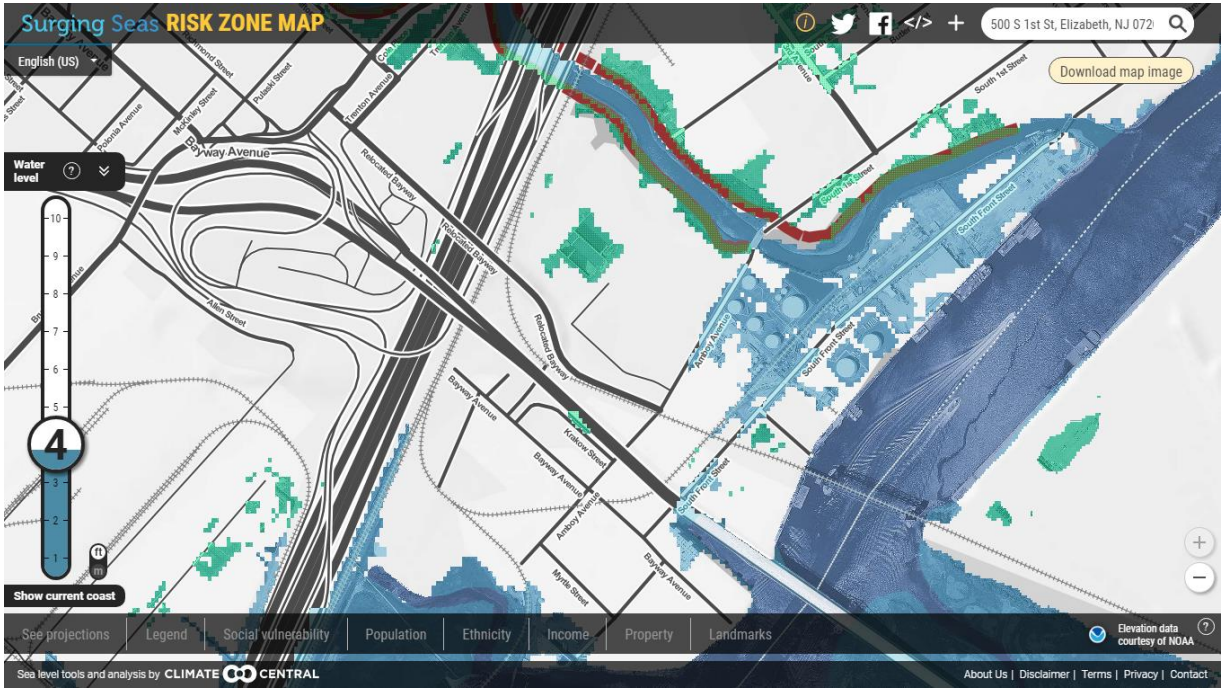
Sea Level Rise and Coastal Flood Risk in NJ: Tools & Analysis - Potential Impacts on New Jersey Authorities – A Quick Case Study



Dan Rizza - Climate Central
Rich Erickson – First Environment
NJ AEA, November 15, 2017

Superstorm Sandy
Owl's Head WWTP, NYC

FIRST ENVIRONMENT

CLIMATE CENTRAL

Superstorm Sandy
Owl's Head WWTP, NYC

FIRST ENVIRONMENT

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Hurricane Harvey

- Category 4 hurricane – landfall in southern Texas on August 25, 2017
- Dissipated by September 3, 2017
- Damages estimated around $200 billion USD
- Eight wastewater facilities declared “non-operational”
- One wastewater facility classified as “destroyed”

FIRST ENVIRONMENT

CLIMATE CENTRAL

Hurricane Harvey – Houston, TX

Turkey Creek Wastewater Treatment Plant on Sept. 5, 2017.
The wastewater plant is now fully operational.

FIRST ENVIRONMENT

CLIMATE CENTRAL

Hurricane Harvey – Houston, TX

West District Wastewater Treatment Plant during Hurricane Harvey

FIRST ENVIRONMENT

CLIMATE CENTRAL

Hurricane Irma

- Landfall in Cudjoe Key FL on September 10, 2017, after a devastating swing through the Caribbean as a Category 5 hurricane
- Catastrophic damage to Barbuda, St. Martin, Virgin Islands and others
- Damages estimated around $65 billion USD
- Largest evacuation in Florida history
- 25% of the buildings in the Keys were destroyed, 65% significantly damaged

FIRST ENVIRONMENT

CLIMATE CENTRAL

Hurricane Irma

Key Largo, Florida

FIRST ENVIRONMENT

CLIMATE CENTRAL

Hurricane Maria

- 4th Major Hurricane of 2017 Atlantic hurricane season
- Category 5 hurricane – top winds of 175 mph
- Puerto Rico landfall on September 20, 2017; with destruction of electrical grid, communications systems, and about 80% of the territory's agriculture
- Damages estimated around $51 billion USD

FIRST ENVIRONMENT

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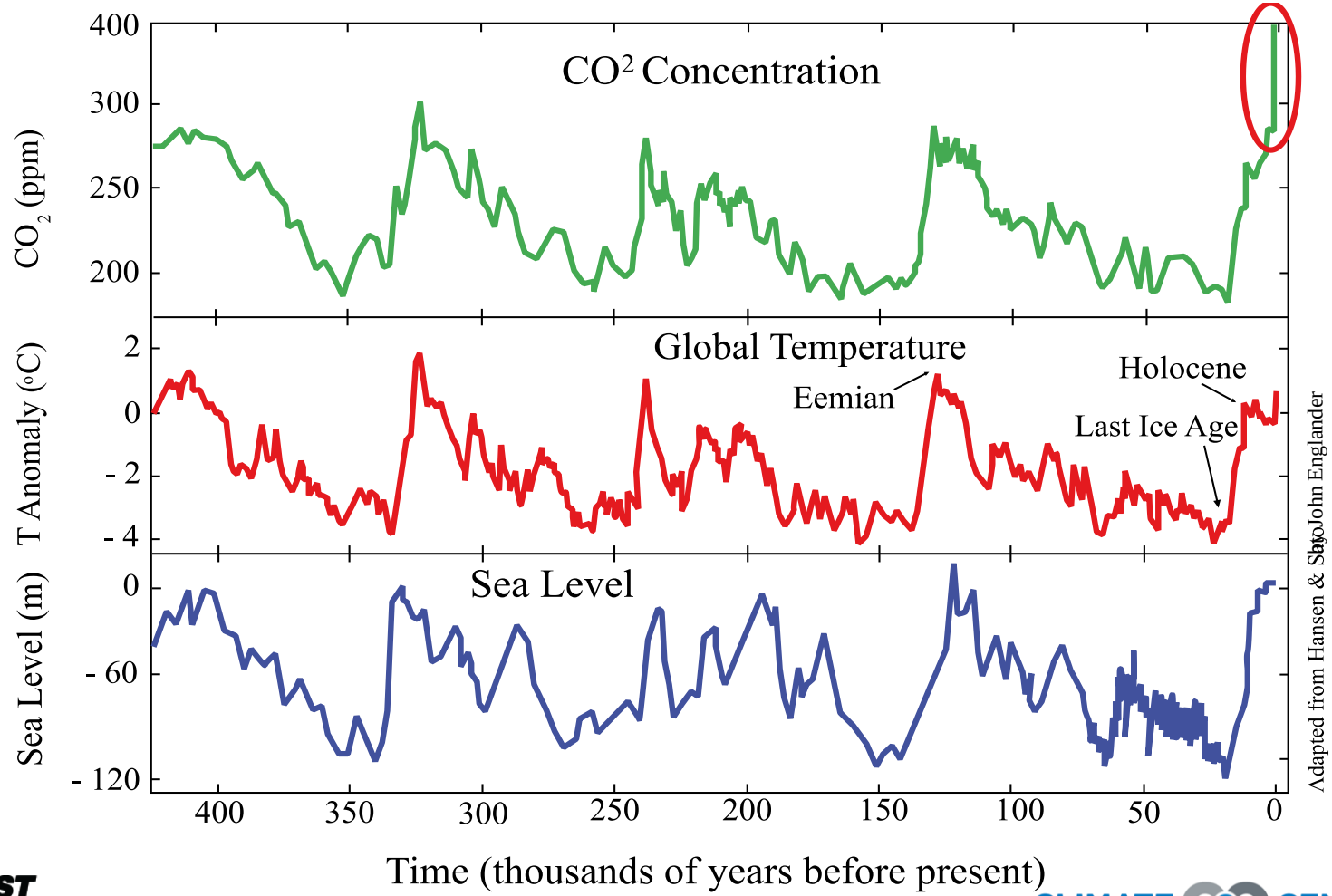
Hurricane Maria

San Juan, Puerto Rico

FIRST ENVIRONMENT

CLIMATE CENTRAL

Past



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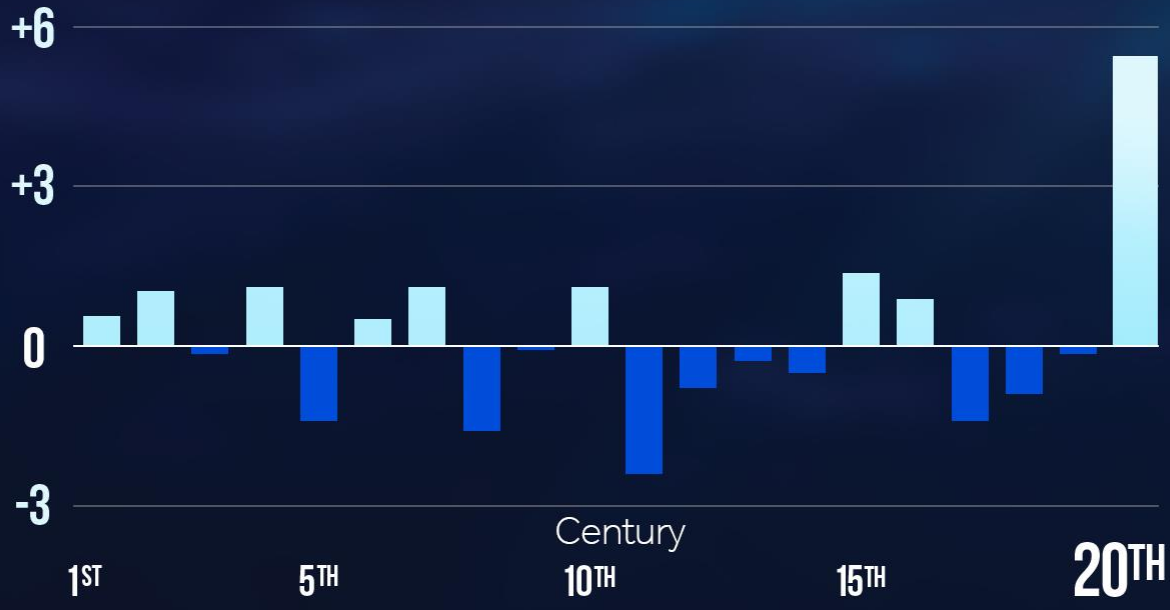
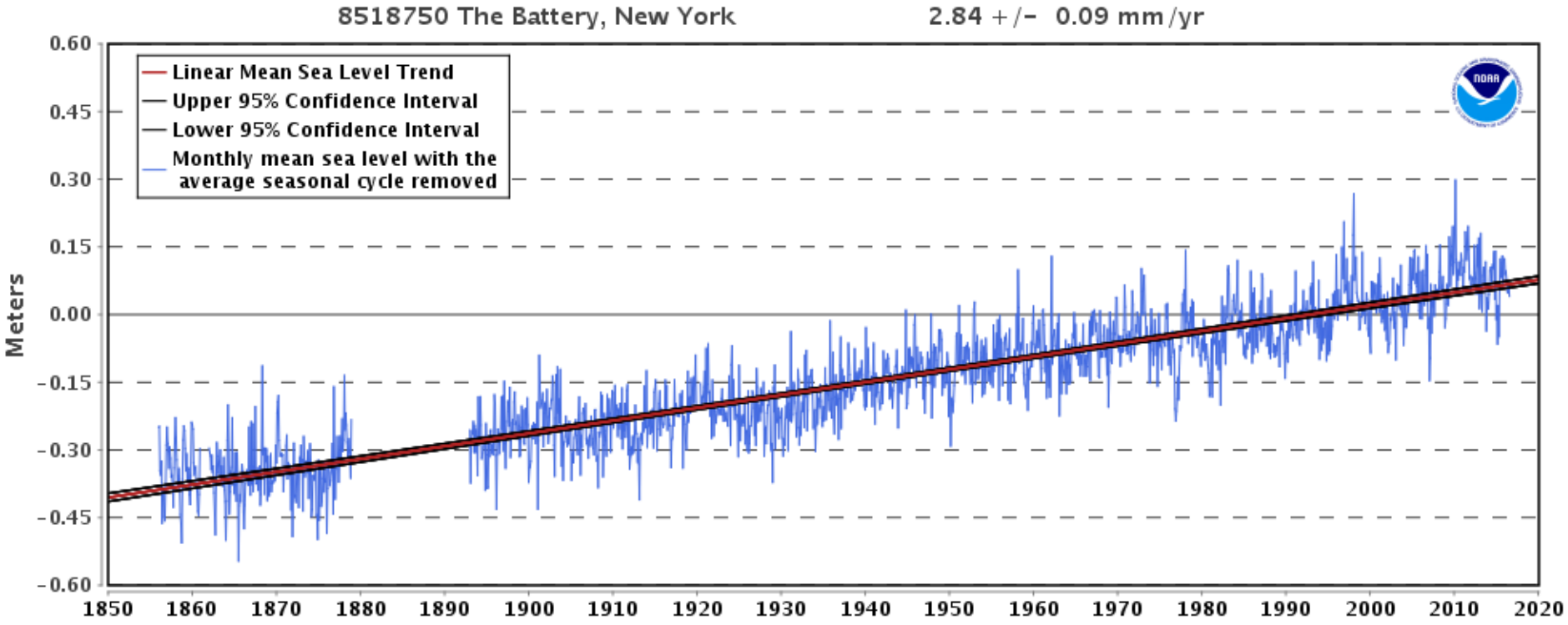
SEA LEVEL RISE

BY CENTURY



Central reconstruction shown
Source: Kopp et al. 2016 (PNAS)

CLIMATE CENTRAL



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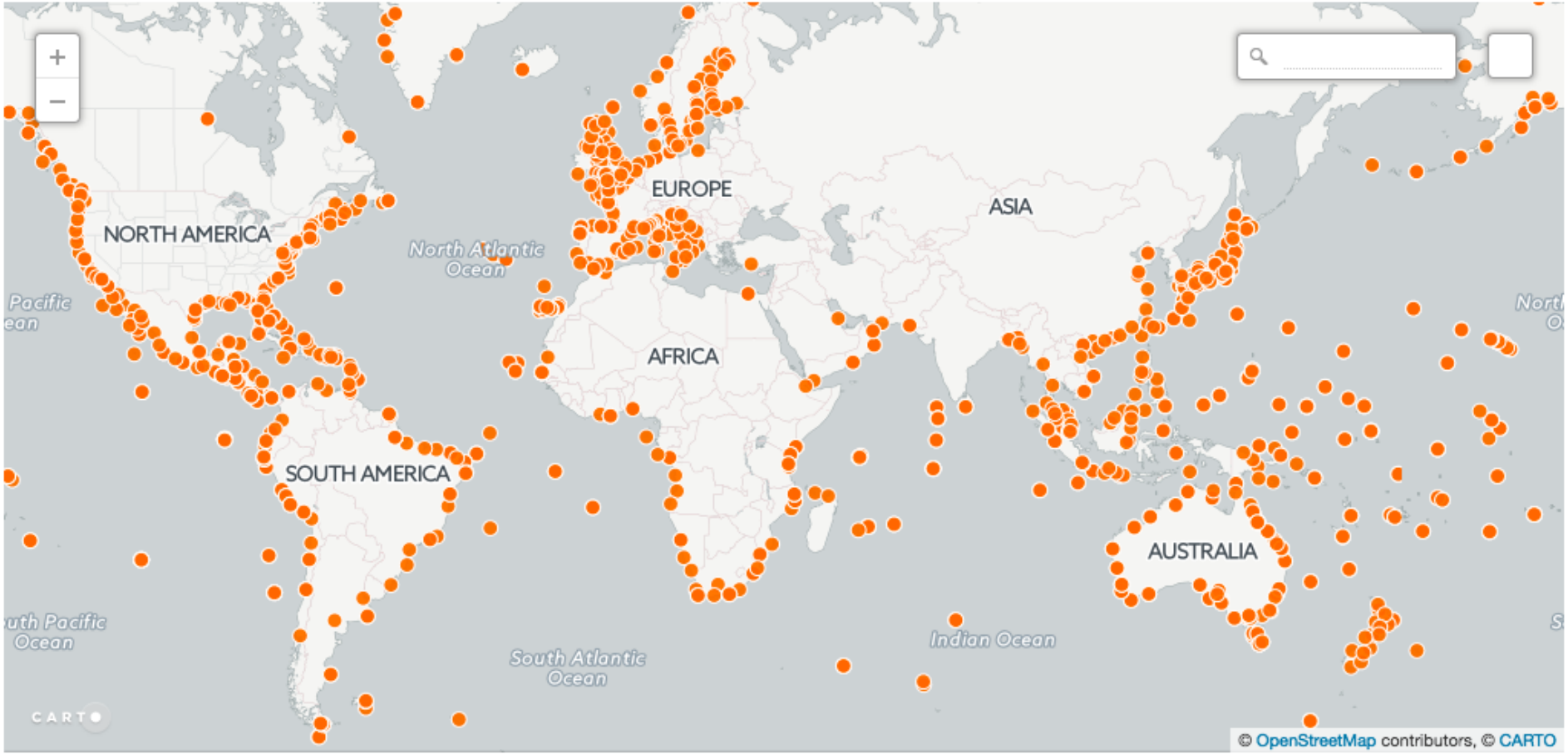

Map created by gesla

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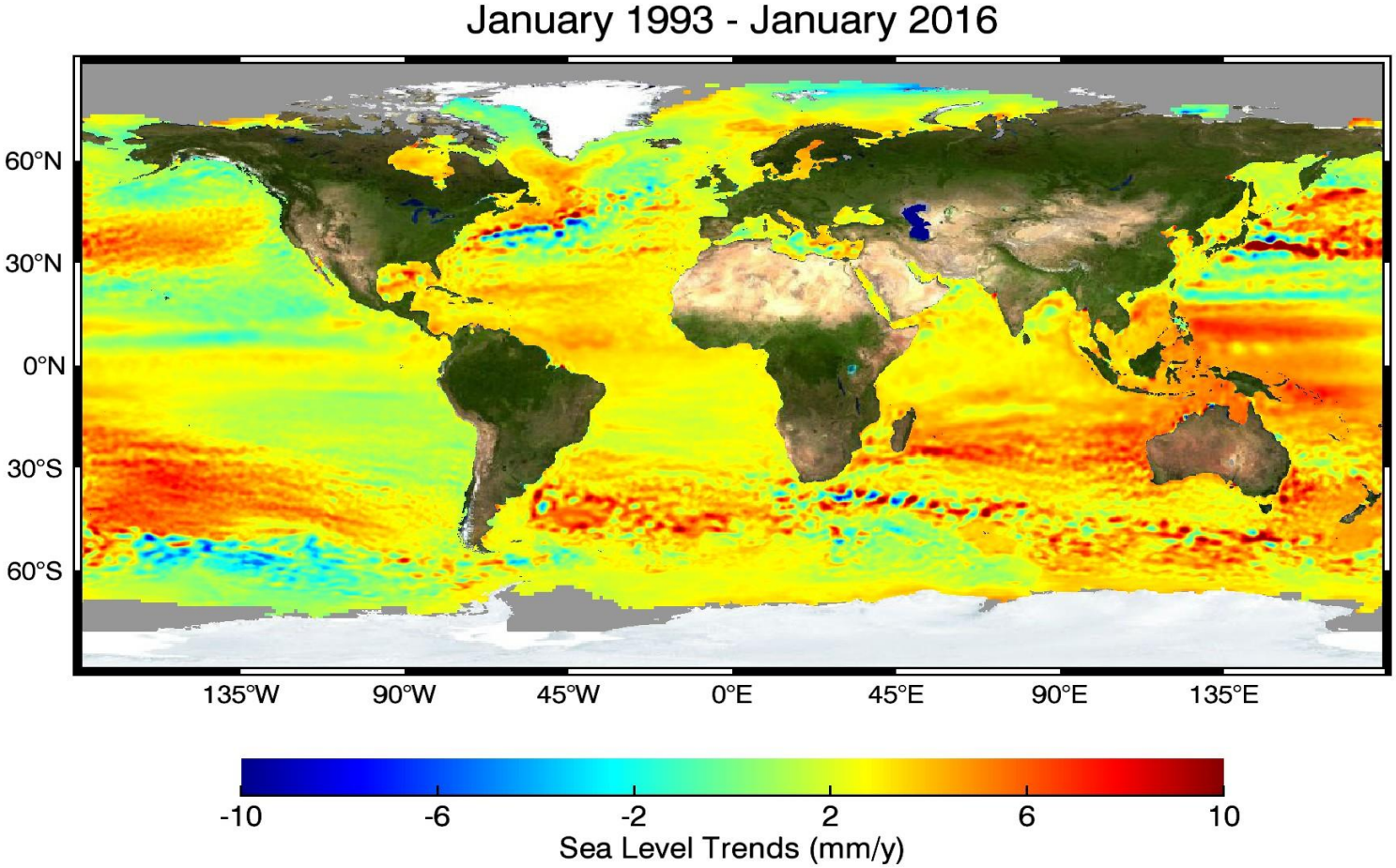
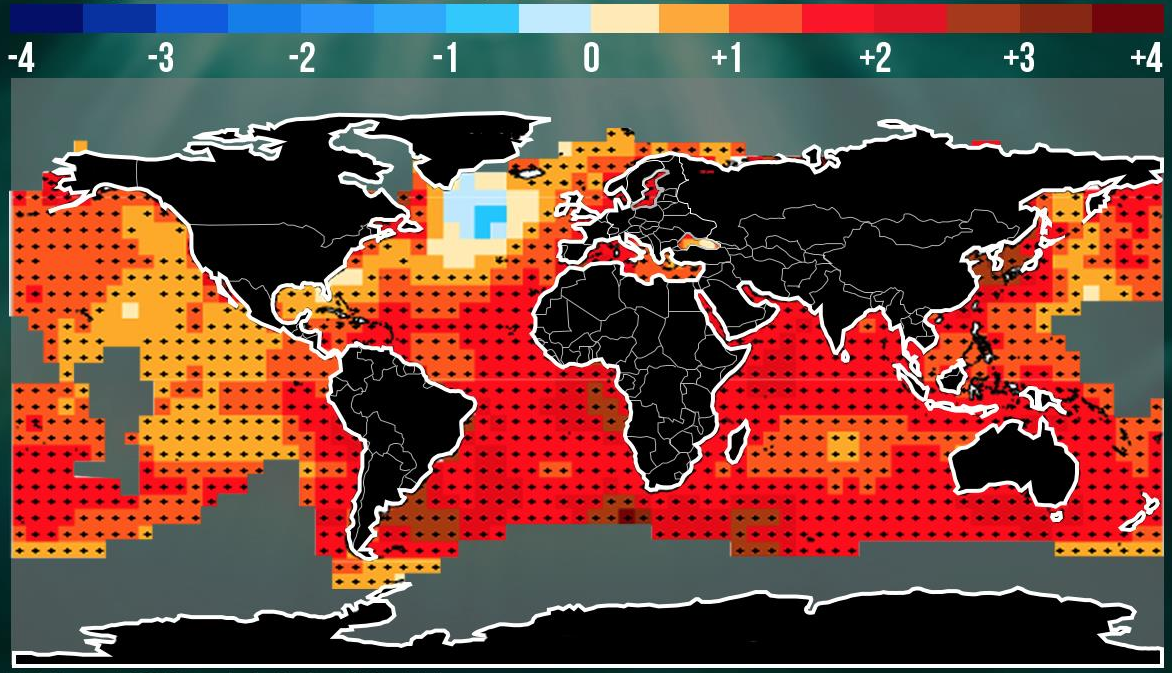


Source: NASA, https://sealevel.nasa.gov/understanding-sea-level/key-indicators/global-mean-sea-level

OCEANS HEATING UP

Change in Sea Surface Temperature (°F) Since 1901:



Data through 2014. Gray indicates insufficient data
"+" Indicates statistically significant trend
Source: IPCC, NOAA: Merged Land-Ocean Surface Temp Analysis

CLIMATE CENTRAL

Muir and Riggs Glaciers, Alaska

USGS

1941 1950 2004

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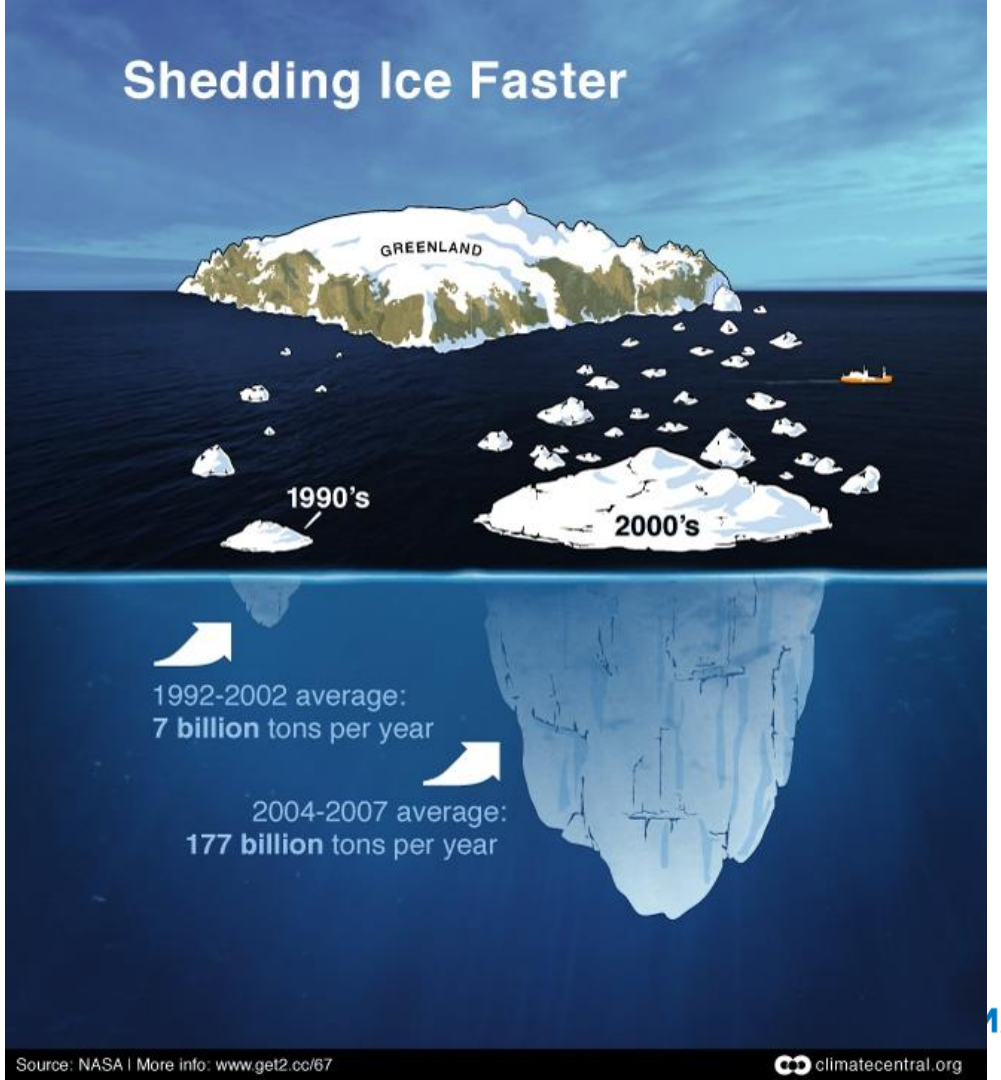
Shedding Ice Faster
GREENLAND
1990's
2000's
1992-2002 average:
7 billion tons per year
2004-2007 average:
177 billion tons per year
Source: NASA | More info: www.get2.cc/67
climatecentral.org

Present

John Upton, Climate Central

UNNATURAL COASTAL FLOODS:

Sea level rise and the human fingerprint on U.S. floods since 1950

February 2016

FIRST ENVIRONMENT

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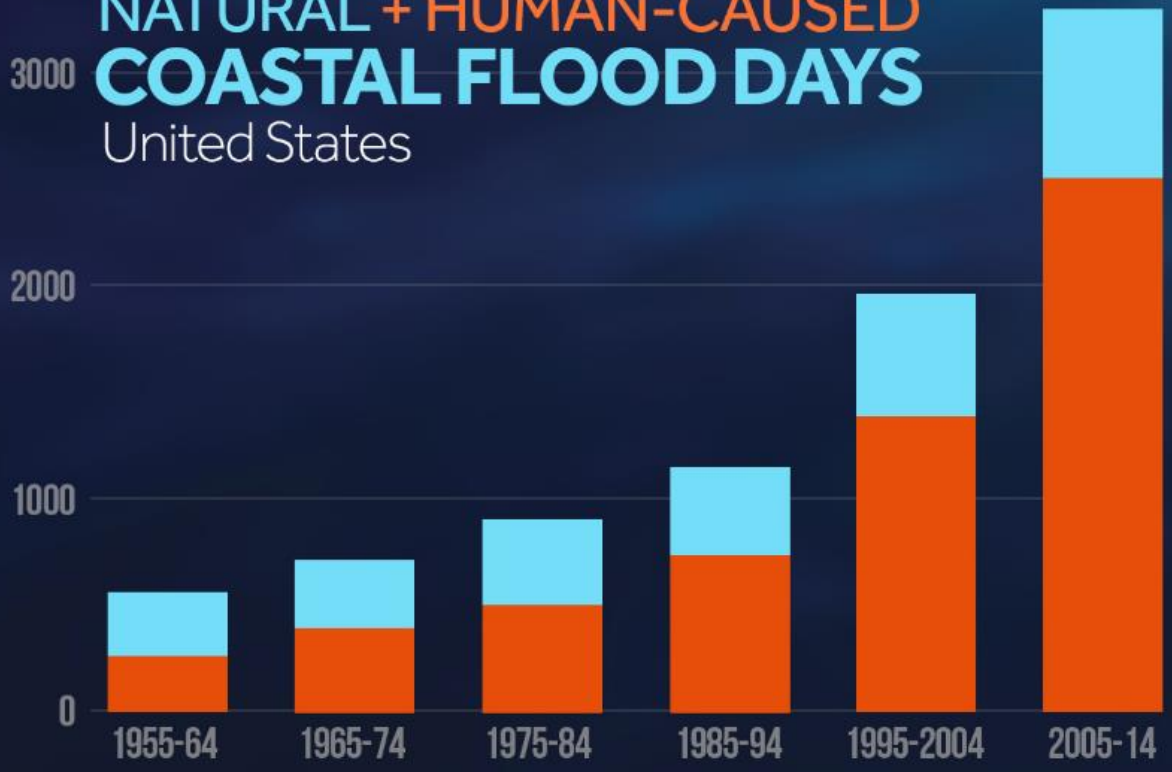
NATURAL + HUMAN-CAUSED COASTAL FLOOD DAYS

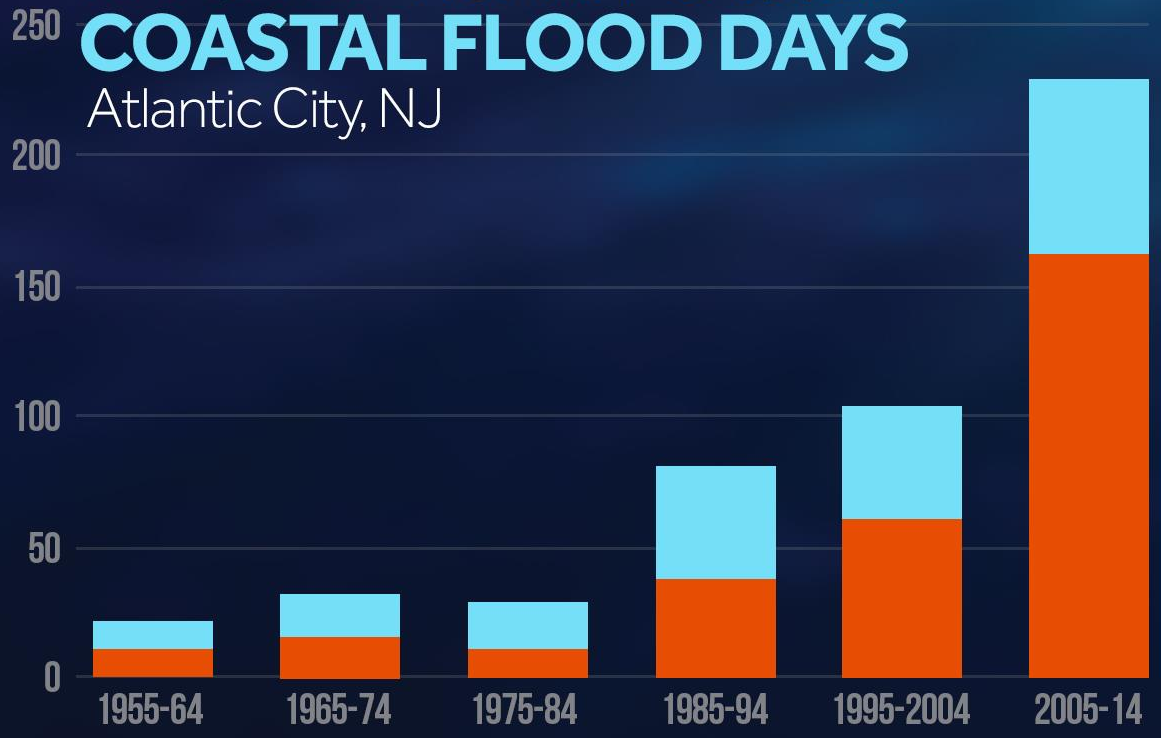
United States



Orange shows human-caused global sea level rise effects
Floods totaled across 27 sites; must top NWS 'nuisance' thresholds
Source: Kopp et al. 2016 (PNAS), NOAA, & Climate Central

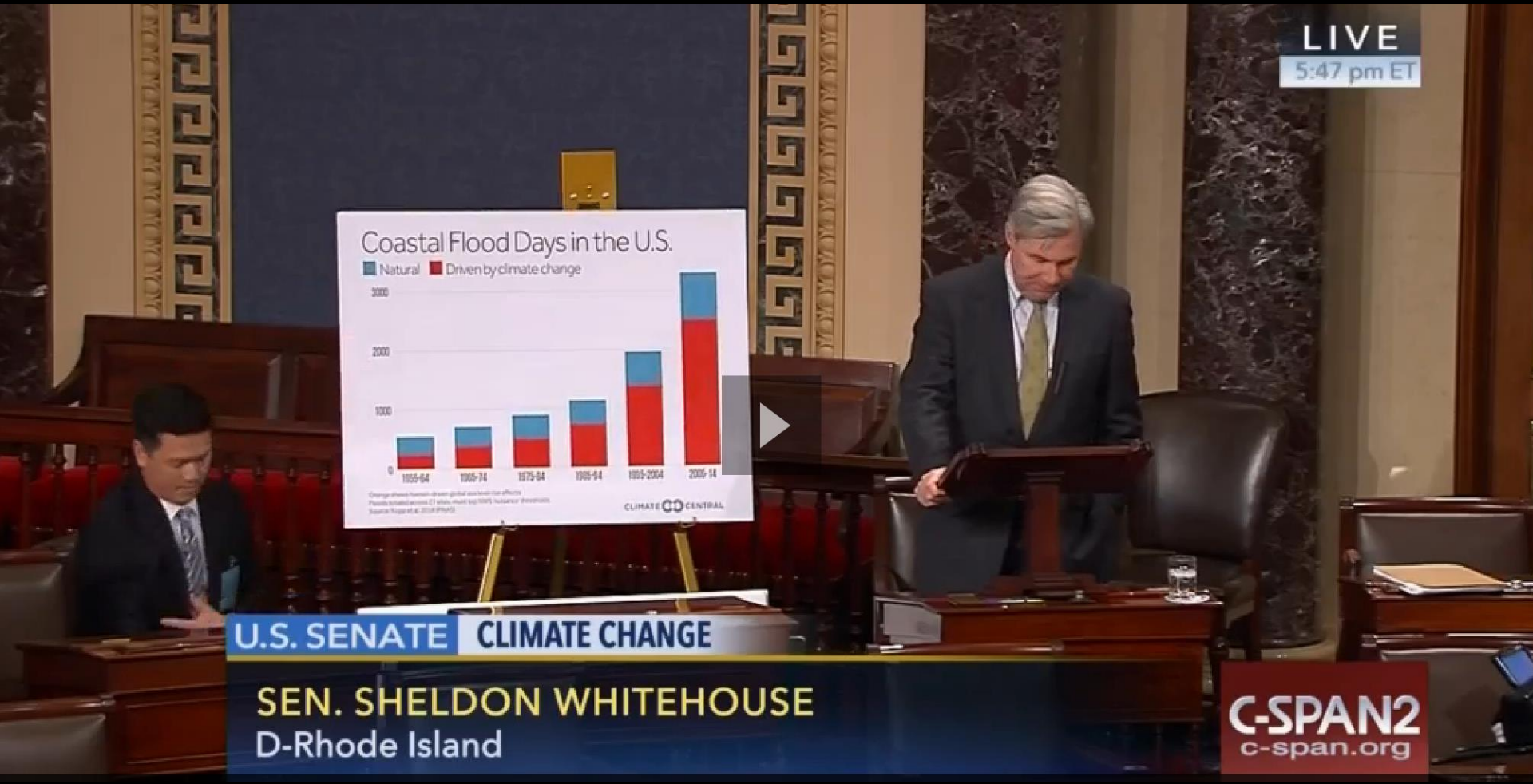
CLIMATE CENTRAL

NATURAL + HUMAN-CAUSED
COASTAL FLOOD DAYS
Atlantic City, NJ

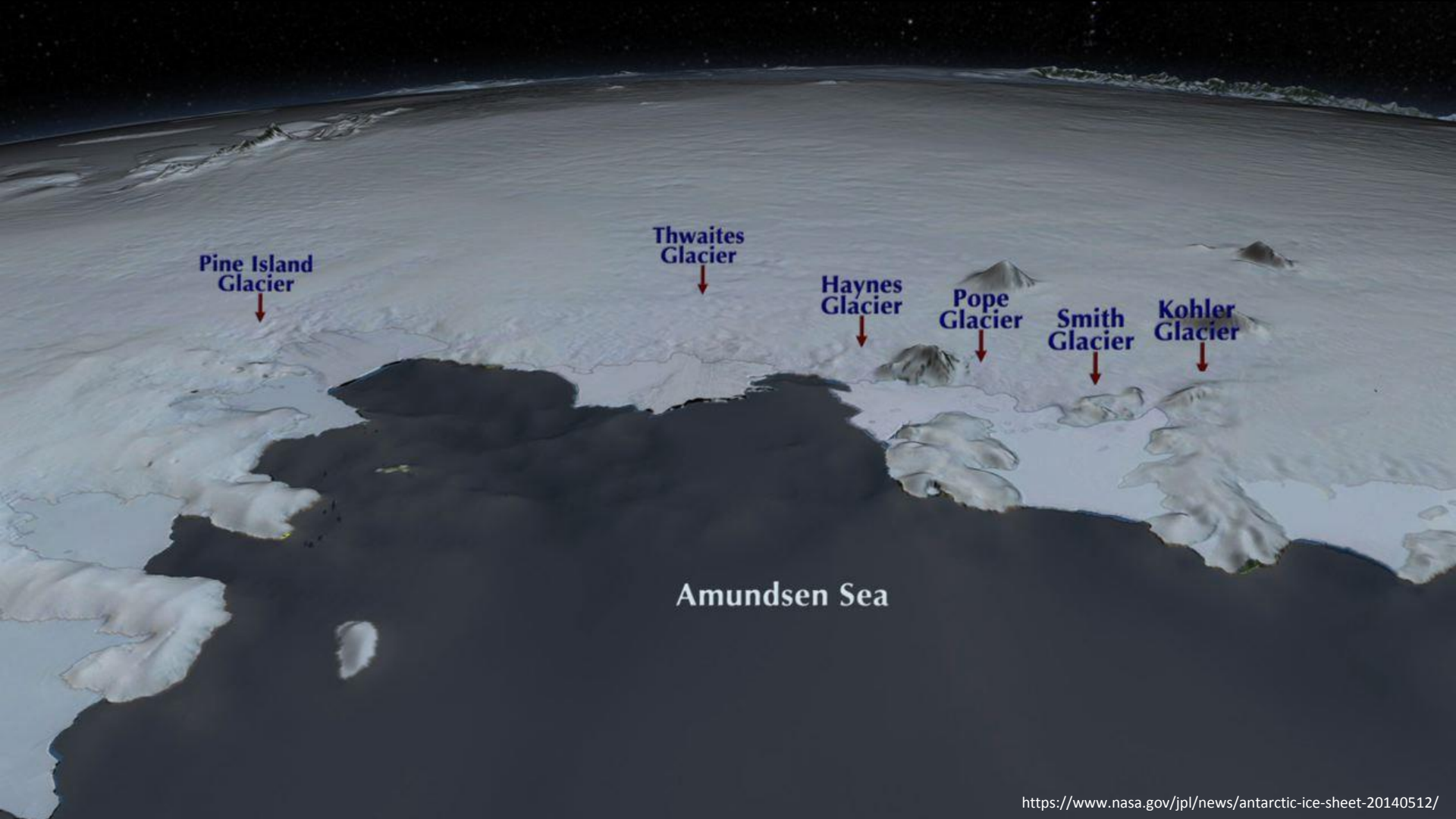


Orange shows human-caused global sea level rise effects
Must top NWS 'nuisance' thresholds
Source: Kopp et al. 2016 (PNAS), NOAA, & Climate Central

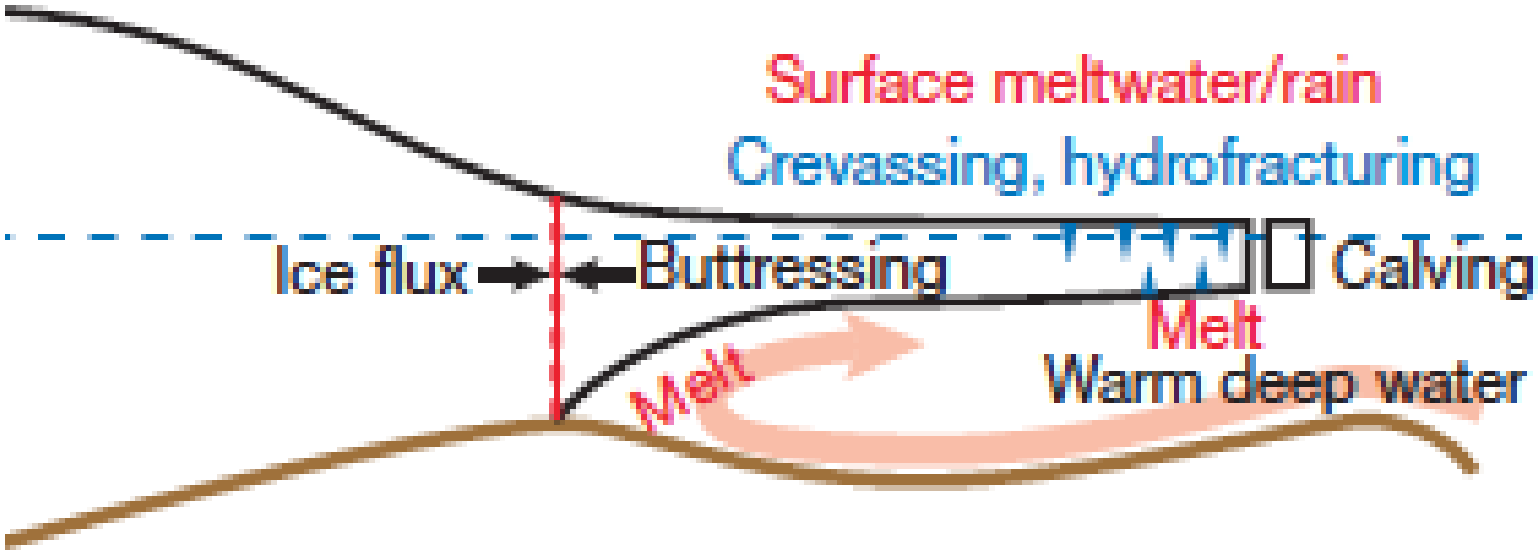
CLIMATE CENTRAL


LIVE
5:47 pm ET
Coastal Flood Days in the U.S.
Natural
Driven by climate change
3000
2000
1000
0
1955-64
1965-74
1975-84
1985-94
1995-2004
2005-14
CLIMATE CENTRAL
U.S. SENATE
CLIMATE CHANGE
SEN. SHELDON WHITEHOUSE
D-Rhode Island
C-SPAN2
c-span.org

