



Coastal Hazards & Sea-Level Rise Asset Vulnerability Assessment for Cumberland Island National Seashore

Summary of Results

NPS 640/186744, November 2022



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Dungeness Ruins at Cumberland Island National Seashore

Photo credit: Program for the Study of Developed Shorelines at Western Carolina University

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Executive Summary

This document presents the results of the **Coastal Hazards & Sea-Level Rise (SLR) Asset Vulnerability Assessment (VA)** completed by Western Carolina University at Cumberland Island National Seashore (CUIS) in 2021. In this VA, we evaluate the vulnerability (as a combination of exposure and sensitivity) of NPS buildings and transportation assets¹ to identified coastal hazards and climate change factors, approximately to the year 2050 (for full methodology, see Peek et al. 2022).

We assessed 71 buildings (including houses/cottages, comfort stations/bathrooms, visitor centers, a ranger station, and historical ruins) and 79 transportation assets (roads/road segments, parking lots, trails/trail segments, bridges, boardwalks, and seawalls/shorelines) at CUIS. Less than one-third (32%) of assets analyzed have high or moderate vulnerability to the evaluated coastal hazards and SLR, while the majority (56%) have minimal vulnerability (are not in any of the evaluated hazard zones). Scoring details and results for all assets evaluated at CUIS are reported in the provided Excel sheets.

Exposure Results

Exposure is a measure of the character, magnitude, and rate of changes a target may experience (e.g., from the impacts of climate change or a natural hazard influenced by climate change; NPS 2021). In this VA, we evaluate the exposure of each asset to the following coastal hazard indicators: flooding potential, shoreline change, SLR inundation, extreme event flooding, and reported coastal hazards (Table 1).

Table 1. Exposure indicators and hazard data sources used.

Exposure Indicator (Description)	CUIS Data (Citation)
Flooding potential (1% annual-chance)	Effective FEMA VE & A zones (FEMA 2017)
Shoreline change (coastal proximity)	35-m shoreline proximity buffer (Peek et al. 2022)
SLR inundation (2050 proxy) *	NPS 2100 4.5 RCP SLR model; 0.56 m rise (Caffrey et al. 2018)
Extreme event flooding (category 3 surge)	NPS storm surge inundation model (Caffrey et al. 2018)
Reported coastal hazards (historic flooding)	Questionnaire results & discussions (Peek et al. 2022)

*See Unique Considerations

¹ The NPS Facility Management Software System (FMSS) database defines assets as “...a physical structure or grouping of structures, land features, or other tangible property that has a specific service or function, such as a farm, cemetery, campground, marina, or sewage treatment plant. The term ‘asset’ shall also be applied to movable items, such as vehicles and equipment.”

Assets with high exposure are within at least four exposure indicator hazard zones. Assets with moderate exposure are within two or three exposure indicator hazard zones. Assets with low exposure are within only one exposure indicator hazard zone. The asset could still be seriously impacted by this hazard. Assets with minimal exposure are not in any exposure indicator hazard zone. This does not mean that the asset has no exposure to coastal hazards, but it is not within the exposure hazard data used in this study.

One-third (33%) of assets analyzed at CUIS have either high or moderate exposure to the evaluated coastal hazards (Table 2, and Figure 1). Most of the high exposure assets are transportation related (roads, bridges, trails, and shorelines/seawalls), as only five buildings have high exposure. Eleven assets (three buildings and eight transportation) at CUIS are within all evaluated exposure zones, including the Waterwheel House Ruin, Boat House, Garden Point Road, and Marsh Boardwalk at Dungeness. Only 11% of assets have low exposure and over half (56%) have minimal exposure. Although CUIS is a barrier island, it has significant elevation and width in many locations, leading to lower exposure overall of many assets.

Table 2. CUIS exposure results. Sum of percentages may not equal 100 due to rounding.

