Virginia Eastern Shore Coastal Resilience Tool

Exercises and Skills

Part One: Basic Navigation

Exercise A. Getting there

- Start by going to the Virginia Eastern Shore Coastal Resilience project website: http://coastalresilience.org/project/virginia-eastern-shore/
  - Scroll down the page to learn more about the Coastal Resilience work going on in the region.
  - In the upper right hand corner of the header banner, click **Mapping Portal** to launch the Coastal Resilience mapping tool *(or enter URL:* maps.coastalresilience.org).

- Either click on the **Virginia** pin on the map or scroll down and Click on **United States**, then scroll down and click on **Virginia**. Click on the **Map** button to open the mapping tool. Use the scroll bar on the right to scroll down past the project information and click on **Explore the Map** in the Getting Started window.

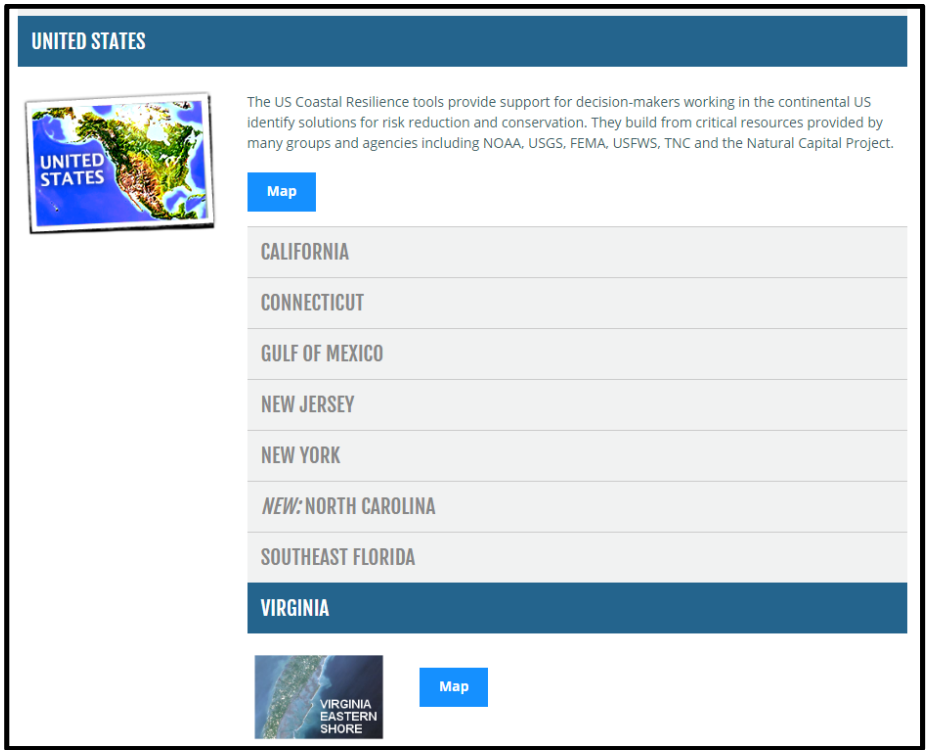

Figure 1. Accessing the Virginia map at maps.coastalresilience.org/Virginia

Exercise B. Basic orientation to framework and apps

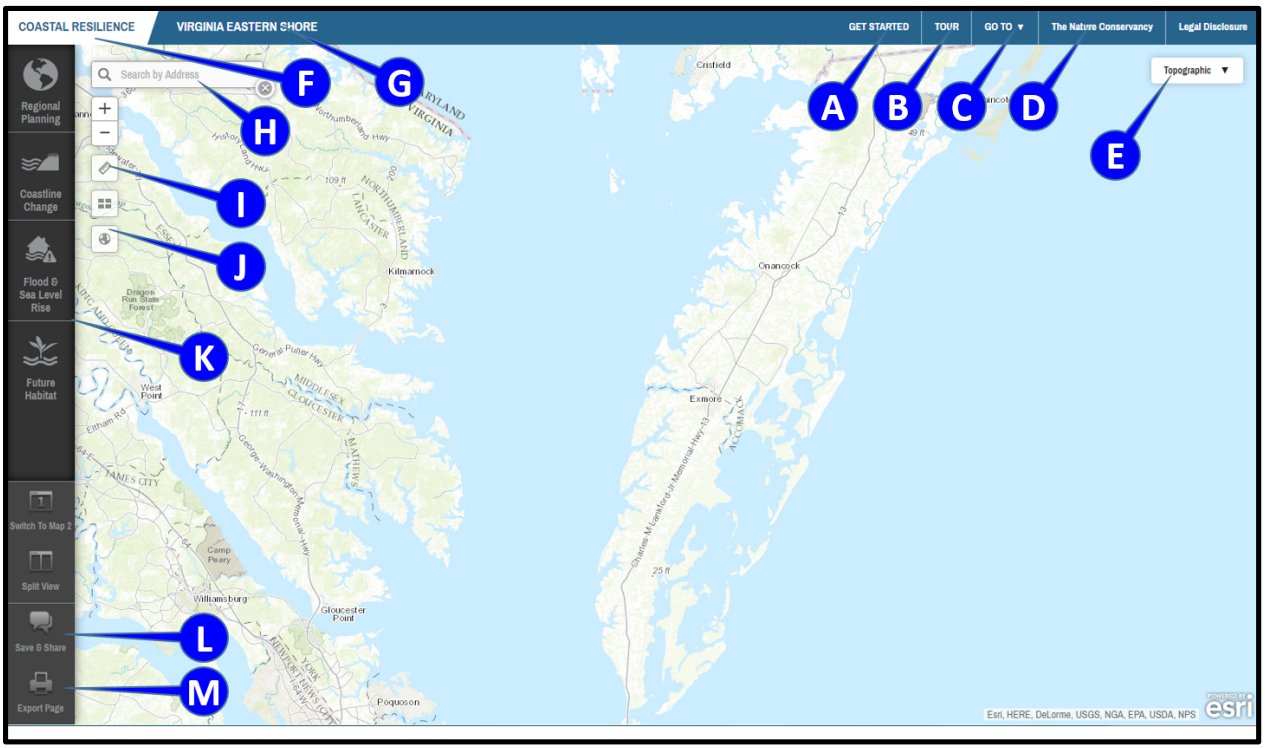

Figure 2. Orientation to the framework

- **A.** The **Get Started** window automatically appears and shows menus of bookmarked maps and information on project partners. Note that you need to scroll down to see the bookmarked maps. Close this window by clicking the **X** in the upper right hand corner.
- **B.** Click **Tour** for an introduction to the map interface. Click on each number for feature information and close this window when finished.
- **C.** Click **Go To** to access a drop down menu to toggle to different Coastal Resilience geographies.
- **D.** Click **The Nature Conservancy** to go to the www.nature.org Ocean and Coasts website.
- **E.** Click **Topographic** in upper right hand corner and select the **Imagery** basemap option. Note that other base maps are available here as well.
- **F.** Clicking on **Coastal Resilience** will go back to the main Coastal Resilience website in a new tab.
- **G.** Clicking on **Virginia Eastern Shore** at the top will open the Virginia Eastern Shore Coastal Resilience website project page in a new tab.
- **H.** Go to the **Search by Address** search window in the top left corner of the map to find and zoom to a particular area on the map:
    a. Type in your point of interest and you will get a list of available selections from a global address database.
    b. Choose the correct location from the dropdown menu.
    c. Close the search window by clicking on the **X** icon twice.
- **I.** Measure an area or distance by selecting the measure tool and clicking on the map. Click the **X** to close this tool.
- **J.** Zoom to the full extent of the map by clicking the **globe** icon.

