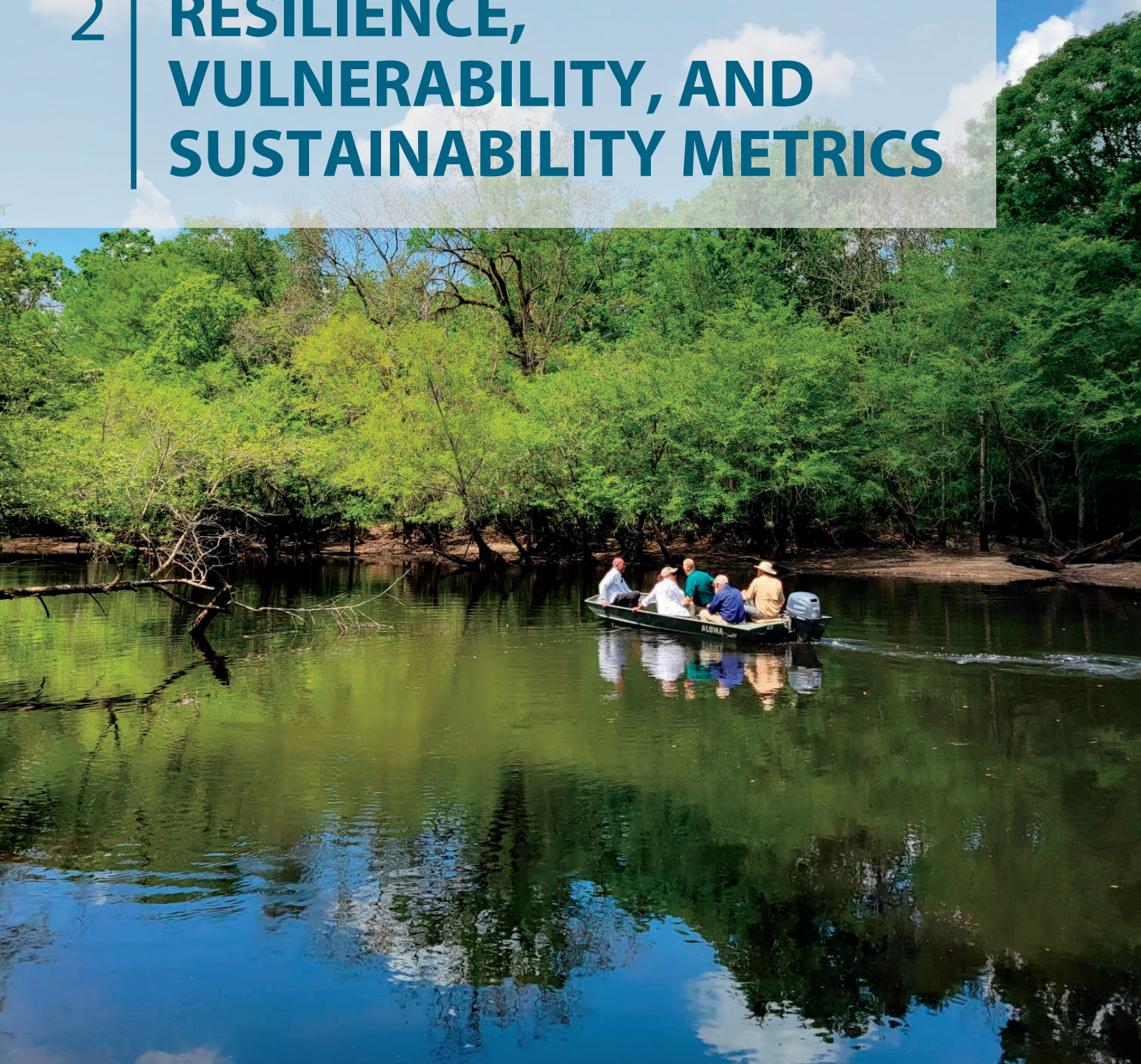


Strategic Statewide Resilience and Risk Reduction Plan

# 2 | RESILIENCE, VULNERABILITY, AND SUSTAINABILITY METRICS



## OVERVIEW

This chapter explores the metrics used to measure resilience, vulnerability, and sustainability. The ability to measure resilience is key to ensuring that investments made are having the intended impact and maximize benefits to the communities, economies, and ecosystems of South Carolina over time. The metrics used for vulnerability and sustainability are closely related to resilience.

