

Virginia Eastern Shore Coastal Resilience Mapping & Decision Support Tool

Introductory Workshop & Training Manual



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February 11 & 12, 2016
Eastern Shore
Community College,
Melfa, VA

*A project funded by the
Department of Interior
Hurricane Sandy
Coastal Resilience Fund*



Cover Photo:

Aerial view of the sand bar off Savage Neck near Cape Charles, VA.

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Following Page Photo:

Fowling Point, Hog Island Bay

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Virginia Eastern Shore *Coastal Resilience Tool*

Introductory Workshop and Training Manual

With input from the Community Leader Workshop held in November 2014, the customized Virginia Eastern Shore Coastal Resilience online mapping and decisions support tool for visualizing and assessing regional vulnerability to storm surge, sea-level rise, and changes in coastal habitats can be found at maps.coastalresilience.org/Virginia. Please visit the project webpage for more information at coastalresilience.org/virginia.



Training Team

Deborah Brosnan, Brosnan Center
Gwynn Crichton, The Nature Conservancy
Jenny Miller Garmendia, Brosnan Center
Jill Bieri, The Nature Conservancy
Jim McGowan, The Nature Conservancy
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Virginia Eastern Shore Coastal Resilience Tool
Introductory Workshop & Training Manual

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Coastal Resilience Tool Introductory Workshop & Training Schedule

A project funded by the Department of Interior Hurricane Sandy Coastal Resilience Fund

Thursday, February 11, 2016

Eastern Shore Community College, 29300 Lankford Highway, Melfa, Virginia



Training Objectives

1. Brief participants on the *Coastal Resilience* approach and tool in the context of the larger NFWF Hurricane Sandy Coastal Resilience grant project.
2. Demonstrate how to use the *Coastal Resilience* tool and apps through hands-on, structured exercises.
3. Gather feedback on the look, feel, function, and usability of the *Coastal Resilience* tool.
4. Solicit input on content and substance of apps and information presented in the tool.
5. Equip participants with skills to be able to train others to use the *Coastal Resilience* tool.

Coastal Resilience Tool
Introductory Workshop & Training Schedule
 Eastern Shore Community College 29300 Lankford Hwy, Melfa, VA 23410

Schedule – Thursday, February 11

<u>Opening Themes & Setting</u>	
12:30 pm	➤ Registration
1:00 pm	➤ Welcome and introductions– <i>Jill Bieri, The Nature Conservancy</i>
1:05 pm	➤ Overview of Coastal Resilience approach and mapping portal – <i>Gwynn Crichton, TNC</i>
1:10 pm	➤ Potential uses and applications for Coastal Resilience tool for Eastern Shore communities - <i>Curt Smith, ANPDC</i>
1:15 pm	➤ Coastal Resilience training workshop purpose, objectives, agenda and underlying science for tool - <i>Deborah Brosnan, Brosnan Institute for Risk Reduction</i>

<u>Training & Exercises</u>	
<i>Jenny Miller Garmendia (Brosnan Institute for Risk Reduction) & Mike Bonsteel (LJT & Associates, Inc.)</i>	
1:30 pm	➤ Basic Skills – Navigation & Apps ➤ Introduction to apps & training related to basic skills ○ Flood & Sea Level App – Basic Inundation ○ Future Habitat App ○ Flood & Sea Level App – Storm Surge
2:20 pm	➤ Break
2:30 pm	➤ Next Level Skills – Additional Tools ➤ Training related to more advanced skills including search, Split View, Link, measuring, Save & Share, options, and tips and cautions about tool use
3:00 pm	➤ Exercises – Application ➤ Participants will conduct specific exercises then have the opportunity to work on questions/exercises proposed by participants

<u>Conclusion</u>	
3:30 pm	➤ Tool Utility & Support for Decision-Making – Discussion - <i>Jenny Miller Garmendia (BIRR) & Mike Bonsteel (LJT)</i> ➤ Examples & Discussion of using the tool to support decision-making ➤ Hand-out regarding teaching others
3:50 pm	➤ Survey & Evaluations – <i>Joyce Winterton, NASA</i> ➤ Upcoming apps and trainings – <i>Chris Bruce, TNC</i>
4:00 pm	➤ Closing - <i>Gwynn Crichton, TNC</i>

Coastal Resilience Tool Introductory Workshop & Training Schedule

A project funded by the Department of Interior Hurricane Sandy Coastal Resilience Fund

Friday, February 12, 2016

Eastern Shore Community College, 29300 Lankford Highway, Melfa, Virginia



Training Objectives

1. Brief participants on the *Coastal Resilience* approach and tool in the context of the larger NFWF Hurricane Sandy Coastal Resilience grant project.
2. Demonstrate how to use the *Coastal Resilience* tool and apps through hands-on, structured exercises.
3. Gather feedback on the look, feel, function, and usability of the *Coastal Resilience* tool.
4. Solicit input on content and substance of apps and information presented in the tool.
5. Equip participants with skills to be able to train others to use the *Coastal Resilience* tool.

**Coastal Resilience Tool
Introductory Workshop & Training Schedule**
Eastern Shore Community College 29300 Lankford Hwy, Melfa, VA 23410

Schedule – Thursday, February 12

<u>Opening Themes & Setting</u>	
8:30 am	➤ Registration
9:00 am	➤ Welcome and introductions– <i>Jill Bieri, The Nature Conservancy</i>
9:05 am	➤ Overview of Coastal Resilience approach and mapping portal – <i>Gwynn Crichton, TNC</i>
9:10 am	➤ Potential uses and applications for Coastal Resilience tool for Eastern Shore communities - <i>Curt Smith, ANPDC</i>
9:15 am	➤ Coastal Resilience training workshop purpose, objectives, agenda and underlying science for tool - <i>Deborah Brosnan, Brosnan Institute for Risk Reduction</i>

<u>Training & Exercises</u>	
<i>Jenny Miller Garmendia (Brosnan Institute for Risk Reduction) & Mike Bonsteel (LJT & Associates, Inc.)</i>	
9:30 am	➤ Basic Skills – Navigation & Apps ➤ Introduction to apps & training related to basic skills ○ Flood & Sea Level App – Basic Inundation ○ Future Habitat App ○ Flood & Sea Level App – Storm Surge
10:20 am	➤ Break
10:30 am	➤ Next Level Skills – Additional Tools ➤ Training related to more advanced skills including search, Split View, Link, measuring, Save & Share, options, and tips and cautions about tool use
11:00 am	➤ Exercises – Application ➤ Participants will conduct specific exercises then have the opportunity to work on questions/exercises proposed by participants

<u>Conclusion</u>	
11:30 am	➤ Tool Utility & Support for Decision-Making – Discussion - <i>Jenny Miller Garmendia (BIRR) & Mike Bonsteel (LJT)</i> ➤ Examples & Discussion of using the tool to support decision-making ➤ Hand-out regarding teaching others
11:50 am	➤ Survey & Evaluations – <i>Joyce Winterton, NASA</i> ➤ Upcoming apps and trainings – <i>Chris Bruce, TNC</i>
12:00 pm	➤ Closing - <i>Gwynn Crichton, TNC</i>

