferry Terminal infrastructure to extreme wave impacts, and consider construction of a breakwater.
- ☐ Evaluate the timing when vehicle access to the Ferry boat will be difficult.
- ☐ Allow planning to be flexible and evolve with new information and experiences.

Ex) Maine Flood Resilience Checklist

Top-down



Flood Resilience
Checklist



Bottom-up

Maine Flood Resilience Checklist



*A self-assessment tool for Maine's coastal communities to
evaluate vulnerability to flood hazards and increase
resilience.*



Version 1, July 2017

What Is It?

**Practical self-assessment tool and
integrated framework for...**

- Examining local flood risk and preparedness
- Assessing vulnerability of the social, built, and natural environments
- Identifying strategies for increasing resilience

Who Should Use It?

Communities wanting to...

- Understand flood vulnerability and sea level rise
- Build flood resilience
- Enhance coastal hazard recovery

Ex) Guidance Series for Maine Communities



Municipal Climate Adaptation Guidance Series for Maine Communities

REGIONAL PARTNERS

[Androscoggin Valley Council of Governments](#)
[Greater Portland Council of Governments](#)
[Hancock County Planning Commission](#)
[Kennebec Valley Council of Governments](#)
[Lincoln County Regional Planning Commission](#)
[MidCoast Council of Governments](#)
[Midcoast Regional Planning Commission](#)
[Northern Maine Development Commission](#)
[Washington County Council of Governments](#)
[Southern Maine Planning and Development Commission](#)

See http://www.maine.gov/dacf/municipalplanning/technical/regional_council.shtml

STATE PARTNERS

Maine Department of Marine Resources: [Maine Coastal Program](#)
Maine Department of Agriculture Conservation and Forestry:
[Municipal Planning Assistance Program](#), [Maine Geological Survey](#),
[Maine Floodplain Management Program](#), [Maine Natural Areas Program](#)
Maine Department of Environmental Protection: [Sustainability](#)
Maine Department of Transportation: [Environmental Office](#)

