



Sea Level Rise Mapping

Using the Sea Level Scenario Sketch Planning Tool and
NOAA Coastal Flood Exposure Mapper

Prepared by the St. Lucie Transportation Planning Organization

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1. PROJECT BACKGROUND

As climate change continues to threaten both natural and built environments, the risk of impact to transportation infrastructure rises. Scientific studies predict that sea level rise will accelerate and, therefore, transportation infrastructure along the coast continues to be vulnerable to inundation.

The St. Lucie TPO's Unified Planning Work Program (UPWP) initiated efforts to assess vulnerabilities of local transportation assets and services to extreme weather and other environmental conditions and for identifying ways to improve the climate adaptation/resiliency of the assets and services.

This document is a case study assessing local transportation system vulnerability to sea level rise by using Sea Level Scenario Sketch Planning Tool and the National Oceanic and Atmospheric Administration (NOAA) Coastal Flood Exposure Mapper. It is a selected scenario planning exercise and demonstration of geospatial hazard assessment tools.

2. SEA LEVEL RISE OVERVIEW

2.1 Sea Level Rise (SLR)

Sea level has been rising over the past century, and the rate has increased in recent decades. There are two kinds of SLR: global and local. Global SLR is occurring mainly due to thermal expansion and melting of land ice. Land ice accounted for about 65% of the total SLR budget. Local SLR rates depend on natural geologic processes as well as land use processes and groundwater withdrawal. The local SLR rates in the Treasure Coast and Southeast Florida are very similar to the global sea level rise rates.

2.2 SLR Trend

In the Treasure Coast and Southeast Florida, sea level has risen 5.5 inches in the past 50 years, according to tide gauge data (Source: noaa.gov). Sea level is measured by tide gauges and, more recently, satellite altimetry.

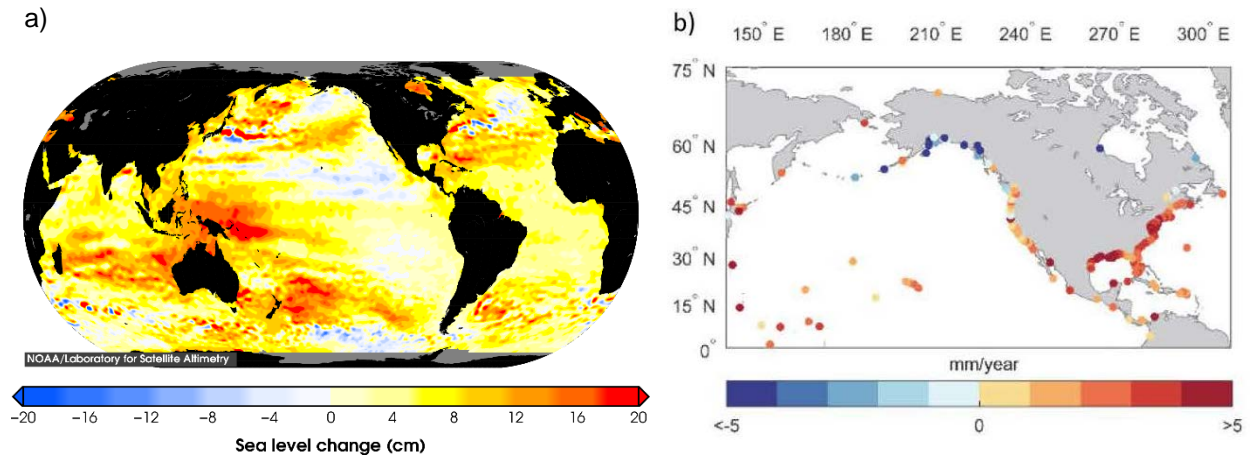


Figure 1. a) Total sea level change since 1993 from TOPEX/Poseidon, Jason-1 and Jason-2 (www.star.nesdis.noaa.gov/sod/lsa/SeaLevelRise) and b) relative sea level trends based upon full record (>30-year period of record in all cases) measured and published for NOAA tide gauges through 2018 (tidesandcurrents.noaa.gov/sltrends).

2.3 SLR Projection Curves

A total of five SLR projection curves from National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (USACE) are commonly used to project SLR (Please note: there are 3 USACE projections and 4 NOAA projections, but 2 of the projections are the same).

The graph below shows the projected amounts of relative SLR from 2000 – 2100 using these five SLR projection curves. The graph was generated from the USACE Sea Level Change Curve Calculator and NOAA sea level trends from 2018. In this study, the intermediate-high rate (green curve) was selected for the mapping purpose because it represents the average of all scenarios.

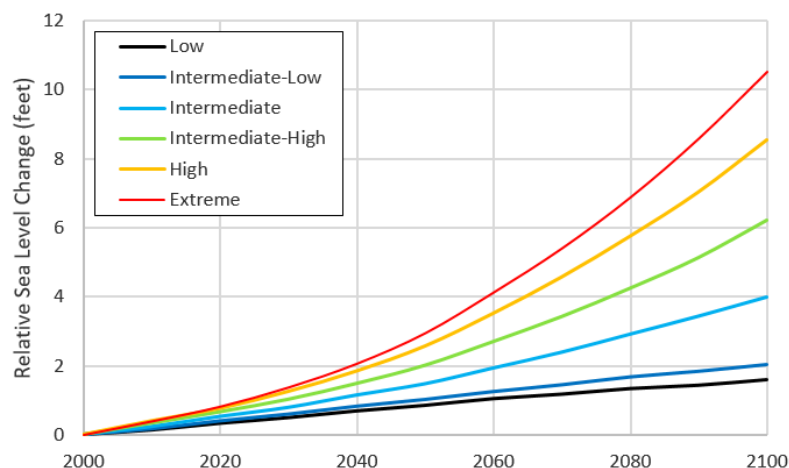


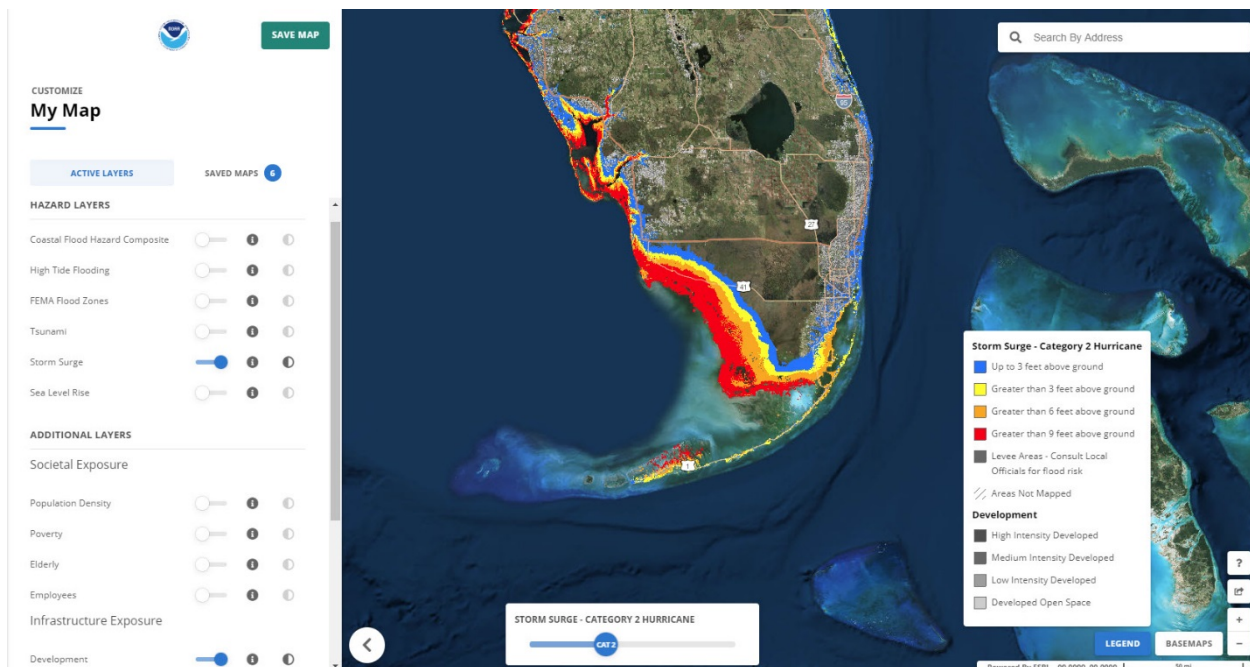
Figure 2. Relative Sea Level Projections (2000-2100). The low and extreme scenarios represent the minimum and maximum of plausible future sea level rise. Data source: NOAA Technical Report NOS CO OPS 083

3. SLR MAPPING

In this study, two visualization tools are used to create simulations and graphics of potential conditions of SLR and its impacts to transportation infrastructure within the St. Lucie TPO area. These online interactive tools do not require specific software or hardware.

3.1 NOAA Coastal Flood Exposure Mapper

<https://coast.noaa.gov/digitalcoast/tools/flood-exposure.html>



This free online visualization tool can be used to assess coastal hazard risks and vulnerabilities. The tool creates a collection of user-defined maps that show the overview of vulnerability within the St. Lucie TPO area to the following events:

- Coastal Flood Hazard
- High Tide Flooding
- Storm Surge
- Sea Level Rise

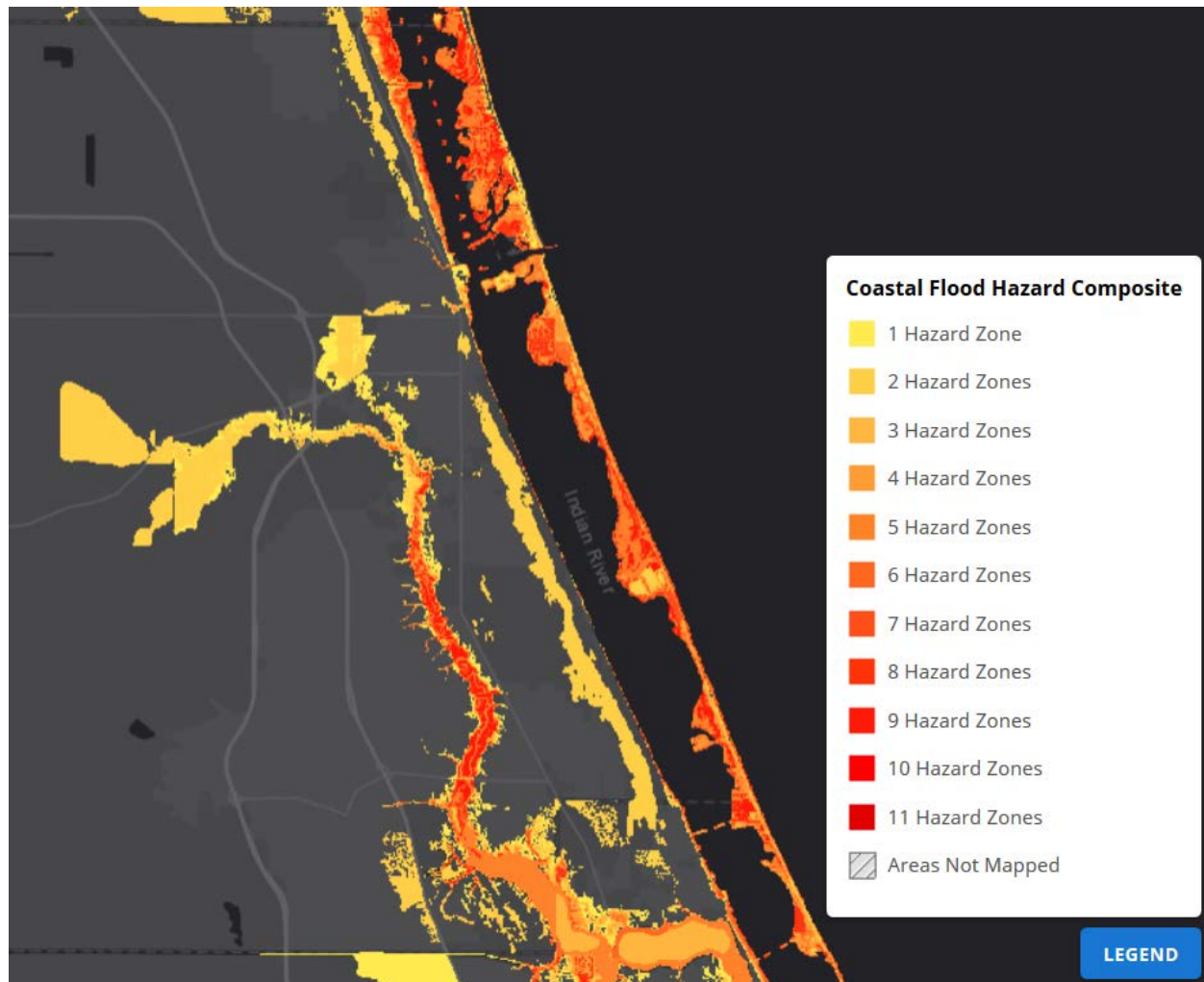


Figure 3. Coastal Flood Hazard Composite

Figure 3 shows areas prone to flooding from one or more of the following hazards:

- High tide flooding
- High risk (1% annual chance for A and V zones) and moderate risk (0.2% annual chance) flooding (designated by the Federal Emergency Management Agency)
- Storm surge for Category 1 through Category 3 hurricanes
- Sea level rise scenarios of 1, 2, and 3 feet

The darker the color on the map, the more flood hazard zones there are for that area.

