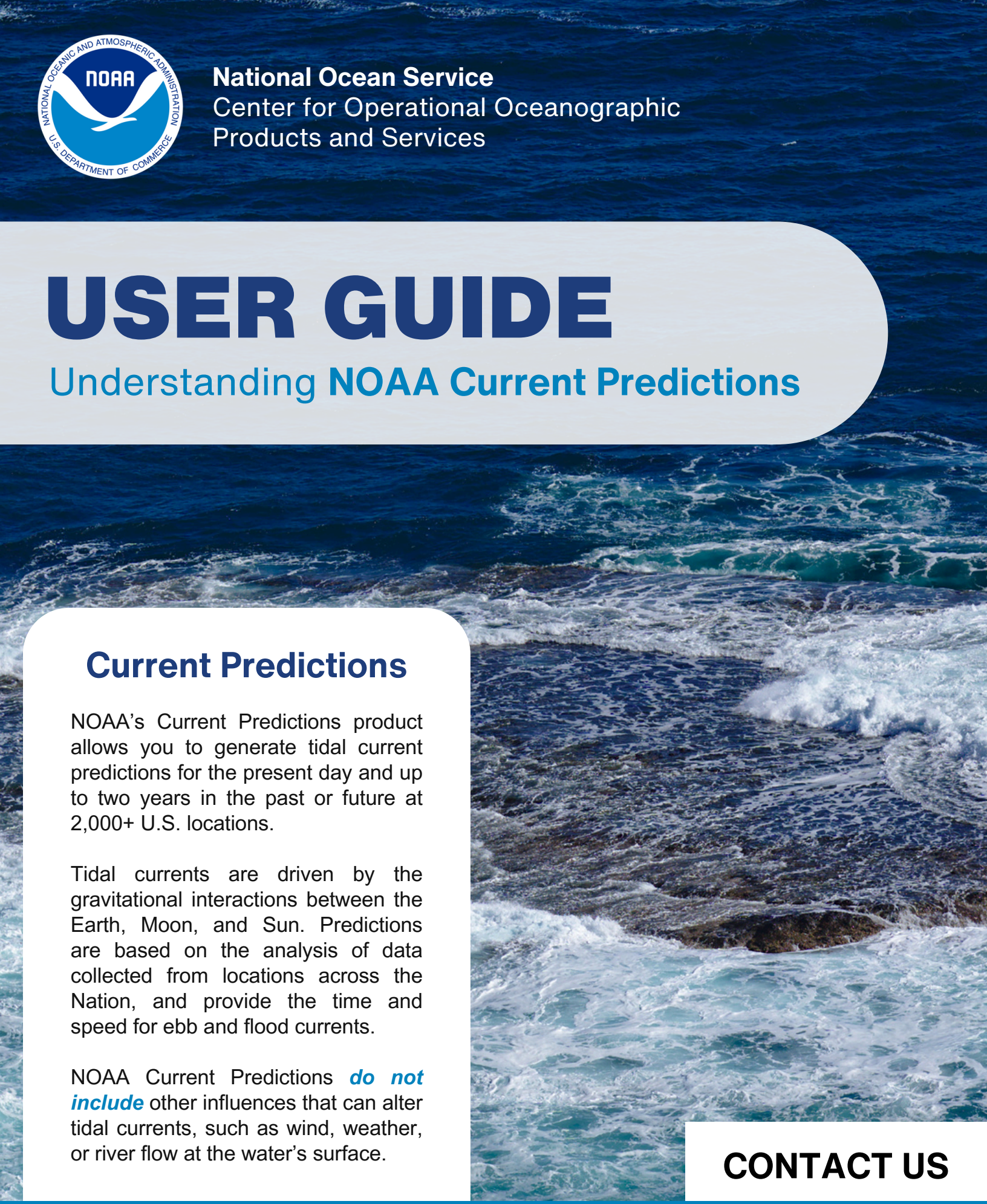
National Ocean Service
Center for Operational Oceanographic
Products and Services

USER GUIDE

Understanding **NOAA Current Predictions**



Current Predictions

NOAA's Current Predictions product allows you to generate tidal current predictions for the present day and up to two years in the past or future at 2,000+ U.S. locations.

Tidal currents are driven by the gravitational interactions between the Earth, Moon, and Sun. Predictions are based on the analysis of data collected from locations across the Nation, and provide the time and speed for ebb and flood currents.

NOAA Current Predictions ***do not include*** other influences that can alter tidal currents, such as wind, weather, or river flow at the water's surface.

CONTACT US

www.tidesandcurrents.noaa.gov

tide.predictions@noaa.gov

About Tidal Currents

*Whereas **tides are defined* as the vertical movement of water**, **currents are the horizontal movement of water.** Currents can be tidal or nontidal.*

CO-OPS collects data to measure and predict tidal currents, which are caused by gravitational interactions between the Earth, Moon, and Sun that create tides.