Future



https://www.nasa.gov/jpl/news/antarctic-ice-sheet-20140512/



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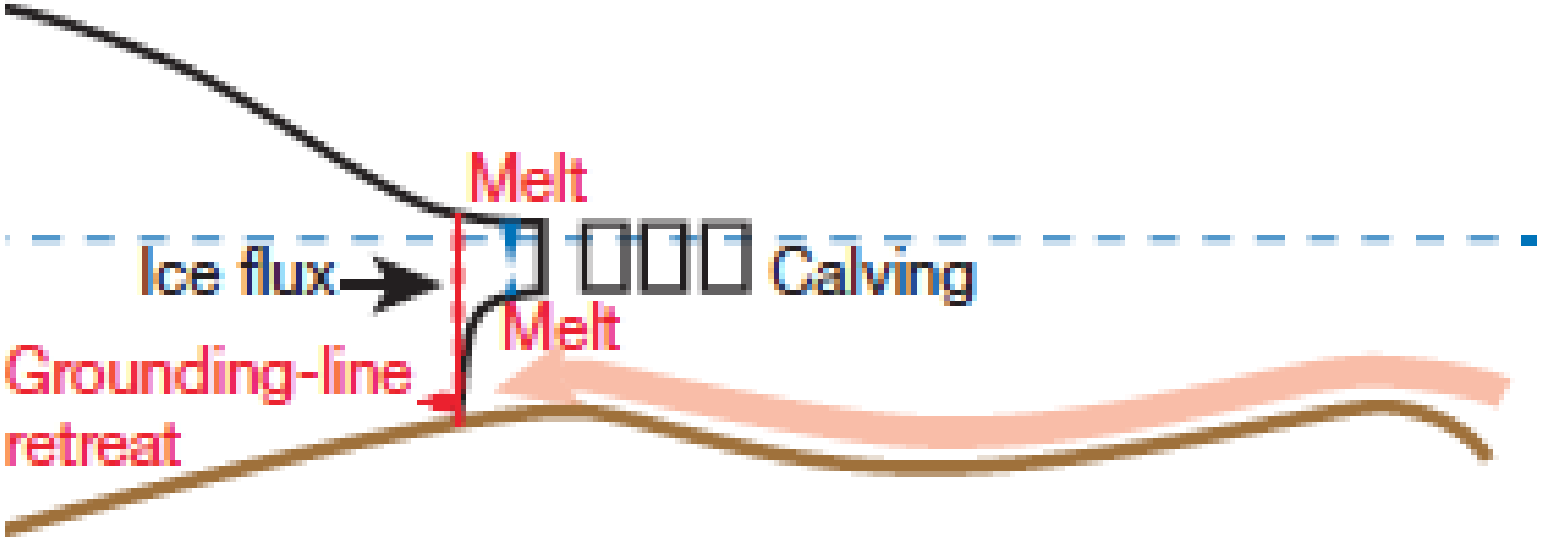
CLIMATE CENTRAL



FIRST ENVIRONMENT

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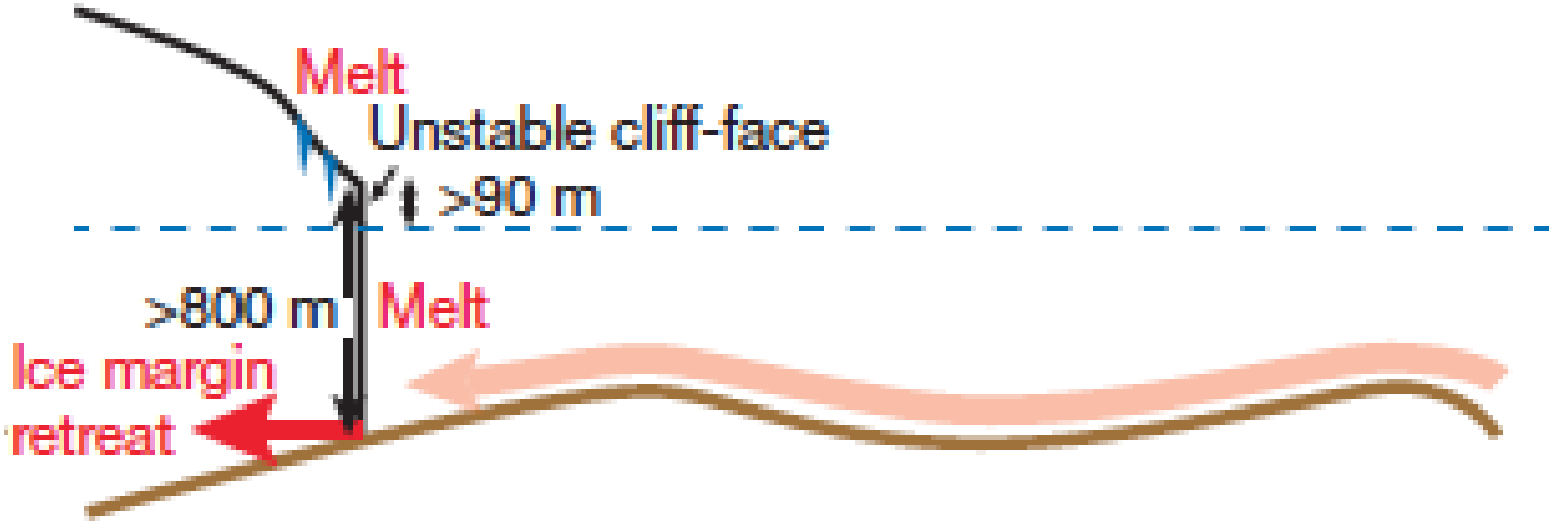

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GLOBAL AND REGIONAL SEA LEVEL RISE SCENARIOS FOR THE UNITED STATES

Photo: Ocean City, Maryland

Silver Spring, Maryland
January 2017

noaa National Oceanic and Atmospheric Administration

U.S. DEPARTMENT OF COMMERCE
National Ocean Service
Center for Operational Oceanographic Products and Services

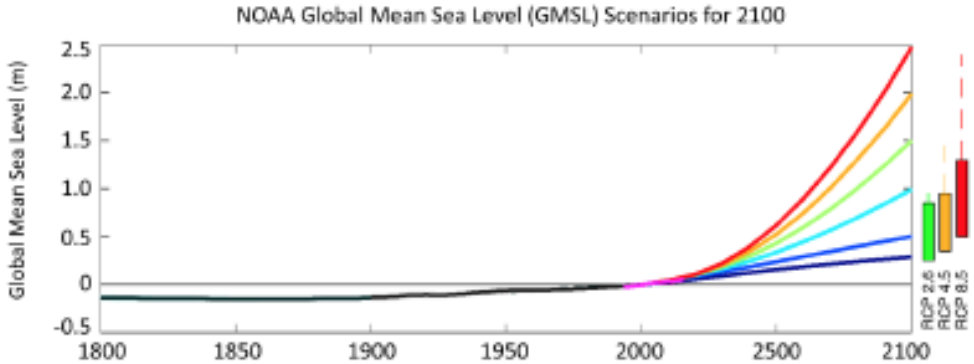
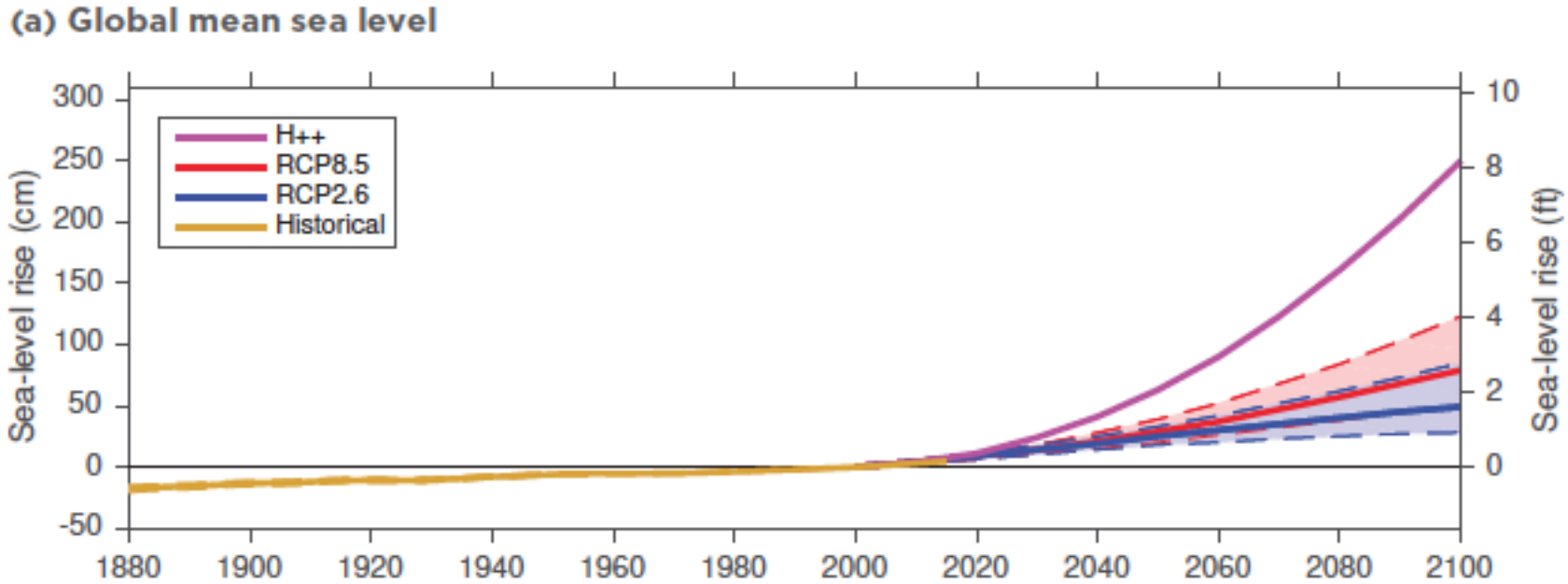


Figure 8. This study's six representative GMSL rise scenarios for 2100 (6 colored lines) relative to historical geological, tide gauge and satellite altimeter GMSL reconstructions from 1800–2015 (black and magenta lines; as in Figure 3a) and central 90% conditional probability ranges (colored boxes) of RCP-based GMSL projections of recent studies (Church et al., 2013a; Kopp et al., 2014; 2016a; Slangen et al., 2014; Grinsted et al., 2015; Mengel et al., 2016). These central 90% probability ranges are augmented (dashed lines) by the difference between the median Antarctic contribution of Kopp et al. (2014) probabilistic GMSL/RSL study and the median Antarctic projections of DeConto and Pollard (2016), which have not yet been incorporated into a probabilistic assessment of future GMSL.

CLIMATE CENTRAL



Griggs, G, Árvai, J, Cayan, D, DeConto, R, Fox, J, Fricker, HA, Kopp, RE, Tebaldi, C, Whiteman, EA (California Ocean Protection Council Science Advisory Team Working Group). Rising Seas in California: An Update on Sea-Level Rise Science. California Ocean Science Trust, April 2017.

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Google Earth

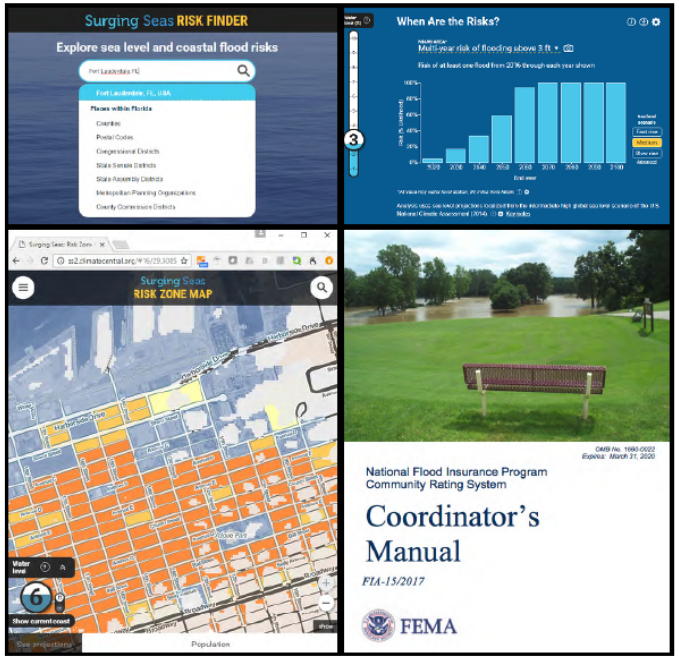
Explore sea level and coastal flood risks

Enter a U.S. coastal place

Video tutorial

Download uses by keyword (gov. downloaders)

USING *SURGING SEAS* WITHIN FEMA'S COMMUNITY RATING SYSTEM (CRS)



Surging Seas

Sea Level Rise Tools & Analysis by

CLIMATE CENTRAL

Updated September, 2017

Do you implement CRS for your coastal community? Learn how the *Surging Seas* public web tool can support many CRS activities and help you earn points.

The 2017 edition of the CRS Coordinator's Manual includes more opportunities for users to gain credit for considering the impacts of climate change and sea level rise on flood-related issues. Section 404 of the CRS Manual lists several activities that credit consideration of future sea level rise, including elements of Activities 410, 430 and 450. This guide demonstrates how Surging Seas can be used to gain points for these activities and several others.

Table of Contents

http://sealevel.climatecentral.org/crs

Local Surge Impacts Information

Surge Overview | National Surge Hazard Maps | Storm Surge Unit | SLOSH | P-SURGE | Surge Products | Local Impacts | FAQ | Resources

While the National Hurricane Center public advisory statements provide tropical cyclone related impacts on a regional scale, the local WFOs coordinate closely with the NHC to provide refined forecast products and warnings on a local level. Two of these products are the Hurricane Local Statement (HLS) and the associated Graphical HLS.

The HLS is a valuable product that can be used as a tool to monitor several different threats (not just surge) and potential impacts to your area. It includes:

- Counties, parishes, or cities affected
- Watches and/or warnings in effect
- Recommended precautionary actions
- Storm surge and storm tide information
- Present winds and the expected time of onset of tropical storm or hurricane-force winds
- Tornado, flood, flash flood, rip current, beach erosion, and inland high wind potential

Below is an example of the storm surge portion of an Hurricane Local Statement:

...STORM SURGE AND STORM TIDE...

TIDE LEVELS REPORTED BETWEEN 330 AND 400 PM SATURDAY:
HOUSTON SHIP CHANNEL/MANCHESTER - 10.4 FEET
EAGLE POINT - 7.7 FEET
PIER 21 - 5.8 FEET
PLEASURE PIER - 5.2 FEET
FREEPORT - 2.7 FEET

STORM SURGE FLOODING PERSISTS ALONG THE SHORE OF GALVESTON BAY AND ON THE BOLIVAR PENINSULA. THIS INCLUDES NEIGHBORHOODS NEAR THE SHORE OF CLEAR LAKE...AND THE COMMUNITIES OF SMITH POINT...LA PORTE...SEABROOK...KEMAH...BACLIFF...SAN LEON...AND SURROUNDING AREAS. TIDE LEVELS RANGE FROM 7 TO 11 FEET IN THESE AREAS. BOLIVAR PENINSULA IS COVERED WITH WATER. RAINFALL-INDUCED FLOODING OVER THE LAND AND IN CREEKS AND BAYOUS MUST DRAIN OUT INTO GALVESTON BAY WHICH WILL KEEP WATER LEVELS ON THE BAY ABOVE NORMAL FOR AN EXTENDED PERIOD OF TIME. TIDE LEVELS WILL ONLY SLOWLY SUBSIDE IN THESE AREAS THROUGH TONIGHT...AND WILL NOT RECOVER TO NEAR NORMAL LEVELS UNTIL SUNDAY MORNING.

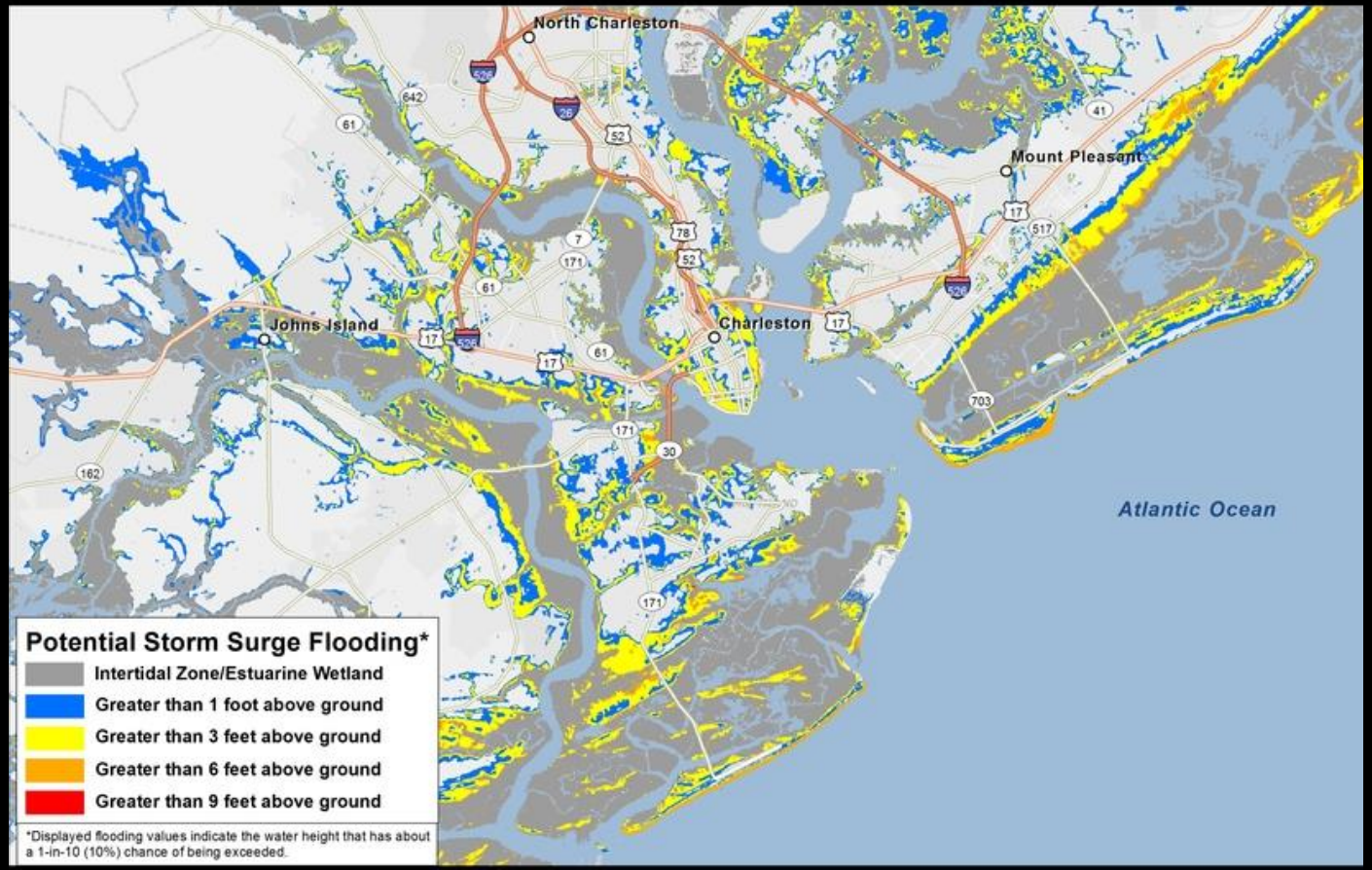
Visit your local National Weather Service office website for more information about local surge impacts under the Hurricane Local Statements (HLS)

[Visit your local NWS Office] [Go]

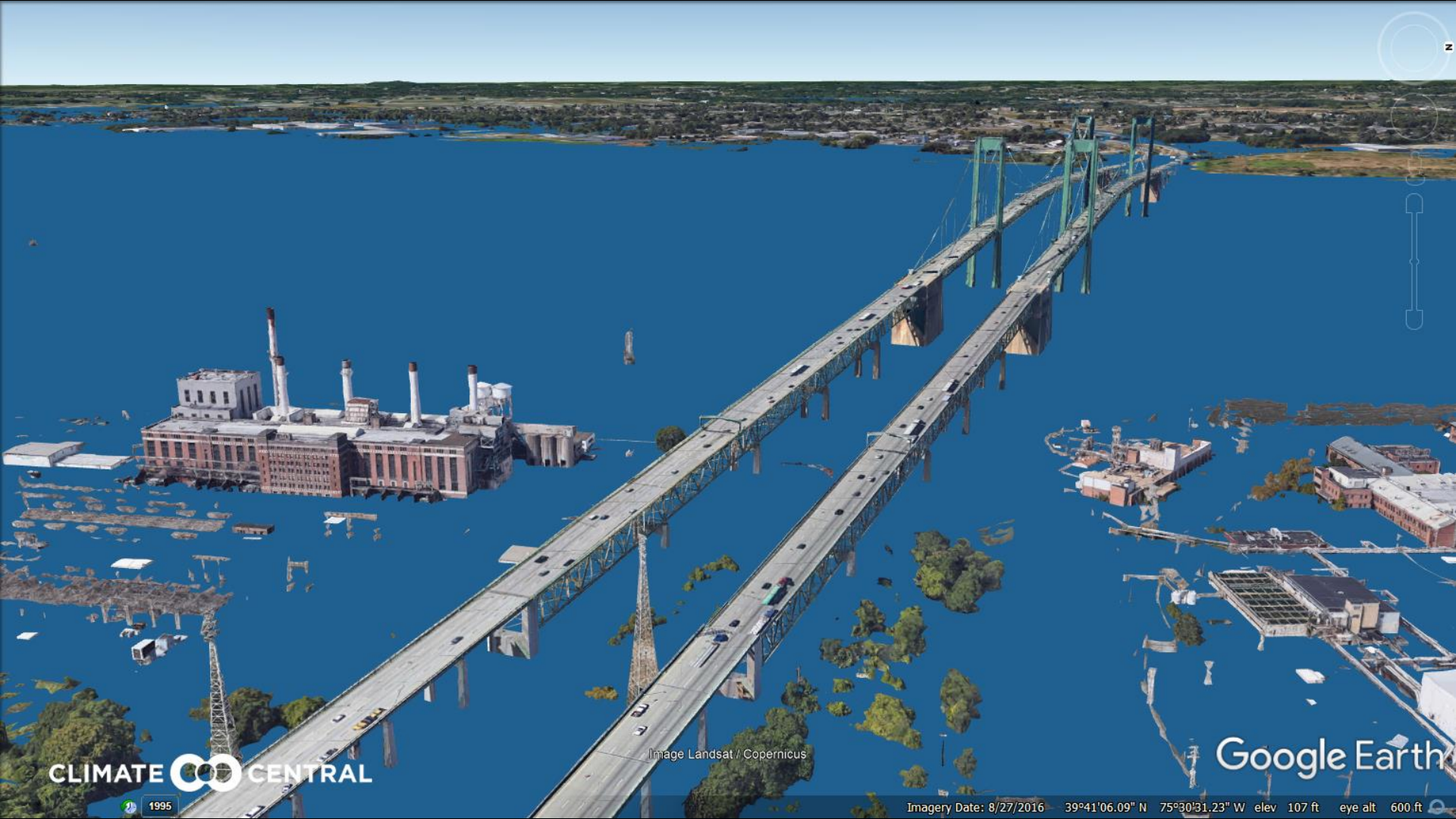
The State emergency management offices work closely with the NHC in assessing evacuations with respect to coastal storm surge vulnerability. The NHC updates SLOSH basins creating the MOMs and MEOWs which are ultimately used by EMs to drive the nation's evacuation zones.

Visit your State EM office website for more information about local surge evacuation zones

Hurricane X



National Hurricane Center
Storm Surge Unit


CLIMATE CENTRAL
1995
Image Landsat / Copernicus
Google Earth
Imagery Date: 8/27/2016 39°41'06.09" N 75°30'31.23" W elev 107 ft eye alt 600 ft

Climate Central on Twitter

Twitter, Inc. [US] | https://twitter.com/ClimateCentral/status/901155256599539715

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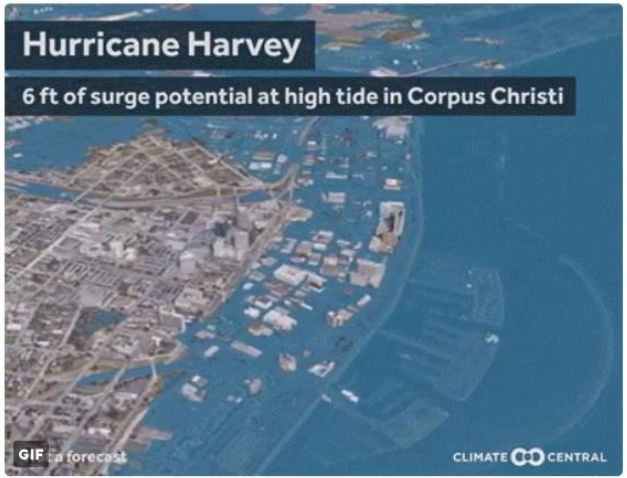
Researching and reporting the science and impacts of climate change

Princeton, NJ
climatecentral.org
Joined July 2008

Climate Central
@ClimateCentral

Follow

#Harvey could bring dangerous storm surge to the Texas coast at high tide. This is what it could look like in Corpus Christi if that happens

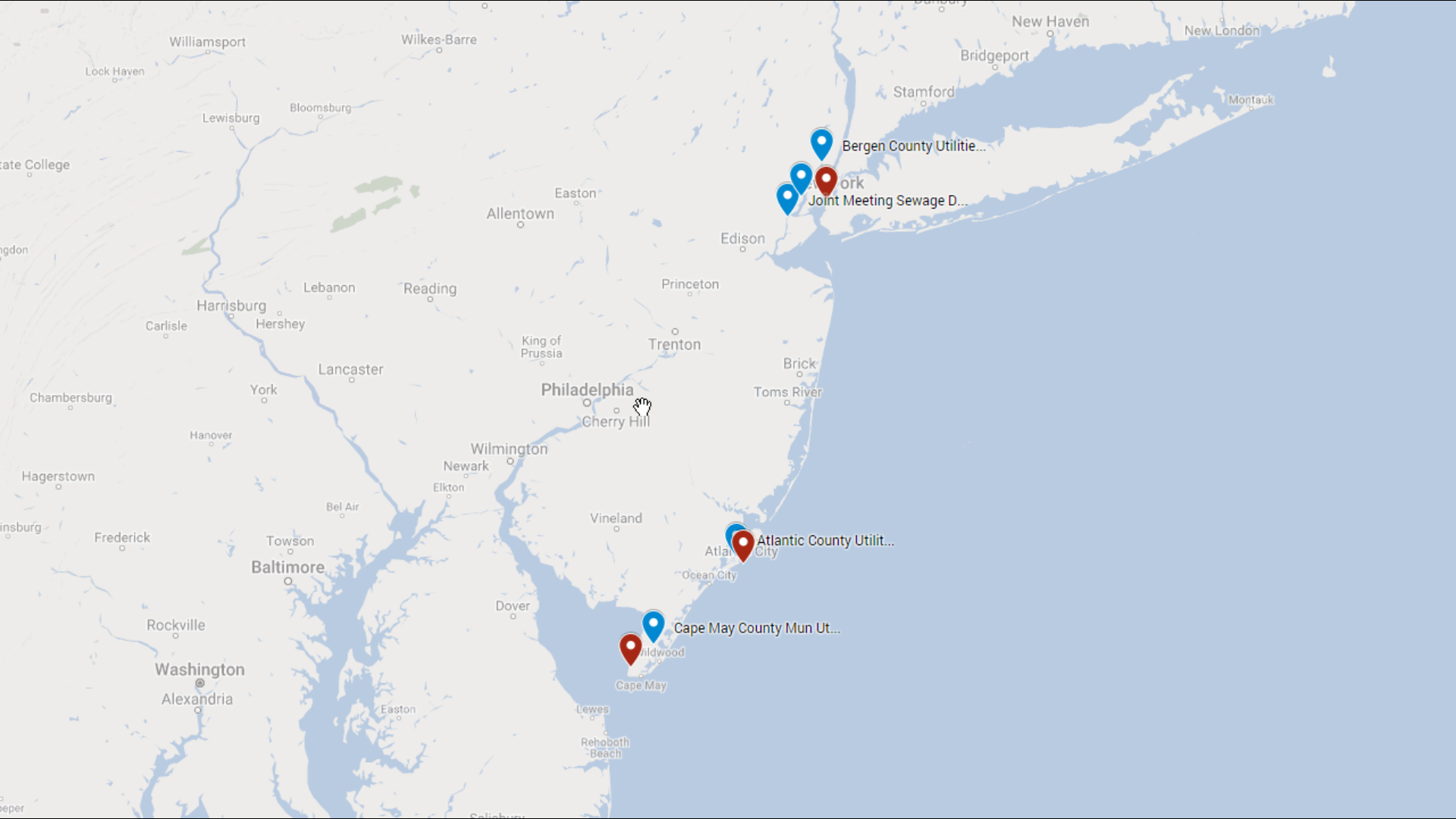


11:52 AM - 25 Aug 2017

231 Retweets 159 Likes

8 231 159

New Jersey


Bergen County Utilitie...
Joint Meeting Sewage D...
Atlantic County Utilit...
Cape May County Mun Ut...
Williamsport
Wilkes-Barre
Lock Haven
Bloomsburg
Lewisburg
Allentown
Easton
Edison
Princeton
Lebanon
Reading
Harrisburg
Hershey
Carlisle
King of Prussia
Trenton
Brick
Lancaster
York
Philadelphia
Cherry Hill
Toms River
Chambersburg
Hanover
Wilmington
Newark
Elkton
Hagerstown
Bel Air
Vineland
Frederick
Towson
Baltimore
Ocean City
Dover
Rockville
Washington
Alexandria
Cape May
Lewes
Rehoboth Beach
New Haven
New London
Bridgeport
Stamford
Montauk

SEA LEVEL TRENDS

Home/Map

U.S. Stations

Global Stations

Data Tables

Select

U.S. Trends Map

U.S. Regional Trends

Select

Global Regional Trends

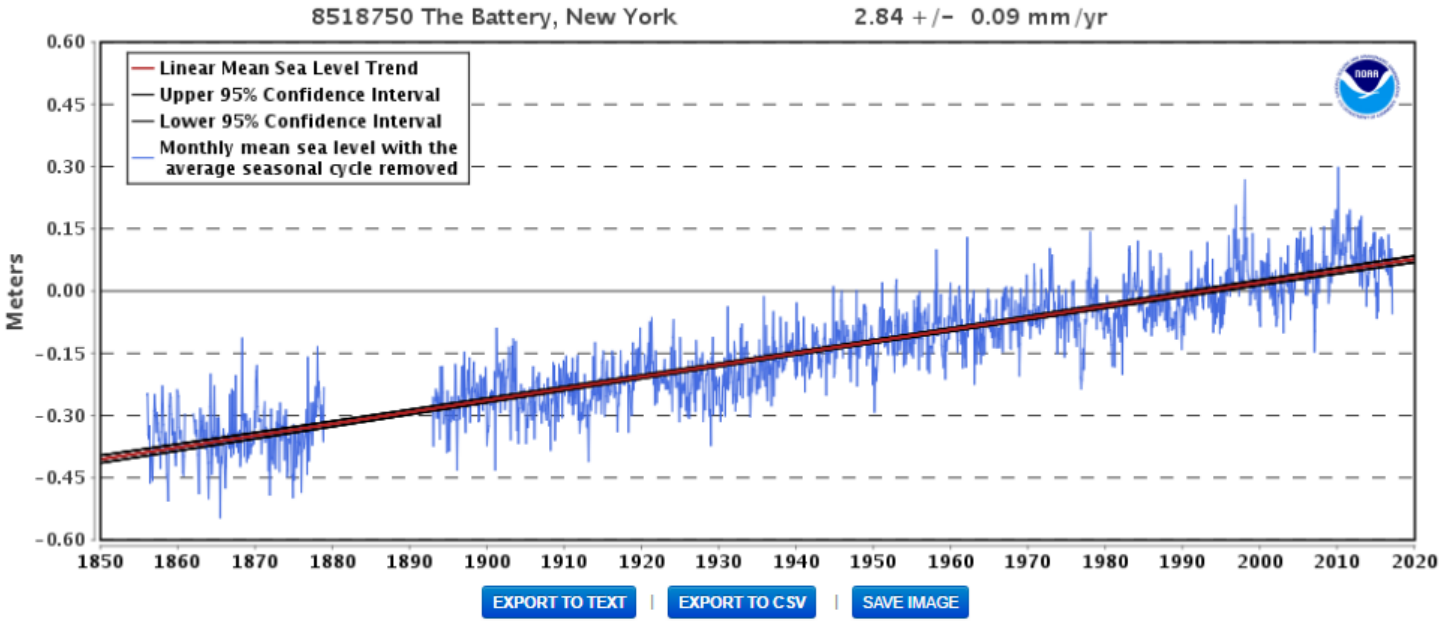
Anomalies

Select

Get Adobe Reader

Mean Sea Level Trend | Interannual Variation | Average Seasonal Cycle | Variation Of 50-Year MSL Trends | Previous MSL Trends

Mean Sea Level Trend
8518750 The Battery, New York



EXPORT TO TEXT | EXPORT TO CSV | SAVE IMAGE

The mean sea level trend is 2.84 millimeters/year with a 95% confidence interval of +/- 0.09 mm/yr based on monthly mean sea level data from 1856 to 2016 which is equivalent to a change of 0.93 feet in 100 years.

Source: https://tidesandcurrents.noaa.gov

The plot shows the monthly mean sea level without the regular seasonal fluctuations due to coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents. The long-term linear trend is also shown, including its 95% confidence interval. The plotted values are relative to the most recent Mean Sea Level datum established by CO-OPS. The calculated trends for all stations are available as a table in millimeters/year and in feet/century (0.3 meters = 1 foot).

EXTREME WATER LEVELS

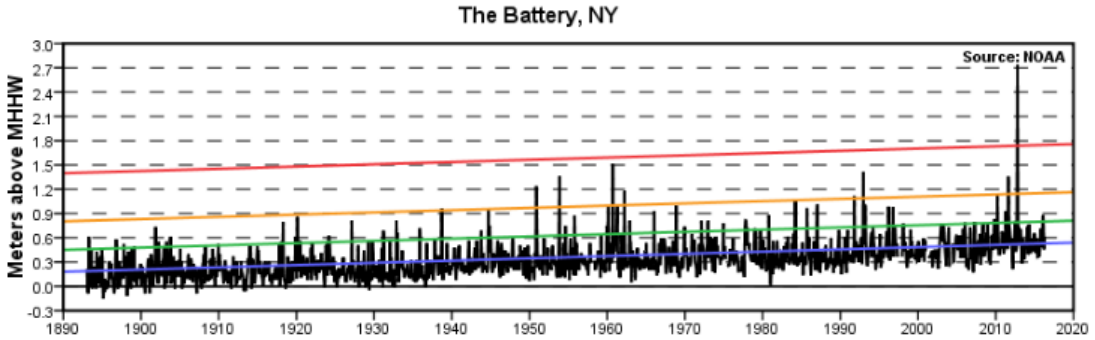
- Alabama
- Alaska
- California
- Connecticut
- Delaware
- Florida
- Georgia
- Hawaii
- Louisiana
- Maine
- Maryland
- Massachusetts
- New Jersey
- New York
- North Carolina
- Oregon
- Pennsylvania
- Rhode Island
- South Carolina
- Texas
- Virginia
- Washington
- Washington DC
- Island Stations

LINKS

- Top Ten Levels (Table in meters)

Extreme Water Levels

8518750 The Battery, NY



Top 3 floods:

Year	Level (ft)
2012	9.0
1960	5.0
1992	4.7

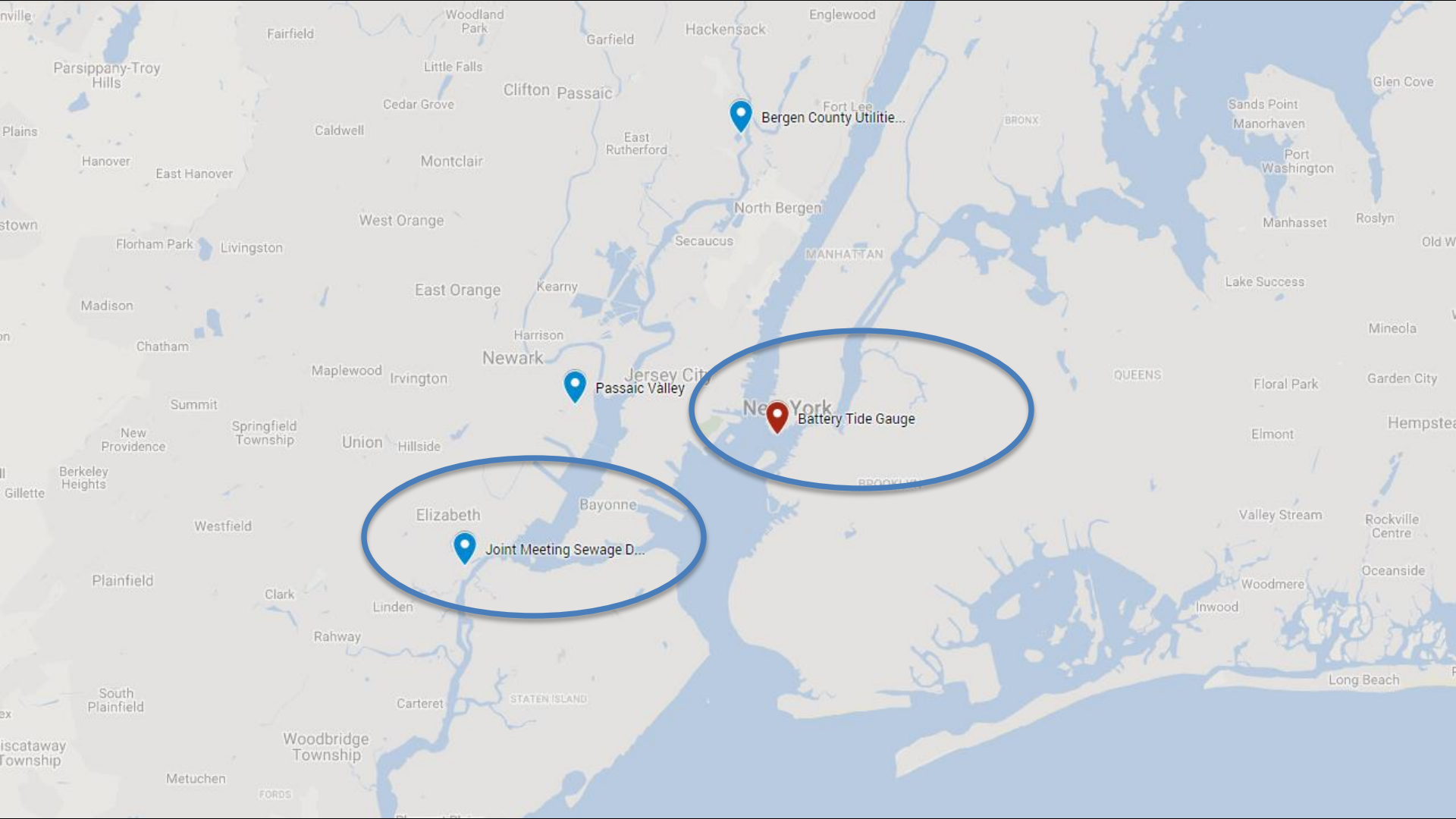
NWS minor flood definition: 2.1 ft

1 year per 100
10 years per 100
50 years per 100
99 years per 100

The monthly extreme water levels include a Mean Sea Level (MSL) trend of 2.77 millimeters/year with a 95% confidence interval of +/- 0.09 millimeters/year based on monthly MSL data from 1856 to 2006 which is equivalent to a change of 0.91 feet in 100 years.

