Water, Weather, Climate and Community Workshop III: What Coastal Communities Have Done and Why New Hampshire Coastal Adaptation Work Group

Adaptation to Sea-Level Rise: A Regional Approach in Saco Bay

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Southern Maine Regional Planning Commission

Project Partners:

DEPARTMENT OF CONSERVATION MAINE GEOLOGICAL SURVEY

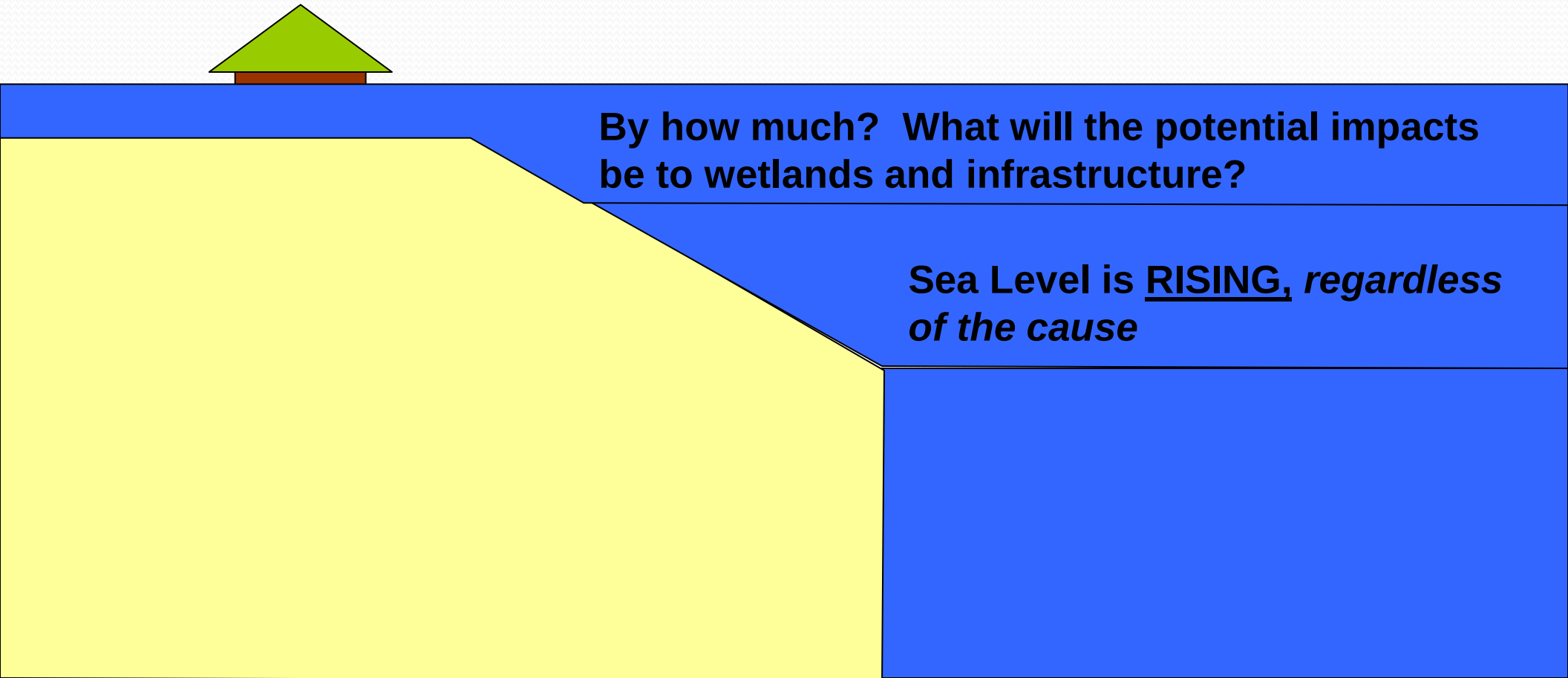
SOUTHERN MAINE REGIONAL PLANNING COMMISSION

Project Funding from:

Maine Coastal Program

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

Framing the Problem



Why does sea level change?

<u>Global Sea Level Changes…</u>

Thermal Expansion (the ocean heats up and expands as atmosphere warms)

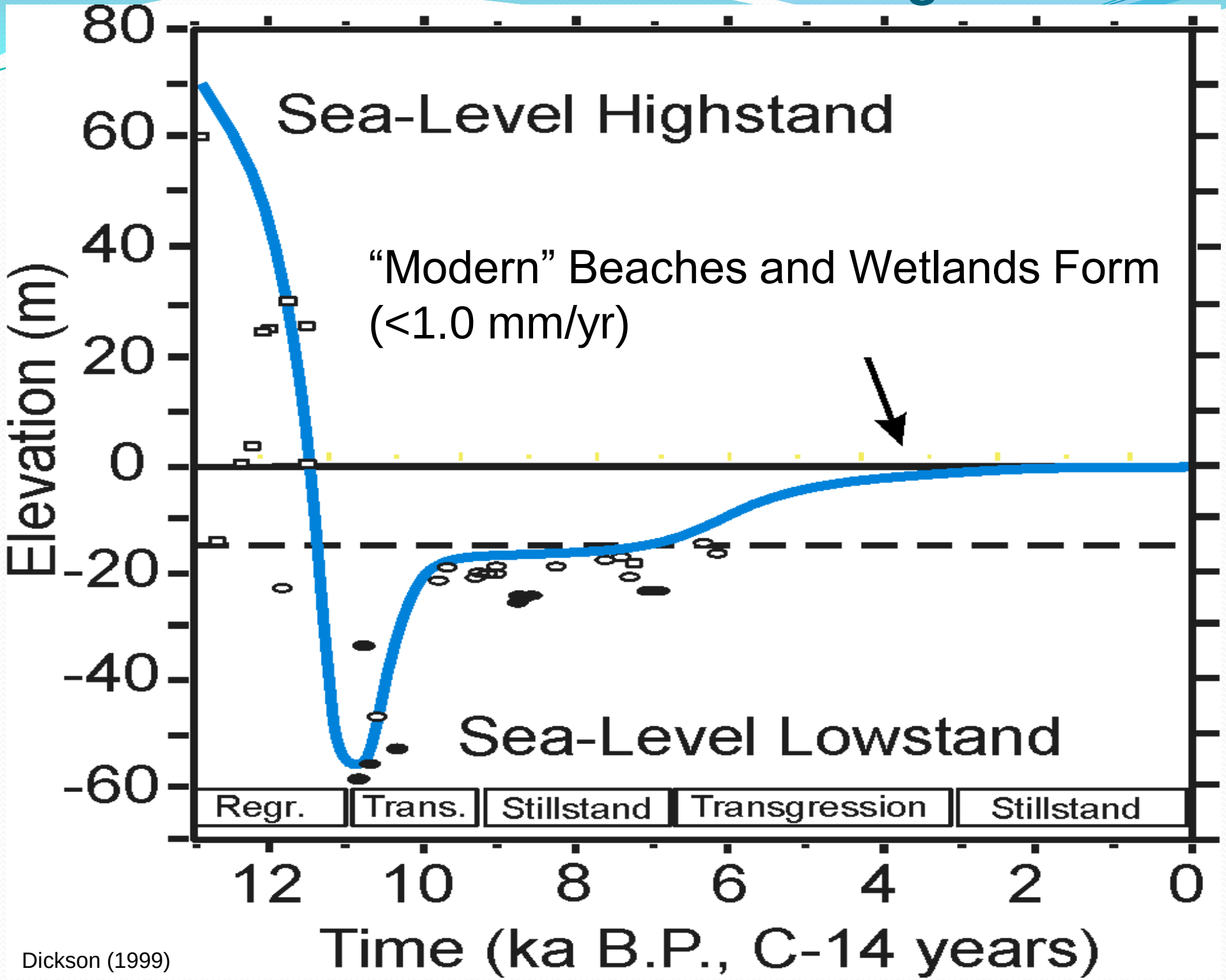
Volumetric Increase (volume increases with water from melting glaciers and land-based ice sheets).

<u>Relative Sea Level Changes…</u>

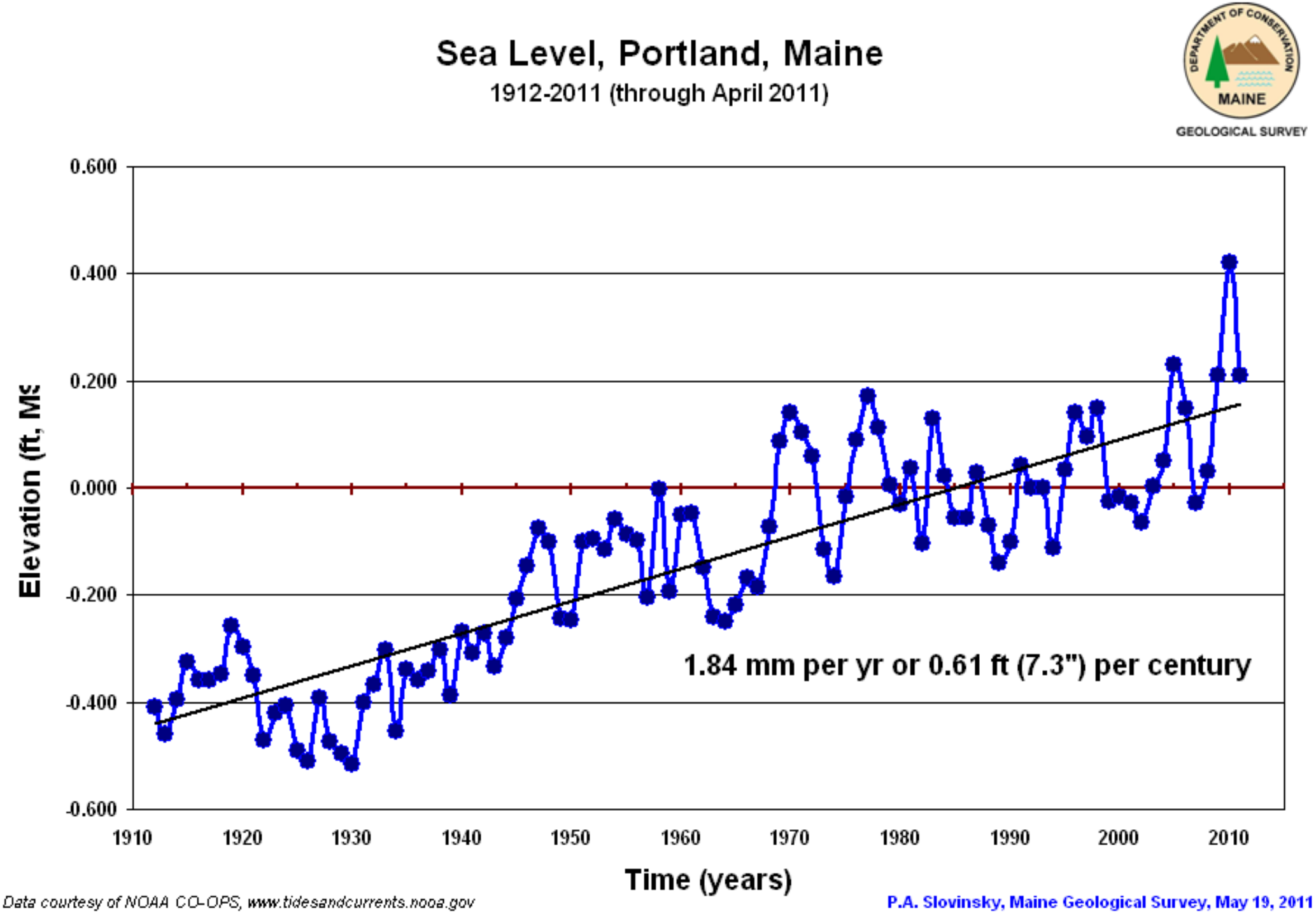
Isostatic rebound (crustal response to glaciation)

Subsidence (sinking of the land mass)

Sea Level Since the Ice Age



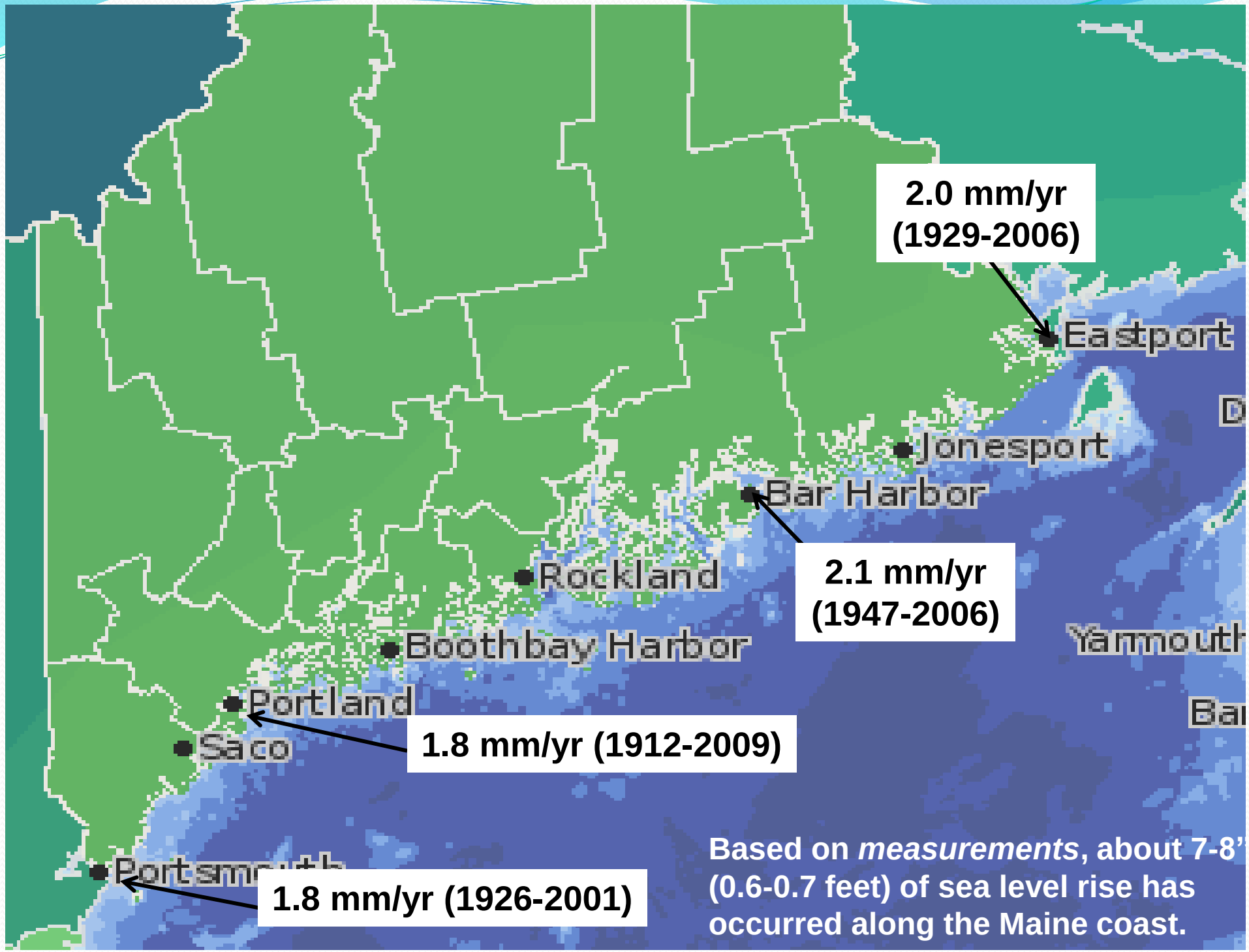
Dickson (1999)



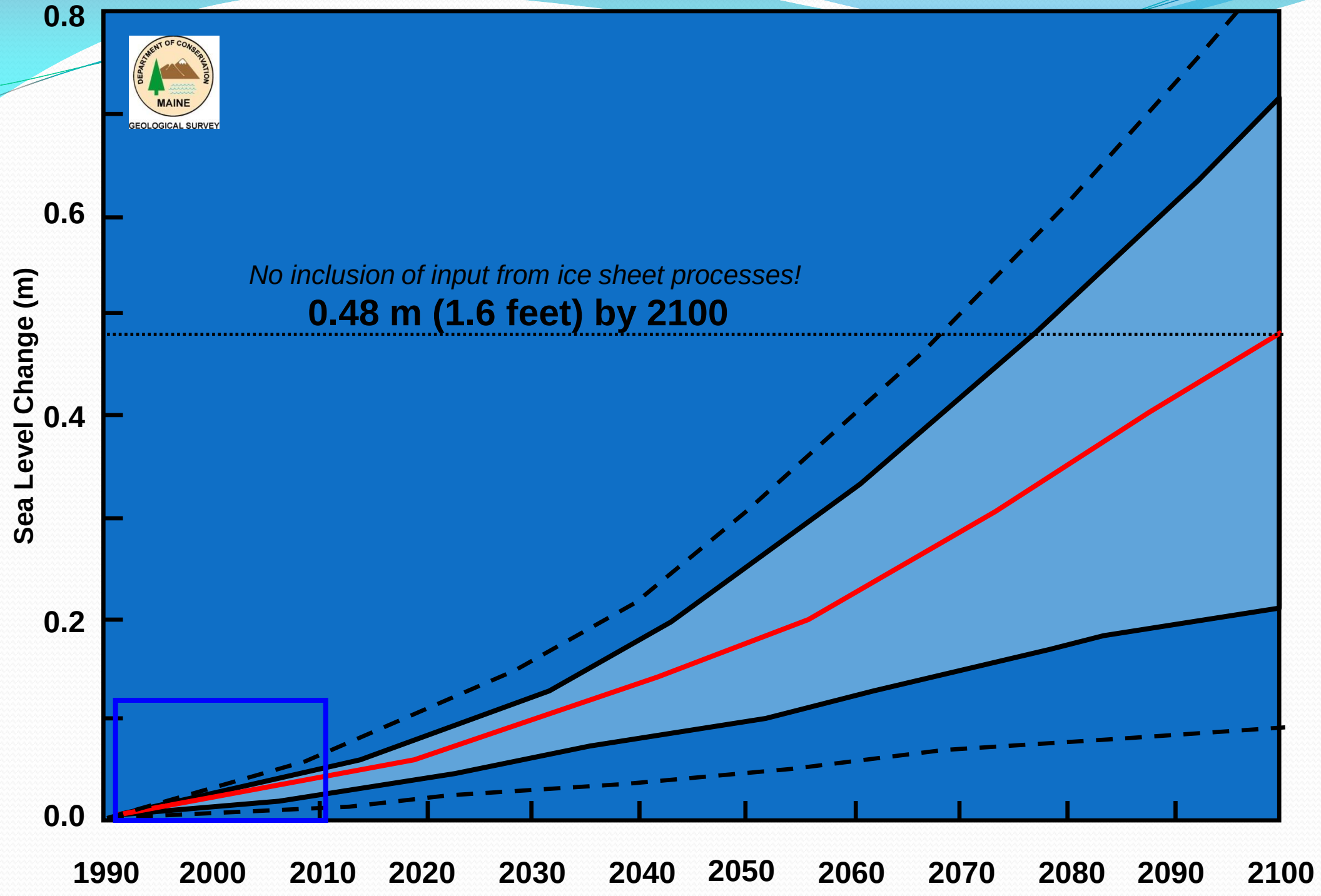
Portland Tide gauge = global ocean over last century 1.8 mm/yr (IPCC, 2007).

In Maine, this is the fastest in past 3000 years

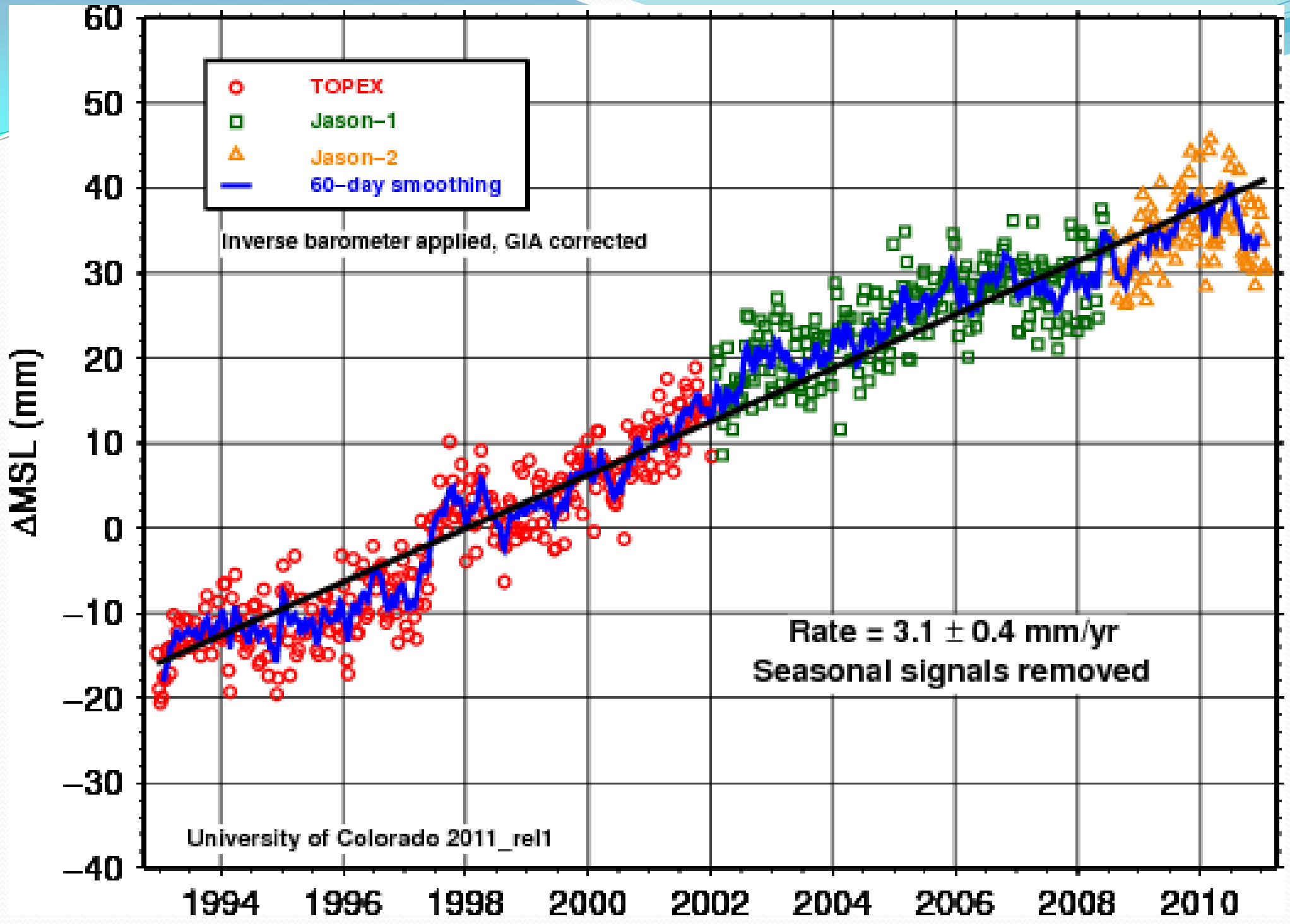
Documented Sea Level Rise



Data courtesy of NOAA CO-OPS



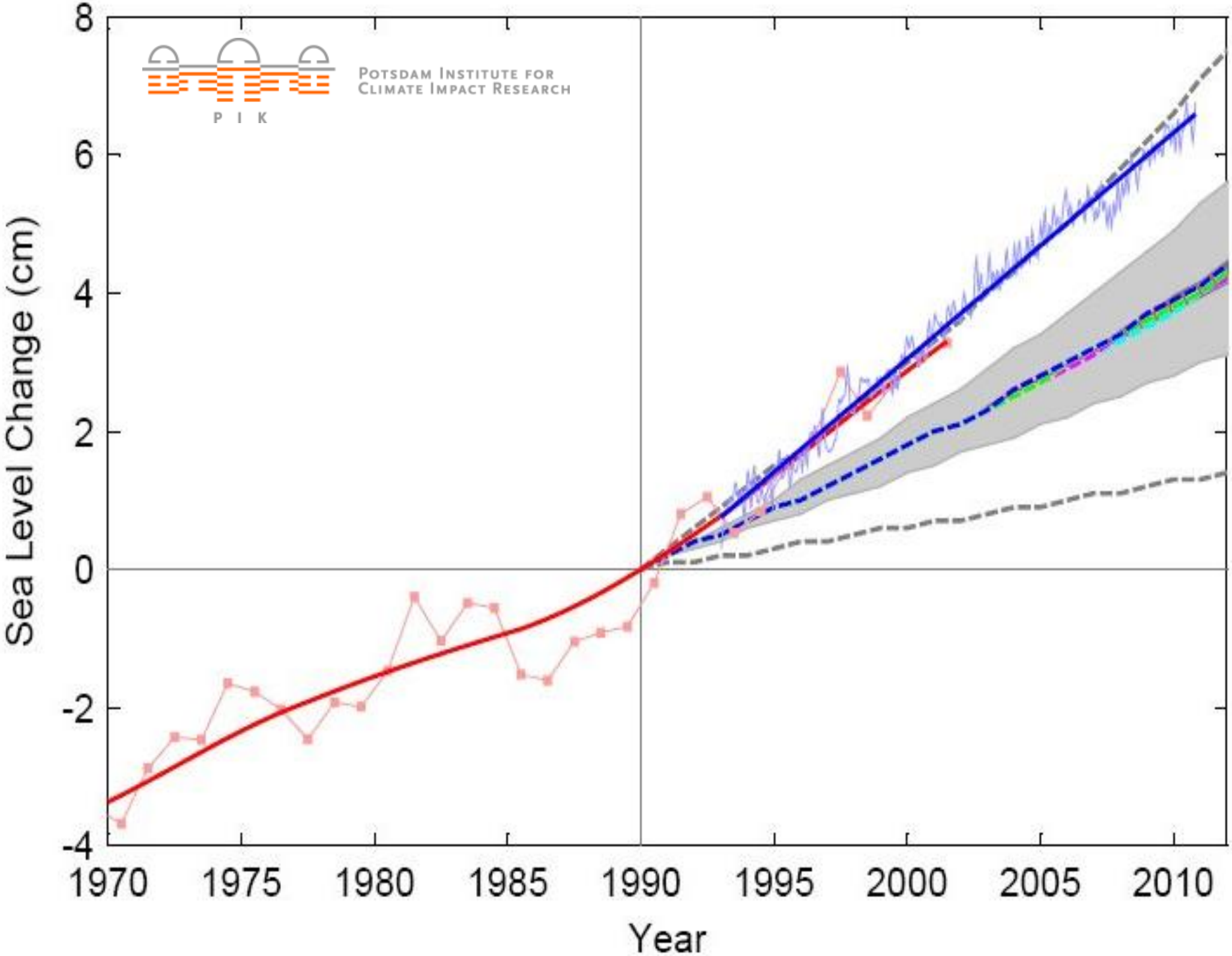
Adapted from the IPCC 3rd Assessment (Tech. Summary of Working Group I Report, Fig. 24, p. 74., 2001)



Satellite altimetry (1992-2011) = global sea level 3.1 ± 0.4 mm/yr

This is along the *upper levels of current projections*

http://sealevel.colorado.edu/

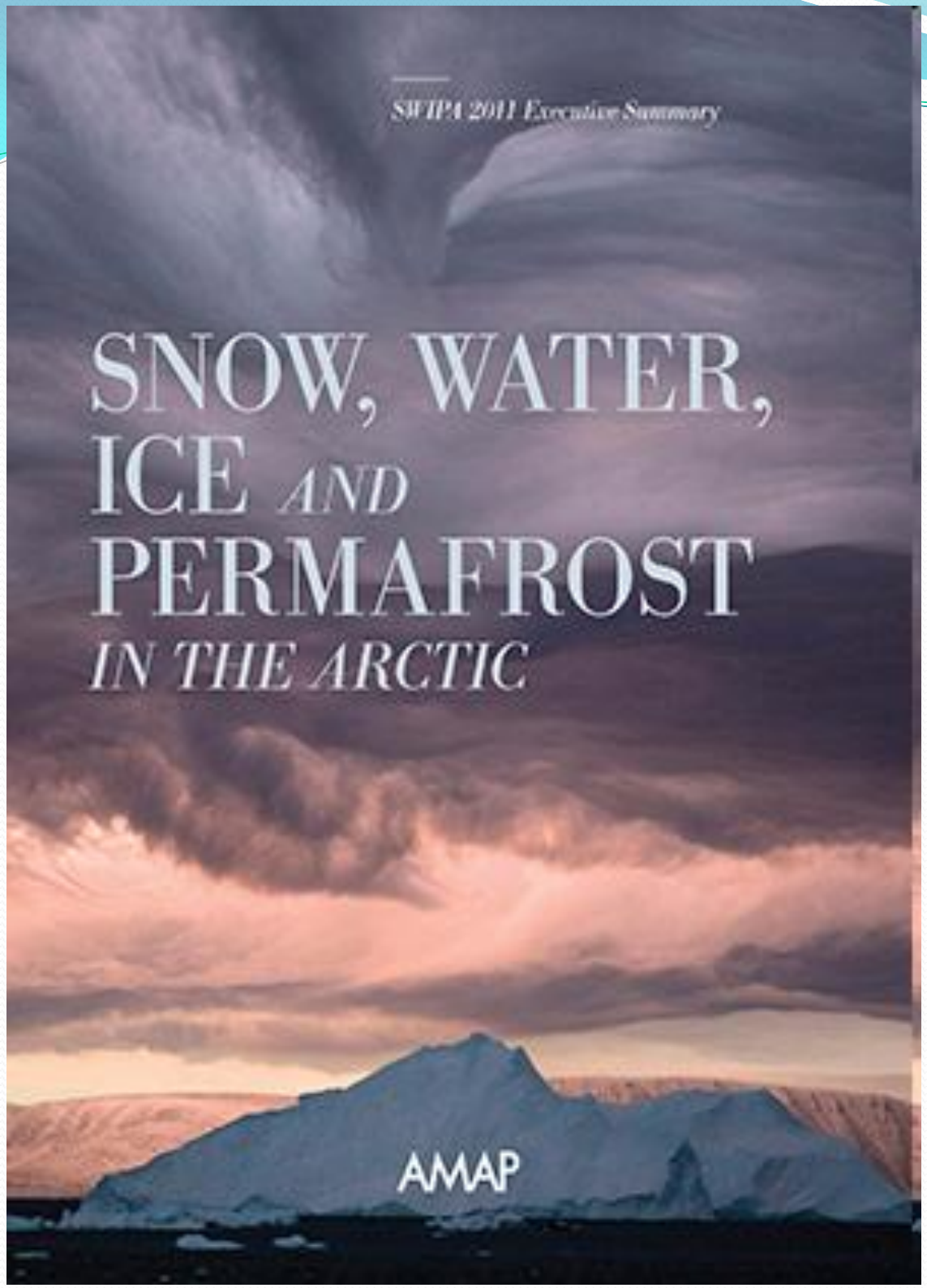

Potsdam Institute for Climate Impact Research
P I K
Sea Level Change (cm)
8
6
4
2
0
-2
-4
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year

Rignot and others, March 2011 (AGU, in press):

…if current [Antarctic and Greenland] ice sheet melting rates continue for the next four decades, their cumulative loss could raise sea level by 15 centimeters (5.9 inches) by 2050. When this is added to the predicted sea level contribution of 8 centimeters (3.1 inches) from glacial ice caps and 9 centimeters (3.5 inches) from ocean thermal expansion, **total sea level rise could reach 32 centimeters (12.6 inches)**.

http://www.agu.org/news/press/pr_archives/2011/2011-09.shtml

Image from www.swisseduc.ch



Arctic Monitoring and Assessment Program

May, 2011 report

Global sea level is projected to rise by *0.9 to 1.6m (2.95 to 5.25 ft) by 2100*, and Arctic ice loss will make a substantial contribution to this.