Because tidal currents are driven primarily by astronomical interactions (though they can be impacted by weather at the water's surface as well), they are periodic.

Like Tide Predictions, NOAA's Current Predictions are generated by observing currents in a location for a minimum of 30 days.

Most of CO-OPS' tidal current stations collect data for approximately 120 days, while select stations may be occupied up to a year.

Nontidal currents include permanent currents in the ocean's circulatory system, as well as temporary currents that arise as a result of the weather. NOAA Current Predictions depend only on tidal currents.

**For additional definitions of common terms, visit our glossary on pages 13-14 of this guide.*

Most tidal currents have 4 phases: flood current, ebb current, slack before flood, and slack before ebb.

1. **Flood is** *the movement of a tidal current toward the shore or up a tidal river or estuary as a result of rising tide.*

2. **Ebb is** *the movement of a tidal current away from the shore or down a tidal river or estuary as a result of receding tide.*

Slack is *the state of a tidal current when its speed is near zero, particularly the moment when a reversing current changes direction.*

3. Slack water that occurs immediately before ebb is called "slack before ebb."

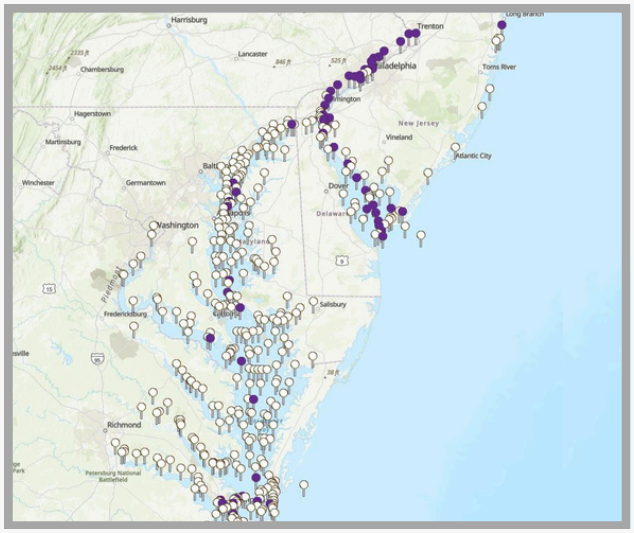
4. Slack water that occurs before flood is called "slack before flood."

During slack, the current is typically too weak to have a significant impact on navigation. In NOAA Current Predictions, "slack" may be used to indicate when the current's speed is at a minimum.

Three Types of Stations

CO-OPS displays tidal current predictions for ***harmonic and subordinate*** stations, ***but not weak/variable stations***.

Harmonic Stations



Harmonic stations are labeled with purple pins on the map interface. They represent locations with enough long-term data to establish harmonic constants.

Predictions for these stations are generated from the analysis of this data. *Note: harmonic stations are different from* ***real-time current stations***. Harmonic stations are those that were at one point part of a now completed tidal current survey. Real-time current stations are actively collecting and disseminating data as part of an ongoing tidal current survey. All real-time stations are also harmonic stations, but there are more than 1,000 harmonic stations that are no longer actively collecting real-time data.

Subordinate Stations

Subordinate stations are labeled with white pins on the map. On the Current Predictions interface, their reference station is named and linked. They are typically older stations that did not collect enough data to calculate harmonic constants. Predictions at subordinate stations are obtained by taking the predictions calculated at nearby reference stations and applying time and speed corrections. These include four corrections for time (slack before flood, max flood, slack before ebb, and max ebb) and two corrections for speed (max flood and max ebb).

Weak/Variable Stations

The third type of tidal current station is known as weak and variable. You will see this designation on the **Current Predictions station listing** when you click on a state to bring up its current predictions. Stations designated as weak and variable represent locations with currents that do not, on average, exceed a quarter of a knot. These currents are driven primarily by wind and weather rather than astronomical forces. Due to the currents' weak nature, predictions cannot be made at these locations and will not appear as pins on the map interface.

Accessing NOAA Current Predictions

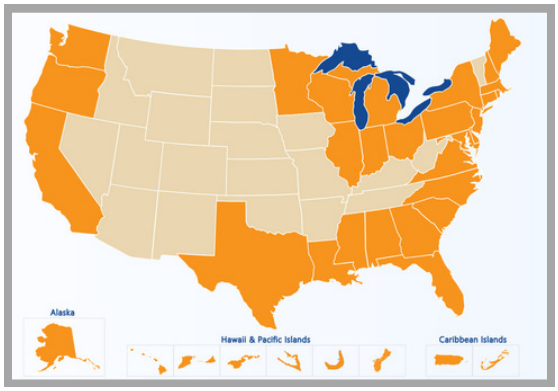
for a location

On our website, www.tidesandcurrents.noaa.gov, there are two ways to access this information.

