Charles County, MD
Climate Adaptation Report Card

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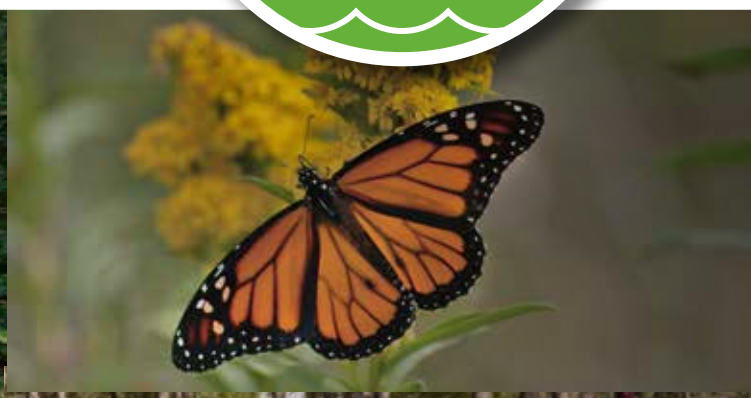

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Report Card Contributions

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Contents

A Message from
Stacy J. Schaefer, J.D.
Resilience Authority Executive Director

It is an honor to serve as the first Executive Director of the first Resilience Authority in Maryland, and on behalf of the Resilience Authority of Charles County's Board of Directors, it is a privilege to present the first ever Charles County Climate Adaptation Report Card by the University of Maryland Center for Environmental Sciences.

Charles County is a leader in climate adaptation and resilience; by establishing the first Resilience Authority in the state (and possibly in the nation), Charles County is pushing the envelope on community engagement and scientifically informed approaches to strengthen resilience to the effects of climate change.

Charles County Government and the Resilience Authority pursued the development of adaptation indicators through this report card to establish an accountability and progress metric for adaptation efforts. By identifying indicators that can measure progress, we are taking a necessary step towards enhancing climate adaptation efforts by recognizing that while we have accomplished much, we still have work to do as climate change continues.

Sincerely,

Stacy J. Schaefer, J.D.
Executive Director
Resilience Authority of Charles County, Inc.

Deborah E. Hall, CPA
Acting County Administrator
Charles County Government

"The **Climate Adaptation Report Card** represents an important milestone in our ongoing efforts to strengthen Charles County's resilience to climate change. By establishing clear, measurable indicators, we are not only holding ourselves accountable but also building a stronger foundation for future progress. This work reflects our commitment to protecting our communities, infrastructure, and natural resources today and for generations to come. While we're proud of the progress made, this report card also underscores the need for continued action as we adapt to a changing climate."

What Is Climate Resilience?

Climate resilience is the ability of a community or ecosystem to respond to and withstand climate change impacts.

What Is Climate Adaptation?

Climate adaptation refers to the processes and actions taken to improve resilience.

Climate adaptation actions may include adjusting behaviors, physical processes, or environmental relationships. For example, installing living shorelines rather than bulkheads can protect property from storm surge, and reducing water use can reduce the threat of drought. These measures should always consider impacts on both human and natural systems.

Adapting to the ever-increasing threats of climate change is essential to Charles County, and many initiatives, from the county to the community level, are focused on just that. This assessment quantifies the resilience already reached through these efforts and provides recommendations to aid in prioritizing adaptation actions to build resilience into the future.

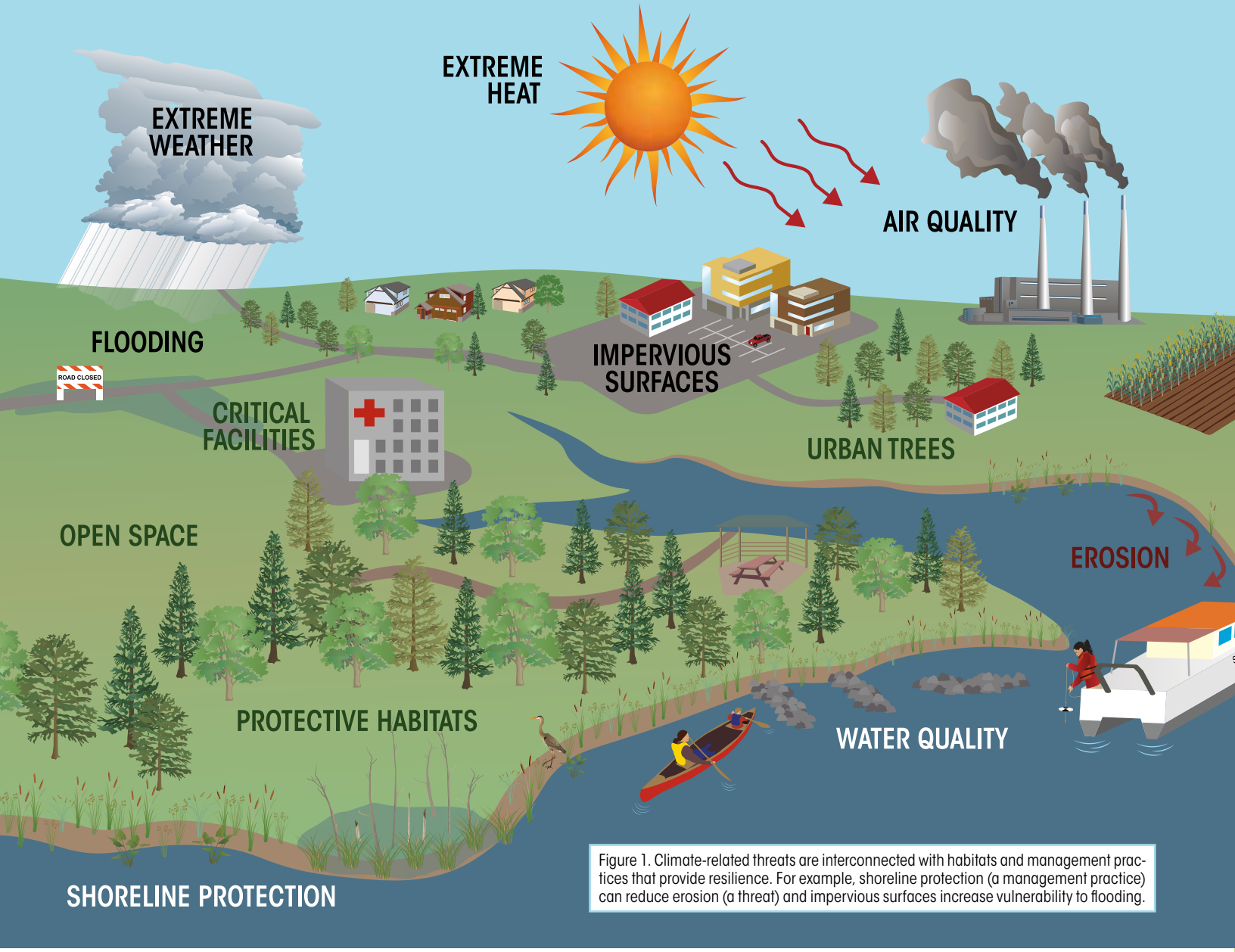


Figure 1. Climate-related threats are interconnected with habitats and management practices that provide resilience. For example, shoreline protection (a management practice) can reduce erosion (a threat) and impervious surfaces increase vulnerability to flooding.

Adaptation Builds Climate Resilience

Like all Maryland counties, Charles County is susceptible to climate-related risks such as extreme heat and weather events. Uniquely characterized by large freshwater shorelines on the Potomac and Wicomico Rivers, Charles County also faces risks of riverine flooding. Extreme heat negatively impacts human health by causing heat-related illnesses and death, and by making air quality worse. Extreme weather and flooding can lead to road closures, business disruption, property loss, and injury or loss of life. These events may cause stream and shoreline erosion, leading to excessively high levels of runoff into rivers and reducing water quality.

