

April 2021

Future Flood Risk: Harriet Tubman Underground Railroad Byway

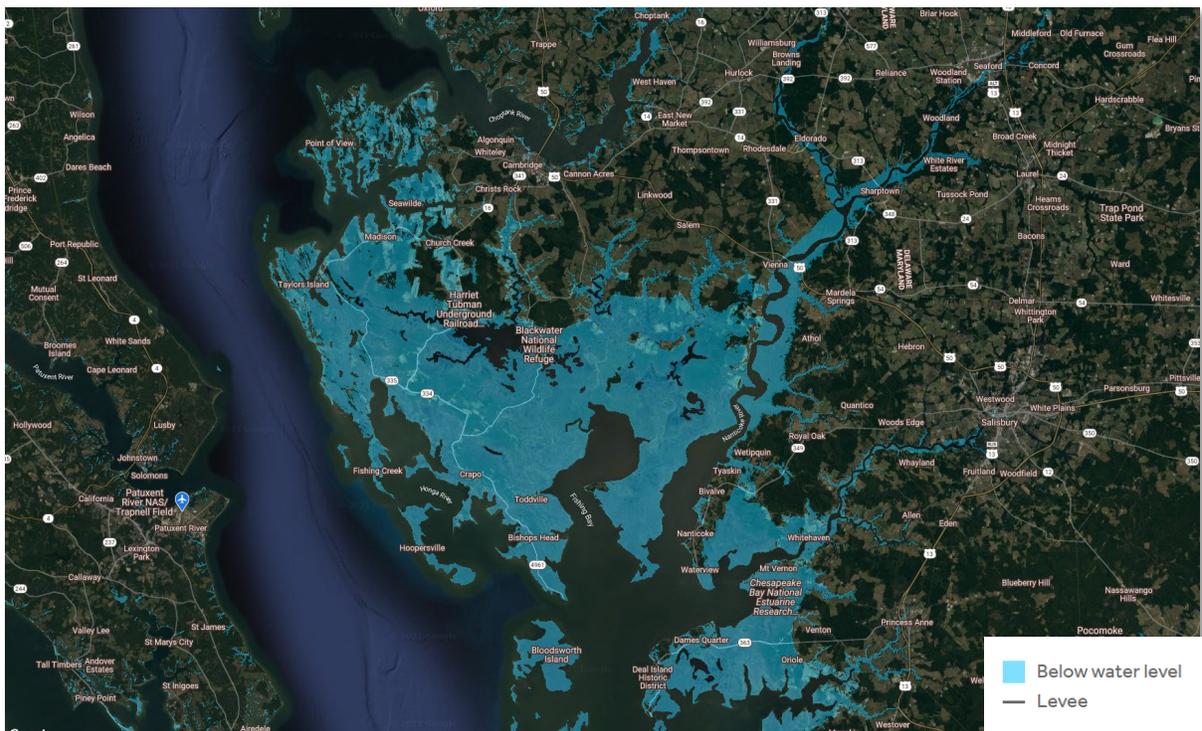


INTRODUCTION

Accelerating sea level rise has increased the quantity and severity of floods in communities around the country. Quantifying coastal flood risk allows individuals, businesses, and communities located along coastlines to plan for sea level rise and increased flooding due to climate change.

[Climate Central](#) used its public and proprietary tools to assess the current and future coastal flood risk to the [Harriet Tubman Underground Railroad Byway](#). The Byway is a 125-mile, self-guided, scenic tour, originating along Maryland's Eastern Shore and ending in Philadelphia. The 45 sites along the Byway include the [Harriet Tubman Underground Railroad Visitor Center](#), historic sites connected to the underground trail along which Tubman guided nearly 70 enslaved people to freedom, as well as wildlife refuges and other cultural or environmental places of interest.

Since much of the Byway is situated only a few feet above sea level, coastal flooding already poses a significant risk to many of these sites. As the climate continues to warm and sea levels rise, the risk of flooding to these historic sites will increase dramatically.



Dorchester County, Maryland, home to many Byway sites, showing areas below a water level 3 feet above the local high tide line marked in blue. This water level, which could occur through combinations of sea level rise, tide, and storm surge, had a 16% chance of occurring in 2020, increasing to a 67% chance in 2050.

