

# Building Coastal Flood Hazard Resiliency in Central Florida Communities

COASTAL RESILIENCY TOOLS BUFFET

OCTOBER 26, 2016

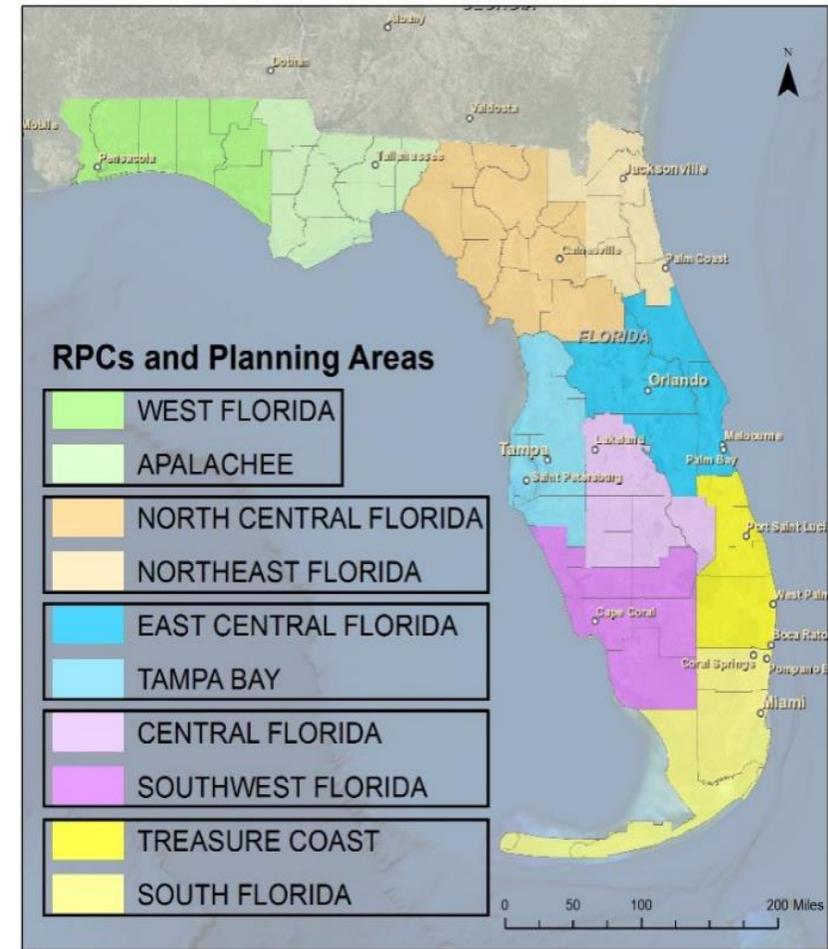
EAST CENTRAL FLORIDA REGIONAL PLANNING COUNCIL  
TAMPA BAY REGIONAL PLANNING COUNCIL  
UF GEOPLAN



# Statewide Train the Trainer Program



**DigitalCoast**  
OFFICE FOR COASTAL MANAGEMENT

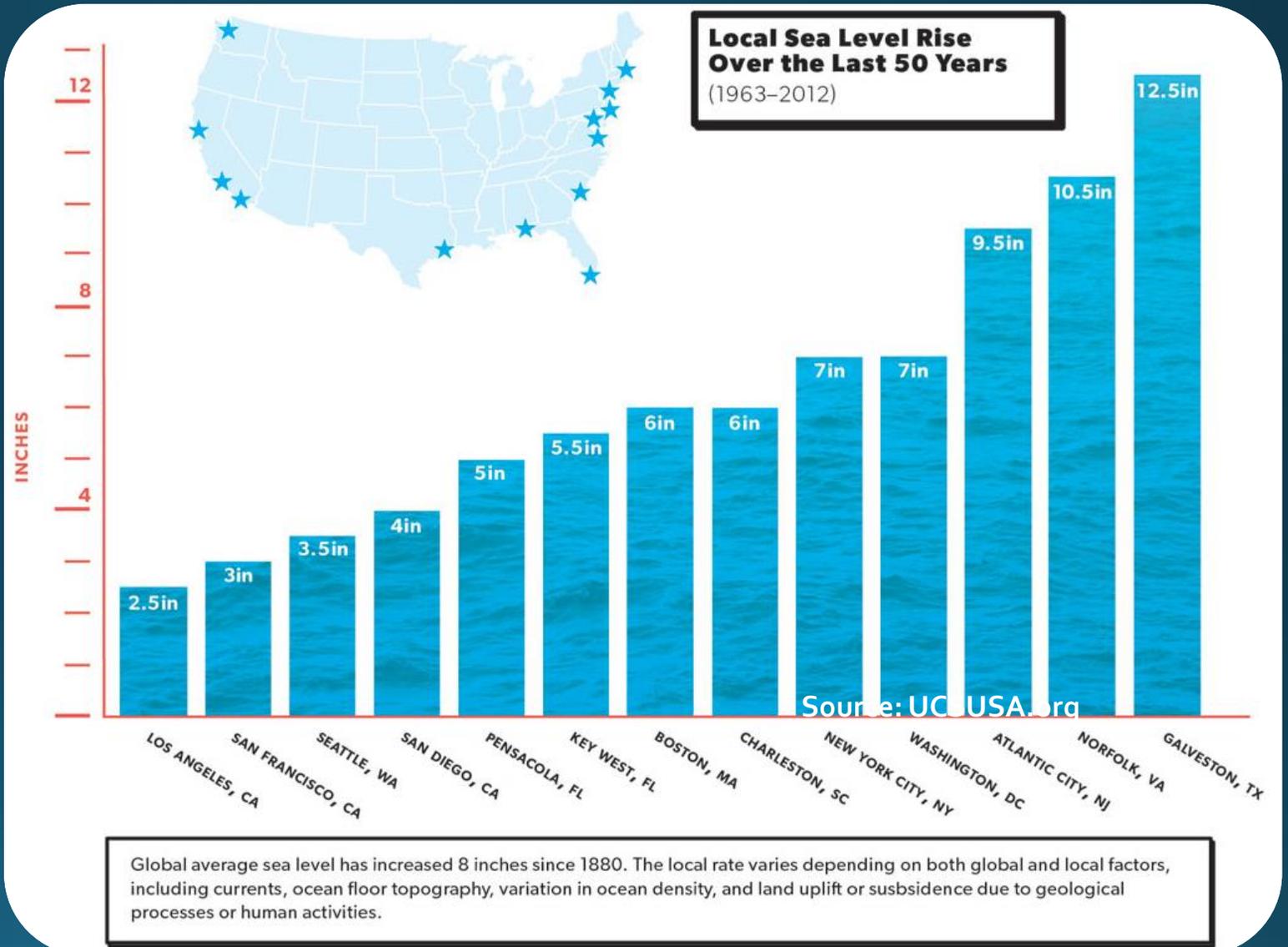


**Trainers and Tools:**

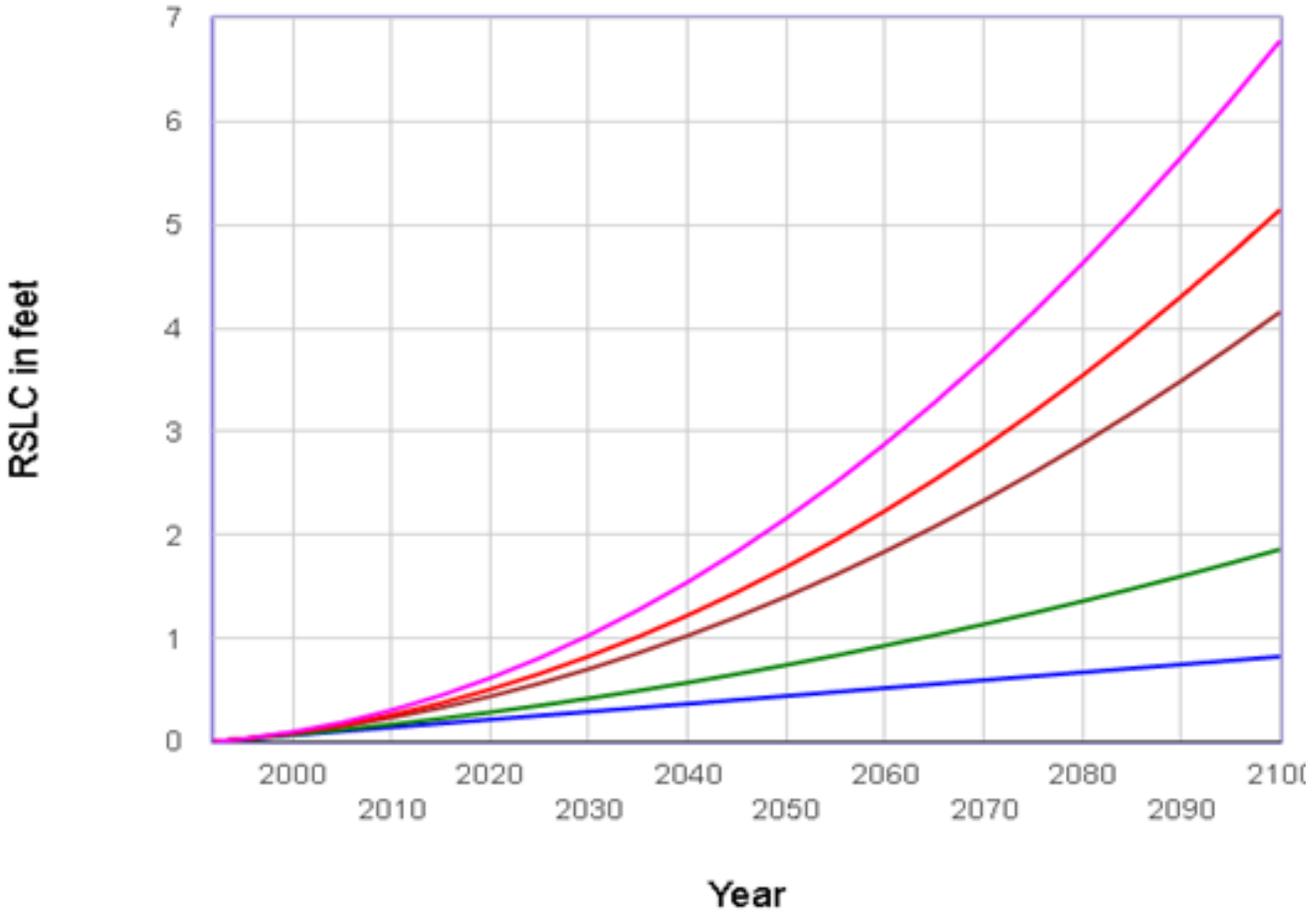
**Building Coastal Flood Hazard Resiliency in Florida's Regional Planning Council Communities**

# Terminology

## Global Versus Local Sea Level Rise



Estimated Relative Sea Level Change Projections From 1992 To 2100 -  
Gauge: 8721120, Daytona Beach Shores, FL (2.32 mm/yr)



[Print Curves](#)

- █ NOAA High Rate
- █ USACE High Rate
- █ NOAA Int High Rate
- █ NOAA Int Low Rate/USACE Intermediate
- █ NOAA Low Rate/USACE Low

Sea Level Rise (inches) - Daytona Beach Shores: 8721120			
Year	Low	Intermediate	High
2040	4.38	6.84	14.63
2070	7.12	13.62	34.19
2100	9.86	22.31	61.76

Army Corps of Eng. Curves

# Projection Rate Curves NOAA VS USACE



# CURRENT & FUTURE IMPACTS OF COASTAL HAZARDS

- Tidal Flooding
- Saltwater Intrusion
- Failing Drainage
- Compromised Canal Systems
- Beach Erosion
- Habitat loss
- Reduced Groundwater Storage

# Adaptation Strategies

- 1) Land-use regulations & building codes
- 2) Limits on insurance subsidies
- 3) Redesign and retrofitting of structures
- 4) Enhance drainage, flood control, and water supply infrastructure
- 5) Increase coastal protection
- 6) Adaptation Action Areas



<http://www.city-data.com/forum/attachments/sarasota-bradenton-venice-area/112916d1370928684-little-freaked-over-flooding-issues-less-build-levee-0511-mdn.jpg>

# Storm Surge

- Mangrove replenishment & restoration
- Living shorelines/ soft infrastructure
- Beach replenishment
- Sea walls & rip-rap
- Levees
- Flood gates
- Pumps



# Flooding

- Increase surface storm water storage
- Green Infrastructure
- Storm water injection wells
- Backflow preventers
- Elevation
- Increase permeable surface area
- Update flood control structures



<http://www.gcbl.org/blog/2013/06/inside-clevelands-first-complete-and-green-street>

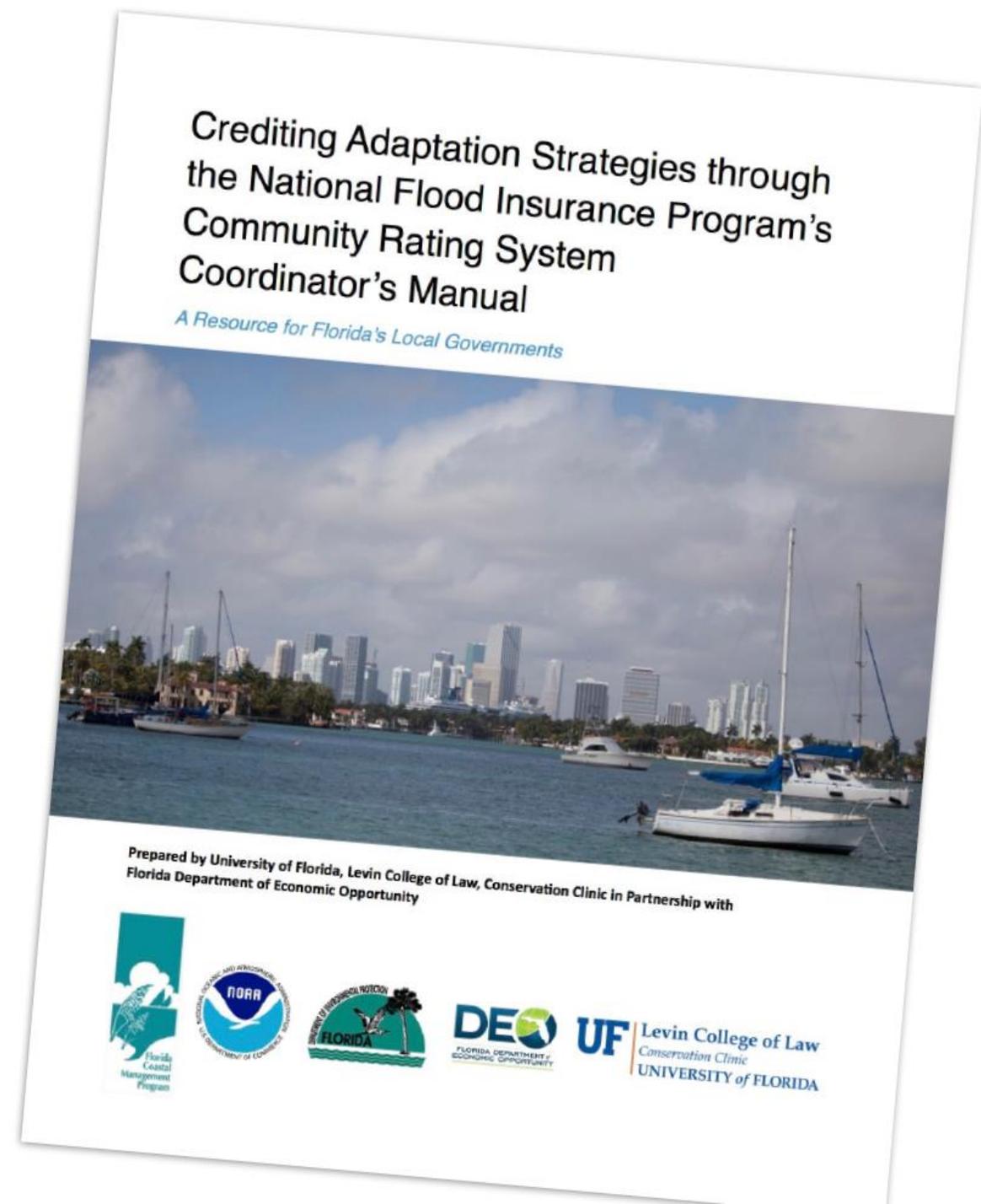


## June 3: NFIP Community Rating System Workshop

[http://www.tbrpc.org/onebay/working\\_group.shtml](http://www.tbrpc.org/onebay/working_group.shtml)

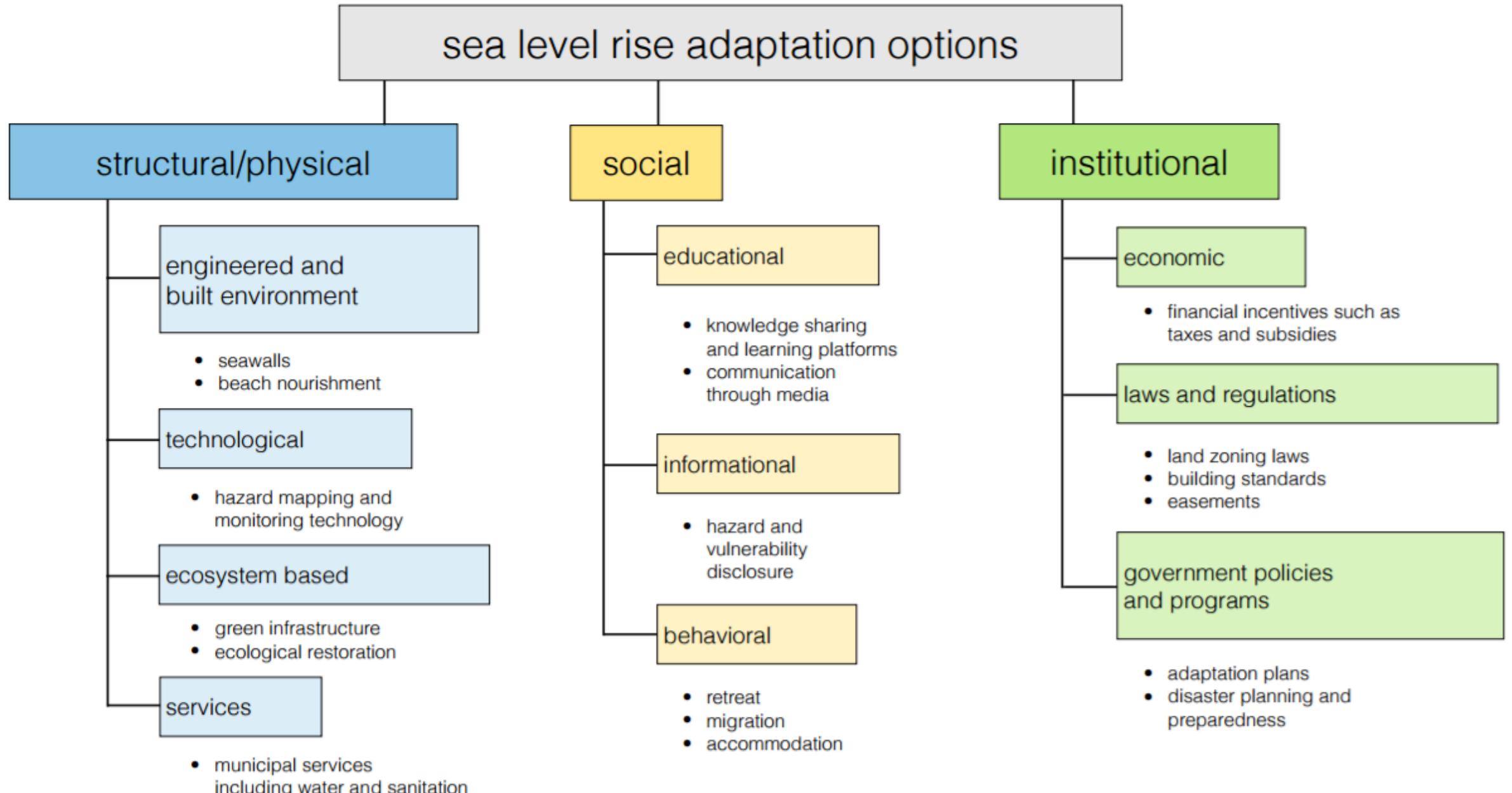
# Crediting Adaptation Strategies through the National Flood Insurance Program's Community Rating System Coordinator's Manual

[https://www.law.ufl.edu/\\_pdf/academics/centers-clinics/clinics/conservation/resources/final-deliverable-1B-crs-guidance-document.pdf](https://www.law.ufl.edu/_pdf/academics/centers-clinics/clinics/conservation/resources/final-deliverable-1B-crs-guidance-document.pdf)



# CRS recent changes

- credit for mapping areas of future flooding due to sea level rise
- credit for notifying property buyers of sea level rise
- credit for regulatory map based on future conditions
- Class 4 rating or higher requires minimized increases in future flooding
- Class 1 rating requires flood elevations that reflect future conditions





<https://coast.noaa.gov/digitalcoast/tools/>



# DigitalCoast

OFFICE FOR COASTAL MANAGEMENT

/digitalcoast/tools/



### C-CAP Land Cover Atlas

View and explore coastal land cover and change data

#### Contributing Partners

NOAA OCM

Reporting, Visualization



### CMECS Crosswalk Tool

Translates existing benthic habitat data sets to the Coastal and Marine Ecological Classification Standard (CMECS)

#### Contributing Partners

NOAA OCM

Analysis



### CanVis

Visualize future scenarios using your photographs and this tool's object icons

#### Contributing Partners

NOAA OCM, USDA National Agroforestry Center

Visualization



### Climate Wizard

Use state-of-the-art climate models and statistical analysis to view, generate, and download climate change maps and tables

#### Contributing Partners

The Nature Conservancy

Analysis, Reporting, Visualization



### Coastal Change Hazards Portal

Create a map of potential ecological, social, and economic impacts from rising seas and changing climate

#### Contributing Partners

USGS

Analysis, Reporting, Visualization



### Coastal County Snapshots

Turn complex data into easy-to-understand stories, complete with charts and graphs

#### Contributing Partners

NOAA OCM

Reporting



### Coastal Flood Exposure Mapper

Maps people, places, and natural resources that are potentially exposed to coastal flooding



### Coastal Resilience Mapping Portal

Create a map of potential ecological, social, and economic impacts from rising seas and changing climate



### Data Access Viewer

Find and download data hosted on the NOAA Office for Coastal Management website

# 58 Tools

# 3

# HAZARD ASSESSMENT TOOLS

<b>CANVIS</b> NOAA	<b>SEA LEVEL RISE (SLR) VIEWER</b> NOAA	<b>COASTAL FLOOD EXPOSURE MAPPER</b> NOAA	<b>SKETCH PLANNING TOOL</b> UF GEOPLAN CENTER
<p>is intended to elicit higher levels of stakeholder engagement, CanVis utilizes no data and modifies imagery to show potential inundation scenarios.</p>	<p>can facilitate stakeholder engagement, scoping and inventory, and assessment and analysis. SLR Viewer offers an online interactive platform in map format to display a variety of sealevel rise scenarios.</p>	<p>Helps start community discussions about hazard impacts with maps of your area that show people, places, and natural resources exposed to coastal flooding. Select a section to view maps showing flood hazards or different aspects of community exposure to those flood hazards.</p>	<p>visualizer and modelling software package intended to promote stakeholder engagement, scoping/inventory, assessment/analysis, and planning, the Geoplan Sketch Planning Tool offers a variety of sea-level rise analyses related to transportation</p>

# HAZARD ASSESSMENT TOOLS

<b>CANVIS</b> NOAA	<b>SEA LEVEL RISE (SLR) VIEWER</b> NOAA	<b>COASTAL FLOOD EXPOSURE MAPPER</b> NOAA	<b>SKETCH PLANNING TOOL</b> UF GEOPLAN CENTER
<p>is intended to elicit higher levels of stakeholder engagement, CanVis utilizes no data and modifies imagery to show potential inundation scenarios.</p>	<p>can facilitate stakeholder engagement, scoping and inventory, and assessment and analysis. SLR Viewer offers an online interactive platform in map format to display a variety of sealevel rise scenarios.</p>	<p>Helps start community discussions about hazard impacts with maps of your area that show people, places, and natural resources exposed to coastal flooding. Select a section to view maps showing flood hazards or different aspects of community exposure to those flood hazards.</p>	<p>visualizer and modelling software package intended to promote stakeholder engagement, scoping/inventory, assessment/analysis, and planning, the Geoplan Sketch Planning Tool offers a variety of sea-level rise analyses related to transportation</p>

# HAZARD ASSESSMENT TOOLS

<b>CANVIS</b> NOAA	<b>SEA LEVEL RISE (SLR) VIEWER</b> NOAA	<b>COASTAL FLOOD EXPOSURE MAPPER</b> NOAA	<b>SKETCH PLANNING TOOL</b> UF GEOPLAN CENTER
<p>is intended to elicit higher levels of stakeholder engagement, CanVis utilizes no data and modifies imagery to show potential inundation scenarios.</p>	<p>can facilitate stakeholder engagement, scoping and inventory, and assessment and analysis. SLR Viewer offers an online interactive platform in map format to display a variety of sealevel rise scenarios.</p>	<p>Helps start community discussions about hazard impacts with maps of your area that show people, places, and natural resources exposed to coastal flooding. Select a section to view maps showing flood hazards or different aspects of community exposure to those flood hazards.</p>	<p>visualizer and modelling software package intended to promote stakeholder engagement, scoping/inventory, assessment/analysis, and planning, the Geoplan Sketch Planning Tool offers a variety of sea-level rise analyses related to transportation</p>

# HAZARD ASSESSMENT TOOLS

<b>CANVIS</b> NOAA	<b>SEA LEVEL RISE (SLR) VIEWER</b> NOAA	<b>COASTAL FLOOD EXPOSURE MAPPER</b> NOAA	<b>SKETCH PLANNING TOOL</b> UF GEOPLAN CENTER
<p>is intended to elicit higher levels of stakeholder engagement, CanVis utilizes no data and modifies imagery to show potential inundation scenarios.</p>	<p>can facilitate stakeholder engagement, scoping and inventory, and assessment and analysis. SLR Viewer offers an online interactive platform in map format to display a variety of sealevel rise scenarios.</p>	<p>Helps start community discussions about hazard impacts with maps of your area that show people, places, and natural resources exposed to coastal flooding. Select a section to view maps showing flood hazards or different aspects of community exposure to those flood hazards.</p>	<p>visualizer and modelling software package intended to promote stakeholder engagement, scoping/inventory, assessment/analysis, and planning, the Geoplan Sketch Planning Tool offers a variety of sea-level rise analyses related to transportation</p>

# CanVis: A Tool for Visualizing Coastal Changes and Potential Adaptation Strategies



# Why Visualization?

- Brainstorming or developing a concept
- Evaluating a design or management option
- Illustrating ideas and alternatives to users and decision makers
- Assessing visual impacts



Lake Superior

Simulation

*NOAA Office for Coastal Management, USDA National Agroforestry Center*

## Overview

This easy-to-use, downloadable visualization tool allows users to “see” potential changes, from coastal development (including a new building or marina) to sea level rise. Controls are similar to Photoshop, but with less of a learning curve. Users can quickly develop realistic visualizations for their stakeholders. Hundreds of coast-based icons (coastal object libraries) are provided.

