Image credit: google earth

Volume 1: Vulnerability Mapping

An input to work assessing the impacts climate change may have on the State of Maine’s economy, revenues, and investments decisions

September 2020

Introduction

The enclosed series of maps aided the ERG team in identifying vulnerable communities, geographies, and economic sectors to focus on throughout our assessment of climate impacts on Maine’s economy.

Climate vulnerability maps are organized by:

1. Community vulnerability
2. Employment and economic vulnerability
3. Buildings and infrastructure vulnerability

Photo credit: Paul Van DerWerf

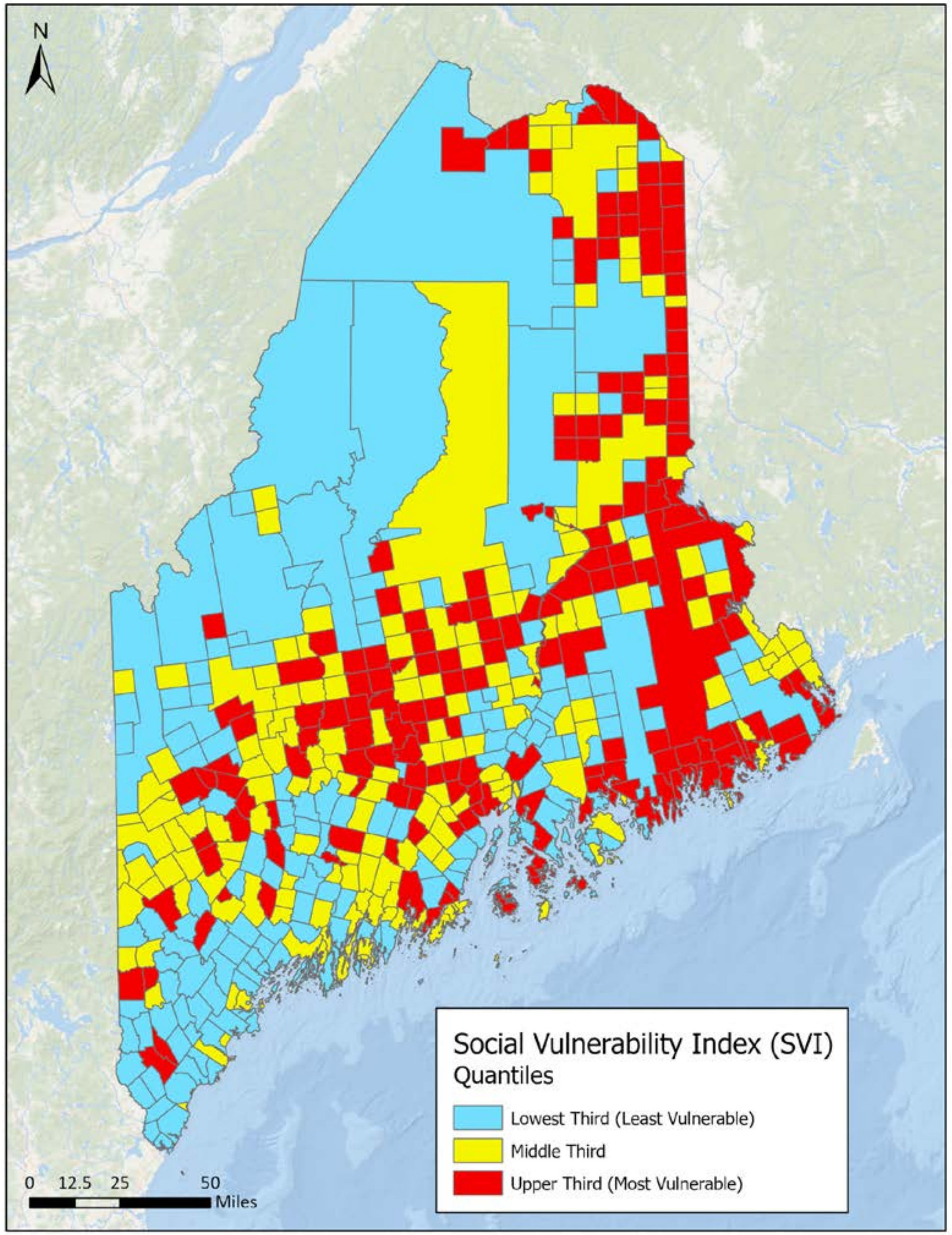
I. Community Vulnerability

Photo credit: Paul Van DerWerf

Social Vulnerability Index (SVI)

- **Key message**
  - **Communities are divided into three quantiles of vulnerability. Communities in dark red are more vulnerable than nearly 67% of the other communities in Maine and are expected to be most challenged to prepare for and recover from climate-related hazards.**
- Data
  - The Maine SVI (2016) is a percentile ranking of vulnerability based on socioeconomic and demographic factors, calculated county subdivision. The index is modified from the CDC's Social Vulnerability Index developed by Flanagan et al 2011. The Maine SVI was developed by Eileen S. Johnson (Bowdoin College); Jeremy M. Bell, Daniel Coker, and Nicole LaBarge (The Nature Conservancy); and Gavin Blake (Colby College).
  - The SVI is based on factors such as socioeconomic status, minority status, household composition and disability, and housing and transportation.

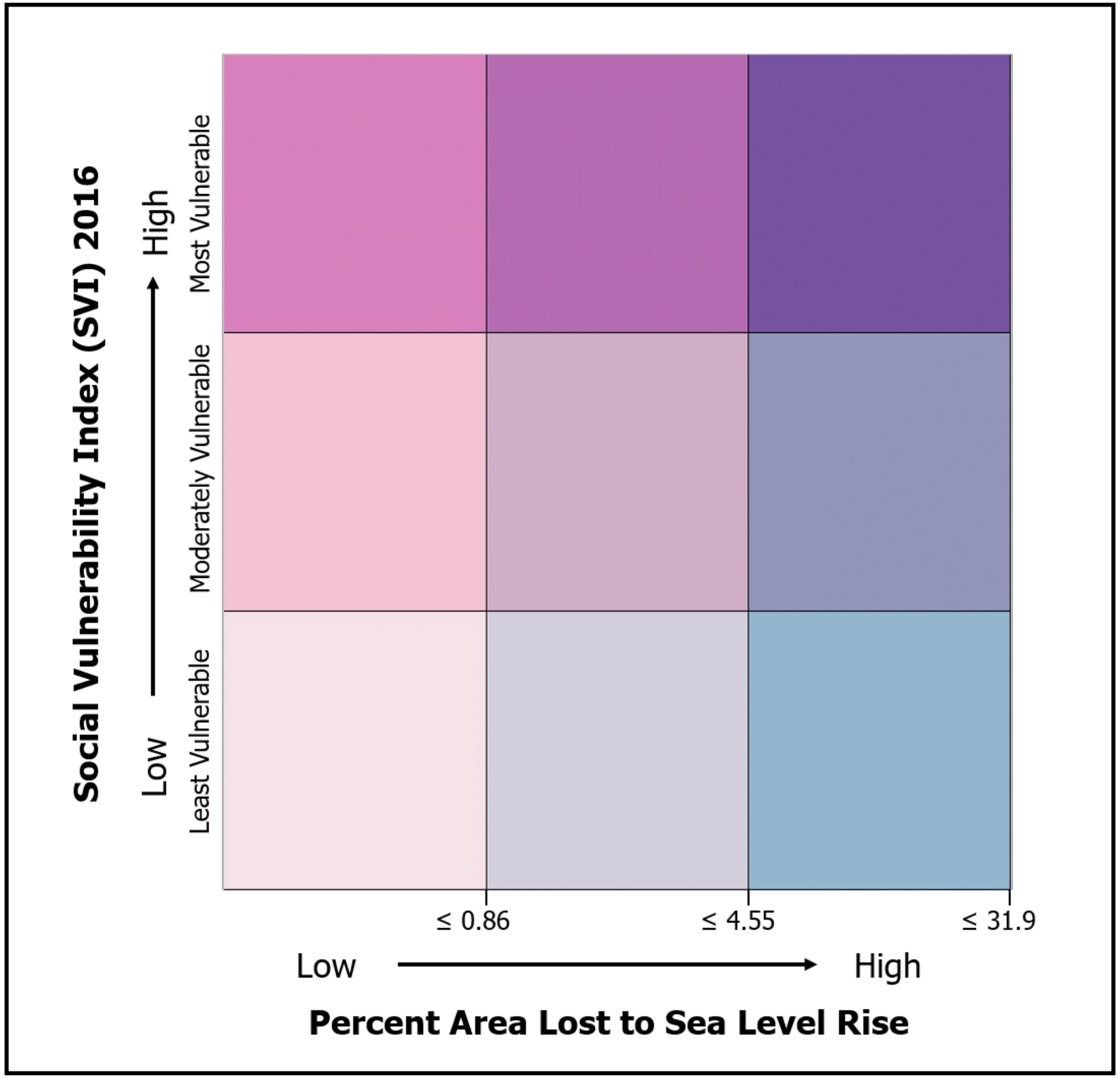
Social Vulnerability Index (SVI) By County Subdivisions



Service Layer Credits: World Ocean Base: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

SVI + Sea Level Rise/Storm Surge

- **Key Message**
  - **By reviewing SVI and sea level rise (SLR) data together, we can identify areas that are not only at risk to sea level rise and storm surge flooding but also have limited capacity to respond to and recover from floods. These areas are mapped in dark purple.**
- Data
  - Maine SVI data is described on the previous slide.
  - Sea Level Rise inundation data layers were obtained from the Maine Geological Survey.
- Limitations
  - Wave action such as runup from storm swells not included.
  - Calculation of percent land area in flood zone does not include area in highest astronomical tide zone.

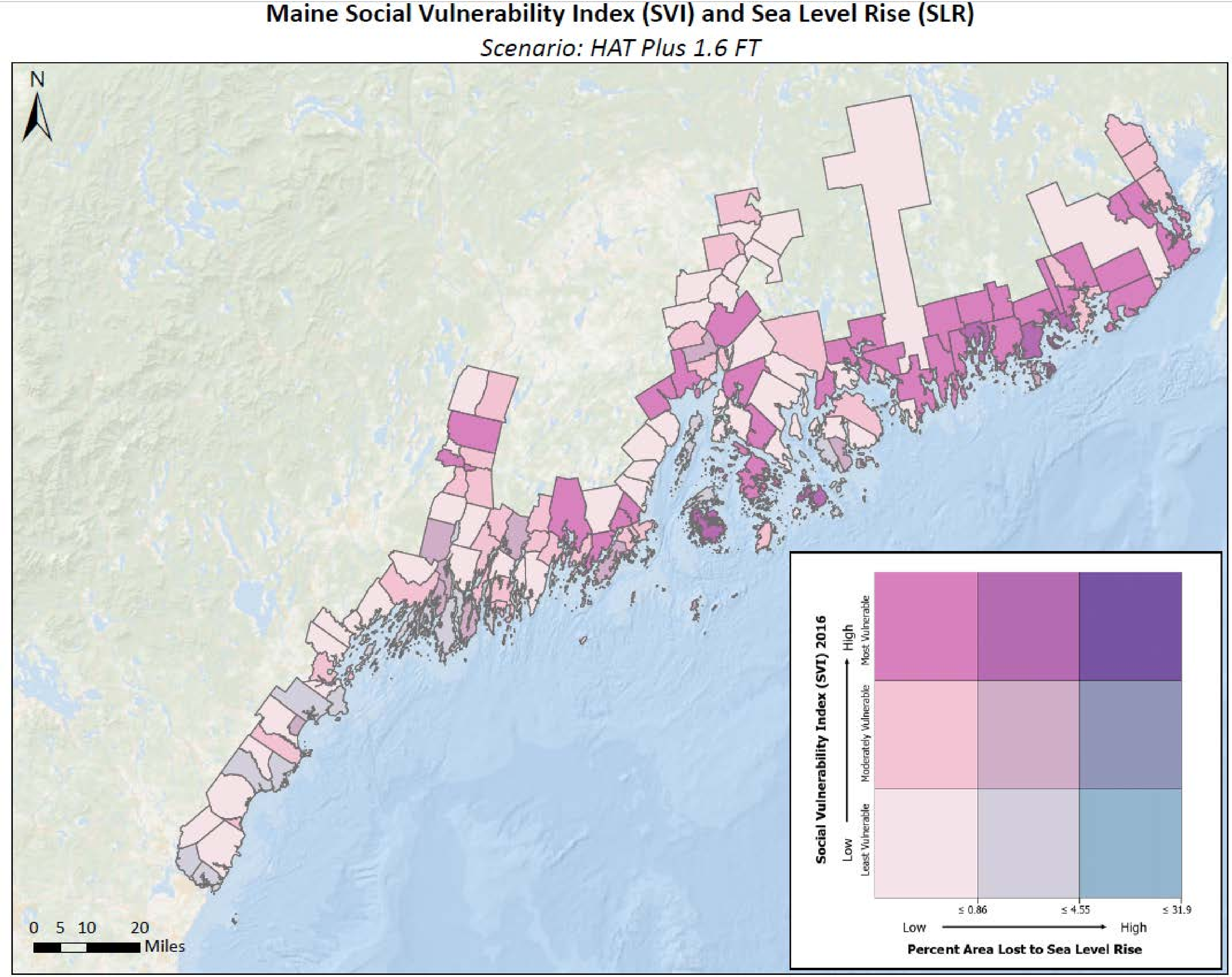


SVI + Sea Level Rise Storm Surge

Highest Astronomical Tide + 1.6 ft

Year	Central Estimate 50% Probability SLR meets or exceeds	Likely Range 67% Probability SLR is between
2030	0.8	0.6-1.0
2050	1.5	1.1-1.8
2070	2.4	1.8-2.8
2100	3.9	3.0-4.6

- **Key Message: At this water level, several communities with an SVI ranking of "most vulnerable" start to experience land loss to flooding.**



Service Layer Credits: World Ocean Base: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

SVI + Sea Level Rise Storm Surge

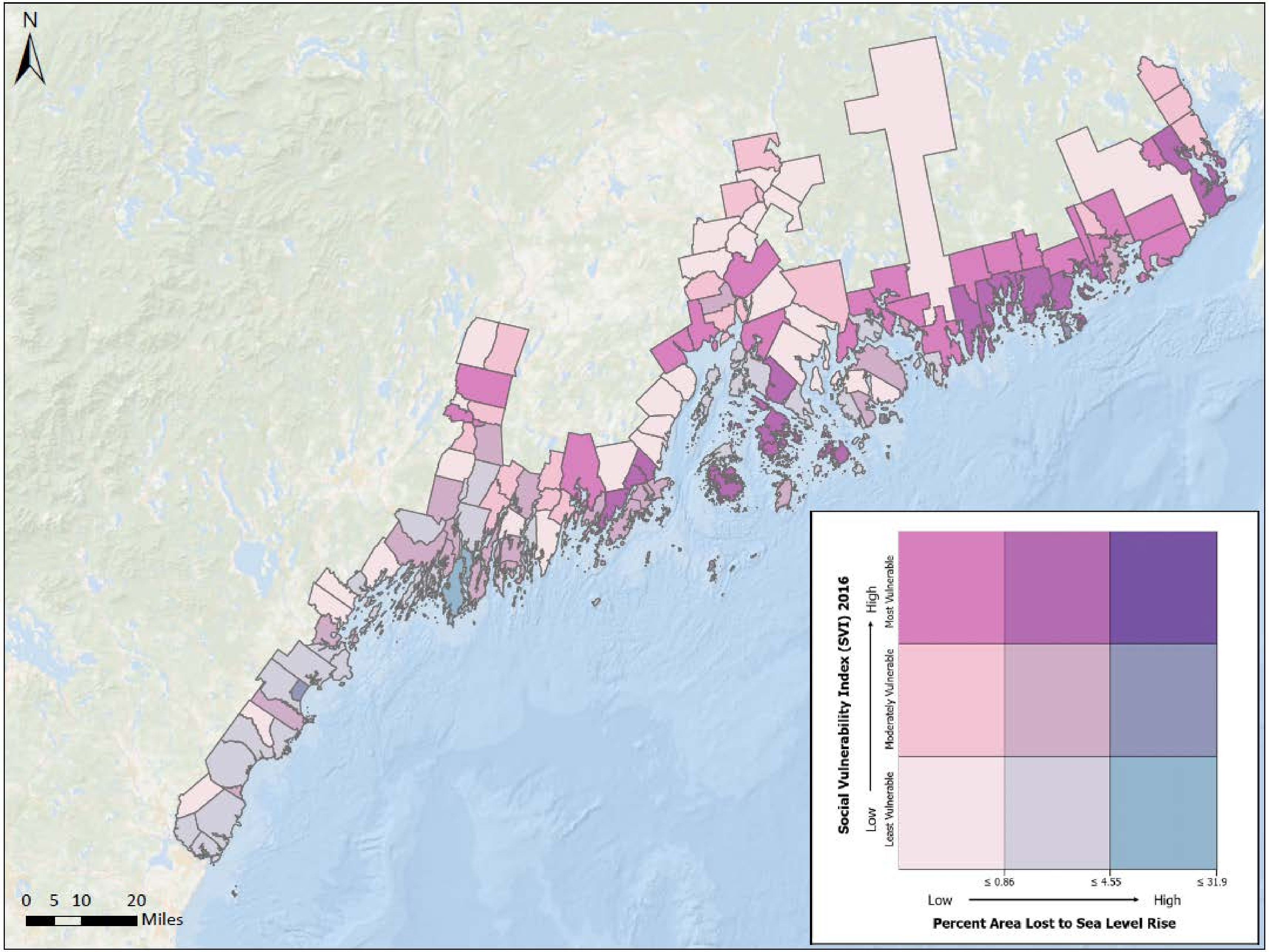
Highest Astronomical Tide + 3.9 ft

Year	Central Estimate 50% Probability SLR meets or exceeds	Likely Range 67% Probability SLR is between
2030	0.8	0.6-1.0
2050	1.5	1.1-1.8
2070	2.4	1.8-2.8
2100	3.9	3.0-4.6

- **Key Message: At this water level, additional communities with an SVI ranking of "most vulnerable" face land loss to flooding.** The "most vulnerable" SVI communities with land loss are Downeast and the islands. The area around Phillipsburg faces the most land loss.