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## KEY FINDINGS

- There is no dominant framework or standard for resilience measurement because communities are different in their physical, social, and built environment characteristics, disaster risk exposures, and capacities.
- SCOR has partnered with the Hazards and Vulnerability Research Institute (HVRI) at the University of South Carolina to construct two South Carolina-specific resilience metrics, one top-down and one bottom-up. The top-down metric will be used to measure the impacts of changes at the state level, highlighting those variables that are most relevant and actionable for South Carolina. The bottom-up metric will be designed specifically for local implementation within South Carolina.

## RESILIENCE METRICS

SCOR partnered with the Hazards Vulnerability and Resilience Institute (HVRI) at the University of South Carolina to develop a report titled, “Evaluation of Existing Community Disaster Resilience Approaches and Tools to Support Resilience Planning Efforts” (Habets & Cutter, 2023). The report covers various resilience metrics and can be read in its entirety in Appendix C. The following are the key findings of the report:

- Vulnerability and resilience metrics are not the same as they measure different concepts.
- Top-down resilience metrics are best used for an initial filter or broad assessment of where more information on resilience and its drivers should be gathered.
- Bottom-up metrics can be employed most effectively after a top-down assessment narrows down study areas of interest.
- Bottom-up metrics can delve into specific communities to best target resilience programming and funding based on actionable information.

Building on this report, SCOR will continue to work with HVRI to develop South Carolina-specific metrics for use at the state and local level.

## DEVELOPING SOUTH CAROLINA-SPECIFIC RESILIENCE METRICS

Building on the findings of the “Evaluation of Existing Community Disaster Resilience Approaches and Tools to Support Resilience Planning Efforts,” SCOR has partnered with HVRI to construct two South Carolina-specific resilience metrics, one top-down and one bottom-up. The top-down metric is based on HVRI’s Baseline Resilience Indicators for Communities (BRIC).

### BASELINE RESILIENCE INDICATORS FOR COMMUNITIES (BRIC)

The BRIC index uses 49 variables across six broad capitals (or categories) of community disaster resilience:

- Human Well-Being/Cultural/Social: Physical attributes of populations, values, and belief systems
- Economic/Financial: Economic assets and livelihoods
- Infrastructure/Built Environment/Housing: Buildings and infrastructure
- Institutional/Governance: Access to resources and the power to influence their distribution
- Community Capacity: Social networks and connectivity among individuals and groups
- Environmental/Natural: Natural resource base and environmental conditions

BRIC is currently available at the county level and can be used to compare counties across the country to one another and to determine the specific drivers of resilience and to monitor improvements in resilience over time (Hazards Vulnerability & Resilience Institute, 2023).

### DEVELOPMENT OF A SOUTH CAROLINA SPECIFIC TOP DOWN METRIC (CUSTOM BRIC)

The first of the two metrics HVRI and SCOR are developing is a custom and actionable top down resilience metric specifically for the state of South Carolina.

The metric will use the existing BRIC framework and six capitals but emphasize and add datasets that are most relevant and actionable for South Carolina, while omitting datasets that are unactionable or only useful in regional or national metrics. This assessment will allow for analysis and comparison at both the county and census tract level to better target the subjects and locations of resilience building efforts.

This metric will be used to track statewide trends after the completion of this plan and implementation of plan recommendations, informing the update of the plan and the implementation of further resilience projects, programs, and policies across the state.

## DEVELOPING A COMMUNITY LEVEL RESILIENCE INDEX FOR SOUTH CAROLINA

While the top down South Carolina specific BRIC will be designed for state tracking and implementation, the custom bottom up approach in development will be designed for local implementation within South Carolina.

Measuring resilience for the purposes of resilience planning at the local level to inform the implementation of projects, programs and policies that increase resilience can be difficult. There is no single metric that can tell a community everything they need to know about an area's resilience, and top down metrics should be critically assessed before applying to a specific subject area (Jones, 2018).

In addition to the above issues of using top down metrics for local implementations, there are also gaps in the available bottom up approaches. There are several bottom up metrics that may be applicable and useful in specific areas of the state, such as coastal, rural, or post-disaster communities. HVRI and SCOR are working together to develop a tool that will allow individual communities across the State to undertake a process of looking at their resilience designed with their use in mind, to lead to actionable outcomes.

This custom tool will be refined and utilized along with community engagement through the watershed-based resilience planning process to measure baseline conditions, identify needs, and allow for the monitoring of resilience planning and implementation outcomes at the local level.

## OTHER RESILIENCE RELATED CONCEPTS

### VULNERABILITY & SUSTAINABILITY

While the concepts of vulnerability, sustainability and resilience are overlapping and interwoven, they are not the same, nor do they predict each other. For example, increased social vulnerability does not always indicate decreased resilience, with the two being different empirical and conceptual constructs (Cutter, Ash, & Emrich, 2014).