K. View Coastal Resilience apps on left hand side of screen: **Regional Planning, Coastline Change, Flood & Sea-Level Rise, and Future Habitat** (note slider bar to see all app options on smaller screens).
   a. Click on an app to activate; when active, the app icon will be blue.
   b. You can have multiple apps running at the same time; simply open other apps and they will overlap each other in the app window (the icons will stay blue), use the **Minimize button (-)** in the upper right corner to minimize or **X** to close.
   c. Click the **Learn More** link within the app interface to view a fact sheet describing the app's purpose and how it works. Note that these fact sheets open in a new tab.

L. Click on **Save & Share** at the bottom of the left pane**.** Note that the link at the top can be copied to share with colleagues.

M. Click on **Export Page** to save your map as an Adobe Portable Document Format (PDF).

Apps in the Toolbox

Regional Planning

The **Regional Planning** app includes supporting infrastructure, ecological, socioeconomic, and other data important for resilience and adaptation planning. These layers may be used in combination with the other apps to identify and assess vulnerability and potential solutions for specific locations and resources.

Flood and Sea Level Rise

The **Flood and Sea Level Rise** app allows users to view the potential future risk of inundation and flooding due to sea-level rise and storm surge on towns, homes, property, and critical built infrastructure like roads and utilities, as well as coastal habitats. This information helps support planning and decision-making related to hazard mitigation, emergency services, storm water management, land use and conservation.

Future Habitat

The **Future Habitat** app allows users to examine how coastal habitats, like salt marsh or freshwater tidal wetlands, may change and migrate inland over time under different sea-level rise scenarios. This information is useful when developing land acquisition, species management, shoreline management, or restoration plans.

Coastline Change

The **Coastline Change** app's **Historical Data** module and **Future Scenarios** module collectively serve to educate stakeholders about the dynamic nature of barrier islands over time and provide planners and managers with overall trends in shoreline changes in response to climate change. This provides planners and managers with useful context for understanding the barrier islands as they evolve in the future.

Part Two: Flood & Sea Level Rise App

Assessing Vulnerability of Property and Infrastructure to Sea-Level Rise and Storm Surge

Exercise A. Characterizing the risk of sea-level rise in Quinby, Virginia

★ **Exercise A Planning Outcome:** *Identify number of people, properties, and critical infrastructure in Quinby that are predicted to become inundated in the future under different scenarios of sea-level rise.*

- Click on the **Flood & Sea Level Rise App** on left.
- Click on **Choose Data Source** in the upper left corner of the app window and select **Basic Inundation.**
  - See **Learn More** link for information on the mapping methodology.
  - Click on the blue **" i "** icon for information on sea-level rise (SLR) scenarios; click on the **X** to close the information window.
- Move the app window down slightly by clicking and dragging on the top bar. Go to the **Search by Address** window and type **Quinby, VA** and hit **Enter**, click the search result that comes up, then click the **X** to close the search result window.
  - Zoom in or out to adjust extent by clicking on the **plus sign [+]** or the **minus sign [-]** on the upper left or by using the mouse wheel.
  - **Pan**: hold the left mouse button down and move the mouse in the direction you want to pan.
  - For **Choose SLR Scenario**, slide the bar to the **High** SLR scenario.
  - For **Choose a Scenario Year**, slide the bar to **2040** and look at results, then to **2065** and **2100**.
  - Change **SLR scenario** to **Highest.**
  - You can change the layer transparency as needed using the **Layer Properties** slider at the bottom of the app window.

- Minimize the Flood & Sea Level Rise App by clicking on the **Minimize button (-)** on the top right corner of the App window.
- Click on the **Regional Planning** app icon at the top of the left pane.
- Click **Virginia**, then **Social and Economic** and select **Persons per Square Mile**.

Question 1-A: How many people per square mile might be affected by permanent inundation under the Highest SLR Scenario in 2100 on the southeast side of the Machipongo River, immediately north of Quinby Bridge Road? Note that the Persons per square mile layer can be toggled on and off as needed.

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- ➢ Uncheck **Persons per Square Mile** to turn that dataset off.
- ➢ Click **Base Data** and check box for **Roads**.
- ➢ Click **Coastal Management** and check box for **Flood Hazard Areas (2014)**.
    - Click the "**i**" button next to any layer to see brief description and link to metadata.
- ➢ Minimize the **Regional Planning** App by clicking on the **Minimize (_) button** on the top right corner of the App window.
- ➢ Click on **Flood & Sea Level Rise** app icon to reopen (note App button is blue when still active).
    - Continue to explore different SLR options by moving the **slider bars**.