Assets	High Exposure		Moderate Exposure		Low Exposure		Minimal Exposure		Total
	#	%	#	%	#	%	#	%	#
Buildings	5	7%	8	11%	7	10%	51	72%	71
Transportation	13	16%	23	29%	10	13%	33	42%	79
All Assets	18	12%	31	21%	17	11%	84	56%	150

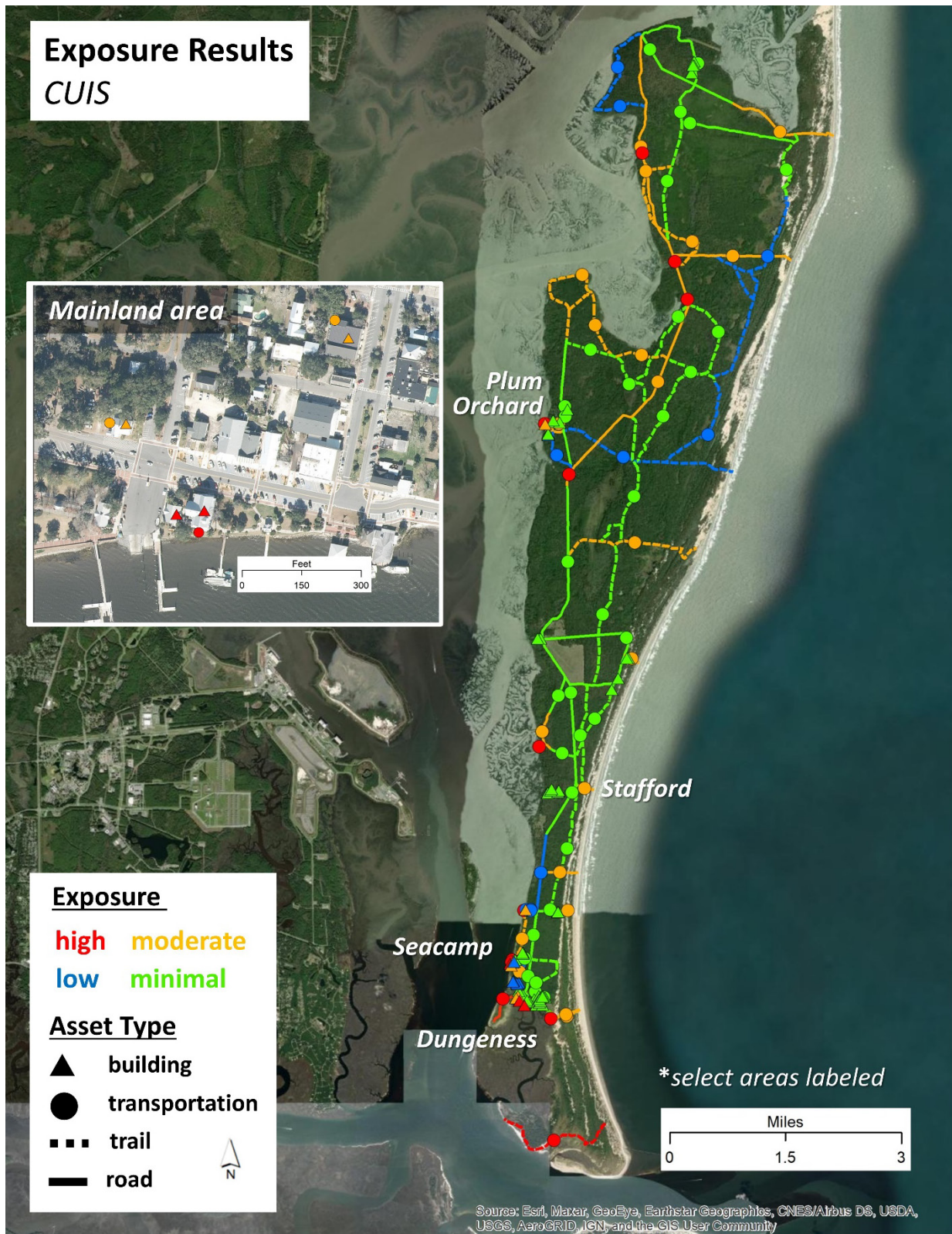


Figure 1. CUIS exposure results summary. Only select areas are labeled. Background map is ESRI streaming imagery.

