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

Summary of Results

NPS 622/188380, May 2023

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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 Assateague Island National Seashore (ASIS) in 2022. In this VA, we evaluate the vulnerability (as a combination of exposure and sensitivity) of NPS buildings and transportation assets[1] to identified coastal hazards and climate change factors, approximately to the year 2050 (for full methodology, see Peek et al. 2022).

We assessed 79 buildings/structures (including housing, storage sheds, bathhouses, restrooms, offices, historic lodges, dump stations, and boathouses) and 73 transportation assets (roads/road segments, parking, bridges, trails, piers/docks, and a bulkhead) at ASIS. Most assets have high (59%) or moderate (24%) vulnerability to the evaluated coastal hazards. Only 14% of assets have low vulnerability, and 3% have minimal vulnerability. Scoring details and results for all assets evaluated at ASIS 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)	ASIS Data (Citation)
Flooding potential (1% annual-chance)	Effective FEMA VE & A zones (FEMA 2020; 2021)
Shoreline change / coastal proximity	ASIS 1996-2013 shoreline change rate (NPS 2015) buffers; 30-m shoreline proximity buffer (Peek et al. 2022)
SLR inundation (proxy for 2050) *	NPS 2100 4.5 RCP SLR model, 0.63 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

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[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.

The majority (83%) of assets analyzed at ASIS have either high or moderate exposure to the evaluated coastal hazards (Table 2, and Figures 1-3). Slightly more assets have high exposure (43%) than moderate (40%). Thirty-eight assets (16 buildings and 22 transportation) are within all evaluated exposure zones, including the Virginia Visitor Center, USCG Boathouse, Beach Road at Tom's Cove, Assateague Channel Bridge, and USCG Dock. All five minimal exposure assets are located in the Virginia Mainland Maintenance Area (Maintenance Garage Complex, Air Compressor Building, Pole Shed, Storage Building, and Maintenance Area and Unpaved Parking Area).