Virginia Eastern Shore Coastal Resilience Tool

Introductory Workshop & Training Manual

Skills & Exercises

Learning Outcomes

- I. Desired Learning Outcomes – Participants will be able to:
 1. Briefly explain the purpose, use and limitations of the Coastal Resilience Tool to support decision-making.
 2. Activate and use the **Flood & Sea Level Rise** app, including the following options and settings:
 - a. **Choose a Data Source** for **Basic Inundation** or **Storm Surge**
 - b. **Scenario Year**
 - c. **SLR** (Sea Level Rise)
 - d. **Storm Type**
 - e. **Additional Layers**
 - f. **Opacity**
 3. Navigate around the map to **Zoom** in and out and **Pan** by:
 - a. Zoom in and out using the +/- buttons or the mouse wheel
 - b. Pan by clicking on the map, holding the mouse button down and dragging
 4. Activate and use the **Future Habitat** app, including the following options and settings:
 - a. **Choose Parameters**
 - b. **Scenario Year**
 - c. Draw a **User Defined Area** and **Zoom to Selection**
 - d. **Filter Results by Habitat(s) of Interest**
 - e. Find the analysis results in the **Results & Chart** tab and the **Compare & Chart** tab
 5. Activate and use the **Map Layers** app and set the following parameters:
 - a. Set the data points on the map within the following layer options:
 - i. **Base Data**
 - ii. **Infrastructure**
 - iii. **Coastal Management**
 - iv. **Habitats**
 - v. **Physical Features**
 - vi. **Social and Economic**
 - b. Set the **Opacity**
 - c. Use the layers in combination with other apps
 - d. Use the **Clear All** function to remove all layers
 6. See a demonstration of how the **Launch Pad** can be used to have a pre-set map ready to show others or use as a teaching example
 7. Briefly explain the key points of the **Flood & Sea Level Rise**, **Future Habitat**, and **Map Layers** app as follows:

- a. The difference between **Low**, **High**, and **Highest SLR** (sea level rise)
 - b. **Scenario Years**
 - c. **Inundation**
 - d. **Storm Surge**
 - e. **Opacity**
8. Activate the **Split View** and **Link** tool to show two maps and use apps to compare data in two maps
 9. Use the map tools to **Search** for an area, draw a **User Defined Area**, zoom in and pan around an area and use the apps on that particular area
 10. Use the **Save & Share** function to save a map, copy the link and share it with others for later use a particular map

Skills and Exercises

Open the Coastal Resilience Tool for the Eastern Shore of Virginia:

maps.coastalresilience.org/Virginia

Click on *Explore the Map* in the “Getting Started” Launch Pad window.

I. CR Tool Basic Skills – Navigation & Apps

a. Flood & Sea Level Rise App – Basic Inundation Option

Click on the Flood & Sea Level Rise App on left

Click on Choose Data Source in the upper left corner

Click on Basic Inundation

Note that the Map Legend in the bottom right corner is now populated

Look at the three sea level options under Choose SLR (Sea Level Rise)

Click on the blue “i” for information on SLR

Click on the “X” to close the “i” SLR info window

Slide the bar to set SLR to High

Look at the four options under Choose a Scenario Year

Slide the bar to set Scenario Year to 2040

Look at the results

Set Scenario Year to 2065

Set Scenario Year to 2100 – set SLR to Highest

Minimize the App by clicking on the Minimize button on the top right corner of the App window

Click on App to reopen (note App button is blue when still active)

Zoom in by clicking on the plus sign [+] on the left or using the mouse wheel

Pan: move the map by dragging the screen: hold left mouse button down and move

Zoom out by clicking on the minus sign [-] on the left or using the mouse wheel

Click on the lower right corner and pull on App to expand view

maps.coastalresilience.org/Virginia

Close the Flood and Sea Level Rise App by clicking on the “X” in the top right corner

Return the map to the full extent view by clicking on globe button on the left

Press F5 (reload/refresh) to clear the map

Click on “Explore the Map” in the Launch Pad

SKILLS COMPLETED

Choose Basic Inundation, set SLR to High and Scenario Year to 2040, 2065, 2100

Choose Basic Inundation, set SLR to Highest and Scenario Year to 2040, 2065, 2100

Click on the zoom in [+] and zoom out [-] tools, and pan around the map using the mouse

Return map to the full extent main view

NOTES:

b. Future Habitat App

Click on the Future Habitat App on left

Click continue (you may need to check box to skip the opening picture)

Begin with the Choose Parameters tab

Set the Scenario Year to 2065

Set the SLR to High

Check the box for Salt Marsh under Filter the Results by Habitat of Interest

Look under the Filter Results by a User Defined Area section

Click on Click to Draw an Area - the cursor is now active and ready to draw a shape

Draw a shape with at least three sides – click once for each point and twice for the final point to end [don’t hold the mouse button down as you draw]

Zoom in by clicking on Zoom to Selection

View the results [see legend]

Click on Clear Filters to remove the Draw Area

Close the app

Return to full extent (click on the globe to the left)

Press F5 to clear the map

Click on “Explore the Map” in the Launch Pad

SKILLS COMPLETED

Choose Scenario Year 2065, set SLR to HIGH, click on Click to Draw an Area, create a box around a particular area, click on Zoom to Selection, and filter results by salt marsh

NOTES:

maps.coastalresilience.org/Virginia

c. Flood and Sea Level Rise App - Storm Surge Option

Click on the Flood & Sea Level Rise App on the left

Click on Choose Data Source

Click on Storm Surge

Notice that the app shows Nor'Ida impacts when opened

Click on the blue "i" as needed

Look at the three options under Choose a Scenario Year

Slide bar to set Scenario Year to 2040

Look at the four options under Choose a Storm Type

Slide bar to set Storm Type to Moderate Intensity

Look at the options under Depth or Difference and notice that the app is automatically set to Water Depth (ft)

Use the scroll bar at the right (if necessary) to view the Additional Layers below or expand the size of App by pulling on lower right corner

Click on the Show tidal range option

Hold a shift key and draw to zoom on an area to focus on

Minimize the Legend for a clear view

Re-open the Legend by clicking on the button on the left above the globe

Close the app

Return to full extent (click on the globe to the left)

Press F5 to clear the map

Click on "Explore the Map" in the Launch Pad

SKILLS COMPLETED

_____ Choose Storm Surge, set Scenario Year to 2040, set Storm Type to Nor'Ida, then to Moderate Intensity

_____ Choose Storm Surge, set Scenario Year to 2065, set Storm Type to Moderate Intensity, and set Depth or Difference to Water Depth

_____ Under Additional Layers, select Show Tidal Range

NOTES:

d. Map Layers App and Use with Future Habitat

[NOTE: When using the Map Layers App with other Apps, always open the Map Layers App last]

Click open the Future Habitat App

Choose the Year 2065

Choose the SLR Scenario at High

Click on the Map Layers App on the left

Click on the plus signs (+) to open the menu for Virginia

Click on plus sign to open each menu for:

Base Data

Infrastructure

Coastal Management

Habitats

Physical Features

Social and Economic

Look at available options under each menu (roads, schools, populations, etc.)

