Chapter 3
Statewide Climate Vulnerability Assessment

Statewide Climate Vulnerability Assessment

This climate risk screening was conducted to enable multi-hazard comparison of risk across a range of infrastructural, economic, environmental, and societal asset types.

This assessment follows a standardized approach to assessing climate risk across 21 asset types (ranging from Coastal Wetlands to Public Libraries to Evacuation Routes, and more) across five climate hazards, as applicable.

Where possible, this assessment takes in asset condition data and other relevant details that inform asset vulnerability, but it is understood to be inherently higher level. This assessment process was carried out with consultation from the Resilience EC4 Subgroup, RI Resilience Partner Group, Municipal Resilience Stakeholders, and Community Resilience Stakeholders, to ensure it aligned to their priority climate risks. For further information on the community process, refer to Chapter 1: Community Engagement Summary Report.

The purpose of this assessment is to understand the climate-related risks most material to each asset type, how those risks may change over time under multiple climate change scenarios, and the relative risk distribution for assets within a given asset type across the State. The outputs of this risk assessment informed Chapter 5: Climate Adaptation & Resilience Solutions, in which aspects of asset criticality were embedded to prioritize high-impact climate change adaptation solutions.

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Rhode Island Sunset © Narragansett Bay National Estuarine Research Reserve (NBNERR)

How to Read This Document

1. **Vulnerability Assessment Introduction:** Provides a high-level overview of the vulnerability assessment process, defining the metrics assessed.
2. **Asset-Hazard Pairs:** Defines the process for selecting the assessed assets, hazards, climate scenarios, and consequences.
3. **Risk Assessment Methodology:** Walks through the process for identifying risk ratings for each asset.
4. **Summary Outputs:** Presents summary results by asset type, including coastal and riverine flooding maps.
5. **Disclaimer and Limitations:** Summarizes the context of this document and defines steps on how it should be utilized.

Appendices

Appendix A. Previous Rhode Island Reports and Data: Provides a table summarizing past Rhode Island studies and data that inform this assessment.

Appendix B. Asset Buffer Approach: Provides a table summarizing the data sources used for each asset location and their buffer size and methodology.

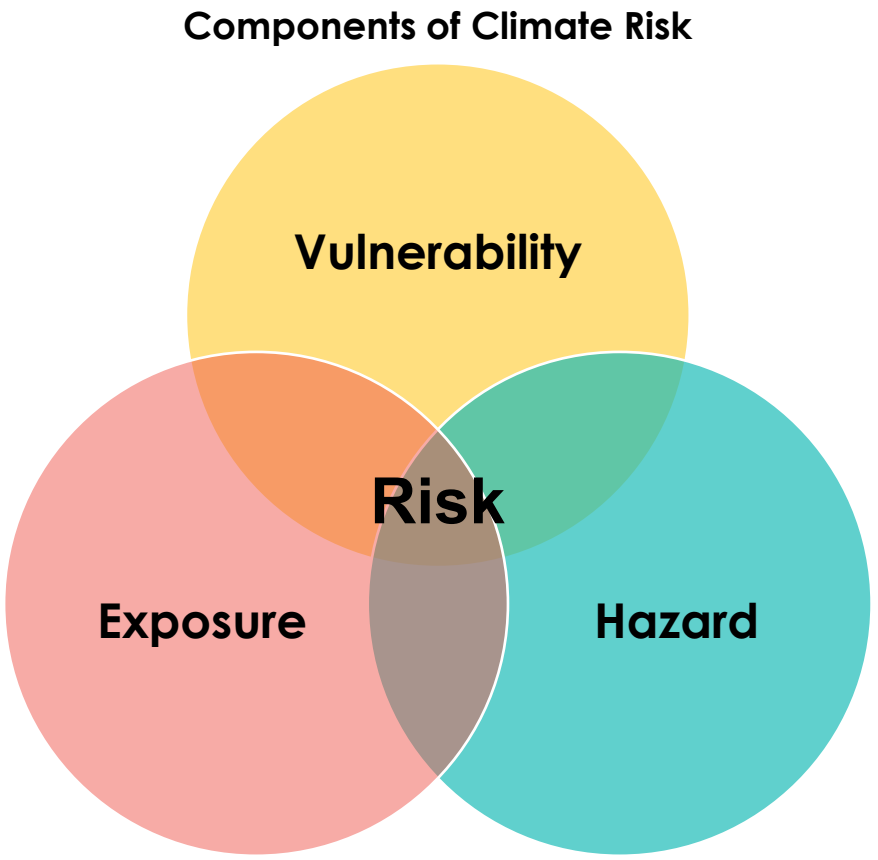
Appendix C. Asset Risk Assessment Results: Provides detailed risk assessment results for each asset.

1. Vulnerability Assessment Introduction

Vulnerability Assessment Process

In this study we conducted a Climate Vulnerability Assessment to determine which assets across Rhode Island have the greatest relative climate risk to be considered for Chapter 5: Climate Adaptation & Resilience Solutions.

Climate risk is here defined as the combination of climate **hazards**, asset **exposure**, and asset **vulnerability** – reflecting for each asset the possibility of climate exposure and the potential negative consequences that exposure could create.

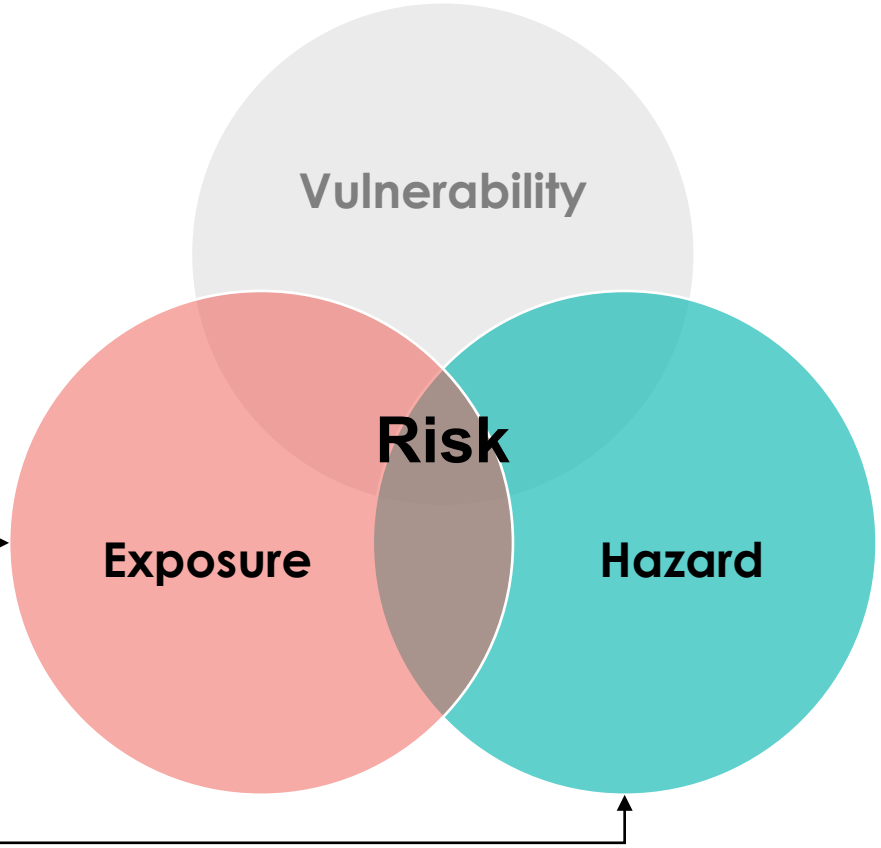


Screening Level Exposure Assessment Process

This task builds off the previously conducted *Screening Level Exposure Assessment*.

In the Exposure Assessment, asset type *vulnerability* data had not yet been embedded. As such, the outputs were a measure of hazard and exposure, which creates the potential for risk, but is not yet a direct measure of risk.

Components of Climate Risk



Exposure
How likely is a hazard event to occur and what is the intensity?

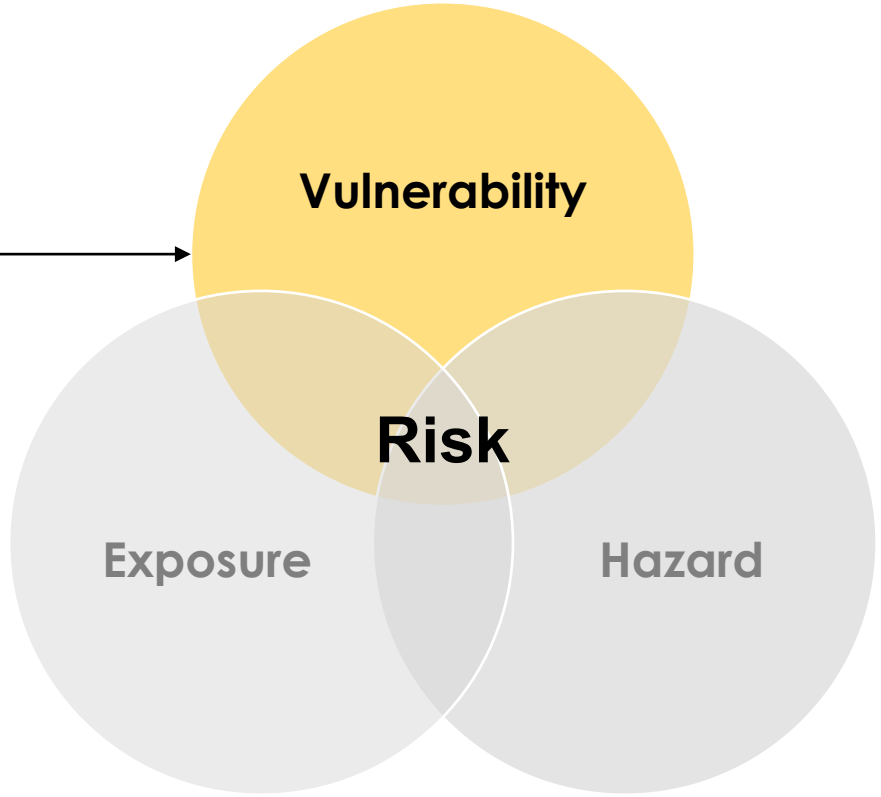
Hazard
Occurrence of climate-related events

Vulnerability Component

As part of the *Statewide Climate Vulnerability Assessment*, available asset data was reviewed to determine which characteristics may make an asset more or less vulnerable to the hazards it is exposed to, and to assign that vulnerability rating to each individual asset within an asset type.

These vulnerability assignments then permit the combination of hazard, exposure, and vulnerability to produce a risk rating for that asset, allowing for comparison of asset risk levels across the State.

Components of Climate Risk

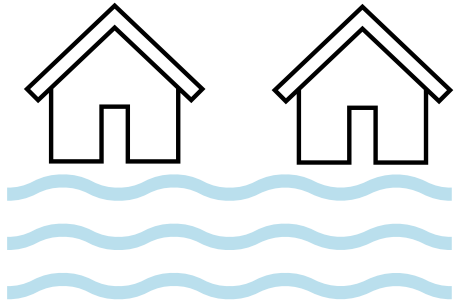


Vulnerability
How susceptible to damage are the exposed assets and what are the consequences of that damage?

Exposure vs. Vulnerability

Exposure

High Exposure Rating High Exposure Rating

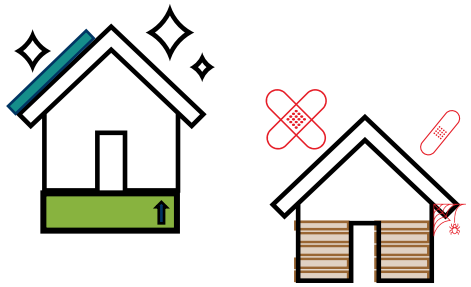


Two assets share the same probability of experiencing a Nor'easter, resulting in a High exposure rating.

Exposure reflects the *likelihood* and *extent* to which an asset may experience a hazard.

Vulnerability

Low Vulnerability Rating High Vulnerability Rating

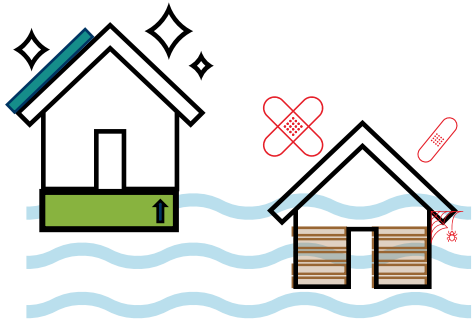


One asset is newer, elevated, and constructed with resilient materials. It also has backup power. The other is older, in poor condition, and built with less flood-resistant materials.

These characteristics determine how *susceptible* each asset is to experience hazard *consequences*.

Risk

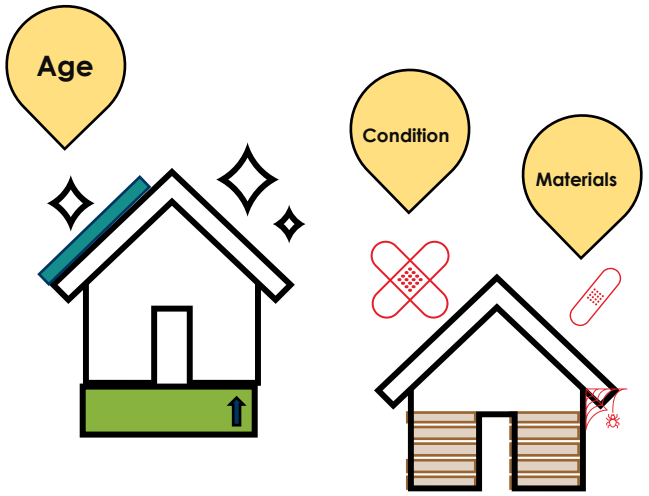
Medium Risk Rating Very-High Risk Rating



Although both assets are exposed to the same hazard, **the one with lower vulnerability is expected to experience fewer consequences; resulting in reduced overall risk.**

This report aims to communicate how available asset data for each included asset type can inform its relative vulnerability to assessed hazards.

Vulnerability Assessment Methodology



Now that we've assessed the exposure of each asset type to each relevant hazard, this Vulnerability Assessment Methodology:

1. *Identifies the specific characteristics of different asset type(s)* that influence how susceptible exposed assets are to experiencing consequences such as damage, disruption, or impacts to health and wellness;

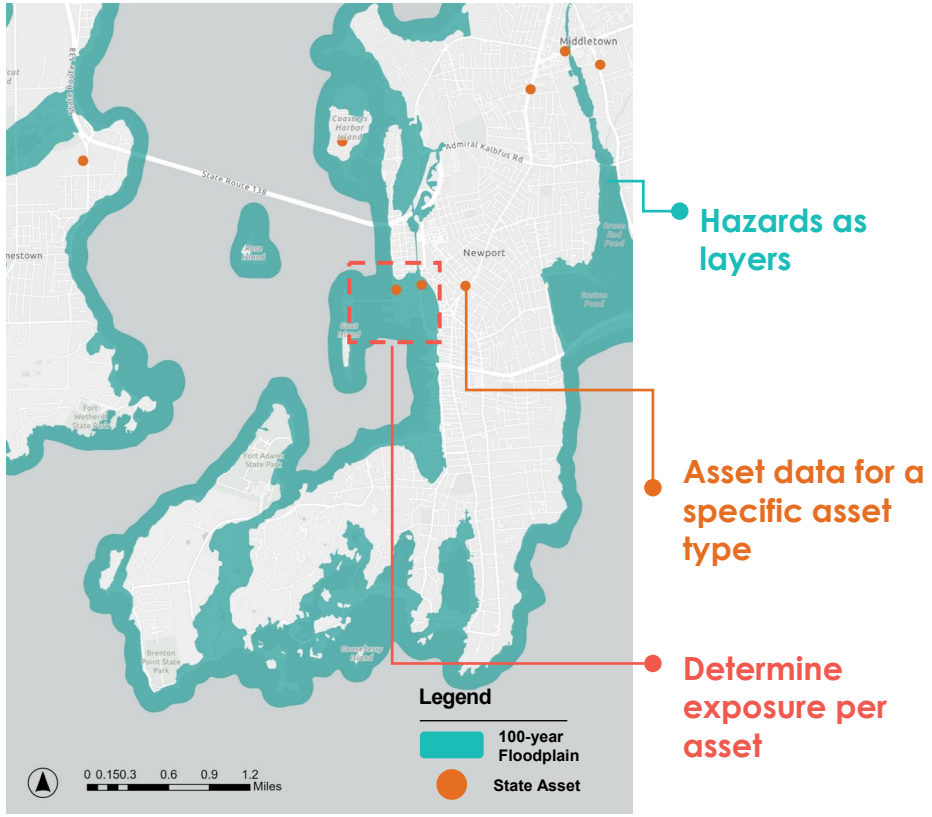
2. *Proposes the approaches* we will use to *translate those characteristics into corresponding vulnerabilities* to pair with hazard exposure to determine resultant risk.

Vulnerability Assessment Process

1. Exposure: **Review hazard exposure** previously identified to determine what hazards a given asset is exposed to.

2.Asset Vulnerability: **Determine asset type vulnerability characteristics** based on engineering judgment / literature review / previous studies and identify available asset data that can inform whether assets are more or less vulnerable to exposed hazards.

3. Risk: **Combine exposure and vulnerability** to determine qualitative risk ratings for each asset



Example GIS-based Exposure Assessment

2. Asset-Hazard Pairs

Hazards Assessed

Overview

In the Screening Level Exposure Assessment, five relevant climate hazards were identified, derived from the six manifestations of climate change outlined in *Resilient Rhody (2018)*. The manifestations were established by the EC4 Group based on observed shifts in Rhode Island's climate patterns.

Hazard	Description	Relevant Manifestations
Coastal Flooding	Flooding resulting from coastal waters. This is inclusive of both coastal storm surge events, which cause temporary flooding, and chronic sea level rise, which could lead to permanent inundation.	
Stormwater Flooding	Flooding resulting from extreme rainfall, often as a result of an extreme storm event overwhelming drainage systems.	
Riverine Flooding	Flooding resulting from overtopping of streams and rivers, often after extreme rainfall events and may be worsened by rising sea levels.	
Extreme Heat	Increasing temperatures and heat wave events, which may be temporary, and chronic increases in average temperatures.	
Extreme Wind	Damaging winds, often caused by storm events.	

Rhode Island's Six Manifestations of Climate Change

Hazards Assessed

Overview

The five climate hazards were assessed over present and future climate conditions. The future climate conditions include the time horizons 2035, 2050, 2100. Each time horizon was assessed under an Intermediate emissions scenario, a scenario where mitigation efforts are low, and a Very High Emissions scenario, a scenario where there is no progress made in mitigation efforts. Statewide geospatial hazard data was collected to assess these scenarios.

5 Hazards

Coastal Flooding

Stormwater Flooding

Riverine Flooding

Extreme Heat

Extreme Wind

4 Time Horizons

- Current: Present Conditions
- Future: 2035, 2050, 2100

2 Climate Scenarios

- SSP2-4.5: Intermediate emissions scenario
- SSP5-8.5: Very High emissions scenario

Hazards Assessed

Data Sources

Hazards may have multiple outputs that are assessed in the exposure assessment. The outputs of each hazard were assessed for the identified time horizons and climate scenarios. The future time horizons for erosion and riverine flooding were not assessed due to the unavailability of future-looking data.

The statewide geospatial data and their outputs are highlighted in the table on the right.

Hazard	Outputs	Data Sources	Resolution	Present	2035		2050		2100	
					SSP2 -4.5	SSP5 -8.5	SSP2 -4.5	SSP5 -8.5	SSP2 -4.5	SSP5 -8.5
Coastal Flooding	**Hurricane** Depth (ft)	STORMTOOLS:*100-yr with SLR scenarios**	Asset	■			■	■	■	■
		STORMTOOLS: *500-yr floodplain**	Asset	■						
		STORMTOOLS: *50-yr with SLR scenarios**	Asset		■	■				
	Nor'easter Depth (ft)	STORMTOOLS: *10-yr with SLR scenarios**	Asset	■	■	■	■	■	■	■
	Sea Level Rise Depth (ft)	STORMTOOLS: *MHHW with SLR scenarios**	Asset	■	■	■	■	■	■	■
	Erosion (yes/no)	FEMA: *Zone VE*	Asset	■						
Stormwater Flooding	**Rainfall** Depth (ft)	NOAA, NRCC, IPCC AR6: *24-hr 100-year storm*	County	■	■	■	■	■	■	■
Riverine Flooding	**Inundation** (yes/no)	FEMA: *100-yr floodplain*	Asset	■						
	Inundation (yes/no)	FEMA: *500-yr floodplain*	Asset	■						
Extreme Heat	**Heat Index** (°F)	NASA Earth Exchange GDDP: Heat Index	County	■	■	■	■	■	■	■
	Number of Extreme Heat Days (days)	NOAA: *Annual Number of Days above 90 °F and 95°F*	County	■	■	■	■	■	■	■
Extreme Wind	**Design Wind Speeds** (mph)	ASCE7 Hazard Tool and IPCC AR 5: *Design Wind Speeds*	County	■	■	■	■	■	■	■

*The NOAA 2022 Sea Level Report was utilized to evaluate the High SLR scenario and connect STORMTOOLS SLR scenarios to future time horizons. See next page for more information.

■ **Outputs Assessed** ■ **Outputs Not Assessed**

Hazards Assessed

Coastal Flooding Data Sources

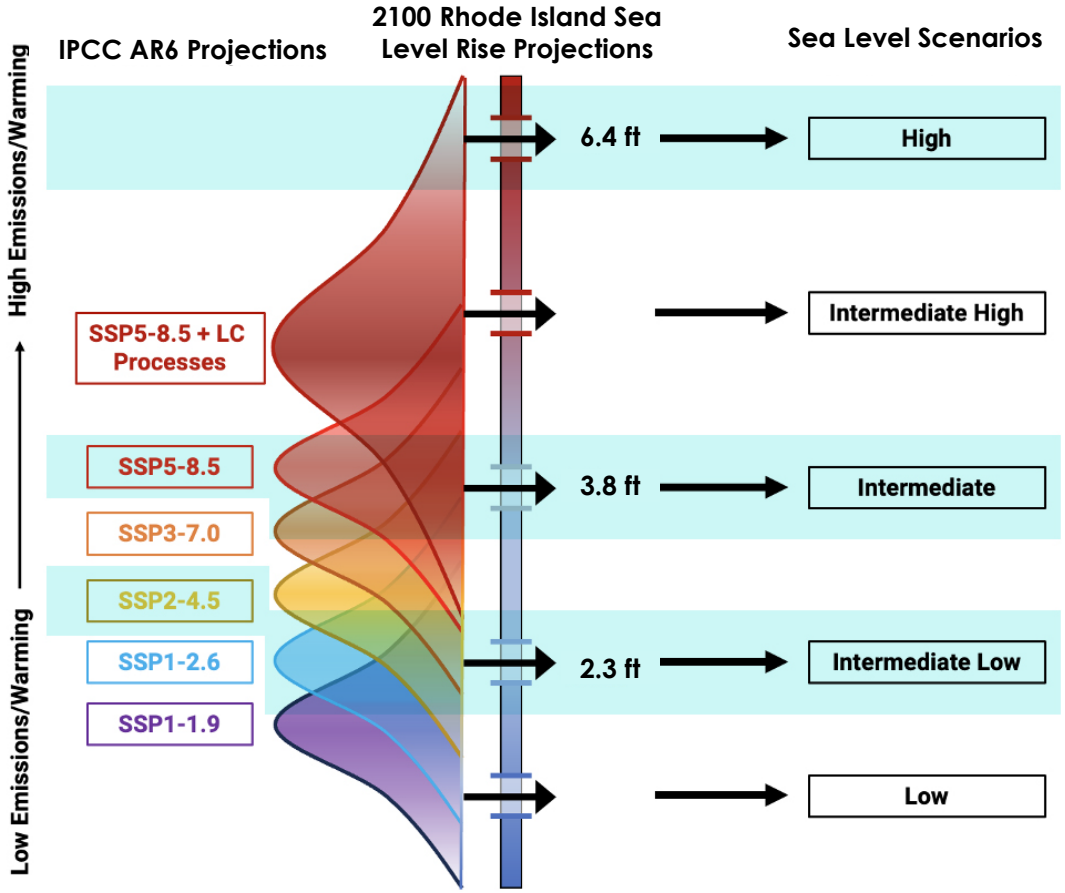
NOAA's 2022 Sea Level Rise technical report connects sea level rise (SLR) scenarios to representative equivalent climate change scenarios. The Intermediate-Low and Intermediate SLR scenarios, aligned with the SSP2-4.5 and SSP5-8.5 emission scenarios, were evaluated for coastal flooding. The High SLR scenario was also evaluated because the scenario is used by RI Coastal Resources Management Council (CRMC) to inform coastal policies and planning efforts. NOAA's SLR scenarios connect COASTAL STORMTOOLS SLR projections to future time horizons.

NOAA's report produces RI-specific estimates of SLR (at Providence and Newport) at each considered time horizon and SLR scenario. These were conservatively rounded up to the nearest available model from Coastal STORMTOOLS (0', 1', 2', 3', 5', and 7'). For example, SLR is estimated to be 7 ft in 2100 under a High SLR scenario and 3 ft under an Intermediate-Low SLR scenario or SSP2-4.5 emission scenario.

Coastal STORMTOOLS SLR Model: 0' 1' 2' 3' 5' 7'

SLR Scenario	Present		2030		2050		2100	
	Reported	*Rounded*	*Reported*	*Rounded*	*Reported*	*Rounded*	*Reported*	*Rounded*
Intermediate – Low	0'	0'	0.6'	1'	1.1'	2'	2.3'	3'
Intermediate	0'	0'	0.6'	1'	1.2'	2'	3.8'	5'
High	0'	0'	0.6'	1'	1.5'	2'	6.4'	7'

Rhode Island Sea Level Rise Projections
(source: NOAA 2022 Sea Level Rise Technical Report)



Alignment between Climate Change Scenarios and Sea Level Rise Scenarios
(source: US Interagency Task Force on Sea Level Change and NOAA 2022 Sea Level Rise Technical Report)

Assets Assessed

Overview

Climate hazard exposure and vulnerability was assessed for priority asset types as determined in *Resilient Rhody 2018*. Approximately over 130,000 assets were assessed statewide across 4 asset groups and 21 asset types.

The assessment covers the assets identified in the table to the right. However, the asset type Historic Resources and the asset Blackstone River Valley National Park, were not included in the Vulnerability Assessment.

Additional assets were not included in the assessment due to limited geospatial data availability, including culverts, hardened shorelines outside of Narragansett, residential electrical lines, and wells and septic systems. Assets not owned by the State (e.g. above ground storage tanks) were also not included in the assessment.

4 Groups	**21 Asset Types**
Critical Infrastructure and Facilities	Drinking Water Systems, Wastewater Treatment Facilities, Dams, Seawalls and Tidal Gates, Stormwater Infrastructure, Ports, Electric Grid, Fuel Supply, Roads, Bridges, and Culverts, Historic Resources and Public Transportation.
Natural Systems	Coastal Wetlands, Beaches and Barriers, Forests, and Water Resources.
Community Resilience Structures	Public Housing, Municipal Buildings, Schools, and Food Markets.
Emergency Preparedness Structures	Evacuation routes, emergency shelters, and Emergency Services.

Asset Assessed

Data Sources

6 Data Sources

Asset geospatial data was gathered from local Rhode Island data sources or was clipped from national data sources. The selected data was reviewed by project stakeholders throughout this task. For a list matching the asset types to data sources, see Appendix B: Asset Buffer Approach.

Rhode Island Data Sources:

- RI Department of Transportation (RIDOT) Stormwater Program
- RI Department of Emergency Management Agency (RIEMA)
- Rhode Island Geographic Information System (RIGIS)
- University of Rhode Island Environmental Data Center (URI EDC)

National Data Sources:

- Esri
- The United States Wind Turbine Database (USGS)

Assets Assessed

Buffer Approach

The geospatial data consisted of lines, points, and polygons. Most polygons did not need a buffer. However, for line, point, and larger polygon data, buffers were applied to determine the appropriate assessment area. Buffer creation followed one of the following approaches:

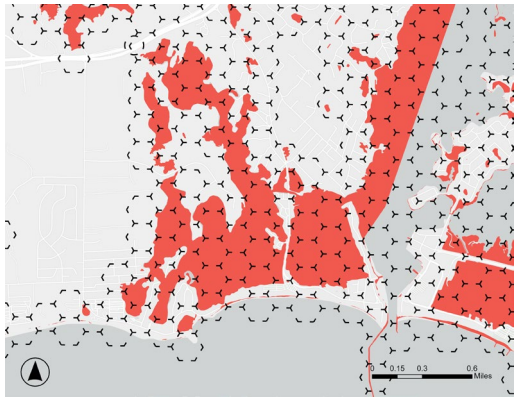
- **Single Parameter:** If the sizes of the asset were relatively consistent across the State, a single buffer was assigned based on the average asset size.
- **Custom Buffer:** When asset sizes varied significantly, especially with larger outliers, individual research was conducted to assign custom buffer sizes. Assets of similar size were then grouped and assigned a single buffer parameter.
- **Data-Driven Buffer:** When asset size indicators were present in the data source, buffer sizes were scaled in proportion to those values.
- **Grid-Based:** For assets that spanned most of the state, typically natural systems, a hexagonal grid was used to segment the asset for more manageable analysis.

See Appendix B: Asset Buffer Approach for a complete list of the buffer methodologies.

Example Single Parameter Buffer
Bus Route

Example Custom Buffer
Wastewater Treatment Facilities

Example Data-Driven Buffer
Hospital: Based on Number of Beds



Example Grid-Based Buffer
Coastal Wetlands

Buffer **Asset**

Asset-Hazard Pairs: Identification

To determine which combinations of asset type and hazard pairs to take forward into the vulnerability assessment, an initial screening was done to evaluate which asset-hazard pairs had the potential for highest consequence.

Asset-hazard pairs with the highest consequence were identified as a primary consequence. These combinations were subsequently screened against stakeholder priorities through public engagement, with community-emphasized pairs being highlighted. **All primary and community pairs were assessed in the vulnerability assessment.**

Asset		Hazard				
Asset Type	Asset Category	Coastal Flooding	Stormwater Flooding	Riverine Flooding	Extreme Heat	Extreme Wind
Critical Infrastructure and Facilities	Dams	Secondary	Primary	Community	Secondary	Secondary
	Drinking Water Systems	Primary	Primary	Primary	Community	Secondary
	Electrical Grid	Primary	Primary	Primary	Primary	Community
	Fuel Supply	Primary	Primary	Primary	Secondary	Secondary
	Ports	Community	Primary	Secondary	Secondary	Secondary
	Public Transportation	Primary	Primary	Primary	Community	Primary
	Roads, Bridges, and Culverts	Community	Community	Primary	Secondary	Secondary
	Seawalls and Tidal Gates	Primary	Secondary	Secondary	Secondary	Secondary
	Stormwater Infrastructure	Primary	Community	Secondary	Secondary	Secondary
	Wastewater Treatment Facilities	Primary	Community	Community	Secondary	Secondary
Natural Systems	Beaches and Barriers	Community	Secondary	Secondary	Secondary	Secondary
	Coastal Wetlands	Community	Secondary	Secondary	Secondary	Secondary
	Forests	Secondary	Secondary	Secondary	Primary	Community
	Water Resources	Primary	Primary	Secondary	Primary	Secondary
Community Resilience Structures	Public Housing	Community	Primary	Primary	Community	Primary
	Municipal Buildings	Primary	Primary	Primary	Primary	Primary
	Schools	Primary	Primary	Primary	Community	Primary
	Food Markets	Primary	Primary	Primary	Primary	Primary
Emergency Preparedness Structures	Emergency Services	Primary	Community	Primary	Primary	Primary
	Evacuation Routes &Emergency Shelters	Primary	Primary	Community	Primary	Primary

Primary | Community | Secondary

Asset-Hazard Pairs: Primary Consequence

A primary consequence is identified for each assessed asset-hazard pair. Three consequences were assessed:

- **Health and Wellness:** Negative human health outcomes that are not attached to physical damage of other assets but pose a direct risk to life safety of asset occupants.
- **Damage:** Physical damage experienced by an asset resulting in financial loss and/or inability to function as required.
- **Disruption:** Disruption of critical functionality resulting from hazard demand on infrastructure systems exceeding their capacity or leading to deterioration of natural systems.

The consequences were determined by previous Rhode Island studies, literature reviews, and subject matter expert judgment.

*These asset categories include multiple assets within each group, each with varying consequences. For the purposes of this summary table, a single representative primary consequence has been assigned per category. For detailed, asset-specific consequences, please refer to Appendix C: Asset Risk Assessment Results.

Health / Wellness | Damage | Disruption | Not Assessed

Asset		Hazard				
Asset Type	Asset Category	Coastal Flooding	Stormwater Flooding	Riverine Flooding	Extreme Heat	Extreme Wind
Critical Infrastructure and Facilities	Dams		Damage	Damage		
	Drinking Water Systems	Health / Wellness	Health / Wellness	Health / Wellness	Health / Wellness	
	Electrical Grid*	Damage	Damage	Damage	Disruption	Damage
	Fuel Supply	Damage	Damage	Damage		
	Ports	Disruption	Damage			
	Public Transportation*	Disruption	Disruption	Disruption	Health / Wellness	Damage
	Roads, Bridges, and Culverts	Disruption	Disruption	Disruption		
	Seawalls and Tidal Gates	Damage				
	Stormwater Infrastructure*	Damage	Damage			
	Wastewater Treatment Facilities	Damage	Damage	Damage		
Natural Systems	Beaches and Barriers	Damage				
	Coastal Wetlands	Damage				
	Forests				Damage	Damage
	Water Resources*	Disruption	Health / Wellness		Health / Wellness	
Community Resilience Structures	Public Housing	Damage	Damage	Damage	Health / Wellness	Damage
	Municipal Buildings	Damage	Damage	Damage	Health / Wellness	Damage
	Schools	Damage	Damage	Damage	Health / Wellness	Damage
	Food Markets	Damage	Damage	Damage	Health / Wellness	Damage
Emergency Preparedness Structures	Emergency Services	Damage	Damage	Damage	Health / Wellness	Damage
	Evacuation Routes and Emeregency Shelters*	Disruption	Disruption	Disruption	Damage	Health / Wellness

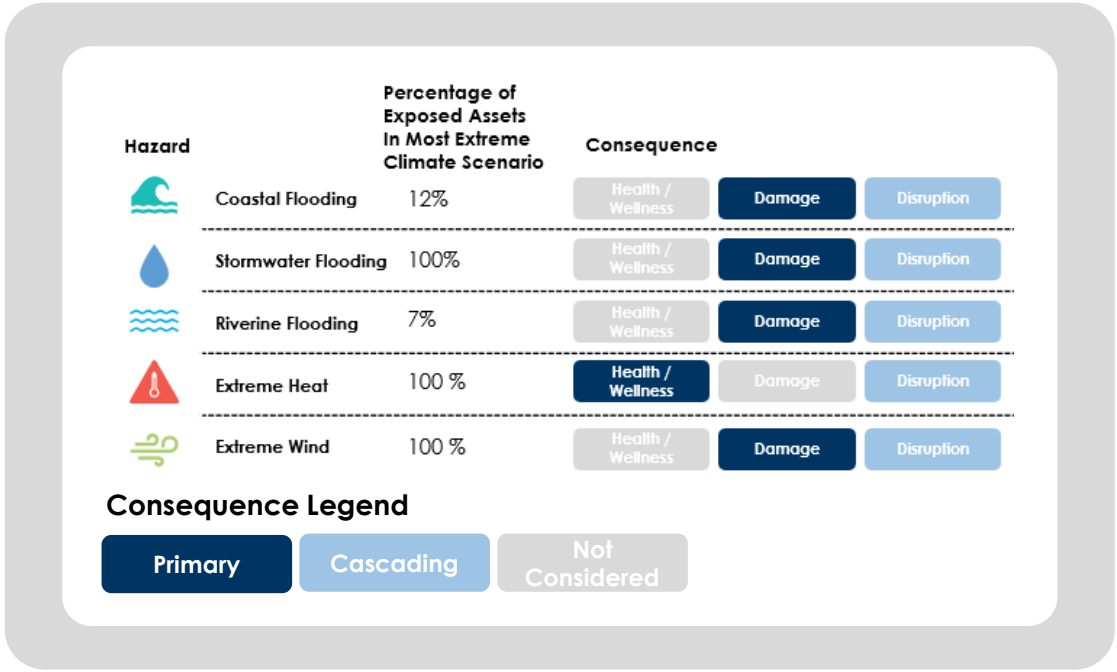
Asset-Hazard Pairs: Consequence Assignment

While each pair is evaluated based on one consequence, we acknowledge that consequences are often interconnected. For example, coastal flooding may lead to damage of infrastructure and can result in downtime of the asset.