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

Assets	High Exposure		Moderate Exposure		Low Exposure		Minimal Exposure		Total
	#	%	#	%	#	%	#	%	#
Buildings	30	38%	29	37%	16	20%	4	5%	79
Transportation	35	48%	32	44%	5	7%	1	1%	73
All Assets	65	43%	61	40%	21	14%	5	3%	152
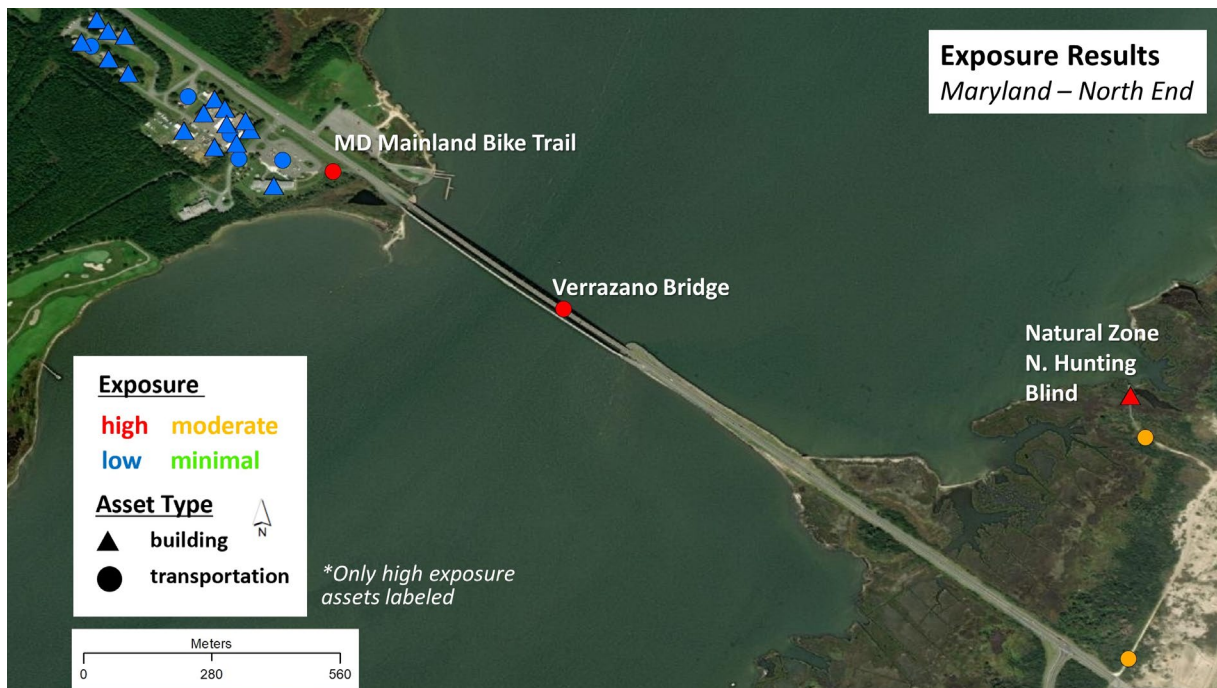
Figure 1. ASIS exposure results for the Maryland North End area. Only high exposure assets are labeled. Background map is ESRI streaming imagery.