OUR FINDINGS

Using coordinates from the Byway map and our proprietary [Portfolio Analysis Tool](#), Climate Central screened sites along the Harriet Tubman Underground Railroad Byway for coastal flood risk. The screen found that 16 of the Byway locations are exposed to at least occasional flood risk by 2050, and 25 are exposed by the end of the century. Ten of the locations show chronic flood risk currently, meaning that these sites are expected to experience a flood risk event at least annually. A flood risk event occurs when nearby coastal water levels exceed the elevation of a location and there is an unobstructed pathway for the water to reach that site.

These findings assume heat trapping emissions continue unchecked (the RCP 8.5 scenario). Results for lower emissions scenarios are similar, as there is not a significant difference in projected sea level rise between different emissions scenarios until the second half of the century due to the lag between emissions, warming, and sea level rise.

Using this first screen, we took a more in-depth look at 10 sites to better quantify the risk these historically and environmentally significant locations are facing from sea level rise and climate change.

THIS REPORT DEFINES FLOOD RISK BY ANNUAL CHANCE OF OCCURRENCE, NOT FLOOD DEPTH:

OCCASIONAL FLOOD RISK



At least 0.01 expected flood risk events per year, corresponding to approximately a 1% annual chance of a flood risk event. This is the level commonly used to establish flood hazard zones. One can statistically expect a 26% chance of a 100-year flood during a 30-year period.

FREQUENT FLOOD RISK



At least 0.1 expected flood risk event per year, corresponding to approximately a 10% annual chance of a flood risk event.