To reflect this complexity, each asset-specific slide highlights:

- The **primary consequence** assessed for the associated hazard in dark blue.
- **Cascading consequences**, or those that may occur as secondary effects, in light blue.
- **Consequences not considered** for that asset type are marked in grey. To concentrate the assessment, only two consequences were highlighted.

Example Asset-Hazard-Consequence Summary: Public Libraries



Asset Vulnerability Determination

Asset data was then reviewed for each included asset type. This was done to determine which characteristics may make a given asset more or less vulnerable to exposed hazards.

For example, road quality may influence how well a given road handles floodwater exposure.

Each asset type has its own vulnerability logic, reflecting available data and primary metrics relevant to the consequence being evaluated. Where relevant characteristic data was not available, external data, such as an overlay of geospatial data, was used to supplement, or assets within that category were assumed to be equally vulnerable.

A full list of asset vulnerability sources and assignment logic is provided in *Appendix C. Asset Risk Assessment Results.*

Example Vulnerability Determination Using Asset Characteristic Data
Roads and Coastal Flooding

Vulnerability Rating	Vulnerability Methodology
High Rating	Poor, fair, or no information on pavement condition
Low Rating	Excellent or good pavement condition

Data Sources: Rhode Island Department of Transportation Resilience Improvement Plan (RIDOT), 2024.

Example Vulnerability Determination Using External Geospatial Data
Forests and Extreme Heat

Vulnerability Rating	Vulnerability Methodology
High Rating	More than 25% of forest block has low terrestrial resilience
Low Rating	Other

Data Sources: The Nature Conservancy (TNC) Resilient Land Mapping Tool

3. Risk Assessment Methodology

Risk Rating Methods

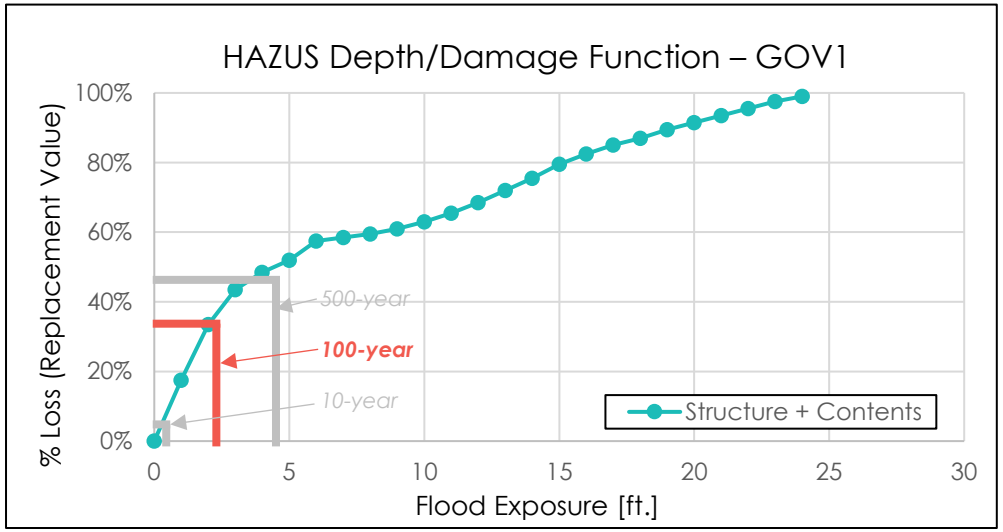
Once asset-hazard exposure and vulnerability data is determined, risk ratings are produced via one of two methods:

Fragility Curve: quantitative evaluation of consequence based on hazard exposure. This method leverages flood and wind fragility curves produced by Hazus for building assets to determine direct estimates of consequence level based on coastal flood depths and extreme wind speeds.

Risk Matrix: combination of hazard rating and vulnerability rating via a matrix to produce a resultant risk rating. This method utilizes determined vulnerability characteristics with qualitative hazard exposure ratings to determine a representative risk rating.

A full list of rating method per asset – hazard pair is provided in *Appendix C: Asset Risk Assessment Results.*

Example Fragility Curve – Coastal Flooding and Public Libraries



Example Risk Matrix

Risk Matrix		Hazard			
		None	Low	**Medium**	High
Vuln.	Low	Negligible	Low	Medium	High
	High	Negligible	Medium	**High**	Very High

Example Risk Assessment Process – Fragility Curve

Public Library – Coastal Flooding

Example Assessment

A library asset was determined to have the following coastal flood exposure in the Current climate scenario:

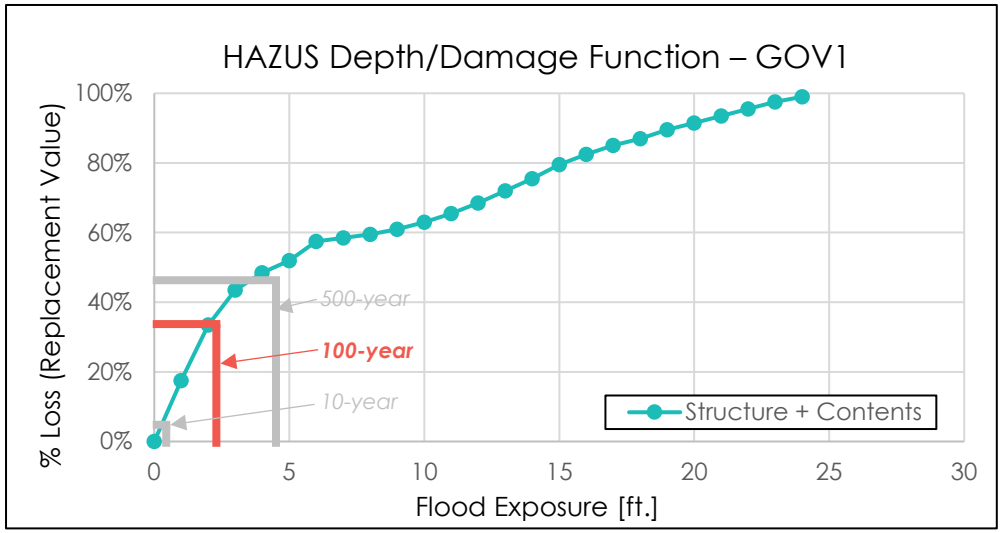
Hazard Exposure – Coastal – Current

Evaluation	Nor'Easter (10-year)	Hurricane (100-year)	Major Event (500-year)
Depth [ft]	0.3'	2.2'	4.3'
Damage [%]	5%	36%	50%

The flood depth resulting from the 100-year storm event is evaluated against a fragility curve for library assets. This evaluation shows that the 100-year event produces damage greater than 30% of the total replacement cost – resulting in a **High** risk rating for the Current climate scenario.

This exercise is repeated for each climate scenario and time horizon assessed.

Hazus Depth/Damage Function – Average Government Services (GOV1)



Coastal Flood Risk – Assessment Logic

Coastal Risk Rating	Description
None	No flood exposure in any return period event
Low	100-year event leads to <10% damage
Medium	100-year event leads to between 10 - 30% damage
High	100-year event leads to greater than 30% damage

Example Risk Assessment Process – Risk Matrix

Forest Block – Extreme Heat

Example Assessment

A forest block asset was determined to have a Medium extreme heat hazard rating in 2050 based on its county's extreme heat hazard exposure.

Hazard Exposure – Extreme Heat – 2050 SSP5-8.5

Evaluation	Hot Days (> 90 F)	Hot Days (> 95 F)
Annual Total	10.1	1.2
Rating	Medium	n/a

The forest block was evaluated as having more than 25% of its area comprised of low terrestrial resilience, resulting in a High vulnerability rating.

High vulnerability and Medium hazard result in a High risk rating for this forest block in 2050.

This exercise is repeated for each climate scenario and time horizon assessed.

Example Risk Matrix Application

Risk Matrix		Hazard			
		None	Low	**Medium**	High
Vuln.	Low	Negligible	Low	Medium	High
	High	Negligible	Medium	**High**	Very High

Risk Assessment Output

The output of conducting the assessment for each asset against its asset-hazard pairs is a risk rating for each hazard under each climate scenario.

Assets will then be designated as "High Risk" or not based on their risk ratings under emissions scenario SSP5-8.5* at each time horizon.

The example asset shown to the right would be a "High Risk" asset in 2050 and 2100.

A summary of asset type results by hazard is provided in *Appendix C: Asset Risk Assessment Results.*

* For Coastal, the High Sea Level Rise scenario is used

Example Risk Assessment Output – Individual Asset

Hazard	Current	2035		2050		2100	
		SSP2-4.5	SSP5-8.5	SSP2-4.5	SSP5-8.5	SSP2-4.5	SSP5-8.5
Coastal	Low	Low	Low	Medium	High	High	High
Riverine	Medium	*Not assessed - Current taken as representative*					
Stormwater	Low	Low	Low	Low	Low	Low	Low
Extreme Heat	Medium	Medium	Medium	Medium	High	High	High
Extreme Wind	Low	Low	Low	Medium	Medium	High	High

Risk Assessment Output

A scoring system was developed to combine risks across hazards for an asset. An asset's score is based on its risk level across each included hazard, considering the severity and immediacy of the risk level.

This was not how assets were prioritized to inform the Chapter 5: Climate Adaptation & Resilience Solutions but provides an initial sense of which asset types are exposed to high risk from multiple hazards.

A score is produced based on the table below for each hazard, and then the hazard scores are averaged to produce the total asset score. For each asset type, assets scoring the highest are designated as the highest risk.

Example Risk Assessment Output – Individual Asset

Hazard	Current	2035		2050		2100	
		SSP2-4.5	SSP5-8.5	SSP2-4.5	SSP5-8.5	SSP2-4.5	SSP5-8.5
Coastal	Low	Low	Low	Medium	High	High	High
Riverine	Medium	*Not assessed - Current taken as representative*					
Stormwater	Low	Low	Low	Low	Low	Low	Low
Extreme Heat	Medium	Medium	Medium	Medium	High	High	High
Extreme Wind	Low	Low	Low	Medium	Medium	High	High

Asset Scoring Rubric

Score	Qualifying Risk
4	High or Very High in the Current scenario
3	High or Very High by 2050
2	High or Very High by 2100
1	Non-negligible
0	Negligible across all scenarios

Example Evaluation

Hazard	Score
Coastal	3
Riverine	1
Stormwater	1
Extreme Heat	3
Extreme Wind	2

$$\frac{3 + 1 + 1 + 3 + 2 = 10}{5 \text{ hazards}} = 2$$

4. Summary Outputs

Summary Results

Overview

This section provides a high-level summary of the risk assessment results for each asset group.

1. **Critical Infrastructure and Facilities**
2. **Natural Systems**
3. **Community Resilience Structures**
4. **Emergency Preparedness Structures**

Each asset group section includes an overview of the types and number of assets. This asset count corresponds to the number of geospatial data buffers generated, which were created based on geospatial points, lines, and polygons. For details on the buffer creation methodology and data sources, refer to *Appendix B: Asset Buffer Approach*.

Each asset group section presents summary tables showing the number of High and Very-High risk assets across individual climate scenarios, as well as a consolidated summary across all scenarios. These highlighted at-risk assets are intended to illustrate the distribution of at-risk assets across asset types. *Climate Resilience Solutions* builds from the asset-level results summarized in this report.

Each asset group section also has coastal flooding maps and riverine flooding risk maps, if assessed, showing a geographic representation of risk across the State. Maps for stormwater flooding, extreme heat, and extreme wind are not included, as the climate data was at the county level rather than the asset level. As a result, maps were not created because they do not effectively illustrate the distribution of asset-level across the State.

For detailed asset-level results and methodologies, refer to *Appendix C: Asset Risk Assessment Results.*

Key Takeaways by Asset Type

All key takeaways reflect the most extreme assessed scenario, which is SSP5-8.5 in 2100 for coastal flooding, stormwater flooding, extreme heat, and extreme wind, and present day for riverine flooding.

Critical Infrastructure and Facilities

Flood hazards pose the greatest risk to Critical Infrastructure and Facilities

Over **7,300** high or very high-risk assets (not including roads)

- 100% of assets at high or very high risk to stormwater flooding
- 12% of assets at high or very high risk to coastal flooding
- 1 in 10 (10%) assets at high or very high risk to riverine flooding

Natural Systems

Heat, stormwater flooding, and coastal flooding pose the greatest risk to Natural Systems

Over **1,250** high or very high-risk assets

- 100% of assets at high or very high risk to stormwater flooding
- 100% of assets at high or very high risk to extreme heat
- 57% of assets at high or very high risk to coastal flooding

Community Resilience Structures

Stormwater flooding and heat pose the greatest risk to Community Resilience Structures

Over **1,200** high or very high-risk assets

- 100% of assets at high or very high risk to stormwater flooding
- 100% of assets at high or very high risk to extreme heat
- 41% of assets at high or very high risk to extreme wind

Emergency Preparedness Structures

Stormwater flooding and heat pose the greatest risk to Emergency Preparedness Structures

Over **230** high or very high-risk assets (not including evac routes)

- 100% of assets at high or very high risk to extreme heat and stormwater flooding (not counting evacuation routes)
- 17% of assets at high or very high risk to coastal flooding and 15% of assets to riverine flooding

Results – Critical Infrastructure and Facilities

Critical Infrastructure and Facilities

10 Asset Types

Asset type refers to the assets we are analysing as outlined in *Resilient Rhody 2018*.

21 Assets

Assets refer to the specific dataset that was used for each asset type. Many asset types have multiple assets.

Asset Type	Assets	Number of Assets
Dams	Dams	668
Drinking Water Systems	Public Water Supply Reservoirs	49
	Community Wellhead Protection Areas	62
Electric Grid	Electrical Transmission Lines	1,770 half-mile segments
	Power Plants (fossil fuel)	15
	Wind Turbines	30
	Solar Systems (and farms)	173
Fuel Supply	Underground Storage Tanks	317
Ports	Ports and Commercial Areas	1,568
Public Transportation	RIPTA Bus Stops	3,588
	RIPTA Bus Routes	5,079 half-mile segments
	MBTA Commuter Rail Stations	4
	MBTA Commuter Rail Line	51
Roads, Bridges, and Culverts	Roads	84,669 half-mile segments
	Bridges	1,179
Seawalls and Tidal Gates	Hardened Shorelines in Narragansett Bay	1,098
Stormwater Infrastructure	Sewer Overflows	93
	Sewered Areas	21
	Stormwater Treatment Units (STU)	2,476
	Stormwater Control Plan (SCP) Watersheds	297
Wastewater Treatment Facilities	Wastewater Treatment Facilities	19

Results

The number of Very-High and High-Risk assets in each asset category are listed for each climate hazard.

Results reflect the most severe climate scenario assessed for the relevant hazard.

Asset-hazard pairs not assessed are noted with a dash.

Number of Very-High and High-Risk assets under the most extreme scenario relevant to that hazard.

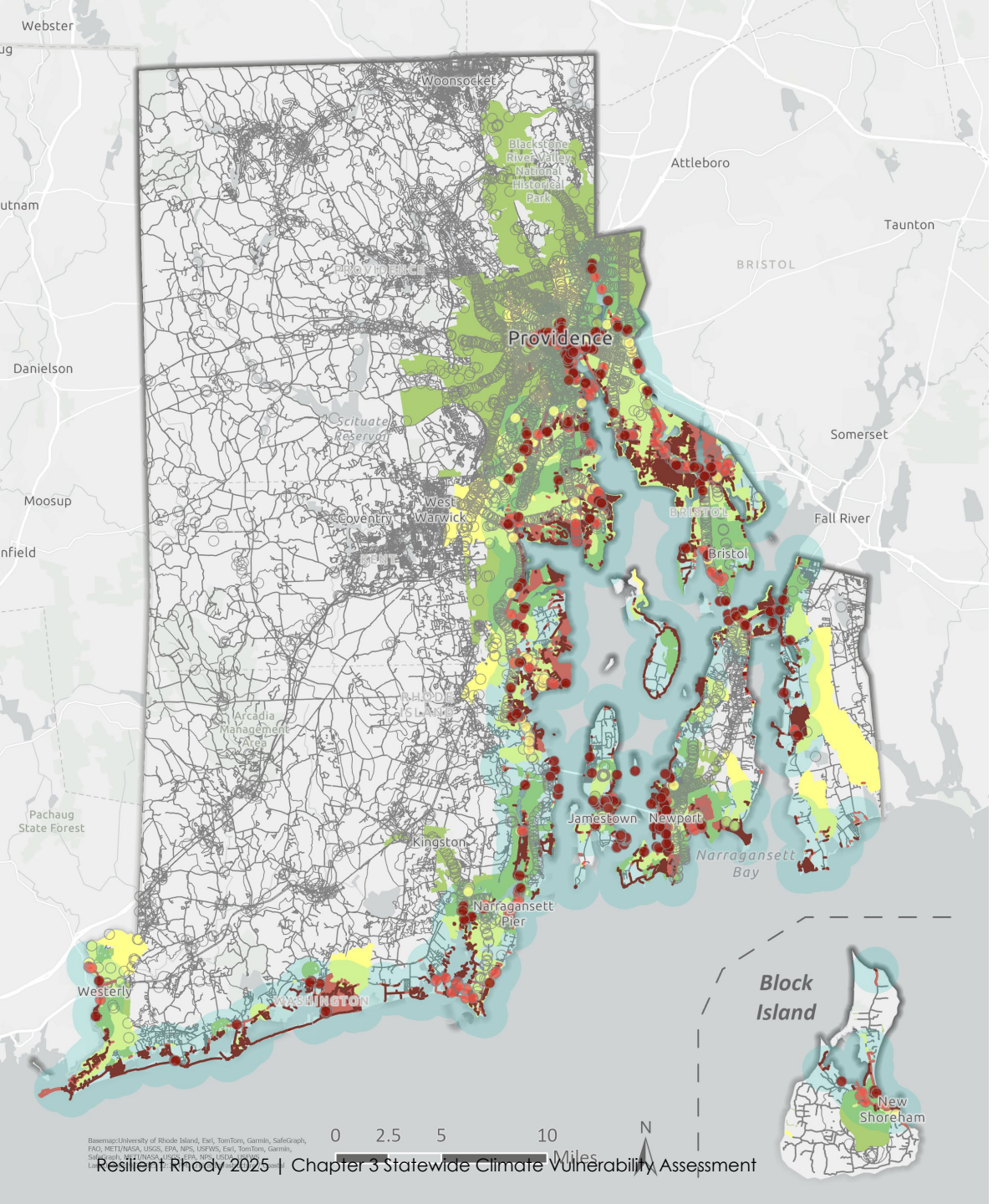
Asset Type	Assets	Number of Assets	Coastal Flooding	Stormwater Flooding	Riverine Flooding	Extreme Heat	Extreme Wind
Dams	Dams	668	-	**668**/668	**391**/668	-	-
Drinking Water Systems	Public Water Supply Reservoirs	49	**4**/49	**49**/49	**29**/49	**49**/49	-
	Community Wellhead Protection Areas	62	**0**/62	**62**/62	**46**/62	**62**/62	-
Electric Grid	Electrical Transmission Lines	1,770 ½ mile segments	-	-	-	-	**1770**/1770
	Power Plants (fossil fuel)	15	**2**/15	**15**/15	**3**/15	**15**/15	**0**/15
	Wind Turbines	30	**6**/30	**30**/30	**2**/30	-	**0**/30
	Solar Systems (and farms)	173	**3**/173	**173**/173	**4**/173	-	**0**/173
Fuel Supply	Underground Storage Tanks	317	**29**/317	**317**/317	**39**/317	-	-
Ports	Ports and Commercial Areas	1,568	**813**/1568	**1567**/1568	-	**0**/1568	-
Public Transportation	RIPTA Bus Stops	3,588	**230**/3588	**3588**/3588	**127**/3588	**3588**/3588	-
	RIPTA Bus Routes	5,079 ½ mile segments	**642**/5079	**5079**/5079	**636**/5079	-	-
	MBTA Commuter Rail Stations	4	**1**/4	**4**/4	**2**/4	**4**/4	**0**/4
	MBTA Commuter Rail Line	51	**10**/51	**51**/51	**26**/51	-	-
Roads, Bridges, and Culverts	Roads	84,669 ½ mile segments	**9476**/84669	**84699**/84669	**8065**/84669	-	
	Bridges	1,179	**368**/1179	**1179**/1179	**578**/1179	-	-
Seawalls and Tidal Gates	Hardened Shorelines in Narragansett Bay	1,098	**70**/1098	-	-	-	-
Stormwater Infrastructure	Sewer Overflows	93	**36**/93	**93**/93	-	-	-
	Sewered Areas	21	**0**/21	**21**/21	-	-	-
	Stormwater Treatment Units (STU)	2,476	**314**/2476	**2476**/2476	-	-	-
	Stormwater Control Plan (SCP) Watershed	297	**24**/297	**297**/297	-	-	-
Wastewater Treatment Facilities	Wastewater Treatment Facilities	19	**13**/19	**19**/19	**5**/19	-	-

Note: Results are taken for the most extreme scenario, which is SSP5-8.5 in 2100 for coastal flooding, stormwater flooding, extreme heat, and extreme wind, and present day for riverine flooding.

Results – Summary Outputs

The risk outputs from all assessed climate scenarios were summarized by counting the number of highest-scoring assets in each asset type. This number illustrates the distribution of high-risk assets across each asset type. Assets containing a single high-scoring asset are highlighted in blue.

Asset Type	Assets	Number of Assets	Number of Highest Scoring Assets
Dams	Dams	668	**215**/668
Drinking Water Systems	Public Water Supply Reservoirs	49	**1 – Gardiner Pond**
	Community Wellhead Protection Areas	62	**2**/62
Electric Grid	Electrical Transmission Lines	1,770 half-mile segments	**376**/1,770 half-mile segments
	Power Plants (fossil fuel)	15	**4**/15
	Wind Turbines	30	**1 – Green Providence Wind II**
	Solar Systems (and farms)	173	**1 – Smithfield, Rhode Island**
Fuel Supply	Underground Storage Tanks	317	**122**/317
Ports	Ports and Commercial Areas	1,568	**167**/1,568
Public Transportation	RIPTA Bus Stops	3,588	**2**/2,588
	RIPTA Bus Routes	5,079 half-mile segments	**42**/5,079 half-mile segments
	MBTA Commuter Rail Stations	4	**1 – Wickford Junction**
	MBTA Commuter Rail Line	51	**7**/51
Roads, Bridges, and Culverts	Roads	84,669 half-mile segments	**172**/84,669 half-mile segments
	Bridges	1,179	**32**/1,179
Seawalls and Tidal Gates	Hardened Shorelines in Narragansett Bay	1,098	**70**/1,098
Stormwater Infrastructure	Sewer Overflows	93	**11**/93
	Sewered Areas	21	**5**/21
	Stormwater Treatment Units (STU)	2,476	**32**/2,476
	Stormwater Control Plan (SCP) Watershed	297	**6**/297
Wastewater Treatment Facilities	Wastewater Treatment Facilities	19	**1 - Warwick**



Coastal Flooding

Coastal Flooding Risk for Critical Infrastructure and Facilities

The adjacent map demonstrates clusters of high and very high risk ratings across assessed Critical Infrastructure and Facilities. These concentrated areas of coastal flooding risk are highlighted.

Critical Infrastructure and Facilities

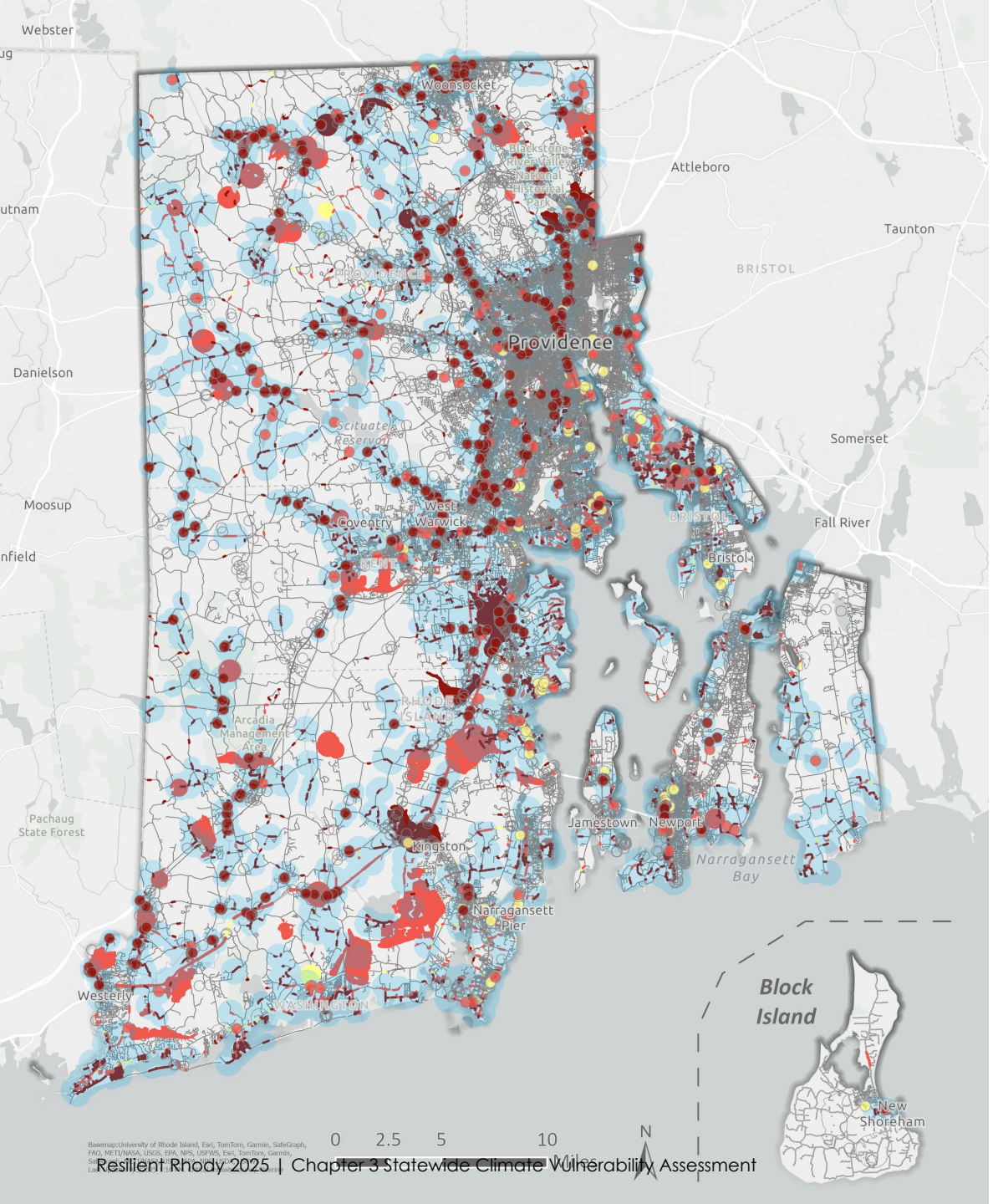
Asset	Risk Results (High or Very High Rating, 2100, High SLR*)
Drinking Water Systems	**4** / 111 **drinking water systems**
Electric Grid	**11** / 218 **electric grid assets**
Fuel Supply	**29** / 317 **underground storage tanks**
Ports	**813** / 1568 **ports**
Public Transportation	**883** / 8722 **public transportation assets**
Roads, Bridges, and Culverts	**9844** / 85848 **roads and bridges**
Seawalls and Tidal Gates	**70** / 1098 **hardened shorelines**
Stormwater Infrastructure	**374** / 2887 **stormwater infrastructure**
Wastewater Treatment Facilities	**13** / 19 **wastewater treatment facilities**

Coastal Risk Rating

Hotspot

- **Low Rating**
- **Medium Rating**
- **High Rating**
- **Very High Rating**

*University of Rhode Island's (URI) Coastal STORMTOOLS data was used to map coastal flooding through the State. For more detail on the various coastal flooding scenarios assessed for each asset, refer to *Appendix C: Asset Risk Assessment Results*. Additionally, the climate risk geospatial data will be made publicly available on the Rhode Island Geographic Information System (RIGIS) website.



Riverine Flooding

Riverine Flooding Risk for Critical Infrastructure and Facilities

The adjacent map demonstrates clusters of high and very high risk ratings across assessed Critical Infrastructure and Facilities. These concentrated areas of riverine risk are highlighted.

Critical Infrastructure and Facilities

Asset	Risk Results (High or Very High Rating, Present*)
Dams	**391** / 669 **dams**
Drinking Water Systems	**75** / 111 **drinking water systems**
Electric Grid	**9** / 218 **electric grid assets**
Fuel Supply	**39** / 317 **underground storage tanks**
Public Transportation	**791** / 8722 **public transportation assets**
Roads, Bridges, and Culverts	**8643** / 85848 **roads and bridges**
Wastewater Treatment Facilities	**5** / 19 **wastewater treatment facilities**

Riverine Risk Rating

Hotspot

- **Low Rating**
- **Medium Rating**
- **High Rating**
- **Very High Rating**

*FEMA FIRM data was used to map riverine flooding throughout the State. For more detail on the various riverine flooding scenarios assessed for each asset, refer to *Appendix C: Asset Risk Assessment Results*. Additionally, the climate risk geospatial data will be made publicly available on the Rhode Island Geographic Information System (RIGIS) website.

Results – Natural Systems

Assets Assessed

Natural Systems

4 **Asset Types**

Asset type refers to the assets we are analysing as outlined in *Resilient Rhody 2018*.

7 **Assets**

Assets refer to the specific dataset that was used for each asset type. Many asset types have multiple assets.

Asset Type	Assets	Number of Assets
Beaches and Barriers	Coastal Barriers	134
Coastal Wetlands	Coastal Wetlands	9,966
Forests	Forest Blocks	353
	Conservation Lands	1,032
Water Resources	Rivers and Streams	1,972
	Streams	6,816
	Lakes and Ponds	3,160

Results

The number of Very-High and High-Risk assets in each asset category are listed for each climate hazard. Results come from the most severe climate scenario. Scenarios not assessed are noted with a dash.

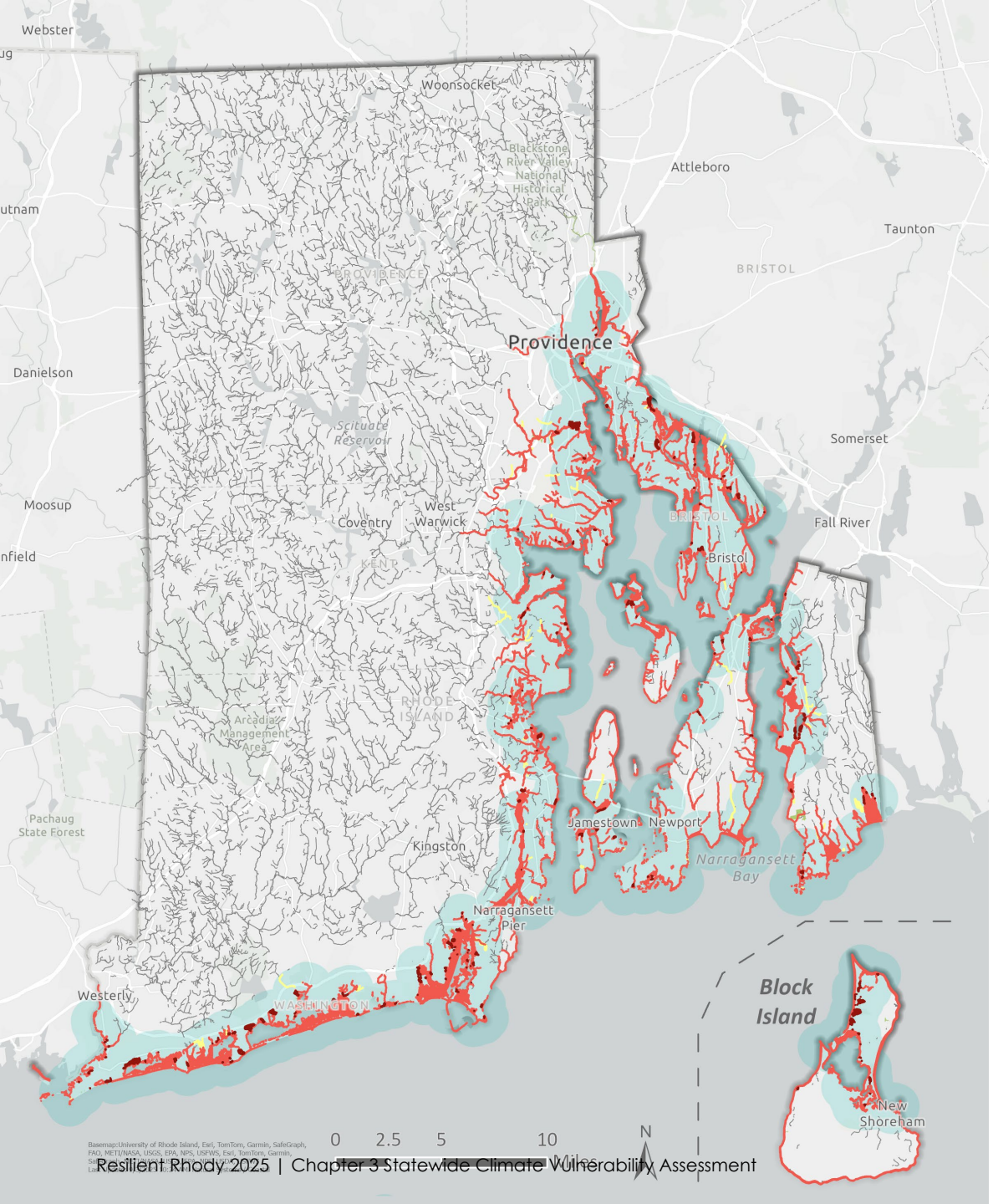
Number of Very-High and High-Risk Assets under the most Extreme Climate Scenario

Asset Type	Assets	Number of Assets	Coastal Flooding	Stormwater FLooding	Riverine Flooding	Extreme Heat	Extreme Wind
Beaches and Barriers	Coastal Barriers	134	**37**/134	-	-	-	-
Coastal Wetlands	Coastal Wetlands	9,966	**9821**/ 9966	-	-	-	-
Forests	Forest Blocks	353	-	-	-	**353**/353	**81**/353
	Conservation Lands	1,032	-	-	-	**1032**/ 1032	**412**/1032
Water Resources	Rivers and Streams	1,972	**275**/ 1972	**1971**/ 1972	-	**1971**/ 1972	-
	Streams	6,816	**629**/ 6816	-	-	**6815**/ 6816	-
	Lakes and Ponds	3,160	-	**3160**/3160	-	**3160**/ 3160	-

Results – Summary Outputs

The risk outputs from all assessed climate scenarios were summarized by counting the number of highest-scoring assets in each asset type. This number illustrates the distribution of high-risk assets across each asset type.

Asset Type	Assets	Number of Assets	Highest Scoring Assets
Beaches and Barriers	Coastal Barriers	134	**37**/134
Coastal Wetlands	Coastal Wetlands	9,966	**60**/9,966
Forests	Forest Blocks	353	**28**/353
	Conservation Lands	1,032	**217**/1,032
Water Resources	Rivers and Streams	1,972	**120**/1,972
	Streams	6,816	**228**/6,816
	Lakes and Ponds	3,160	**123**/3,160



Coastal Flooding

Coastal Flooding Risk for Natural Systems

The adjacent map demonstrates clusters of high and very high risk ratings across assessed Natural Systems. These concentrated areas of coastal flooding risk are highlighted.

Natural Systems

Asset	Risk Results (High or Very High Rating, 2100, High SLR*)
Beaches and Barriers	**37**/134 **beaches and barriers**
Coastal Wetlands	**9,821**/9,966 **coastal wetlands**
Water Resources	**904**/8,788 **rivers, streams, lakes and ponds.**

Coastal Risk Rating

Hotspot

- **Low Rating**
- **Medium Rating**
- **High Rating**
- **Very High Rating**

*University of Rhode Island's (URI) Coastal STORMTOOLS data was used to map coastal flooding through the State. For more detail on the various coastal flooding scenarios assessed for each asset, refer to *Appendix C: Asset Risk Assessment Results*. Additionally, the climate risk geospatial data will be made publicly available on the Rhode Island Geographic Information System (RIGIS) website.

Results – Community Resilience Structures

Assets Assessed

Community Resilience Structures

4 Asset Types

Asset type refers to the assets we are analysing as outlined in *Resilient Rhody 2018*.

6 Assets

Assets refer to the specific dataset that was used for each asset type. Many asset types have multiple assets.

Asset Type	Assets	Number of Assets
Housing	Public Housing	799
Municipal Buildings	City and Town Halls	39
	Public Libraries	71
Schools	K-12 Schools	552
	Colleges and Universities	16
Food Markets	Food Markets	470

Results

The number of Very-High and High-Risk assets in each asset category are listed for each climate hazard. Results come from the most severe climate scenario. Scenarios not assessed are noted with a dash.