These threats can be minimized by implementing adaptation and resilience measures including nature-based solutions, modification of flood-risk properties, and improved planning and preparedness. Protective habitats such as living shorelines reduce erosion and flood risk, wetlands absorb flood waters (reducing damage), and forests and urban trees absorb carbon and help maintain climate. The preservation of open, undeveloped spaces like fields and farmland is beneficial because unpaved, vegetated surfaces are more permeable and absorb more stormwater than impervious surfaces like asphalt and concrete. Critical facilities like hospitals and fire stations should be sited in non-flood prone areas to ensure that they remain accessible and operational when flood events do occur. Dynamics between risks and adaptations are depicted in Figure 1, above.

Charles County — A Model for Climate Change Planning and Preparation

Charles County is leading the way in climate change adaptation and resilience in Maryland. In 2020, the County created the **State's first Resilience Authority**, a nonprofit organization granted with governmental functions, to help fortify Charles County and surrounding areas against the effects of climate change. The Resilience Authority helps prioritize the needs of the County's communities, with the goal of centering their work around environmental justice. In only a few short years, the Resilience Authority has established valuable partnerships and spearheaded several resilience-building projects across the County. Their current projects aim to empower youth with environmental career development opportunities, reforest schools, tackle stormwater flooding, install living shorelines, and assess the County's progress toward resilience goals through initiatives like this assessment.

The County is developing a **Climate Action Plan** to guide government and community efforts that mitigate greenhouse gas emissions, while also building resilience to the effects of climate change. This **Report Card**, co-developed with Charles County Government and the Resilience Authority, provides a snapshot of county-level resilience and illustrates the success of the County's investments, to date, toward increased resilience. By using this Report Card to inform decision-making and by focusing resilience-building efforts on underserved communities, the County and the Resilience Authority can ensure that climate threats are not disproportionately harmful. The continued planning and implementation of climate change adaptation and resilience efforts by Charles County will serve as an example for other regions in Maryland and beyond.

The Cedar Point Restoration project highlights Charles County's commitment to conservation and climate resilience.

Photos by Will Parson, Chesapeake Bay Program

What Is a Report Card?

Report cards are **scientific assessments** that measure community and ecosystem condition and resilience. They help communities, governments, and organizations identify goals for ongoing activities and measure progress toward those goals. They also identify gaps in data and efforts.

The development of this report card followed a well-established, multi-step methodology. Through a series of **workshops**, the research team identified the climate change threats that most concern Charles County residents, how these threats have or have not been addressed, and what adaptation actions may help reduce climate risk and build community preparedness for and resilience to climate change. This resulted in the identification of 18 "indicators" of resilience, as well as nine indicators that quantify the County's vulnerability to the harmful effects of climate change. The current condition of each indicator was assessed by comparing the best available data to established goals based on expert knowledge, scientific consensus, and regulatory targets. This provides a snapshot not only of the level of risk climate change poses to Charles County, but also the ability of communities to respond to these risks. Resilience is assessed at the county level, with a subset of indicators also assessed at the watershed level, to provide additional information that may help guide where future resilience-building and adaptation efforts occur.

Pictured: Interactive workshops were held, encouraging community collaboration.
Photo by the Integration and Application Network

Charles County Shows Moderate Resilience to Climate

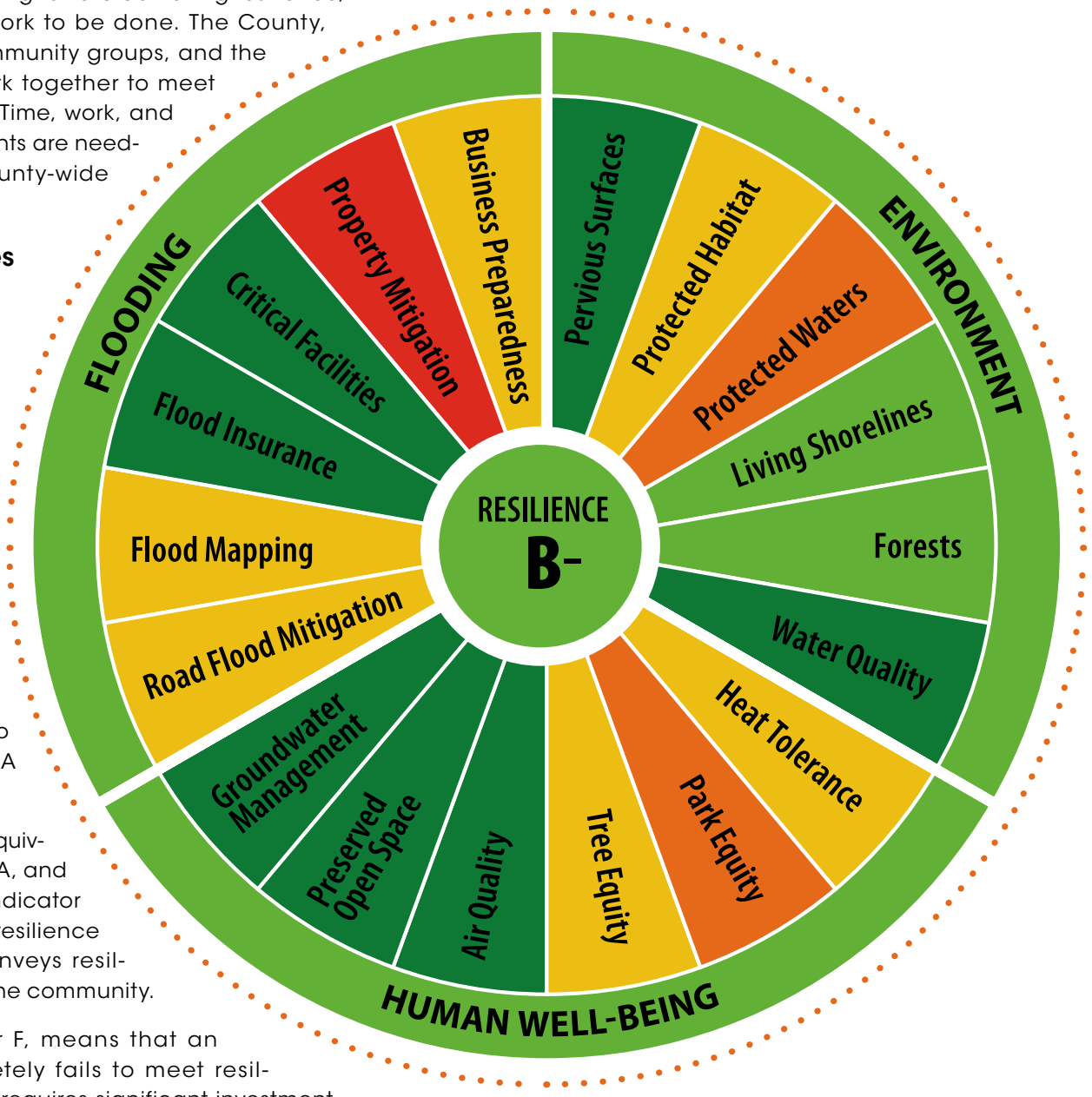
Overall resilience in **Charles County scores a B-**. The County is working toward achieving resilience, but there is still work to be done. The County, communities, community groups, and the State must all work together to meet resilience targets. Time, work, and financial investments are needed to achieve county-wide resilience.

Three categories of resilience indicators were assessed: Environment, Human Well-being, and Flooding indicators.

Each indicator was scored on a 0% to 100% scale, corresponding to letter grades from A to F.

A score of 100% is equivalent to a score of A, and means that that indicator meets targets for resilience and therefore conveys resilience benefits to the community.

A score of 0%, or F, means that an indicator completely fails to meet resilience targets and requires significant investment to capture potential resilience benefits.