Sensitivity Results

Sensitivity reflects the degree to which a resource is affected by exposure (NPS 2021). In this VA, we assess the following sensitivity indicators: flood damage potential/elevated, storm resistance and condition, historic damage, and protective engineering. In general, assets with high sensitivity have unfavorable determinations for 3 or 4 of these indicators, moderate-sensitivity assets have unfavorable determinations for 2 indicators, and low-sensitivity assets have unfavorable determinations for 0 or 1 indicator. Assets with minimal exposure are not analyzed for sensitivity (this is the case for 84 assets at CUIS).

Only seven assets analyzed at CUIS have high sensitivity to coastal hazards and SLR (Table 3), including the Dungeness Waterwheel House Ruin, Beach Creek Dock House, Mainland Museum, and several segments of Grand Avenue (Island Main Road). The majority (80%) of assets analyzed at CUIS have moderate sensitivity, and only six assets have low sensitivity. In most cases, the assets with high sensitivity (as opposed to moderate or low) are in poor condition and have been significantly damaged by coastal flooding in the past.

Table 3. CUIS sensitivity results. Sum of percentages may not equal 100 due to rounding.

Assets	High Sensitivity		Moderate Sensitivity		Low Sensitivity		Total Analyzed	Excluded*
	#	%	#	%	#	%	#	#
Buildings	3	15%	15	75%	2	10%	20	51
Transportation	4	9%	38	83%	4	9%	46	33
All Assets	7	11%	53	80%	6	9%	66	84

*Minimal exposure assets were excluded from the sensitivity analysis; total number analyzed is different for sensitivity.

Vulnerability Results

Vulnerability is a measure of the degree to which park resources and assets are “susceptible to harm from direct and indirect effects of climate change, including variability and extremes” (NPS 2021). In this VA, we evaluate the vulnerability of infrastructure assets as a simple combination of exposure and sensitivity ratings. It should be noted that the vulnerability of any asset can change with time (e.g., due to adaptation actions or the result of geomorphic change).

Only 11% of assets analyzed at CUIS have high vulnerability to the assessed coastal hazards, 21% have moderate vulnerability, and 11% have low vulnerability (Table 4, and Figures 2-6). Most assets (56%) have minimal vulnerability. Five assets have both high vulnerability and a high asset priority index (API > 70, as reported in FMSS): the Mainland Museum, Dungeness Boat House, Dungeness Seawall, and two segments of Grand Avenue (Island Main Road). Three assets at CUIS have both high exposure and high sensitivity: Dungeness Waterwheel House Ruin, Beach Creek Dock House, and Dungeness Seawall.

Table 4. CUIS vulnerability results. Sum of percentages may not equal 100 due to rounding.

Assets	High Vulnerability		Moderate Vulnerability		Low Vulnerability		Minimal Vulnerability		Total
	#	%	#	%	#	%	#	%	
Buildings	6	8%	6	8%	8	11%	51	72%	71
Transportation	11	14%	26	33%	9	11%	33	42%	79
All Assets	17	11%	32	21%	17	11%	84	56%	150