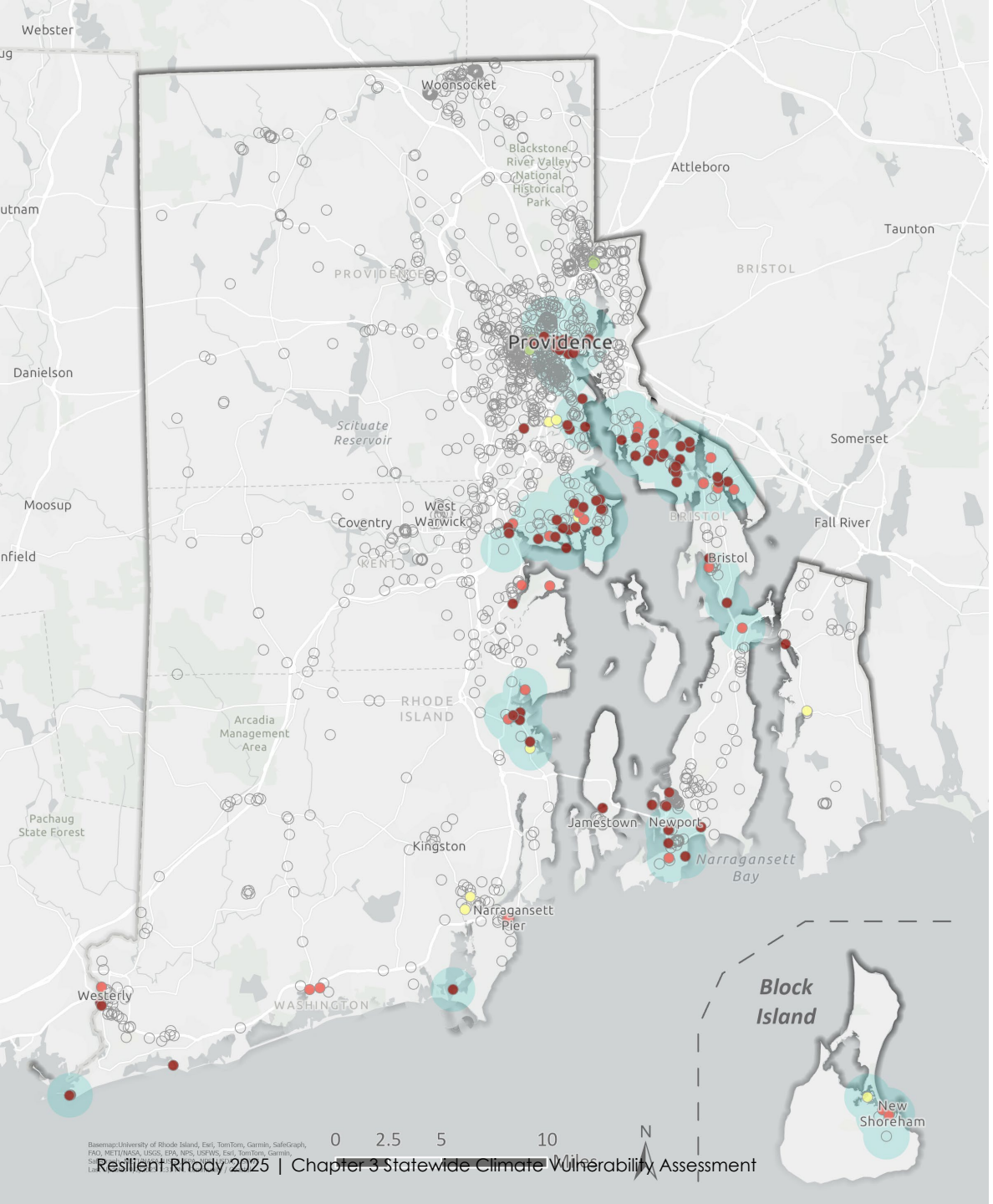
Number of Very-High and High-Risk Assets under the most Extreme Climate Scenario

Asset Type	Assets	Number of Assets	Coastal Flooding	Stormwater Flooding	Riverine Flooding	Extreme Heat	Extreme Wind
Public Housing	Public Housing	799	**26**/799	**799**/799	**21**/799	**799**/799	**799**/799
Municipal Buildings	City and Town Halls	39	**3**/39	**39**/39	**2**/39	**39**/39	**0**/39
	Public Libraries	71	**6**/71	**71**/71	**3**/71	**71**/71	**0**/71
Schools	K-12 Schools	552	**46**/552	**552**/552	**59**/552	**552**/552	**0**/552
	Colleges and Universities	16	**8**/16	**16**/16	**2**/16	**16**/16	**0**/16
Food Markets	Food Markets	470	**41**/470	**470**/470	**41**/470	**470**/470	**0**/470

Results – Summary Outputs

The risk outputs from all assessed climate scenarios were summarized by counting the number of highest-scoring assets in each asset type. This number illustrates the distribution of high-risk assets across each asset type. Assets containing a single high-scoring asset are highlighted in blue.

Asset Type	Assets	Number of Assets	Highest Scoring Assets
Housing	Public Housing	799	**3**/799
Municipal Buildings	City and Town Halls	39	**1 – North Kingstown Town Hall**
	Public Libraries	71	**1 – Maury Loontjens Memorial Library**
Schools	K-12 Schools	552	**13**/552
	Colleges and Universities	16	**5**/16
Food Markets	Food Markets	470	**7**/470



Coastal Flooding

Coastal Flooding Risk for Community Resilience Structures

The adjacent map demonstrates clusters of high and very high risk ratings across assessed Community Resilience Structures. These concentrated areas of coastal flooding risk are highlighted.

Community Resilience Structures

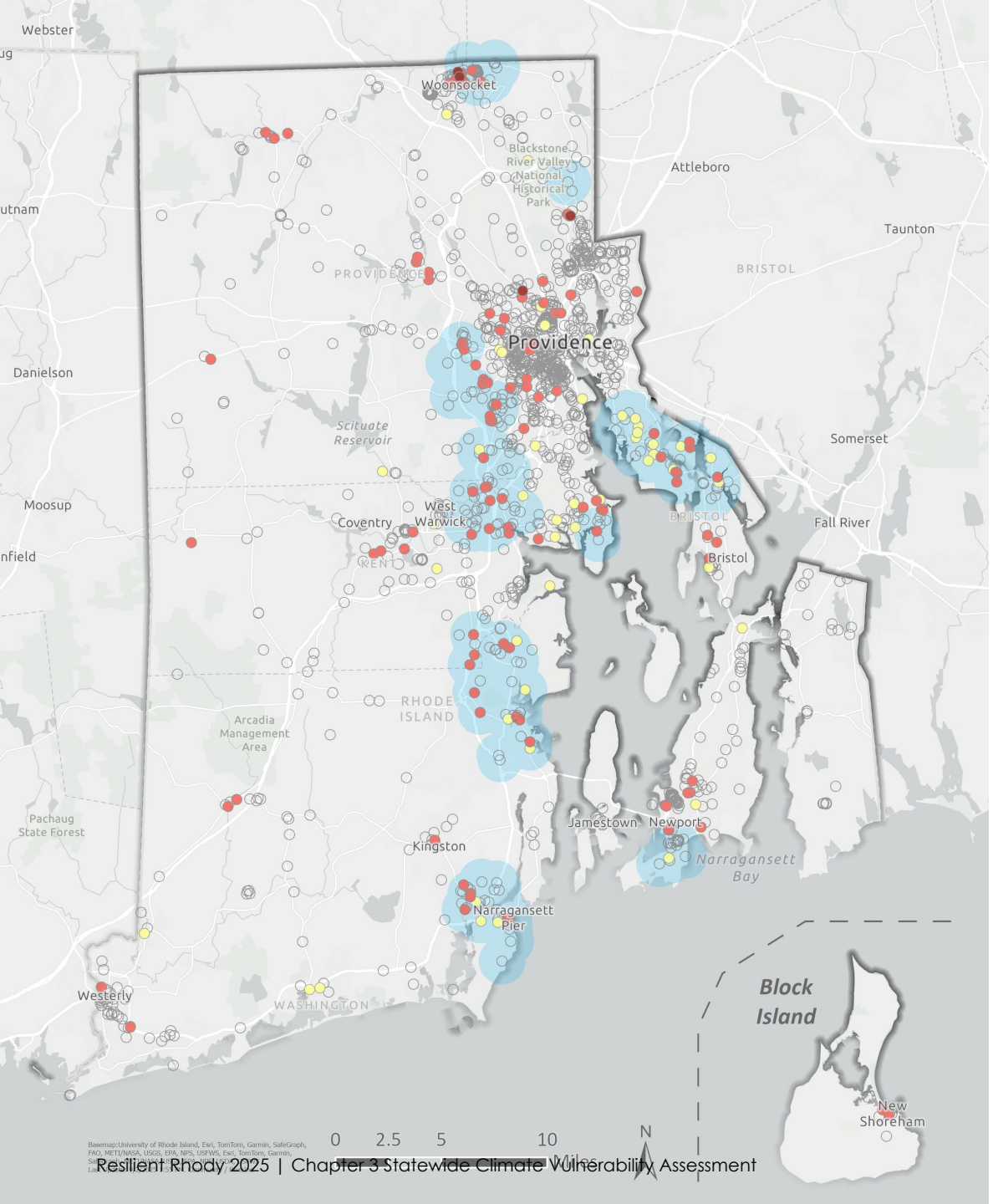
Asset Type	**Risk Results** (High or Very High Rating, 2100, High SLR*)
Public Housing	**26**/ 799 **housing assets**
Municipal Buildings (Libraries and Town Halls)	**9** / 110 **buildings**
Schools (K-12 Schools and Colleges and Universities)	**54** / 568 **schools**
Food Markets	**41**/ 470 **food markets**

Coastal Risk Rating

Hotspot

- **Low Rating**
- **Medium Rating**
- **High Rating**
- **Very High Rating**

*University of Rhode Island's (URI) Coastal STORMTOOLS data was used to map coastal flooding through the State. For more detail on the various coastal flooding scenarios assessed for each asset, refer to *Appendix C: Asset Risk Assessment Results*. Additionally, the climate risk geospatial data will be made publicly available on the Rhode Island Geographic Information System (RIGIS) website.



Riverine Flooding

Riverine Flooding Risk for Community Resilience Structures

The adjacent map demonstrates clusters of high and very high risk ratings across assessed Community Resilience Structures. These concentrated areas of riverine flooding risk are highlighted.

Community Resilience Structures

Asset Type	Risk Results (High or Very High Rating, Present*)
Public Housing	**21** / 799 **housing assets**
Municipal Buildings (Libraries and Town Halls)	**5** / 110 **buildings**
Schools (K-12 Schools and Colleges and Universities)	**61** / 568 **schools**
Food Markets	**41** / 470 **service providers**

Riverine Risk Rating

Hotspot

- **Low Rating**
- **Medium Rating**
- **High Rating**
- **Very High Rating**

*FEMA FIRM data was used to map riverine flooding throughout the State. For more detail on the various riverine flooding scenarios assessed for each asset, refer to *Appendix C: Asset Risk Assessment Results*. Additionally, the climate risk geospatial data will be made publicly available on the Rhode Island Geographic Information System (RIGIS) website.

Results – Emergency Preparedness Structures

Assets Assessed

Emergency Preparedness Structures

2 Asset Types

Asset type refers to the assets we are analysing as outlined in *Resilient Rhody 2018*.

5 Assets

Assets refer to the specific dataset that was used for each asset type. Many asset types have multiple assets.

Asset Type	Assets	Number of Assets
Emergency Services	Hospitals	17
	Fire Stations	173
	Police Facilities	68
Evacuation Routes and Emergency Shelters	Evacuation Routes	4,065 half-mile segments
	Emergency Shelters	192

Results

The number of Very-High and High-Risk assets in each asset category are listed for each climate hazard. Results come from the most severe climate scenario. Scenarios not assessed are noted with a dash.

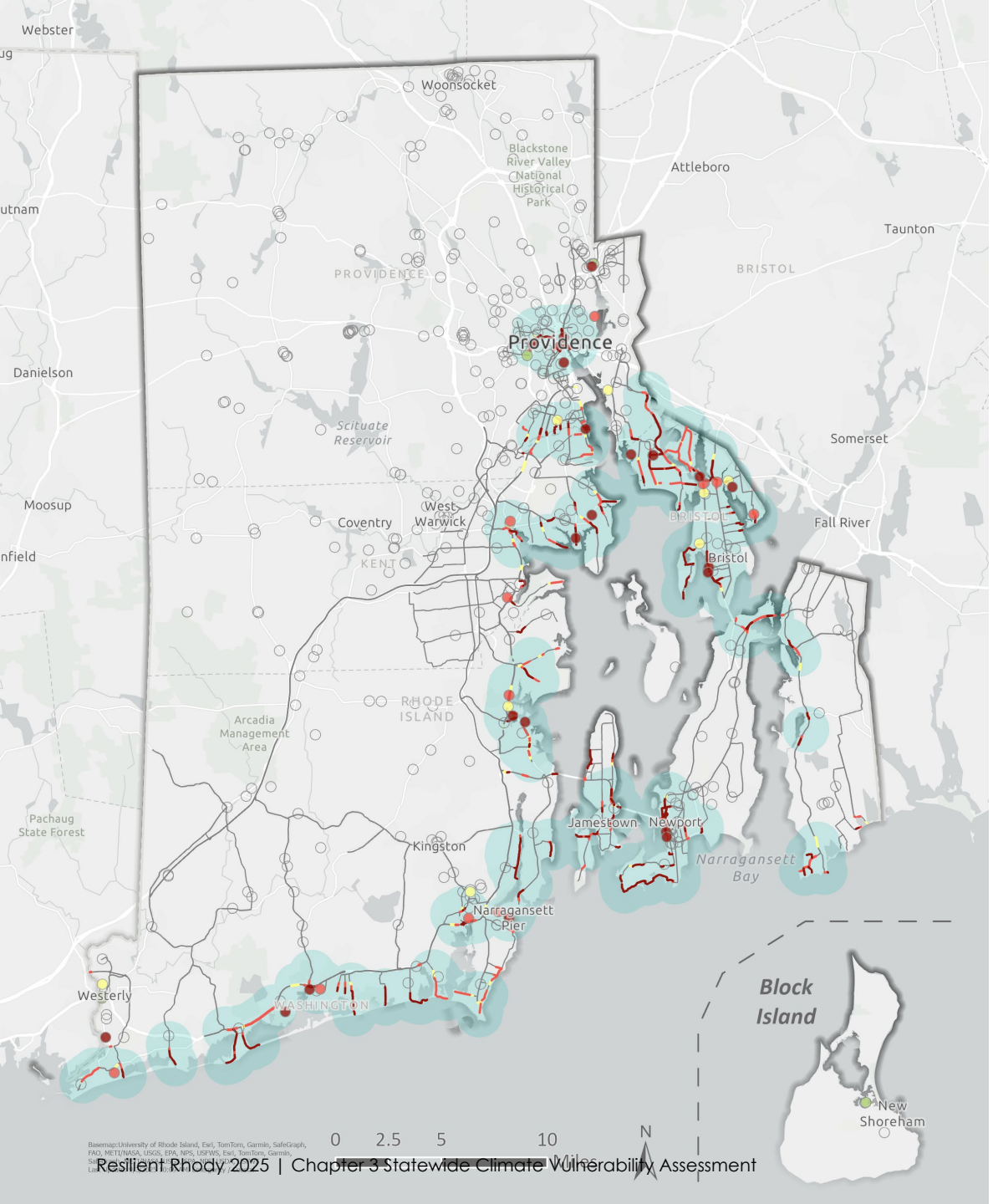
Number of Very-High and High-Risk Assets under the most Extreme Climate Scenario

Asset Type	Assets	Number of Assets	Coastal Flooding	Stormwater Flooding	Riverine Flooding	Extreme Heat	Extreme Wind
Emergency Services	Hospitals	17	**3**/17	**17**/17	**3**/17	**17**/17	**0**/17
	Fire Stations	173	**15**/173	**173**/173	**15**/173	**173**/173	**0**/173
	Police Facilities	68	**6**/68	**68**/68	**9**/68	**68**/68	**0**/68
Emergency Shelters and Routes	Evacuation Routes	4,065 half-mile segments	**728**/4065	**4065**/4065	**612**/4065	-	-
	Emergency Shelters	192	**14**/192	**192**/192	**23**/192	**192**/192	**0**/192

Results – Summary Outputs

The risk outputs from all assessed climate scenarios were summarized by counting the number of highest-scoring assets in each asset type. This number illustrates the distribution of high-risk assets across each asset type. Assets containing a single high-scoring asset are highlighted in blue.

Asset Type	Assets	Number of Assets	Highest Scoring Assets
Emergency Services	Hospitals	17	**1 – South County Health**
	Fire Stations	173	**1 – Atwells Fire Station**
	Police Facilities	68	**1 – Newport Substation**
Evacuation Routes and Emergency Shelters	Evacuation Routes	4,065 half-mile segments	**8**/4,065 half-mile segments
	Emergency Shelters	192	**1 – Hugh Cole School**



Coastal Flooding

Coastal Flooding Risk for Emergency Preparedness Structures

The adjacent map demonstrates clusters of high and very high risk ratings across assessed Emergency Preparedness Structures. These concentrated areas of coastal flooding risk are highlighted.

Emergency Preparedness Structures

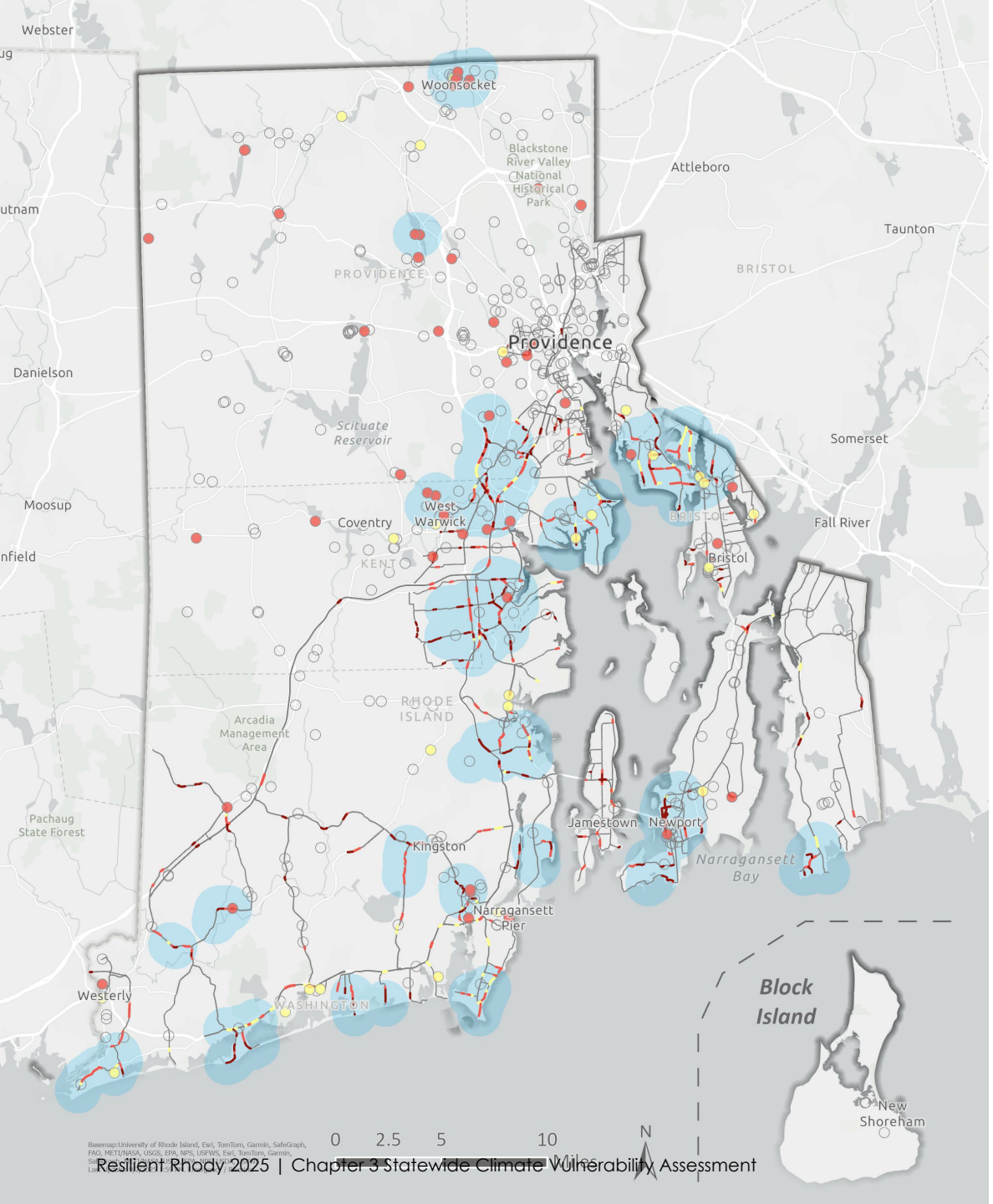
Asset	Risk Results (High or Very High Rating, 2100, High SLR*)
Hospitals	**3**/17 **hospitals**
Fire Stations	**15**/173 **fire stations**
Police Facilities	**6**/68 **police facilities**
Evacuation Routes	**18% of half-mile evacuation route segments**
Emergency Shelters	**14**/192 **emergency shelters**

Coastal Risk Rating

Hotspot

- **Low Rating**
- **Medium Rating**
- **High Rating**
- **Very High Rating**

*University of Rhode Island's (URI) Coastal STORMTOOLS data was used to map coastal flooding through the State. For more detail on the various coastal flooding scenarios assessed for each asset, refer to *Appendix C: Asset Risk Assessment Results*. Additionally, the climate risk geospatial data will be made publicly available on the Rhode Island Geographic Information System (RIGIS) website.



Riverine Flooding

Riverine Flooding Risk for Emergency Preparedness Structures

The adjacent map demonstrates clusters of high and very high risk ratings across assessed Emergency Preparedness Structures. These concentrated areas of riverine risk exposure are highlighted.

Emergency Preparedness Structures

Asset	Risk Results (High or Very High Rating, Present*)
Hospitals	**3**/17 **hospitals**
Fire Stations	**15**/173 **fire stations**
Police Facilities	**9**/68 **police facilities**
Evacuation Routes	**15% of half- mile evacuation route segments**
Emergency Shelters	**23**/192 **emergency shelters**

Riverine Risk Rating

Hotspot

- **Low Rating**
- **Medium Rating**
- **High Rating**
- **Very High Rating**

*FEMA FIRM data was used to map riverine flooding throughout the State. For more detail on the various riverine flooding scenarios assessed for each asset, refer to *Appendix C: Asset Risk Assessment Results*. Additionally, the climate risk geospatial data will be made publicly available on the Rhode Island Geographic Information System (RIGIS) website.

5. Disclaimer and Limitations

Disclaimer

This assessment is intended to provide a high-level risk screening across a wide variety of asset types and potential consequences. Not every potentially damaging natural hazard is considered, nor is every potentially damaging asset-hazard interaction considered. The analysed hazards and asset-hazard pairs were selected based on perceived relevance and in coordination with relevant stakeholders, based on engagement with RIDEM, the Resilience EC4 Subgroup, the RI Resilience Partner Group, Municipal Resilience Stakeholders, and Community Resilience Stakeholders. Every effort was made to capture the most important asset-hazard pairs.

Any recipient utilizing this content acknowledges that Rhode Island's current and future natural hazard risk exposure is dependent on many factors beyond Arup's control, including uncertainties around existing project sites and their construction details, natural hazards, and climate change. Arup emphasizes that the forward-looking projections, forecasts, or estimates are based upon interpretations or assessments of available information at the time of this assessment.

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Limitations

- Inherent uncertainties exist for all hazard data, but especially for future hazard data
- Asset data was collected during *Task 2.3: Develop State Asset Inventory*, in which a state asset inventory was developed based on publicly available datasets and supplemented by existing inventories provided by members of the Resilience EC4 Subgroup. Supplemental data requests were made in order to resolve data gaps. Where data gaps remain, the assessment is limited in its ability to differentiate low and high vulnerability assets.
- There is a lack of existing, available research quantitatively linking hazard intensity to expected consequences for many of the asset-hazard pairs included in this study. As such, vulnerability models utilizing the risk matrix framework are intended to approximate expected climate risks.
- No direct state-wide stormwater flood modelling was identified for use in the assessment. Extreme rainfall projections are therefore used as a proxy representation, though local topographical details will determine exact stormwater flood conditions.
- The climate risk assessment outputs are understood to be a high-level screening based on the scale and nature of a state-wide climate risk assessment covering 40 asset groups, assessed for five climate hazards across seven combinations of time horizon and climate change scenario. More detailed modelling of specific natural hazard events with site- and asset-specific characteristics would be necessary to model direct climate risk with more precision and fidelity.
- Many combinations of asset group and climate hazard have had detailed site-specific analysis conducted by relevant asset owners or state agencies. Where possible, this assessment takes in asset condition data and other relevant details that inform asset vulnerability, but it is understood to be inherently higher level for the purposes of comparison across asset types. Detailed assessments should be further consulted, where available, for a deeper understanding of individual assets.

Appendix A. Previous Rhode Island Reports and Data

Previous Rhode Island Reports

Critical Infrastructure and Facilities

Appendix A provides a list of previous Rhode Island reports that support the research of assets and climate across the State. In addition, to the research listed in the two tables, other State reports include

- *Resilient Rhody: An Actionable Vision for Addressing the Impacts of Climate Change in Rhode Island* – 2018
- *Resilient Rhody: Three Year Impact Report* – 2021
- *Resilient Rhody: State of Resilience Report* – 2024
- *State of Rhode Island Hazard Mitigation Plan* - February 2024

Asset Category	Rhode Island Report
Drinking Water Systems	• Water Quality 2035: Rhode Island Water Quality Management Plan, Rhode Island Department of Administration, Division of Planning, October 2016 • Safe Water RI: Ensuring Safe Water for Rhode Island's Future, July 2013 • Rhode Island Water 2030, Rhode Island Department of Administration, Division of Planning, 2012
Electrical Grid	• Resilient Microgrids for Rhode Island Critical Services, Rhode Island Office of Energy Resources, 2017 • Rhode Island State Energy Plan, Rhode Island Department of Administration, Division of Planning, 2015
Ports	• Stakeholder vulnerability and resilience strategy assessment of maritime infrastructure: Pilot project for Providence, RI, Becker et al., May 2017
Public Transportation	• RIDOT Resilience Improvement Plan, Rhode Island Department of Transportation, 2024 • Rhode Island Coordinated Public Transit Human Services Transportation Plan, Rhode Island Public Transit Authority (RIPTA), March 2023 • Vulnerability of Municipal Transportation Assets to Sea Level Rise and Storm Surge, Rhode Island Department of Administration, Division of Planning, September 2016
Roads, Bridges, and Culverts	• RIDOT Road-Stream Crossing Design Manual, Rhode Island Department of Transportation, 2022 • Transit Forward 2040: Rhode Island Transit Master Plan, Rhode Island Department of Administration, Division of Planning, December 2020 • Rhode Island Transportation Plan, Rhode Island Department of Administration, Division of Planning, 2020
Stormwater Infrastructure	• Stakeholder Vulnerability and Resilience Strategy Assessment of Maritime Infrastructure: Pilot project for Providence, RI, Becker et al., May 2017
Wastewater Treatment Facilities	• Implications of Climate Change for RI Wastewater Collection & Treatment Infrastructure, Rhode Island Department of Environmental Management, March 2017
Multiple Assets	• Report Card for Rhode Island's Infrastructure, American Society of Civil Engineers (ASCE), 2020

Previous Rhode Island Reports

Natural Systems, Climate Resilience Structures, and Emergency Preparedness Structures

Asset Category	Rhode Island Report
Coastal Wetlands	• Coastal and Estuarine Land Conservation Plan, RI Coastal Resources Management Council (CRMC) & RI Department of Environmental Management (RIDEM), 2025 &2010 • Comprehensive Conservation & Management Plan (2010, 2025), Narragansett Bay Estuary Program, 2025 &2010 • Narragansett Bay Estuary Program Science Updates, Narragansett Bay Estuary Program, 2025 & 2010
Forests	• Rhode Island 2020 Forest Action Plan, Rhode Island Department of Environmental Management, Division of Forest Environment, June 2020 • The Value of Rhode Island Forests, Rhode Island Department of Environmental Management, August 2019
Water Resources	• Non-Point Source (NPS) Management Plan, Rhode Island Department of Environmental Management, 2024 • Southeast New England Program Strategic Plan, SNEP Network, 2021 • Water Quality 2035: Rhode Island Water Quality Management Plan, Rhode Island Department of Administration, Division of Planning, October 2016 • Rhode Island Water 2030, Rhode Island Department of Administration, Division of Planning, 2012 • Rhode Island Freshwater Wetland Monitoring and Assessment Plan, Rhode Island Department of Environmental Management, 2006
Public Housing	• Coastal Property Guide, Rhode Island Coastal Resources Management Council (CRMC), 2014
Emergency Services	• Rhode Island First Responder Network Authority (FirstNet) and AT&T, Rhode Island Emergency Management Agency, 2017
Evacuation Routes & Emergency Shelters	• Rhode Island Evacuation Plan, Rhode Island Emergency Management Agency, 2013

Previous Data Sources

Federal and State

Data	Data Source
RI Coastal Resources Management Council (CRMC)	• Shoreline Change Maps, https://www.crmc.ri.gov/maps/maps_shorechange.html
National Oceanic and Atmospheric Administration (NOAA)	• Coastal Flood Exposure Mapper, https://www.coast.noaa.gov/floodexposure/#-10575352,4439107,5z • NOAA National Storm Surge Maps, https://www.nhc.noaa.gov/nationalsurge/ • NOAA Sea Level Rise Viewer, https://coast.noaa.gov/slr/#/layer/slr/6.5/-7940533.226979762/5121539.8831784185/13.000/satellite/none/0.8/2050/interHigh/noAccretion/NOS_Minor

Appendix B. Asset Buffer Approach

Assets Assessed

Buffer Approach

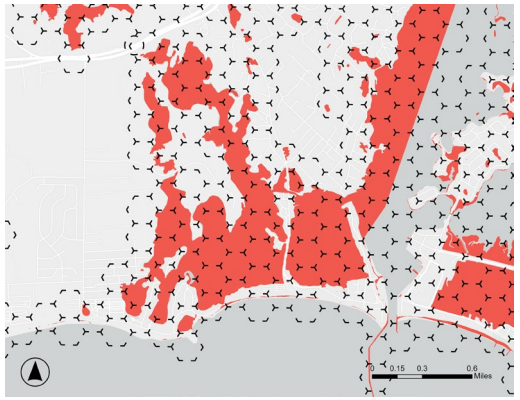
The geospatial data consisted of lines, points, and polygons. Most polygons did not need a buffer. However, for line, point, and larger polygon data, buffers were applied to determine the appropriate assessment area. Buffer creation followed one of the following approaches:

- **Single Parameter:** If the sizes of the asset were relatively consistent across the State, a single buffer was assigned based on the average asset size.
- **Custom Buffer:** When asset sizes varied significantly, especially with larger outliers, individual research was conducted to assign custom buffer sizes. Assets of similar size were then grouped and assigned a single buffer parameter.
- **Data-Driven Buffer:** When asset size indicators were present in the data source, buffer sizes were scaled in proportion to those values.
- **Grid-Based:** For assets that spanned most of the state, typically natural systems, a hexagonal grid was used to segment the asset for more manageable analysis.

Example Single Parameter Buffer
Bus Route

Example Custom Buffer
Wastewater Treatment Facilities

Example Data-Driven Buffer
Hospital: Based on Number of Beds



Example Grid-Based Buffer
Coastal Wetlands

Buffer **Asset**

Assets Assessed

Buffer Approach: Critical Infrastructure and Facilities

Asset Type	Assets	Data Source	Geometry	Buffer Methodology	Buffer Size
Dams	Dams	URI EDC and RIGIS	Point	Custom Buffer	75 to 1,700 ft
Drinking Water Systems	Public Water Supply Reservoirs	URI EDC and RIGIS	Polygon	-	-
	Community Wellhead Protection Areas	URI EDC and RIGIS	Polygon	-	-
Electric Grid	Electrical Transmission Lines	URI EDC and RIGIS	Line	Single parameter	150 ft
	Power Plants (fossil fuel)	Esri	Point	Data-driven Buffer	Based on Capacity
	Wind Turbines	USGS	Point	Data-driven Buffer	Based on Capacity
	Solar Systems (and farms)	URI EDC and RIGIS	Polygon	-	-
Fuel Supply	Underground Storage Tanks	URI EDC and RIGIS	Point	Data-driven Buffer	Based on Tank Size
Ports	Ports and Commercial Areas	URI EDC and RIGIS	Polygon	-	-
Public Transportation	RIPTA Bus Stops	URI EDC and RIGIS	Point	Single parameter	30 ft
	RIPTA Bus Routes	URI EDC and RIGIS	Line	Single parameter	60 ft
	MBTA Commuter Rail Stations	Mass GIS	Line	Single parameter	150 ft
	MBTA Commuter Rail Line	Mass GIS	Line	Single parameter	150 ft
Roads, Bridges, and Culverts	Roads	RIDOT	Line	Data-driven Buffer	Based on the Number of Lanes
	Bridges	RIDOT	Point	Custom Buffer	400 to 12,000 ft
Seawalls and Tidal Gates	Hardened Shorelines in Narragansett Bay	URI EDC and RIGIS	Polyline	Single parameter	20 ft
Stormwater Infrastructure	Sewer Overflows	URI EDC and RIGIS	Point	Single parameter	0 ft
	Sewered Areas	URI EDC and RIGIS	Polygon	Grid based	500 ft hexagon
	Stormwater Treatment Units (STU)	RIDOT Stormwater Program	Polygon	-	-
	Stormwater Control Plan (SCP) Watershed	RIDOT Stormwater Program	Polygon	Grid based	500 ft hexagon
Wastewater Treatment Facilities	Wastewater Treatment Facilities	URI EDC and RIGIS	Point	Custom Buffer	500 to 1,700 ft

Assets Assessed

Buffer Approach: Natural Systems

Asset Type	Assets	Data Source	Geometry	Buffer Methodology	Buffer Size
Beaches and Barriers	Coastal Barriers	URI EDC and RIGIS	Polygon	-	-
Coastal Wetlands	Coastal Wetlands	URI EDC and RIGIS	Polygon	Grid based	500 ft hexagon, 250 ft from the coast
Forests	Forest Blocks	URI EDC and RIGIS	Polygon	Grid based	500 ft hexagon
	Conservation Lands	URI EDC and RIGIS	Polygon	Grid based	500 ft hexagon
Water Resources	Streams and Rivers	URI EDC and RIGIS	Line	-	-
	Streams	Project Team Existing Data	Line	-	-
	Lakes and Ponds	URI EDC and RIGIS	Polygon	Grid based	500 ft hexagon

Assets Assessed

Buffer Approach: Community & Emergency Preparedness Structures

Asset Type	Assets	Data Source	Geometry	Buffer Methodology	Buffer Size
Housing	Public Housing	HUD	Point	Data-driven Buffer	Based on Total Occupancy
Municipal Buildings	City and Town Halls	URI EDC and RIGIS	Point	Single parameter	150 ft
	Public Libraries	URI EDC and RIGIS	Point	Data-driven Buffer	Based on the Square Footage of the Library
Schools	K-12 Schools	URI EDC and RIGIS	Point	Data-driven Buffer	Based on the Square Footage of the School
	Colleges and Universities	Project Team Existing Data	Point	Custom Buffer	1,500 to 4,500 ft
Emergency Services	Hospitals	URI EDC and RIGIS	Point	Data-driven Buffer	Based on the Number of Beds
	Fire Stations	Project Team Existing Data	Point	Single parameter	150 ft
	Police Facilities	Project Team Existing Data	Point	Single parameter	150 ft
	Food Markets	URI EDC and RIGIS	Point	Data-driven Buffer	Based on the Number of Cash Registers
Evacuation Routes and Emergency Shelters	Evacuation Routes	RIEMA	Line	Data-driven Buffer	Based on the Number of Lanes
	Emergency Shelters	RIEMA	Point	Single parameter	300 ft

Appendix C. Asset Risk Assessment Results

How to Read the Asset Risk Assessment Results

Appendix C

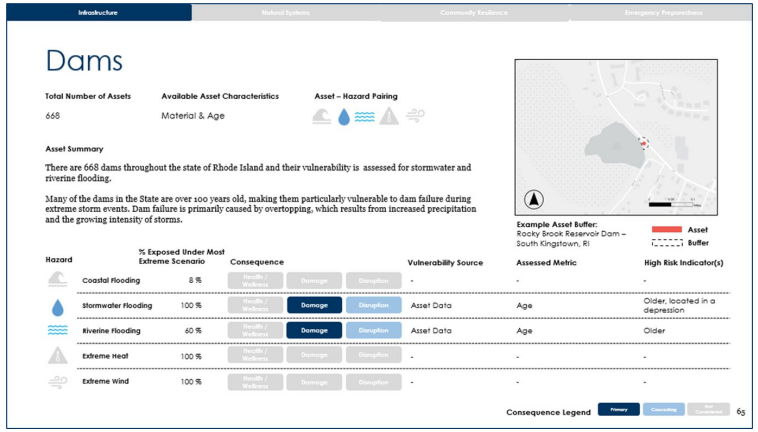
This section provides an asset-level summary for the risk assessment results for each asset group.