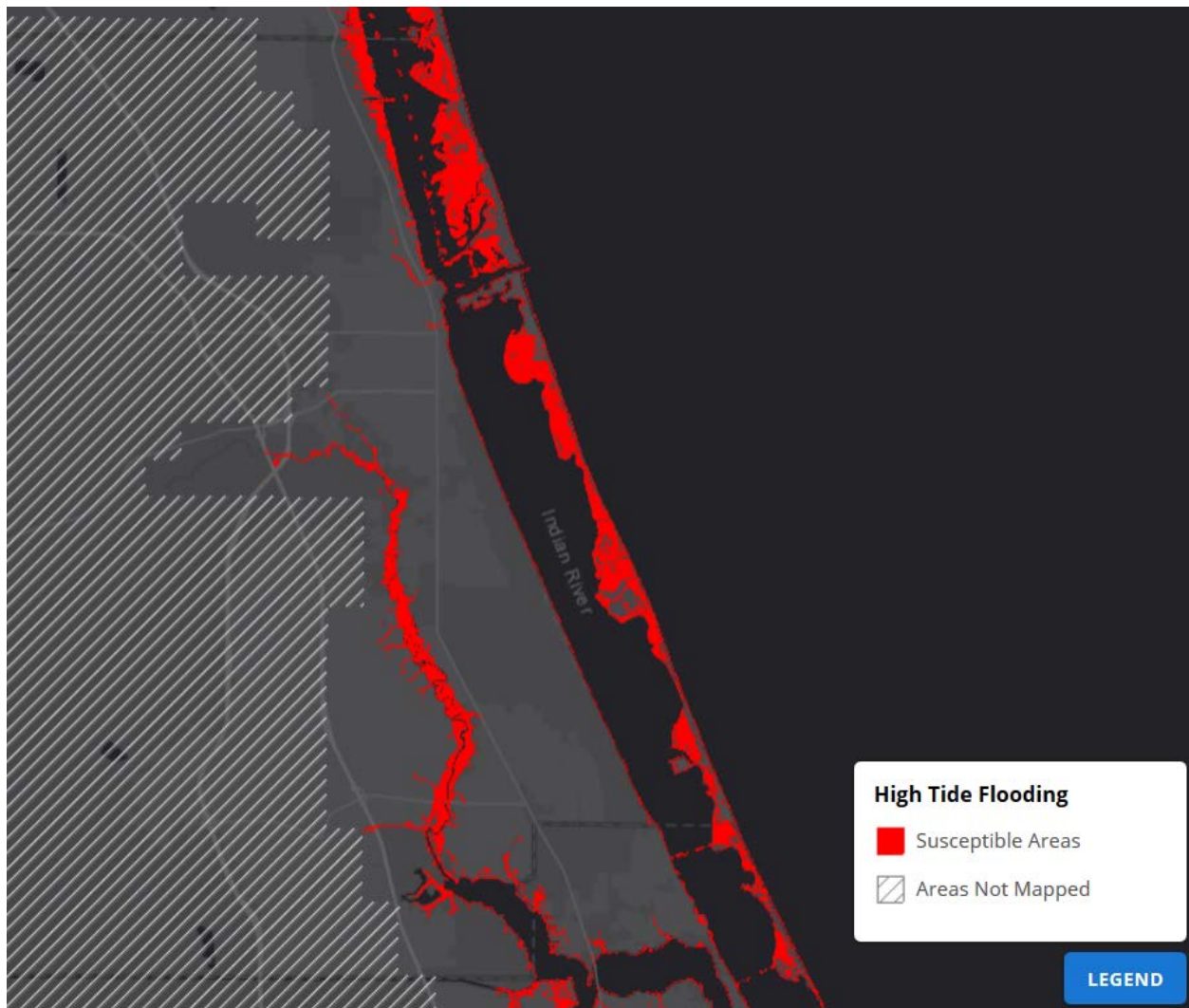


Figure 4. High Tide Flooding

Figure 4 illustrates in red low-lying coastal areas prone to flooding during extreme high tides. Extreme high tides 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. Annual occurrences of high tide flooding—exceeding local thresholds for minor impacts to infrastructure—have increased 5- to 10-fold since the 1960s in several U.S. coastal cities. In one 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.

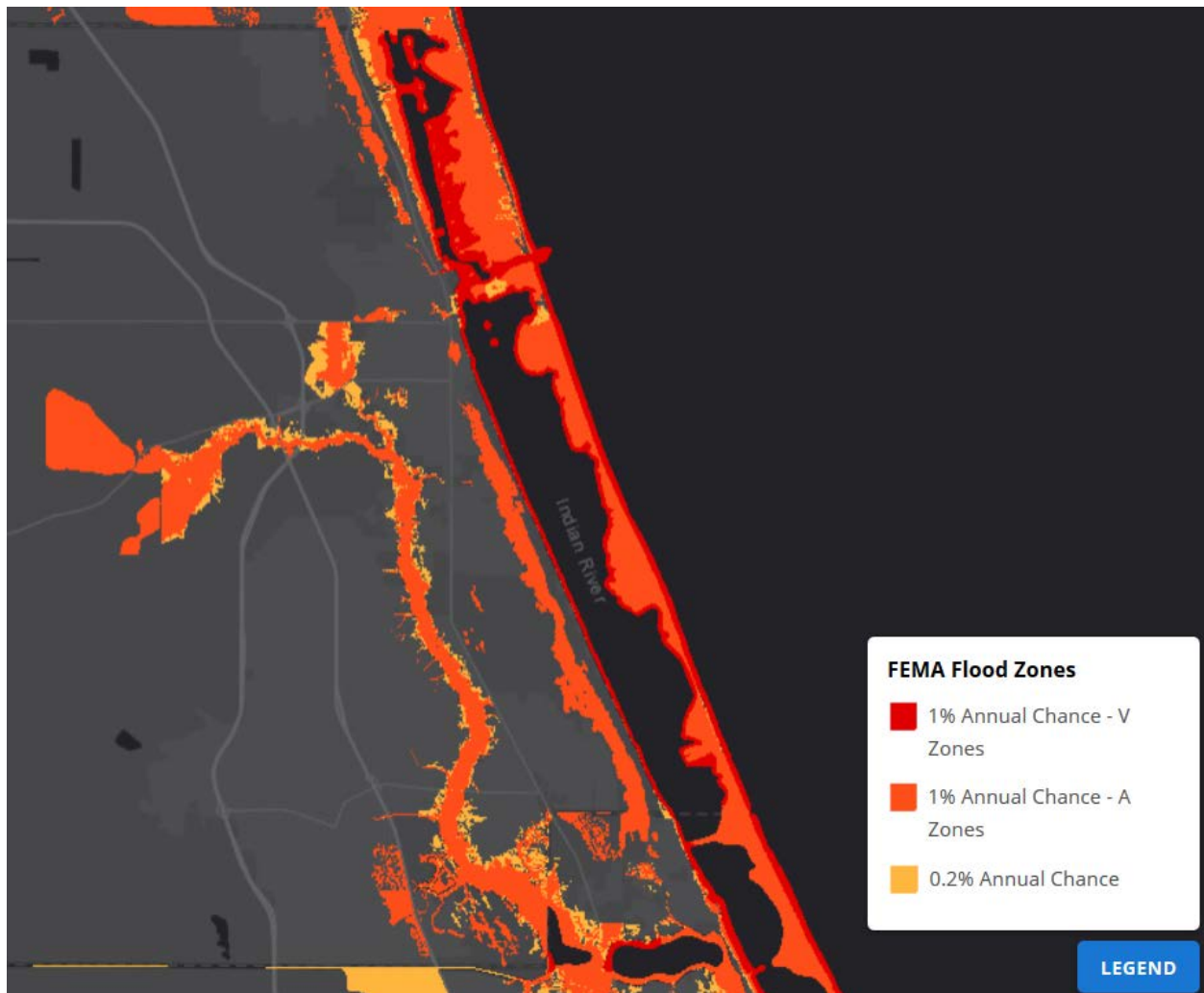


Figure 5. FEMA Flood Zones

Figure 5 shows high-risk for A and V flood zones (1% annual chance, or 100-year floodplain) and moderate-risk (0.2% annual chance, or 500-year floodplain) 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. High-risk flood zones are also commonly referred to as Special Flood Hazard Areas.

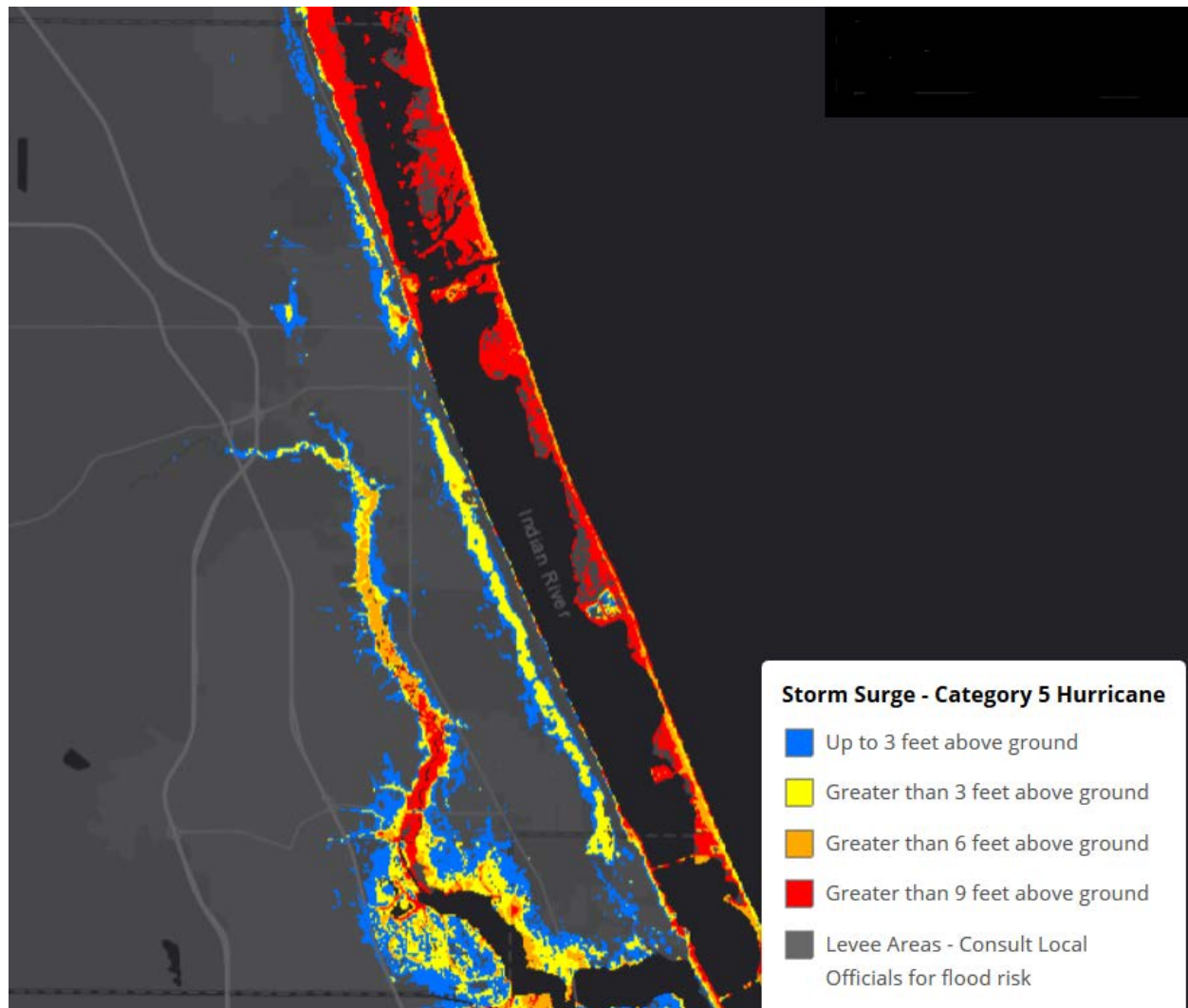


Figure 6. Storm Surge in Category 5 Hurricane

Figure 6 displays the depth of storm surge inundation for a category 5 hurricane, from less than 3 feet above ground (in blue) to greater than 9 feet above ground (in red). Data shown in 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 category, size, forward speed, the angle of approach to the shoreline, and the characteristics of the coastline. Since many factors influence storm surge heights, maximum inundations from multiple storm surge scenarios are composited into one data layer.

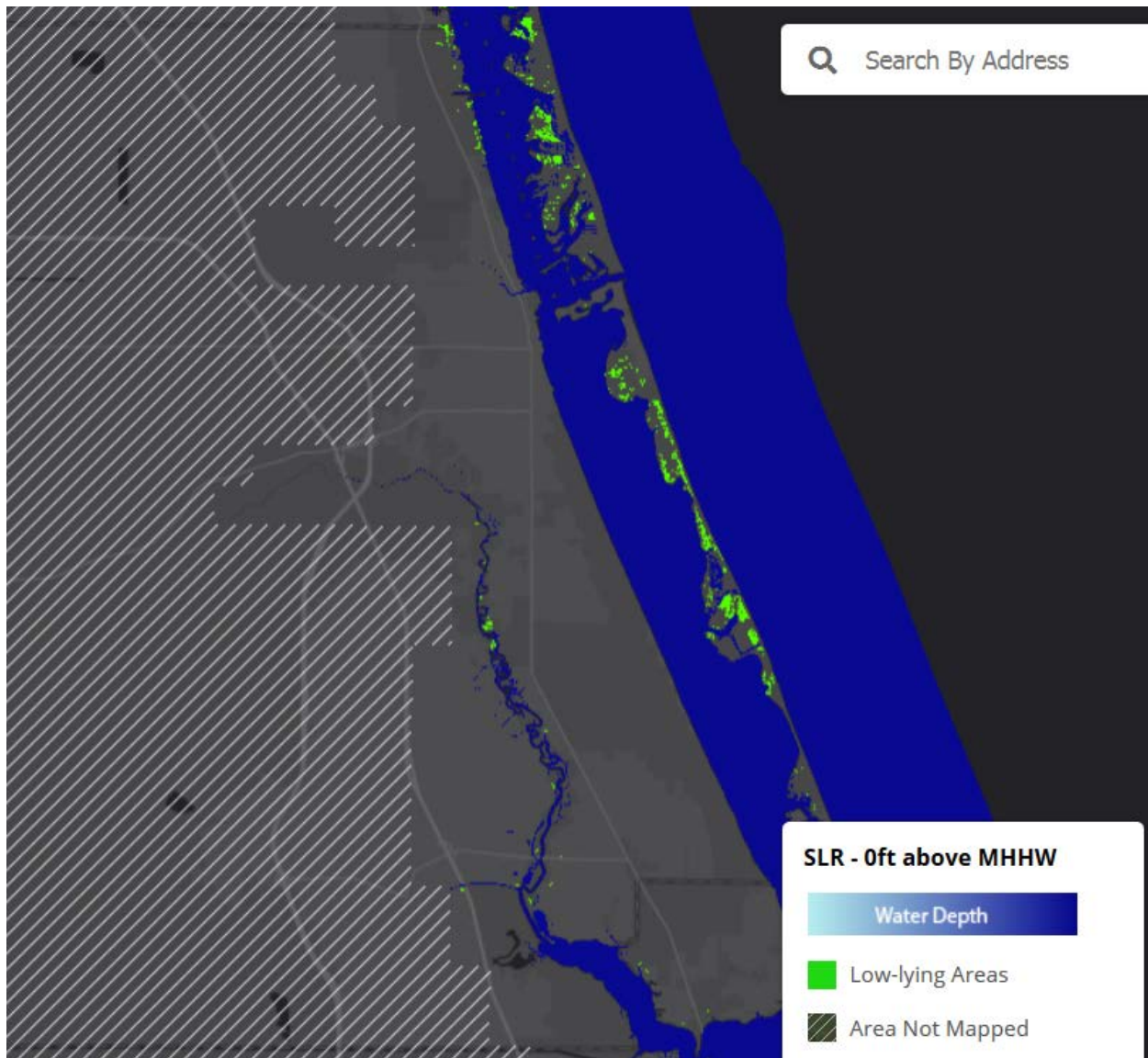


Figure 7. Sea Level Rise – Scenario of 0 ft

Figures 7 and 8 show sea level rise scenarios of 0 and 10 feet, which simulate 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 hydrologically connected to the ocean are shown in shades of blue (darker blue = greater depth). Low-lying areas, displayed in green, are hydrologically “unconnected” areas that may also flood.