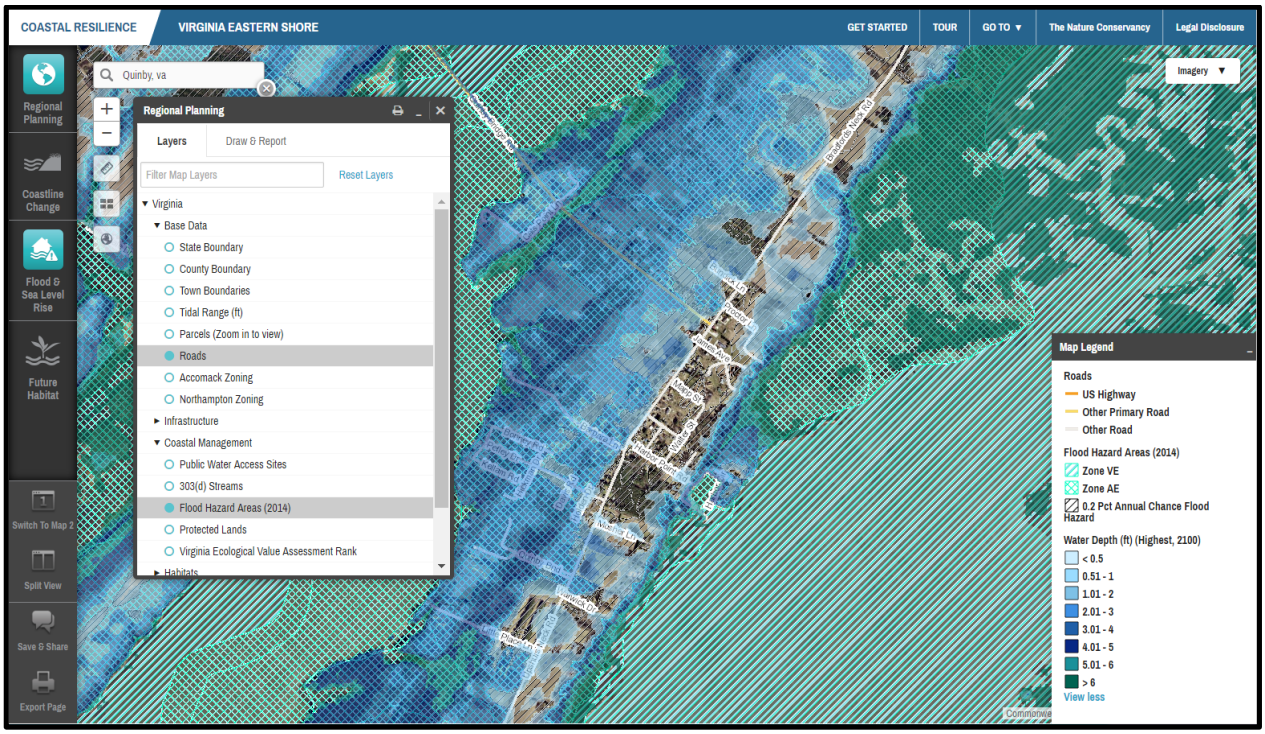

Figure 3. Example of what your screen should look like prior to Exercise A question 2-A.

Question 2-A: What areas within the 100-year floodplain (VE and AE Zones) in Quinby (including the Causeway) are potentially at risk of permanent inundation in 2025, 2040, or 2065 under the "High" sea level rise scenario?

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Question 3-A: Under what SLR Scenario and Year does the 0.2 Pct Annual Chance Flood Zone in Quinby begin to experience inundation?

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- **Where is this happening? _____**
- **What water depths are expected in these places? _____**

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On Your Own:

Question 4-A: Under what SLR Scenario might portions of the Quinby Bridge and causeway (Route 182) become inundated?

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Question 5-A: If both roads are inundated, are there alternative evacuation routes? If not, what are some options for adapting road infrastructure to accommodate the potential future areas of inundation?

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Exercise B. Characterizing the risks due to flooding and inundation from future sea-level rise combined with storm surge in the vicinity of Quinby.

★ **Exercise B Planning Outcomes:** (1) *Identify 0.2-pct Flood Hazard Zones in Quinby and vicinity that are at risk for flooding under various scenarios of sea-level rise combined with storm surge and local conditions;* (2) *Identify potential estimated economic losses under different scenarios of sea-level rise combined storm surge.*

- In the **Flood & Sea Level Rise** app, click on **Choose Data Source** and choose **Storm Surge**.
- Click on **Learn More** hyperlink to view fact sheet and click on the blue "**i**" buttons as needed.
- See two options: **Show modeled storm surge depth** or **Show estimated economic loss**. Notice that the app defaults to modeled storm surge depth for the **Current** scenario year and **Nor'Ida** as the storm type when opened.
- Make sure you are still zoomed to **Quinby, VA**, have the **imagery basemap** turned on, and still have the **Flood Hazard Areas (2014)** layer from **Regional Planning** displayed.
- With **Show modeled storm surge depth** still selected, explore how storm surge water depths change for the three options under **Choose a Scenario Year** by sliding the bar to **2040** then **2065** while keeping **Storm Type** on **Nor'Ida**.

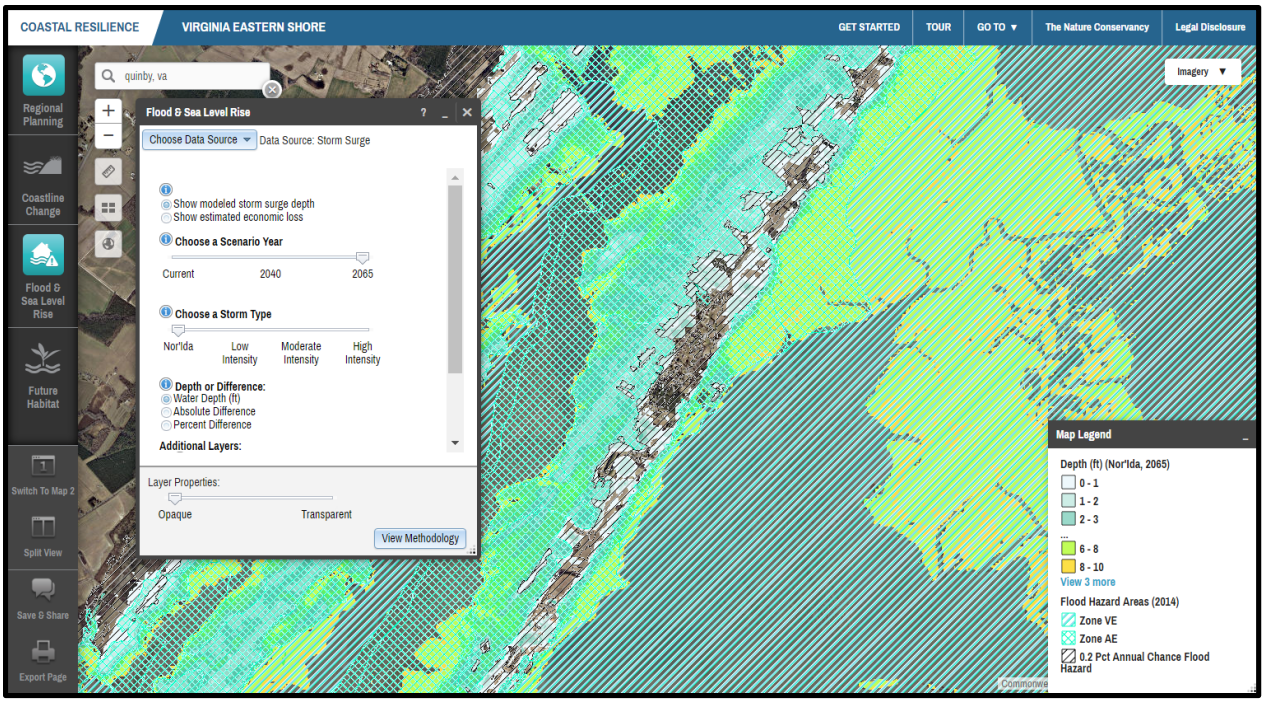

Figure 4. Example of what your screen should look like prior to Exercise B question 1-B.

Question 1-B: Roughly how many feet of surge would the 0.2 Pct Annual Chance Flood Zone near Quinby Harbor potentially experience in a 2040 and 2065 Nor'Ida event?

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- Slide the top slider back to **Current.**
- Under **Choose a Storm Type**, slide the bar to **Low Intensity**, **Moderate Intensity** and **High Intensity** and compare scenarios for **Current, 2040 and 2065**.