1. Critical Infrastructure and Facilities
2. Natural Systems
3. Community Resilience Structures
4. Emergency Preparedness Structures

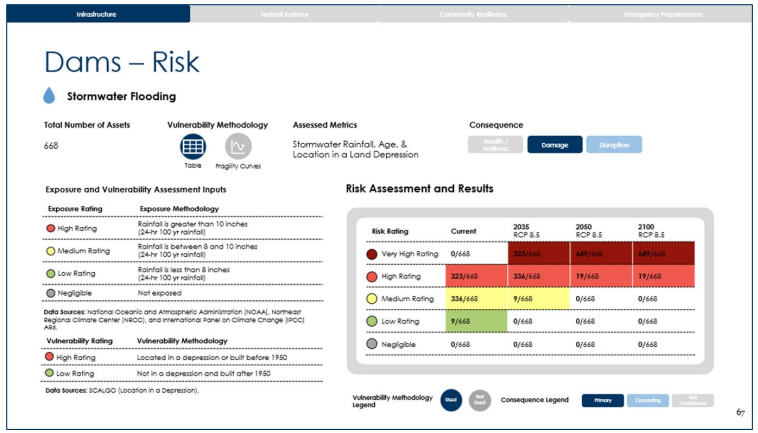
Each asset section includes a **summary page** that introduces the asset, including a summary table of the assessed scenarios and their associated consequences. Additionally, the summary page provides example buffer maps.

Each asset section also has various **risk results** pages that give an in-depth overview of the exposure and vulnerability methodology, including risk assessment results. There is one risk results page for each Asset-Hazard pair assessed.

Example Asset Summary Page



Example Risk Results Page

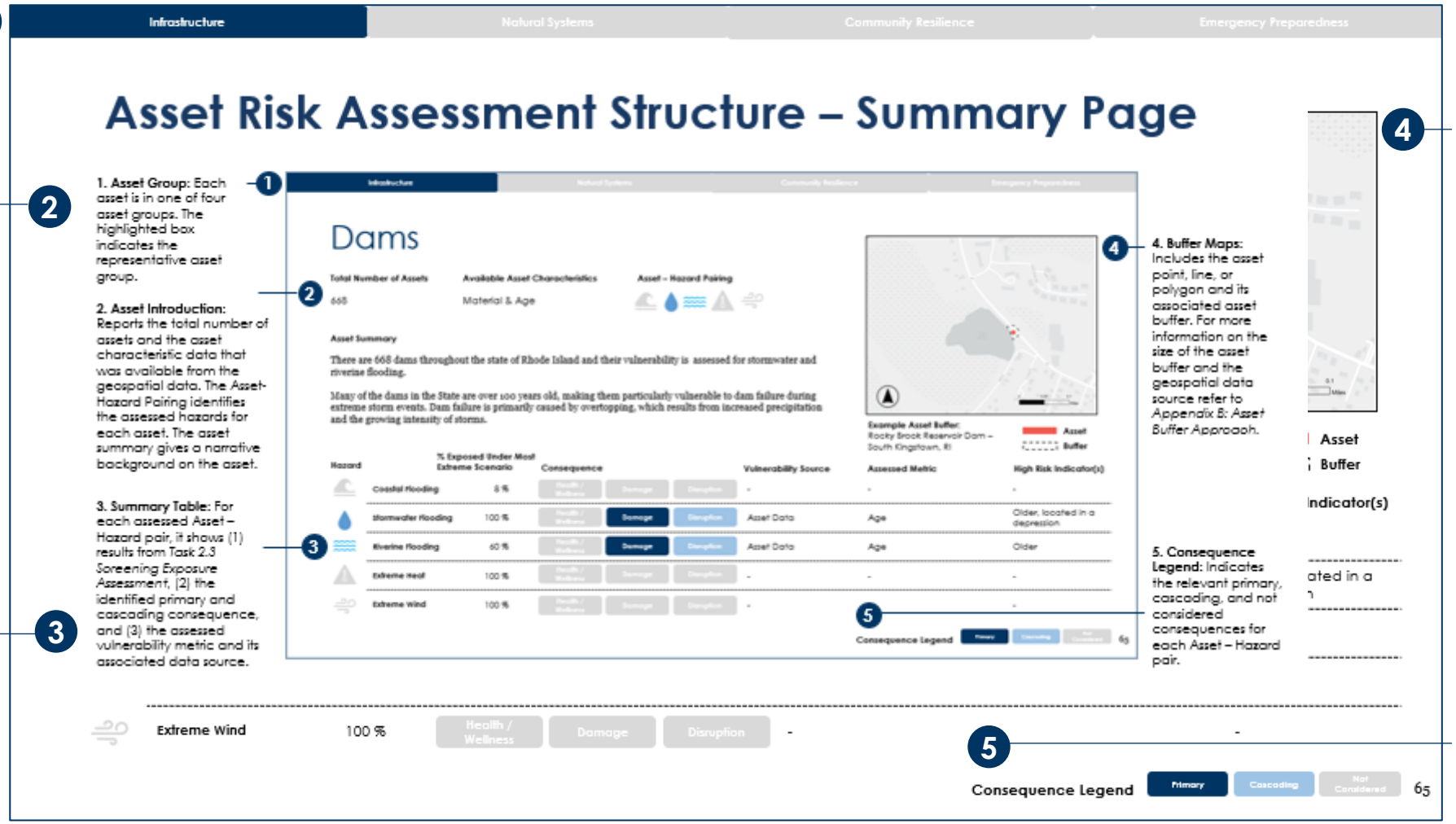


Asset Risk Assessment Structure – Summary Page

1. Asset Group: Each asset is in one of four asset groups. The highlighted box indicates the representative asset group.

2. Asset Introduction: Reports the total number of assets and the asset characteristic data that was available from the geospatial data. The Asset-Hazard Pairing identifies the assessed hazards for each asset. The asset summary gives a narrative background on the asset.

3. Summary Table: For each assessed Asset – Hazard pair, it shows (1) results from *Task 2.3 Screening Exposure Assessment*, (2) the identified primary and cascading consequence, and (3) the assessed vulnerability metric and its associated data source.



4. Buffer Maps: Includes the asset point, line, or polygon and its associated asset buffer. For more information on the size of the asset buffer and the geospatial data source refer to *Appendix B: Asset Buffer Approach.*

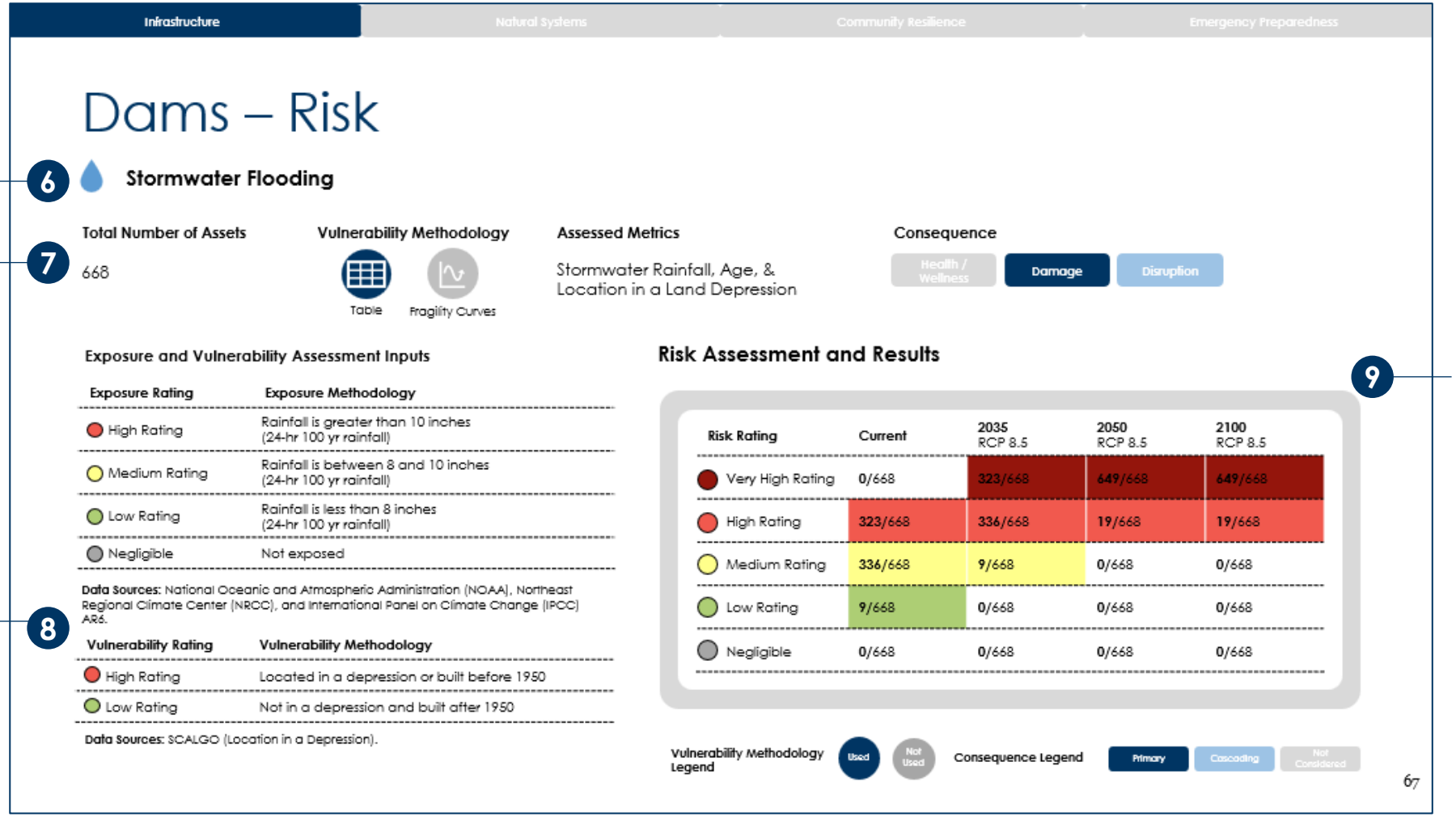
5. Consequence Legend: Indicates the relevant primary, cascading, and not considered consequences for each Asset – Hazard pair.

Asset Risk Assessment Structure – Risk Results

6. Climate Hazard: Vulnerability Introduction: Identifies the assed climate hazard. There will be one page of results for each assessed hazard.

7. Vulnerability Introduction: Includes number of assets, the vulnerability methodology used (table vs. fragility curve), the metrics that were used in the vulnerability assessment, and restates the identified consequences.

8. Exposure and Vulnerability Assessment Inputs: Summary of the exposure and vulnerability inputs and their associated methodologies. Includes data sources used in the assessment.



Infrastructure | Natural Systems | Community Resilience | Emergency Preparedness

Dams – Risk

6 **Stormwater Flooding**

7

Total Number of Assets	Vulnerability Methodology	Assessed Metrics	Consequence
668	Table, Fragility Curves	Stormwater Rainfall, Age, & Location in a Land Depression	Health / Wellness, **Damage**, Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

8

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression or built before 1950
Low Rating	Not in a depression and built after 1950

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

9

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	0/668	323/668	649/668	649/668
High Rating	323/668	336/668	19/668	19/668
Medium Rating	336/668	9/668	0/668	0/668
Low Rating	9/668	0/668	0/668	0/668
Negligible	0/668	0/668	0/668	0/668

Vulnerability Methodology Legend: Used, Not Used

Consequence Legend: Primary, Cascading, Not Considered

67

9. Risk Assessment Results: Reports the summary risk results for each assessed climate hazard and time horizon.

C.1. Critical Infrastructure and Facilities

Asset Results

Critical Infrastructure and Facilities

1. Dams
2. Drinking Water Systems
3. Electric Grid
4. Fuel Supply
5. Ports
6. Public Transportation
7. Roads, Bridges and Culverts
8. Seawalls and Tidal Gates
9. Stormwater Infrastructure
10. Wastewater Treatment Facilities

Dams

Dams

Total Number of Assets

668

Available Asset Characteristics

Material & Age

Asset – Hazard Pairing

Asset Summary

There are 668 dams throughout the state of Rhode Island and their vulnerability is assessed for stormwater and riverine flooding.

Many of the dams in the State are over 100 years old, making them particularly vulnerable to dam failure during extreme storm events. Dam failure is primarily caused by overtopping, which results from increased precipitation and the growing intensity of storms.

Example Asset Buffer:
Rocky Brook Reservoir Dam – South Kingstown, RI

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	8 %	Health / Wellness	Damage	Disruption	-	-	-
Stormwater Flooding	100 %	Health / Wellness	**Damage**	Disruption	Asset Data	Age	Older, located in a depression
Riverine Flooding	60 %	Health / Wellness	**Damage**	Disruption	Asset Data	Age	Older
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

Dams – Risk

Stormwater Flooding

Total Number of Assets

668

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall, Age, & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression or built before 1950
Low Rating	Not in a depression and built after 1950

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/668	**323**/668	**649**/668	**649**/668
High Rating	**323**/668	**336**/668	**19**/668	**19**/668
Medium Rating	**336**/668	**9**/668	**0**/668	**0**/668
Low Rating	**9**/668	**0**/668	**0**/668	**0**/668
Negligible	**0**/668	**0**/668	**0**/668	**0**/668

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Dams - Risk

Riverine Flooding

Total Number of Assets

668

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Riverine Flood Exposure and Age

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	Dam built prior to 1950
Low Rating	Dam built 1950 or after

Data Sources: URI Environmental Data Center and RIGIS (Age).

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**328**/668
High Rating	**63**/668
Medium Rating	**7**/668
Low Rating	**0**/668
Negligible	**270**/668

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Drinking Water Systems

1. Public Water Reservoirs
2. Wellhead Protection Areas

Public Water Reservoirs

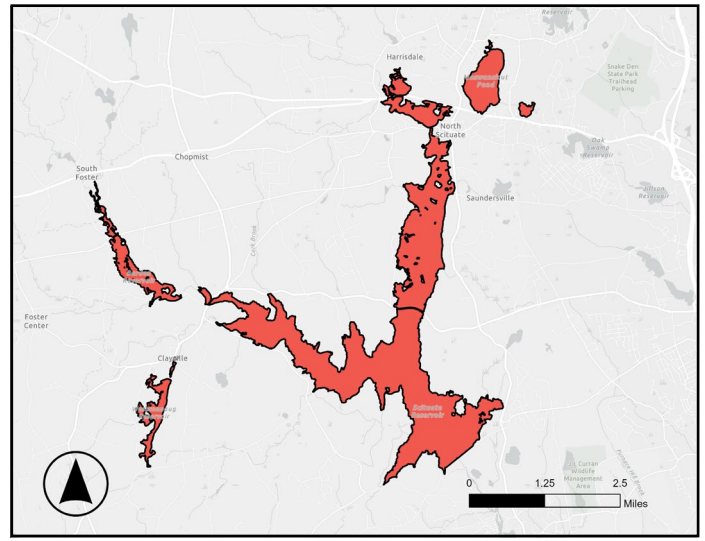
Total Number of Assets

49

Available Asset Characteristics

Area and Proximity to Algal Blooms and Superfund Sites

Asset – Hazard Pairing



Example Asset Buffer:
Public Water Reservoirs

Asset
Buffer

Asset Summary

There are 49 public water reservoirs throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding, stormwater flooding, riverine flooding, and extreme heat.

Climate hazards are a threat to drinking water quality due to contamination of public water reservoirs. Coastal flooding can cause saltwater intrusion, while all flooding increases contamination risks. Extreme heat can reduce the quality and availability of water.

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	22 %	Health / Wellness	Damage	Disruption	Asset Data	Area	Large % of Asset Exposed
Stormwater Flooding	100 %	Health / Wellness	Damage	Disruption	RIDEM; EPA	Proximity to Contamination Sites	Close Proximity
Riverine Flooding	61 %	Health / Wellness	Damage	Disruption	RIDEM; EPA	Proximity to Contamination Sites	Close Proximity
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	RIDEM	Algal Blooms	History of Cyanobacteria
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

Public Water Reservoirs - Risk

Coastal Flooding

Total Number of Assets

49

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Coastal Flood Exposure

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	> 30% MHHW Inundation
Medium Rating	10 – 30% MHHW Inundation
Low Rating	< 10% MHHW Inundation
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**0**/49	**0**/49	**0**/49	**0**/49
High Rating	**0**/49	**1**/49	**2**/49	**4**/49
Medium Rating	**1**/49	**0**/49	**0**/49	**0**/49
Low Rating	**10**/49	**7**/49	**9**/49	**7**/49
Negligible	**38**/49	**41**/49	**38**/49	**38**/49

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Public Water Reservoirs - Risk

Stormwater Flooding

Total Number of Assets

49

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall & Distance from a Superfund Site

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Distance from a superfund site is equal to 5,280 ft or more
Low Rating	Distance from a superfund site is less than 5,280 ft

Data Sources: Environmental Protection Agency (EPA).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/49	**0**/49	**0**/49	**0**/49
High Rating	**0**/49	**30**/49	**49**/49	**49**/49
Medium Rating	**30**/49	**19**/49	**0**/49	**0**/49
Low Rating	**19**/49	**0**/49	**0**/49	**0**/49
Negligible	**0**/49	**0**/49	**0**/49	**0**/49

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Public Water Reservoirs - Risk

Riverine Flooding

Total Number of Assets

49

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure & Distance from a Superfund Site

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	Distance from a superfund site is equal to 5,280 ft or more
Low Rating	Distance from a superfund site is less than 5,280 ft

Data Sources: Environmental Protection Agency (EPA).

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**3**/49
High Rating	**26**/49
Medium Rating	**1**/49
Low Rating	**0**/49
Negligible	**19**/49

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Public Water Reservoirs - Risk

Extreme Heat

Total Number of Assets

49

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Extreme Heat Exposure & Number of Algal Bloom Advisories

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	More than 14 annual days above 90°F
Medium Rating	Between 7 and 14 annual days above 90°F
Low Rating	Less than 7 annual days above 90°F
Negligible	Not exposed

Data Sources: RIDOH Climate Explorer and NOAA.

Vulnerability Rating	Vulnerability Methodology
High Rating	One or more algal bloom advisories from 2011 - 2025
Low Rating	No algal bloom advisories from 2011 - 2025

Data Sources: Rhode Island Department of Environmental Management (RIDEM).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/49	**0**/49	**0**/49	**4**/49
High Rating	**0**/49	**0**/49	**37**/49	**45**/49
Medium Rating	**4**/49	**37**/49	**12**/49	**0**/49
Low Rating	**45**/49	**12**/49	**0**/49	**0**/49
Negligible	**0**/49	**0**/49	**0**/49	**0**/49

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Wellhead Protection Areas

Total Number of Assets

62

Available Asset Characteristics

Number of Wells per County & Proximity to Algal Blooms and Superfund Sites

Asset – Hazard Pairing

Asset Summary

There are 62 wellhead protection areas throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding, stormwater flooding, riverine flooding, and extreme heat.

Climate hazards are a threat to drinking water quality due to contamination of wellhead protection areas. Coastal flooding can cause saltwater intrusion, while all flooding increases contamination risks. Extreme heat can reduce the quality and availability of water.

Example Asset Buffer:
Wellhead Protection Areas

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	19 %	**Health / Wellness**	Damage	**Disruption**	Asset Data	Area	Large % of Asset Exposed
Stormwater Flooding	100 %	**Health / Wellness**	Damage	**Disruption**	RIDEM; EPA	Proximity to Contamination Sites	Close Proximity
Riverine Flooding	77 %	**Health / Wellness**	Damage	**Disruption**	RIDEM; EPA	Proximity to Contamination Sites	Close Proximity
Extreme Heat	100 %	**Health / Wellness**	Damage	**Disruption**	RIDEM	Algal Blooms	History of Cyanobacteria
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

Wellhead Protection Areas - Risk

Coastal Flooding

Total Number of Assets

62

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Coastal Flood Exposure

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	> 30% MHHW Inundation
Medium Rating	10 – 30% MHHW Inundation
Low Rating	< 10% MHHW Inundation
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**0**/62	**0**/62	**0**/62	**0**/62
High Rating	**0**/62	**0**/62	**0**/62	**0**/62
Medium Rating	**0**/62	**0**/62	**0**/62	**3**/62
Low Rating	**12**/62	**12**/62	**12**/62	**9**/62
Negligible	**50**/62	**50**/62	**50**/62	**50**/62

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Wellhead Protection Areas - Risk

Stormwater Flooding

Total Number of Assets

62

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall & Distance from a Superfund Site

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Distance from a superfund site is equal to 5,280 ft or more
Low Rating	Distance from a superfund site is less than 5,280 ft

Data Sources: Environmental Protection Agency (EPA).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/62	**0**/62	**0**/62	**0**/62
High Rating	**0**/62	**22**/62	**62**/62	**62**/62
Medium Rating	**22**/62	**40**/62	**0**/62	**0**/62
Low Rating	**40**/62	**0**/62	**0**/62	**0**/62
Negligible	**0**/62	**0**/62	**0**/62	**0**/62

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Wellhead Protection Areas - Risk

Riverine Flooding

Total Number of Assets

62

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure & Distance from a Superfund Site

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	Distance from a superfund site is equal to 5,280 ft or more
Low Rating	Distance from a superfund site is less than 5,280 ft

Data Sources: Environmental Protection Agency (EPA).

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**9**/62
High Rating	**37**/62
Medium Rating	**2**/62
Low Rating	**0**/62
Negligible	**14**/62

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Wellhead Protection Areas - Risk

Extreme Heat

Total Number of Assets

62

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Extreme Heat Exposure and Distance from Reported Algal Blooms

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	More than 14 annual days above 90°F
Medium Rating	Between 7 and 14 annual days above 90°F
Low Rating	Less than 7 annual days above 90°F
Negligible	Not exposed

Data Sources: RIDOH Climate Explorer and NOAA.

Vulnerability Rating	Vulnerability Methodology
High Rating	Distance from a body of water with reported algal bloom is equal to 5,280 ft or more
Low Rating	Distance from a body of water with reported algal boom is less than 5, 280 ft

Data Sources: Rhode Island Department of Environmental Management (RIDEM).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/62	**0**/62	**10**/62	**14**/62
High Rating	**0**/62	**10**/62	**26**/62	**48**/62
Medium Rating	**14**/62	**26**/62	**26**/62	**0**/62
Low Rating	**48**/62	**26**/62	**0**/62	**0**/62
Negligible	**0**/62	**0**/62	**0**/62	**0**/62

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Electric Grid

1. Electrical Transmission Lines
2. Power Plants
3. Wind Turbines
4. Solar Systems

Electrical Transmission Lines

Total Number of Assets

1,170 ½ mile segments

Available Asset Characteristics

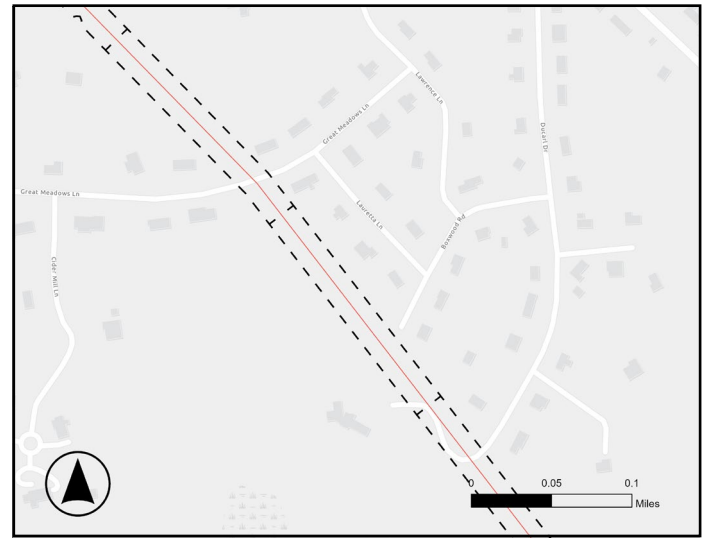
N/a

Asset – Hazard Pairing

Asset Summary

There are over 800 miles of electrical transmission lines throughout the state of Rhode Island and their vulnerability are assessed for extreme wind.

Infrastructure damage can result from climate hazards—all of which may lead to power outages. In particular, extreme winds may bring down overhead power lines.



Example Asset Buffer:
Electrical Transmission Lines

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	4 %	Health / Wellness	Damage	Disruption	-	-	-
Stormwater Flooding	100 %	Health / Wellness	Damage	Disruption	-	-	-
Riverine Flooding	20 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	**Damage**	Disruption	Engineering Judgment	Hazard Exposure	High Wind Speeds

Consequence Legend Primary | Cascading | Not Considered

Electrical Transmission Lines - Risk

Extreme Wind

Total Number of Assets

1,770 ½ mile segments

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Length

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	100-year, 3-s gust is Category 2 or higher
Medium Rating	100-year, 3-s gust is equal to Category 1
Low Rating	100-year, 3-s gust is lower than Category 1
Negligible	Not exposed

Data Sources: ASCE7 Design Wind Speeds.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/1770	**0**/1770	**0**/1770	**0**/1770
High Rating	**376**/1770	**376**/1770	**655**/1770	**1770**/1770
Medium Rating	**1394**/1770	**1394**/1770	**1115**/1770	**0**/1770
Low Rating	**0**/1770	**0**/1770	**0**/1770	**0**/1770
Negligible	**0**/1770	**0**/1770	**0**/1770	**0**/1770

Vulnerability Methodology Legend

Used | Not Used

Consequence Legend

Primary | Cascading | Not Considered

Power Plants

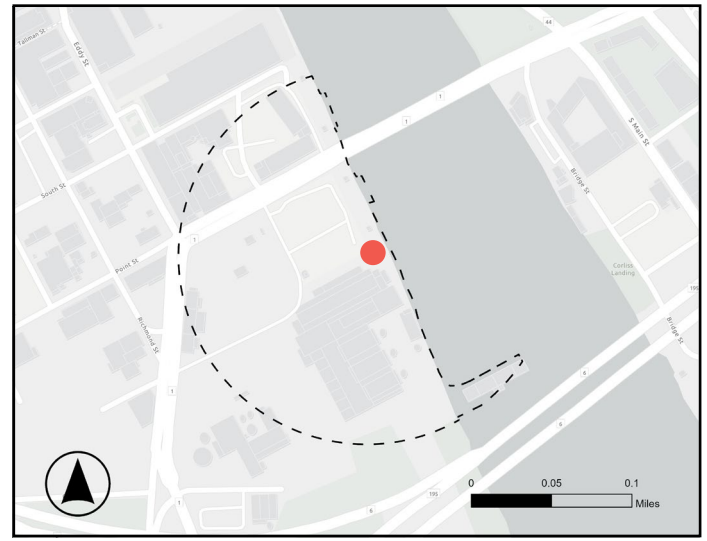
Total Number of Assets

15

Available Asset Characteristics

Fuel Source

Asset – Hazard Pairing



Example Asset Buffer:
Manchester Powerplant – Providence, RI

Asset
Buffer

Asset Summary

There are 15 power plants throughout the state of Rhode Island and their vulnerability are assessed for all climate hazards.

Infrastructure damage can result from climate hazards—all of which may lead to power outages. Flooding can directly damage electrical equipment, while extreme heat increases energy demand from cooling systems, straining the powerplant. Extreme winds may bring additional damage.

Power Plants are evaluated as FEMA Occupancy Class: IND1

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	20 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	High Damage
Stormwater Flooding	100 %	Health / Wellness	**Damage**	Disruption	Engineering Judgment	Hazard Exposure	High Rainfall, Located in a Depression
Riverine Flooding	33 %	Health / Wellness	**Damage**	Disruption	Engineering Judgment	Hazard Exposure	Exposed
Extreme Heat	100 %	Health / Wellness	Damage	**Disruption**	Asset Data	Primary Type	Natural Gas or Petroleum
Extreme Wind	100 %	Health / Wellness	**Damage**	Disruption	Engineering Judgment	Hazard Exposure	High Wind Speeds

Consequence Legend Primary | Cascading | Not Considered

Power Plants - Risk

Coastal Flooding

Total Number of Assets

15

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Coastal Flood Depth

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 30% damage to the 100-yr flood
High Rating	10-30% damage to the 100-yr flood
Medium Rating	<10 % damage to the 100-yr flood
Low Rating	Exposure damage to the 100-yr flood
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLs and Hazus Flood Fragilities*

* Occupancy code IND1 assumed at-grade

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**1**/15	**1**/15	**1**/15	**1**/15
High Rating	**0**/15	**1**/15	**1**/15	**1**/15
Medium Rating	**0**/15	**0**/15	**0**/15	**1**/15
Low Rating	**1**/15	**0**/15	**0**/15	**0**/15
Negligible	**13**/15	**13**/15	**13**/15	**12**/15

Vulnerability Methodology Legend

Used | Not Used

Consequence Legend

Primary | Cascading | Not Considered

Power Plants - Risk

Stormwater Flooding

Total Number of Assets

15

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/15	**10**/15	**11**/15	**11**/15
High Rating	**10**/15	**3**/15	**4**/15	**4**/15
Medium Rating	**3**/15	**2**/15	**0**/15	**0**/15
Low Rating	**2**/15	**0**/15	**0**/15	**0**/15
Negligible	**0**/15	**0**/15	**0**/15	**0**/15

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Power Plants - Risk

Riverine Flooding

Total Number of Assets

15

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**0**/15
High Rating	**3**/15
Medium Rating	**2**/15
Low Rating	**0**/15
Negligible	**10**/15

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Power Plants - Risk

Extreme Heat

Total Number of Assets

15

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Extreme Heat Exposure & Type of Powerplant

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	More than 14 annual days above 90°F
Medium Rating	Between 7 and 14 annual days above 90°F
Low Rating	Less than 7 annual days above 90°F
Negligible	Not exposed

Data Sources: RIDOH Climate Explorer and NOAA.

Vulnerability Rating	Vulnerability Methodology
High Rating	Primary type is Natural Gas or Petroleum
Low Rating	Primary type is not Natural Gas or Petroleum

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/15	**0**/15	**6**/15	**9**/15
High Rating	**0**/15	**6**/15	**9**/15	**6**/15
Medium Rating	**9**/15	**9**/15	**0**/15	**0**/15
Low Rating	**6**/15	**0**/15	**0**/15	**0**/15
Negligible	**0**/15	**0**/15	**0**/15	**0**/15

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Power Plants - Risk

Extreme Wind

Total Number of Assets

15

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Wind Exposure

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	100-yr, 3-s gust is more than Category 3
Medium Rating	100-yr, 3-s gust is greater than Category 1
Low Rating	100-yr, 3-s gust is equal to Category 1
Negligible	Not applicable

Data Sources: ASCE7 Design Wind Speeds.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/15	**0**/15	**0**/15	**0**/15
High Rating	**0**/15	**0**/15	**0**/15	**0**/15
Medium Rating	**3**/15	**3**/15	**3**/15	**15**/15
Low Rating	**12**/15	**12**/15	**12**/15	**0**/15
Negligible	**0**/15	**0**/15	**0**/15	**0**/15

Vulnerability Methodology Legend

Used | Not Used

Consequence Legend

Primary | Cascading | Not Considered

Wind Turbines

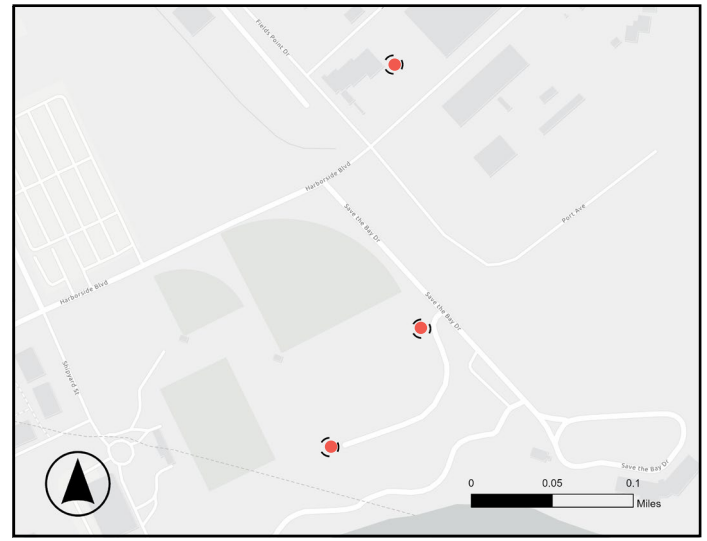
Total Number of Assets

30

Available Asset Characteristics

Fuel Source

Asset – Hazard Pairing



Example Asset Buffer:
Wind Turbines – Providence County

Asset
Buffer

Asset Summary

There are 30 wind turbines throughout the state of Rhode Island and their vulnerability are assessed for flooding and extreme wind.

Infrastructure damage can result from flooding and extreme heat—all of which may lead to disruption. Excessive flooding can directly damage turbines, while extreme heat increases energy demand from cooling systems.

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	20 %	Health / Wellness	Damage	Disruption	Engineering Judgment	Hazard Exposure	High Flood Depth
Stormwater Flooding	100 %	Health / Wellness	Damage	Disruption	Engineering Judgment	Hazard Exposure	High Rainfall, Located in a Depression
Riverine Flooding	17 %	Health / Wellness	Damage	Disruption	Engineering Judgment	Hazard Exposure	Exposed
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	Engineering Judgment	Hazard Exposure	High Wind Speeds

Consequence Legend Primary | Cascading | Not Considered

Wind Turbines - Risk

Coastal Flooding

Total Number of Assets

30

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Coastal Flood Depth

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Depth of 100-yr flood is more than 2 ft
Medium Rating	Depth of 100-yr flood is between 0.5 and 2 ft
Low Rating	Depth of 100-yr flood is less than 0.5 ft
Not Assessed	Not assessed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**0**/30	**0**/30	**0**/30	**0**/30
High Rating	**3**/30	**3**/30	**5**/30	**6**/30
Medium Rating	**2**/30	**2**/30	**1**/30	**0**/30
Low Rating	**1**/30	**1**/30	**0**/30	**0**/30
Negligible	**24**/30	**24**/30	**24**/30	**24**/30

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Wind Turbines - Risk

Stormwater Flooding

Total Number of Assets

30

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall & Location in a Depression

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/30	**4**/30	**5**/30	**5**/30
High Rating	**4**/30	**10**/30	**25**/30	**25**/30
Medium Rating	**10**/30	**16**/30	**0**/30	**0**/30
Low Rating	**16**/30	**0**/30	**0**/30	**0**/30
Negligible	**0**/30	**0**/30	**0**/30	**0**/30

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Wind Turbines - Risk

Riverine Flooding

Total Number of Assets

30

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**0**/30
High Rating	**2**/30
Medium Rating	**3**/30
Low Rating	**0**/30
Negligible	**25**/30

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Wind Turbines - Risk

Extreme Wind

Total Number of Assets

30

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Wind Exposure

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	100-yr, 3-s gust is more than Category 3
Medium Rating	100-yr, 3-s gust is greater than Category 1
Low Rating	100-yr, 3-s gust is equal to Category 1
Negligible	Not applicable

Data Sources: ASCE7 Design Wind Speeds.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/30	**0**/30	**0**/30	**0**/30
High Rating	**0**/30	**0**/30	**0**/30	**0**/30
Medium Rating	**5**/30	**5**/30	**17**/30	**30**/30
Low Rating	**25**/30	**25**/30	**13**/30	**0**/30
Negligible	**0**/30	**0**/30	**0**/30	**0**/30

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Solar Systems

Total Number of Assets

173

Available Asset Characteristics

N/A

Asset – Hazard Pairing

Asset Summary

There are 173 solar systems throughout the state of Rhode Island and their vulnerability are assessed for flooding and extreme wind.

Infrastructure damage can result from climate hazards—all of which may lead to disruption. Excessive flooding can directly damage electrical equipment, while extreme heat increases energy demand from cooling systems. Extreme winds may bring additional damage.