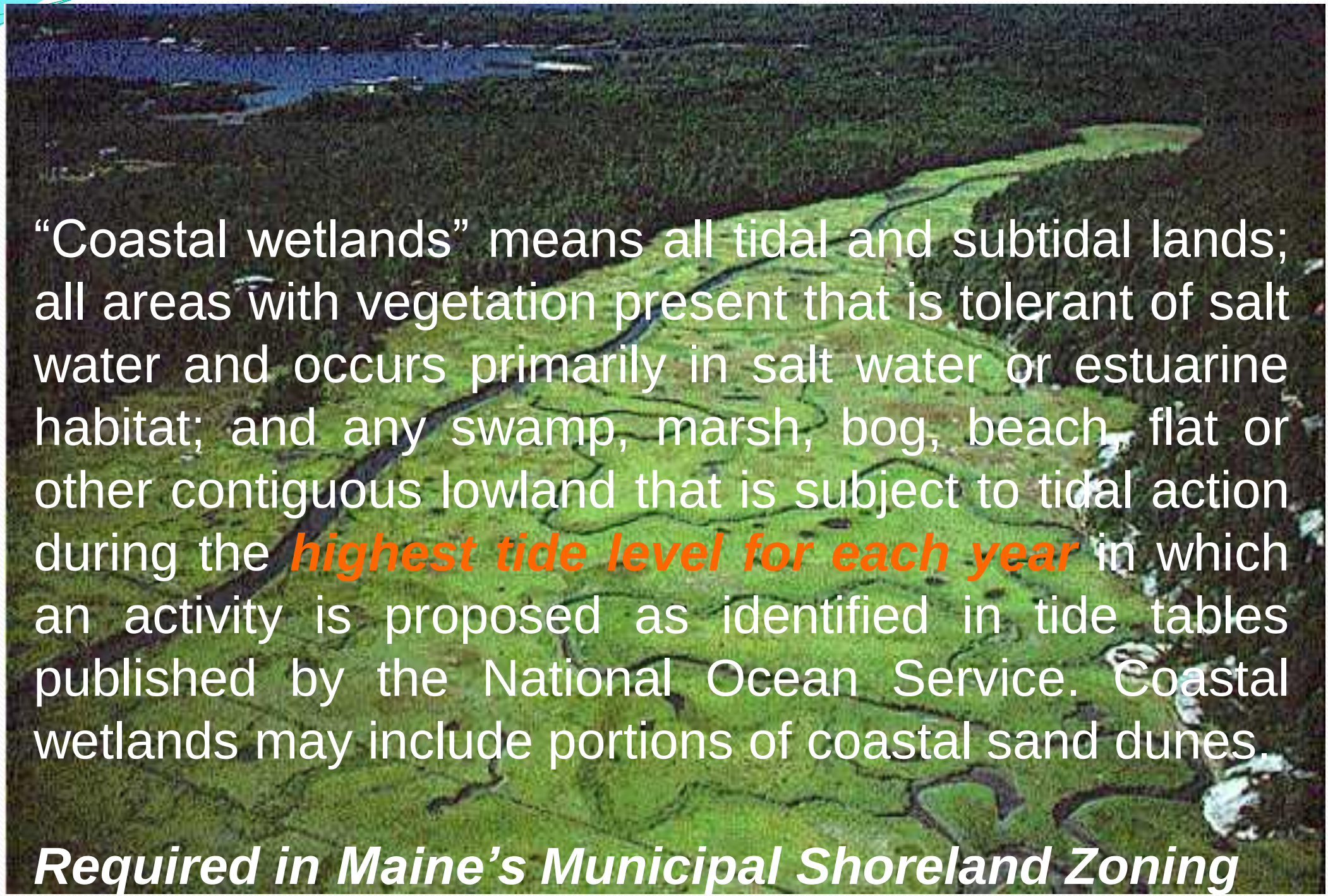
http://www.amap.no/swipa/

Maine Coastal Sand Dune Rules (Chapter 355 NRPA)

In response, in the coastal sand dune system, in 2004, Maine decided to plan for **2 feet of sea level rise over the next 100 years**, which was a “middle-of-the road” prediction for global sea level rise.

P.A. Slovinsky, MGS

Coastal wetlands



"Coastal wetlands" means all tidal and subtidal lands; all areas with vegetation present that is tolerant of salt water and occurs primarily in salt water or estuarine habitat; and any swamp, marsh, bog, beach, flat or other contiguous lowland that is subject to tidal action during the ***highest tide level for each year*** in which an activity is proposed as identified in tide tables published by the National Ocean Service. Coastal wetlands may include portions of coastal sand dunes.

Required in Maine's Municipal Shoreland Zoning

So what legal and policy basis exists today in Maine to bring this issue to the <u>local level</u>?

Maine's Coastal Policies

Title 38 M.R.S.A sec. 1801:

"The Legislature directs that state and local agencies and federal agencies as required by the United States Coastal Zone Management Act of 1972, PL 92-583, with responsibility for regulating, planning, developing or managing coastal resources, shall conduct their activities affecting the coastal area consistent with the following policies to:

…Discourage growth and new development in coastal areas where, because of coastal storms, flooding, landslides or sea-level rise, it is hazardous to human health and safety;"

Maine's Coastal Policies

- Adopted and Placed in Statutes in 1985, which is three years before the Growth Management Act passed, requiring municipal comprehensive plans.
- Obviously, planning for sea level rise is not a new idea…as that was 25 years ago!
- Ronald Reagan was the President…

What Policies Has the State Adopted Lately?

- **Resolves, Chapter 16, LD 460,**

"Resolve, To Evaluate Climate Change Adaptation Options for the State"

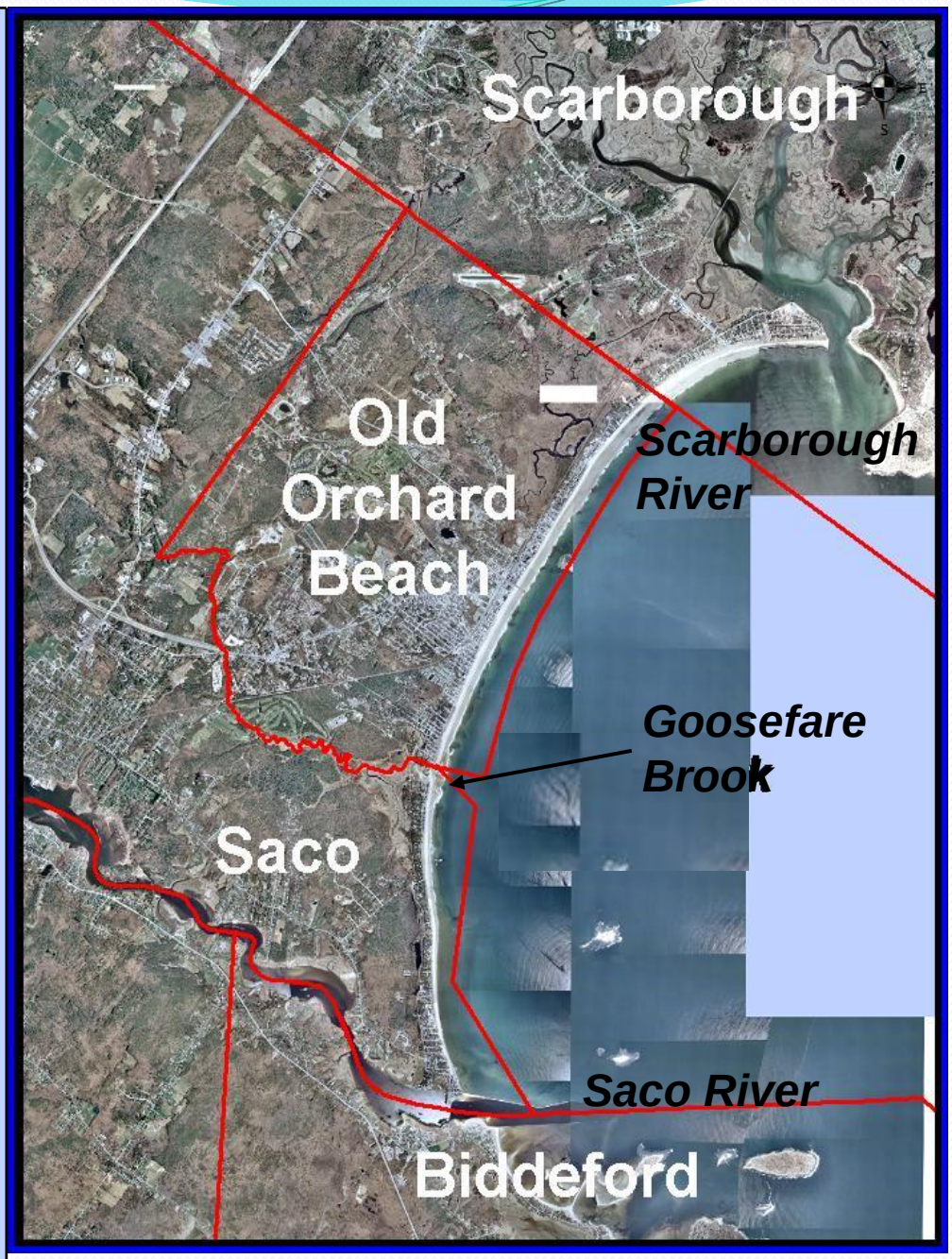
- Adopted by the 124 Legislature, in the first session, Spring 2009.
- Stakeholder Process led to the production of a report, as required by this resolve, in early 2010:

  "People and Nature Adapting to a Changing Climate: Charting Maine's Course - A report to the Joint Standing Committee on Natural Resources"

Strategy B.4.2 - Develop a Series of Models for Adaptive Land Use Planning for Decision-Makers at all Jurisdictional Levels (page 42)

"…Municipal and regional decisions must be based on climate change risk assessment to inform both existing development and growth management. Maine's Growth Management Act currently requires towns to address marine resources, water resources, critical natural resources, transportation, municipal facilities, and future land use in their Comprehensive Plans. Each has a clear nexus to climate change adaptation. Models and planning tools should distinguish between existing developed areas, those that may be considered for development, and rural areas.

Saco Bay – Where Maine has focused its efforts:



Coastal Hazard Resiliency Tools Project

State Agencies – Regional Planning Commission - Municipalities

Maine Coastal Program

SOUTHERN MAINE REGIONAL PLANNING COMMISSION

SCARBOROUGH INCORPORATED 1658 MAINE

OLD ORCHARD BEACH Organized 1883

DEPARTMENT OF CONSERVATION MAINE

GEOLOGICAL SURVEY

DOMINE DIRIGE NOS CITY OF SACO, ME. 1867

CITY OF BIDDEFORD MAINE

Data Development, Outreach, Education**, and **Partnership Development

Year 3, Moving on to Year 4!

Sea Level Adaptation Working Group
Developing a Regional Approach

Direct Participation:

Science/Technical Support:

GEOLOGICAL SURVEY

Additional Support Funding:

Maine Coastal Program

Sea Level Adaptation Working Group

Steering Committee

• Met numerous times over summer of 2010 to develop an ***Interlocal Agreement*** outlining the creation of a Working Group and its potential duties and action plan.

• Received approval from each municipal council.

• Funded by Regional Challenge Grant (SPO) and local matches

Working Group

• Comprised of assigned members; 1 municipal planner and 1 citizen at-large from each community; SMRPC planner; technical support from MGS.

• Met over the fall of 2010 to complete an initial ***Vulnerability Assessment*** and produce a preliminary report that was submitted to municipal councils for approval.

Sea Level Rise
And Potential Impacts by the Year 2100

A Vulnerability Assessment
for the Saco Bay Communities of
Biddeford, Saco, Old Orchard Beach, and
Scarborough

A Report of the Sea Level Adaptation Working Group
31 December 2010
With the Assistance of the
Maine Department of Conservation – Maine Geological Survey
and the
Southern Maine Regional Planning Commission
With Funding from the Maine State Planning Office & Maine Coastal Program and Partner Communities

Major Assumptions:

- 2 feet of sea level rise will occur over the next 100 years. The two foot sea level rise scenario **does not include the effects of freshwater runoff from rain events**.
- The sea level rise scenario assume that the land surface will remain static and will not be altered due to erosion or accretion, and the current configuration of land forms and contours will remain static, during and after each inundation.
- Values of estimated damage to land and buildings are based upon the most recent assessments for property tax purposes; these values are conservative, and are not necessarily representative of fair market value. **Loss of building value, and the associated land value, was assumed to occur only if the center of the building footprint was inundated in the flood scenario.**
- Erosion Hazard Area (EHA) maps, pursuant to Maine's Coastal Sand Dune Rules, were used as a **preliminary approach to estimate the potential impact of sea level rise and dynamic erosion and inundation along the open coast.** All building footprints that intersect the EHA are assumed to be within it, and assumed to sustain damage with sea level rise.

Conditions Simulated – Vulnerability Assessment

Highest Annual Tide (HAT), sometimes called the "spring" tide, is the highest predicted water level for any given year but is reached within several inches numerous tides a year.

1978 Storm is the highest recorded water level at the Portland Tide Gauge which occurred on the February 7, 1978 Noreaster' Storm.

Current and Historic Tides - by Community	Mean High Water		Highest Annual Tide		1978 Storm *	
Tidal Datum	MLLW	NAVD88	MLLW	NAVD88	MLLW	NAVD88
Scarborough	9.2	4.1	11.3	6.2	14.1	8.9
Old Orchard Beach	9.2	4.1	11.3	6.2	14.1	8.9
Saco	9.2	4.1	11.3	6.1	14.1	8.9
Biddeford	9.4	4.2	11.5	6.3	14.1	8.9

All tidal elevation data calculated from NOAA NOS CO-OPS tidal station data and predictions

*** 1978 Storm elevation taken from Portland Tide Gauge highest observed water level recorded on February 7, 1978*

For each scenario, 2 feet of projected sea level rise was added to each tidal elevation for simulation of potential impacts to <u>natural resources, buildings, and infrastructure.</u>

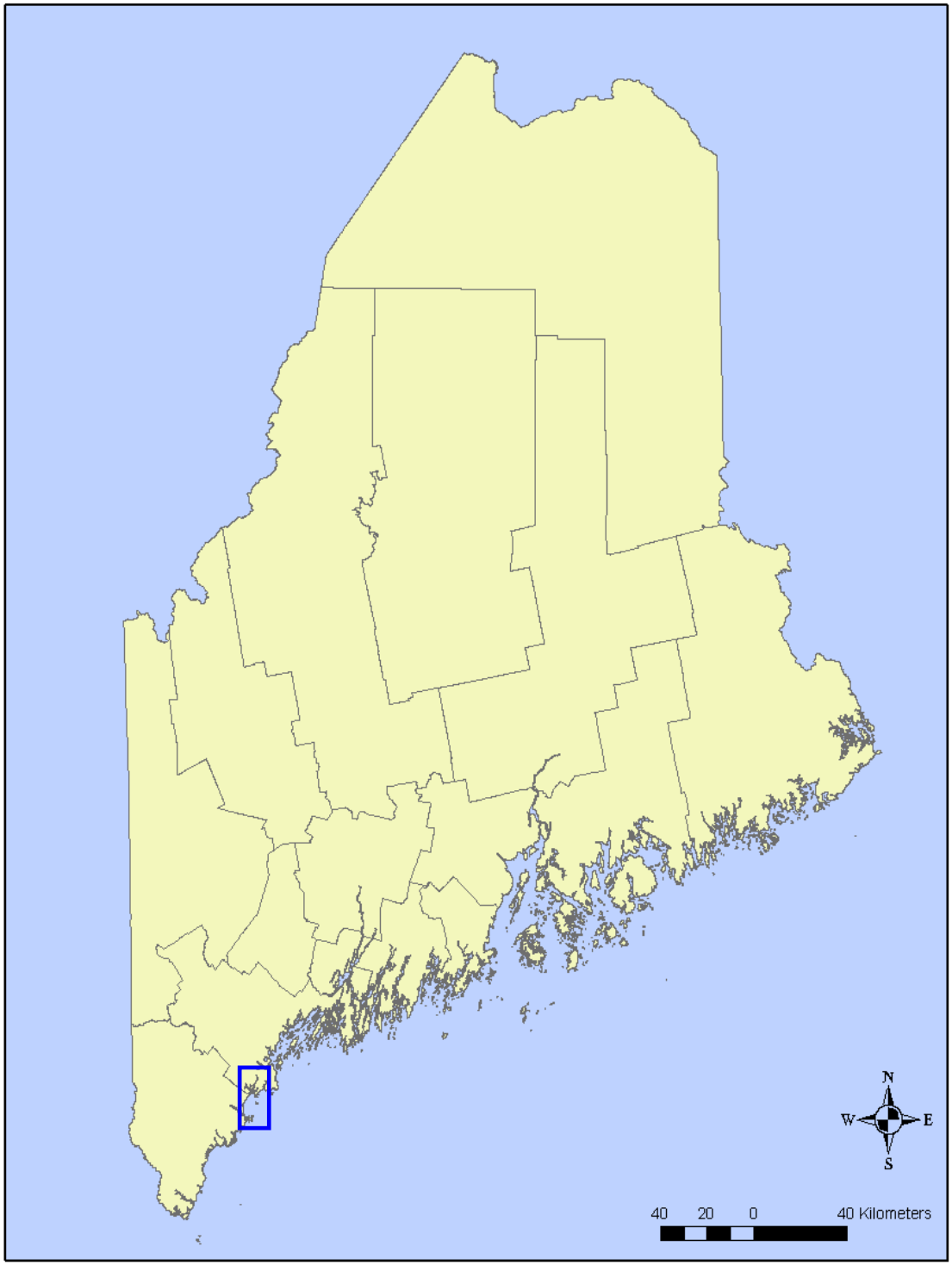
So how do we simulate the potential impacts of sea level rise on the natural environment and built infrastructure?

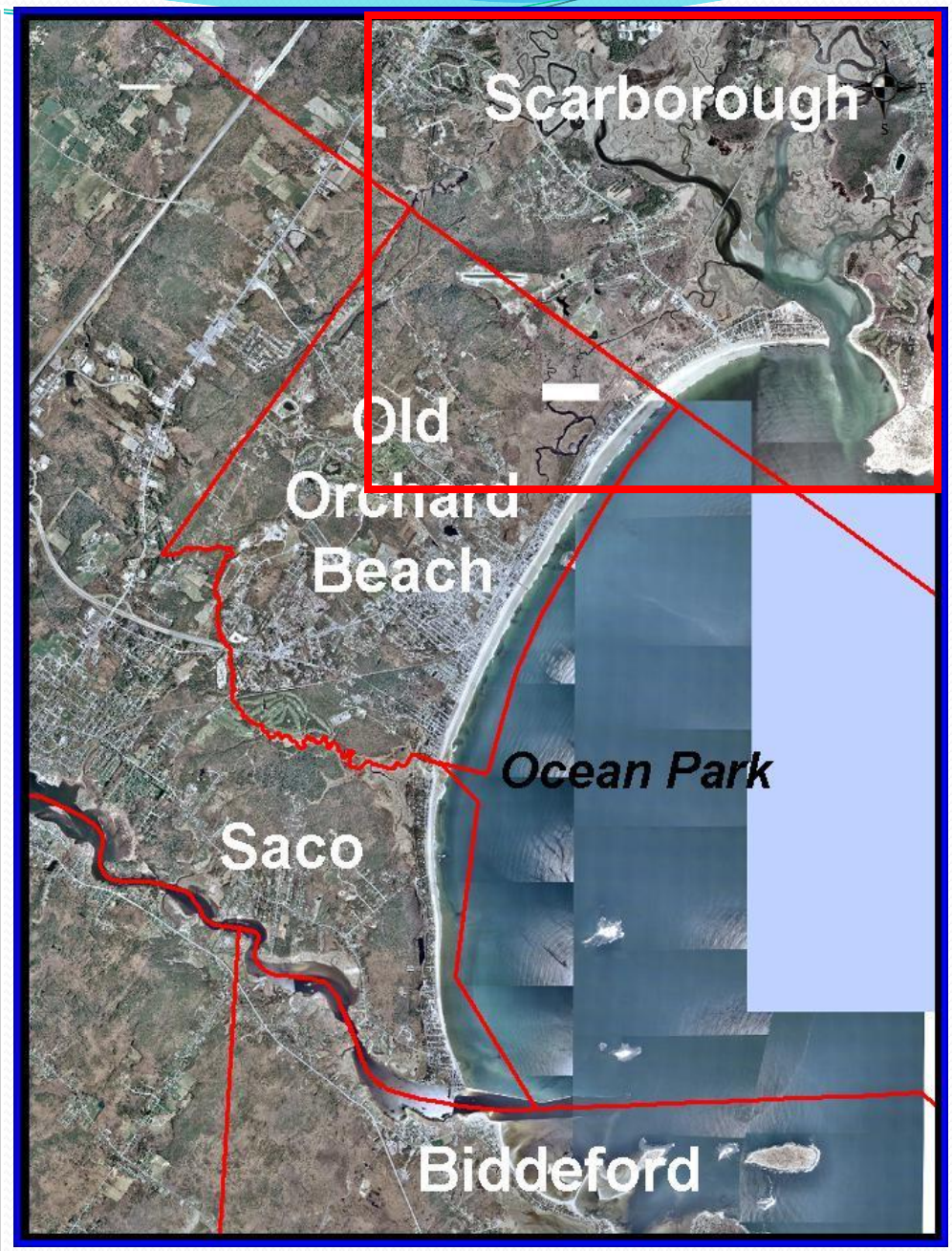
Using the Sea Level Rise Simulation Tool

Steps:

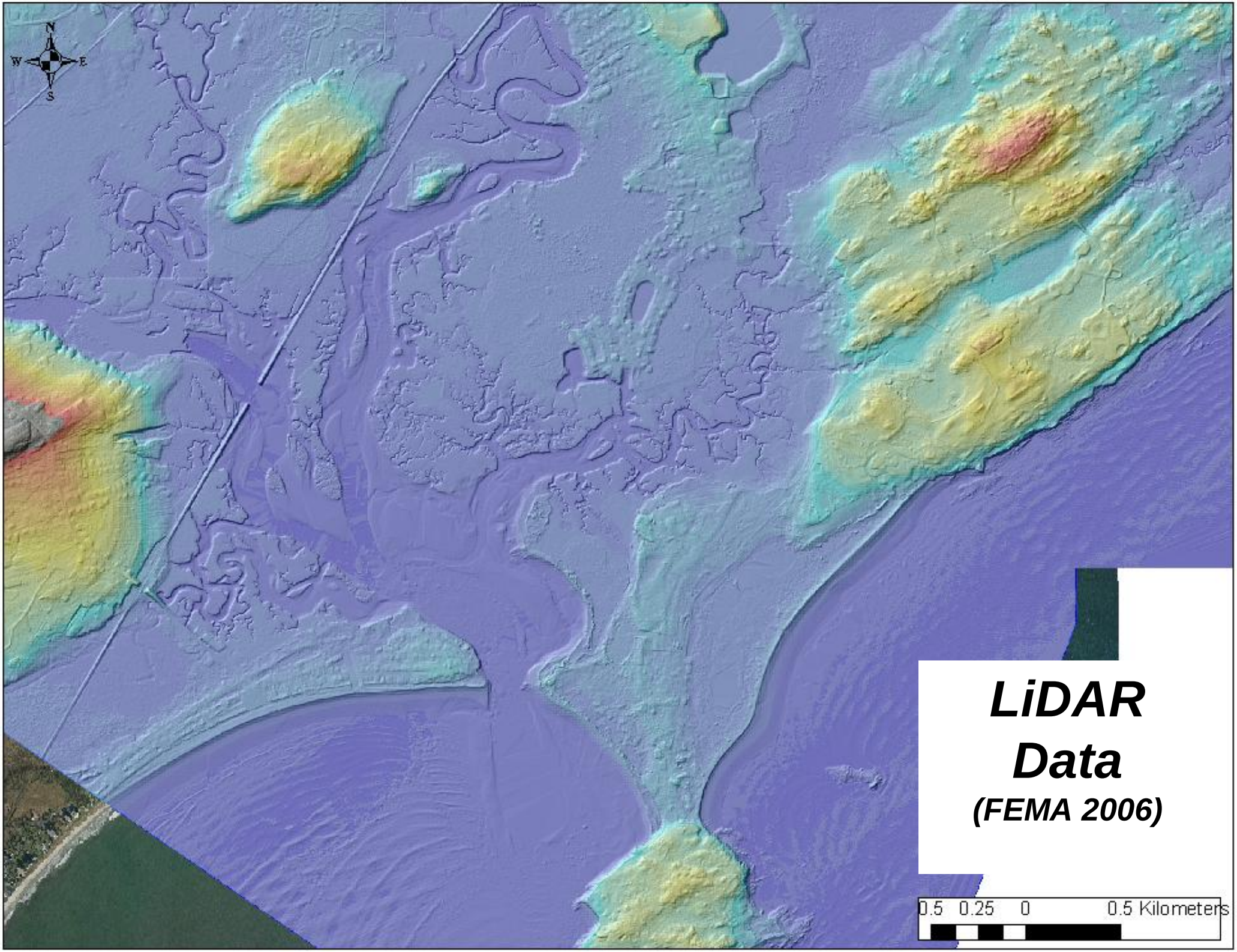
1) Groundtruth **LiDAR** data for representing ground conditions using RTK – GPS *(very accurate).*
2) Determine Tidal Elevations as proxies for existing marsh surfaces
3) Demonstrate accuracy in simulating **existing conditions** using **tidal elevations** to define marsh habitats and inundation
4) Simulate **potential** **impacts of sea level** rise on:
   a) Marsh Habitat
   b) Existing Infrastructure
5) Identify areas potentially suitable for marsh migration and at-risk built infrastructure