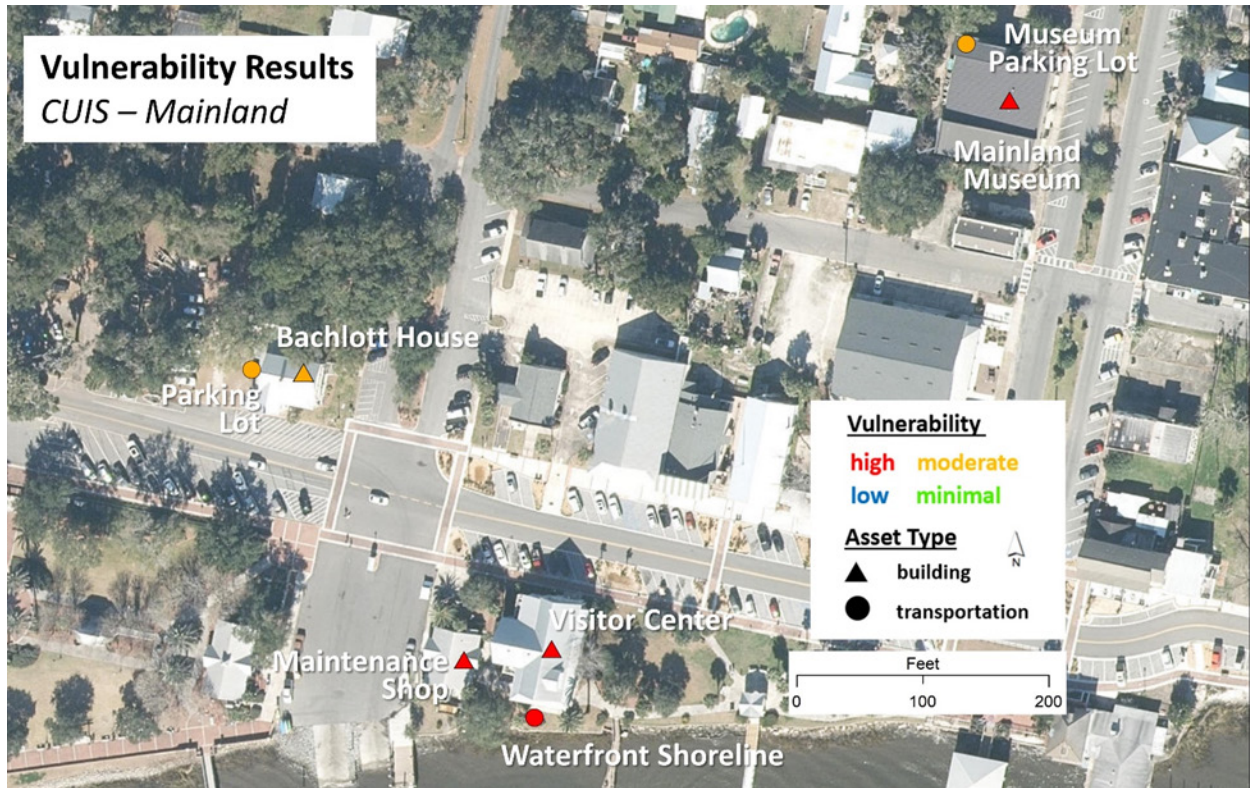


Figure 2. CUIS vulnerability results summary for the Mainland area. Only select assets are labeled. Background is ESRI streaming imagery.