MAINE'S REGIONAL PLANNING ORGANIZATIONS - LAND USE TECHNICAL ASSISTANCE TO MUNICIPALITIES

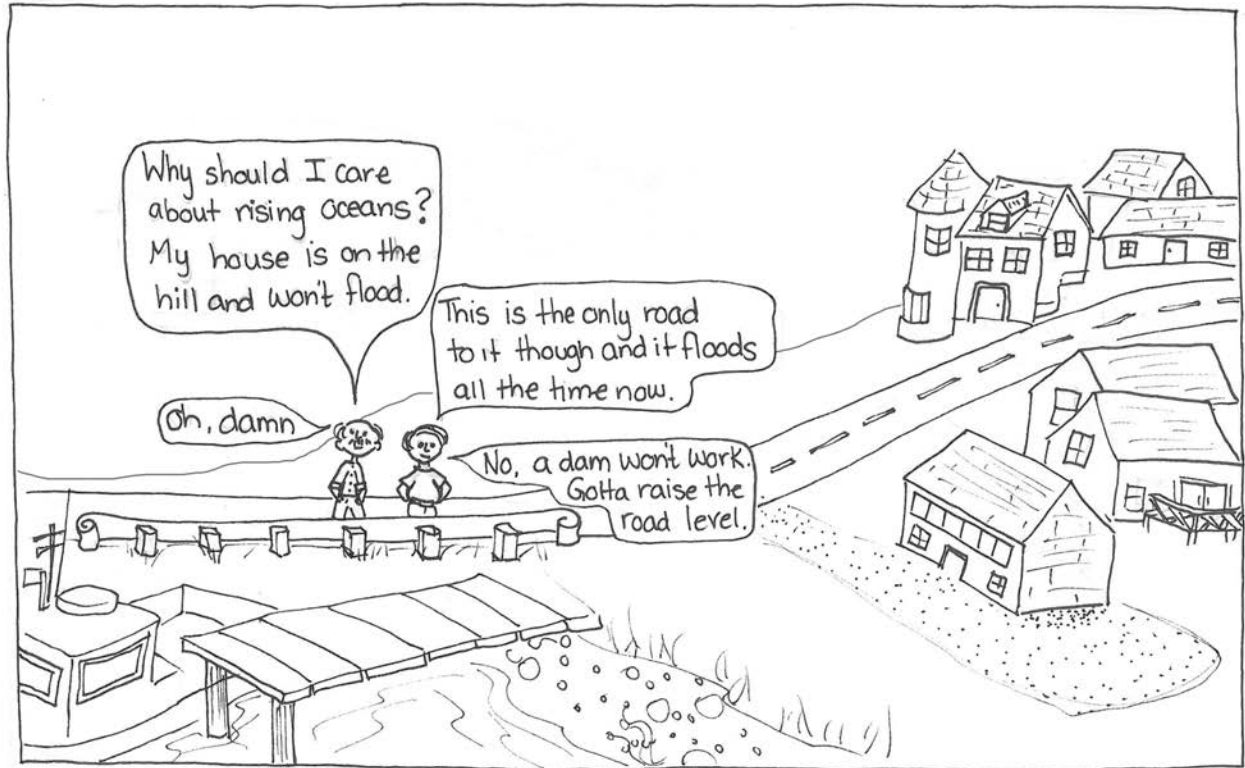


Inundation of Chebeague Island's Stone Pier

1. [Overview](#)
2. [Transportation](#)
3. [StreamSmart Crossings](#)
4. [Wastewater Management](#)
5. [Drinking Water](#)
6. [Storm Water](#)
7. [Comprehensive Planning](#)
8. [Shoreland Zoning Ordinance](#)
9. [Site Plan Review Ordinance](#)
10. [Subdivision Ordinance](#)

Available at: www.maine.gov/dacf/municipalplanning/docs/CAGS_01_Overview.pdf

3) Tools and scenarios being used for planning



Coastal Risk Explorer

A web tool for assessing road flooding, lifelines, and social vulnerability in Maine



The Nature
Conservancy
Maine



Bowdoin

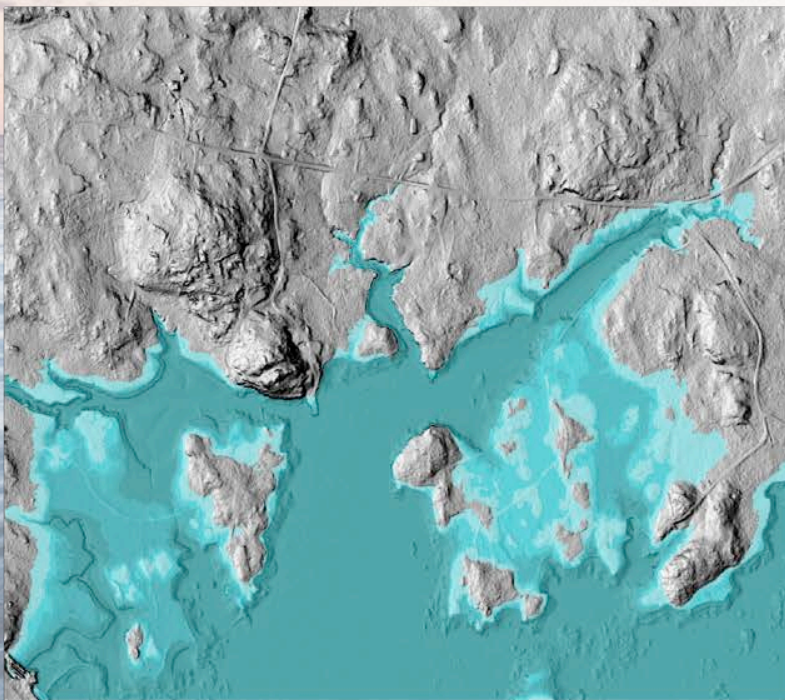
**BLUE SKY
PLANNING**



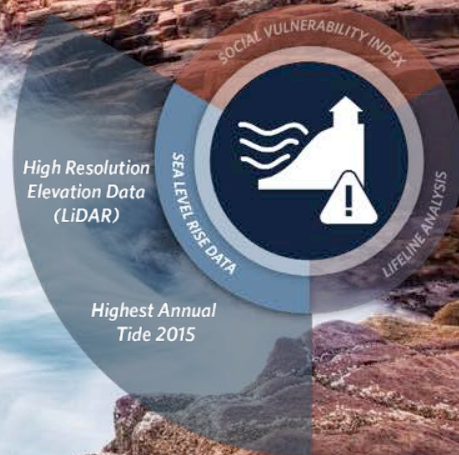
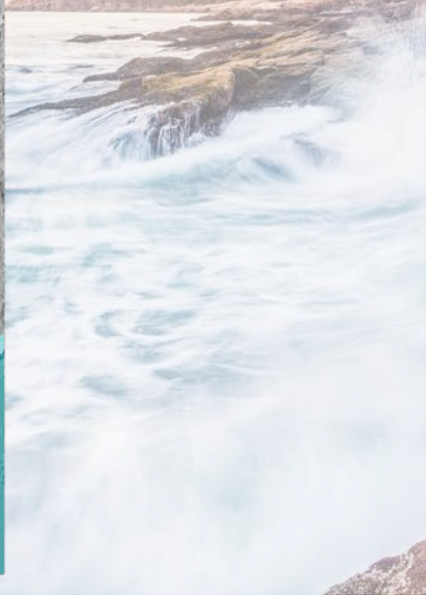
<https://maps.coastalresilience.org/maine/>