Maine Social Vulnerability Index (SVI) and Sea Level Rise (SLR)

Scenario: HAT Plus 3.9 FT



Service Layer Credits: World Ocean Base: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

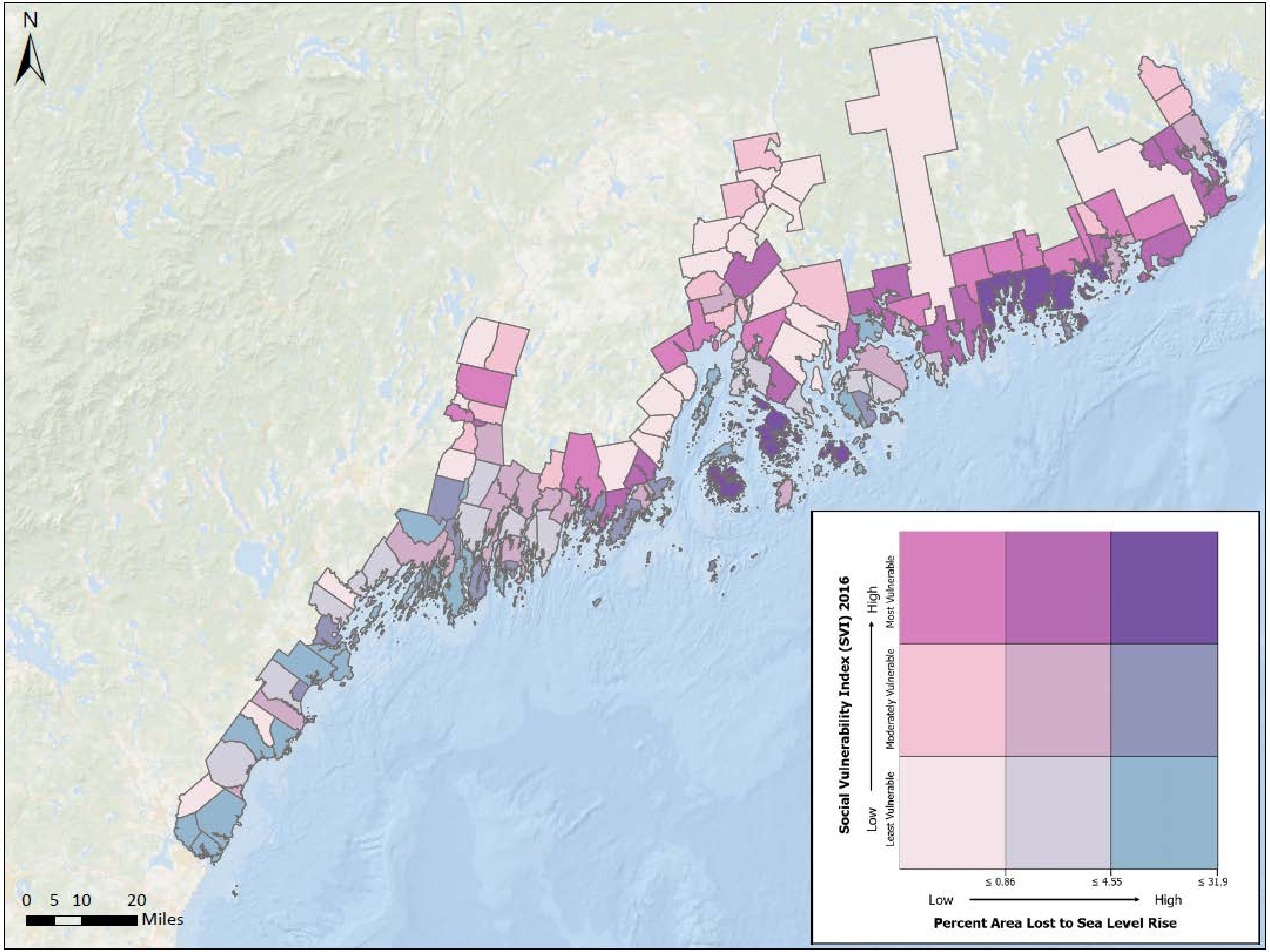
SVI + Sea Level Rise Storm Surge

Highest Astronomical Tide + 8.8 ft

- Equivalent to several future scenarios:
    - 3.9 ft SLR + 1% annual chance storm (4.7 ft)= 8.6ft (close to 8.8ft)
    - Central estimate for a high sea level rise scenario for 2100 (8.8ft SLR)
- **Key Message: Several of the "most vulnerable" SVI communities face larger areas of land loss due to flooding**. These communities are primarily Downeast and the Penobscot Bay islands.

Maine Social Vulnerability Index (SVI) and Sea Level Rise (SLR)

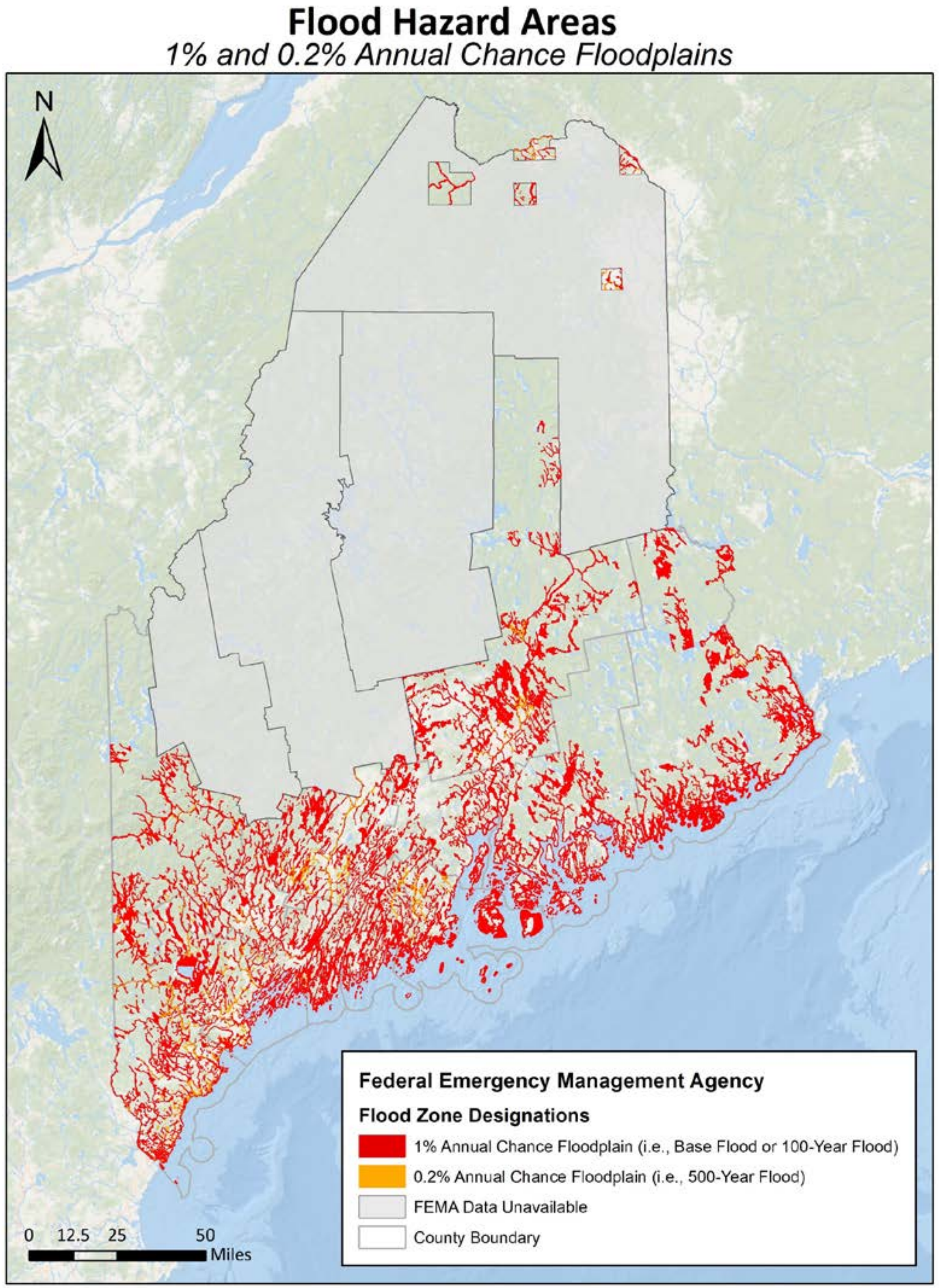
Scenario: HAT Plus 8.8 FT



Service Layer Credits: World Ocean Base: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Riverine & Coastal Flood Risk: 1% & 0.2 % Annual Chance Flood

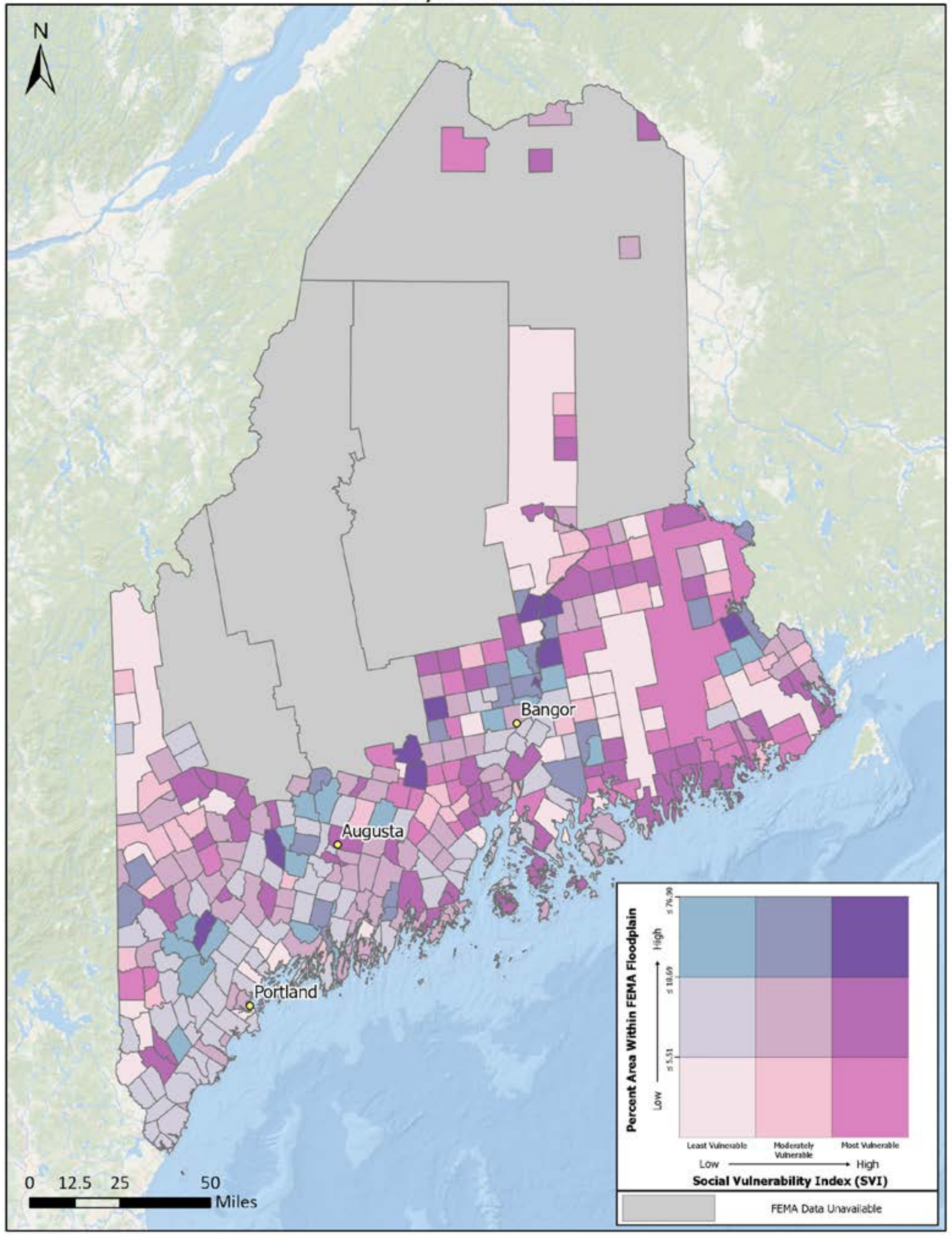
- Key Message
  - **Models project mixed increases and decreases for the 1% annual chance riverine flood in Maine.**
  - **This FEMA map (showing a combined riverine and coastal floodplain) includes the best available state-wide data to begin looking at current riverine flood risk.**
  - **We expect the 1% annual chance coastal flood to increase—a flood 0.2 % chance flood intensity may occur with the same frequency as the 1 % annual chance flood over the coming decades.**
- Data
  - FEMA's National Flood Hazard Layer and the Maine Office of GIS's Flood Insurance Rate Map (FIRM) Q3 Data (updated on 1/8/2020).
- Limitations
  - FEMA flood hazard data unavailable for a subset of counties (shaded in gray).
  - FEMA floodplain reflects current estimates and historic flood risk. It does not project future risk under a changing climate. Projected changes to floodplains are not available across the state.



SVI + Riverine Flood Risk: 1% Annual Chance Floodplain

- **Key Message**
  - **Areas in dark purple are "most vulnerable" on the social vulnerability index and face riverine flood risk in their communities. This flood risk could grow or decline to end of the century.**
- Data
  - Maine SVI data as described above.
  - FEMA's National Flood Hazard Layer and the Maine Office of GIS's Flood Insurance Rate Map (FIRM) Q3 Data
- Limitations
  - Limits noted on previous slide (slide 9).

Social Vulnerability Index (SVI) and FEMA 1% Annual Chance Floodplain
County Subdivisions



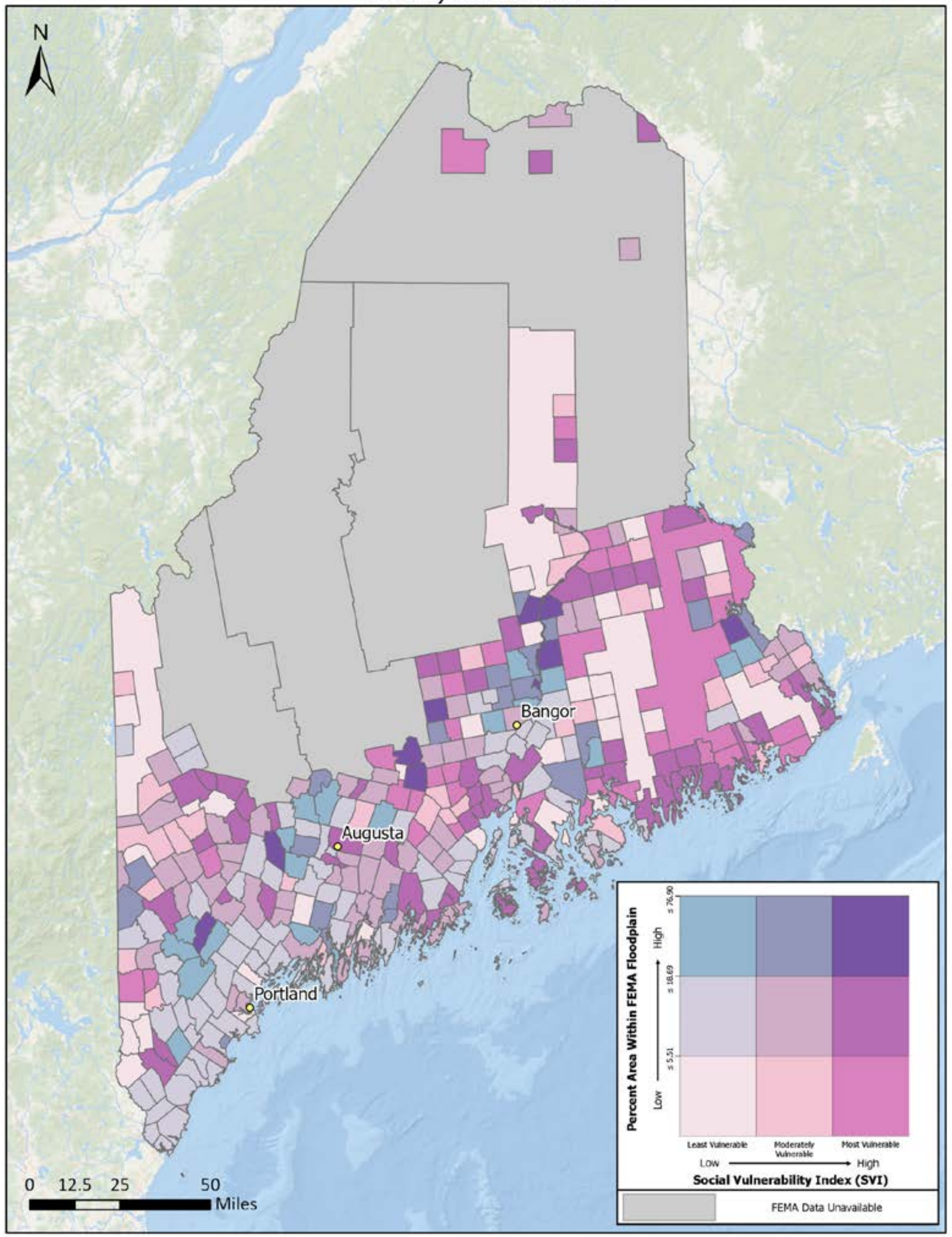
Service Layer Credits: World Ocean Base: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

SVI + Riverine Flood Risk: 0.2% Annual Chance Floodplain

- **Key Message**
  - **Areas in dark purple are "most vulnerable" on the social vulnerability index and face riverine flood risk in their communities. This flood risk could grow or decline to end of the century.**
  - **There are minor changes in specific communities impacted by a 1% annual chance vs. 0.2% annual chance event. Damages to communities will be more extensive with a 0.2% chance event. Should the 1% chance riverine flood increase in Maine, it will start to look like the 0.2 % chance flood.**
- Data
  - Maine SVI data as described above.
  - FEMA's National Flood Hazard Layer and the Maine Office of GIS's Flood Insurance Rate Map (FIRM) Q3 Data
- Limitations
  - Limits noted on previous slide (slide 9).