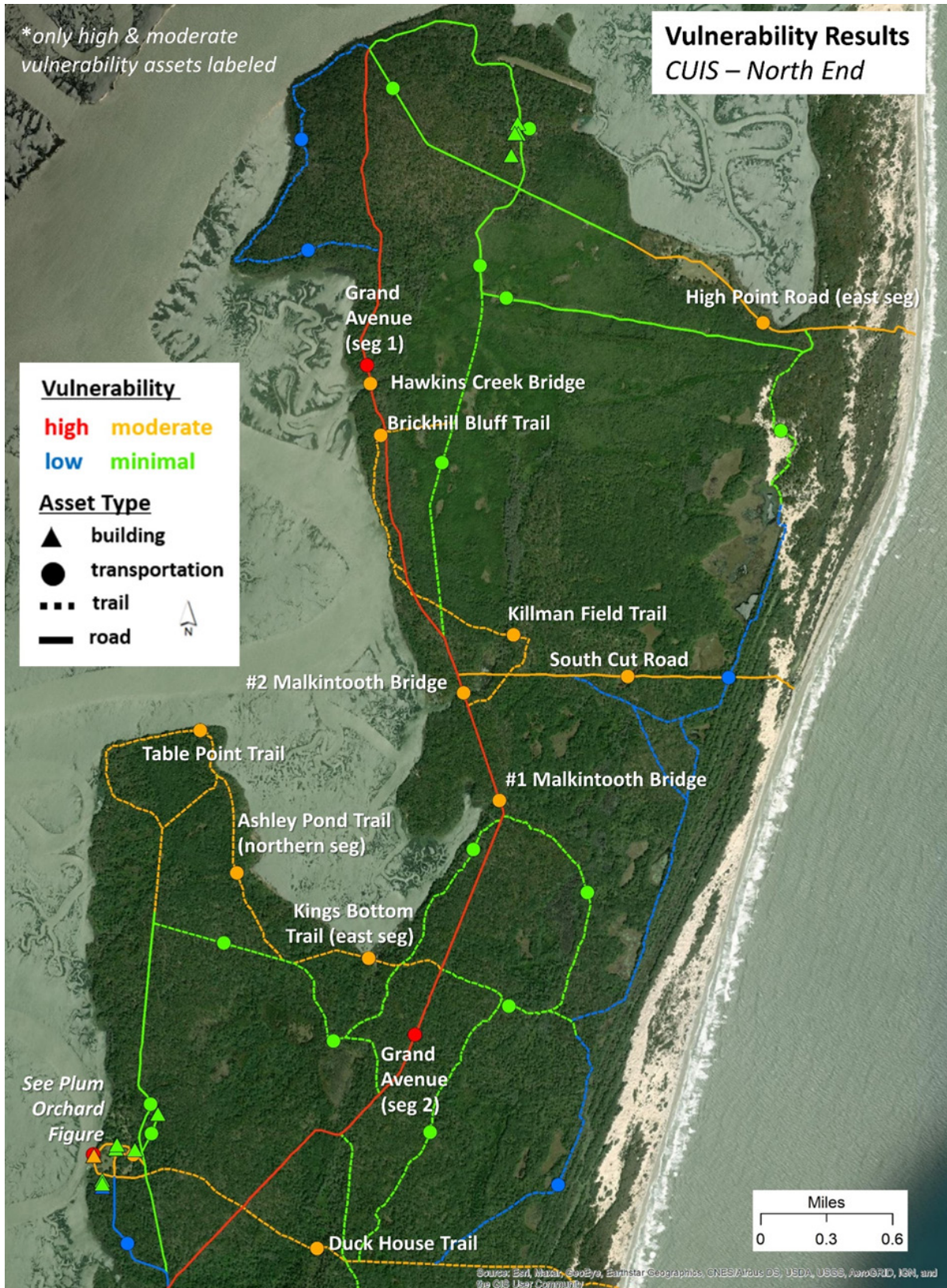


Figure 3. CUIS vulnerability results summary for the north portion of the island. Only select assets are labeled. Background is ESRI streaming imagery.



Figure 4. CUIS vulnerability results summary for the central portion of the island. Only select assets are labeled. Background is ESRI streaming imagery.