Example Asset Buffer:
Solar Farm (ID150) – Providence, RI

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	3 %	Health / Wellness	Damage	Disruption	Engineering Judgment	Hazard Exposure	High Flood Depth
Stormwater Flooding	100 %	Health / Wellness	Damage	Disruption	Engineering Judgment	Hazard Exposure	High Rainfall, Located in a Depression
Riverine Flooding	7 %	Health / Wellness	Damage	Disruption	Engineering Judgment	Hazard Exposure	Exposed
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	Engineering Judgment	Hazard Exposure	High Wind Speeds

Consequence Legend Primary | Cascading | Not Considered

Solar Systems - Risk

Coastal Flooding

Total Number of Assets

173

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Coastal Flood Depth

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Depth of 100-yr flood is more than 2 ft
Medium Rating	Depth of 100-yr flood is between 0.5 and 2 ft
Low Rating	Depth of 100-yr flood is less than 0.5 ft
Not Assessed	Not assessed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**0**/173	**0**/173	**0**/173	**0**/173
High Rating	**0**/173	**0**/173	**1**/173	**3**/173
Medium Rating	**2**/173	**2**/173	**2**/173	**1**/173
Low Rating	**1**/173	**1**/173	**0**/173	**2**/173
Negligible	**170**/173	**170**/173	**170**/173	**167**/173

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Solar Systems - Risk

Stormwater Flooding

Total Number of Assets

173

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/173	**40**/173	**110**/173	**110**/173
High Rating	**40**/173	**96**/173	**63**/173	**63**/173
Medium Rating	**96**/173	**37**/173	**0**/173	**0**/173
Low Rating	**37**/173	**0**/173	**0**/173	**0**/173
Negligible	**0**/173	**0**/173	**0**/173	**0**/173

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Solar Systems - Risk

Riverine Flooding

Total Number of Assets

173

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**0**/173
High Rating	**4**/173
Medium Rating	**8**/173
Low Rating	**0**/173
Negligible	**161**/173

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Solar Systems - Risk

Extreme Wind

Total Number of Assets

173

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Wind Exposure

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	100-yr, 3-s gust is more than Category 2
Medium Rating	100-yr, 3-s gust is greater than Category 1
Low Rating	100-yr, 3-s gust is equal to Category 1
Negligible	Not applicable

Data Sources: ASCE7 Design Wind Speeds.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/173	**0**/173	**0**/173	**0**/173
High Rating	**0**/173	**0**/173	**0**/173	**0**/173
Medium Rating	**78**/173	**78**/173	**107**/173	**173**/173
Low Rating	**95**/173	**95**/173	**66**/173	**0**/173
Negligible	**0**/173	**0**/173	**0**/173	**0**/173

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Fuel Supply

1. Underground Storage Tanks

Underground Storage Tanks

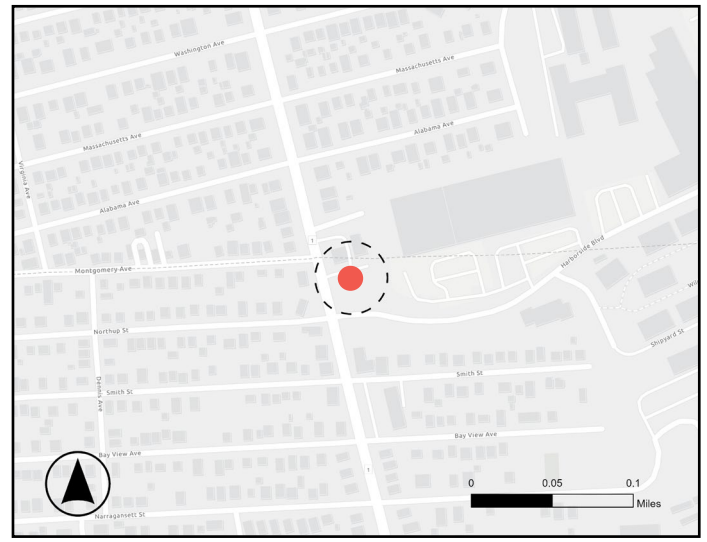
Total Number of Assets

317

Available Asset Characteristics

Tank Capacity, Tank Wall, & Leaking Status

Asset – Hazard Pairing



Example Asset Buffer:
Harbor Shell Food Mart - Providence, RI

Asset
Buffer

Asset Summary

There are 317 underground storage tanks throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding, stormwater flooding, and riverine flooding.

Fuel supply is considered vulnerable to flooding. Flooding can physically damage the storage tank, leading to repair costs and subsequent downtime. This is especially consequential for leaking underground storage tanks.

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	9 %	Health / Wellness	Damage	Disruption	RIDEM	LUST Status	Identified as LUST
Stormwater Flooding	100 %	Health / Wellness	Damage	Disruption	RIDEM	LUST Status	Identified as LUST
Riverine Flooding	12 %	Health / Wellness	Damage	Disruption	RIDEM	LUST Status	Identified as LUST
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

Underground Storage Tanks - Risk

Coastal Flooding

Total Number of Assets

317

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Coastal Flood Depth & Leaky Underground Storage Tank (LUST)

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Depth of 100-yr flood is more than 2 ft
Medium Rating	Depth of 100-yr flood is between 0.5 and 2 ft
Low Rating	Depth of 100-yr flood is less than 0.5 ft
Not Assessed	Not assessed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	Leaky Underground Storage Tank (LUST)
Low Rating	Not Leaky Underground Storage Tank (LUST)

Data Sources: Rhode Island Department of Environmental Management (RIDEM)

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**10**/317	**11**/317	**13**/317	**20**/317
High Rating	**6**/317	**9**/317	**10**/317	**9**/317
Medium Rating	**1**/317	**2**/317	**1**/317	**1**/317
Low Rating	**11**/317	**6**/317	**4**/317	**0**/317
Negligible	**289**/317	**289**/317	**289**/317	**287**/317

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Underground Storage Tanks - Risk

Stormwater Flooding

Total Number of Assets

317

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall, Leaky Underground Storage Tank (LUST), & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression or a Leaky Underground Storage Tank (LUST)
Low Rating	Not located in a depression and not a Leaky Underground Storage Tank (LUST)

Data Sources: Rhode Island Department of Environmental Management (RIDEM) (LUST classification) and SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/317	**162**/317	**292**/317	**292**/317
High Rating	**162**/317	**143**/317	**25**/317	**25**/317
Medium Rating	**143**/317	**12**/317	**0**/317	**0**/317
Low Rating	**12**/317	**0**/317	**0**/317	**0**/317
Negligible	**0**/317	**0**/317	**0**/317	**0**/317

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Ports

1. Ports and Harbors

Ports and Harbors

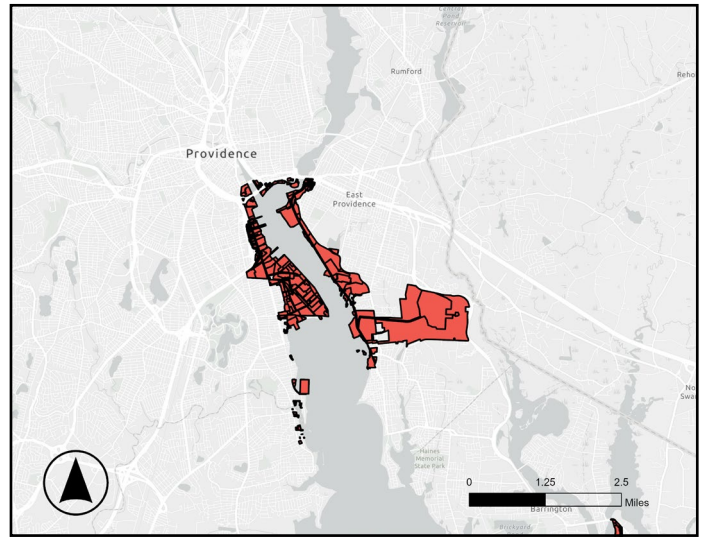
Total Number of Assets

1,568

Available Asset Characteristics

Use Type, Use Level, & Community Use

Asset – Hazard Pairing



Example Asset Buffer:
Ports and Harbors - Providence, RI

Asset
Buffer

Asset Summary

There are 1,568 ports and harbors segments throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding, stormwater flooding, and extreme wind.

The ports generate more than $200 million in economic benefits and over 2,400 jobs for the State, making them essential infrastructure. Flooding and extreme wind may cause port infrastructure damage causing an impact to delivery times and other port operations.

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	89 %	Health / Wellness	Damage	Disruption	URI Environmental Data Center and RIGIS	Use Type	Commercial or Industrial
Stormwater Flooding	100 %	Health / Wellness	Damage	Disruption	URI Environmental Data Center and RIGIS	Use Type	Commercial or Industrial
Riverine Flooding	25 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	Engineering Judgment	Hazard Exposure	High Wind Speeds

Consequence Legend Primary | Cascading | Not Considered

Ports and Harbors - Risk

Coastal Flooding

Total Number of Assets

1,568

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Coastal Flood Depth & Use Type

Consequence

Health / Wellness | Damage | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	> 30% MHHW Inundation
Medium Rating	10 – 30% MHHW Inundation
Low Rating	< 10% MHHW Inundation
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	Commercial and industrial use type
Low Rating	All other use types

Data Sources: URI Environmental Data Cener and RIGIS (Port Type) and SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**35**/1568	**37**/1568	**52**/1568	**467**/1568
High Rating	**103**/1568	**113**/1568	**144**/1568	**346**/1568
Medium Rating	**240**/1568	**247**/1568	**234**/1568	**116**/1568
Low Rating	**977**/1568	**958**/1568	**926**/1568	**466**/1568
Negligible	**213**/1568	**213**/1568	**212**/1568	**176**/1568

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Ports and Harbors - Risk

Stormwater Flooding

Total Number of Assets

1,568

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall, Use Type, & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Commercial and industrial use type
Low Rating	All other use types

Data Sources: URI Environmental Data Cener and RIGIS.

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/1568	**178**/1568	**1028**/1568	**1028**/1568
High Rating	**178**/1568	**1006**/1568	**539**/1568	**539**/1568
Medium Rating	**1006**/1568	**383**/1568	**0**/1568	**0**/1568
Low Rating	**384**/1568	**1**/1568	**1**/1568	**1**/1568
Negligible	**0**/1568	**0**/1568	**0**/1568	**0**/1568

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Ports and Harbors - Risk

Extreme Wind

Total Number of Assets

1,568

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Wind Exposure & Use Type

Consequence

Health / Wellness | Damage | **Disruption**

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 50% Damage, 700-yr 3-s gust
High Rating	30 - 50% Damage, 700-yr 3-s gust
Medium Rating	10 - 30% Damage, 700-yr 3-s gust
Low Rating	< 10% Damage, 700-yr 3-s gust
Negligible	Not exposed

Data Sources: ASCE7 Hazard Tool, International Panel on Climate Change (IPCC) AR5, and Hazus Wind Fragilities.*

* Hazus wind fragility SECBL with built-up roof, medium window area, no shutters, missile environment A, and standard roof assumed. Open Terrain, damage state 4.

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/1568	**0**/1568	**0**/1568	**0**/1568
High Rating	**0**/1568	**0**/1568	**0**/1568	**0**/1568
Medium Rating	**335**/1568	**335**/1568	**335**/1568	**335**/1568
Low Rating	**1233**/1568	**1233**/1568	**1233**/1568	**1233**/1568
Negligible	**0**/1568	**0**/1568	**0**/1568	**0**/1568

Vulnerability Methodology Legend

Used | Not Used

Consequence Legend

Primary | Cascading | Not Considered

Public Transportation

1. RIPTA Bus Stops
2. RIPTA Bus Routes
3. MBTA Commuter Rail Stations
4. MBTA Commuter Rail Line

RIPTA Bus Stops

Total Number of Assets

3,588

Available Asset Characteristics

N/A

Asset – Hazard Pairing

Example Asset Buffer:
Bus Stops at Point Judith after Sunnybrook Farm

Asset
Buffer

Asset Summary

There are 3,588 bus stops throughout the state of Rhode Island, as of August 2025, and their vulnerability are assessed for coastal flooding, stormwater flooding, and extreme heat.

RIPTA's statewide bus network serves approximately 15,000 Rhode Islanders daily. Flooding at bus stops can lead to significant delays, while extreme heat poses health risks to riders as they wait and commute to the bus.

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	10 %	Health / Wellness	**Damage**	**Disruption**	Engineering Judgment	Hazard Exposure	High Flood Depth
Stormwater Flooding	100 %	Health / Wellness	**Damage**	**Disruption**	Engineering Judgment	Hazard Exposure	High Rainfall, Located in a Depression
Riverine Flooding	7 %	Health / Wellness	**Damage**	**Disruption**	Engineering Judgment	Hazard Exposure	Exposure
Extreme Heat	100 %	**Health / Wellness**	Damage	**Disruption**	NOAA	Heat Index Classification	Heat Index exceeding Tolerable Conditions
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

* Note: RIPTA stops and routes undergo regular changes which may impact the number of stops and segments. These numbers represent the assets recorded at the time of this evaluation.

Consequence Legend Primary | Cascading | Not Considered

RIPTA Bus Stops - Risk

Coastal Flooding

Total Number of Assets

3,588

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Coastal Flood Depth

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Depth of 100-yr flood is more than 2 ft
Medium Rating	Depth of 100-yr flood is between 0.5 and 2 ft
Low Rating	Depth of 100-yr flood is less than 0.5 ft
Not Assessed	Not assessed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**0**/3588	**0**/3588	**0**/3588	**0**/3588
High Rating	**113**/3588	**114**/3588	**147**/3588	**230**/3588
Medium Rating	**77**/3588	**79**/3588	**72**/3588	**108**/3588
Low Rating	**102**/3588	**99**/3588	**73**/3588	**18**/3588
Negligible	**3296**/3588	**3296**/3588	**3296**/3588	**3232**/3588

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

RIPTA Bus Stops - Risk

Stormwater Flooding

Total Number of Assets

3,588

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/3588	**393**/3588	**706**/3588	**706**/3588
High Rating	**393**/3588	**2078**/3588	**2882**/3588	**2882**/3588
Medium Rating	**2078**/3588	**1117**/3588	**0**/3588	**0**/3588
Low Rating	**1117**/3588	**0**/3588	**0**/3588	**0**/3588
Negligible	**0**/3588	**0**/3588	**0**/3588	**0**/3588

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

RIPTA Bus Stops - Risk

Riverine Flooding

Total Number of Assets

3,588

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**0**/3588
High Rating	**127**/3588
Medium Rating	**124**/3588
Low Rating	**0**/3588
Negligible	**3337**/3588

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

RIPTA Bus Stops - Risk

Extreme Heat

Total Number of Assets

3,588

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Extreme Heat Exposure & Heat Index Classification

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	1- or 5-yr = Extreme Danger (>123F)
Medium Rating	1-yr = Danger (>103 F)
Low Rating	1-yr < Danger (<103 F)
Negligible	Not exposed

Data Sources: NASA Earth Exchange GDDP, NOAA Heat Index Classifications

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/3588	**0**/3588	**0**/3588	**3588**/3588
High Rating	**0**/3588	**2879**/3588	**2879**/3588	**0**/3588
Medium Rating	**3588**/3588	**709**/3588	**709**/3588	**0**/3588
Low Rating	**0**/3588	**0**/3588	**0**/3588	**0**/3588
Negligible	**0**/3588	**0**/3588	**0**/3588	**0**/3588

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

RIPTA Bus Routes

Total Number of Assets

5,079 half-mile segments

Available Asset Characteristics

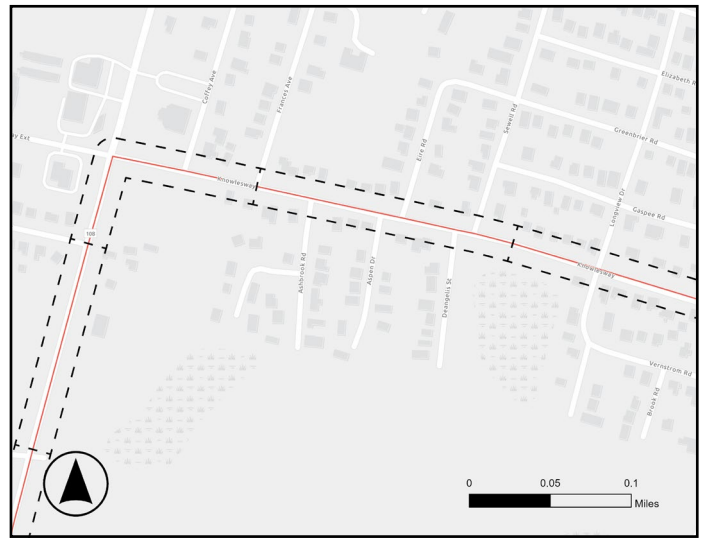
Route Name, Pavement Condition (Sensitivity), & Route Density (Adaptive Capacity)

Asset – Hazard Pairing

Asset Summary

There is over 2,500 miles of bus routes, as of August 2025, throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding, stormwater flooding, and riverine flooding.

RIPTA's statewide bus network serves approximately 15,000 Rhode Islanders daily. Flooding of bus routes can lead to significant delays.



Example Asset Buffer:
Bus Routes – Newport County

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	14 %	Health / Wellness	Damage	Disruption	RIDOT RIP	Sensitivity	Poor Condition
Stormwater Flooding	100 %	Health / Wellness	Damage	Disruption	RIDOT RIP	Sensitivity	Poor Condition, Located in a Depression
Riverine Flooding	14 %	Health / Wellness	Damage	Disruption	RIDOT RIP	Sensitivity	Poor Condition
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

RIPTA Bus Routes - Risk

Coastal Flooding

Total Number of Assets

5,079 half-mile segments

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Coastal Flood Depth & Pavement Condition

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Depth of 100-yr flood is more than 2 ft
Medium Rating	Depth of 100-yr flood is between 0.5 and 2 ft
Low Rating	Depth of 100-yr flood is less than 0.5 ft
Not Assessed	Not assessed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	Poor, fair, or no information on pavement condition
Low Rating	Excellent or good pavement condition

Data Sources: Rhode Island Department of Transportation Resilience Improvement Plan (RIDOT), 2024.

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**244**/5079	**250**/5079	**292**/5079	**386**/5079
High Rating	**197**/5079	**206**/5079	**211**/5079	**256**/5079
Medium Rating	**47**/5079	**48**/5079	**54**/5079	**50**/5079
Low Rating	**146**/5079	**130**/5079	**84**/5079	**33**/5079
Negligible	**4445**/5079	**4445**/5079	**4438**/5079	**4354**/5079

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

RIPTA Bus Routes - Risk

Stormwater Flooding

Total Number of Assets

5,079 half-mile segments

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall, Pavement Condition, & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Poor, fair, or no information on pavement condition or located in a depression
Low Rating	Excellent or good pavement condition and not located in a depression

Data Sources: Rhode Island Department of Transportation Resilience Improvement Plan (RIDOT), 2024.

Risk Assessment and Results

Risk Rating	Current	**2035** (RCP8.5)	**2050** (RCP8.5)	**2100** (RCP8.5)
Very High Rating	**0**/5079	**2364**/5079	**4503**/5079	**4503**/5079
High Rating	**2364**/5079	**2400**/5079	**576**/5079	**576**/5079
Medium Rating	**2400**/5079	**315**/5079	**0**/5079	**0**/5079
Low Rating	**315**/5079	**0**/5079	**0**/5079	**0**/5079
Negligible	**0**/5079	**0**/5079	**0**/5079	**0**/5079

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

RIPTA Bus Routes - Risk

Riverine Flooding

Total Number of Assets

5,079 half-mile segments

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure and Pavement Condition

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	Poor, fair, or no information on pavement condition
Low Rating	Excellent or good pavement condition

Data Sources: Rhode Island Department of Transportation Resilience Improvement Plan (RIDOT), 2024.

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**341**/5079
High Rating	**295**/5079
Medium Rating	**72**/5079
Low Rating	**0**/5079
Negligible	**4371**/5079

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

MBTA Commuter Rail Stations

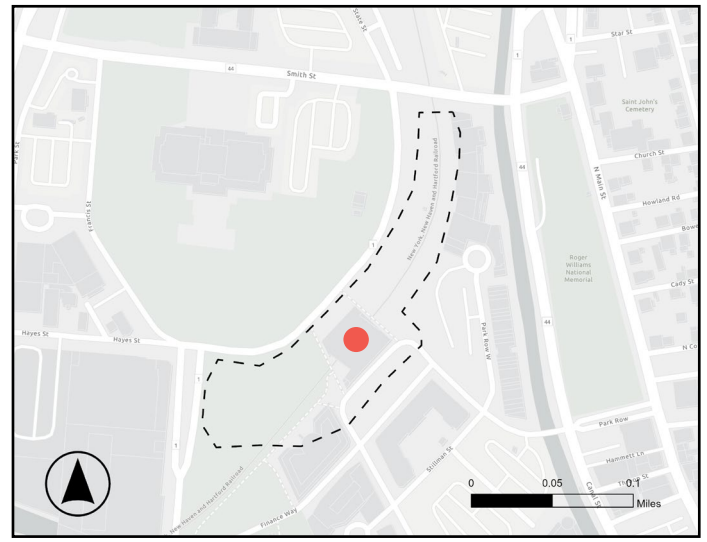
Total Number of Assets

4

Available Asset Characteristics

N/A

Asset – Hazard Pairing



Example Asset Buffer:
Train Station – Providence, RI

Asset
Buffer

Asset Summary

There are 4 train stations throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding, stormwater flooding, riverine flooding, and extreme heat.

The train stations support the commuter rail which supports riders efficient commute throughout the State and neighboring states. Flooding of train stations can lead to damage and significant delays, while extreme heat poses health risks to riders as they wait and commute to the train.

MBTA Commuter Rail Stations are evaluated as FEMA Occupancy Class: GOV1

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	25 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	High Damage
Stormwater Flooding	100 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	Occupancy Class, Located in a Depression
Riverine Flooding	50 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	Relatively Vulnerable Occupancy Class
Extreme Heat	100 %	**Health / Wellness**	Damage	Disruption	NOAA	Heat Index Classification	Heat Index exceeding Tolerable Conditions
Extreme Wind	100 %	Health / Wellness	**Damage**	Disruption	Hazus Wind Fragilities	Building Typology	High Damage

Consequence Legend Primary | Cascading | Not Considered

MBTA Commuter Rail Stations - Risk

Coastal Flooding

Total Number of Assets

4

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Coastal Flood Depth & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 30% damage to the 100-yr flood
High Rating	10-30% damage to the 100-yr flood
Medium Rating	<10 % damage to the 100-yr flood
Low Rating	Exposure damage to the 100-yr flood
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLs and Hazus Flood Fragilities*

* Occupancy code GOV1 assumed at-grade

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**1**/4	**1**/4	**1**/4	**1**/4
High Rating	**0**/4	**0**/4	**0**/4	**0**/4
Medium Rating	**0**/4	**0**/4	**0**/4	**0**/4
Low Rating	**0**/4	**0**/4	**0**/4	**0**/4
Negligible	**3**/4	**3**/4	**3**/4	**3**/4

Vulnerability Methodology Legend — **Used** | Not Used

Consequence Legend — **Primary** | Cascading | Not Considered

MBTA Commuter Rail Stations - Risk

Stormwater Flooding

Total Number of Assets

4

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/4	**2**/4	**4**/4	**4**/4
High Rating	**2**/4	**2**/4	**0**/4	**0**/4
Medium Rating	**2**/4	**0**/4	**0**/4	**0**/4
Low Rating	**0**/4	**0**/4	**0**/4	**0**/4
Negligible	**0**/4	**0**/4	**0**/4	**0**/4

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

MBTA Commuter Rail Stations - Risk

Riverine Flooding

Total Number of Assets

4

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Riverine Flood Exposure

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be low vulnerability

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**0**/4
High Rating	**2**/4
Medium Rating	**0**/4
Low Rating	**0**/4
Negligible	**2**/4

Vulnerability Methodology Legend

Used | Not Used

Consequence Legend

Primary | Cascading | Not Considered

MBTA Commuter Rail Stations - Risk

Extreme Heat

Total Number of Assets

4

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Extreme Heat Exposure & Heat Index Classification

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	1- or 5-yr = Extreme Danger (>123F)
Medium Rating	1-y r = Danger (>103 F)
Low Rating	1-yr < Danger (<103 F)
Negligible	Not exposed

Data Sources: NASA Earth Exchange GDDP, NOAA Heat Index Classifications

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	0/4	0/4	0/4	0/4
High Rating	0/4	0/4	0/4	4/4
Medium Rating	0/4	3/4	3/4	0/4
Low Rating	4/4	1/4	1/4	0/4
Negligible	0/4	0/4	0/4	0/4

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

MBTA Commuter Rail Stations - Risk

Extreme Wind

Total Number of Assets

4

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Wind Exposure & Building Typology

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 50% Damage, 700-yr 3-s gust
High Rating	30 - 50% Damage, 700-yr 3-s gust
Medium Rating	10 - 30% Damage, 700-yr 3-s gust
Low Rating	< 10% Damage, 700-yr 3-s gust
Negligible	Not exposed

Data Sources: ASCE7 Hazard Tool, International Panel on Climate Change (IPCC) AR5, and Hazus Wind Fragilities.*

* Hazus wind fragility SECBL with built-up roof, medium window area, no shutters, missile environment A, and standard roof assumed. Open Terrain, damage state 4.

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/4	**0**/4	**0**/4	**0**/4
High Rating	**0**/4	**0**/4	**0**/4	**0**/4
Medium Rating	**2**/4	**2**/4	**2**/4	**2**/4
Low Rating	**2**/4	**2**/4	**2**/4	**2**/4
Negligible	**0**/4	**0**/4	**0**/4	**0**/4

Vulnerability Methodology Legend — Used | Not Used

Consequence Legend — Primary | Cascading | Not Considered

MBTA Commuter Rail Line

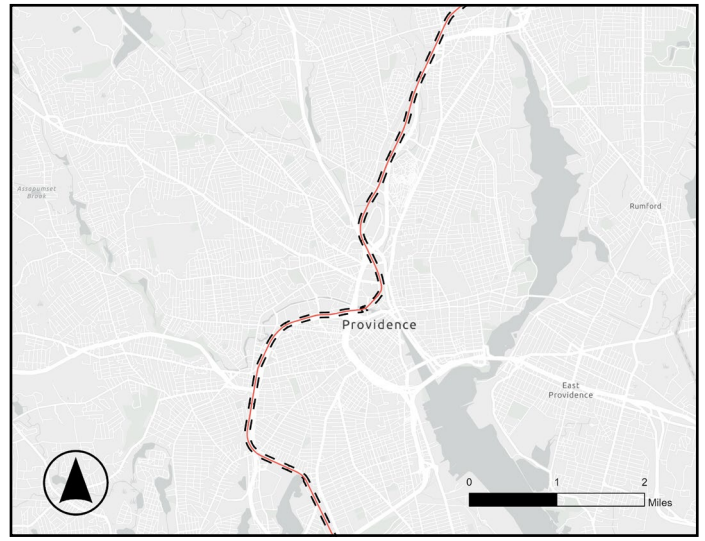
Total Number of Assets

51 haf-mile segments

Available Asset Characteristics

Route Name

Asset – Hazard Pairing



Example Asset Buffer:
Commuter Rail – Providence, RI

Asset
Buffer

Asset Summary

There are 25 miles of the commuter rail throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding, stormwater flooding, and riverine flooding.

The commuter rails supports riders efficient commute throughout the State and neighboring states. Flooding and extreme heat may cause damage to the rail, causing significantly delays.

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	14 %	Health / Wellness	Damage	Disruption	Engineering Judgment	Hazard Exposure	High Flood Depth
Stormwater Flooding	100 %	Health / Wellness	Damage	Disruption	Engineering Judgment	Hazard Exposure	High Rainfall, Located in a Depression
Riverine Flooding	53 %	Health / Wellness	Damage	Disruption	Engineering Judgment	Hazard Exposure	Exposure
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

MBTA Commuter Rail Line - Risk

Coastal Flooding

Total Number of Assets

51 half-mile segments

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Depth of Coastal Flooding

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Depth of 100-yr flood is more than 2 ft
Medium Rating	Depth of 100-yr flood is between 0.5 and 2 ft
Low Rating	Depth of 100-yr flood is less than 0.5 ft
Not Assessed	Not assessed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**0**/51	**0**/51	**0**/51	**0**/51
High Rating	**8**/51	**9**/51	**9**/51	**10**/51
Medium Rating	**0**/51	**0**/51	**1**/51	**1**/51
Low Rating	**3**/51	**2**/51	**1**/51	**1**/51
Negligible	**40**/51	**40**/51	**40**/51	**39**/51

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

MBTA Commuter Rail Line - Risk

Stormwater Flooding

Total Number of Assets

51 half-mile segments

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall & Location in a Depression

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/51	**14**/51	**51**/51	**51**/51
High Rating	**14**/51	**37**/51	**0**/51	**0**/51
Medium Rating	**37**/51	**0**/51	**0**/51	**0**/51
Low Rating	**0**/51	**0**/51	**0**/51	**0**/51
Negligible	**0**/51	**0**/51	**0**/51	**0**/51

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

MBTA Commuter Rail Line - Risk

Riverine Flooding

Total Number of Assets

51 half-mile segments

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**0**/51
High Rating	**26**/51
Medium Rating	**1**/51
Low Rating	**0**/51
Negligible	**24**/51

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Roads, Bridges, and Culverts

1. Roads
2. Bridges

Roads

Total Number of Assets

84,699 half-mile segments

Available Asset Characteristics

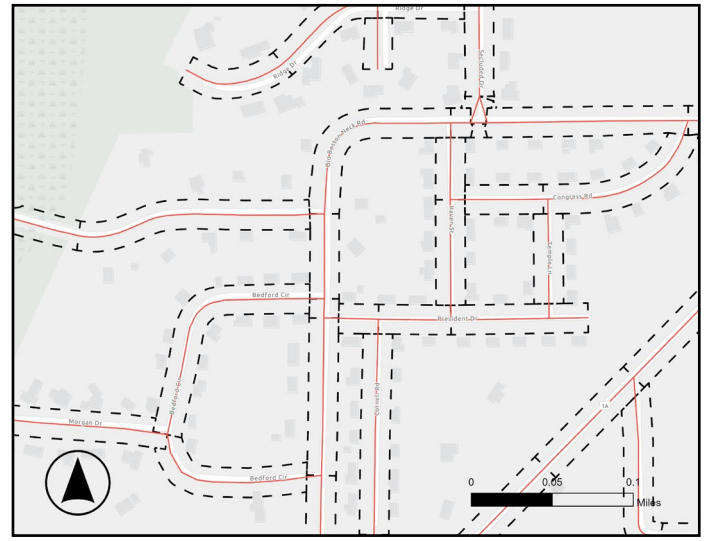
Route Name, Pavement Condition (Sensitivity), & Route Density (Adaptive Capacity)

Asset – Hazard Pairing

Asset Summary

There are over 40,000 miles of roads throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding, stormwater flooding, and riverine flooding.

Roads are a vital part of the State's infrastructure, serving as the primary means of transportation for Rhode Islanders. Flooding can significantly disrupt the daily commute.



Example Asset Buffer:
Roads - Narragansett, RI

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	12 %	Health / Wellness	Damage	Disruption	RIDOT RIP	Sensitivity	Poor Condition
Stormwater Flooding	100 %	Health / Wellness	Damage	Disruption	RIDOT RIP	Sensitivity	Poor Condition, Located in a Depression
Riverine Flooding	49 %	Health / Wellness	Damage	Disruption	RIDOT RIP	Sensitivity	Poor Condition
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

Roads - Risk

Coastal Flooding

Total Number of Assets

84,699 half-mile segments

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Depth of Coastal Flooding & Pavement Condition

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Depth of 100-yr flood is more than 2 ft
Medium Rating	Depth of 100-yr flood is between 0.5 and 2 ft
Low Rating	Depth of 100-yr flood is less than 0.5 ft
Not Assessed	Not assessed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	Poor, fair, or no information on pavement condition
Low Rating	Excellent or good pavement condition

Data Sources: Rhode Island Department of Transportation Resilience Improvement Plan (RIDOT), 2024.

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**3636**/84699	**3715**/84699	**4694**/84699	**6887**/84699
High Rating	**2261**/84699	**2445**/84699	**2357**/84699	**2589**/84699
Medium Rating	**613**/84699	**701**/84699	**708**/84699	**629**/84699
Low Rating	**2226**/84699	**1875**/84699	**1040**/84699	**163**/84699
Negligible	**75963**/84699	**75963**/84699	**75900**/84699	**74431**/84699

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Roads - Risk

Stormwater Flooding

Total Number of Assets

84,699 half-mile segments

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Stormwater Rainfall, Pavement Condition, & Location in a Land Depression

Consequence

Health / Wellness | Damage | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Poor, fair, or no information on pavement condition or located in a depression
Low Rating	Excellent or good pavement condition and not located in a depression

Data Sources: Rhode Island Department of Transportation Resilience Improvement Plan (RIDOT), 2024.

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/84699	**37814**/84699	**79532**/84699	**79532**/84699
High Rating	**37814**/84699	**44242**/84699	**5167**/84699	**5167**/84699
Medium Rating	**44242**/84699	**2643**/84699	**0**/84699	**0**/84699
Low Rating	**2643**/84669	**0**/84699	**0**/84699	**0**/84699
Negligible	**0**/84699	**0**/84699	**0**/84699	**0**/84699

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Roads - Risk

Riverine Flooding

Total Number of Assets

84,699 half-mile segments

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Riverine Flood Exposure & Pavement Condition

Consequence

Health / Wellness | Damage | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	Poor, fair, or no information on pavement condition
Low Rating	Excellent or good pavement condition

Data Sources: Rhode Island Department of Transportation Resilience Improvement Plan (RIDOT), 2024.

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**4542**/84699
High Rating	**3523**/84699
Medium Rating	**424**/84699
Low Rating	**0**/84669
Negligible	**76210**/84699

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Bridges

Total Number of Assets

1,179

Available Asset Characteristics

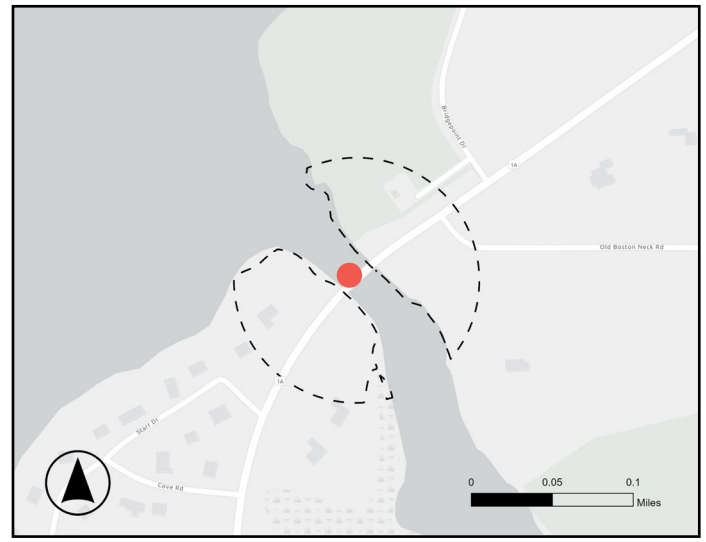
Condition (Sensitivity), Owner, Status, Road Density (Adaptive Capacity)

Asset – Hazard Pairing

Asset Summary

There are 1,179 bridges throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding, stormwater flooding, and riverine flooding.

Bridges are densely located around the State, connecting towns and essential resources. Excessive flooding may cause significant disruptions and delays to transportation over the bridge.



Example Asset Buffer:
Governor Sprague Bridge – Narragansett, RI

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	30 %	Health / Wellness	Damage	Disruption	RIDOT RIP	Sensitivity	Poor Condition
Stormwater Flooding	100 %	Health / Wellness	Damage	Disruption	RIDOT RIP	Sensitivity	Poor Condition, Located in a Depression
Riverine Flooding	49 %	Health / Wellness	Damage	Disruption	RIDOT RIP	Sensitivity	Poor Condition
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

Bridges - Risk

Coastal Flooding

Total Number of Assets

1,179

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Depth of Coastal Flooding & Bridge Condition.

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Depth of 100-yr flood is more than 2 ft
Medium Rating	Depth of 100-yr flood is between 0.5 and 2 ft
Low Rating	Depth of 100-yr flood is less than 0.5 ft
Not Assessed	Not assessed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	Poor, fair, or no information on bridge condition
Low Rating	Excellent or good bridge condition

Data Sources: Rhode Island Department of Transportation Resilience Improvement Plan (RIDOT), 2024.

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**168**/1179	**279**/1179	**287**/1179	**310**/1179
High Rating	**49**/1179	**73**/1179	**72**/1179	**58**/1179
Medium Rating	**3**/1179	**7**/1179	**8**/1179	**10**/1179
Low Rating	**161**/1179	**22**/1179	**18**/1179	**14**/1179
Negligible	**798**/1179	**798**/1179	**794**/1179	**787**/1179

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Bridges - Risk

Stormwater Flooding

Total Number of Assets

1,179

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall, Bridge Condition, & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Poor, fair or no information on bridge condition or located in a depression
Low Rating	Excellent or good bridge condition and not located is a depression

Data Sources: Rhode Island Department of Transportation Resilience Improvement Plan (RIDOT), 2024 and SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/1179	**648**/1179	**1175**/1179	**1175**/1179
High Rating	**648**/1179	**527**/1179	**4**/1179	**4**/1179
Medium Rating	**527**/1179	**0**/1179	**0**/1179	**0**/1179
Low Rating	**0**/1179	**0**/1179	**0**/1179	**0**/1179
Negligible	**0**/1179	**0**/1179	**0**/1179	**0**/1179

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Bridges - Risk

Riverine Flooding

Total Number of Assets

1,179

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Riverine Flood Exposure & Bridge Condition

Consequence

Health / Wellness | Damage | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	Poor, fair, or no information on bridge condition
Low Rating	Excellent or good bridge condition

Data Sources: Rhode Island Department of Transportation Resilience Improvement Plan (RIDOT), 2024.