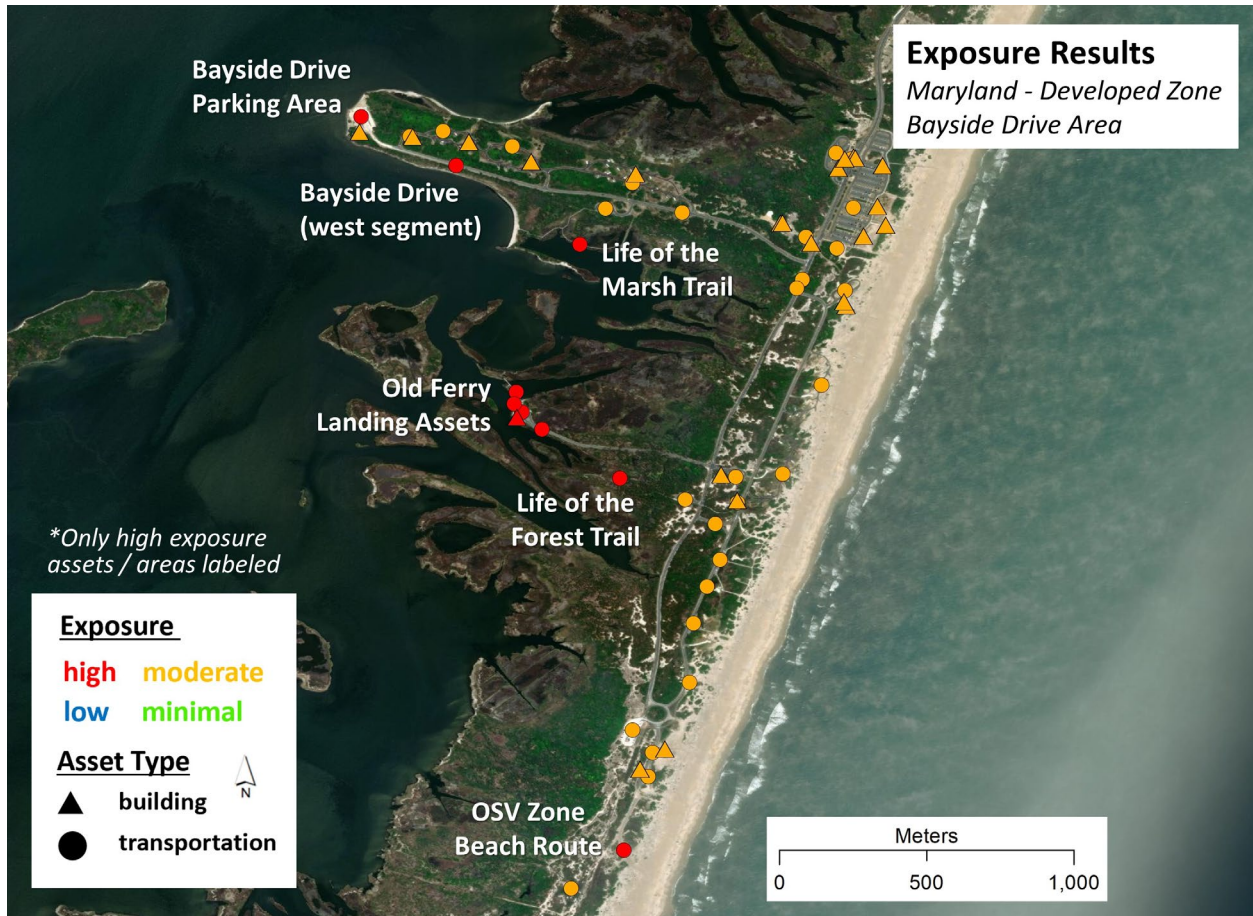
Figure 2. ASIS exposure results for the Maryland Developed Zone and Bayside Drive area. Only high exposure assets and areas are labeled. Background map is ESRI streaming imagery.
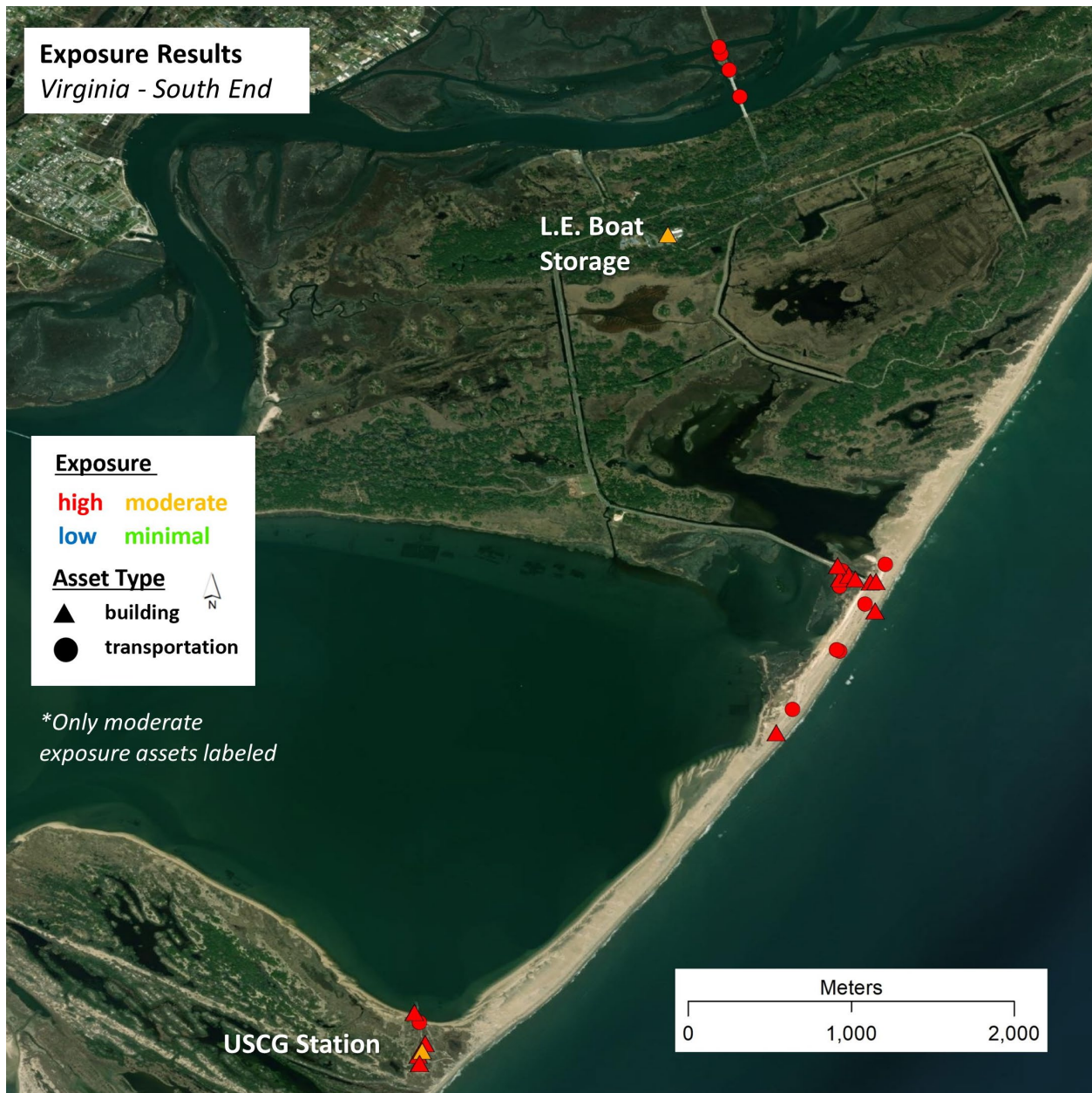
Figure 3. ASIS exposure results for the Virginia South End area. Only moderate exposure assets are labeled. Background map is ESRI streaming imagery.