CHRONIC FLOOD RISK

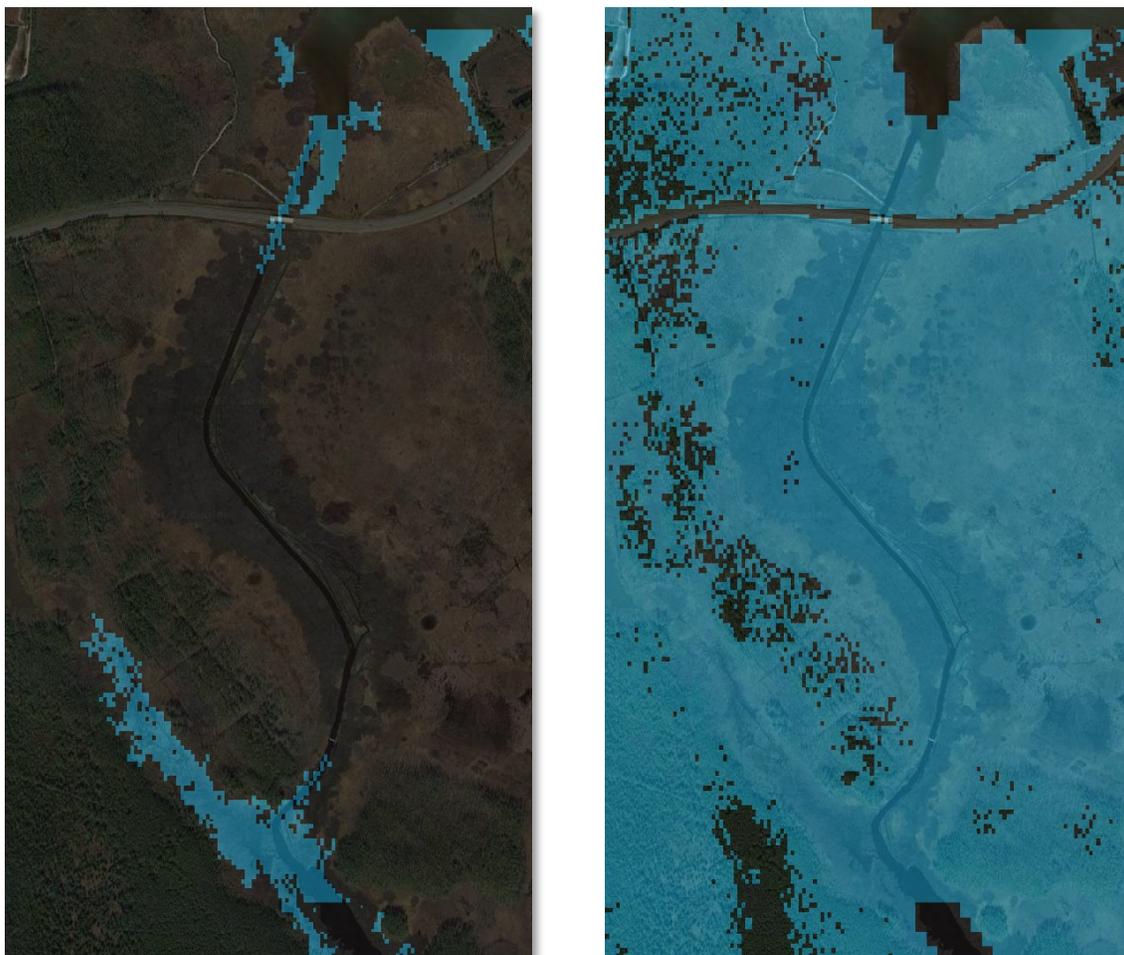


At least 1 expected flood risk event per year, corresponding to approximately a 99%+ annual chance of a flood risk event.