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### SOCIAL VULNERABILITY

Social vulnerability can be described as “a measure of both the sensitivity of populations to natural hazards and its ability to respond to and recovery from the impacts of hazards” (Cutter & Finch, 2008).

Social vulnerability is a product of social and place inequalities resulting in differential harm and ability to respond to different population groups. This is distinct from resilience, which encompasses the everyday qualities of a community that may enhance its ability to prepare for, respond to, and recover from hazard events (Habets & Cutter, 2023).

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### SOVI

The Social Vulnerability Index ([SoVI®](#)), compiled and processed by HVRI, measures the social vulnerability of counties in the United States, providing information on “where there is uneven capacity for preparedness and response and where resources might be used most effectively to reduce pre-existing vulnerability” using 29 socioeconomic variables (University of South Carolina). Total scores, percentiles, and individual scores for each component are available to allow for specific analysis about what demographics drive local vulnerability.

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### SVI

The CDC/ATSDR Social Vulnerability Index is a measure developed by the Centers for Disease Control and Prevention’s (CDC) Agency for Toxic Substances and Disease Registry to “help emergency response planners and public health officials identify and map communities that will most likely need support before, during, and after a hazardous event on a Census tract level, ranking tracts on 15 factors in four themes: socioeconomic status, household composition, race/ethnicity/language, and housing/transportation” (Centers for Disease Control, 2020).

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### ENVIRONMENTAL JUSTICE (JUSTICE40)

Justice40 is an environmental justice initiative with the goal of directing 40% of climate and clean infrastructure federal investments to disadvantaged communities. In May 2021, South

Carolina legislators were the first in country to introduce a bill in response to the federal Justice40 initiative, but it did not pass during the 2021 session (UCLA Luskin Center for Innovation, 2021).

[The Climate and Economic Justice Screening Tool](#), a new tool by the White House Council on Environmental Quality, aims to help Federal agencies identify disadvantaged communities, ensuring that the benefits of existing and new programs under the Inflation Reduction Act, Bipartisan Infrastructure Law and the American Rescue Plan flow to disadvantage communities and advance environmental justice (The White House, 2023).

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## COASTAL VULNERABILITY

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### CVI

The Coastal Vulnerability Index (CVI) proposed is an integrated coastal vulnerability assessment framework that considers both biophysical and socio-economic dimensions. The proposed CVI for coastal systems can (1) measure the degree of vulnerability where the system is exposed to biophysical hazards, and (2) measure the degree of socio-economic and ecological vulnerability of exposed places (Tanim, Goharian, & Moradkhani, 2022).

The CVI uses 5 vulnerability groups that include a total of 20 vulnerability indicators.

1. Hydroclimate: number of coastal hazard events, hurricane track density, surge height, and rainfall intensity.
2. Physical: land use, available water storage, elevation, distance from coast
3. Socio-economic: SoVI, number of historical and archeological structures, cost of fatalities
4. Ecological: species richness, shellfish harvesting, turtle
5. Shoreline: rate of shoreline change, tide range, significant wave height, coastal slope, and beachfront stability.

Two CVIs were developed using a Multi-Criteria Decision-Making method. CVI-50 uses average conditions (50<sup>th</sup> percentile weight) while CVI-90 considers extreme conditions (90<sup>th</sup> percentile weight). Coastal vulnerability was also calculated using a data-driven Probabilistic Principal Component Analysis. Maps for each of these methods are below (Figure 2.1).