## Features

- Simulate potential on-the-ground impacts of various actions
- Compare outcomes of multiple scenarios
- Create a possible vision of the future

## Additional Information

- + Coastal Object Libraries
- + IAN Symbol Libraries
- + Guidance Documents
- + Instructional Videos

DOWNLOAD

TAKE THE TRAINING

## Related Resources

Stories	10
Classroom, Instructor-Led	3
Quick Reference	2
Tools	1
Videos and Webinars	1
Publications	1
Self-Guided Resources	1
Contributing Partners	2

- National Oceanic and Atmospheric Administration Office for Coastal Management
- USDA National Agroforestry Center

# CanVis



## TRAINING TYPE

Self-Guided Resources



## DURATION

Self-Paced

## Overview

This self-guided training is divided into two parts and demonstrates the basic components and instruction for CanVis visualization software.

## You will learn how to

### Part 1: Visualization Basics and Intro to CanVis (10 minutes)

- Describe the benefits and limitations of visualizations
- Recognize how visualizations can change behaviors
- Create effective visualizations

[Evaluate Part 1](#)

### Part 2: CanVis Before and After Tour (self-paced)

- Apply CanVis to address an array of issues by seeing how others have used this powerful communication tool

[Evaluate Part 2](#)

[BEGIN PART 1](#)

[BEGIN PART 2](#)

## Related Resources

Stories	10
Tools	2
Publications	1
Mixed Delivery	1
Quick Reference	1
Videos and Webinars	1
<a href="#">Contributing Partners</a>	2

- [National Oceanic and Atmospheric Administration Office for Coastal Management](#)
- [U.S. Department of Agriculture](#)

*NOAA Office for Coastal Management, USDA National Agroforestry Center*

## Overview

This easy-to-use, downloadable visualization tool allows users to “see” potential changes, from coastal development (including a new building or marina) to sea level rise. Controls are similar to Photoshop, but with less of a learning curve. Users can quickly develop realistic visualizations for their stakeholders. Hundreds of coast-based icons (coastal object libraries) are provided.

## Features

- Simulate potential on-the-ground impacts of various actions
- Compare outcomes of multiple scenarios
- Create a possible vision of the future

## Additional Information

- + Coastal Object Libraries
- + IAN Symbol Libraries
- + Guidance Documents
- + Instructional Videos

DOWNLOAD

TAKE THE TRAINING

## Related Resources

Stories	10
Classroom, Instructor-Led	3
Quick Reference	2
Tools	1
Videos and Webinars	1
Publications	1
Self-Guided Resources	1
Contributing Partners	2

- National Oceanic and Atmospheric Administration Office for Coastal Management
- USDA National Agroforestry Center

# CanVis Software

**CanVis**  
VISUALIZATION SOFTWARE FOR  
COASTAL COMMUNITIES



U.S. Department of Agriculture (USDA) Forest Service

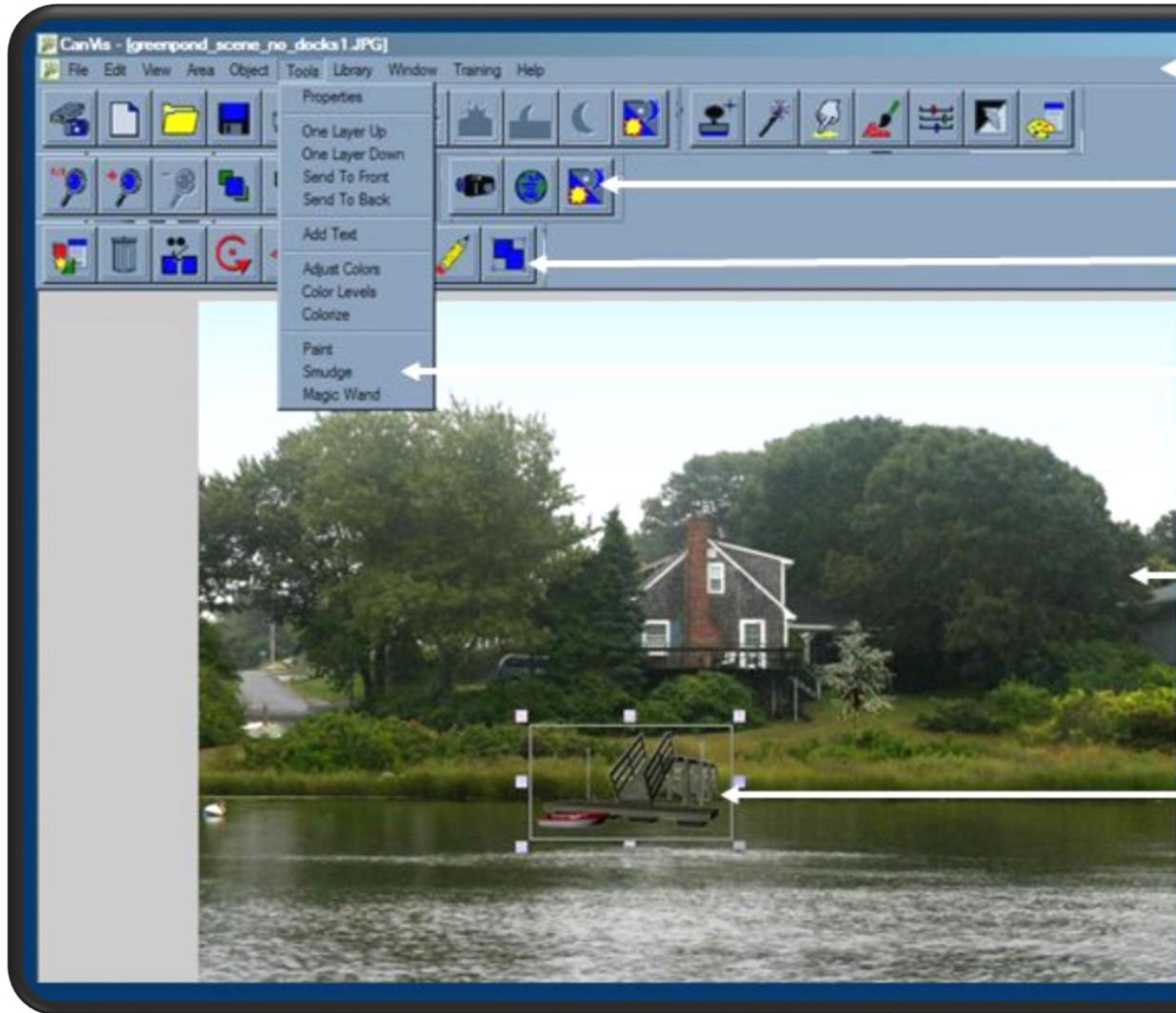
USDA Natural Resources Conservation Service

[www.unl.edu/nac/simulation/](http://www.unl.edu/nac/simulation/)

[www.unl.edu/nac/simulation/](http://www.unl.edu/nac/simulation/)

USDA Natural Resources Conservation Service

U.S. Department of Agriculture (USDA) Forest Service



Menu

Icons

Toolbars

Dropdown menu or tab

Base image

Object



# CanVis in Action



Original object photograph



Extracted object



Image with extracted object

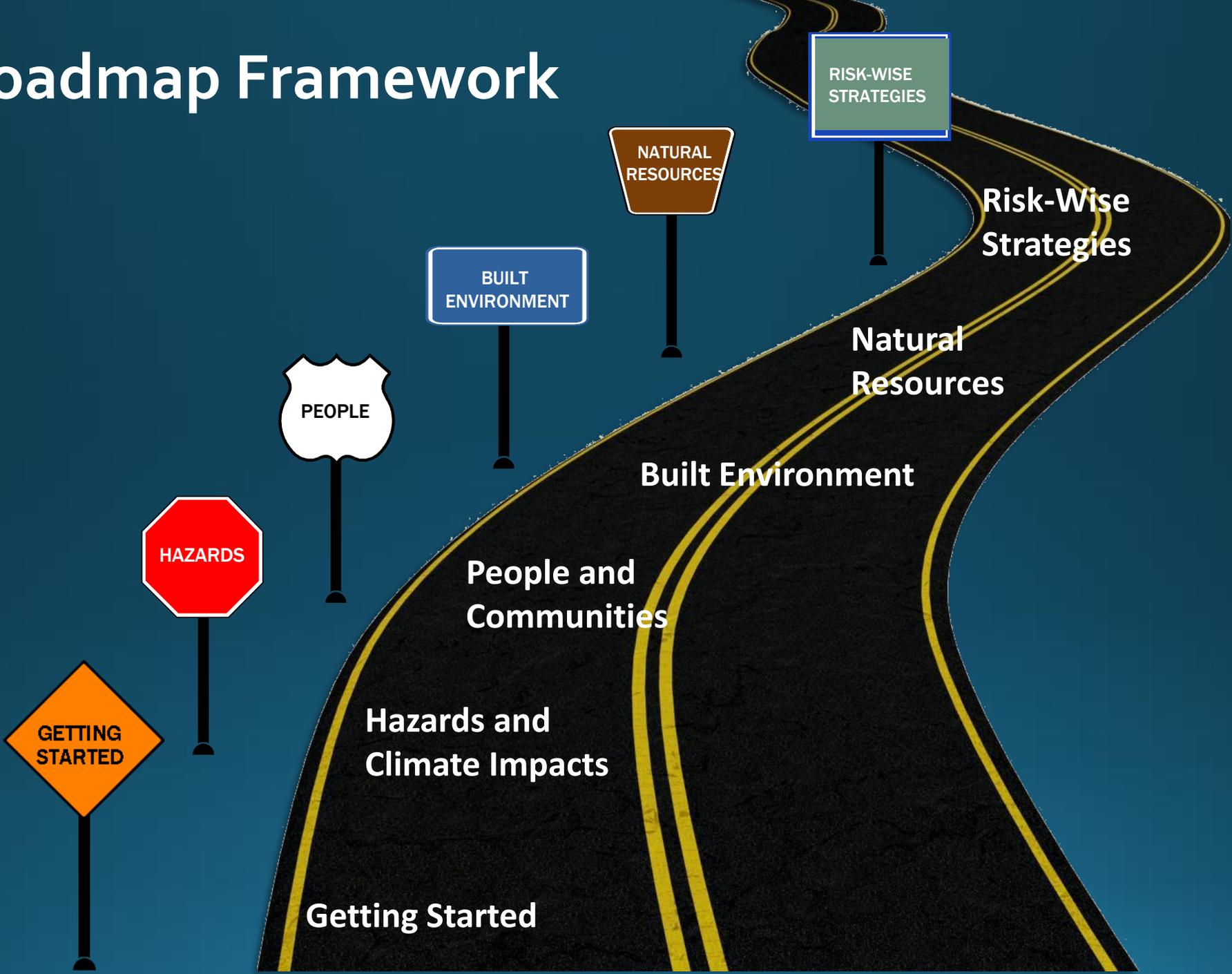


Background image



<https://coast.noaa.gov/data/digitalcoast/pdf/canvis-guidance.pdf>

# Roadmap Framework



# Sea Level Rise Viewer

NOAA Office for Coastal Management

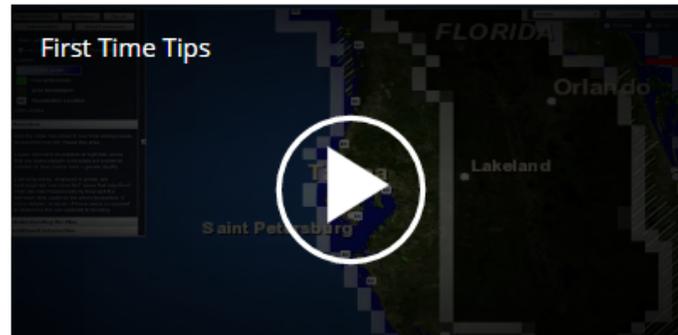
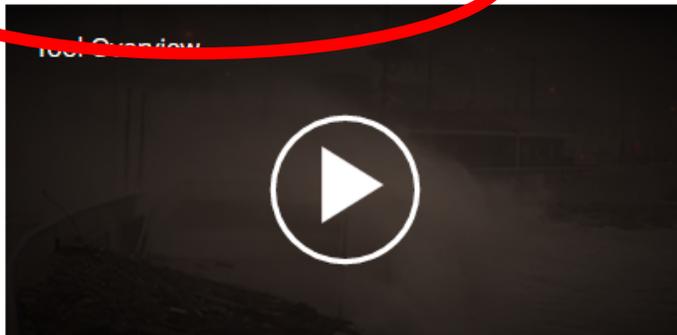
## Overview

Use this web mapping tool to visualize community-level impacts from coastal flooding or sea level rise (up to 6 feet above average high tides). Photo simulations of how future flooding might impact local landmarks are also provided, as well as data related to water depth, connectivity, flood frequency, socio-economic vulnerability, wetland loss and migration, and mapping confidence.

## Features

- **Visualize** potential impacts from sea level rise through maps and photos
- **Learn** about data and methods through documentation
- **Share** maps and links via email and social media
- **Download** inundation layers and digital elevation models, and access web map services for custom GIS applications

## Supporting Videos



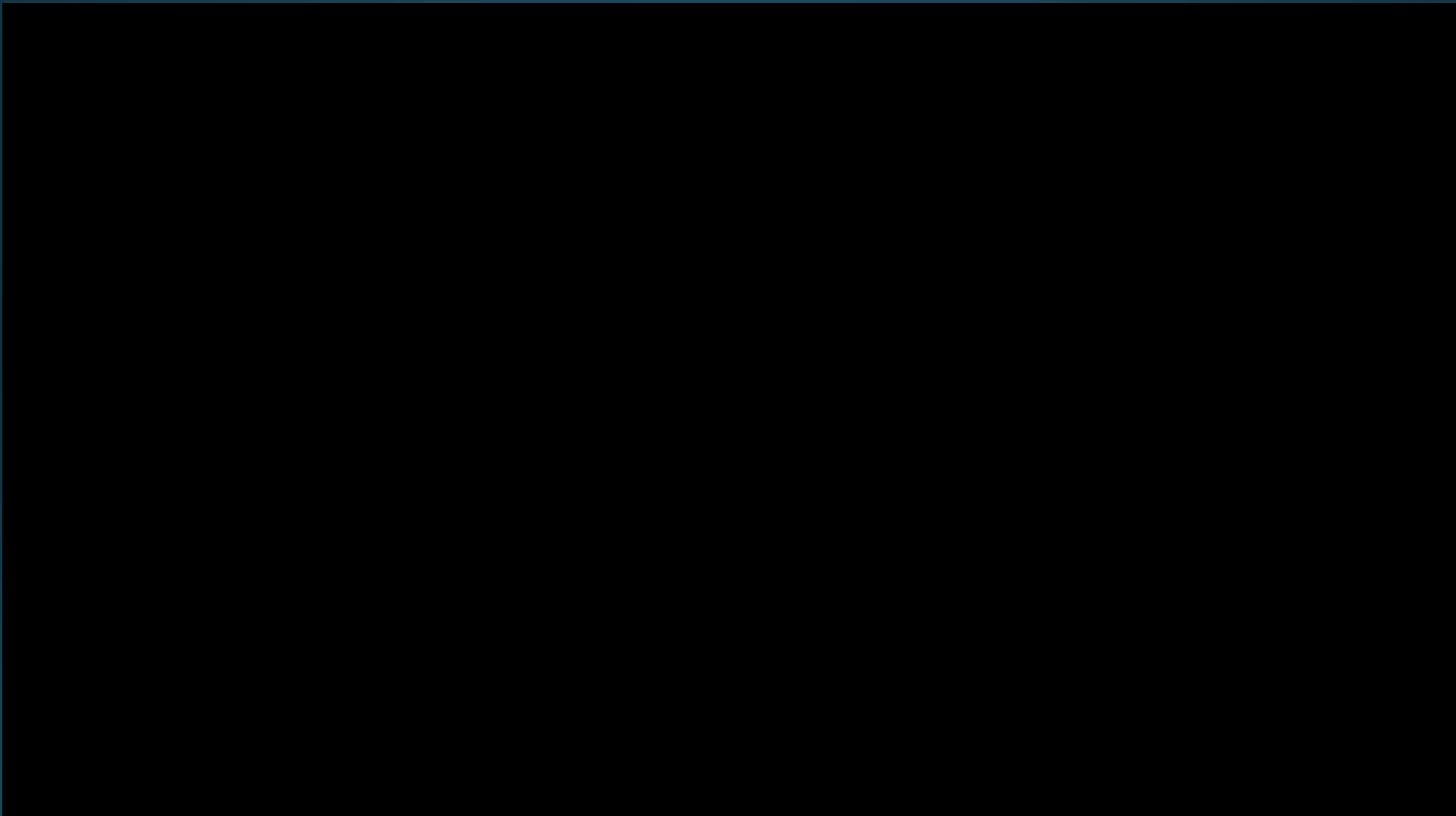
LAUNCH

DOWNLOAD DATA

## Related Resources

Stories	25
Data	7
Publications	5
Tools	4
Videos and Webinars	3
Self-Guided Resources	2
Classroom, Instructor-Led	2
Contributing Partners	1

- [National Oceanic and Atmospheric Administration Office for Coastal Management](#)



# Sea Level Rise Viewer

NOAA Office for Coastal Management

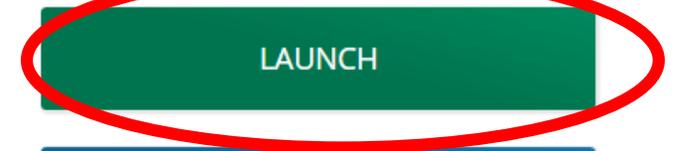
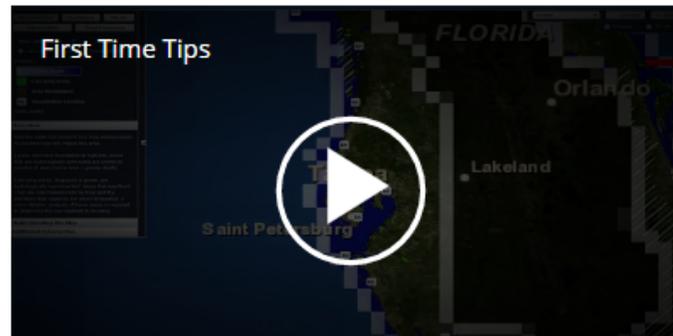
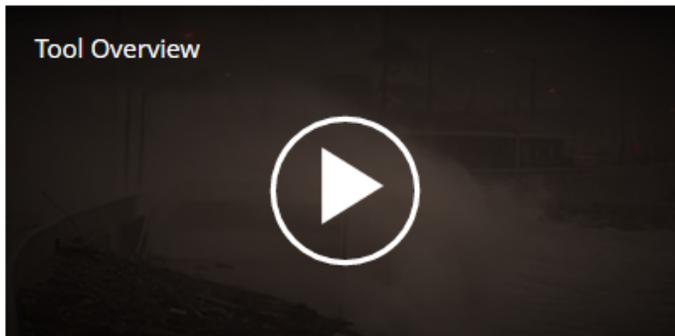
## Overview

Use this web mapping tool to visualize community-level impacts from coastal flooding or sea level rise (up to 6 feet above average high tides). Photo simulations of how future flooding might impact local landmarks are also provided, as well as data related to water depth, connectivity, flood frequency, socio-economic vulnerability, wetland loss and migration, and mapping confidence.

## Features

- **Visualize** potential impacts from sea level rise through maps and photos
- **Learn** about data and methods through documentation
- **Share** maps and links via email and social media
- **Download** inundation layers and digital elevation models, and access web map services for custom GIS applications

## Supporting Videos



## Related Resources

Stories	25
Data	7
Publications	5
Tools	4
Videos and Webinars	3
Self-Guided Resources	2
Classroom, Instructor-Led	2
Contributing Partners	1

- [National Oceanic and Atmospheric Administration Office for Coastal Management](#)



# Sea Level Rise and Coastal Flooding Impacts

- Sea Level Rise
- Confidence
- Marsh
- Vulnerability
- Flood Frequency

## Sea Level Rise ?

 Current MHHW

### Legend

- Water Depth**
- Low-lying Areas
- Area Not Mapped
- Visualization Location
- Leveed Areas

## Overview

Use the slider bar above to see how various levels of sea level rise will impact this area.

Levels represent inundation at high tide. Areas that are hydrologically connected are shown in shades of blue (darker blue = greater depth).

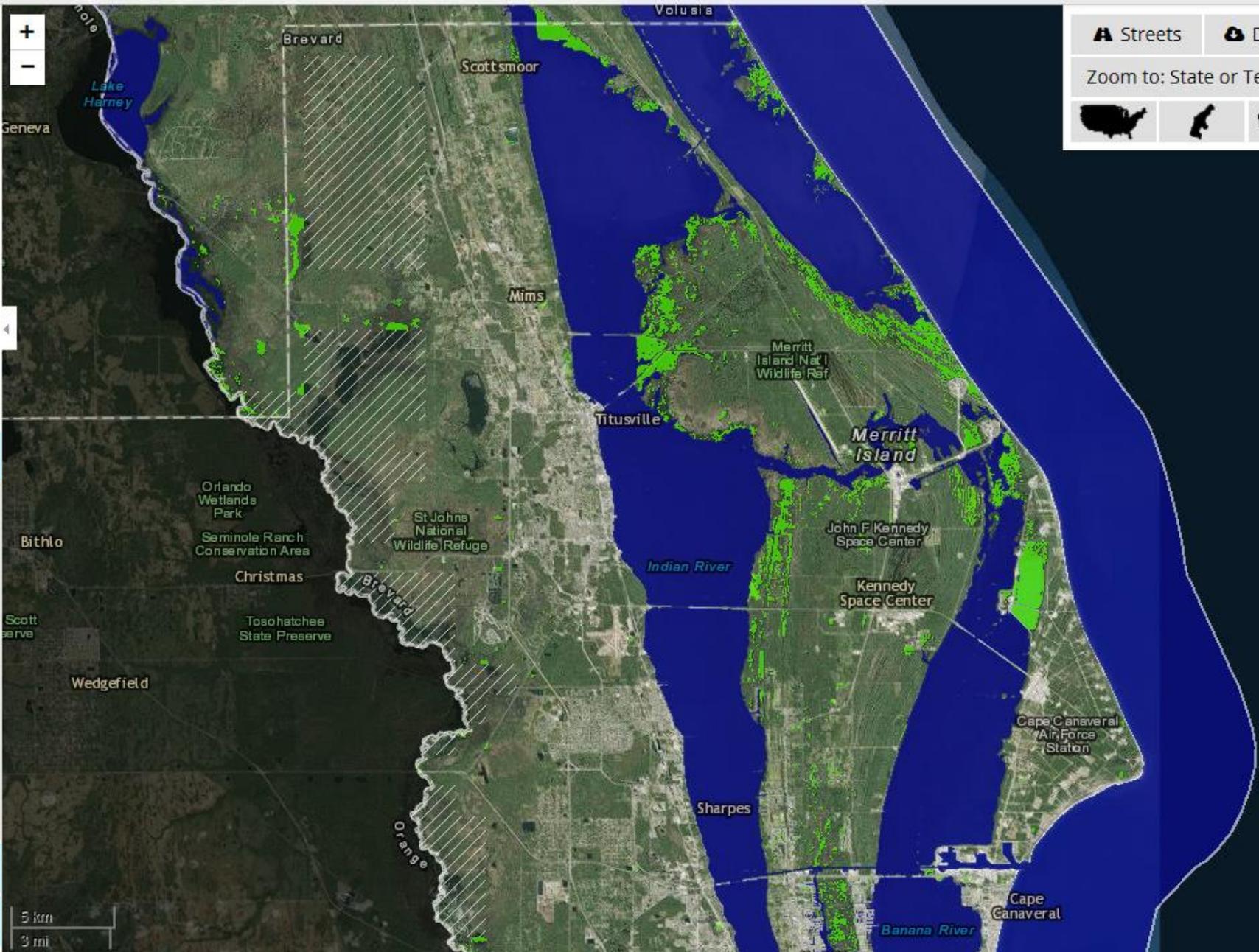
Low-lying areas, displayed in green, are hydrologically "unconnected" areas that may flood. They are determined solely by how well the elevation data captures the area's hydraulics. A more detailed analysis of these areas is required to determine the susceptibility to flooding.