SITES CONSIDERED



A. JOSEPH STEWART'S CANAL

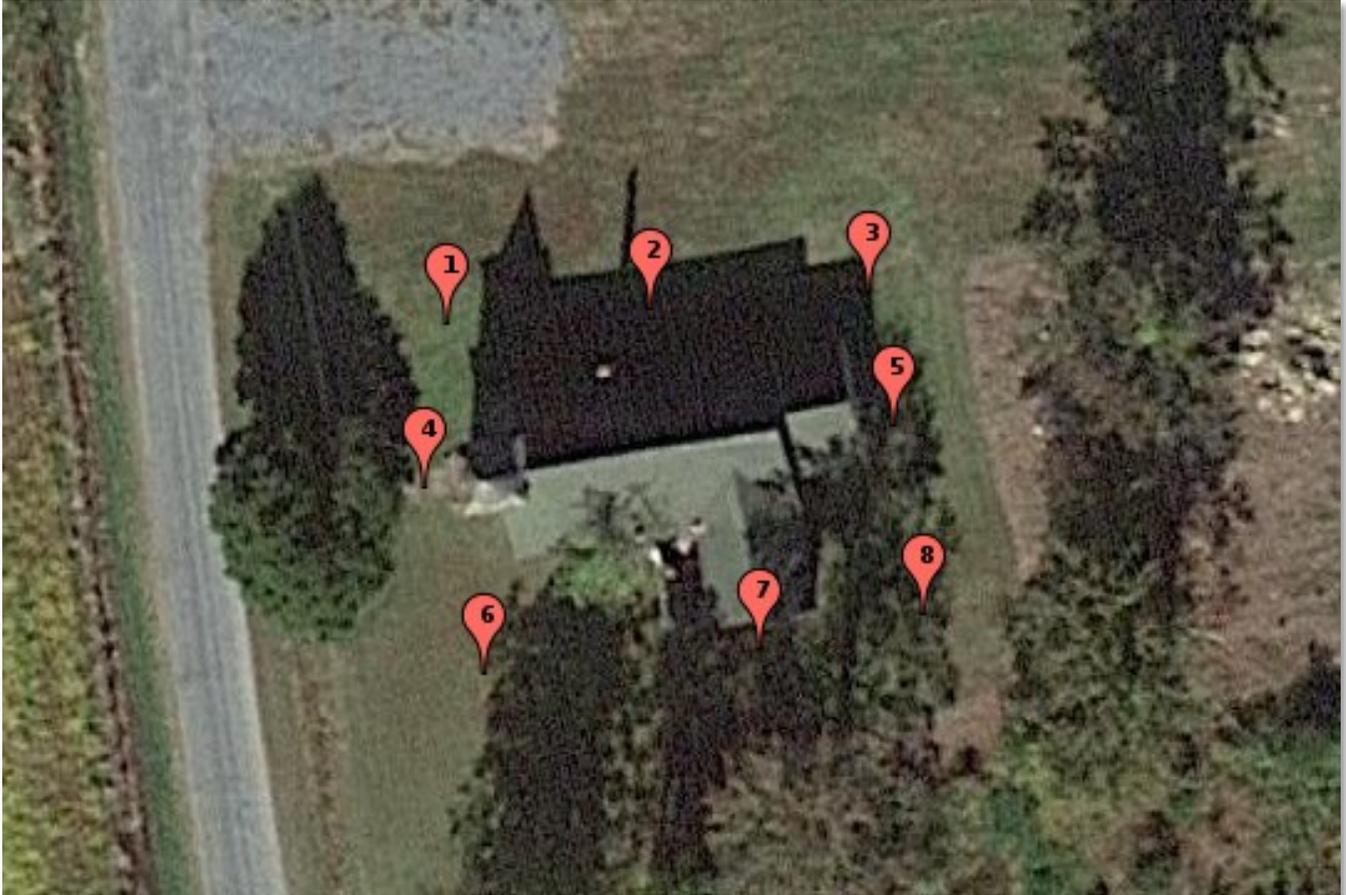


Joseph Stewart's Canal present day (left) and in 2050 (right), with areas below the high tide marked in blue.

7-mile-long Joseph Stewart's Canal was dug by hand by enslaved and free Black people over a period of 20 years in the early 1800s. Waterways like this one laid the foundation of secret communication networks used to organize escapes. Tubman used such a network to communicate with and free her three brothers in the winter of 1854. More information on Joseph Stewart's Canal can be found [here](#).

The land along Joseph Stewart's Canal, now called Parsons Creek Canal, is marshy, already experiencing flooding several times a year. However, as sea levels rise, much of that land could fall below the high tide line, impacting the ecosystem and potentially obscuring the canal. Furthermore, the only road providing access to the canal, Taylors Island Road, is projected to experience occasional flood risk by 2060, increasing to frequent flood risk in 2080, and chronic risk in 2100. Coastal floods could degrade the road and block access to the site.

B. MALONE'S CHURCH



Malone's Church as viewed by satellite. The pins are color coded to represent coastal flood risk in 2050. Red represents chronic flood risk.

Malone's Church was the first African American church established locally after the Civil War, in 1864. The free Black people who attended this church created an important social network for Tubman, and oral history suggests she lived near the church as a free woman. More information on Malone's Church can be found [here](#).

Our analysis of the Malone Methodist Episcopal Church estimates that most of the area around the building is experiencing chronic flood risk now, and the entire footprint of the church will experience chronic flood risk by 2050. There is an adjacent cemetery, parts of which are facing chronic risk now and all of which will experience chronic flood risk by 2060. In the latter half of the century, both the church and the cemetery could experience almost monthly flood risk events.

C. TUBMAN VISITOR CENTER



The site of the new Harriet Tubman Underground Railroad Visitor's Center as viewed by satellite. The pins are color coded to represent their coastal flood risk in 2020. Red represents chronic flood risk, orange represents frequent flood risk, and yellow represents occasional flood risk.

The Harriet Tubman Underground Railroad Visitor Center is located near where Harriet Tubman lived and features a number of exhibits about her life. More information on the Harriet Tubman Underground Railroad Visitor Center can be found [here](#).

The Harriet Tubman Underground Railroad Visitor Center opened in 2017, and although there is no satellite image of the building available yet, we were able to estimate the coastal flood risk to the site upon which it was built. As shown above, 18% of the site is currently experiencing chronic flood risk. By 2050, 91% is projected to be at chronic flood risk and the entire property is projected to experience chronic flood risk events by 2060.