Question 2-B: How many *more* feet of surge would the same area in Quinby potentially experience in a Moderate Intensity Storm Type in 2040 versus in 2065?

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- Look at the options under **Choose Depth or Difference** (scroll down in the app window as needed) and notice that the app is automatically set to **Water Depth (ft).** Click on the blue **"i"** icon for information on **Choose Depth or Difference.**
- Click on **Regional Planning** app icon, click **Reset Layers** to turn off all ancillary data, click the **X** in the upper right corner to close the Regional Planning app.
- Click **Flood & Sea Level Rise** app icon to reopen, and zoom OUT to the area between **Wachapreague and Willis Wharf** by clicking the minus zoom extent **"-"** button three times. Pan the map as needed.

Question 3-B: What is the absolute difference and percent difference in surge due to sea-level rise in Quinby in 2065 for a Moderate Intensity storm? How does this differ from Wachapreague to the north? What is your conclusion about the risk of flooding at Quinby versus Wachapreague?

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- If necessary, use the scroll bar at the right of the app window to view the **Additional Layers** section or expand the size of app window by pulling on the lower right corner with your mouse.
    - Click on **Show tidal range.** Look for tide range numbers at various locations on the map.
    - Click on hyperlink to NOAA's historic sea level trends for **Wachapreague**.

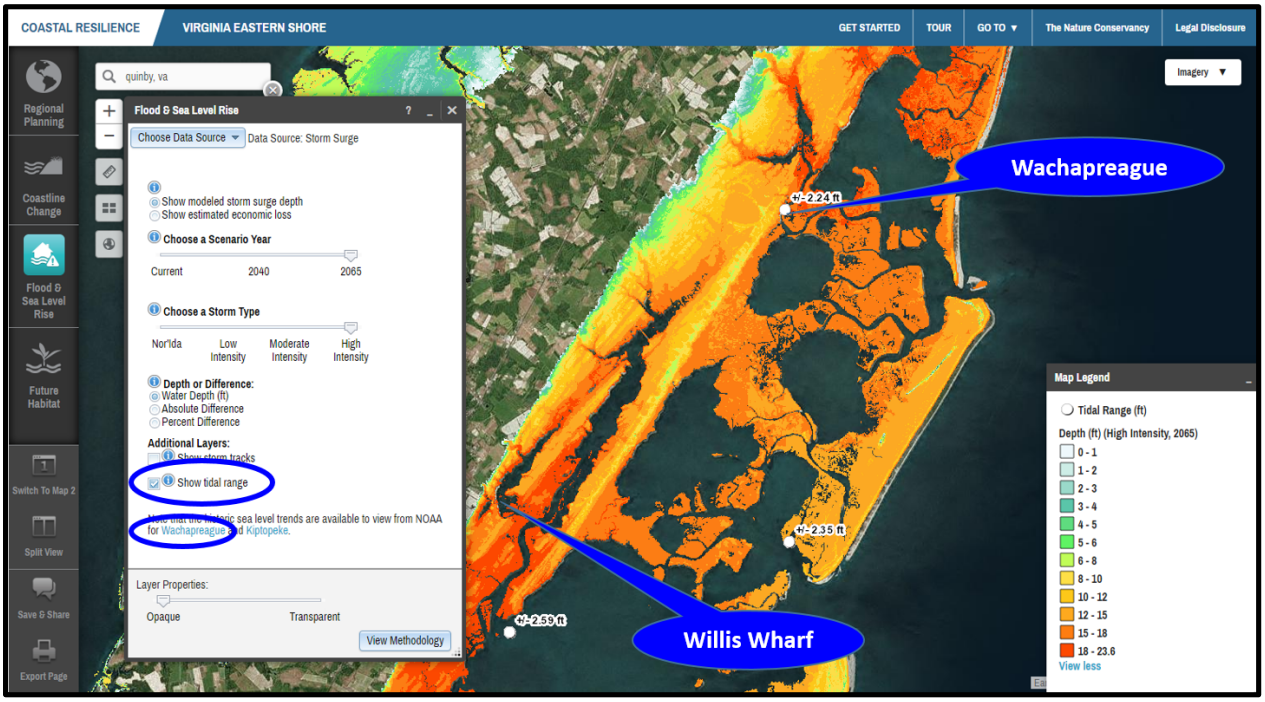

Figure 5. Example of what your screen should look like prior to Exercise B question 4-B.

- Back at the top of the app window, Select the radio button for **Show estimated economic loss**
    - Repeat exploration from above of Scenario Year and Storm Type to see potential changes in economic losses under different scenarios.

Question 4-B: Between the Towns of Wachapreague and Willis Wharf, could census blocks that did *not* experience economic losses under Nor'Ida in the Current Scenario Year potentially experience economic losses in a Nor'Ida event in 2040 or 2065?

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On Your Own:

Question 5-B: Using the information you have visualized; how many feet might you recommend the town of Quinby increase their Base Flood Elevation by for structures located in the 0.2 Pct Annual Chance Flood Zone to minimize flood risks under a Moderate Intensity Storm in 2040?

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TECHNICAL SKILLS COMPLETED

- ❑ Ability to assess risk and vulnerability to specific places or infrastructure due to a range of flooding scenarios based on SLR inundation only or SLR plus storm surge scenarios
- ❑ Ability to evaluate the relative impact SLR has on storm surge
- ❑ Ability to evaluate potential future economic losses due to different scenarios of SLR plus storm surge
- ❑ Ability to consider a range of hazard mitigation actions that may reduce risk of flooding to specific areas based on planning horizons.

Implementation:

- ❑ You can now use the Flood & Sea Level Rise app to help guide stakeholder workshops or conversations around community-scale socio-economic vulnerability to permanent inundation among a range of projected sea-level rise scenarios along with the potential impacts of sea-level rise on storm surge. For example, Quinby Bridge Road is vulnerable to increased inundation under future sea-level rise scenarios.
- ❑ You can now create a meaningful map that can help clearly communicate to decision-makers and stakeholders that the impacts of sea-level rise on storm surge are not uniform and vary based on place. For example, sea-level rise may have a greater impact on storm surge in areas around the Machipongo River.
- ❑ You can use the understanding of flood risk that you have gained to help make the case for adaptation recommendations like infrastructure or evacuation route relocation or future base flood elevation requirements, to help make your community more resilient.

Part Three: Future Habitat App

Identifying and Planning for Areas of Future Marsh Migration

Exercise A. Future Habitat for Marsh Retreat at a Regional Scale

★ **Exercise A Planning Outcome:** *Identify general regional trends in marsh habitat distribution and extent under different future sea-level rise scenarios for Virginia's Eastern Shore.*

- ➢ Press **F5** on your keyboard to refresh the site.
- ➢ Close the **Getting Started** window.
- ➢ Click on the **Future Habitat App** on left.
- ➢ Click on **Learn More** to open the **Future Habitat App Fact Sheet** in a new browser tab (note that Barrier Islands are not included in results).
- ➢ Begin with the **Choose Parameters** tab.