Saco Bay





Marsh Habitats
Scarborough River, Scarborough

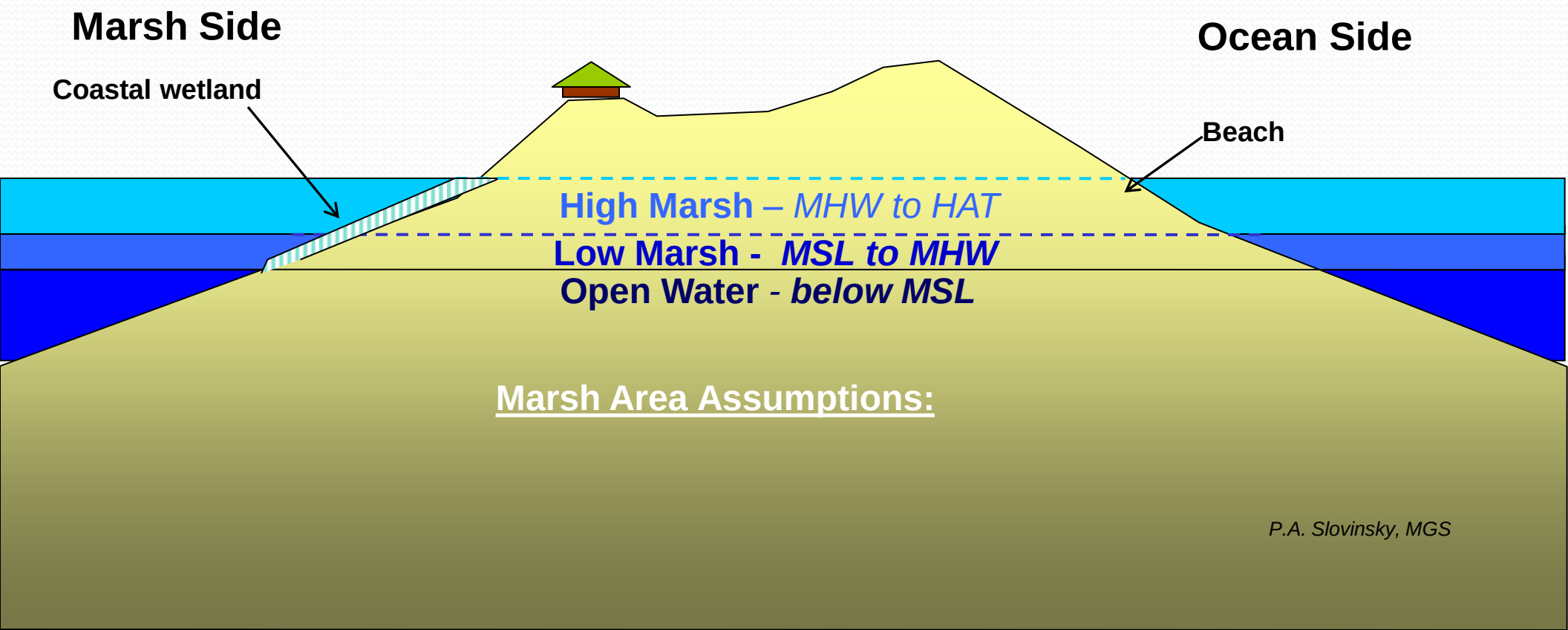

N
W
E
S
LiDAR
Data
(FEMA 2006)
0.5 0.25 0 0.5 Kilometers

Step 2: Setting the Stage with Tidal Elevations

Highest Annual Tide (HAT) - “spring” tide, the highest predicted water level for any given year but is reached within several inches numerous tides a year

Mean High Water (MHW) - the average normal high water level.

Mean sea level (MSL) = average height of the ocean’s surface (high and low tide).



Assessing Potential Impacts to Wetlands

<u>Assumptions made:</u>

Coastal Wetlands exist from mean sea level to highest annual tide

-0.35 ft to 6.35 ft NAVD

Low marsh exists from mean sea level to mean high water

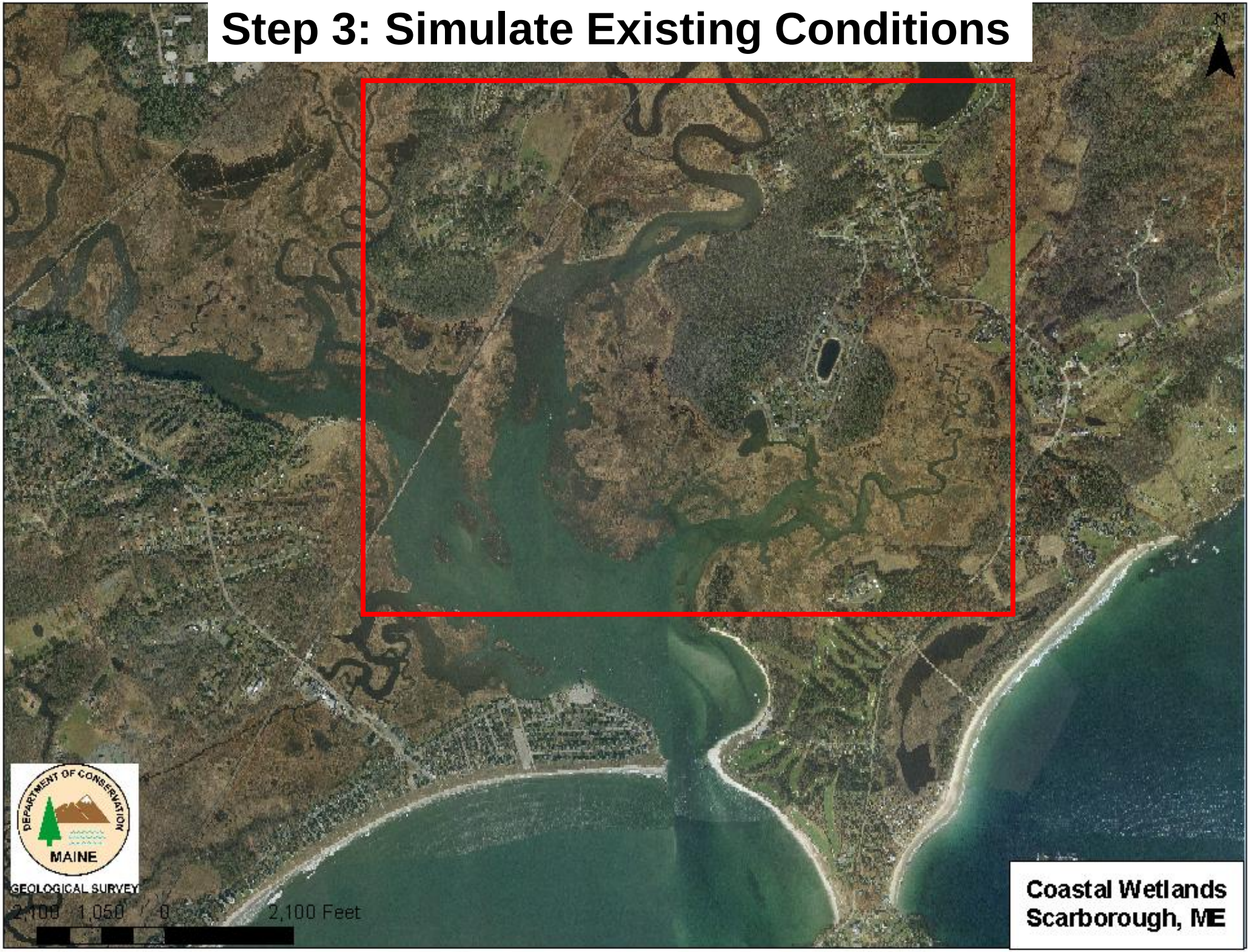
-0.35 ft to 4.10 ft NAVD

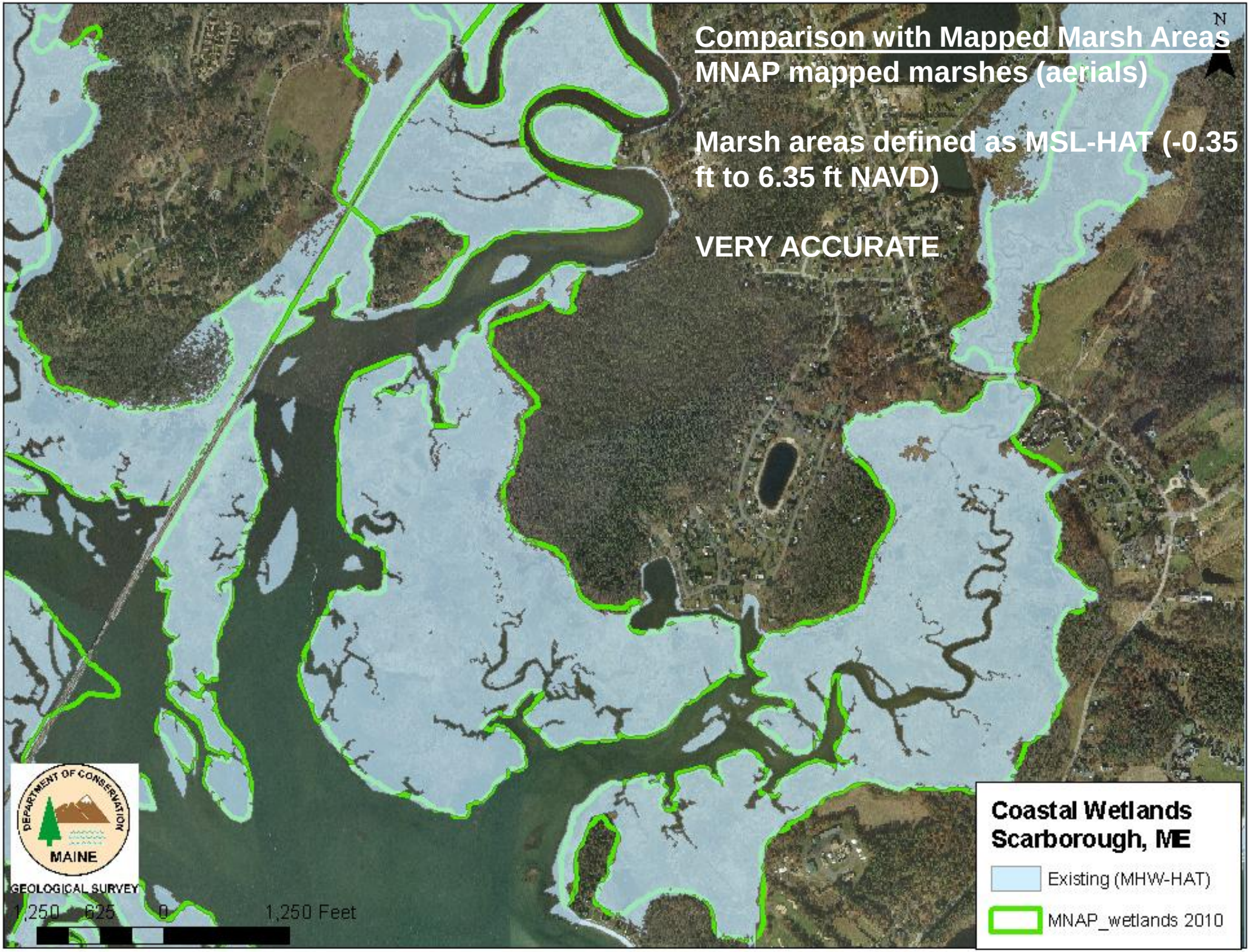
High marsh exists from mean high water to highest annual tide

4.10 to 6.35 ft NAVD

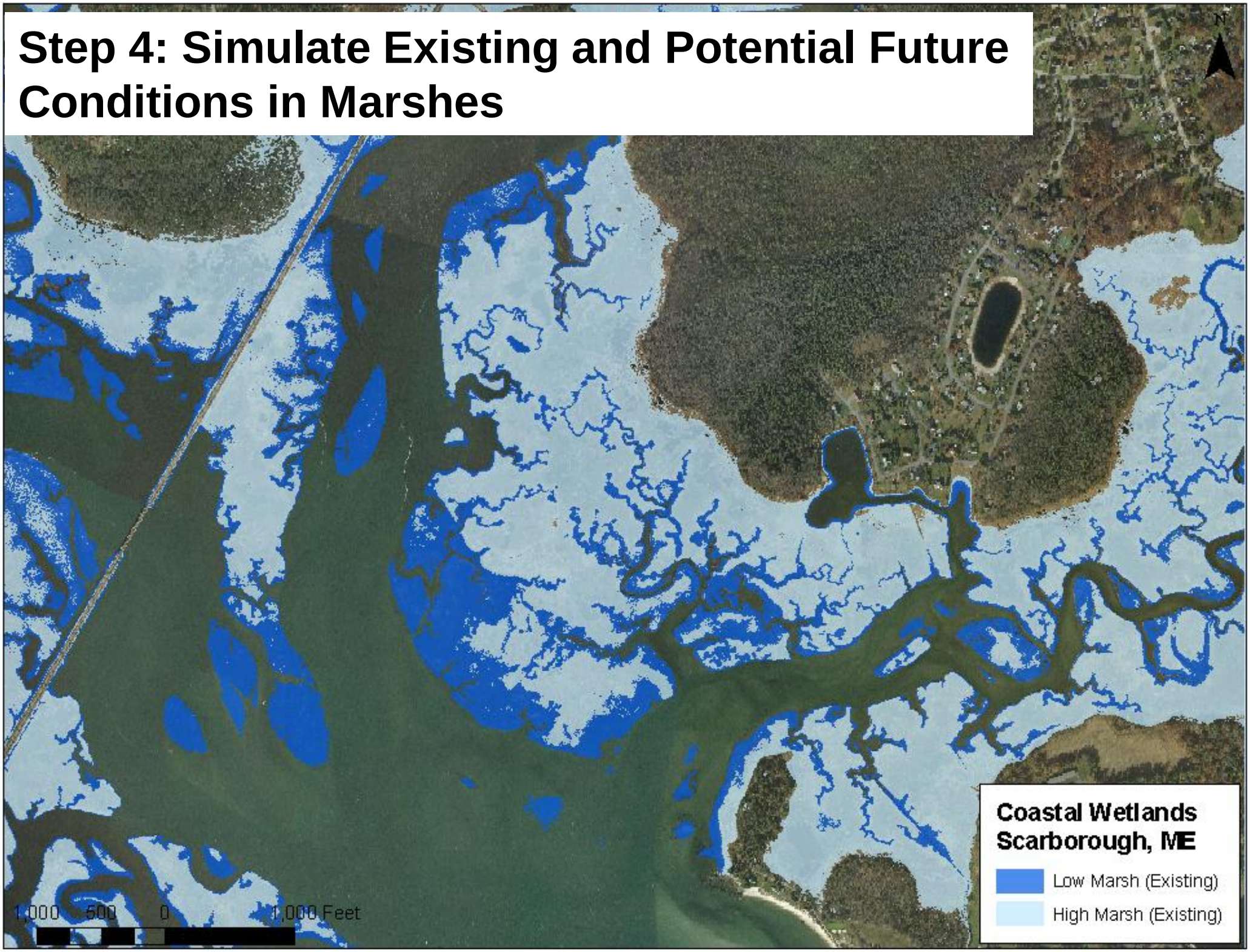
Topography stays static

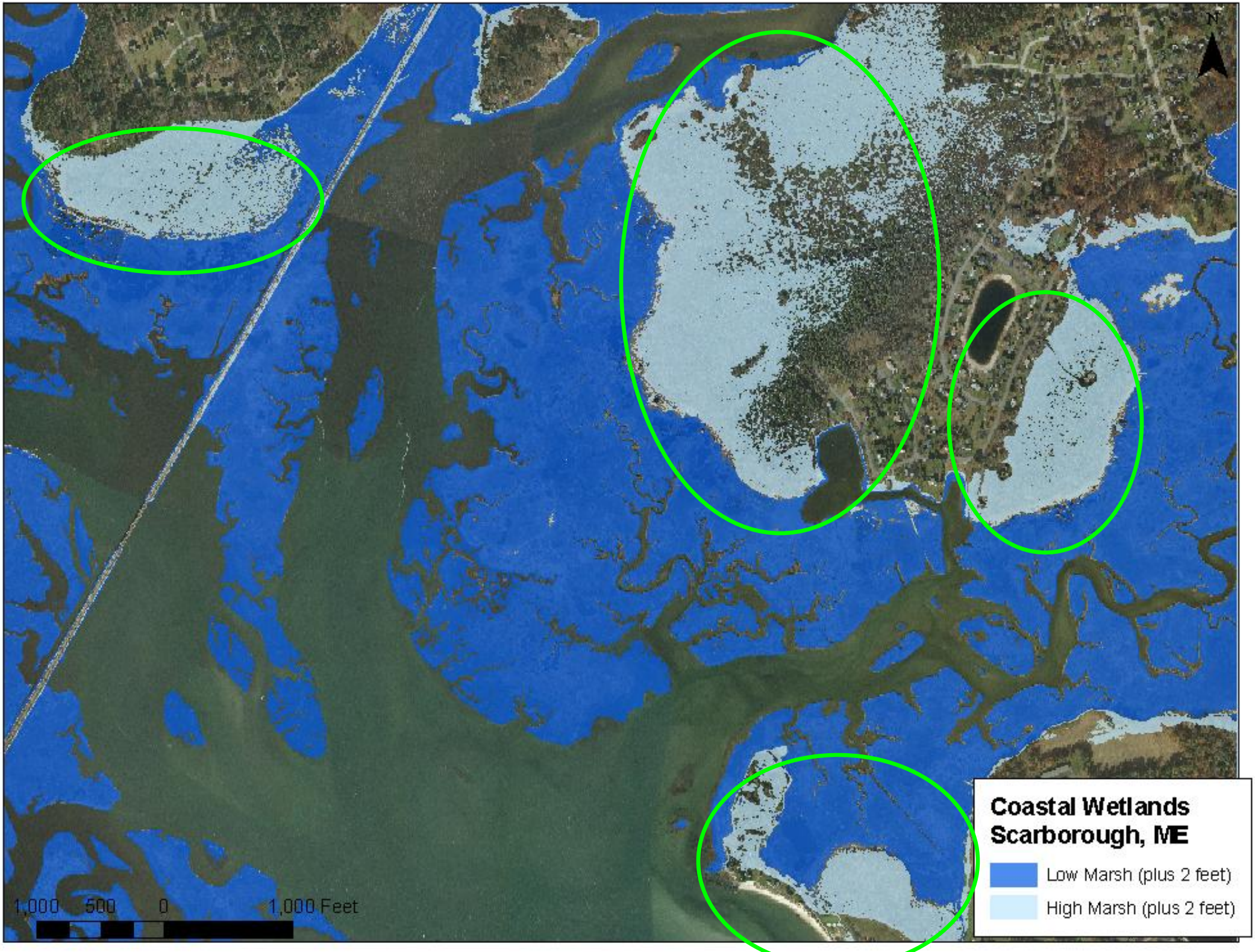
Step 3: Simulate Existing Conditions




Comparison with Mapped Marsh Areas
MNAP mapped marshes (aerials)
Marsh areas defined as MSL-HAT (-0.35 ft to 6.35 ft NAVD)
VERY ACCURATE
N
Coastal Wetlands
Scarborough, ME
Existing (MHW-HAT)
MNAP_wetlands 2010
DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY
1,250 625 0 1,250 Feet

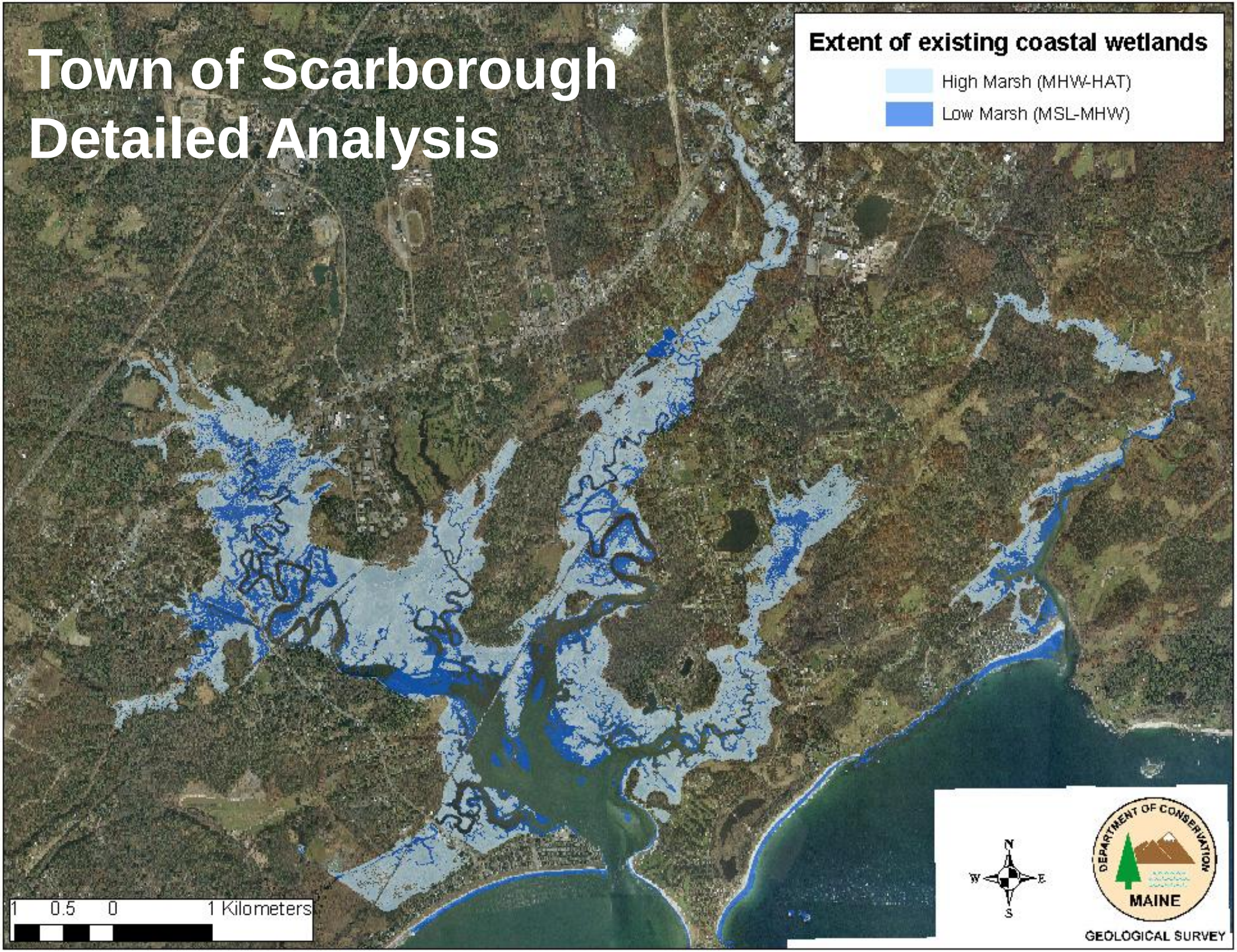
Step 4: Simulate Existing and Potential Future Conditions in Marshes

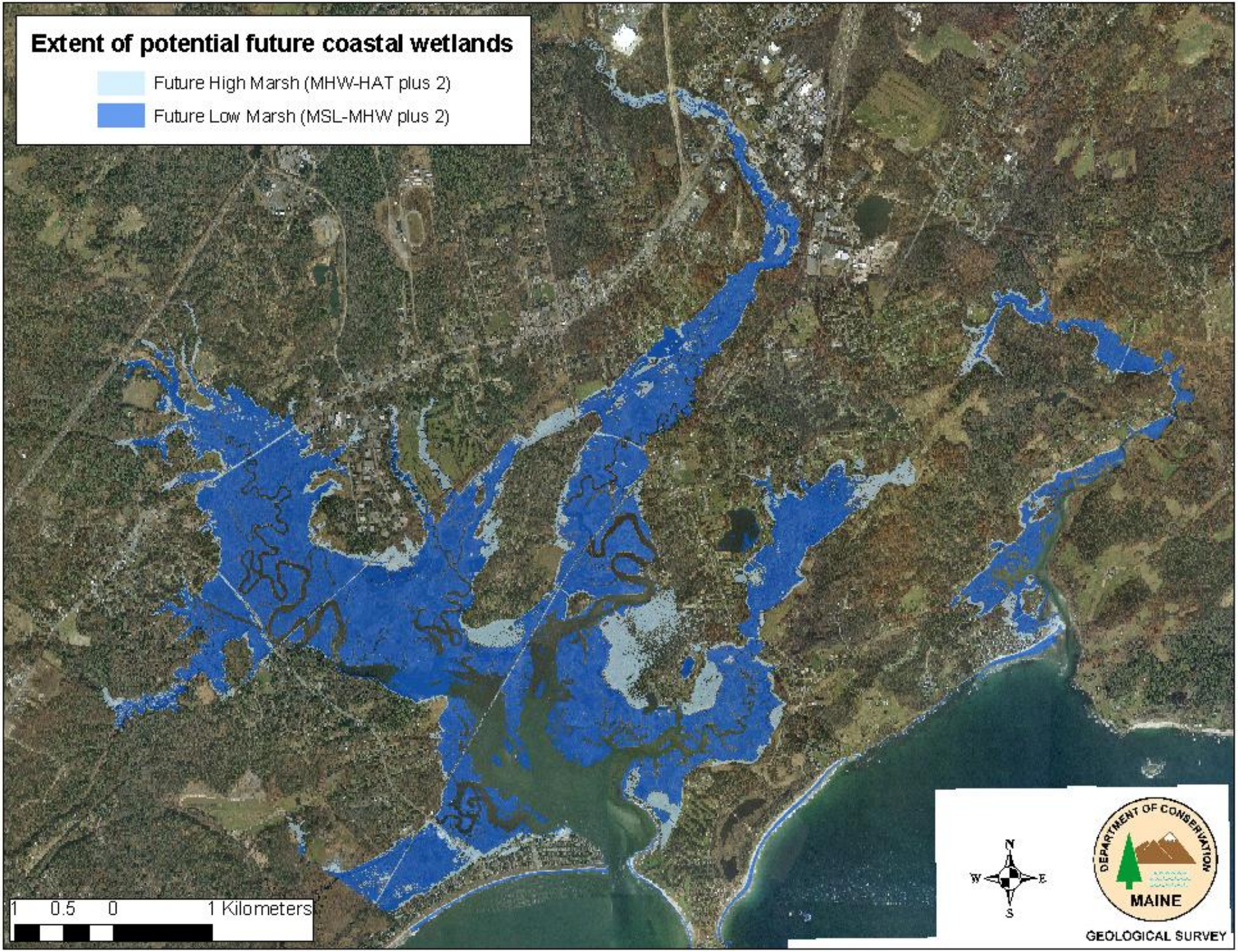


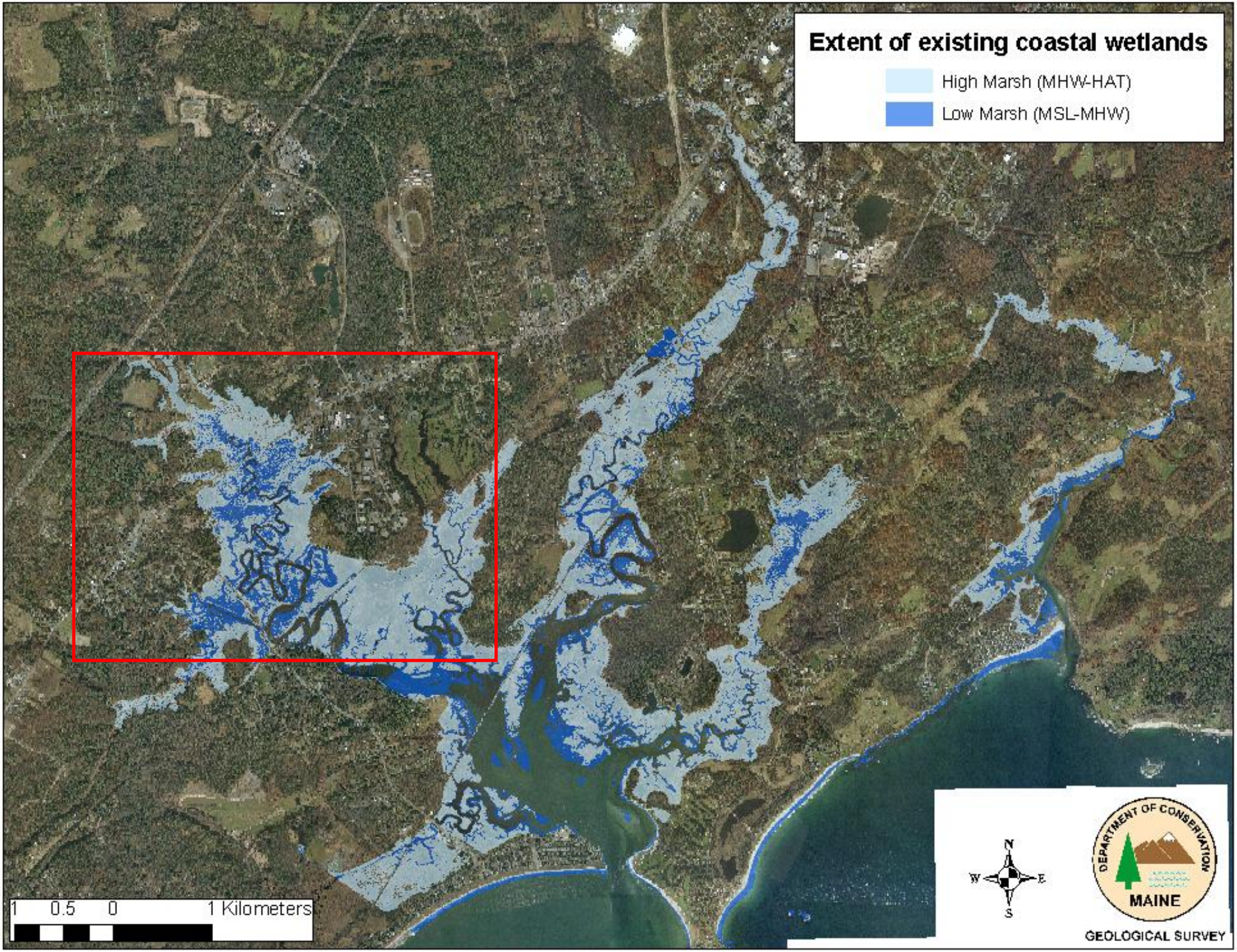

N
Coastal Wetlands
Scarborough, ME
Low Marsh (plus 2 feet)
High Marsh (plus 2 feet)
1,000 500 0 1,000 Feet