D. BUCKTOWN GENERAL STORE

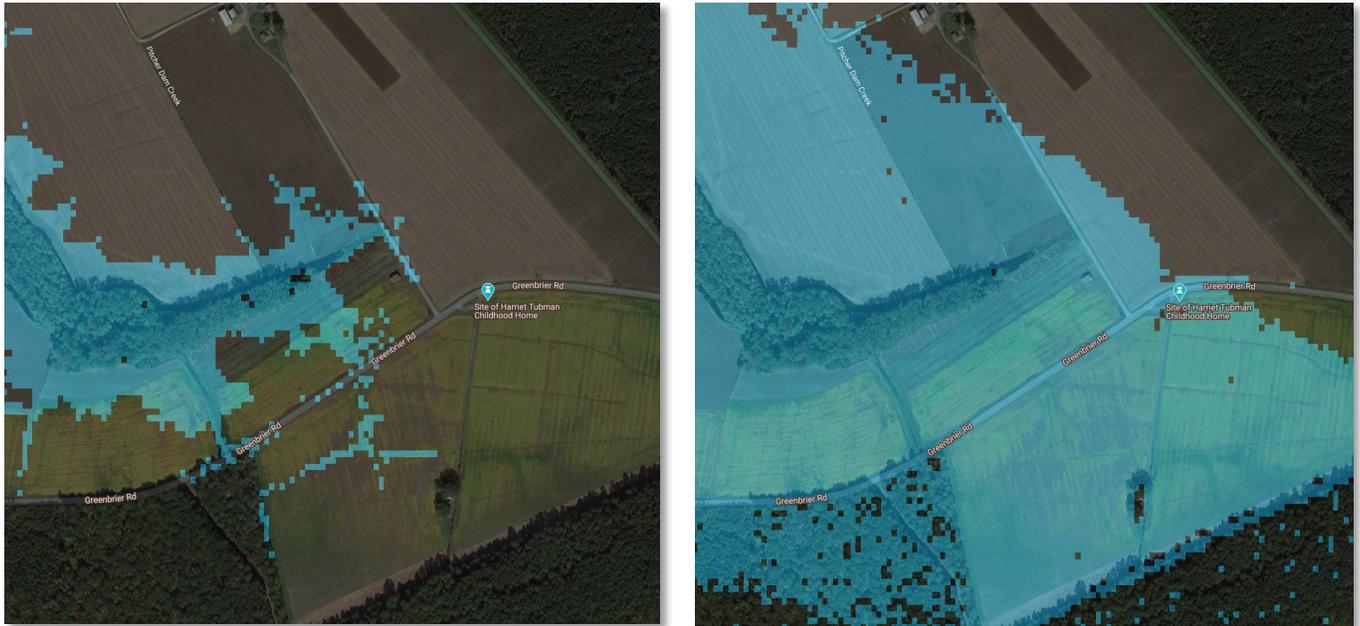


The Bucktown General Store as viewed by satellite . The pins are color coded to represent their coastal flood risk in 2020 (left) and 2050 (right). Red represents chronic flood risk, orange represents frequent flood risk, and yellow represents occasional flood risk.

The Bucktown General Store was the site of an influential event in young Harriet Tubman’s life. There, she sustained a head injury at the hands of a slave overseer whom Tubman refused to assist in restraining a fellow slave. More information on the events at Bucktown Village Store can be found [here](#).

Our analysis shows the back of the store already experiences chronic coastal flood risk, and three sides of the building will be at such risk by 2050. By 2060, the Bucktown General Store could experience monthly flood risk events.

E. BRODESS FARM



Brodess Farm in 2050 (left) and in 2100 (right), with areas expected to be exposed to flooding once a year or more marked in blue.

No buildings remain at Brodess Farm, the site of Harriet Tubman’s enslaver’s home and where she spent her early years. However, the increasing flood risk to the area could endanger archaeological efforts to find historically significant artefacts and sites. The area around this site will become more and more exposed to coastal flooding as the century progresses.

Visitors can find a road marker at the site, and more information on the Brodess Farm and Harriet Tubman’s early life can be found [here](#).

F. SCOTT'S CHAPEL



Scott's Chapel as viewed by satellite. The pins are color coded to represent their coastal flood risk in 2100. Red represents chronic flood risk, and orange represents frequent flood risk.

Edward Brodess, Harriet Tubman's enslaver, was a member of the congregation that worshipped in Scott's Chapel. Tubman and her family were likely made to worship here as well, segregated from the White congregants in the back of the church. This segregation extended to the two separate graveyards on the church grounds. More information on Scott's Chapel can be found [here](#).

Our analysis of Scott's Chapel (now Bucktown United Methodist Church) estimates the chapel will experience occasional flood risk by 2060. By 2090, that will escalate to frequent flood risk and by 2100, the chapel could experience flood risk events annually. Portions of the graveyard in which Black people were buried are already at frequent flood risk, and could experience chronic flood risk by 2040.