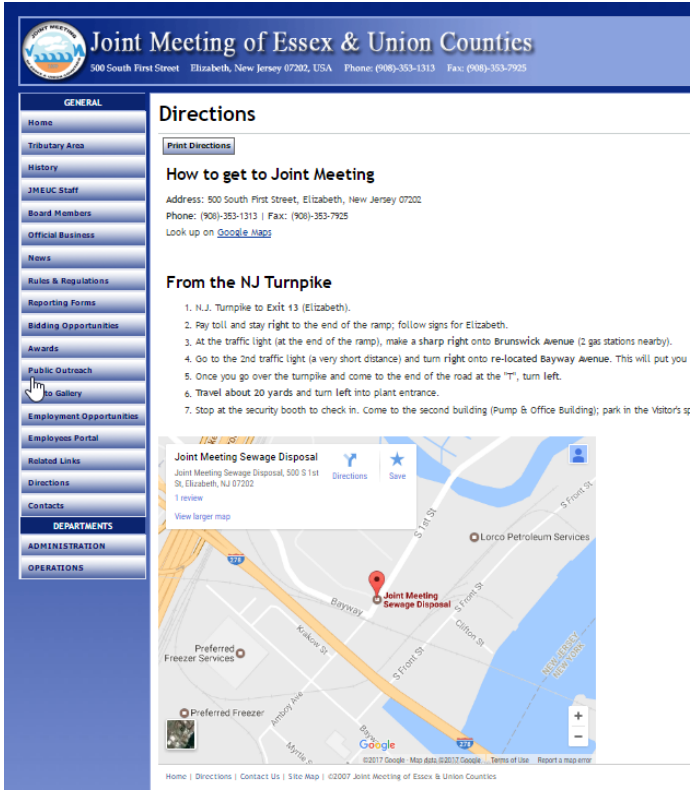
highest and lowest water levels with the 1%, 10%, 50%, and 99% annual exceedance probability levels in red, orange, green, and blue. The plotted values

Source: https://tidesandcurrents.noaa.gov


Bergen County Utilitie...
Passaic Valley
Battery Tide Gauge
Joint Meeting Sewage D...
Parsippany-Troy Hills
Fairfield
Woodland Park
Garfield
Hackensack
Englewood
Little Falls
Clifton
Passaic
Cedar Grove
Fort Lee
Glen Cove
Sands Point
Manorhaven
Caldwell
East Rutherford
Hanover
East Hanover
Montclair
Port Washington
North Bergen
West Orange
Manhasset
Roslyn
Florham Park
Livingston
Secaucus
MANHATTAN
East Orange
Kearny
Lake Success
Madison
Harrison
Mineola
Chatham
Newark
Maplewood
Irvington
Jersey City
QUEENS
Floral Park
Garden City
Summit
Springfield Township
Union
Hillside
Elmont
New Providence
Berkeley Heights
Bayonne
Valley Stream
Rockville Centre
Westfield
Elizabeth
Oceanside
Plainfield
Clark
Linden
Woodmere
Inwood
Rahway
Long Beach
South Plainfield
Carteret
STATEN ISLAND
Woodbridge Township
Metuchen

Joint Meeting of Union & Essex – Elizabeth, NJ

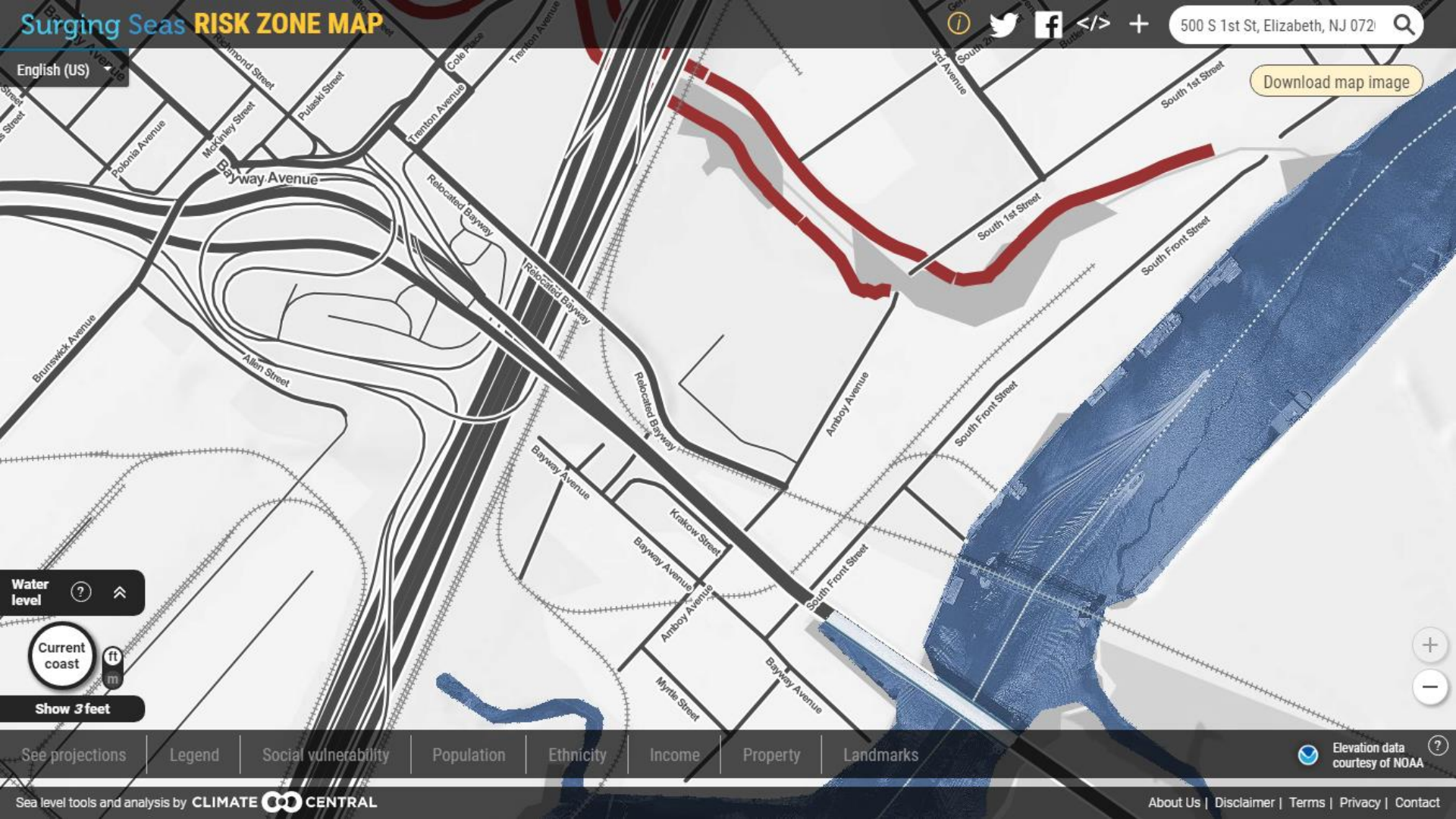
http://www.jmeuc.com/



FIRST ENVIRONMENT

CLIMATE CENTRAL


Today
500 S 1st St
Image Landsat / Copernicus
CLIMATE CENTRAL
1995
Google Earth
40°38'22.68" N 74°11'58.28" W elev 58 ft eye alt 1411 ft


Surging Seas RISK ZONE MAP
English (US)
500 S 1st St, Elizabeth, NJ 072
Download map image
Bayway Avenue
Relocated Bayway
Relocated Bayway
Relocated Bayway
Trenton Avenue
Trenton Avenue
Cole Place
Richmond Street
Pulaski Street
McKinley Street
Polonia Avenue
Brunswick Avenue
Allen Street
3rd Avenue
South 1st Street
South 1st Street
South Front Street
South Front Street
Amboy Avenue
Amboy Avenue
Bayway Avenue
Bayway Avenue
Krakow Street
Bayway Avenue
Amboy Avenue
South Front Street
Myrtle Street
Bayway Avenue
Water level
Current coast
ft
m
Show 3 feet
See projections
Legend
Social vulnerability
Population
Ethnicity
Income
Property
Landmarks
Elevation data courtesy of NOAA
Sea level tools and analysis by CLIMATE CENTRAL
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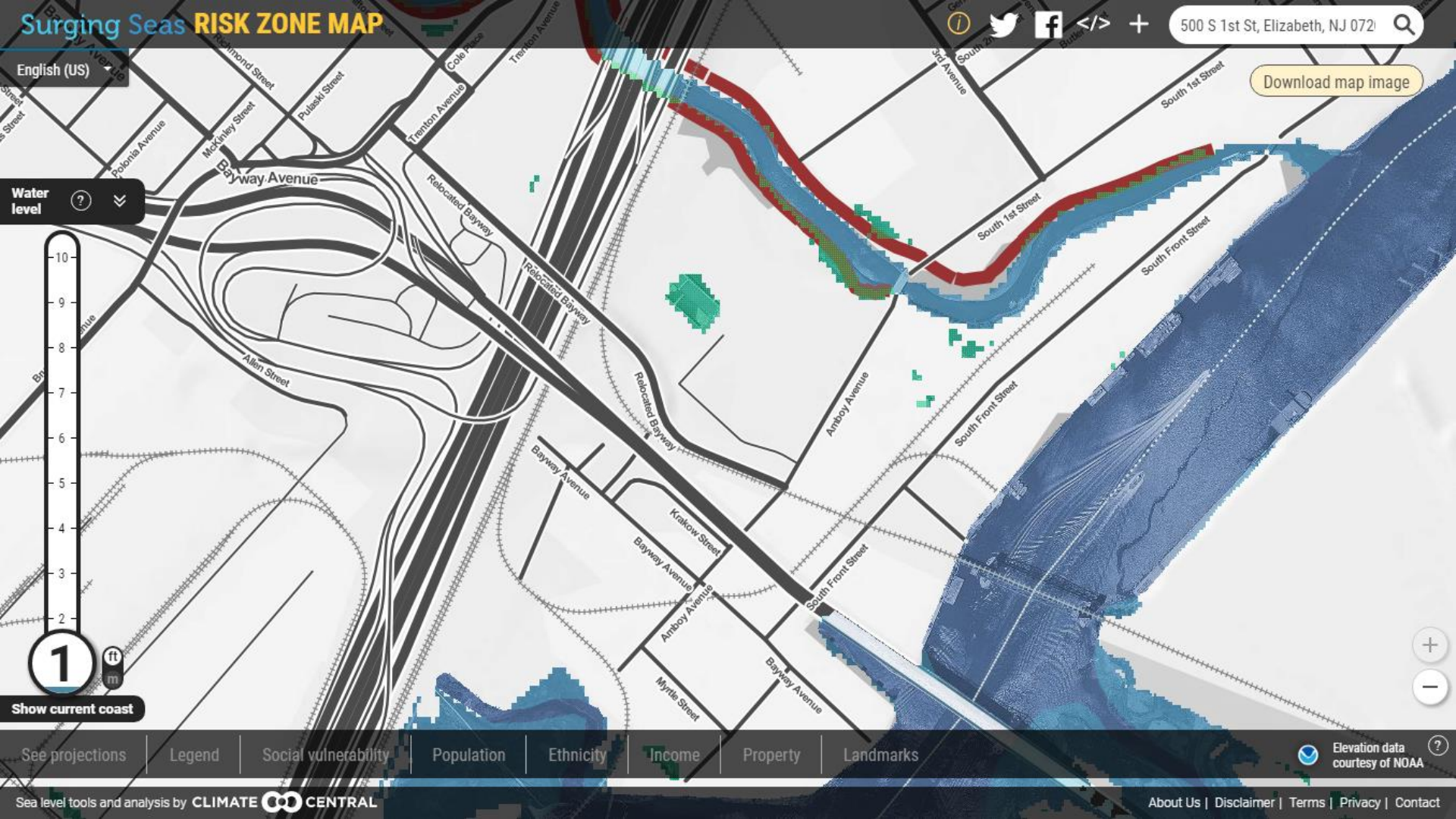
Surging Seas RISK ZONE MAP
English (US)
500 S 1st St, Elizabeth, NJ 072
Download map image
Water level
10
9
8
7
6
5
4
3
2
1
ft
m
Show current coast
Bayway Avenue
Relocated Bayway
Allen Street
McKinley Street
Polonia Avenue
Pulaski Street
Trenton Avenue
Cole Place
Richmond Street
3rd Avenue
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Krakow Street
Myrtle Street
See projections
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Social vulnerability
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Landmarks
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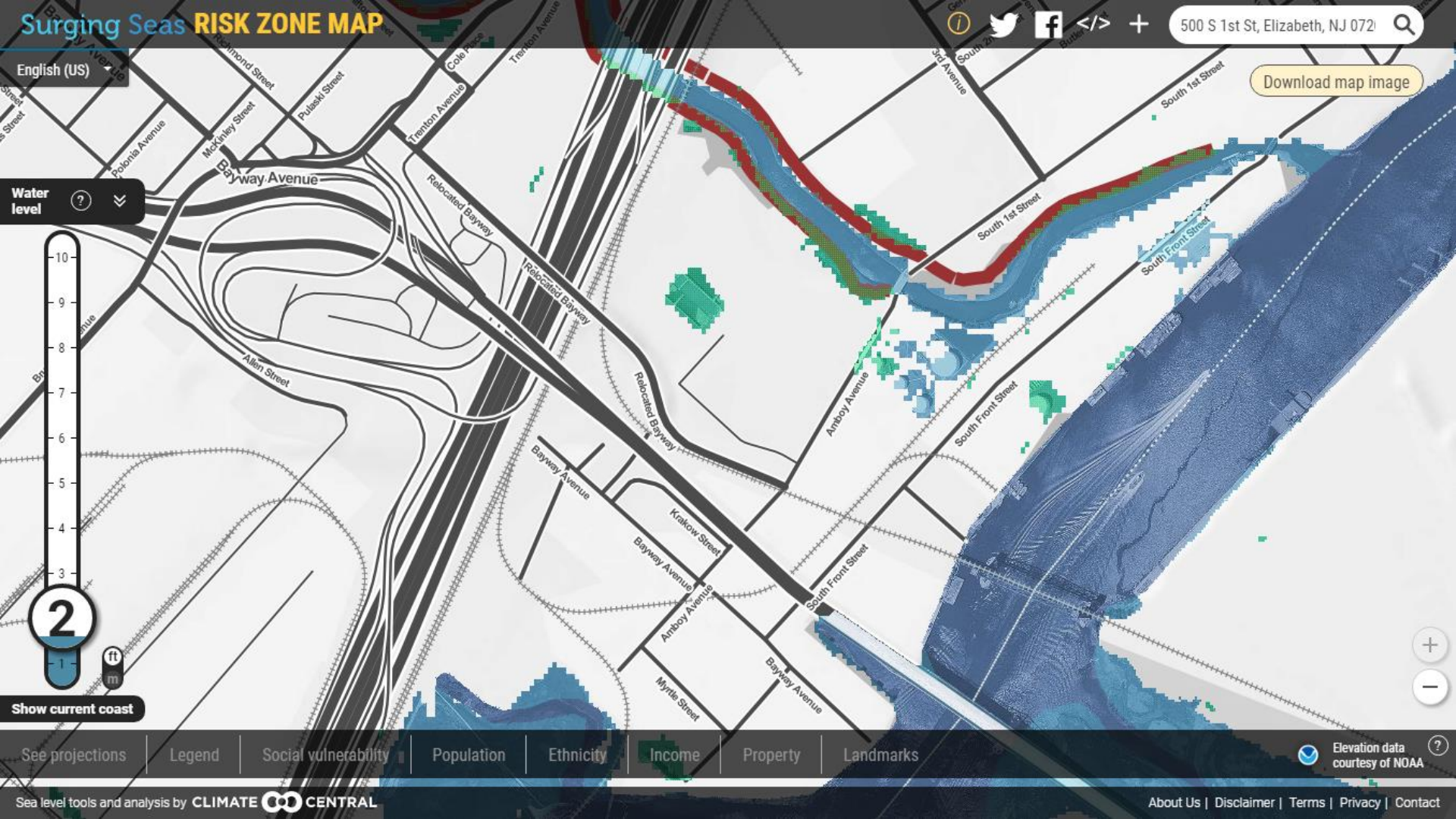
Surging Seas RISK ZONE MAP
500 S 1st St, Elizabeth, NJ 072
English (US)
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Show current coast
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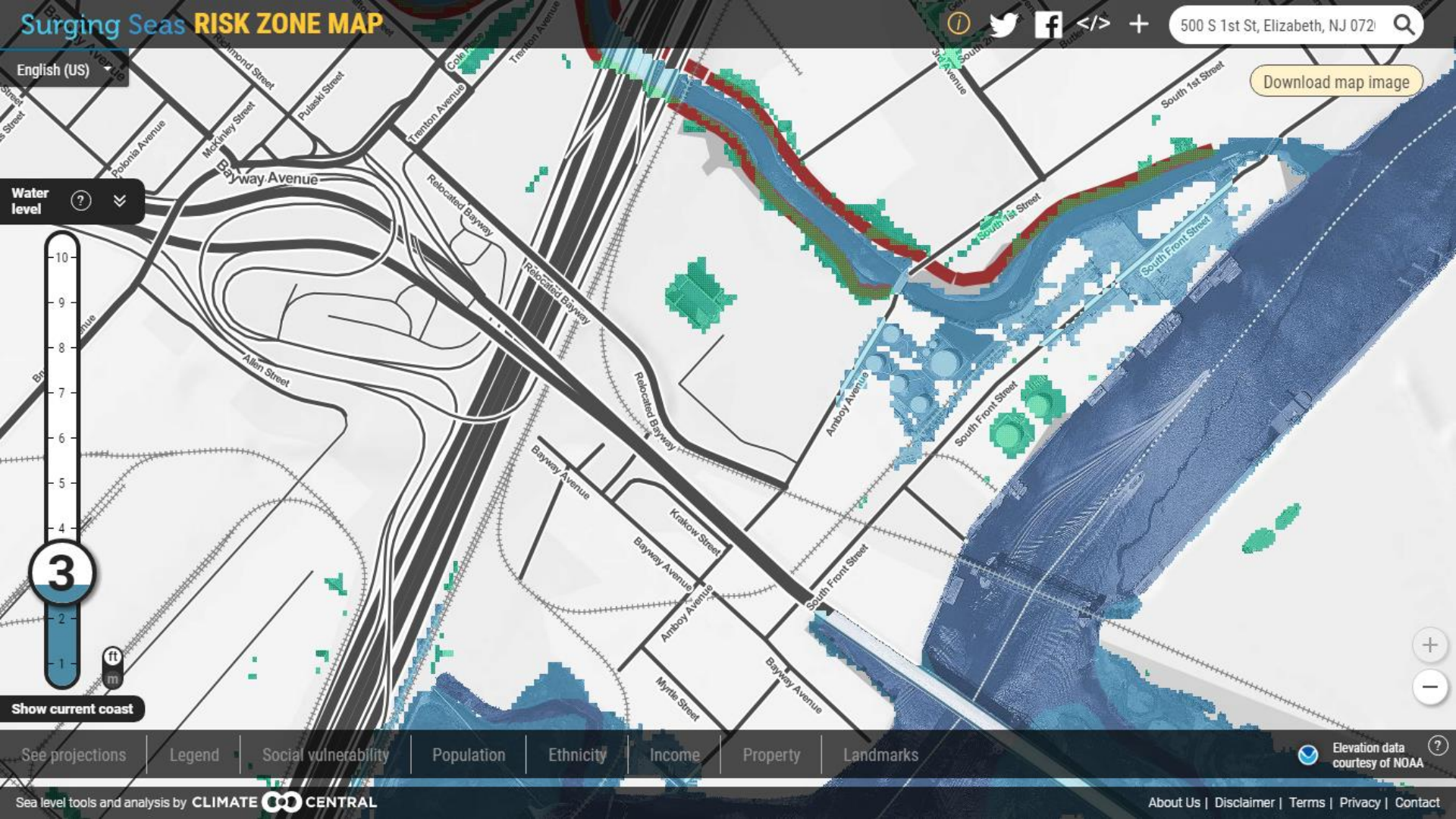
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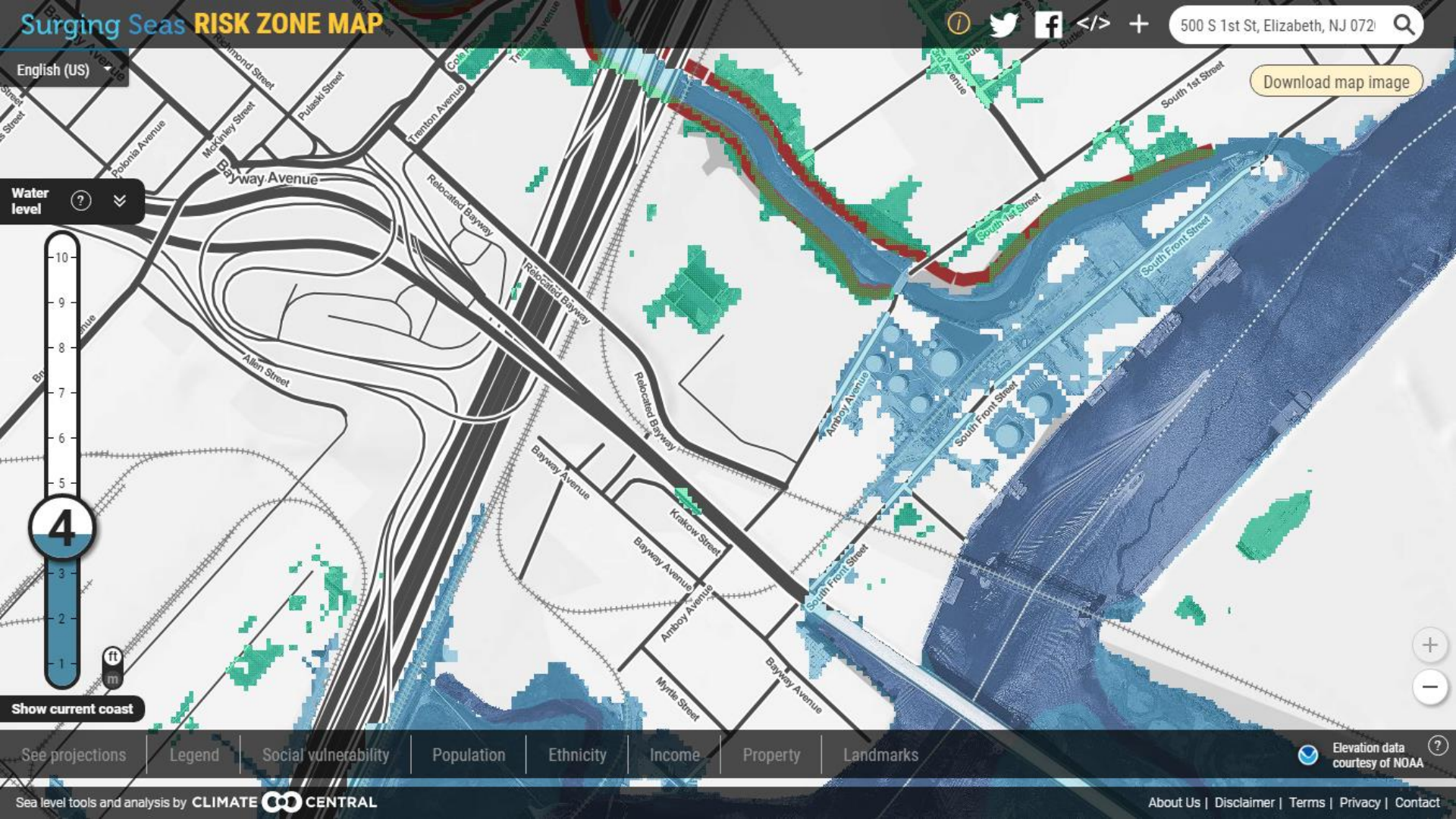
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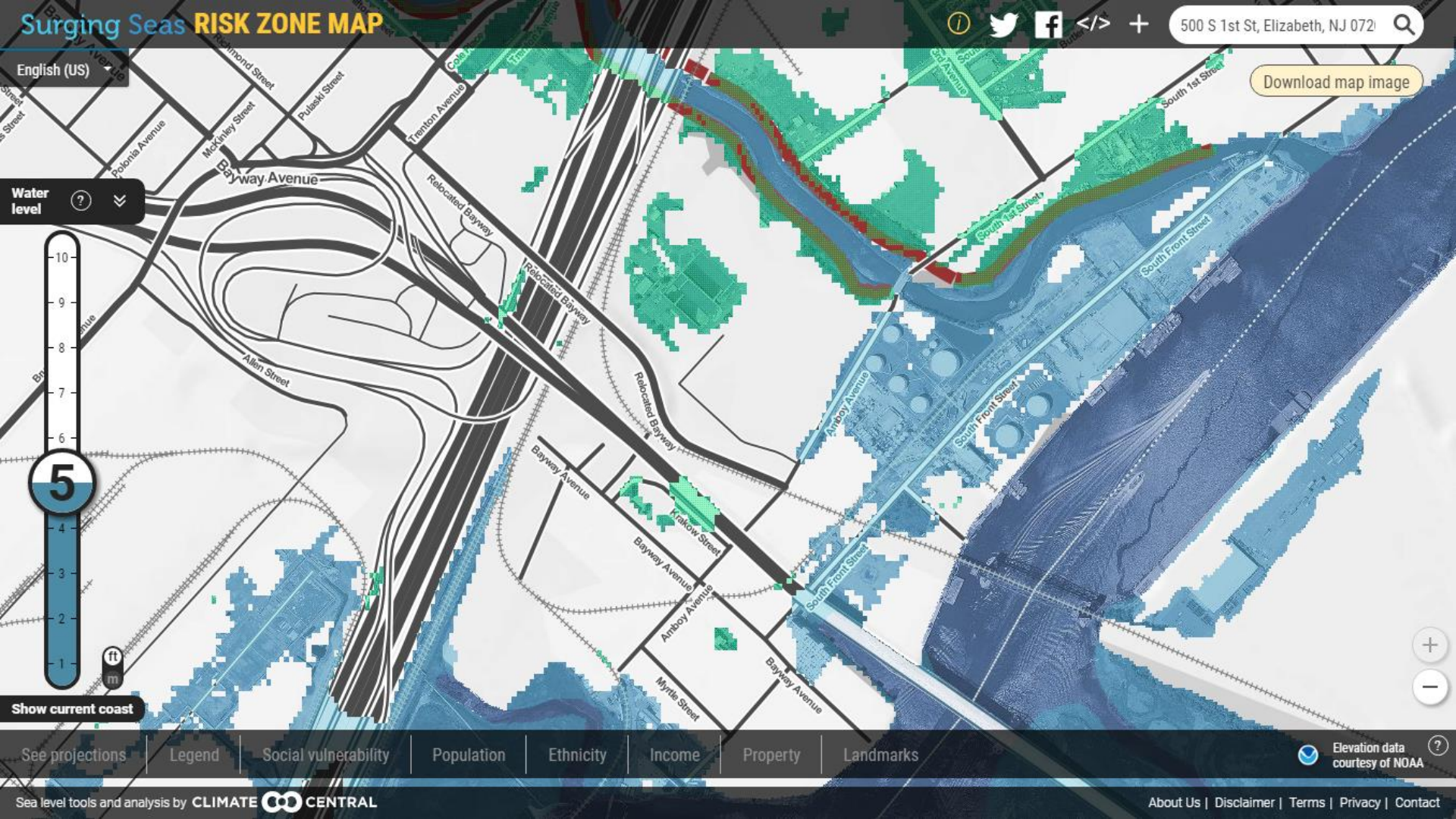
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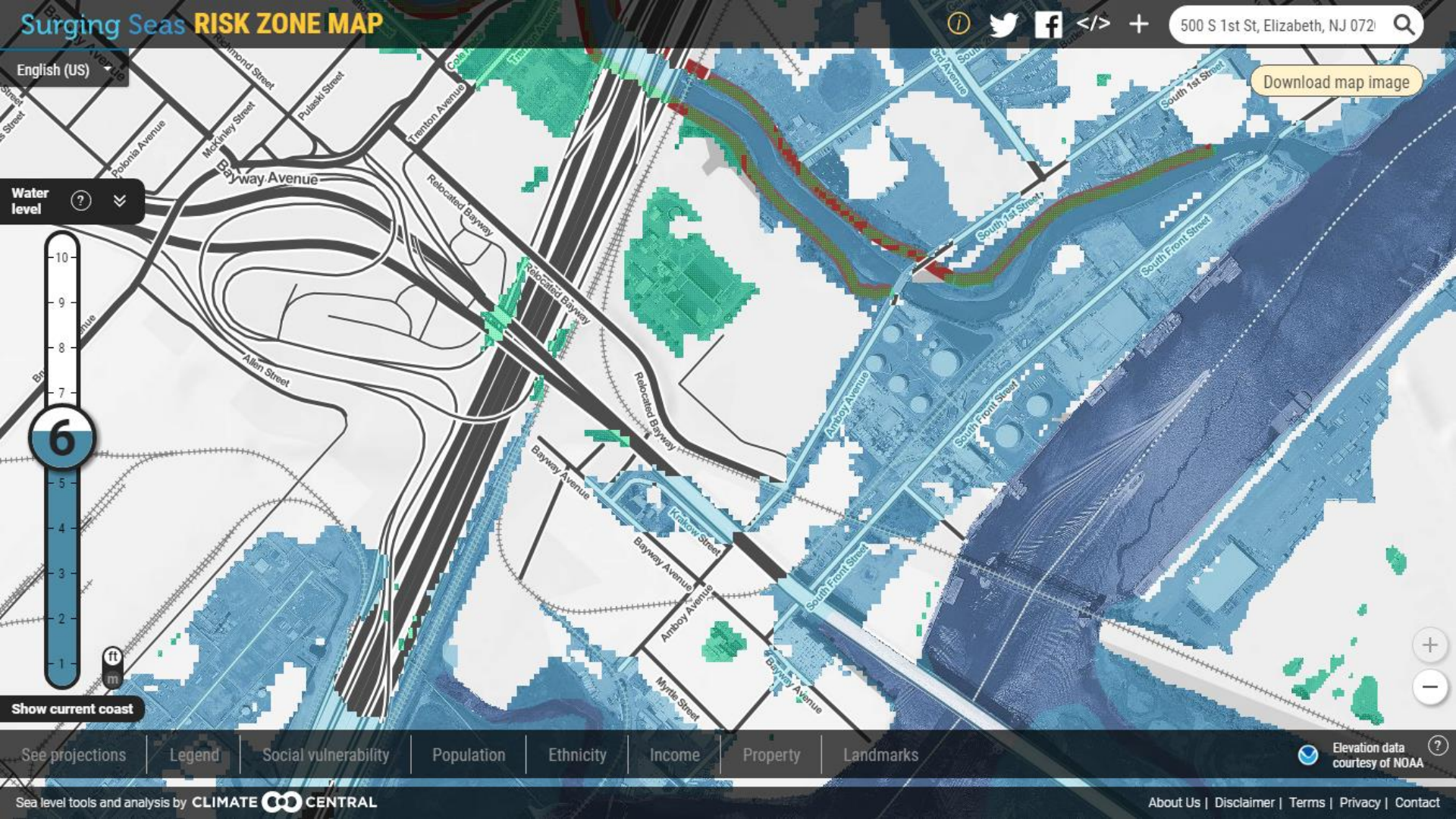
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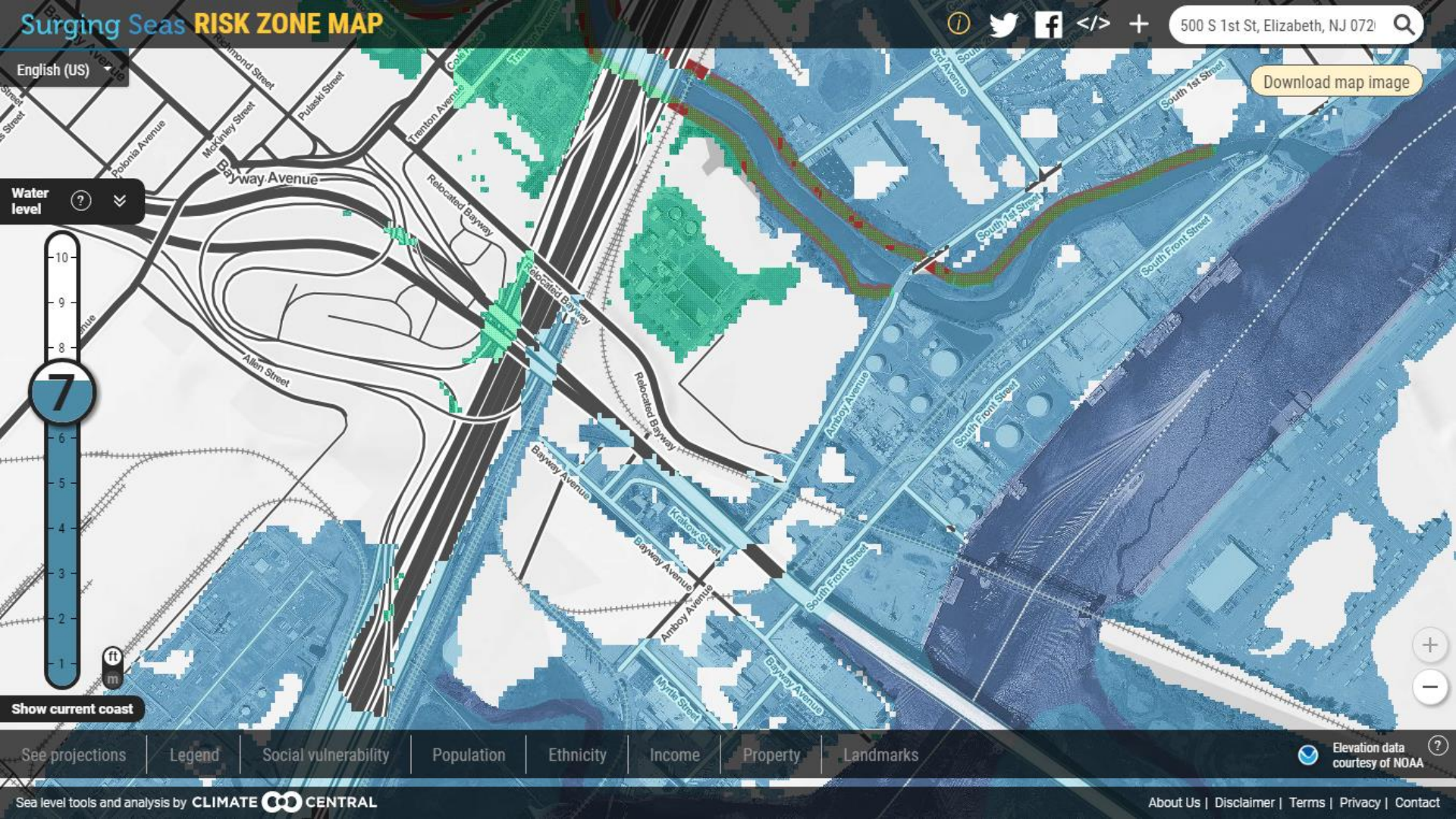
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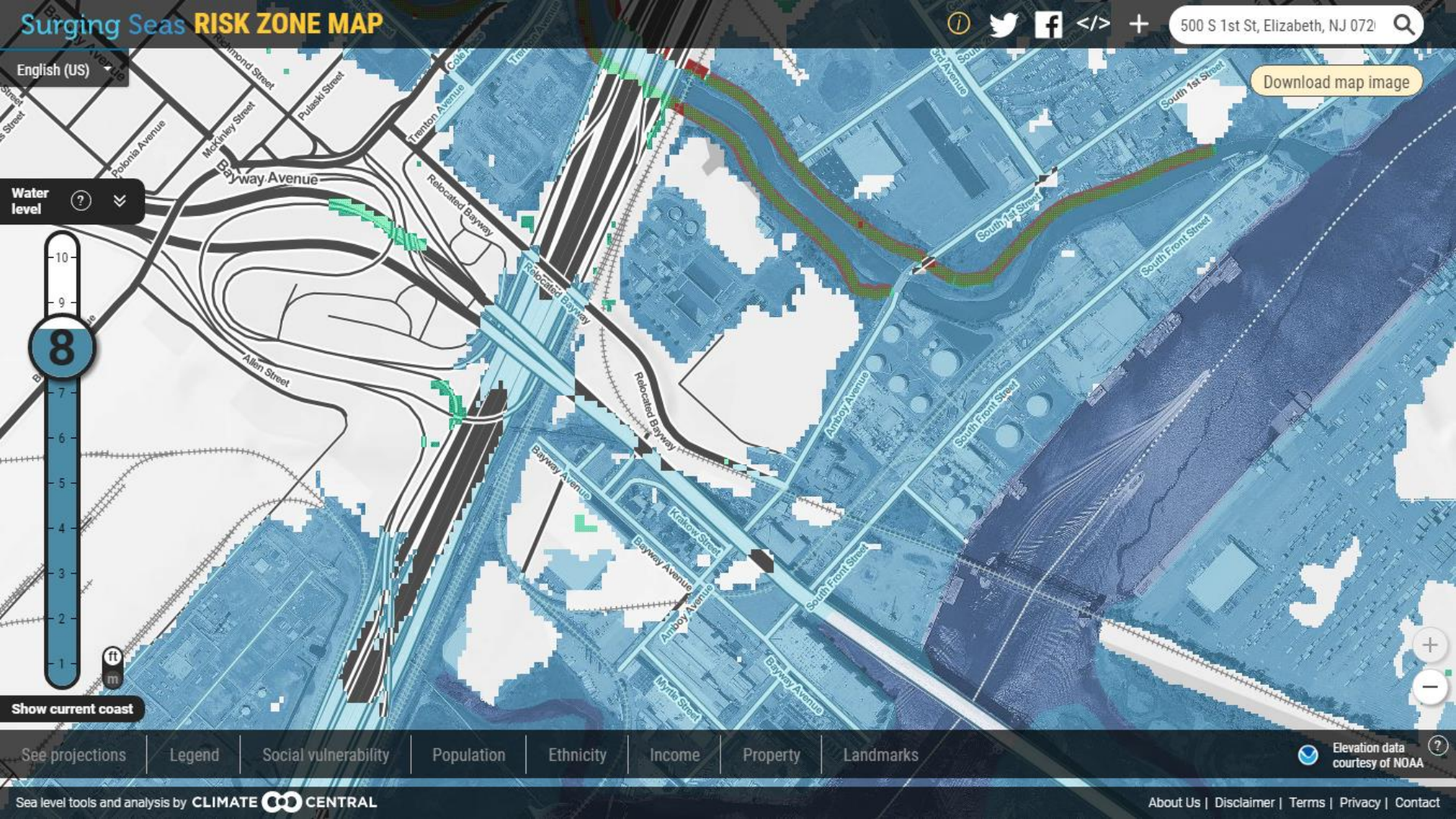
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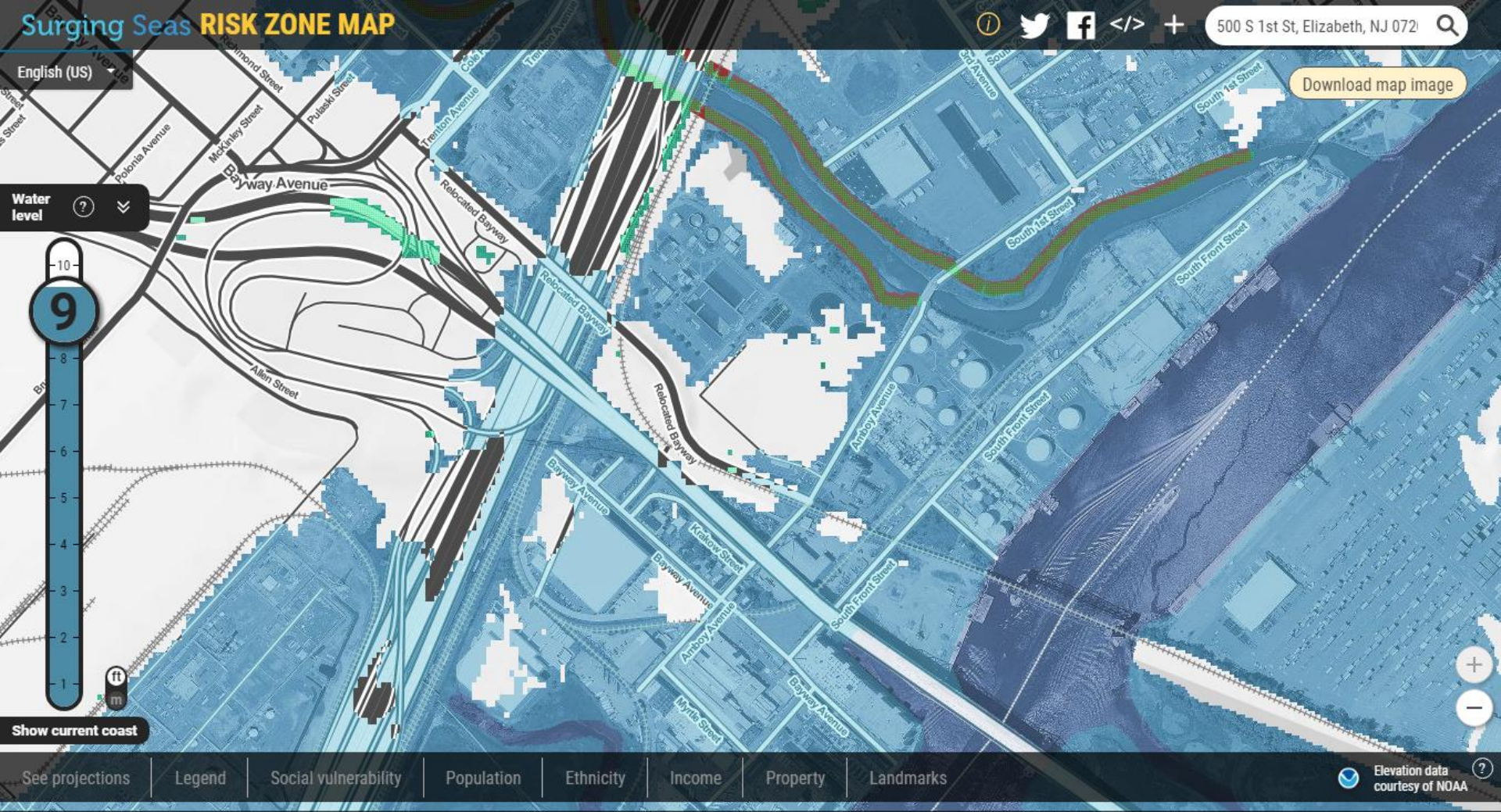
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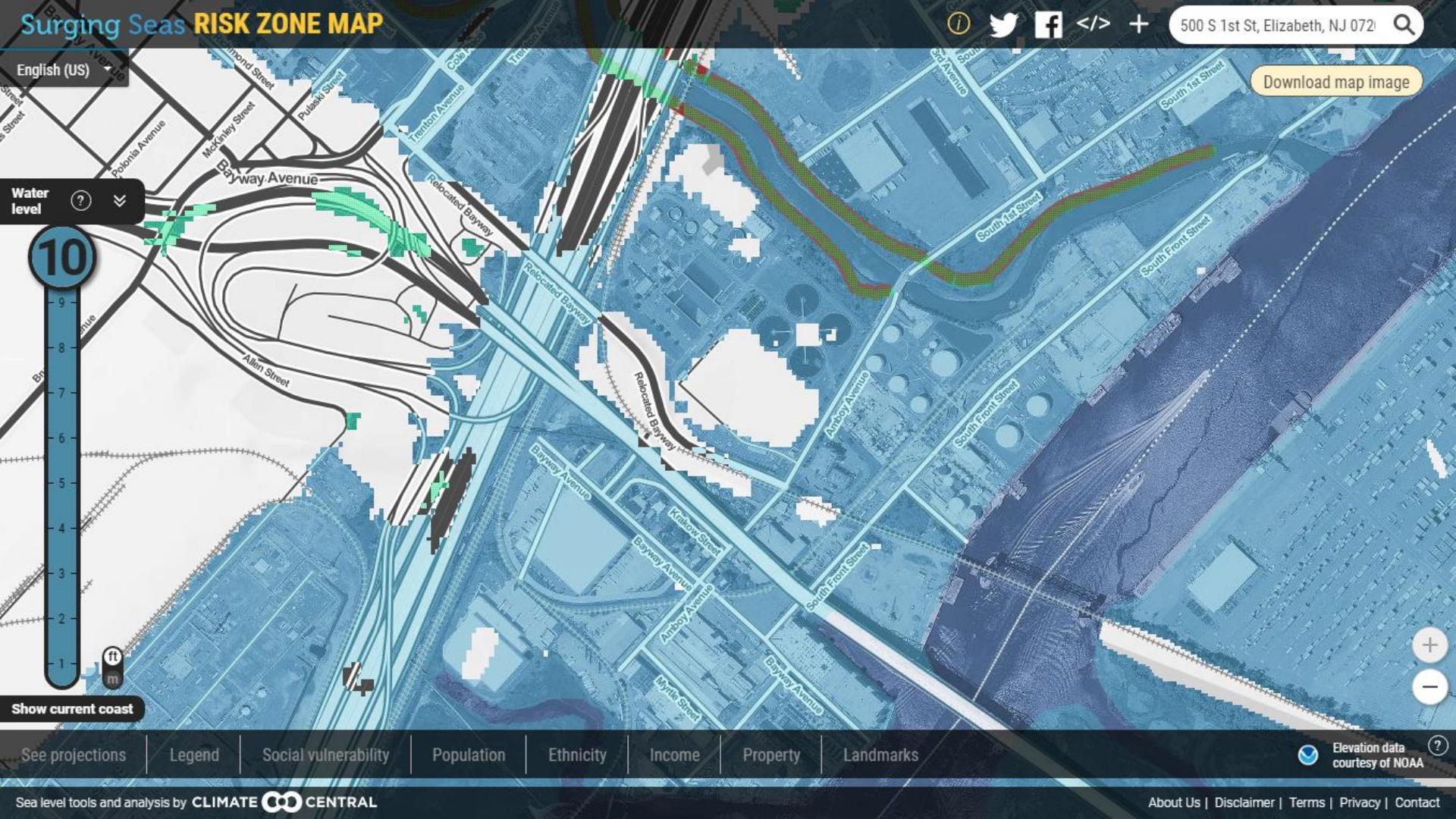
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Today
500 S 1st St
Image Landsat / Copernicus
CLIMATE CENTRAL
1995
Google Earth
40°38'22.68" N 74°11'58.28" W elev 58 ft eye alt 1411 ft


6 feet
500 S 1st St
Image Landsat / Copernicus
CLIMATE CENTRAL
Google Earth
1995
40°38'22.68" N 74°11'58.28" W elev 58 ft eye alt 1411 ft


7 feet
500 S 1st St
Image Landsat / Copernicus
CLIMATE CENTRAL
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10 feet
500 S 1st St
Image Landsat / Copernicus
CLIMATE CENTRAL
Google Earth
1995
40°38'22.68" N 74°11'58.28" W elev 58 ft eye alt 1411 ft

Elizabeth, NJ, USA

Water level (ft)

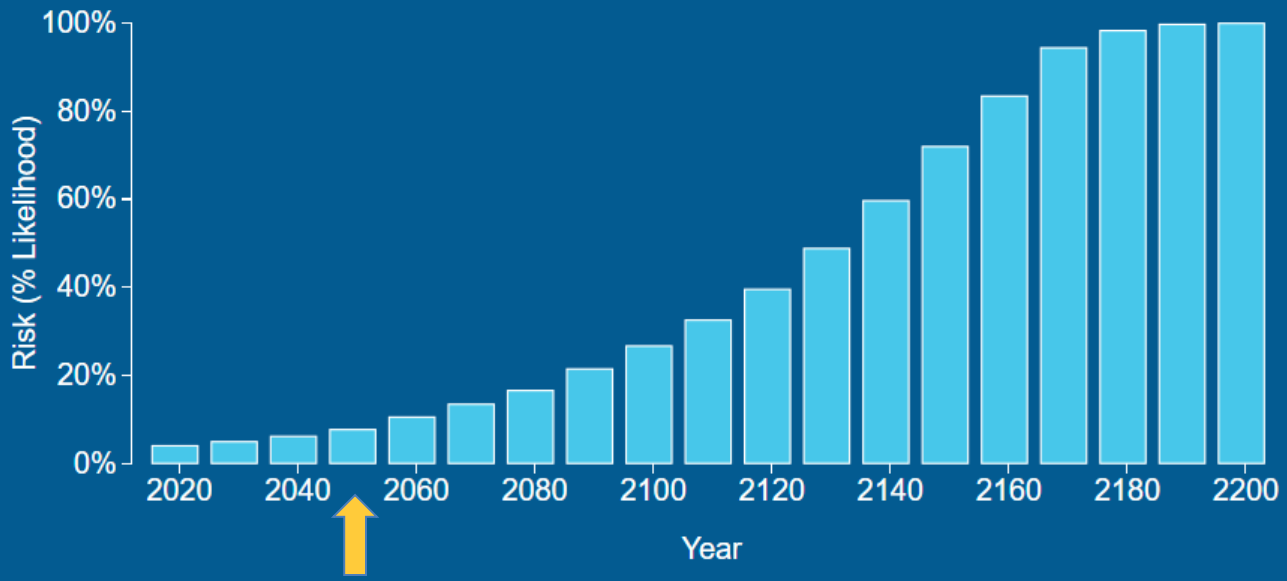
10 9 8 7 6 **5** 4 3 2 1

When Are the Risks?