Potential Impacts to Natural Resources

Town of Scarborough Detailed Analysis




Extent of potential future coastal wetlands
Future High Marsh (MHW-HAT plus 2)
Future Low Marsh (MSL-MHW plus 2)
1 0.5 0 1 Kilometers
N
W
E
S
DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY


Extent of existing coastal wetlands
High Marsh (MHW-HAT)
Low Marsh (MSL-MHW)
1 0.5 0 1 Kilometers
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DEPARTMENT OF CONSERVATION
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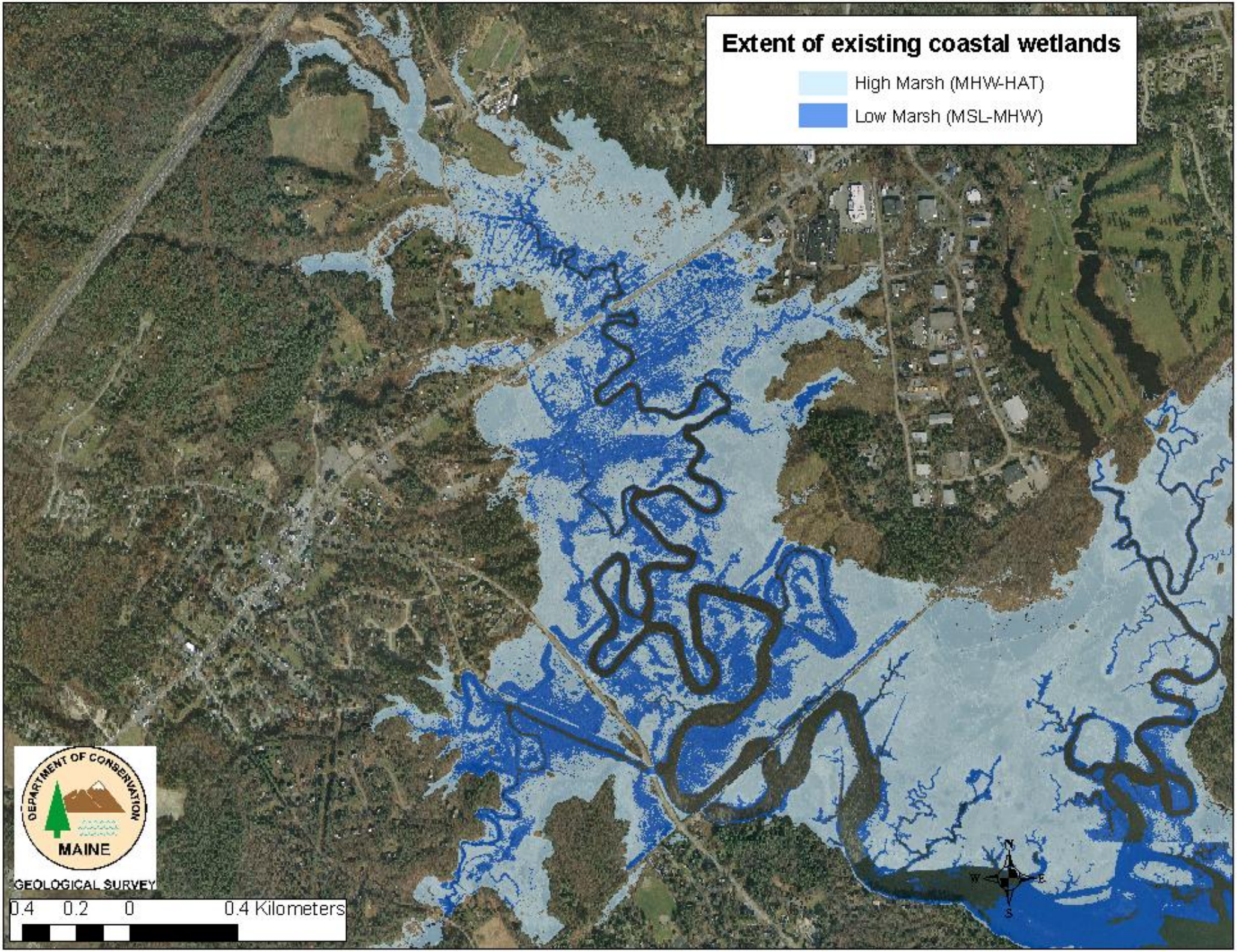
GEOLOGICAL SURVEY


Extent of existing coastal wetlands
High Marsh (MHW-HAT)
Low Marsh (MSL-MHW)
DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY
0.4 0.2 0 0.4 Kilometers
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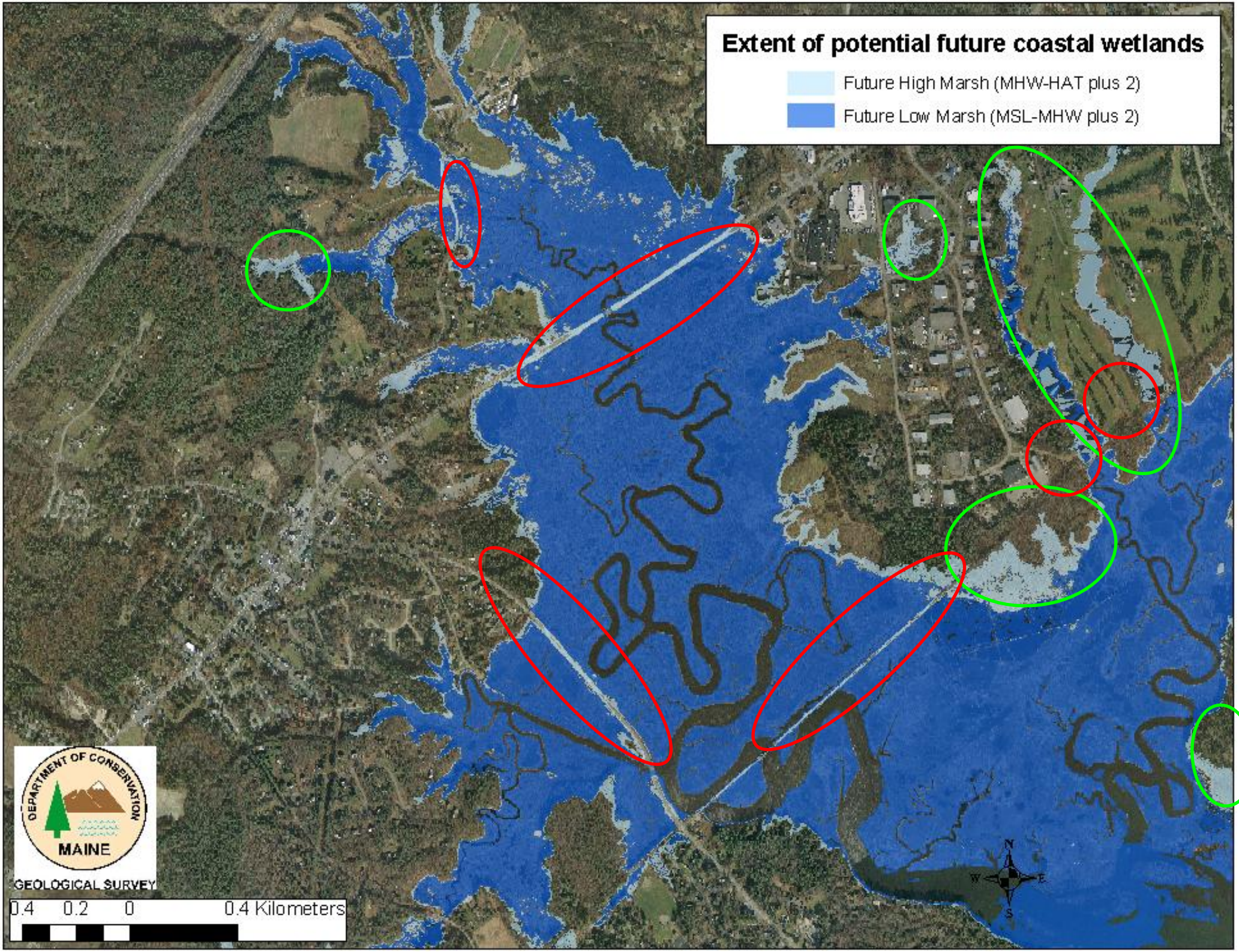
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DEPARTMENT OF CONSERVATION
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0.4 0.2 0 0.4 Kilometers
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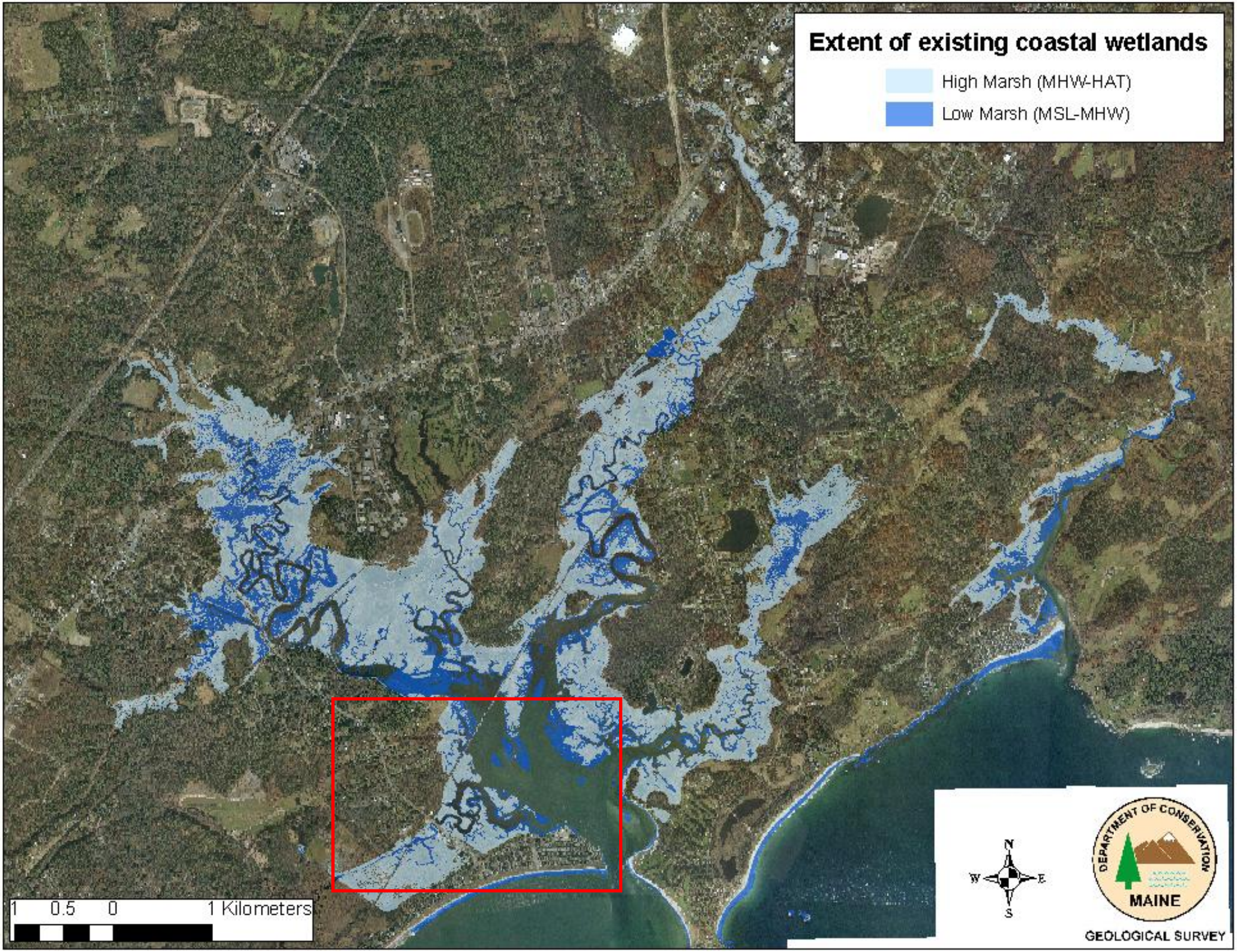
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1 0.5 0 1 Kilometers
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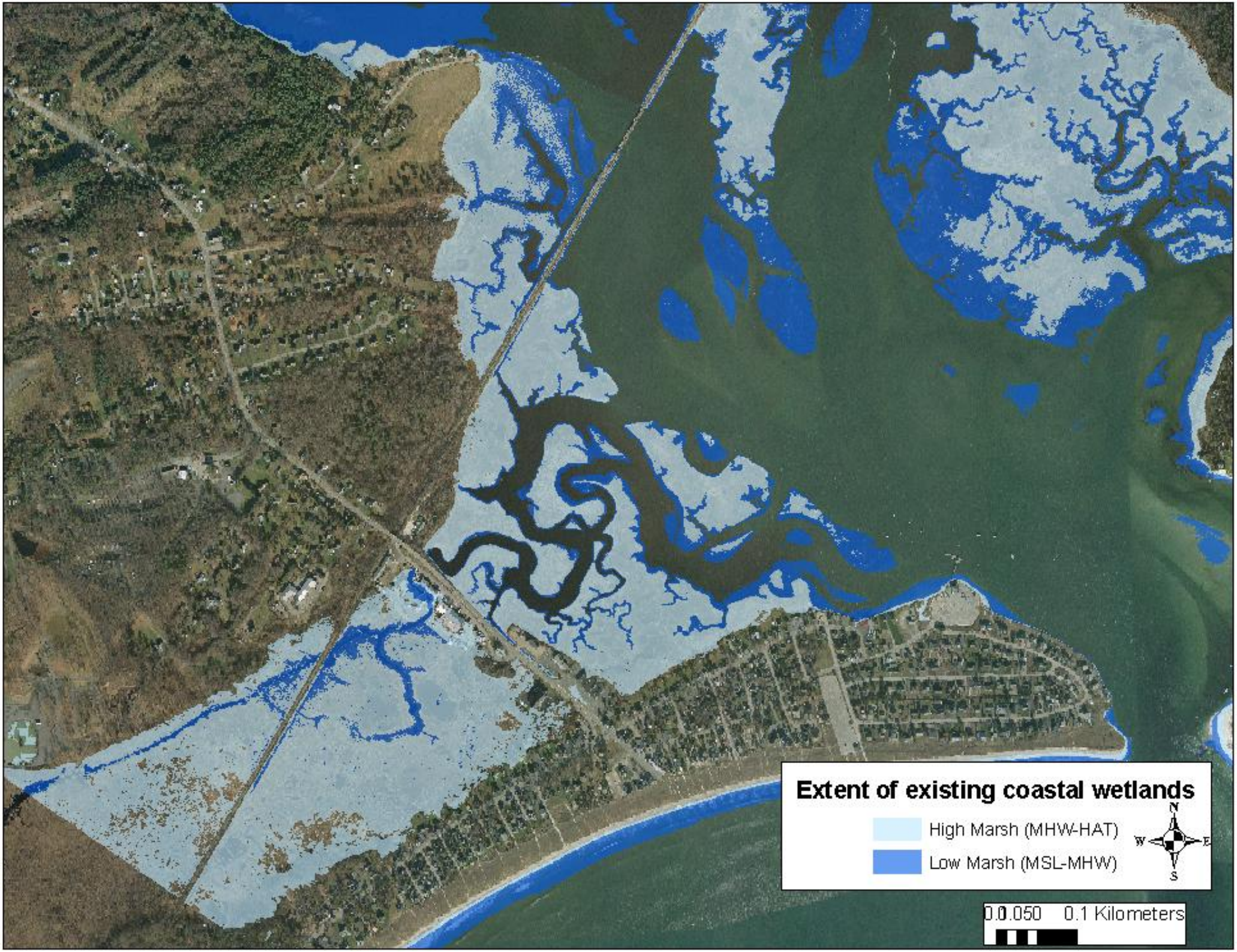
Extent of existing coastal wetlands
High Marsh (MHW-HAT)
Low Marsh (MSL-MHW)
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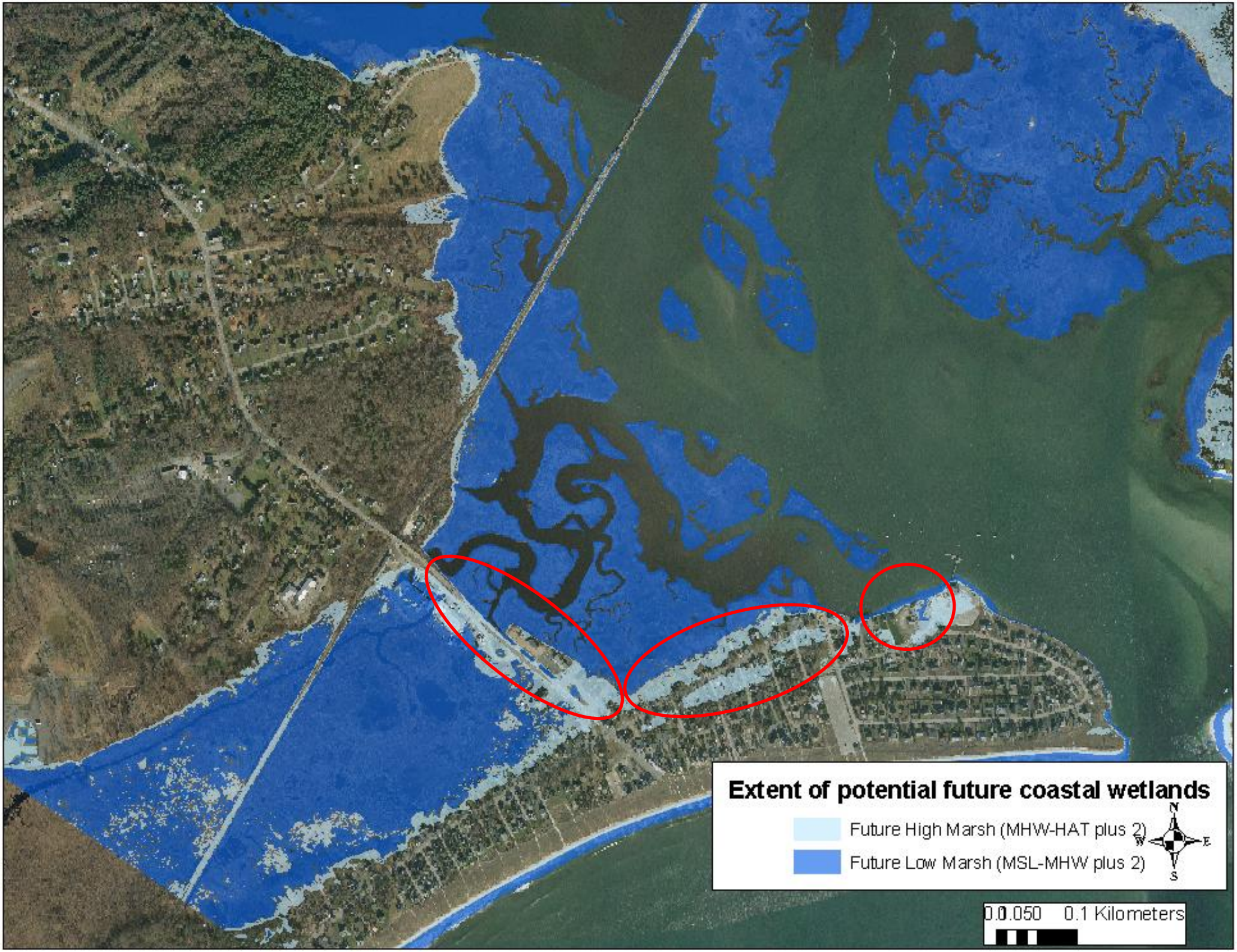
0.0.050 0.1 Kilometers


Extent of potential future coastal wetlands
Future High Marsh (MHW-HAT plus 2)
Future Low Marsh (MSL-MHW plus 2)
N
W
E
S
0.0.050 0.1 Kilometers

Conclusions on Coastal Wetlands

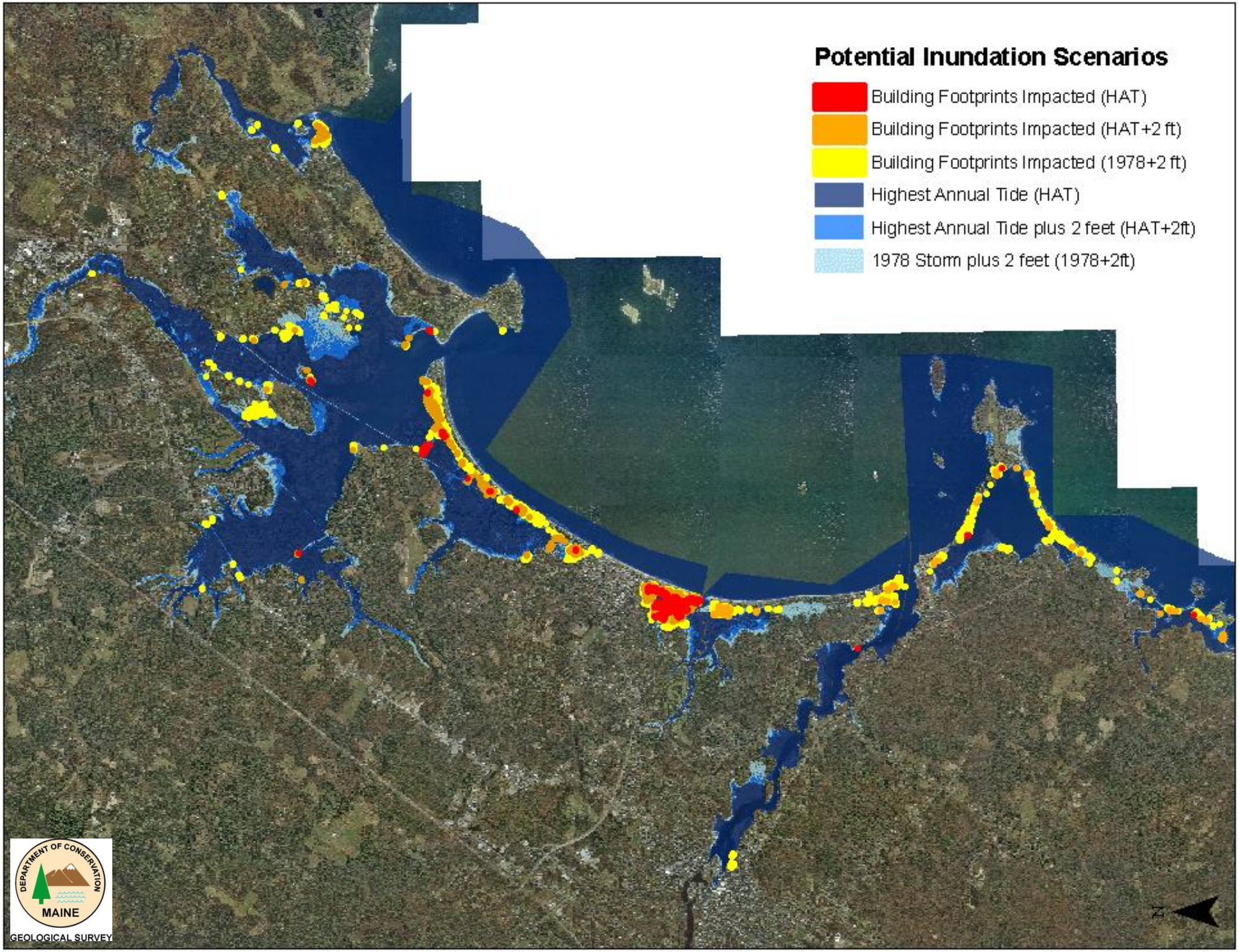
The Bay is currently dominated by high marsh (63%) as opposed to low marsh (37%).