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**516**/1179
High Rating	**62**/1179
Medium Rating	**5**/1179
Low Rating	**0**/1179
Negligible	**596**/1179

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Seawalls and Tidal Gates

1. Hardened Structures

Hardened Shorelines

Total Number of Assets

1,098

Available Asset Characteristics

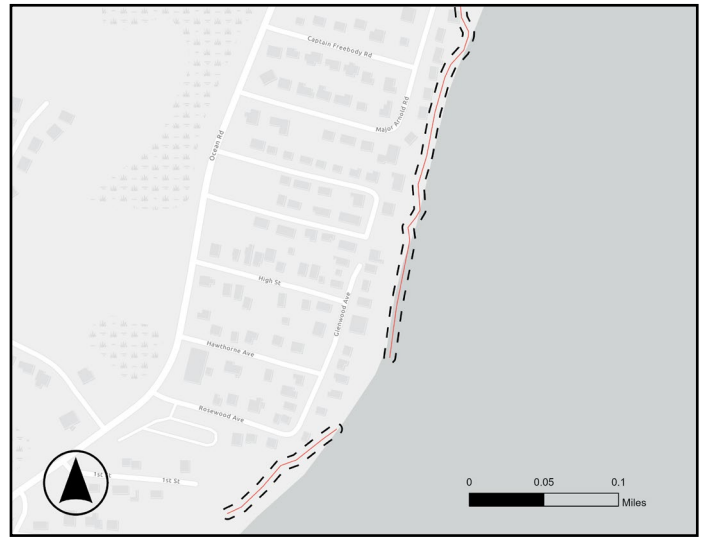
Type of Structure

Asset – Hazard Pairing

Asset Summary

The 1,098 hardened shoreline structures in Narragansett Bay and their vulnerability are assessed to coastal flooding.

Hardened structures are used to protect inland areas from coastal flooding; however, they remain vulnerable to coastal flooding and degradation caused by erosion.



Example Asset Buffer:
Hardened Shorelines – Narragansett, RI

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	98 %	Health / Wellness	**Damage**	Disruption	Asset Data	Type of Structure	Less Protective Structure
Stormwater Flooding	100 %	Health / Wellness	Damage	Disruption	-	-	-
Riverine Flooding	0 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

Hardened Shorelines - Risk

Coastal Flooding

Total Number of Assets

1,098

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Type of Structure & Location in a Wave Action Area (FEMA Zone VE)

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	-
Medium Rating	Erosion (Located in FEMA Zone VE, Wave)
Low Rating	No Erosion (Not located in FEMA Zone VE, Wave Action)
Not Assessed	Not assessed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	Permanent Pier, Other Significant Pier, or Other Hardened Structure.
Low Rating	Revetment, Groin, Seawall, Bulkhead, Jetty, or Breakwater.

Data Sources: URI Environmental Data Center and RIGIS.

*Results are presented only for the current, because only present-day data on erosion, FEMA FIRM, was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**0**/1098
High Rating	**70**/1098
Medium Rating	**844**/1098
Low Rating	**0**/1098
Negligible	**184**/1098

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Stormwater Infrastructure

1. Sewer Overflows
2. Sewered Area
3. Stormwater Treatment Unit (STU)
4. Stormwater Control Plan (SCP) Watersheds

Sewer Overflows

Total Number of Assets

93

Available Asset Characteristics

Status

Asset – Hazard Pairing

Asset Summary

There are 93 sewer overflows throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding and stormwater flooding.

Sewer overflows are used when wastewater systems exceed their capacity. During periods of excessive flooding, this infrastructure can become compromised, leaving limited space to manage the additional water volume.

Example Asset Buffer:
Sewer Overflow – Providence, RI

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	54 %	Health / Wellness	**Damage**	**Disruption**	Engineering Judgment	Hazard Exposure	High Flood Depth
Stormwater Flooding	100 %	Health / Wellness	Damage	**Disruption**	Engineering Judgment	Hazard Exposure	High Rainfall
Riverine Flooding	26 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

Sewer Overflows - Risk

Coastal Flooding

Total Number of Assets

93

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Depth of Coastal Flooding

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Depth of 100-yr flood is more than 2 ft
Medium Rating	Depth of 100-yr flood is between 0.5 and 2 ft
Low Rating	Depth of 100-yr flood is less than 0.5 ft
Not Assessed	Not assessed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**0**/93	**0**/93	**0**/93	**0**/93
High Rating	**23**/93	**33**/93	**35**/93	**36**/93
Medium Rating	**3**/93	**4**/93	**3**/93	**4**/93
Low Rating	**24**/93	**13**/93	**12**/93	**10**/93
Negligible	**43**/93	**43**/93	**43**/93	**43**/93

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Sewer Overflows - Risk

Stormwater Flooding

Total Number of Assets

93

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall & Location in a Land Depression

Consequence

Health / Wellness | Damage | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/93	**35**/93	**35**/93	**35**/93
High Rating	**35**/93	**58**/93	**58**/93	**58**/93
Medium Rating	**58**/93	**0**/93	**0**/93	**0**/93
Low Rating	**0**/93	**0**/93	**0**/93	**0**/93
Negligible	**0**/93	**0**/93	**0**/93	**0**/93

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Sewered Area

Total Number of Assets

21

Available Asset Characteristics

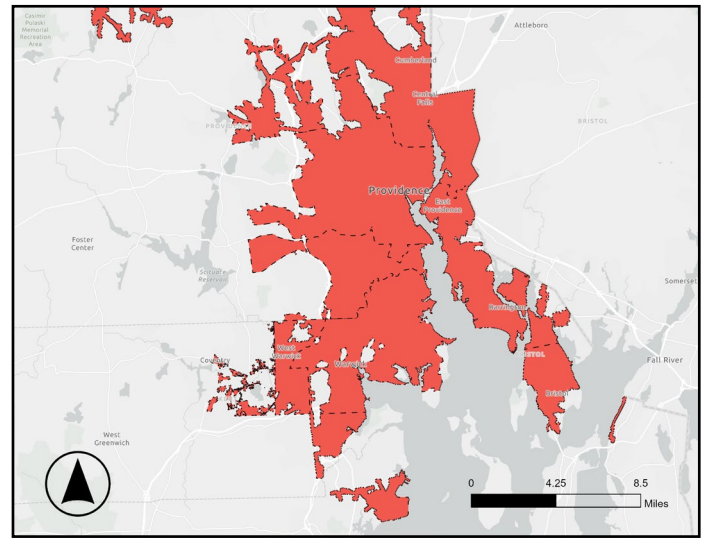
Condition, Owner, & Status

Asset – Hazard Pairing

Asset Summary

There are 21 sewer areas throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding and stormwater flooding.

Sewered areas consist of regions served by both public and private sewer systems. During periods of excessive flooding, these systems can exceed their capacity, potentially leading to damage or contamination of other water supplies.



Example Asset Buffer:
Sewered Areas

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	76 %	Health / Wellness	**Damage**	**Disruption**	Engineering Judgment	Hazard Exposure	Large % of Area Exposed
Stormwater Flooding	100 %	Health / Wellness	**Damage**	**Disruption**	Engineering Judgment	Hazard Exposure	High Rainfall
Riverine Flooding	95 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

Sewered Area - Risk

Coastal Flooding

Total Number of Assets

21

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Depth of Coastal Flooding

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	> 30% MHHW Inundation
Medium Rating	10 – 30% MHHW Inundation
Low Rating	< 10% MHHW Inundation
Not Assessed	Not exposed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**0**/21	**0**/21	**0**/21	**0**/21
High Rating	**0**/21	**0**/21	**0**/21	**0**/21
Medium Rating	**0**/21	**0**/21	**0**/21	**5**/21
Low Rating	**16**/21	**16**/21	**16**/21	**11**/21
Negligible	**5**/21	**5**/21	**5**/21	**5**/21

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Sewered Area - Risk

Stormwater Flooding

Total Number of Assets

21

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/21	**10**/21	**21**/21	**21**/21
High Rating	**0**/21	**11**/21	**0**/21	**0**/21
Medium Rating	**11**/21	**0**/21	**0**/21	**0**/21
Low Rating	**10**/21	**0**/21	**0**/21	**0**/21
Negligible	**0**/21	**0**/21	**0**/21	**0**/21

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Stormwater Treatment Unit (STU)

Total Number of Assets

2,476

Available Asset Characteristics

Type of STU & Inspection Scores

Asset – Hazard Pairing

Example Asset Buffer:
I-295 from Rt 37 to Plainfield Pike

Asset
Buffer

Asset Summary

There are 2,476 stormwater treatment units (STUs) throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding and stormwater flooding.

The STUs is a type of stormwater infrastructure that treats the pollutants in stormwater runoff, so water can re-enter the natural environment. During periods of excessive flooding, these systems can exceed their capacity and potentially get damaged.

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	16 %	Health / Wellness	**Damage**	Disruption	RIDOT RIP	Sensitivity and Adaptive Capacity	Poor Condition
Stormwater Flooding	100 %	Health / Wellness	**Damage**	Disruption	RIDOT RIP	Sensitivity and Adaptive Capacity	Poor Condition
Riverine Flooding	17 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

Stormwater Treatment Unit (STU) - Risk

Coastal Flooding

Total Number of Assets

2,476

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Depth of Coastal Flooding & Inspection Scores

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Depth of 100-yr flood is more than 2 ft
Medium Rating	Depth of 100-yr flood is between 0.5 and 2 ft
Low Rating	Depth of 100-yr flood is less than 0.5 ft
Not Assessed	Not assessed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	Inspection scores between 0 and 60 or have no information
Low Rating	Inspection scores between 60 and 100

Data Sources: Rhode Island Department of Transportation Resilience Improvement Plan (RIDOT), 2024.

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**24**/2476	**29**/2476	**36**/2476	**55**/2476
High Rating	**103**/2476	**183**/2476	**198**/2476	**259**/2476
Medium Rating	**72**/2476	**45**/2476	**51**/2476	**64**/2476
Low Rating	**133**/2476	**75**/2476	**54**/2476	**14**/2476
Negligible	**2144**/2476	**2144**/2476	**2137**/2476	**2084**/2476

Vulnerability Methodology Legend — Used | Not Used

Consequence Legend — Primary | Cascading | Not Considered

Stormwater Treatment Unit (STU) - Risk

Stormwater Flooding

Total Number of Assets

2,476

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall, Location in a Land Depression, & Inspection Scores

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Inspection scores between 0 and 60 or have no information or located in a depression
Low Rating	Inspection scores between 60 and 100 and not located is a depression

Data Sources: Rhode Island Department of Transportation Resilience Improvement Plan (RIDOT), 2024 (Inspection Scores) and SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/2476	**1144**/2476	**2475**/2476	**2475**/2476
High Rating	**1144**/2476	**1331**/2476	**1**/2476	**1**/2476
Medium Rating	**1331**/2476	**1**/2476	**0**/2476	**0**/2476
Low Rating	**1**/2476	**0**/2476	**0**/2476	**0**/2476
Negligible	**0**/2476	**0**/2476	**0**/2476	**0**/2476

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

SCP Watersheds

Total Number of Assets

297

Available Asset Characteristics

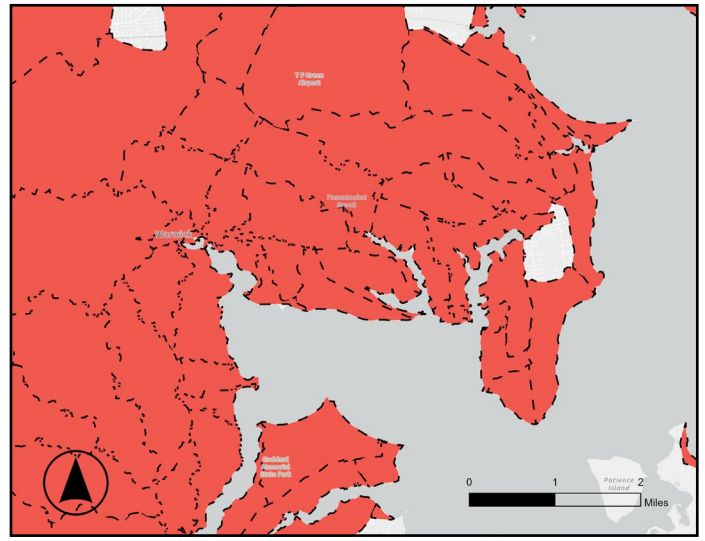
Status, Materiality, Type of Water, Total Maximum Daily Load (TWML) & Contamination

Asset – Hazard Pairing

Asset Summary

There are 297 Stormwater Control Plan (SCP) watersheds throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding and stormwater flooding.

The SCP watersheds are designated bodies of water for stormwater runoff. During periods of excessive flooding, these systems can exceed their capacity and potentially get damaged due to additional contamination.



Example Asset Buffer:
SCP Watershed

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	76 %	Health / Wellness	**Damage**	Disruption	Asset Data	Water Type	Fresh Water
Stormwater Flooding	100 %	Health / Wellness	**Damage**	Disruption	Asset Data	TMDLs	Presence of TMDL
Riverine Flooding	95 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

SCP Watersheds - Risk

Coastal Flooding

Total Number of Assets

297

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Coastal Flooding Exposure and Type of Water

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	> 30% MHHW Inundation
Medium Rating	10 – 30% MHHW Inundation
Low Rating	< 10% MHHW Inundation
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	Fresh water
Low Rating	Salt water

Data Sources: Rhode Island Department of Transportation (RIDOT) Stormwater Program

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**0**/297	**0**/297	**1**/297	**5**/297
High Rating	**6**/297	**7**/297	**8**/297	**19**/297
Medium Rating	**31**/297	**38**/297	**43**/297	**58**/297
Low Rating	**43**/297	**41**/297	**37**/297	**21**/297
Negligible	**217**/297	**211**/297	**208**/297	**194**/297

Vulnerability Methodology Legend — Used | Not Used

Consequence Legend — **Primary** | Cascading | Not Considered

SCP Watersheds - Risk

Stormwater Flooding

Total Number of Assets

297

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall & Total Maximum Daily Load (TMDL)

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Listed Total Maximum Daily Load (TMDL)
Low Rating	No Total Maximum Daily Load (TMDL) listed

Data Sources: Rhode Island Department of Transportation (RIDOT) Stormwater Program

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/297	**46**/297	**172**/297	**172**/297
High Rating	**46**/297	**178**/297	**125**/297	**125**/297
Medium Rating	**178**/297	**73**/297	**0**/297	**0**/297
Low Rating	**73**/297	**0**/297	**0**/297	**0**/297
Negligible	**0**/297	**0**/297	**0**/297	**0**/297

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Wastewater Treatment Facilities

Wastewater Treatment Facility

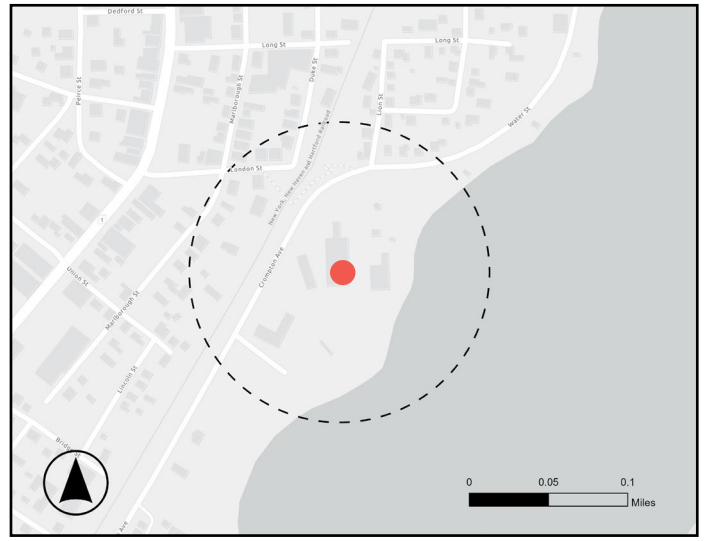
Total Number of Assets

19

Available Asset Characteristics

Design Flow & Daily Flow

Asset – Hazard Pairing



Example Asset Buffer:
Wastewater Treatment Facility – East Greenwich, RI

Asset
Buffer

Asset Summary

There are 19 wastewater treatment facilities throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding and stormwater flooding.

Wastewater treatment facilities process contaminated water so it can be safely returned to the natural environment. However, during periods of excessive flooding, these facilities may exceed their flow capacity. Smaller treatment plants are particularly vulnerable to the impacts of flooding.

Wastewater Treatment Facilities are evaluated as FEMA Occupancy Class: IND2

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	19 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	High Damage
Stormwater Flooding	100 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	Occupancy Class, Located in a Depression
Riverine Flooding	37 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	Relatively Vulnerable Occupancy Class
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

Wastewater Treatment Facility - Risk

Coastal Flooding

Total Number of Assets

19

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Coastal Flooding Exposure and Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 30% damage to the 100-yr flood
High Rating	10-30% damage to the 100-yr flood
Medium Rating	<10 % damage to the 100-yr flood
Low Rating	Exposure damage to the 100-yr flood
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLs and Hazus Flood Fragilities*

* Occupancy code IND2 assumed at-grade

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**9**/19	**9**/19	**11**/19	**12**/19
High Rating	**2**/19	**2**/19	**1**/19	**1**/19
Medium Rating	**1**/19	**2**/19	**2**/19	**1**/19
Low Rating	**2**/19	**1**/19	**0**/19	**0**/19
Negligible	**5**/19	**5**/19	**5**/19	**5**/19

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Wastewater Treatment Facility - Risk

Stormwater Flooding

Total Number of Assets

19

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/19	**7**/19	**19**/19	**19**/19
High Rating	**7**/19	**12**/19	**0**/19	**0**/19
Medium Rating	**12**/19	**0**/19	**0**/19	**0**/19
Low Rating	**0**/19	**0**/19	**0**/19	**0**/19
Negligible	**0**/19	**0**/19	**0**/19	**0**/19

Vulnerability Methodology Legend — Used | Not Used

Consequence Legend — Primary | Cascading | Not Considered

Wastewater Treatment Facility - Risk

Riverine Flooding

Total Number of Assets

19

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**0**/19
High Rating	**5**/19
Medium Rating	**2**/19
Low Rating	**0**/19
Negligible	**12**/19

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

C.2. Natural Systems

Asset Results

Natural Systems

1. Beaches and Barriers
2. Coastal Wetlands
3. Forests
4. Water Resources

Beaches and Barriers

1. Coastal Barriers

Coastal Barriers

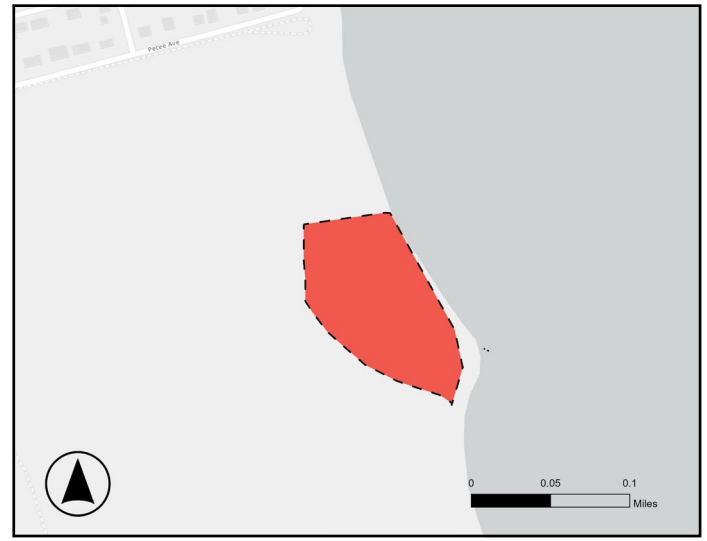
Total Number of Assets

134

Available Asset Characteristics

Barrier Type & Presence of Hardened Structures

Asset – Hazard Pairing



Example Asset Buffer:
Coastal Barriers – North Kingston, RI

Asset
Buffer

Asset Summary

There are 134 coastal barriers throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding.

Coastal barriers are sand or gravel islands or spits that run parallel to the shoreline and are separated from the mainland. Developed barriers, which contain houses and commercial structures, are more vulnerable to coastal flooding than undeveloped barriers, which lack such infrastructure.

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	99 %	Health / Wellness	**Damage**	Disruption	Asset Data	Barrier Type	Developed Barrier
Stormwater Flooding	100 %	Health / Wellness	Damage	Disruption	-	-	-
Riverine Flooding	0 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

Coastal Barriers - Risk

Coastal Flooding

Total Number of Assets

134

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Type of Structure and Location in a Wave Action Area (FEMA Zone VE)

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	-
Medium Rating	Erosion (Located in FEMA Zone VE, Wave)
Low Rating	No Erosion (Not located in FEMA Zone VE, Wave Action)
Not Assessed	Not assessed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	Bar type is developed or moderately developed
Low Rating	Bar type is undeveloped or welded

Data Sources: URI Environmental Data Center and RIGIS.

*Results are presented only for the current, because only present-day data on erosion, FEMA FIRM, was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**0**/134
High Rating	**37**/134
Medium Rating	**92**/134
Low Rating	**0**/134
Negligible	**0**/134

Vulnerability Methodology Legend Used | Not Used

Consequence Legend **Primary** | Cascading | Not Considered

Coastal Wetlands

Coastal Wetlands

Total Number of Assets

9,953

Available Asset Characteristics

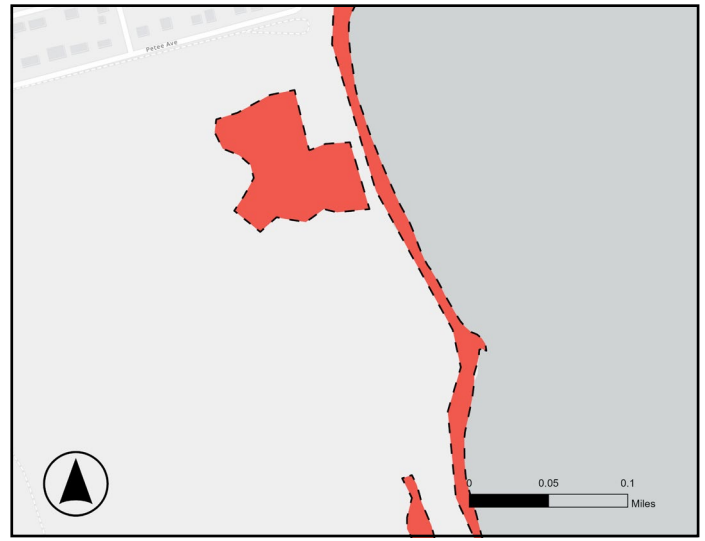
Type of Wetlands

Asset – Hazard Pairing

Asset Summary

There are 9,953 coastal wetlands throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding.

Coastal wetlands are bodies of water located within 250 feet of the shoreline, but distinct from the open ocean. These areas, including ponds, rivers, and lakes, are susceptible to the impacts of coastal flooding, especially widespread inundation.



Example Asset Buffer:
Coastal Wetlands – North Kingston, RI

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	100 %	Health / Wellness	**Damage**	Disruption	Asset Data	Type of Wetland	Wetland Vulnerable to Satlwater Intrusion
Stormwater Flooding	100 %	Health / Wellness	Damage	Disruption	-	-	-
Riverine Flooding	1 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

Coastal Wetlands - Risk

Coastal Flooding

Total Number of Assets

9,953

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Coastal Flooding Exposure & Type of Wetland

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	> 30% MHHW Inundation
Medium Rating	10 – 30% MHHW Inundation
Low Rating	< 10% MHHW Inundation
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	Freshwater Pond, Freshwater Forested/Shrub Wetland, and Freshwater Emergent Wetland
Low Rating	Lake, Estuarine and Marine Deepwater, and Estuarine and Marine Wetland, and Other

Data Sources: URI Environmental Data Cener and RIGIS.

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**60**/9953	**75**/9953	**106**/9953	**279**/9953
High Rating	**8223**/9953	**8640**/9953	**8994**/9953	**9542**/9953
Medium Rating	**631**/9953	**551**/9953	**417**/9953	**46**/9953
Low Rating	**1022**/9953	**670**/9953	**419**/9953	**73**/9953
Negligible	**17**/9953	**17**/134	**17**/134	**13**/9953

Vulnerability Methodology Legend Used | Not Used

Consequence Legend **Primary** | Cascading | Not Considered

Forests

1. Forest Blocks
2. State Conservation Lands

Forest Blocks

Total Number of Assets

353

Available Asset Characteristics

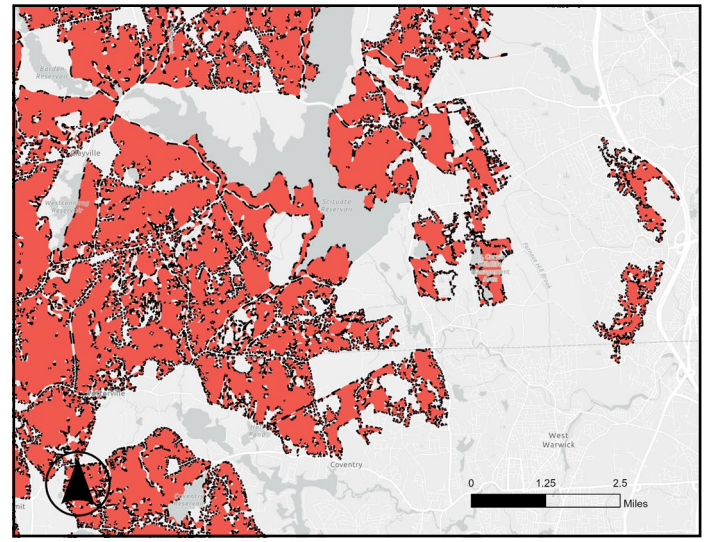
Area

Asset – Hazard Pairing

Asset Summary

There are 353 forest blocks throughout the state of Rhode Island and their vulnerability are assessed for extreme heat and wind.

Forest blocks cover approximately 55% of Rhode Island, totaling around 360,000 acres. These forests provide numerous ecological benefits, including enhanced biodiversity, improved air and water quality, and soil conservation. However, they are vulnerable to damage from extreme winds, which can cause trees to be uprooted or broken. Prolonged extreme heat can also stress forest ecosystems.



Example Asset Buffer:
Forest Blocks

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	8 %	Health / Wellness	Damage	Disruption	-	-	-
Stormwater Flooding	100 %	Health / Wellness	Damage	Disruption	-	-	-
Riverine Flooding	91 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Heat	100 %	Health / Wellness	**Damage**	Disruption	The Nature Conservancy	Terrestrial Resilience	Least Resilient
Extreme Wind	100 %	Health / Wellness	**Damage**	Disruption	The Nature Conservancy	Terrestrial Resilience	Least Resilient

Consequence Legend Primary | Cascading | Not Considered

Forest Blocks - Risk

Extreme Heat

Total Number of Assets

353

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Extreme Heat Exposure & Terrestrial Resilience

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	More than 14 annual days above 90°F
Medium Rating	Between 7 and 14 annual days above 90°F
Low Rating	Less than 7 annual days above 90°F
Negligible	Not exposed

Data Sources: RIDOH Climate Explorer and NOAA.

Vulnerability Rating	Vulnerability Methodology
High Rating	More than 25% of forest block has low terrestrial resilience
Low Rating	Other

Data Sources: The Nature Conservancy (TNC) Resilient Land Mapping Tool

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/353	**0**/192	**54**/353	**81**/353
High Rating	**0**/353	**54**/353	**188**/353	**272**/353
Medium Rating	**81**/353	**188**/353	**111**/353	**0**/353
Low Rating	**272**/353	**111**/353	**0**/353	**0**/353
Negligible	**0**/353	**0**/353	**0**/353	**0**/353

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Forest Blocks - Risk

Extreme Wind

Total Number of Assets

353

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Wind Exposure & Terrestrial Resilience

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	100-yr, 3-s gust is more than Category 2
Medium Rating	100-yr, 3-s gust is equal to Category 2
Low Rating	100-yr, 3-s gust is equal to Category 1
Negligible	100-yr, 3-s gust is less than Category 1

Data Sources: ASCE7 Design Wind Speeds.

Vulnerability Rating	Vulnerability Methodology
High Rating	More than 25% of forest block has low terrestrial resilience
Low Rating	Other

Data Sources: The Nature Conservancy (TNC) Resilient Land Mapping Tool

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/353	**0**/353	**0**/353	**0**/353
High Rating	**28**/353	**28**/353	**38**/353	**81**/353
Medium Rating	**167**/353	**167**/353	**198**/353	**272**/353
Low Rating	**158**/353	**158**/353	**117**/353	**0**/353
Negligible	**0**/353	**0**/353	**0**/353	**0**/353

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

State Conservation Lands

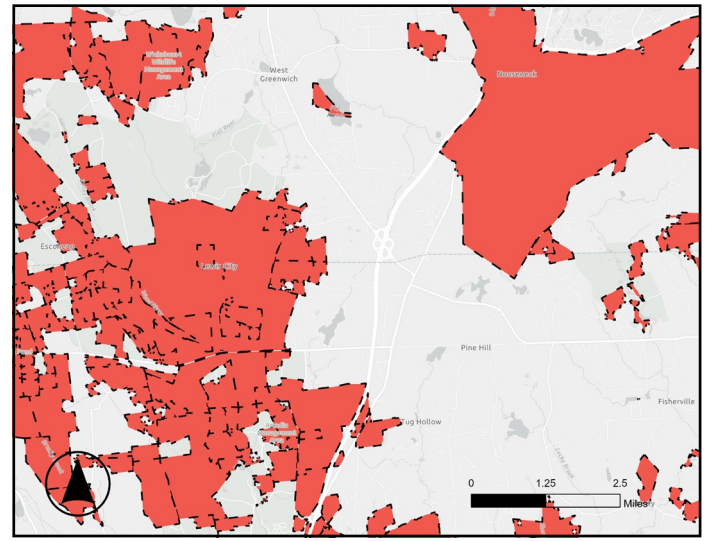
Total Number of Assets

1,032

Available Asset Characteristics

Primary Use Type

Asset – Hazard Pairing



Example Asset Buffer:
State Conservation Lands

Asset
Buffer

Asset Summary

There are 1,032 state conservation lands throughout the state of Rhode Island and their vulnerability are assessed for extreme heat and wind.

These protected areas, designated by the state of Rhode Island, include various types, including forest habitats, state parks, bikeways, and scenic roadways. These sites are susceptible to damage due to extreme heat and wind.

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	25 %	Health / Wellness	Damage	Disruption	-	-	-
Stormwater Flooding	100 %	Health / Wellness	Damage	Disruption	-	-	-
Riverine Flooding	59 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Heat	100 %	**Health / Wellness**	**Damage**	Disruption	The Nature Conservancy	Terrestrial Resilience	Least Resilient
Extreme Wind	100 %	Health / Wellness	**Damage**	**Disruption**	The Nature Conservancy	Terrestrial Resilience	Least Resilient

Consequence Legend Primary | Cascading | Not Considered

State Conservation Lands - Risk

Extreme Heat

Total Number of Assets

1,032

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Extreme Heat Exposure & Terrestrial Resilience

Consequence

Health / Wellness | Damage | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	More than 14 annual days above 90°F
Medium Rating	Between 7 and 14 annual days above 90°F
Low Rating	Less than 7 annual days above 90°F
Negligible	Not exposed

Data Sources: RIDOH Climate Explorer and NOAA.

Vulnerability Rating	Vulnerability Methodology
High Rating	More than 25% of forest block has low terrestrial resilience
Low Rating	Other

Data Sources: The Nature Conservancy (TNC) Resilient Land Mapping Tool

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/1032	**0**/1032	**195**/1032	**412**/1032
High Rating	**0**/1032	**195**/1032	**472**/1032	**620**/1032
Medium Rating	**412**/1032	**472**/1032	**365**/1032	**0**/1032
Low Rating	**620**/1032	**365**/1032	**0**/1032	**0**/1032
Negligible	**0**/1032	**0**/1032	**0**/1032	**0**/1032

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

State Conservation Lands - Risk

Extreme Wind

Total Number of Assets

1,032

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Wind Exposure & Terrestrial Resilience

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	100-yr, 3-s gust is more than Category 2
Medium Rating	100-yr, 3-s gust is equal to Category 2
Low Rating	100-yr, 3-s gust is equal to Category 1
Negligible	100-yr, 3-s gust is less than Category 1

Data Sources: ASCE7 Design Wind Speeds.

Vulnerability Rating	Vulnerability Methodology
High Rating	More than 25% of forest block has low terrestrial resilience
Low Rating	Other

Data Sources: The Nature Conservancy (TNC) Resilient Land Mapping Tool

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/1032	**0**/1032	**0**/1032	**0**/1032
High Rating	**217**/1032	**217**/1032	**275**/1032	**412**/1032
Medium Rating	**561**/1032	**561**/1032	**580**/1032	**620**/1032
Low Rating	**254**/1032	**254**/1032	**177**/1032	**0**/1032
Negligible	**0**/1032	**0**/1032	**0**/1032	**0**/1032

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Water Resources

1. Rivers and Streams
2. Streams
3. Lakes and Ponds

Rivers and Streams

Total Number of Assets

1,972

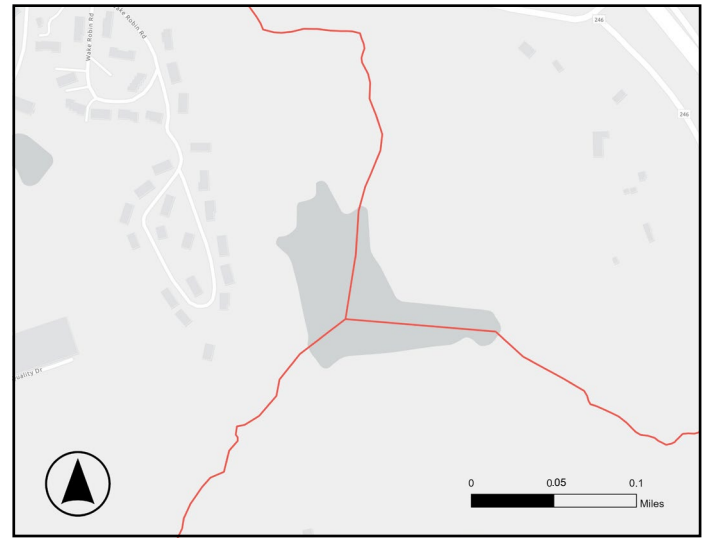
Available Asset Characteristics

Proximity to Algal Blooms and Superfund Sites, Water Temperature, Critical Habitat, Runoff Contamination, & Water Purpose

Asset – Hazard Pairing

Asset Summary

There are 1,972 rivers and streams throughout the state of Rhode Island and their vulnerability are assessed for extreme heat. Warmer water temperatures can increase the likelihood of algal blooms, which may have harmful effects on aquatic ecosystems. This is especially concerning for critically endangered habitats, where even minor disruptions can have significant consequences.



Example Asset Buffer:
Rivers and Streams

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	16 %	Health / Wellness	Damage	**Disruption**	Engineering Judgment	Hazard Exposure	Saltwater Intrusion
Stormwater Flooding	100 %	**Health / Wellness**	Damage	Disruption	RIDEM	Runoff Contamination	Contamination
Riverine Flooding	65 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Heat	100 %	**Health / Wellness**	Damage	Disruption	RIDEM	Algal Blooms	History of Cyanobacteria
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

Rivers and Streams - Risk

Coastal Flooding

Total Number of Assets

1,972

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Coastal Flood Exposure

Consequence

Health / Wellness | Damage | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Depth of 100-yr flood is more than 2 ft
Medium Rating	Depth of 100-yr flood is between 0.5 and 2 ft
Low Rating	Depth of 100-yr flood is less than 0.5 ft
Not Assessed	Not assessed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	Distance from a superfund site is equal to 5,280 ft or more
Low Rating	Distance from a superfund site is less than 5,280 ft

Data Sources: Environmental Protection Agency (EPA).