## Understanding The Map

## Additional Information

- Streets
- Download
- Share Map

Zoom to: State or Territory





# Sea Level Rise and Coastal Flooding Impacts

Sea Level Rise Confidence Marsh  
 Vulnerability Flood Frequency

## Sea Level Rise ?

3 ft SLR

### Legend

- Water Depth
- Low-lying Areas
- Area Not Mapped
- Visualization Location
- Leveed Areas ?

### Overview

Use the slider bar above to see how various levels of sea level rise will impact this area.

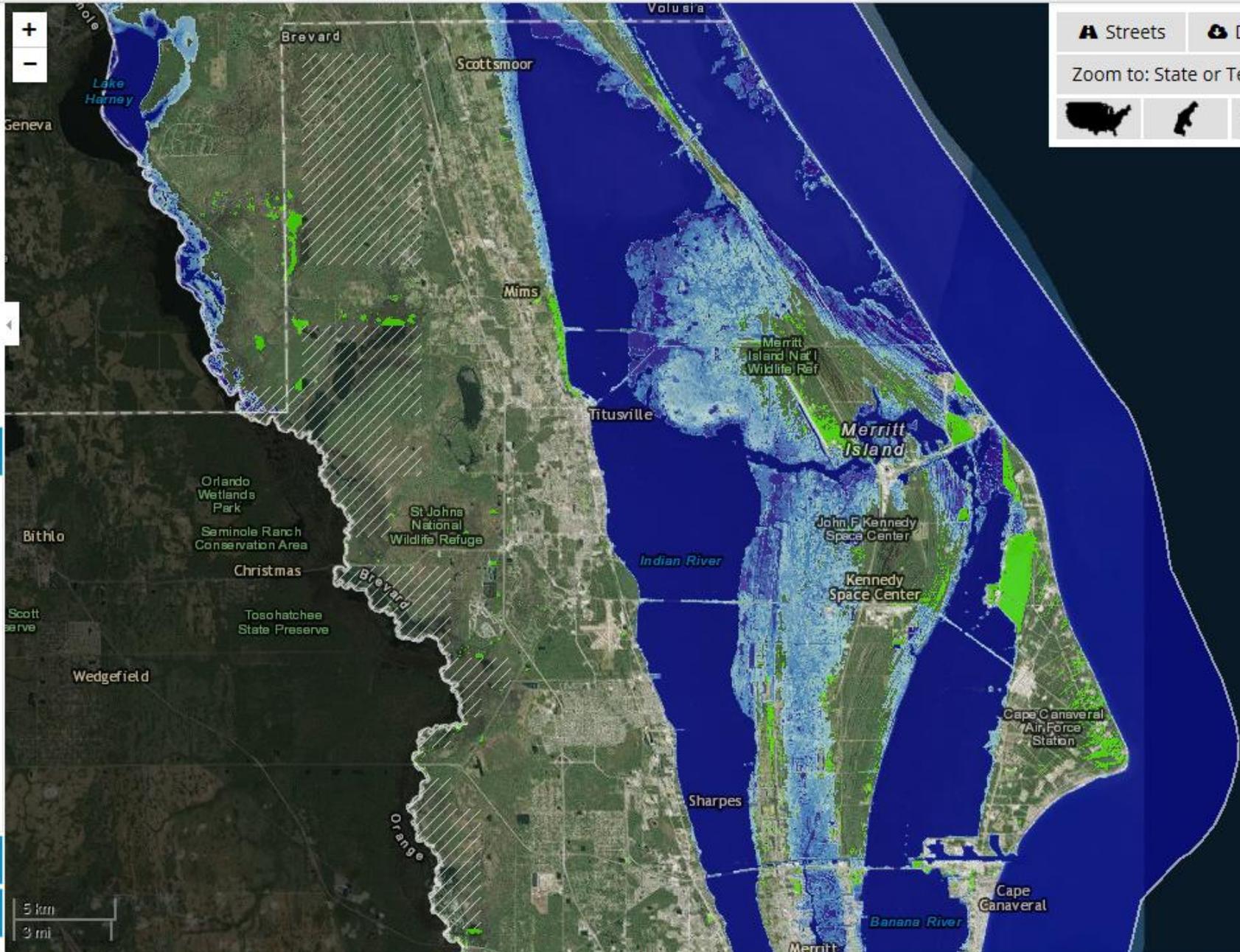
Levels represent inundation at high tide. Areas that are hydrologically connected are shown in shades of blue (darker blue = greater depth).

Low-lying areas, displayed in green, are hydrologically "unconnected" areas that may flood. They are determined solely by how well the elevation data captures the area's hydraulics. A more detailed analysis of these areas is required to determine the susceptibility to flooding.

### Understanding The Map

### Additional Information

Streets Download Share Map  
 Zoom to: State or Territory





# Sea Level Rise and Coastal Flooding Impacts

Sea Level Rise Confidence Marsh

Vulnerability Flood Frequency

## Sea Level Rise ?

Current MHHW

## Legend

### Water Depth

- Low-lying Areas
- Area Not Mapped
- Visualization Location
- Leveed Areas

## Overview

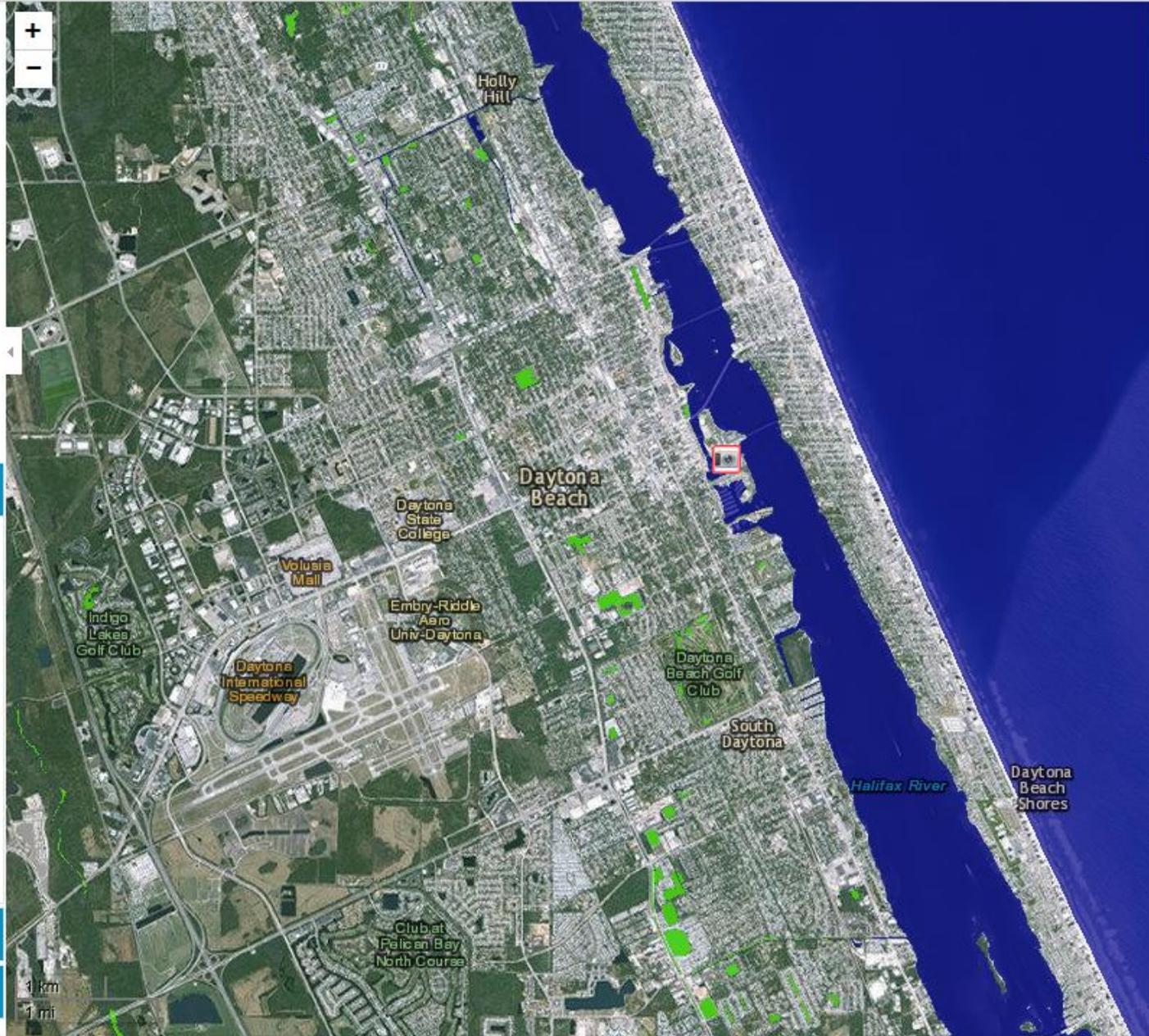
Use the slider bar above to see how various levels of sea level rise will impact this area.

Levels represent inundation at high tide. Areas that are hydrologically connected are shown in shades of blue (darker blue = greater depth).

Low-lying areas, displayed in green, are hydrologically "unconnected" areas that may flood. They are determined solely by how well the elevation data captures the area's hydraulics. A more detailed analysis of these areas is required to determine the susceptibility to flooding.

## Understanding The Map

## Additional Information



Streets Download Share Map

Zoom to: State or Territory



## Jackie Robinson Park



Use the slider to view a simulation of sea level rise at this location.



# Sea Level Rise and Coastal Flooding Impacts

- Sea Level Rise
- Confidence
- Marsh
- Vulnerability
- Flood Frequency

## Sea Level Rise ?

 4 ft SLR

- Legend
- Water Depth
  - Low-lying Areas
  - Area Not Mapped
  - Visualization Location
  - Leveed Areas

## Overview

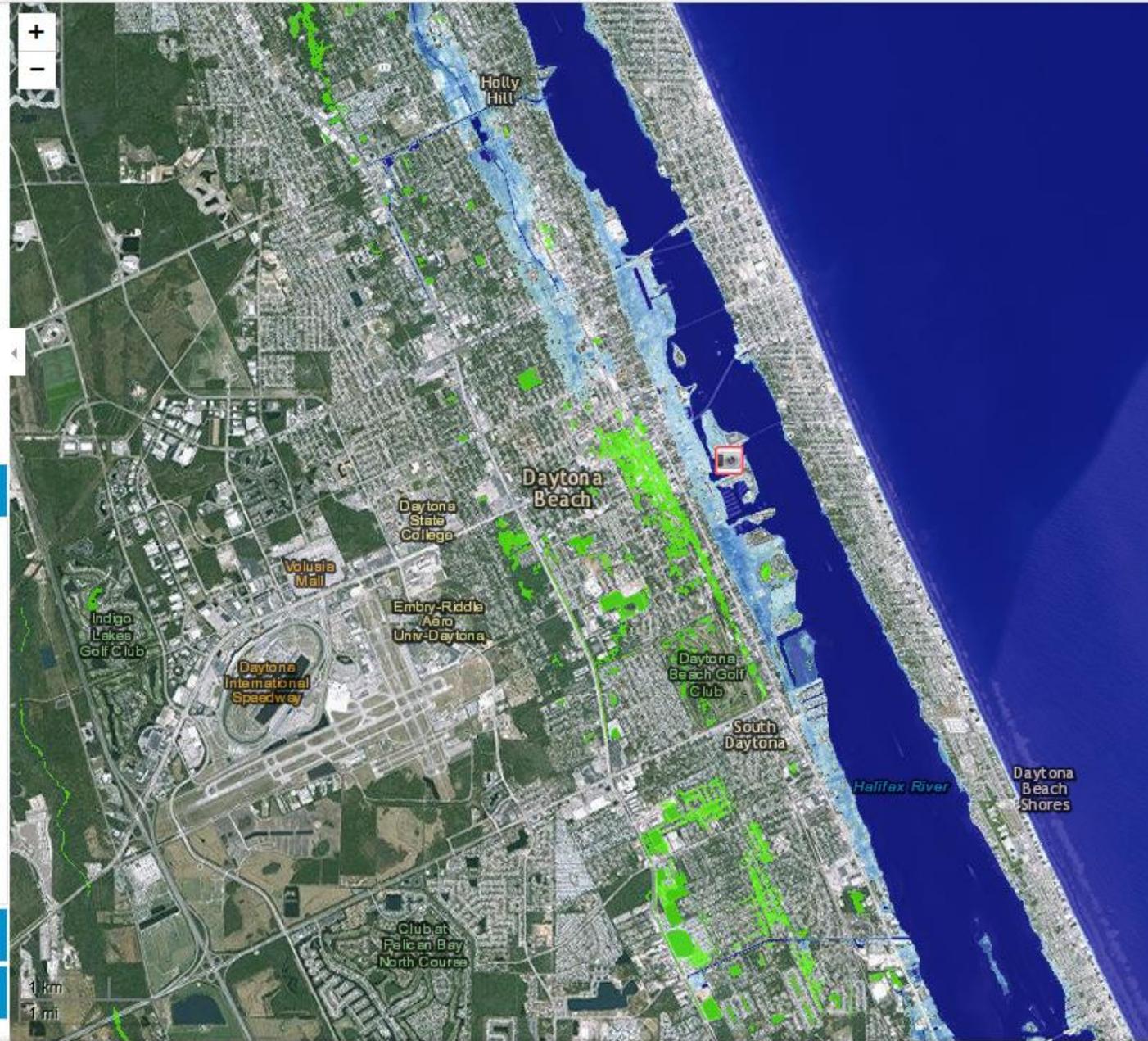
Use the slider bar above to see how various levels of sea level rise will impact this area.

Levels represent inundation at high tide. Areas that are hydrologically connected are shown in shades of blue (darker blue = greater depth).

Low-lying areas, displayed in green, are hydrologically "unconnected" areas that may flood. They are determined solely by how well the elevation data captures the area's hydraulics. A more detailed analysis of these areas is required to determine the susceptibility to flooding.

## Understanding The Map

## Additional Information



- Streets
- Download
- Share Map

Zoom to: State or Territory

### Jackie Robinson Park

Use the slider to view a simulation of sea level rise at this location.



# Sea Level Rise and Coastal Flooding Impacts

- Sea Level Rise
- Confidence
- Marsh
- Vulnerability
- Flood Frequency

## Sea Level Rise ?



- Legend
- Water Depth
  - Low-lying Areas
  - Area Not Mapped
  - Visualization Location
  - Leveed Areas

## Overview

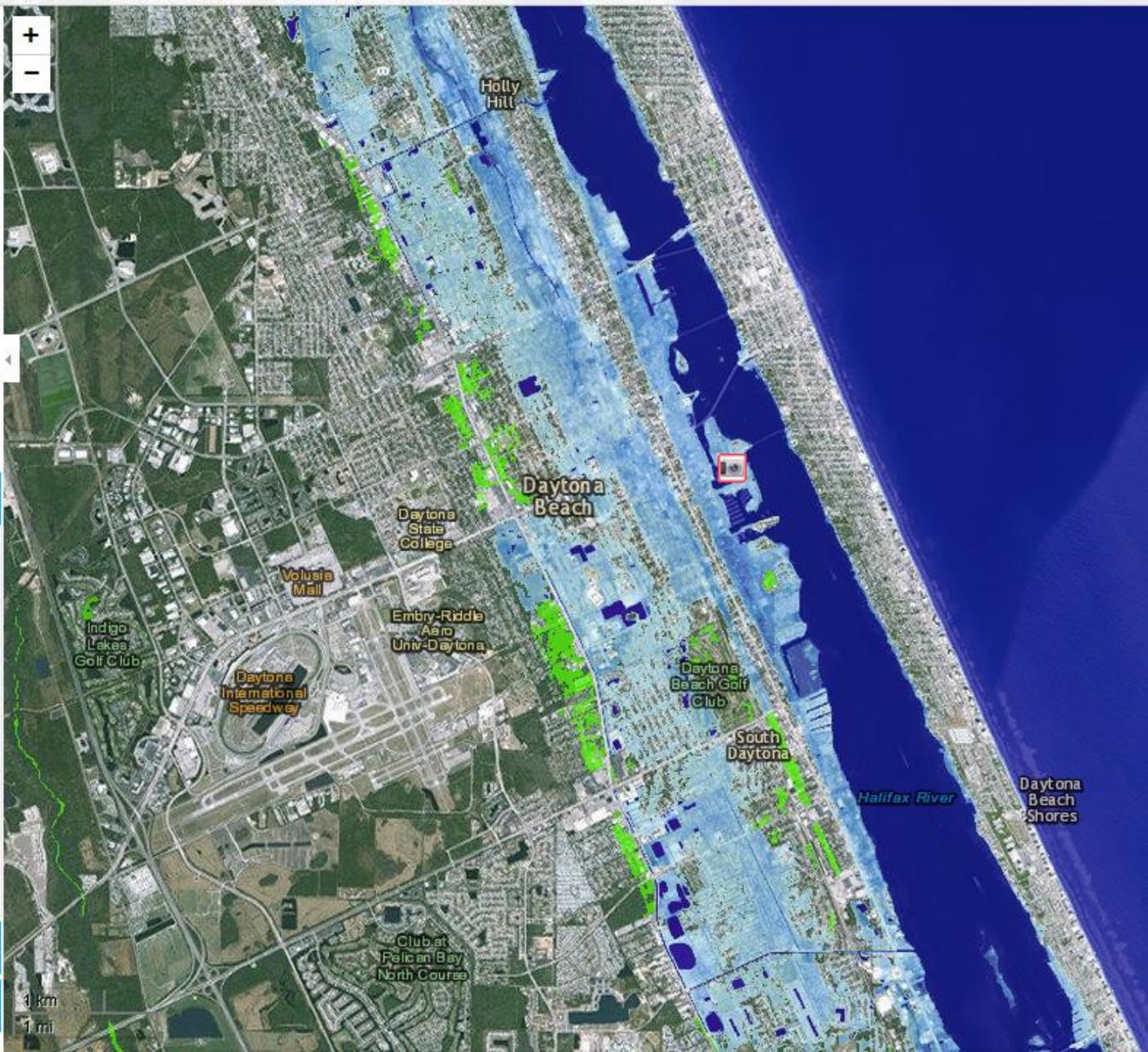
Use the slider bar above to see how various levels of sea level rise will impact this area.

Levels represent inundation at high tide. Areas that are hydrologically connected are shown in shades of blue (darker blue = greater depth).

Low-lying areas, displayed in green, are hydrologically "unconnected" areas that may flood. They are determined solely by how well the elevation data captures the area's hydraulics. A more detailed analysis of these areas is required to determine the susceptibility to flooding.

## Understanding The Map

## Additional Information



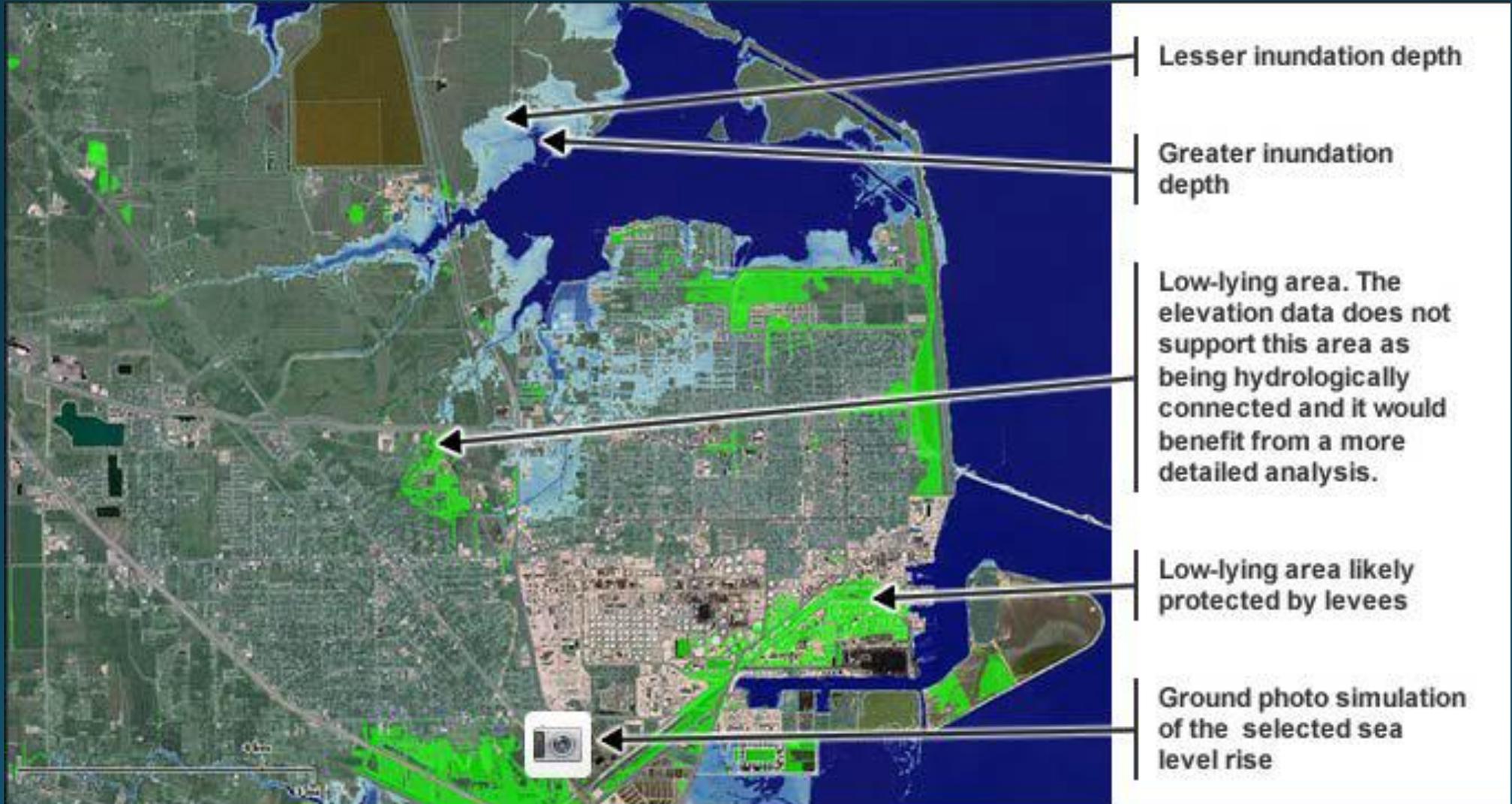
Streets
 Download
 Share Map

Zoom to: State or Territory

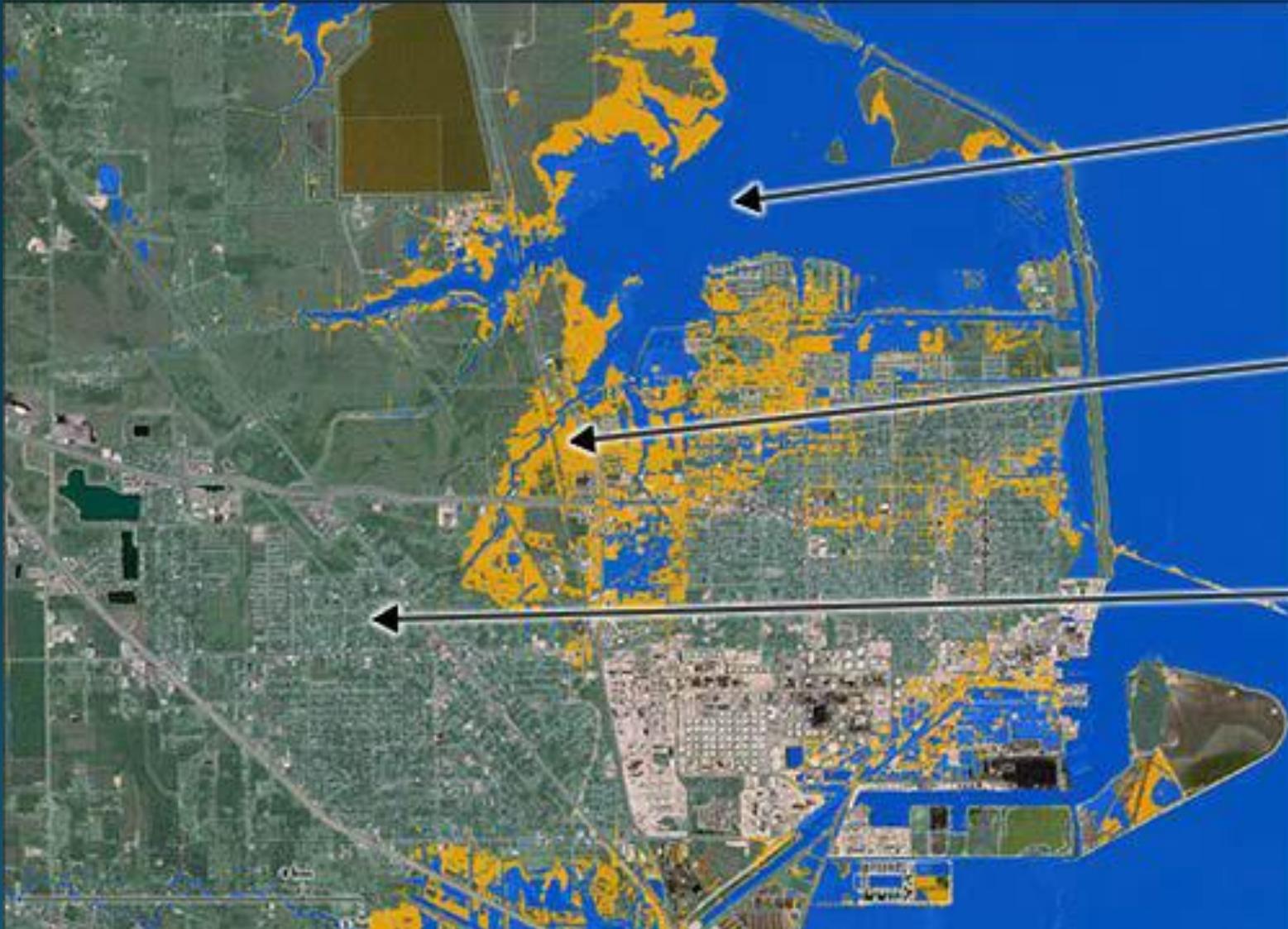
### Jackie Robinson Park

Use the slider to view a simulation of sea level rise at this location.