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- Explore **Choose a Scenario Year** and **Choose Sea-Level Rise Scenario** by sliding the bars in varying combinations to visualize where marshes may be most vulnerable to sea-level rise (SLR) and where marshes have the most potential for migration inland.
- Click on **More Info (Click)** in the Map Legend for descriptions of future habitat types.
- Under **Filter Results by Habitat(s) of Interest**, check **Salt Marsh** and then explore different Scenario Year and SLR Scenario combinations. The filter allows the user to view only how Regularly Flooded, Irregularly Flooded, and Transitional Salt Marsh Habitat Types change over time.

Question 1-A: How do Regularly Flooded, Irregularly Flooded and Transitional Salt Marsh Habitat Types change in distribution (general locations) and extent in 2065 under the High SLR Scenario from current condition?

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Exercise B: Future Habitat for Marsh Conservation in Deep Creek

★ **Exercise B Planning Outcome:** *Identify areas of potential future marsh retreat currently secured by some form of land protection that should be the focus of restoration actions in the Deep Creek area.*

- Hit **F5** to reset and click the **X** to close the Getting Started window.
- Go to the **Search by Address** box and type **Deep Creek, VA** and select **Deep Creek, Accomack County, Virginia, United States** from drop down menu. Click the **X** to close the drop down menu.
- Click on the **Future Habitat** app.
- Click on **Regional Planning** app.
- Turn on **Protected Lands** layer (under **Coastal Management**) and **Parcels** layer (**Base Data**).
- Click on **Future Habitat** app icon to bring the app window back up.
- Examine the distribution of Habitat Types and the types of habitat that are Protected Lands under current conditions (pan the map as needed).
- Slide Scenario Year to **2065** and SLR Scenario to **Highest**. Explore how the distribution of Habitat Types changes in the Parcels that are Protected Lands under different combinations of Scenario Years and SLR Scenarios.
- Slide the **Layer Properties** slider at the bottom of the app window about halfway between Opaque and Transparent.
- Zoom out and/or pan the map to view the neck of land between Deep Creek and Doe Creek (to the east of Deep Creek).
- Click on **Click to Draw an Area**. The cursor is now active and ready to draw a shape.
- Draw a polygon around a grouping of Protected Parcels in the area between Deep Creek and Doe Creek that best captures the gradient from current to potential future Transitional and Irregularly Flooded Salt Marsh under the Highest SLR Scenario in 2065. **Click once for each point** and **twice for the final point** to end. Do not hold the mouse button down as you draw.

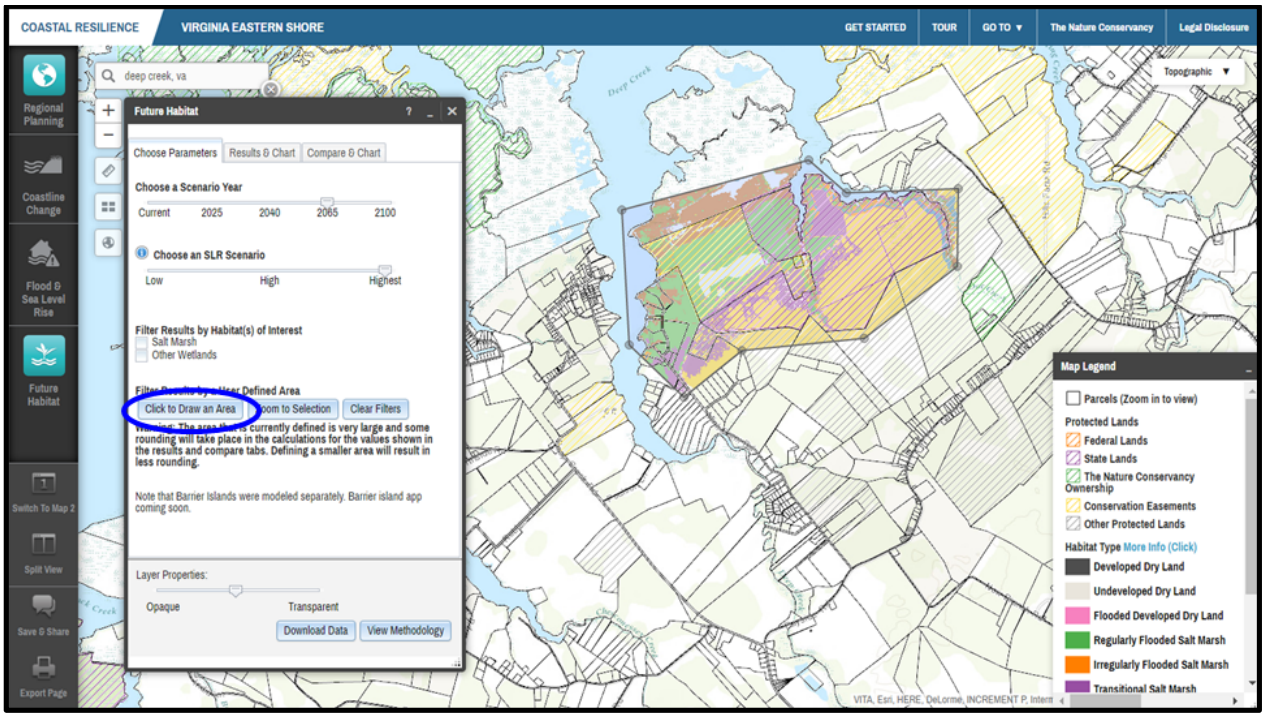

Figure 6. Example of what your screen should look like prior to Exercise B question 1-B.

- Select the **Results & Chart** tab at the top of the app window. View and mouse-over the **pie chart** for acreage of each Habitat Type within your custom polygon extent.
  - **Scroll down** to view table format for same information.

Question 1-B: What is the total acreage and percent area for Regularly Flooded vs. Irregularly Flooded vs. Transitional Salt Marsh in your polygon?

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- Click the **Compare & Chart** tab.
  - View and mouse-over **chart** to see change in acreage by Habitat Type from current condition within your custom polygon extent.
  - **Scroll down** to see table that shows Total Acres, Change in Acres vs. Percent for each Habitat Type found in your custom polygon extent.

Question 2-B: What is the change in acres and percent change from current condition for Undeveloped Dry Land?

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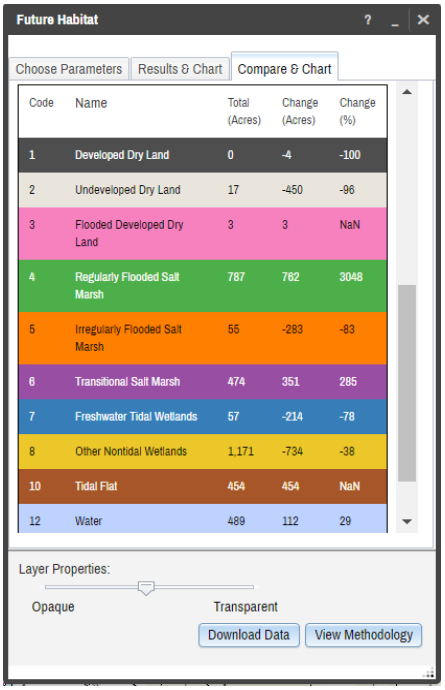

Figure 7.