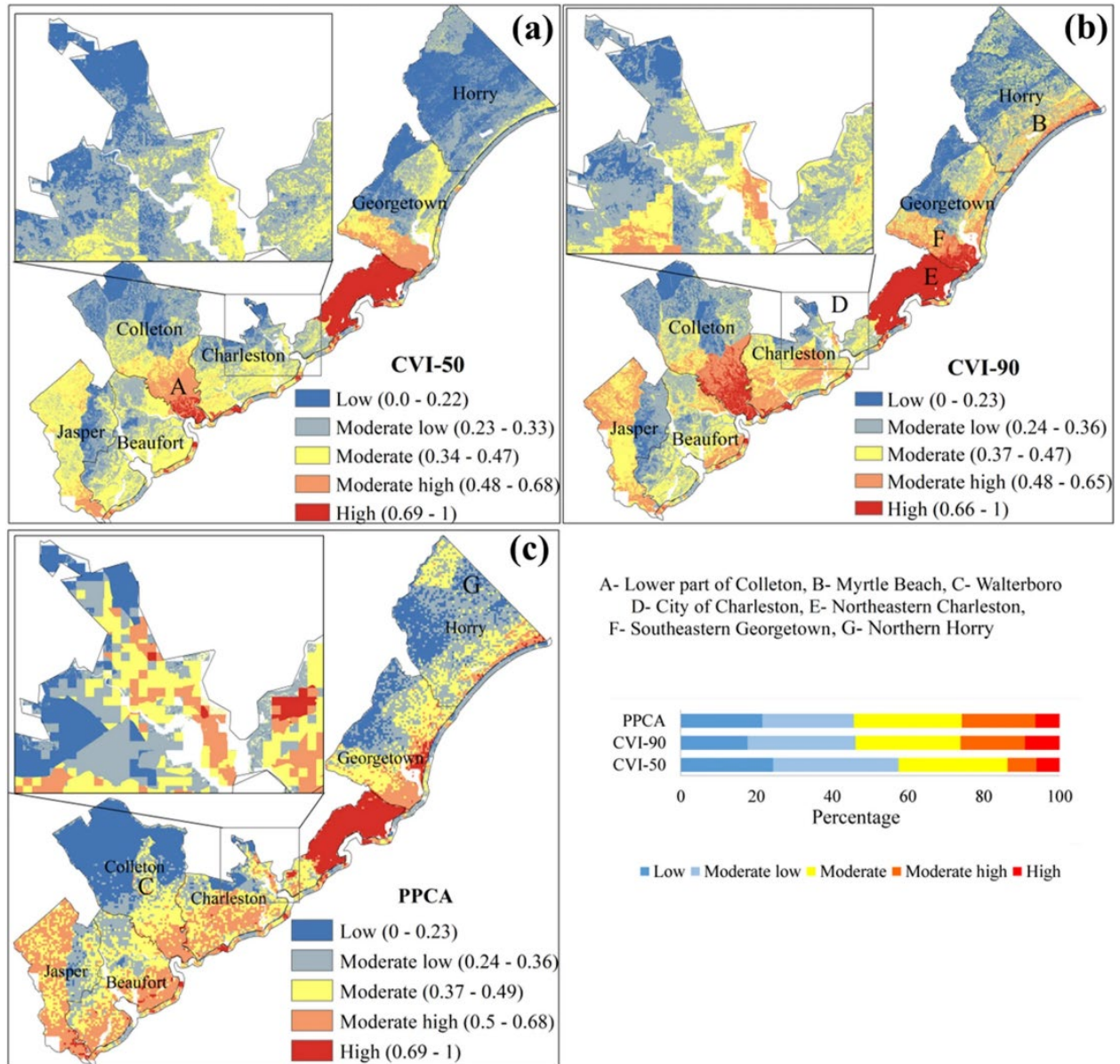


Figure 2.1: Comparison of CVI-50, CVI-90 and the Probabilistic Principal Component Analysis for the South Carolina coast

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## **SENDAI FRAMEWORK FOR DISASTER RISK REDUCTION**

The Sendai Framework advocates for the substantial reduction of disaster risk and losses in lives, livelihoods, and health and in the economic, physical, social, cultural, and environmental assets of persons, businesses, communities, and countries. It has 4 priorities:

1. Understanding disaster risk
2. Strengthening disaster risk governance to manage disaster risk
3. Investing in disaster risk reduction for resilience
4. Enhancing disaster preparedness for effecting response and to build back better in recovery, rehabilitation, and reconstruction

The framework addresses the three dimensions of disaster risk: exposure to hazards, vulnerability and capacity, and hazard's characteristics); through seven global targets and 38 indicators to measure progress towards those goals (United Nations Office for Disaster Risk Reduction, n.d.). This framework works hand in hand with the Sustainable Development Goals, with monitoring of the Sendia Framework indicators complementing the monitoring of 11 of the Sustainable Development Goals indicators (United Nations Office for Disaster Risk Reduction, n.d.).

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## **SUSTAINABLE DEVELOPMENT GOALS**

The Sustainable Development Goals is an international measure of sustainability and “connects state efforts to broader, international movements for an environmentally, socially, and economically just world, and supports an interdisciplinary approach to understanding state progress” (Lynch & Sachs, 2021). South Carolina ranks 37<sup>th</sup> nationwide on the SDG Index, with a score of 39.5. Of the 17 goals, SC scores in the areas of No Poverty, Good Health & Well-Being, Clean Water & Sanitation, and Industry/Innovation/Infrastructure are decreasing.

SCOR is participating in an effort led by Sustain SC to understand and improve South Carolina's ranking in the SDG Index. The effort includes representatives from South Carolina's business and conservation communities.

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