1

Through the Map Interface

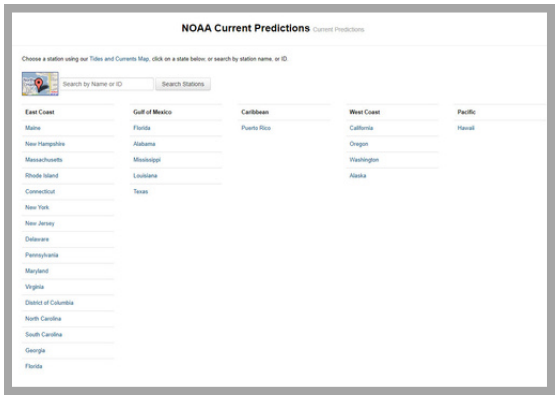
Read on pages 5-6



2

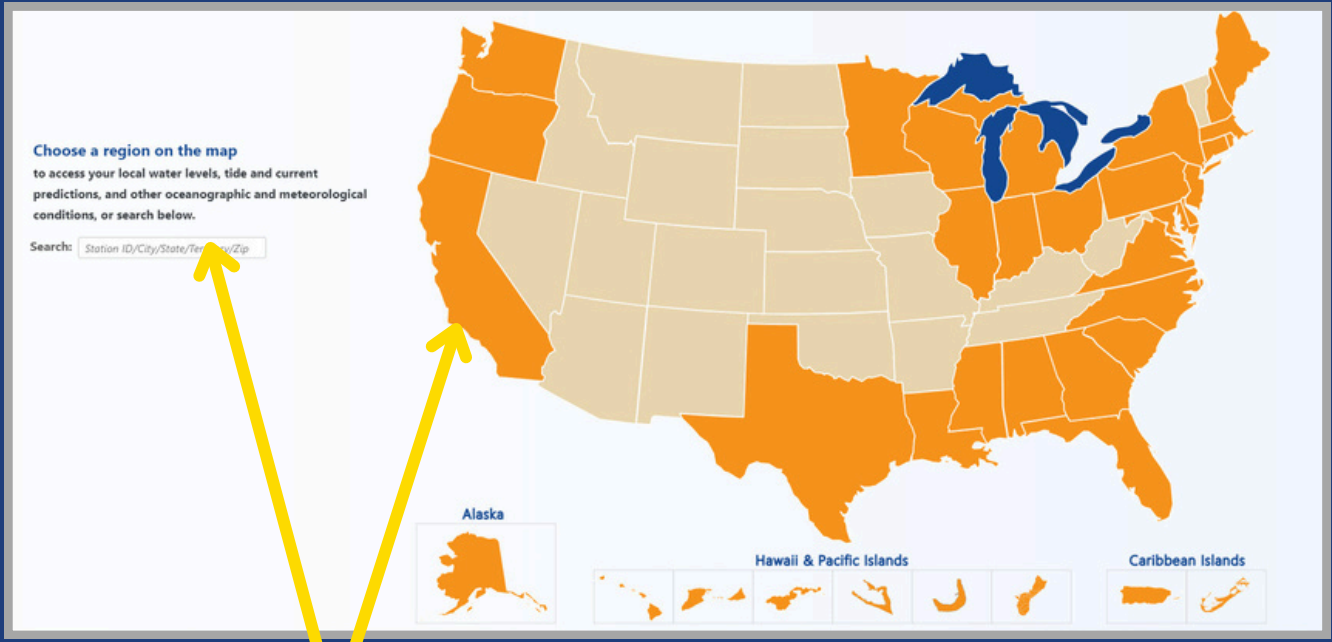
Through the Station Listing

Read on page 7-8



1

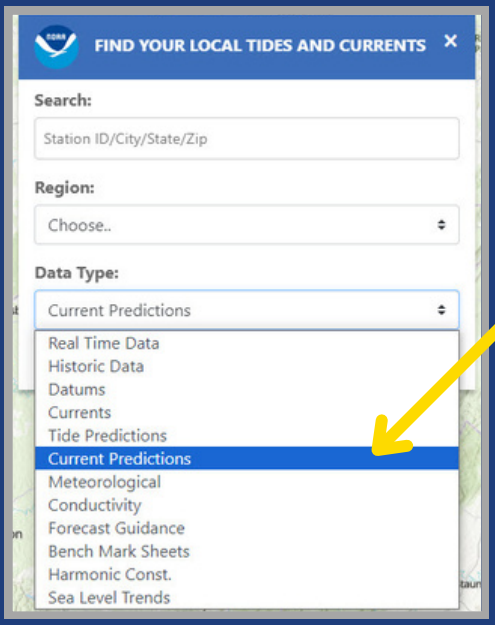
Through the Map Interface



From the *Tides and Currents homepage*, you can locate a station by:

1. *clicking on a state on the map to bring up all the pins for that state, or*
2. *entering a city, state, or zip code to get results within a general area.*

Harmonic stations are also searchable by their station ID.