Data Driven Maine Specific

Sea Level Rise Prediction

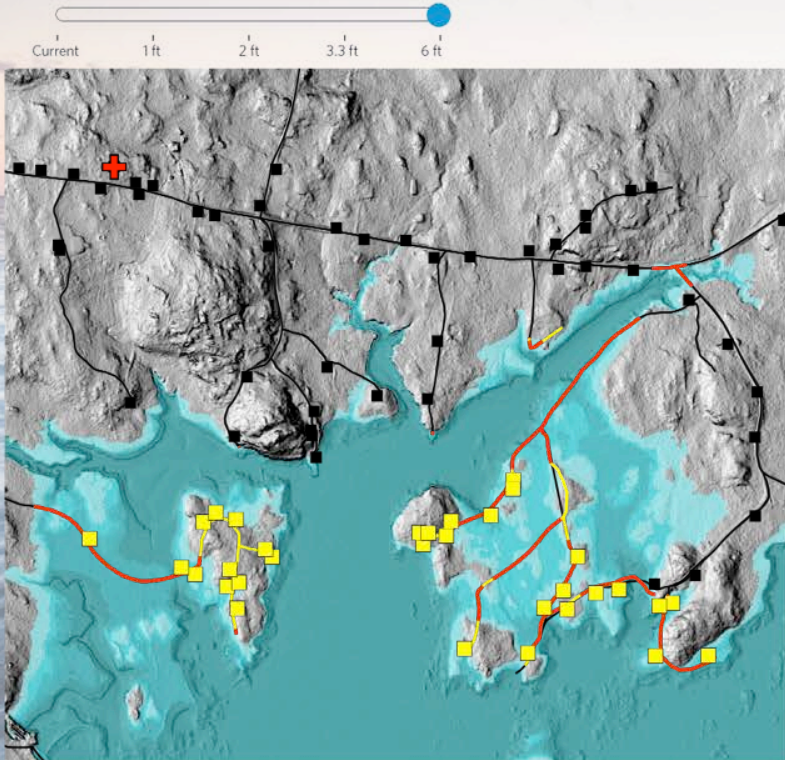


View coastal areas under several
sea level rise scenarios



Data Driven Maine Specific

Sea Level Rise Prediction



View coastal areas under several sea level rise scenarios

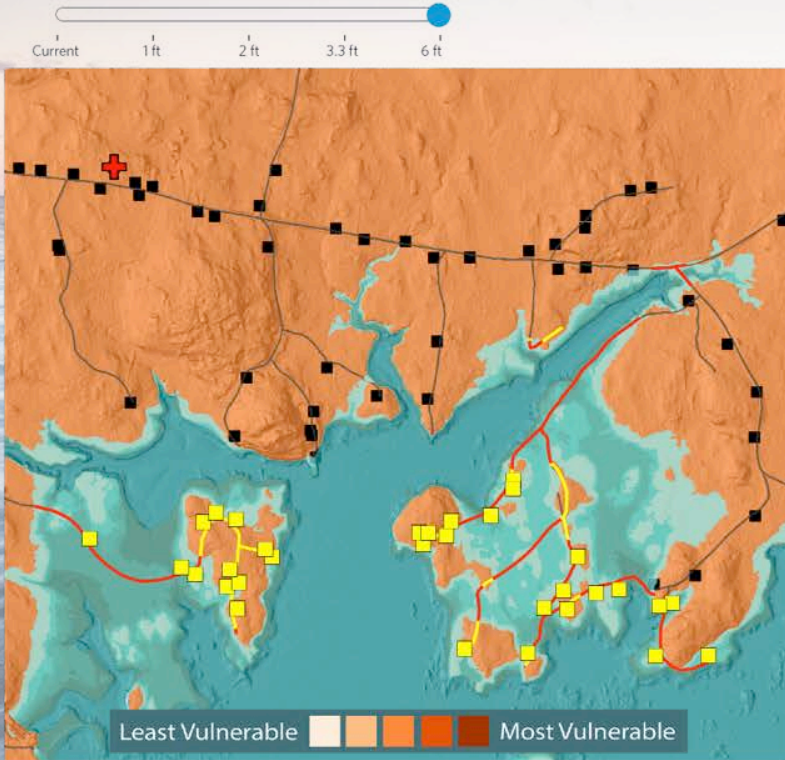
Number of addresses inaccessible to emergency services