Social Vulnerability Index (SVI) and FEMA 0.2% Annual Chance Floodplain

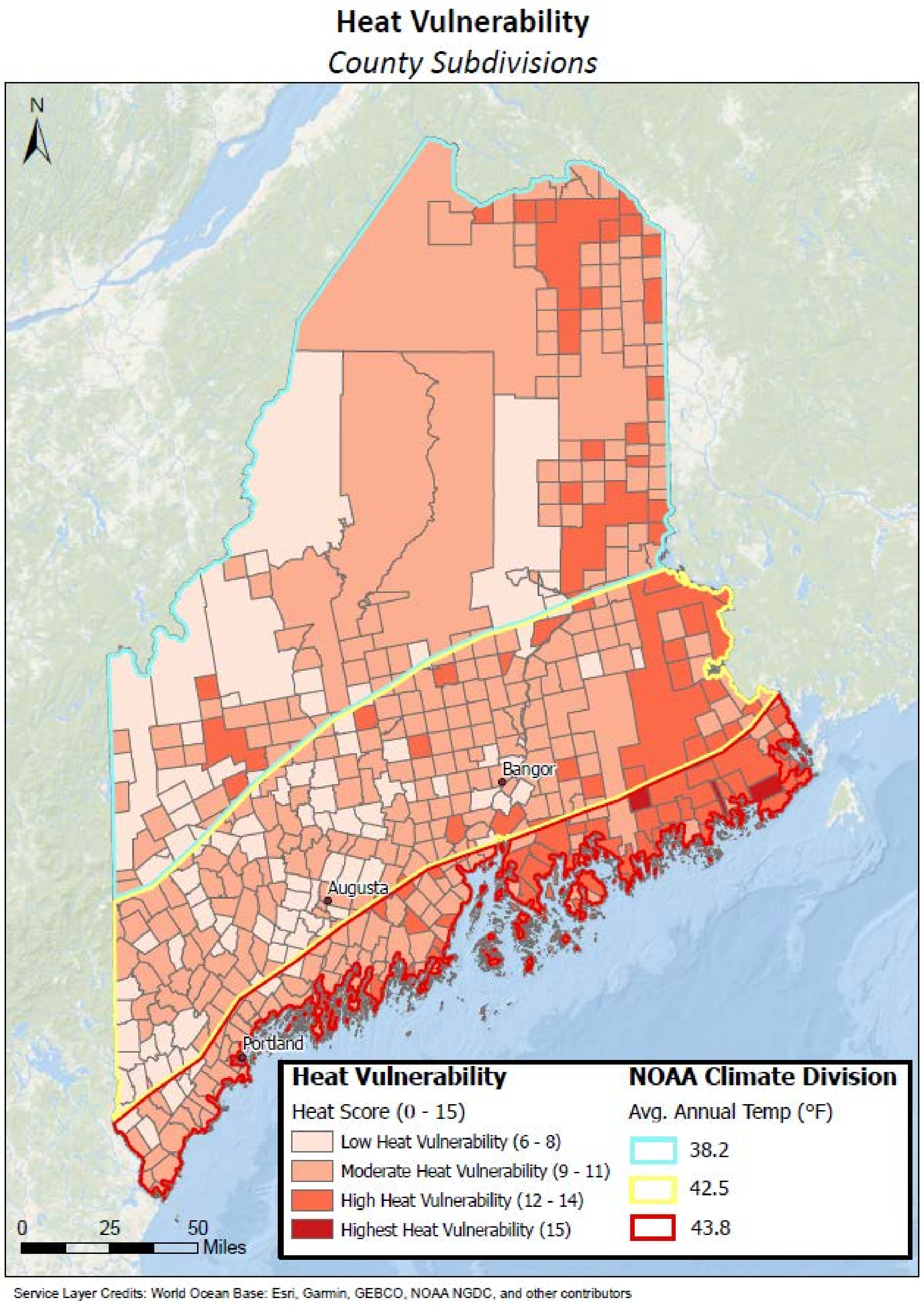
County Subdivisions



Service Layer Credits: World Ocean Base: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

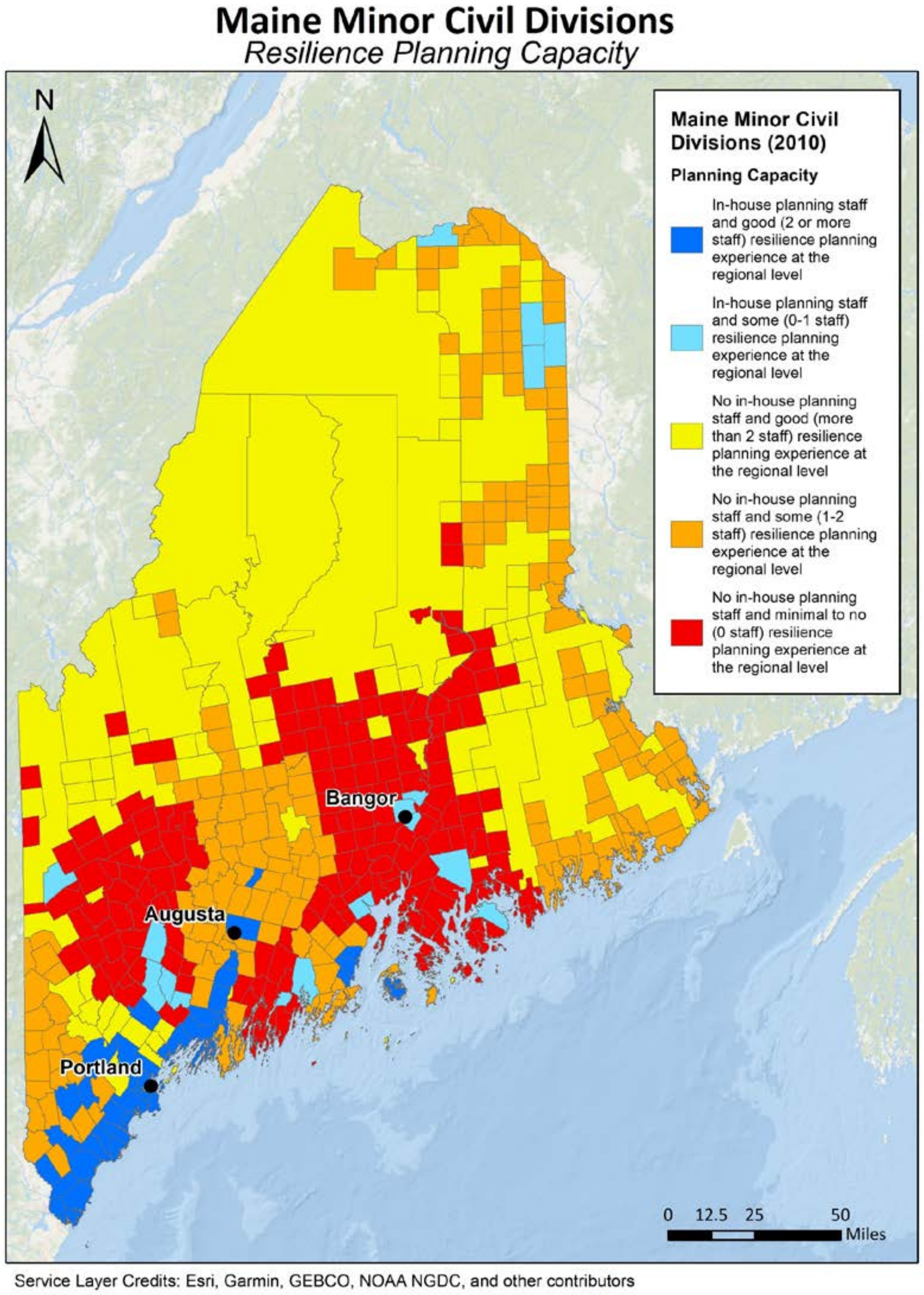
Populations vulnerable to high heat

- **Key Message**
  - **Communities in red and dark orange meet more of the socioeconomic characteristics below that make them more vulnerable to high heat days.**
  - **County subdivisions located in the coastal and central climate divisions also had a higher heat vulnerability ranking as these divisions are warmer today—these climate divisions are expected to persist as temperatures rise in the future.**
- Data
  - The following variables are mapped:
    - Over 65 years old and living alone (Maine SVI 2016)
    - Under 5 years old (American Communities Survey 2013-2018)
    - No Air Conditioning (Maine Center for Disease Control and Prevention).
    - Low population density (ACS 2018, persons per square mile)
    - NOAA Climate Divisions (NOAA U.S. Climate Divisional Database).
  - To assign scores, each individual data source was split into three quantiles, and all values within each variable were assigned a 1, 2, or 3. The three climate divisions were immediately assigned scores of 1 to 3 (from coolest to warmest).
- Limitations
  - This map does not present future heat projections. It assumes that those living in the warmer central and coastal climate divisions will continue to experience hotter days as temperatures rise.



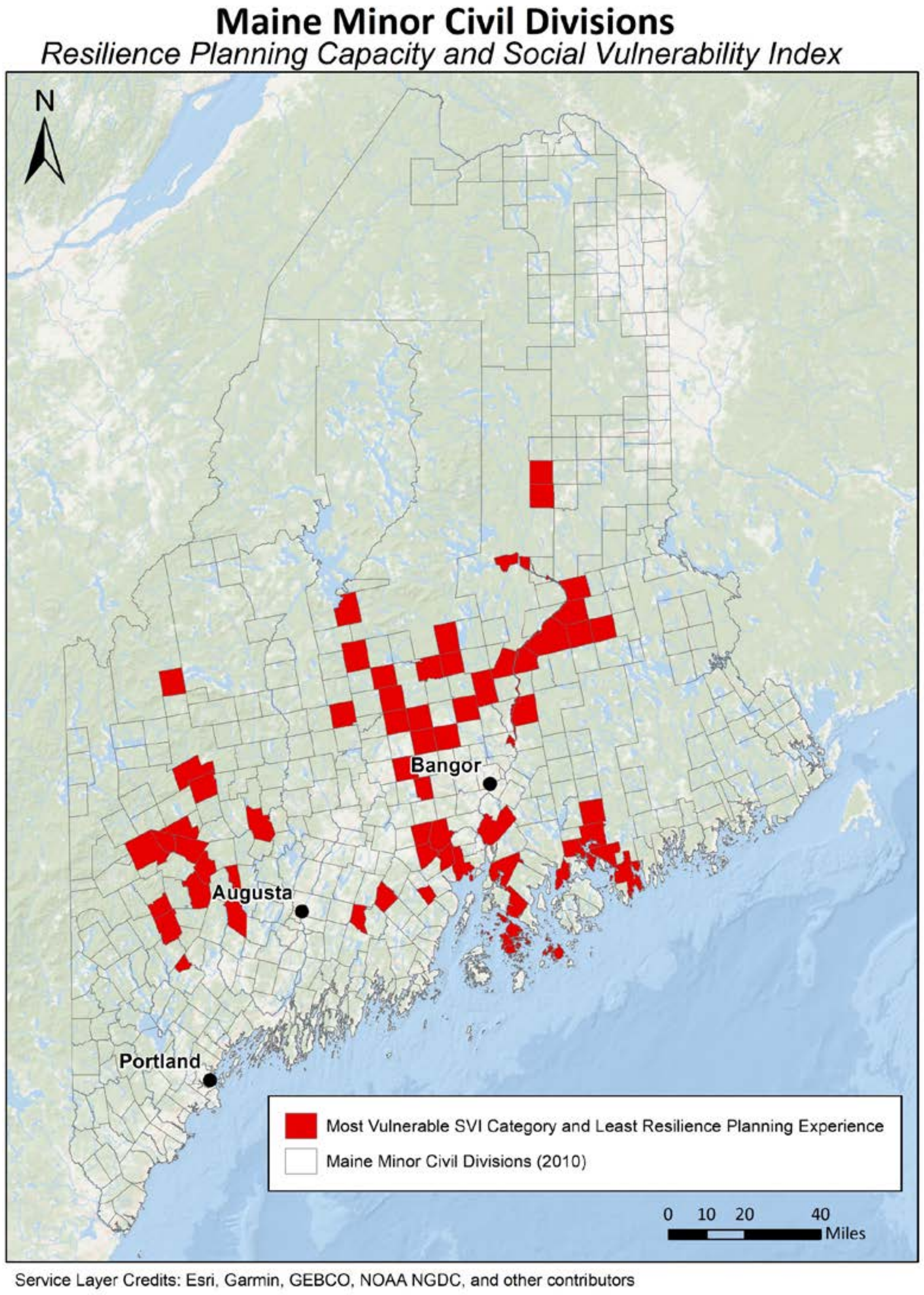
Municipal Resilience Planning Capacity

- **Key message**
  - **187 minor civil divisions have no in-house planning staff and minimal to no support for resilience planning at the regional level.**
  - **Capacity is concentrated in the cities.**
- Data
  - Compiled by Land Use Planning Commission (2020). Capacity assignments based on municipal planning staffing:
    - In-house planning staff? Yes/No
    - Support from a Regional Planning Organization (RPO) with resilience planning experience?
      - No
      - Yes—how many experienced staff?
- Limitations
  - Areas solely covered by the Maine Land Use Planning Commission (LUPC) are included within the 'No in-house planning staff and some (1-2 staff) resilience planning experience at the regional level' category due to the large area the LUPC covers.



Municipal Resilience Planning Capacity + SVI

- **Key message:**
    - **Communities with an SVI rating of 'most vulnerable' are expected to be most challenged to prepare for and recover from climate-related hazards. This overlap with areas lacking municipal resilience planning capacity (in red) points to communities that may be particularly challenged to prepare for climate impacts.**
- Data:
    - Municipal resilience planning capacity data compiled by the Land Use Planning Commission (2020)
    - Maine SVI
- Limitations
    - The municipalities identified as the most vulnerable in the SVI were compared to the municipalities with the least resilience planning capacity (no in-house planning staff and minimal resilience planning experience at the regional level). Other municipalities were omitted from this map.