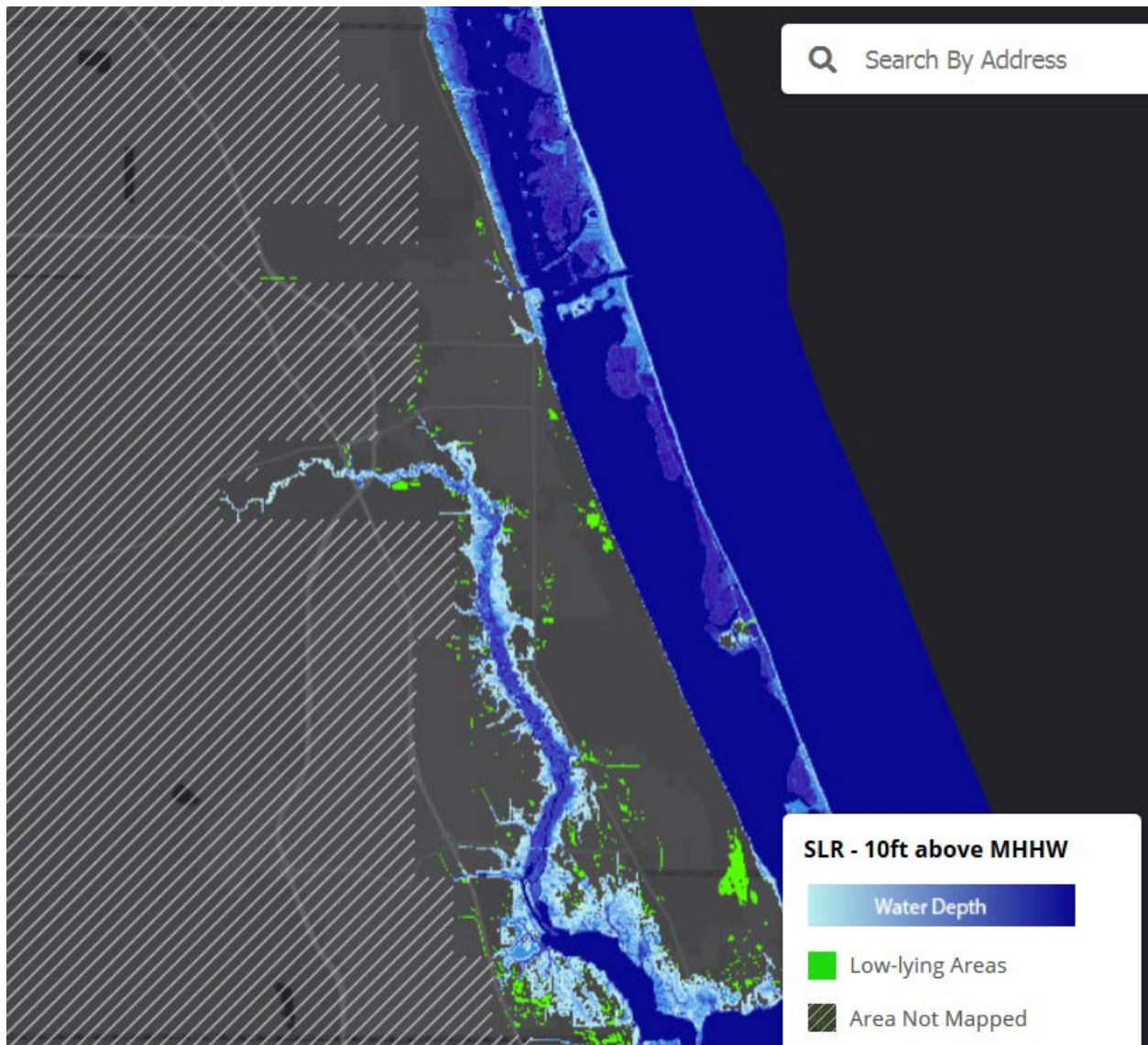
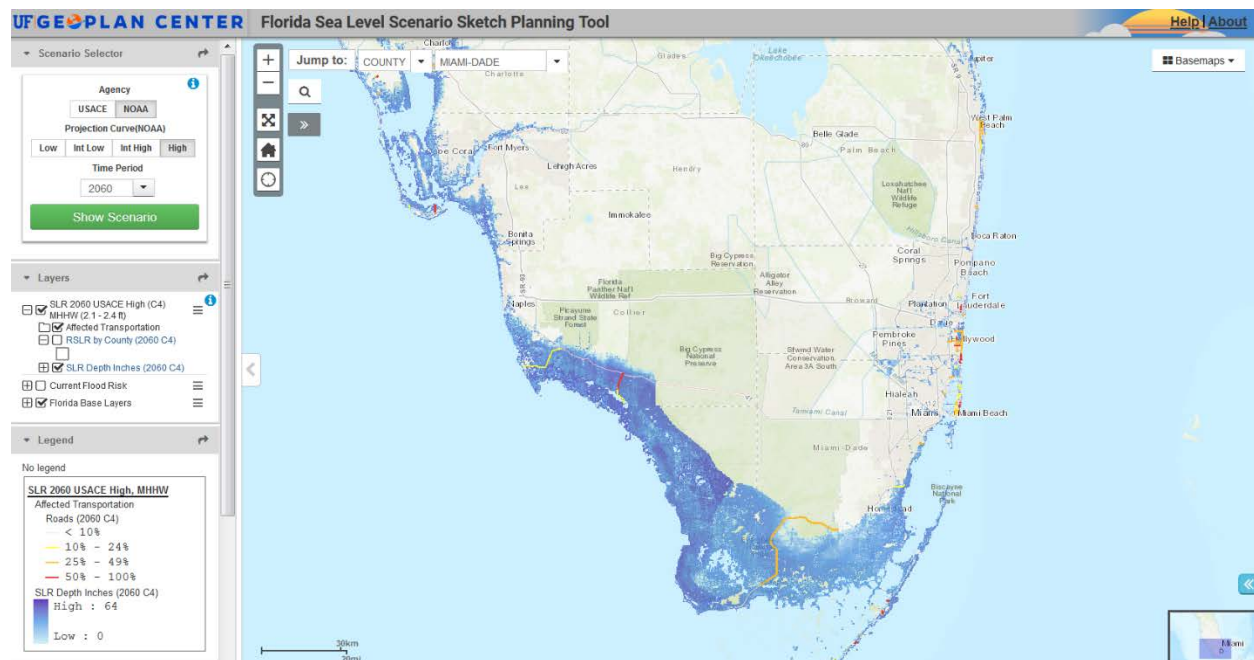


Figure 8. Sea Level Rise – Scenario of 10 ft

3.2 Sea Level Scenario (SLS) Sketch Planning Tool

<https://sls.geoplan.ufl.edu/>



In recent years, the Florida Department of Transportation (FDOT) has expressed concerns over the continuation and acceleration of sea level rise impacts in the future and the need to integrate this critical issue into its planning processes. To further this objective, FDOT provided funding to the University of Florida's Geo Plan Center to develop the Florida Sea Level Scenario Sketch Planning Tool. This tool is an interactive, web based, geospatial application designed to identify the transportation infrastructure in Florida that are most likely to be impacted by tidal inundation from the projected sea level rise.

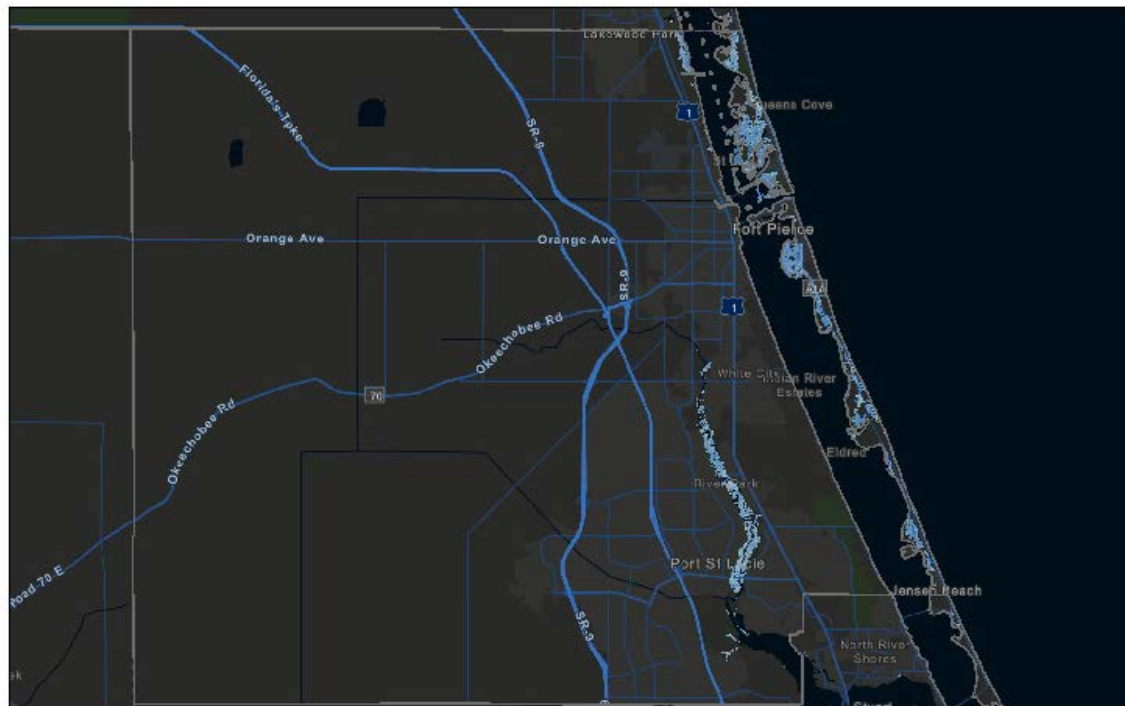
With the online map viewer, users can visualize when and where inundation is projected to occur and which transportation facilities are potentially vulnerable to inundation due to SLR. The map viewers can display SLR inundation scenarios and affected transportation infrastructure for four decades (2040, 2060, 2080, and 2100) with five SLR rates (USACE and NOAA). In this study, NOAA Intermediate High Rate Scenario was selected to project the inundation within the St. Lucie TPO area.

After exploring the study area with the Sketch Planning Tool, the SLR projections reveal that all roads in the area are mostly unaffected up until year 2060 (see figure 9), but begin to suffer impacts by 2080 (see figure 10).

For the 2080 time period, approximately 2.6 miles of roadway will experience inundation. The value will increase to 14 miles of roadway of inundation by 2100. The following table and figures quantify and illustrate vulnerable road segments for the scenario.

2080 NOAA Int High Projection					
Road Name	From	To	Length of Segment (ft)	Feet Affected	% Affected
N. BEACH CSWY	US-1	Indian River County Line	40852	2337	6%
BINNEY DR	Seaway Dr.	S. Ocean Dr.	3870	640	17%
S. OCEAN DR	Harbour Isle Dr.	Martin County Line	88333	10754	12%
Total			133056	13731	10%
2100 NOAA Int High Projection					
Road Name	From	To	Length of Segment (ft)	Feet Affected	% Affected
S. INDIAN RIVER DR	Savannah Rd.	Martin County Line	61421	366	1%
AVE H	N. 7th St.	Coast	2032	838	41%
AVE C	US-1	N. Indian River Dr.	1197	196	16%
N. BEACH CSWY	US-1	Indian River County Line	40852	8336	20%
BINNEY DR	Seaway Dr.	S. Ocean Dr.	3870	3001	78%
S. OCEAN DR	Harbour Isle Dr.	Martin County Line	88333	61010	69%
SEAWAY DR	US-1	Harbour Isle Dr.	6569	255	4%
Total			204275	74002	36%

Table 1. Flooded Roadways by 2080 and 2100 (NOAA Int High Projection)



SLR Depth Inches:

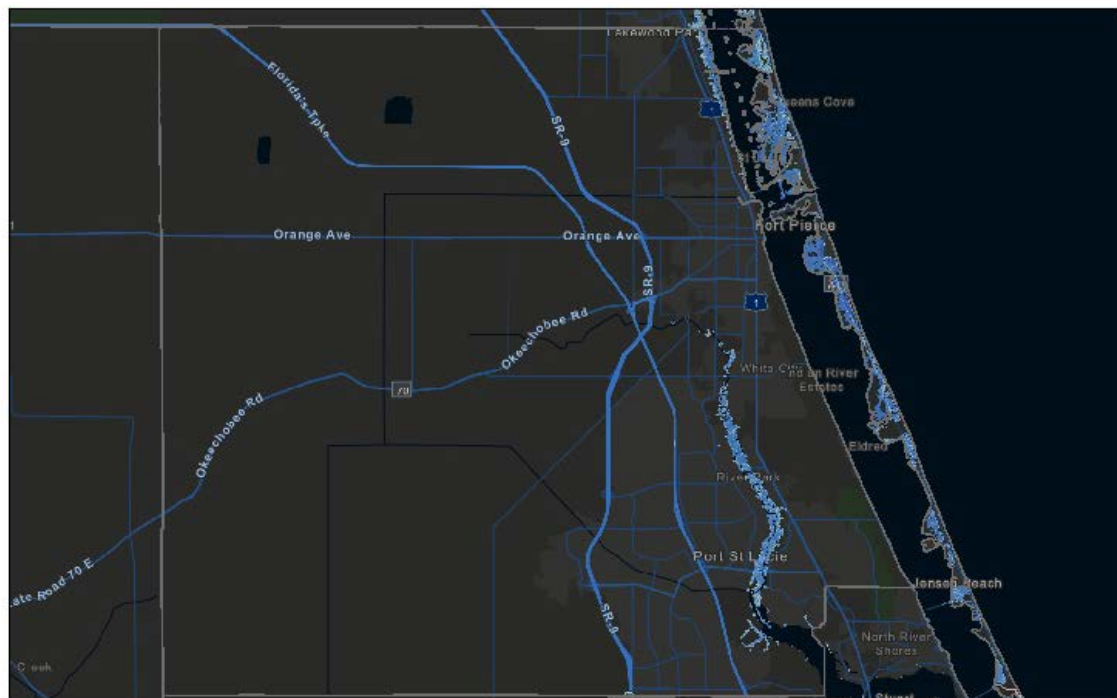
High: 50

Low: 0

2040 SLR

1:288,895

0 2.25 4.5 9 mi
0 3.5 7 14 km



SLR Depth Inches:

High: 69

Low: 0

2060 SLR

1:288,895

0 2.25 4.5 9 mi
0 3.5 7 14 km

Figure 9. No Flooded Roadways by 2060 (NOAA Int High Rate)

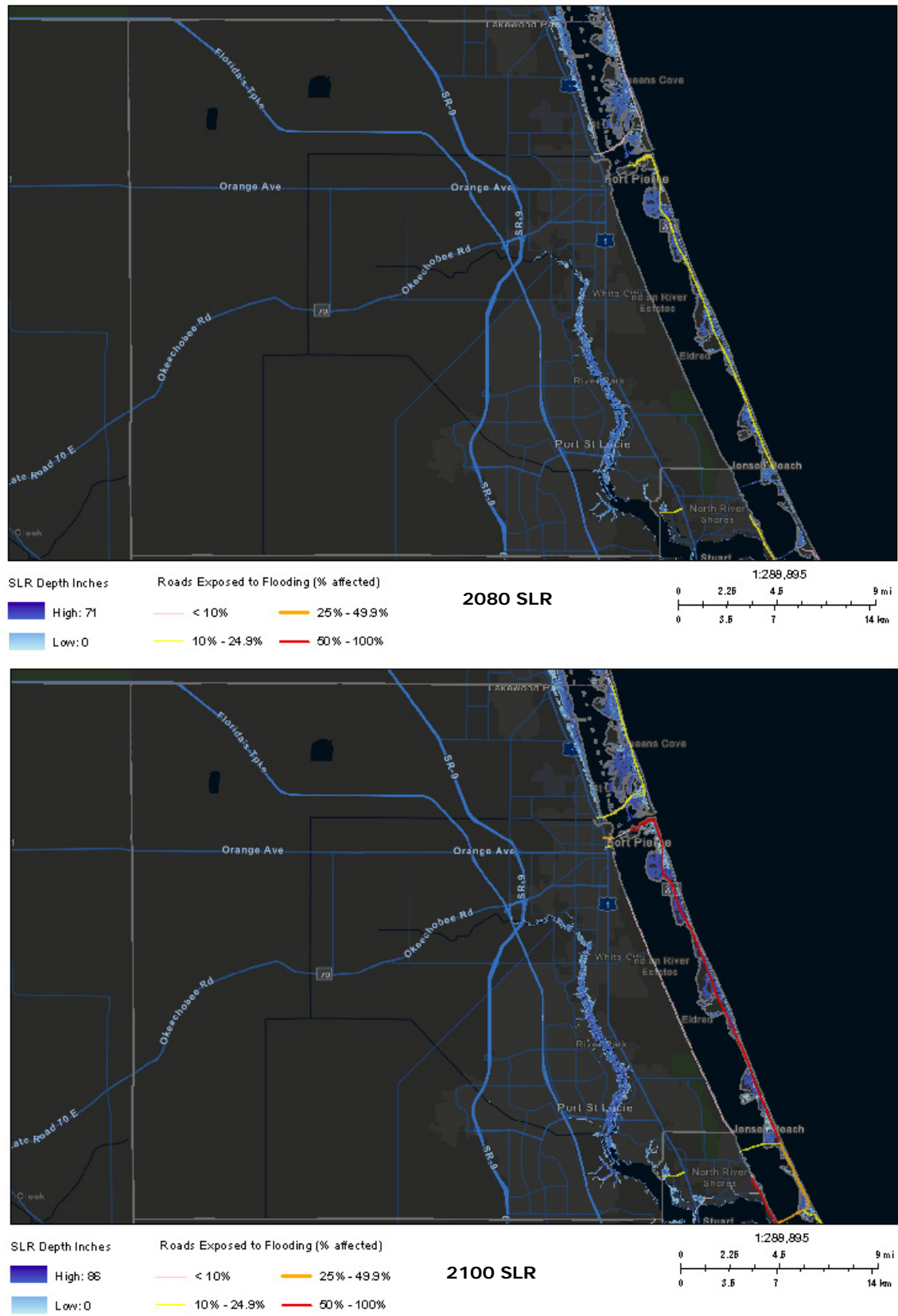


Figure 10. Flooded Roadways by 2080 and 2100 (NOAA Int High Projection)

4. CONCLUSION

It is evident that sea level rise poses the greatest threat to coastal communities due to their proximity to oceans and other large bodies of water. Consequently, the risk of roadway flooding in these areas from tidal inundation, groundwater lifting and higher storm surges will increase.

Spatial information technologies such as the SLS Sketch Planning Tool help to increase the visual understanding of the future expansion of coastal water bodies and the potential inundation of vulnerable transportation facilities and infrastructure by mapping the location of projected impacts. The technology also helps to inform the St. Lucie TPO and local jurisdiction's processes of planning, prioritizing and directing resources toward transportation infrastructure design, construction, improvement and maintenance.

Based on the SLR projected by the Sketch Planning Tool with NOAA intermediate high rate, the following road segments will be impacted by 2080:

- 6% of N. Beach Causeway from US-1 to Indian River County line
- 12% of S. Ocean Drive from Harbour Isle Drive to Martin County line
- 17% of Binney Drive

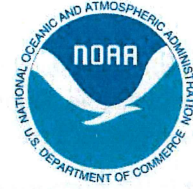
By 2100, the following road segments will be impacted:

- 1% of S. Indian River Drive from Savannah Road to Martin County line
- 4% of Seaway Drive from US-1 to Harbour Isle Drive
- 16% of Avenue C from US-1 to N. Indian River Drive
- 20% of N. Beach Causeway from US-1 to Indian River County line
- 41% of Avenue H from N. 7th Street to the coast
- 69% of S. Ocean Drive from Harbour Isle Drive to Martin County line
- 78% of Binney Drive

The Sea Level Rise Mapping study serves as a guide to begin the preliminary discussions necessary to develop a framework for a comprehensive transportation system vulnerability assessment. The St. Lucie TPO will continue to coordinate with other government agencies and non-governmental entities in the TPO area to assess existing and projected transportation facilities conditions related to climate change and sea level rise and to develop appropriate strategies.

Appendix A: Coastal Flood Exposure Mapper Q&A

Frequent Questions



Coastal Flood Exposure Mapper

NOAA Office for Coastal Management
coast.noaa.gov/digitalcoast/tools/flood-exposure.html

At what scale is the tool meant to be used?

The mapper is a screening-level tool with existing national data that are locally relevant. The mapper was developed to get the conversation started around coastal flood hazard risks and associated vulnerabilities, but we encourage users to obtain local data to conduct more detailed analyses, if necessary.

At what scale are the data being displayed?

For the contiguous United States, map data are displayed down to the neighborhood level—roughly 1:9,000. For Hawaii and U.S. territories in the Pacific and Caribbean, map data are displayed one additional level down—to roughly 1:4,500.

What is the boundary for coastal counties shown in the mapper?

The county data set used in the mapper is a generalized county boundary data set that includes a three-kilometer buffer along the shoreline of shore-adjacent counties.

Which coastal counties are included?

Coastal counties within the generalized county boundary data set that have data for one or more coastal flood hazards included. If data are not available for a location, it is not included in the mapper.

Why is my county missing data for one or more of the coastal flood hazards?

Sea Level Rise and High Tide Flooding – Your county may not have suitable lidar-based elevation data and hydro-enforced digital elevation models required for accurate coastal inundation mapping.

FEMA Flood Zones – a) Digital flood data may not exist for your county or may not have existed when the mapper was completed. Check the availability of data for your county on FEMA's Flood Map Viewer. The flood data used in the mapper are a combination of Digital Flood Insurance Rate Maps and Q3 flood data available as of October 2018.

b) Your county may only have paper Flood Insurance Rate Maps (FIRMs). Check to see the availability of FIRMs for your community.

c) Your county may not participate in the National Flood Insurance Program (NFIP), which means that flood maps have not been created. Check your state to determine if your county or community participates. You may also contact your state or local floodplain manager as listed on the Association of State Floodplain Managers' website.

Coastal Flood Hazard Composite – The flood hazard composite includes multiple flood hazard data sets combined (best available as of October 2018), including high tide flooding; FEMA flood data including V zones, A zones, and 500-year zones treated as individual layers; storm surge for category 1, 2, and 3

hurricanes; sea level rise scenarios for 1, 2, and 3 feet above mean high tide; and tsunami run-up zones where available. Flood hazard composites were developed only for counties that have all three of the following hazard data sets: FEMA flood zones, sea level rise scenarios, and high tide flooding.

What is the purpose of the Coastal Flood Hazard Composite map?

The concept for a coastal flooding composite hazard layer was initially developed for coastal areas of New York after Hurricane Sandy to depict geographically dependent susceptibility to coastal flooding, storm surge, and long-range inundation impacts. The mapping method was modified and expanded to the rest of the East Coast, Gulf of Mexico, West Coast, and Pacific and Caribbean islands and territories for the Coastal Flood Exposure Mapper. This map layer aggregates risk information for multiple coastal flood hazards. This map shows the gradient of coastal flood risk that ranges from areas outside the FEMA 1% annual chance floodplain that are still at risk from high magnitude, low frequency events like major landfalling hurricanes and tsunamis, to areas nearer the coast that are also at risk from higher frequency flood events, wave impacts, and long-term sea level change. At any given location the user can query which coastal flood hazards may impact that spot. This layer should not be confused with, and may not be substituted for, any existing regulatory risk maps or associated boundaries. These maps are for planning purposes only.

Does the sea level rise map show scenarios added to FEMA flood zones (base flood elevation)?

No. The sea level rise layers show inundation scenarios of 0 to 10 feet based on the current average highest high tide (called mean higher high water, or MHHW).

Are the data available for download?

The layers displayed in the Coastal Flood Exposure Mapper are available as map services to pull into platforms outside the tool. However, data are not available for download directly from the tool. In most cases, data used in these layers can be downloaded from the authoritative source. View the “Data Sources” documentation for links to the map services and the authoritative sources for each data set.

Are you expanding the mapper nationally?

We have gradually expanded the geographic coverage of the Coastal Flood Exposure Mapper. Currently, the mapper covers coastal areas along the East Coast, West Coast, Gulf of Mexico, Hawaii, and U.S. territories in the Pacific and Caribbean. We are exploring options to expand the mapper to other regions. Please [contact us](#) if interested.

Do you have examples of how communities have used the mapper?

The “Related Stories” section of the Digital Coast mapper home page has several stories describing how communities have used the mapper. We are always interested in learning how the tool has been used. Please [contact us](#) to share your examples. Your story may help others.

How does this tool differ from NOAA’s Sea Level Rise Viewer?

The mapper was designed with a specific audience in mind and was developed based on needs heard during NOAA’s risk and vulnerability trainings for maps that show coastal flood hazards in addition to sea level rise, along with community assets. Sea level rise and high tide flooding data from the Sea Level Rise Viewer are included in the mapper. The Sea Level Rise Viewer is focused specifically on sea level rise, high tide flooding, and marsh impacts.

Can we add our own local data to the mapper?

No, but layers displayed in the mapper are available as map services (links in the “Data Sources” documentation), which you can use in online mapping platforms or desktop software to create maps with local data. Visit the [ArcGIS Online Tutorial](#) to learn how to add data and map services to a map in that free online mapping platform.

**Appendix B: Sea Level Scenario Sketch Planning Tool Map Viewer
User Guide**

Map Viewer User Guide

Sea Level Scenario Sketch Planning Tool

Version 2, 2017

University of Florida GeoPlan Center



Introduction

The purpose of this document is to guide users on how to use the Sea Level Scenario Sketch Planning Tool Map Viewer (Version 2). The map viewer visualizes transportation assets and their exposure to **current flood risk** (100-year and 500-year floodplains and hurricane storm surge zones) and **future flood risk** using sea level rise (SLR) scenarios from the U.S. Army Corps of Engineers (USACE, 2013) and the National Oceanic and Atmospheric Administration (NOAA, 2012)/ National Climate Assessment.

The SLS Sketch Planning Tool was created by the University of Florida GeoPlan Center with funding from the Florida Department of Transportation. SLR scenarios and transportation analyses were updated in 2017 with updated input data and a new map viewer was developed for data visualization. The SLS Sketch Planning tool can assist in understanding how and when future sea level rise may impact the transportation system.

The SLS Sketch Planning Tool includes: (1) Online map viewer for visualizing current and future flood risk under SLR scenarios and potentially affected transportation infrastructure. (2) GIS data layers of SLR inundation and affected transportation; and (3) ArcMap add-in tool for creating GIS layers of SLR inundation.

Accessing the Map & Supported Browsers

The map viewers are accessible from the project website: <http://sls.geoplan.ufl.edu>

From the website, click on the “View Maps” tab at the top of the page to access the map viewers.

The Map Viewer is best viewed in Google Chrome or Mozilla Firefox.

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SLR Projections and Areas Mapped

Users can explore areas of projected inundation and potentially affected infrastructure under five SLR scenarios at time periods (2040, 2060, 2080, and 2100).

SLR Projection Curves

A total of **five SLR projection curves** from USACE (2013) and NOAA (2012) can be displayed in the viewer. **Please note:** there are 3 USACE projections and 4 NOAA projections, but 2 of the projections are the same.

The table to the right shows the five SLR projections available for display in the Map Viewer. In the map, each scenario is named with a “C1” through “C5” to indicate the SLR curve. C1 is the *lowest* rate of SLR, while C5 is the *highest* rate of SLR.

The graph shows the projected amounts of relative SLR from 2000 – 2100 using these five SLR projection curves. The graph and SLR projections were generated from the USACE Sea Level Change Curve Calculator (2015.46) and NOAA sea level trends from 2015.

USACE Sea-Level Change Curve Calculator

<http://www.corpsclimate.us/ccaceslcurves.cfm>

USACE (2013). *Incorporating Sea Level Change into Civil Works Programs*. [ER 1100-2-8162](https://www.federalregister.gov/documents/2013/04/23/2013-08162).