Approximate cost to update inundated roads



Data Driven Maine Specific

Sea Level Rise Prediction



View coastal areas under several sea level rise scenarios

Number of addresses inaccessible to emergency services

Approximate cost to update inundated roads

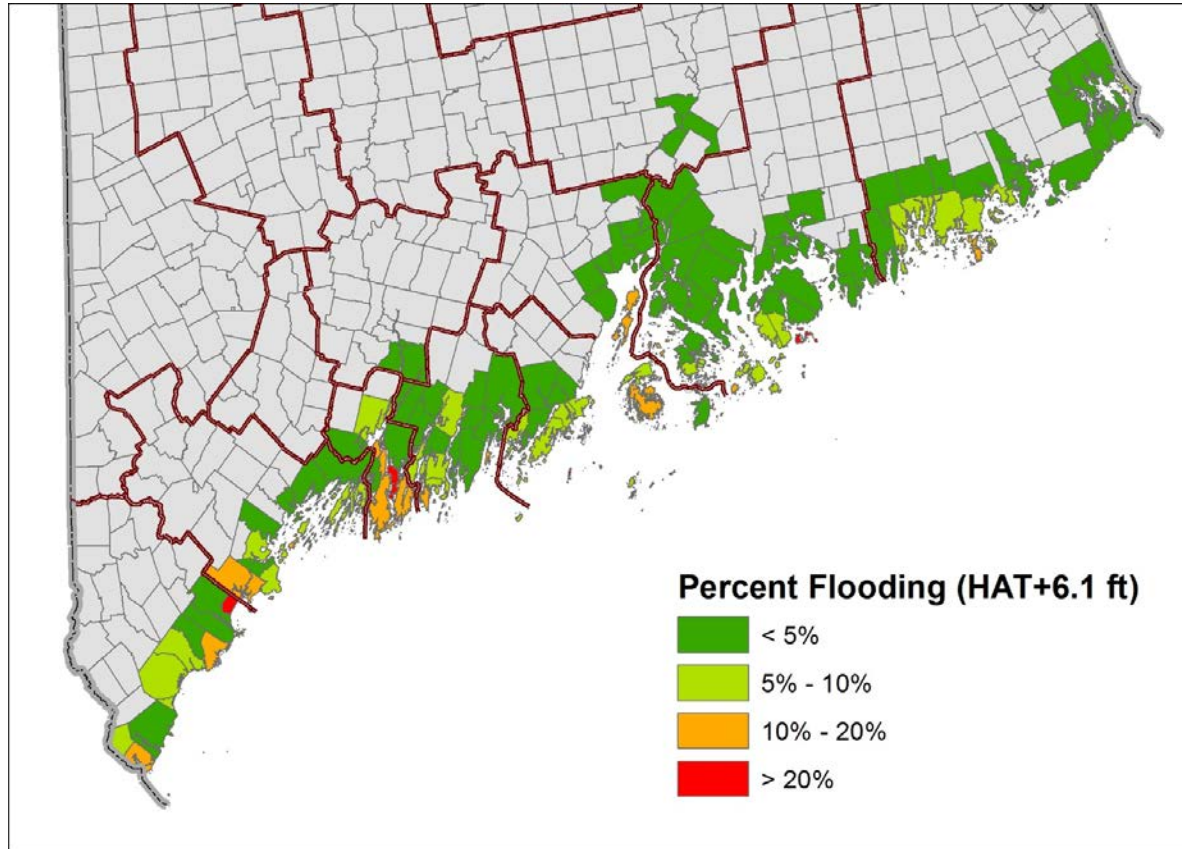
Overall social vulnerability of a town or block group

Measures included in the social vulnerability index:

- Socioeconomic status
- Household Composition & Disability
- Minority Status & Language
- Housing & Transportation