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**0**/1972	**0**/1972	**0**/1972	**0**/1972
High Rating	**225**/1972	**247**/1972	**247**/1972	**275**/1972
Medium Rating	**29**/1972	**34**/1972	**27**/1972	**23**/1972
Low Rating	**39**/1972	**26**/1972	**21**/1972	**18**/1972
Negligible	**1679**/1972	**1679**/1972	**1677**/1972	**1656**/1972

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Rivers and Streams - Risk

Stormwater Flooding

Total Number of Assets

1,972

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Stormwater Rainfall & Distance from a Superfund Site

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Distance from a superfund site is equal to 5,280 ft or more
Low Rating	Distance from a superfund site is less than 5,280 ft

Data Sources: Environmental Protection Agency (EPA).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/1972	**97**/1972	**197**/1972	**197**/1972
High Rating	**97**/1972	**1019**/1972	**1774**/1972	**1774**/1972
Medium Rating	**1019**/1972	**855**/1972	**0**/1972	**0**/1972
Low Rating	**856**/1972	**1**/1972	**1**/1972	**1**/1972
Negligible	**0**/1972	**0**/1972	**0**/1972	**0**/1972

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Rivers and Streams - Risk

Extreme Heat

Total Number of Assets

1,972

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Extreme Heat Exposure and Distance from Reported Algal Blooms

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	More than 14 annual days above 90°F
Medium Rating	Between 7 and 14 annual days above 90°F
Low Rating	Less than 7 annual days above 90°F
Negligible	Not exposed

Data Sources: RIDOH Climate Explorer and NOAA.

Vulnerability Rating	Vulnerability Methodology
High Rating	Distance from a body of water with reported algal bloom is equal to 5,280 ft or more
Low Rating	Distance from a body of water with reported algal boom is less than 5, 280 ft

Data Sources: Rhode Island Department of Environmental Management (RIDEM).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/1972	**0**/1972	**246**/1972	**336**/1972
High Rating	**0**/1972	**246**/1972	**1200**/1972	**1635**/1972
Medium Rating	**336**/1972	**1200**/1972	**525**/1972	**0**/1972
Low Rating	**1636**/1972	**526**/1972	**1**/1972	**1**/1972
Negligible	**0**/1972	**0**/1972	**0**/1972	**0**/1972

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Streams

Total Number of Assets

6,816

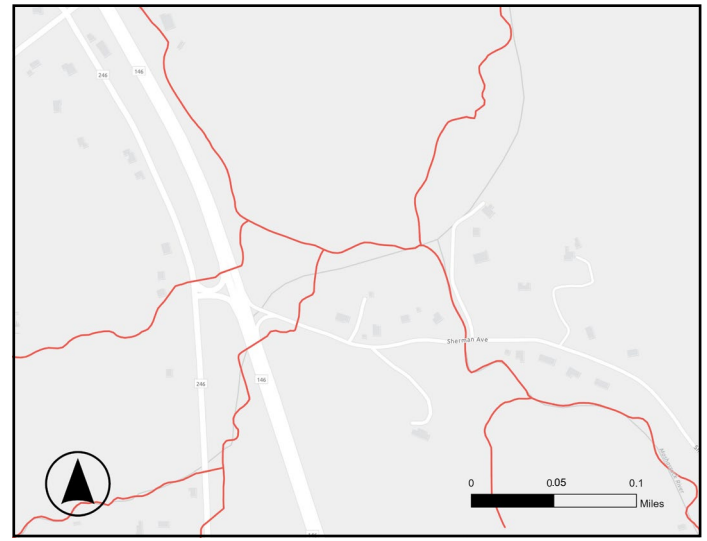
Available Asset Characteristics

Algal Blooms Advisories

Asset – Hazard Pairing

Asset Summary

There are 6,816 streams throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding and extreme heat. Some but not all assets in this dataset are also represented in the "Rivers and Streams" asset. Warmer water temperatures can increase the likelihood of algal blooms, which may have harmful effects on aquatic ecosystems.



Example Asset Buffer:
Streams

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	11 %	Health / Wellness	**Damage**	**Disruption**	Engineering Judgment	Hazard Exposure	Saltwater Intrusion
Stormwater Flooding	100 %	Health / Wellness	Damage	Disruption	-	-	-
Riverine Flooding	49 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Heat	100 %	**Health / Wellness**	**Damage**	Disruption	RIDEM	Algal Blooms	History of Cyanobacteria
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

Streams - Risk

Coastal Flooding

Total Number of Assets

6,816

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Coastal Flood Exposure

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Depth of 100-yr flood is more than 2 ft
Medium Rating	Depth of 100-yr flood is between 0.5 and 2 ft
Low Rating	Depth of 100-yr flood is less than 0.5 ft
Not Assessed	Not assessed

Data Sources: URI Coastal STORMTOOLS.

Vulnerability Rating	Vulnerability Methodology
High Rating	Distance from a superfund site is equal to 5,280 ft or more
Low Rating	Distance from a superfund site is less than 5,280 ft

Data Sources: Environmental Protection Agency (EPA).

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**0**/6816	**0**/6816	**0**/6816	**0**/6816
High Rating	**496**/6816	**538**/6816	**564**/6816	**629**/6816
Medium Rating	**60**/6816	**66**/6816	**63**/6816	**73**/6816
Low Rating	**159**/6816	**111**/6816	**95**/6816	**72**/6816
Negligible	**6101**/6816	**6101**/6816	**6094**/6816	**6042**/6816

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Streams - Risk

Extreme Heat

Total Number of Assets

6,816

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Extreme Heat Exposure and Distance from Reported Algal Blooms

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	More than 14 annual days above 90°F
Medium Rating	Between 7 and 14 annual days above 90°F
Low Rating	Less than 7 annual days above 90°F
Negligible	Not exposed

Data Sources: RIDOH Climate Explorer and NOAA.

Vulnerability Rating	Vulnerability Methodology
High Rating	Distance from a body of water with reported algal bloom is equal to 5,280 ft or more
Low Rating	Distance from a body of water with reported algal boom is less than 5, 280 ft

Data Sources: Rhode Island Department of Environmental Management (RIDEM).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/6816	**0**/6816	**592**/6816	**872**/6816
High Rating	**0**/6816	**592**/6816	**4076**/6816	**5943**/6816
Medium Rating	**872**/6816	**4076**/6816	**2147**/6816	**0**/6816
Low Rating	**5944**/6816	**2148**/6816	**1**/6816	**1**/6816
Negligible	**0**/6816	**0**/6816	**0**/6816	**0**/6816

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Lakes and Ponds

Total Number of Assets

3,160

Available Asset Characteristics

Water Temperature, Contamination, Critical Habitat, Presence of Dam, Runoff Contamination, Algal Bloom Advisories, & Size

Asset – Hazard Pairing

Asset Summary

There are 3,160 lakes ands ponds throughout the state of Rhode Island and their vulnerability are assessed for stormwater and extreme heat. Warmer water temperatures can increase the likelihood of algal blooms, which may have harmful effects on aquatic ecosystems. This is especially concerning for critically endangered habitats, where even minor disruptions can have significant consequences.

Example Asset Buffer:
Lakes and Ponds – Lincoln, RI

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	17 %	Health / Wellness	Damage	Disruption	-	-	-
Stormwater Flooding	100 %	**Health / Wellness**	**Damage**	Disruption	RIDEM	Runoff Contamination	Contamination
Riverine Flooding	44 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Heat	100 %	**Health / Wellness**	**Damage**	Disruption	RIDEM	Algal Blooms	History of Cyanobacteria
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

Lakes and Ponds - Risk

Stormwater Flooding

Total Number of Assets

3,160

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Stormwater Rainfall & Distance from a Superfund Site

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Distance from a superfund site is equal to 5,280 ft or more
Low Rating	Distance from a superfund site is less than 5,280 ft

Data Sources: Environmental Protection Agency (EPA).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/3160	**123**/3160	**271**/3160	**271**/3160
High Rating	**123**/3160	**1038**/3160	**2889**/3160	**2889**/3160
Medium Rating	**1038**/3160	**1999**/3160	**0**/3160	**0**/3160
Low Rating	**1999**/3160	**0**/3160	**0**/3160	**0**/3160
Negligible	**0**/3160	**0**/3160	**0**/3160	**0**/3160

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Lakes and Ponds - Risk

Extreme Heat

Total Number of Assets

3,160

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Extreme Heat Exposure & Reported Algal Bloom Advisories

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	More than 14 annual days above 90°F
Medium Rating	Between 7 and 14 annual days above 90°F
Low Rating	Less than 7 annual days above 90°F
Negligible	Not exposed

Data Sources: RIDOH Climate Explorer and NOAA.

Vulnerability Rating	Vulnerability Methodology
High Rating	One or more algal bloom advisories reported
Low Rating	No algal bloom advisories reported

Data Sources: Rhode Island Department of Environmental Management (RIDEM).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/3160	**0**/3160	**21**/3160	**37**/3160
High Rating	**0**/3160	**21**/3160	**1516**/3160	**3123**/3160
Medium Rating	**37**/3160	**1516**/3160	**1623**/3160	**0**/3160
Low Rating	**3123**/3160	**1623**/3160	**0**/3160	**0**/3160
Negligible	**0**/3160	**0**/3160	**0**/3160	**0**/3160

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

C.3. Community Resilience Structures

Asset Results

Community Resilience Structures

1. Public Housing
2. Municipal Buildings
3. Schools
4. Food Markets

Public Housing

Public Housing

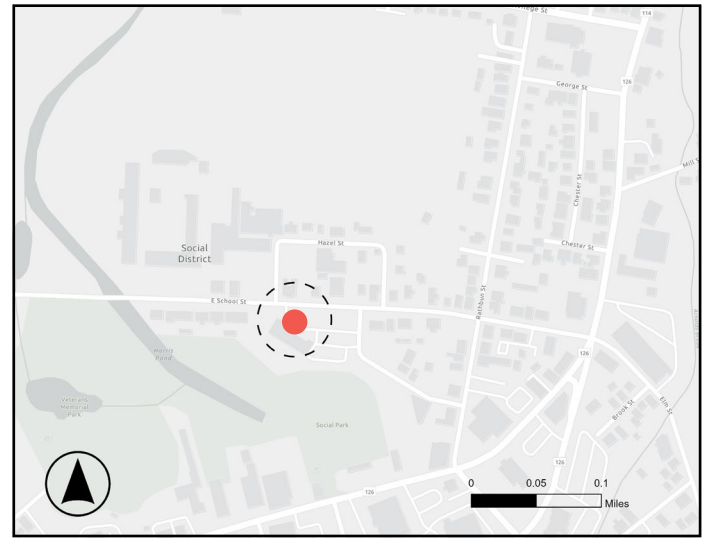
Total Number of Assets

799

Available Asset Characteristics

Owner, Age, Number of Units, & Occupancy Class

Asset – Hazard Pairing



Example Asset Buffer:
St German Manor – Woonsocket, RI

Asset
Buffer

Asset Summary

There are 799 public housing buildings throughout the state of Rhode Island and their vulnerability are assessed for all five hazards.

Housing is considered vulnerable to flooding, extreme wind, and extreme heat. Flooding and extreme wind can physically damage the house, leading to repair costs and subsequent downtime. Extreme heat can lead to unsafe conditions for occupants, reducing the thermal comfort.

Public Housing is evaluated as FEMA Occupancy Class: RES1 or RES3 (based on total units)

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	4 %	Health / Wellness	**Damage**	**Disruption**	Hazus Flood Fragilities	Occupancy Class	High Damage
Stormwater Flooding	100 %	Health / Wellness	**Damage**	**Disruption**	Hazus Flood Fragilities	Occupancy Class	Occupancy Class, Located in a Depression
Riverine Flooding	3 %	Health / Wellness	**Damage**	**Disruption**	Hazus Flood Fragilities	Occupancy Class	Relatively Vulnerable Occupancy Class
Extreme Heat	100 %	**Health / Wellness**	Damage	**Disruption**	NOAA	Heat Index Classification	Heat Index exceeding Tolerable Conditions
Extreme Wind	100 %	Health / Wellness	**Damage**	**Disruption**	Hazus Wind Fragilities	Building Typology	High Damage

Consequence Legend Primary | Cascading | Not Considered

Public Housing - Risk

Coastal Flooding

Total Number of Assets

799

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Coastal Flood Depth, Occupancy Class, & Number of Units

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 30% damage to the 100-yr flood
High Rating	10-30% damage to the 100-yr flood
Medium Rating	<10 % damage to the 100-yr flood
Low Rating	Exposure damage to the 100-yr flood
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLs and Hazus Flood Fragilities*

* Occupancy code RES1-1SWB used for single-family, semi-detached, and row-house. Occupancy code RES3A used for walk-up and estates.

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**0**/799	**0**/799	**4**/799	**11**/799
High Rating	**7**/799	**7**/799	**3**/799	**15**/799
Medium Rating	**0**/799	**0**/799	**0**/799	**0**/799
Low Rating	**11**/799	**11**/799	**11**/799	**5**/799
Negligible	**781**/799	**781**/799	**781**/799	**768**/799

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Public Housing - Risk

Stormwater Flooding

Total Number of Assets

799

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall, Occupancy Class, & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression or built before 1975
Low Rating	Not located is a depression and built after 1975

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/799	**371**/799	**553**/799	**553**/799
High Rating	**371**/799	**307**/799	**246**/799	**246**/799
Medium Rating	**307**/799	**121**/799	**0**/799	**0**/799
Low Rating	**121**/799	**0**/799	**0**/799	**0**/799
Negligible	**0**/799	**0**/799	**0**/799	**0**/799

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Public Housing - Risk

Riverine Flooding

Total Number of Assets

799

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Not Assessed	Not assessed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	House built prior to 1975
Low Rating	House built after 1975

Data Sources: URI Environmental Data Center and RIGIS

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**5**/799
High Rating	**16**/799
Medium Rating	**2**/799
Low Rating	**0**/799
Negligible	**776**/799

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Public Housing - Risk

Extreme Heat

Total Number of Assets

799

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Extreme Heat Exposure & Heat Index Classification

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	1- or 5-yr = Extreme Danger (>123F)
Medium Rating	1-y r = Danger (>103 F)
Low Rating	1-yr < Danger (<103 F)
Negligible	Not exposed

Data Sources: NASA Earth Exchange GDDP, NOAA Heat Index Classifications

Vulnerability Rating	Vulnerability Methodology
High Rating	House built prior to 1975
Low Rating	House built after 1975

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/799	**0**/799	**0**/799	**495**/799
High Rating	**0**/799	**402**/799	**402**/799	**304**/799
Medium Rating	**495**/799	**291**/799	**291**/799	**0**/799
Low Rating	**304**/799	**106**/799	**106**/799	**0**/799
Negligible	**0**/799	**0**/799	**0**/799	**0**/799

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Public Housing - Risk

Extreme Wind

Total Number of Assets

799

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Wind Exposure & Building Typology

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 50% Damage, 700-yr 3-s gust
High Rating	30 - 50% Damage, 700-yr 3-s gust
Medium Rating	10 - 30% Damage, 700-yr 3-s gust
Low Rating	< 10% Damage, 700-yr 3-s gust
Negligible	Not exposed

Data Sources: ASCE7 Hazard Tool, International Panel on Climate Change (IPCC) AR5, and Hazus Wind Fragilities.*

* Hazus wind fragility WSF2 with hip roof, no secondary water resistance, 6d nails, no shutters or impact resistant glazing, and shingle roof assumed. Straps included for houses built after 2013. Open Terrain, damage state 4.

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**42**/799	**182**/799	**286**/799	**782**/799
High Rating	**244**/799	**600**/799	**496**/799	**17**/799
Medium Rating	**513**/799	**17**/799	**17**/799	**0**/799
Low Rating	**0**/799	**0**/799	**0**/799	**0**/799
Negligible	**0**/799	**0**/799	**0**/799	**0**/799

Vulnerability Methodology Legend — **Used** | Not Used

Consequence Legend — **Primary** | Cascading | Not Considered

Municipal Buildings

1. City and Town Halls
2. Public Libraries

City and Town Halls

Total Number of Assets

39

Available Asset Characteristics

Type of Municipal Building & Year of Establishment

Asset – Hazard Pairing

Example Asset Buffer:
Newport City Hall – Newport, RI

Asset
Buffer

Asset Summary

There are 39 city and town halls throughout the state of Rhode Island and their vulnerability are assessed for all five hazards.

City and town halls are considered vulnerable to flooding, extreme wind, and extreme heat. Flooding and extreme wind can physically damage the building, leading to repair costs and subsequent downtime. Extreme heat can lead to unsafe conditions for occupants, reducing the usage of the city and town hall.

Cities and Town Halls are evaluated as FEMA Occupancy Class: GOV1

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	4 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	High Damage
Stormwater Flooding	100 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	Occupancy Class, Located in a Depression
Riverine Flooding	3 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	Relatively Vulnerable Occupancy Class
Extreme Heat	100 %	**Health / Wellness**	Damage	Disruption	NOAA	Heat Index Classification	Heat Index exceeding Tolerable Conditions
Extreme Wind	100 %	Health / Wellness	**Damage**	Disruption	Hazus Wind Fragilities	Building Typology	High Damage

Consequence Legend **Primary** Cascading Not Considered

City and Town Halls - Risk

Coastal Flooding

Total Number of Assets

39

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Coastal Flood Depth & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 30% damage to the 100-yr flood
High Rating	10-30% damage to the 100-yr flood
Medium Rating	<10 % damage to the 100-yr flood
Low Rating	Exposure damage to the 100-yr flood
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLs and Hazus Flood Fragilities*

* Occupancy code GOV1 assumed at-grade

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**2**/39	**2**/39	**2**/39	**2**/39
High Rating	**0**/39	**0**/39	**0**/39	**1**/39
Medium Rating	**0**/39	**0**/39	**0**/39	**0**/39
Low Rating	**2**/39	**2**/39	**2**/39	**1**/39
Negligible	**35**/39	**35**/39	**35**/39	**35**/39

Vulnerability Methodology Legend — **Used** | Not Used

Consequence Legend — **Primary** | Cascading | Not Considered

City and Town Halls - Risk

Stormwater Flooding

Total Number of Assets

39

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall, Occupancy Class, & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/39	**11**/39	**25**/39	**25**/39
High Rating	**11**/39	**19**/39	**14**/39	**14**/39
Medium Rating	**19**/39	**9**/39	**0**/39	**0**/39
Low Rating	**9**/39	**0**/39	**0**/39	**0**/39
Negligible	**0**/39	**0**/39	**0**/39	**0**/39

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

City and Town Halls - Risk

Riverine Flooding

Total Number of Assets

39

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**0**/39
High Rating	**2**/39
Medium Rating	**0**/39
Low Rating	**0**/39
Negligible	**37**/39

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

City and Town Halls - Risk

Extreme Heat

Total Number of Assets

39

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Extreme Heat Exposure & Heat Index Classification

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	1- or 5-yr = Extreme Danger (>123F)
Medium Rating	1-y r = Danger (>103 F)
Low Rating	1-yr < Danger (<103 F)
Negligible	Not exposed

Data Sources: NASA Earth Exchange GDDP, NOAA Heat Index Classifications

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/39	**0**/39	**0**/39	**0**/39
High Rating	**0**/39	**24**/39	**24**/39	**39**/39
Medium Rating	**0**/39	**15**/39	**15**/39	**0**/39
Low Rating	**39**/39	**0**/39	**0**/39	**0**/39
Negligible	**0**/39	**0**/39	**0**/39	**0**/39

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

City and Town Halls - Risk

Extreme Wind

Total Number of Assets

39

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Wind Exposure & Building Typology

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 50% Damage, 700-yr 3-s gust
High Rating	30 - 50% Damage, 700-yr 3-s gust
Medium Rating	10 - 30% Damage, 700-yr 3-s gust
Low Rating	< 10% Damage, 700-yr 3-s gust
Negligible	Not exposed

Data Sources: ASCE7 Hazard Tool, International Panel on Climate Change (IPCC) AR5, and Hazus Wind Fragilities.*

* Hazus wind fragility MLRM1 with built-up roof, medium window area, no shutters, and missile environment A assumed. Open Terrain, damage state 4.

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/39	**0**/39	**0**/39	**0**/39
High Rating	**0**/39	**0**/39	**0**/39	**0**/39
Medium Rating	**16**/39	**16**/39	**16**/39	**16**/39
Low Rating	**23**/39	**23**/39	**23**/39	**23**/39
Negligible	**0**/39	**0**/39	**0**/39	**0**/39

Vulnerability Methodology Legend

Used | Not Used

Consequence Legend

Primary | Cascading | Not Considered

Public Libraries

Total Number of Assets

71

Available Asset Characteristics

Size & weeks open

Asset – Hazard Pairing

Example Asset Buffer:
Rodger's Free Library - Bristol, RI

Asset
Buffer

Asset Summary

There are 71 libraries throughout the state of Rhode Island and their vulnerability are assessed for all five hazards.

Libraries are considered vulnerable to flooding, extreme wind, and extreme heat. Flooding and extreme wind can physically damage the library, leading to repair costs and subsequent downtime. Extreme heat can lead to unsafe conditions for occupants, reducing the usage of the library.

Public Libraries are evaluated as FEMA Occupancy Class: EDU1

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	12 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	High Damage
Stormwater Flooding	100 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	Occupancy Class, Located in a Depression
Riverine Flooding	7 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	Relatively Vulnerable Occupancy Class
Extreme Heat	100 %	**Health / Wellness**	Damage	Disruption	NOAA	Heat Index Classification	Heat Index exceeding Tolerable Conditions
Extreme Wind	100 %	Health / Wellness	**Damage**	Disruption	Hazus Wind Fragilities	Building Typology	High Damage

Consequence Legend Primary | Cascading | Not Considered

Public Libraries - Risk

Coastal Flooding

Total Number of Assets

71

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Coastal Flood Depth & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 30% damage to the 100-yr flood
High Rating	10-30% damage to the 100-yr flood
Medium Rating	<10 % damage to the 100-yr flood
Low Rating	Exposure damage to the 100-yr flood
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLs and Hazus Flood Fragilities*

* Occupancy code EDU1 assumed at-grade

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**1**/71	**2**/71	**2**/71	**3**/71
High Rating	**2**/71	**1**/71	**2**/71	**3**/71
Medium Rating	**0**/71	**0**/71	**1**/71	**1**/71
Low Rating	**3**/71	**3**/71	**1**/71	**1**/71
Negligible	**65**/71	**65**/71	**65**/71	**63**/71

Vulnerability Methodology Legend — Used | Not Used

Consequence Legend — Primary | Cascading | Not Considered

Public Libraries - Risk

Stormwater Flooding

Total Number of Assets

71

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall, Occupancy Class, & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/71	**22**/71	**41**/71	**41**/71
High Rating	**22**/71	**34**/71	**30**/71	**30**/71
Medium Rating	**34**/71	**15**/71	**0**/71	**0**/71
Low Rating	**15**/71	**0**/71	**0**/71	**0**/71
Negligible	**0**/71	**0**/71	**0**/71	**0**/71

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Public Libraries - Risk

Riverine Flooding

Total Number of Assets

71

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**0**/71
High Rating	**3**/71
Medium Rating	**2**/71
Low Rating	**0**/71
Negligible	**66**/71

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Public Libraries - Risk

Extreme Heat

Total Number of Assets

71

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Extreme Heat Exposure & Heat Index Classification

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	1- or 5-yr = Extreme Danger (>123F)
Medium Rating	1-y r = Danger (>103 F)
Low Rating	1-yr < Danger (<103 F)
Negligible	Not exposed

Data Sources: NASA Earth Exchange GDDP, NOAA Heat Index Classifications

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/71	**0**/71	**0**/71	**0**/71
High Rating	**0**/71	**0**/71	**0**/71	**71**/71
Medium Rating	**0**/71	**50**/71	**50**/71	**0**/71
Low Rating	**71**/71	**21**/71	**21**/71	**0**/71
Negligible	**0**/71	**0**/71	**0**/71	**0**/71

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Public Libraries - Risk

Extreme Wind

Total Number of Assets

71

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Wind Exposure & Building Typology

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 50% Damage, 700-yr 3-s gust
High Rating	30 - 50% Damage, 700-yr 3-s gust
Medium Rating	10 - 30% Damage, 700-yr 3-s gust
Low Rating	< 10% Damage, 700-yr 3-s gust
Negligible	Not exposed

Data Sources: ASCE7 Hazard Tool, International Panel on Climate Change (IPCC) AR5, and Hazus Wind Fragilities.*

* Hazus wind fragility MLRM1 with built-up roof, medium window area, no shutters, and missile environment A assumed. Open Terrain, damage state 4.

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/71	**0**/71	**0**/71	**0**/71
High Rating	**0**/71	**0**/71	**0**/71	**0**/71
Medium Rating	**37**/71	**37**/71	**37**/71	**37**/71
Low Rating	**34**/71	**34**/71	**34**/71	**34**/71
Negligible	**0**/71	**0**/71	**0**/71	**0**/71

Vulnerability Methodology Legend

Used | Not Used

Consequence Legend

Primary | Cascading | Not Considered

Schools

1. PreK-12 Schools
2. Colleges and Universities

PreK-12 Schools

Total Number of Assets

552

Available Asset Characteristics

Type of School, Age, Replacement Value, Enrollment, Functional Capacity, & Utilization

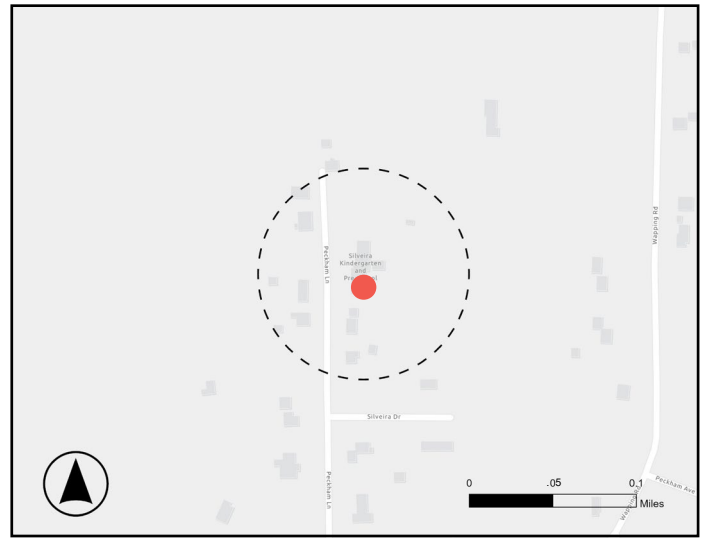
Asset – Hazard Pairing

Asset Summary

There are 552 pre-k schools throughout the state of Rhode Island and their vulnerability are assessed for all five hazards.

Schools are considered vulnerable to flooding, extreme wind, and extreme heat. Flooding and extreme wind can physically damage the school, leading to repair costs and subsequent downtime. Extreme heat can lead to unsafe conditions for occupants, reducing the usage of the school.

PreK-12 Schools are evaluated as FEMA Occupancy Class: EDU1



Example Asset Buffer:
Silveira Kindergarten and Nursery School – Middletown, RI

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	10 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	High Damage
Stormwater Flooding	100 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	Occupancy Class, Located in a Depression
Riverine Flooding	16 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	Relatively Vulnerable Occupancy Class
Extreme Heat	100 %	**Health / Wellness**	Damage	Disruption	NOAA	Heat Index Classification	Heat Index exceeding Tolerable Conditions
Extreme Wind	100 %	Health / Wellness	**Damage**	Disruption	Hazus Wind Fragilities	Building Typology	High Damage

Consequence Legend Primary | Cascading | Not Considered

PreK-12 Schools - Risk

Coastal Flooding

Total Number of Assets

552

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Coastal Flood Depth & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 30% damage to the 100-yr flood
High Rating	10-30% damage to the 100-yr flood
Medium Rating	<10 % damage to the 100-yr flood
Low Rating	Exposure damage to the 100-yr flood
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLs and Hazus Flood Fragilities*

* Occupancy code EDU1 assumed at-grade

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**14**/552	**15**/552	**19**/552	**34**/552
High Rating	**17**/552	**18**/552	**18**/552	**12**/552
Medium Rating	**1**/552	**4**/552	**4**/552	**6**/552
Low Rating	**16**/552	**11**/552	**8**/552	**2**/552
Negligible	**504**/552	**504**/552	**503**/552	**498**/552

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

PreK-12 Schools - Risk

Stormwater Flooding

Total Number of Assets

552

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall, Occupancy Class, & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/552	**298**/552	**521**/552	**521**/552
High Rating	**298**/552	**245**/552	**31**/552	**31**/552
Medium Rating	**245**/552	**9**/552	**0**/552	**0**/552
Low Rating	**9**/552	**0**/552	**0**/552	**0**/552
Negligible	**0**/552	**0**/552	**0**/552	**0**/552

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

PreK-12 Schools - Risk

Riverine Flooding

Total Number of Assets

552

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**0**/552
High Rating	**59**/552
Medium Rating	**28**/552
Low Rating	**0**/552
Negligible	**465**/552

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

PreK-12 Schools - Risk

Extreme Heat

Total Number of Assets

552

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Extreme Heat Exposure & Heat Index Classification

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	1- or 5-yr = Extreme Danger (>123F)
Medium Rating	1-y r = Danger (>103 F)
Low Rating	1-yr < Danger (<103 F)
Negligible	Not exposed

Data Sources: NASA Earth Exchange GDDP, NOAA Heat Index Classifications

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/552	**0**/552	**0**/552	**0**/552
High Rating	**0**/552	**0**/552	**0**/552	**552**/552
Medium Rating	**0**/552	**112**/552	**112**/552	**0**/552
Low Rating	**552**/552	**440**/552	**440**/552	**0**/552
Negligible	**0**/552	**0**/552	**0**/552	**0**/552

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

PreK-12 Schools - Risk

Extreme Wind

Total Number of Assets

552

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Wind Exposure & Building Typology

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 50% Damage, 700-yr 3-s gust
High Rating	30 - 50% Damage, 700-yr 3-s gust
Medium Rating	10 - 30% Damage, 700-yr 3-s gust
Low Rating	< 10% Damage, 700-yr 3-s gust
Negligible	Not exposed

Data Sources: ASCE7 Hazard Tool, International Panel on Climate Change (IPCC) AR5, and Hazus Wind Fragilities.*

* Hazus wind fragility MLRM1 with built-up roof, medium window area, no shutters, and missile environment A assumed. Open Terrain, damage state 4.

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/552	**0**/552	**0**/552	**0**/552
High Rating	**0**/552	**0**/552	**0**/552	**552**/552
Medium Rating	**0**/552	**440**/552	**440**/552	**0**/552
Low Rating	**552**/552	**112**/552	**112**/552	**0**/552
Negligible	**0**/552	**0**/552	**0**/552	**0**/552

Vulnerability Methodology Legend — **Used** | Not Used

Consequence Legend — **Primary** | Cascading | Not Considered

Colleges and Universities

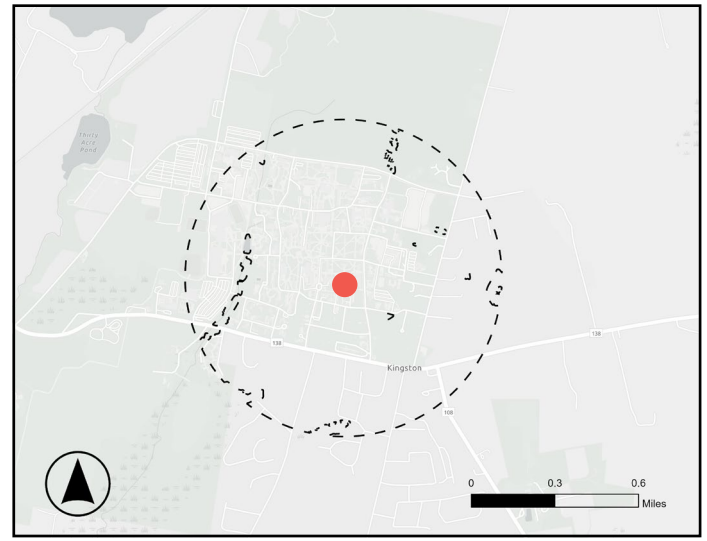
Total Number of Assets

16

Available Asset Characteristics

Type of School (State/Private)

Asset – Hazard Pairing



Example Asset Buffer:
University of Rhode Island – Kingston, RI

Asset
Buffer

Asset Summary

There are 16 colleges and universities throughout the state of Rhode Island and their vulnerability are assessed for all five hazards.

Colleges and universities are considered vulnerable to flooding, extreme wind, and extreme heat. Flooding and extreme wind can physically damage the campus, leading to repair costs and subsequent downtime. Extreme heat can lead to unsafe conditions for occupants, reducing the usage of the campus.

Colleges and Universities are evaluated as FEMA Occupancy Class: EDU2

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	50 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	High Damage
Stormwater Flooding	100 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	Occupancy Class, Located in a Depression
Riverine Flooding	13 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	Relatively Vulnerable Occupancy Class
Extreme Heat	100 %	**Health / Wellness**	Damage	Disruption	NOAA	Heat Index Classification	Heat Index exceeding Tolerable Conditions
Extreme Wind	100 %	Health / Wellness	**Damage**	Disruption	Hazus Wind Fragilities	Building Typology	High Damage

Consequence Legend Primary | Cascading | Not Considered

Colleges and Universities - Risk

Coastal Flooding

Total Number of Assets

16

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Coastal Flood Depth & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 30% damage to the 100-yr flood
High Rating	10-30% damage to the 100-yr flood
Medium Rating	<10 % damage to the 100-yr flood
Low Rating	Exposure damage to the 100-yr flood
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLs and Hazus Flood Fragilities*

* Occupancy code EDU2 assumed at-grade

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**8**/16	**8**/16	**8**/16	**8**/16
High Rating	**0**/16	**0**/16	**0**/16	**0**/16
Medium Rating	**0**/16	**0**/16	**0**/16	**0**/16
Low Rating	**0**/16	**0**/16	**0**/16	**0**/16
Negligible	**8**/16	**8**/16	**8**/16	**8**/16

Vulnerability Methodology Legend — **Used** | Not Used

Consequence Legend — **Primary** | Cascading | Not Considered

Colleges and Universities - Risk

Stormwater Flooding

Total Number of Assets

16

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Stormwater Rainfall, Occupancy Class, & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/16	**9**/16	**16**/16	**16**/16
High Rating	**9**/16	**7**/16	**0**/16	**0**/16
Medium Rating	**7**/16	**0**/16	**0**/16	**0**/16
Low Rating	**0**/16	**0**/16	**0**/16	**0**/16
Negligible	**0**/16	**0**/16	**0**/16	**0**/16

Vulnerability Methodology Legend — **Used** | Not Used

Consequence Legend — **Primary** | Cascading | Not Considered

Colleges and Universities - Risk

Riverine Flooding

Total Number of Assets

16

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Not Assessed	Not assessed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**0**/16
High Rating	**2**/16
Medium Rating	**0**/16
Low Rating	**0**/16
Negligible	**14**/16

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Colleges and Universities - Risk

Extreme Heat

Total Number of Assets

16

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Extreme Heat Exposure & Heat Index Classification

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	1- or 5-yr = Extreme Danger (>123F)
Medium Rating	1-y r = Danger (>103 F)
Low Rating	1-yr < Danger (<103 F)
Negligible	Not exposed

Data Sources: NASA Earth Exchange GDDP, NOAA Heat Index Classifications

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/16	**0**/16	**0**/16	**0**/16
High Rating	**0**/16	**0**/16	**0**/16	**16**/16
Medium Rating	**0**/16	**12**/16	**12**/16	**0**/16
Low Rating	**16**/16	**4**/16	**4**/16	**0**/16
Negligible	**0**/16	**0**/16	**0**/16	**0**/16

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Colleges and Universities - Risk

Extreme Wind

Total Number of Assets

16

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Wind Exposure & Building Typology

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 50% Damage, 700-yr 3-s gust
High Rating	30 - 50% Damage, 700-yr 3-s gust
Medium Rating	10 - 30% Damage, 700-yr 3-s gust
Low Rating	< 10% Damage, 700-yr 3-s gust
Negligible	Not exposed

Data Sources: ASCE7 Hazard Tool, International Panel on Climate Change (IPCC) AR5, and Hazus Wind Fragilities.*

* Hazus wind fragility MLRM1 with built-up roof, medium window area, no shutters, and missile environment A assumed. Open Terrain, damage state 4.

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/16	**0**/16	**0**/16	**0**/16
High Rating	**0**/16	**0**/16	**0**/16	**0**/16
Medium Rating	**9**/16	**9**/16	**9**/16	**9**/16
Low Rating	**7**/16	**7**/16	**7**/16	**7**/16
Negligible	**0**/16	**0**/16	**0**/16	**0**/16

Vulnerability Methodology Legend — **Used** | Not Used

Consequence Legend — **Primary** | Cascading | Not Considered

Food Markets

Food Markets

Total Number of Assets

470

Available Asset Characteristics

Type of Market (Profit/Not for Profit), & Number of Registers

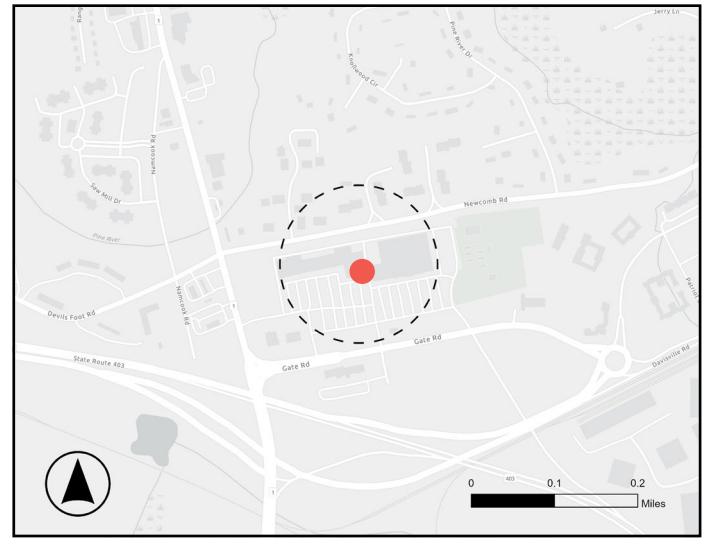
Asset – Hazard Pairing

Asset Summary

There are 470 food markets throughout the state of Rhode Island and their vulnerability are assessed for all five hazards.