To ensure that you are accessing only stations that generate NOAA Current Predictions, from the map interface you will need to select:

- *"Advanced"* within the top left search box
- Then, in the Data Type dropdown, select *"Current Predictions"*

You can now choose from purple pins (harmonic stations) or white pins (subordinate stations) that populate the map to get information on that station. If you are searching by station ID, you may need to reenter the ID after these steps. Refer to the section *"Types of Stations" (on page 3 of this file)* for more information on harmonic and subordinate stations.

1

Through the Map Interface *Continued...*

Once you click on a pin, you will get a pop-up window, called the **station dashboard**. On this pop-up, click on the *"More Data"* button to reveal a dropdown.

Select *"Current Prediction Data"* from the list. This selection will take you directly to the Current Predictions page (*see bottom image on this page*) for that specific station. For some stations, like the one pictured, a location may have predictions at multiple depths. When selecting a station from the map, the predictions interface will always display predictions at the most shallow depth.

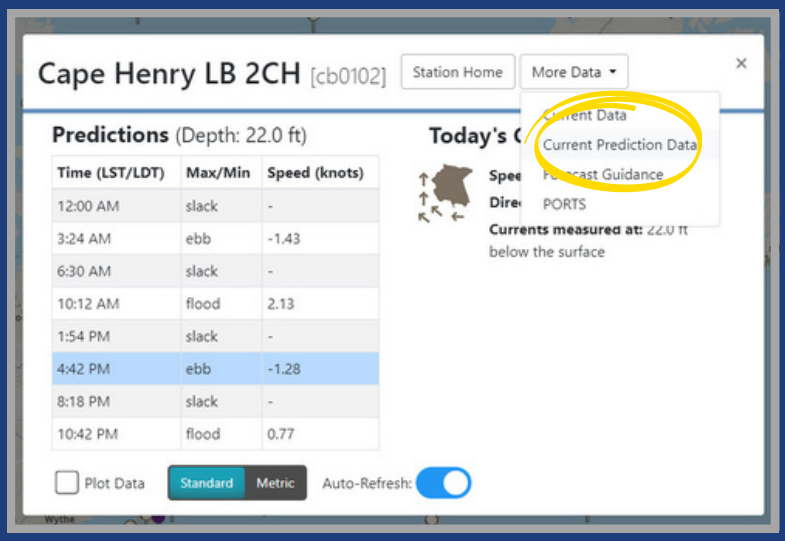


Image: Station Dashboard for Cape Henry, VA

Note: *Unlike with NOAA Tide Predictions, you cannot access Current Predictions from a station dashboard by selecting "Station Home." If you are looking at a station dashboard for a harmonic station that also happens to record real-time currents, selecting "Station Home" will take you to the station's Real-time Currents page, not its Current Predictions.*