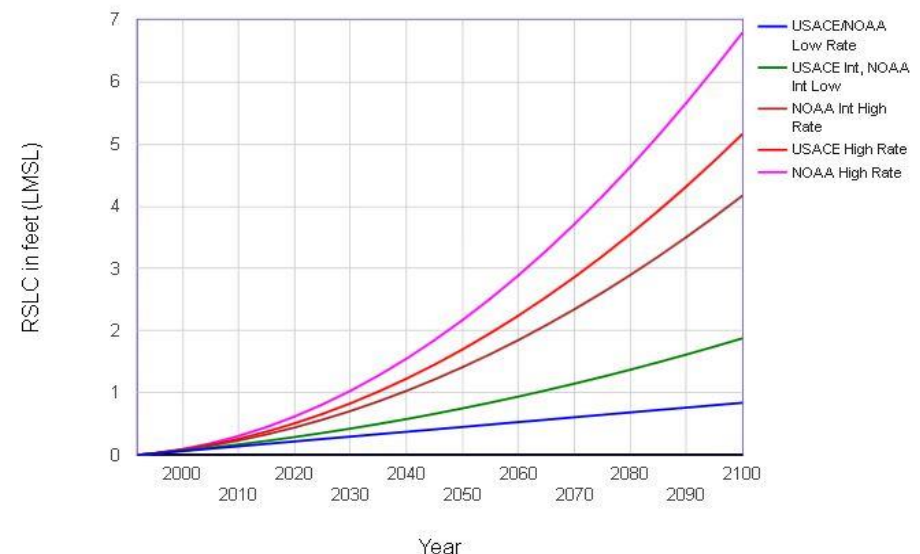
http://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1100-2-8162.pdf

NOAA (2012). *Global Sea Level Rise Scenarios for the United States National Climate Assessment*.

https://scenarios.globalchange.gov/sites/default/files/NOAA_SLR_r3_0.pdf

SLR Projection Curves

SLR Curve	SLR Curve Description	Amount of SLR (relative to mean sea level) by 2100
C5	NOAA High Rate (2012)	~ 6.6 feet (or 2.0 m)
C4	USACE High Rate (2013)	~ 5.0 feet (or 1.5 m)
C3	NOAA Intermediate High Rate (2012)	~ 3.9 feet (or 1.2 m)
C2	USACE Intermediate Rate (2013) / NOAA Intermediate Low Rate (2012)	~ 1.6 feet (or 0.5 m)
C1	USACE Low Rate (2013)/ NOAA Low Rate (2012)	~ 8 inches (or 0.2m)



U.S. Army Corps of Engineers and National Oceanic and Atmospheric Administration Relative Sea Level Change Projections for Key West, FL

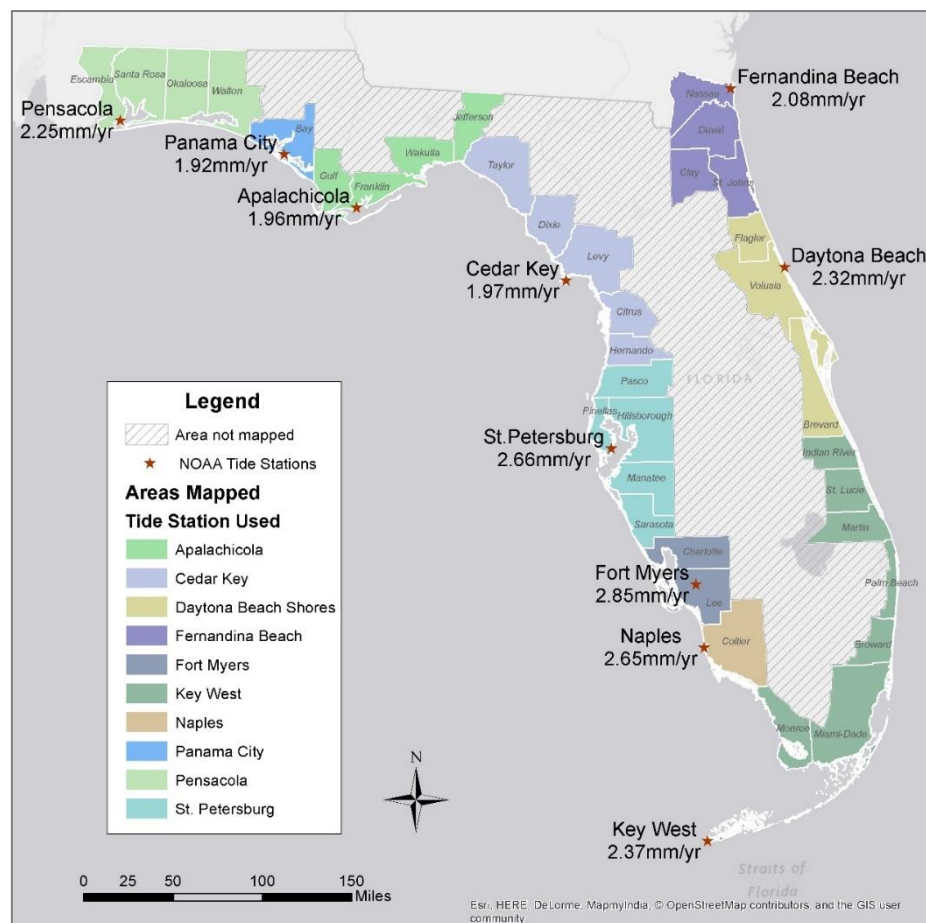
Areas Mapped, Sea Level Trends & Tide Stations Used in Inundation Mapping

SLR scenarios were mapped by county using local tide gauge data and sea level trends. The map to the right shows the coastal areas mapped and tide stations used for each county. Some areas were not mapped due to the lack of high resolution elevation data.

The USACE Sea-Level Change Curve Calculator (2015.46) and 2015 NOAA sea level trends for ten Florida tide stations were used to generate relative SLR values for five SLR curves by decade from 2040 - 2100. Only four decades (2040, 2060, 2080, 2100) are currently displayed in the map viewer, but all are available for download.

Projected inundation was mapped on top of Mean Higher High Water (MHHW), using a tidal surface grid (obtained from NOAA Office of Coastal Management) that represented MHHW conditions around the State. Inundation surfaces were mapped using a 5-meter horizontal resolution, lidar-based Digital Elevation Model (DEM).

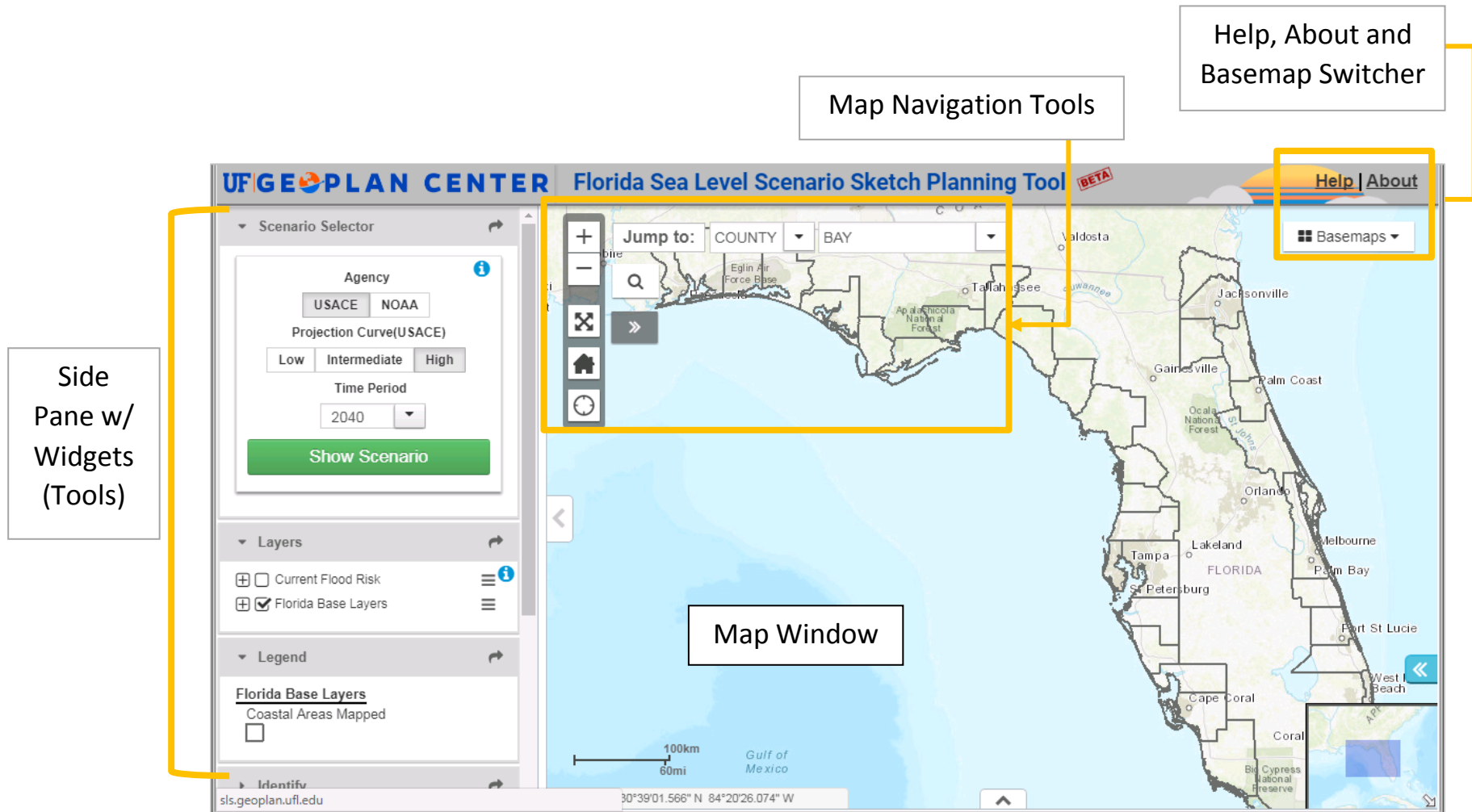
A straight bathtub model and enhanced bathtub model with hydro-connectivity assessment were both produced. Only the hydro-connectivity model outputs are displayed in the map viewer, though bathtub models are available for download.



Coastal Areas Mapped and Tide Stations used by County for Inundation Mapping

Map Viewer – Overview

This is the default view of the Map Viewer. This User Guide will explain how to use the map navigation tools and additional tools, called “widgets” located in the Side Pane.



Map Navigation Controls

The Map controls are in the top left corner of the map. On opening the map viewer, the default map control is pan. Left-click and drag the mouse to pan on the map.

Vertical Navigation Bar



Fixed Zoom In/ Zoom Out:

Zooms in and out of the map. If you have a scroll wheel on your mouse or keyboard, then you can zoom in or out on the map, regardless of the map control selected.



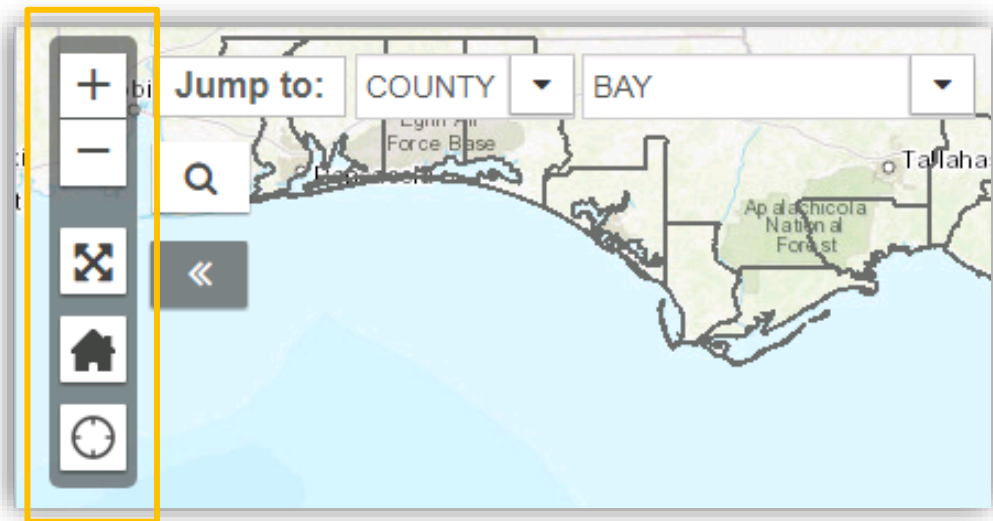
Full Screen: Expands the browser to the full extent of your computer screen. To get out of full screen, simply hit the Esc button.



Home: Zooms to the default extent of the map, which is the State of Florida.



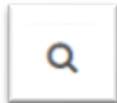
Locate Me: Zooms the map to your current physical location (level of accuracy depends on your location). You first need to allow the map to access your location.



After clicking the Locate Me button, the compass icon will change to a square stop icon and on the map, there will be a blue dot with a blue circle around it. Remember to click on the Stop button to close the Locate Me. Your map will stay in the same place.

Jump to

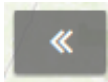
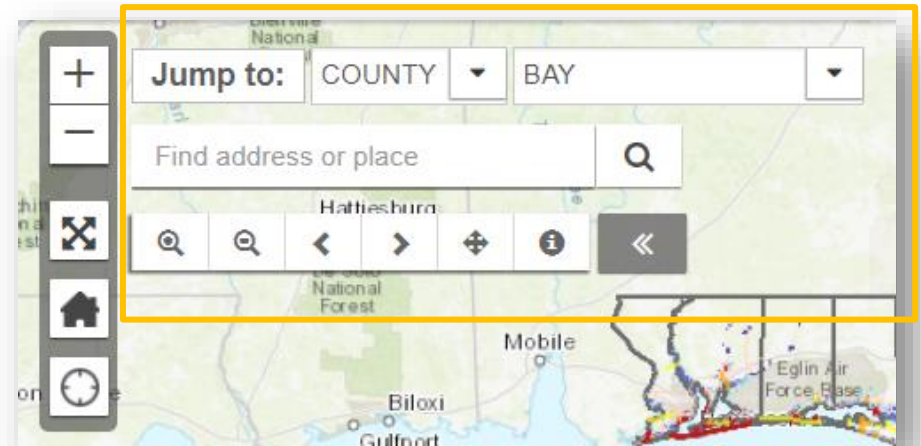
Zooms to predefined regions. First, choose a region type (County, FDOT District, MPO or State). Then select a region from the list.



Address Locator

Zooms to an address. First, click on the magnifying glass to open the tool. Then enter a valid address in the input box and hit enter. The map will zoom to that address. The input box will auto-complete with known addresses.

To minimize the address locator, first click **in** the box (where it says “Find address or place”) and then click anywhere on the map.



Additional Map Navigation Toolbar

Toolbar with additional map navigation tools. By default, the toolbar is closed. Click the double arrows to open the tool bar.

Zoom In: Draw a box to zoom in to desired extent

Zoom Out: Draw a box to zoom out to desired extent

Pan: Grab map and drag to desired location



Open/
Close
toolbar

Previous Extent:
Jump back to last map extent

Next Extent:
Return to map extent prior to using previous extent

Identify: Show attribute information of map features

Help

The Help link opens a pop-up window that contains introductory information about the map viewer, a list of map navigation short cuts for the mouse and keyboard, and links to User Guides. This is the same pop-up window that appears on the first load of the website.