ELIZABETH AREA*

Single-year risk of flooding above 5 ft ▼ PPT PNG XLS

Risk of at least one flood within each year shown



Sea level scenario

- Extreme
- Fast rise
- Medium
- Slow rise

Advanced

*At The Battery water level station, 10 miles from Elizabeth

Elizabeth, NJ, USA

Water level (ft)

10 9 8 7 6 **5** 4 3 2 1

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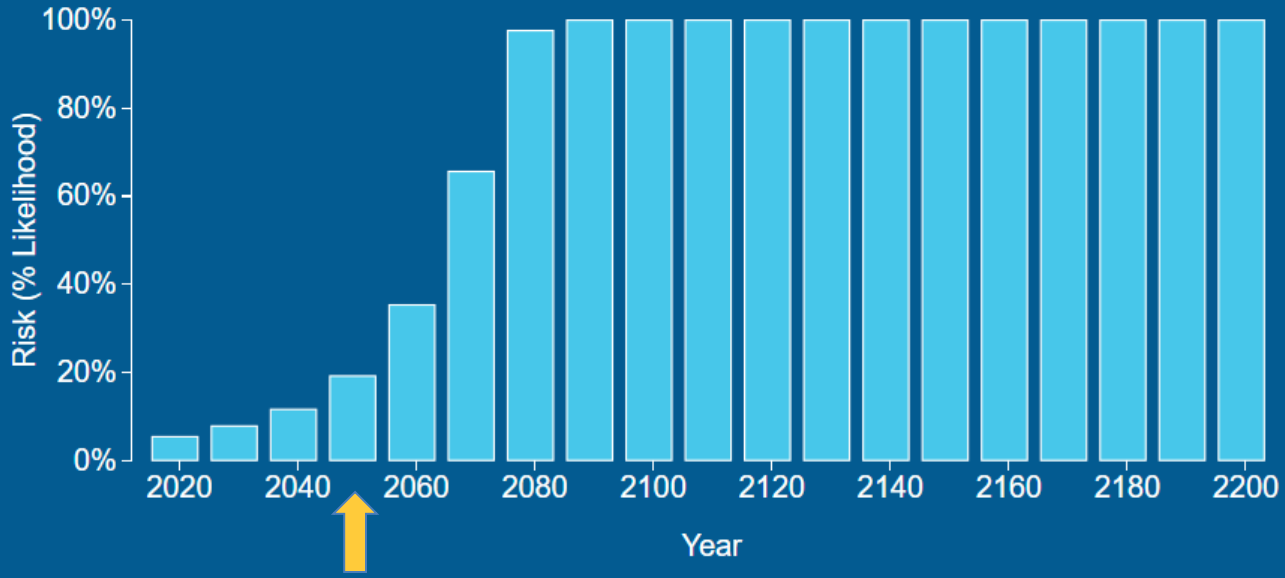

Sea level scenario

- Extreme
- Fast rise
- Medium
- Slow rise

Advanced

*At The Battery water level station, 10 miles from Elizabeth

Elizabeth, NJ, USA

Water level (ft)

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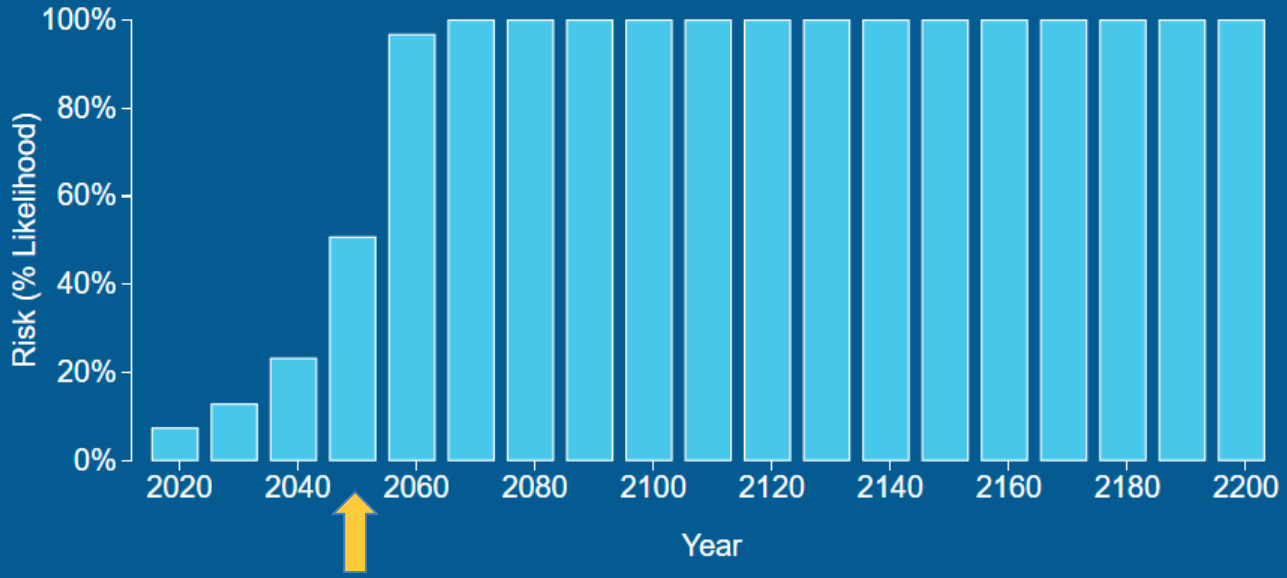

Sea level scenario

Extreme
Fast rise
Medium
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Advanced

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Elizabeth, NJ, USA

Water level (ft)

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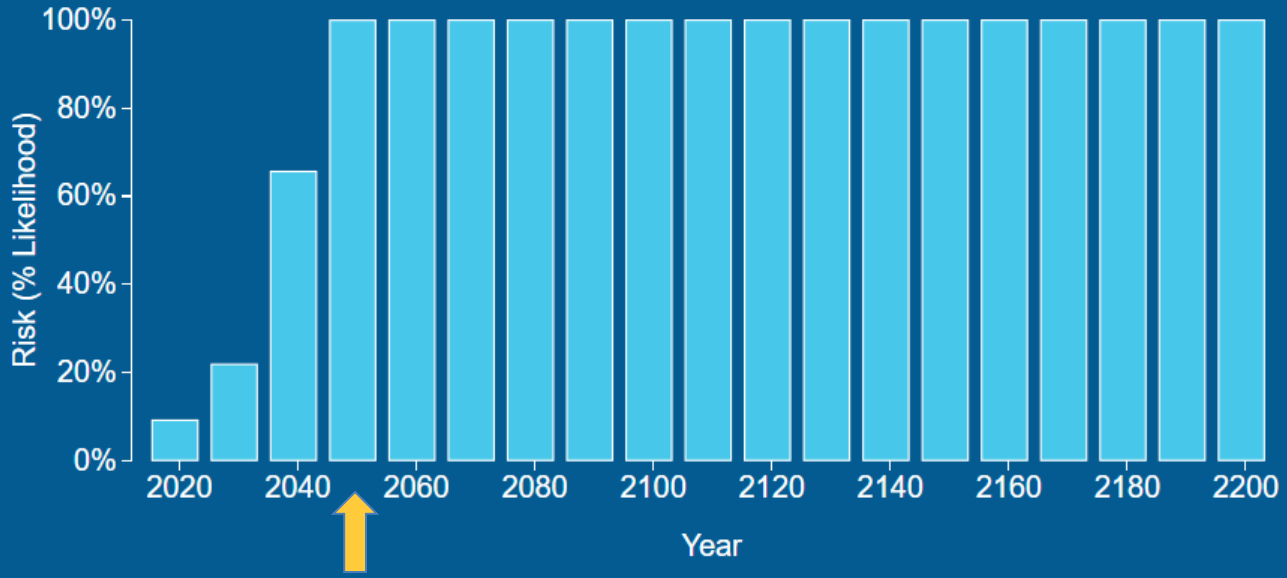

Sea level scenario

Extreme

Fast rise

Medium

Slow rise

Advanced

*At The Battery water level station, 10 miles from Elizabeth

Elizabeth, NJ, USA

Water level (ft)

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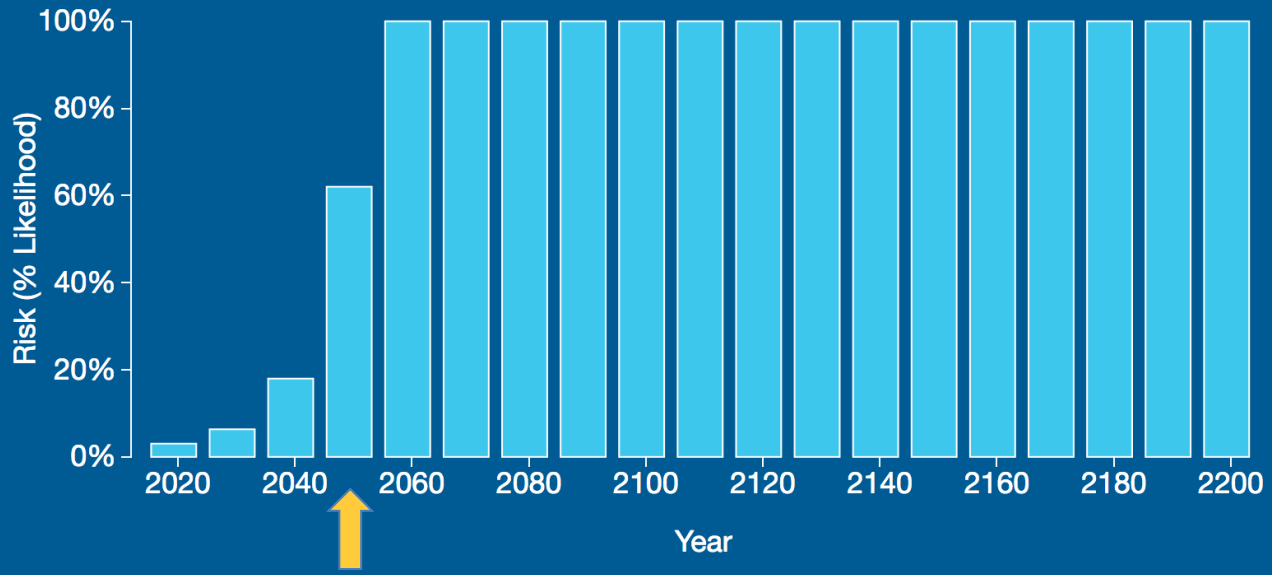
When Are the Risks?

ELIZABETH AREA*

Single-year risk of flooding above 6 ft ▾ PPT PNG XLS

Risk of at least one flood within each year shown



Sea level scenario

- Extreme
- Fast rise
- Medium
- Slow rise

Advanced

*At The Battery water level station, 10 miles from Elizabeth

Elizabeth, NJ, USA

Water level (ft)

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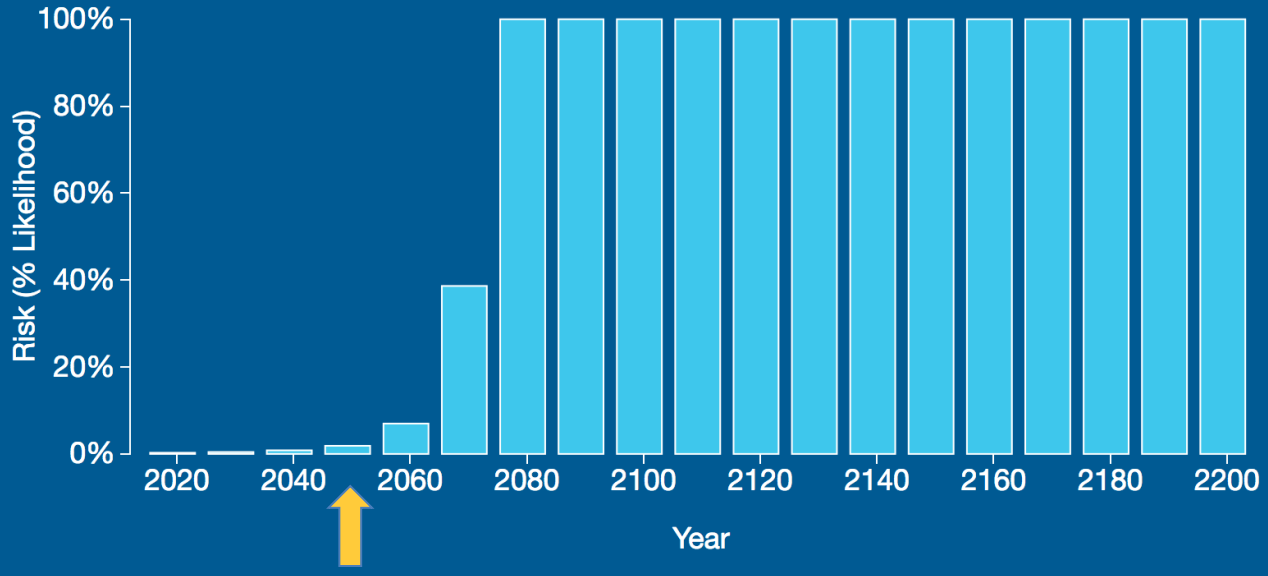
When Are the Risks?

ELIZABETH AREA*

Single-year risk of flooding above 9 ft ▾ PPT PNG XLS

Risk of at least one flood within each year shown



Sea level scenario

- Extreme
- Fast rise
- Medium
- Slow rise

Advanced

*At The Battery water level station, 10 miles from Elizabeth

Water level (ft)

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What Is at Risk?

Population | Buildings | Infrastructure | Contamination Risks | Land

Total contamination risks below 5ft in 07202

Contamination Risks: All	Total
EPA listed sites	12
RADINFO sites	5
Unspecified hazardous waste sites	5
Hazardous waste sites	5
Wastewater sites	3
Nonmajor wastewater sites	3
NPDES sites	3

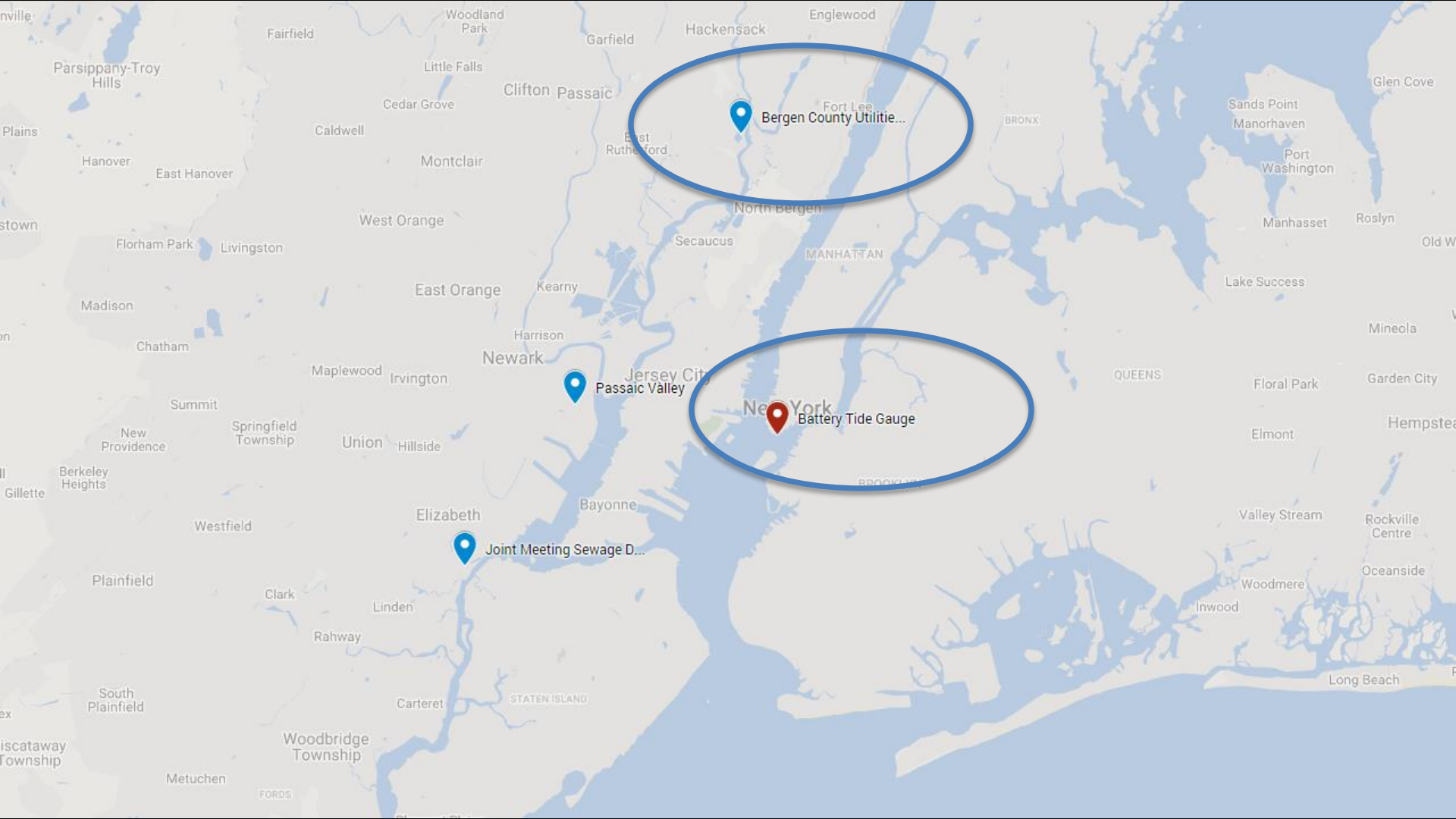
Sources for raw epa listed sites data: EPA 2013 | Details

Values exclude sub-5ft areas potentially protected by levees or other features.

Choose a threat to map using the scrollable list above

Total EPA listed sites below 5ft in zip codes in Union County

EPA-listed sites


Bergen County Utilitie...
Passaic Valley
Battery Tide Gauge
Joint Meeting Sewage D...
Fairfield
Woodland Park
Garfield
Hackensack
Englewood
Parsippany-Troy Hills
Little Falls
Clifton
Passaic
Cedar Grove
Fort Lee
Glen Cove
Sands Point
Manorhaven
Caldwell
Montclair
Hanover
East Hanover
Port Washington
West Orange
North Bergen
Manhasset
Roslyn
Florham Park
Livingston
Secaucus
MANHATTAN
East Orange
Kearny
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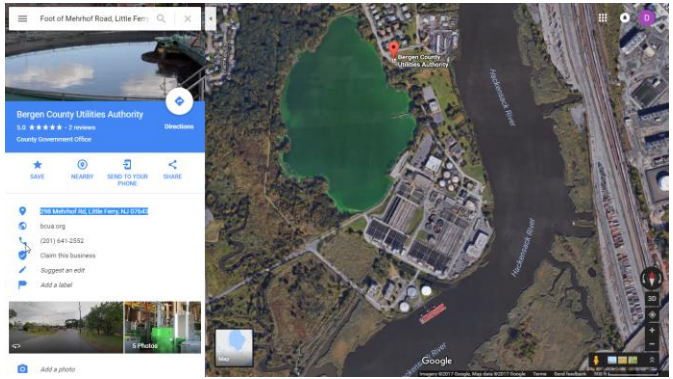
Madison
Chatham
Harrison
Mineola
Newark
Maplewood
Irvington
Jersey City
QUEENS
Floral Park
Garden City
Summit
Springfield Township
Union
Hillside
Elmont
Berkeley Heights
Bayonne
Elizabeth
Valley Stream
Rockville Centre
Westfield
Plainfield
Clark
Linden
Woodmere
Oceanside
Inwood
Rahway
Long Beach
South Plainfield
Carteret
STATEN ISLAND
Woodbridge Township
Metuchen

Bergen County Utilities Authority (Little Ferry, NJ)

http://www.bcua.org/




Today
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CLIMATE CENTRAL
Google Earth
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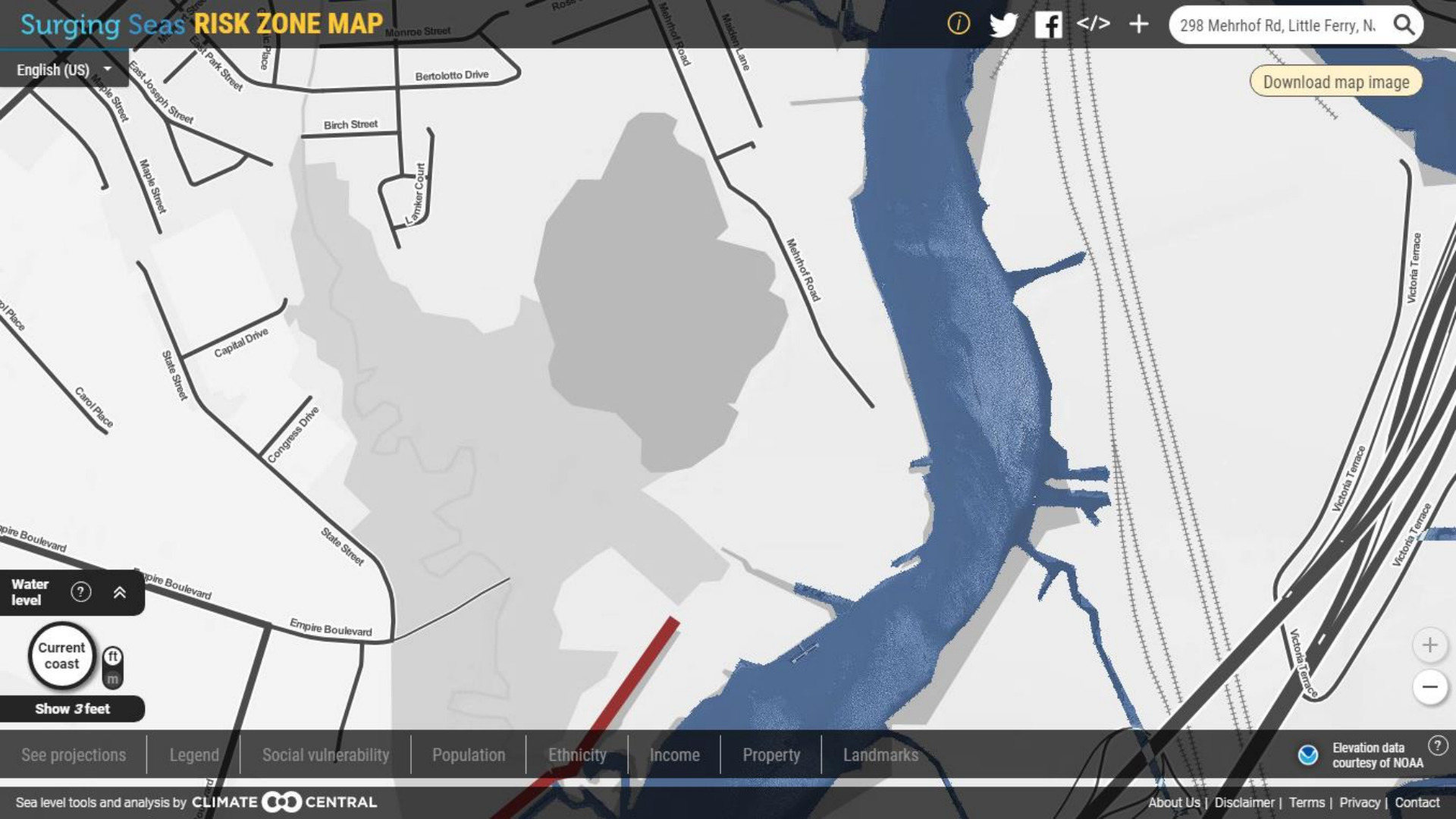
40°50'00.90" N 74°02'02.45" W elev 10 ft eye alt 2090 ft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Birch Street
Lanker Court
Mehrhof Road
Maiden Lane
East Joseph Street
East Park Street
Maple Street
Capital Drive
State Street
Congress Drive
Carol Place
Empire Boulevard
Victoria Terrace
Water level
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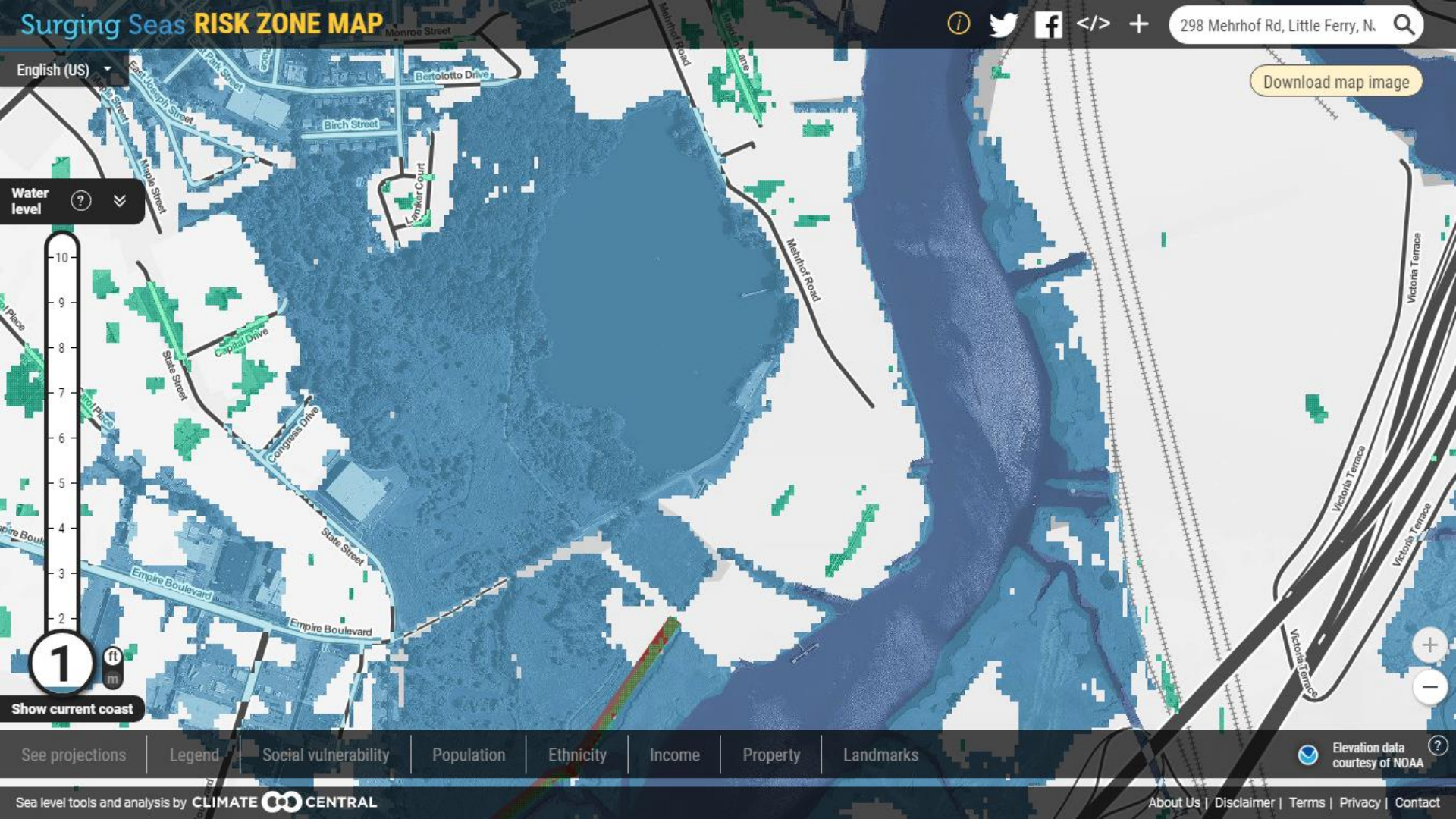
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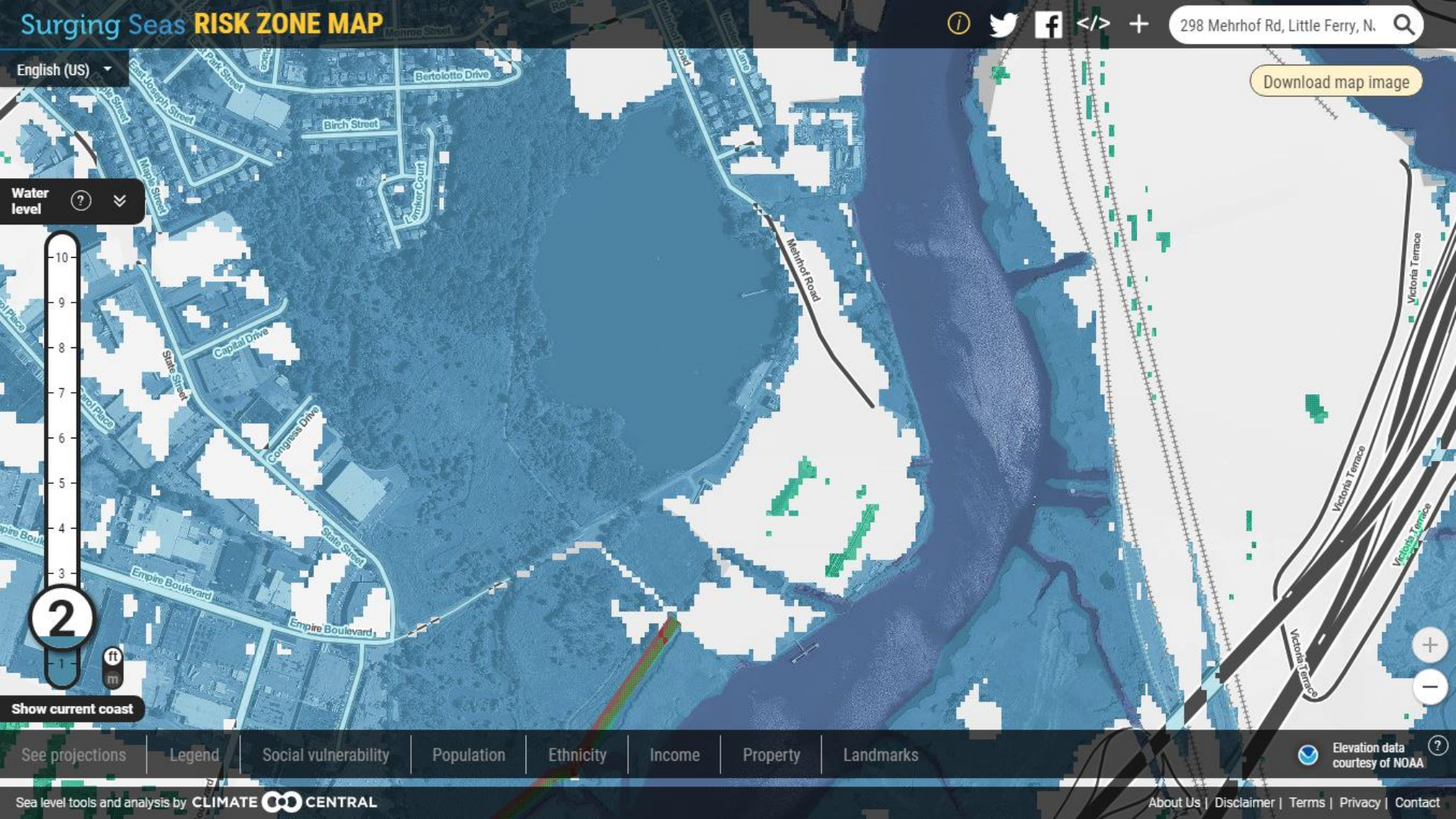
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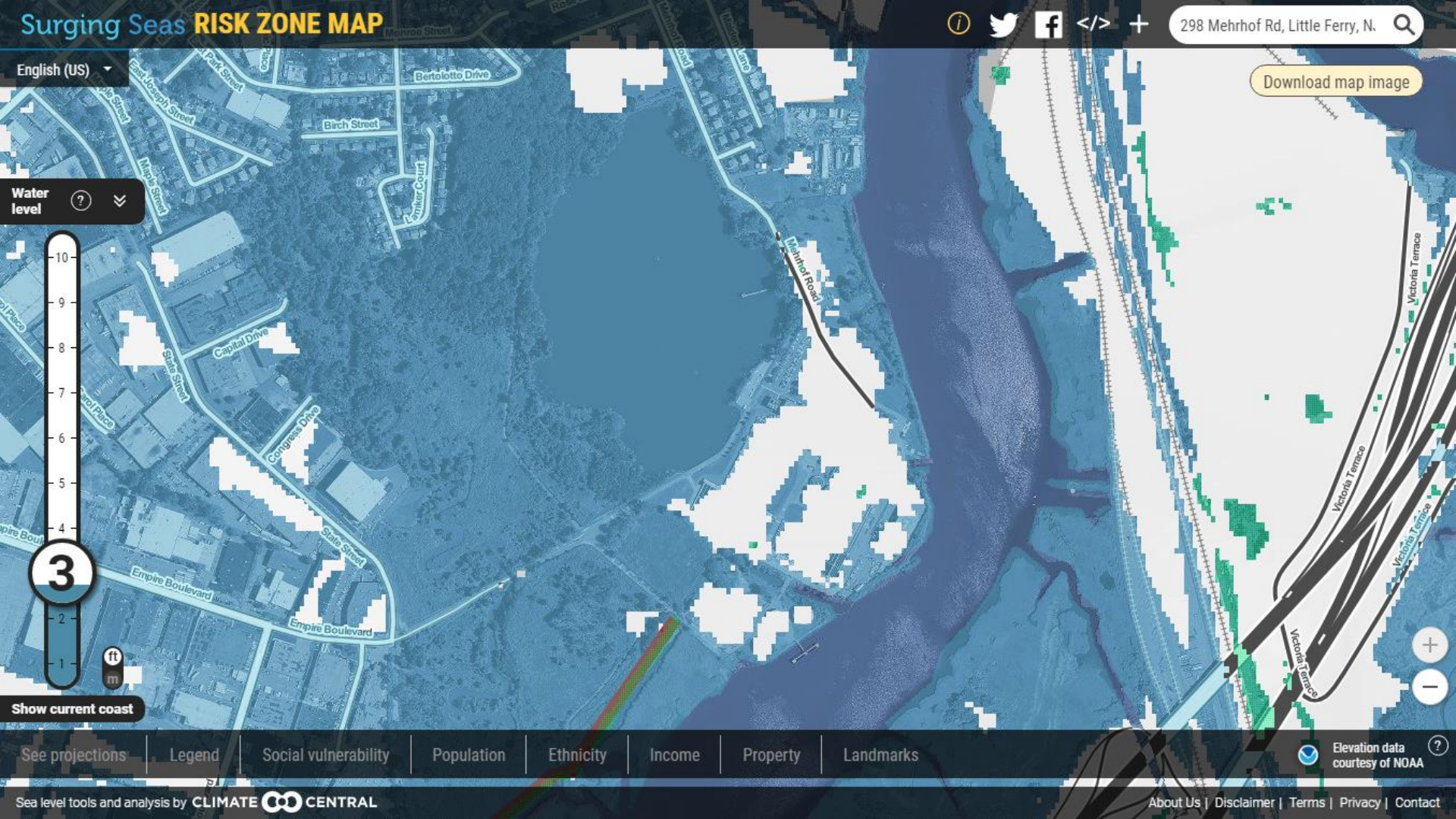
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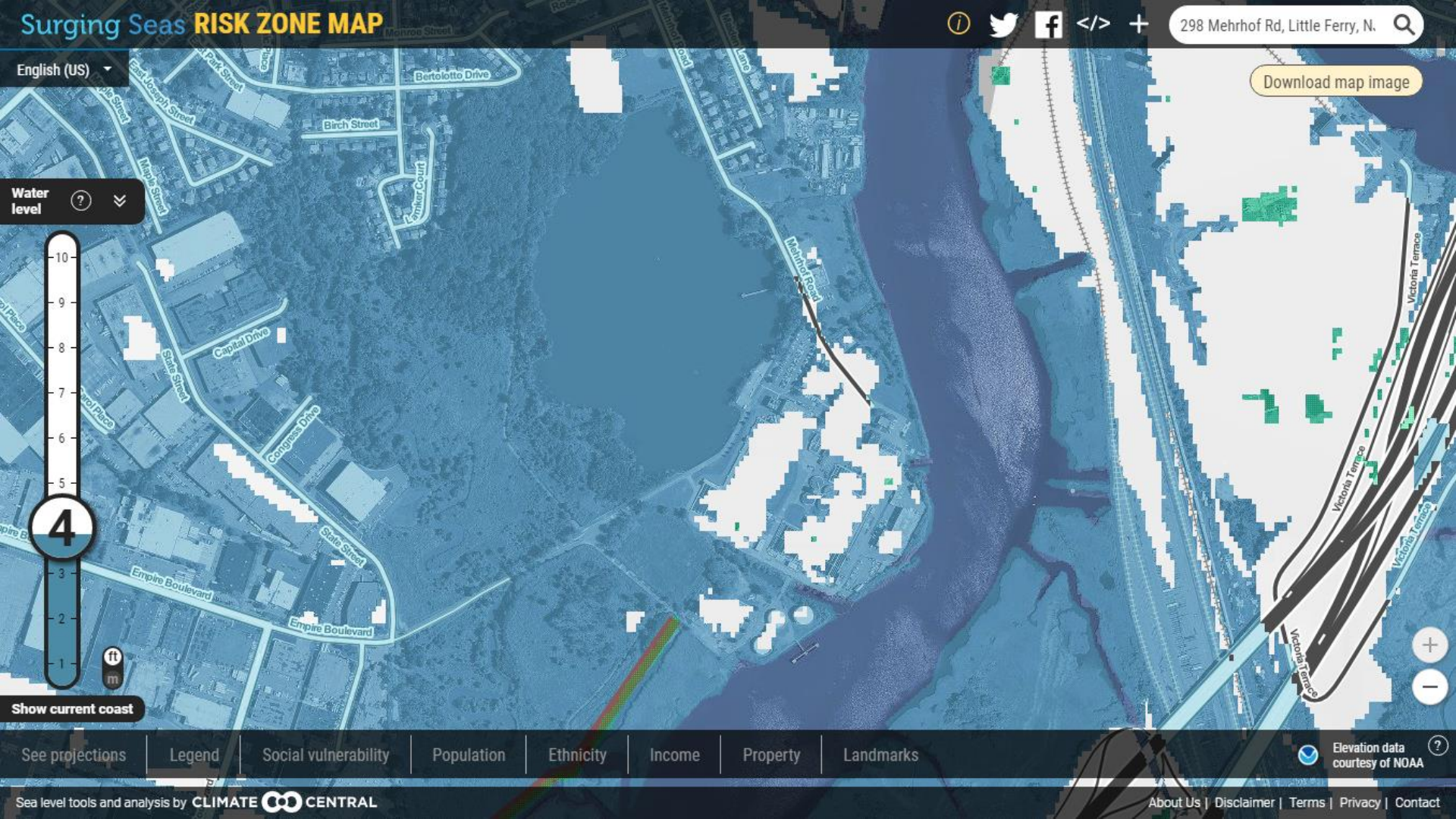
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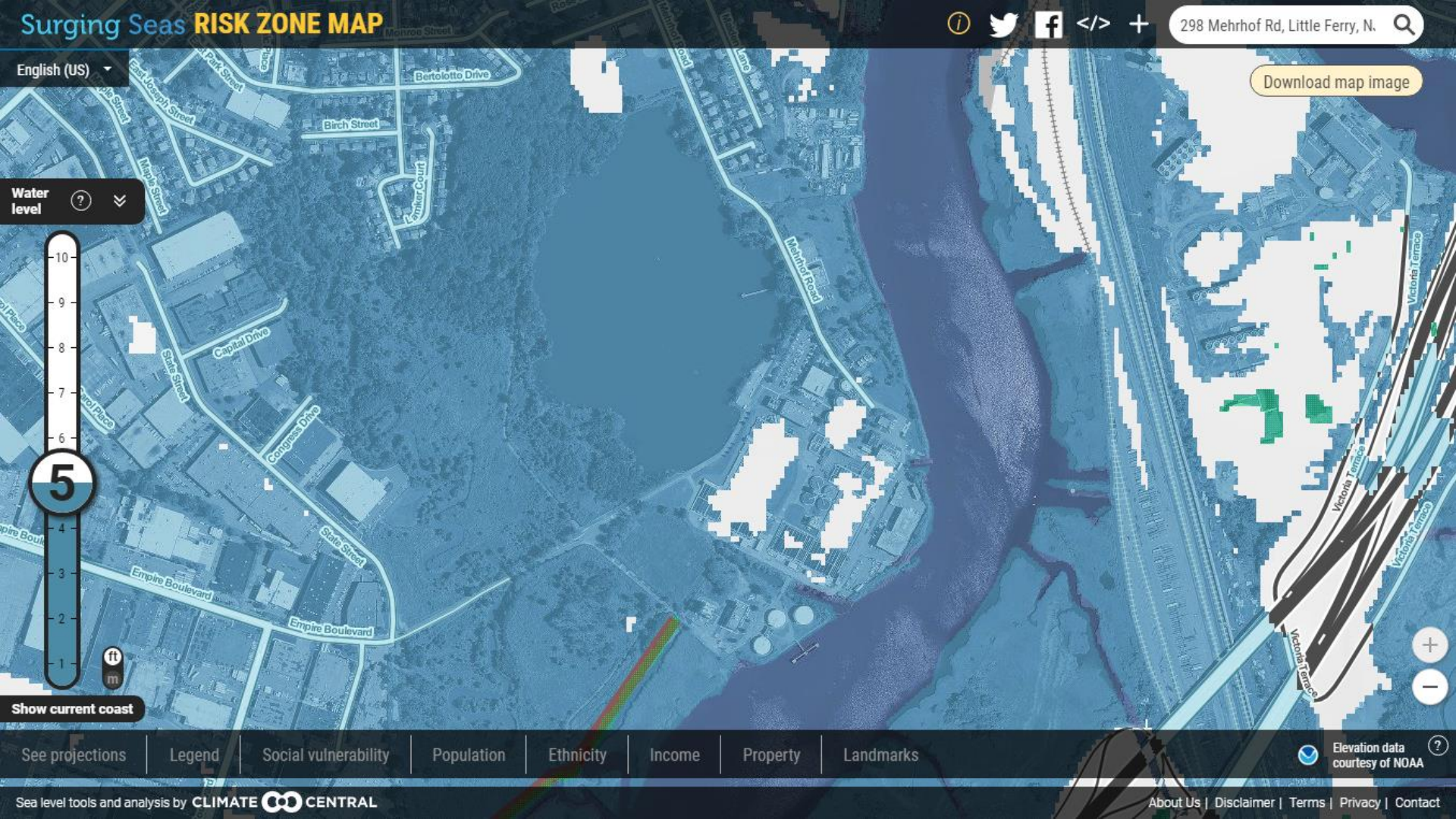
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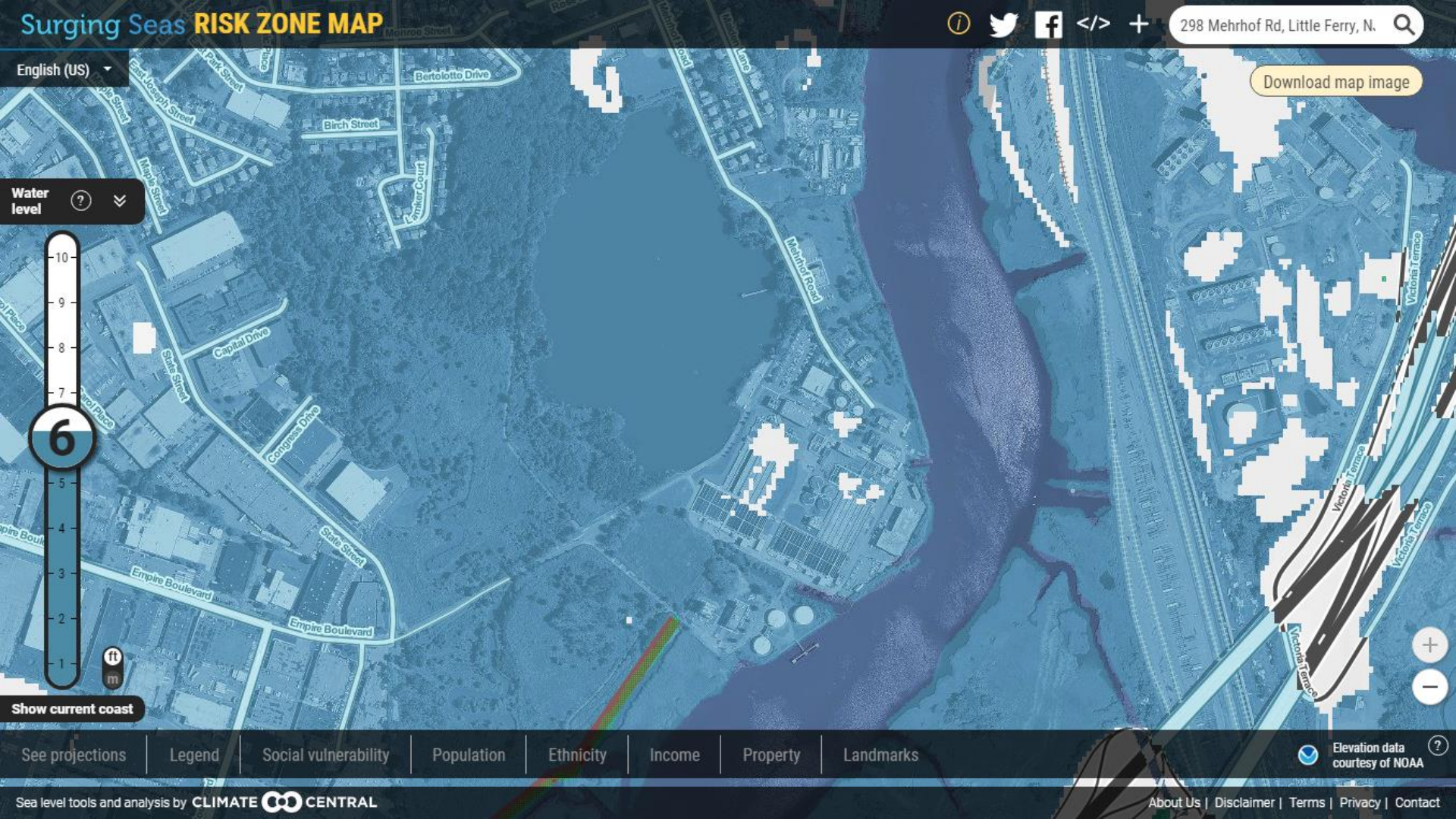
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See projections
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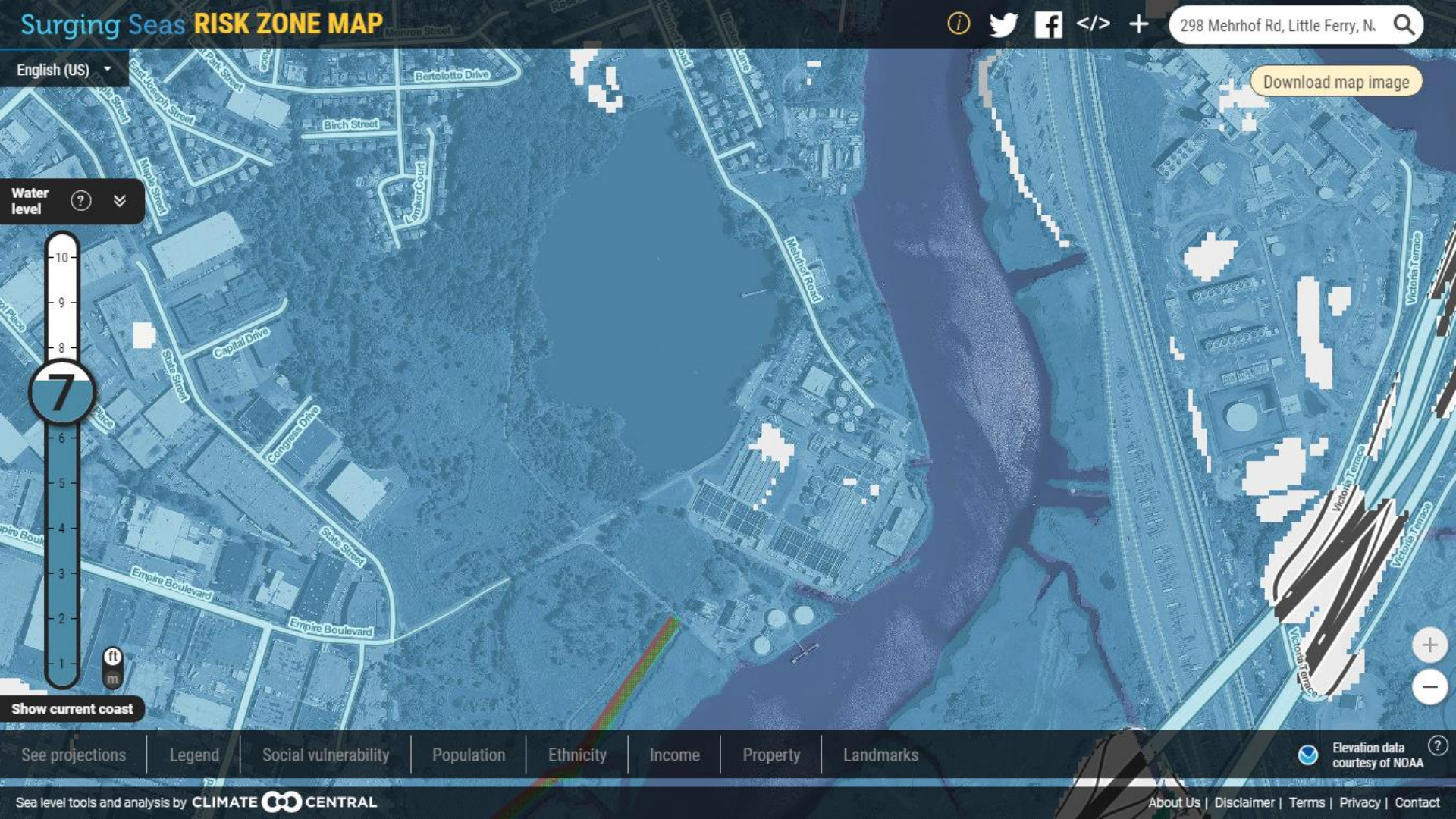
Surging Seas RISK ZONE MAP
298 Mehrhof Rd, Little Ferry, N.
English (US)
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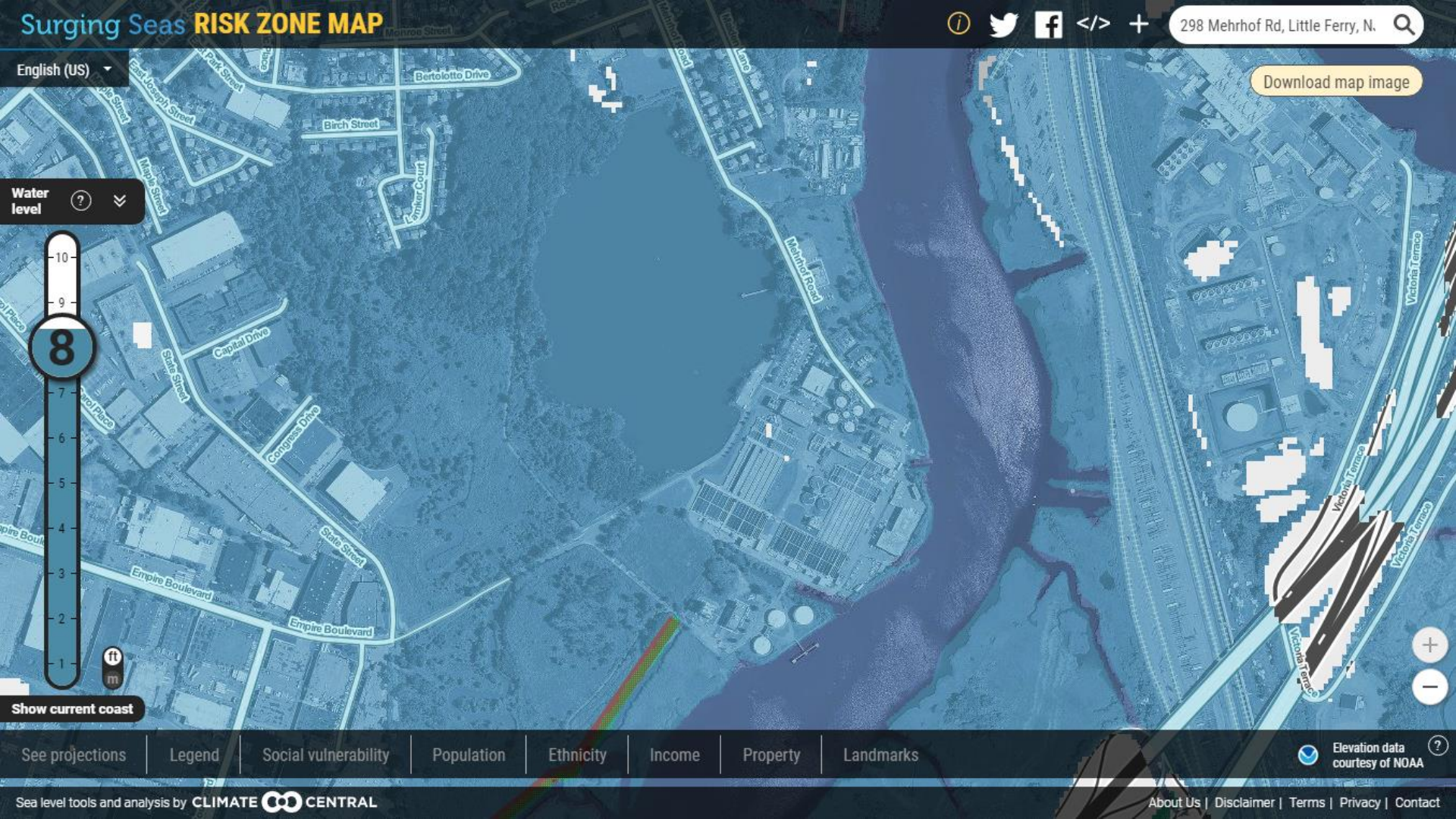
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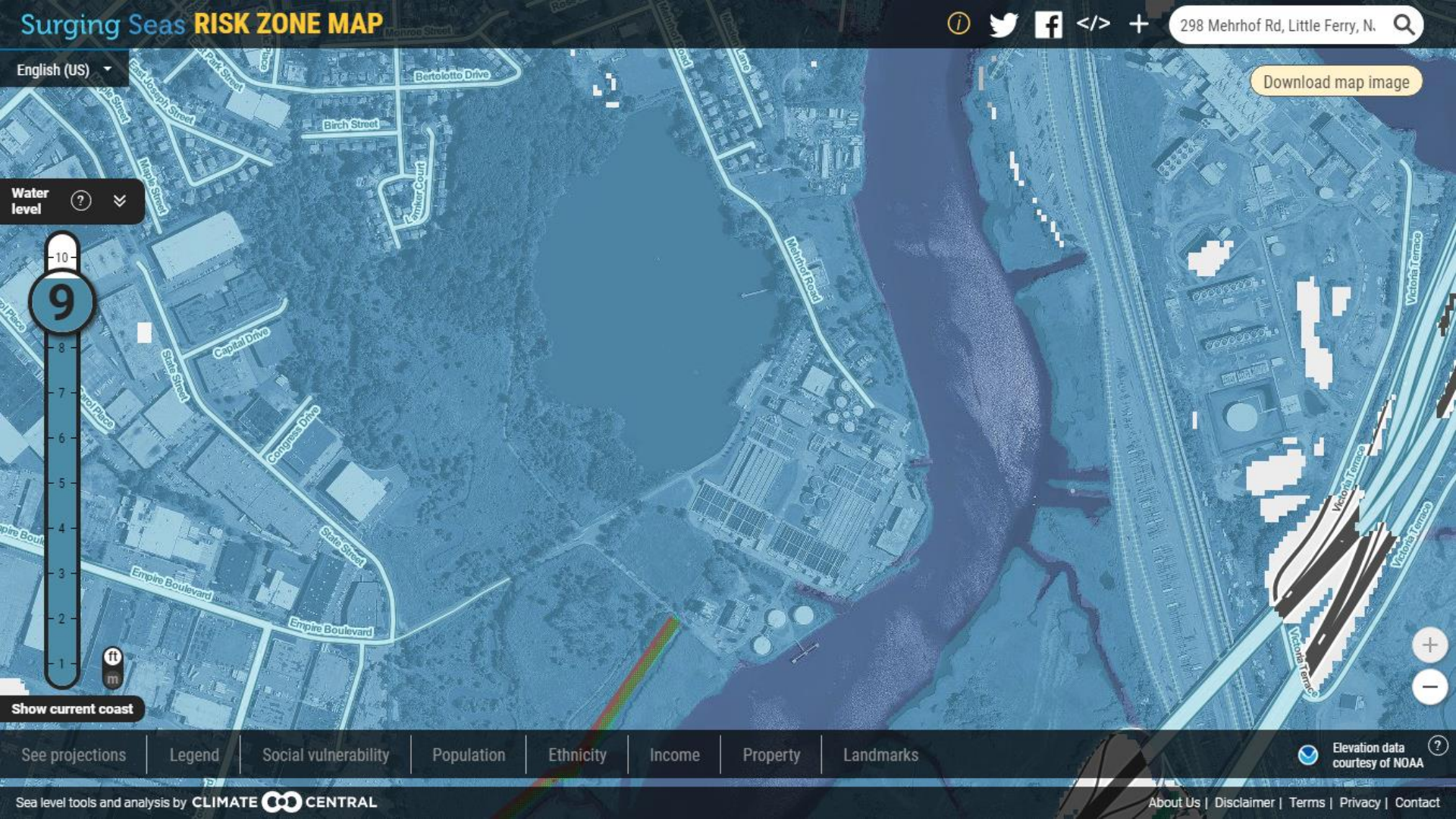
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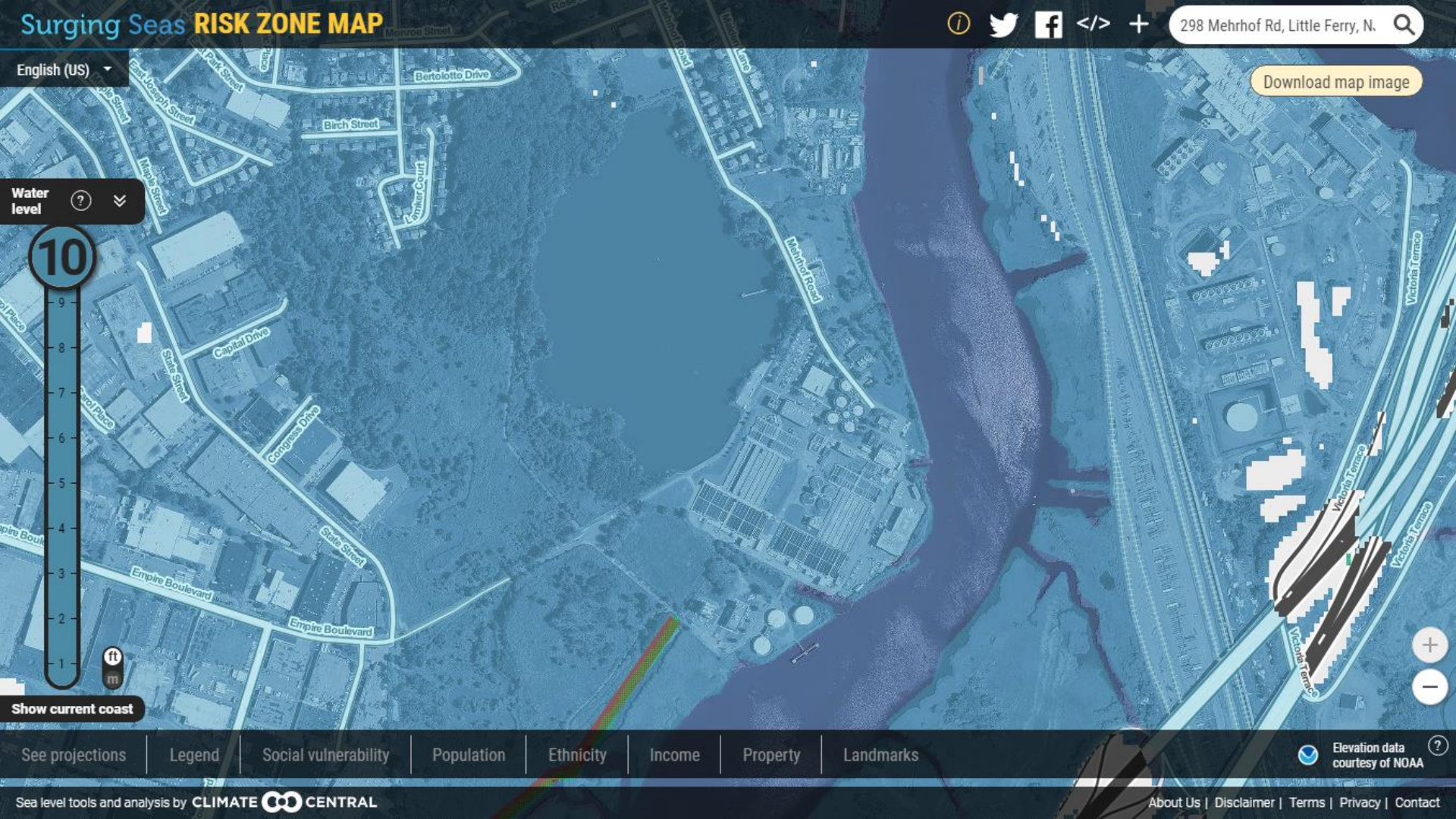
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Water level (ft)