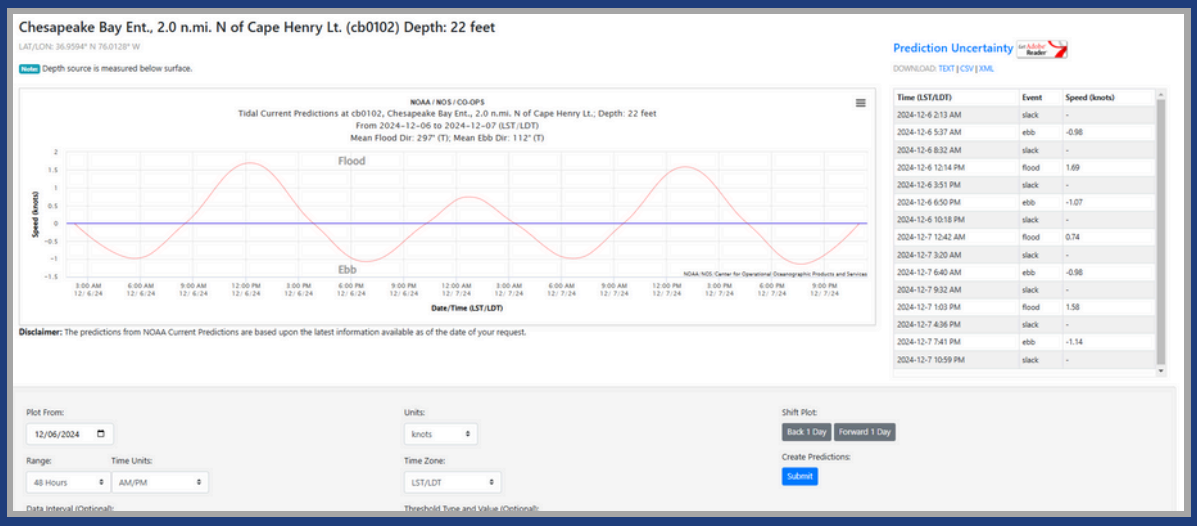
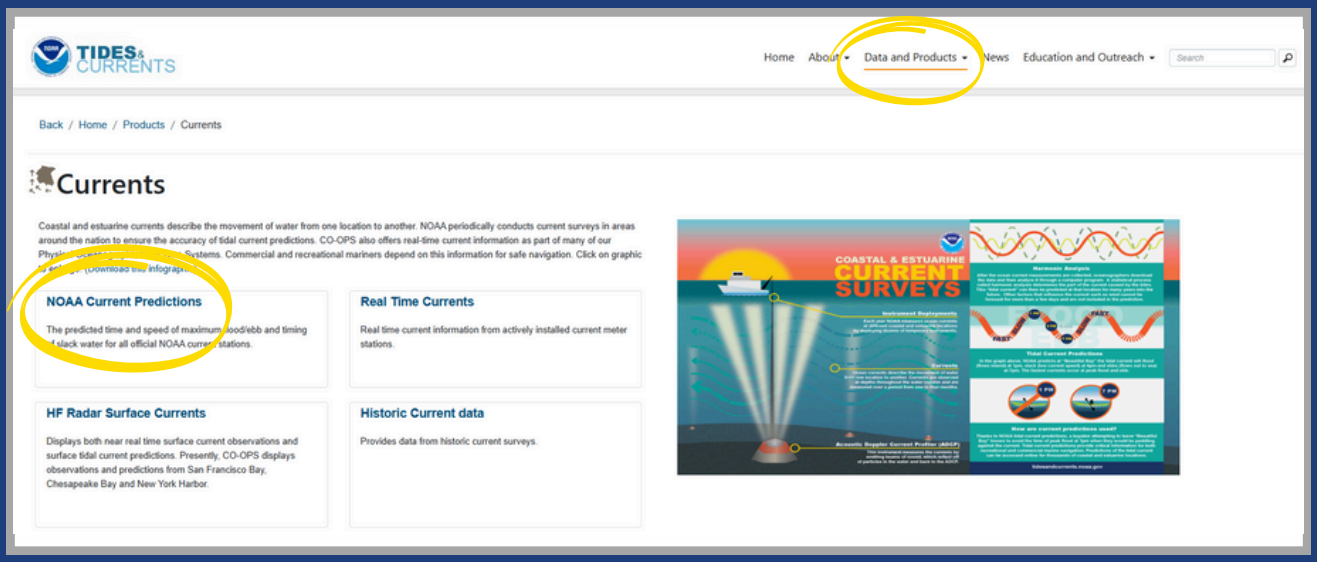


Image: Current Predictions page for Cape Henry, VA

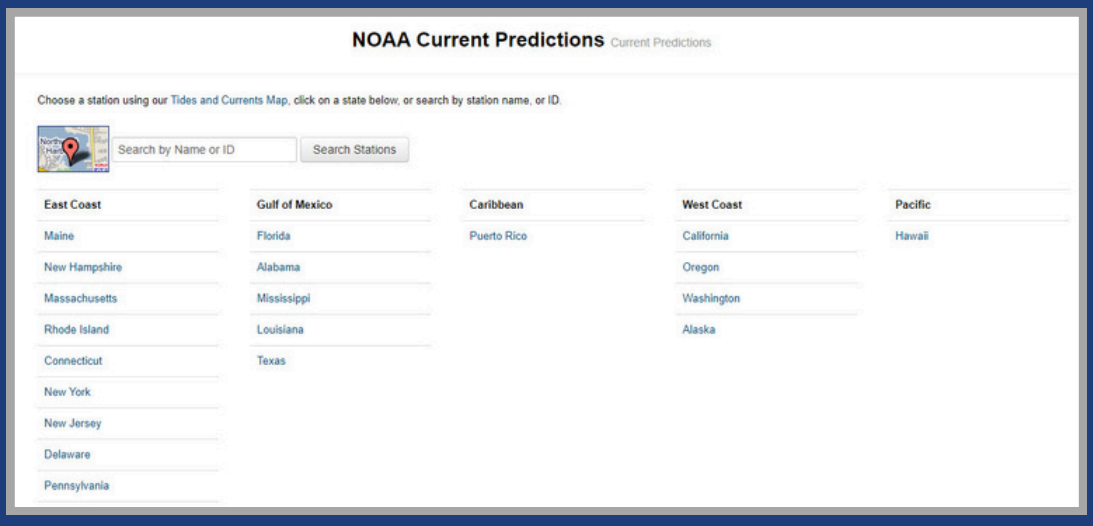
2

Through the Station Listing

You can also access a list of stations with current-predicting capabilities from anywhere on the CO-OPS website by hovering your cursor over or selecting the *"Data & Products"* dropdown, then selecting *"Currents,"* and on the subsequent webpage selecting *"NOAA Current Predictions."*



From here, click on a state or territory to see all the stations available in that region.