About

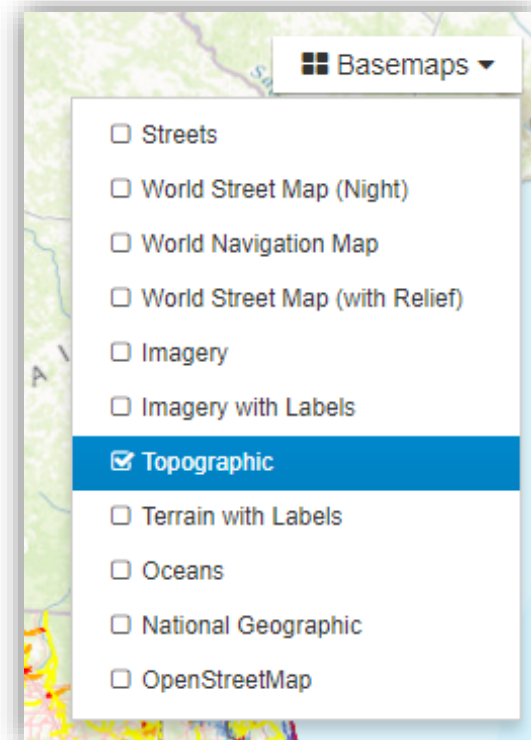
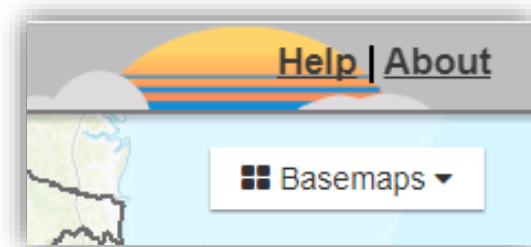
The About link will open the Sea Level Scenario Sketch Planning Tool main website in another browser tab or window. The website contains more information about this project.

Basemap Switcher

The widget allows you to change the basemap of your map. The topographic basemap is displayed by default.

To change the basemap, first click on the basemap menu to see the available maps. Then check the basemap you would like to use and the map will be refreshed with your choice.

These basemaps are pulled from ArcGIS online, and periodically, they are unavailable. If the basemap you chose does not display, then choose another one.



Widget Controls

Widgets are tools that allow you to interact with the map and data. The widgets are in the side pane (left side of map viewer) and each widget is represented by a gray bar.

The widgets are designed to open and close. You can open the widget to see more detail and close the widget to save space and reduce visual clutter. Some widgets are open by default, including the Scenario Selector, Layers and Legend widgets.

Additionally, the widgets are designed to “dock” and “undock” from the left side pane to give you flexibility on where you want to place the tools.

Open/ Close Widgets

To open a widget, click on the gray bar near the widget name. Closed widgets have an arrow pointing to the right, while open widgets have an arrow pointing down.

Dock/ Undock Widget

Undocking allows you to move the widget outside of the side pane. To undock, drag and pull from the grey bar. The left pointing arrow indicates the widget is undocked.

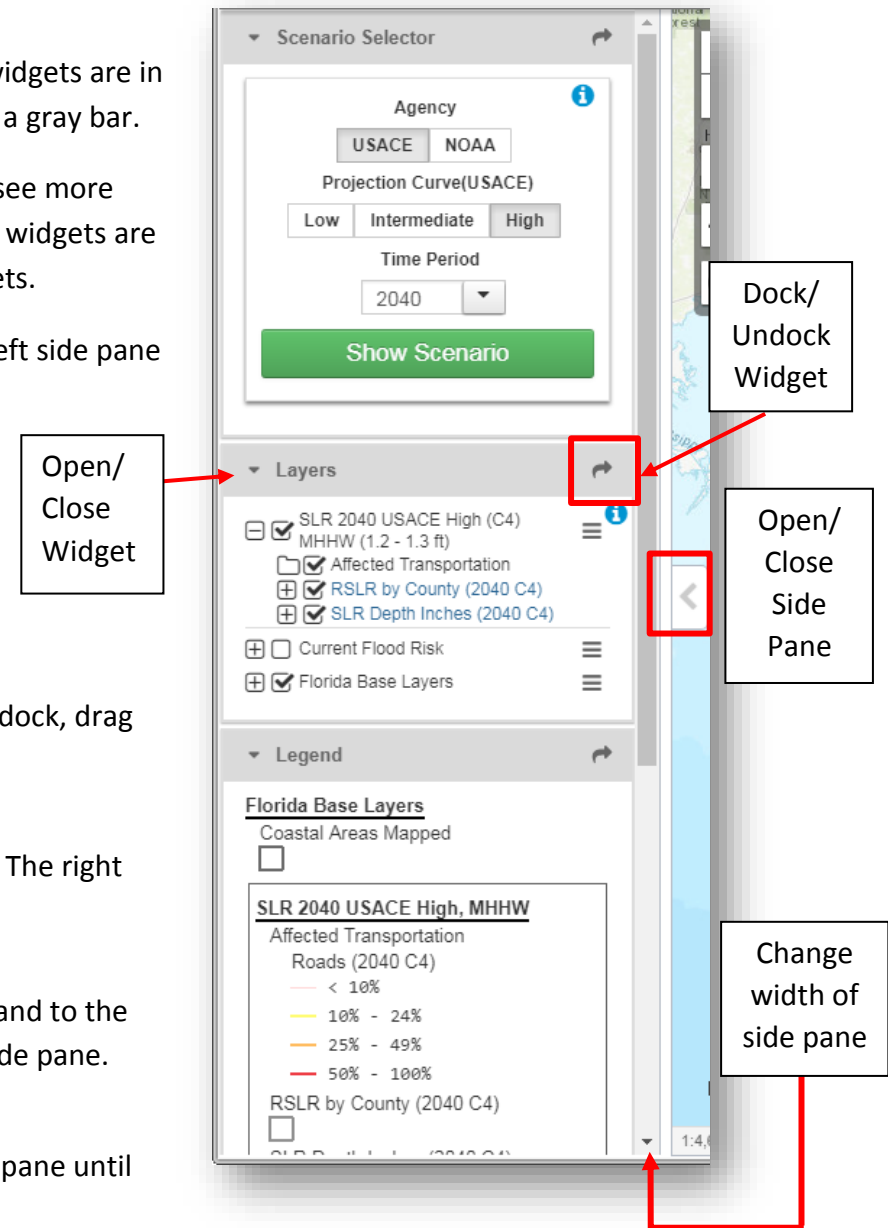
To dock the widget back to the side pane, click on the left pointing arrow. The right pointing arrow indicates the widget is docked.

Open/ Close Side Pane

Click the left pointing arrow to close the side pane. The map will now expand to the full extent of the browser. Click on the right pointing arrow to open the side pane.

Change Width of Side Pane

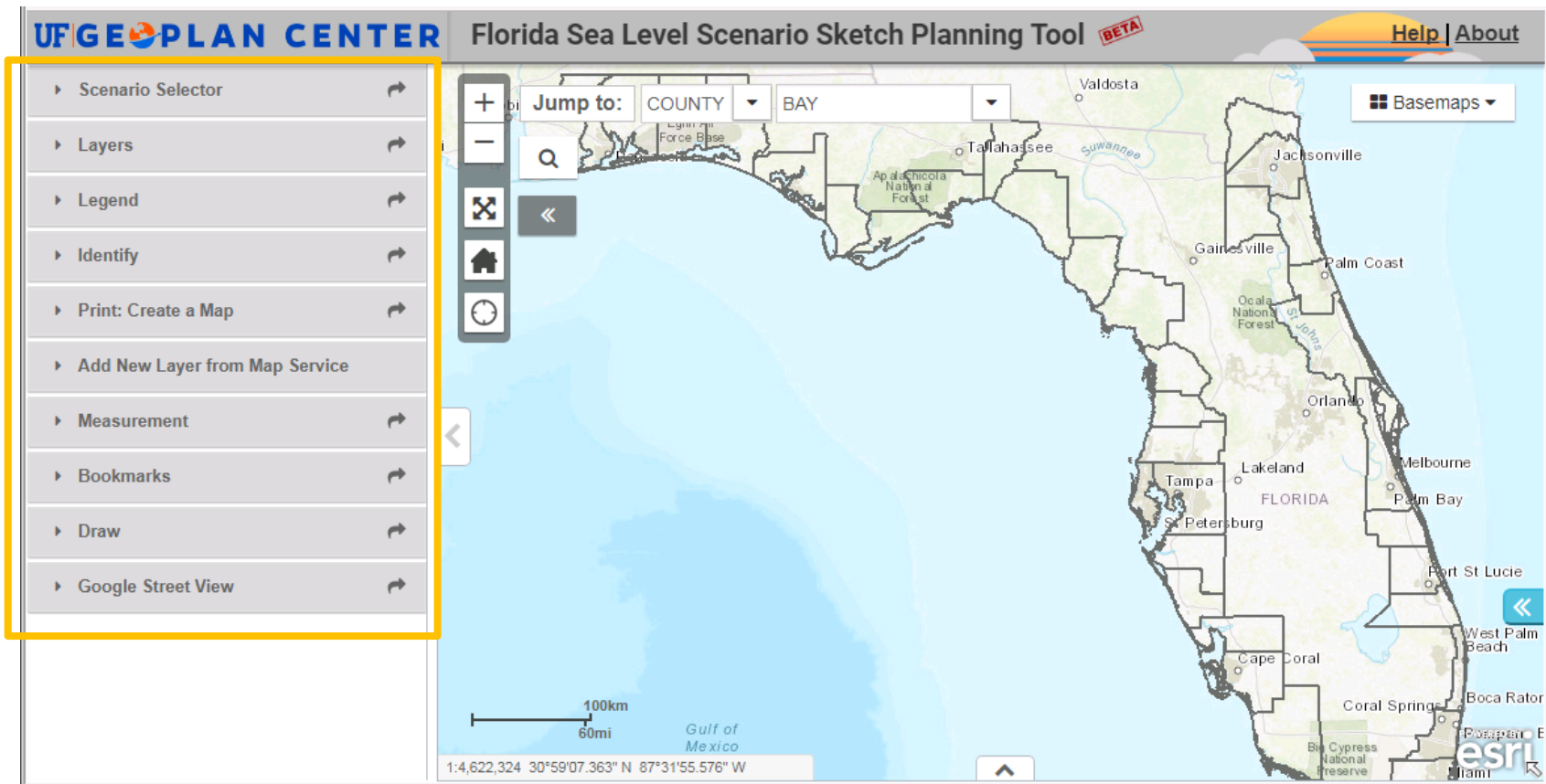
To change the width of the side pane, mouse over the right border of the pane until you see the double arrows, then drag to the desired width.



Tools aka “Widgets”

The widgets are located in the side pane on the left side of the map viewer. Below is a view of the map with all widgets closed. If you have not read the prior page on Widget Controls, then you should do that now.

The following pages will go into detail on each widget. We will first discuss the Layers Widget, then the Scenario Selector Widget, and then the other widgets in the order they are shown below. Since the Scenario Selector adds layers to the Layers widget, it is important to discuss the Layers Widget first.



Layers

The Layers widget includes the map layers available for display. Each group of layers is a map service. By default, two map services are included in the widget:

Current Flood Risk & Florida Base Layers.

- **Current Flood Risk** includes current floodplain and storm surge layers and roadways exposed to current flood risks.
- **Florida Base Layers** contains base roads data, a polygon layer representing areas mapped, and elevation data.
- SLR Scenario data layers must be added by the user through the Scenario Selector.

Please see the information icon for more information about the data layers.

Working with Layers

Open/ Close Map Service

To open the map service, click on the plus + sign to the left of the name. To close the map service, click on the minus – sign to the left of the name.

Open/Close Folders

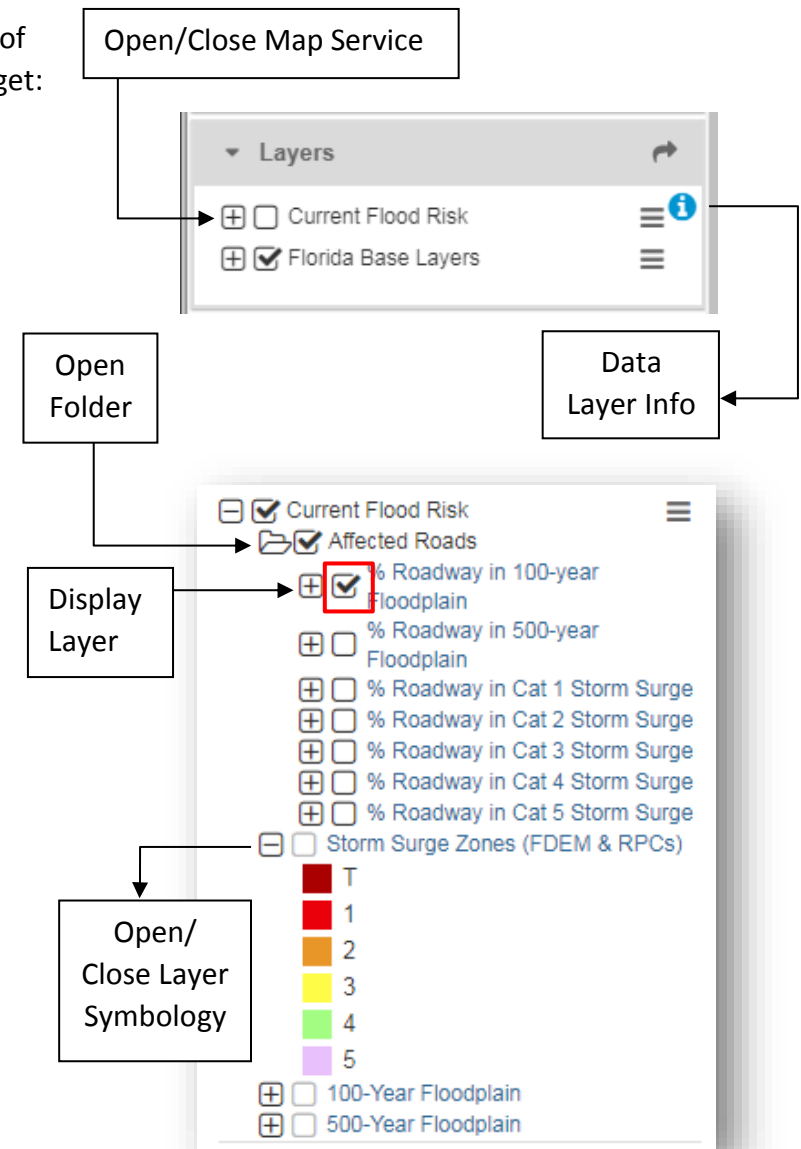
Click on the closed folder icon to open that folder and see the individual layers. To close the folder, click on the open folder icon.