Click the checkboxes beside Infrastructure. Look at the options specific to roads.

Click each checkbox for the Roads Vulnerable to 1 ft, 2 ft, and 3 ft Sea Level Rise

[NOTE: This step allows the Map Layers to show over the Future Habitat App]

Look for roads covered by water or marshes

Use the zoom in [+] tool to get a closer look

Click on Clear All to remove all layers

Close the app

Return to full extent (click on the globe to the left)

Press F5 to clear the map

Click on "Explore the Map" in the Launch Pad

SKILLS COMPLETED

____ Map Layers with Future Habitat App:

Click on Map Layers. Under Infrastructure, click checkboxes for Roads vulnerable to 1 ft., 2 ft. and 3 ft. Sea Level Rise. Open Future Habitat and set Scenario Year to 2065 and SLR to High. Look at how the roads have been covered by water or marshes. Zoom in [+] for a better view.

NOTES:

II. Next Level Skills – Additional Tools

a. Search Tool, Imagery, Use of Split Screen, & Measuring

SEARCH TOOL & IMAGERY

To find a particular area on the map by name, use the search tool

Click on the search tool (magnifying glass button) at the top left, type the name of the location into the search bar, and hit enter. Search for Brownsville, Virginia.

Choose the correct location from the dropdown menu: “Brownsville (historical) Virginia, United States”

Close the search function by clicking on the “X” icon twice

Open the Flood & Sea Level Rise App on the left

Click on Choose Data Source and select Basic Inundation

Set Choose SLR to Low and set Scenario Year to 2100

Change the background layer type by mousing over the dropdown menu at the top right (currently says “Topographic”). Click on the Imagery option.

In the Flood & Sea Level Rise App window, find the Layer Properties slider bar.

Set the Layer Properties bar to more transparent in order to see the background layer below the Flood & Sea Level Rise App layer

SPLIT SCREEN TOOL & MEASURING

Now you can split the screen to compare two maps

Click on Split View on the bottom left

Minimize open apps and legends so you have a clear view of both Maps

Note that the second map (Map 2) does not start with the same background layer or apps as Map 1

Click on Link Maps at the bottom of the middle bar – this locks the maps together so Map 2 follows any zoom or pan changes in Map 1

Click on the zoom out [-] tool in Map 1 and watch Map 2 respond

This feature allows you to do a side-by-side comparison of scenarios

Change the background layer for Map 2 to Imagery so it matches Map 1

Open the Flood & Sea Level Rise App in the middle bar (for Map 2)

Click on Choose Data Source and select Basic Inundation

Set Choose SLR to High and set Scenario Year to 2100. Minimize the App.

Compare the two SLR scenarios between maps

Adjust Opacity to be equal on both maps

YOU ARE NOW COMPARING 2 MAPS IN THE YEAR 2100, ONE SHOWING LOW SLR AND ONE SHOWING HIGH SLR

You may have to pan to get back to Brownsville

Click on the measure tool (ruler symbol) on the left side of either map

Measure the length of the narrow pond at the northwest edge of the Brownsville grounds by clicking once at the start point and double-clicking at the end.

Note the information box with results, then click the “X” next to the tool to close the results window

SAVE AND SHARE

Click on Save and Share

Copy the permalink at the top

Paste the URL into a new browser window [opens to the same maps where you left off]

You can send this URL to colleagues to view the same maps

Close all apps (in both maps).

Return to full extent (click on the globe to the left)

Press F5 to clear the map

SKILLS COMPLETED

____ Search tool and imagery:

Map 1: Type the location Brownsville, Virginia, into the search bar, open the Basic Inundation App, set Choose SLR to Low, set Scenario Year to 2100, select Imagery from the background layer dropdown menu, and change the Flood & Sea Level Rise Layer Properties slider to more transparent.

____ Split screen and measuring:

Map 2: Click on Split View, minimize open apps, click on Link Maps, change the background layer of Map 2 to Imagery, open the Basic Inundation App in Map 2, set Choose SLR to High, set Scenario Year to 2100, and minimize the app. Compare the inundation maps for Brownsville in the present and future conditions. Click on the measure tool and measure the length of the narrow pond at Brownsville by clicking once at the start and double-clicking at the end.

____ Save and Share function

III. Exercises

a. Future Habitat App – Use of the Brownsville, VA Map

Search for Brownsville, Virginia. Choose the third (“historical”) option.

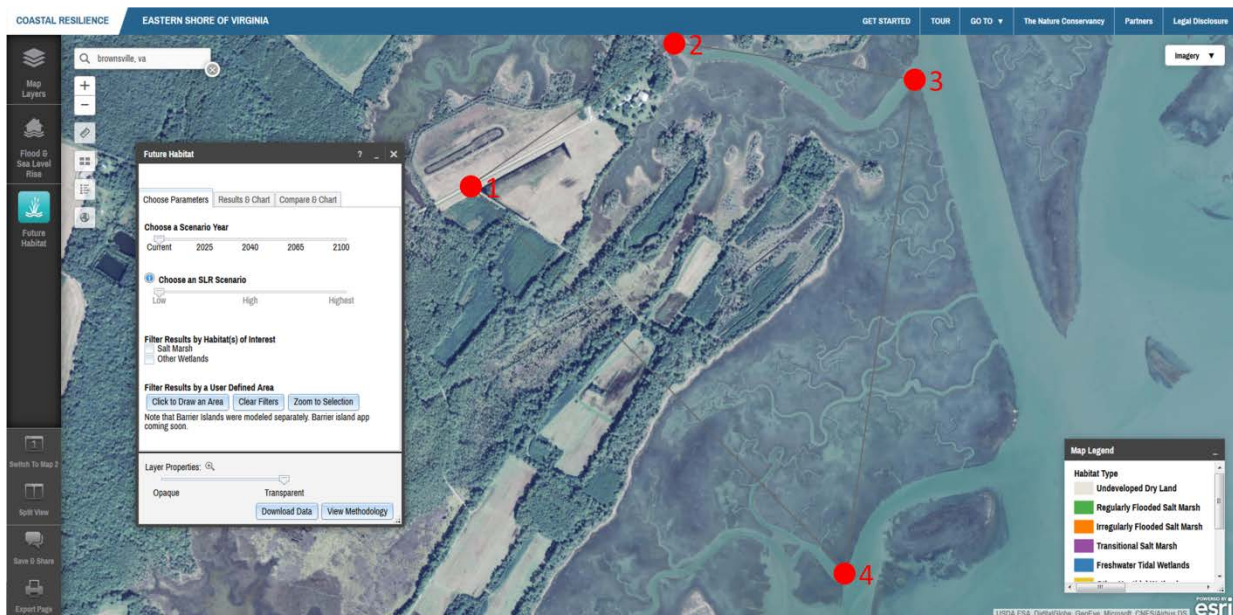
Change the background layer to Imagery.