2

Through the Station Listing *Continued...*

Cape Henry Light, 1.4nm NE of (Depth 30ft)	ACT4516	36.9455° N	75.9897° W	Subordinate
Cape Henry Light, 1.4nm NE of (Depth 45ft)	ACT4516	36.9455° N	75.9897° W	Subordinate
Cape Henry Light, 1.4nm NE of (Depth 60ft)	ACT4516	36.9455° N	75.9897° W	Subordinate
Cape Henry Light, 0.8 n.mi. NNE of (Depth 15ft)	ACT4521	36.9388° N	75.9997° W	Subordinate
Cape Henry Light, 0.8 n.mi. NNE of (Depth 38ft)	ACT4521	36.9388° N	75.9997° W	Subordinate
Chesapeake Bay Ent., 2.0 n.mi. N of Cape Henry Lt. (Depth 22ft)	cb0102	36.9594° N	76.0128° W	Harmonic
Chesapeake Bay Ent., 2.0 n.mi. N of Cape Henry Lt. (Depth 38ft)	cb0102	36.9594° N	76.0128° W	Harmonic
Chesapeake Bay Ent., 2.0 n.mi. N of Cape Henry Lt. (Depth 55ft)	cb0102	36.9594° N	76.0128° W	Harmonic
Cape Henry Light, 3.2 miles north of (Depth 15ft)	ACT4531	36.9800° N	75.9980° W	Subordinate
Cape Henry Light, 4.6 miles north of	ACT4536	37.0017° N	75.9883° W	Subordinate
Cape Henry Light, 5.9 n.mi. north of (Depth 14ft)	ACT4541	37.0233° N	75.9925° W	Subordinate
Cape Henry Light, 8.3 mi. NW of (Depth 12ft)	ACT4546	37.0367° N	76.1100° W	Subordinate
Lynnhaven Roads	ACT4551	36.9183° N	76.0817° W	Subordinate
Lynnhaven Inlet bridge	ACT4556	36.9067° N	76.0933° W	Subordinate

Image: Current station listing page on the CO-OPS website

After selecting a state or territory, you will be looking at the station listing for that region. On the East and Gulf Coasts, stations are listed geographically from north to south, while on the West Coast they are listed south to north. Selecting a station from one of these lists will take you directly to that station's Current Predictions page.

The Station Listing provides the station:

- Name
- ID
- Coordinates in latitude and longitude
- Station type

You may notice that some locations have multiple stations listed under the same ID. At these locations, multiple predictions exist at different depths. Tidal current speed and timing may vary with water depth due to bottom friction and other forces, such as estuarine circulation, where the fastest currents typically occur near the surface and current speeds tend to slow near the bottom. Though the predictions may be different, the same station ID is used at each location.

CO-OPS provides mainly near-surface predictions to aid navigation, but predictions at other depths may be useful for recreation, tracking environmental conditions, and other applications. Note that the ability to access multiple depth readings is not available when selecting a pin from the map interface.

Interpreting Our Data

You have now reached our Current Predictions interface.

Once here you will see a **plot displaying tidal current predictions** *(see below image)* for your selected location for the present day and the next day in local standard time with adjustments for daylight saving time (LST/LDT). **These parameters can all be customized.**

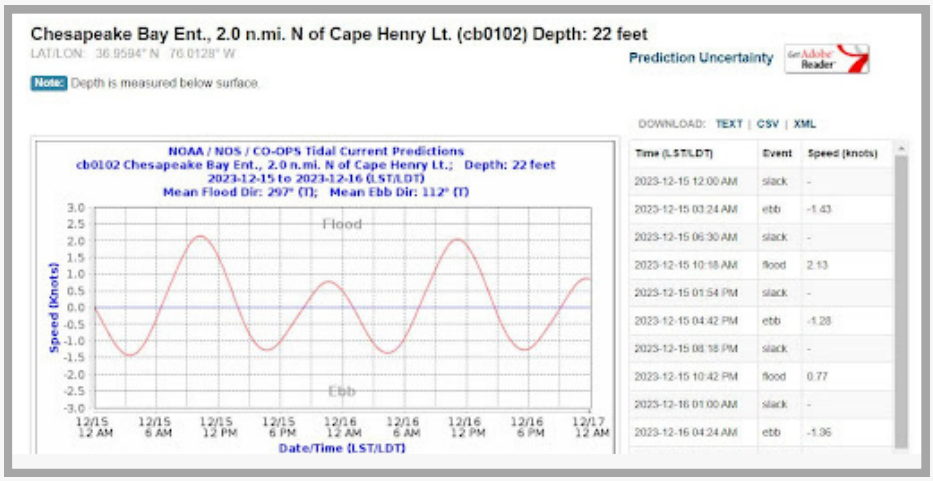


Image: Tidal Current Predictions **plot for Cape Henry, VA**

Tidal currents are provided as a speed and a direction that the current is flowing relative to True North.