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 five assets at ASIS).

More than half (55%) of the assets analyzed at ASIS have high sensitivity to coastal hazards and SLR, including the Virginia Visitor Center, South Beach Restroom Complex, USCG Boathouse, and Bayberry Drive (Table 3). Less than half (41%) of assets have moderate sensitivity and only six assets (4%) have low sensitivity. Almost all assets that are high sensitivity (compared to moderate) have been damaged in the past by coastal floods. Few assets are significantly elevated above local ground level (or above the Federal Emergency Management Agency Base Flood Elevation) and only a small percentage are storm resistant or protected by engineering (e.g., seawalls, bulkheads). Several assets at ASIS received a favorable rating for storm resistance due to being storm resilient (e.g., shell-hash or sand roads), which is relatively unique for coastal parks in the NPS.

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

Assets	High Sensitivity		Moderate Sensitivity		Low Sensitivity		Total Analyzed	Excluded*
	#	%	#	%	#	%	#	#
Buildings	38	51%	33	44%	4	5%	75	4
Transportation	43	60%	27	38%	2	3%	72	1
All Assets	81	55%	60	41%	6	4%	147	5

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

Twenty buildings received an unfavorable rating for all sensitivity indicators, including several historic lodges and buildings throughout the park (Green Run Lodge, Bob Odell's Lodge, People's & Lynch Lodge, and Bunting Lodge). Six transportation assets also received an unfavorable rating for all indicators, including the Oceanside Campground Road Loop 1, Oceanside Group Campsite Parking Area, and Oceanside Campground 86-104 Parking Area.

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).

The majority (83%) of assets analyzed at ASIS have either high or moderate vulnerability to the evaluated coastal hazards (Table 4, and Figures 4-9). Fifty-one assets (26 buildings and 25 transportation) have both high exposure and high sensitivity; most of these assets are in the Island Natural Zone and Tom's Cove areas of the park. Twelve transportation assets have high vulnerability

and a high asset priority index (API ≥ 70, as reported in FMSS), including: Beach Road Tom's Cove, Old Ferry Landing Bulkhead, Tom's Cove Parking areas, Bayside Drive (west segment), Bayberry Drive, and Virginia Park Entrance Beach Road. Almost all assets with low (14%) or minimal (3%) vulnerability are located on the mainland areas of the park.