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What Is at Risk?

Population | Buildings | Infrastructure | Contamination Risks | Land

Total buildings below 5ft in 07643

Buildings: All	Total
Homes	3,465
Property value	$1.5 Billion
Medical facilities	3
Houses of worship	2
Schools	2
Public Schools	2
Libraries	1

Sources for raw homes data: Census 2010 | Details

Values exclude sub-5ft areas potentially protected by levees or other features.

Choose a threat to map using the scrollable list above

Total homes below 5ft in zip codes in Bergen County

Homes

Water level (ft)

10 9 8 7 6 **5** 4 3 2 1

What Is at Risk?

Population | Buildings | Infrastructure | Contamination Risks | Land

Total infrastructure below 5ft in 07643

Infrastructure: All	Total
Roads	20 miles
Local roads	19 miles
Federal roads	1 miles
Heliports	1
Secondary roads	1 miles

Sources for raw roads data: Census 2012 | *Details*

Values exclude sub-5ft areas potentially protected by levees or other features.

Choose a threat to map using the scrollable list above

Total roads below 5ft in zip codes in Bergen County

Water level (ft)

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What Is at Risk?

Population | Buildings | Infrastructure | Contamination Risks | Land

Total contamination risks below 5ft in 07643

Contamination Risks: All	Total
EPA listed sites	37
RADINFO sites	29
Hazardous waste sites	29
Unspecified hazardous waste sites	25
Nonmajor wastewater sites	5
Wastewater sites	5
NPDES sites	5

Sources for raw epa listed sites data: EPA 2013 | Details

Values exclude sub-5ft areas potentially protected by levees or other features.