The values shown on the plot indicate speed along the **Mean Flood Direction** and **Mean Ebb Direction**, which are always noted at the top of each Current Predictions chart.

The graph plots speed in knots against date and time. On the y-axis, positive values indicate flood status (water is flowing at the noted speed in the Mean Flood Direction) and negative values indicate ebb status (water is flowing at the noted speed in the Mean Ebb Direction).

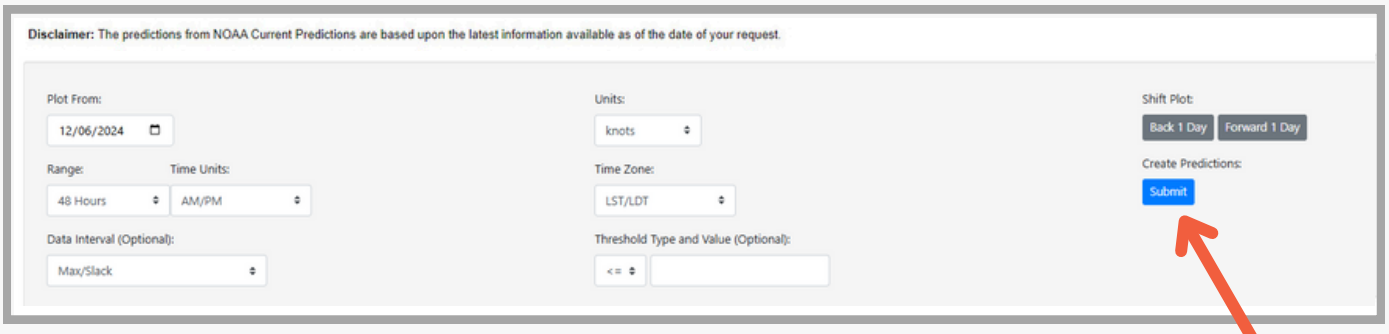
> ***An Example:*** *in the image above, at around 10:00 am on 12/15/2023, the current was at maximum flood at a speed of 2.13 knots, heading in the Mean Flood Direction, which is 297° relative to True North. Slack status is indicated by the blue line in the center of the plot. You can download an image of the plot by right clicking on it and selecting "Save image as…"*

To the right of the plot you will see a table with the same data. By default, this table displays the time of maximum ebb and maximum flood, with the speed of the current at that time in knots. You can change this setting using the *"Data Interval"* dropdown below the interface, though this parameter is available only for harmonic stations.

The table also shows the time of the slack between each ebb and flood, which corresponds with each time the red line crosses the blue line on the graph. You can download a copy of this table in TEXT, CSV, or XML format using the buttons above the table.

Navigating Our Current Predictions Interface

Below the plot and table, you will find the interface where you can query data per your specifications *(see below image)*. This section allows you to set various parameters for the data. You can also shift the entire plot forward or backward one day while keeping the same parameters you've already set.



Note: for each change you make on this interface, you will need to click the *"Submit"* button under *"Create Predictions"* to see changes reflected in the plot or table.

The interface can also highlight predicted current speeds above or below a user-identified threshold using the *"Threshold Type and Value"* options.

Selecting a threshold direction, entering a value into the box, and clicking *"Submit"* will highlight any predictions that fall above or below the set parameters in red. This function is useful for highlighting strong or weak current speeds that may impact navigation, diving, and other activities.

Annual Current Predictions

Download & Print

Our web interface allows users ***to generate and print annual current prediction tables for any tidal current-predicting station.***

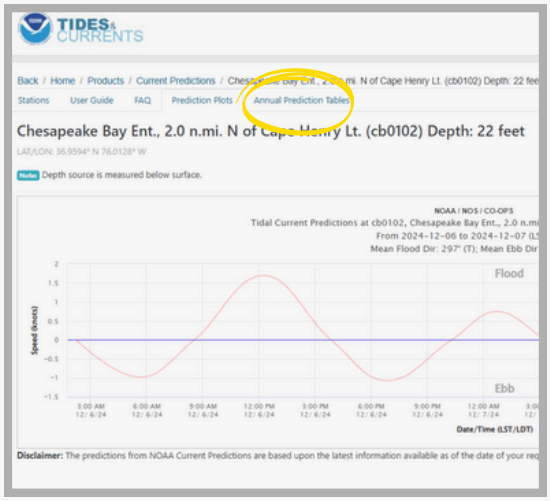


Image: NOAA Annual Current Predictions

To download an annual Current Predictions sheet, at the top of the Currents Predictions interface page, select the tab labeled *"Annual Prediction Tables"* (to the right of *"Prediction Plots"*).