Open the Future Habitat App, set the Scenario Year to 2025, and set the SLR Scenario to High

Set the Layer Properties to completely transparent

Under the Filter Results by a User Defined Area, click on Click to Draw an Area

Draw a polygon starting with the fork in the road leading to Brownsville, then the Brownsville dock, followed by the northern point of the marsh east of the dock, and ending (double-click) at the point of the marsh almost directly south from there. Use the image below as a guide, clicking on points 1 through 3 in order, then double-clicking on point 4.



Set the Layer Properties bar to completely opaque

Click on the Compare & Chart tab (scroll down if necessary)

View the results. These represent changes from current conditions

Questions: How much tidal flat exists in 2025 under the High SLR scenario? What about transitional salt marsh? How have these values changed from current conditions?

Advanced Question: Now split the screen into two maps, link the maps, and recreate the steps above, but set the Scenario Year to 2065 and SLR to High.

How do the results for regularly flooded salt marsh compare between years?

Close apps and return to full extent (click on the globe to the left)

Press F5 to clear the map

b. Map Layers App – Cape Charles

Set the background layer to Topographic

Search for Cape Charles, Virginia (choose the first option)

Zoom and pan so Cape Charles fills the screen, but you can still see Kings Creek to the north

Open the Map Layers App and choose Coastal Management, and Flood Hazard Areas

Also activate the Social and Economic layer, Persons per Square Mile

Click on the round, orange “i” icon beside Social and Economic and adjust layer transparency to see overlap

Note the overlap of the Flood Hazard Area and the concentration of people per square mile

Zoom in to Cape Charles, notice the rectangle in the center. That is Central Park.

Questions 1: What Flood Hazard Area affects Cape Charles’ Central Park? How many people per square mile does this affect? What about the rest of Cape Charles?

In the Map Layers App, unclick the Persons per Square Mile layer under Social and Economic

Activate the Flood & Sea Level Rise App and select Storm Surge data. Set the Scenario Year to 2065 and the Storm Type to Moderate Intensity.

Adjust opacity to slightly less than mid-range.

Note how the layers overlap, using the legend to compare data (scroll down if necessary)

Questions 2: What storm surge levels line up with the 0.2 Pct Annual Chance Hazard Flood Hazard (“500-year storm”)? What does this tell you about the likelihood of this level of storm in 2065?

Advanced questions: What road in Cape Charles could become impassible in the case of four feet of SLR or a major flood event? Hint: it is in an AE Flood Hazard Area. Also, based on aerial imagery, what businesses would likely be impacted if this road was blocked by SLR or flood waters?

Close apps and return to full extent (click on the globe to the left)

Press F5 to clear the map

c. Flood & Sea Level Rise Storm Surge App – Quinby, Virginia

Search or pan and zoom to Quinby, Virginia

Notice the Quinby Bridge and causeway, listed as Route 182

Open the Flood & Sea Level Rise App Storm Surge option and adjust opacity to mid-range

Compare Nor'Ida scenarios across Scenario Years

Questions 1: How much flooding (feet of storm surge) would the Quinby Bridge and causeway experience in a 2040 Nor'Ida event? Zoom in if necessary and use the legend to find your answer.

Activate the Map Layers App and the Infrastructure layer. Click through the Roads Vulnerable to Sea Level Rise options until you see one that affects the Quinby Bridge and Causeway.

Questions 2: Which vulnerability to SLR checkbox applies to the Quinby Bridge and causeway? Based on this information, can you estimate the elevation of the Quinby Bridge and causeway? What percent of people in Quinby affected by closing the bridge during a Nor'Ida storm in 2040 are employed in agriculture, fishing, or forestry? Hint: use additional Map Layer App options.

Advanced Question: In the same year in which the Quinby Bridge and causeway become impassible due to SLR, will people be able to access the town using other, existing infrastructure?

Close apps and return to full extent (click on the globe to the left)

Press F5 to clear the map

IV. Exercises from Participants

a. Examples from the group

b. Extra example:

Future Habitat App – Saxis and Onancock, VA

Search or zoom and pan to Saxis, Virginia

Open the Future Habitat App and adjust opacity to mid-range

Examine how habitat types change across Scenario Years and the low and high SLR Scenarios

Questions 1: What is the directional trend for habitat change in Saxis? Is it mainly north-south, east-west, etc.?

Open the Flood & Sea Level Rise App, Basic Inundation data. Examine how sea level rise changes across Scenario Years and the low and high SLR Scenarios

Questions 2: How does the directional trend of inundation compare to what you saw in the Future Habitat App?

Close both Apps

Click on Split View on the bottom left

In Map 1, pan so that Saxis is in the middle of the map, or use the search option to center the map on it. Open the Flood & Sea Level Rise App and select the Basic Inundation data source.

In Map 2, search for or zoom and pan to Onancock, Virginia

In Map 2, open the Flood & Sea Level Rise App and select the Basic Inundation data source

In the Flood & Sea Level Rise App in both maps, set SLR to high and the Scenario Year to 2040

Minimize apps for a better view of the two maps

Questions 3: How do the towns differ in terms of impacts from sea level rise?

In the Flood & Sea Level Rise App in both maps, adjust the Scenario Year to 2065

Questions 4: What developed areas are most affected in each town? How are infrastructure features such as roads and marinas affected? Hint: use imagery to answer this question.

In both maps, activate the Map Layers App and the Social and Economic, Percent population age 65 and over layer. Compare the results between maps, adjusting opacity if necessary.

Questions 5: Between these two towns, which age group(s) are most affected by sea level rise?

Advanced Questions: Using additional Map Layers App data, and assuming that tidal range (under Base Data) remains the same, how much SLR is necessary before Dennis Drive in Saxis is flooded by high tides? What about Chandler Street in Onancock? Hint: Close any other apps. You may have to zoom in to see the street name.

Close apps and return to full extent

Press F5 to clear the map

V. Use of Tool in Decision-Making

a. Comparison - which fire station floods first?

Open the Flood & Sea Level Rise App, Basic Inundation data

*Open the Map Layers App and the Infrastructure, Fire and Rescue Stations layer
Change to Imagery*

Questions: Which of the Fire and Rescue Station in Accomack County floods first and when? What about Northampton County?

Questions 2: What is the rough distance between those Fire and Rescue Stations that flood first in each county and the nearest station that is still dry? Hint: use the measure tool to find your answers.

Close apps and return to full extent

Press F5 to clear the map

b. Group suggestions for locations, settings

c. Individuals or groups working on additional examples

- Which Eastern Shore of Virginia schools will be most impacted by SLR in the next 50 to 100 years?
- What level of Storm Surge may be experienced by homes in Captain's Cove?
- Which access routes to coastal island communities are most vulnerable to SLR, and for how long are these communities predicted to remain as uplands?
- Which of the two Eastern Shore of Virginia counties will experience the most habitat change (disregarding barrier islands), and which is most impacted in terms of developed dry land?

Send any questions, feedback, or suggestions to
vacoastalresilience.org@tnc.org

Additional Resources:

For a quick review, click on the **Tour** menu while in maps.coastalresilience.org/Virginia.