Food markets are considered vulnerable to flooding, extreme wind, and extreme heat. Flooding and extreme wind can physically damage the market, leading to repair costs and subsequent downtime. Extreme heat can lead to unsafe conditions for occupants, reducing the usage of the market.

Food Markets are evaluated as FEMA Occupancy Class: IND3



Example Asset Buffer:
Dave's Fresh Market of Quonset – North Kingstown, RI

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	10 %	Health / Wellness	**Damage**	**Disruption**	Hazus Flood Fragilities	Occupancy Class	High Damage
Stormwater Flooding	100 %	Health / Wellness	**Damage**	**Disruption**	Hazus Flood Fragilities	Occupancy Class	Occupancy Class, Located in a Depression
Riverine Flooding	12 %	Health / Wellness	**Damage**	**Disruption**	Hazus Flood Fragilities	Occupancy Class	Relatively Vulnerable Occupancy Class
Extreme Heat	100 %	**Health / Wellness**	Damage	**Disruption**	NOAA	Heat Index Classification	Heat Index exceeding Tolerable Conditions
Extreme Wind	100 %	Health / Wellness	**Damage**	**Disruption**	Hazus Wind Fragilities	Building Typology	High Damage

Consequence Legend Primary | Cascading | Not Considered

Food Markets - Risk

Coastal Flooding

Total Number of Assets

470

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Coastal Flood Depth & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 30% damage to the 100-yr flood
High Rating	10-30% damage to the 100-yr flood
Medium Rating	<10 % damage to the 100-yr flood
Low Rating	Exposure damage to the 100-yr flood
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLs and Hazus Flood Fragilities*

* Occupancy code IND3 assumed at-grade

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**19**/470	**22**/470	**26**/470	**34**/470
High Rating	**8**/470	**11**/470	**9**/470	**7**/470
Medium Rating	**1**/470	**3**/470	**3**/470	**5**/470
Low Rating	**14**/470	**6**/470	**4**/470	**2**/470
Negligible	**428**/470	**428**/470	**428**/470	**422**/470

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Food Markets - Risk

Stormwater Flooding

Total Number of Assets

470

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall, Occupancy Class, & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/470	**128**/470	**217**/470	**217**/470
High Rating	**128**/470	**257**/470	**253**/470	**253**/470
Medium Rating	**257**/470	**85**/470	**0**/470	**0**/470
Low Rating	**85**/470	**0**/470	**0**/470	**0**/470
Negligible	**0**/470	**0**/470	**0**/470	**0**/470

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Food Markets - Risk

Riverine Flooding

Total Number of Assets

470

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**0**/470
High Rating	**41**/470
Medium Rating	**17**/470
Low Rating	**0**/470
Negligible	**412**/470

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Food Markets - Risk

Extreme Heat

Total Number of Assets

470

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Extreme Heat Exposure & Heat Index Classification

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	1- or 5-yr = Extreme Danger (>123F)
Medium Rating	1-y r = Danger (>103 F)
Low Rating	1-yr < Danger (<103 F)
Negligible	Not exposed

Data Sources: NASA Earth Exchange GDDP, NOAA Heat Index Classifications

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/470	**0**/470	**0**/470	**0**/470
High Rating	**0**/470	**376**/470	**376**/470	**470**/470
Medium Rating	**0**/470	**94**/470	**94**/470	**0**/470
Low Rating	**470**/470	**0**/470	**0**/470	**0**/470
Negligible	**0**/470	**0**/470	**0**/470	**0**/470

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Food Markets - Risk

Extreme Wind

Total Number of Assets

470

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Wind Exposure & Building Typology

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 50% Damage, 700-yr 3-s gust
High Rating	30 - 50% Damage, 700-yr 3-s gust
Medium Rating	10 - 30% Damage, 700-yr 3-s gust
Low Rating	< 10% Damage, 700-yr 3-s gust
Negligible	Not exposed

Data Sources: ASCE7 Hazard Tool, International Panel on Climate Change (IPCC) AR5, and Hazus Wind Fragilities.*

* Hazus wind fragility MLRM1 with built-up roof, medium window area, no shutters, and missile environment A assumed. Open Terrain, damage state 4.

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/470	**0**/470	**0**/470	**0**/470
High Rating	**0**/470	**0**/470	**0**/470	**0**/470
Medium Rating	**296**/470	**296**/470	**296**/470	**296**/470
Low Rating	**174**/470	**174**/470	**174**/470	**174**/470
Negligible	**0**/470	**0**/470	**0**/470	**0**/470

Vulnerability Methodology Legend

Used | Not Used

Consequence Legend

Primary | Cascading | Not Considered

C.4. Emergency Preparedness Structures

Asset Results

Emergency Preparedness Structures

1. Emergency Services
2. Evacuation Routes and Emergency Shelters

Emergency Services

1. Hospitals
2. Fire Stations
3. Police Stations

Hospitals

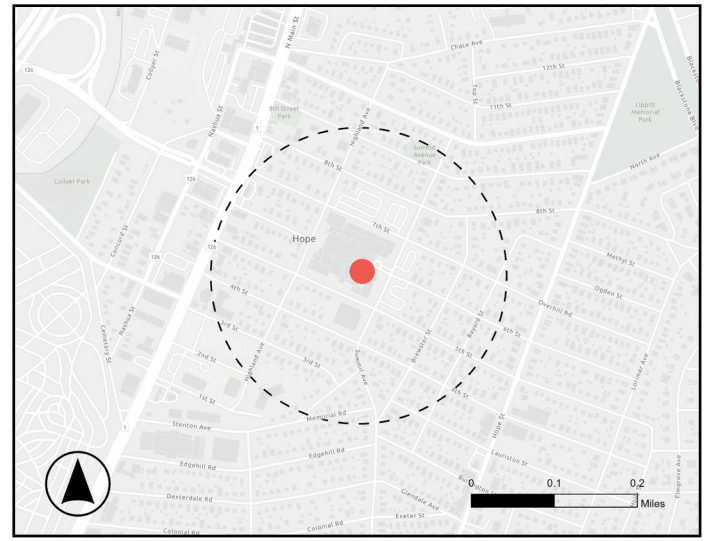
Total Number of Assets

17

Available Asset Characteristics

Number of Beds

Asset – Hazard Pairing



Example Asset Buffer:
The Miriam Hospital – Providence, RI

Asset
Buffer

Asset Summary

There are 17 hospitals throughout the state of Rhode Island and their vulnerability are assessed for all five hazards.

Hospitals are considered vulnerable to flooding, extreme wind, and extreme heat. Flooding and extreme wind can physically damage the hospitals, leading to repair costs and subsequent downtime. Extreme heat can lead to unsafe conditions for local population, increasing demand on the hospital.

Hospitals are evaluated as FEMA Occupancy Class: COM6

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	24 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	High Damage
Stormwater Flooding	100 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	Occupancy Class, Located in a Depression
Riverine Flooding	18 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	Relatively Vulnerable Occupancy Class
Extreme Heat	100 %	**Health / Wellness**	Damage	Disruption	NOAA	Heat Index Classification	Heat Index exceeding Tolerable Conditions
Extreme Wind	100 %	Health / Wellness	**Damage**	Disruption	Hazus Wind Fragilities	Building Typology	High Damage

Consequence Legend Primary | Cascading | Not Considered

Hospitals - Risk

Coastal Flooding

Total Number of Assets

17

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Coastal Flood Depth & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 30% damage to the 100-yr flood
High Rating	10-30% damage to the 100-yr flood
Medium Rating	<10 % damage to the 100-yr flood
Low Rating	Exposure damage to the 100-yr flood
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLs and Hazus Flood Fragilities*

* Occupancy code COM6 assumed at-grade

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**1**/17	**1**/17	**1**/17	**1**/17
High Rating	**0**/17	**0**/17	**2**/17	**2**/17
Medium Rating	**2**/17	**2**/17	**0**/17	**1**/17
Low Rating	**1**/17	**1**/17	**1**/17	**0**/17
Negligible	**13**/17	**13**/17	**13**/17	**13**/17

Vulnerability Methodology Legend — **Used** | Not Used

Consequence Legend — **Primary** | Cascading | Not Considered

Hospitals - Risk

Stormwater Flooding

Total Number of Assets

17

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall, Occupancy Class, & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/17	**13**/17	**17**/17	**17**/17
High Rating	**13**/17	**4**/17	**0**/17	**0**/17
Medium Rating	**4**/17	**0**/17	**0**/17	**0**/17
Low Rating	**0**/17	**0**/17	**0**/17	**0**/17
Negligible	**0**/17	**0**/17	**0**/17	**0**/17

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Hospitals - Risk

Riverine Flooding

Total Number of Assets

17

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**0**/17
High Rating	**3**/17
Medium Rating	**0**/17
Low Rating	**0**/17
Negligible	**14**/17

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Hospitals - Risk

Extreme Heat

Total Number of Assets

17

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Extreme Heat Exposure & Heat Index Classification

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	1- or 5-yr = Extreme Danger (>123F)
Medium Rating	1-y r = Danger (>103 F)
Low Rating	1-yr < Danger (<103 F)
Negligible	Not exposed

Data Sources: NASA Earth Exchange GDDP, NOAA Heat Index Classifications

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be low vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/17	**0**/17	**0**/17	**0**/17
High Rating	**0**/17	**0**/17	**0**/17	**17**/17
Medium Rating	**0**/17	**14**/17	**14**/17	**0**/17
Low Rating	**17**/17	**3**/17	**3**/17	**0**/17
Negligible	**0**/17	**0**/17	**0**/17	**0**/17

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Hospitals - Risk

Extreme Wind

Total Number of Assets

17

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Wind Exposure & Building Typology

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 50% Damage, 700-yr 3-s gust
High Rating	30 - 50% Damage, 700-yr 3-s gust
Medium Rating	10 - 30% Damage, 700-yr 3-s gust
Low Rating	< 10% Damage, 700-yr 3-s gust
Negligible	Not exposed

Data Sources: ASCE7 Hazard Tool, International Panel on Climate Change (IPCC) AR5, and Hazus Wind Fragilities.*

* Hazus wind fragility CECBL with built-up roof, medium window area, no shutters, and missile environment A assumed. Open Terrain, damage state 4.

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/17	**0**/17	**0**/17	**0**/17
High Rating	**0**/17	**0**/17	**0**/17	**0**/17
Medium Rating	**13**/17	**13**/17	**13**/17	**13**/17
Low Rating	**4**/17	**4**/17	**4**/17	**4**/17
Negligible	**0**/17	**0**/17	**0**/17	**0**/17

Vulnerability Methodology Legend

Used | Not Used

Consequence Legend

Primary | Cascading | Not Considered

Fire Stations

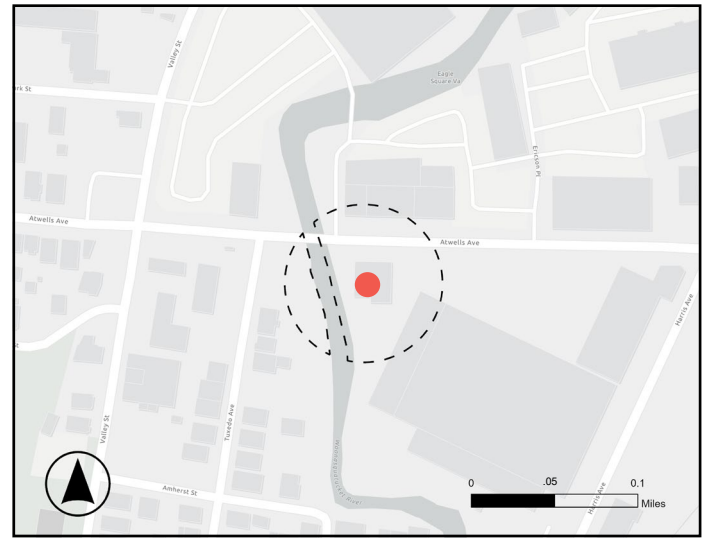
Total Number of Assets

173

Available Asset Characteristics

N/A

Asset – Hazard Pairing



Example Asset Buffer:
Providence Fire Department – Providence, RI

Asset
Buffer

Asset Summary

There are 173 fire stations throughout the state of Rhode Island and their vulnerability are assessed for all five hazards.

Fire stations are considered vulnerable to flooding, extreme wind, and extreme heat. Flooding and extreme wind can physically damage the station, leading to repair costs and subsequent downtime. Extreme heat can lead to unsafe conditions for occupants, reducing the usage of the station.

Fire Stations are evaluated as FEMA Occupancy Class: GOV2

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	19 %	Health / Wellness	**Damage**	**Disruption**	Hazus Flood Fragilities	Occupancy Class	High Damage
Stormwater Flooding	100 %	Health / Wellness	**Damage**	**Disruption**	Hazus Flood Fragilities	Occupancy Class	Occupancy Class, Located in a Depression
Riverine Flooding	16 %	Health / Wellness	**Damage**	**Disruption**	Hazus Flood Fragilities	Occupancy Class	Relatively Vulnerable Occupancy Class
Extreme Heat	100 %	**Health / Wellness**	Damage	**Disruption**	NOAA	Heat Index Classification	Heat Index exceeding Tolerable Conditions
Extreme Wind	100 %	Health / Wellness	**Damage**	**Disruption**	Hazus Wind Fragilities	Building Typology	High Damage

Consequence Legend Primary | Cascading | Not Considered

Fire Stations - Risk

Coastal Flooding

Total Number of Assets

173

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Coastal Flood Depth & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 30% damage to the 100-yr flood
High Rating	10-30% damage to the 100-yr flood
Medium Rating	<10 % damage to the 100-yr flood
Low Rating	Exposure damage to the 100-yr flood
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLs and Hazus Flood Fragilities*

* Occupancy code GOV2 assumed at-grade

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**2**/173	**3**/173	**5**/173	**10**/173
High Rating	**3**/173	**3**/173	**4**/173	**5**/173
Medium Rating	**4**/173	**4**/173	**4**/173	**2**/173
Low Rating	**7**/173	**6**/173	**3**/173	**2**/173
Negligible	**157**/173	**157**/173	**157**/173	**154**/173

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Fire Stations - Risk

Stormwater Flooding

Total Number of Assets

173

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall, Occupancy Class, & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/173	**58**/173	**131**/173	**131**/173
High Rating	**58**/173	**96**/173	**42**/173	**42**/173
Medium Rating	**96**/173	**19**/173	**0**/173	**0**/173
Low Rating	**19**/173	**0**/173	**0**/173	**0**/173
Negligible	**0**/173	**0**/173	**0**/173	**0**/173

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Fire Stations - Risk

Riverine Flooding

Total Number of Assets

173

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**0**/173
High Rating	**15**/173
Medium Rating	**13**/173
Low Rating	**0**/173
Negligible	**145**/173

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Fire Stations - Risk

Extreme Heat

Total Number of Assets

173

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Extreme Heat Exposure & Heat Index Classification

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	1- or 5-yr = Extreme Danger (>123F)
Medium Rating	1-y r = Danger (>103 F)
Low Rating	1-yr < Danger (<103 F)
Negligible	Not exposed

Data Sources: NASA Earth Exchange GDDP, NOAA Heat Index Classifications

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be low vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/173	**0**/173	**0**/173	**0**/173
High Rating	**0**/173	**0**/173	**0**/173	**173**/173
Medium Rating	**0**/173	**127**/173	**127**/173	**0**/173
Low Rating	**173**/173	**46**/173	**46**/173	**0**/173
Negligible	**0**/173	**0**/173	**0**/173	**0**/173

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Fire Stations - Risk

Extreme Wind

Total Number of Assets

173

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Wind Exposure & Building Typology

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 50% Damage, 700-yr 3-s gust
High Rating	30 - 50% Damage, 700-yr 3-s gust
Medium Rating	10 - 30% Damage, 700-yr 3-s gust
Low Rating	< 10% Damage, 700-yr 3-s gust
Negligible	Not exposed

Data Sources: ASCE7 Hazard Tool, International Panel on Climate Change (IPCC) AR5, and Hazus Wind Fragilities.*

* Hazus wind fragility CECBL with built-up roof, medium window area, no shutters, and missile environment A assumed. Open Terrain, damage state 4.

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/173	**0**/173	**0**/173	**0**/173
High Rating	**0**/173	**0**/173	**0**/173	**0**/173
Medium Rating	**81**/173	**81**/173	**81**/173	**81**/173
Low Rating	**92**/173	**92**/173	**92**/173	**92**/173
Negligible	**0**/173	**0**/173	**0**/173	**0**/173

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Police Stations

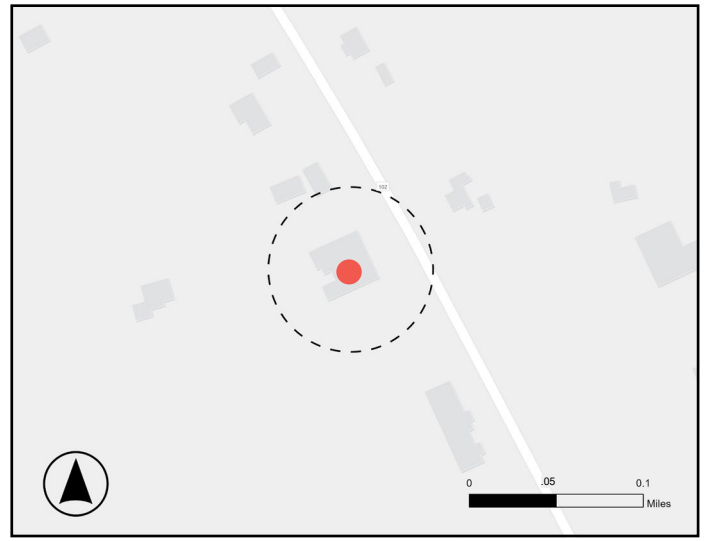
Total Number of Assets

68

Available Asset Characteristics

N/A

Asset – Hazard Pairing



Example Asset Buffer:
Scituate Police Department – Scituate, RI

Asset
Buffer

Asset Summary

There are 68 police stations throughout the state of Rhode Island and their vulnerability are assessed for all five hazards.

Police stations are considered vulnerable to flooding, extreme wind, and extreme heat. Flooding and extreme wind can physically damage the station, leading to repair costs and subsequent downtime. Extreme heat can lead to unsafe conditions for occupants, reducing the usage of the station.

Police Stations are evaluated as FEMA Occupancy Class: GOV2

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	15 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	High Damage
Stormwater Flooding	100 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	Occupancy Class, Located in a Depression
Riverine Flooding	21 %	Health / Wellness	**Damage**	Disruption	Hazus Flood Fragilities	Occupancy Class	Relatively Vulnerable Occupancy Class
Extreme Heat	100 %	**Health / Wellness**	Damage	Disruption	NOAA	Heat Index Classification	Heat Index exceeding Tolerable Conditions
Extreme Wind	100 %	Health / Wellness	**Damage**	Disruption	Hazus Wind Fragilities	Building Typology	High Damage

Consequence Legend Primary | Cascading | Not Considered

Police Stations - Risk

Coastal Flooding

Total Number of Assets

68

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Coastal Flood Depth & Occupancy Class.

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 30% damage to the 100-yr flood
High Rating	10-30% damage to the 100-yr flood
Medium Rating	<10 % damage to the 100-yr flood
Low Rating	Exposure damage to the 100-yr flood
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLs and Hazus Flood Fragilities*

* Occupancy code GOV2 assumed at-grade

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**0**/68	**0**/68	**0**/68	**3**/68
High Rating	**2**/68	**2**/68	**4**/68	**3**/68
Medium Rating	**2**/68	**3**/68	**2**/68	**2**/68
Low Rating	**4**/68	**3**/68	**3**/68	**2**/68
Negligible	**60**/68	**60**/68	**59**/68	**58**/68

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Police Stations - Risk

Stormwater Flooding

Total Number of Assets

68

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall, Occupancy Class, & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/68	**35**/68	**59**/68	**59**/68
High Rating	**35**/68	**27**/68	**9**/68	**9**/68
Medium Rating	**27**/68	**6**/68	**0**/68	**0**/68
Low Rating	**6**/68	**0**/68	**0**/68	**0**/68
Negligible	**0**/68	**0**/68	**0**/68	**0**/68

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Police Stations - Risk

Riverine Flooding

Total Number of Assets

68

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	0/68
High Rating	**9**/68
Medium Rating	**5**/68
Low Rating	**0**/68
Negligible	**54**/68

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Police Stations - Risk

Extreme Heat

Total Number of Assets

68

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Extreme Heat Exposure & Heat Index Classification

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	1- or 5-yr = Extreme Danger (>123F)
Medium Rating	1-y r = Danger (>103 F)
Low Rating	1-yr < Danger (<103 F)
Negligible	Not exposed

Data Sources: NASA Earth Exchange GDDP, NOAA Heat Index Classifications

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/68	**0**/68	**0**/68	**0**/68
High Rating	**0**/68	**0**/68	**0**/68	**68**/68
Medium Rating	**0**/68	**46**/68	**46**/68	**0**/68
Low Rating	**68**/68	**22**/68	**22**/68	**0**/68
Negligible	**0**/68	**0**/68	**0**/68	**0**/68

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Police Stations - Risk

Extreme Wind

Total Number of Assets

68

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Wind Exposure & Building Typology

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 50% Damage, 700-yr 3-s gust
High Rating	30 - 50% Damage, 700-yr 3-s gust
Medium Rating	10 - 30% Damage, 700-yr 3-s gust
Low Rating	< 10% Damage, 700-yr 3-s gust
Negligible	Not exposed

Data Sources: ASCE7 Hazard Tool, International Panel on Climate Change (IPCC) AR5, and Hazus Wind Fragilities.*

* Hazus wind fragility CECBL with built-up roof, medium window area, no shutters, and missile environment A assumed. Open Terrain, damage state 4.

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/68	**0**/68	**0**/68	**0**/68
High Rating	**0**/68	**0**/68	**0**/68	**0**/68
Medium Rating	**38**/68	**38**/68	**38**/68	**38**/68
Low Rating	**30**/68	**30**/68	**30**/68	**30**/68
Negligible	**0**/68	**0**/68	**0**/68	**0**/68

Vulnerability Methodology Legend — **Used** | Not Used

Consequence Legend — **Primary** | Cascading | Not Considered

Evacuation Routes and Emergency Shelters

1. Evacuation Routes
2. Emergency Shelters

Evacuation Routes

Total Number of Assets

4,065 ½ mile segments

Available Asset Characteristics

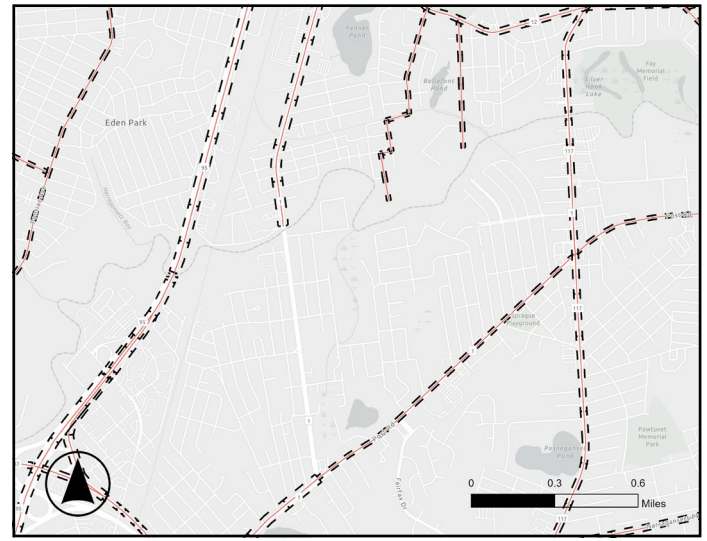
Route Name, Pavement Condition (Sensitivity), & Route Density (Adaptive Capacity)

Asset – Hazard Pairing

Asset Summary

There are over 2,000 miles of evacuation routes throughout the state of Rhode Island and their vulnerability are assessed for coastal flooding, stormwater flooding, and riverine flooding.

Flooding of evacuation routes can lead to significant delays and inability to use the routes in times of need.



Example Asset Buffer:
Evacuation Routes

Asset
Buffer

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	20 %	Health / Wellness	Damage	Disruption	RIDOT RIP	Sensitivity	Poor Condition
Stormwater Flooding	100 %	Health / Wellness	Damage	Disruption	RIDOT RIP	Sensitivity	Poor Condition, Located in a Depression
Riverine Flooding	18 %	Health / Wellness	Damage	Disruption	RIDOT RIP	Sensitivity	Poor Condition
Extreme Heat	100 %	Health / Wellness	Damage	Disruption	-	-	-
Extreme Wind	100 %	Health / Wellness	Damage	Disruption	-	-	-

Consequence Legend Primary | Cascading | Not Considered

Evacuation Routes - Risk

Coastal Flooding

Total Number of Assets

4,065 half-mile segments

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Depth of Coastal Flooding & Pavement Condition.

Consequence

Health / Wellness | Damage | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Depth of coastal flooding is more than 2 ft
Medium Rating	Depth of coastal flooding is between 0.5 and 2 ft
Low Rating	Depth of coastal flooding is less than 0.5 ft
Not Assessed	Not assessed

Data Sources: University of Rhode Island (URI) Coastal STORMTOOLs.

Vulnerability Rating	Vulnerability Methodology
High Rating	Poor, fair, or no information on pavement condition
Low Rating	Excellent or good pavement condition

Data Sources: Rhode Island Department of Transportation Resilience Improvement Plan (RIDOT), 2024.

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**262**/4065	**273**/4065	**312**/4065	**423**/4065
High Rating	**198**/4065	**216**/4065	**254**/4065	**305**/4065
Medium Rating	**81**/4065	**87**/4065	**71**/4065	**66**/4065
Low Rating	**163**/4065	**128**/4065	**70**/4065	**19**/4065
Negligible	**3361**/4065	**3361**/4065	**3358**/4065	**3252**/4065

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Evacuation Routes - Risk

Stormwater Flooding

Total Number of Assets

4,065 half-mile segments

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Stormwater Rainfall, Pavement Condition, & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression or poor, fair, or no condition
Low Rating	Not located is a depression and good condition

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/4065	**551**/4065	**3667**/4065	**3667**/4065
High Rating	**551**/4065	**3163**/4065	**398**/4065	**398**/4065
Medium Rating	**3163**/4065	**351**/4065	**0**/4065	**0**/4065
Low Rating	**351**/4065	**0**/4065	**0**/4065	**0**/4065
Negligible	**0**/4065	**0**/4065	**0**/4065	**0**/4065

Vulnerability Methodology Legend: Used | Not Used

Consequence Legend: Primary | Cascading | Not Considered

Evacuation Routes - Risk

Riverine Flooding

Total Number of Assets

4,065 half-mile segments

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Riverine Flood Exposure

Consequence

Health / Wellness | Damage | **Disruption**

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	Poor, fair, or no information on pavement condition
Low Rating	Excellent or good pavement condition

Data Sources: Rhode Island Department of Transportation Resilience Improvement Plan (RIDOT), 2024.

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**286**/4065
High Rating	**326**/4065
Medium Rating	**115**/4065
Low Rating	**0**/4065
Negligible	**3338**/4065

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Emergency Shelters

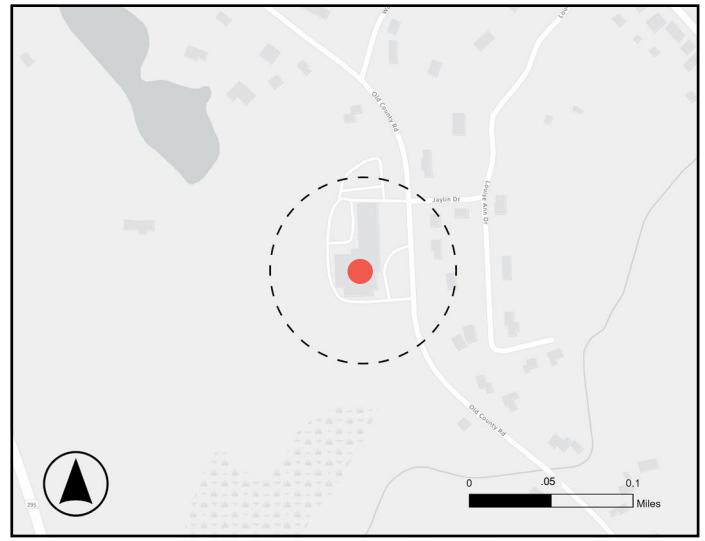
Total Number of Assets

192

Available Asset Characteristics

ADA Compliant, Wheelchair Accessible, & Generator Available

Asset – Hazard Pairing



Example Asset Buffer:
Old County Elementary School – Smithfield, RI

Asset
Buffer

Asset Summary

There are 192 emergency shelters throughout the state of Rhode Island and their vulnerability are assessed for all five hazards.

Emergency shelters are considered vulnerable to flooding, extreme wind, and extreme heat. Flooding and extreme wind can physically damage the shelters, leading to repair costs and subsequent downtime. Extreme heat can lead to unsafe conditions for occupants, reducing the usage of the shelter.

Emergency Shelters are evaluated as FEMA Occupancy Class: GOV2

Hazard	% Exposed Under Most Extreme Scenario	Consequence			Vulnerability Source	Assessed Metric	High Risk Indicator(s)
Coastal Flooding	11 %	Health / Wellness	**Damage**	**Disruption**	Hazus Flood Fragilities	Occupancy Class	High Damage
Stormwater Flooding	100 %	Health / Wellness	**Damage**	**Disruption**	Hazus Flood Fragilities	Occupancy Class	Occupancy Class, Located in a Depression
Riverine Flooding	18 %	Health / Wellness	**Damage**	**Disruption**	Hazus Flood Fragilities	Occupancy Class	Relatively Vulnerable Occupancy Class
Extreme Heat	100 %	**Health / Wellness**	Damage	**Disruption**	NOAA	Heat Index Classification	Heat Index exceeding Tolerable Conditions
Extreme Wind	100 %	Health / Wellness	**Damage**	**Disruption**	Hazus Wind Fragilities	Building Typology	High Damage

Consequence Legend Primary | Cascading | Not Considered

Emergency Shelters - Risk

Coastal Flooding

Total Number of Assets

192

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Coastal Flood Depth & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 30% damage to the 100-yr flood
High Rating	10-30% damage to the 100-yr flood
Medium Rating	<10 % damage to the 100-yr flood
Low Rating	Exposure damage to the 100-yr flood
Negligible	Not exposed

Data Sources: URI Coastal STORMTOOLs and Hazus Flood Fragilities*

* Occupancy code GOV2 assumed at-grade

Risk Assessment and Results

Risk Rating	Current	2035 High SLR	2050 High SLR	2100 High SLR
Very High Rating	**5**/192	**6**/192	**8**/192	**11**/192
High Rating	**2**/192	**2**/192	**3**/192	**3**/192
Medium Rating	**3**/192	**4**/192	**2**/192	**5**/192
Low Rating	**8**/192	**6**/192	**5**/192	**3**/192
Negligible	**174**/192	**174**/192	**174**/192	**170**/192

Vulnerability Methodology Legend — **Used** | Not Used

Consequence Legend — **Primary** | Cascading | Not Considered

Emergency Shelters - Risk

Stormwater Flooding

Total Number of Assets

192

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Stormwater Rainfall, Occupancy Class, & Location in a Land Depression

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Rainfall is greater than 10 inches (24-hr 100 yr rainfall)
Medium Rating	Rainfall is between 8 and 10 inches (24-hr 100 yr rainfall)
Low Rating	Rainfall is less than 8 inches (24-hr 100 yr rainfall)
Negligible	Not exposed

Data Sources: National Oceanic and Atmospheric Administration (NOAA), Northeast Regional Climate Center (NRCC), and International Panel on Climate Change (IPCC) AR6.

Vulnerability Rating	Vulnerability Methodology
High Rating	Located in a depression
Low Rating	Not located is a depression

Data Sources: SCALGO (Location in a Depression).

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/192	**93**/192	**182**/192	**182**/192
High Rating	**93**/192	**92**/192	**10**/192	**10**/192
Medium Rating	**92**/192	**7**/192	**0**/192	**0**/192
Low Rating	**7**/192	**0**/192	**0**/192	**0**/192
Negligible	**0**/192	**0**/192	**0**/192	**0**/192

Vulnerability Methodology Legend — Used | Not Used

Consequence Legend — Primary | Cascading | Not Considered

Emergency Shelters - Risk

Riverine Flooding

Total Number of Assets

192

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Riverine Flood Exposure & Occupancy Class

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	Asset is in both the 100-year and 500-year floodplain
Medium Rating	Asset is in the 500-year but not the 100-year floodplain
Low Rating	Asset is not in the 100-year or 500-year floodplain
Negligible	Not exposed

Data Sources: FEMA FIRM.

Vulnerability Rating	Vulnerability Methodology
High Rating	-
Low Rating	All assets assumed to be equal vulnerability

*Results are presented only for the current, because only present-day data on riverine flooding was available.

Risk Assessment and Results

Risk Rating	Current*
Very High Rating	**0**/192
High Rating	**23**/192
Medium Rating	**11**/192
Low Rating	**0**/192
Negligible	**158**/192

Vulnerability Methodology Legend: **Used** | Not Used

Consequence Legend: **Primary** | Cascading | Not Considered

Emergency Shelters - Risk

Extreme Heat

Total Number of Assets

192

Vulnerability Methodology

Table | Fragility Curves

Assessed Metrics

Extreme Heat Exposure, Heat Index Classification & Access to a Generator

Consequence

Health / Wellness | Damage | Disruption

Exposure and Vulnerability Assessment Inputs

Exposure Rating	Exposure Methodology
High Rating	1- or 5-yr = Extreme Danger (>123F)
Medium Rating	1-y r = Danger (>103 F)
Low Rating	1-yr < Danger (<103 F)
Negligible	Not exposed

Data Sources: NASA Earth Exchange GDDP, NOAA Heat Index Classifications

Vulnerability Rating	Vulnerability Methodology
High Rating	No access to a generator
Low Rating	Access to a generator or no information

Data Sources: Rhode Island Department of Emergency Management Agency (RIEMA)

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/192	**0**/192	**0**/192	**145**/192
High Rating	**0**/192	**96**/192	**96**/192	**47**/192
Medium Rating	**145**/192	**82**/192	**82**/192	**0**/192
Low Rating	**47**/192	**14**/192	**14**/192	**0**/192
Negligible	**0**/192	**0**/192	**0**/192	**0**/192

Vulnerability Methodology Legend Used | Not Used

Consequence Legend Primary | Cascading | Not Considered

Emergency Shelters - Risk

Extreme Wind

Total Number of Assets

192

Vulnerability Methodology

Table

Fragility Curves

Assessed Metrics

Wind Exposure & Building Typology

Consequence

Health / Wellness | **Damage** | Disruption

Exposure and Vulnerability Assessment Inputs

Risk Rating	Risk Methodology
Very High Rating	> 50% Damage, 700-yr 3-s gust
High Rating	30 - 50% Damage, 700-yr 3-s gust
Medium Rating	10 - 30% Damage, 700-yr 3-s gust
Low Rating	< 10% Damage, 700-yr 3-s gust
Negligible	Not exposed

Data Sources: ASCE7 Hazard Tool, International Panel on Climate Change (IPCC) AR5, and Hazus Wind Fragilities.*

* Hazus wind fragility CECBL with built-up roof, medium window area, no shutters, and missile environment A assumed. Open Terrain, damage state 4.

Risk Assessment and Results

Risk Rating	Current	2035 RCP 8.5	2050 RCP 8.5	2100 RCP 8.5
Very High Rating	**0**/192	**0**/192	**0**/192	**0**/192
High Rating	**0**/192	**0**/192	**0**/192	**0**/192
Medium Rating	**96**/192	**96**/192	**96**/192	**96**/192
Low Rating	**96**/192	**96**/192	**96**/192	**96**/192
Negligible	**0**/192	**0**/192	**0**/192	**0**/192

Vulnerability Methodology Legend

Used | Not Used

Consequence Legend

Primary | Cascading | Not Considered