II. Employment and Economic Vulnerability

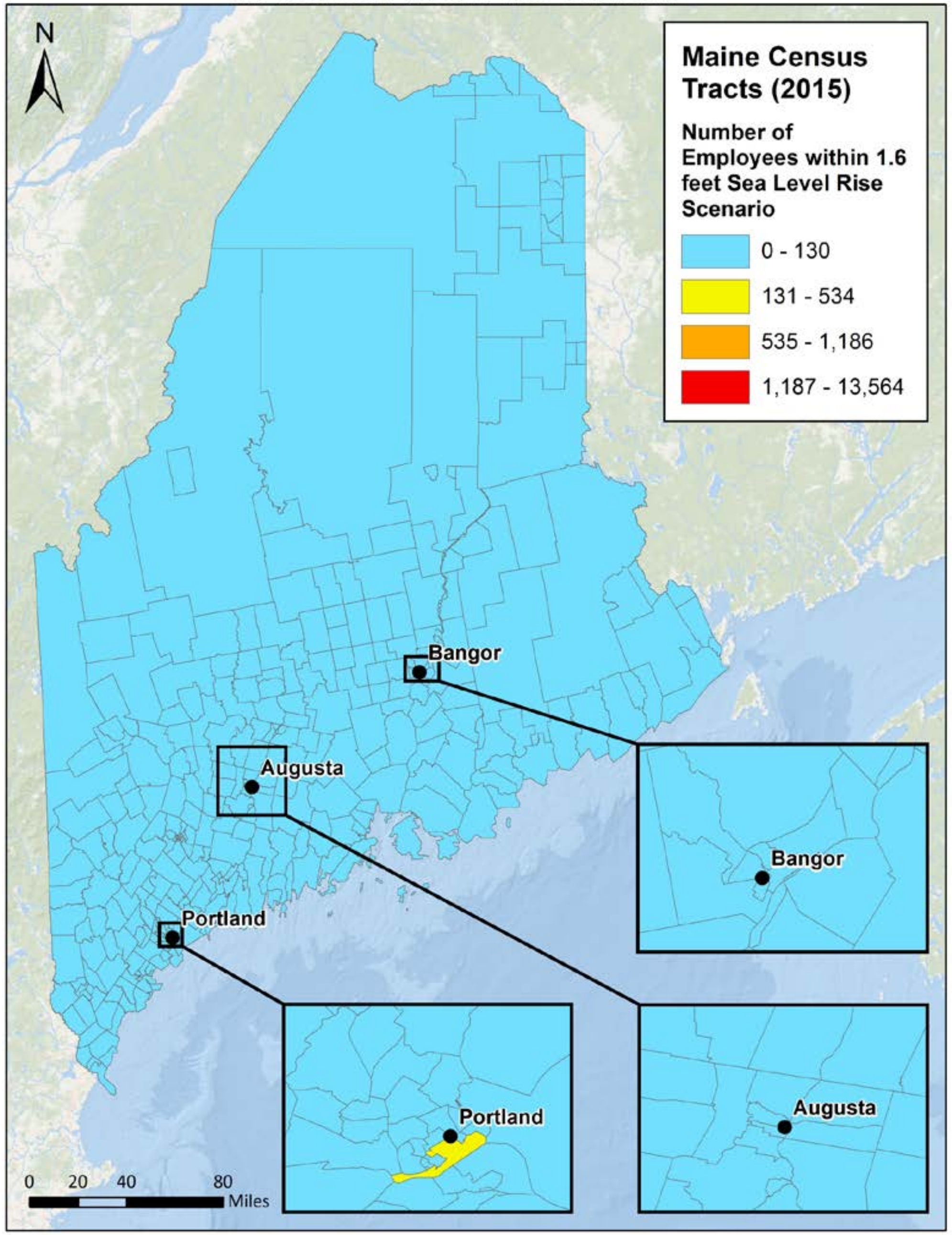

Photo credit: Junan Sonin

Jobs at risk to sea level rise flooding: HAT + 1.6 ft SLR

- **Key message:**
  - **Businesses and jobs along the coast and upstream stretches of rivers (tidal influence moves miles inland) are at risk to sea level rise and storm surge flooding.**
- Data:
  - Employment and jobs data were obtained from InfoUSA.
  - Sea Level Rise scenario data were obtained from the Maine Geological Survey.
- Limitations
  - Size of businesses (number of employees) is not available for all listings within InfoUSA.

Employees Impacted by Census Tract

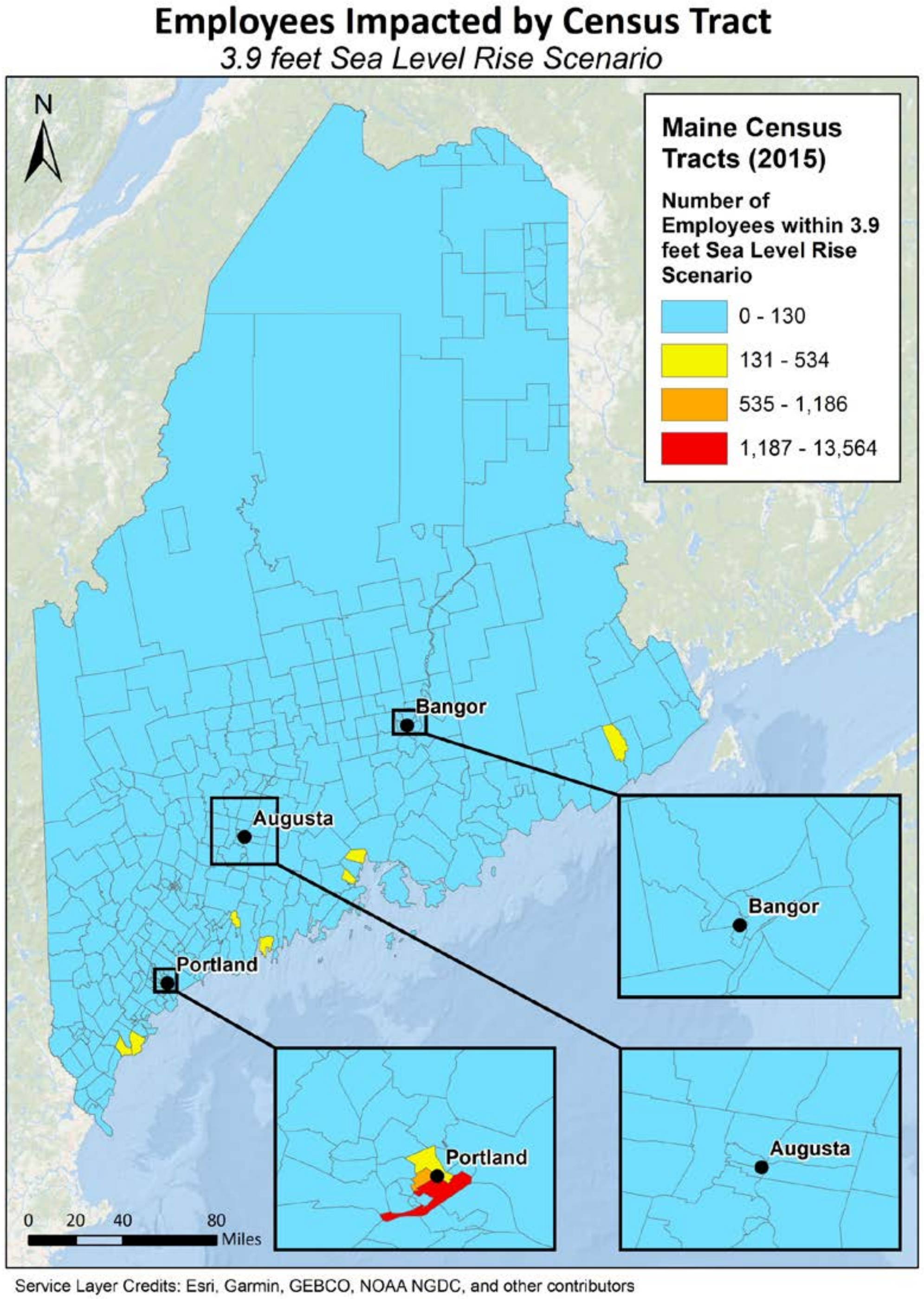
1.6 feet Sea Level Rise Scenario



Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

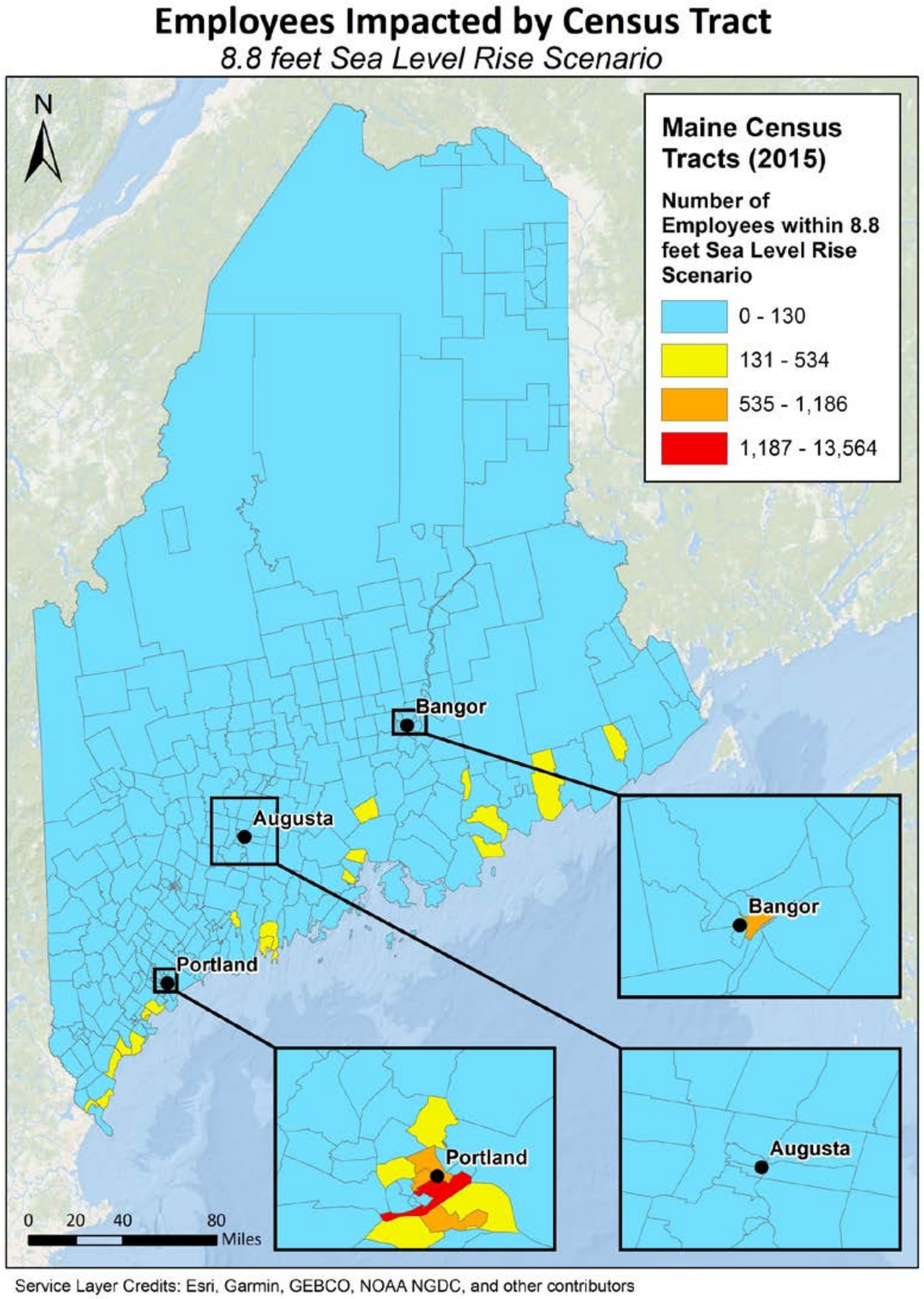
Jobs at risk to sea level rise flooding: HAT + 3.9 ft SLR

- **Key message:**
  - **Businesses and jobs along the coast and upstream stretches of rivers (tidal influence moves miles inland) are at risk to sea level rise and storm surge flooding.**
- Data:
  - Employment and jobs data were obtained from InfoUSA.
  - Sea Level Rise scenario data were obtained from the Maine Geological Survey.
- Limitations
  - Size of businesses (number of employees) is not available for all listings within InfoUSA.



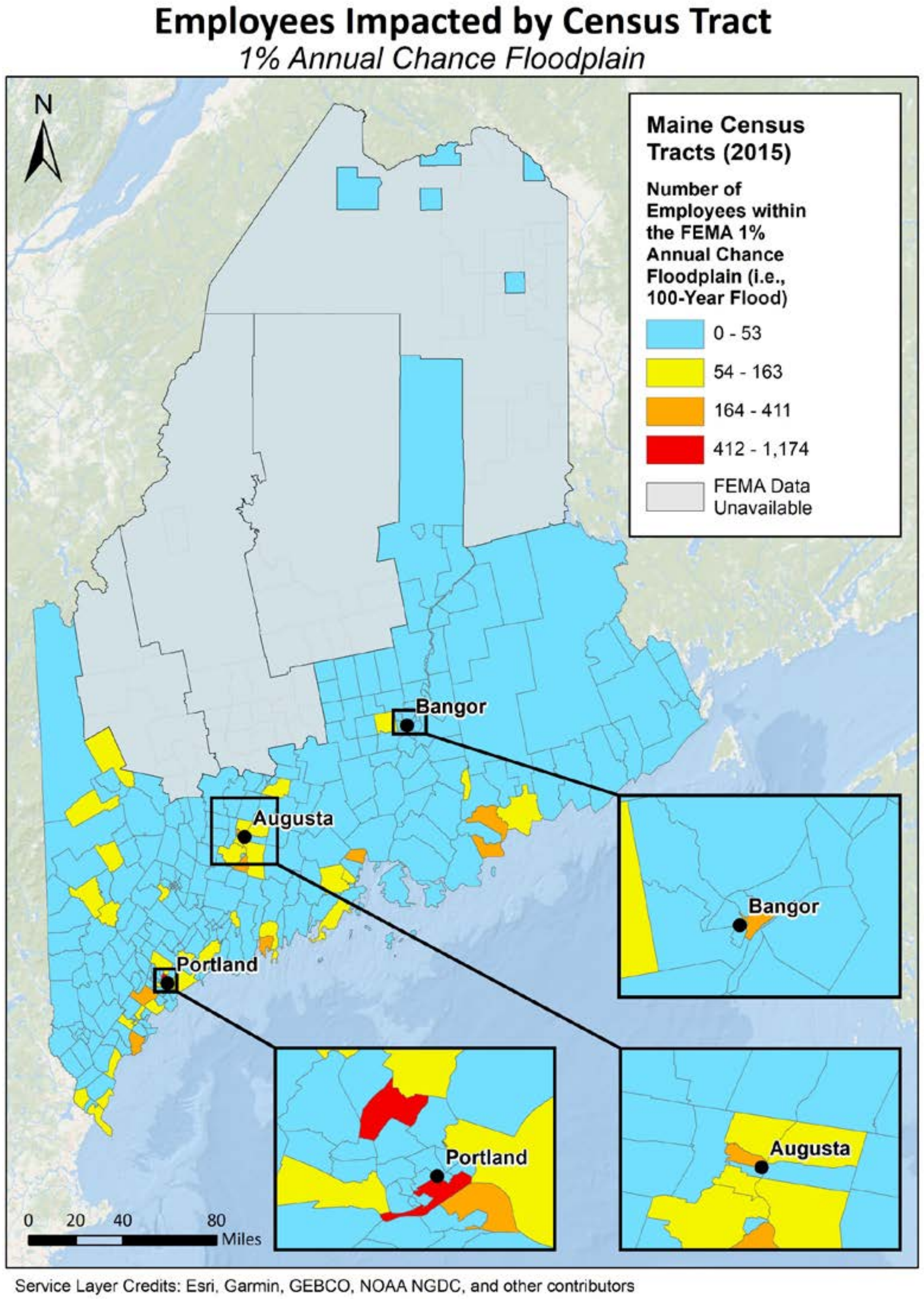
Jobs at risk to sea level rise flooding: HAT + 8.8 ft SLR

- **Key message:**
  - **Businesses and jobs along the coast and upstream stretches of rivers (tidal influence moves miles inland) are at risk to sea level rise and storm surge flooding.**
- Data:
  - Employment and jobs data were obtained from InfoUSA.
  - Sea Level Rise scenario data were obtained from the Maine Geological Survey.
- Limitations
  - Size of businesses (number of employees) is not available for all listings within InfoUSA.