Choose a threat to map using the scrollable list above

Total EPA listed sites below 5ft in zip codes in Bergen County

EPA-listed sites

Passaic Valley Sewerage Commission (Newark, NJ)
http://www.nj.gov/pvsc/

FIRST ENVIRONMENT

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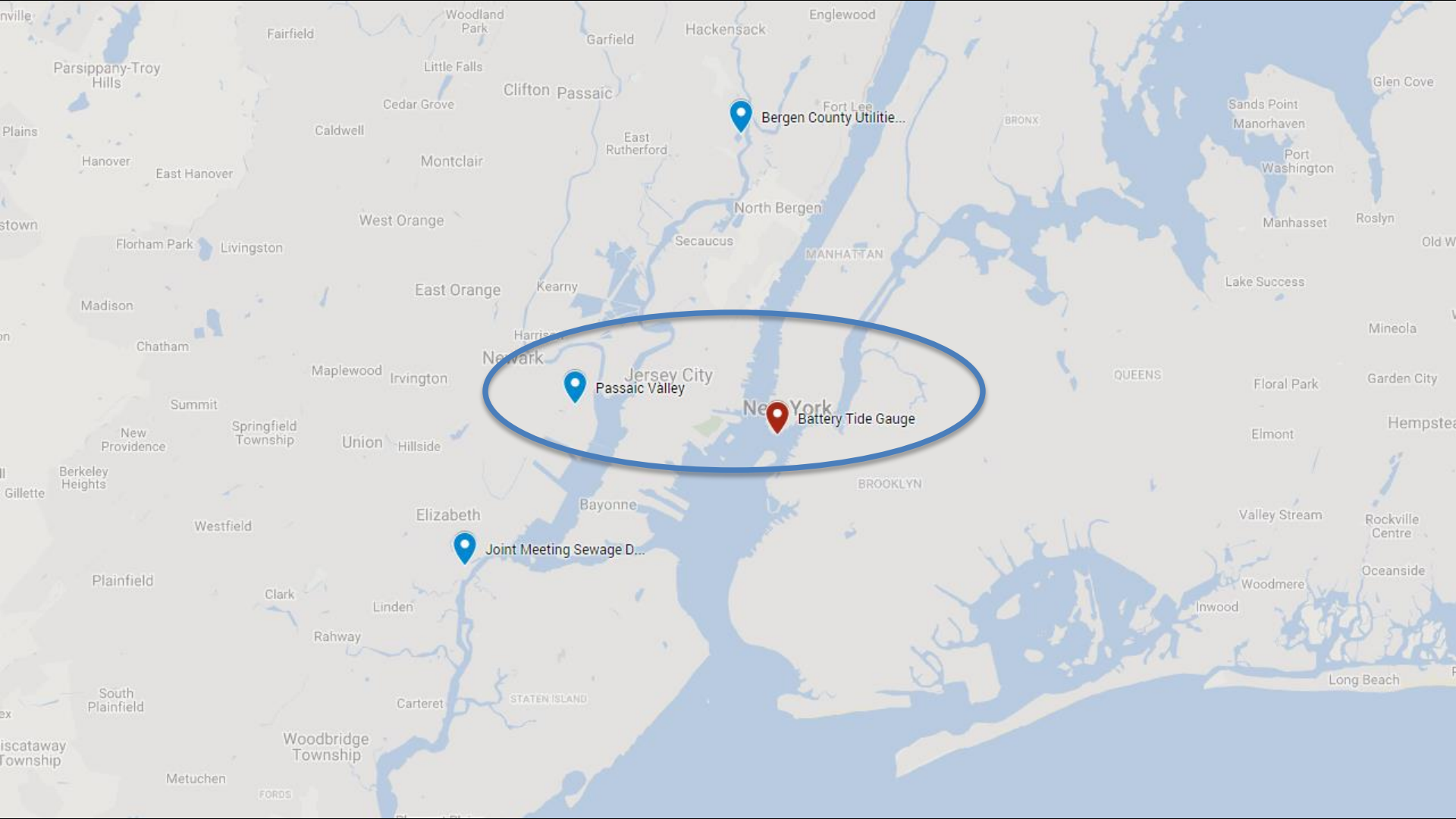
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Passaic Valley
Battery Tide Gauge
Joint Meeting Sewage D...
Parsippany-Troy Hills
Fairfield
Woodland Park
Garfield
Hackensack
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Little Falls
Clifton
Passaic
Cedar Grove
Fort Lee
Glen Cove
Sands Point
Manorhaven
Caldwell
East Rutherford
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Chatham
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Irvington
Jersey City
QUEENS
Floral Park
Garden City
Summit
New York
Springfield Township
Union
Hillside
Elmont
New Providence
Berkeley Heights
Gillette
BROOKLYN
Bayonne
Elizabeth
Valley Stream
Rockville Centre
Westfield
Oceanside
Plainfield
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Long Beach
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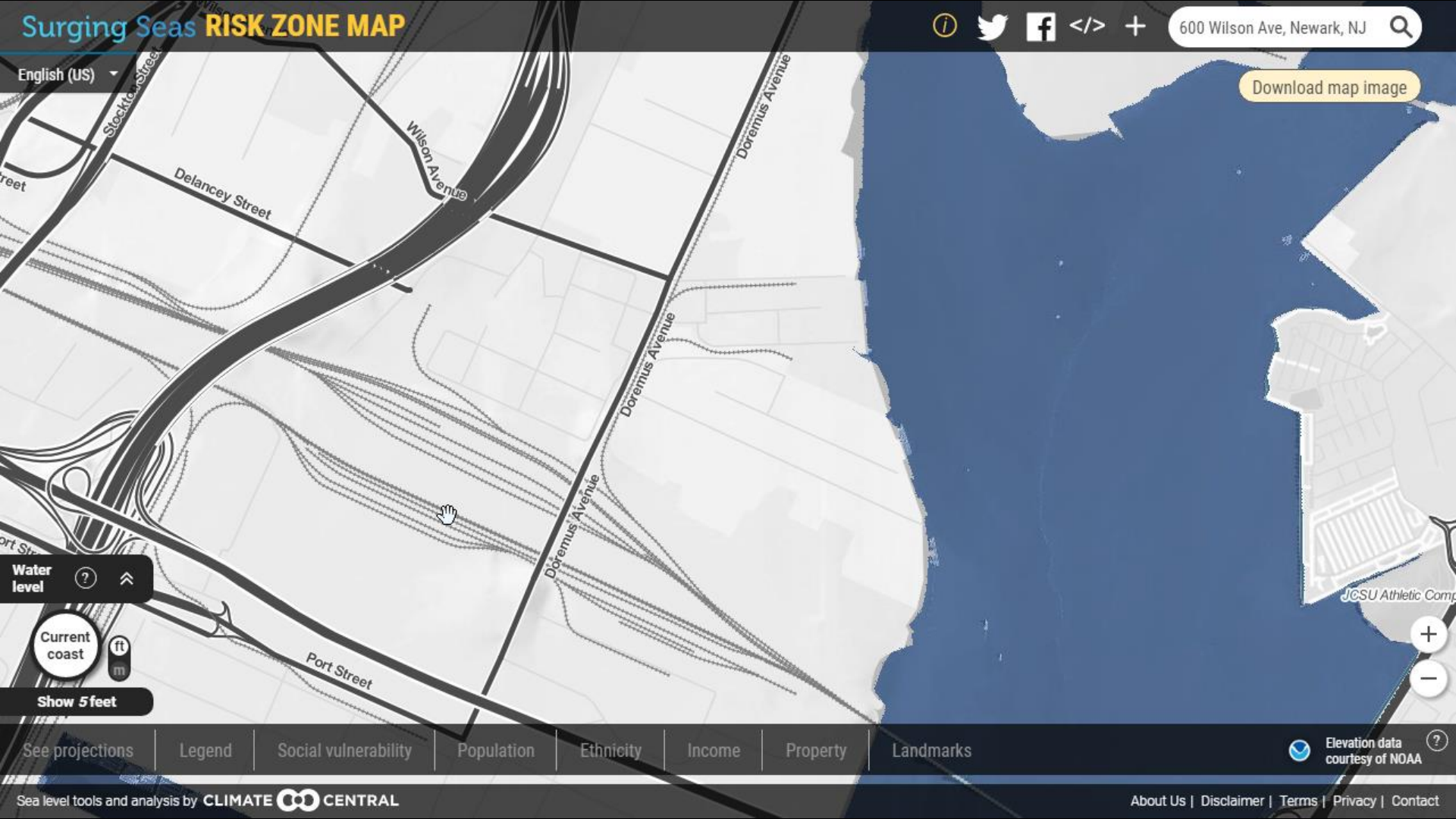
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English (US)
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Doremus Avenue
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JCSU Athletic Comp
Water level
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Show 5 feet
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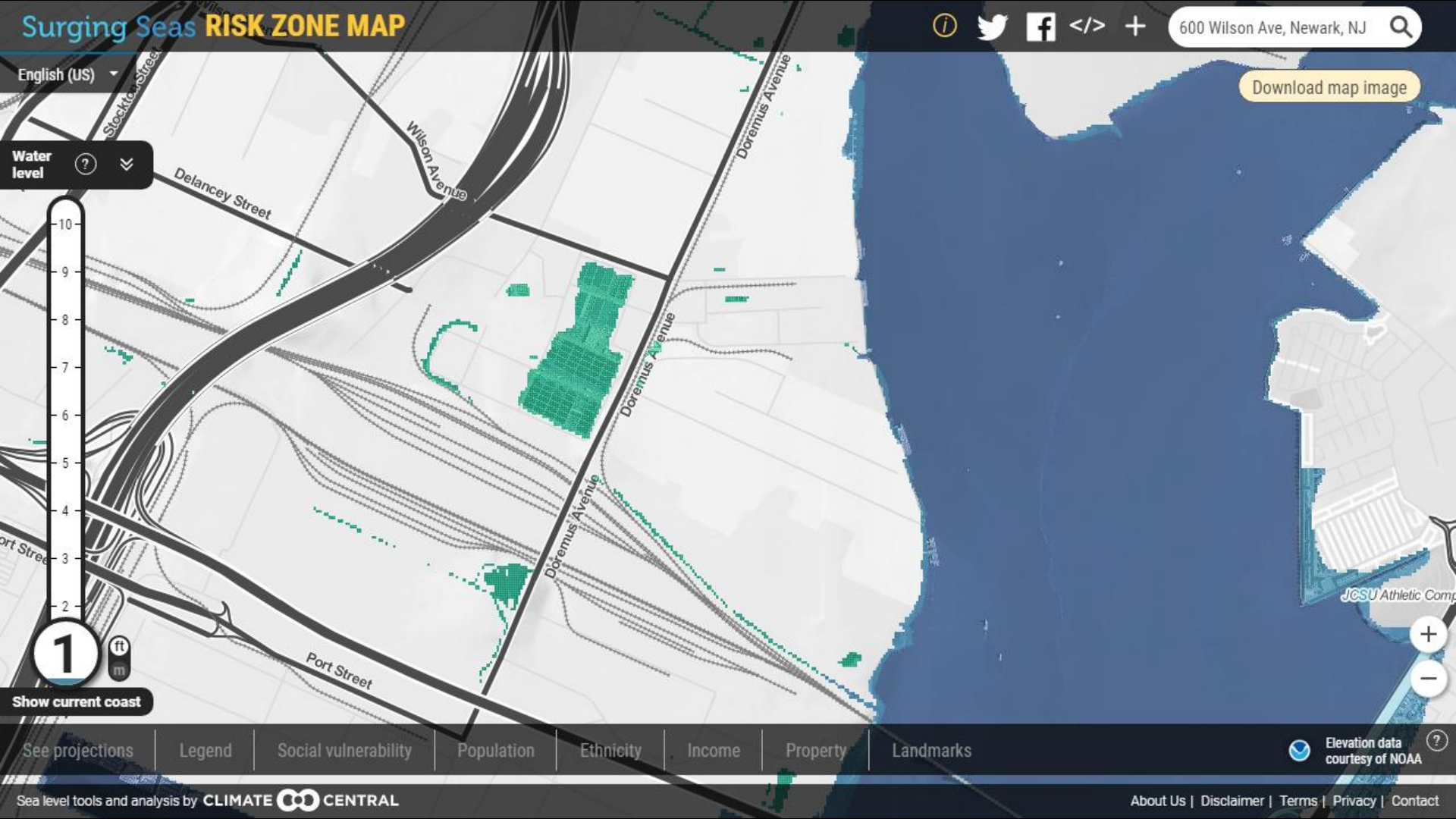
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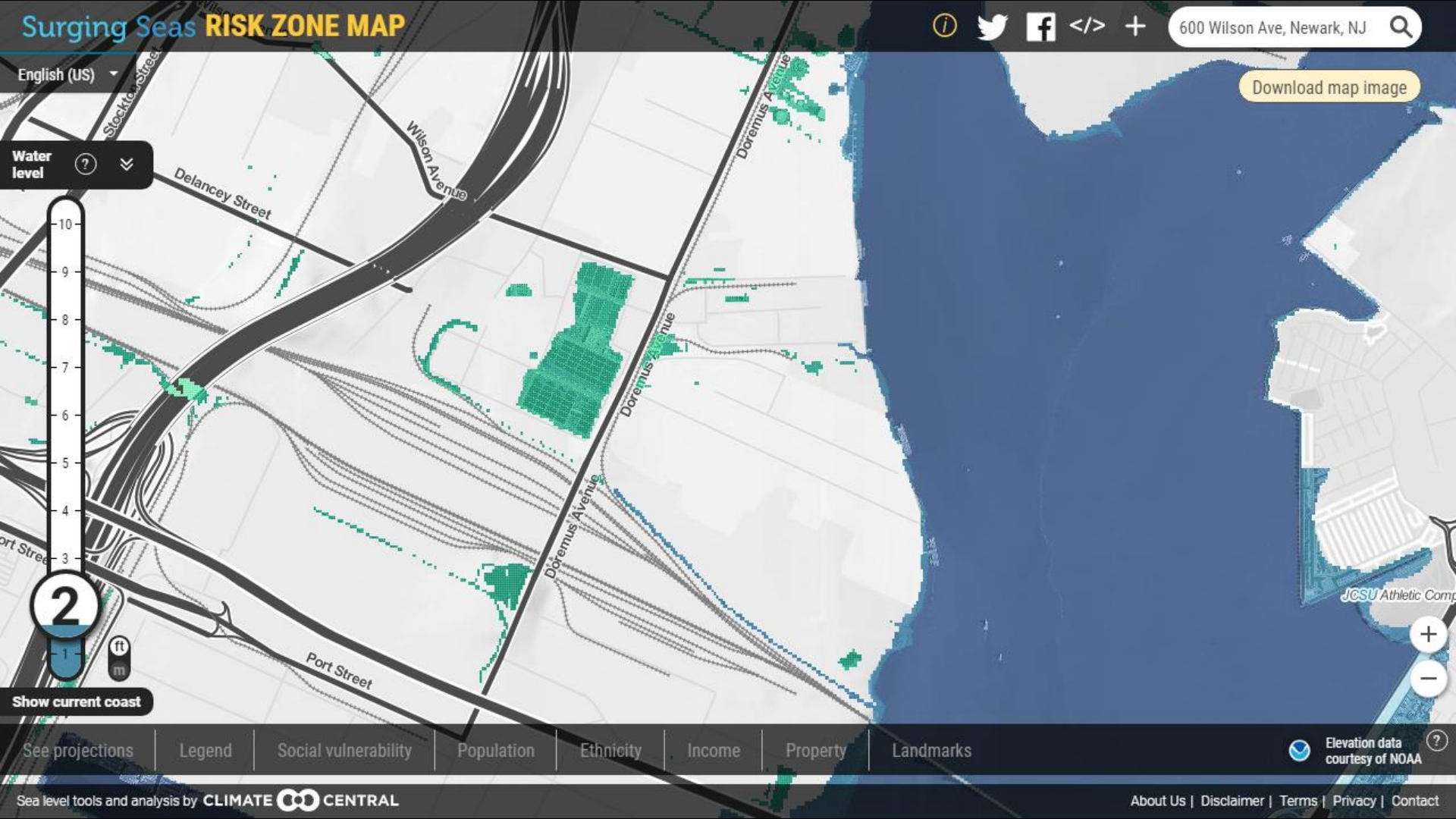
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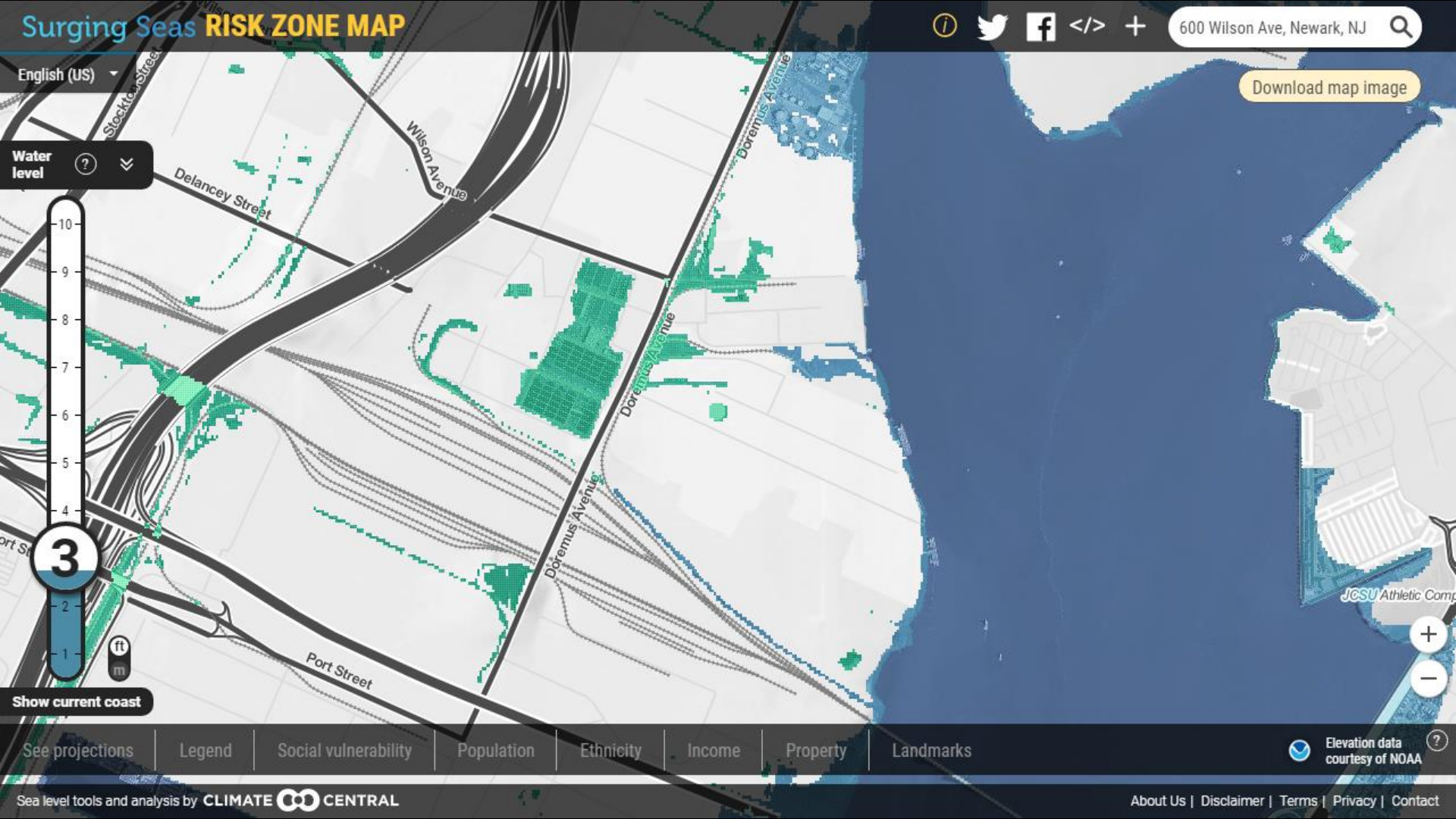
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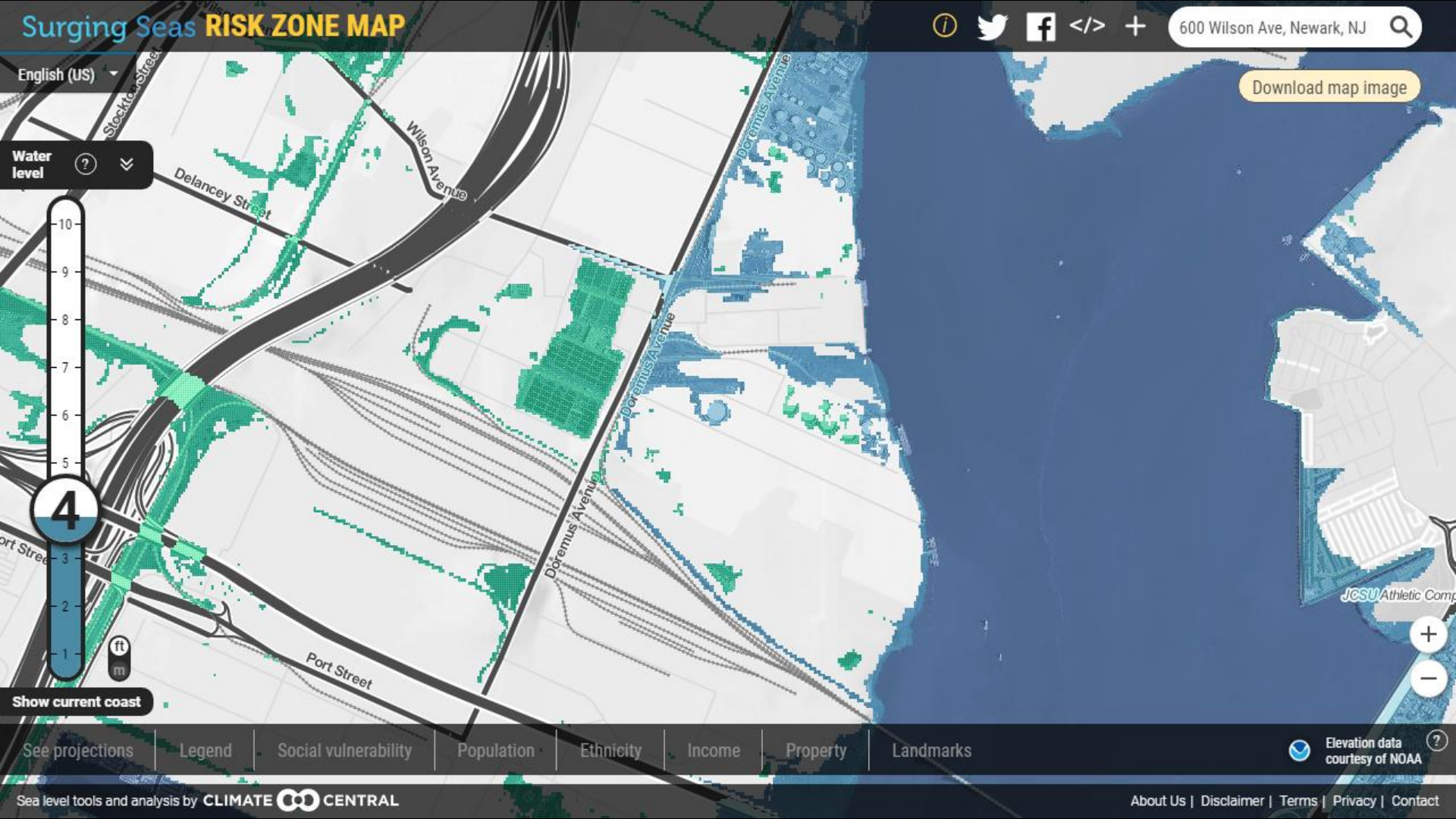
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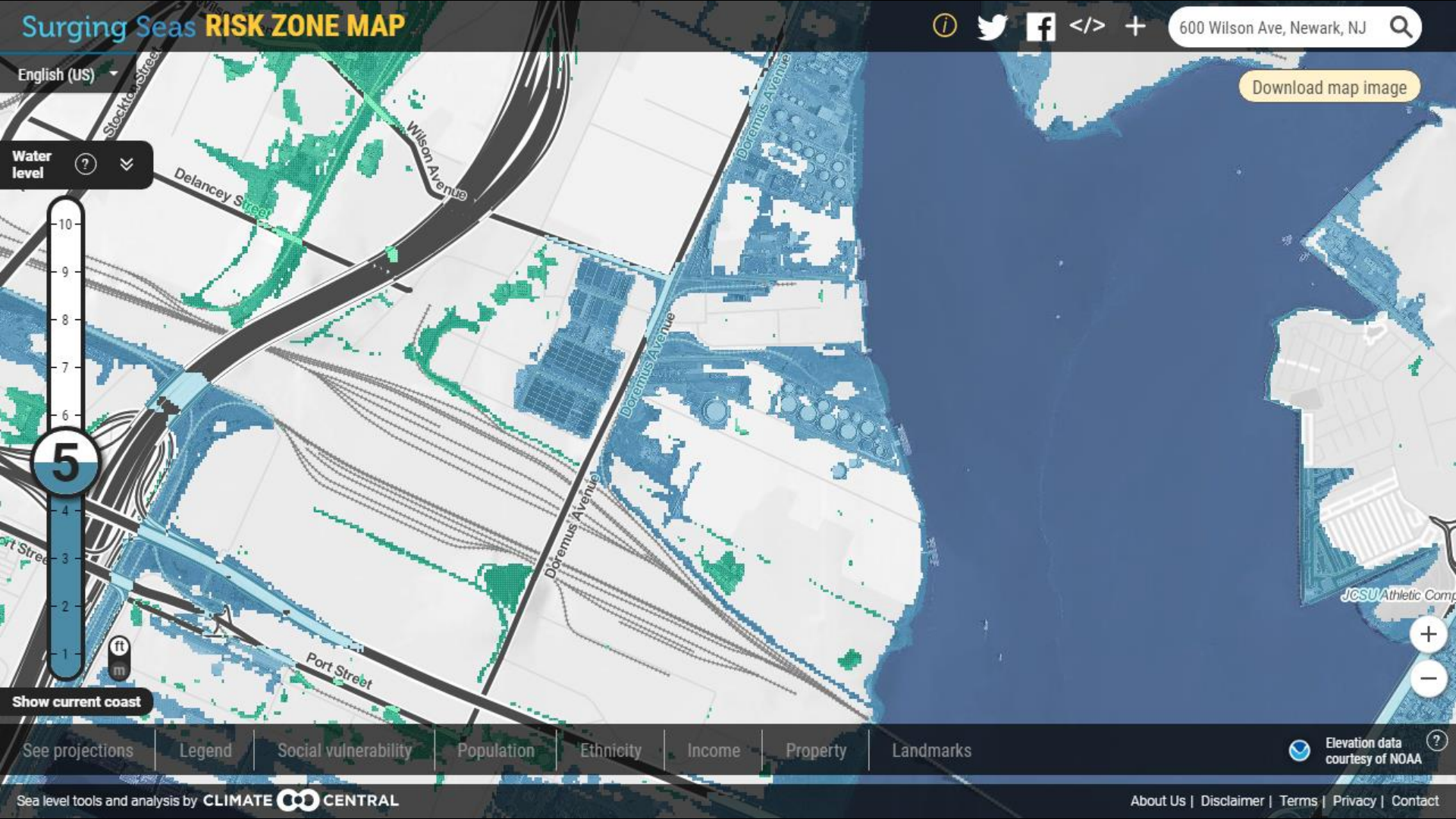
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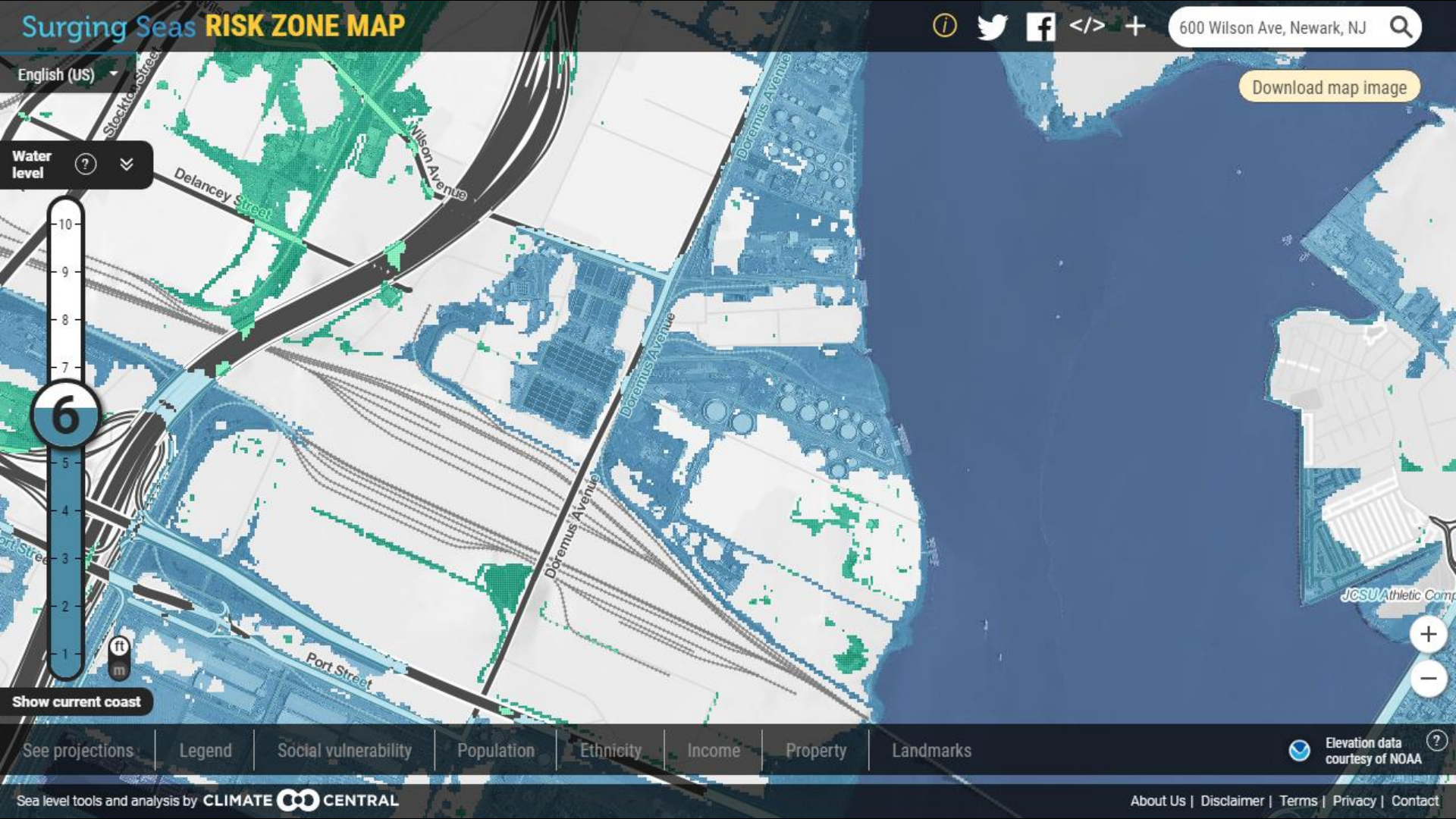
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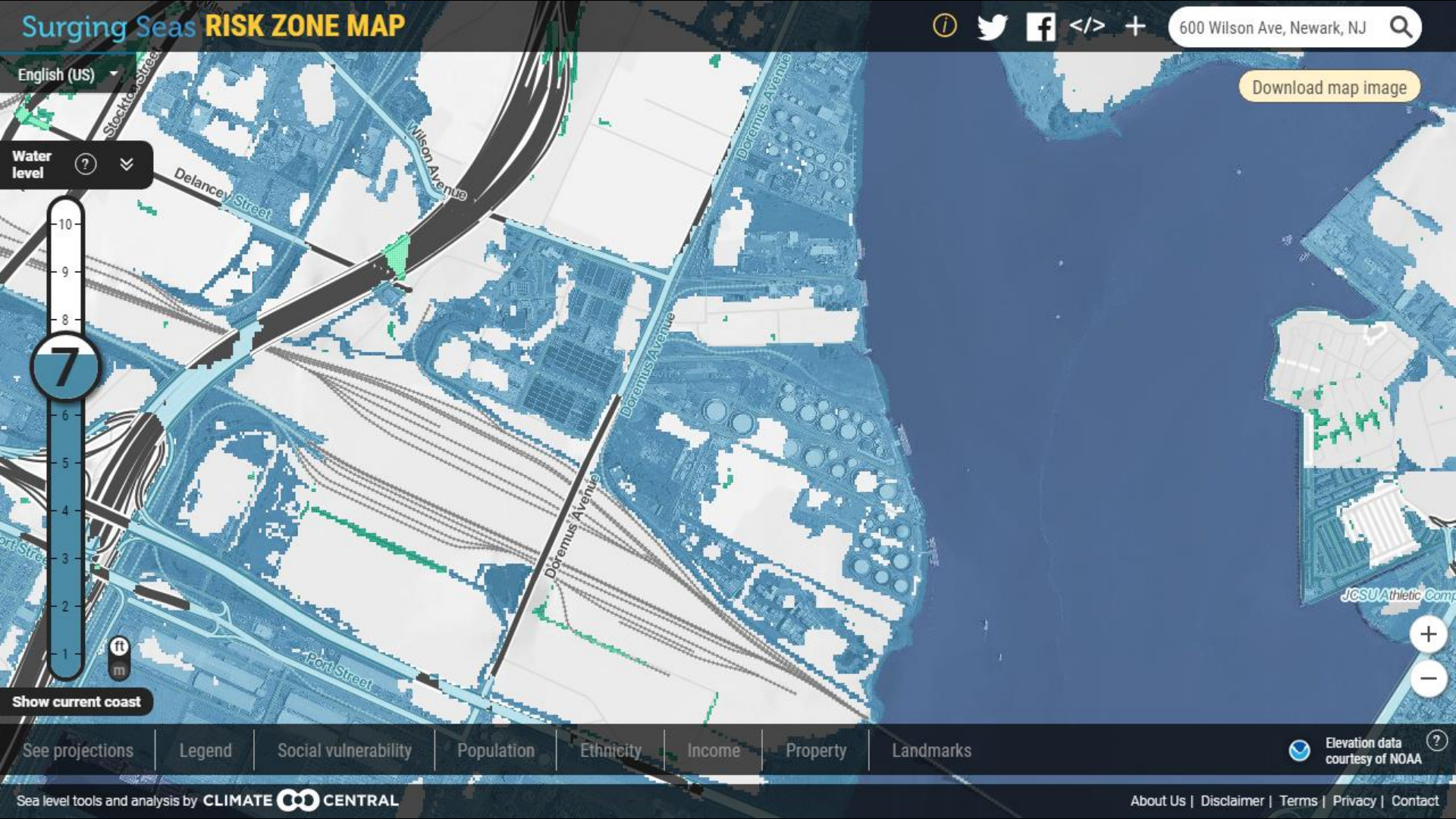
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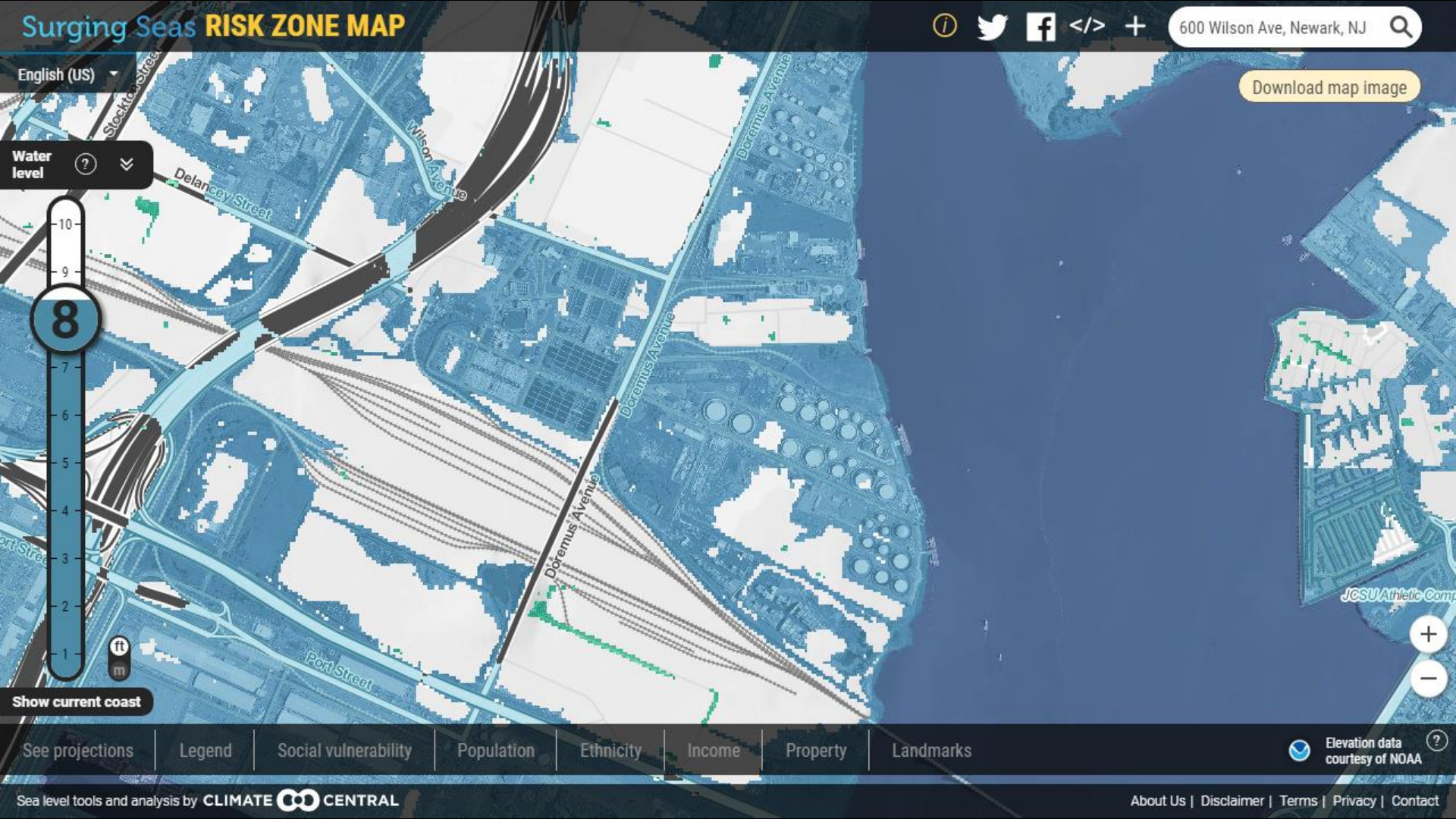
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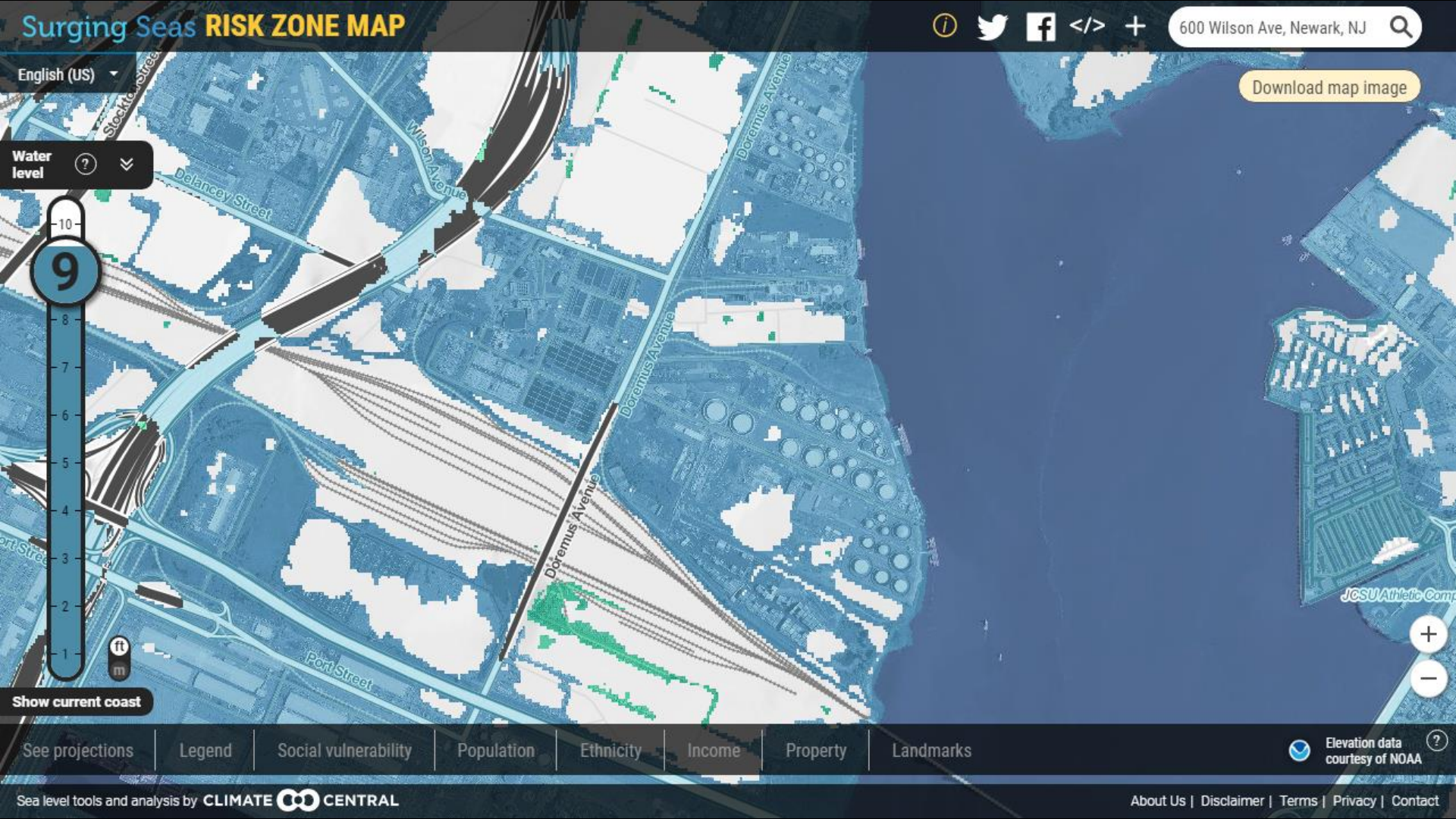
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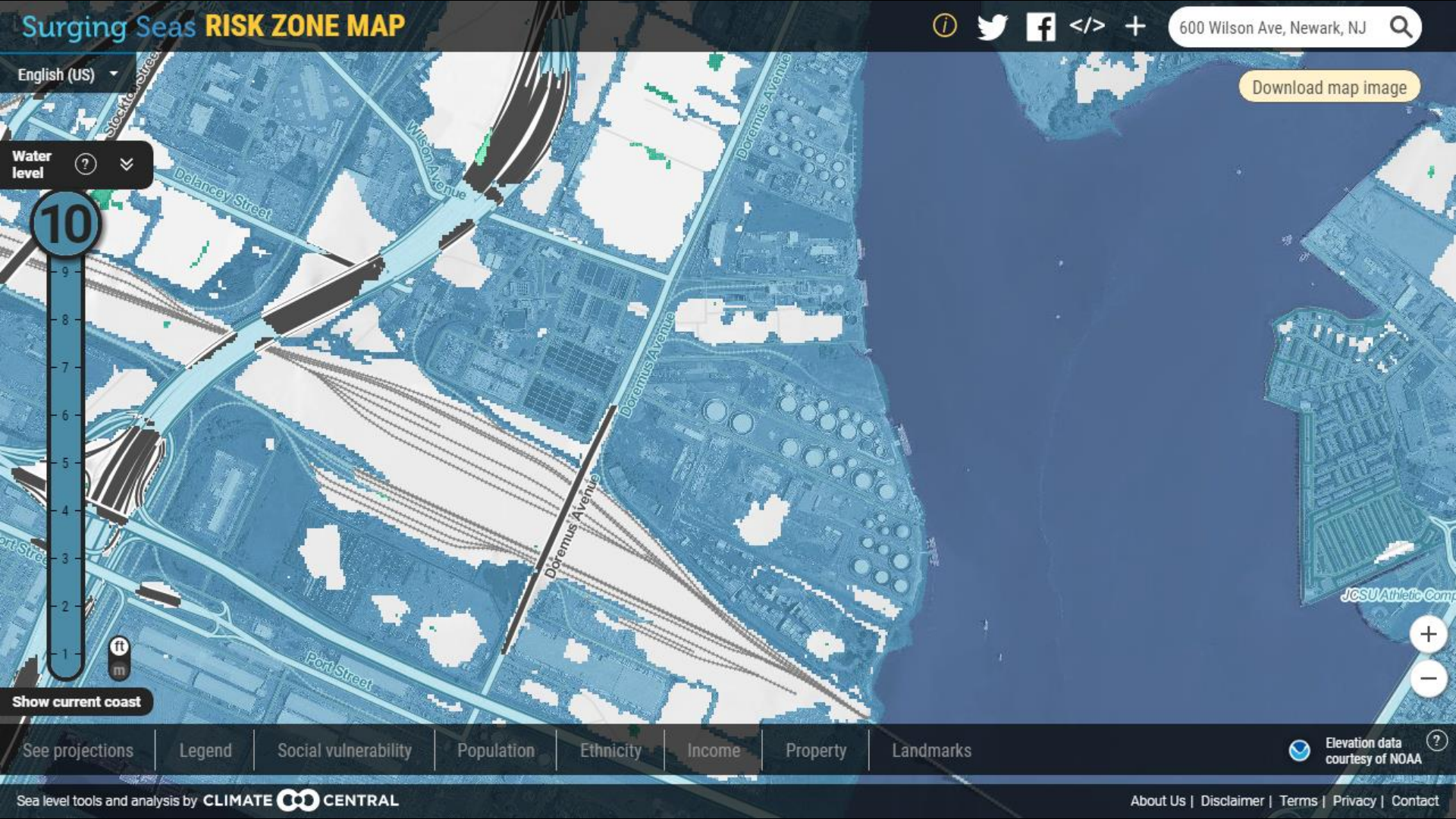
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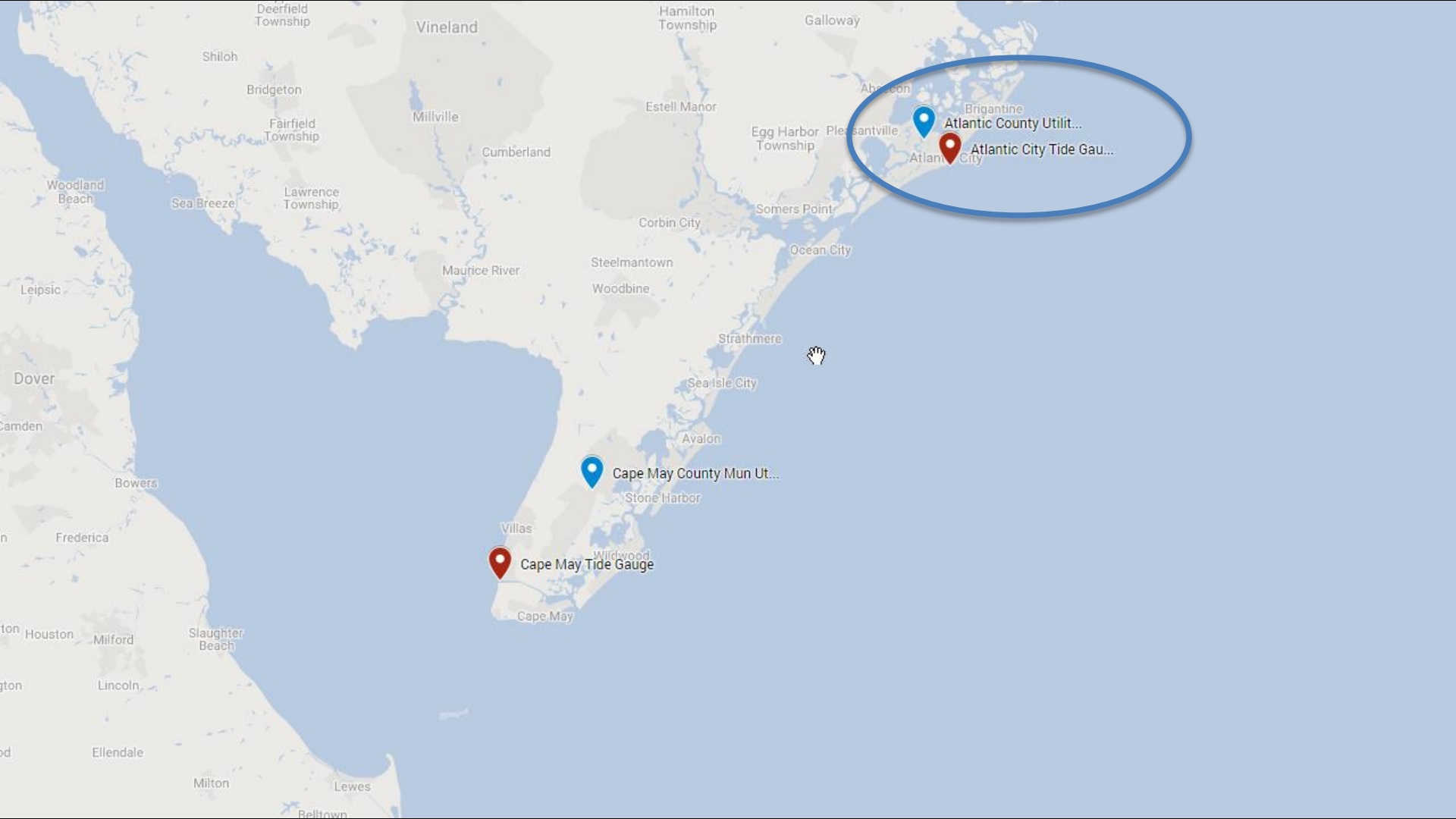
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Pleasantville
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Cumberland
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Sea Breeze
Lawrence Township
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Maurice River
Steelmantown
Woodbine
Leipsic
Strathmere
Dover
Sea Isle City
Avalon
Cape May County Mun Ut...
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Stone Harbor
Villas
Frederica
Wildwood
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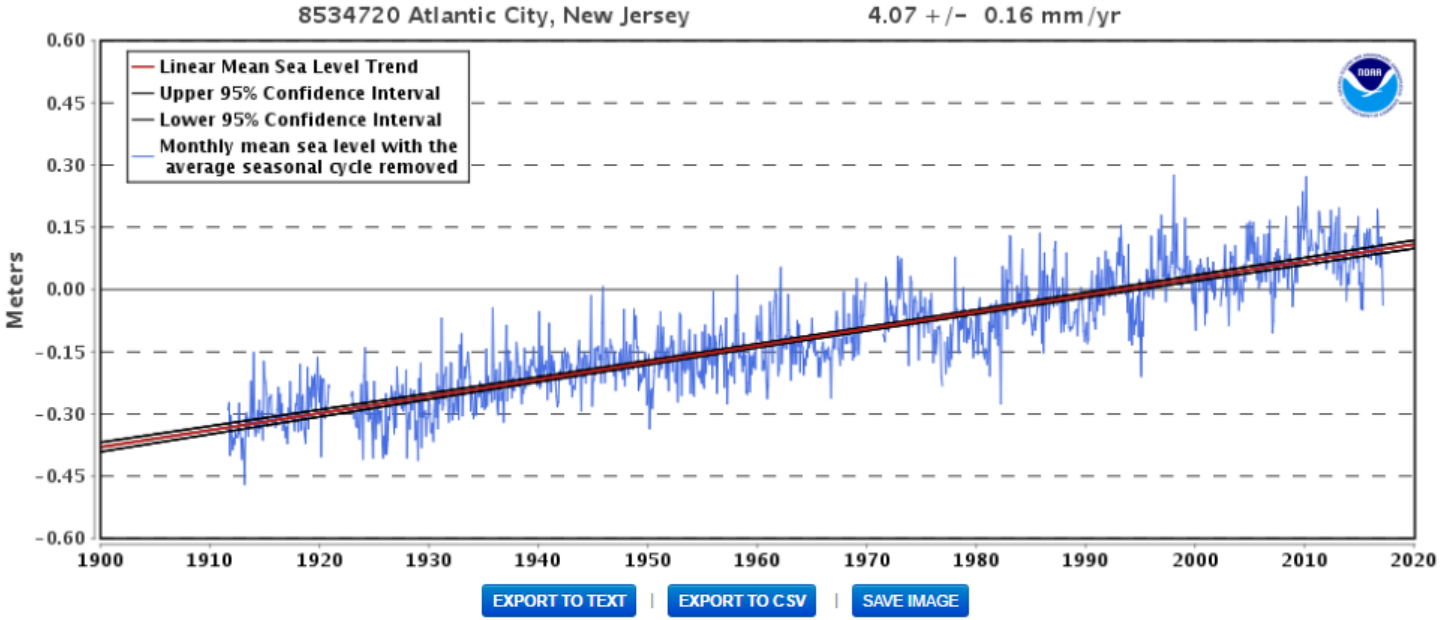
Mean Sea Level Trend
8534720 Atlantic City, New Jersey



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The mean sea level trend is 4.07 millimeters/year with a 95% confidence interval of +/- 0.16 mm/yr based on monthly mean sea level data from 1911 to 2016 which is equivalent to a change of 1.34 feet in 100 years.

The plot shows the monthly mean sea level without the regular seasonal fluctuations due to coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents. The long-term linear trend is also shown, including its 95% confidence interval. The plotted values are relative to the most recent Mean Sea Level datum established by CO-OPS. The calculated trends for all stations are available as a table in millimeters/year and in feet/century (0.3 meters = 1 foot).

Source: https://tidesandcurrents.noaa.gov

EXTREME WATER LEVELS

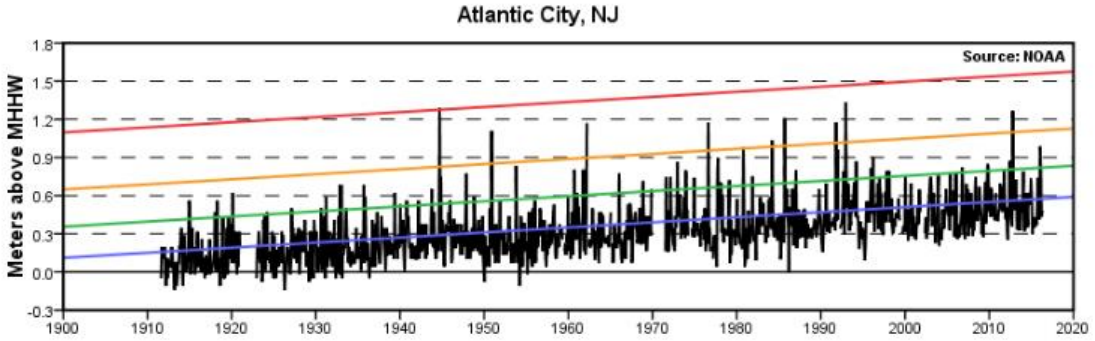
- Alabama
- Alaska
- California
- Connecticut
- Delaware
- Florida
- Georgia
- Hawaii
- Louisiana
- Maine
- Maryland
- Massachusetts
- New Jersey
- New York
- North Carolina
- Oregon
- Pennsylvania
- Rhode Island
- South Carolina
- Texas
- Virginia
- Washington
- Washington DC
- Island Stations

LINKS

- Top Ten Levels (Table in meters)

Extreme Water Levels

8534720 Atlantic City, NJ



Top 3 floods:

Year	Level (ft)
1992	4.4
1944	4.2
2012	4.2

NWS minor flood definition: 1.4 ft

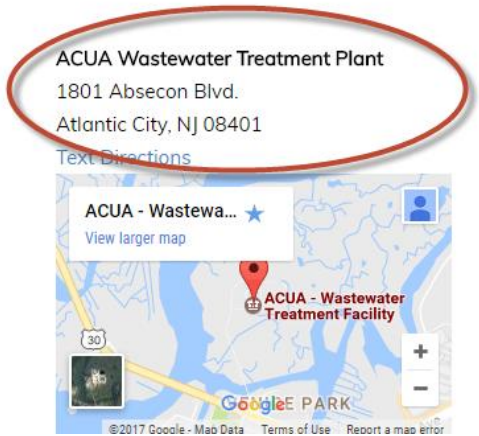
1 year per 100
10 years per 100
50 years per 100
99 years per 100

The monthly extreme water levels include a Mean Sea Level (MSL) trend of 3.99 millimeters/year with a 95% confidence interval of +/- 0.18 millimeters/year based on monthly MSL data from 1911 to 2006 which is equivalent to a change of 1.31 feet in 100 years.

highest and lowest water levels with the 1%, 10%, 50%, and 99% annual exceedance probability levels in red, orange, green, and blue. The plotted values

Source: https://tidesandcurrents.noaa.gov

Atlantic County Utilities Authority – http://www.acua.com/




Today
1801 Absecon Blvd
CLIMATE CENTRAL
1995
Google Earth
39°22'51.70" N 74°26'53.35" W elev 14 ft eye alt 934 ft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Absecon Boulevard
Absecon Boulevard
Absecon Boulevard
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Gramercy Ave
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Water level
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Show 2 feet
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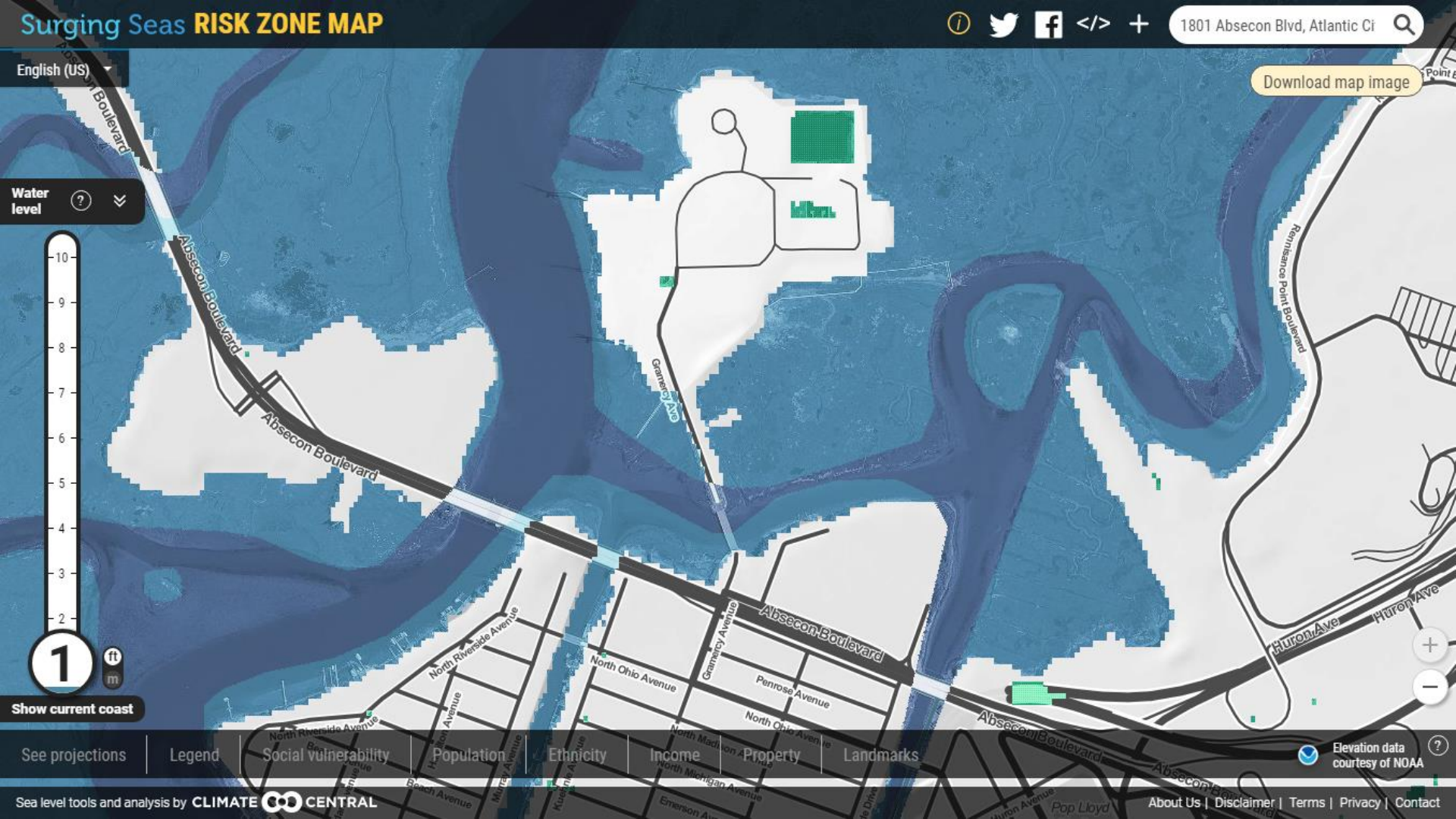
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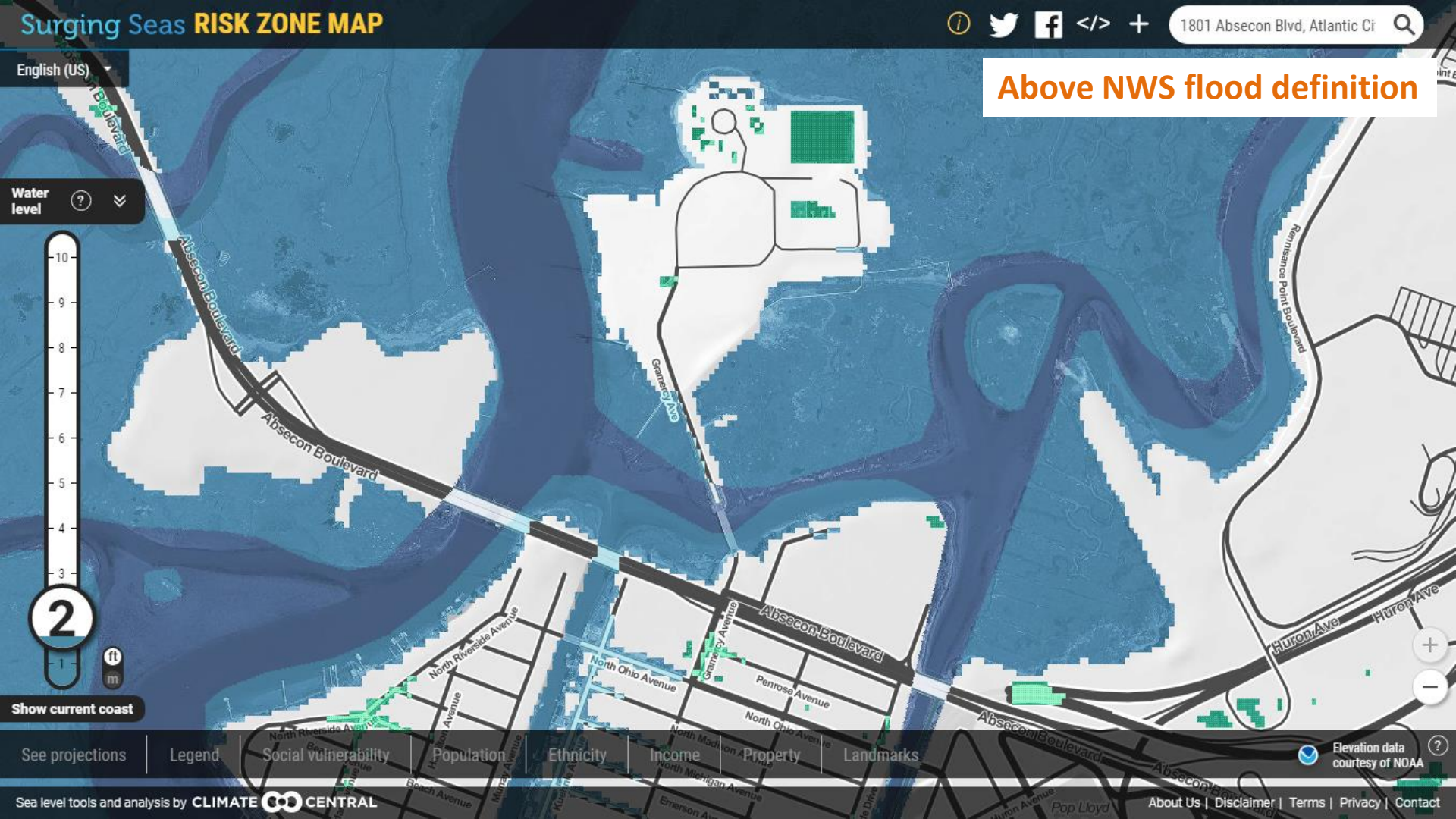
Surging Seas RISK ZONE MAP
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Above NWS flood definition
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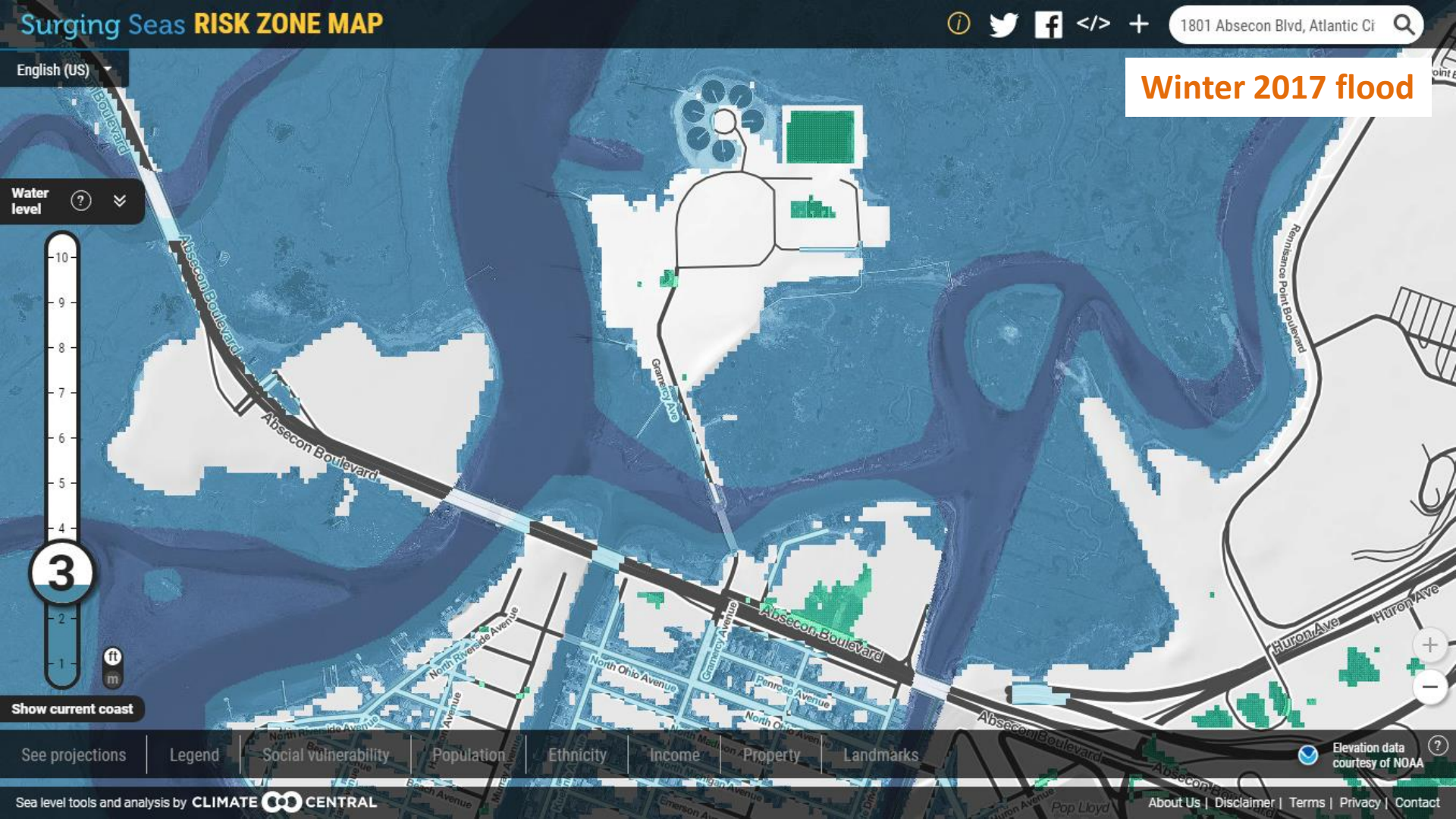
Surging Seas RISK ZONE MAP
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North Riverside Avenue
North Ohio Avenue
Penrose Avenue
See projections
Legend
Social vulnerability
Population
Ethnicity
Income
Property
Landmarks
Elevation data courtesy of NOAA
Sea level tools and analysis by CLIMATE CENTRAL
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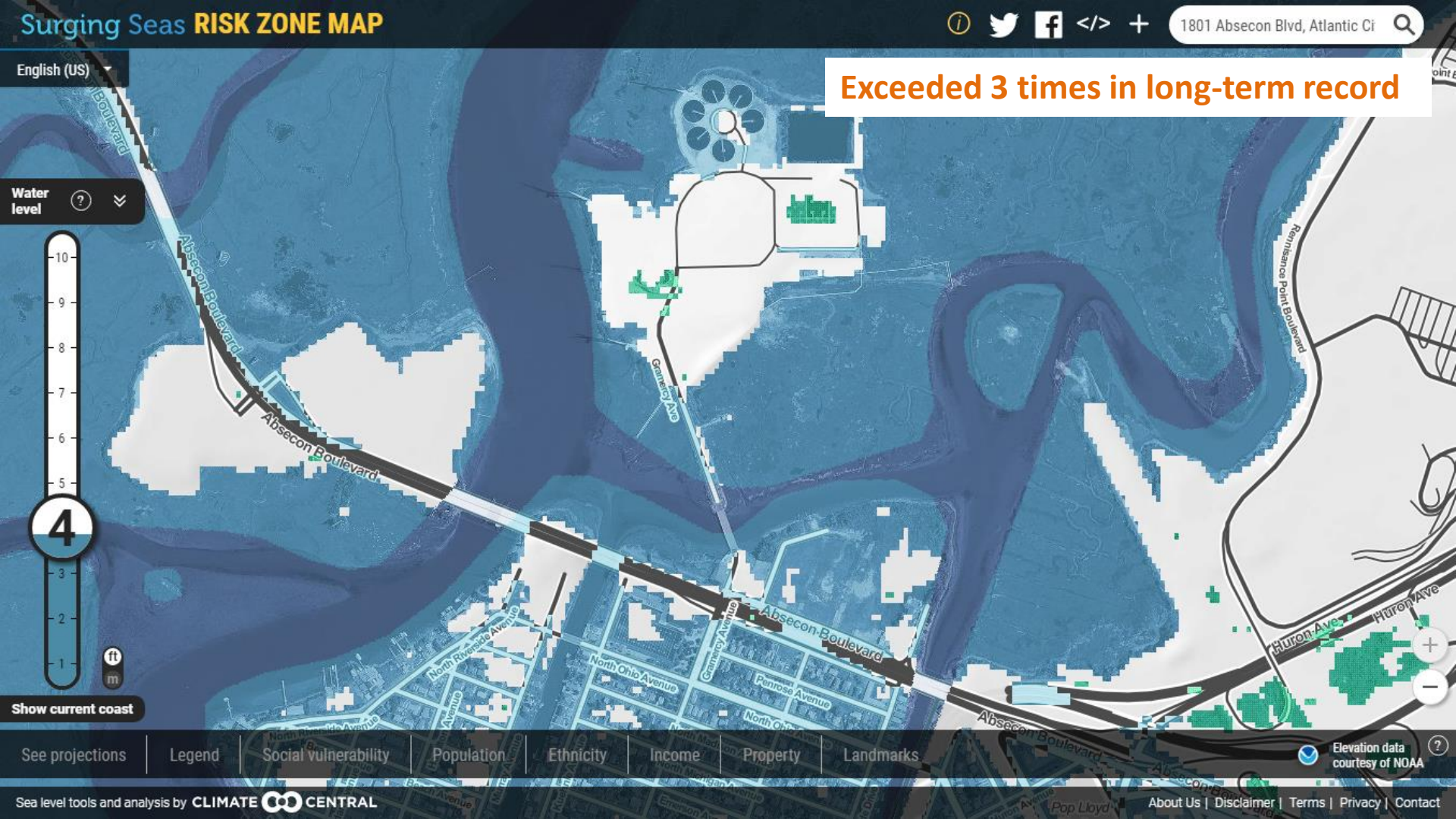
Surging Seas RISK ZONE MAP
1801 Absecon Blvd, Atlantic Ci
English (US)
Exceeded 3 times in long-term record
Water level
10
9
8
7
6
5
4
3
2
1
ft
m
Show current coast
Absecon Boulevard
Gennesy Ave
Renaissance Point Boulevard
Huron Ave
North Ohio Avenue
Penrose Avenue
North Riverside Avenue
See projections
Legend
Social vulnerability
Population
Ethnicity
Income
Property
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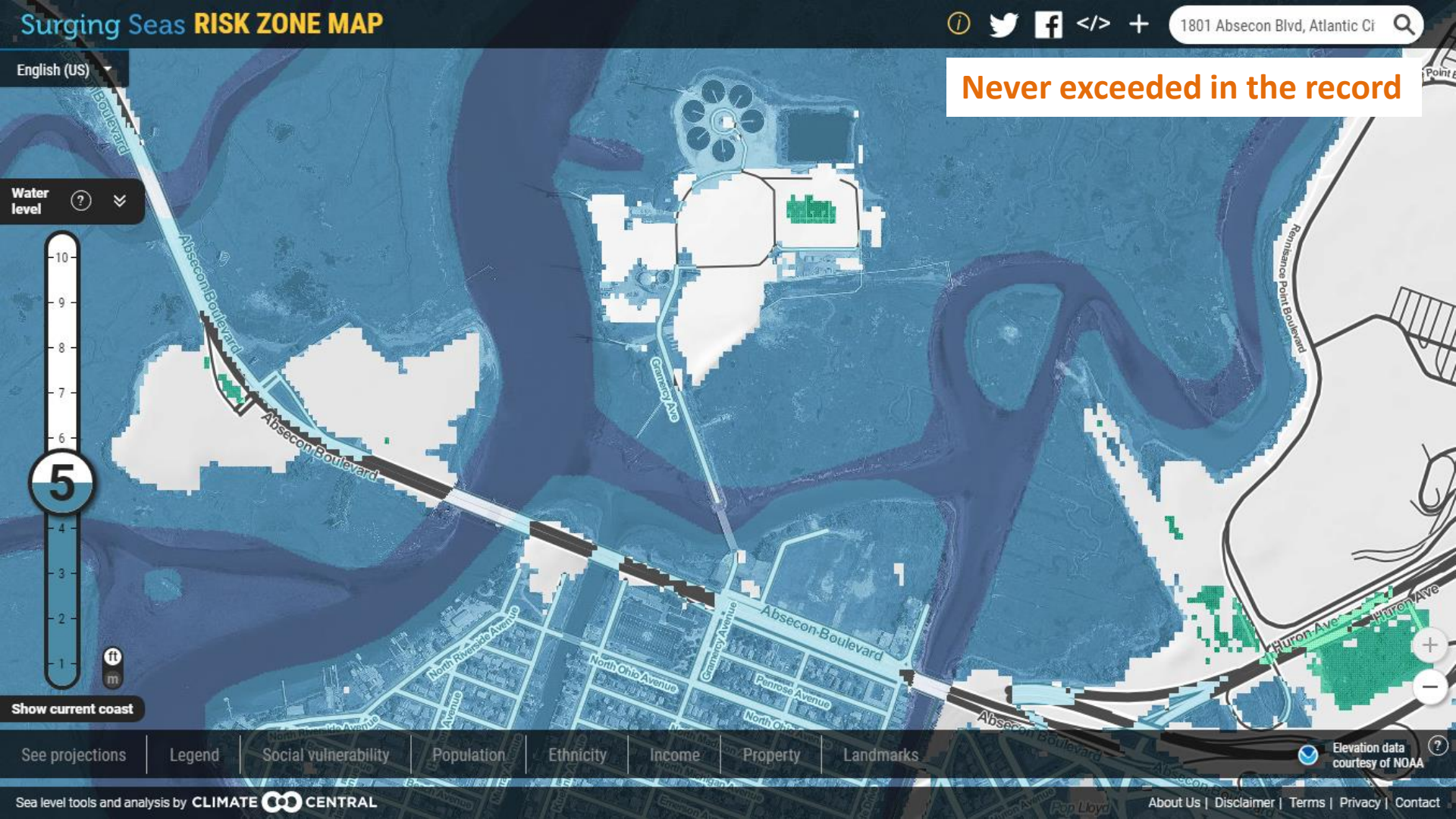
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Surging Seas EXTREME SCENARIO 2100
Instructions
KML
ACUA - Wastewater Treatment Facility
CLIMATE CENTRAL
Google
2D
Google Data SIO, NOAA, U.S. Navy, NGA, GEBCO Landsat / Copernicus 39°22'36"N 74°26'52"W 327 m

When Are the Risks?