Meets Goals

A (81–100)	B (61–80)	C (41–60)	D (21–40)	F (0–20)

Does Not Meet Goals

Charles County On the Resilience Scale

The lowest-scoring indicator in the Environment category is **PROTECTED WATERS**. Protected Waters are areas where fishing and shellfish harvest is prohibited to allow for species recovery and to maintain natural habitats that support climate resilience, for example oyster reefs, which dampen wave action. Oyster reefs also clean the water by filter feeding and help slow wave action, reducing erosion and potential flooding. Protected Waters in Charles County include an oyster sanctuary in the Wicomico River and the Mallows Bay National Marine Sanctuary. While some critical waters are protected, Charles County falls short of the global goal of protecting 30% of waters by 2030. This does not mean the County is not committed to conserving and restoring oyster populations and habitats. In 2022 and 2023, the Wicomico Watermen's Association, using financial investments from the County, planted oyster spat (an early life stage of oysters) in an effort to increase the oyster population, which had declined in previous years.

Within the Flooding category, the poorest-scoring indicator is **PROPERTY MITIGATION**, which received an F score. This indicator considers whether properties with frequent flood damage have been mitigated, or modified, to better withstand flood events. Mitigation is expensive, and the difficulty in acquiring adequate funds to prepare properties for future floods is reflected in the low score.

Within the Human Well-being category, **PARK EQUITY** — *equitable access to high-quality parks that provide respite from heat* — scores most poorly. This score should improve as the County invests in more parks, and these should be focused in areas with the lowest Park Equity.

Examining the **best-scoring resilience indicators** across the County shows us that the County is achieving, or is on track to achieve, goals set for ecosystem-based solutions such as maintaining open spaces, preventing development where possible, and maintaining protective habitats.

It is equally important to examine the indicators that score mostly poorly in order to determine what indicators need more focus and should be prioritized in order to improve resilience. We discuss the three most poorly scoring indicators on this page.

Resilience Indicators Definitions

Environment

PERVIOUS SURFACES soak up rainwater during storm events, reducing the risk and magnitude of floods. Impervious surfaces, on the other hand, cannot absorb water, and therefore contribute to flooding during storm and high tide events. Areas with impervious surface covering less than 5% of land area are considered to be ecologically protected and resilient to climate change threats like flooding. It is estimated that every 1% increase in impervious surface increases flood magnitude by 5.6%. Therefore, Pervious Surface scored a 100% if impervious surface coverage was 5% or lower, and the score was reduced by 5.6% for each 1% increase in impervious surface coverage over 5%. This method was done at the watershed level, and the county-level score was calculated as the area-weighted sum of watershed-level scores.

PROTECTED HABITAT considers areas that are protected from development, including those that allow for some resource extraction (e.g., timber harvesting). This indicator measures how close Charles County is to permanently protecting 30% of its total land area for biodiversity and habitat. This goal was adopted internationally as the 30 x 30 goal for conserving biodiversity by protecting at least 30% of land and marine areas by 2030.

PROTECTED WATERS include oyster sanctuaries and the Mallows Bay-Potomac River National Marine Sanctuary. Oyster sanctuaries are permanently closed to oyster harvesting. While fishing is allowed in Mallows Bay, the sunken ship "ghost fleet" is protected and provides valuable habitat for a variety of wildlife. This indicator evaluates how close the County is to achieving the 30 x 30 international goal for Protected Waters.

LIVING SHORELINES include coastal habitat types—forests and wetlands—that act as a buffer against erosion and flooding. As the climate changes, storms will become more frequent and severe, so Living Shorelines are crucial in buffering coastlines and protecting coastal communities. Additionally, Living Shorelines provide habitats for many species of plants and animals. This indicator calculates the percentage of Charles County's coastline that can be categorized as living.

FORESTS provide ecosystem functions that protect against climate change. In addition to storing carbon and improving air quality, Forests provide natural flood management and reduce erosion. Forest cover helps maintain microclimates by cooling shaded areas and reflecting heat. The Sustainable Forestry Council recommends that 40% of land be maintained as forest cover; this is a broadly accepted target used in development planning around the world. For watershed-level scores, each watershed was scored based on how close it is to that target. For the county-level score, each watershed received a pass (100%, meets goal) or fail (0%, does not meet goal) score; pass/fail scores were then weighted by area and summed for an overall Forests score.

WATER QUALITY of streams and rivers contributes to the resilience and health of the overall ecosystem. Healthy streams are better able to handle stressors like rising temperatures or changing land use. Four Water Quality variables—salinity, temperature, dissolved oxygen, and pH—were scored separately, then averaged for an overall Water Quality indicator score. The threshold for pH was set by the US Environmental Protection Agency. The temperature threshold was set by the Maryland Department of Natural Resources. The thresholds for salinity and dissolved oxygen were set by the Mid-Atlantic Tributary Assessment Coalition.

Flooding

ROAD FLOOD MITIGATION actions improve roads subject to flooding to ensure they remain passable during flood events. This indicator considers whether mitigation actions have been taken at each of 57 road locations designated as "nuisance and urban flood locations" in the 2020 Charles County Nuisance & Urban Flood Plan.

FLOOD MAPPING is critical to understanding and planning for current and future flood risk. The State of Maryland has a wide array of mapping products available, developed in response to legislative requirements or for specific projects or communities. This indicator measures the current state of Flood Mapping products available specifically for Charles County, the quality of data within, and the technical assistance available to support use of these essential tools.

FLOOD INSURANCE evaluates what proportion of estimated future flood damage would be covered by current insurance policies. Flood Insurance is only required in FEMA-identified flood risk areas, but floods are predicted to impact properties beyond these areas. Flood Insurance is available for properties outside the FEMA floodplain, but because it is not required, these areas may be un- or under-insured. This indicator considers how much of the property that is expected to be impacted in a 100-year flood is covered by existing Flood Insurance policies.

Resilience Indicators Definitions — cont'd

CRITICAL FACILITIES include hospitals, emergency services, and utilities. These facilities and their services are important in everyday life, and their continued operation during emergency events, such as floods, is crucial. FEMA indicates that "even a slight chance of flooding" of these structures is too great, and that they should not be located in floodplains. This indicator considers how many of Charles County's Critical Facilities are located in FEMA-identified flood risk areas.

PROPERTY MITIGATION focuses on "repetitive loss properties," or properties that have had two or more National Flood Insurance Program claims over $1,000 within 10 years. These properties can be adapted to better withstand threats of climate change by, for example, elevating them above flood levels. This indicator assesses the proportion of repetitive loss properties with such adaptations already in place.

BUSINESS PREPAREDNESS determines how ready businesses are for disruptions in operations caused by climate change events. Storms and floods, which are increasing in severity and frequency with climate change, threaten short- and long-term business closures that may impact whole economies. The Congressional Budget Office calls a loss of 5% of annual income "substantial." This indicator considers whether the expected business disruption cost from a climate change event is less than 5%, and therefore not considered "substantial."

Human Well-Being

HEAT TOLERANCE will become increasingly important as climates warm across the globe. The effects of increased temperatures will not be felt uniformly, and some communities are more vulnerable to heat than others. This indicator assesses the ability of communities within Charles County to withstand extreme heat events, and is based on multiple indicators scored by the research organization First Street. Community scores from First Street were scaled up for county-level and watershed-level scores.

PARK EQUITY assesses whether parks and the benefits they confer are equitably distributed and accessible to all communities. The benefits of parks, such as cooling urban areas and sequestering carbon, are important for community resilience. Those benefits should be distributed equitably. This indicator is scored based on Park Equity scores provided by the MD Department of Natural Resources (DNR) in the "Park Equity Mapper." DNR scores are converted to the 0–100% scoring scale for each community, then scaled up for county-level and watershed-level scores.