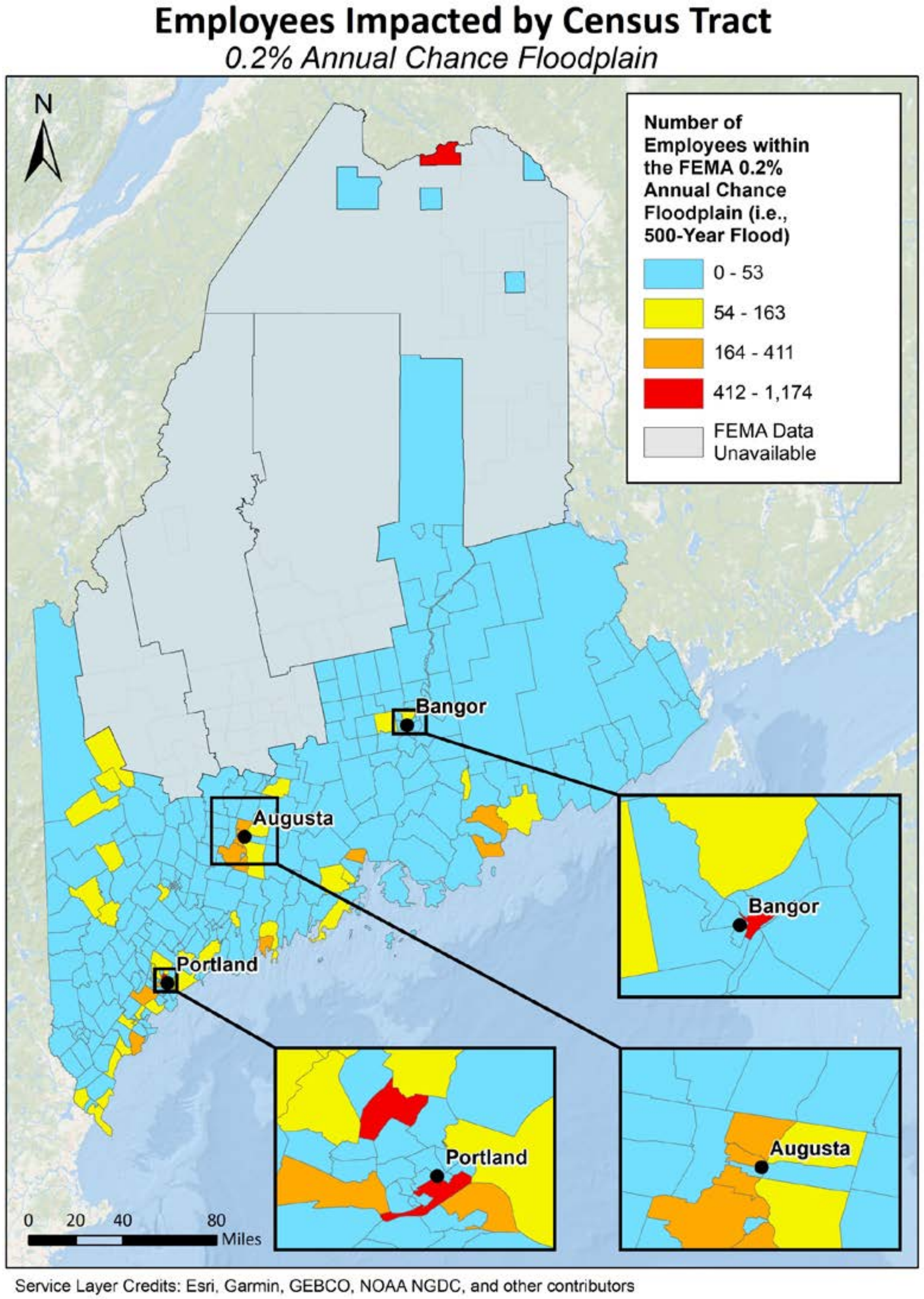
Jobs at risk to riverine flooding:
1% Annual Chance Flood

- **Key message:**
  - **Businesses and jobs along key stretches of Maine rivers face flood risk.**
- Data:
  - Employment and jobs data were obtained from InfoUSA.
  - Floodplain data was acquired from FEMA's National Flood Hazard Layer and the Maine Office of GIS's Flood Insurance Rate Map (FIRM) Q3 Data.
- Limitations
  - As noted above, size of businesses (number of employees) is not available for all listings within InfoUSA.
  - FEMA flood hazard data was unavailable for a subset of counties.



Jobs at risk to riverine flooding:
0.2% Annual Chance Flood

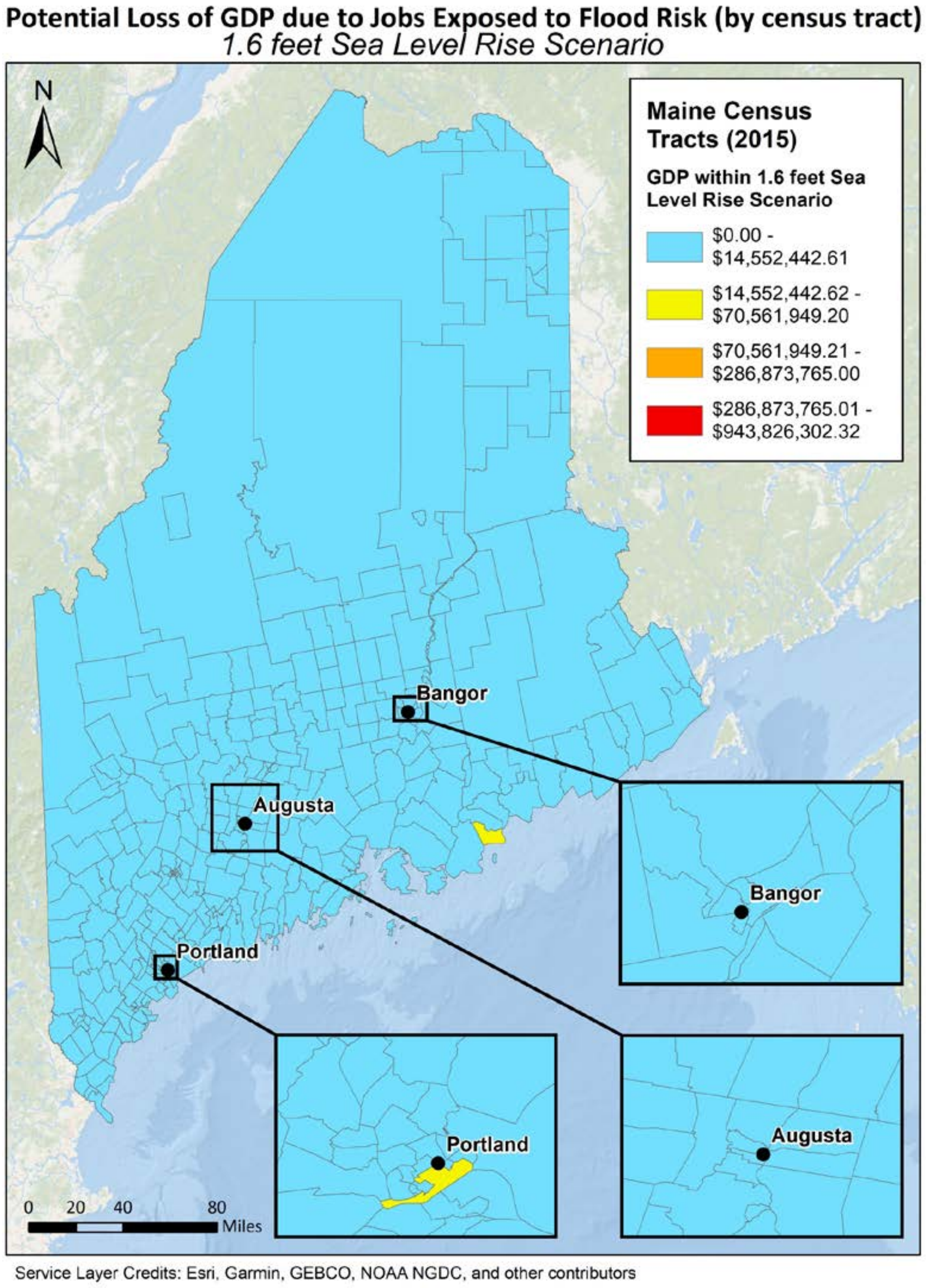
- **Key message:**
    - **Businesses and jobs along key stretches of Maine rivers face flood risk.**
- Data:
    - Employment and jobs data were obtained from InfoUSA.
    - Floodplain data was acquired from FEMA's National Flood Hazard Layer and the Maine Office of GIS's Flood Insurance Rate Map (FIRM) Q3 Data.
- Limitations
    - As noted above, size of businesses (number of employees) is not available for all listings within InfoUSA.
    - FEMA flood hazard data was unavailable for a subset of counties.



Loss of Annual GDP due to Jobs Exposed to flooding:

HAT + 1.6 ft SLR

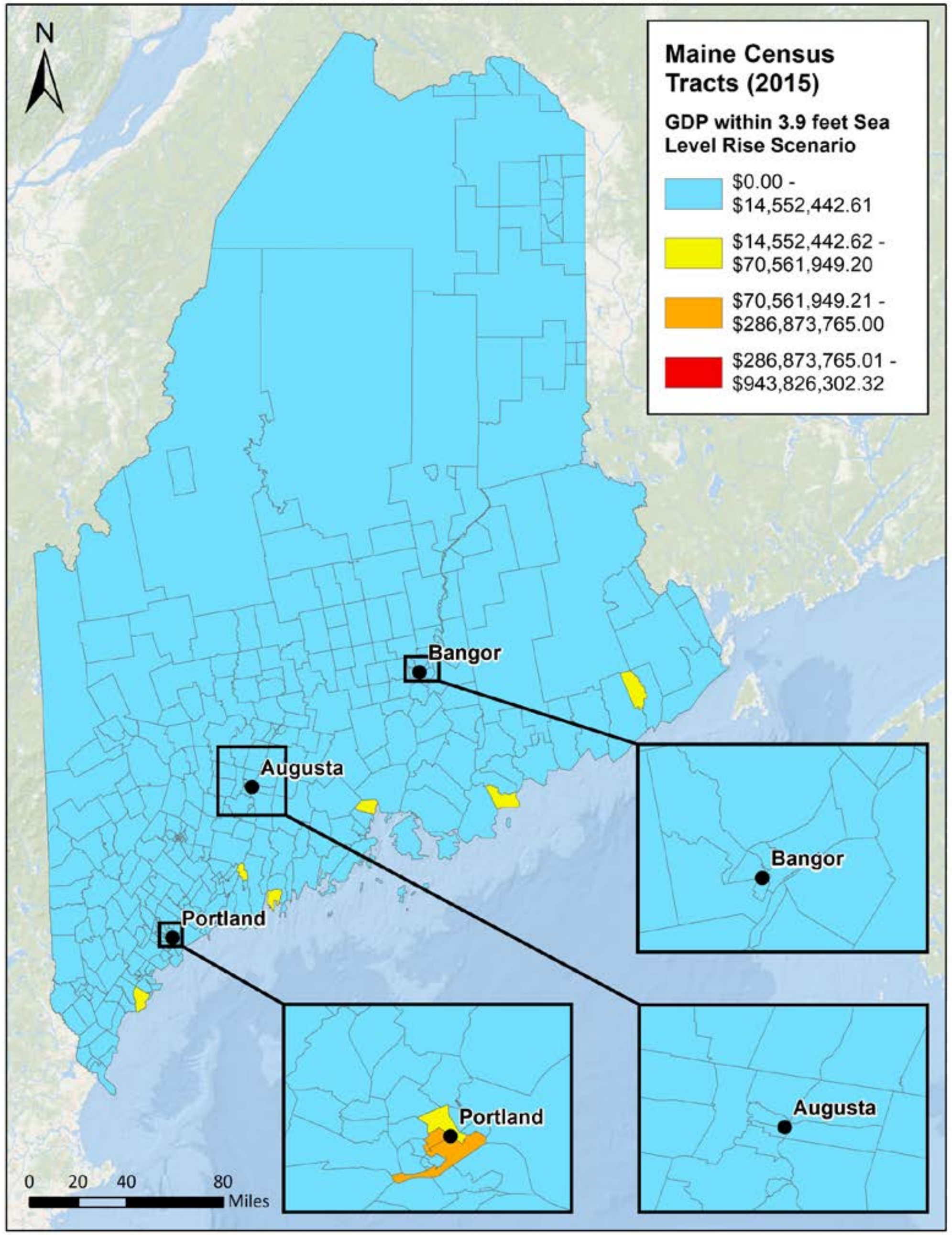
- **Key message:**
  - **Loss of jobs due to sea level and storm surge flooding represents a potential loss of GDP. These impacts reach inland due to tidal influence in lower river stretches.**
  - **This potential statewide GDP loss amounts to $118,756,887.**
- Data:
  - Employment and jobs data were obtained from InfoUSA.
  - Sea Level Rise scenario data were obtained from the Maine Geological Survey.
- Limitations
  - GDP per job was calculated for each industry and each county. There were some limits to these calculations as employee GDP data was not available for every facility. In these cases, county GDP averages were applied; if necessary, a statewide average was applied.



Loss of Annual GDP due to Jobs Exposed to flooding:
HAT + 3.9 ft SLR

- **Key message:**
  - **Loss of jobs due to sea level and storm surge flooding represents a potential loss of GDP. These impacts reach inland due to tidal influence in lower river stretches.**
  - **This potential statewide GDP loss amounts to $664,907,953.**
- Data:
  - Employment and jobs data were obtained from InfoUSA.
  - Sea Level Rise scenario data were obtained from the Maine Geological Survey.
- Limitations
  - GDP per job was calculated for each industry and each county. There were some limits to these calculations as employee GDP data was not available for every facility. In these cases, county GDP averages were applied; if necessary, a statewide average was applied.

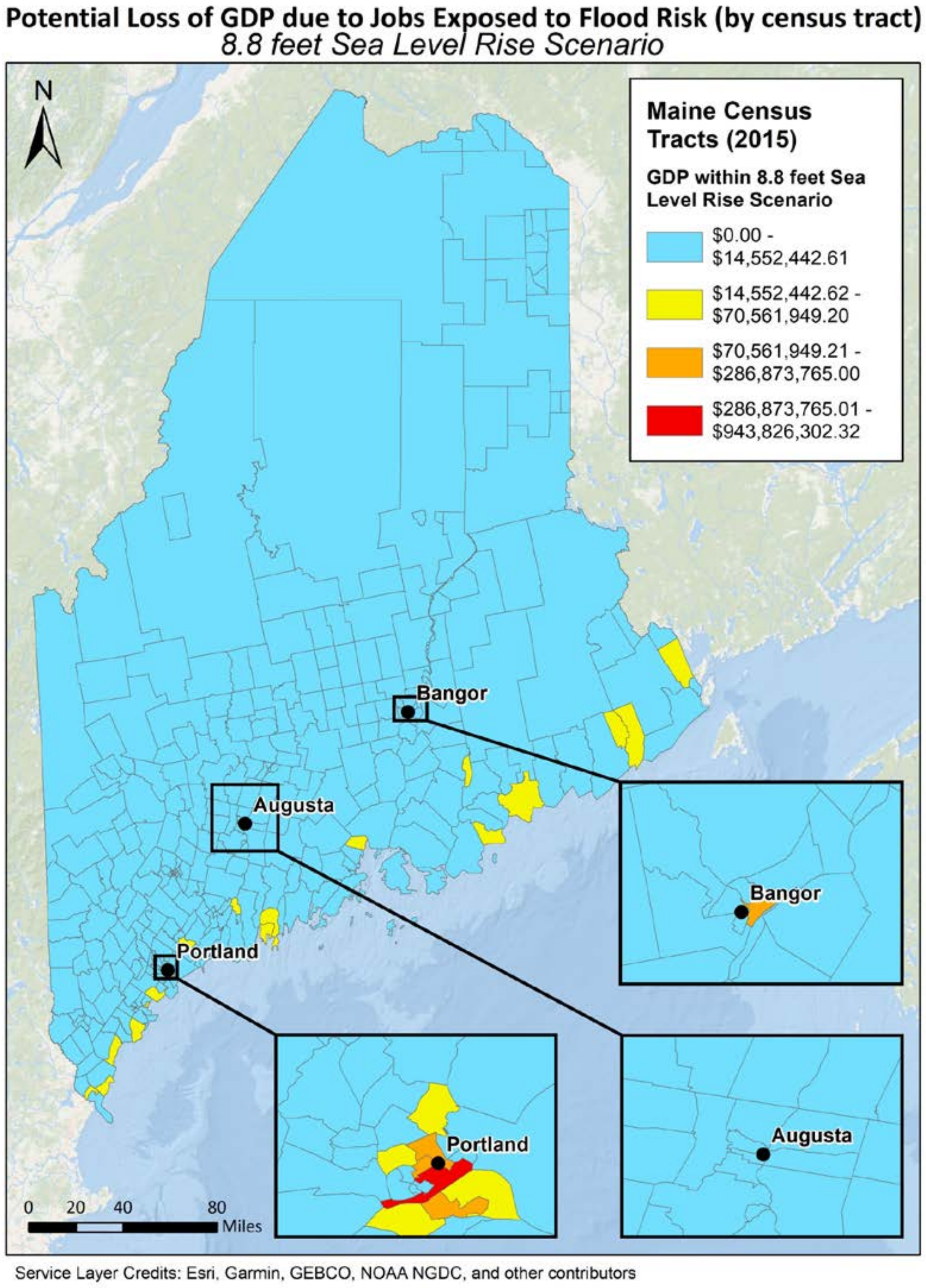
Potential Loss of GDP due to Jobs Exposed to Flood Risk (by census tract)
3.9 feet Sea Level Rise Scenario



Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

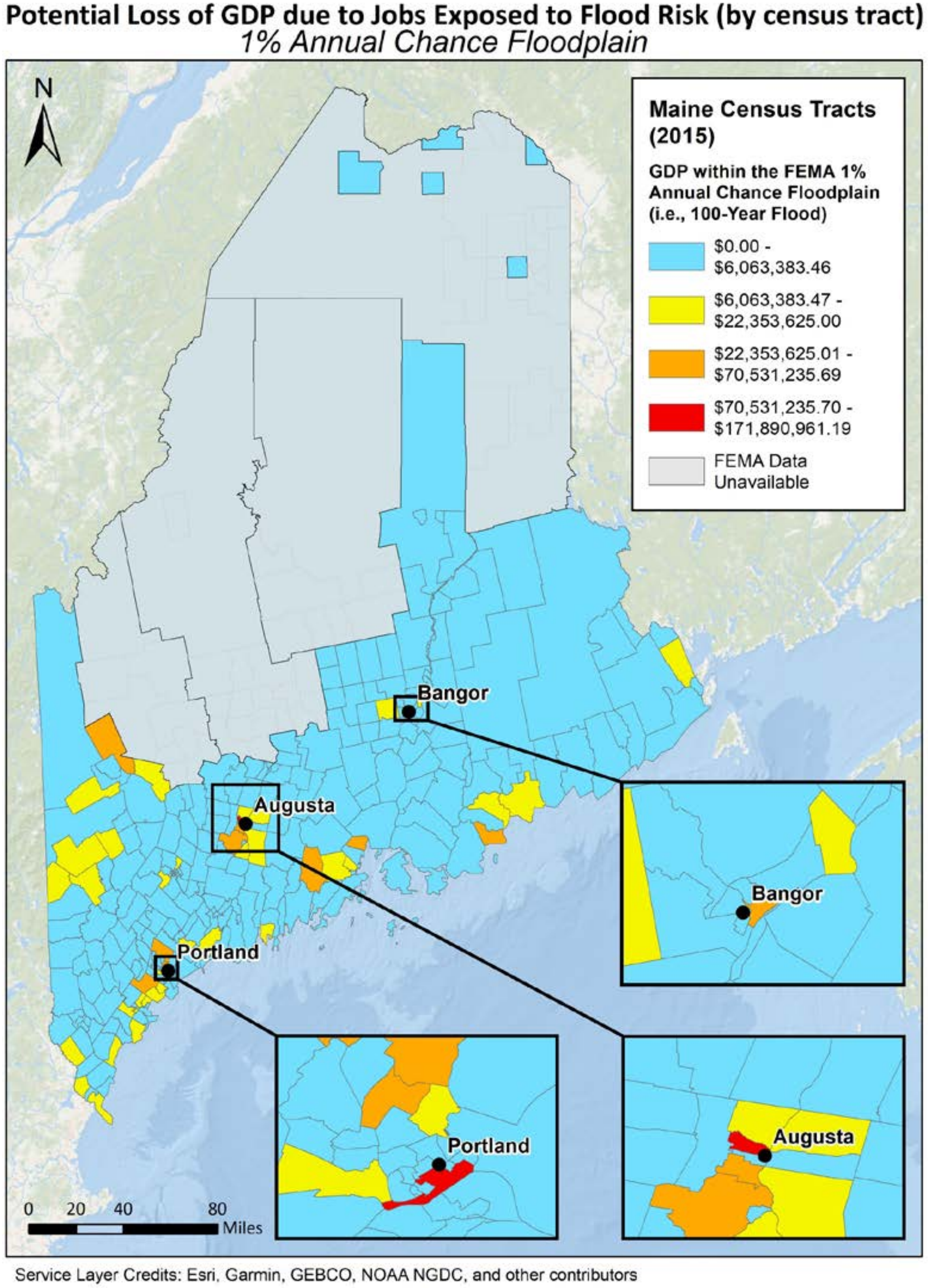
Loss of Annual GDP due to Jobs Exposed to flooding:
HAT + 8.8 ft SLR

- **Key message:**
  - **Loss of jobs due to sea level and storm surge flooding represents a potential loss of GDP. These impacts reach inland due to tidal influence in lower river stretches.**
  - **This potential statewide GDP loss amounts to $2,415,031,308.**
- Data:
  - Employment and jobs data were obtained from InfoUSA.
  - Sea Level Rise scenario data were obtained from the Maine Geological Survey.
- Limitations
  - GDP per job was calculated for each industry and each county. There were some limits to these calculations as employee GDP data was not available for every facility. In these cases, county GDP averages were applied; if necessary, a statewide average was applied.



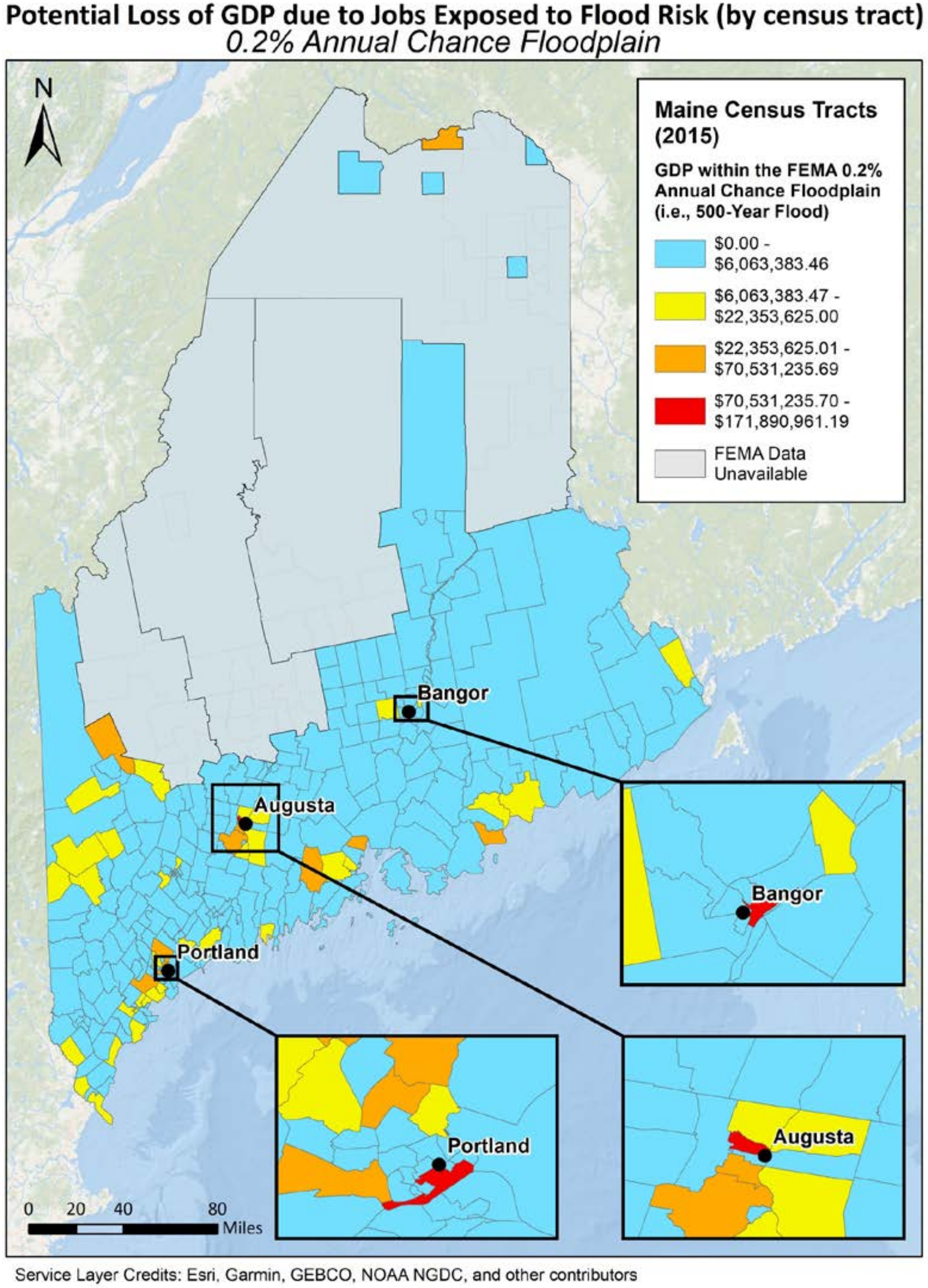
Loss Annual of GDP due to Jobs Exposed to flooding:
1% Annual Chance Flood

- **Key message:**
  - **Loss of jobs within the 1% annual chance floodplain represents a loss of GDP.**
  - **This potential statewide GDP loss amounts to $1,197,487,410.**
- Data:
  - Employment and jobs data were obtained from InfoUSA.
  - Floodplain data was acquired from FEMA's National Flood Hazard Layer and the Maine Office of GIS's Flood Insurance Rate Map (FIRM) Q3 Data.
- Limitations
  - GDP per job was calculated for each industry and each county. There were some limits to these calculations as employee GDP data was not available for every facility. In these cases, county GDP averages were applied; if necessary, a statewide average was applied.
  - FEMA flood hazard data was unavailable for a subset of counties.



Loss of Annual GDP due to Jobs Exposed to flooding:
0.2% Annual Chance Flood

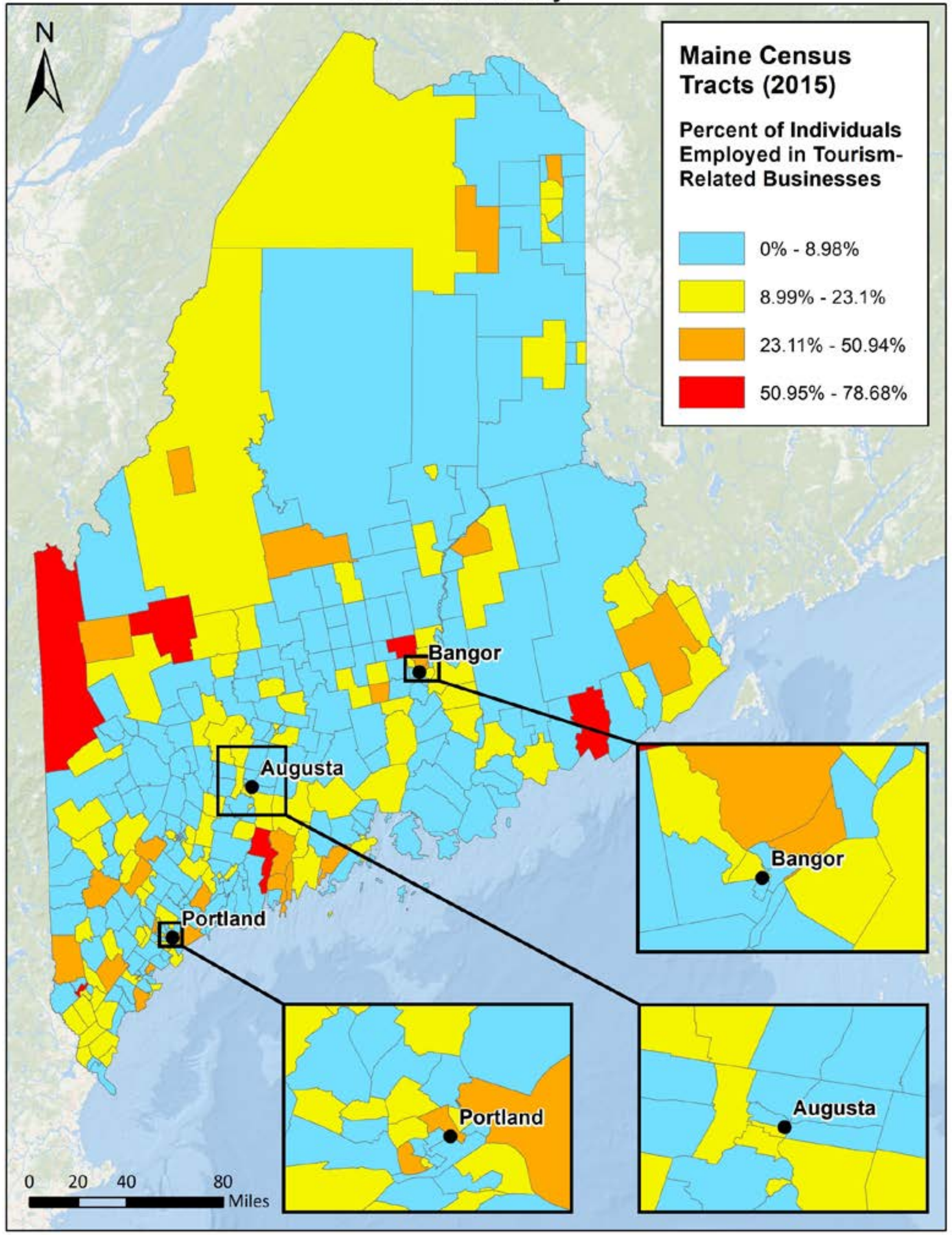
- **Key message:**
  - **Loss of jobs within the 0.2% annual chance floodplain represents a loss of GDP.**
  - **This potential statewide GDP loss amounts to $1,449,214,475**
- Data:
  - Employment and jobs data were obtained from InfoUSA.
  - Floodplain data was acquired from FEMA's National Flood Hazard Layer and the Maine Office of GIS's Flood Insurance Rate Map (FIRM) Q3 Data.
- Limitations
  - GDP per job was calculated for each industry and each county. There were some limits to these calculations as employee GDP data was not available for every facility. In these cases, county GDP averages were applied; if necessary, a statewide average was applied.
  - FEMA flood hazard data was unavailable for a subset of counties.



Natural resource sector jobs:
Tourism

- **Key message:**
  - **Understanding distribution of jobs by sector can help decide how to target economic analysis and adaptation strategies.**
- Data:
  - Employment and jobs data from InfoUSA.
  - The Tourism sector, as defined here, includes all businesses and activity within the coastal tourism and recreation category (as defined by NOAA) as well as other tourism industries like sightseeing transportation, tour operators, convention and visitor bureaus, other arts and entertainment, and other accommodation and food services not captured by NOAA's coastal Tourism & Recreation definition.
    - NAICS codes are listed in notes.
- Limitations
  - Size of businesses (number of employees) is not available for all listings within InfoUSA.

Relative Employment by Census Tract
Tourism Industry



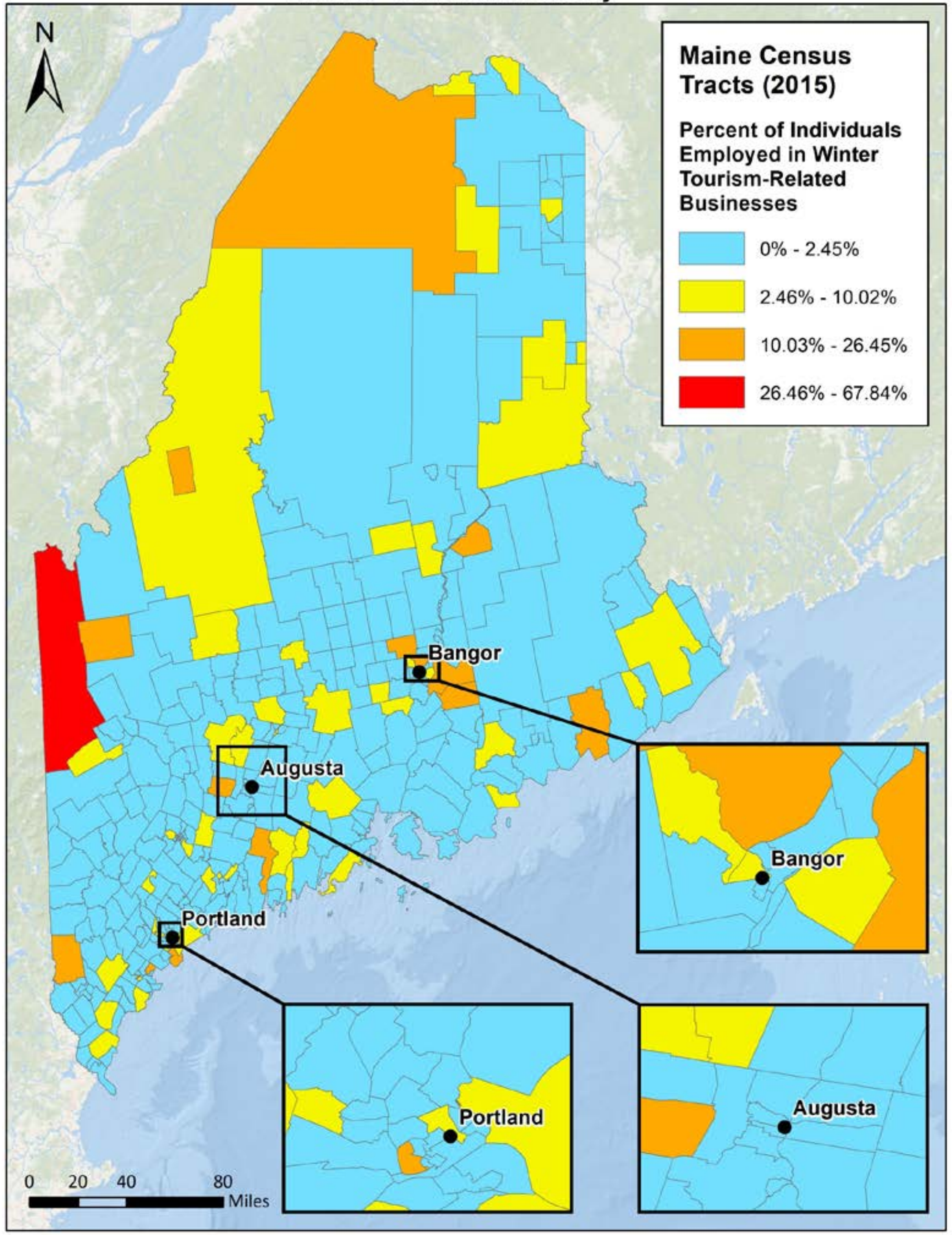
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Natural resource sector jobs:
Winter Tourism

- **Key message:**
  - **Understanding distribution of jobs by sector can help us decide how to target economic analysis and adaptation strategies.**
- Data:
  - Employment and jobs data from InfoUSA.
  - The Winter Tourism sector, as defined here, includes all businesses and activity from sporting and recreation goods stores, athletic goods manufacturing, sports and recreation instruction, skiing facilities, snowmaking, hotels, snow-related transportation equipment manufacturing (snowmobiles), and snowmobile racetracks.
    - NAICS codes are listed in notes.
    - Separate category from "Tourism."
- Limitations
  - Size of businesses (number of employees) is not available for all listings within InfoUSA.