# Sea Level Rise



# Confidence



Area (blue) with a high likelihood of being flooded given the chosen inundation level.

Area (orange) with a higher degree of uncertainty as to whether it is flooded or not given the chosen inundation level.

Area (no color) with a high likelihood of being 'dry' given the chosen inundation level.

# Marsh

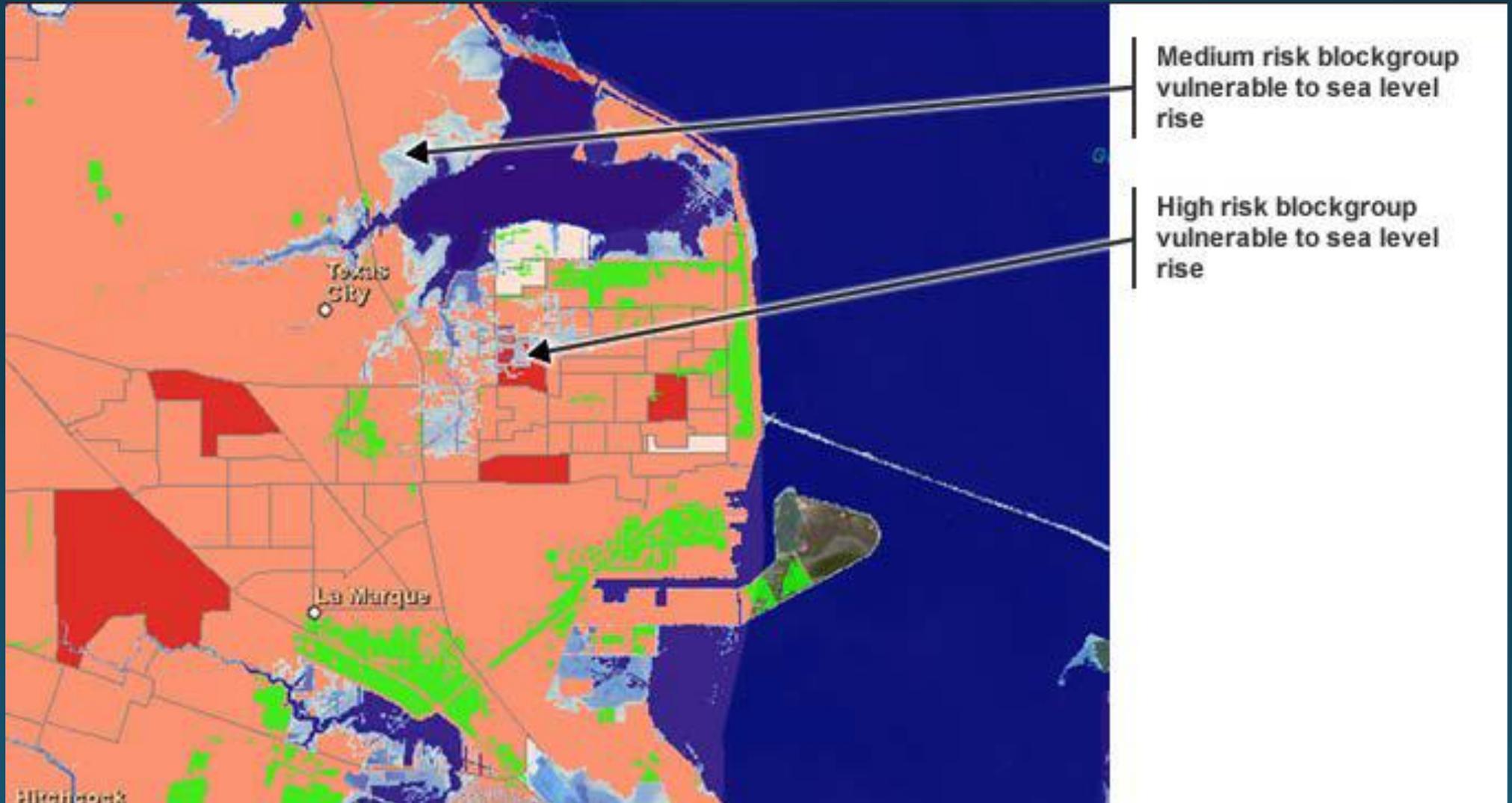


Zone of transition  
between salt and  
freshwater wetlands  
(transitional / brackish  
marsh)

Unaffected upland cover  
type

Developed areas are  
always protected from  
SLR

# Social Vulnerability Index





# Sea Level Rise and Coastal Flooding Impacts

Sea Level Rise Confidence Marsh

Vulnerability **Flood Frequency**

## Flood Frequency ?

### Legend

- Shallow Coastal Flooding Areas
- Area Not Mapped
- X Tide Gauges
- Leveed Areas ?

### Overview

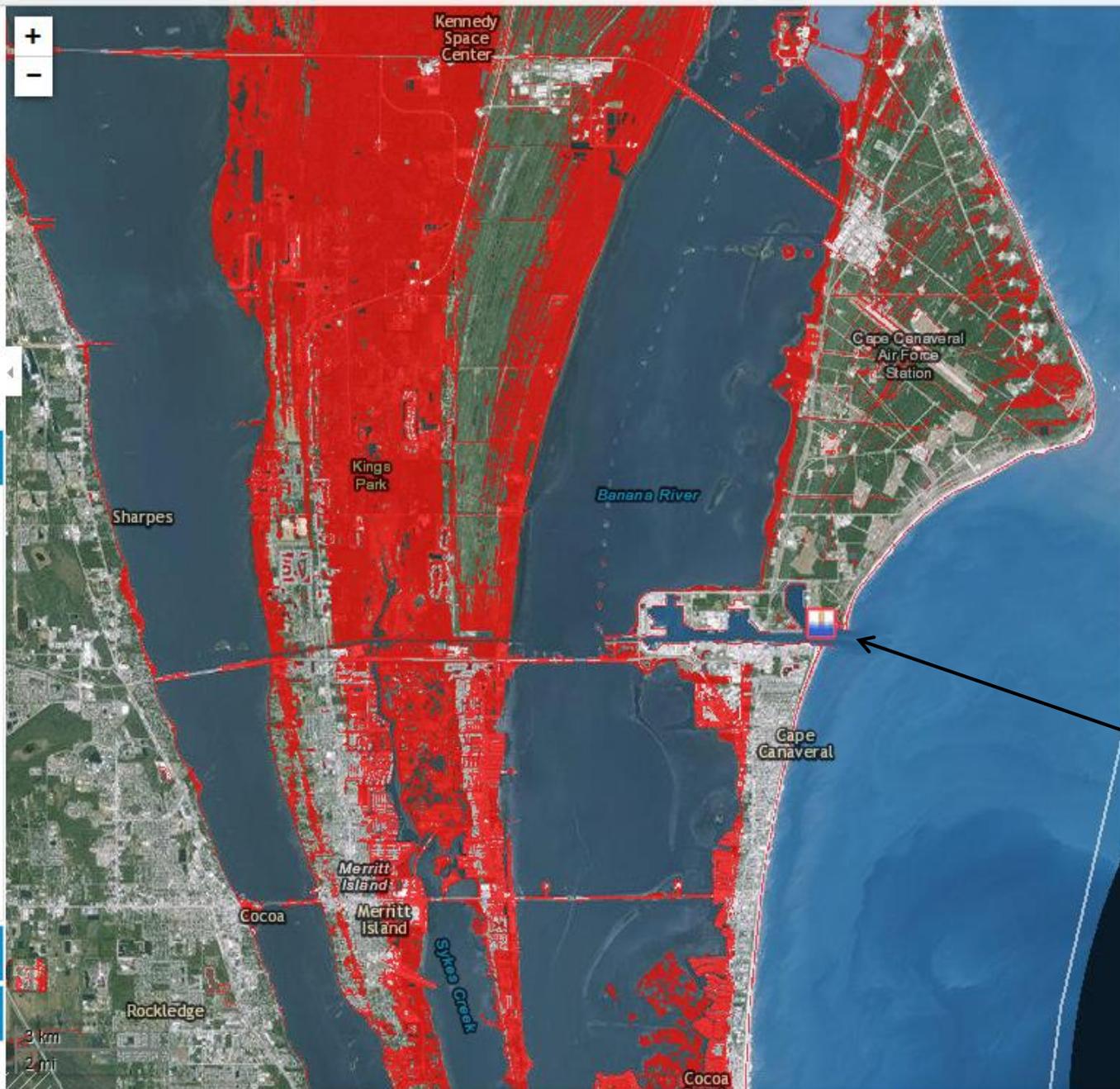
Flooding will become more frequent as sea level rises. In a sense, today's flood will become tomorrow's high tide, as sea level rise will cause flooding to occur more frequently and last for longer durations of time.

The red layer in the map represents areas currently subject to shallow coastal flooding.

Click on a NOAA tide station in the map to see information on the current frequency of coastal flood events and durations as compared to hypothetical half-meter and one-meter sea level rise scenarios.

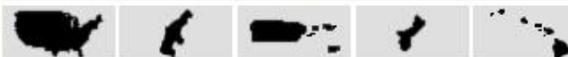
### Understanding The Map

### Additional Information



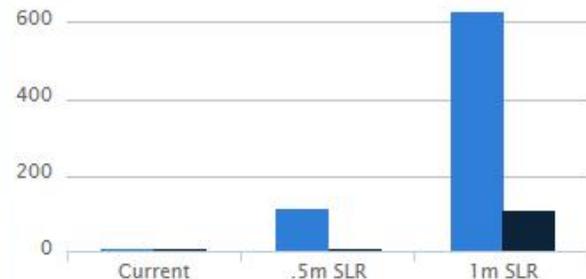
Streets Download Share Map

Zoom to: State or Territory



### Coastal Flood Frequency

Trident Pier Tide Gauge #8721604  
Flooding begins at 6 ft MLLW



- Coastal Flooding Events (Events/Year)
- Coastal Flooding Duration (Days/Year)

Real-Time Tidal Data Sea Level Trends

# Sea Level Rise Viewer

NOAA Office for Coastal Management

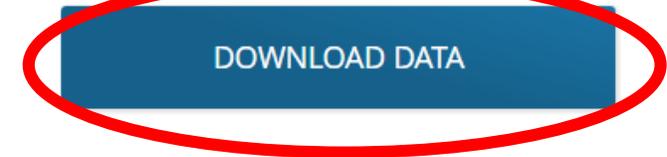
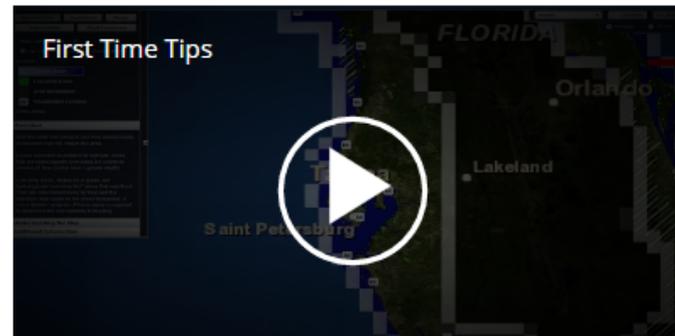
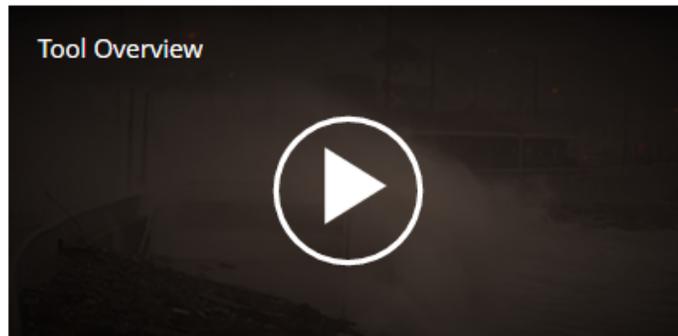
## Overview

Use this web mapping tool to visualize community-level impacts from coastal flooding or sea level rise (up to 6 feet above average high tides). Photo simulations of how future flooding might impact local landmarks are also provided, as well as data related to water depth, connectivity, flood frequency, socio-economic vulnerability, wetland loss and migration, and mapping confidence.

## Features

- **Visualize** potential impacts from sea level rise through maps and photos
- **Learn** about data and methods through documentation
- **Share** maps and links via email and social media
- **Download** inundation layers and digital elevation models, and access web map services for custom GIS applications

## Supporting Videos



## Related Resources

Stories	25
Data	7
Publications	5
Tools	4
Videos and Webinars	3
Self-Guided Resources	2
Classroom, Instructor-Led	2
Contributing Partners	1

- [National Oceanic and Atmospheric Administration Office for Coastal Management](#)

Filter by States or Counties



Alabama



American Samoa



CNMI



California



Connecticut



Delaware



Florida



Bay, Dixie, Escambia, Franklin, Gulf, Jefferson, Levy, Liberty, Okaloosa, Santa Rosa, Taylor, Wakulla, Walton, Washington

Sea Level Rise Mapping Confidence DEM Flood Frequency

Clay, Duval, Flagler, Nassau, Putnam, St. Johns

Sea Level Rise Mapping Confidence DEM Flood Frequency

Broward, Collier, Miami-Dade, Monroe, Palm Beach

Sea Level Rise Mapping Confidence DEM Flood Frequency

Brevard, Indian River, Martin, St. Lucie, Volusia

Sea Level Rise Mapping Confidence DEM Flood Frequency

# Coastal Flood Exposure Mapper

*NOAA Office for Coastal Management*

## Overview

This online visualization tool supports communities that are assessing their coastal hazard risks and vulnerabilities. The tool creates a collection of user-defined maps that show the people, places, and natural resources exposed to coastal flooding. The maps can be saved, downloaded, or shared to communicate flood exposure and potential impacts. In addition, the tool provides guidance for using these maps to engage community members and stakeholders. *The current geography includes the East Coast and Gulf of Mexico.*

## Features

- Visualize people, places, and natural resources exposed to coastal flood hazards
- Share online maps to communicate with and engage stakeholders

## Additional Information

[LAUNCH](#)

## Related Resources

[Publications](#)

[Classroom, Instructor-Led](#)

[Tools](#)

[Videos and Webinars](#)

[Stories](#)

[Quick Reference](#)

[Mixed Delivery](#)

[Data](#)

[Self-Guided Resources](#)

[Contributing Partners](#)

Help start your community discussions about hazard impacts with maps of your area that show people, places, and natural resources exposed to coastal flooding.



## Coastal Flood **Exposure Mapper**

Help start your community discussions about hazard impacts with maps of your area that show people, places, and natural resources exposed to coastal flooding.

Start Collecting Maps

The information in this product is based on the [Roadmap for Adapting to Coastal Risk](#) approach to assessing coastal hazard risks and vulnerabilities.

[www.coast.noaa.gov/digitalcoast/tools/flood-exposure](http://www.coast.noaa.gov/digitalcoast/tools/flood-exposure)

## Select the Flood Hazards Map or One of the Community Exposure Maps

Select a section below to view maps showing flood hazards or different aspects of community exposure to those flood hazards.

First-time user? Starting with Flood Hazards is a good idea.



### Flood Hazards

Flooding events are among the more frequent, costly, and deadly hazards that can impact coastal communities. There are two types:

- Short-term (episodic) – Temporary flooding caused by extreme conditions, including storm surge, tsunamis, inland flooding, and shallow coastal flooding.
- Long-term (chronic) – Flooding caused by a rise in relative sea level or some other change in conditions.



### Societal Exposure

Understanding the populations that live in or near coastal flood-prone areas is an important information need, since residents who are elderly, who live in high-density areas, or who are impoverished may merit special considerations.



### Infrastructure Exposure

Community infrastructure, including roads, bridges, and water and sewer systems, can be damaged by coastal flooding. Communities should first assess infrastructure vulnerabilities and associated environmental and economic issues to determine what steps are needed to protect these assets.



### Ecosystem Exposure

Natural areas provide important benefits to coastal communities, including hazard protection, flood storage, water quality maintenance, fisheries support, and recreational opportunities. Communities can increase resilience by protecting natural areas along the coast that are exposed to flooding and adjacent inland areas.

Flood Hazards Map

Coastal Flood Hazard Composite

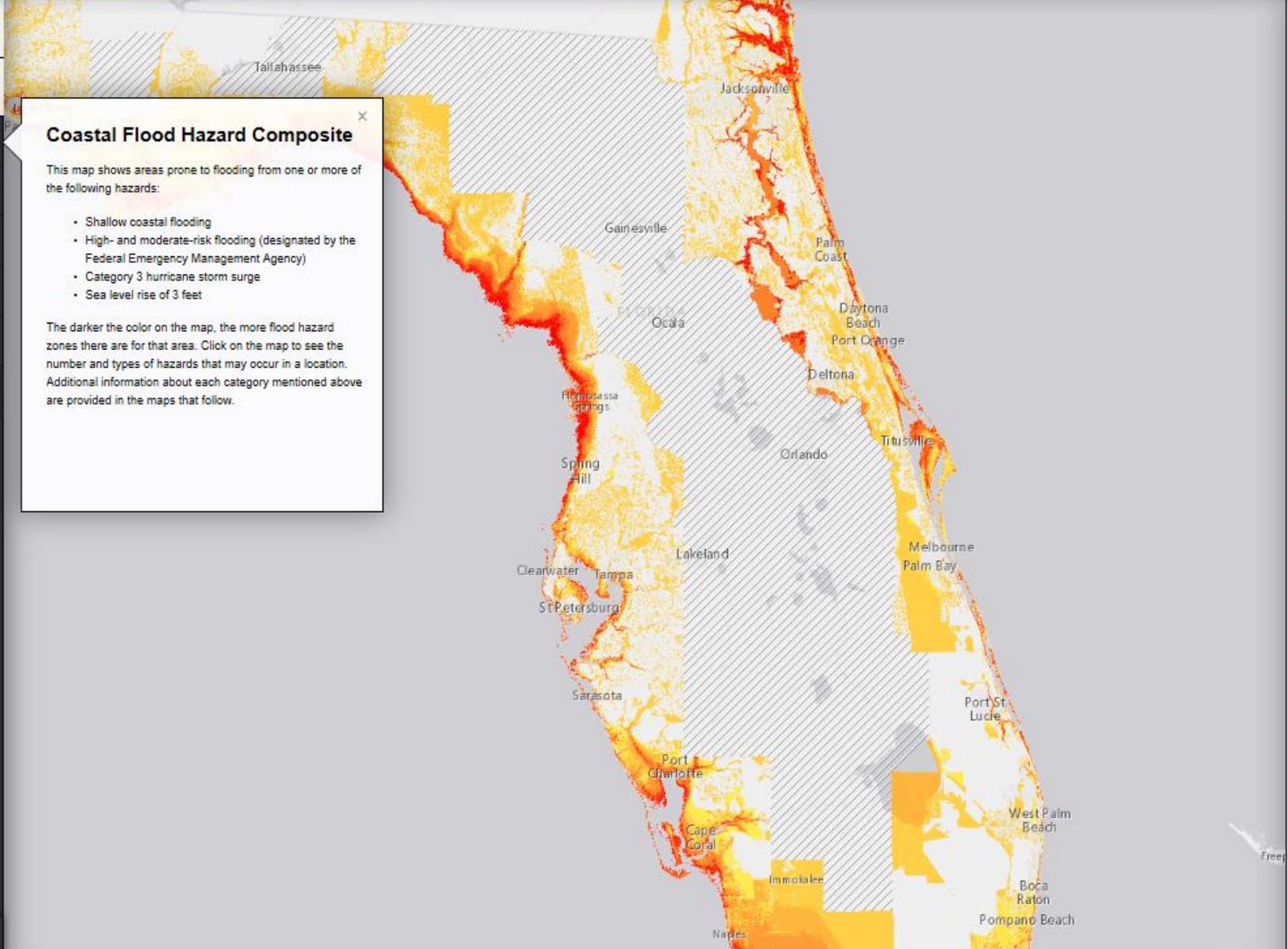
Shallow Coastal Flooding

FEMA Flood Zones

Storm Surge

Sea Level Rise

Layers Opacity 100%



### Coastal Flood Hazard Composite

This map shows areas prone to flooding from one or more of the following hazards:

- Shallow coastal flooding
- High- and moderate-risk flooding (designated by the Federal Emergency Management Agency)
- Category 3 hurricane storm surge
- Sea level rise of 3 feet

The darker the color on the map, the more flood hazard zones there are for that area. Click on the map to see the number and types of hazards that may occur in a location. Additional information about each category mentioned above are provided in the maps that follow.

### Flood Hazard Composite

- 1 Hazard Zone
- 2 Hazard Zones
- 3 Hazard Zones
- 4 Hazard Zones
- 5 Hazard Zones
- 6 Hazard Zones
- 7 Hazard Zones
- 8 Hazard Zones
- 9 Hazard Zones
- 10 Hazard Zones
- Areas Not Mapped

Data Sources  Map Services

# Exposure Data and Information

This page provides information on the data used in the Coastal Flood Exposure Mapper, map services available for use in ArcGIS Online or other online mapping platforms, and instructions on using map services within ArcGIS Online. [Click here](#) to directly access all map services.

## Flood Hazards

Name	Description	Where to Get It		Significance
		Map Service	Authoritative Source	
Coastal Flood Hazard Composite	Spatial extents of multiple flood hazard data sets combined. Flood hazard data sets include shallow coastal flooding, Federal Emergency Management Agency (FEMA) flood data (V zones, A zones, and 500-year zones treated as individual layers), storm surge for Category 3 hurricane (from FEMA Hurricane Evacuation Studies), and sea level rise of three feet above mean high tide.	<a href="#">Coastal Flood Hazard Composite Map Service</a>	<a href="#">Coastal Flood Exposure Mapper</a>	Provides a quick visual assessment of areas most prone to flood hazard events.
Shallow Coastal Flooding	Areas that flood when coastal flood warning thresholds are exceeded. Derived from the flood frequency layer within the Sea Level Rise and Coastal Flooding Impacts Viewer.	<a href="#">Shallow Coastal Flooding Map Service</a>	<a href="#">Sea Level Rise and Coastal Flooding Impacts Viewer</a>	Areas subject to shallow coastal flooding.
FEMA Flood Zones	Digital FEMA flood data. The data represent the digital riverine and coastal flood zones available as of June 2014 and are a combination of Digital Flood Insurance Rate Maps and Q3 flood data.	<a href="#">FEMA Flood Zones Map Service</a>	<a href="#">FEMA's Map Service Center</a>	Areas at risk from flooding.
Storm Surge	Areas of near-worst-case storm surge flooding scenarios for coastal areas along the Gulf of Mexico and Continental U.S. Atlantic coasts. Data were derived from <a href="#">storm surge inundation maps created by the National Hurricane Center (NHC) Storm Surge Unit</a> with the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model.  Note: this storm surge layer was created with newer NHC surge data and is not the same layer found in the coastal flood hazard composite map. The data were developed during hurricane season 2014.	<a href="#">Storm Surge Map Service</a>	<a href="#">National Hurricane Program Center Storm Surge Unit</a>	Areas at risk from storm surge.
Sea Level Rise	Sea level rise inundation scenarios ranging from zero to six feet above mean higher high water (MHHW). Derived from data created for the <a href="#">Sea Level Rise and Coastal Flooding Impacts Viewer</a> .	<a href="#">Sea Level Rise Map Service</a>	<a href="#">Sea Level Rise and Coastal Flooding Impacts Viewer</a>	Areas likely to be inundated by sea level rise.