G. LONG WHARF PARK



Long Wharf Park as viewed by satellite. The pins are color coded to represent their coastal flood risk in 2020. Red represents chronic flood risk, orange represents frequent flood risk, and yellow represents occasional flood risk.

Long Wharf in Cambridge, Maryland was once a regional center for the slave trade. More information on Long Wharf Park can be found [here](#).

Sections of Long Wharf Park are already experiencing chronic flood risk. 27% of the park was found to be at such risk in 2020. By 2050, 80% of the park is projected to be at risk of chronic flooding and by 2070, the entirety of the park could experience flood risk events annually.

H. VINEY/CROUSE MEMORIAL PARK



The Moses Viney/Daniel Crouse Memorial Park as seen by satellite. The pins are color coded to represent their coastal flood risk in 2050. Red represents chronic flood risk, orange represents frequent flood risk, and yellow represents occasional flood risk.

The Moses Viney/Daniel Crouse Memorial Park honors the lives of Moses Viney and Daniel Crouse. Mosey Viney escaped slavery in 1840, fleeing across the Choptank River near the park that bears his name. More information on the Moses Viney/Daniel Crouse Memorial Park can be found [here](#).

Much of the park is already experiencing chronic flood risk—65% in 2020. By 2050, 91% of the park will be at risk of chronic flooding, and by 2080, the entire park will be at such risk.

I. MADISON

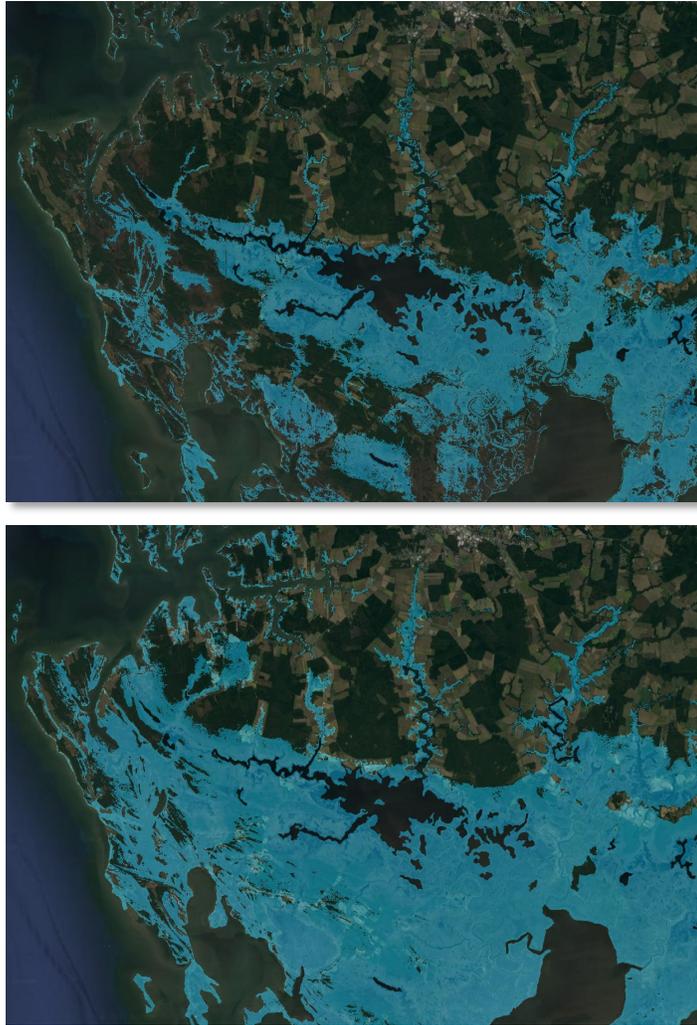


The town of Madison present day (top) and in 2050 (bottom), with areas below the high tide marked in blue.

Harriet Tubman spent her teenage years in Madison, after being hired out by her master to work for John T. Stewart in his house, fields, docks, and timber business. While laboring in the woods for Stewart, Tubman picked up important outdoor survival skills that would later be crucial to her success in freeing herself and others from bondage. More information about the town of Madison can be found [here](#).

Madison currently experiences regular coastal flood risk. As sea levels continue to rise, much of the town will fall beneath the high tide line.