Relative Employment by Census Tract

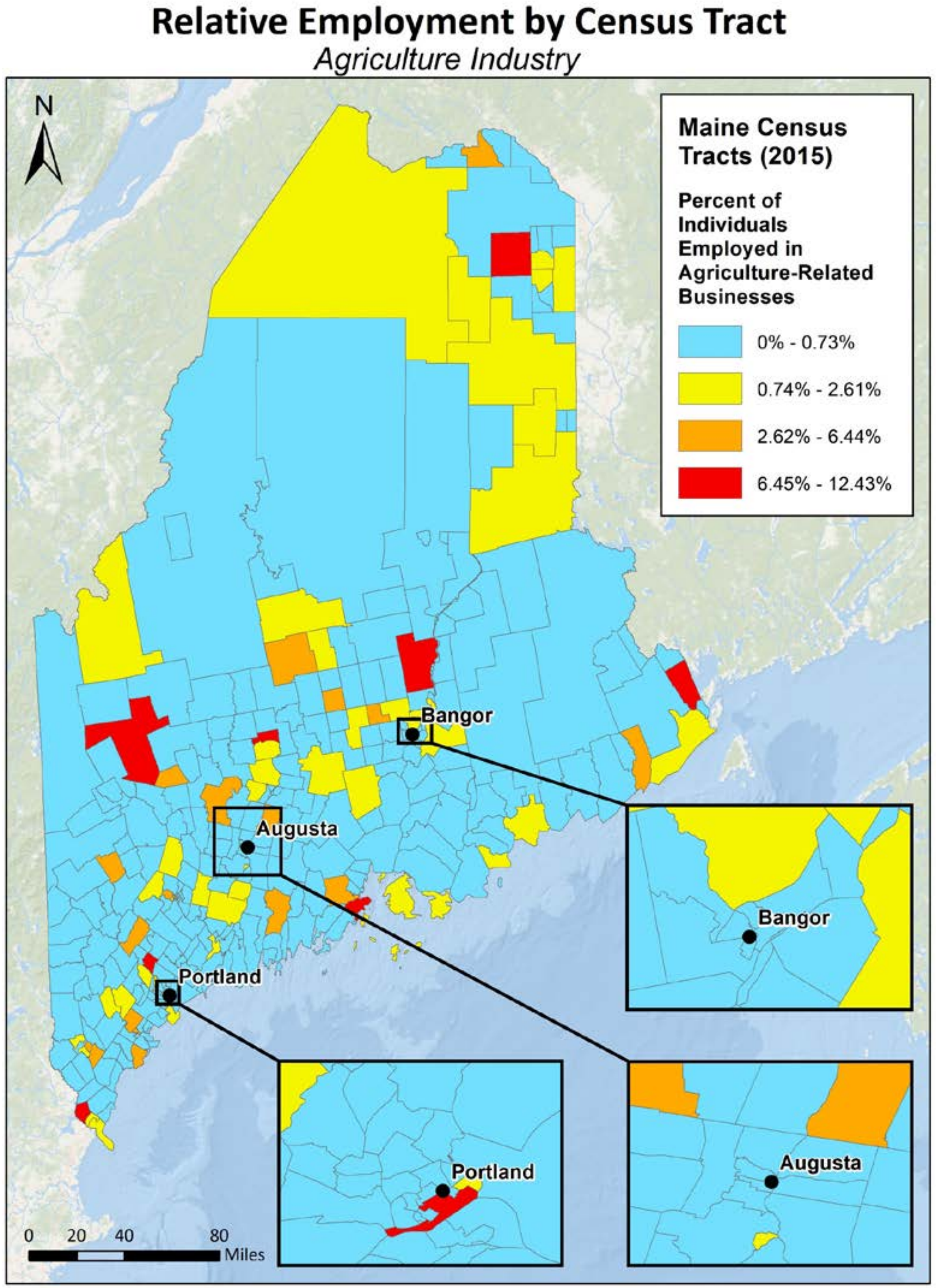
Winter Tourism Industry



Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Natural resource sector jobs:
Agriculture

- **Key message:**
  - **Understanding distribution of jobs by sector can help us decide how to target economic analysis and adaptation strategies.**
- Data:
  - Employment and jobs data from InfoUSA.
  - The Agriculture sector, as defined here, includes all businesses and activity within the NAICS codes that involve crop production, animal production, aquaculture, farm labor contractors, farm machinery manufacturing and wholesalers, farm management services, and farm supply stores.
    - NAICS codes are listed in notes.
- Limitations
  - Size of businesses (number of employees) is not available for all listings within InfoUSA.

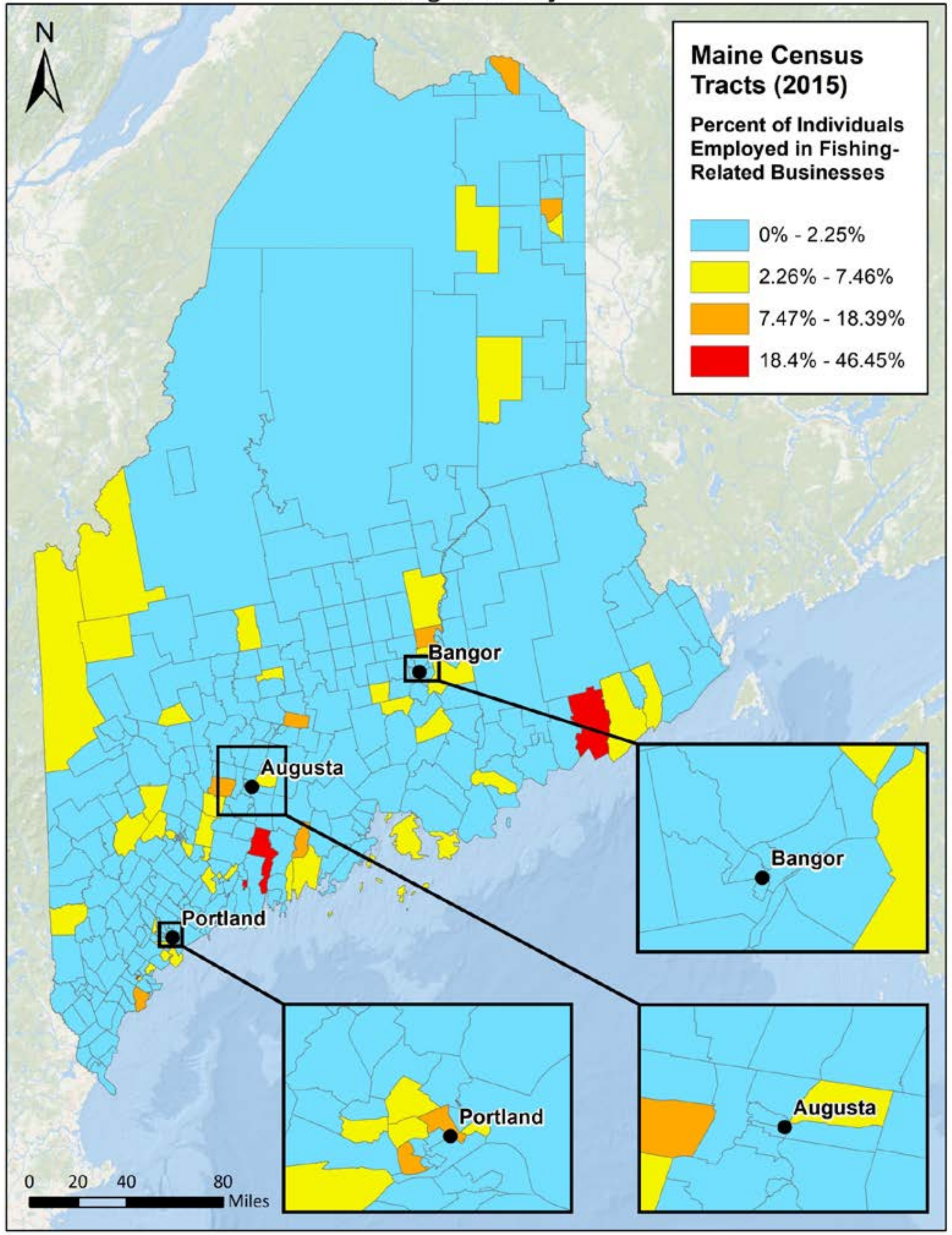


Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Natural resource sector jobs:
Fishing

- **Key message:**
  - **Understanding distribution of jobs by sector can help us decide how to target economic analysis and adaptation strategies.**
- Data:
  - Employment and jobs data from InfoUSA.
  - The Fishing sector, as defined here, includes all businesses and activity in the fishing, hunting and trapping industry, fishing goods manufacturing and sales, ship building and repair, fishing boat charter operations, recreational fishing clubs, and fishing advocacy organizations.
    - NAICS codes are listed in notes.
- Limitations
  - Size of businesses (number of employees) is not available for all listings within InfoUSA.

Relative Employment by Census Tract
Fishing Industry

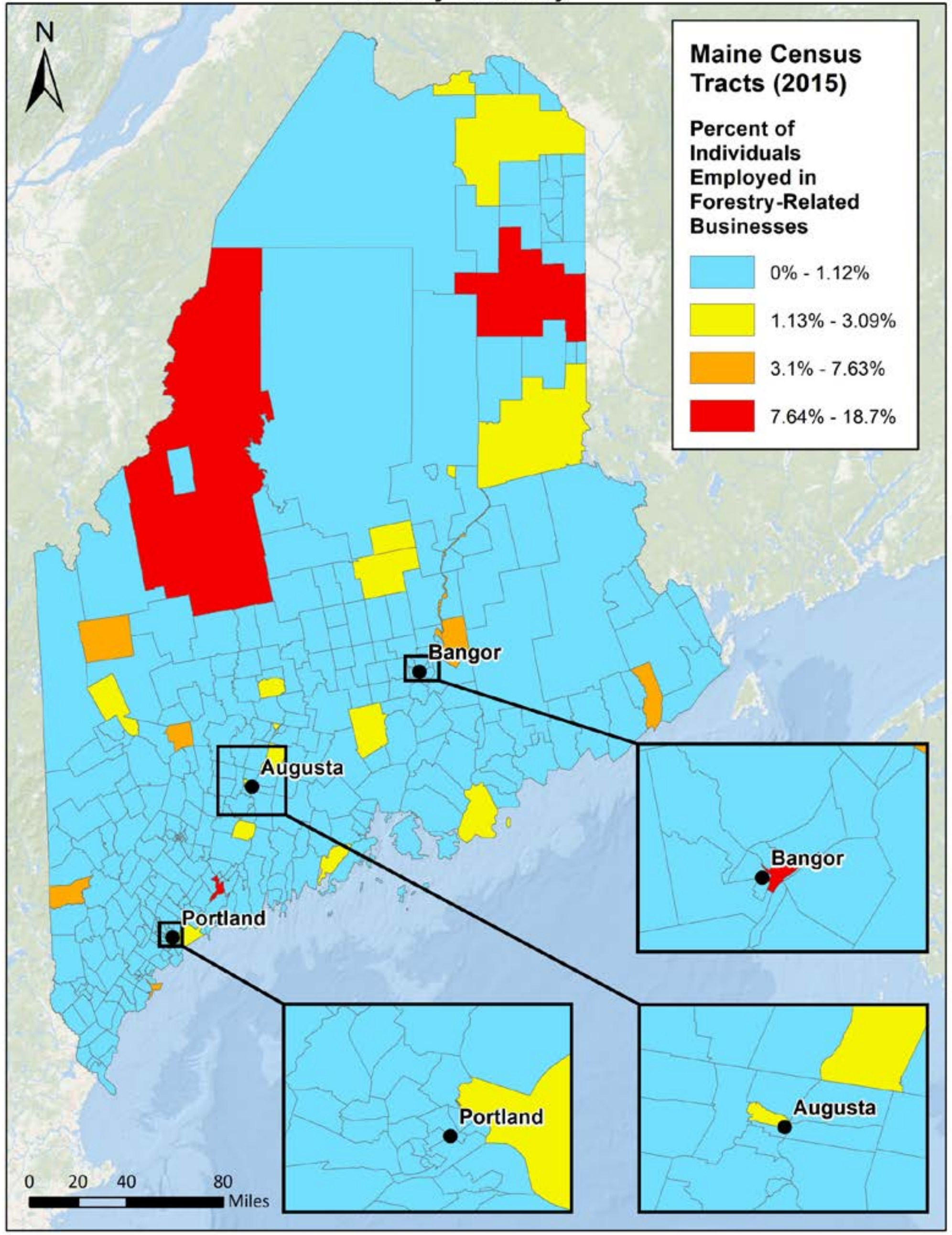


Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Natural resource sector jobs: Forestry

- **Key message:**
  - **Understanding distribution of jobs by sector can help us decide how to target economic analysis and adaptation strategies.**
- Data:
  - Employment and jobs data from InfoUSA.
  - The Forestry sector, as defined here, includes all businesses and activity within the NAICS codes that involve forestry and logging; forestry services; forestry equipment wholesale, leasing, and maintenance; and forestry research.
    - NAICS codes are listed in notes.
- Limitations
  - Size of businesses (number of employees) is not available for all listings within InfoUSA.

Relative Employment by Census Tract
Forestry Industry



Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Natural resource sector jobs: Exposure to flood risk

Flood Hazard Scenario	Number of Employees Impacted by Natural Resource Industry			
	Forestry	Agriculture	Tourism	Winter Tourism
1.6 ft Sea Level Rise	0	0	331	0
3.9 ft Sea Level Rise	0	12	1,699	384
8.8 ft Sea Level Rise	30	39	4,966	1,251
FEMA 1% Annual Chance Floodplain (i.e., 100-Year Flood)	6	28	2,818	425
FEMA 0.2% Annual Chance Floodplain (i.e., 500-Year Flood)	8	28	3,196	486

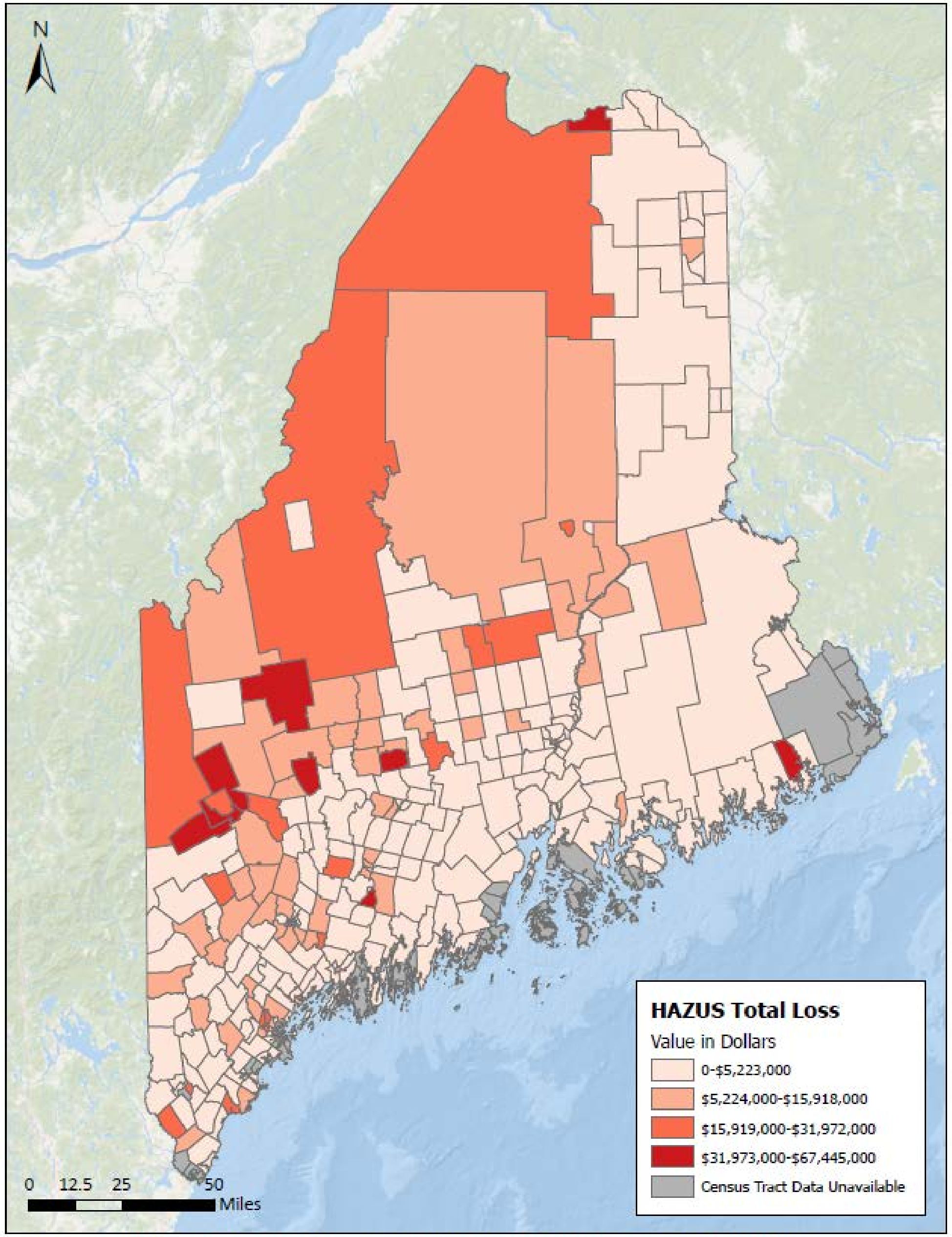
- **Key message:**
  - **Natural resource jobs are at risk to flooding due to sea level, storm surge, and riverine flooding, with the greatest number of tourism jobs facing flood risks.**
- Data:
  - Employment and jobs data were obtained from InfoUSA.
  - Sea Level Rise scenario data were obtained from the Maine Geological Survey.
  - Floodplain data was acquired from FEMA’s National Flood Hazard Layer and the Maine Office of GIS’s Flood Insurance Rate Map (FIRM) Q3 Data.
- Limitations
  - Size of businesses (number of employees) is not available for all listings within InfoUSA.