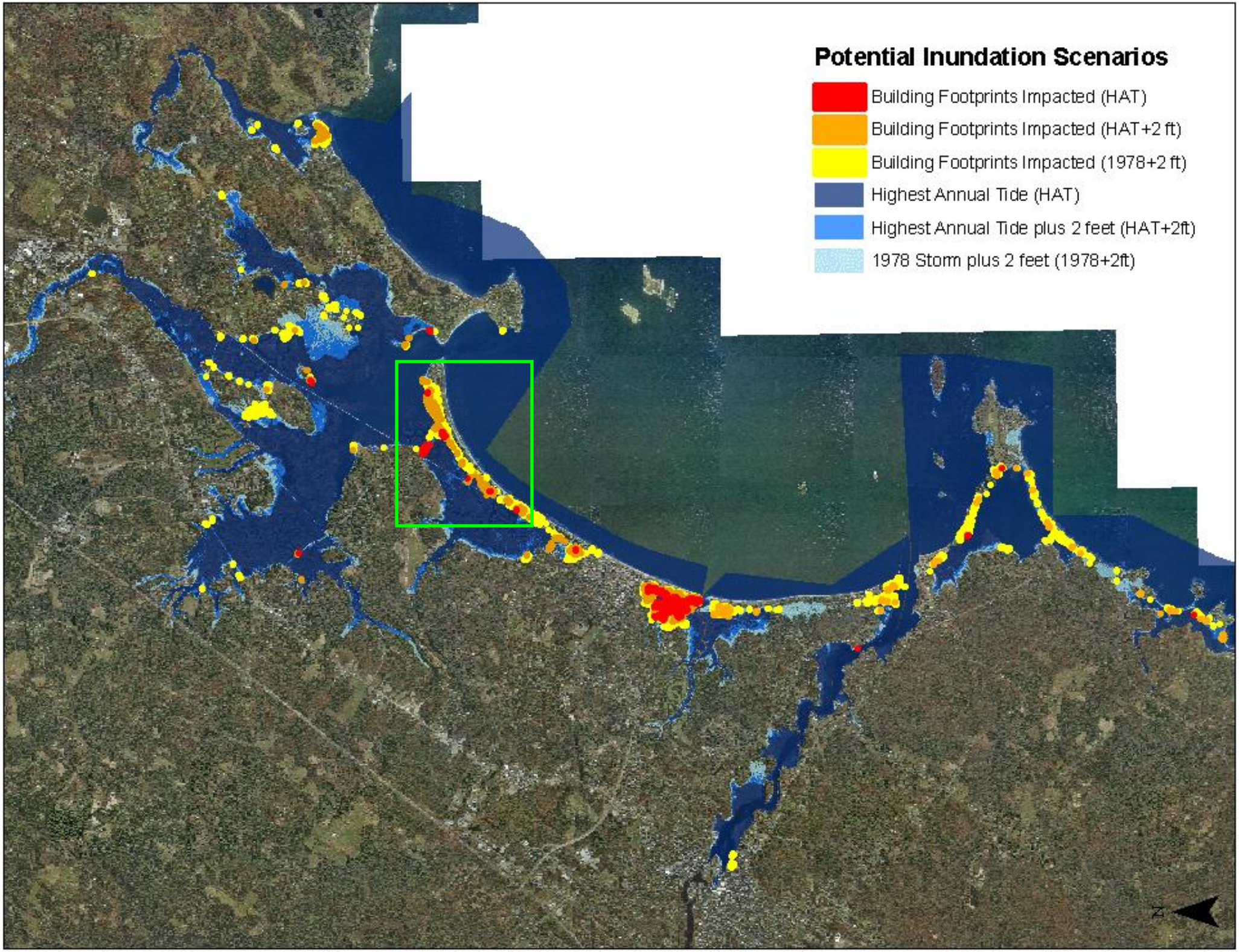
Existing high marsh is <u>at capacity;</u> there is little room to move inland in response to sea level rise due to steeper sloped or developed uplands.

There may be a significant change in the makeup of the marsh in response to 2 feet of sea level rise. High marsh may decrease (to <20% of the marsh area), while the low marsh may significantly increase (to >80% of marsh area), while a certain acreage of existing marsh will be lost to open water conversion.

Estimates do not account for erosion or sedimentation and assume static topography.

Potential Impacts to Buildings


Potential Inundation Scenarios
Building Footprints Impacted (HAT)
Building Footprints Impacted (HAT+2 ft)
Building Footprints Impacted (1978+2 ft)
Highest Annual Tide (HAT)
Highest Annual Tide plus 2 feet (HAT+2ft)
1978 Storm plus 2 feet (1978+2ft)
DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY
N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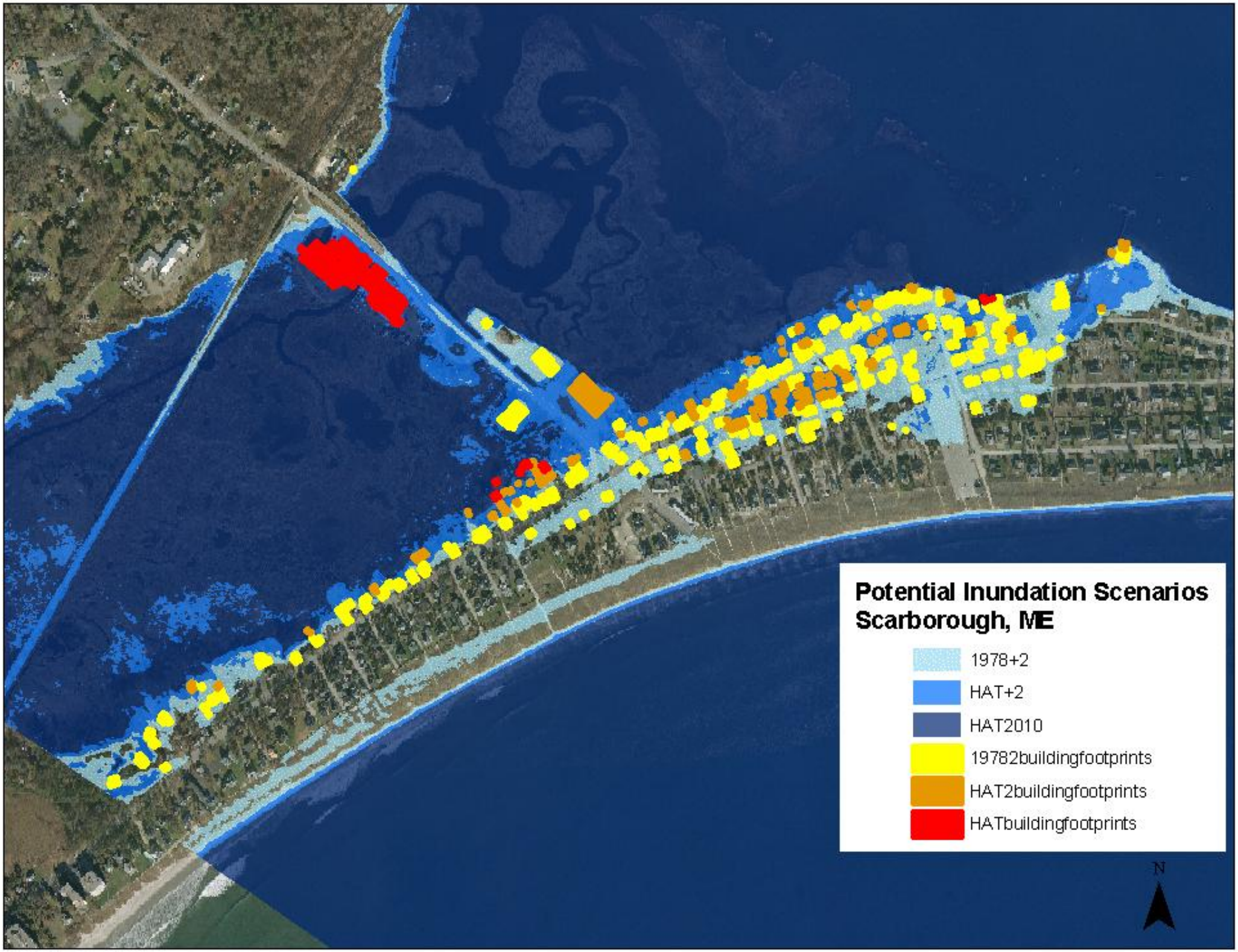
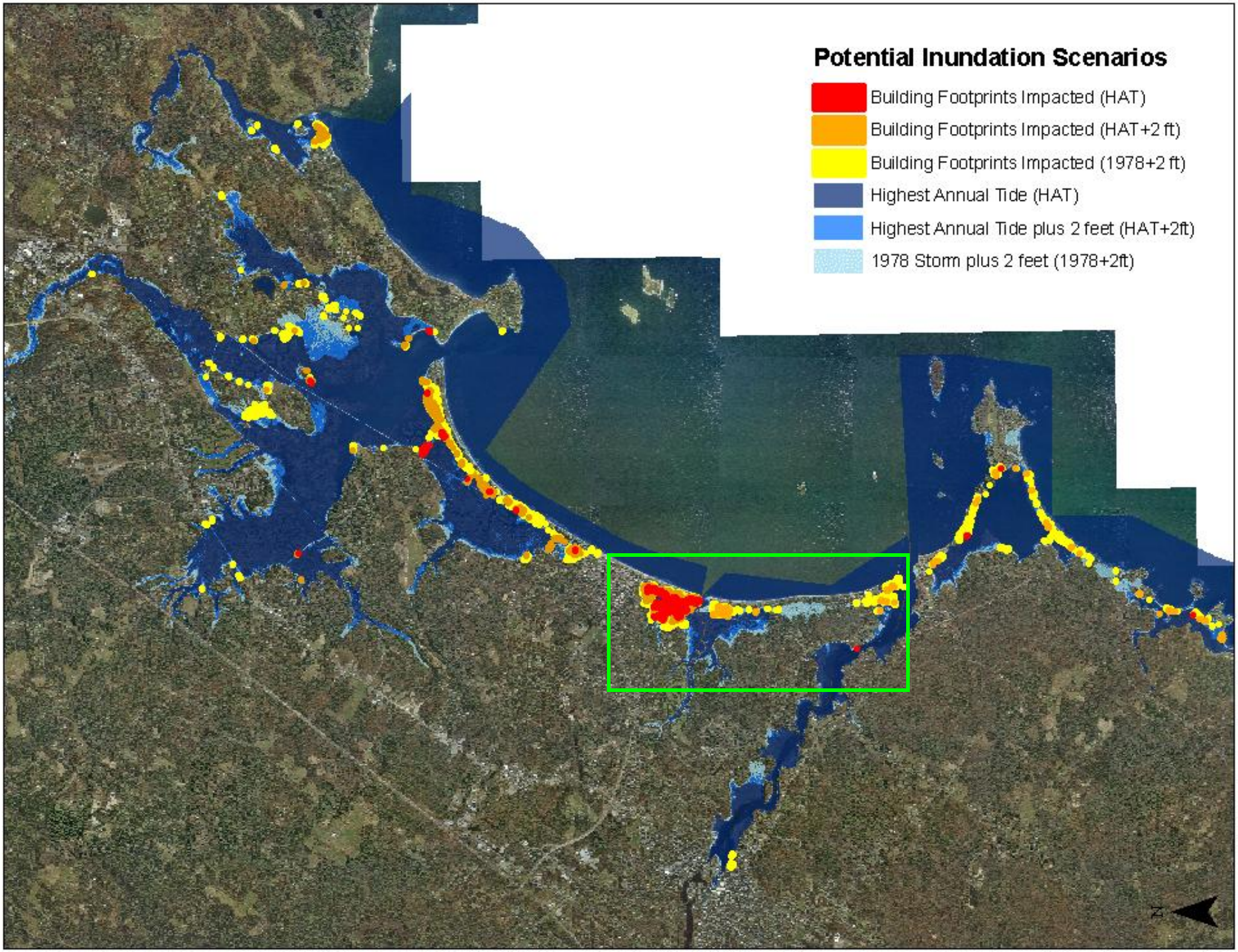
1978 Storm plus 2 feet (1978+2ft)
N


Potential Inundation Scenarios
Scarborough, ME
1978+2
HAT+2
HAT2010
19782buildingfootprints
HAT2buildingfootprints
HATbuildingfootprints
N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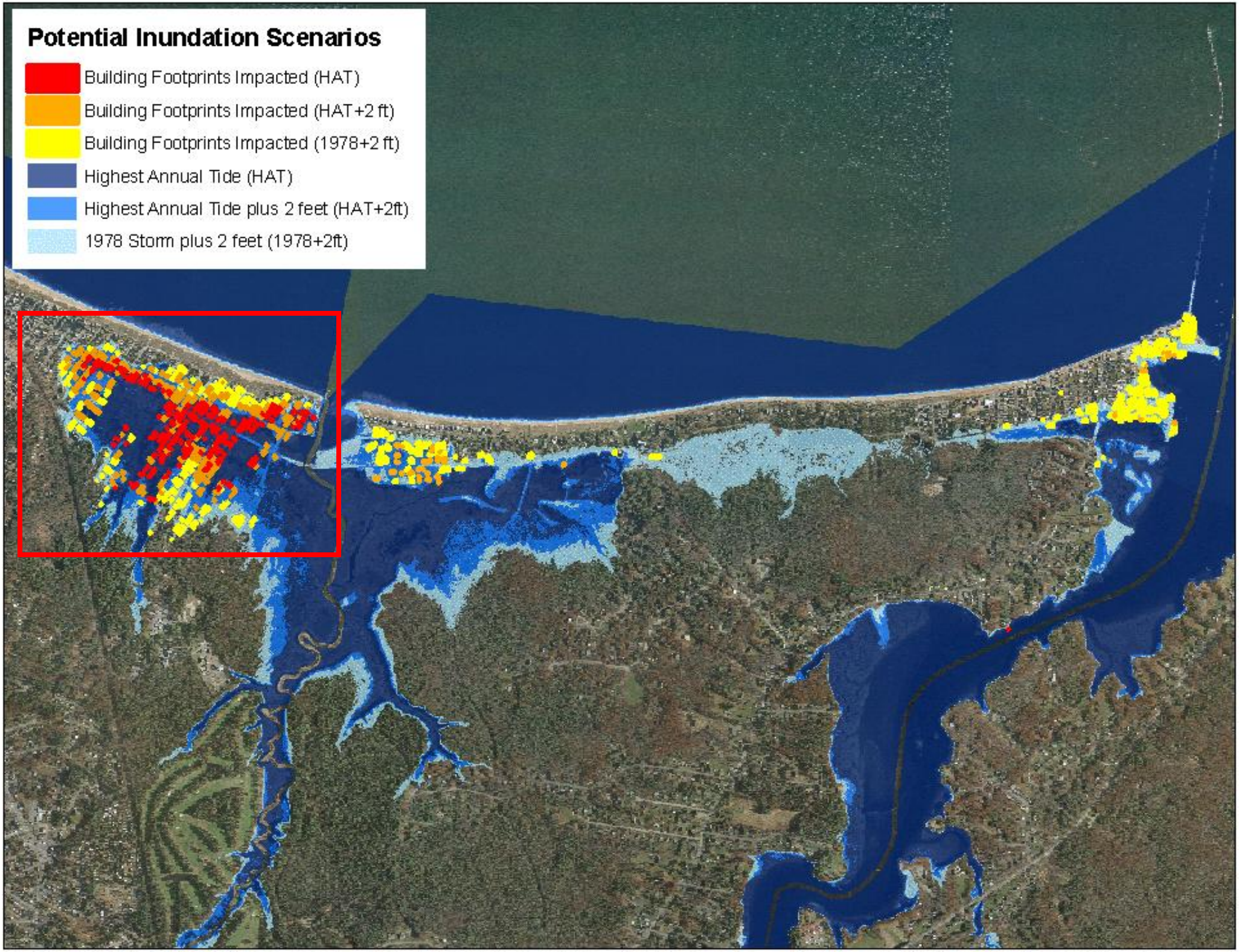
1978 Storm plus 2 feet (1978+2ft)
N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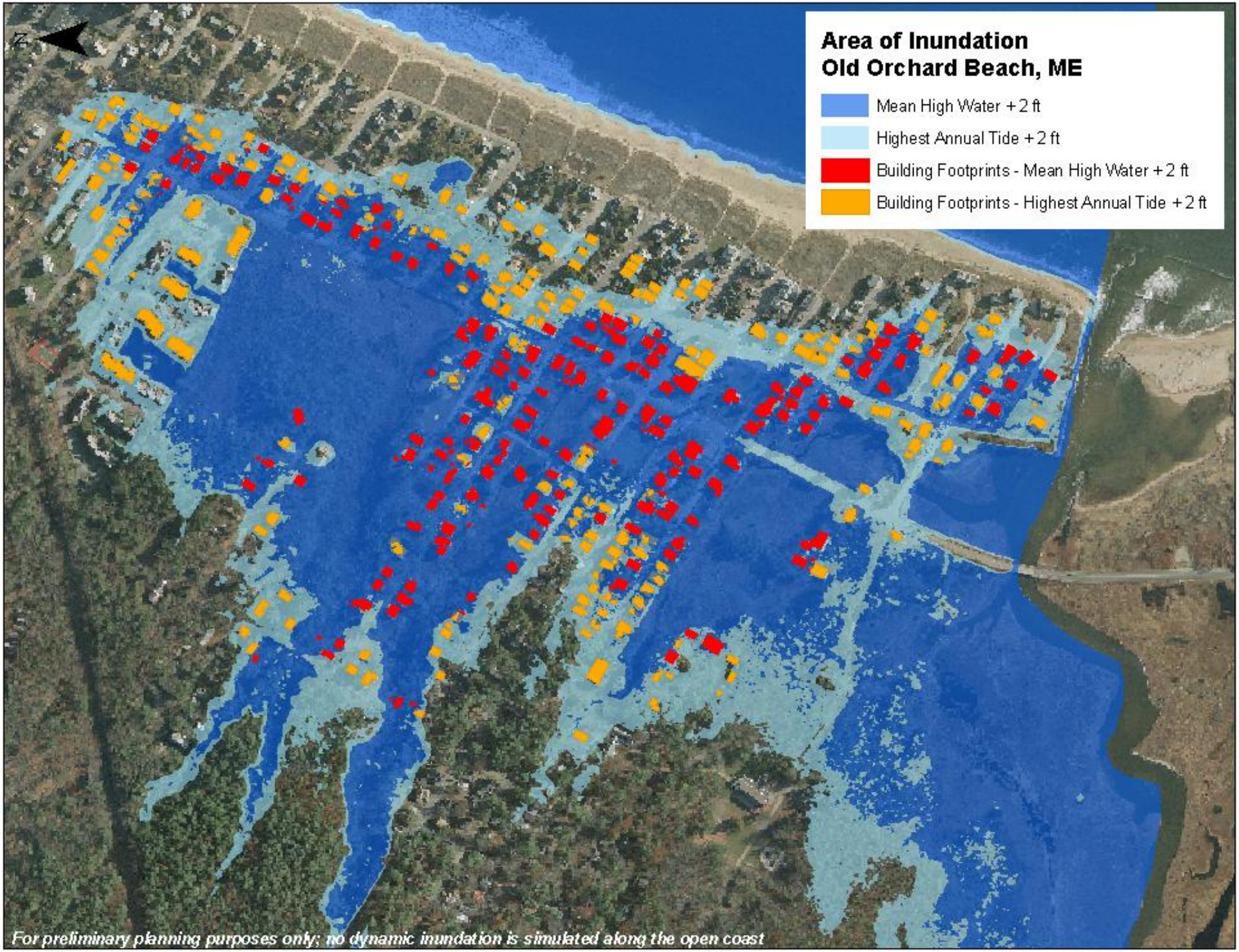
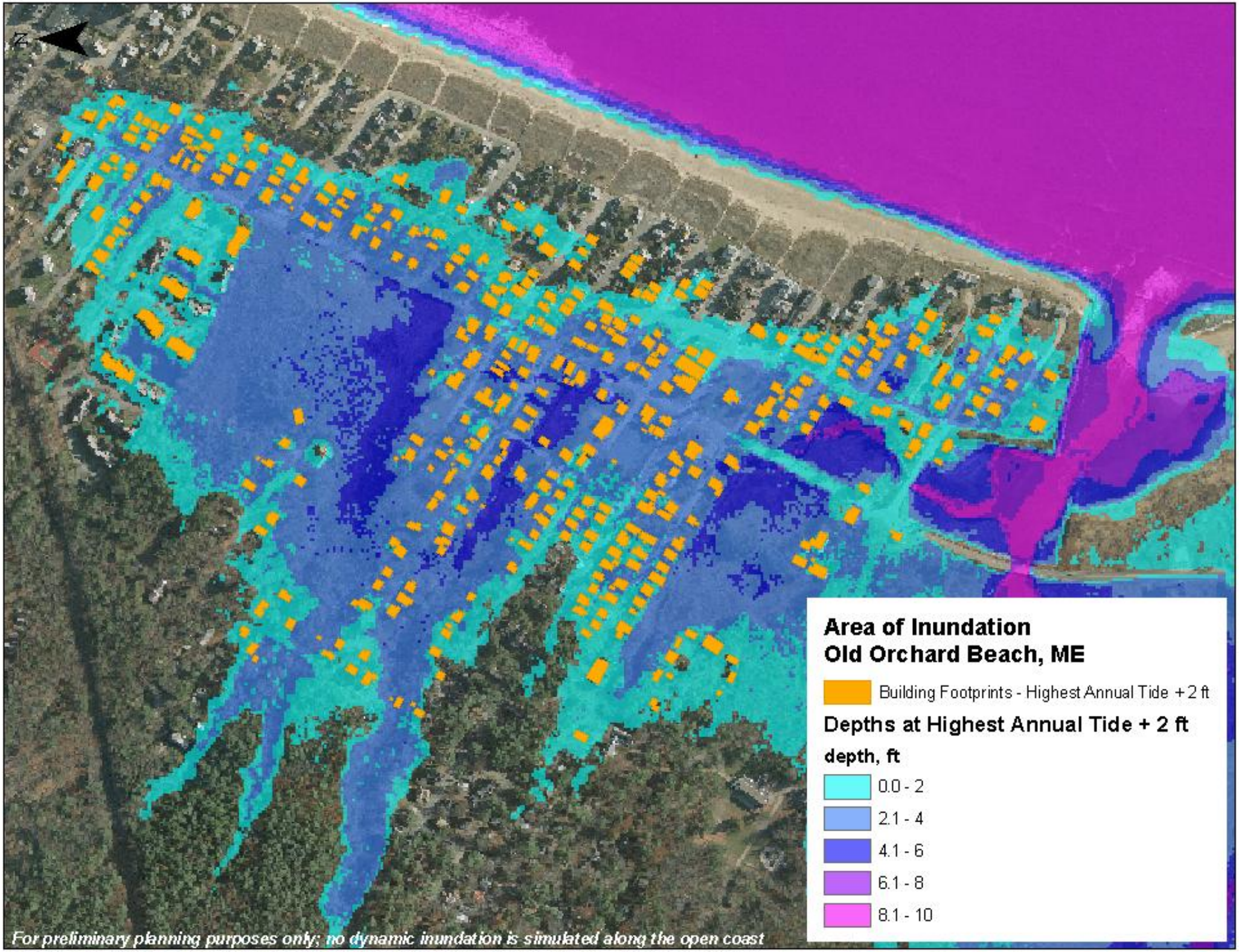
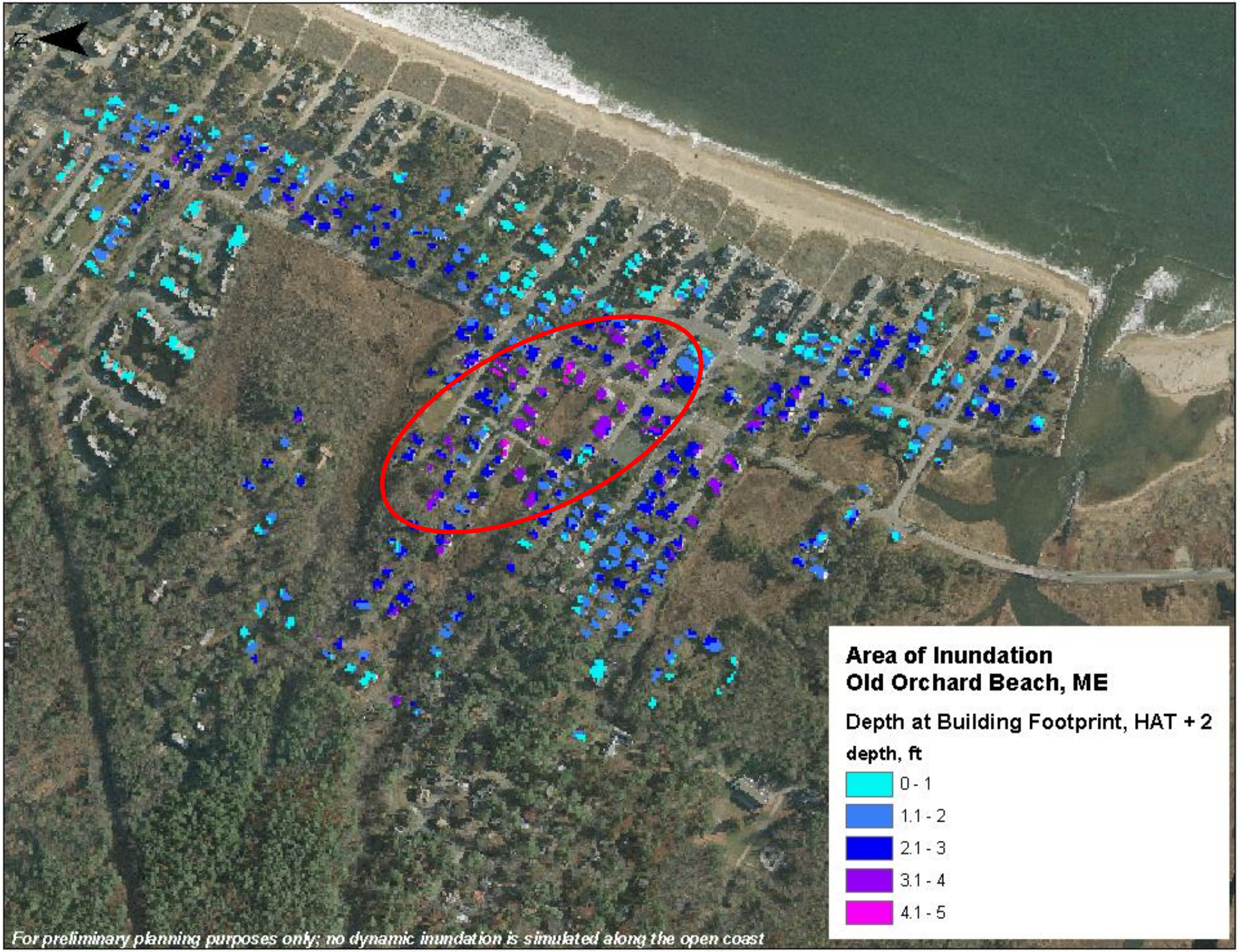
Highest Annual Tide plus 2 feet (HAT+2ft)
1978 Storm plus 2 feet (1978+2ft)


Area of Inundation
Old Orchard Beach, ME
Mean High Water + 2 ft
Highest Annual Tide + 2 ft
Building Footprints - Mean High Water + 2 ft
Building Footprints - Highest Annual Tide + 2 ft
N
For preliminary planning purposes only; no dynamic inundation is simulated along the open coast


N
Area of Inundation
Old Orchard Beach, ME
Building Footprints - Highest Annual Tide + 2 ft
Depths at Highest Annual Tide + 2 ft
depth, ft
0.0 - 2
2.1 - 4
4.1 - 6
6.1 - 8
8.1 - 10
For preliminary planning purposes only; no dynamic inundation is simulated along the open coast


N
Area of Inundation
Old Orchard Beach, ME
Depth at Building Footprint, HAT + 2
depth, ft
0 - 1
1.1 - 2
2.1 - 3
3.1 - 4
4.1 - 5
For preliminary planning purposes only; no dynamic inundation is simulated along the open coast

Conclusions on Buildings

In Saco Bay as a whole…

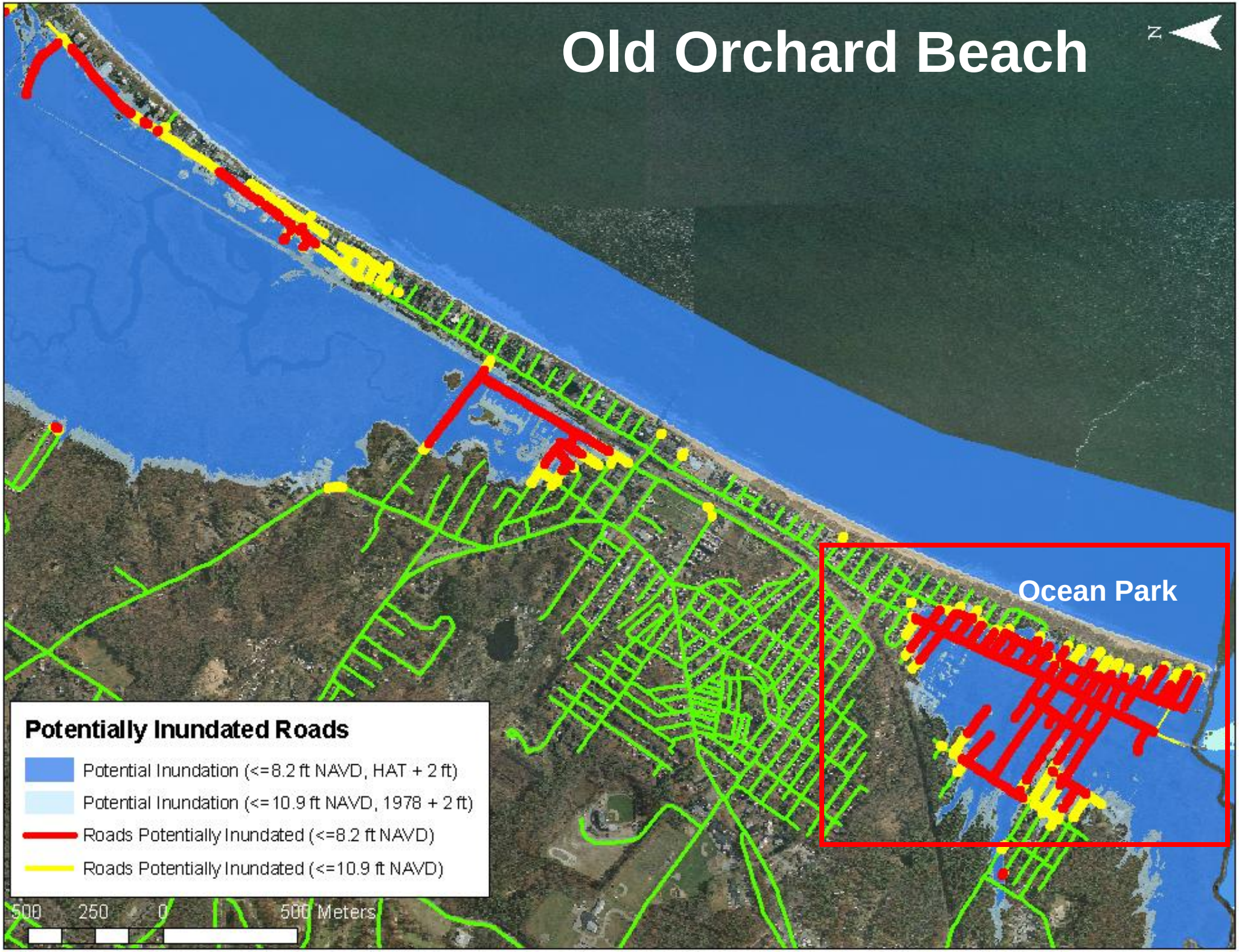
Over <u>1,220 building footprints and associated land, with a value of over $397M</u>, will be potentially vulnerable to inundation at higher high tides after a 2 foot rise in sea level.