- Select **Choose Parameters** tab and move the **Scenario Year** slider bar from **2065** to **2100**, check the box to filter results by **Salt Marsh**, and then explore filtered results for polygon using **Results & Chart** and **Compare & Chart** options, shown in figure 7.

Question 3-B: What is the change in acres and percent change from current condition for Regularly Flooded vs. Irregularly Flooded vs. Transitional Salt Marsh in your polygon?

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- Click on **Clear Filters** to remove Draw Area.
- Let's say you want to share this analysis with a colleague to get their input. Click the **Save and Share** icon in the bottom left of the screen which creates an active bookmark of your map and any data or apps that are open. You would then copy the **Permalink** and paste it into an email.
    - To simulate what your colleague would see when they opened the link, paste the **Permalink** into a new tab in your browser. The link opens at the exact place you left off, and your colleague can continue to make changes and send back to you.

On Your Own:

Question 4-B: What are some long-term shoreline management, land use, or restoration strategies that the Protected Parcels stakeholders might consider to ensure the successful migration of marsh in this area over the next 85 years?

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Exercise C. Future Habitat for Marsh Retreat at Henry's Point

★ **Exercise C Planning Outcome:** *Identify areas currently zoned for residential development that are currently classified as undeveloped dry land where salt marsh could potentially migrate in the future at Henry's Point (near Folly Creek).*

- Press **F5** on your keyboard to refresh the site.
- Scroll down in the Getting Started window and select **Henry's Point Future Habitat** in the One-Click Interactive Maps section.
- Move the Layer Properties slider at the bottom of the app window about halfway between Opaque and Transparent.
- Switch to **Imagery** as map background.
- Click on **Regional Planning** app and under **Virginia**...**Base Data** turn on **Parcels** to view the high density of undeveloped and developed residential lots fronting existing Regularly Flooded Salt Marsh. (Note: if you are too zoomed in, the parcels disappear so play with the zoom level by rolling the mouse wheel gently until you find the closest zoom level possible.)
- Click back to **Future Habitat** app.
- Examine the current distribution of Habitat Types in proximity to the residential parcels on Henry's Point.
- Set slider bars on Scenario Year **2065** and SLR Scenario **High**.
- Zoom into the area shown in Figure 8.

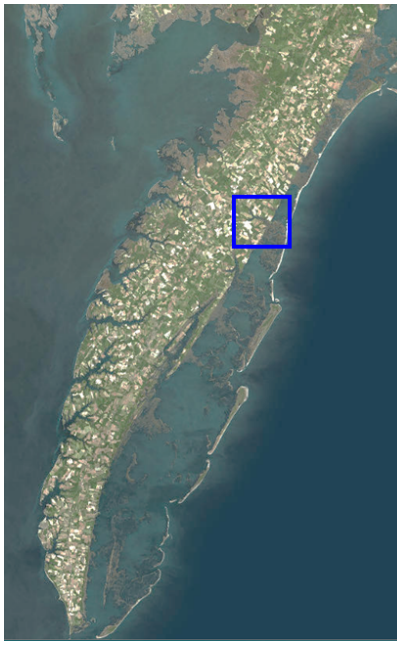

Figure 8. Henry's Point Lane Area.

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➢ Click on **Click to Draw an Area** and draw a polygon that captures the residential development area between Custis Neck Road, Seaview Street, and the creek fronting Henry's Point Lane. **Click once for each point** and **twice for the final point** to end and don't hold the mouse button down as you draw.

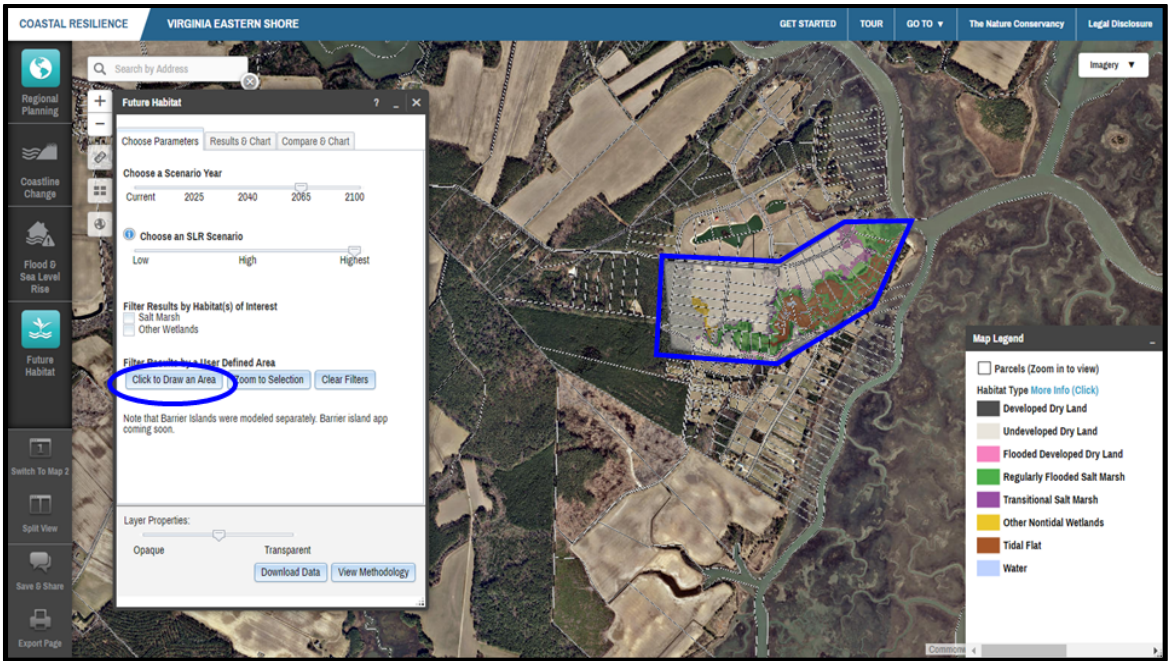

Figure 9. Example of what your screen should look like prior to Exercise C question 1-C.

On Your Own:

Question 1-C: In your polygon, how much Undeveloped Dry Land could be converted to different Marsh Habitat Types?

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Question 2-C: Roughly how many undeveloped parcels (empty lots) are most vulnerable to marsh migration without intervention?

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Question 3-C: Based on visible development, which groups of parcels and shoreline segments would you recommend for natural marsh migration versus living shoreline treatments versus conventional bulkheads?