Turning on Visibility of Layers

To “turn on” or display a layer on the map, check the empty box next to the layer name. Layers that are visible in the map will already have a check box.

Show/ Hide Symbology

The plus signs next to individual layers control whether show/ hide legend



Layer Controls:

On the right side of each map service, there is a menu with additional layer settings.



Move Up/ Move Down

Allows you to re-order the map services in the Layers Widget. Move up will move the map service up and Move Down will move the map service down. The option will be greyed out if that operation is not available.

Turn On All Sublayers/ Turn Off All Sublayers

Controls layer visibility. Turns on or off all the layers in that map service.

Transparency

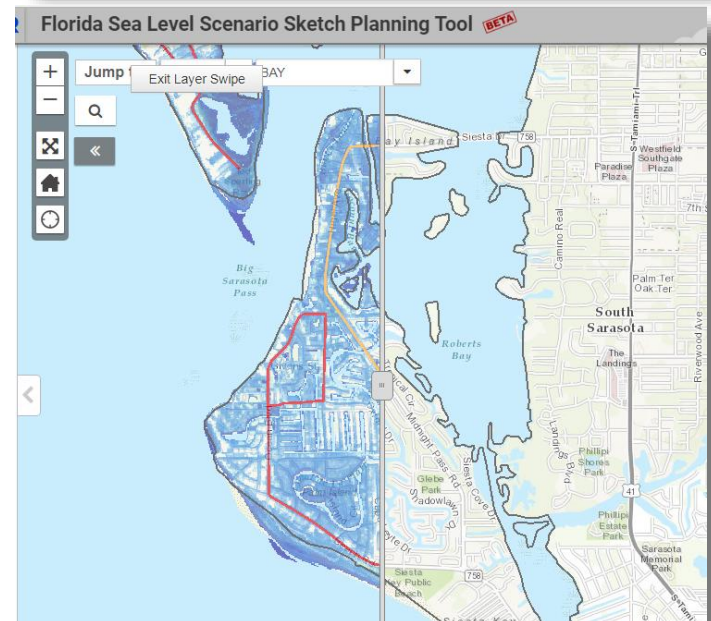
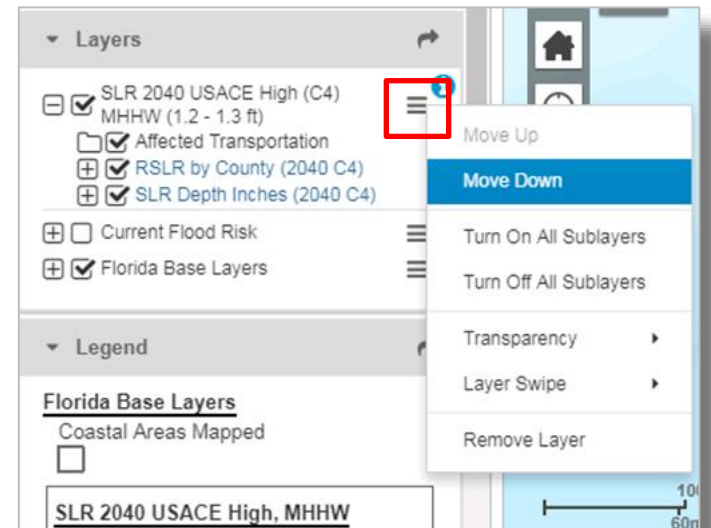
Allows you to change the transparency of the map layers. A slider bar allows you to change the map layer transparency from 0 to 100%, where 0% is opaque and 100% makes the map layers completely transparent/invisible. The transparency setting controls all the layers in the map service.

Layer Swipe

Allows you to pull or swipe one map service on and off over the map. You can do a vertical or horizontal swipe. The example to the right shows a vertical swipe, with SLR layers. **Tip:** When using Layer Swipe with two SLR scenarios, start the swipe from the scenario with more SLR.

Remove Layer

Removes SLR Scenario map services from the Layers Widget. We recommend looking at no more than 3 scenarios at a time. The maximum number of scenarios that can be added is 6.



Scenario Selector

The Scenario Selector is how you add SLR layers to the map.
It requires 3 inputs: Agency, Projection Curve and Time Period.

1. **First, choose an Agency:** This is the source agency of the SLR projection.

USACE = United States Army Corps of Engineers

NOAA = National Oceanic and Atmospheric Administration

After selecting the Agency, the Projection Curves will automatically change to show the curves for that agency.

2. **Next choose a Projection Curve**

Projection Curve (USACE):

Low = About 8 inches (or 0.2m) SLR by 2100

Intermediate = About 1.6 feet (or 0.5 m) SLR by 2100

High = About 5 feet (or 1.5 m) by 2100

Projection Curve (NOAA):

Low = About 8 inches (or 0.2m) SLR by 2100

Int Low = Intermediate Low, about 1.6 feet (or 0.5 m) SLR by 2100

Int High = Intermediate High, about 3.9 feet (or 1.2 m) by 2100

High = About 6.6 feet (or 2.0 m) by 2100

3. **Next, choose a Time Period**

Decades available: 2040, 2060, 2080, 2100

4. **Finally click “Show Scenario”**

The map layers for the scenario selected will be added to the map.

Click on the blue information icon to access the pop-up help.

The image displays two screenshots of the 'Scenario Selector' interface and a 'Scenario Selector Pop-up Help' window. The top-left screenshot shows the 'USACE' agency selected, with projection curves 'Low', 'Intermediate', and 'High' available. The top-right screenshot shows the 'NOAA' agency selected, with projection curves 'Low', 'Int Low', 'Int High', and 'High' available. Both screenshots have a red circle around the information icon (i) in the top right corner. The bottom screenshot is a pop-up help window titled 'Scenario Selector' with a close button (X). It contains the following text: 'To view a SLR scenario, please choose one of each of the following: 1 - First choose a source Agency (either USACE or NOAA) for projections'. It lists USACE projections (C1 = USACE Low, C2 = USACE Intermediate, C4 = USACE High) and NOAA projections (C1 = NOAA Low, C2 = NOAA Intermediate Low, C3 = NOAA Intermediate High). A box labeled 'Scenario Selector Pop-up Help' with an arrow points to the pop-up window.

Scenario Selector

Agency

USACE NOAA

Projection Curve(USACE)

Low Intermediate High

Time Period

2040

Show Scenario

Scenario Selector

Agency

USACE NOAA

Projection Curve(NOAA)

Low Int Low Int High High

Time Period

2040

Show Scenario

Scenario Selector

To view a SLR scenario, please choose one of each of the following:

1 - First choose a source Agency (either USACE or NOAA) for projections

- USACE = U.S. Army Corp of Engineers sea level projections
- NOAA = National Oceanic and Atmospheric Administration sea level projections

2 – Next choose the projection curve, C = curve, the higher the number the larger the SLR

USACE has three projections:

- C1 = USACE Low (Same as NOAA Low)
- C2 = USACE Intermediate (Same as NOAA Int Low)
- C4 = USACE High

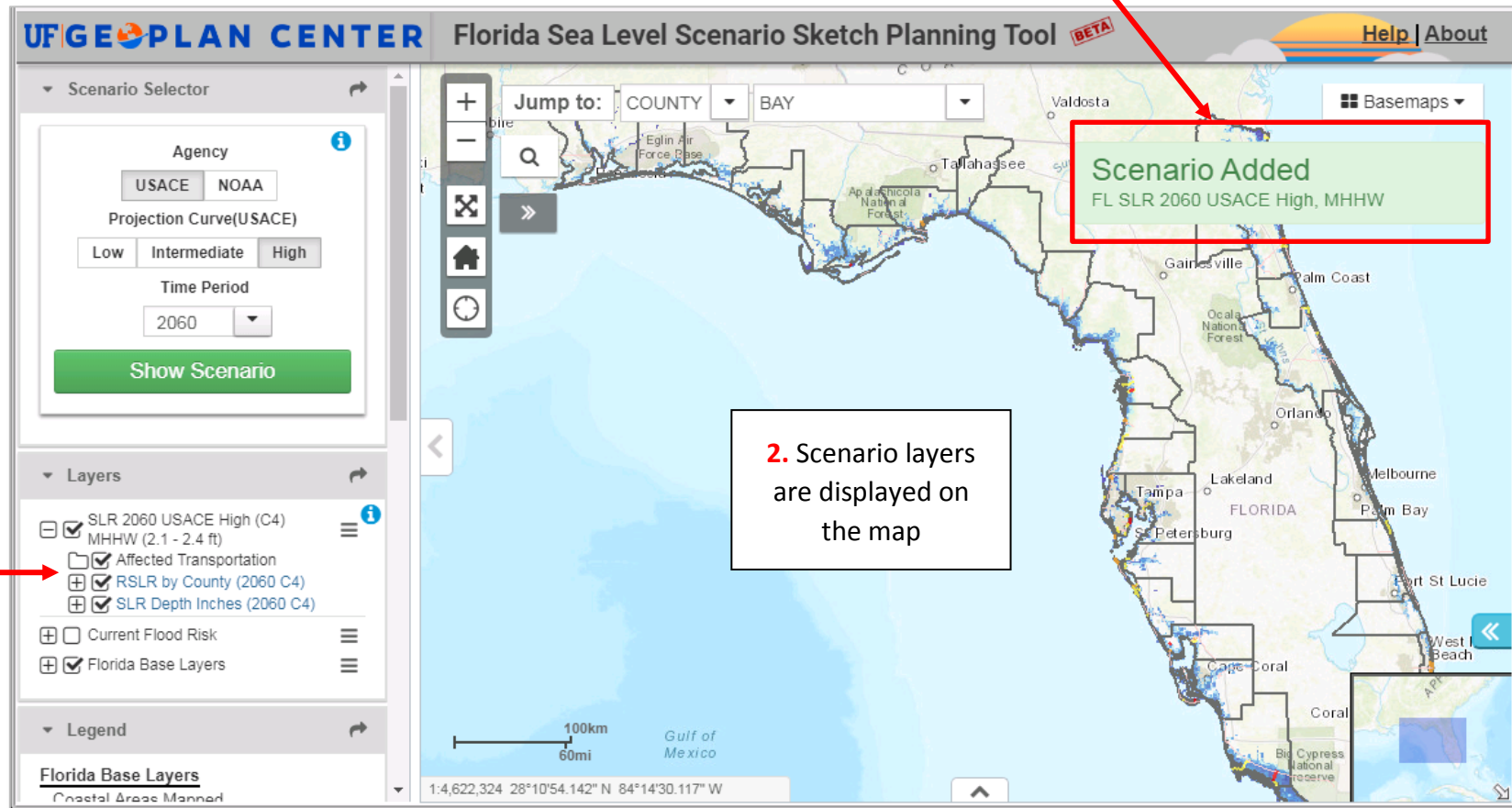
NOAA has four projections:

- C1 = NOAA Low (Same as NOAA Low)
- C2 = NOAA Intermediate Low (Same as NOAA Int)
- C3 = NOAA Intermediate High

Scenario Selector Pop-up Help

Using the Scenario Selector

1. After choosing a scenario and clicking “Show Scenario”, a message will appear in the top right to indicate whether the scenario loaded properly.



2. Scenario layers are displayed on the map

3. Scenario layers are added to the Layers Widget. By default, three layers are visible on the map: Affected Roads, RSLR by County and SLR Depth Inches.

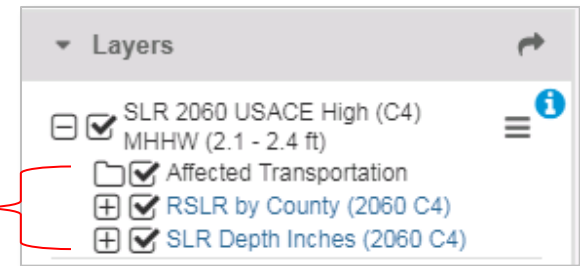
Exploring the SLR Scenario Layers

There are six data layers added with each SLR scenario map service.

Three of these layers are visible on the map by default (these are listed in bold):

1. **Roads:** RCI Roads affected by SLR scenario
2. **RSLR by County:** SLR over MHHW amount by county
3. **SLR Depth Inches:** Extent and depth of flooding in inches
4. SIS Highways: SIS Highways affected by SLR scenario
5. SIS Rails: SIS Rails affected by SLR scenario
6. SIS Facilities: SIS Facilities affected by SLR scenario

Layers visible
by default



For more information on the individual layers, see the [Map Viewer Data Layers Guide](ftp://ftp.sls.geoplan.ufl.edu/pub/sls/docs/Map_Viewer_Data_Layers_Guide_v2.pdf)
ftp://ftp.sls.geoplan.ufl.edu/pub/sls/docs/Map_Viewer_Data_Layers_Guide_v2.pdf

Scenario Naming

The Scenario Name includes the year and projection curve, and shows the amount of relative SLR above MHHW.

Ex: On the previous page, we chose USACE, High, and 2060.

As a result, the SLR Scenario loaded is:

“SLR 2060 USACE High (C4) MHHW (2.1 – 2.4 ft)”

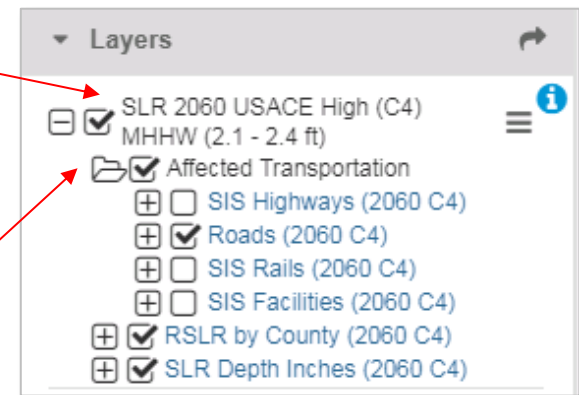
Relative SLR is a range because projections were generated by county and vary slightly based on local sea level trends. All six layers are named with “2060 C4” to indicate the SLR scenario.

SLR Curve Key

- | | |
|----|---|
| C5 | NOAA High Rate (2012) |
| C4 | USACE High Rate (2013) |
| C3 | NOAA Intermediate High Rate (2012) |
| C2 | USACE Intermediate Rate (2013)/ NOAA Intermediate Low Rate (2012) |
| C1 | USACE Low Rate (2013)/ NOAA Low Rate (2012) |

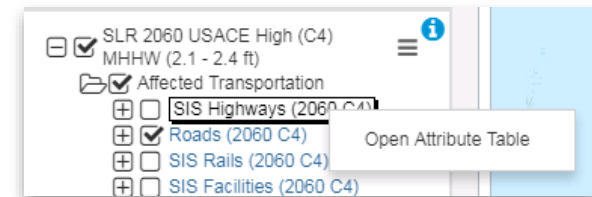
Scenario
Name

Expand Affected
Transportation
folder to show
more layers



Attribute Table

The Attribute Table is accessed from the Layers Widget. To open the Attribute Table, click on the Layer Name to reveal the “Open Attribute Table” option.