TREE EQUITY, assessed by American Forests™, considers whether urban communities, particularly those that are disproportionately vulnerable to extreme heat, have enough tree canopy to provide vital benefits. These benefits include improving air quality, cooling urban areas, and absorbing excess stormwater. At the county level, this score is calculated based on how many communities in Charles County have the necessary number of trees to provide these benefits. At the watershed level, it is scored by taking the average community Tree Equity score calculated by American Forests™ for each watershed.

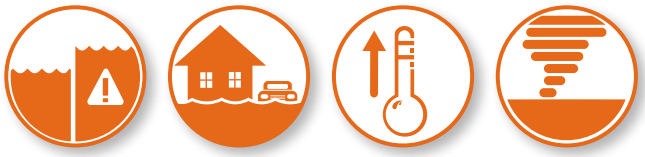
AIR QUALITY is scored based on the EPA's Air Quality Index values for ozone. When concentrated at ground level, ozone is a major pollutant that is harmful to human health. As temperatures rise, ozone production increases, compounding the human health risks of climate change. This indicator determines how healthy Charles County's air is based on EPA standards. Not enough data were available to include additional Air Quality indicators like particulate matter.

PRESERVED OPEN SPACE is defined as land that is protected from development, and includes natural areas, parks, and agricultural lands. Preserved Open Space is more resilient to climate change than developed areas, having less impervious surface and more vegetation that takes up carbon, maintains microclimates, and provides habitat and recreational opportunities. Charles County participates in the State's "Program Open Space," and has set a goal of preserving 50% of total land area as Preserved Open Space. This indicator measures how close the County is to achieving this goal.

GROUNDWATER MANAGEMENT indicator considers whether groundwater management efforts are successful in preventing aquifer depletion. Historically, when aquifer levels have begun becoming depleted, the County has switched to drawing water from deeper, more plentiful aquifers. When those aquifers reached concerningly low levels, the County began using more surface (river) water for public supply, preventing aquifer depletion. A new agreement will allow the County to source even more water from surface waters, which will further lessen the withdrawal of groundwater withdrawn, improving the sustainability of local aquifers and preventing depletion in the future.

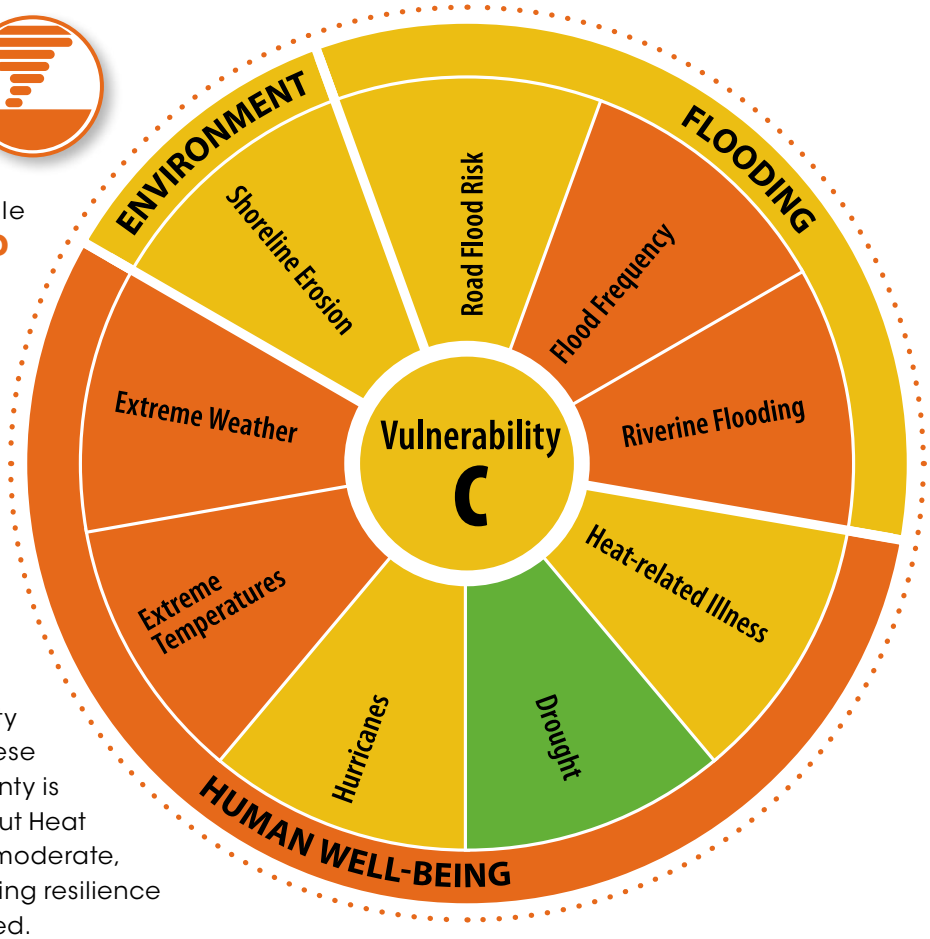
Assessing Vulnerability

In addition to assessing resilience to climate threats posed by climate change, this assessment considers the risk posed by specific threats and scores the County based on how vulnerable it is to each of these threats. Each Vulnerability indicator is linked to Resilience indicators that help ameliorate the associated risk. To reduce overall vulnerability, the lowest-scoring vulnerabilities should be addressed through adaptation and resilience-building actions.



Charles County is particularly vulnerable to **RIVERINE FLOODING**, and **FLOOD FREQUENCY** is increasing with climate change. **EXTREME TEMPERATURES** and **EXTREME WEATHER** such as storms, hurricanes, and tornadoes are also particular threats to the County.

By examining resilience scores alongside vulnerability scores, we can identify priorities for resilience and adaptation action. For example, although the Vulnerability scores indicate high vulnerability to Riverine Flooding and increasingly frequent floods, Flooding scores a B in terms of Resilience, showing that the County is making progress toward addressing these vulnerabilities. On the other hand, the County is quite vulnerable to Extreme Temperatures but Heat Tolerance (a Resilience indicator) is only moderate, with a score of C; thus, more focus on building resilience to increasingly high temperatures is needed.



Vulnerability was assessed according to three categories of indicators: **Environment, Flooding, and Human Well-being**. The individual indicators belonging to these three categories are defined below. Aside from the Road Flood Risk, Heat-related Illness, and Flood Frequency scores, Vulnerability indicator scores were based on risk analyses reported in the Charles County 2024 Hazard Mitigation Plan Update.

Table 1. The scores of Vulnerability indicators are shown with their corresponding Resilience indicators and their scores.

VULNERABILITY INDICATOR	RESILIENCE INDICATOR
Extreme temperators	Heat Tolerance
Heat-related illness	
Drought	Groundwater Management
Shoreline Erosion	Living Shorelines
Road Flood Risk	Road Flood Mitigation
Riverine Flooding	Flooding (category)
Extreme Weather	
Flood Frequency	
Hurricanes	

Vulnerability Indicators

Environment

Shoreline Erosion causes land loss and property loss and reduces water quality. Thirty-one percent of tidal shorelines in Charles County are eroding, reducing their ability to mitigate coastal flooding. This may be improved by increasing or protecting existing Living Shorelines (a Resilience indicator).

Flooding

Road Flood Risk was assessed based on information in the 2020 Charles County Nuisance & Urban Flood Plan. This plan identified 57 road locations as "nuisance and urban flood locations" and determined whether the flood risk of each was "high," "medium," or "low." This indicator score is the average of individual location risks across the County. The corresponding Resilience indicator, Road Flood Mitigation, provides information on progress towards preparing for this risk.