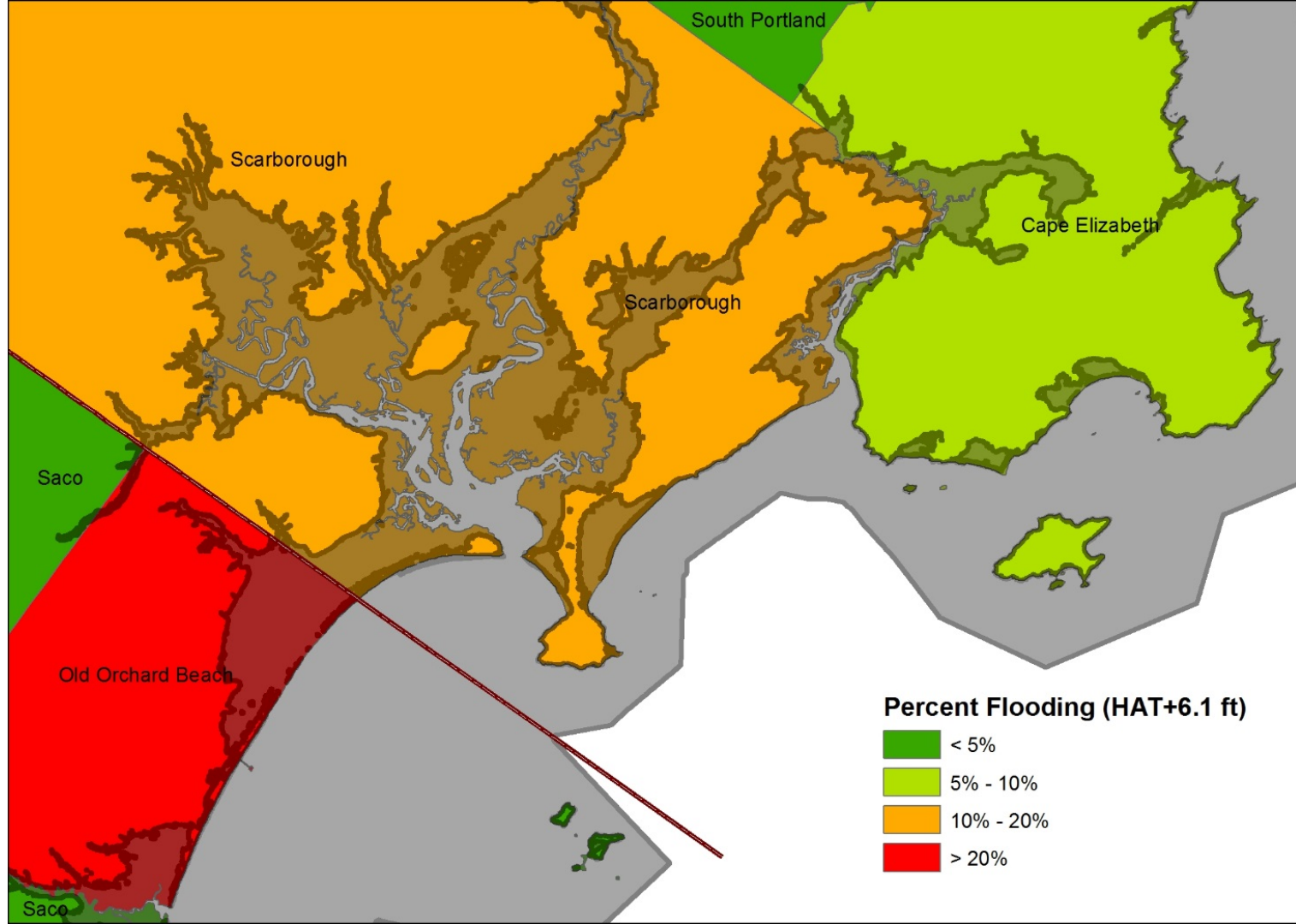


Submerged properties and economic repercussions of SLR- implications for municipal finance