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TECHNICAL SKILLS COMPLETED

- ❑ Ability to identify places where habitats, particularly salt marsh, may change in the future due to sea-level rise
- ❑ Ability to identify areas that are currently undeveloped dry land but that could become salt marsh under future sea-level rise scenarios
- ❑ Ability to consider a range of planning options that would allow marshes to migrate naturally

Implementation:

- ❑ You can use the Future Habitat app to more effectively communicate to decision-makers and stakeholders that coastal habitats will respond dynamically to sea-level rise.
- ❑ You have a better understanding that although potential exists to lose much of the existing tidal marshes due to sea-level rise in the future, the landscape has high capacity for marsh migration on the mainland at the regional scale. The ability for marsh migration to occur unimpeded on the mainland will ultimately depend on shoreline management and land use decisions. Armed with this information, you can begin to work with private landowners, resource management entities, and localities to identify open spaces or parcels where accommodating inland marsh migration is a viable management approach.
- ❑ You can use the "Save and Share" feature to work collaboratively with colleagues to get input on an analysis or create a map to help make the case for a project proposal.

Part Four: Coastline Change App

Understanding Past and Future Changes to the Seaside Barrier Islands

Exercise A: Historical Shoreline Change Data for Virginia's Barrier Islands

★ **Exercise A Planning Outcome:** *Gain understanding of historic long- and shorter-term rates of shoreline change at the scale of individual barrier islands and for the regional Virginia Barrier Island chain.*

- ➢ Press **F5** on your keyboard to refresh the site, then close the Getting Started window.
- ➢ Click on the **Coastline Change App** on left.
- ➢ Review opening infographic and hyperlinks to fact sheets for each module.
- ➢ Click **Next** to launch app.
  - Note: You can check the box **Don't show this on start** to skip the opening infographic in the future.
- ➢ The app automatically loads historical data.
  - Once app is open if you click **?** at the top, it will take you back to opening infographic.
  - Click **Explain Each Choice** for additional information on the various options below.

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- Click **Hide Explanations** to hide this information.

➢ Click on **Learn More** to view the Historical Data Fact Sheet and Supplemental Information in a new browser tab. This document can be downloaded or printed out and shared with colleagues or decision makers.

➢ Select **Hog Island** from the island dropdown menu

➢ Click **Play** underneath the Select Shoreline Year slider to see how the Hog Island shoreline has evolved since the 1850s.

➢ Click **Stop** and move the slider to **1910s**.

➢ In option 3 (Display Historic Shorelines) select **Multiple** then check the boxes for **1940s** and **2014.**

Question 1-A: Does the Hog Island shoreline appear to be rotating or is it moving progressively in one direction across its entire length?

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➢ Zoom in to the northern part of Hog Island then select **Change Rate** in option 2. Notice that the imagery basemap changes to a more recent image.

➢ Click on a few transects on the map to view change rate information about each transect in the bottom of the app window, as shown in Figure 10. Note that the length of each transect is proportional to the change rate.

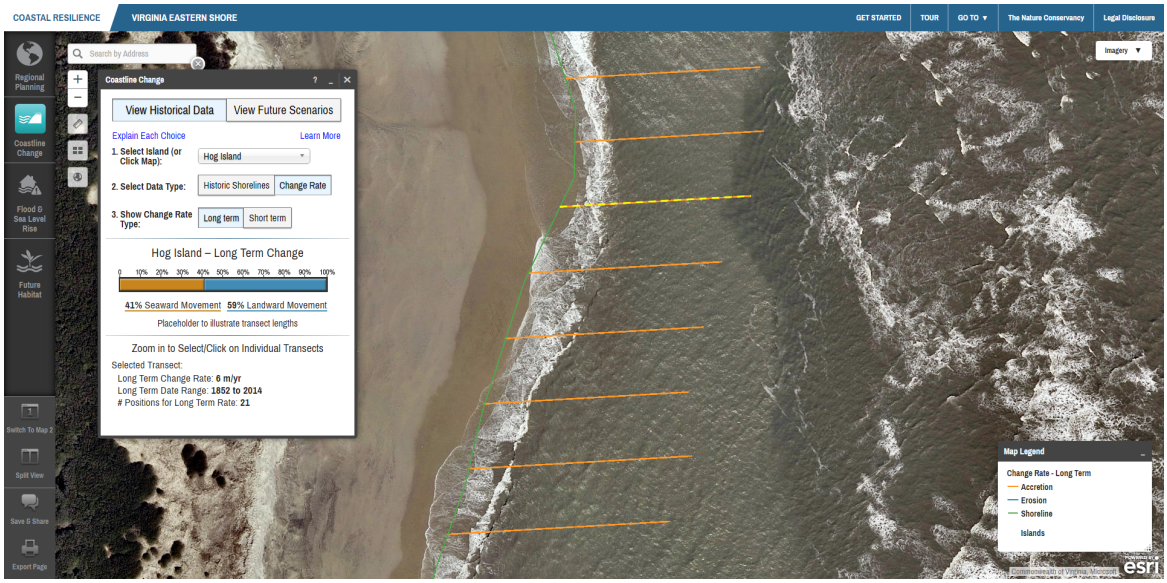

Figure 10. Zoomed to transects in northern part of Hog Island.

➢ Zoom out until the full extent of Hog Island is visible.

➢ In option 3 select **Short term**. Now select **Long term** for comparison.

➢ Toggle back and forth between these two options for comparison.

Question 2-A: Where has Hog Island experienced a change in the long-term coastline change trend?

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➢ Select **Virginia Eastern Shore** from the **Select Island** dropdown menu.
➢ Select **Change Rate** and **Short term**.

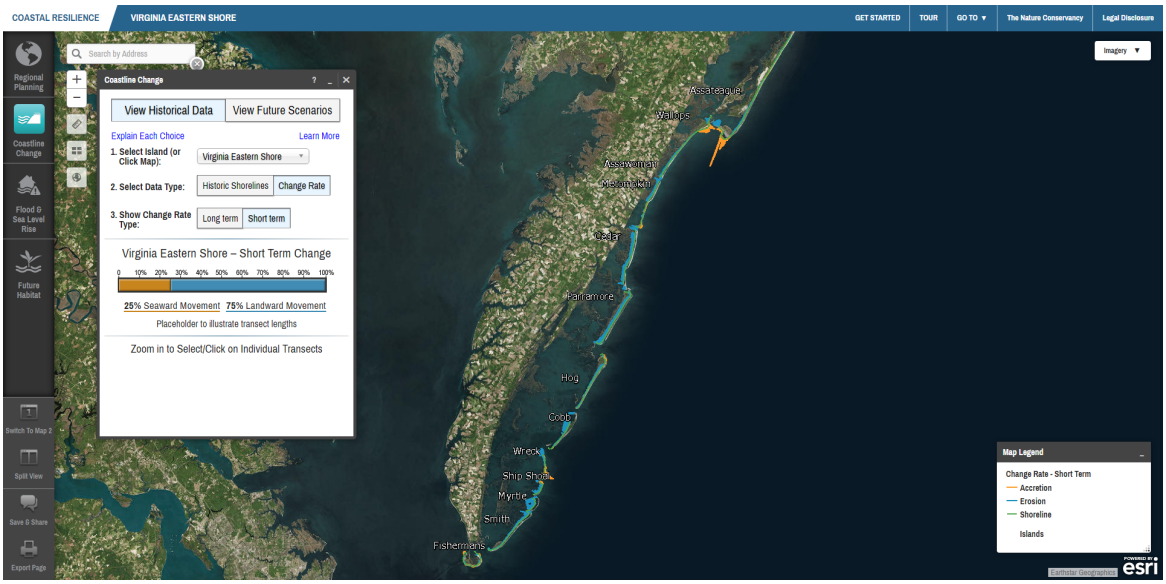

Figure 11. Example of what your screen should look like prior to Exercise A question 3-A.