Flood Frequency is increasing due to sea level rise combined with the increase in the intensity and frequency of heavy rains brought on by climate change. Damaging floods impact human health, property, and the environment. This indicator is based on trends in the amount of reported property damage caused by floods in Charles County. Many indicators in the Flooding Resilience category show how prepared the County is to deal with and recover from increasing floods.

Riverine Flooding can be caused by storm surge, extreme rainfall, runoff, and potentially snow melt. Climate resilience assessments often focus on coastal flooding, which is caused in part by sea level rise, but Riverine Flooding also has a large impact. Charles County is particularly susceptible to Riverine Flooding; over 140 miles of County land are bordered by the Potomac, Wicomico, and Patuxent Rivers. In fact, these rivers are the primary sources of flooding in the County. Actions can be taken to improve the County's ability to withstand flood risk, including those in the Resilience Flooding category.

Human Well-Being

Heat-related Illness is a growing concern as climate change continues, with both hospitalizations and deaths due to heat expected to increase with rising temperatures. Heat-related Illness is scored based on the number of heat-related Emergency Medical Service calls and deaths in the County over a two-year period. Mitigation efforts such as increasing green space and establishing cooling centers can be used to increase Heat Tolerance (a Resilience indicator), reducing the risk.

Drought can cause severe damage to human health, property, and the agricultural industry. For example, in 1998 Drought caused over $1.5 million in crop damage in Charles County alone. Because Droughts are difficult to predict, it is important to take measures to ameliorate their effects. This includes effective Groundwater Management (a Resilience indicator).

Hurricanes cause increased flooding, and may therefore be mitigated through various measures in the Resilience Flooding category, including through Property Mitigation and Road Flood Mitigation.

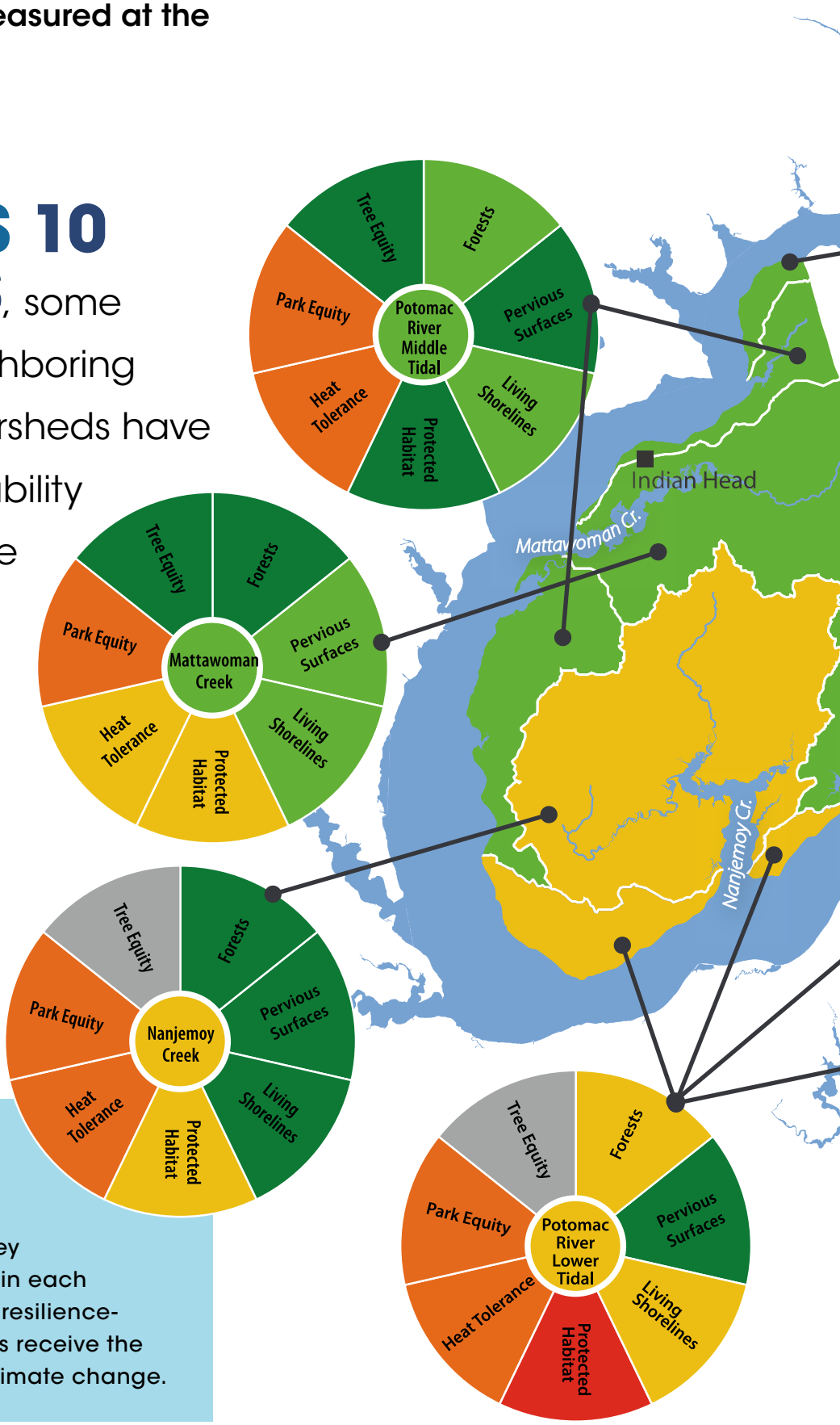
Extreme Temperatures are felt most strongly in winters, and in summers when temperatures soar and air quality declines. Heat Tolerance (the corresponding Resilience indicator) can be improved in various ways, such as by planting street trees and establishing cooling centers.

Extreme Weather includes thunder, lightning, wind, rainstorms, and tornados, which are possible at any time of year. Resilience-building efforts include Flooding preparation, soundproofing, and bolstering indicators in other areas of the Resilience score wheel.

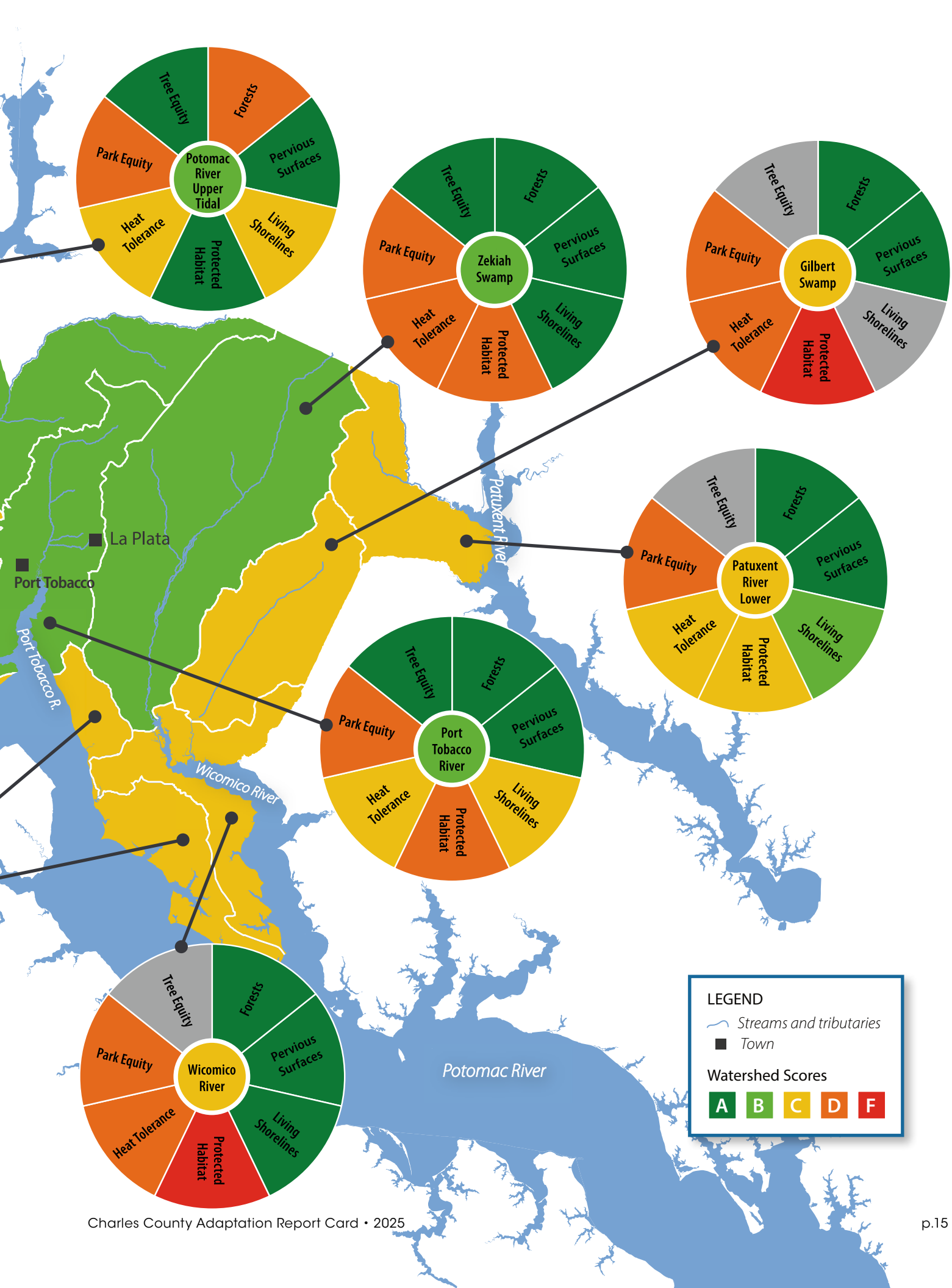
Some Indicators Can be Measured at the Watershed Level