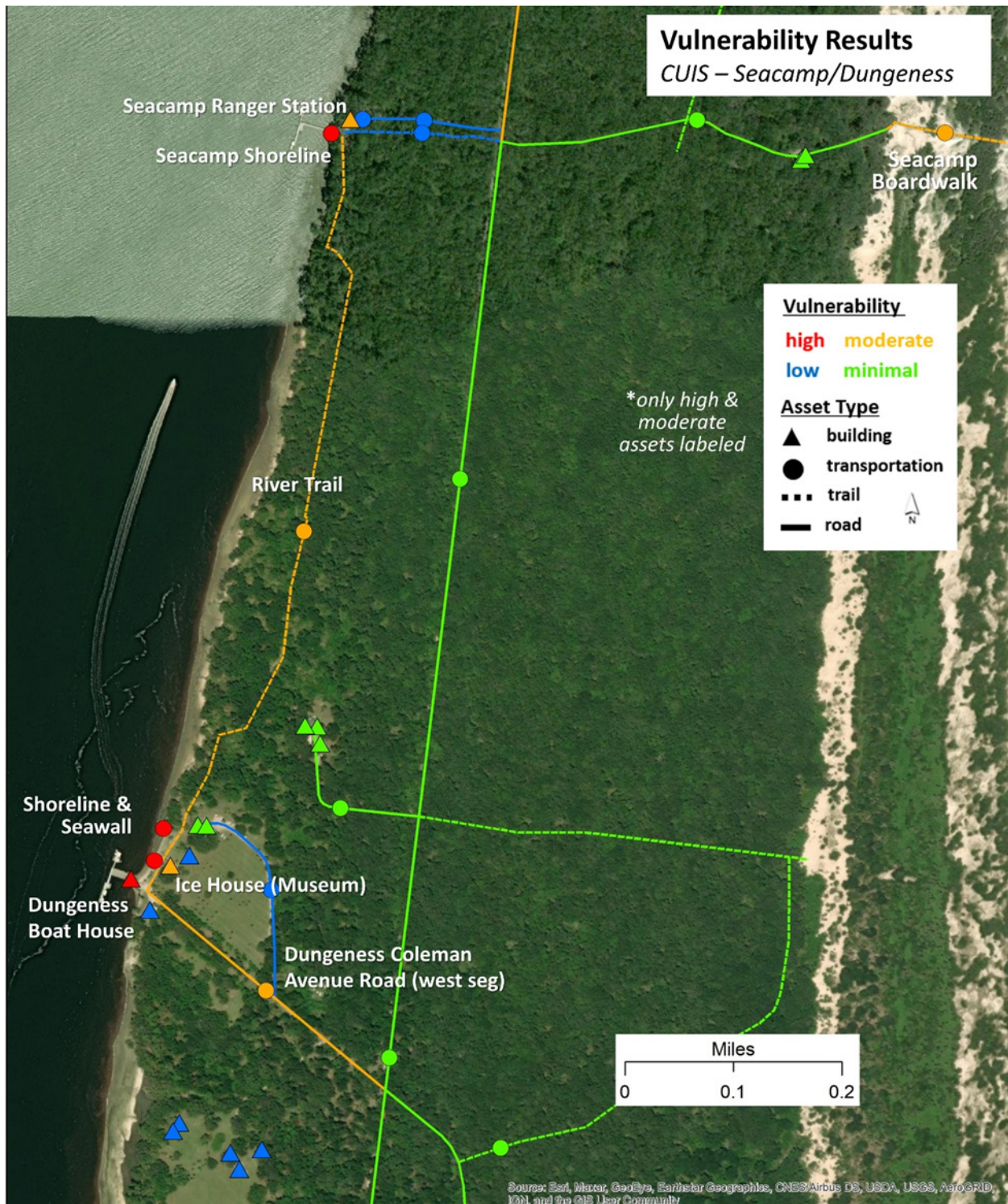


Figure 5. CUIS vulnerability results summary for the Seacamp/Dungeness area. Only select assets are labeled. Background is ESRI streaming imagery.