## Step-by-Step Instructions for Using Map Services in ArcGIS.com

### 1. Setup

- Go to [ArcGIS.com](#)
- Click **Sign In**
- If needed, register for new account

### 2. Build a Map

- Click the **MAP** button in the top banner
- Click the **Basemap** button
- If you would like a different basemap, select a **Basemap** from the available options

### 3. Add a Layer From ArcGIS Online

- Click the **Add** drop-down list
- Select **Search for Layers**
- In Find: type a keyword to search (example: Hurricane Evacuation Routes)
- Click **Add** beside the layer(s) you want to add to the map
- Click **Done Adding Layers** when finished

### 4. Add a Layer that is not published to ArcGIS Online

- Go to the ArcGIS Service Directory where you can find services (example: Office for Coastal Management, [coast.noaa.gov/arcgis/rest/services](#))
- Browse to the REST page for the service you want (example: FloodExposureMapper link and the Critical Facilities map service, [coast.noaa.gov/arcgis/rest/services/FloodExposureMapper/CFEM\\_CriticalFacilities/MapServer](#))

Please Select a Location

Infrastructure Exposure Map

Development

Critical Facilities

Development Patterns

Layers Opacity

100%

Daytona Park Estates

Lake Helen

Cassadaga

Data Sources

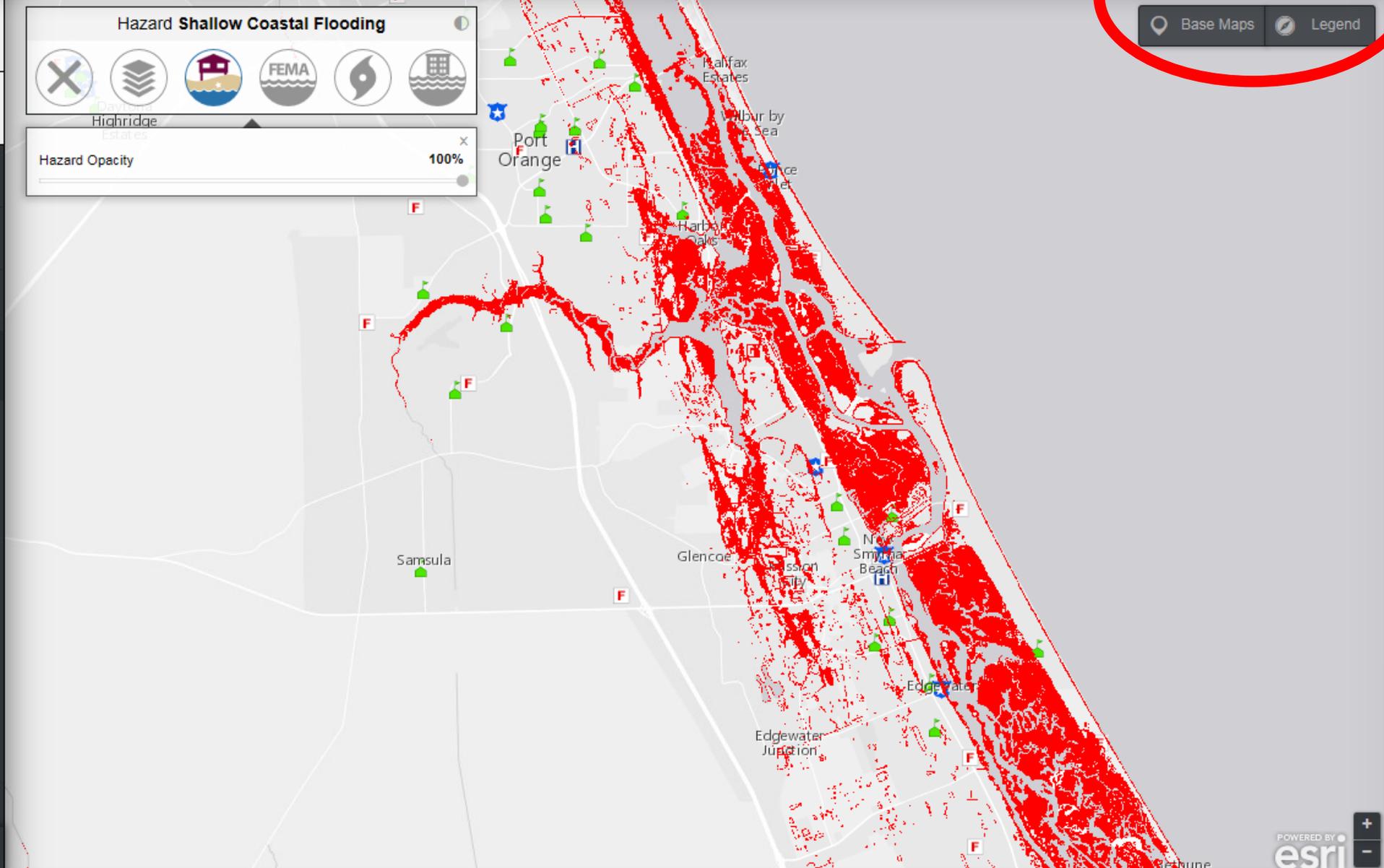
Map Services

Hazard Shallow Coastal Flooding



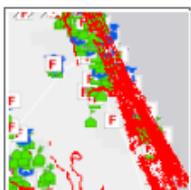
Hazard Opacity

100%



### Infrastructure Exposure

Critical Facilities



Layers Opacity 100%

Daytona  
Park  
Estates

Lake  
Helen

Cassadaga

Data Sources

Map Services

### Hazard Shallow Coastal Flooding



Highridge

Hazard Opacity

100%

Base Maps

Legend

Samsula

Glencoe

Edgewater

Edgewater  
Junction

Edgewater  
Beach

Edgewater

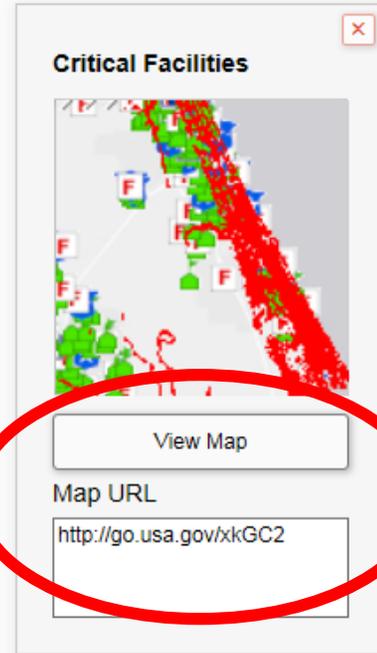
Edgewater  
Junction

## Collect and Share Your Maps

Download and print these maps or copy the link to share online with colleagues or in a community workshop.

Important: These maps will not be saved once you leave this site. To ensure your work is safe, either create and download a PDF or save and share the map URLs.

Tips for using these maps



Critical Facilities

View Map

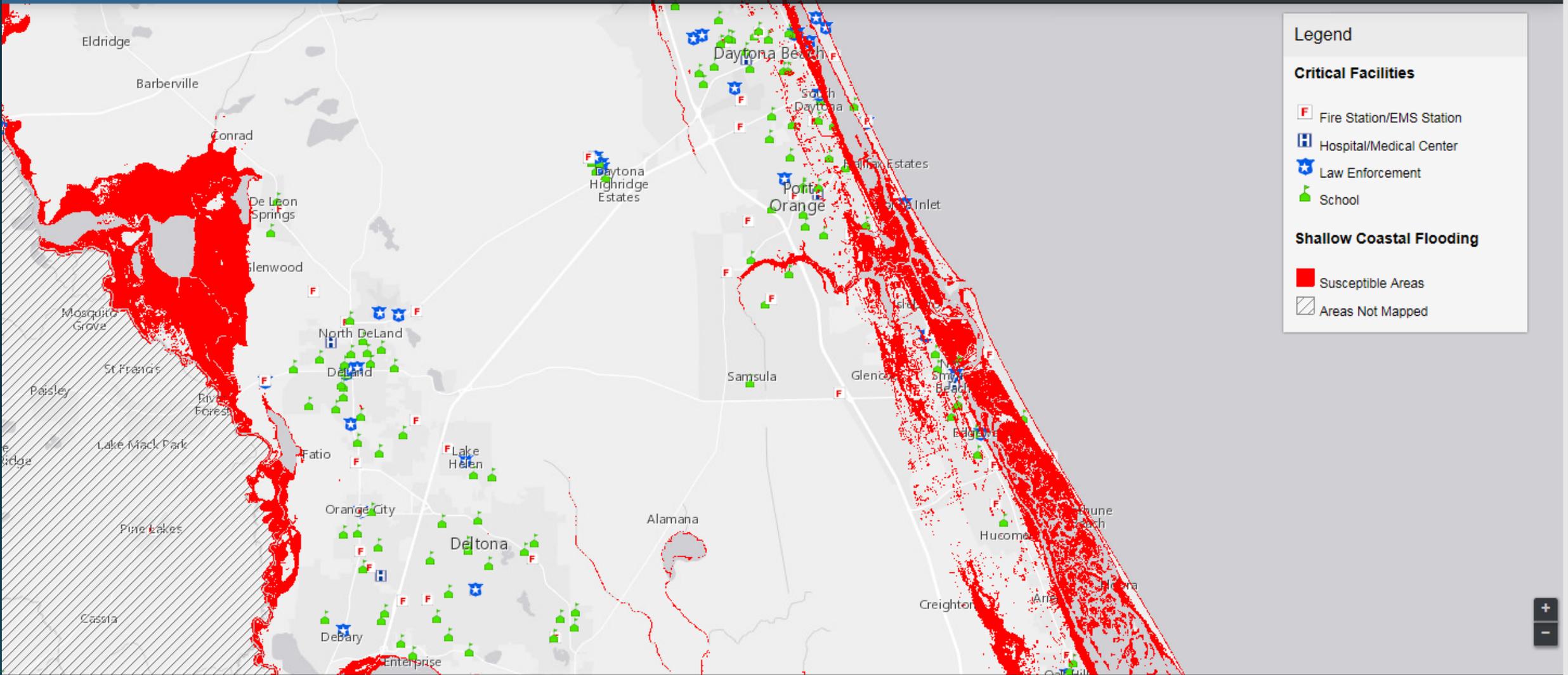
Map URL

<http://go.usa.gov/xkGC2>

Print Maps

# Coastal Flood Exposure Mapper

Infrastructure Exposure: Critical Facilities



## Legend

### Critical Facilities

- Fire Station/EMS Station
- Hospital/Medical Center
- Law Enforcement
- School

### Shallow Coastal Flooding

- Susceptible Areas
- Areas Not Mapped

## Collect and Share Your Maps

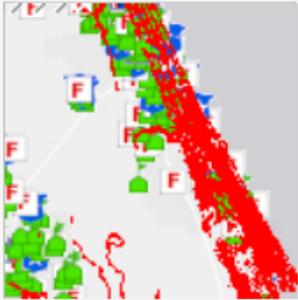
Download and print these maps or copy the link to share online with colleagues or in a community workshop.

Important: These maps will not be saved once you leave this site. To ensure your work is safe, either create and download a PDF or save and share the map URLs.

Tips for using these maps

✕

**Critical Facilities**



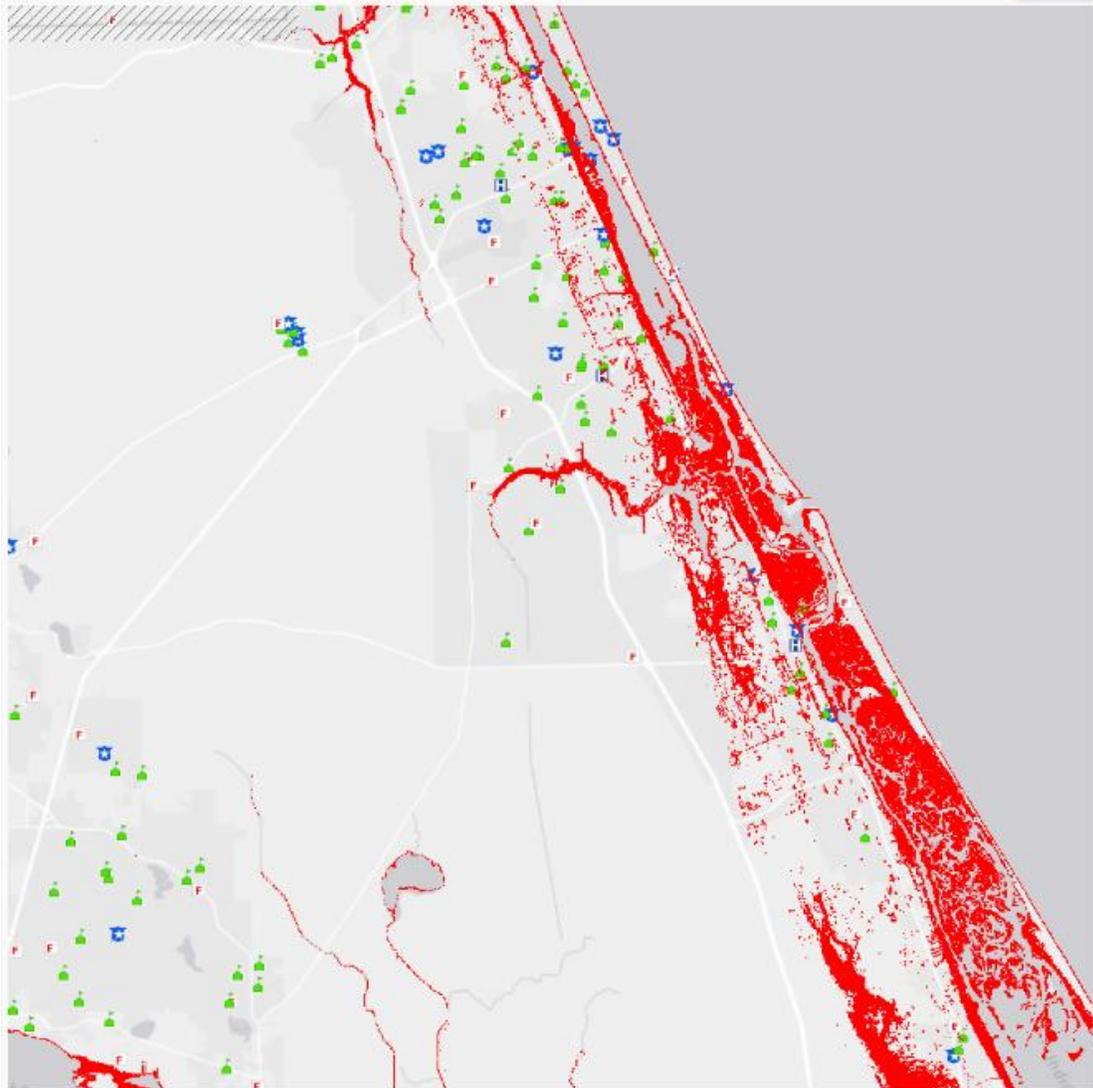
View Map

Map URL

<http://go.usa.gov/xkGC2>

Print Maps

Print All Maps



Infrastructure Exposure | Critical Facilities

Shallow Coastal Flooding

-  Susceptible Areas
-  Areas Not Mapped

Critical Facilities

-  Fire Station/EMS Station
-  Hospital/Medical Center
-  Law Enforcement
-  School

<http://go.usa.gov/xkGC2>



Flood Hazards Map

Coastal Flood Hazard Composite

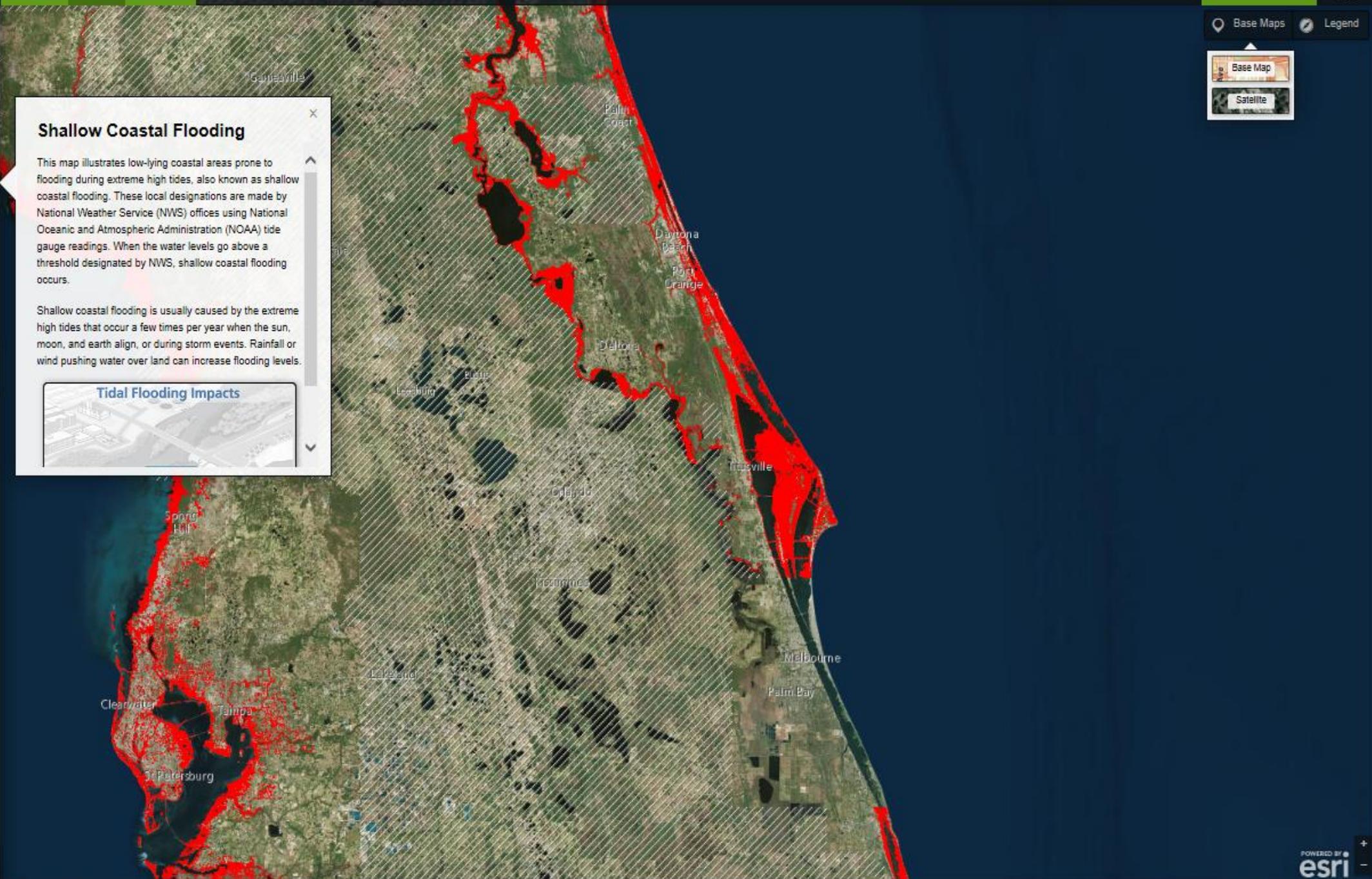
Shallow Coastal Flooding

FEMA Flood Zones

Storm Surge

Sea Level Rise

Layers Opacity 100%



### Shallow Coastal Flooding

This map illustrates low-lying coastal areas prone to flooding during extreme high tides, also known as shallow coastal flooding. These local designations are made by National Weather Service (NWS) offices using National Oceanic and Atmospheric Administration (NOAA) tide gauge readings. When the water levels go above a threshold designated by NWS, shallow coastal flooding occurs.

Shallow coastal flooding is usually caused by the extreme high tides that occur a few times per year when the sun, moon, and earth align, or during storm events. Rainfall or wind pushing water over land can increase flooding levels.

[Tidal Flooding Impacts](#)

Base Maps Legend

Base Map

Satellite

# Tidal Flooding Impacts

<https://coast.noaa.gov/tidalfloodingvis/>

The screenshot shows a web browser window with the URL <https://coast.noaa.gov/tidalfloodingvis/>. The browser tabs include "powerpoints from training - G...", "Coastal Flood Exposure Mapper", and "Tidal Flooding". The main content area features a 3D isometric illustration of a coastal town with buildings, streets, and a bridge over a waterway. The title "Tidal Flooding Impacts" is displayed in large blue text at the top of the illustration. A prominent blue "Play" button with a white play icon is centered over the illustration. In the bottom right corner of the illustration, there is a "TIDE CALENDAR" graph showing "NORMAL CONDITIONS" with a wave-like pattern representing tides. On the left side of the browser window, there is a "Menu" sidebar with the following items:

- Introduction
- Part 1: Tidal Flooding Impacts
  - Normal Conditions
  - Formation of Extreme High Tides
  - Impacts of Extreme High Tides
  - Flooding and Sea Level Rise
- Part 2: How to Prepare
  - Tidal Flooding on the Rise
  - Adaptation Strategies
  - Start the Conversation
- Resources

Flood Hazards Map

- Coastal Flood Hazard Composite  *i*
- Shallow Coastal Flooding  *i*
- FEMA Flood Zones  *i*
- Storm Surge  *i*
- Sea Level Rise  *i*

Layers Opacity 100%

### FEMA Flood Zones

This map shows high-risk (1% annual chance, or 100-year floodplain) and moderate-risk (0.2% annual chance, or 500-year floodplain) flood zones designated by the Federal Emergency Management Agency (FEMA).

Some parts of the flood zone may experience frequent flooding while other areas are only affected by severe storms. Areas outside of mapped zones may also be at risk since land use changes could have occurred after the maps were created, changing the flooding potential.

To designate the zones and determine insurance premiums, FEMA conducts flood insurance studies. Incorporated in the studies are statistical data for river flow and storm tides, hydrologic and hydraulic analyses, rainfall and topographic surveys, and storm frequency and intensity models.

Note: High-risk flood zones are also commonly referred to as Special Flood Hazard Areas.



Please Select a Location

Flood Hazards Map

Coastal Flood Hazard Composite  *i*

Shallow Coastal Flooding  *i*

FEMA Flood Zones  *i*

Storm Surge  *i*

Sea Level Rise  *i*

Layers Opacity 100%

**Storm Surge**

Data shown on this map were derived from storm surge inundation maps created by the National Hurricane Center (NHC) Storm Surge Unit with the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model. SLOSH is used to calculate storm surge heights and the extents of inundation for hurricane evacuation studies. Hurricane storm surge heights are influenced by many factors, including hurricane intensity (categorized by the Saffir-Simpson hurricane wind scale, ranging from 1 to 5), size (radius of maximum winds), forward speed, the angle of approach to the shoreline, and the characteristics of the coastline. Since many factors influence storm surge heights, the maximum inundation from multiple storm surge scenarios are composited into one data layer. SLOSH products do not include Category 5 storms north of the North Carolina and Virginia border.

This map emphasizes areas with the highest degree of exposure. Therefore, areas in the Saffir-Simpson Category 1 storm surge zones are displayed in the darkest



Base Maps *i* Legend



Please Select a Location



Flood Hazards Map

Coastal Flood Hazard Composite



Shallow Coastal Flooding



FEMA Flood Zones



Storm Surge

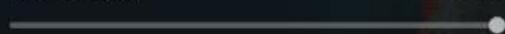


Sea Level Rise



Layers Opacity

100%



### Sea Level Rise

This map shows sea level rise scenarios of 0 to 6 feet, which represent a rise in water above the average of the highest high tides (called mean higher high water, or MHHW) for hydrologically connected areas. Areas that are lower in elevation will be exposed to flooding from sea level rise first and are represented by the darkest red.

Changes in local, or relative, sea level have long-term implications, including increased extent and frequency of events such as storm surge, as well as permanent changes to shorelines and coastal habitats. To get more details about the data shown in this map, visit the [Sea Level Rise and Coastal Flooding Impacts Viewer](#).



Ocala

Daytona Beach

Port Orange

Deltona

Titusville

Orlando

Kissimmee

Melbourne

Palm Bay

Clearwater

Tampa

Paraburg

## Select the Flood Hazards Map or One of the Community Exposure Maps

Select a section below to view maps showing flood hazards or different aspects of community exposure to those flood hazards.

First-time user? Starting with Flood Hazards is a good idea.



### Flood Hazards

Flooding events are among the more frequent, costly, and deadly hazards that can impact coastal communities. There are two types:

- Short-term (episodic) – Temporary flooding caused by extreme conditions, including storm surge, tsunamis, inland flooding, and shallow coastal flooding.
- Long-term (chronic) – Flooding caused by a rise in relative sea level or some other change in conditions.



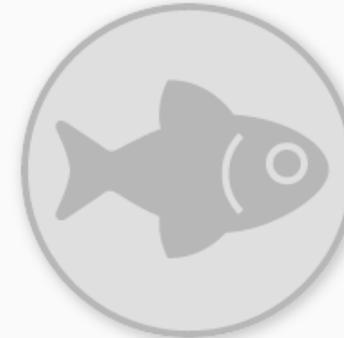
### Societal Exposure

Understanding the populations that live in or near coastal flood-prone areas is an important information need, since residents who are elderly, who live in high-density areas, or who are impoverished may merit special considerations.



### Infrastructure Exposure

Community infrastructure, including roads, bridges, and water and sewer systems, can be damaged by coastal flooding. Communities should first assess infrastructure vulnerabilities and associated environmental and economic issues to determine what steps are needed to protect these assets.



### Ecosystem Exposure

Natural areas provide important benefits to coastal communities, including hazard protection, flood storage, water quality maintenance, fisheries support, and recreational opportunities. Communities can increase resilience by protecting natural areas along the coast that are exposed to flooding and adjacent inland areas.

Please Select a Location



Societal Exposure Map

Population Density



Poverty



Elderly



Employees



Projected Population Growth



Layers Opacity

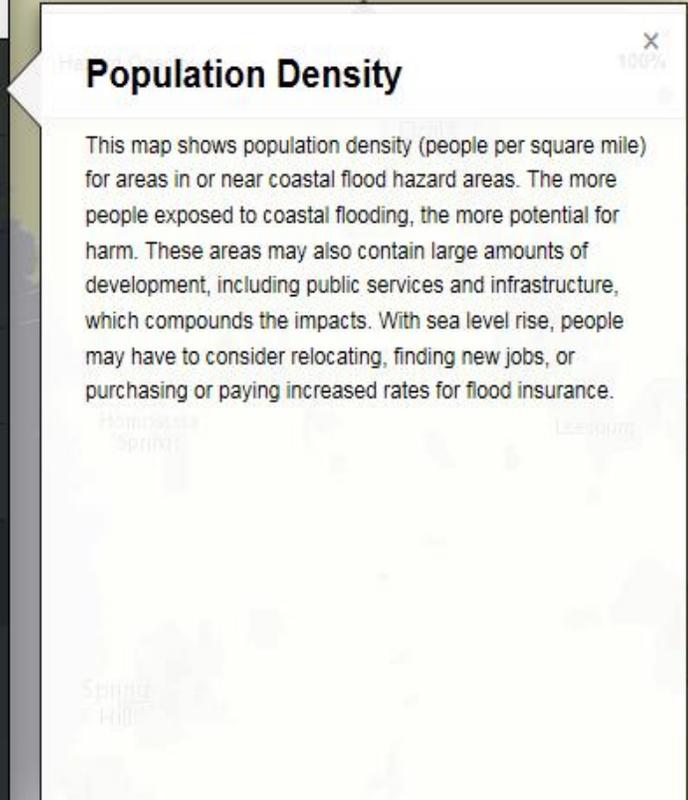
100%

Hazard Flood Hazard Composite



Population Density

This map shows population density (people per square mile) for areas in or near coastal flood hazard areas. The more people exposed to coastal flooding, the more potential for harm. These areas may also contain large amounts of development, including public services and infrastructure, which compounds the impacts. With sea level rise, people may have to consider relocating, finding new jobs, or purchasing or paying increased rates for flood insurance.