On load of the Attribute Table, only records for the features in the map view/extent are loaded to the table. The “Extent Box” is the map extent used to fetch records from the data layer. The attribute table does not load records automatically as you zoom in/out/pan on the map. If you zoom in or out or pan, then click “Refresh Table” to reload the records in the map view.

Zoom Menu

Zoom to selected features: Zooms to selected feature(s) on map. First select a feature on the map and then select this option.

Zoom to Extent Box: Zooms to blue Extent Box

Clear Menu:

Clear Selected Records: Clears any selected feature from both the table and map.

Clear Extent Box – Clears the blue extent box from the map. Records are kept in the table.

Clear Table – Clears all records in the table.

Refresh Table:

Reloads the records in the attribute table based on the current map view extent

Export

Exports the records in the table to either an Excel Spreadsheet (xlsx or xls) or a comma-delimited files (csv).

A screenshot of the Map Viewer interface. The top part shows a map of a coastal area with a blue extent box. The bottom part shows the Attribute Table for the 'Roads (2060 C4)' layer. The table has columns: NAME, Functional Class, Feet Affected, % Affected (2060), Begin Mile Pt, End Mile Pt, and Length of Segment. There are 6 records in the table. The table is titled 'Roads (2060 C4) [x]' and has buttons for 'Zoom', 'Clear', 'Refresh Table', 'Selected Records', and 'Export'. The table is currently showing 1 - 6 of 6 results.

Legend

The Legend Widget displays the symbology of the map layers currently displayed in the map. This widget is located under the Layers Widget and by default, this widget is expanded/ open.

The Legend Widget automatically builds a legend for the map layers that are currently visible in the map. If you uncheck a layer (to stop displaying it), then you will need to zoom in or zoom out to refresh the Legend.

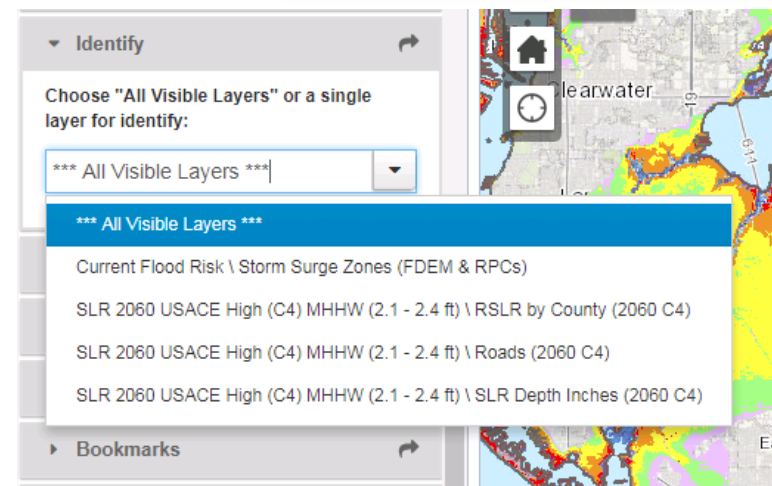
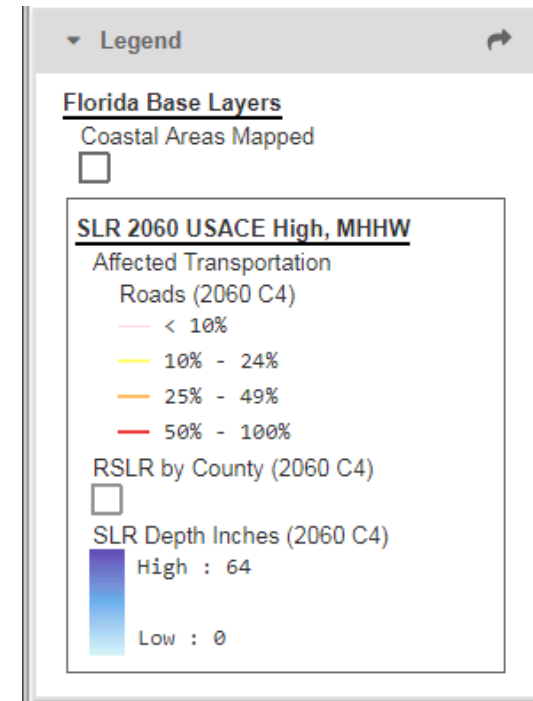
Identify

The Identify Widget controls which layers are available for use in the Identify Tool.

The Identify Tool displays attribute values of features on the map. The Identify Tool is located on the map with the map navigation tools, but can also be accessed by a single left-click on the map (no matter what map navigation tool is selected).

By default, the Identify settings are configured to show attributes from *** All Visible Layers ***, which means all layers that are *currently* visible in the map.

If you want to only see attribute values of a single map layer, then first open the Identify Widget, next click on the dropdown menu, and then select a single layer.



Print: Create a Map

The Print Widget allows you to create a map of the current map view. This widget is not open by default. First, open the widget by clicking on the arrow on the left side of widget. In the widget, there are various settings to configure.

Print Settings:

Title: Map Title. The default is “Slr Viewer Map”. Change to desired title.

Format: The default file format is PDF. Available formats include: PDF, EPS, GIF, JPG, PNG32, PNG8, SVG, and SVGZ.

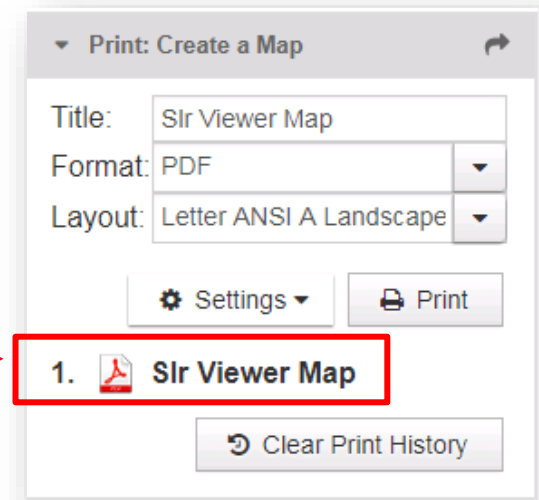
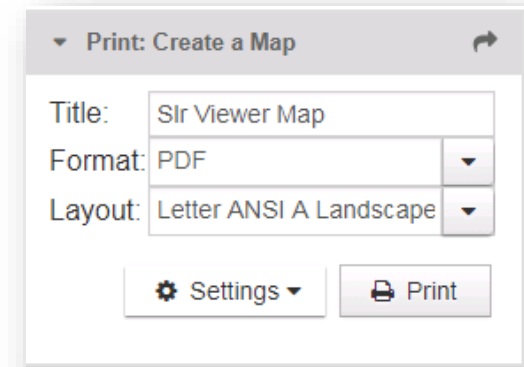
Layout: The layout controls the paper size and printing orientation (portrait or landscape). The default layout is Letter ANSI A Landscape (8.5” x 11”). ANSI is short for the North American ANSI series paper sizes.

Available layouts include: A3 Landscape, A3 Portrait, A4 Landscape, Letter ANSI A Landscape, Letter ANSI A Portrait, MAP_ONLY, Tabloid ANSI B Landscape, Tabloid ANSI B Portrait. Sizes: A3 = 11.7” x 16.5”, A4 = 8.3” x 11.7”, Letter ANSI A = 8.5” x 11”, ANSI B = 11” x 17”. MAP_ONLY: no legend or scale bar included.

Additional Settings Menu: Additional map settings are accessed through the Settings menu. These settings control the map scale/ extent, scale bar units, legend, print quality, and map only option.

Preserve: Map Scale or Map Extent: When creating the map with the desired layout size, choose whether to preserve map scale or map extent.

After choosing the desired options, click the Print button and wait for your map to be produced.

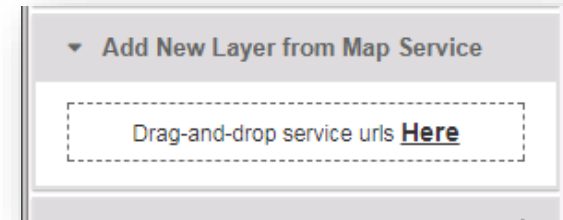


When your map is done, it will appear here. Click on it to open & save.

Add New Layer from Map Service

This widget allows you to add external map service layers to the map viewer.

Using the map service's REST endpoint, you can drag and drop the service URL into the widget.



Measurement

The Measurement Widget includes tools to measure area, distance, and location.

Area and distance measurements:



1. First, choose the type of measurement – area or distance.
2. Next, choose the desired units. The default area unit is Square Miles. The default distance unit is Miles.
3. Next, using single left-clicks, draw a polygon of the area you want to measure or draw a line. Use a double-click to finish the drawing.
4. The measurement will be displayed in the widget under where it says: “Measurement Result”. If you want to see the measured amount in a different unit, click the unit dropdown and choose another unit of measurement.

When you move the map, the measurement result will clear itself. Make sure to write the number down if you need to reference it later.

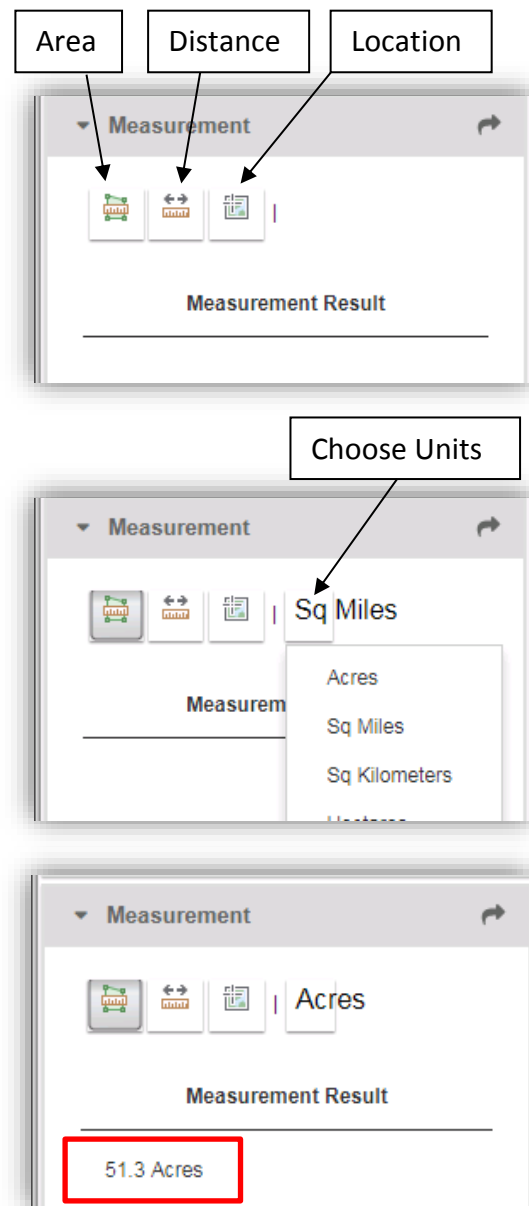
Location Measurement:

The location measurement reveals the latitude and longitude of a location.

First, click the location button. Then choose the units: either Degrees (for decimal degrees) or DMS (for Degrees Minutes Seconds).

Measurement Result		
	Latitude	Longitude
	28.364863	-82.700502
	28.39084	-82.668487

Next, click on the map where you want to reveal the latitude and longitude. The latitude and longitude will display in the widget under “Measurement Result”.



Bookmarks

The Bookmarks Widget allows you to “bookmark” or save a specific geographic area (map extent), so you can easily zoom to that area.

To add a bookmark, first zoom to the map area that you want to save. Then open the widget (it is closed by default) and click “Add Bookmark”. Next, type a name for your bookmark (ex: “Crystal River”).

To zoom to your bookmark, simply click on the Bookmark name.

The bookmarks can be renamed by clicking the pencil icon. They can be deleted using the X icon. Your bookmarks are stored within your browser, so if you clear your browser cache, they will no longer persist.



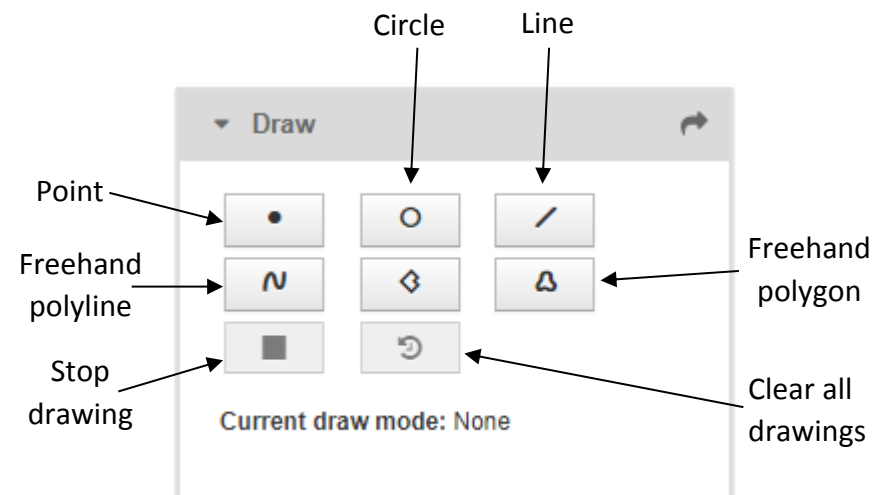
Draw

The Draw Widget allows you to draw lines and shapes directly on the map.

This widget is closed by default.

To draw on the map, first open the Draw widget. Then click on the type of shape you want to draw. Start drawing on the map with a single left-click. You will be prompted on screen with additional instructions on how to continue and/or finish our drawing.

As you zoom in and out on the map, your drawings will persist until you click “Clear All drawings” button or reload your browser.



Google Street View

This widget allows you to view Google Street View Panoramas. This tool is useful for exploring road conditions where potential inundation is expected to occur.

This widget is closed by default.

To use the Google Street View Widget:

- Right-click along a road in the map. Click “Google StreetView here”. A blue arrow will appear on the map.
- In the Side Pane, scroll down to the Google Street View Widget. If Street View panorama is available, then you will see it displayed in the widget. If imagery is not available, then you will get the following message: “Unfortunately, Google StreetView imagery is not yet available at that location”.
- In the widget, drag and pull the image to rotate the view. Follow the arrows along the roadways to move the view up or down a street.
- Tip: Undock the widget, drag it onto the map, and pull the bottom right corner of the widget to expand the size of the panorama for better viewing.
- When you are done, click on the X in the widget to clear the Street View panorama (this will also close and dock the widget if it was undocked).