Coastal Resilience website: coastalresilience.org

Coastal Resilience Training Page: coastalresilience.org/training

Coastal Resilience Mapping Portal General Navigation:

<http://www.screencast.com/t/RnBTZlgSaL>

Coastal Resilience Introduction to Scenario Planning: <http://www.screencast.com/t/1yfX0fV2y>

Coastal Resilience Flood & Sea Level Rise Try Me Video:

http://media.coastalresilience.org/Sea_Level_Rise_Coastal_Hazards_tryme/Sea_Level_Rise_Coastal_Hazards_tryme.htm

Coastal Resilience Future Habitat App: <http://coastalresilience.org/our-approach/assess-risk-vulnerability/future-habitat/>

NOTE:

Export Page

In future you will be able to generate printed maps:

Click on the 'Export Page' at the bottom left of the screen

Enter a title for a map

Check the show legend box

Click 'Generate Map' button - a link to a pdf is generated that you can share or print

maps.coastalresilience.org/Virginia



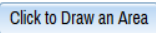


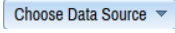
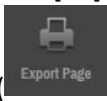
Virginia Eastern Shore Coastal Resilience Tool


Introductory Workshop & Training Manual

Glossary of Terms (alphabetical)

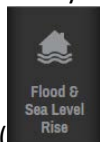
Locations where these terms occur are noted in [brackets]:

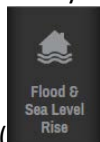
Flood & Sea Level Rise = [F&SLR] Future Habitat = [FH] Map Layers = [ML] Map Viewer = [Map Viewer]


- Absolute Difference:**A measure in feet of the difference current water levels and those during modeled storm events. [F&SLR]
- Base Data:**A background map layer which shows boundaries, parcels, and roads. [ML]
- Basic Inundation:**A data source within the Flood & Sea Level Rise App which displays predicted sea level rise for several sea level rise scenarios and scenario years. [F&SLR]
- Choose Parameters:**A tab in the Future Habitat App window which allows the user to select the Scenario Year and SLR Scenario, affecting the data displayed in the map viewer.
- Clear All:**Clicking this button () clears all selected layers in the Map Layers App. [ML]
- Clear Filters:**Clicking this button () resets the visible data to its original state, removing drawn areas and other filters that narrow results. [FH]
- Click to Draw an Area:**Clicking this button () allows the user to draw an area of interest which will exclude all other data. [FH]
- Compare & Chart:**A tab in the Future Habitat App window which allows the user to view changes between the current inventory of habitat area and the predicted condition. Note that data is only displayed if a future Scenario Year (e.g., 2025) is selected. [FH]
- Download data:**Clicking this button () allows the user to download the current map and data configuration in an ESRI geodatabase format. [FH]
- Coastal Management:**A background map layer which shows public access sites, boat ramps, streams, flood hazard areas, protected lands, and Virginia Ecological Value Assessment. [ML]
- Choose Data Source:**A dropdown menu in the Flood & Sea Level Rise App that allows the user to choose which data they would like to view: Basic Inundation or Storm Surge. [F&SLR]
- Dropdown menu:**A vertical menu of options which is opened by clicking on it. [Map viewer - ] [F&SLR - ]
- Ecosystem:**A system of biological components (species) and physical components (geography and resources). [FH]
- Erosion:**Degradation of features such as shorelines or structures, usually by the action of water or wind. [FH]
- Export Page:**Clicking this button () allows the user to export the current view as an Adobe Acrobat document. The map may also be exported by

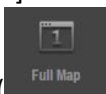

clicking the printer icon () in the upper right of the Map Layers App window. [Map viewer] [ML]

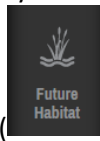
Filter by Habitat(s) of Interest: A section of the Future Habitat App which allows the user to reduce the data being displayed to only salt marsh, only “other wetlands”, or to an area drawn by the user. [FH]

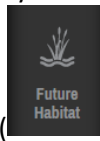


Flood & Sea Level Rise App:.....An app () which shows the predicted effects of sea level rise and storm surge on the Eastern Shore of Virginia. Includes two datasets: Basic Inundation (focuses on the effects of sea level rise) and Storm Surge (displays predictions for storm surge from hurricanes and tropical storms). [Map viewer]

Full Extent:Clicking this button () returns the view to the entire Eastern Shore of Virginia. [Map viewer]

Full Map:Clicking this button ( or ) will leave the Split View and show only one map in the browser.




Future Habitat App:An app () which shows changes in habitat type in response to predicted sea level rise. [Map viewer]

Get Started:Clicking this text () opens the Launchpad. [Map viewer]

Habitat:The biological and physical settings in which species exist. Also, a background map layer which shows commercial shellfish aquaculture, public oyster grounds and tidal marshes. [ML]

Imagery:Aerial imagery of the Eastern Shore of Virginia. [Map viewer]


Infographic:A simple graphic meant to quickly illustrate the purpose or main concepts of an app. The infographic for the Future Habitat App is accessible by clicking the question mark icon () in the upper right corner of the app window. [FH]

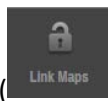
Infrastructure:A background map layer which shows schools, fire stations, roads and evacuations routes. [ML]

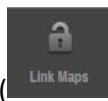
Inundation:Flooding of upland areas. [FH]

Land Accretion:Increase in elevation or area of land due to sediment deposition. [FH]

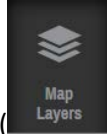
Launch Pad:A collection of geographies (locations) and one-click interactive maps (pre-set data views). [Map viewer]

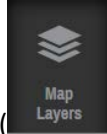
Legend:.....A window which shows the list of active layers and their symbology. This can be toggled on and off with the legend button (). [Map viewer]




Link Maps:Click this button () when Split View is active in order to tie the map views of Map 1 and Map 2 together, such that zooming in or out or panning in one map will also occur in the other. Initially, Map 2 will

move to the same scale and location as Map 1. Note that app data and other map options are not linked. [Map viewer - CENTER]



Map Layers App:An app () which includes information data layers including schools, roads, tidal range, protected lands, and wetlands. [Map viewer]

Measure:A tool used to measure distance and area. It is activated by clicking the measure button (). [Map viewer]

Methodology:A description of the methods used to develop data layers. [F&SLR] [FH]

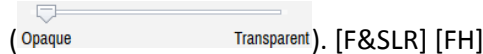
National Geographic:A background map layer developed by National Geographic. [Map viewer]

Nor'Ida:A nor'easter that impacted the mid-Atlantic in November 2009. [F&SLR]

Ocean:A background map layer developed by the National Oceanic and Atmospheric Administration. [Map viewer]

Opacity:The extent to which an image is not transparent. [ML]

Opaque:The opposite of transparent. Appears in transparency slider bars




Pan:Moving the map by clicking, holding, and dragging the mouse. [Map viewer]

Percent Difference:A measure in percentage of the difference between current water levels and those during modeled storm events. [F&SLR]

Physical Features:A background map layer which shows physical geography. [ML]