III. Buildings and Infrastructure Vulnerability

Building Losses Due to Riverine Flooding

- **Key message**
  - **Building damages can amount to major losses in rural areas and smaller towns as the floodplain runs through a variety of valuable assets (e.g. University of Maine Kent, major agricultural areas, and towns catering to tourism).**
- Data
  - FEMA's Hazus model, a nationally applied method for estimating potential losses from floods, hurricanes, and earthquakes.
  - Used model to calculate
    - Building loss: repair and replacement costs for building damage based on building type
    - Contents loss: damages to supplies that are not integral to the building structure, such as furniture or computers;
    - Inventory loss: loss in inventory value for a business based on its type of occupancy, area, and sales/production
- Limitations
  - This model does not project future riverine flood risk.
  - Coastal and riverine building floods were modeled separately so inland and coastal impacts must be visualized separately.

Building, Content, and Inventory Losses from a 1 Percent Annual Chance Riverine Flood

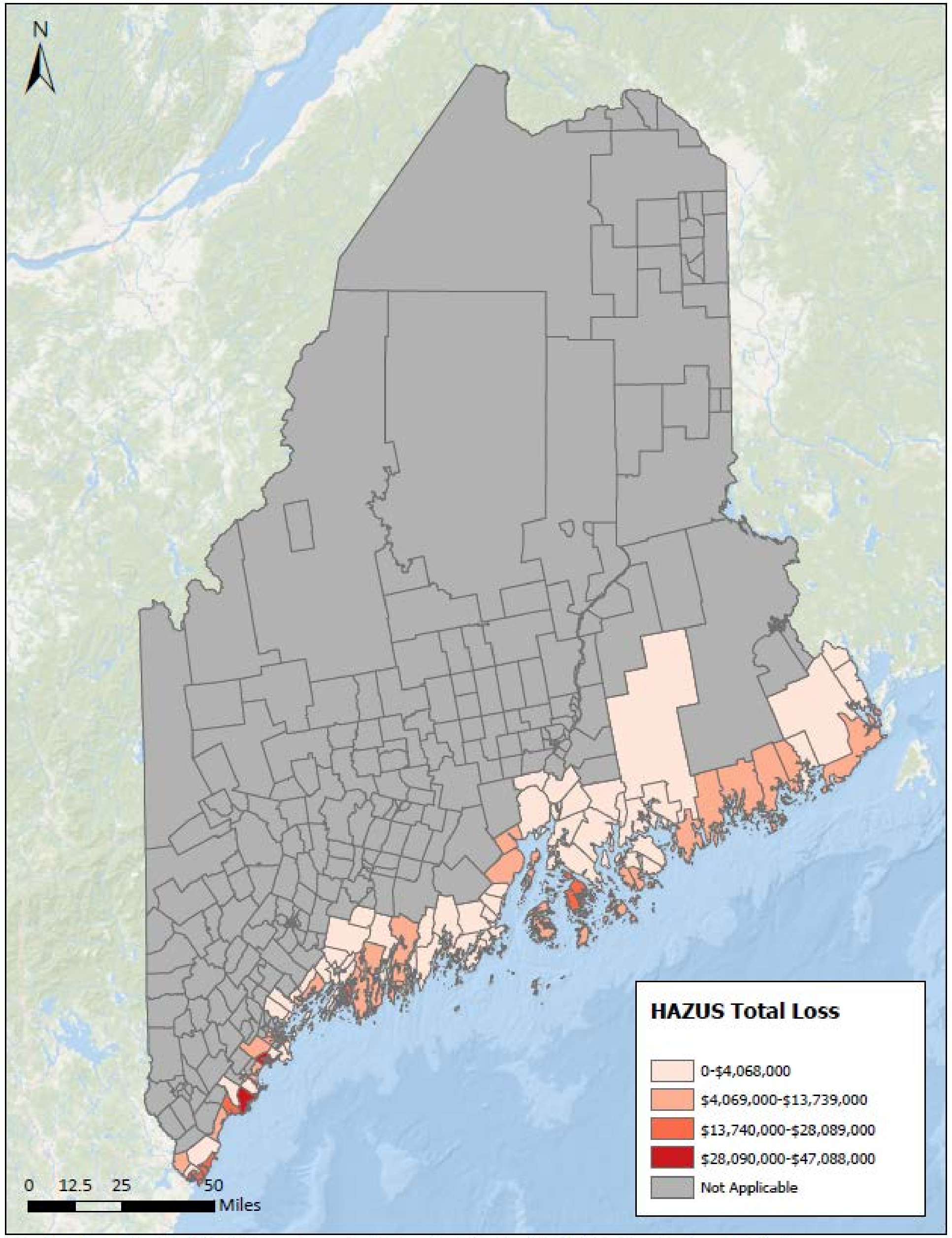


Service Layer Credits: World Ocean Base: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Building Losses Due to Coastal Flooding

- **Key message**
  - **Highest losses are along the southern coast.**
- Data
  - FEMA's Hazus model, a nationally applied method for estimating potential losses from floods, hurricanes, and earthquakes.
  - Used model to calculate
    - Building loss: repair and replacement costs for building damage based on building type
    - Contents loss: damages to supplies that are not integral to the building structure, such as furniture or computers;
    - Inventory loss: loss in inventory value for a business based on its type of occupancy, area, and sales/production
  - 1% annual chance flood based on Still Water Elevation (SWEL)
- Limitations
  - Coastal and riverine building floods were modeled separately so inland and coastal impacts must be visualized separately.

Building, Content, and Inventory Losses from a 1 Percent Annual Chance Coastal Flood



Service Layer Credits: World Ocean Base: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Building damages: Exposure to flood risk

Flood Hazard Scenario	Combined Loss (2018$)
HAT + 1.6 ft Sea Level Rise	$512,097,000
HAT+ 3.9 ft Sea Level Rise	$671,024,000
HAT + 8.8 ft Sea Level Rise	$1,280,389,000
1% Annual Chance Floodplain (riverine)	$610,090,000
1% Annual Chance Floodplain (coastal)	$1,805,784,000

- **Key message**
  - **Building damages from flooding could represent a large loss to the state. These estimates for losses under sea level rise scenarios are likely an underestimate.**
- Data
  - FEMA's Hazus model as noted on the previous slide.
- Limitations
  - In the case of sea level rise, the percent damage likely underestimates the replacement cost for assets that experience low depth but permanent flooding (as repair will not be an option). As such, the scenarios below showing loss due to flooding at a total water level of HAT plus 1.6 feet, 3.9 feet, and 8.8 feet are likely an underestimate compared to the total value that would be lost to permanent inundation from sea level rise at these water levels.

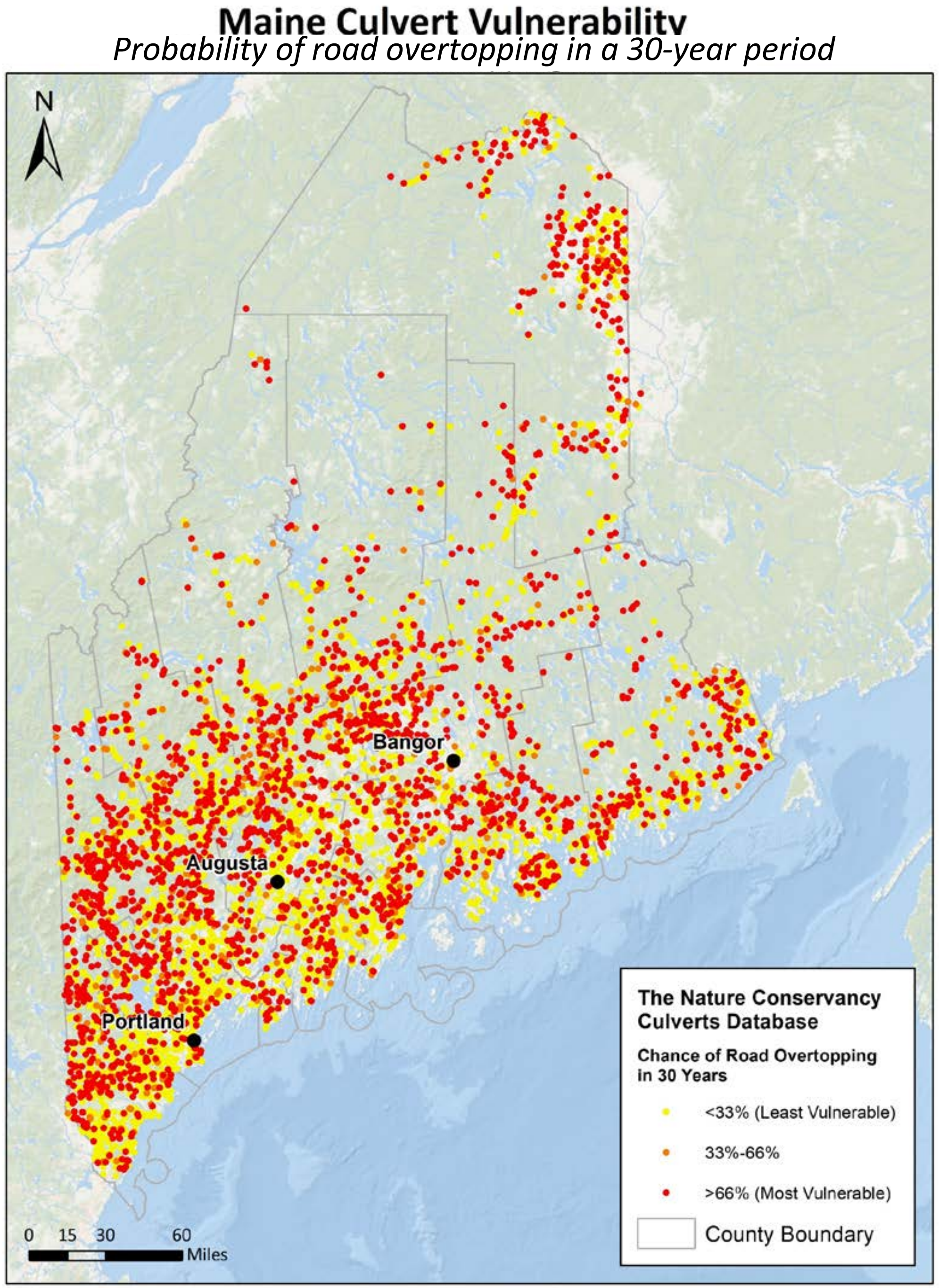
Transportation Infrastructure: Exposure to flood risk

Flood Hazard Scenario	Infrastructure Type Impacted			
	Public Roads (miles)	Railroads (miles)	Airports (total number)	Ports (name)
1.6 ft Sea Level Rise	26	7	0	
3.9 ft Sea Level Rise	116	23	0	Portland Eastport
8.8 ft Sea Level Rise	336	61	0	Searsport
FEMA 1% Annual Chance Floodplain (i.e., 100-Year Flood)	675	163	26	
FEMA 0.2% Annual Chance Floodplain (i.e., 500-Year Flood)	744	178	27	

- **Key message**
  - **Data on exposure of transportation assets can support calculations of the "cost of no action."**
- Data
  - Port, rail, public road centerline, and airport data from Maine Department of Transportation.
  - Sea Level Rise scenario data were obtained from the Maine Geological Survey.
  - Floodplain data was acquired from FEMA's National Flood Hazard Layer and the Maine Office of GIS's Flood Insurance Rate Map (FIRM) Q3 Data.
- Limitations
  - Unable to assess exposure of bridges due to lack of elevation data (more detailed study needed).

Culverts vulnerable to riverine and stream flow events

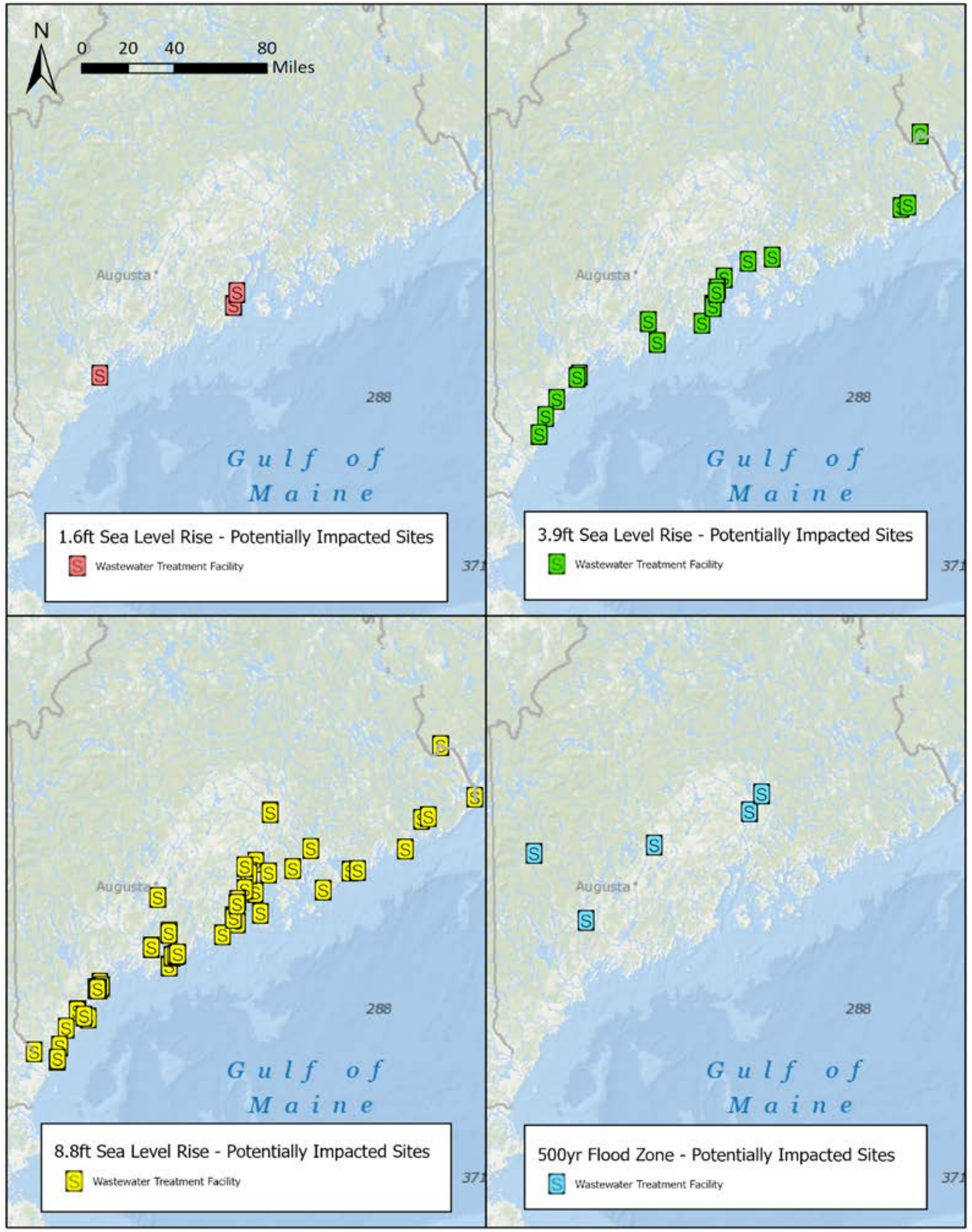
- **Key message**
  - **Many culverts across the state have a greater than 66% chance of overtopping within the next 30 years (25-year or less recurrence interval flows).**
  - **Data on potential overtopping can support calculations of potential damages to culverts during flow events.**
- Data
  - Culvert flood risk data was provided by The Nature Conservancy. Please contact Ben Matthews at (benjamin.matthews@tnc.org) with data questions.
- Limitations
  - Map only shows risk to culvert risk public roads and perennial streams (crossing on private lands are excluded). Data were not gathered on drainage culverts (<18 inches) or crossings without an active stream channel.
  - Flood risk estimates do not account for changing flow regimes due to climate change.



Wastewater treatment plants vulnerable to sea level rise

- **Key message**
  - **Of the many wastewater treatment plants vulnerable to future sea level rise, the Emergency Management Group has selected 10 as top priorities for near-term action.**
- Data
  - Wastewater treatment plant vulnerability data was provided by Maine Department of Environmental Protection.
- Limitations
  - Some wastewater treatment plant assets may be vulnerable at higher probability near-term scenarios, or vice versa (mapped at-risk with lower level of sea level rise but not vulnerable until higher level of sea level rise). Site characteristics not always accounted for.

Wastewater Treatment Plants Exposed to Sea Level Rise



Service Layer Credits: World Ocean Reference: Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors

Conclusion

- This mapping exercise helped to focus the *Cost of Doing Noting Analysis (Volume 2)* which provides estimated losses that the State of Maine and its citizens could incur if the State does not adapt to climate change and make its own contributions to reducing the extent of climate change. This mapping exercise also provided critical spatial information to support the analyses.
- Please see *Volume 2* to learn more.

Photo credit: Susan Bell