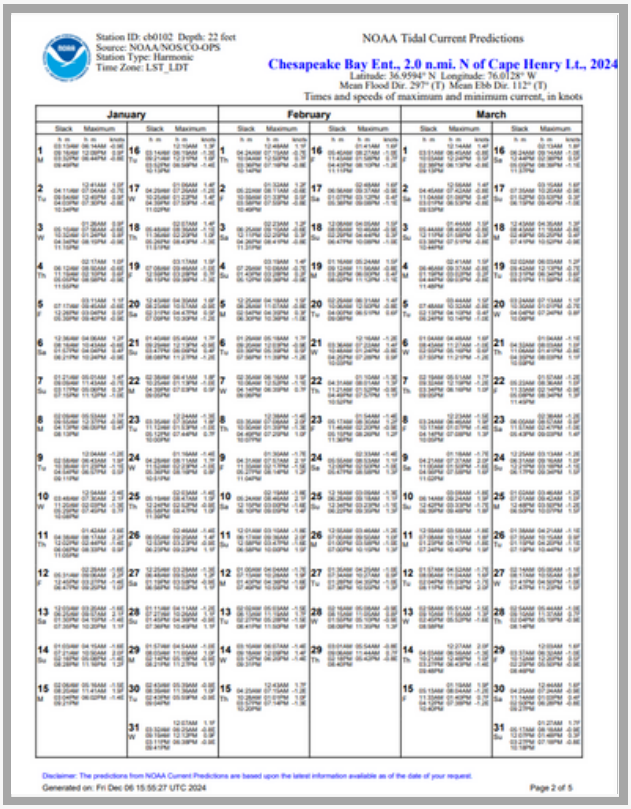


Image: NOAA Current Predictions Table

Set your desired year and other parameters, then click *"Create."* The file will automatically download to your computer in the output format you selected.

All data on our website, including current prediction output, is served via the ***CO-OPS Data API***. For more information on using our APIs to retrieve current predictions and other data, please visit our ***Web Services page***.

Update Schedule

NOAA Current Predictions updates are applied every quarter: during the first two weeks of January, April, July, and October. These updates may include:

- The addition of new stations
- Changes to the adjustment values and reference station for subordinate stations
- The removal of superseded stations that may have been replaced by another station for improved prediction accuracy

Scan this QR Code

to visit our website.

For additional questions about NOAA Current Predictions, or to suggest an update to this guide, please email **tide.predictions@noaa.gov**.

Glossary

*Find these and more terms in our online **glossary**.*

Control Current Station: A current station at which continuous velocity observations have been made over a minimum period of 29 days. Its purpose is to provide data for computing accepted values of the harmonic and nonharmonic constants essential to tidal current predictions and circulatory studies. The data series from this station serves as the control for the reduction of relatively short series from subordinate current stations through the method of comparison of simultaneous observations

Current: Generally, a horizontal movement of water. Currents may be classified as tidal and nontidal

Current Station: The geographic location at which current observations are conducted. Also, the facilities used to make current observations. These may include a buoy, ground tackle, current meters, recording mechanism, and radio transmitter

Ebb Current (Ebb): The movement of a tidal current away from shore or down a tidal river or estuary

Flood Current (Flood): The movement of a tidal current toward the shore or up a tidal river or estuary

Harmonic Analysis: The mathematical process by which the observed tide or tidal current at any place is separated into basic harmonic constituents

Harmonic Constants: The amplitudes and epochs of the harmonic constituents of the tide or tidal current at any place

Harmonic Constituent: One of the harmonic elements in a mathematical expression for the tide-producing force and in corresponding formulas for the tide or tidal current. Each constituent represents a periodic change or variation in the relative positions of the Earth, Moon, and Sun

Glossary *continued...*

Maximum Ebb: Any ebb current at the time of greatest speed

Maximum Flood: Any flood current at the time of greatest speed

Nontidal Currents: The permanent currents in the general circulatory systems of the sea, as well as temporary currents arising from more pronounced meteorological variability

Reference Station: A tide or current station for which independent daily predictions are given in the "Tide Tables" and "Tidal Current Tables," and from which corresponding predictions are obtained for subordinate stations by means of differences and ratios

Slack Before Ebb: The slack water immediately preceding the ebb current

Slack Before Flood: The slack water immediately preceding the flood current

Slack Water (Slack): The state of a tidal current when its speed is near zero, especially the moment when a reversing current changes direction and its speed is zero

Subordinate Current Station: A current station from which a relatively short series of observations is reduced by comparison with simultaneous observations from a control current station

Tidal Current: A horizontal movement of the water caused by gravitational interactions between the Sun, Moon, and Earth. Part of the same general movement of the sea that is manifested in the vertical rise and fall called tide

True Direction: Direction relative to true north (0°) which is the direction of the north geographic pole