Water level (ft)

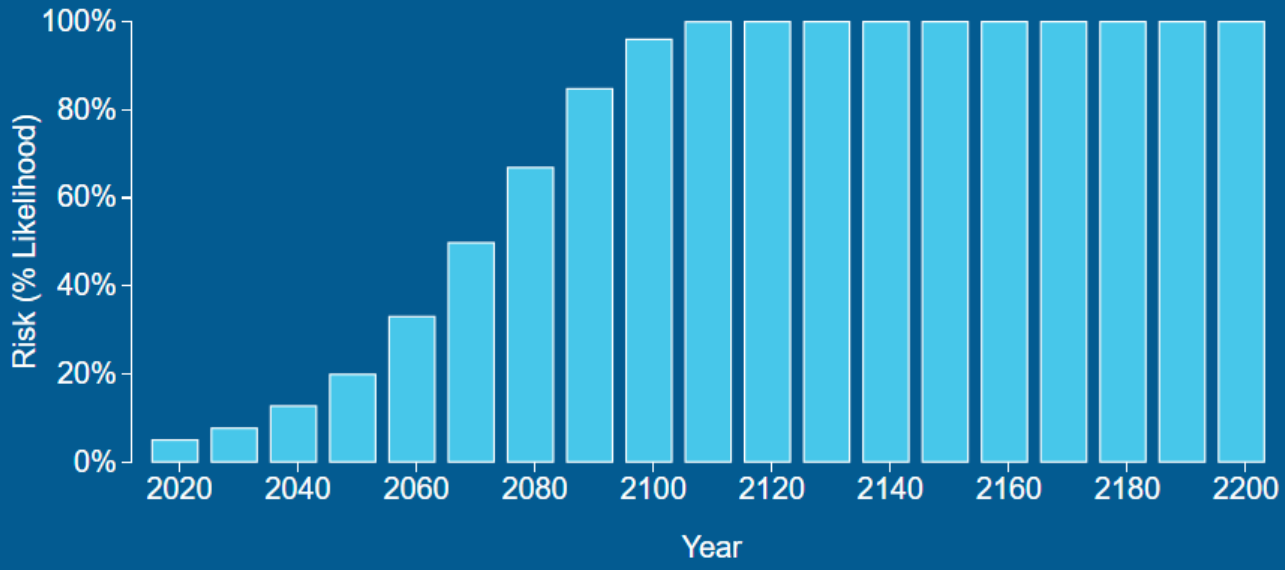
10
9
8
7
6
5
4
3
2
1

ATLANTIC CITY AREA*

Single-year risk of flooding above 4 ft ▼

PPT PNG XLS

Risk of at least one flood within each year shown



Sea level scenario

- Extreme
- Fast rise
- Medium
- Slow rise

Advanced

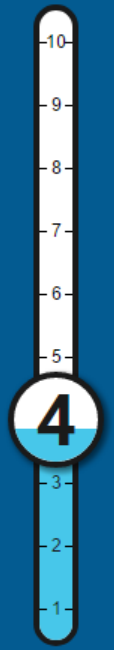
At Atlantic City water level station, 2 miles from Atlantic City

Analysis uses median local sea level projections based on the intermediate low scenario from NOAA Technical Report NOS CO-OPS 083 (2017), intended for the 2018 U.S. National Climate Assessment. Key notes

Enter a coastal place

When Are the Risks?

Water level (ft)



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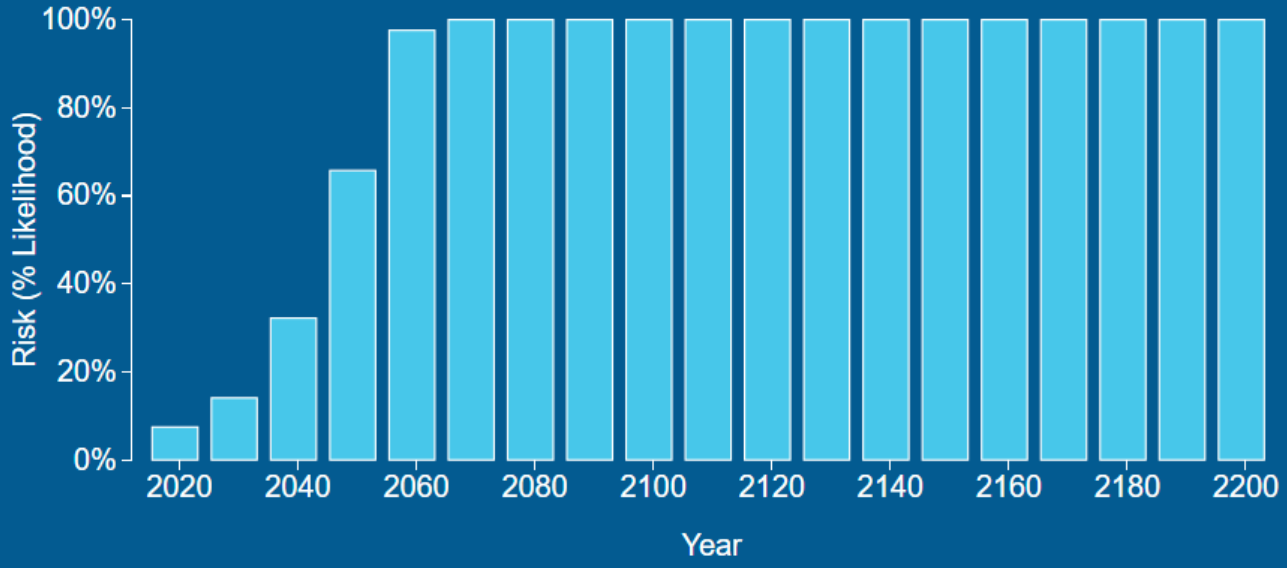

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When Are the Risks?

Water level (ft)

10 9 8 7 6 5 **4** 3 2 1

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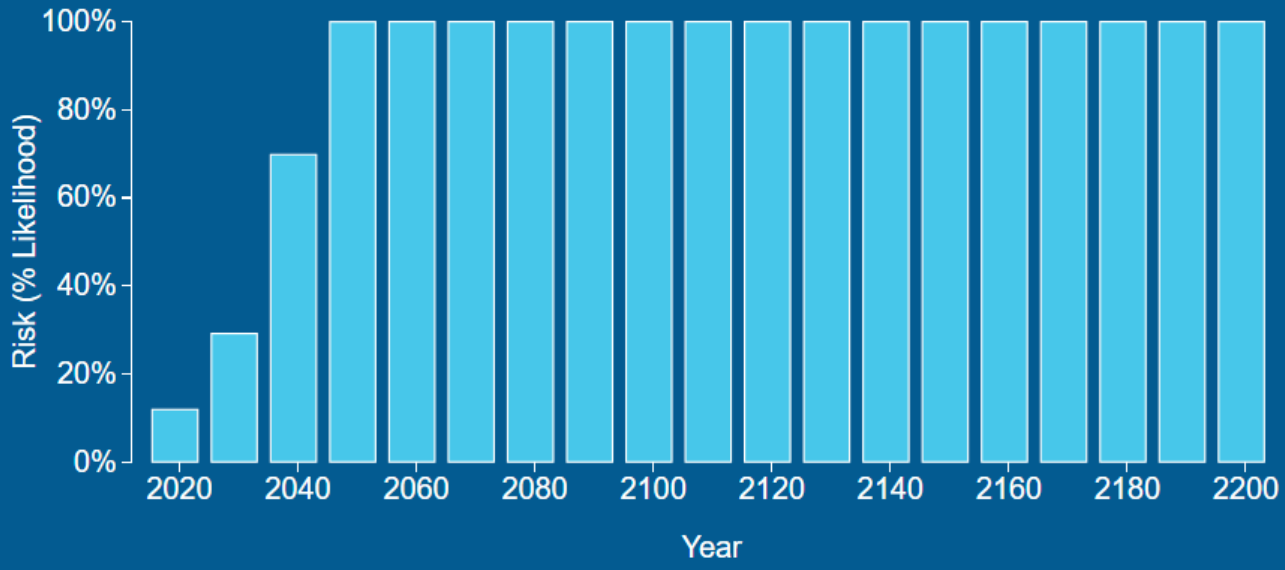
Single-year risk of flooding above 4 ft ▼ PPT PNG XLS

Risk of at least one flood within each year shown



Sea level scenario

Extreme

Fast rise

Medium

Slow rise

Advanced

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When Are the Risks?

Water level (ft)

10
9
8
7
6
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4
3
2
1

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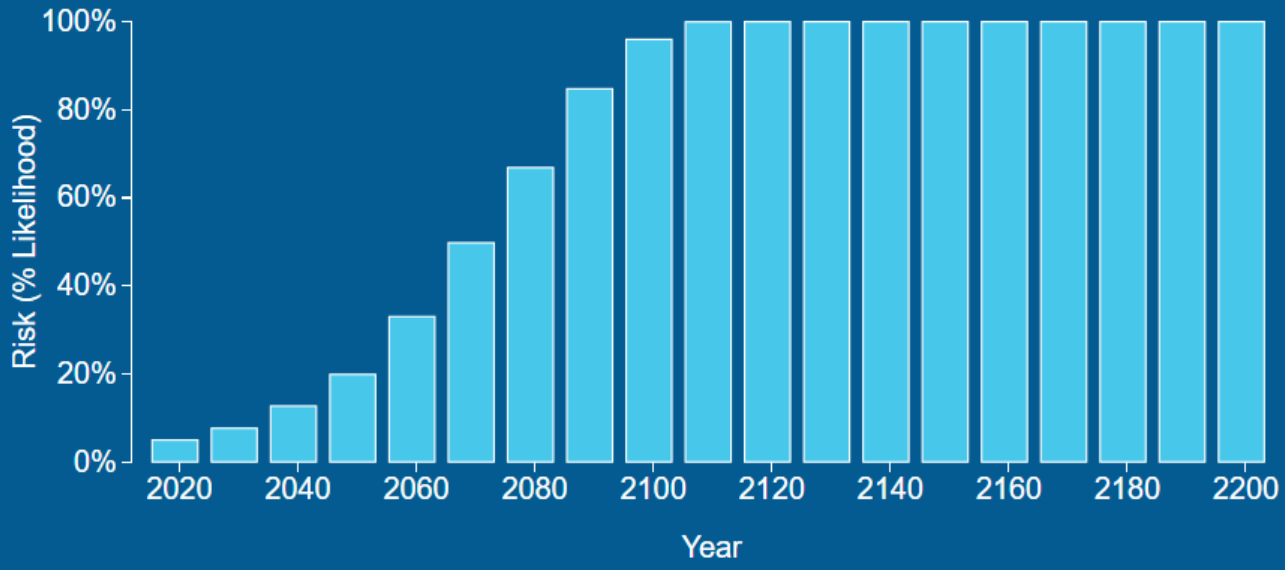
Single-year risk of flooding above 4 ft ▼

PPT PNG XLS

Risk of at least one flood within each year shown



Sea level scenario

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Enter a coastal place

When Are the Risks?

Water level (ft)

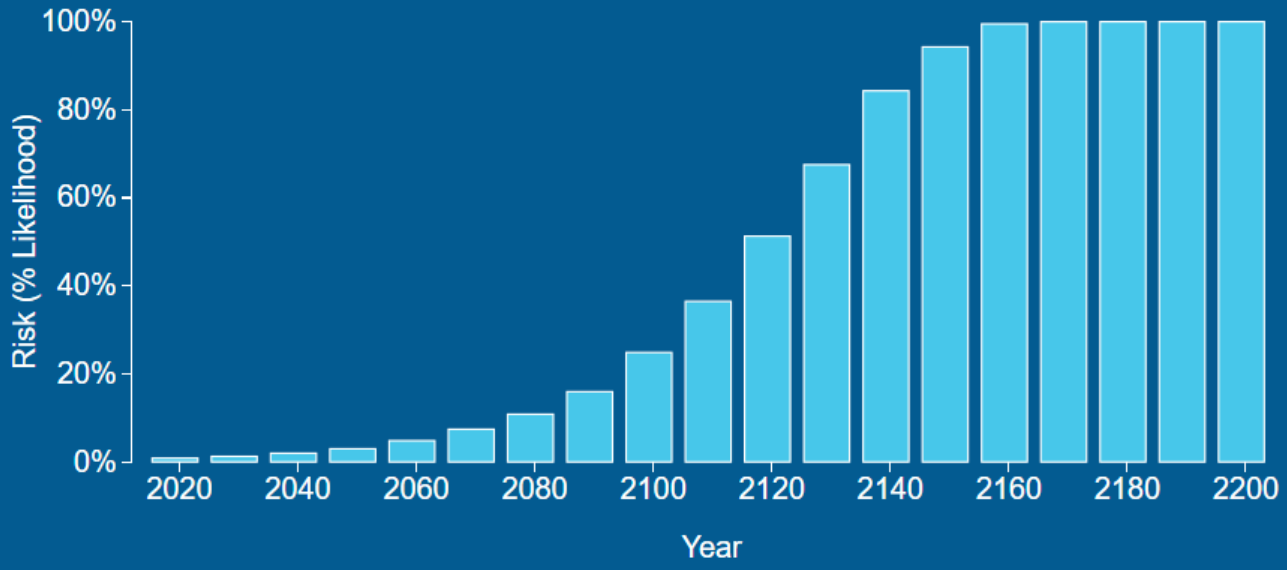
10 9 8 7 6 **5** 4 3 2 1

ATLANTIC CITY AREA*

Single-year risk of flooding above 5 ft

PPT PNG XLS

Risk of at least one flood within each year shown



Sea level scenario

- Extreme
- Fast rise
- Medium
- Slow rise

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Enter a coastal place

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Water level (ft)

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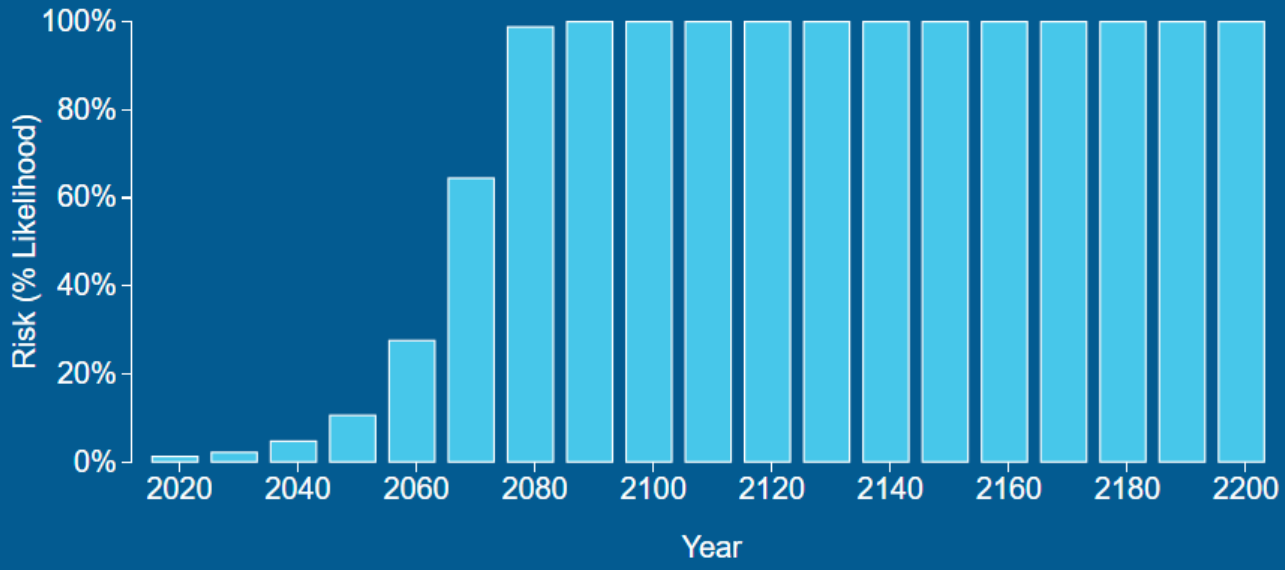
Single-year risk of flooding above 5 ft ▼

PPT PNG XLS

Risk of at least one flood within each year shown



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- Medium
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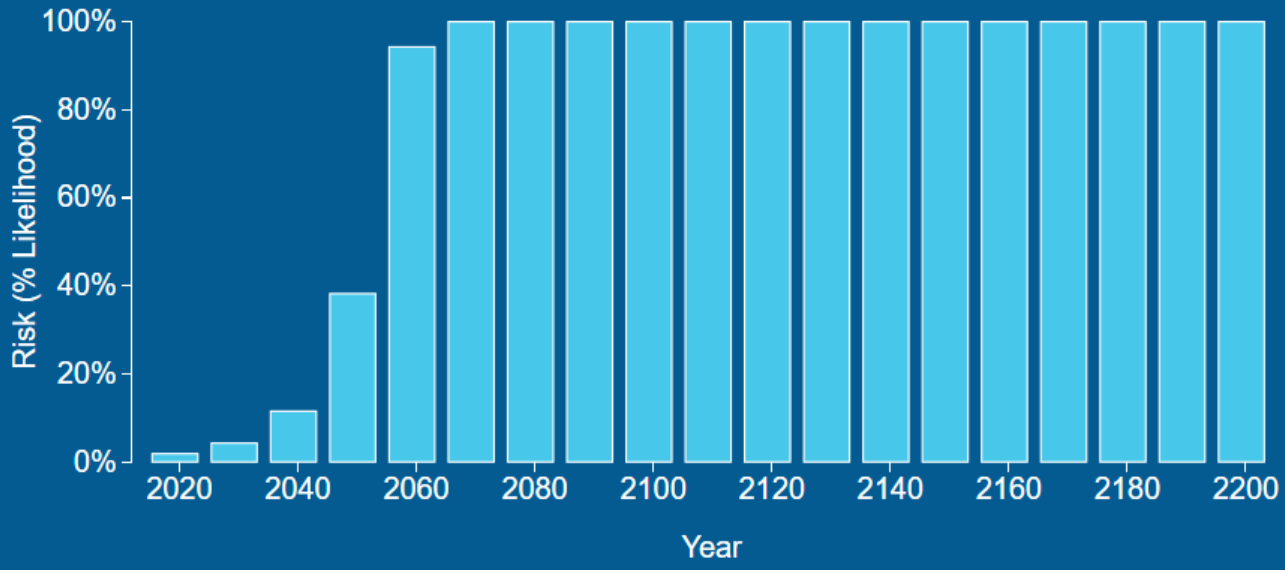

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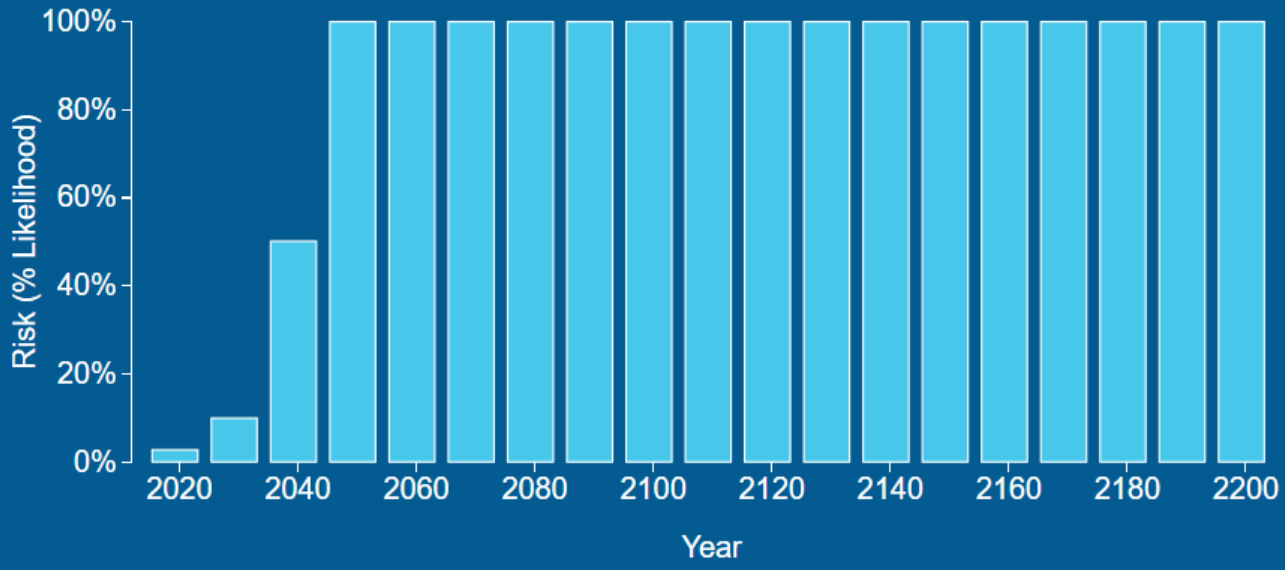

Sea level scenario

Extreme

Fast rise

Medium

Slow rise

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PPT PNG XLS

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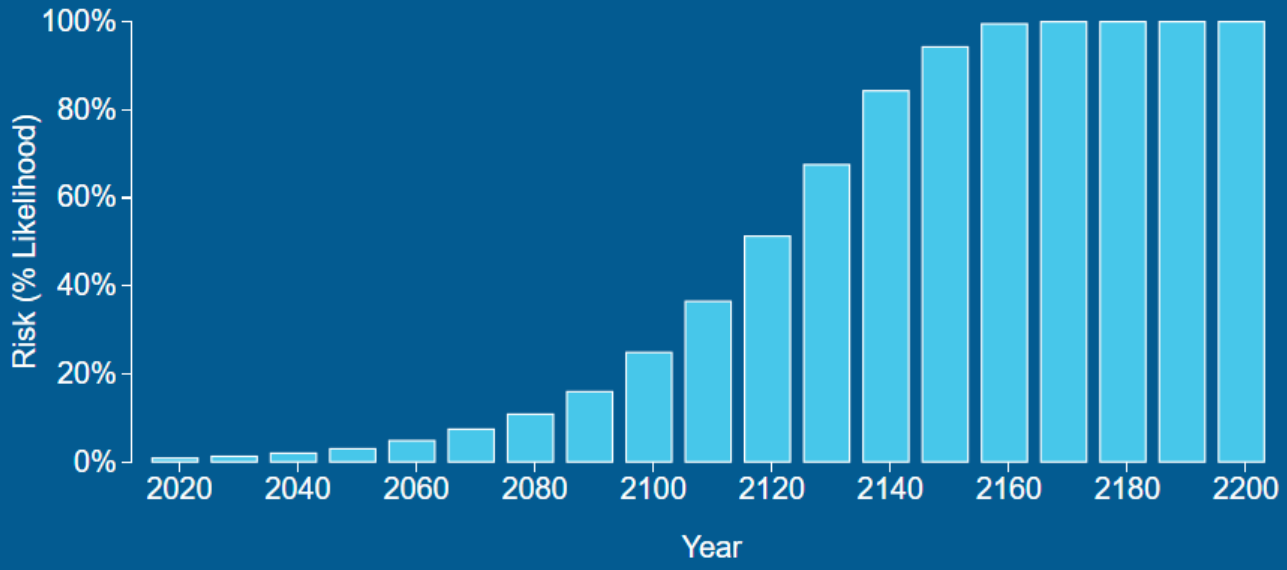

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When Are the Risks?

Water level (ft)

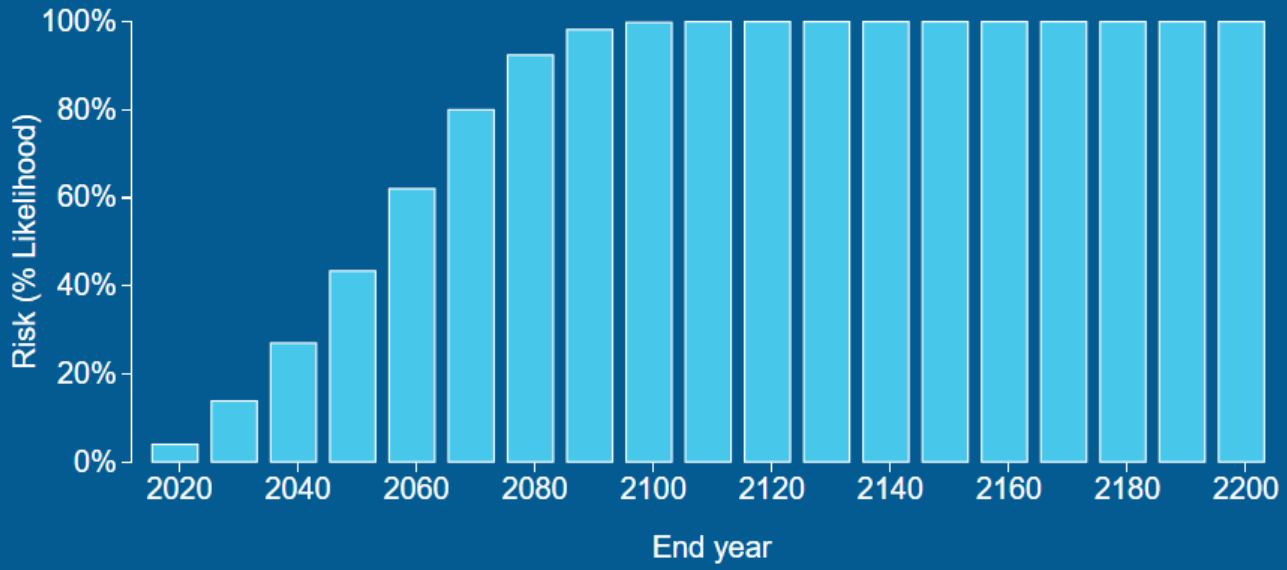
10 9 8 7 6 **5** 4 3 2 1

ATLANTIC CITY AREA*

Multi-year risk of flooding above 5 ft ▼

PPT PNG XLS

Risk of at least one flood from 2016 through each year shown



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Enter a coastal place

When Are the Risks?

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PPT PNG XLS

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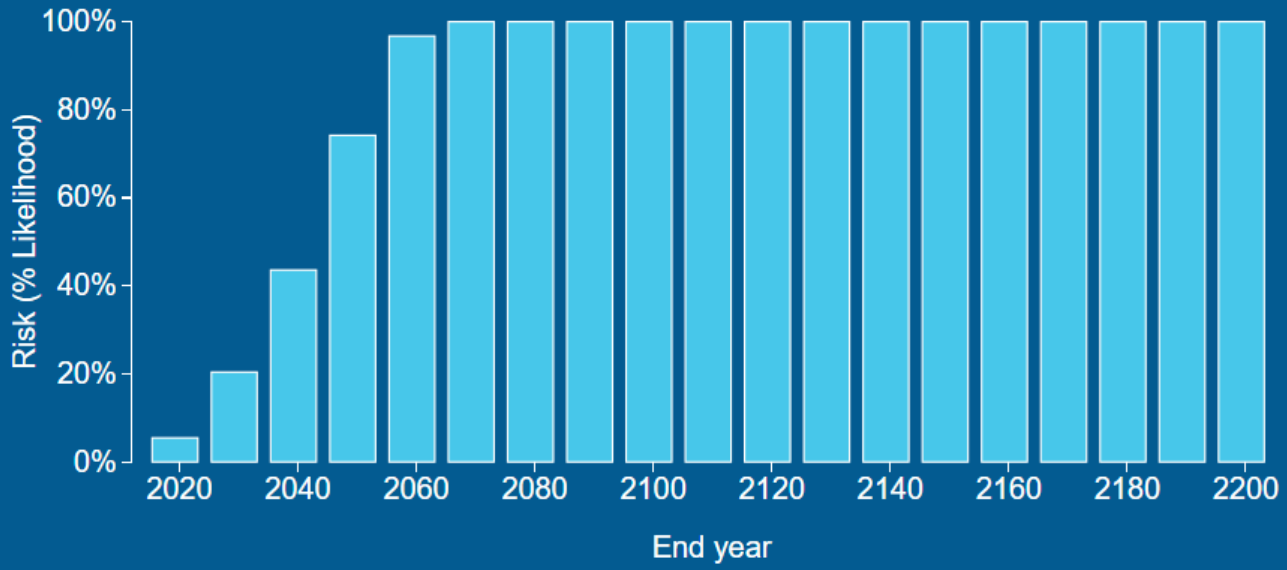

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- Slow rise

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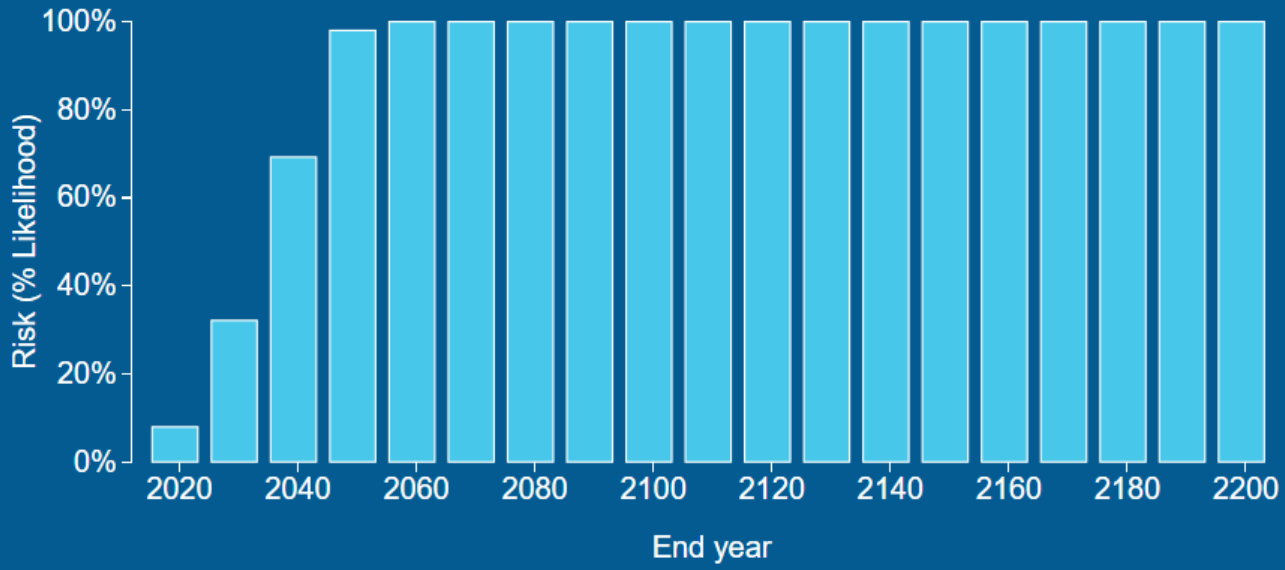

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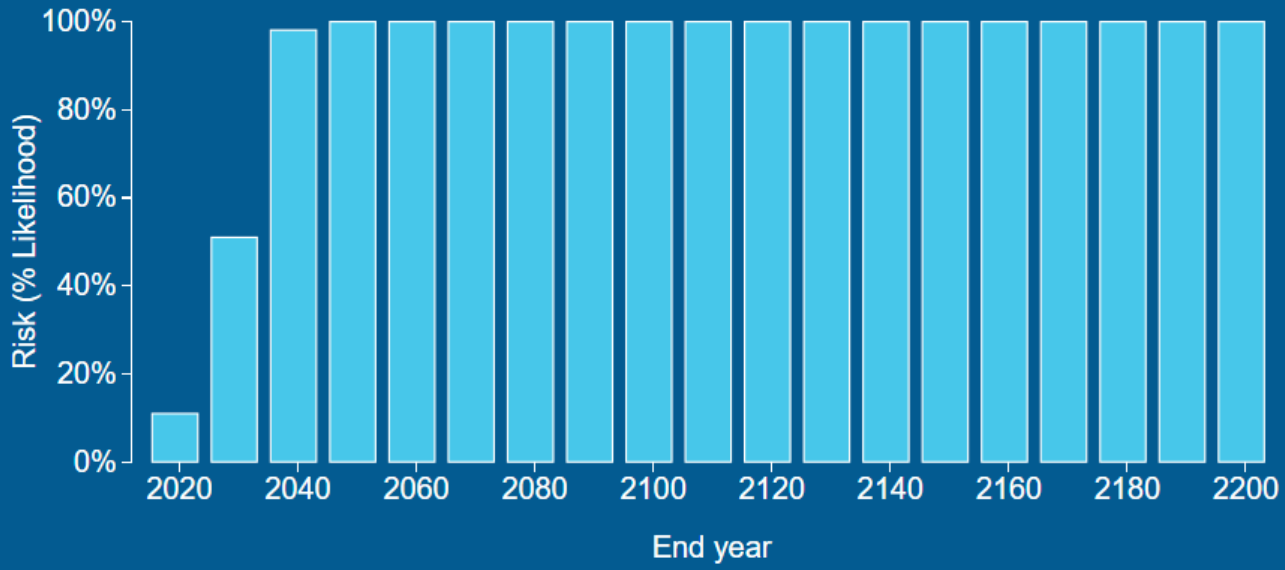

Sea level scenario

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- Slow rise

Advanced

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Analysis uses median local sea level projections based on the extreme scenario from NOAA Technical Report NOS CO-OPS 083 (2017), intended for the 2018 U.S. National Climate Assessment. Key notes

Water level (ft)

10 9 8 7 6 5 4 3 2 1

What Is at Risk?

Population | Buildings | Infrastructure | Contamination Risks | Land

Total buildings below 3ft in 08401

Buildings: All	Total
Homes	4,015
Property value	$2.3 Billion
Medical facilities	6
Public Schools	2
Schools	1

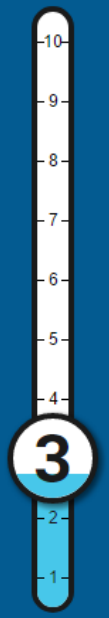
Sources for raw homes data: Census 2010 | *Details*

Values exclude sub-3ft areas potentially protected by levees or other features.

Choose a threat to map using the scrollable list above

Total homes below 3ft in zip codes in Atlantic County

Water level (ft)



What Is at Risk?

Population | Buildings | Infrastructure | Contamination Risks | Land

Total infrastructure below 3ft in 08401

Infrastructure: All	Total
Roads	38 miles
Local roads	38 miles
Heliports	3
FM radio transmitter sites	3
Railroads	2
Mainline rail	2 miles
All passenger rail	1 miles

Sources for raw local roads data: Census 2012 | Details

Values exclude sub-3ft areas potentially protected by levees or other features.

Choose a threat to map using the scrollable list above

Total local roads below 3ft in zip codes in Atlantic County

Local roads

Water level (ft)

10 9 8 7 6 5 4 3 2 1

What Is at Risk?

Population | Buildings | Infrastructure | Contamination Risks | Land

Total contamination risks below 3ft in 08401

Contamination Risks: All	Total
EPA listed sites	24
Hazardous waste sites	17
RADINFO sites	17
Unspecified hazardous waste sites	16
Wastewater sites	4
Nonmajor wastewater sites	4
NPDES sites	4

Sources for raw epa listed sites data: EPA 2013 | Details

Values exclude sub-3ft areas potentially protected by levees or other features.

Choose a threat to map using the scrollable list above

Total EPA listed sites below 3ft in zip codes in Atlantic County

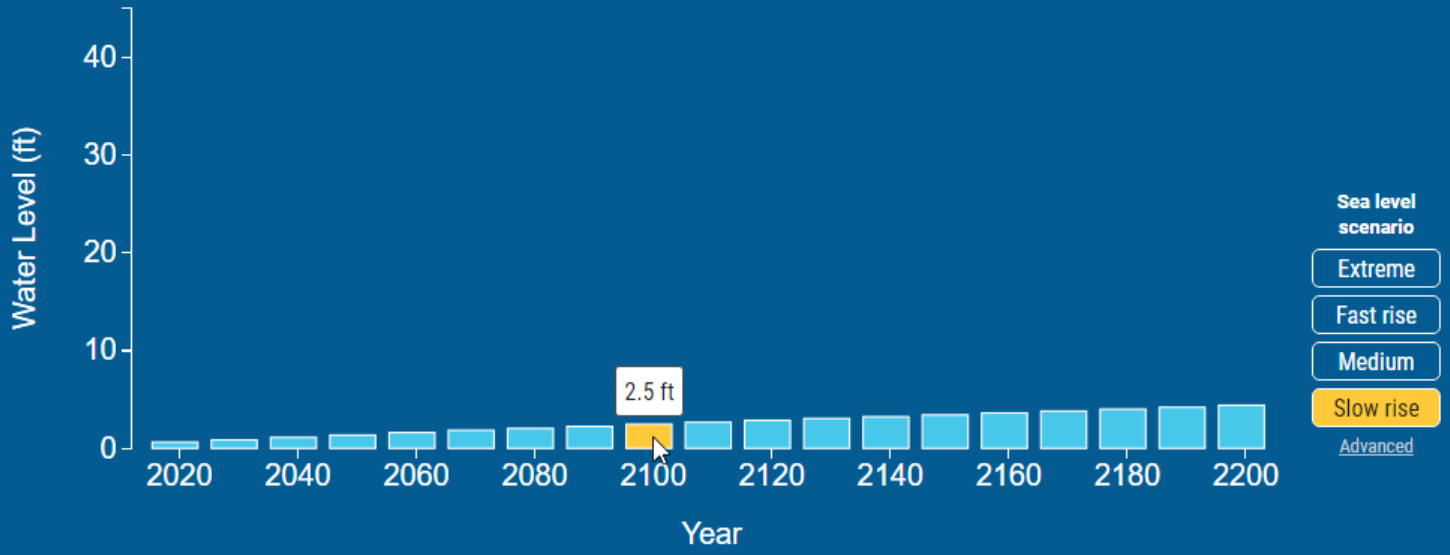
EPA-listed sites

When Are the Risks?