Table 4. ASIS vulnerability results. Sum of percentages may not equal 100 due to rounding.
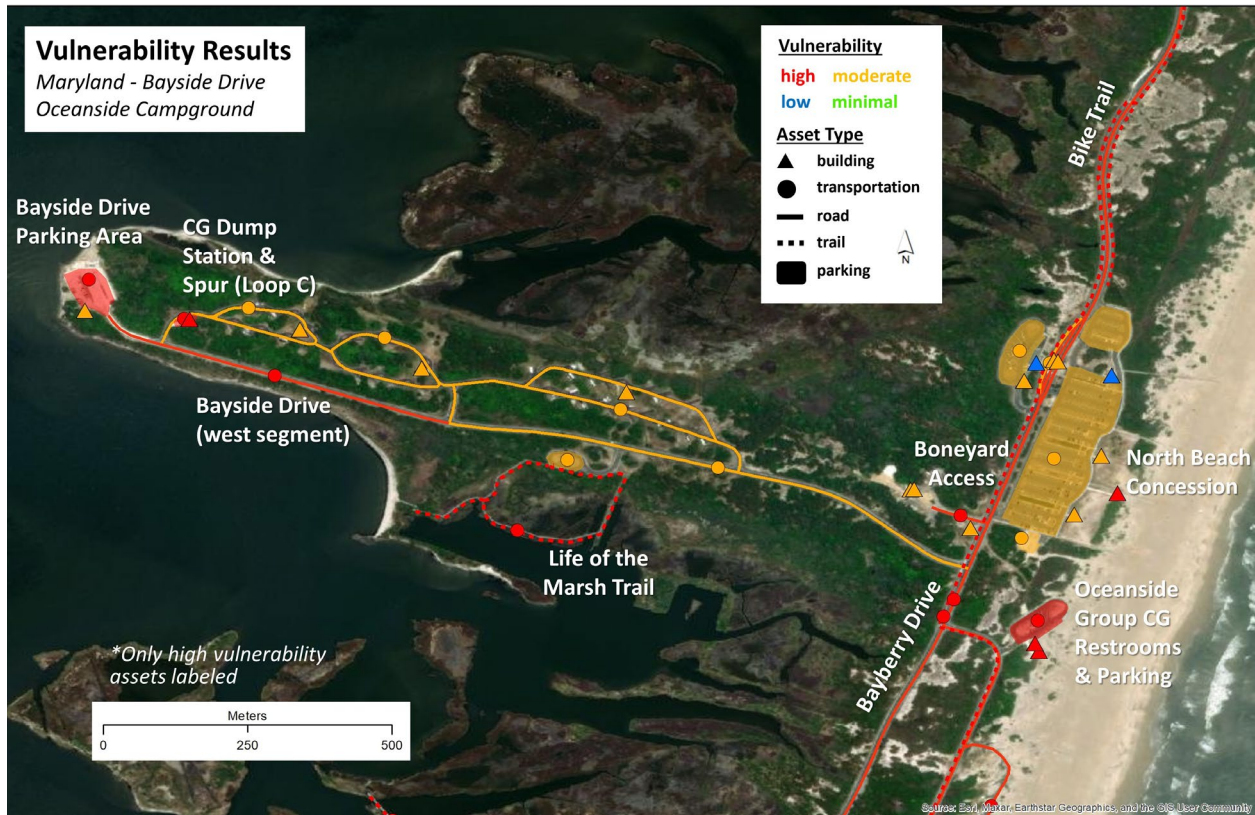
Assets	High Vulnerability		Moderate Vulnerability		Low Vulnerability		Minimal Vulnerability		Total
	#	%	#	%	#	%	#	%	#
Buildings	41	52%	16	20%	18	23%	4	5%	79
Transportation	49	67%	20	27%	3	4%	1	1%	73
All Assets	90	59%	36	24%	21	14%	5	3%	152
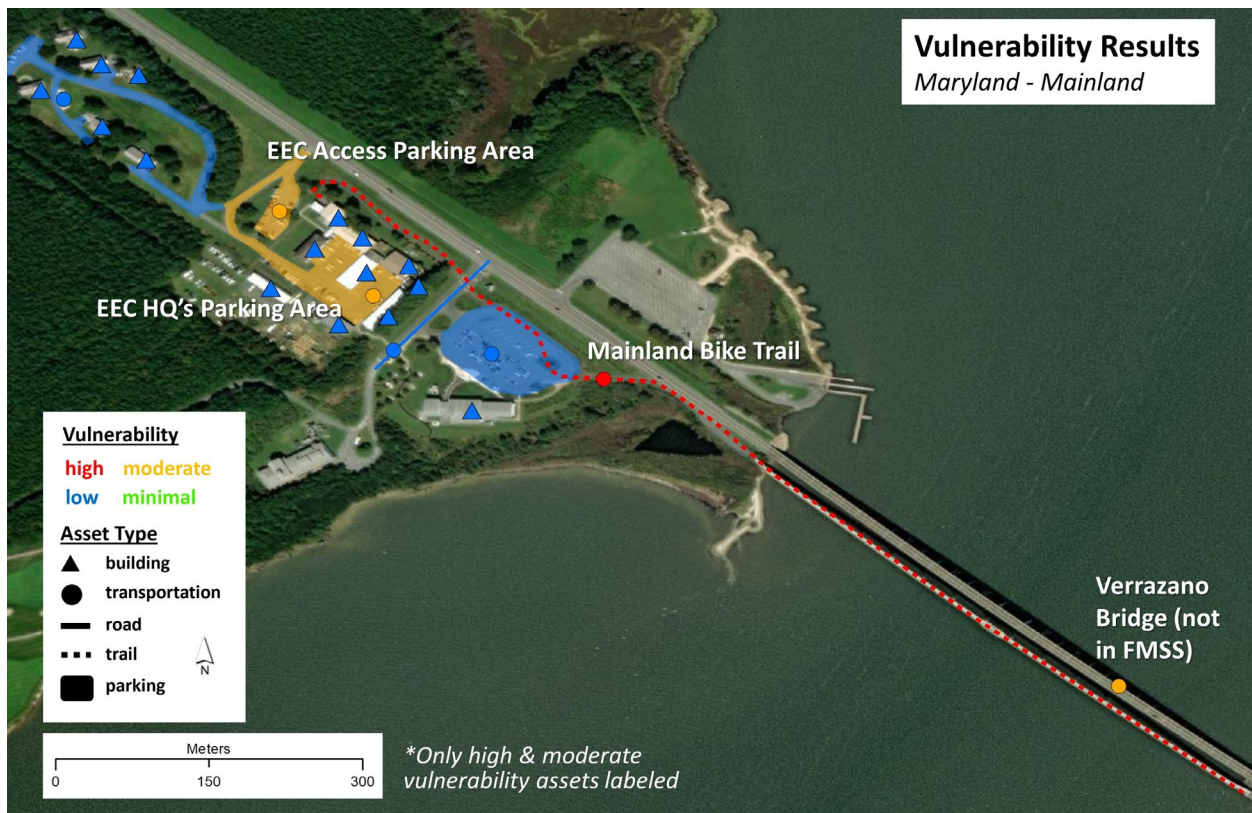
Figure 4. ASIS vulnerability results for the Maryland Mainland area. Only high and moderate vulnerability assets are labeled. Background map is ESRI streaming imagery.