Results & ChartA tab in the Future Habitat App window which allows the user to view a pie chart and chart explaining acreage of habitat types in the total dataset or a user-defined area for the selected Scenario Year and SLR Scenario. [FH]



Save & Share:Clicking this button () allows the user to save the map view and active datasets in order to return to the map or share it with others. [Map viewer]

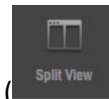
Scenario Year:The year for which predictions (sea level rise, storm surge, or habitat change) were calculated. [F&SLR] [FH]

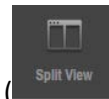
Sea Level Rise (SLR):The predicted increase in the elevation of sea water over time. [F&SLR] [FH] [ML]




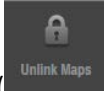
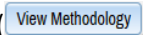


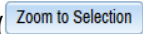
Shaded Relief:A background layer which shows elevation of uplands. [Map viewer]

Social and Economic:A background map layer which shows persons by age and certain types of employment. [ML]

Spatial Model Outputs:Data generated by models which, in this case, estimate changes in marsh extent due to sea level rise. [FH]



Split View:Clicking this button () will split the browser window into two map views, each with its own apps, legend, and options. Note that there is a separate Export Page option for each map. [Map viewer]

- Storm Surge:**.....Increased water height due to storm dynamics. Also a data source in the Flood & Sea Level Rise App. [F&SLR]
- Storm Tracks:**.....Paths taken by hurricanes and tropical storms which were used as the basis for modeling storm surge. [F&SLR]
- Storm Type:**A classification format for modeled hurricane impacts in the Flood & Sea Level Rise App Storm Surge dataset. Impacts from low Intensity storms were based on three theoretical Category 1 hurricanes with maximum winds of 80 miles per hour (mph). Impacts from Moderate Intensity storms were based on six theoretical Category 1 and 2 hurricanes with maximum winds between 85 and 110 mph. Impacts from High Intensity storms were based on seven Category 2 and 3 hurricanes with maximum winds between 95 and 115 mph. Impacts from Nor'Ida are based on the storm surge generated by that particular storm. Impacts from each of these Storm Types are shown for current conditions and two future Scenario Years in which the sea level has risen. [F&SLR]
- Streets:**.....A background map layer which shows roadways. [Map viewer]
- Switch to Map 1 (or Map 2):**.....Click this button ( or ) to switch between single views of two separate map views. [Map viewer]
- Terrain:**.....A background map layer which shows differences in terrain. [Map viewer]
- Tidal Range (ft):**Data regarding the typical variability in water level due to tides. [F&SLR] [ML]
- Topographic:**.....A background map layer which shows roads, waterways, elevation, forested land, and wetlands. [Map viewer]
- Tour:**Clicking this text () opens a quick reference for the parts of the *Coastal Resilience* tool map viewer. [Map viewer]
- Transparent:**.....Allowing light or background images to be seen, as through glass. [F&SLR] [FH]
- Unlink Maps:**Clicking this button () unlinks the maps in Split View, such that changes in scale and location in one map will not be reflected in the other. [Map viewer - CENTER]
- Water Depth (ft):**A measure of the predicted depth of water in feet due to storm surge. [F&SLR]
- View Methodology:**Clicking this button () will load a document which explains the methods used to develop data for the subject app. [F&SLR] [FH]
- Zoom:**.....To change the scale of the map viewer. Click on the zoom in button () for a narrower view or the zoom out button () for a wider view. [Map viewer]
- Zoom to Selection:**.....Clicking this button () will zoom to the area drawn by the user using the Click to Draw an Area option. [FH]

Virginia Eastern Shore Coastal Resilience Tool

Introductory Workshop & Training Manual

Hints and Tips

1. The Coastal Resilience tool is web-based. Make sure your internet connection is working before use.
2. The Coastal Resilience tool can be used in most Internet browsers, including Chrome, Internet Explorer, Firefox, and Safari. However, be sure your browser is up-to-date to avoid issues.
3. It is a good practice to reboot your device before using the tool to ensure that you have sufficient memory available to use it.
4. It may be helpful to periodically refresh the browser window (refresh button or F5 key) in which you are viewing the *Coastal Resilience* tool in order to prevent errors from occurring. Keep in mind that refreshing will return the *Coastal Resilience* tool to its beginning state.
5. Refresh your browser window if the *Coastal Resilience* tool seems laggy, if layers are stuck or not showing, or if features seem to be acting strangely. Again, this will return the *Coastal Resilience* tool to its beginning state. The F5 key is your friend!
6. If the *Coastal Resilience* tool really seems to be stuck, try clearing the local cache in your browser by pressing Control + F5 (you may want to press this several times to fully clear the system). On an Apple machine the command is Command + R. You can also close the browsing window or tab and open it again to fully flush the site.
7. Another option to avoid issues caused by web browser history is to open the *Coastal Resilience* tool in a window which does not retain cookies or other browsing data. This is known by different names in different web browsers. For example:
 - Chrome: incognito window
 - Internet Explorer: InPrivate Browsing
 - Firefox and Safari: private browsing window
8. The *Coastal Resilience* tool is optimized to work on desktops and laptops, and may experience issues when open in a tablet or hand-held devices. Additionally, the *Coastal Resilience* tool map viewer may seem crowded when viewed on a laptop.
9. If a background map layer does not load (grey screen displayed), try choosing another layer or changing the zoom level. Some layers do not appear when zoomed in extensively.
10. For a quick run-down on the functions of the tool click on Tour – this will point to the different elements of the tool and give a short explanation of them.
11. When you open an app the icon changes color and appears like an app on your phone. When done using the app you can either use the close ('x') button in the upper right hand corner to remove it from being active, and will remove data from the map, or the minimize ('_') button

to have it remain active and therefore keep data on the map. You can have multiple apps open – minimizing the apps helps maximize how much of the map is shown. Keep in mind that opening the Map Layers App will minimize other open apps.

12. Likewise, the Map Legend can be minimized (‘_’) – to get the legend back you will find a white button on the left side of the map. Hover your cursor over these button and they will tell you what they do.
13. Most of the windows that appear on the map (i.e. app windows, map legend) can be dragged around by clicking down on your mouse when the cursor is hovering over the top black bar. They can also be resized and may need to be, depending on your browser, platform (computer, tablet, etc.), and the amount of data being shown (Map Legend, for example). Click and drag the bottom right corner of the window to resize it, or simply scroll up or down in the window to view additional data.
14. App data displays in the order in which you access it. For example, if you open the Flood & Sea Level Rise App first, then the Future Habitat App, future habitat data will be layered on top. For this reason, we recommend opening the Map Layer App last if you wish to use it.
15. Clicking on data that appears on the map will open an Identify window showing the attributes of the data layer. If the Identify box is too big and goes off the map then pan the map (click and hold mouse down, then drag) until you see the entire window; the Identify window does not move.
16. You can also hold the Shift key down and click and hold the mouse to draw a box map for zooming into a particular area.
17. Using Split View creates two maps. The left map is Full Map 1, the right map is Full Map 2. When you want to go back to viewing a single map you can choose Map 1 or Map 2 and switch between them without having to go back to Split View.
18. We do not recommend using the Coastal Defense app in Split View given the size of the input app window.
19. Remember that the *Coastal Resilience* tool is a work in progress! If you find obvious errors, feel free to report them to vacoastalresilience@tnc.org.