08401 AREA*

Projected sea level rise ▼ PPT PNG XLS

A localized projection



*At Atlantic City water level station, 2 miles from 08401

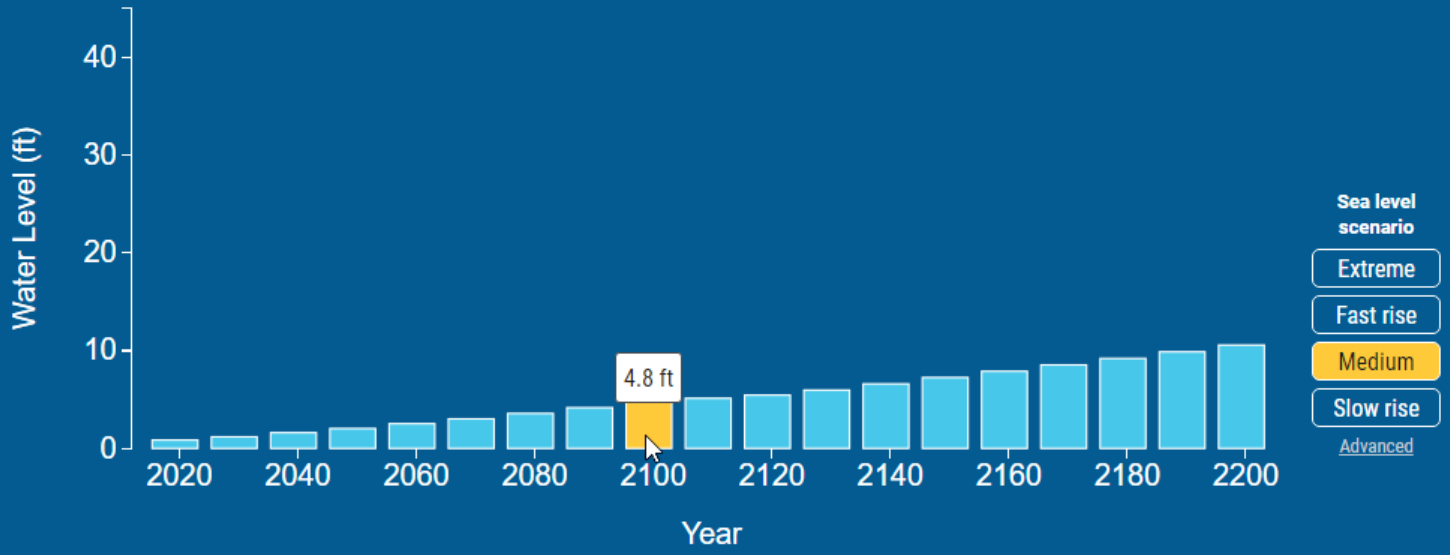
Analysis uses median local sea level projections based on the intermediate low scenario from NOAA Technical Report NOS CO-OPS

When Are the Risks?

08401 AREA*

Projected sea level rise ▼ PPT PNG XLS

A localized projection



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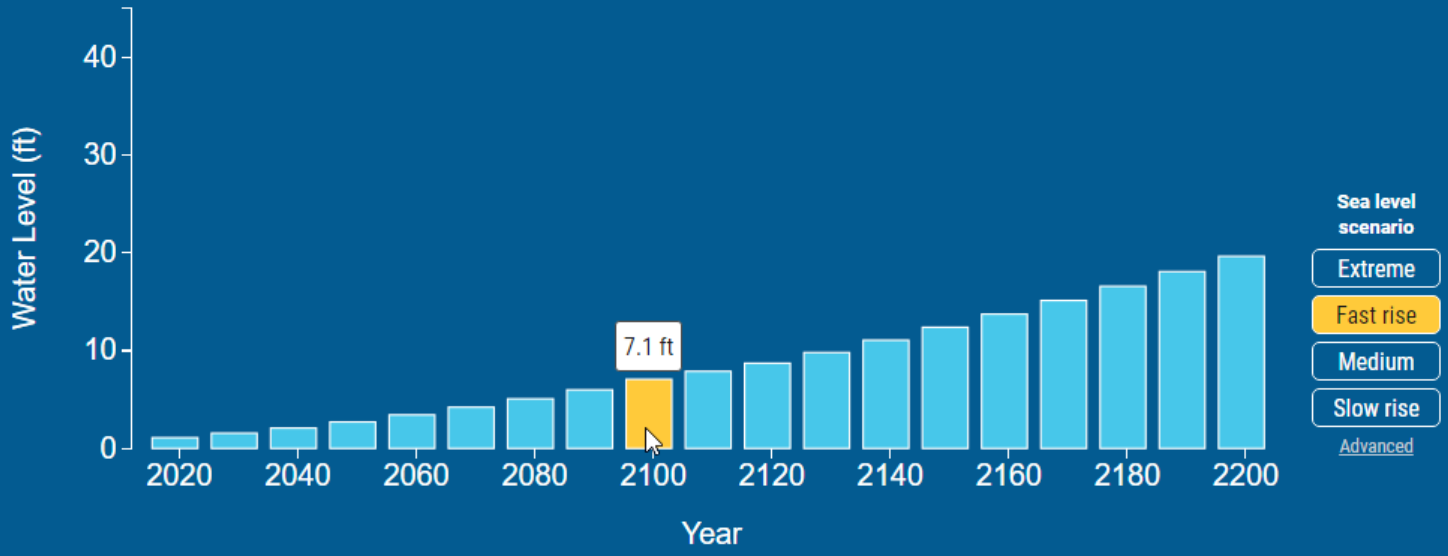
When Are the Risks?

08401 AREA*

Projected sea level rise ▼ PPT PNG XLS

A localized projection



At Atlantic City water level station, 2 miles from 08401

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When Are the Risks?

08401 AREA*

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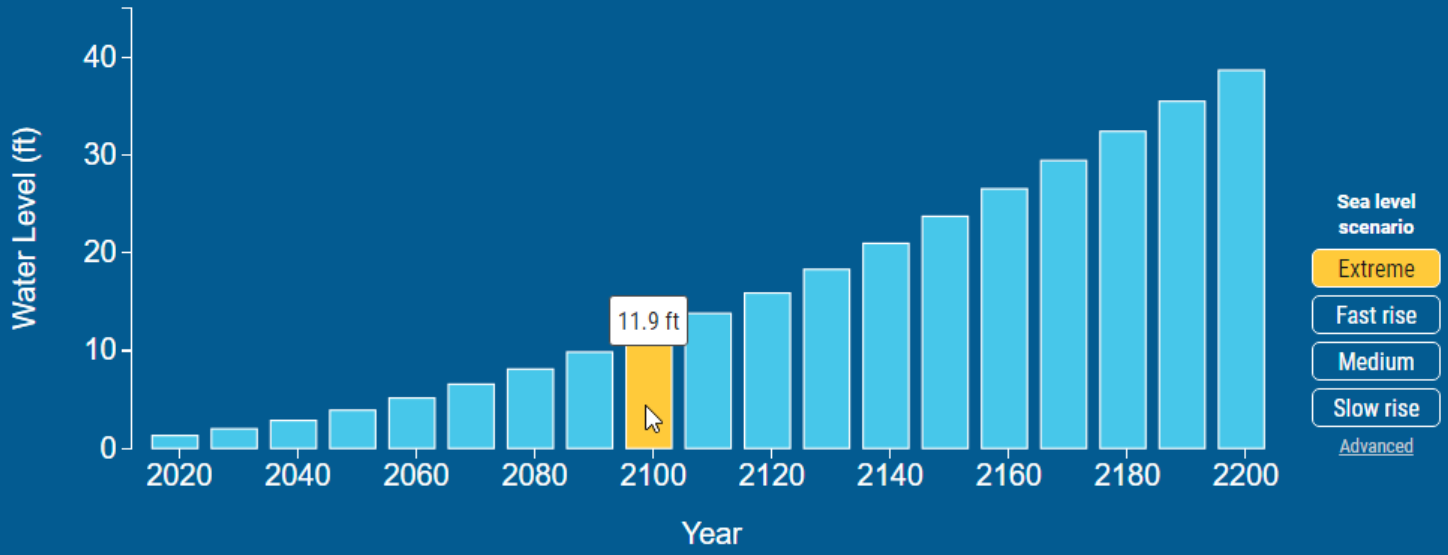
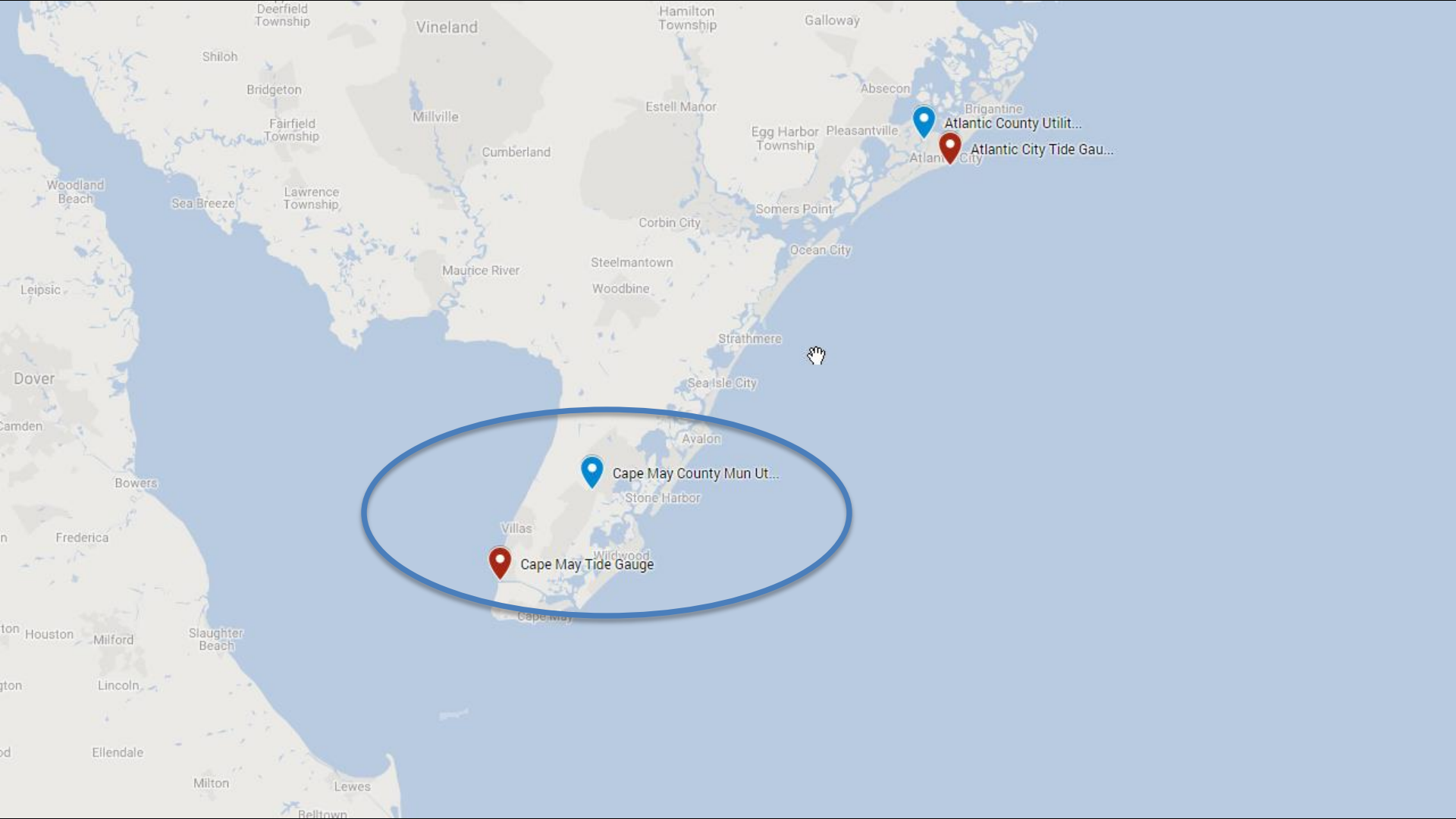
A localized projection



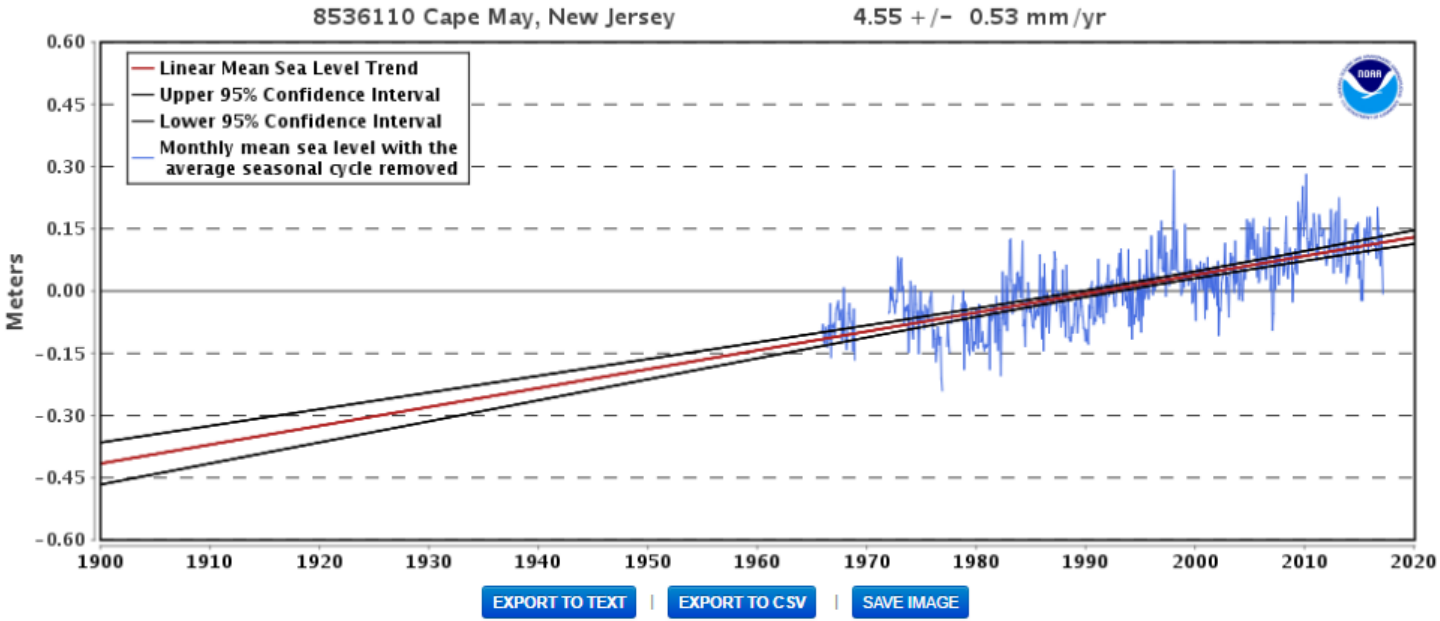
At Atlantic City water level station, 2 miles from 08401

Analysis uses median local sea level projections based on the extreme scenario from NOAA Technical Report NOS CO-OPS 083

Cape May County MUA – (5 facilities)


Deerfield Township
Vineland
Hamilton Township
Galloway
Shiloh
Bridgeton
Absecon
Millville
Estell Manor
Brigantine
Fairfield Township
Egg Harbor Township
Pleasantville
Atlantic County Utilit...
Cumberland
Atlantic City Tide Gau...
Woodland Beach
Sea Breeze
Lawrence Township
Somers Point
Corbin City
Ocean City
Maurice River
Steelmantown
Leipsic
Woodbine
Strathmere
Dover
Sea Isle City
Avalon
Cape May County Mun Ut...
Bowers
Stone Harbor
Villas
Frederica
Wildwood
Cape May Tide Gauge
Houston
Milford
Slaughter Beach
Lincoln
Ellendale
Milton
Lewes

Mean Sea Level Trend
8536110 Cape May, New Jersey



EXPORT TO TEXT | EXPORT TO CSV | SAVE IMAGE

The mean sea level trend is 4.55 millimeters/year with a 95% confidence interval of +/- 0.53 mm/yr based on monthly mean sea level data from 1965 to 2016 which is equivalent to a change of 1.49 feet in 100 years.

The plot shows the monthly mean sea level without the regular seasonal fluctuations due to coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents. The long-term linear trend is also shown, including its 95% confidence interval. The plotted values are relative to the most recent Mean Sea Level datum established by CO-OPS. The calculated trends for all stations are available as a table in millimeters/year and in feet/century (0.3 meters = 1 foot).

Source: https://tidesandcurrents.noaa.gov

EXTREME WATER LEVELS

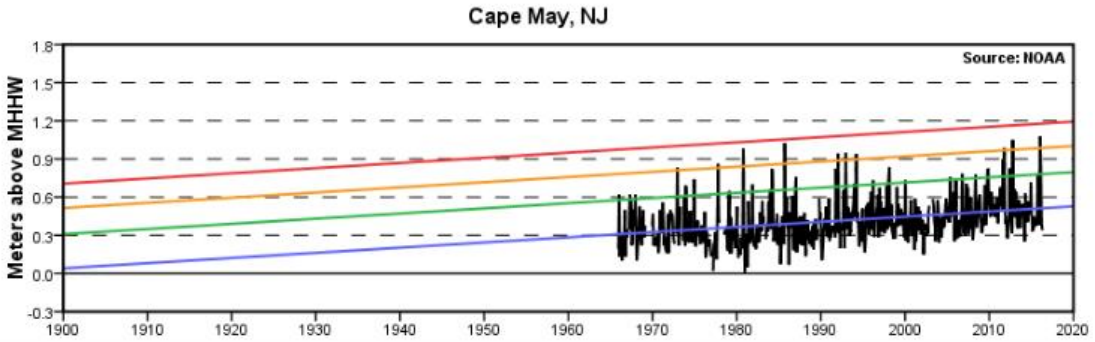
- Alabama
- Alaska
- California
- Connecticut
- Delaware
- Florida
- Georgia
- Hawaii
- Louisiana
- Maine
- Maryland
- Massachusetts
- New Jersey
- New York
- North Carolina
- Oregon
- Pennsylvania
- Rhode Island
- South Carolina
- Texas
- Virginia
- Washington
- Washington DC
- Island Stations

LINKS

- Top Ten Levels (Table in meters)

Extreme Water Levels

8536110 Cape May, NJ



Top 3 floods:

Year	Level (ft)
2016	3.5
2012	3.4
1985	3.4

NWS minor flood definition: n/a

1 year per 100
10 years per 100
50 years per 100
99 years per 100

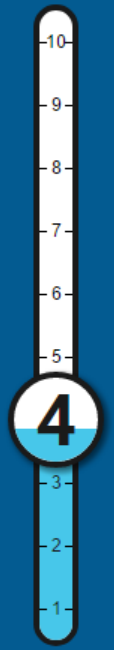
The monthly extreme water levels include a Mean Sea Level (MSL) trend of 4.06 millimeters/year with a 95% confidence interval of +/- 0.74 millimeters/year based on monthly MSL data from 1965 to 2006 which is equivalent to a change of 1.33 feet in 100 years.

highest and lowest water levels with the 1%, 10%, 50%, and 99% annual exceedance probability levels in red, orange, green, and blue. The plotted values

Source: https://tidesandcurrents.noaa.gov

When Are the Risks?

Water level (ft)

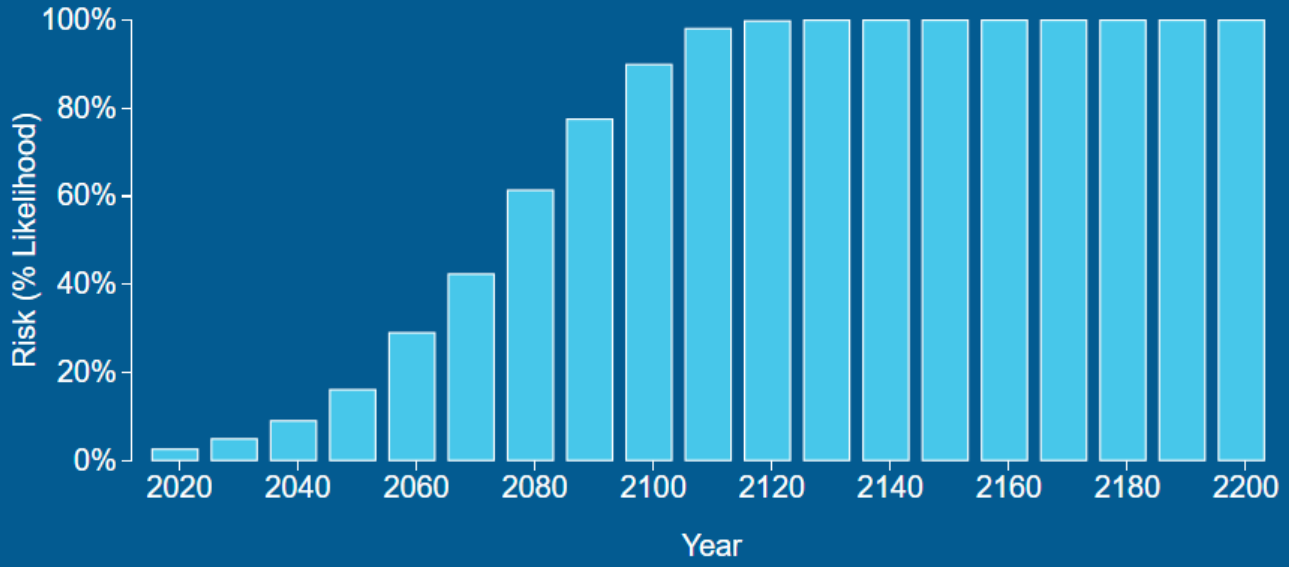


CAPE MAY AREA*

Single-year risk of flooding above 4 ft ▼

PPT PNG XLS

Risk of at least one flood within each year shown



Sea level scenario

- Extreme
- Fast rise
- Medium
- Slow rise

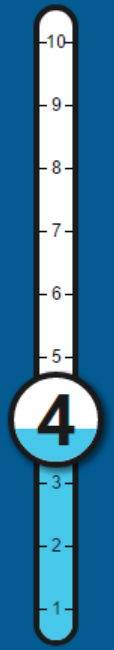
Advanced

At Cape May water level station, 4 miles from Cape May

Analysis uses median local sea level projections based on the intermediate low scenario from NOAA Technical Report NOS CO-OPS 083 (2017), intended for the 2018 U.S. National Climate Assessment. Key notes

When Are the Risks?

Water level (ft)



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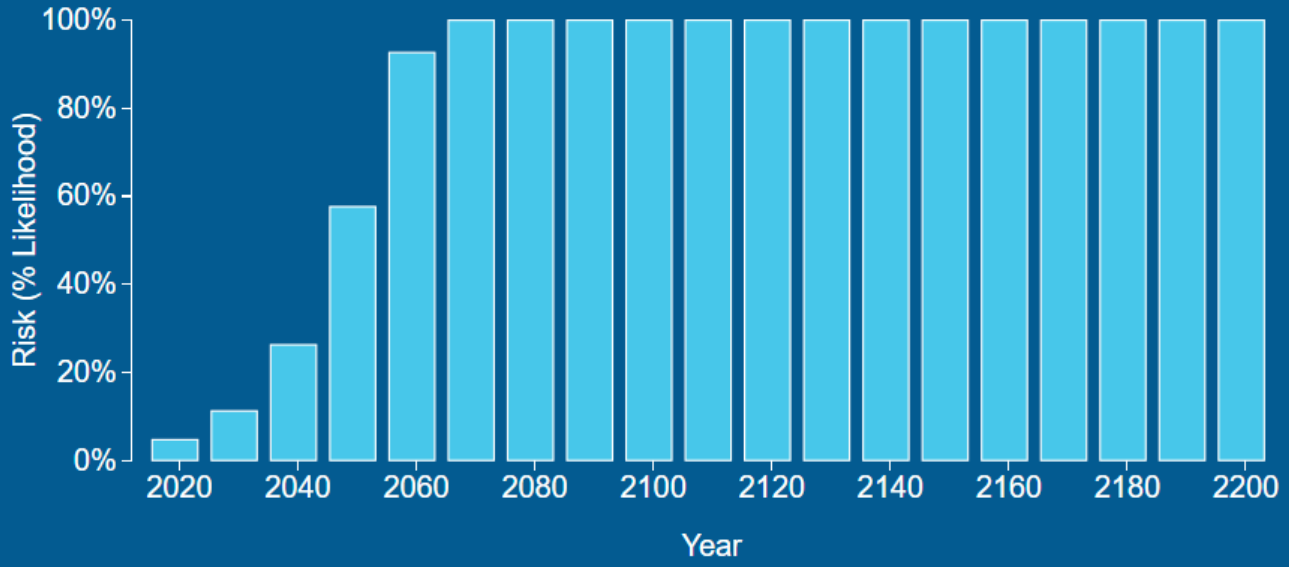

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When Are the Risks?

Water level (ft)

10 9 8 7 6 5 **4** 3 2 1

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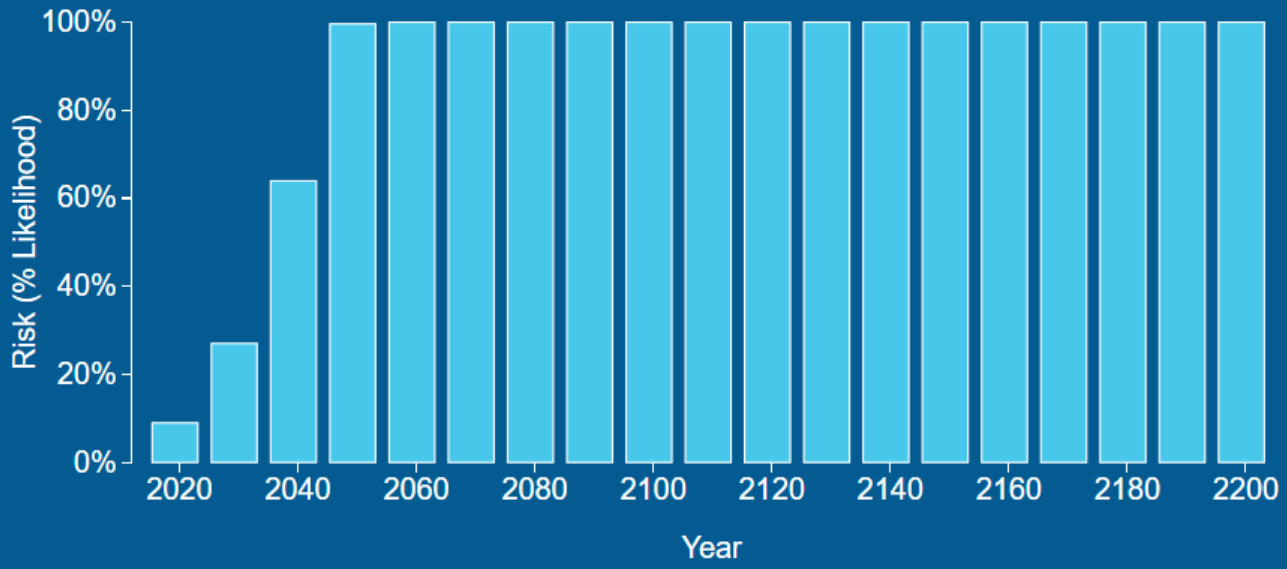
Single-year risk of flooding above 4 ft ▼ PPT PNG XLS

Risk of at least one flood within each year shown



Sea level scenario

- Extreme
- Fast rise
- Medium
- Slow rise

Advanced

*At Cape May water level station, 4 miles from Cape May

Analysis uses median local sea level projections based on the intermediate high scenario from NOAA Technical Report NOS CO-OPS 083 (2017), intended for the 2018 U.S. National Climate Assessment. Key notes

Water level (ft)

10
9
8
7
6
5
4
3
2
1

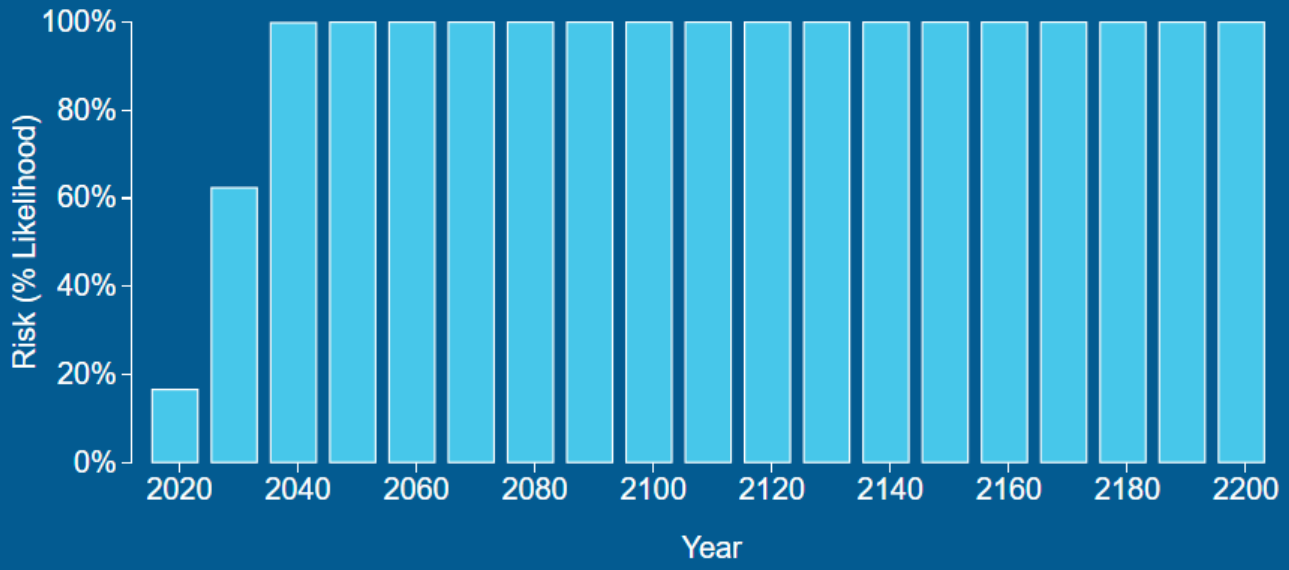
When Are the Risks?

CAPE MAY AREA*

Single-year risk of flooding above 4 ft ▼

PPT PNG XLS

Risk of at least one flood within each year shown



Sea level scenario

- Extreme
- Fast rise
- Medium
- Slow rise

Advanced

At Cape May water level station, 4 miles from Cape May

Analysis uses median local sea level projections based on the extreme scenario from NOAA Technical Report NOS CO-OPS 083 (2017), intended for the 2018 U.S. National Climate Assessment. Key notes

When Are the Risks?

Water level (ft)

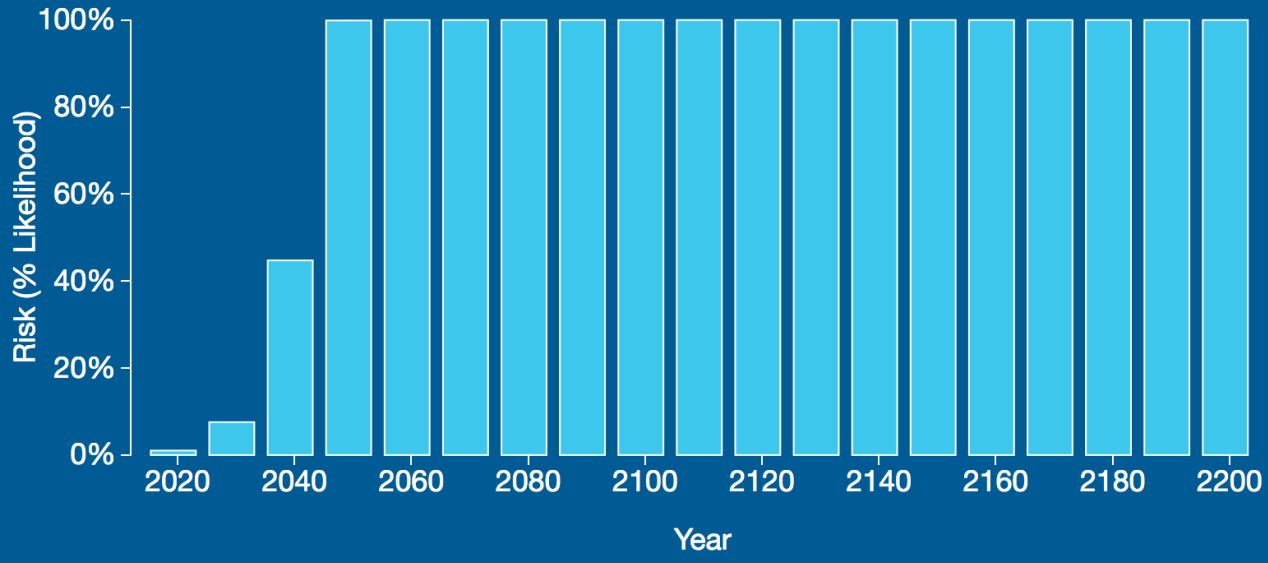
10
9
8
7
6
5
4
3
2
1

CAPE MAY COUNTY AREA*

Single-year risk of flooding above 5 ft ▾

PPT PNG XLS

Risk of at least one flood within each year shown



Sea level scenario

- Extreme
- Fast rise
- Medium
- Slow rise

Advanced

At Cape May water level station, 10 miles from Cape May County

Analysis uses median local sea level projections based on the extreme scenario from NOAA Technical Report NOS CO-OPS 083 (2017), intended for the 2018 U.S. National Climate Assessment. Key notes

Water level (ft)

10
9
8
7
6
5
4
3
2
1

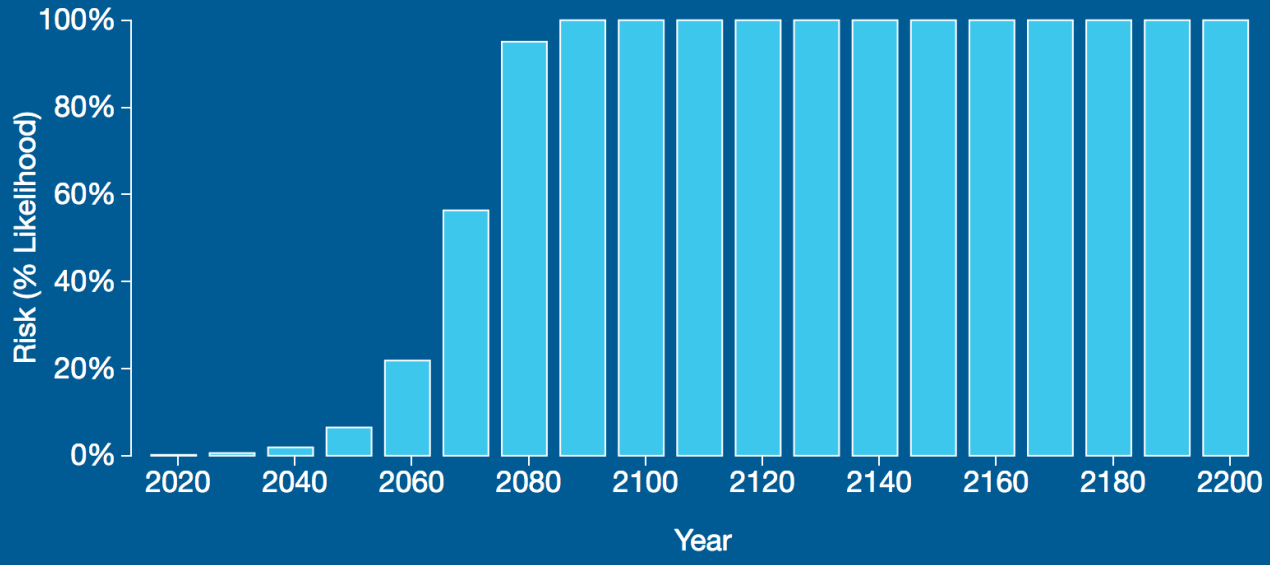
When Are the Risks?

CAPE MAY COUNTY AREA*

Single-year risk of flooding above 5 ft ▼

PPT PNG XLS

Risk of at least one flood within each year shown



Sea level scenario

- Extreme
- Fast rise
- Medium
- Slow rise

Advanced

At Cape May water level station, 10 miles from Cape May County

Analysis uses median local sea level projections based on the intermediate scenario from NOAA Technical Report NOS CO-OPS 083 (2017), intended for the 2018 U.S. National Climate Assessment. Key notes

Surging Seas **RISK FINDER**

Enter a coastal place

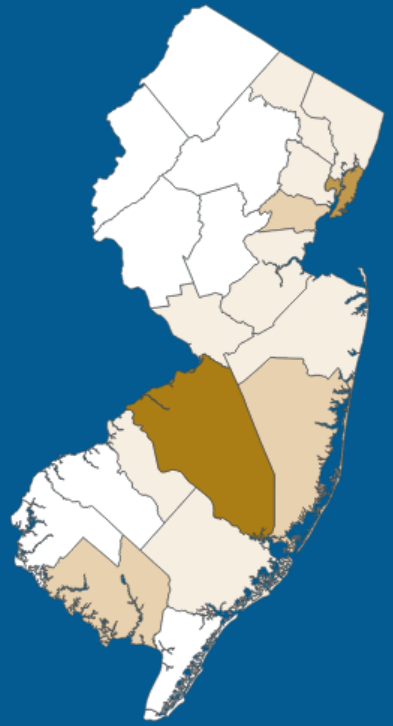
Choose a threat to map using the scrollable list above

Total sewage plants below 1ft in New Jersey by county

PPT PNG XLS

Water level (ft)

10 9 8 7 6 5 4 3 2 **1**



Sewage plants

3
2
1
0
0

Legend values are bin upper limits

Top threats on map

Burlington Co.	3
Hudson Co.	2
Cumberland Co.	1
Union Co.	1
Ocean Co.	1

Sources for raw sewage plants data: EPA 2013 | Details

Values exclude sub-1ft areas potentially protected by levees or other features.

Surging Seas **RISK FINDER**

Enter a coastal place

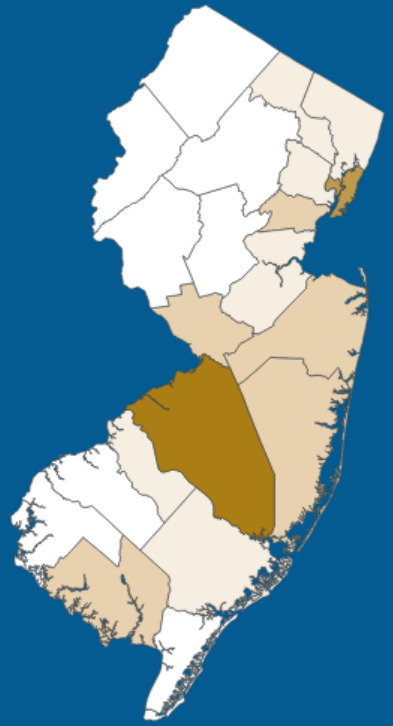
Choose a threat to map using the scrollable list above

Total sewage plants below 2ft in New Jersey by county

PPT PNG XLS

Water level (ft)

10 9 8 7 6 5 4 3 **2** 1



Sewage plants

3
2
1
0
0

Legend values are bin upper limits

Top threats on map

Burlington Co.	3
Hudson Co.	2
Cumberland Co.	1
Mercer Co.	1
Monmouth Co.	1

Sources for raw sewage plants data: EPA 2013 | Details

Values exclude sub-2ft areas potentially protected by levees or other features.

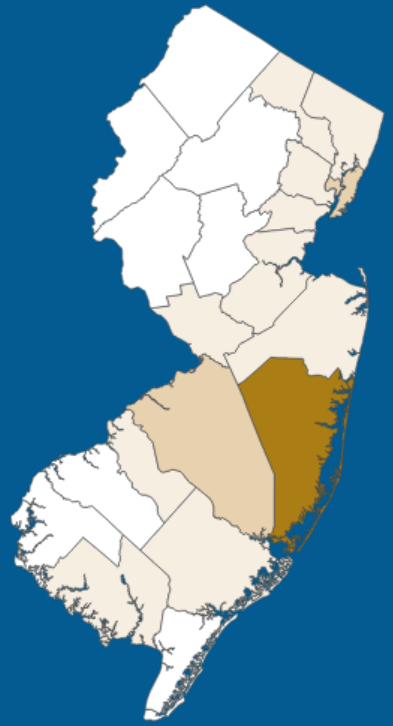
Choose a threat to map using the scrollable list above

Total sewage plants below 3ft in New Jersey by county

PPT PNG XLS

Water level (ft)

10 9 8 7 6 5 4 **3** 2 1



Sewage plants

8
3
1
0

Legend values are bin upper limits

Top threats on map

Ocean Co.	8
Burlington Co.	3
Hudson Co.	2
Cumberland Co.	1
Atlantic Co.	1

Sources for raw sewage plants data: EPA 2013 | *Details*

Values exclude sub-3ft areas potentially protected by levees or other features.

Surging Seas **RISK FINDER**

Enter a coastal place

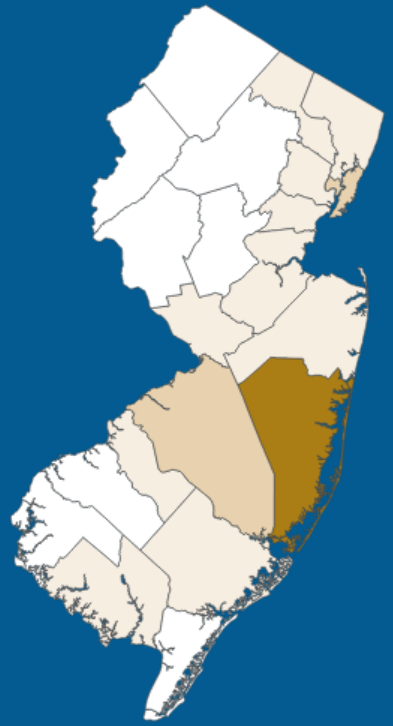
Choose a threat to map using the scrollable list above

Total sewage plants below 4ft in New Jersey by county

PPT PNG XLS

Water level (ft)

10 9 8 7 6 5 **4** 3 2 1



Sewage plants

12
4
2
0

Legend values are bin upper limits

Top threats on map

Ocean Co.	12
Hudson Co.	4
Burlington Co.	3
Atlantic Co.	2
Monmouth Co.	2

Sources for raw sewage plants data: EPA 2013 | *Details*

Values exclude sub-4ft areas potentially protected by levees or other features.

Surging Seas **RISK FINDER**

Enter a coastal place

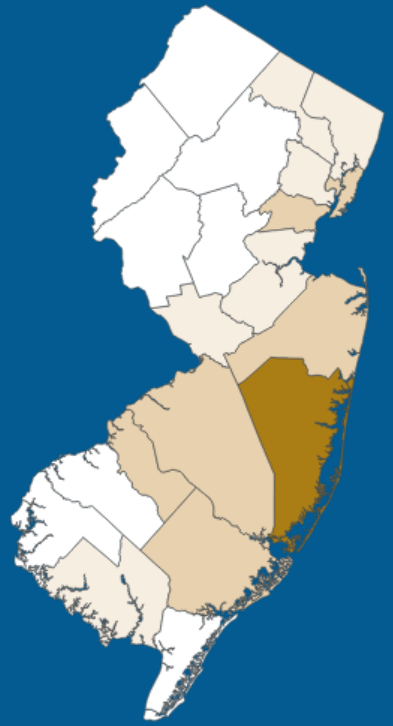
Choose a threat to map using the scrollable list above

Total sewage plants below 5ft in New Jersey by county

PPT PNG XLS

Water level (ft)

10 9 8 7 6 **5** 4 3 2 1



Sewage plants

12
4
2
0

Legend values are bin upper limits

Top threats on map

Ocean Co.	12
Burlington Co.	4
Atlantic Co.	4
Hudson Co.	4
Monmouth Co.	3

Sources for raw sewage plants data: EPA 2013 | Details

Values exclude sub-5ft areas potentially protected by levees or other features.

Water level (ft)

10 9 8 7 6 **5** 4 3 2 1

What Is at Risk?

Population | Buildings | Infrastructure | Contamination Risks | Land

Total contamination risks below 5ft in New Jersey

Contamination Risks: Wastewater	Total
Wastewater sites	363
Nonmajor wastewater sites	358
Sewage plants	43
Major wastewater sites	5

Sources for raw epa listed sites data: EPA 2013 | Details

Values exclude sub-5ft areas potentially protected by levees or other features.

Choose a threat to map using the scrollable list above

Total EPA listed sites below 5ft in New Jersey by county

EPA-listed sites

450
320
140
90

Water level (ft)

10 9 8 7 6 **5** 4 3 2 1

What Is at Risk?

Population | Buildings | Infrastructure | Contamination Risks | Land

Total contamination risks below 5ft in New Jersey

Contamination Risks: All	Total
EPA listed sites	1,558
Hazardous waste sites	1,016
RADINFO sites	1,002
Unspecified hazardous waste sites	776
Wastewater sites	363
NPDES sites	363
Nonmajor wastewater sites	358

Sources for raw epa listed sites data: EPA 2013 | Details

Values exclude sub-5ft areas potentially protected by levees or other features.

Choose a threat to map using the scrollable list above

Total EPA listed sites below 5ft in New Jersey by county

Thank you

SurgingSeas.org

RiskFinder.org

SeeingChoices.org

ClimateCentral.org

Firstenvironment.com

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