CHARLES COUNTY HAS 10 WATERSHEDS, some of which cross into neighboring counties. Different watersheds have varying levels of vulnerability and resilience to climate change threats.

Resilience was assessed at the watershed level for the seven indicators that had watershed-level data.



Assessing the condition of these indicators for each watershed, as well as the County as a whole, will help **prioritize and plan** key resilience actions and initiatives within each watershed, allowing for county-wide resilience-building that ensures all communities receive the investment they need to withstand climate change.

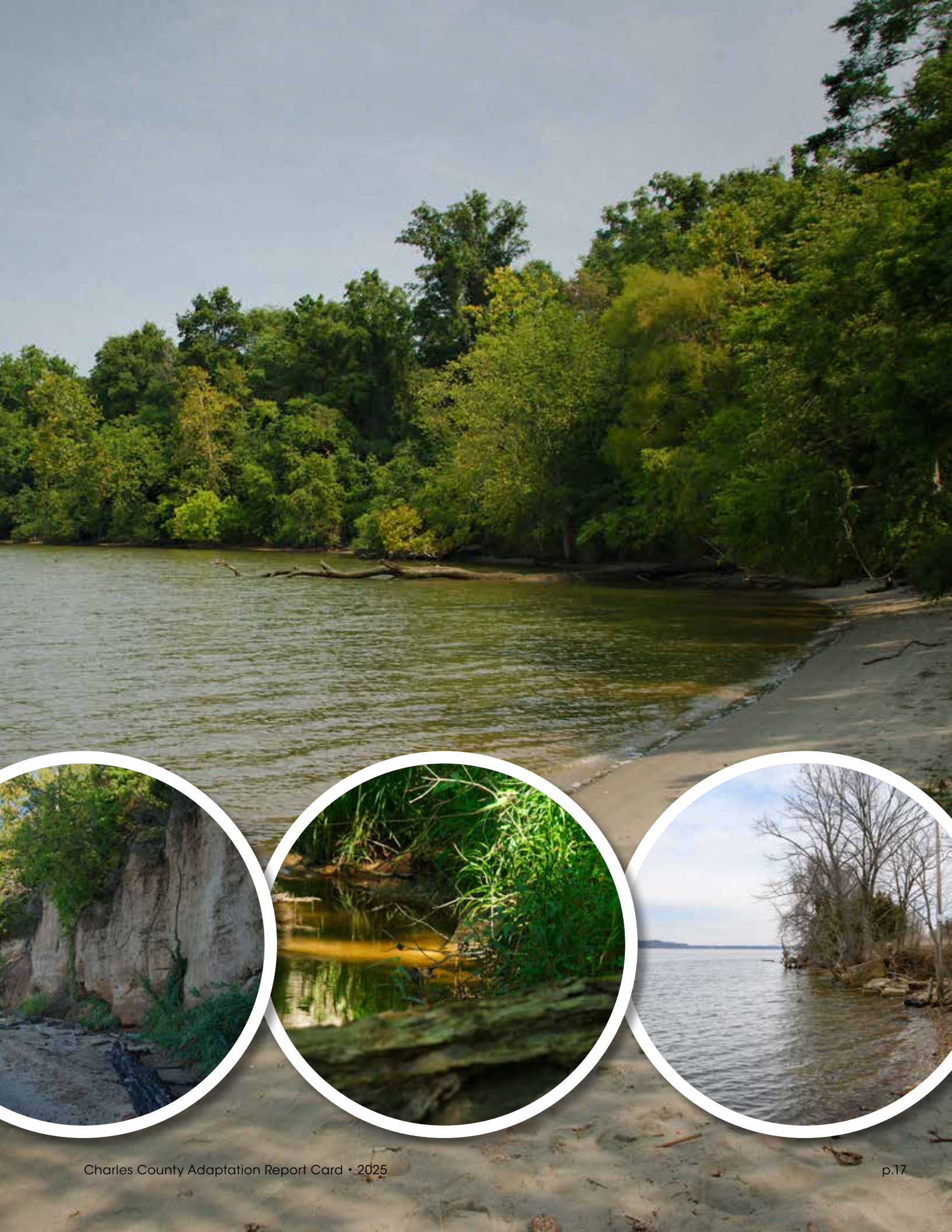

Potomac River Upper Tidal
Tree Equity
Forests
Park Equity
Pervious Surfaces
Heat Tolerance
Living Shorelines
Protected Habitat
Zekiah Swamp
Gilbert Swamp
Patuxent River Lower
Port Tobacco River
Wicomico River
La Plata
Port Tobacco
Port Tobacco R.
Patuxent River
Wicomico River
Potomac River
LEGEND
Streams and tributaries
Town
Watershed Scores
A
B
C
D
F

Indicators assessed at the watershed level fall into the Human Well-being and Environment Resilience categories.

The Environment indicators focus on habitats that protect human communities from the threats of climate change. Among these Environment indicators, Living Shorelines prevent Shoreline Erosion and filter toxins from runoff; Pervious Surfaces absorb water, take up excess stormwater, and reduce flooding; Protected Habitat includes a number of ecosystem and habitat types that provide additional climate change mitigation benefits; and Forests sequester carbon and maintain climates. Human Well-being indicators assessed at the watershed level are primarily related to the threat of increased heat and on equity in general; Park Equity and Tree Equity indicators focus on the distribution of green spaces and trees that can reduce heat in urban areas, and Heat Tolerance addresses the overall ability of a community or watershed to withstand increasing temperatures. Tree Equity data were not available for all watersheds, and the Living Shorelines indicator is not applicable to the Gilbert Swamp Watershed.