J. BLACKWATER WILDLIFE REFUGE



Blackwater National Wildlife Refuge present day (top) and in 2050 (bottom), with areas below high tide marked in blue.

Besides being a valuable resource for people and wildlife alike, the Blackwater National Wildlife Refuge is characteristic of the of types of landscapes Harriett Tubman and other freedom-seekers had to traverse to escape slavery along the Underground Railroad. More information on Blackwater Refuge can be found [here](#).

The Blackwater National Wildlife Refuge, made up of expansive wetlands, naturally experiences tidal flooding. However, sea level rise can harm even landscapes accustomed to regular floods. Rising sea levels can outpace the accumulation of sediment and organic materials that elevate marshes. This slowly drowns valuable habitat for local and migrating species, and degrades the flood protection the wetlands offer to neighboring farms and inland communities.

Methodology

In this analysis, Climate Central’s freely available [Coastal Risk Screening Tool](#) and proprietary [Portfolio Analysis Tool \(PAT\)](#) were used to estimate future coastal flood threats to several sites along the Harriet Tubman Underground Railroad Byway.

Using leading peer-reviewed science, the Coastal Risk Screening Tool allows users to explore coastal flood risk and sea level rise projections by year, water level, temperature increase, and more through interactive maps. See the *Details and Limitations* section of the tool for detailed methodology.

The Portfolio Analysis Tool combines sea level rise science with local flood history data to compute the number of statistically-expected future coastal flood risk events at specific locations each decadal year, from 2020 through 2100. A flood risk event is defined as the occurrence of nearby coastal water levels exceeding the elevation of the ground at a specific inland location (defined by latitude and longitude coordinates), with an unobstructed pathway for the water to reach that location. Not all such events will cause flooding at the location, but each event poses a risk.

Ground elevation is determined from a NOAA database of LiDAR-derived elevation data. Elevations of structures above the ground are not known or evaluated.

Local flood history comes from the nearest NOAA tide station with at least 30 years’ history of hourly water level data. Tide stations that have not experienced a hurricane in their recorded history may not adequately represent the risk of a future hurricane. Precipitation or riverine flooding is not considered, but coastal high water impedes runoff and increases the risk of freshwater flooding inland.

Projected sea level rise is derived from a sea level rise [model](#) (Kopp et al. 2014). Inputs to the model include an assumption that carbon emissions continue unchecked (RCP 8.5).

The Portfolio Analysis Tool estimates the expected number of flood risk events each year and reports the results in decadal increments starting in 2020 through 2100. Our analysis is based on the statistically expected number of future flood risk events during the course of a year.

This report presents statistical expectations, not forecasts or predictions, and should be used for scoping and general planning purposes only. Climate Central accepts no responsibility for any damage to property, death or bodily injury, or other loss arising in any way from the use of this report for any purpose.

ABOUT CLIMATE CENTRAL

[Climate Central](#) is an independent organization of leading scientists and journalists researching and reporting the facts about our changing climate and its impact on the public. Climate Central surveys and conducts scientific research on climate change and informs the public of key findings. Our scientists publish and our journalists report on climate science, energy, sea level rise, wildfires, drought, and related topics. Climate Central is not an advocacy organization. We do not lobby, and we do not support any specific legislation, policy or bill. Climate Central is a qualified 501(c)3 tax-exempt organization.

Climate Central's Program on Sea Level Rise strives to provide accurate, clear, and granular information about sea level rise and coastal flood hazards both locally and globally, today and tomorrow. Anchored in rigorous primary research, our work distinguishes itself by its user-friendly maps and tools, extensive datasets, and high-quality visual presentation. The program dedicates its efforts to helping citizens, communities, businesses, organizations, and governments at every level to understand the consequences of different carbon pathways and to navigate the shifting waters of our warming world.

You can [search or navigate our interactive tools](#) to see maps of areas below different amounts of sea level rise and flooding, down to neighborhood scale, matched with area timelines of risk. Our tool also provides statistics of population, homes, and land affected by city, county, and state, plus links to factsheets, data downloads, action plans, embeddable widgets, and more.

If you are interested in a customized analysis using Climate Central's proprietary Portfolio Analysis Tool (PAT), contact us at portfolio@climatecentral.org.