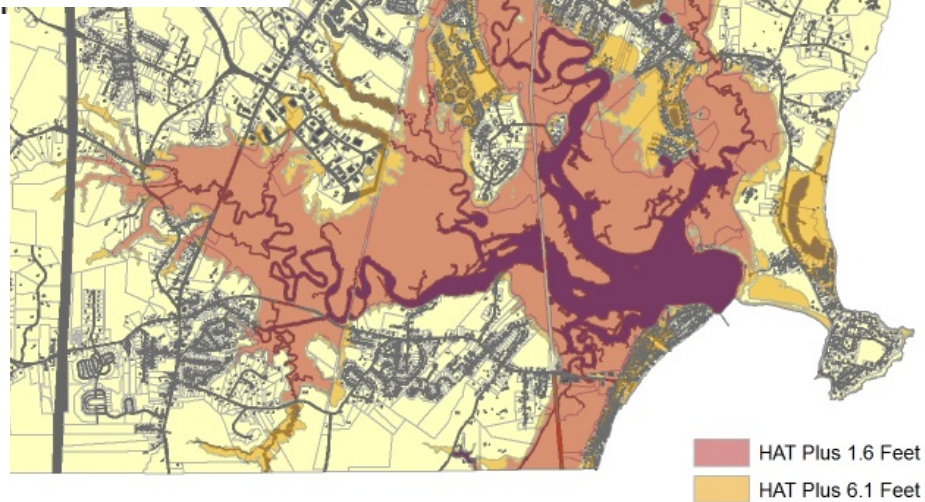
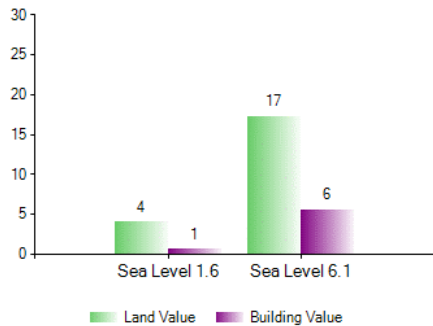
All coastal/island communities-

- % land area of towns submerged
- HAT + 6.1 ft scenario



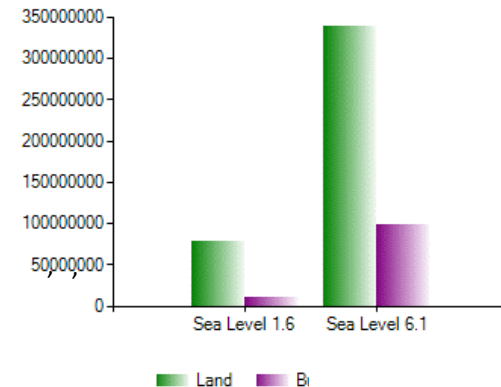
Sea Level Rise Impact

Percentage



Impact of Property Values

Sea Level Rise



Land Value Impact- calculated by reducing the land value by the % of land inundated by the flood scenario

Building Value Impact- calculated by reducing the full value of the building if it is more than half in the inundation zone, if less, only reduce the building value by 20%.

4) Best strategies to increase community awareness and facilitate adaptation





Staying Above High Water: Helping Prepare Maine's Coastal Communities for Coastal Flooding and Sea Level Rise

November 28, 2017, 9:30am-4:00pm

The Wishcamper Center, Rm. 102, University of Southern Maine

Facilitated by Liz Hertz, Blue Sky Planning Solutions

- Coastal hazards
- Overview of map viewers
- FEMA flood maps and insurance
- Maine Flood Resiliency Checklist
- Impacts on real estate
- Salt water intrusion
- Community case studies- local and beyond
- Adaptation options
- Engineering company overviews



Presentations available at: www.islandinstitute.org/sea-level-rise-symposium

Sea Level Rise and Coastal Flooding

The Basics for Maine Communities

Sea level rise is a persistent and long-term problem. The predicted impacts on homes, businesses, and critical infrastructure including working waterfronts could structurally change the communities and economies along our coast. These changes may happen over a long period of time, or they may happen abruptly if we are hit with a large storm.

SEA LEVEL RISE 101

Sea level rise is primarily due to:

- Melting of land-based ice sheets and glaciers
- Expanding ocean water as it warms (thermal expansion)

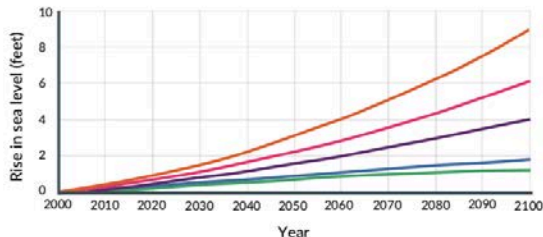
GLOBAL SEA LEVEL HAS RISEN BY ABOUT 8 INCHES SINCE RECORD KEEPING BEGAN IN 1880.