Among the ten watersheds, **Gilbert Swamp** had the lowest Resilience score at 52% out of 100%, or a letter grade of C. The watersheds assessed as most resilient, all with letter grades of B, are the **Mattawoman Creek**, the **Potomac River Middle** and **Upper Tidal**, and the **Zekiah Swamp** watersheds. Pervious Surfaces scored highly across watersheds. Park Equity and Heat Tolerance both scored poorly across watersheds, with letter grades in the D and C range, indicating that increasing Heat Tolerance and the number of parks county-wide should be a priority. The greatest variation in scores across watersheds was seen in Living Shorelines, Protected Habitat, and Forests. Across watersheds, Living Shorelines had scores ranging from A to C. Forests ranged in scores from A to D, and Protected Habitat had the most extreme variation among watersheds, ranging from A to F. Gilbert Swamp Watershed received poor scores in both Living Shorelines and Protected Habitat, and therefore needs more investment in their implementation. **Potomac River Lower Tidal** and **Wicomico River** also scored very poorly in Protected Habitat, with Port Tobacco River and Zekiah Swamp following closely behind. These watersheds would benefit from the establishment of more Protected Habitat, particularly habitats with green spaces that can help mitigate microclimates, reduce potential Shoreline Erosion threats, and provide for absorption of stormwaters. Although Wicomico River and Zekiah Swamp scored poorly regarding Protected Habitat, they, along with **Nanjemoy Creek**, have sufficient Living Shorelines. The Potomac River Upper Tidal Watershed needs increased investment in maintaining Forest cover.

For more details in indicator scores in each watershed, please see "Charles County, MD Watershed Score" supplementary documents.



Air Pollution is a Human Health Concern

High levels of air pollutants are harmful to human health, and the formation of pollutants like ozone increases with increasing temperatures. As the climate warms there will be more hot days, leading to higher ozone levels and poorer air quality. Sensitive populations — the very old or very young and people with asthma or other respiratory concerns — are particularly vulnerable to air pollution, but if it is severe enough even healthy people can be affected.

Air quality in urban areas can be improved by reducing emissions, as through transitioning to EVs, facilitating use of public transit, using electricity instead of gas to heat buildings and homes, and strategically planting trees. Human health can be protected by instituting consistent monitoring to inform air quality warnings.

Air quality warnings depend on air quality monitoring, but there are currently few air quality monitoring sites in Charles County.

The Charles County Resilience Authority Youth Corps (RAYC)

RAYC was created as a partnership between the Resilience Authority and Student Conservation Association (SCA). The groups are working to obtain and install more air quality monitors around the County to improve monitoring. They are also actively working to improve air quality by planting and maintaining trees in urban areas. This illustrates that through collaboration and creative thinking, anyone can take action to build community resilience to climate change.

Although Charles County does experience net forest loss, the county currently maintains over 50% of its land as forest, exceeding the statewide goal of 40%.

Pictured — Mattawoman Creek: Increasing development in Charles County benefits the growing population but raises environmental concerns.

Photo by Will Parson
Chesapeake Bay Program

Trees and Forests are a Nuanced Resource

The climate benefits of trees are well-known. Forests absorb and store massive quantities of carbon dioxide, which offsets emissions that cause climate change. Coastal forests and riparian forests, or forests along streams, prevent erosion and provide a buffer against rising waters. Trees in urban or developed areas help take up pollutants and provide shade, cooling the air and counteracting the warming effects of asphalt and pavement. Disadvantaged or under-resourced neighborhoods tend to have fewer trees, a disparity that can be corrected through urban tree planting programs. Ongoing efforts to plant urban trees are supported by the Charles County Resilience Authority.

The state of Maryland has a goal of no net forest loss and a goal of maintaining at least 40% of land in the state as forest. The on-the-ground reality of forest loss and gain can be complex. Charles County, one of the most forested counties in Maryland, must expect some forest loss due to planned development as the County's population grows.

Scoring Forests in this report card incorporates large-scale goals as well as small-scale nuance. At the county level, the forest score is based on the percent of watersheds in the County that have at least 40% forest cover; this score is weighted by the amount of area each watershed covers. Scores at the watershed level assess how close each watershed is to 40% forest coverage. For example, a watershed that currently has 20% coverage receives a 50% score because it is halfway to the goal. The combination of large-scale and small-scale scoring methods produces a comprehensive picture of forest cover in Charles County, which will provide a baseline for changing forest cover over time.

Living Shorelines Protect Coastlines from Flooding

Nearly 75% of Charles County shoreline is considered to be "living shoreline," meaning that it is forested or marsh. Non-living shoreline, on the other hand, is marked by pavement or development very close to the water, with no living buffer between the water and human structures. Living shorelines increase resilience by reducing erosion, providing habitat for wildlife, and filtering pollution from water runoff. They are more resilient to storm damage than hardened shorelines such as bulkheads and seawalls. Although they are often installed to protect property, hardened shorelines can actually increase erosion. Hardened shorelines also lead to loss of habitat and poor water quality.

A large proportion of Charles County's shorelines overall are living, but some areas have a significant amount of non-living shoreline. For example, only around 60% of the area along the Potomac River south of the Port Tobacco River is living shoreline. Charles County is committed to stabilizing the county's coast using living shorelines when appropriate.

To learn more about the County's efforts to restore shoreline habitat, read the "Habitat restoration is Ongoing" story (p.21).

Wetlands and forests, like these along Nanjemoy Creek, provide protection from flooding and habitat for many species.

Photo by Will Parson
Chesapeake Bay Program

Habitat Restoration is Ongoing

Similar to living shorelines, protecting and restoring streams and wetlands addresses flooding and erosion concerns. Restoring these areas from hardened shorelines to vegetated ones also restores habitat critical to natural communities. Since 2018, **Charles County has completed 6,689 linear feet of shoreline stabilization** including through the Benedict, Clifton, and Potomac Heights projects. Another 1,597 linear feet is in the permitting process. Once those projects are permitted and completed, the restoration credits will be turned over to the County to comply with the Chesapeake Bay Total Maximum Daily Load and the County's MS4 permit.

The County has also completed 12,657 linear feet of stream restoration, with another 8,756 linear feet planned for restoration. Stream restoration activities include planting native trees and reshaping streambeds to mimic natural flow. Slower streams that have curvature are less likely to flood because the water is slowed, so these changes can reduce both erosion and the number of flash floods in a stream. Installing native plants along streams further reduces flooding by absorbing runoff during storms. Altogether, the County has invested in over 20 stream restoration and shoreline stabilization projects, and more are on the way! Habitat restoration across Charles County increases overall resilience to flooding and provides habitat for many species.

CEDAR POINT *(pictured)* is a 1,914-acre site situated on a peninsula between Nanjemoy Creek and the Potomac River, in southwestern Charles County. The location consists of a mix of forested and upland habitats as well as tidal marsh, non-tidal ponds and wetlands, and agricultural fields.

Restored wetlands, like these at Cedar Point, provide shoreline protection and habitat. Tree planting can restore some of the forest that is lost to development, improving air quality and providing habitat. Older forests provide many benefits, including erosion control, that are lost or reduced when forests are cut for construction The Cedar Point restoration project is monitored and maintained to ensure success.

Photos by Will Parson, Chesapeake Bay Program

Charles County Prioritizes Groundwater Management

Charles County's use of water has been slowly but steadily increasing for several decades. As climate change continues, a growing concern is ensuring the availability of water for human use — from drinking water to watering crops. Historically, Charles County's water has been drawn from underground aquifers, and as demand for water increased over the last several decades, there was a decline in the water levels in the aquifers being used. In order to ensure adequate water supply, the County shifted to drawing water from deeper, more plentiful aquifers. When water levels in these aquifers declined to concerning levels, the County worked with state experts to develop a better pumping strategy, pumping from more efficient locations to reduce the impact. To ensure the County was being efficient with these limited water resources, the County introduced a graduated billing structure, allowing the most conservative water users to be rewarded with the lowest water billing rates, while heavy water-users pay a much higher rate per gallon.