Thank you very much for using the *Coastal Resilience* tool!

If you have any feedback, please submit it in the form of our Post-Workshop Survey, or speak with a member of our training team.

Training dates for our Coastal Defense and Barrier Island Apps will be released soon!

Virginia Eastern Shore Coastal Resilience Tool

Introductory Workshop & Training Manual

Instruction Guidelines

Overview

This is a brief guide to help you show others how to use the Coastal Resilience Tool for the Eastern Shore of Virginia. You will need copies of the following for the participants:

- Skills & Exercise List
- Glossary of Terms
- Tips and Hints

Below you will find the Learning Outcomes as a guide to what is covered in the Skills and Exercise List and what participants should be able to do once they have worked through that list with you. First complete the

Learning Outcomes

- A. Participants will be able to:
 1. Briefly explain the purpose, use and limitations of the Coastal Resilience Tool to support decision-making.
 2. Activate and use the **Flood & Sea Level Rise** app and set the following parameters:
 - a. **Choose a Data** Source for **Basic Inundation** or **Storm Surge**
 - b. **Scenario Year**
 - c. **SLR** (Sea Level Rise)
 - d. **Storm Type**
 - e. Additional Layers
 - f. **Opacity**
 3. Activate and use the **Future Habitat** app and set the parameters for:
 - a. **Choose Parameters**
 - b. **Scenario Year**
 - c. **Draw a User Defined Area** and **Zoom to Selection**
 - d. Choose a Habitat
 - e. **Filter by Habitat of Interest**
 - f. Find the analysis results in the **Results & Chart** tab and the **Compare & Chart** tab.
 4. Activate and use the **Map Layers** app and set the parameters for:
 - a. Set the data points on the map within the following layer options:
 - i. **Base Data**
 - ii. **Infrastructure**
 - iii. **Coastal Management**
 - iv. **Habitats**
 - v. **Physical Features**
 - vi. **Social & Economic**

- b. Set the **Opacity**
 - c. Use the layers in combination with other apps
 - d. Use the **Clear All** function to remove all layers
5. Briefly explain the Key Points of the **Flood & Sea Level Rise, Future Habitat** and **Map Layers** app as follows:
- a. The difference between Low, High, and Highest SLR (sea level rise)
 - b. The Year Scenarios
 - c. Inundation
 - d. Storm Surge
 - e. Opacity
6. Activate the **Split Screen and Lock** tool to show two maps and use apps to compare data in two maps.
7. Use the map tools to **Search** for an area, draw a **User Defined Area**, zoom in and pan around an area and use the apps on that particular area.
8. Use the **Save and Share** function to save a map, copy the link and share it with others for later use a particular map.

Skills to Complete

I. CR Tool Basic Skills – Navigation & Apps

Flood & Sea Level Rise App – Basic Inundation Option

SKILLS COMPLETED

- ___ Choose Basic Inundation, set SLR to High and Scenario Year to 2040, 2065, 2100
- ___ Choose Basic Inundation, set SLR to Highest and Scenario Year to 2040, 2065, 2100
- ___ Click on the zoom in [+] and zoom out [-] tools, and pan around the map using the mouse
- ___ Return map to the full extent main view

Future Habitat App

SKILLS COMPLETED

- ___ Choose Scenario Year 2065, set SLR to HIGH, click on Click to Draw an Area, create a box around a particular area, click on Zoom to Selection, and filter results by salt marsh

Flood and Sea Level Rise App - Storm Surge Option

SKILLS COMPLETED

- ___ Choose Storm Surge, set Scenario Year to 2040, set Storm Type to Nor'Ida, then to Moderate Intensity
- ___ Choose Storm Surge, set Scenario Year to 2065, set Storm Type to Moderate Intensity, and set Depth or Difference to Water Depth
- ___ Under Additional Layers, select Show Tidal Range

Map Layers App and Use with Future Habitat

SKILLS COMPLETED

____Map Layers with Future Habitat App:

Click on Map Layers. Under Infrastructure, click checkboxes for Roads vulnerable to 1 ft., 2 ft. and 3 ft. Sea Level Rise. Open Future Habitat and set Scenario Year to 2065 and SLR to High. Look at how the roads have been covered by water or marshes. Zoom in [+] for a better view.

II. Next Level Skills – Additional Tools

Search Tool, Imagery, Use of Split Screen, & Measuring

SKILLS COMPLETED

____Search tool and imagery:

Map 1: Type the location **Brownsville, Virginia**, into the search bar, open the **Basic Inundation App**, set **Choose SLR to Low**, set **Scenario Year to 2100**, select **Imagery** from the background layer dropdown menu, and change the **Flood & Sea Level Rise Layer Properties** slider to more transparent.

____Split screen and measuring:

Map 2: Click on **Split View**, minimize open apps, click on **Link Maps**, change the background layer of **Map 2** to **Imagery**, open the **Basic Inundation App** in **Map 2**, set **Choose SLR to High**, set **Scenario Year to 2100**, and minimize the app. Compare the inundation maps for **Brownsville** in the present and future conditions. Click on the **measure tool** and measure the length of the narrow pond at **Brownsville** by clicking once at the start and double-clicking at the end.

____Save and Share function

Exercises

Work through the Exercises in the Skill and Exercise List. Once these are completed you can try examples of your own or suggested by the participants

1. Future Habitat App – Use of the Brownsville, VA Map
2. Flood & Sea Level Rise Storm Surge App – Quinby, Virginia
3. Future Habitat App – Saxis and Onancock, VA

Use of the Tool in Decision-Making

Using the examples given or ones that apply to your area, discuss how the Tool can be used to support decision-making, as well as its limitations.

Coastal Resilience on Virginia's Eastern Shore

An unprecedented effort to reduce risks from sea-level rise and storms and identify nature-based solutions to enhance resilience.

The Eastern Shore of Virginia lies within one of the nation's most threatened coastal regions. Sea levels here are rising at three to four times the global average and storms are expected to intensify, both linked, in part, to climate change. Tens of millions of dollars have been spent in the past on piecemeal and reactive approaches to address the mounting challenges of climate-related hazards. Often these efforts have exacerbated the area's vulnerability.