Palm Coast

Daytona Beach

Port Orange

Deltona

Eustis

Homosassa Springs

Lakeland

Titusville

Orlando

Kissimmee

Lakeland

Melbourne

Palm Bay

Clearwater

Tampa

Please Select a Location

Societal Exposure Map

Population Density

Poverty

Elderly

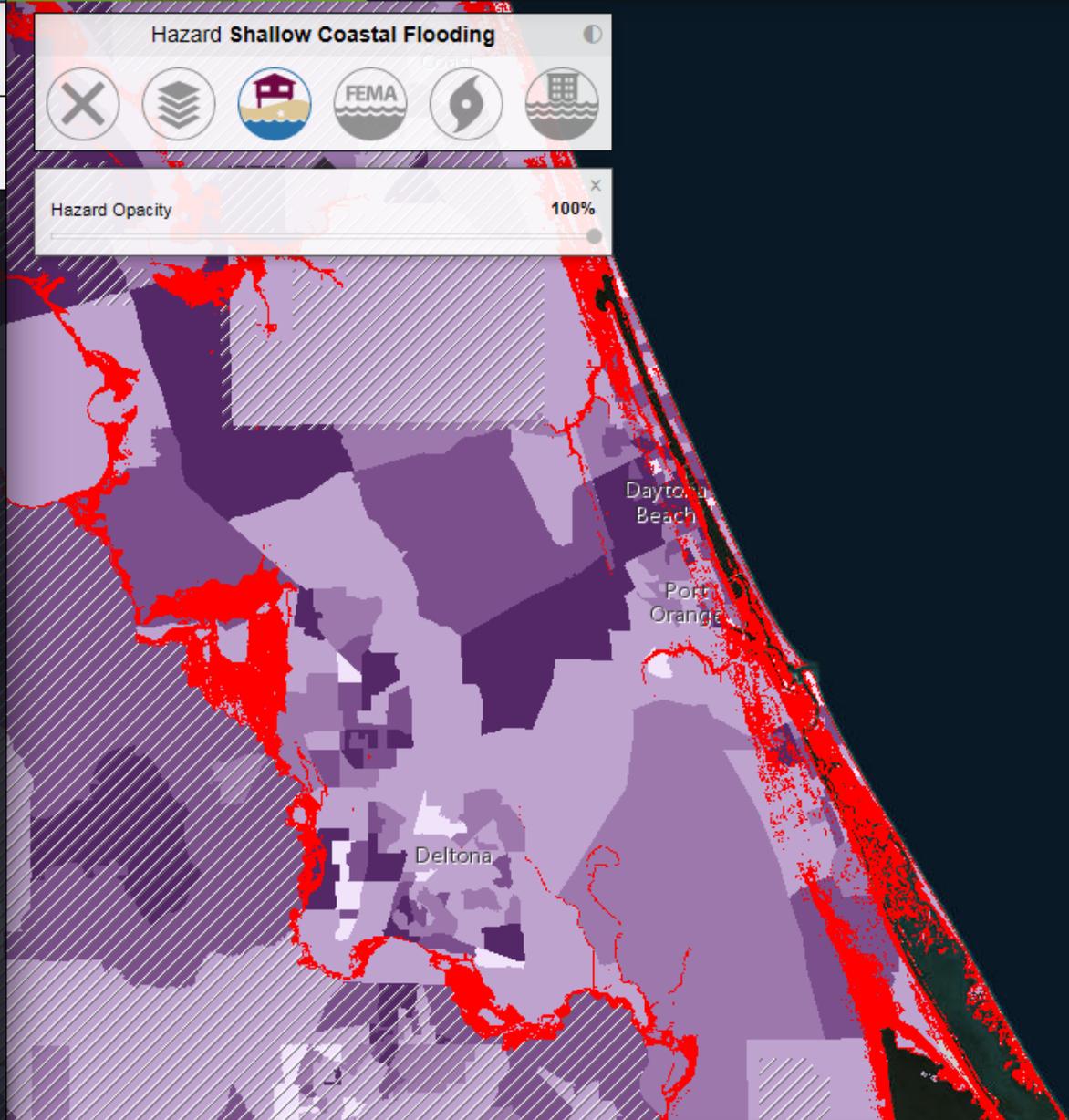
Employees

Projected Population Growth

Layers Opacity 100%

Hazard **Shallow Coastal Flooding**

Hazard Opacity 100%



Base Maps Legend

Percent Living Below Poverty Line

- 25.1% or more
- 15.1% to 25%
- 10.1% to 15%
- 2.1% to 10%
- 2% or less
- Unpopulated
- No Data

Shallow Coastal Flooding

- Susceptible Areas
- Areas Not Mapped

Please Select a Location

Societal Exposure Map

Population Density  *i*

Poverty  *i*

Elderly  *i*

Employees  *i*

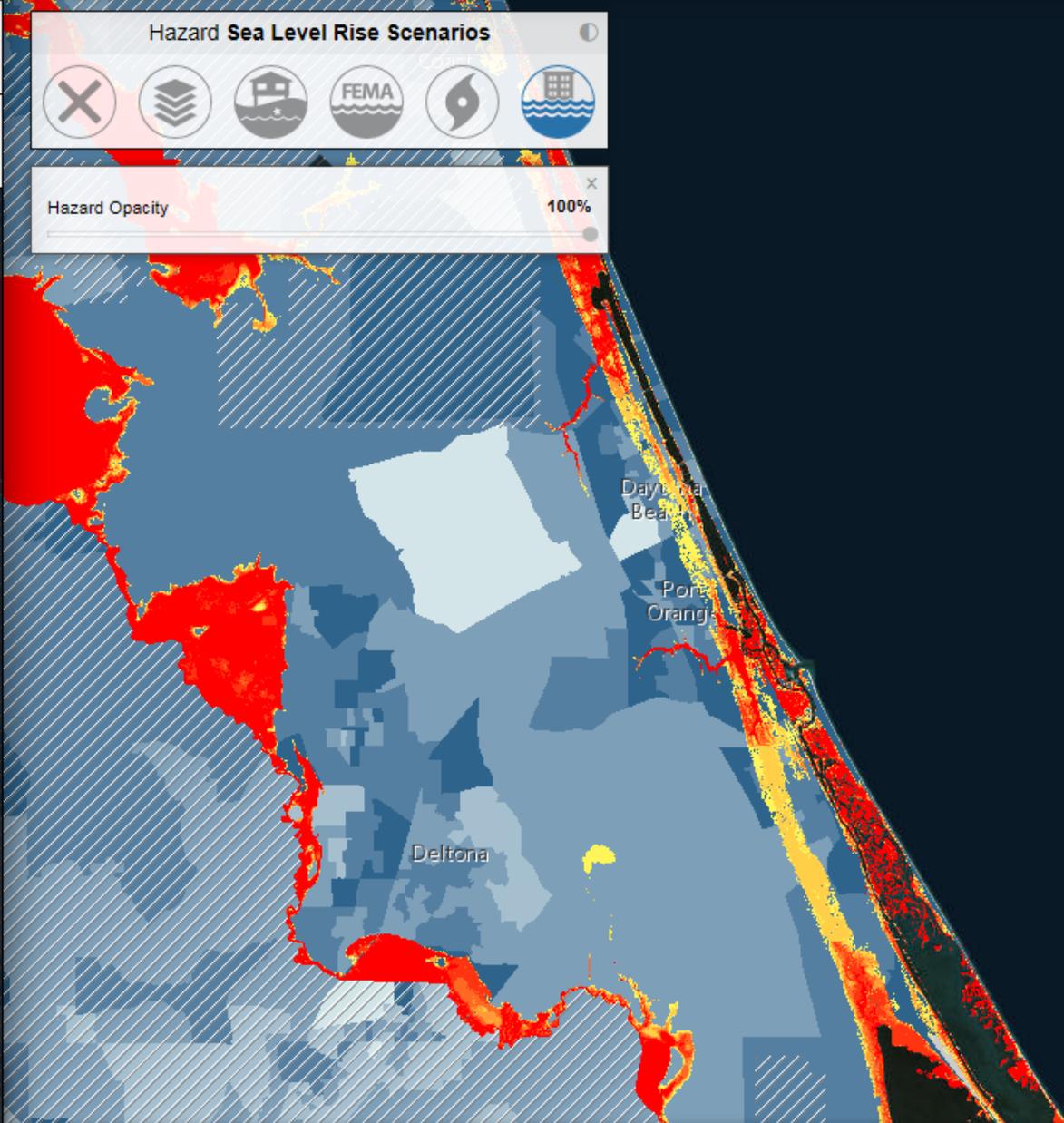
Projected Population Growth  *i*

Layers Opacity 100%

Hazard Sea Level Rise Scenarios



Hazard Opacity 100%



Base Maps Legend

Percent Age 65 and Older

- 25.1% or more
- 15% to 25%
- 10.1% to 15%
- 5.1% to 10%
- 5% or less
- Unpopulated

Sea Level Rise Scenarios

- 1 Ft Above Current MHHW
- 2 Ft Above Current MHHW
- 3 Ft Above Current MHHW
- 4 Ft Above Current MHHW
- 5 Ft Above Current MHHW
- 6 Ft Above Current MHHW
- Levee Areas - Consult Local Officials For Flood Risk
- Areas Not Mapped

Please Select a Location

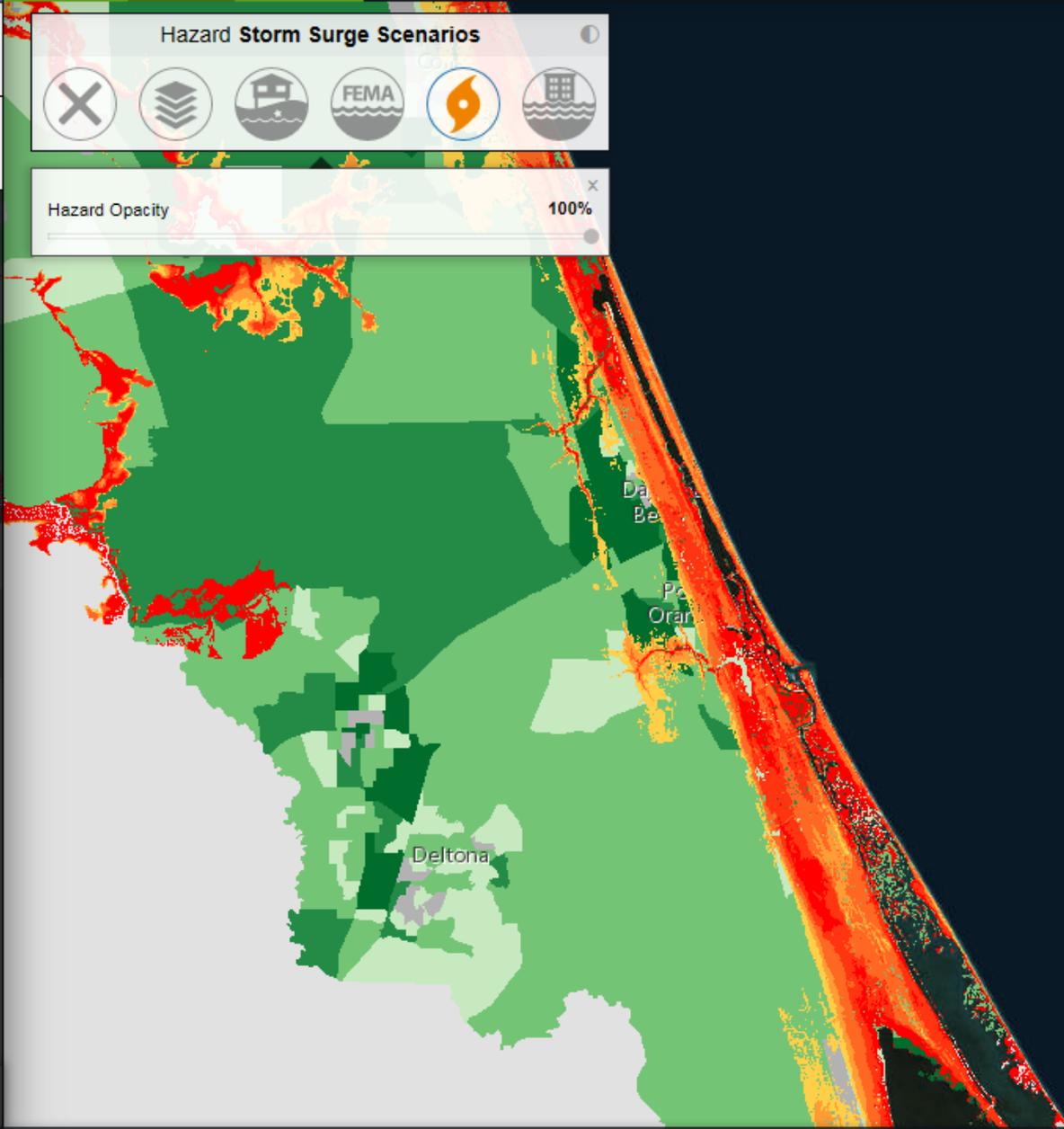
Societal Exposure Map

- Population Density
- Poverty
- Elderly
- Employees
- Projected Population Growth
- Layers Opacity 100%

Hazard Storm Surge Scenarios



Hazard Opacity 100%



Base Maps Legend

Employment

- 1,000 or Greater
- 100-499
- 500-999
- <100
- No Data
- Suppressed

Storm Surge Scenarios

- Category 1
- Category 2
- Category 3
- Category 4
- Category 5
- Levee Areas - Consult Local Officials For Flood Risk



Population Density

Poverty

Elderly

Employees

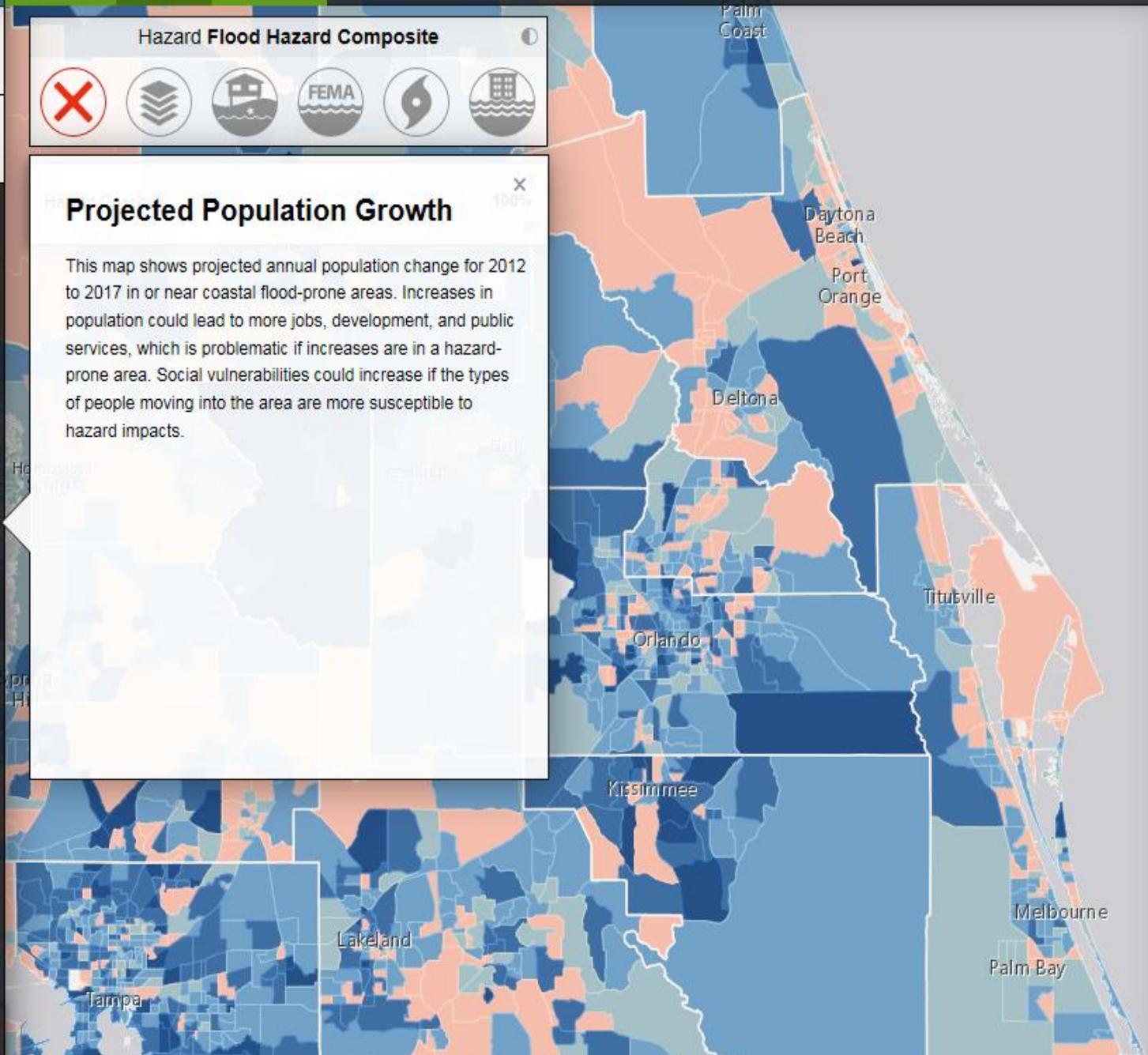
Projected Population Growth

Layers Opacity 100%

Hazard Flood Hazard Composite

**Projected Population Growth**

This map shows projected annual population change for 2012 to 2017 in or near coastal flood-prone areas. Increases in population could lead to more jobs, development, and public services, which is problematic if increases are in a hazard-prone area. Social vulnerabilities could increase if the types of people moving into the area are more susceptible to hazard impacts.



Projected Population Growth

- 2.6% or more
- 1.3% to 2.5%
- 0.4% to 1.2% (US Avg: 0.68%)
- 0.1% to 0.3%
- 0% or negative
- No population

## Select the Flood Hazards Map or One of the Community Exposure Maps

Select a section below to view maps showing flood hazards or different aspects of community exposure to those flood hazards.

First-time user? Starting with Flood Hazards is a good idea.



### Flood Hazards

Flooding events are among the more frequent, costly, and deadly hazards that can impact coastal communities. There are two types:

- Short-term (episodic) - Temporary flooding caused by extreme conditions, including storm surge, tsunamis, inland flooding, and shallow coastal flooding.
- Long-term (chronic) - Flooding caused by a rise in relative sea level or some other change in conditions.



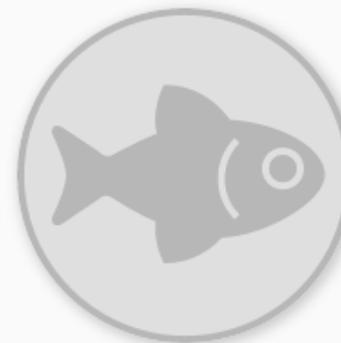
### Societal Exposure

Understanding the populations that live in or near coastal flood-prone areas is an important information need, since residents who are elderly, who live in high-density areas, or who are impoverished may merit special considerations.



### Infrastructure Exposure

Community infrastructure, including roads, bridges, and water and sewer systems, can be damaged by coastal flooding. Communities should first assess infrastructure vulnerabilities and associated environmental and economic issues to determine what steps are needed to protect these assets.



### Ecosystem Exposure

Natural areas provide important benefits to coastal communities, including hazard protection, flood storage, water quality maintenance, fisheries support, and recreational opportunities. Communities can increase resilience by protecting natural areas along the coast that are exposed to flooding and adjacent inland areas.

Please Select a Location

Infrastructure Exposure Map

Development

Critical Facilities

Development Patterns

Layers Opacity

100%

Hazard Sea Level Rise Scenarios



Development

This map shows development located in or near coastal flood-prone areas. Development subjected to flooding puts people in harm's way, and can lead to costly infrastructure repairs, business interruptions, inaccessible roads, and utility disruptions.

Impervious surfaces (e.g., developed, paved areas) do not allow coastal floodwaters to be absorbed into the ground and can exacerbate flooding issues, create storm water problems, and lead to degraded drinking water. With sea level rise, flooding in low-lying coastal areas may become a more frequent or permanent problem, flooding houses or closing roads. Salt water can infiltrate freshwater aquifers, contaminating drinking water, or corrode sewer and water pipes. Insurance rates may increase because of a new or higher risk.

Base Maps Legend

Development

- High Intensity Developed
- Medium Intensity Developed
- Low Intensity Developed
- Developed Open Space

Sea Level Rise Scenarios

- 1 Ft Above Current MHHW
- 2 Ft Above Current MHHW
- 3 Ft Above Current MHHW
- 4 Ft Above Current MHHW
- 5 Ft Above Current MHHW
- 6 Ft Above Current MHHW
- Levee Areas - Consult Local Officials For Flood Risk
- Areas Not Mapped

Please Select a Location

Infrastructure Exposure Map

Development

Critical Facilities

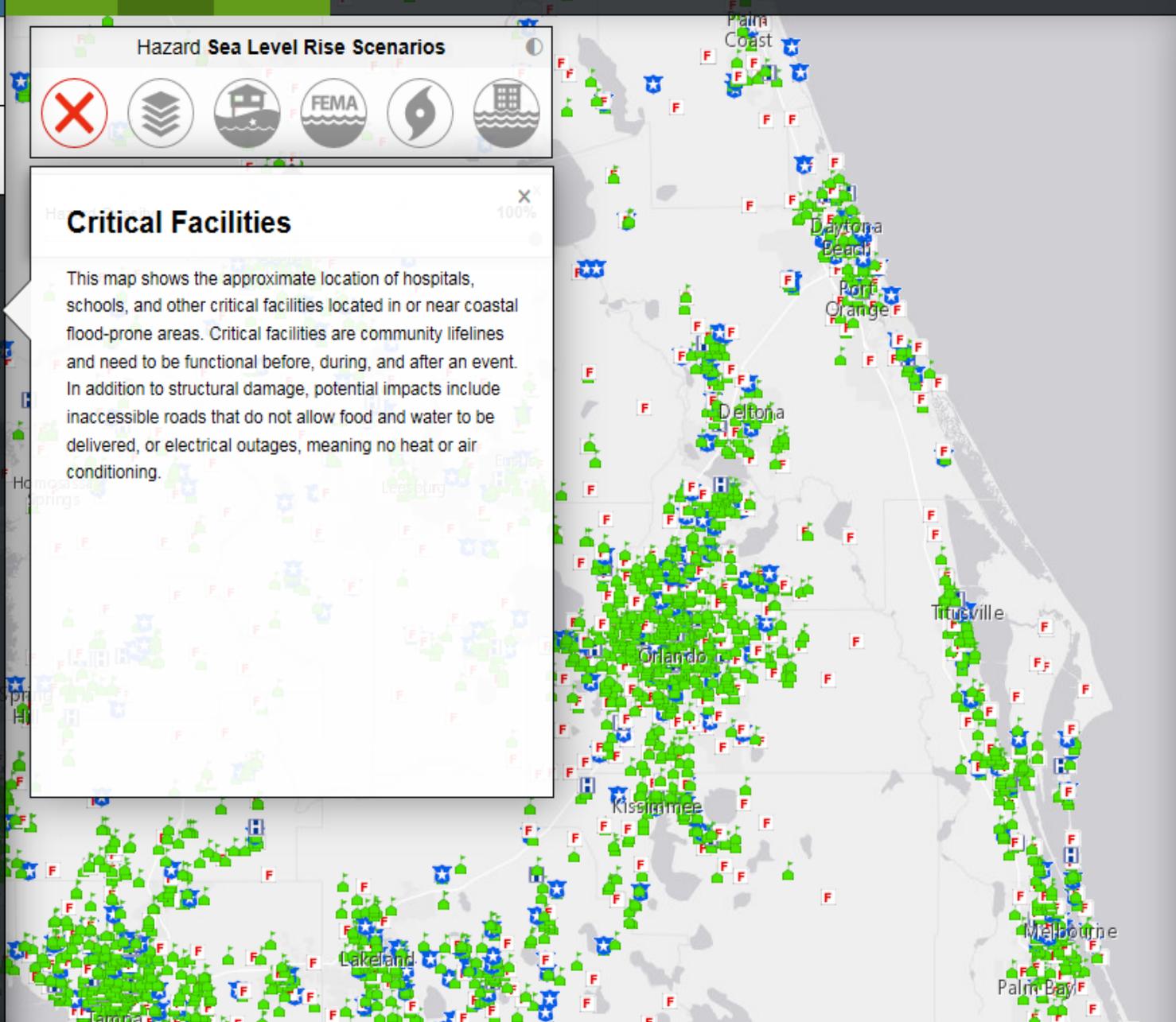
Development Patterns

Layers Opacity 100%

Hazard **Sea Level Rise Scenarios**

**Critical Facilities**

This map shows the approximate location of hospitals, schools, and other critical facilities located in or near coastal flood-prone areas. Critical facilities are community lifelines and need to be functional before, during, and after an event. In addition to structural damage, potential impacts include inaccessible roads that do not allow food and water to be delivered, or electrical outages, meaning no heat or air conditioning.