Question 3-A: What percentage of the entire Seaside barrier island chain has experienced seaward movement (accretion) according to the short-term trend?

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➢ Hover the cursor over **Metompkin Island** on the map (Note that the outline appears blue) and click. This is another method for zooming to a specific island.
➢ Select **Long term** change rate. Now select **Short term** for comparison.

Question 4-A: What is the direction of movement and approximate range in rate of change for Metompkin Island according to the long-term trend? (Note that you may need to zoom in to select individual transects.) Are there parts of the island that are stable or experiencing seaward movement (accretion) according to the short-term trend? How does this pattern of coastline change compare to that of Hog Island?

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➢ Select **your favorite island** from the **Select Island** dropdown menu or select it by clicking on the map.
➢ Explore historic shorelines and rates of change for this and other islands of your choosing.

On Your Own:

Question 5-A: Where is the short-term rate of change the greatest for both erosion and accretion? Hint: Look for very long transect lines.

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Question 6-A: Can you find places where the short-term rate of change is relatively stable?

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Exercise B: Future Scenarios of Barrier Island Evolution

★ **Exercise B Planning Outcome:** *Understand the extent to which relative sea-level rise, changes in wave climate, and beach nourishment activities may change and influence the evolution of the Virginia Barrier Island chain.*

- Click on **View Future Scenarios** at the top of the app window.
- Click on **Learn More** to view the Future Scenarios Fact Sheet and Supplemental Information.
- Click on **Explain Each Choice** to see more information about each option then click **Hide Explanations**.
- Note that zooming is disabled in Future Scenarios due to the approximate nature of the model used to generate the data.
- Note that the data presented represent a modeled, hypothetical shoreline and do not represent the actual individual islands illustrated on the base map.
- Select **Highest** and **High** sea-level rise scenarios and note differences in **Change Rate Difference** on the map and in the chart at the bottom of the app window, shown in figure 12. Note that the numbers in the legend and on the chart refer to the difference in rate of change from a baseline. The baseline is future change under current climate conditions where relative sea level rises at the rate of 3 mm per year, the wave climate is consistent with the best-known present wave climate, and no nourishment occurs at any location.

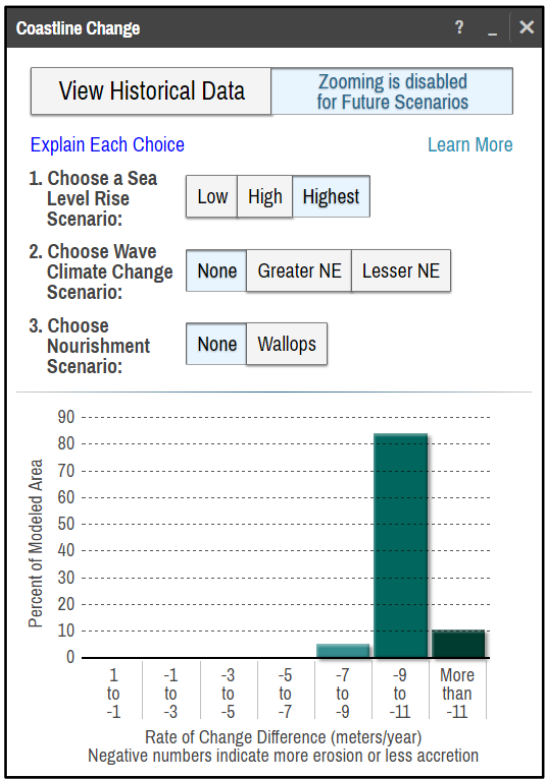

Figure 12. Coastline Change app Future module Scenario Dialogue Box

Question 1-B: Which areas are suggested to experience the greatest Rate of Change Difference in the High and Highest sea-level rise scenarios along the Seaside?

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- With the **High** sea-level rise scenario selected, choose **Greater NE** wave climate scenario and **Wallops** nourishment scenario. Now choose **Lesser NE** wave climate scenario.
  - **NOTE:** *Wallops Island was modeled as a zone where beach nourishment may occur in the future since it has been implemented in the recent past. The modeled projections should in no way indicate an endorsement of beach nourishment as a management option, on Wallops or elsewhere in the region.*
- With any combination of wave climate and nourishment scenarios selected, select the **Highest** sea-level rise scenario.

Question 2-B: Do changes to wave climate and nourishment scenarios have a potentially greater or lesser influence on the Seaside shorelines as compared to sea-level rise?

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- Select **Highest** sea-level rise scenario and **None** for both wave climate and nourishment scenarios. Notice the area in the vicinity of Wallops Island.
- Select **Greater NE** wave climate scenario. Compare this with the **Lesser NE** and **None** options.

Question 3-B: What are the suggested changes to the Wallops Island area according to the various wave climate changes?

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On Your Own:

Question 4-B: Does the Future Scenarios module suggest that nourishment may result in widespread or more localized changes along the Seaside?

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TECHNICAL SKILLS COMPLETED

- ❏ Ability to view various historic shoreline positions along with rates and direction of barrier island movement for all of the Eastern Shore barrier islands
- ❏ Understanding of how sea-level rise, potential wave climate shifts, and nourishment scenarios may affect future changes to barrier island shorelines

Implementation:

- ❏ Organizations and agencies who manage barrier islands, research scientists, and local governments may use the Future Scenarios module in the Coastline Change app to explore different regional climate and nourishment scenarios in order to better anticipate and manage shoreline changes in the future.
- ❏ Suggested conclusions of the Future Scenarios modules outputs:
    - ❏ The Coastline Change app demonstrates that the Virginia Barrier Island chain is highly dynamic and dependent on the interaction of local and regional processes.
    - ❏ On a regional scale, the results suggest that relative sea-level rise is the dominant factor in causing more erosion or less accretion along the barrier island chain.
    - ❏ Nourishment activities are suggested to have a more limited and local effect on the barrier island chain than expected.
- ❏ The information from Future Scenarios as a springboard for additional inquiry and modeling efforts regarding potential local coastline change in the future.