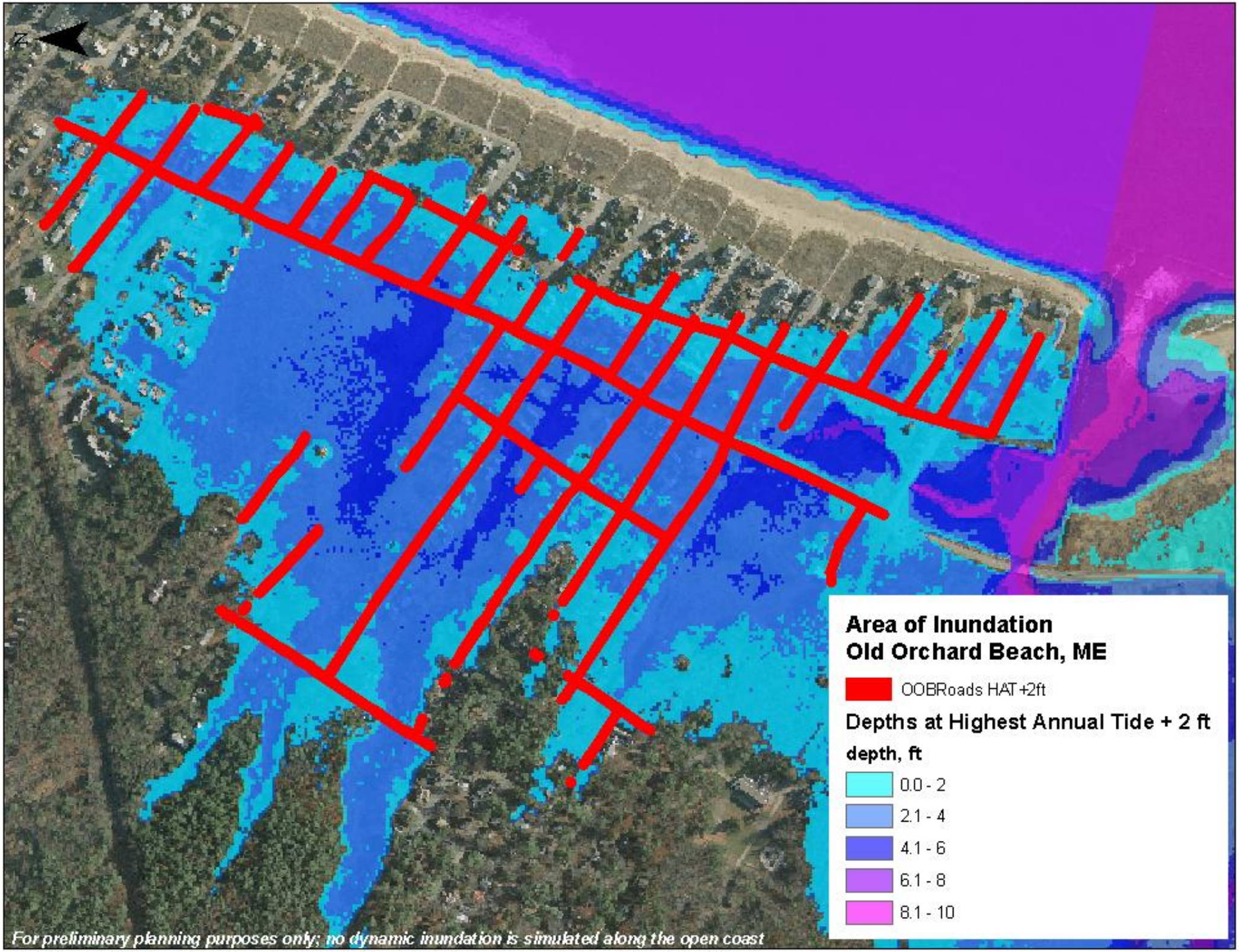
<u>Over 2,400 building footprints and associated land, with a value of over $1B</u> (including along the open coast), will be potentially vulnerable to inundation and erosion in a 100 year storm after a 2 foot rise in sea level.

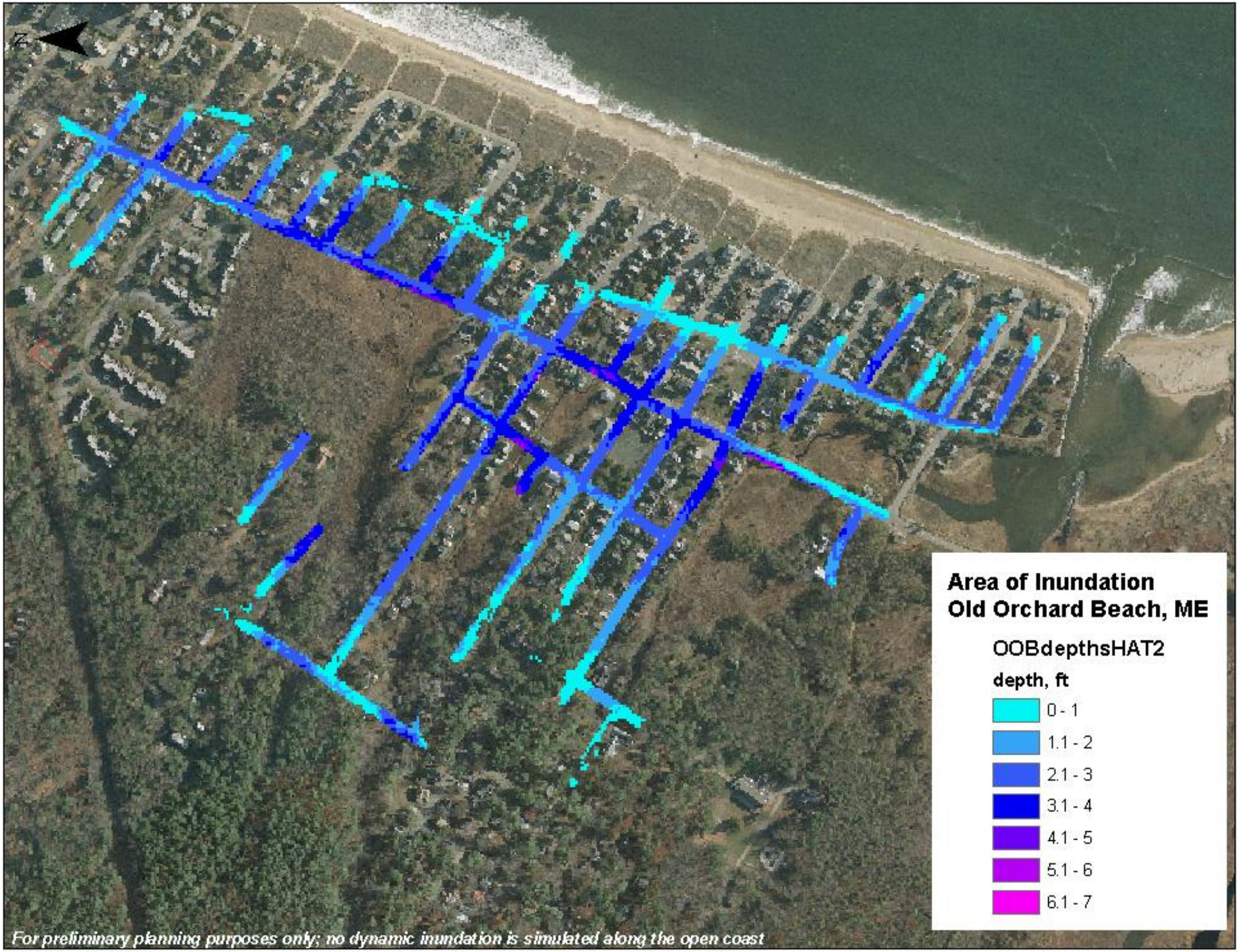
These estimates do not include road or other public infrastructure and do not account for dynamic wave processes on the open coast.

Potential Impacts to Road Infrastructure

Bill Edwards


Old Orchard Beach
N
Ocean Park
Potentially Inundated Roads
Potential Inundation (<=8.2 ft NAVD, HAT + 2 ft)
Potential Inundation (<=10.9 ft NAVD, 1978 + 2 ft)
Roads Potentially Inundated (<=8.2 ft NAVD)
Roads Potentially Inundated (<=10.9 ft NAVD)
500 250 0 500 Meters


N
Area of Inundation
Old Orchard Beach, ME
OOBRoads HAT+2ft
Depths at Highest Annual Tide + 2 ft
depth, ft
0.0 - 2
2.1 - 4
4.1 - 6
6.1 - 8
8.1 - 10
For preliminary planning purposes only; no dynamic inundation is simulated along the open coast


N
Area of Inundation
Old Orchard Beach, ME
OOBdepthsHAT2
depth, ft
0 - 1
1.1 - 2
2.1 - 3
3.1 - 4
4.1 - 5
5.1 - 6
6.1 - 7
For preliminary planning purposes only; no dynamic inundation is simulated along the open coast

The Latest and Greatest…

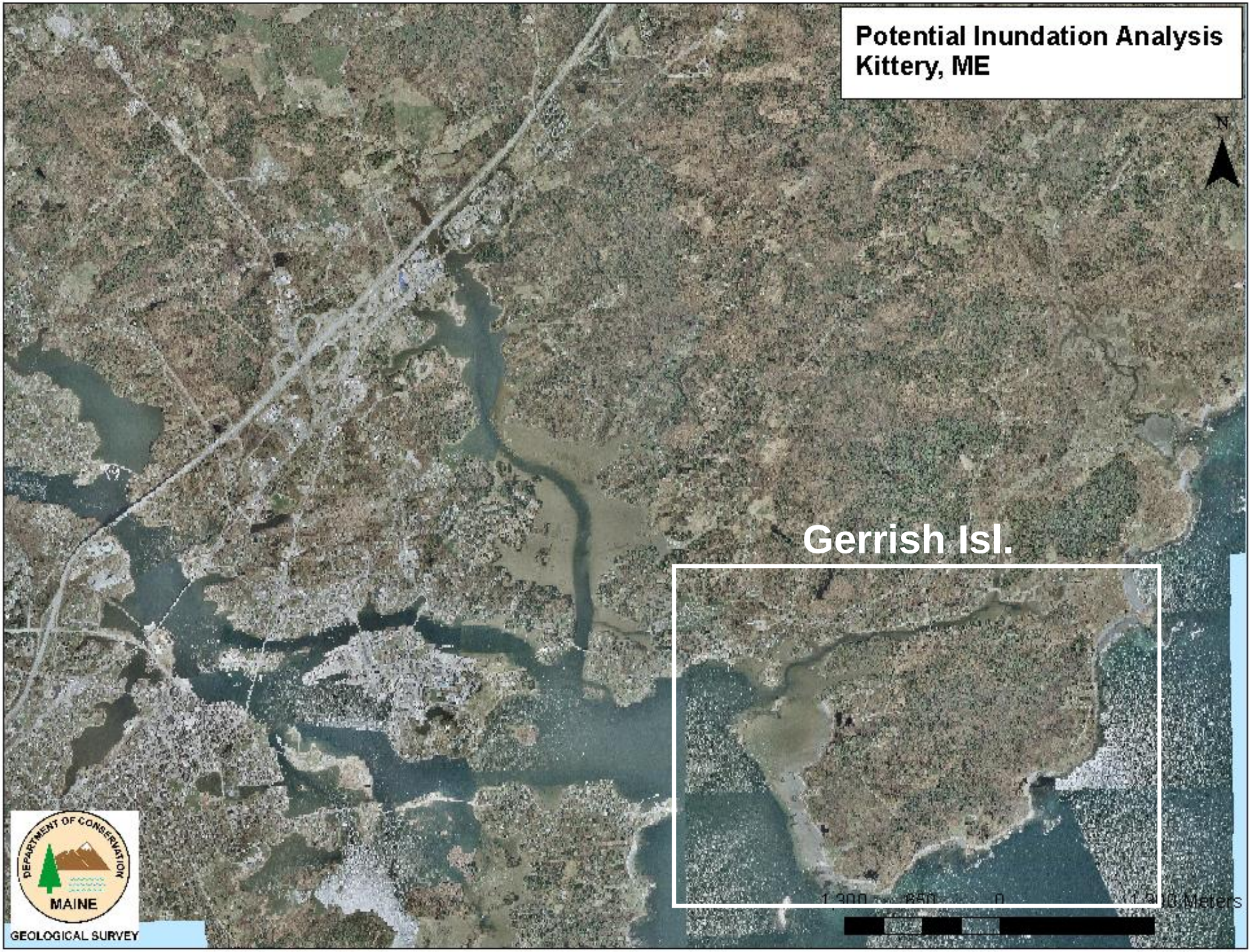
Communities Engaged…York, Kennebunk, Ogunquit

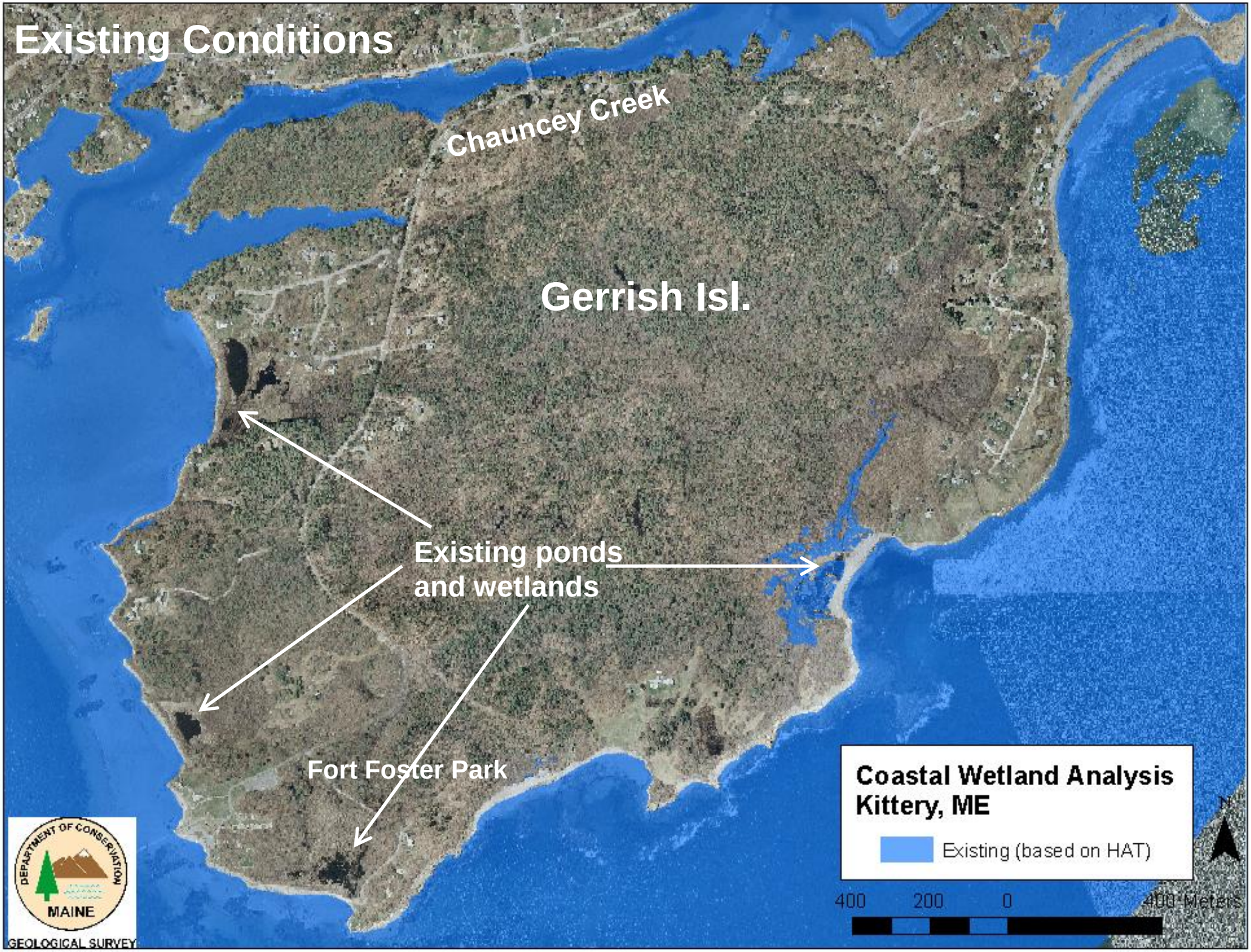
Latest Coastal Hazard Resiliency Tools Project expansion…Kittery

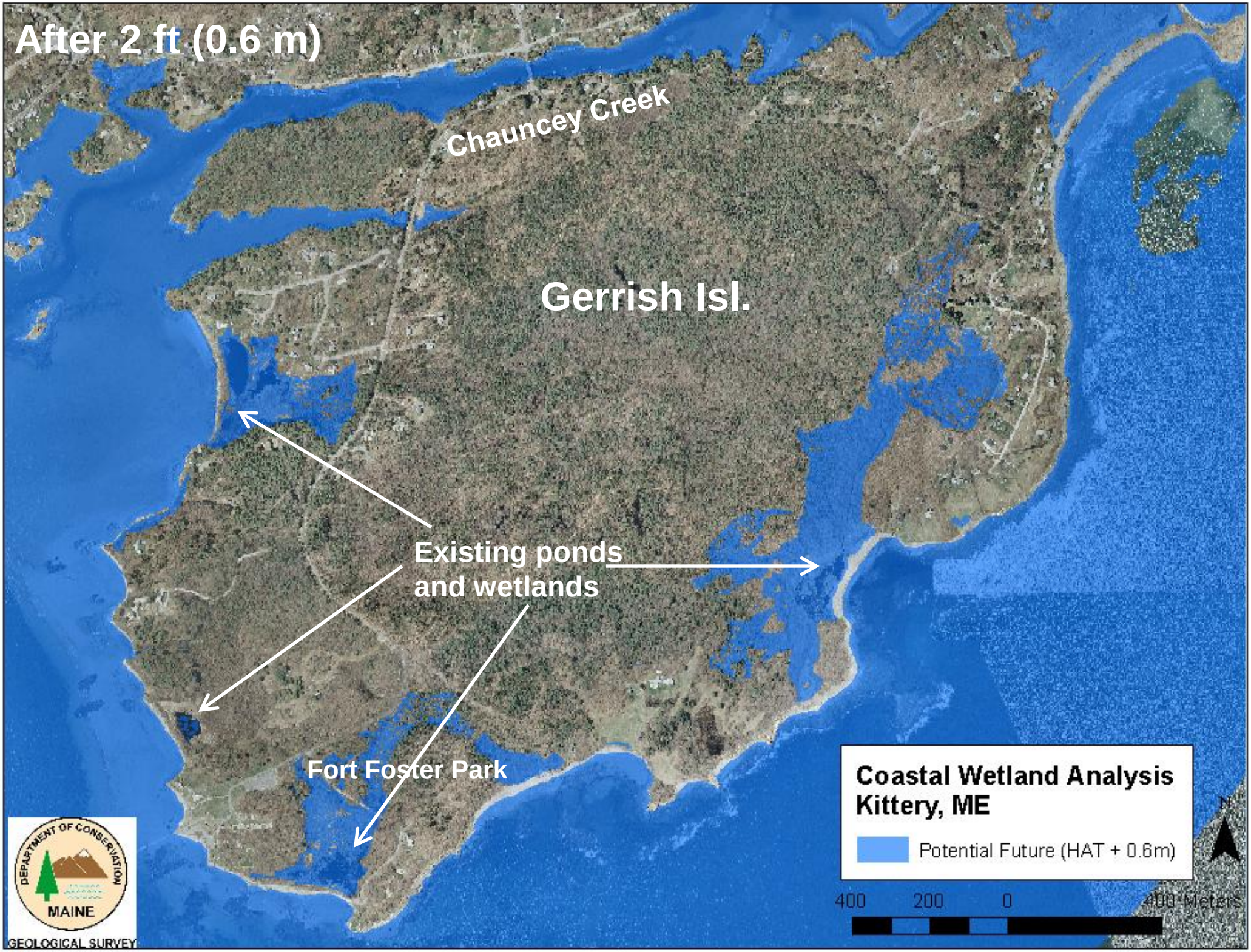
Soon to involve…Greater Portland Area.

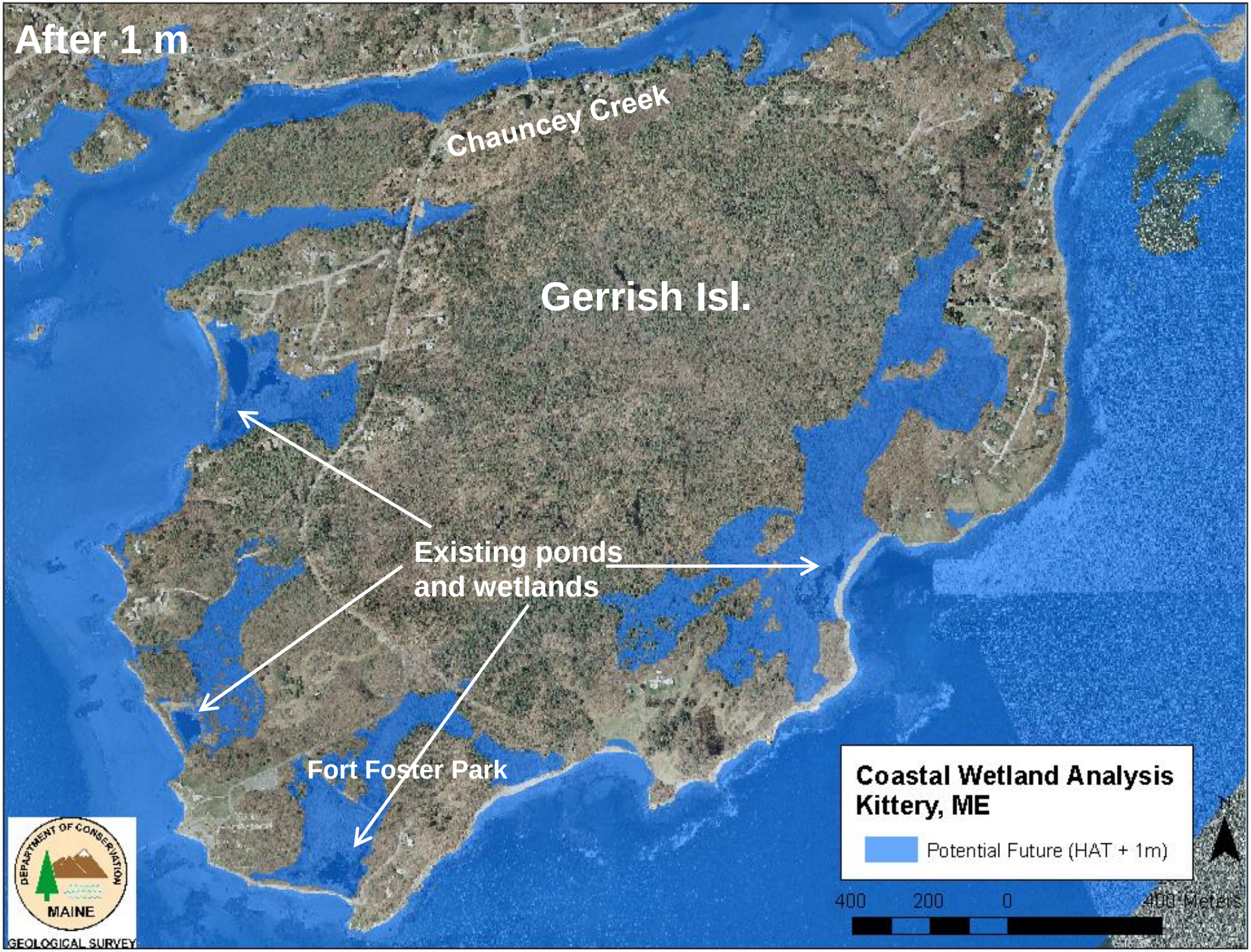
Kittery, Maine
Potential Marsh Conversion

2 feet
1 meter


Potential Inundation Analysis
Kittery, ME
N
Gerrish Isl.
1,300 650 0 1,300 Meters
DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY


Existing Conditions
Chauncey Creek
Gerrish Isl.
Existing ponds
and wetlands
Fort Foster Park
Coastal Wetland Analysis
Kittery, ME
Existing (based on HAT)
400
200
0
400 Meters
N
DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY


After 2 ft (0.6 m)
Chauncey Creek
Gerrish Isl.
Existing ponds
and wetlands
Fort Foster Park
Coastal Wetland Analysis
Kittery, ME
Potential Future (HAT + 0.6m)
400
200
0
400 Meters
N
DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY


After 1 m
Chauncey Creek
Gerrish Isl.
Existing ponds
and wetlands
Fort Foster Park
Coastal Wetland Analysis
Kittery, ME
Potential Future (HAT + 1m)
400
200
0
400 Meters
N
DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY

Assessing Impacts due to Inundation

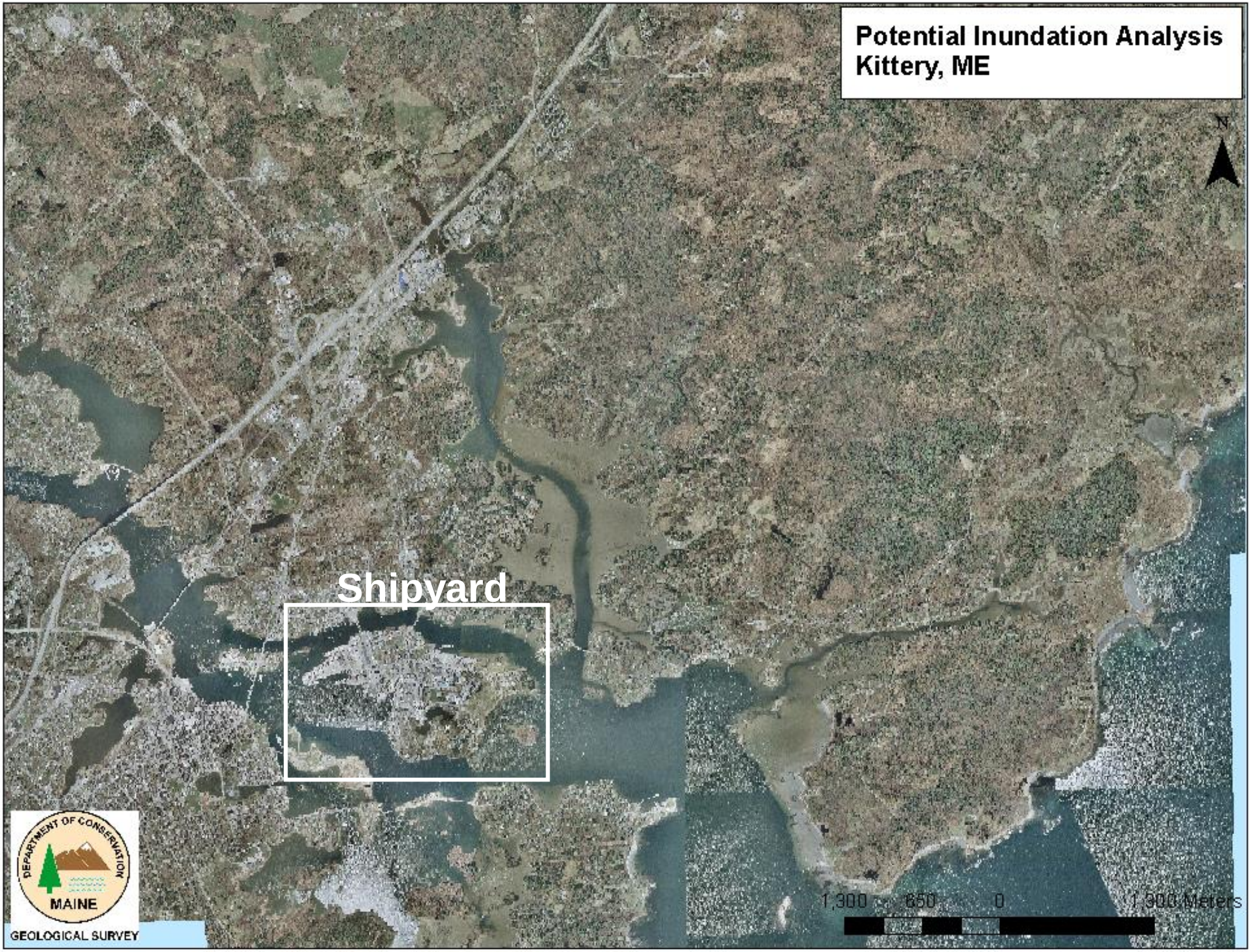
<u>"Existing" and "Future" High Tide conditions</u>

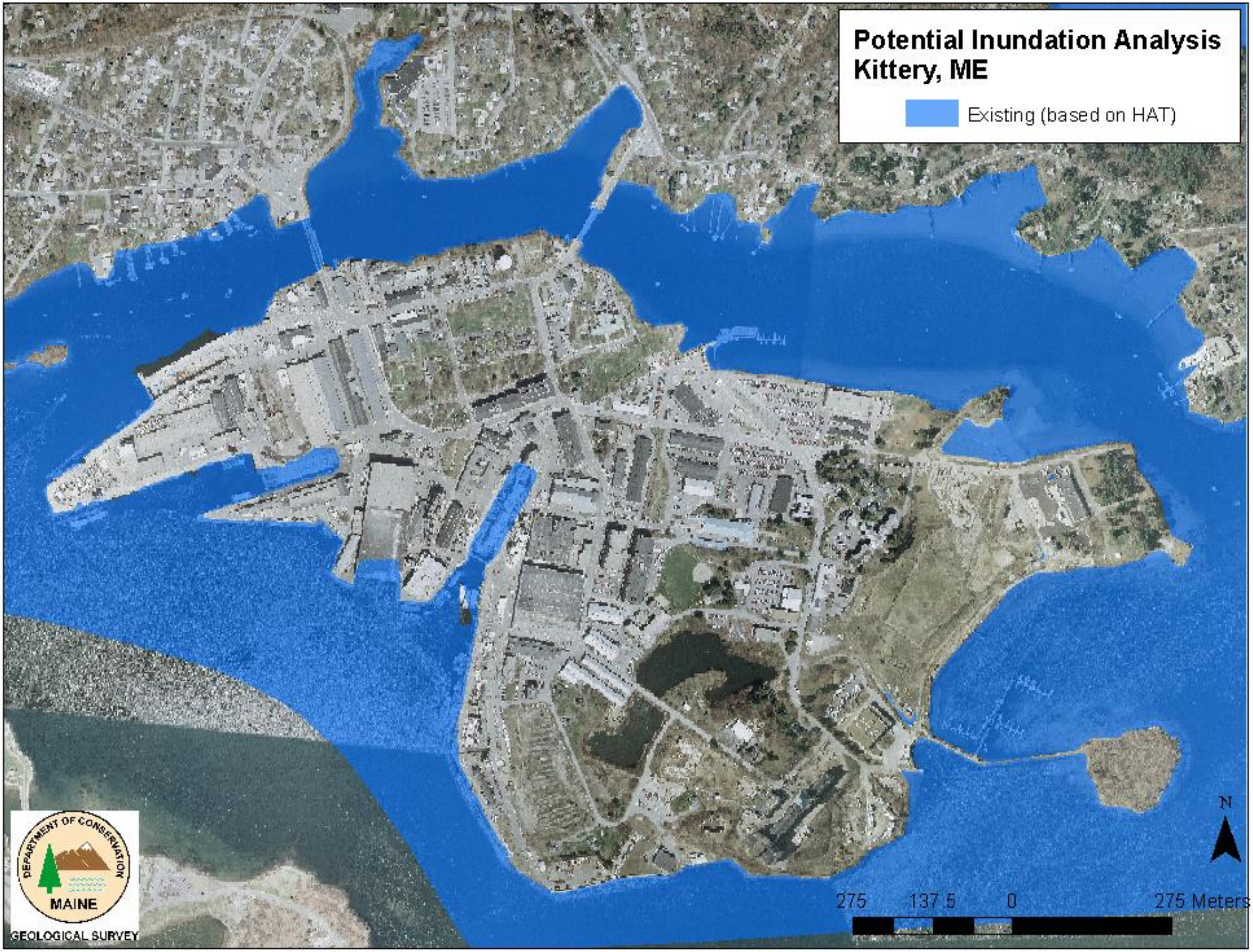
- Highest Annual Tide (6.35 ft NAVD)
- Highest Annual Tide + 0.6 m (8.35 ft NAVD)
- Highest Annual Tide + 1.0 m (9.63 ft NAVD)

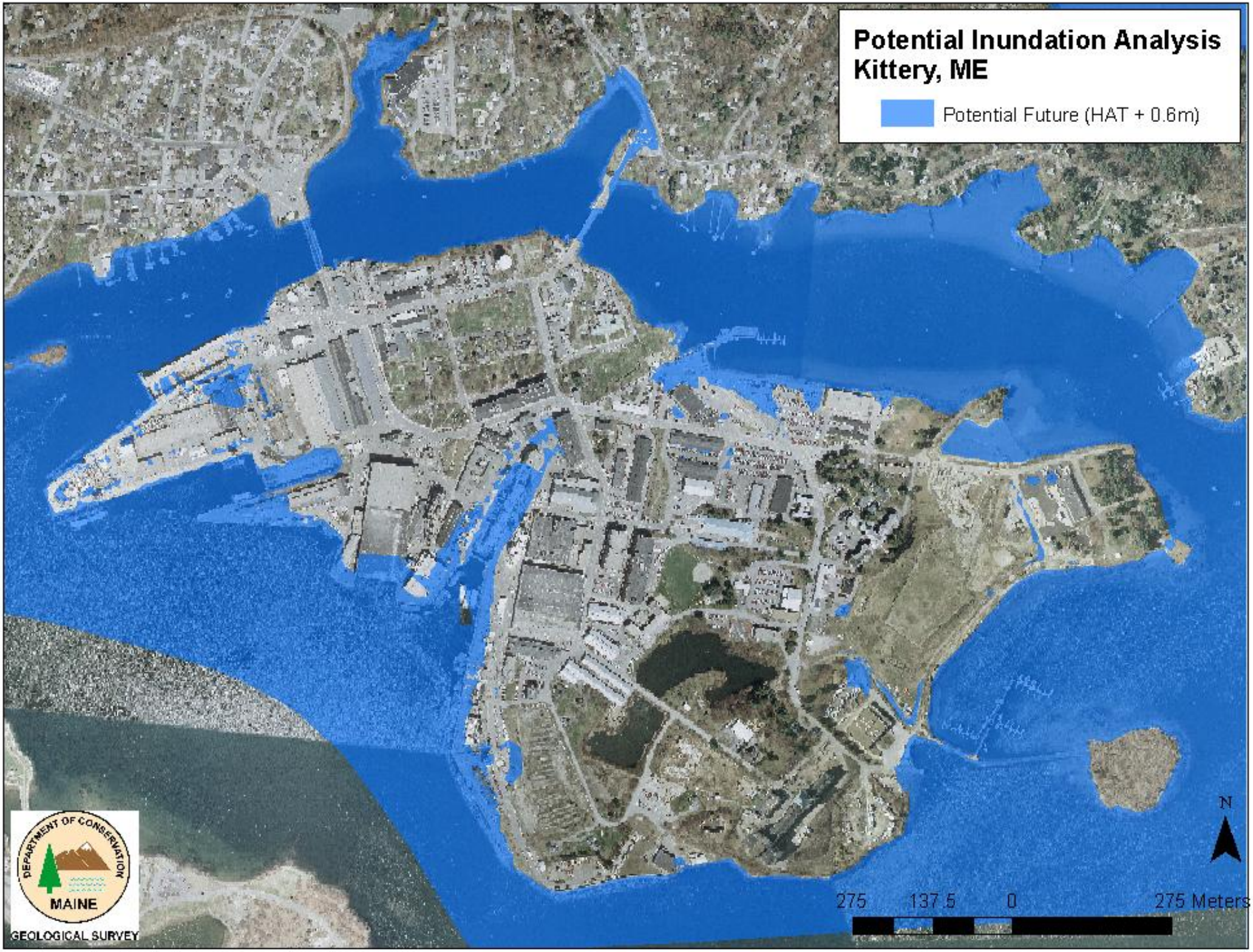
<u>"Historic" and "Future" storm stillwater conditions</u>

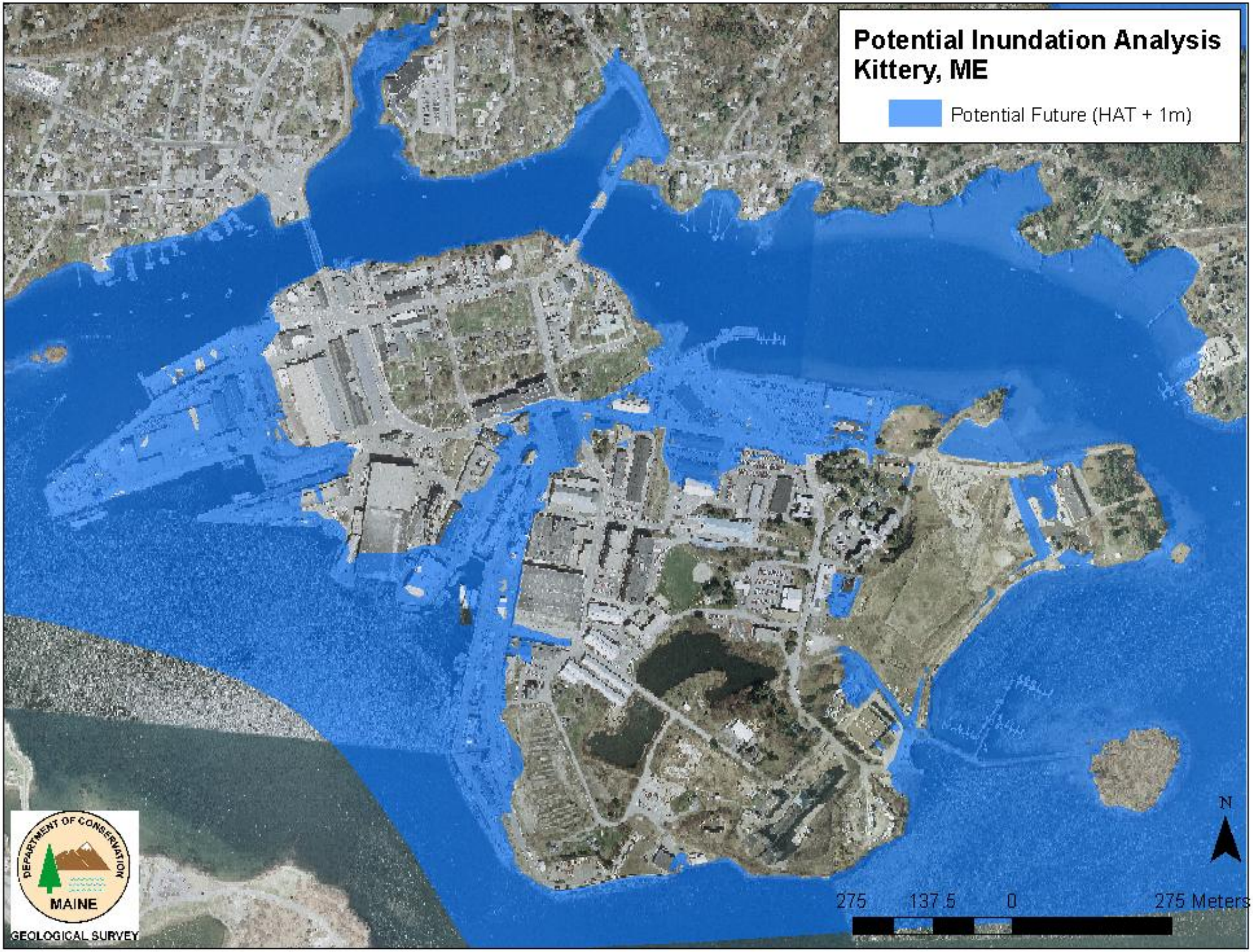
- 1978 Storm (8.90 ft NAVD)
- 1978 Sorm + 0.61 m (10.90 ft NAVD)
- 1978 Storm + 1.0 m (12.18 ft NAVD)

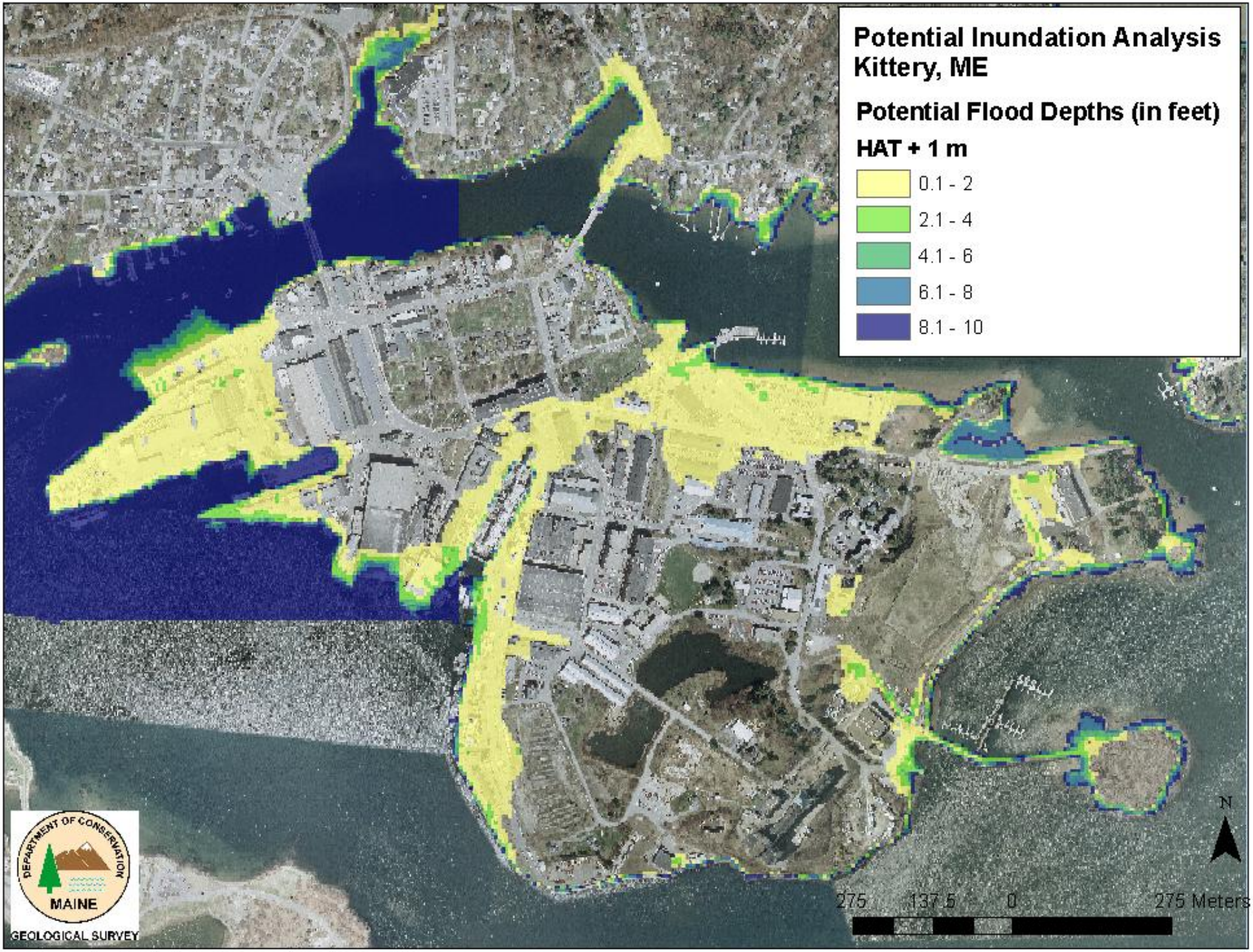
Impacts to both land and infrastructure

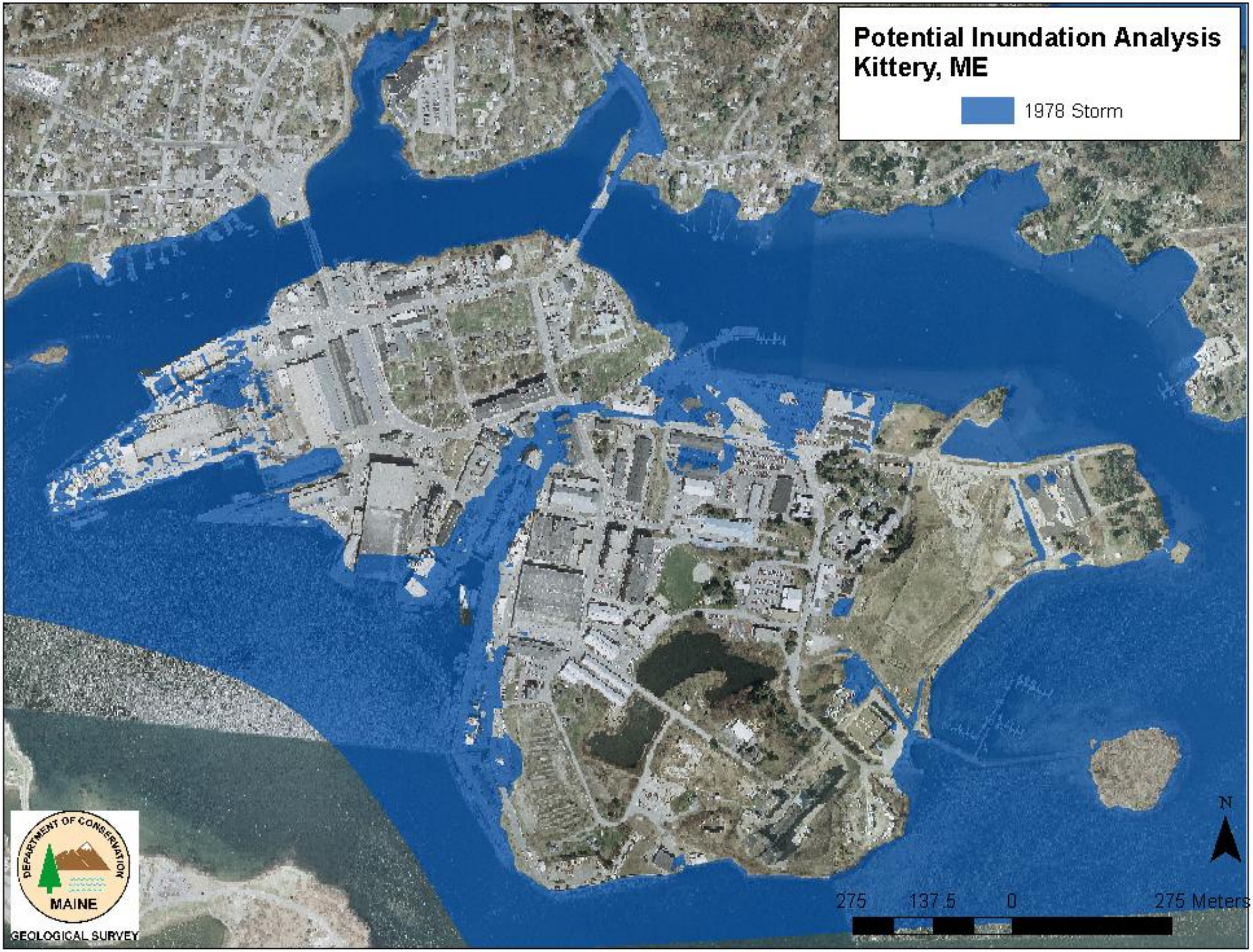

Potential Inundation Analysis
Kittery, ME
N
Shipyard
1,300
650
0
1,300 Meters
DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY

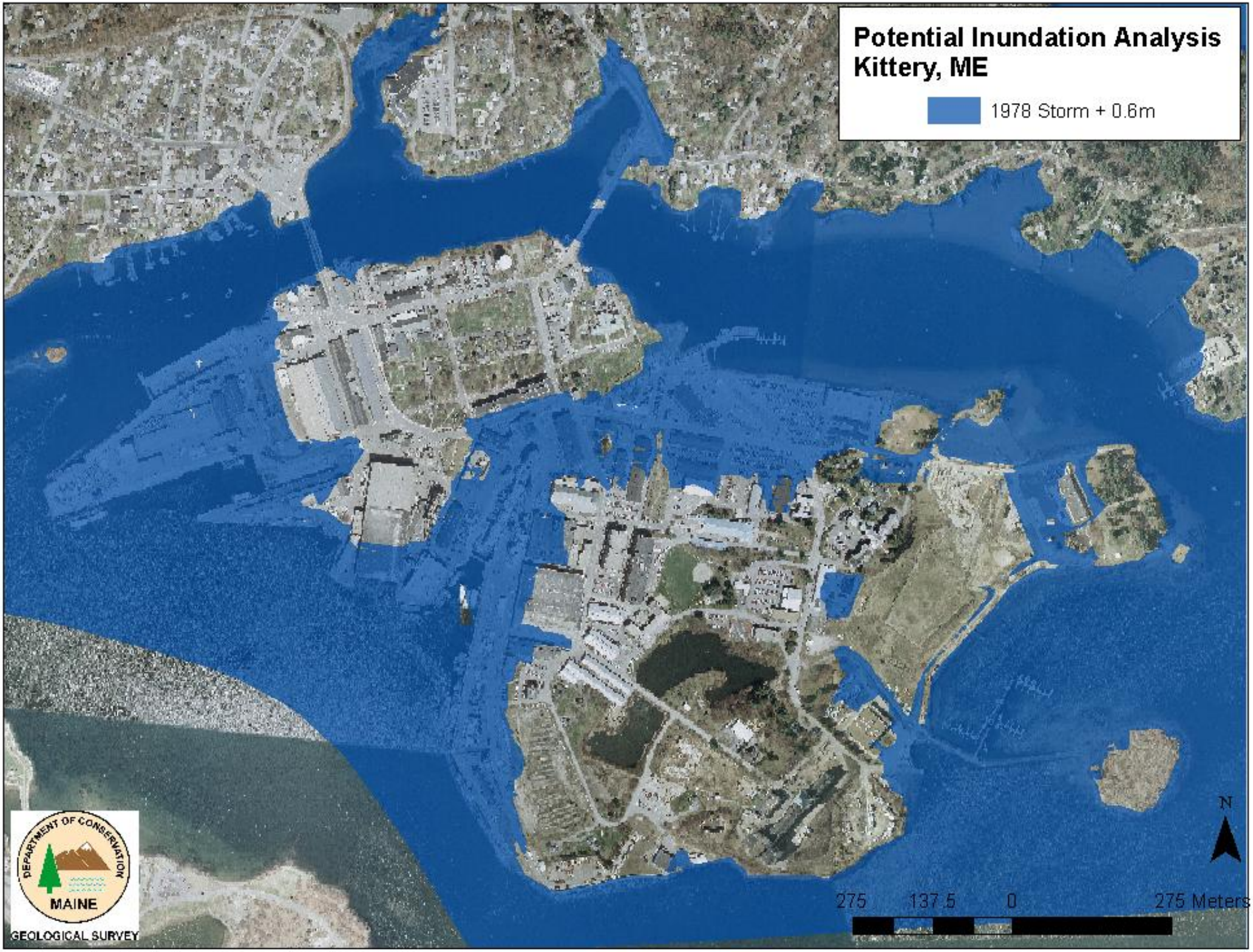

Potential Inundation Analysis
Kittery, ME
Existing (based on HAT)
N
275
137.5
0
275 Meters
DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY

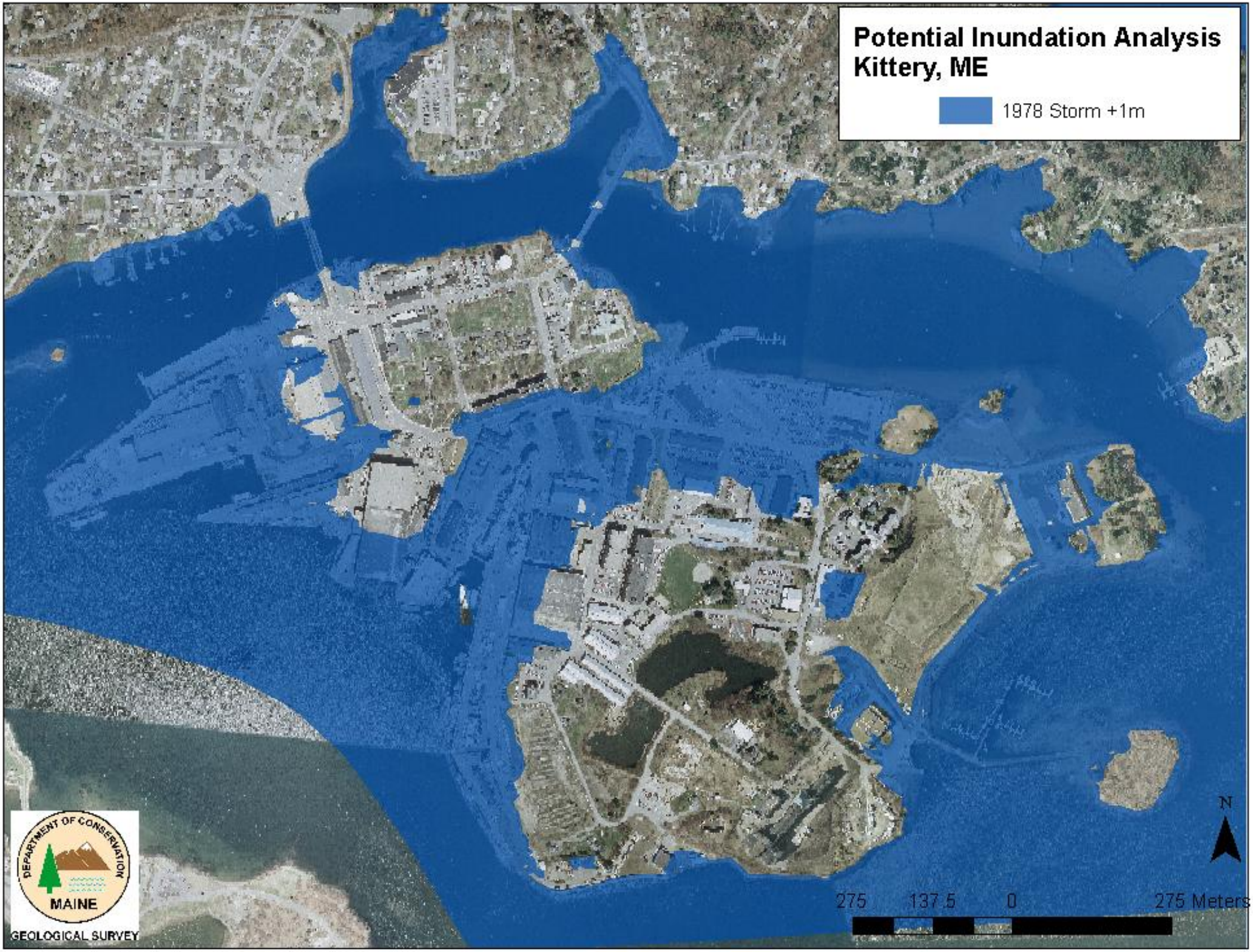

Potential Inundation Analysis
Kittery, ME
Potential Future (HAT + 0.6m)
N
275
137.5
0
275 Meters
DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY

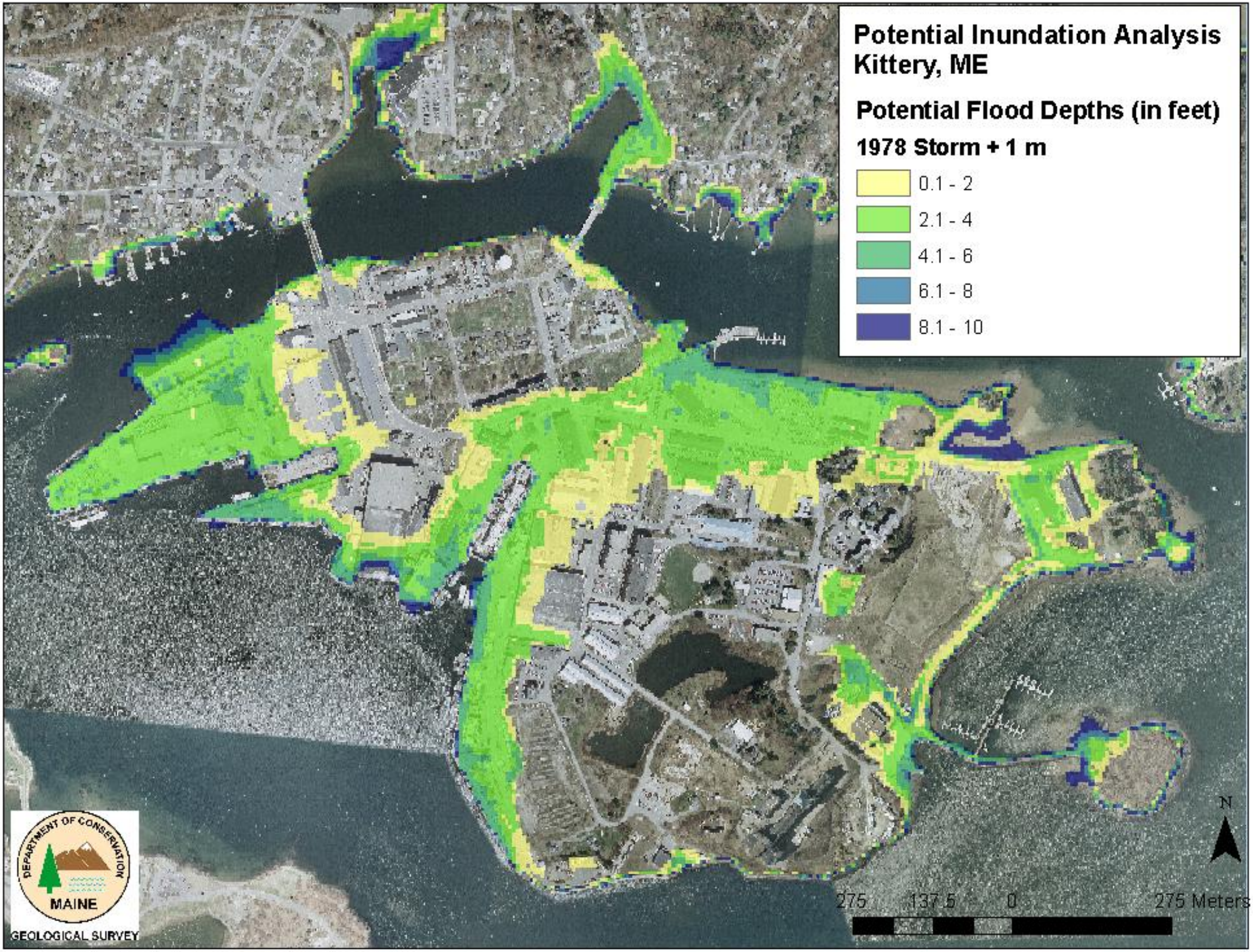

Potential Inundation Analysis
Kittery, ME
Potential Future (HAT + 1m)
N
275
137.5
0
275 Meters
DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY


Potential Inundation Analysis
Kittery, ME
Potential Flood Depths (in feet)
HAT + 1 m
0.1 - 2
2.1 - 4
4.1 - 6
6.1 - 8
8.1 - 10
N
275
137.5
0
275 Meters
DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY


Potential Inundation Analysis
Kittery, ME
1978 Storm
N
275
137.5
0
275 Meters
DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY


Potential Inundation Analysis
Kittery, ME
1978 Storm + 0.6m
N
275
137.5
0
275 Meters
DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY


Potential Inundation Analysis
Kittery, ME
1978 Storm +1m
N
275
137.5
0
275 Meters
DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY


Potential Inundation Analysis
Kittery, ME
Potential Flood Depths (in feet)
1978 Storm + 1 m
0.1 - 2
2.1 - 4
4.1 - 6
6.1 - 8
8.1 - 10
N
275
137.5
0
275 Meters
DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY

Next Steps…

The SLAWG Action Plan!

Action Plan

<u>Regulatory Changes Will Play a Role:</u>

- Existing State Programs will be adjusted– DEP Shoreland Zoning, Sand Dune Act, NRPA, Site Law
- Local Actions will need to be taken to amend local Zoning Ordinances and Floodplain Management Ordinances
- Maine Municipalities are Already Involved!

Action Plan

Working with other groups:

- Commenting on federal or state beach nourishment/erosion control efforts that affect more than one community, including management or deposition of dredged materials.
- SLAWG will coordinate with the Saco Bay Implementation Team, New England Environmental Finance Center, and other groups working on Bay issues.

Duties of the SLAWG

<u>Working together for efficiency and saving money:</u>

- Using regional approaches to plan for improvements;
- Obtaining grants or appropriations for construction projects on a regional basis, or Supporting individual municipal grant or appropriation requests for such projects.

Action Plan

Cutting Red Tape:

- Recommending the standardizing of floodplain management standards and building code interpretations to improve resiliency of individual private structures.
- Recommending standardizing of zoning ordinance review standards affecting the shorelands adjacent to Saco Bay, as well as water activities for structures and activities affected by sea level rise or coastal storms.

Action Plan

- Such water activities may or may not include land-based development, and could include aquaculture, marina, or green energy production projects.
- Providing non-binding comments on various applications for development review affecting Saco Bay that may be vulnerable to sea level rise or coastal storms, to those individual review authorities having jurisdiction.

Some Potential Regional Adaptation Techniques


•Identify areas of undeveloped uplands which may have potential for acquisition to allow for the landward migration of coastal marshes.
P.A. Slovinsky, MGS

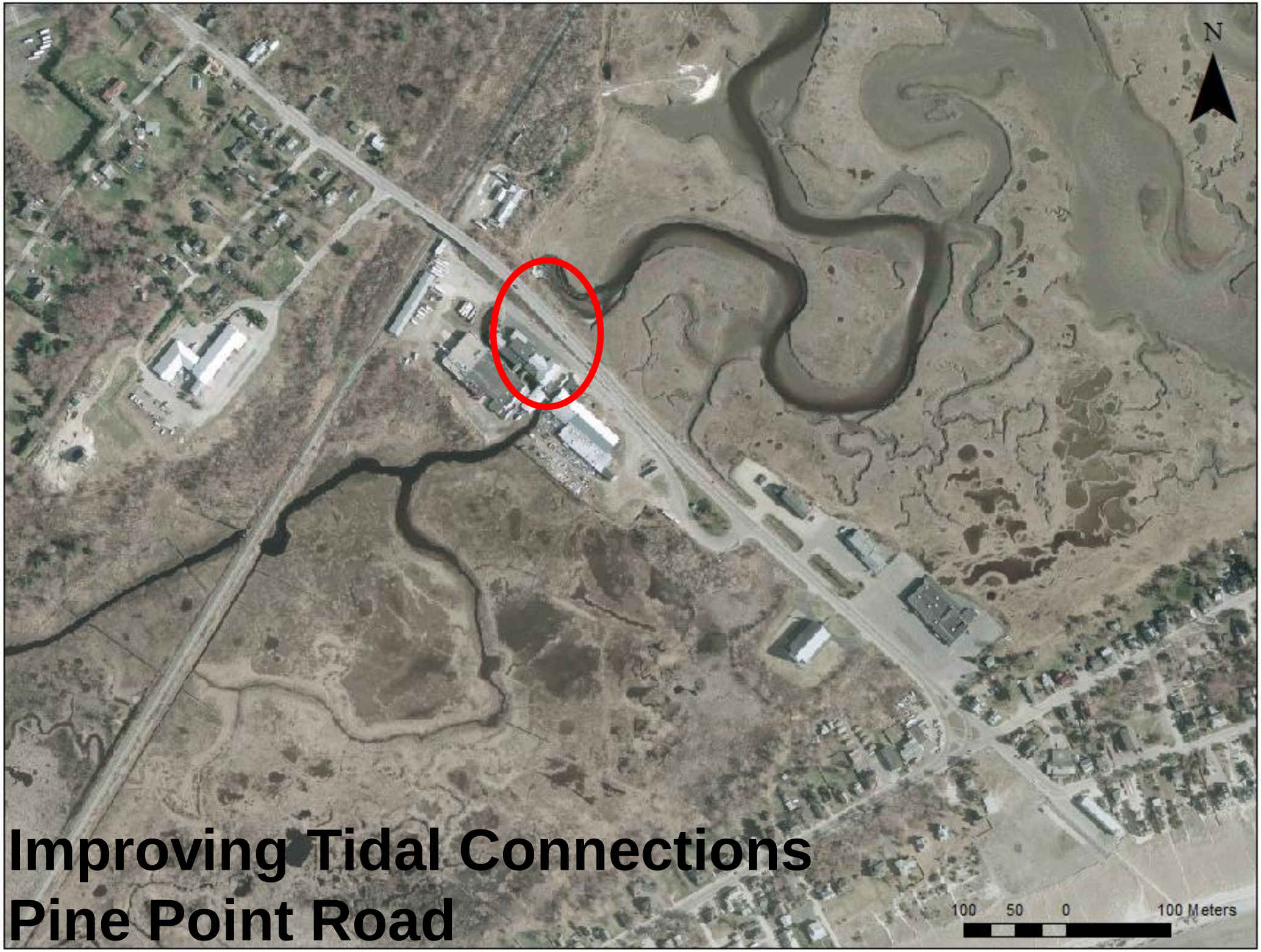
Emergency Access Rerouting

- ***Identify storm surge breach points, and revise evacuation routes accordingly….***

April 16, 2007, approximately10:00 am
Images courtesy of Bill Edwards, and NOAA NWS

Tidal Flow Control

Milone-MacBroom Report
Jones Creek



Improving Tidal Connections
Pine Point Road


N
100 50 0 100 Meters

Possible Implementation Strategies

- Increasing “freeboard” … the amount of clearance under the building, required by the Town’s floodplain management standards
- For new construction, or reconstruction after heavy storm damage.

Elevation and siting

P.A. Slovinsky, MGS

Sea Level Rise as Future requirement?

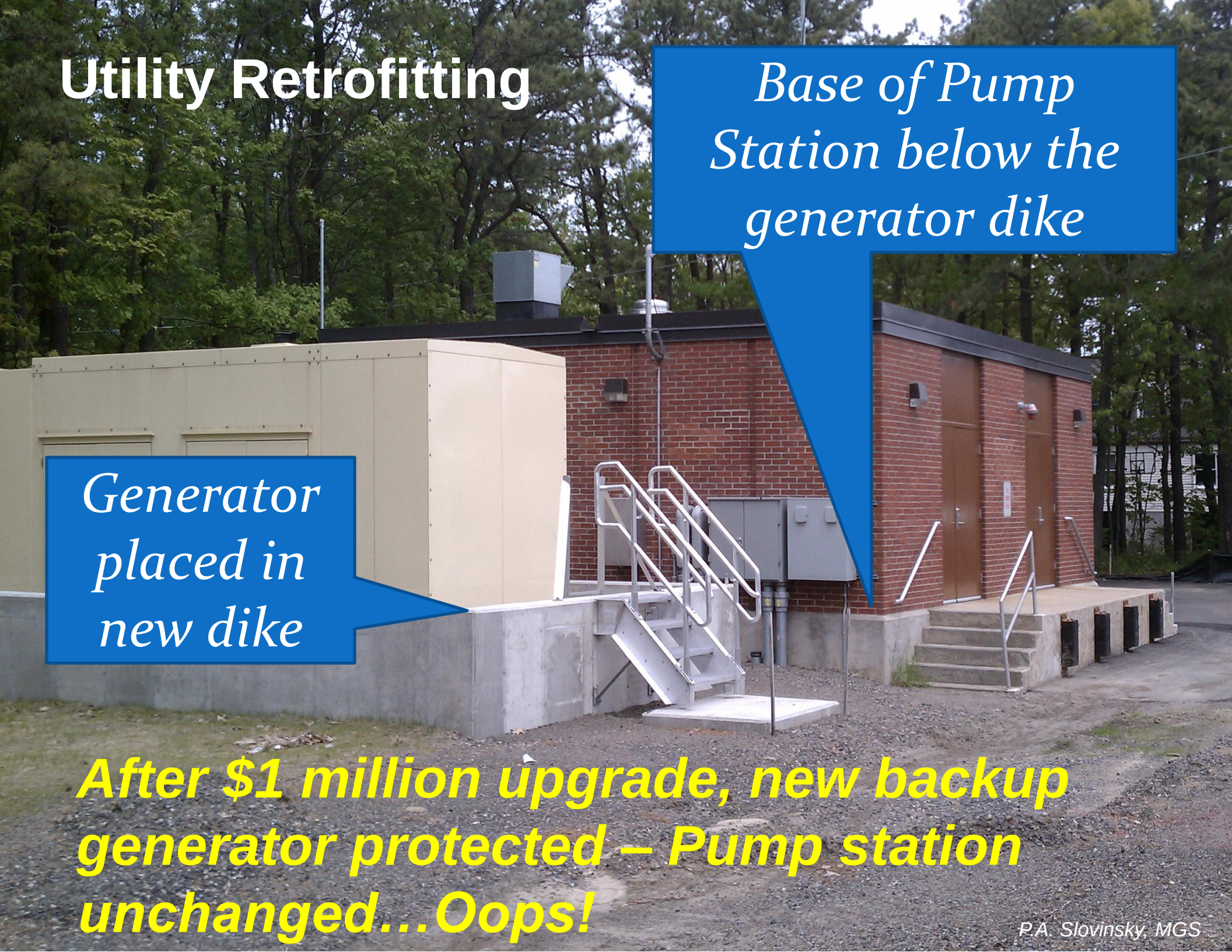
P.A. Slovinsky, MGS

Utility Relocation

Elevate vulnerable infrastructure, including sewer pump stations, roads, culverts and bridges

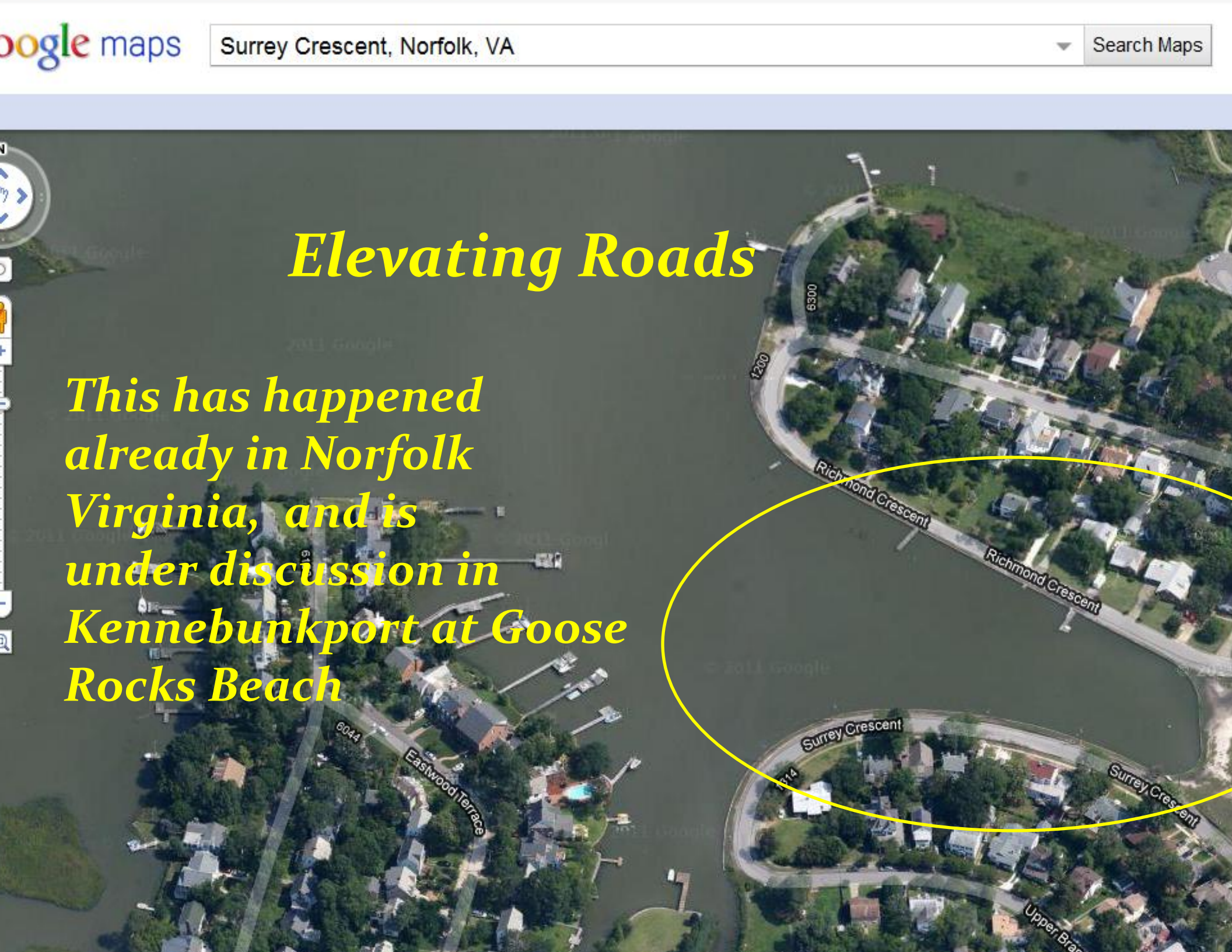
P.A. Slovinsky, MGS

Utility Retrofitting



After $1 million upgrade, new backup generator protected – Pump station unchanged…Oops!

P.A. Slovinsky, MGS


oogle maps
Surrey Crescent, Norfolk, VA
Search Maps
Elevating Roads
This has happened already in Norfolk Virginia, and is under discussion in Kennebunkport at Goose Rocks Beach
6300
1200
Richmond Crescent
Richmond Crescent
Surrey Crescent
Surrey Crescent
6044
Eastwood Terrace

New York Times - November 25, 2010

Front-Line City in Virginia Tackles Rise in Sea

By LESLIE KAUFMAN

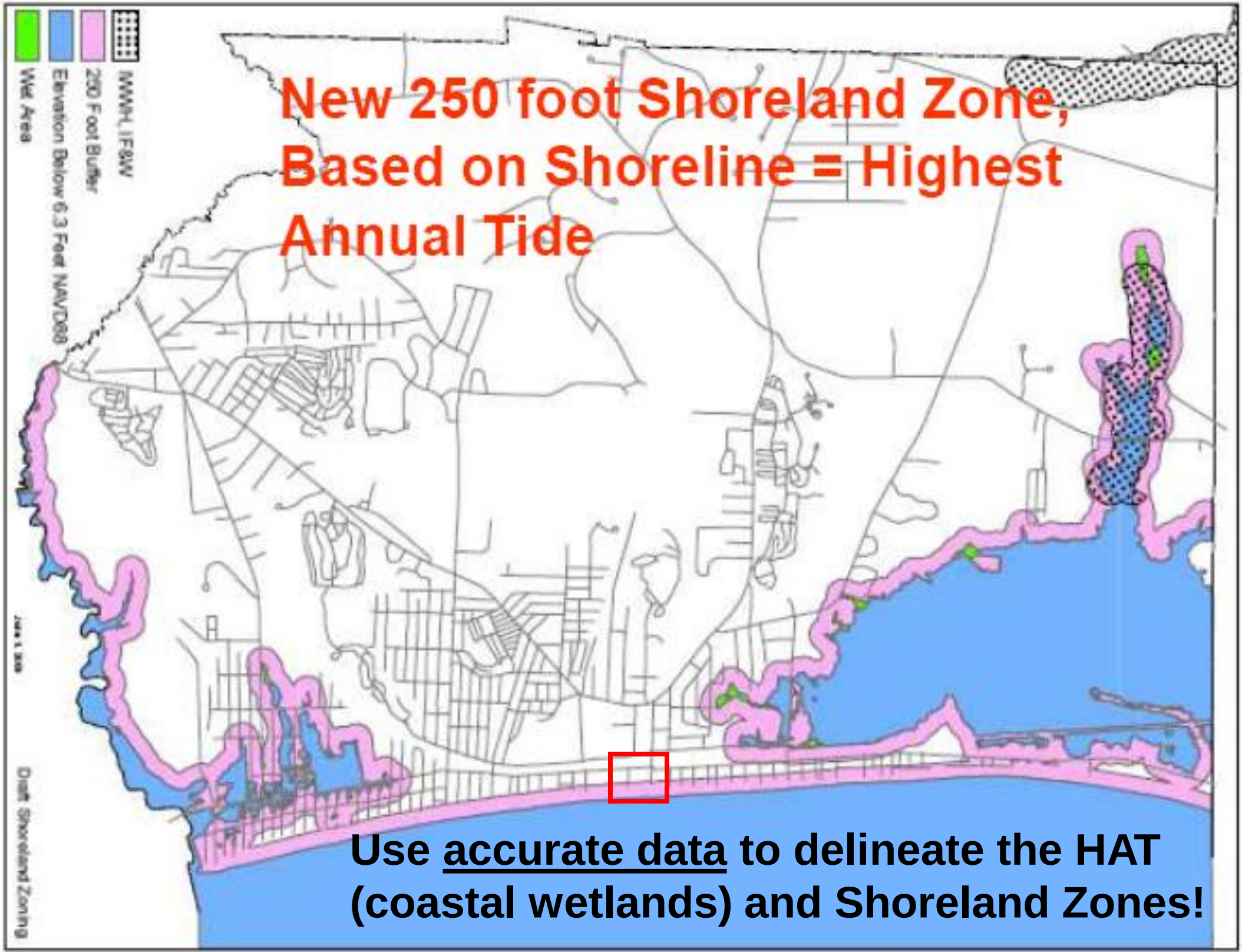
NORFOLK, Va. — In this section of the Larchmont neighborhood, built in a sharp "u" around a bay off the Lafayette River, residents pay close attention to the lunar calendar, much as other suburbanites might attend to the daily flow of commuter traffic. If the moon is going to be full the night before Hazel Peck needs her car, for example, she parks it on a parallel block, away from the river. The next morning, she walks through a neighbor's backyard to avoid the two-to-three-foot-deep puddle that routinely accumulates on her street after high tides. For Ms. Peck and her neighbors, it is the only way to live with the encroaching sea.

Capital Investments Planning

- *A Capital Investments Plan is a required comprehensive plan element for Maine municipalities, in 30-A M.R.S.A. sec. 4326*
- *Sea level rise and the ensuing greater frequency and severity of storm surges, will require capital expenditures during the comprehensive plan period.*
- *Obtaining grants or appropriations for similar construction projects will be much easier, if the comprehensive plan addresses the sea level rise issue.*

Possible Implementation Strategies

- Improving Shoreland Zoning Maps, using LiDAR (Light Detection and Ranging) to set an accurate shoreline position
- You can't begin to deal with adaptation unless you know where your shoreline is!
- Highest Annual Tide Level – HAT
- OOB just adopted new SLZ maps with the shoreline shown at 6.3 feet above mean sea level..


New 250 foot Shoreland Zone, Based on Shoreline = Highest Annual Tide
Use accurate data to delineate the HAT (coastal wetlands) and Shoreland Zones!
NWI/HL IF&W
250 Foot Buffer
Elevation Below 6.3 Feet NAVD88
Wet Area
Draft Shoreland Zoning

Old Orchard Beach – East Grand Avenue Area

Possible Implementation Strategies

- Adjusting your definition of the shoreline to leave extra room for sea level rise.
- Ogunquit, Maine – New Definition of "Normal High Water"
- "In the case of land adjacent to tidal waters, the normal high water line shall be considered to be the contour line at an elevation 11.0 feet above mean sea level as determined by a land surveyor based on the nearest USGS benchmark."

Ogunquit Zoning Ordinance – Adopted SLZ Language

"In the case of land adjacent to tidal waters, the normal high water line shall be considered to be the contour line at an elevation 11.0 feet above mean sea level as determined by a land surveyor based on the nearest USGS benchmark."

Ogunquit Zoning Ordinance – Adopted Language

DEP Highest Annual Tide – Predictions (in feet, NGVD1929).

Location	2008	2011
Kennebunkport	7.0	7.1
Wells, Webhannet River	6.9	7.1
Cape Neddick	6.8	7.0

- This means that Ogunquit is using a position **four feet higher** than the highest annual tide as the start of its setback.
- In the area of marsh between Route 1 and the barrier beach, the FEMA 100-year flood is predicted to rise to an elevation of 9 feet.
- The contour line set for measuring the setback is two feet higher than the height of the 100-year flood (in the salt marsh area).

How is this effort from Seabrook going?

(Taken from a proposal about 2 years ago…)

Table 2
DESIGN FLOOD ELEVATION STANDARDS
EXTENDED COASTAL FLOOD OVERLAY DISTRICT

STRUCTURE TYPE	DESIGN FLOOD ELEVATION	RECONSTRUCTION THRESHOLD
Accessory Structures	10 ft. (9 ft. BFE + 1 ft.)	NA
Single Fam. Residential & Multi- family <5 Units	11 ft. (9 ft. BFE +2ft.)	50%
Multifamily 5+ units	12 ft. (9 ft. BFE + 3ft.)	40%
Commercial Development	12 ft. (9 ft.BFE + 3ft.)	40%
Essential Facilities (schools, hospitals, public safety buildings, etc.)	13 ft. (9ft. BFE + 4ft.)	33%
Public Infrastructure	14 ft. (9ft. BFE+ 5ft.)	25%

Where can our communities go from here?

- Actions to adapt to sea level rise and improve resiliency to storms, can be incorporated into each community's comprehensive plan and capital plan.
- Municipalities should start discussing modifications to Shoreland Zoning and Floodplain Management Ordinances to adapt to Sea Level Rise…SMRPC has started work on model language. We intend to incorporate elements discussed here.

Where can our communities go from here?

- New LiDAR data can be used in coastal tidal areas to set the limits of the coastal wetland to the elevation of the highest annual tide, just like the way Old Orchard Beach has done.
- Why not plan for where the shoreline is now, rather than 40 or 50 years ago?
- And the big challenge, why not plan for where the shoreline is going to be by 2100?

Where can our communities go from here?

- Municipalities can work regionally to create parallel regulations, and obtain funding for capital improvements.
- Communities that have identified their needs to adapt to rising sea levels will have an advantage.
- Perhaps more SLAWGs will be formed in Maine!

Adaptation to Sea-Level Rise:
A Regional Approach in Saco Bay

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207-287-7173