Base Maps Legend

- Critical Facilities**
- Fire Station/EMS Station
  - Hospital/Medical Center
  - Law Enforcement
  - School

- Sea Level Rise Scenarios**
- 1 Ft Above Current MHHW
  - 2 Ft Above Current MHHW
  - 3 Ft Above Current MHHW
  - 4 Ft Above Current MHHW
  - 5 Ft Above Current MHHW
  - 6 Ft Above Current MHHW
  - Levee Areas - Consult Local Officials For Flood Risk
  - Areas Not Mapped

Please Select a Location

Infrastructure Exposure Map

Development

Critical Facilities

Development Patterns

Layers Opacity 100%

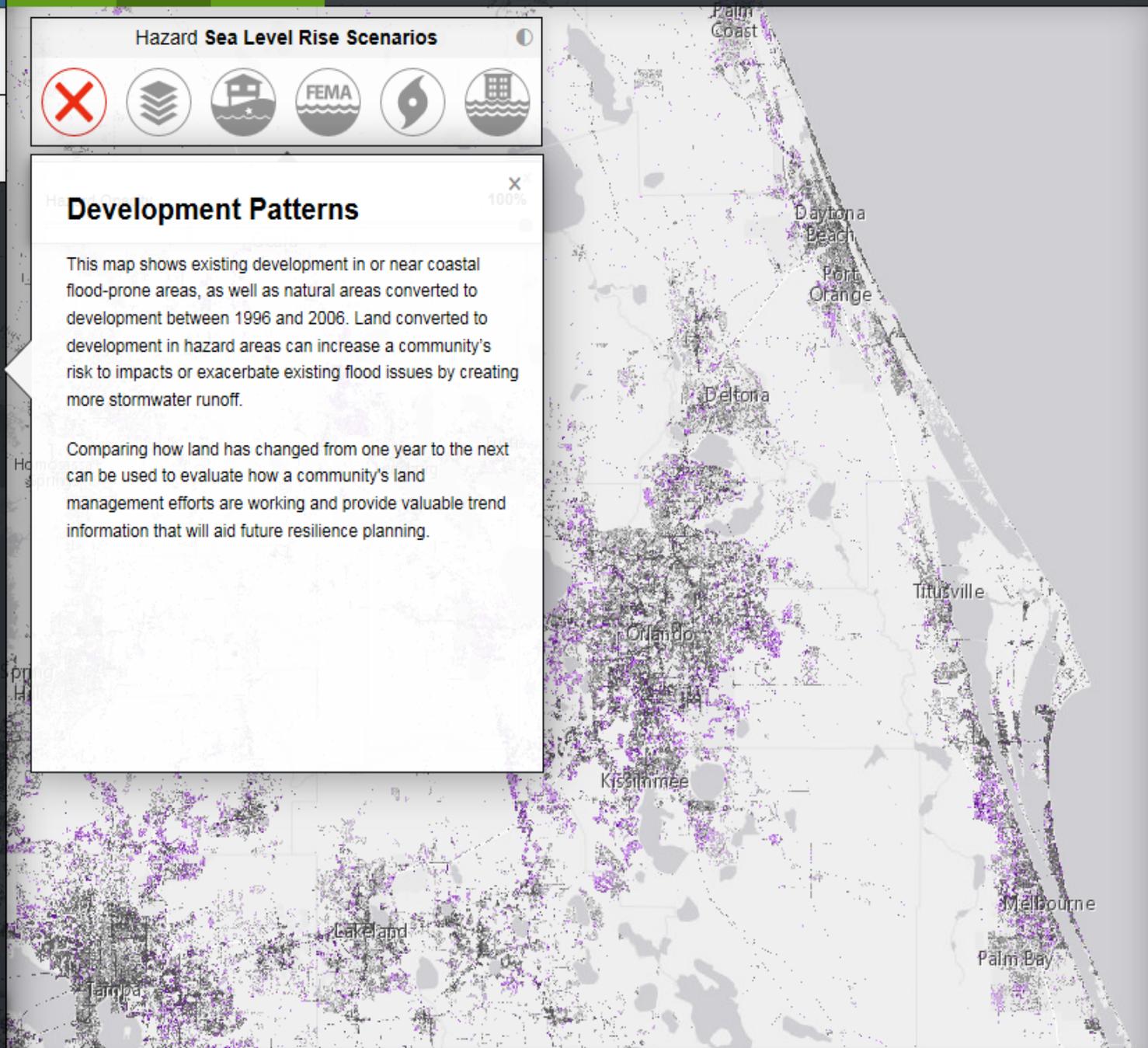
Hazard Sea Level Rise Scenarios



Development Patterns

This map shows existing development in or near coastal flood-prone areas, as well as natural areas converted to development between 1996 and 2006. Land converted to development in hazard areas can increase a community's risk to impacts or exacerbate existing flood issues by creating more stormwater runoff.

Comparing how land has changed from one year to the next can be used to evaluate how a community's land management efforts are working and provide valuable trend information that will aid future resilience planning.



Base Maps Legend

Development

- High Intensity Developed
- Medium Intensity Developed
- Low Intensity Developed
- Developed Open Space

Areas Converted to Development: 1996-2011

- High Intensity Developed
- Medium Intensity Developed
- Low Intensity Developed
- Developed Open Space

Sea Level Rise Scenarios

- 1 Ft Above Current MHHW
- 2 Ft Above Current MHHW
- 3 Ft Above Current MHHW
- 4 Ft Above Current MHHW
- 5 Ft Above Current MHHW

## Select the Flood Hazards Map or One of the Community Exposure Maps

Select a section below to view maps showing flood hazards or different aspects of community exposure to those flood hazards.

First-time user? Starting with Flood Hazards is a good idea.



### Flood Hazards

Flooding events are among the more frequent, costly, and deadly hazards that can impact coastal communities. There are two types:

- Short-term (episodic) – Temporary flooding caused by extreme conditions, including storm surge, tsunamis, inland flooding, and shallow coastal flooding.
- Long-term (chronic) – Flooding caused by a rise in relative sea level or some other change in conditions.



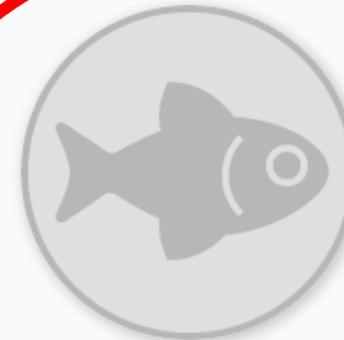
### Societal Exposure

Understanding the populations that live in or near coastal flood-prone areas is an important information need, since residents who are elderly, who live in high-density areas, or who are impoverished may merit special considerations.



### Infrastructure Exposure

Community infrastructure, including roads, bridges, and water and sewer systems, can be damaged by coastal flooding. Communities should first assess infrastructure vulnerabilities and associated environmental and economic issues to determine what steps are needed to protect these assets.



### Ecosystem Exposure

Natural areas provide important benefits to coastal communities, including hazard protection, flood storage, water quality maintenance, fisheries support, and recreational opportunities. Communities can increase resilience by protecting natural areas along the coast that are exposed to flooding and adjacent inland areas.

Please Select a Location

Ecosystem Exposure Map

Hazard Sea Level Rise Scenarios



Natural Areas and Open Space

This map shows wetlands, beaches, dunes, and other natural areas and open space (including agricultural land) exposed to coastal flooding. Healthy natural areas are able to adapt and recover from short-term coastal flooding, but if floodwaters are too powerful they can damage wetland plants, and waves can erode beaches and dunes if sufficient sand supply and space are not available to rebuild them.

Sea level rise can cause change in habitat types or loss of habitat. Freshwater wetlands may experience dieback from saltwater intrusion, and salt marsh may convert to open water unless sedimentation and growth can keep pace and the natural systems have inland areas in which to migrate. If sea level rise outpaces natural coastal processes, beaches and dunes may eventually become submerged.

Natural Areas and Open Space

- Wetlands
- Other Natural Areas and Open Space
- Beaches and Dunes

Sea Level Rise Scenarios

- 1 Ft Above Current MHHW
- 2 Ft Above Current MHHW
- 3 Ft Above Current MHHW
- 4 Ft Above Current MHHW
- 5 Ft Above Current MHHW
- 6 Ft Above Current MHHW
- Levee Areas - Consult Local Officials For Flood
- Areas Not Mapped

Recent Saved Locations

Ecosystem Exposure Map

Natural Areas and Open Space

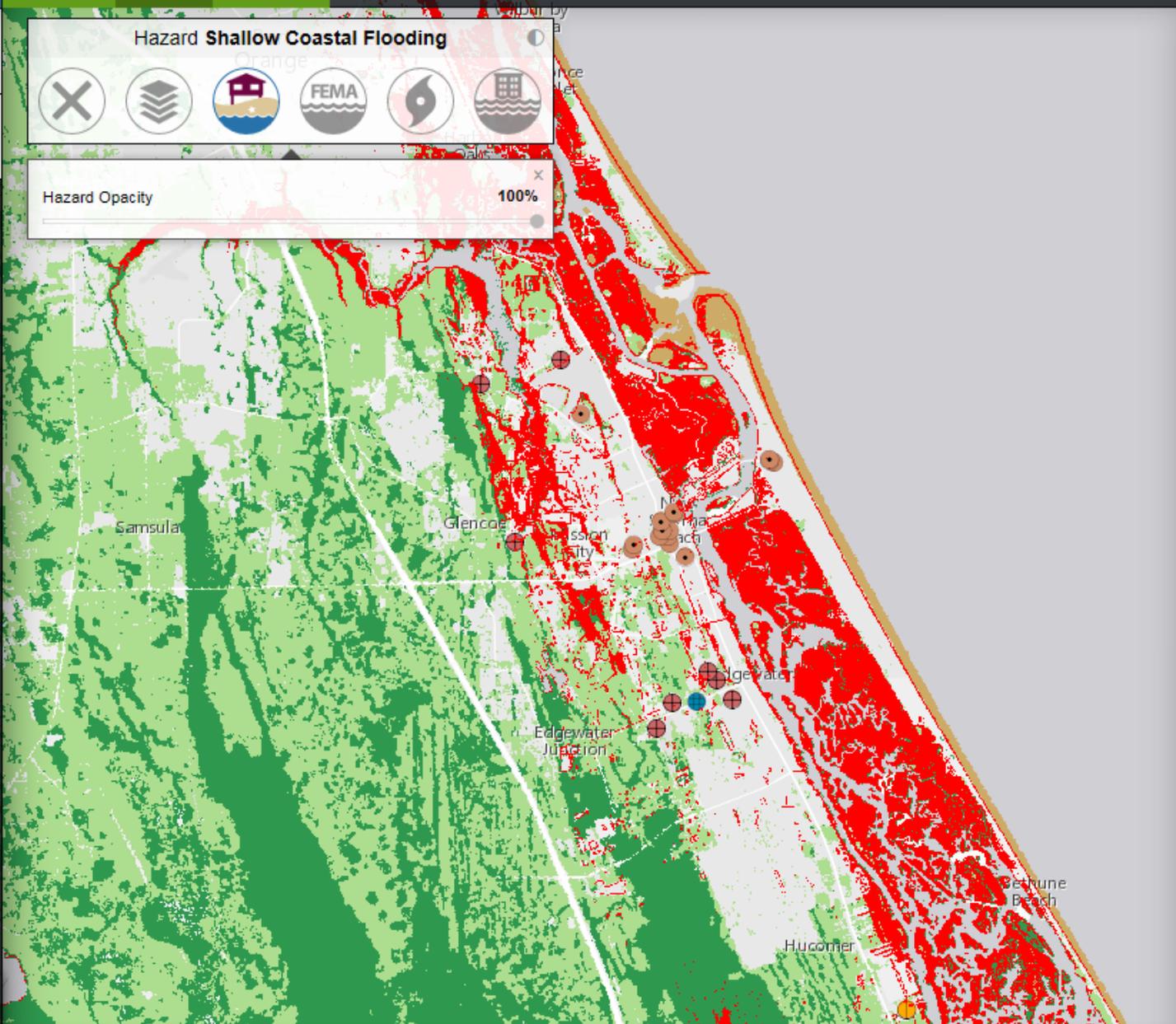
Potential Pollution Sources

Protection

Layers Opacity 100%

**Hazard Shallow Coastal Flooding**

Hazard Opacity 100%



Base Maps Legend

Natural Areas and Open Space

- Wetlands
- Other Natural Areas and Open Space
- Beaches and Dunes

Potential Pollution Sources

- Brownfield Property
- Hazardous Waste
- Superfund Site
- Toxic Chemicals

Shallow Coastal Flooding

- Susceptible Areas
- Areas Not Mapped

Please Select a Location

Ecosystem Exposure Map

Natural Areas and Open Space



Potential Pollution Sources



Protection



Layers Opacity

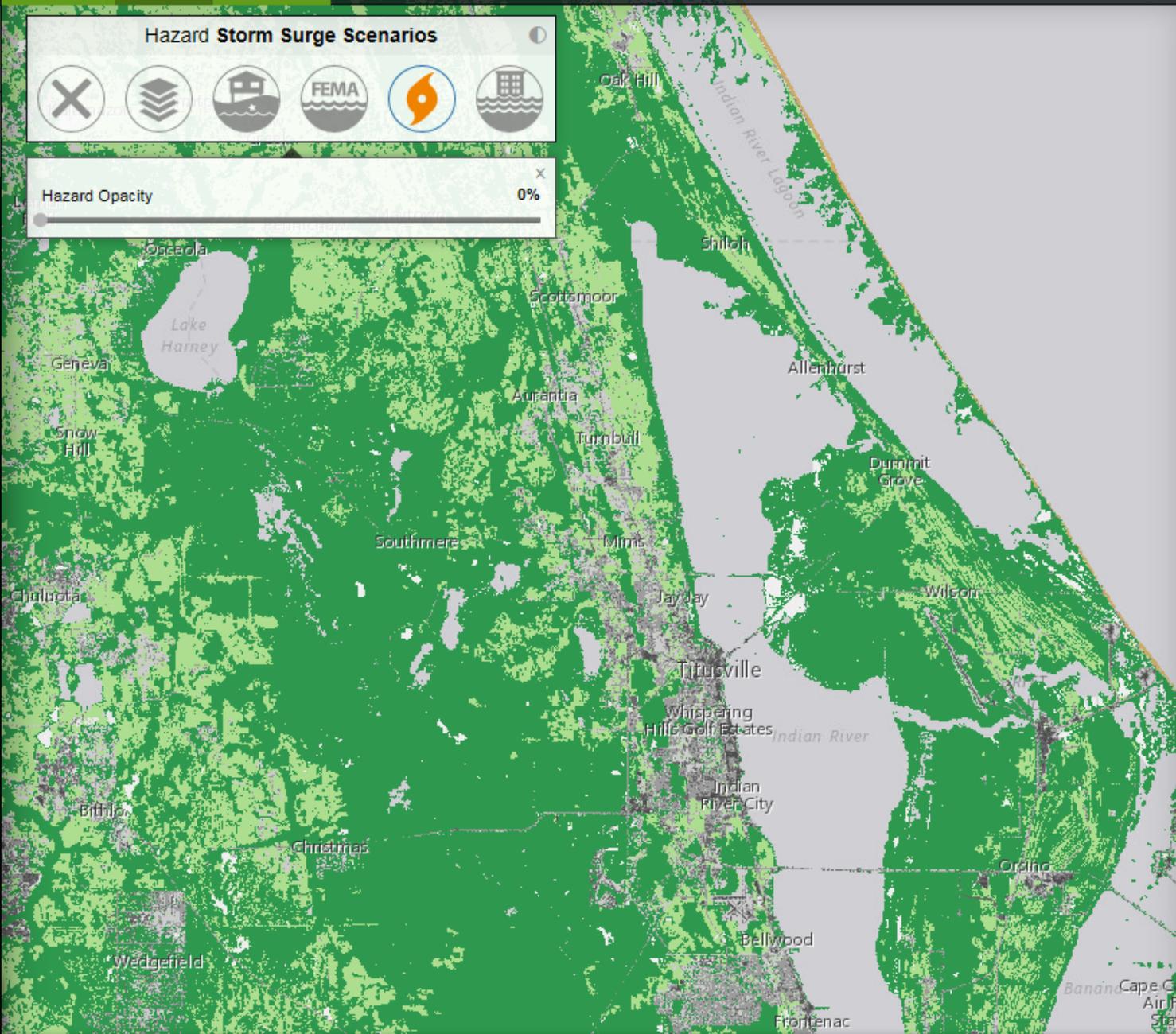
100%

Hazard Storm Surge Scenarios



Hazard Opacity

0%



Development

- High Intensity Developed
- Medium Intensity Developed
- Low Intensity Developed
- Developed Open Space

Natural Areas and Open Space

- Wetlands
- Other Natural Areas and Open Space
- Beaches and Dunes

Storm Surge Scenarios

- Category 1
- Category 2
- Category 3
- Category 4
- Category 5
- Levee Areas - Consult Local Officials For Flood Risk

Please Select a Location

Ecosystem Exposure Map

Natural Areas and Open Space

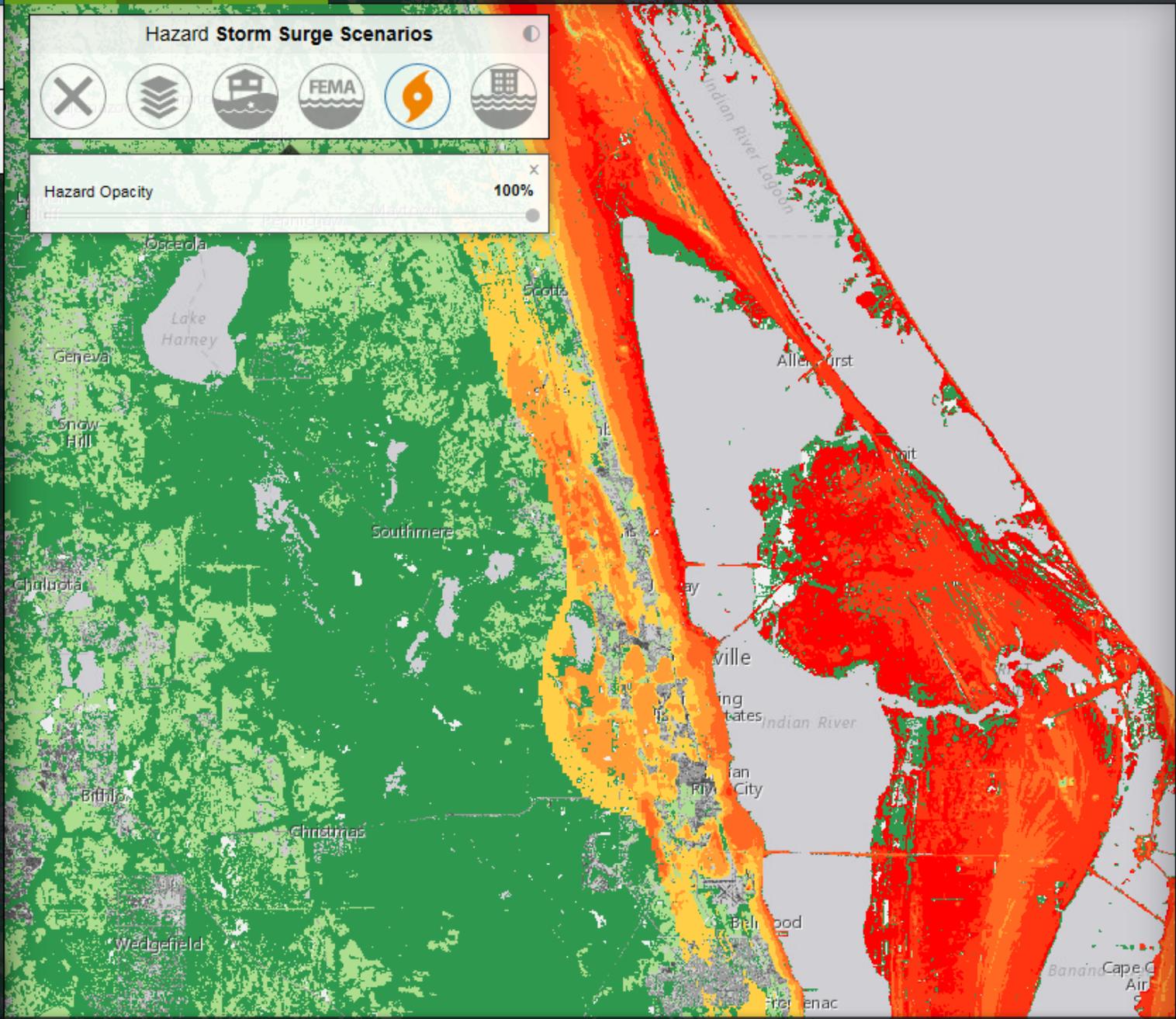
Potential Pollution Sources

Protection

Layers Opacity 100%

**Hazard Storm Surge Scenarios**

**Hazard Opacity** 100%



Base Maps Satellite

**Development**

- High Intensity Developed
- Medium Intensity Developed
- Low Intensity Developed
- Developed Open Space

**Natural Areas and Open Space**

- Wetlands
- Other Natural Areas and Open Space
- Beaches and Dunes

**Storm Surge Scenarios**

- Category 1
- Category 2
- Category 3
- Category 4
- Category 5
- Levee Areas - Consult Local Officials For Flood

## Flood Hazard Layers

- Coastal Flood Hazard Composite
- Shallow Coastal Flooding
- FEMA Flood Zones
- Storm Surge Scenarios
- Sea Level Rise Scenarios

## Societal Exposure Maps

- Population Density
- Percent in Poverty
- Percent Elderly (65 and Up)
- Employees
- Projected Population Growth

## Infrastructure Exposure Maps

- Development
- Critical Facilities
- Development Patterns

## Ecosystem Exposure Maps

- Natural Areas and Open Space
- Potential Pollution Sources
- Natural Protection

# Green Infrastructure Mapping Guide

- new tool that walks spatial analysts through a process to develop a GIS workplan to identify conservation areas that consider sea level rise and storm surge.

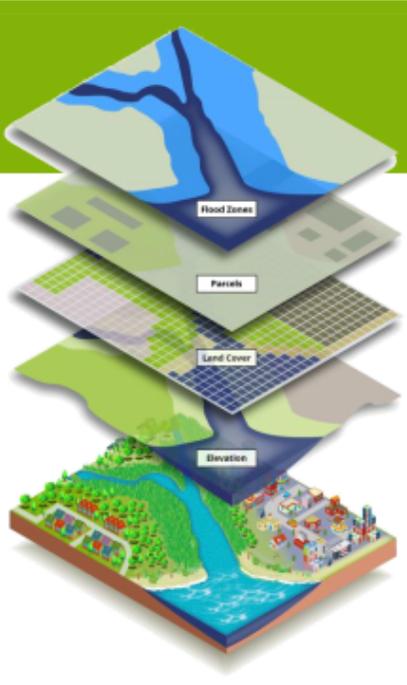
Menu | Resources

## Green Infrastructure Mapping Guide

This guide supports spatial analysts mapping green infrastructure for resilience to coastal hazards. The guide helps analysts incorporate green infrastructure strategies into a GIS work plan, and rank and prioritize green infrastructure for their study area.

Ways to use this guide:

- Use the **work plan** to follow an example project and see how a spatial analyst looks at multiple criteria to generate a final prioritization layer.
- At each step, track a **case study** to see how others have approached the work, or access **detailed guidance** for completing the step.
- View or download **worksheets and templates** that will make the job easier. Access **related resources** or full case study reports.



[Get Started](#)

# Vulnerability assessment

Coastal Flood Exposure

HERNANDO COUNTY

AND

CITY OF COCOA BEACH

TAMPA BAY REGIONAL PLANNING COUNCIL  
EAST CENTRAL REGIONAL PLANNING COUNCIL

# What is a Vulnerability Assessment?

Assessment of **vulnerability** of various aspects of land-use, assets, society and ecosystems to certain hazards with the end goal of enhancing **resiliency**.

**Includes findings, tangibles of assessment, maps, and recommendations.**

# What is Resiliency?

## Resiliency:

Bouncing back - return to its pre-shock condition or continue on its pre-shock path.

Ability to absorb shock - systems that continue to function after a shock even though their structure and organization may change.

Positive adaptability - systems that are in states of constant adaptation in anticipation of and in response to shocks.



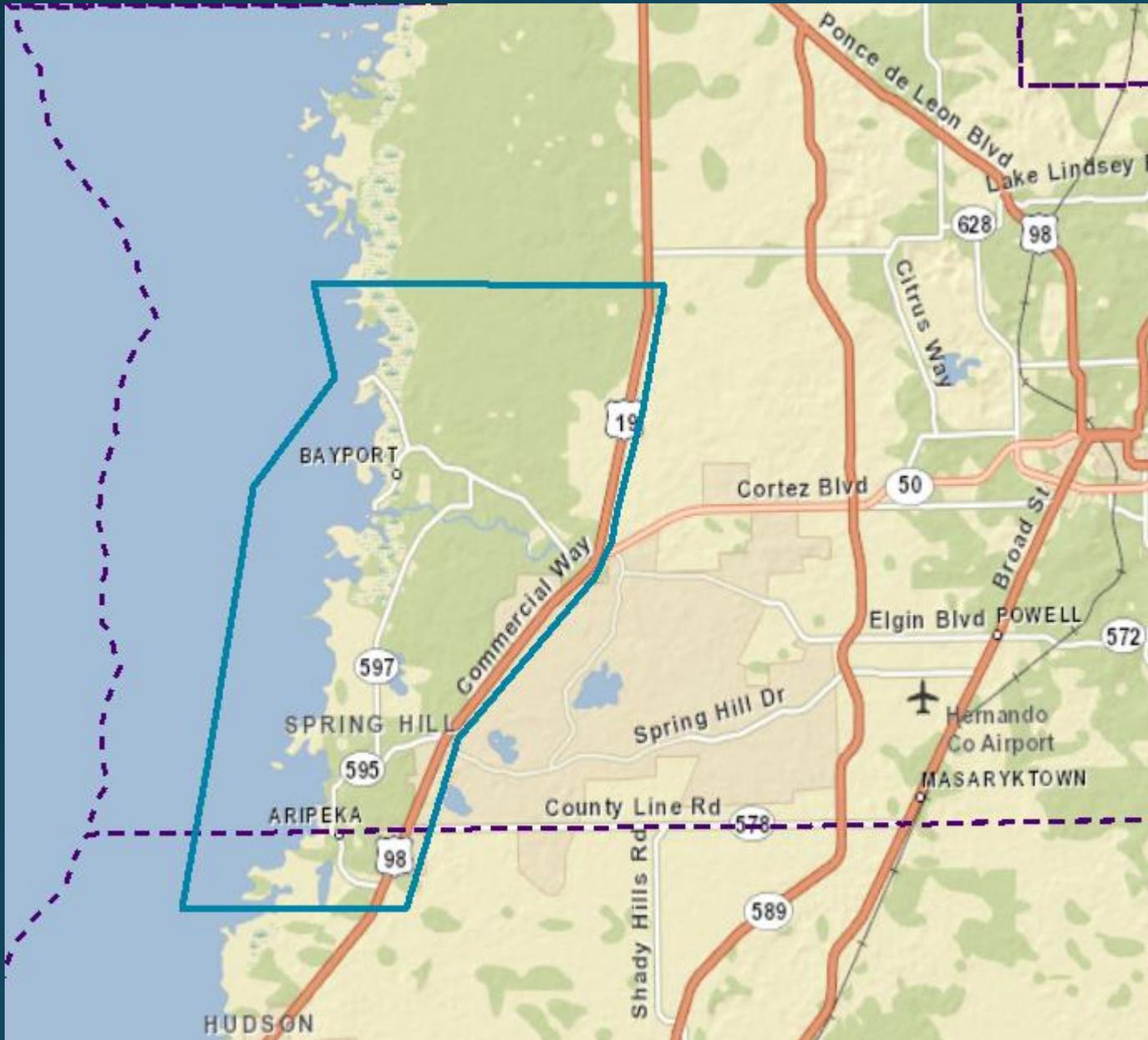
# What do you assess?