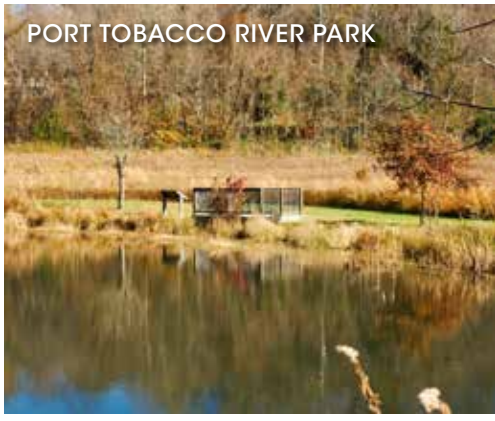
After several decades of studying the aquifers, the County worked with state agencies to develop a more sustainable plan for water supply which included the introduction of more surface water resources to supplement the use of groundwater. While the County already draws about 10-15% of its public water supply from surface (river) water supplied by the Washington Suburban Sanitary Commission (WSSC), the County recently negotiated a new agreement with them to purchase a substantially greater amount of surface water to lessen the withdrawal of groundwater and significantly improve the sustainability of local aquifers while meeting local demand for water.


MALLOWS BAY PARK


GILBERT RUN PARK


OAKRIDGE PARK


BENSVILLE PARK


PORT TOBACCO RIVER PARK

Access to Parks is Not Equitable Across Neighborhoods

Local public parks are essential to human health and well-being; their green spaces directly combat climate change effects by regulating urban heat, absorbing excess rainwater, and taking up carbon from the atmosphere. They also serve as areas to gather, recreate, enjoy being outdoors, and cool off during warm days. Indirectly, parks and community centers confer improved resilience to their communities by providing for recreation and gathering spaces. A community that is happy and healthy is more resilient to changes and stressors—including climate change. Not all residential areas have equal access to quality parks, and nation-wide, lower-income and marginalized neighborhoods tend to have less access to parks.

The Park Equity indicator in this report received a county-wide score of 32 (out of 100), indicating that park equity county-wide is far below standard. This indicator is based on the Maryland Park Equity Mapper, and assesses equity in park quality and accessibility across neighborhoods of varying income, racial makeup, language, and age composition. When considering Park Equity on a watershed scale, none of Charles County's watersheds scored higher than 32. This means that throughout the county, lower income and marginalized communities have less access to parks compared to other, higher income communities.

The watersheds with the lowest Park Equity were the Lower Patuxent River and Port Tobacco River Watersheds (each scored 27%) and Gilbert and Zekiah Swamp Watersheds (each with a score of 28%). The generation of new parks in these areas, including the currently under-development La Plata Farm Park (Port Tobacco Watershed) and Waldorf Park (Zekiah Swamp Watershed), is expected to improve Park Equity—and this score—in those areas and county-wide. The planned Popes Creek Waterfront Park (Lower Potomac Tidal Watershed) and a sports and wellness complex set to provide a pool and potential green infrastructure features in Mattawoman Watershed may also improve the county-wide Park Equity score.

Flood Mitigation is Vital but Complicated

As the climate changes and storms become more frequent and intense, homes and businesses become increasingly vulnerable to flooding. Flood insurance is crucial to the recovery of homes and businesses after storms. Properties that are more prone to flooding damage, such as those near rivers, should be "mitigated" to prepare for future events. Mitigation measures may include raising structures above flood levels, relocating structures away from flood zones, and dry floodproofing to make structures water-tight.

In Charles County,
thirty-one properties
are marked as "repetitive loss" due to repeated flood insurance claims. Of these, one is fully mitigated and 14 others are insured. This list is consistently updated and ever-evolving as properties are mitigated.

While ideally all repetitive loss properties would be mitigated, the reality is often more complicated. Mitigation is not necessarily the responsibility of the County; it is usually the responsibility of the landowner. Because it is expensive and acquiring needed funding may not be straightforward, mitigation is not always pursued, and when it is it is not always completed. In fact, some mitigation efforts have had to be abandoned due to high costs.

Some properties, such as crab shacks, will always be on the waterfront and therefore will always be susceptible to flooding. Other properties, including businesses or homes, have been abandoned because of their repetitive losses. Although these properties could be mitigated and brought back into the community, their vacancy negates the urgency to do so. Funding is always a limiting factor for proper mitigation, and deciding how best to distribute available funds can slow overall community mitigation.

The County's Wetlands Protect Communities

Wetlands are critical habitat for plants, animals, and people. Wetlands slow the flow of water, reducing erosion and allowing nutrients to settle out. The ability of wetlands to absorb water is crucial to human communities, especially those on the coast. During heavy rainfall, water that flows through or into wetlands is more likely to be absorbed; otherwise, it would run off into streets and overflow storm-water systems, flooding homes and businesses. *Pictured: Mallows Bay, Nanjemoy, MD.*

Wetland loss should be avoided, and if wetlands are lost in one place, they must be replaced in another. Charles County has achieved this goal, with a very slight net gain in wetlands over the last several years. While there has been net gain due to some wetlands expanding, some wetlands are still being lost in areas that have historically had them.

It is important to consider the location of wetland loss and gain to ensure that the maximum benefits derived from wetlands can be maintained in Charles County. Wetland loss near buildings would, for example, increase those buildings' vulnerability to flooding. Wetland restoration in or near areas prone to flooding can help reduce flood risk and damage. On the other hand, as sea level rises wetlands may "migrate" inland, taking over land that was once fully terrestrial. Case-by-case examination of wetland loss and gain in Charles County would provide a clearer picture of how the landscape is changing over time.

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The Chesapeake Bay Agreement, which includes Maryland, aims to achieve zero net loss of wetland coverage over time.

Glossary of Terms

- **Living shorelines** are shorelines that have been stabilized using natural materials that reduce climate impacts such as erosion flooding. They are typically vegetated..
- **Bulkheads** are vertical, man-made structures built along shorelines to prevent erosion.
- **Adaptation and resilience measures** are actions taken or measures put into place to increase the ability of a community or ecosystem to respond to and withstand climate change impacts.
- **Nature-based solutions** are actions that use nature to address socio-environmental challenges, protecting or restoring ecosystems in a way that benefits human communities, particularly in terms of building resilience to climate change.
- **Impervious surfaces** are ground types that do not absorb water, causing it to pool and run off, increasing flood risks and introducing pollution to natural systems such as streams. Examples include roofs and paved parking lots.
- **Resilience Authorities** are organizations that provide advice and, in some cases implement actions, to build resilience to climate change. The Charles County Resilience Authority was the first such organization established in the state of Maryland. It is a nonprofit organization granted with governmental functions "for the public purpose of responding to the impacts of climate change in communities across Charles County and the State."
- **Report cards** are effective tools for measuring ecosystem condition and adaptation. They use scientific data and methods to provide information that helps communities, governments, and organizations identify goals for ongoing activities, and measure progress toward those goals. They provide a snapshot of current progress and allow for tracking continued improvement over time. They also identify community and ecosystem needs.
- **Indicators** are measures of specific aspects of ecosystem health or community resilience that are used in report cards.
- **Groundwater i**ncludes freshwater aquifers that exist underground. Groundwater provides avaluable source of clean drinking water for many communities.
- **Surface water** describes water that exists above ground, including streams, rivers, and ponds. Surface waters are another source of water used for human consumption.
- **Vulnerability** describes how susceptible human communities are to damage caused by various threats, including climate change threats like flooding.
- **Risk** expresses the likelihood of exposure to some danger, for example dangers caused by climate change impacts such as flooding.
- **Environment, Flooding, and Human well-being** are categories of indicators used to assess climate resilience and vulnerability in this document.
- **Watershed** refers to an area of land that drains into a particular stream, river, or other body of water.


Few places
offer such a
breathtaking
blend of
history and
nature.

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