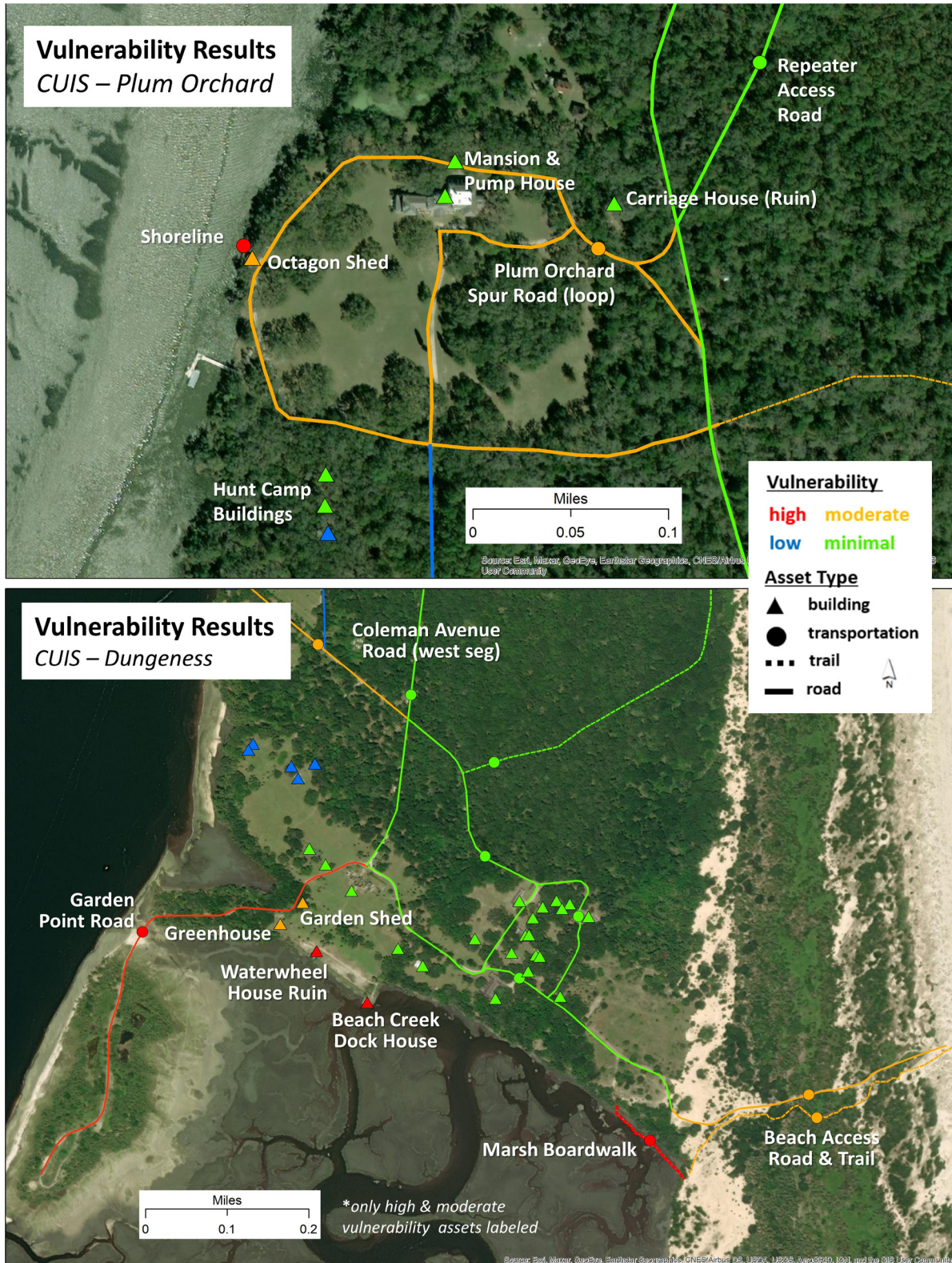


Figure 6. CUIS vulnerability results summary for the Plum Orchard and Dungeness areas. Only select assets are labeled. Background is ESRI streaming imagery.

CUIS Unique Considerations

Shoreline change: USGS shoreline erosion rate data are available for only a portion of the oceanfront coastlines of CUIS. However, most assets at CUIS are located on the soundside shoreline. As a result, we used a simple coastal proximity buffer of 35 meters, which accommodates an erosion rate up to 1m/year and assumes that infrastructure near the coast is likely to experience multiple coastal hazards within the 35-year (approximately 2050) timeframe of this analysis (see Peek et al. 2022).

SLR data: We used the 2100 4.5 RCP SLR projection (0.56 m rise) and inundation model from Caffrey et al. (2018) developed specifically for NPS units to score exposure for this indicator. These data are used as a proxy for 2050 SLR to accommodate higher SLR projections recently released by NOAA (see Peek et al. 2022).

Linear Features: Six roads and five trails were segmented at CUIS due to length and exposure variability. The following roads were segmented: High Point Road (2 segments), Dungeness Coleman Avenue Road (2 segments), Dungeness Beach Access Road (2 segments), Old House Creek Access Road (3 segments), Plum Orchard Spur Road (2 segments), and Grand Avenue (8 segments). The following trails were segmented: Parallel Trail (3 segments), Lost Road Trail (2 segments), Ashley Pond Trail (2 segments), Kings Bottom Trail (2 segments), and Terrapin Point Trail (2 segments). We evaluated each segment individually for exposure, sensitivity, and vulnerability, and assigned each segment a modified location code (segments share the same FMSS attributes).

References

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