On average, sea levels are projected to rise another one to four feet globally by 2100, but sea level change will vary regionally (2017 U.S. National Climate Change Assessment). The Gulf of Maine is especially susceptible to fluctuations in sea level due to changes in the strength of the Gulf Stream and seasonal wind patterns. Sea levels in the Gulf of Maine are projected to rise faster than the global average.

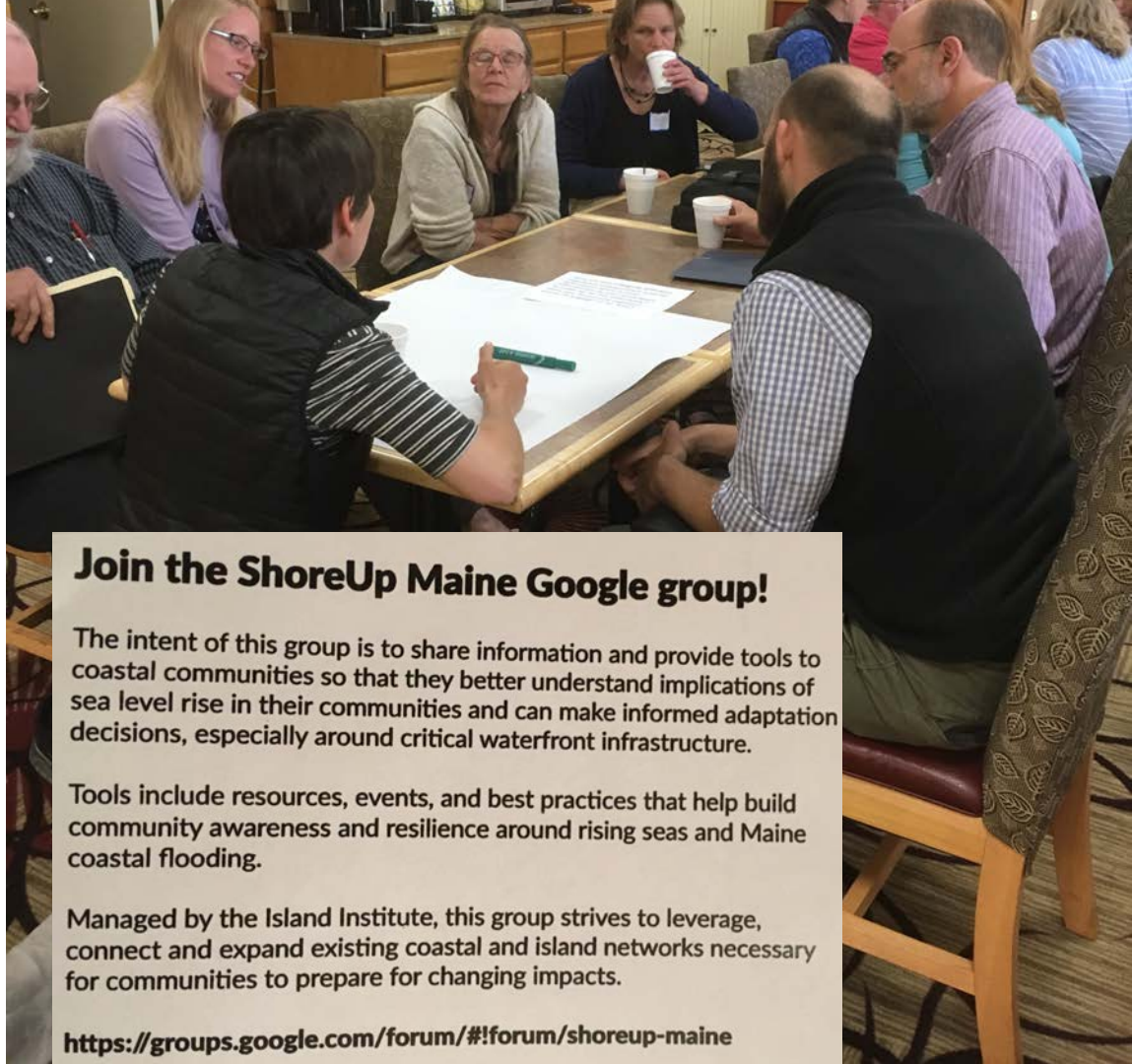
In Maine, a sea level rise of one foot will mean that the 10-year storm of the 21st century could cause the same flooding that the 100-year storm caused during the 20th century.