Hazards may include:

- Sea level rise
- Coastal flooding
- Fire
- Wind
- Others depending on areas

Areas of Assessment:

- Population
- Development types and future development
- Economic exposure
- Critical facilities
- Natural Areas
- HazMat/Pollution areas
- Transportation/Evacuation Facilities
- Infrastructure
- Others

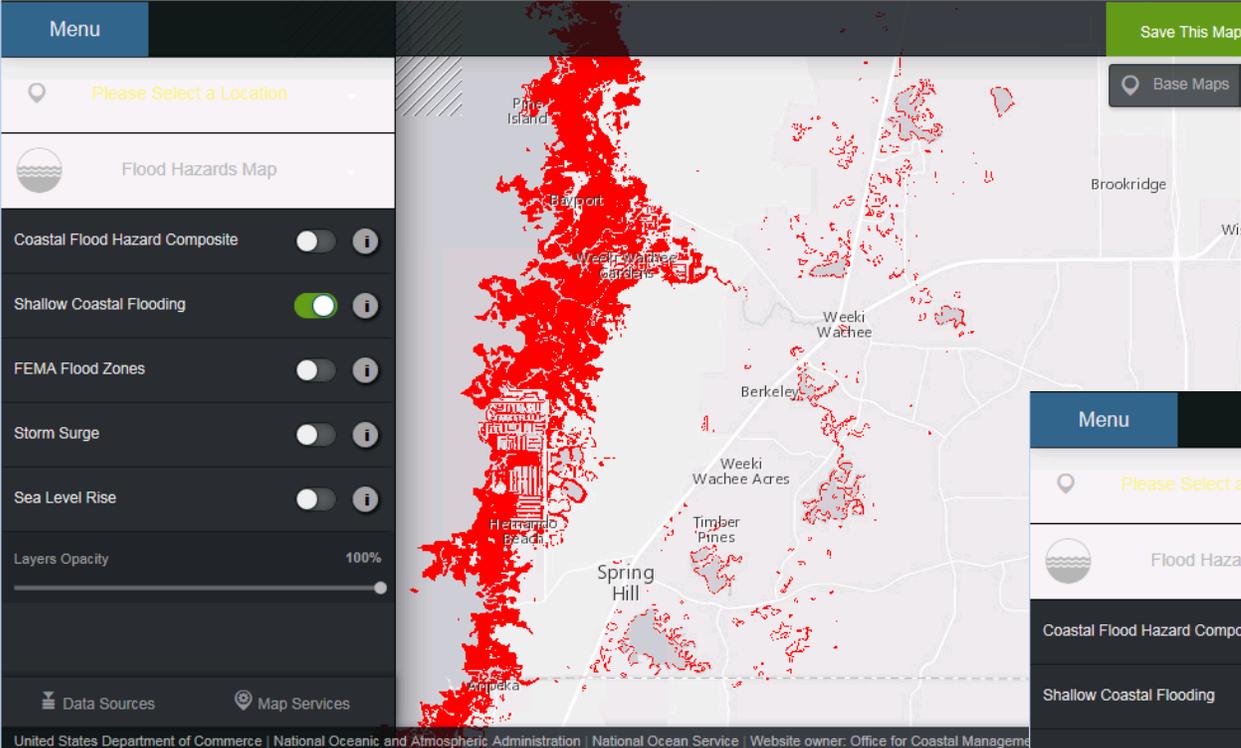


# Hernando County Coastal Flood Exposure Vulnerability Assessment

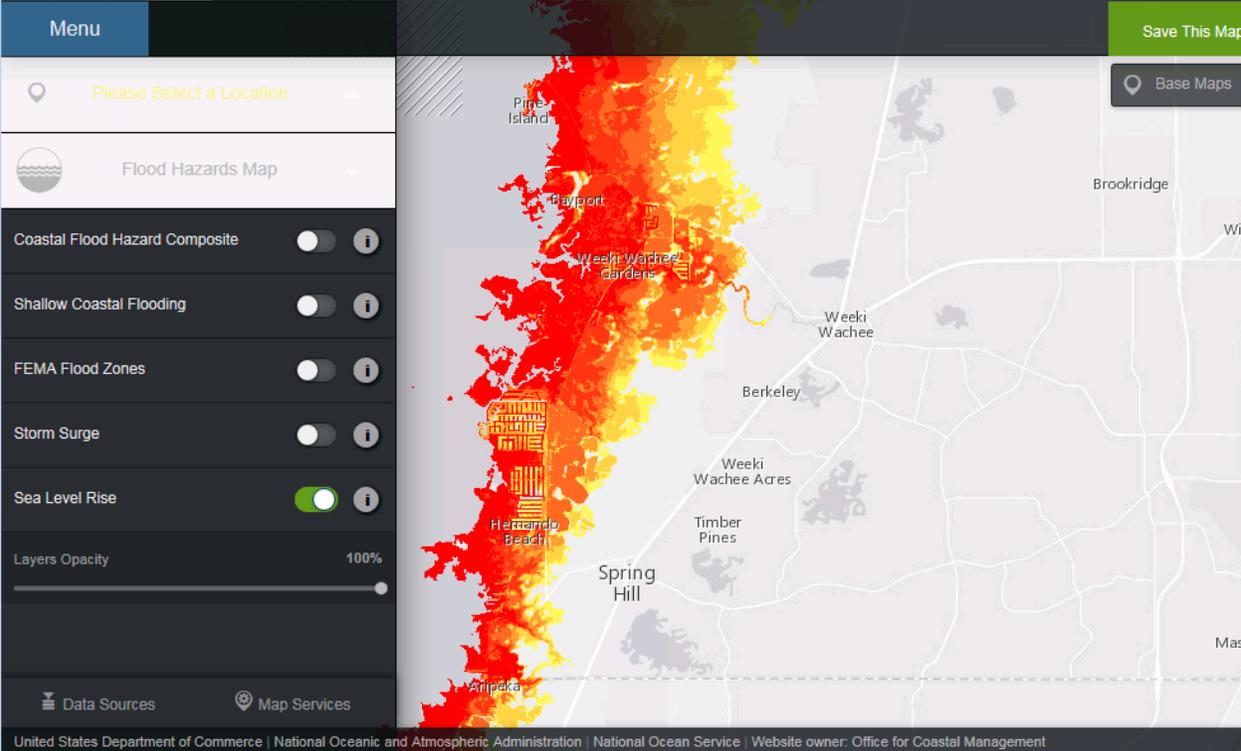
Areas of Assessment:

- Ecosystem Exposure
- Pollution Sources

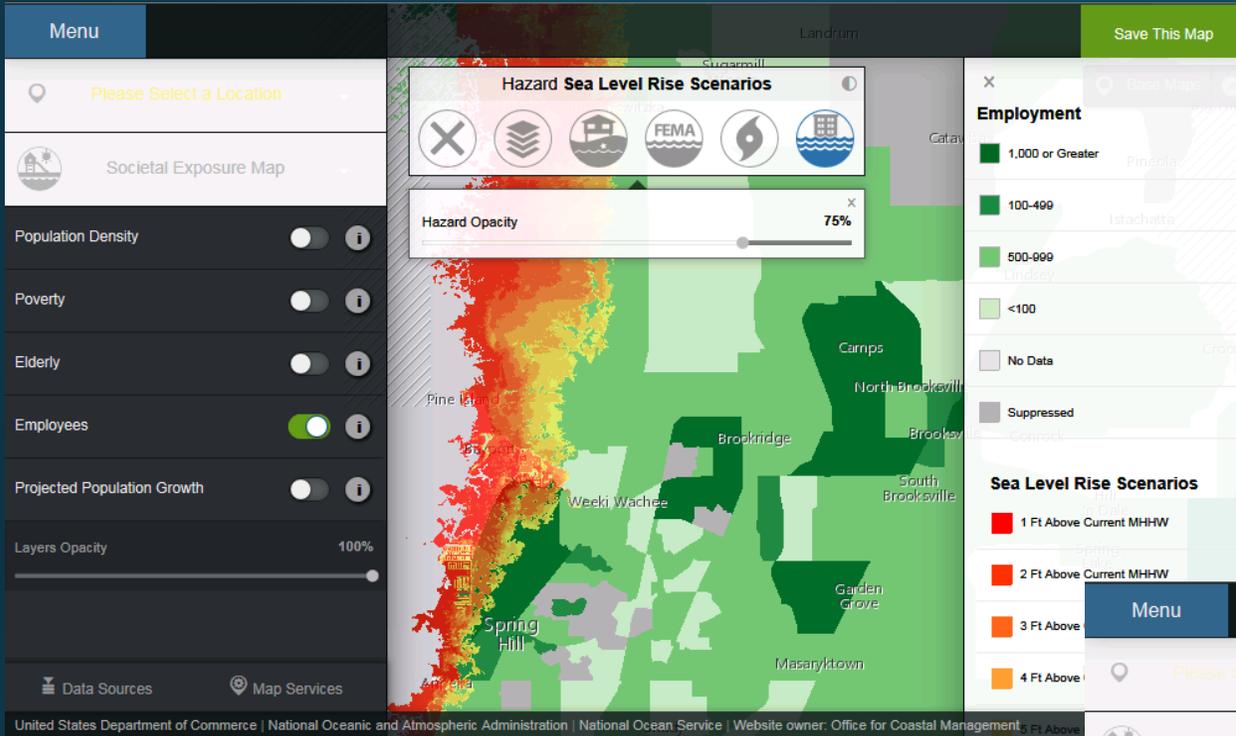
# Current flood frequency threshold extent



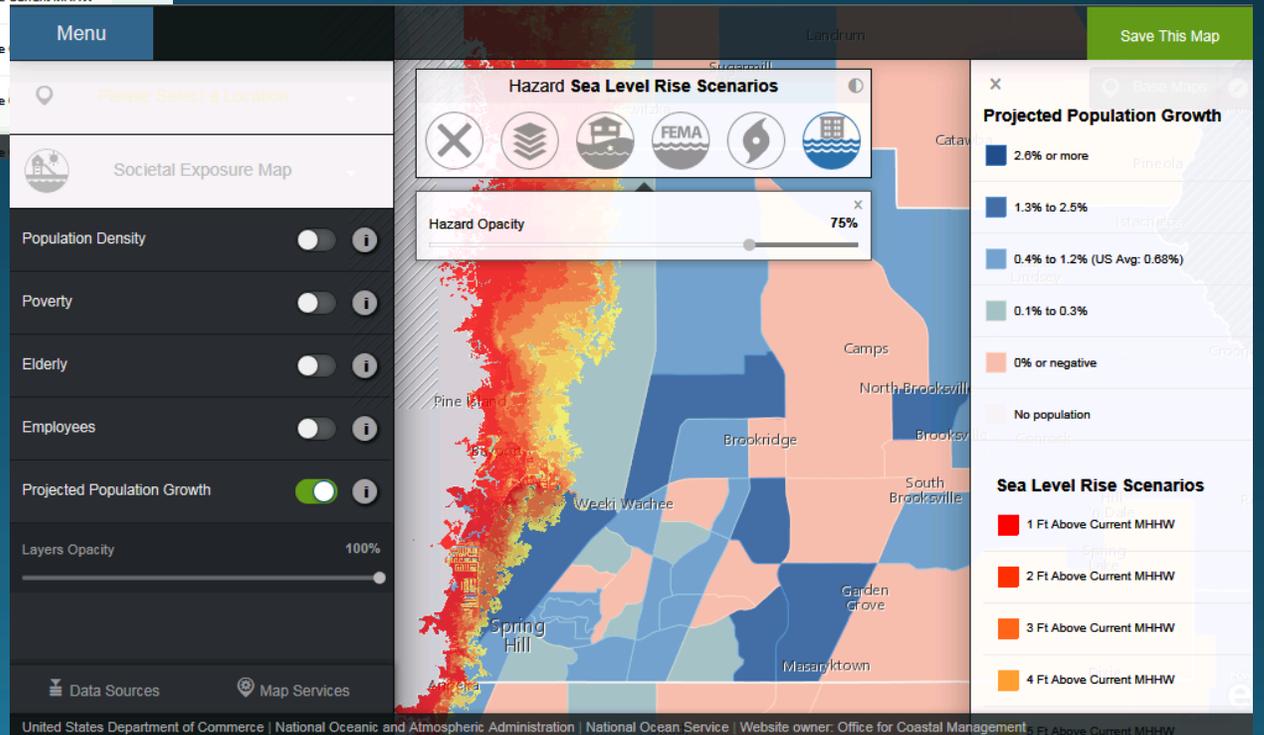
Sea level rise color-coded by feet up to 6ft



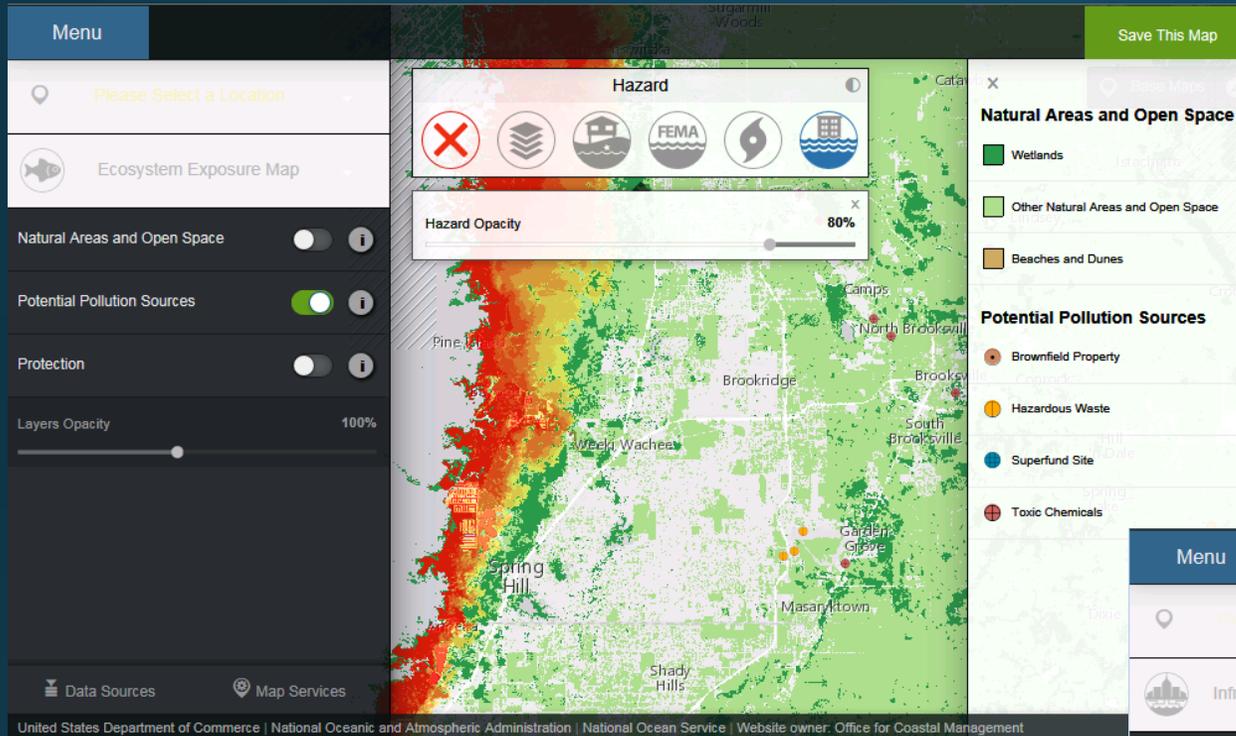
# Employment population with sea level rise



# Projected population growth with sea level rise

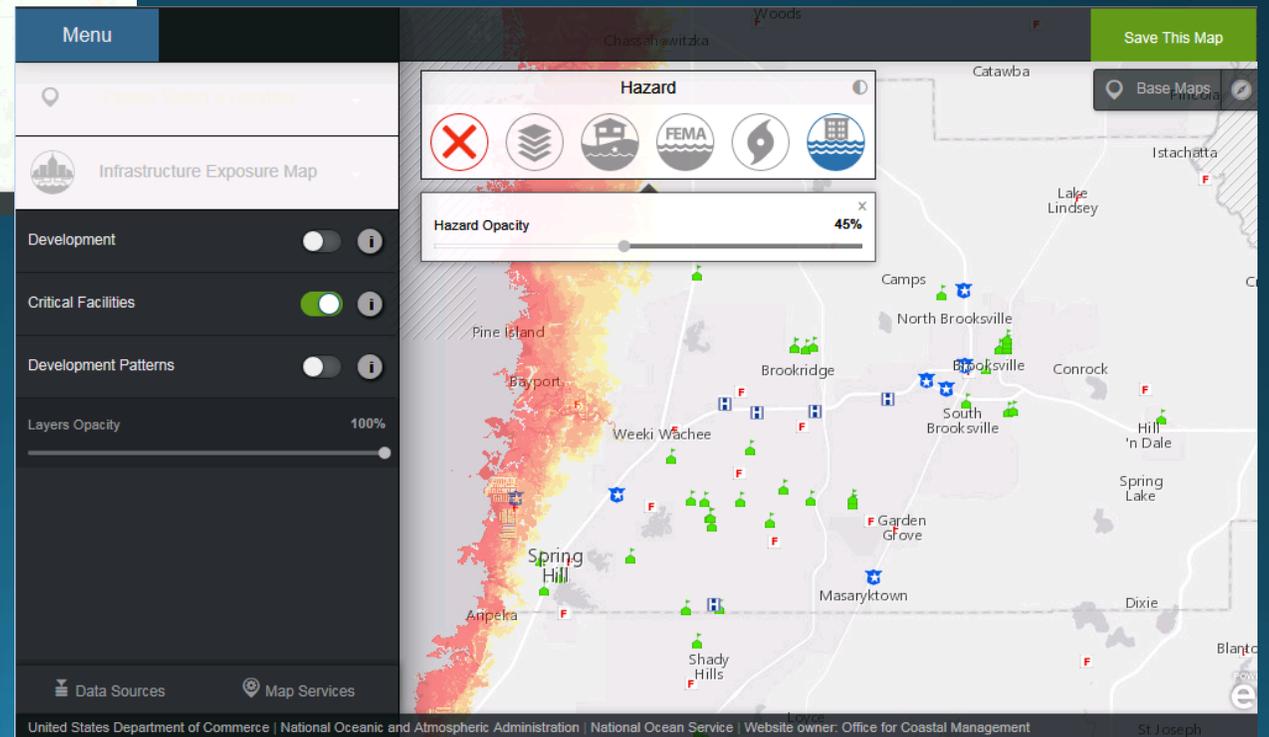


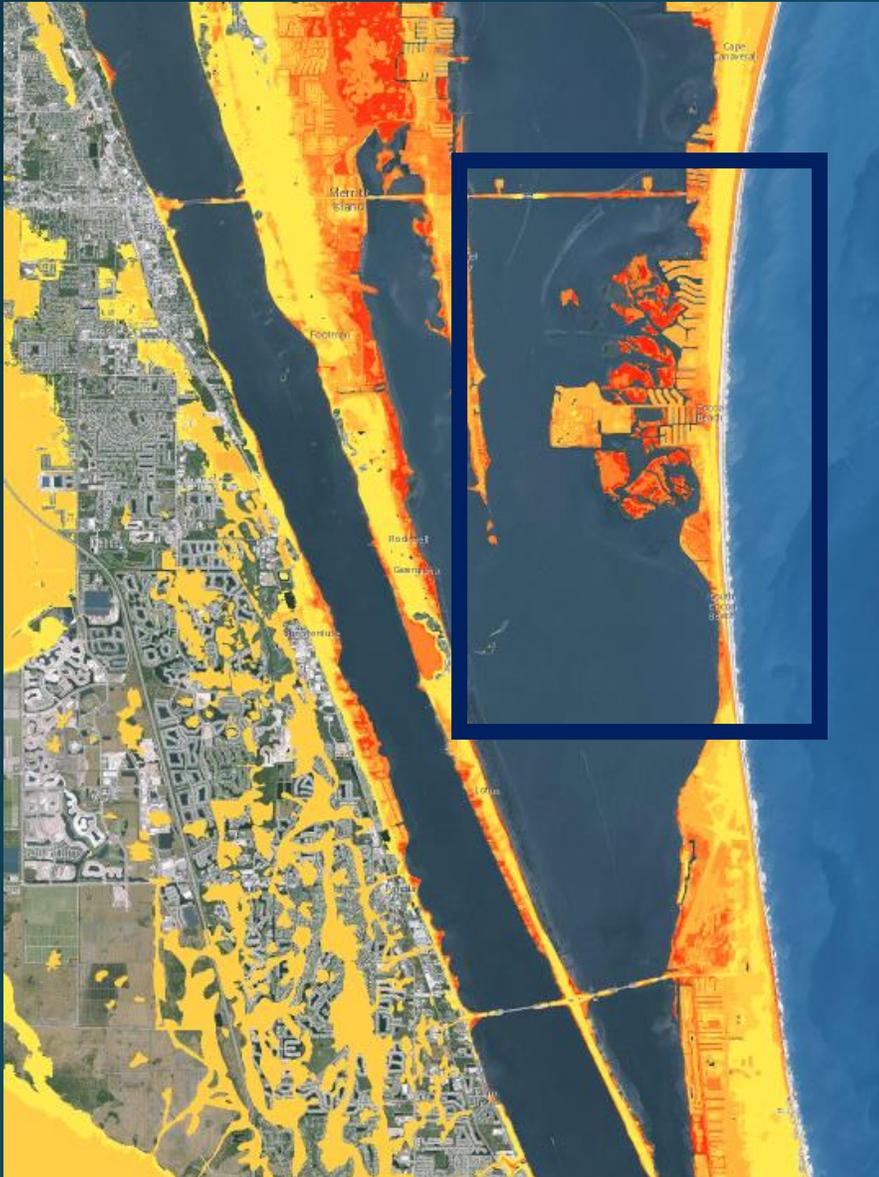
## Ecosystem and pollution sources with sea level rise



- Worse case 6.6ft sea level rise in 2100 does not affect any major road corridors (like U.S. 19)
- Current shallow flooding can be fairly extensive
- Few critical facilities in proportion to total are at risk from 6.6ft rise
- There are isolated communities that will be affected by rise of worse case level

## Critical facilities with sea level rise





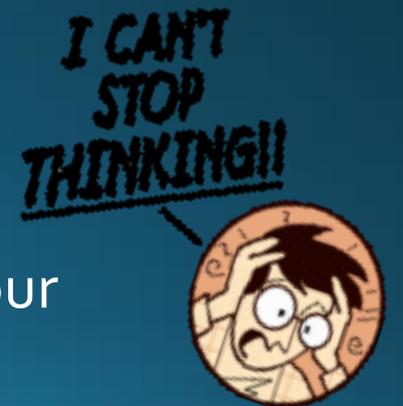
Study Area: City of Cocoa Beach  
(Tables 1-3)

Interesting Study Area of your  
Choosing (Tables 4-6)

Tool: Coastal Flood Exposure Mapper

Report Out: Each Table Powerpoint

What truly is the “study area” for your  
assessment?



## Hazard Areas:

- Composite
- Shallow Flooding
- Sea Level Rise



## Group 1 - Society Exposure:

- Population
- Poverty
- Elderly
- Employees
- Growth

## Group 2 - Ecosystem Exposure:

- Natural Areas
- Pollution Sources
- Protection

## Group 3 - Infrastructure Exposure:

- Development
- Critical Facilities
- Development Patterns
- Access/Evacuation

# Assessment Parameters

- 1) Include range of low, medium and high sea level rise scenarios
- 2) Maps (at least 2)
  - 1) Detail sea level rise and shallow flooding and vulnerable assets in those areas.
  - 2) Map of asset locations
- 3) Summary of vulnerable assets
- 4) Narrative of impacts featuring counts, statistics, descriptions of and any other important information
- 5) Solutions/Recommendations



- It's easier to see facilities using the BASE MAP, not Satellite.
- Adjust Hazard Opacity tool bar if hazards overlay facilities. If you close out the tool bar, you have to refresh to get it back.
- Turn legend on
- Save maps and text as you go. If you go to View your maps, you will need to zoom back into your study area.
- Save final documents/powerpoint and maps on thumb drive for report out



**Group Activity**

**Vulnerability  
Assessments**

**45 minutes**

# Group Report Out

## Vulnerability Assessments

45 minutes



## Contact Information

### **Crystal Goodison**

Associate Director, GeoPlan Center  
University of Florida

(352)392-2351

[goody@geoplan.ufl.edu](mailto:goody@geoplan.ufl.edu)

### **Tara M. McCue, AICP**

Director of Planning and Community Development  
East Central Florida Regional Planning Council

407-262-7772 X 327

[tara@ecfrpc.org](mailto:tara@ecfrpc.org)