Founded in 2010, the Eastern Shore Climate Adaptation Working Group, coordinated by the Accomack-Northampton Planning District Commission, is addressing this challenge through education, outreach, and providing information to local communities to plan for sea-level rise, recurrent flooding, and storm surge. These efforts have resulting in achieving a major new milestone: The U.S. Department of Interior has awarded \$1.46 million from the Hurricane Sandy Coastal Resiliency Fund to The Nature Conservancy and Climate Adaptation Working Group partners **to equip coastal communities with the tools and information urgently needed to reduce the risks posed by climate-related hazards and enhance the area's natural resilience.** This will be accomplished through two major initiatives:



LANDSAT 7 TM image of the Delmarva Peninsula on the U.S. East Coast, 2009



Volunteers constructing oyster reef from Oyster Castles near Box Tree. Photo by Bowdoin Lusk

1. Create Eastern Shore Coastal Resilience Planning Tool. The *Coastal Resilience* tool incorporates the best available science, data, and state-of-the-art analytical tools for assessing risks of sea-level rise, storm surge, and changing habitats on people and the environment of the Eastern Shore using local information. The novelty of this tool is that it enables identification of nature-based solutions like oyster and wetland restoration to mitigate risk and enhance resilience.

2. Demonstrate Nature-Based Solutions.

The Nature Conservancy and partners are restoring five oyster reefs that are being used to demonstrate and quantify how natural infrastructure can dampen wave energy and mitigate coastal erosion. Three of these reefs are being restored along eroded roads at Chincoteague National Wildlife Refuge and two have been built fronting a marsh near the Village of Oyster.

Why the Eastern Shore

Though rural in character, the Eastern Shore is an important economic engine in the Mid-Atlantic. The region is home to the nation's largest clam aquaculture industry, a premier NASA rocket launch facility, and extensive public lands available for recreational and ecotourism activities, including Chincoteague National Wildlife Refuge. The activities are all possible because of the Eastern Shore's unparalleled natural riches and coastal wilderness. Along its seaside runs the world's longest expanse of a naturally functioning barrier island ecosystem. This critical habitat for migratory birds and marine life has been the site of intensive scientific research over the last three decades by the University of Virginia's Virginia Coast Reserve Long-Term Ecological Research Project, which is funded by the National Science Foundation.



Antares rocket launch from NASA-Wallops Flight Facility. Photo courtesy of NASA.



Shoreline at Franklin City. Photo by Gwynn Crichton

The Future

Working together with the Eastern Shore Climate Adaptation Working Group, The Nature Conservancy, Accomack-Northampton Planning District Commission, and UVA's Long-Term Ecological Research Project have an unprecedented opportunity to apply best available science to develop planning tools and natural infrastructure solutions that have the potential to mitigate risks of sea-level rise and storms while enhancing the Eastern Shore's unique natural resilience now and for future generations.

The Eastern Shore is not alone in its plight, yet it is poised to be a leader for communities facing similar challenges. The science and the support tools that emerge from this effort will transfer broadly to other coastal systems, transforming the Eastern Shore into a model of resilience for coastal communities around the globe.

For More Information, please visit:

coastalresilience.org/virginia

Contact for questions, feedback, or suggestions:

vacoastalresilience.org@tnc.org



VIRGINIA EASTERN SHORE

INTRODUCTION

CHALLENGES

SOLUTIONS

Introduction

On Virginia's Eastern Shore—a narrow peninsula that separates the Chesapeake Bay from the Atlantic Ocean—lies the longest coastal wilderness remaining on the U.S. Atlantic Seaboard. Some 60 miles of undeveloped barrier islands are a refuge for hundreds of species of plant and animal life and a mecca for migratory songbirds, raptors, and shorebirds. This iconic wilderness has come to define the local culture and economy. Visitors are greeted with signs proclaiming: "You'll Love Our Nature."

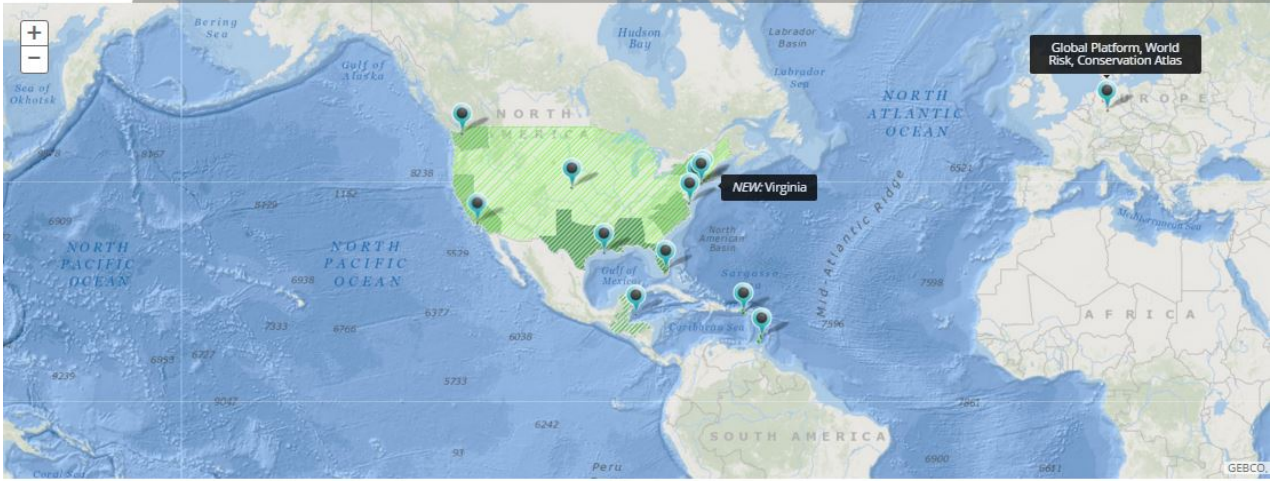
It follows that the natural riches of the Virginia's Eastern Shore make it an important economic engine for the Mid-Atlantic region. ([Click here to view a map of Virginia's Eastern Shore](#))



A typical tidal creek on the Atlantic side of the Eastern Shore where clam aquaculture beds thrive alongside agriculture. Photo © 2015 Gordon Campbell

coastalresilience.org/virginia

idyllic shores. The Chincoteague National Wildlife Refuge, located on Assateague Island is visited by 1.2-1.4 million tourists annually, making it the most heavily visited refuges in the US, generating millions of US dollars in



Coastal Resilience mapping portal

Click on the blue point markers on the map to navigate to specific geographies, or scroll down to see a list of places where we work. The green hatching on the map represents our Coastal Resilience coverage across countries, regions and states.

Coastal Resilience supports a community of practitioners around the world who are applying spatial planning innovations to coastal hazard risk, resilience and adaptation issues. This is a global network providing access to peer practitioners, tools, information and training focused on nature-based solutions. For more information see our [Coastal Resilience website](#)

GLOBAL PLATFORM, WORLD RISK, CONSERVATION ATLAS

CARIBBEAN

maps.coastalresilience.org/virginia

Flood & Sea Level Rise

Choose Data Source: Data Source: Storm Surge

Choose a Scenario Year: Current 2040 2065

Choose a Storm Type: Norida Low Intensity Moderate Intensity High Intensity

Depth or Difference:

- Water Depth (ft)
- Absolute Difference
- Percent Difference

Additional Layers:

- Show storm tracks
- Show tidal range

Layer Properties: Opaque Transparent

Map Legend

Depth (ft) (Moderate Intensity, 2065)

- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 8
- 8 - 10
- 10 - 12
- 12 - 15
- 15 - 18
- 18 - 20