A sea level rise of two feet, without any changes in storms, could more than triple the frequency of coastal flooding throughout most of the Northeast.

Low Intermediate-low Intermediate Intermediate-high High



Potential future local conditions using the Bar Harbor, ME tide gauge and NOAA 2017 regional scenarios for New England. The scenarios are based largely on projections of atmospheric greenhouse gas concentrations. Adapted from WWW.CORPUSCLIMATE.US/CCACESLCURVES.CFM



Join the ShoreUp Maine Google group!

The intent of this group is to share information and provide tools to coastal communities so that they better understand implications of sea level rise in their communities and can make informed adaptation decisions, especially around critical waterfront infrastructure.

Tools include resources, events, and best practices that help build community awareness and resilience around rising seas and Maine coastal flooding.

Managed by the Island Institute, this group strives to leverage, connect and expand existing coastal and island networks necessary for communities to prepare for changing impacts.

<https://groups.google.com/forum/#!forum/shoreup-maine>

Students study sea level rise in Barrington and Warren

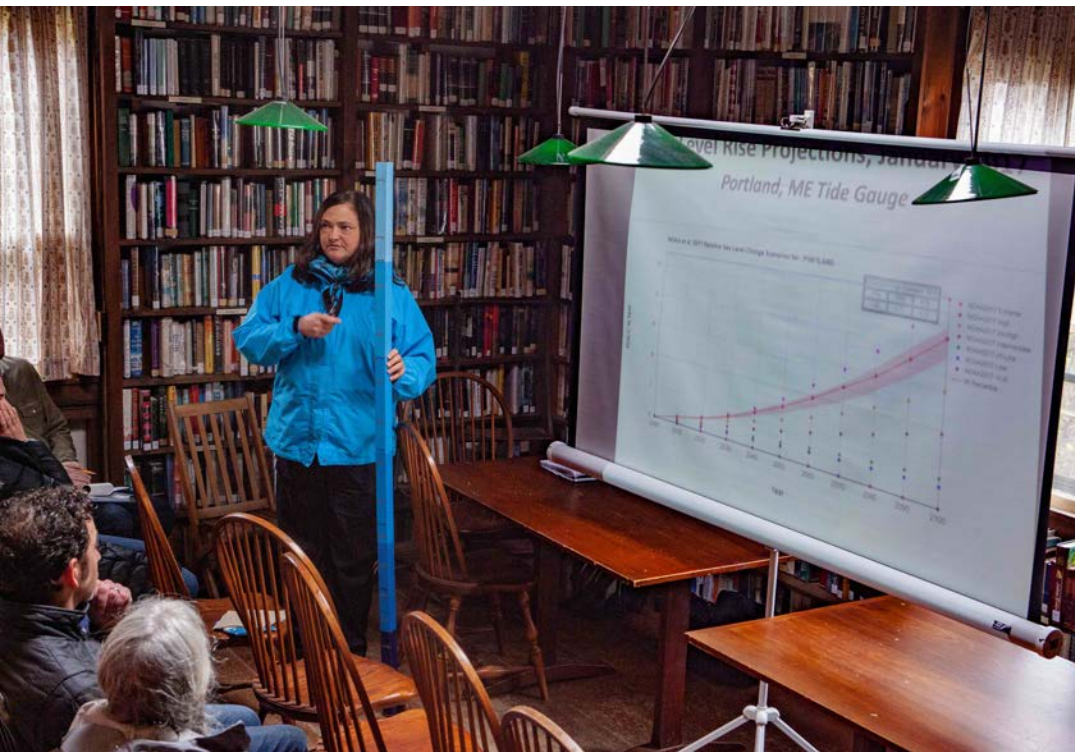
Coastal impacts of climate change draws UPenn planning students to



Teresa Crean, a coastal community planner for Coastal Resources Center at the University of Rhode Island, shows how high sea level is expected to rise in the coming years. Ms. Crean worked closely with University of Pennsylvania students during their recent tour of Barrington and Warren.

PHOTOS BY RICHARD W. DIONNE JR.





SEA LEVEL RISE

It's Happening!



<https://www.youtube.com/watch?v=fJSGvxoHV3g>

Questions?

Susie Arnold
Marine Scientist
sarnold@islandinstitute.org



*The National
Academies of*

SCIENCES
ENGINEERING
MEDICINE

GULF RESEARCH PROGRAM