ASIS has several ongoing adaptation projects that are intended to reduce the exposure and/or sensitivity of assets to coastal hazards. The park has adopted a proactive approach to infrastructure design within this dynamic barrier island environment, including structures that can be easily moved offsite (e.g., in advance of storms) and resilient shell-hash roads and parking lots. Major storms over the past decade have also prompted adaptation actions. Damage from Hurricane Sandy in 2012

initiated the relocation and redesign of the oceanfront parking lot at South Beach. Increased visitation and continued coastal hazards have led to additional redesign efforts of both the parking lot and adjacent roadways. Another planned project focuses on increasing resilience while maintaining visitor use at the Oceanside and Bayside campgrounds. This plan includes incremental changes over time as the campsites, roads, and parking lots are impacted by coastal processes.
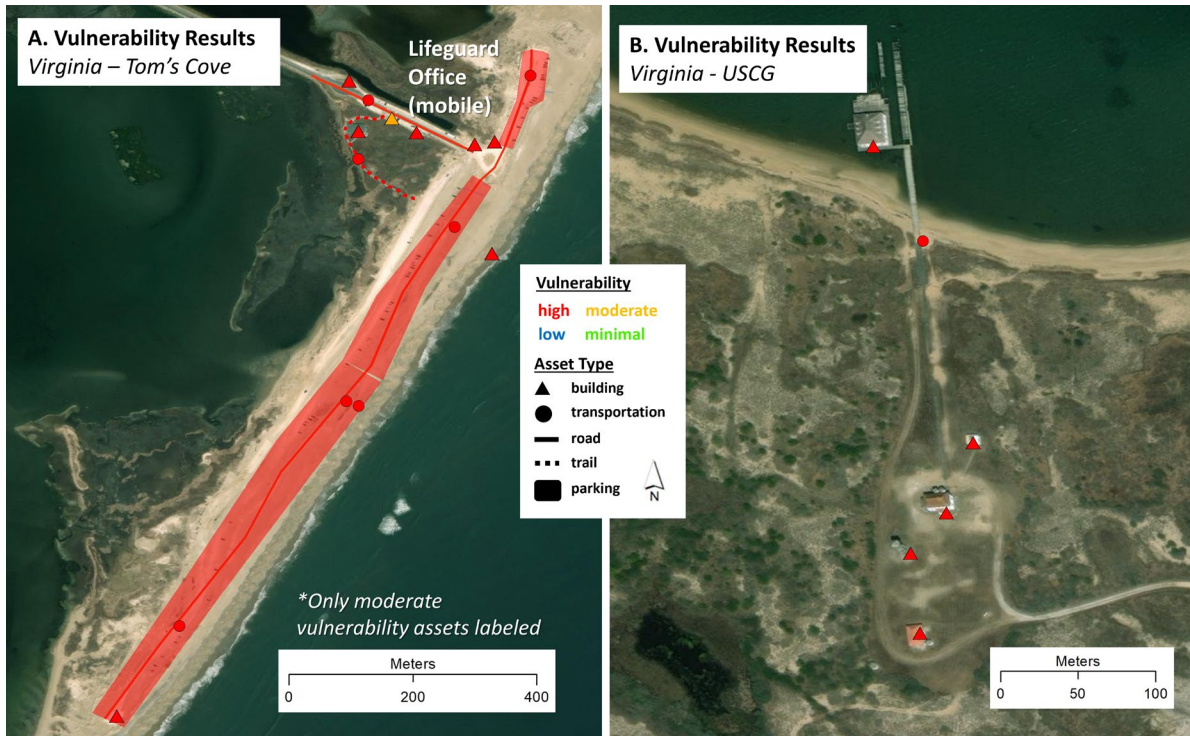

Figure 5. ASIS vulnerability results for the Maryland Bayside Drive and Oceanside Campground areas. Only high vulnerability assets are labeled. Background map is ESRI streaming imagery.
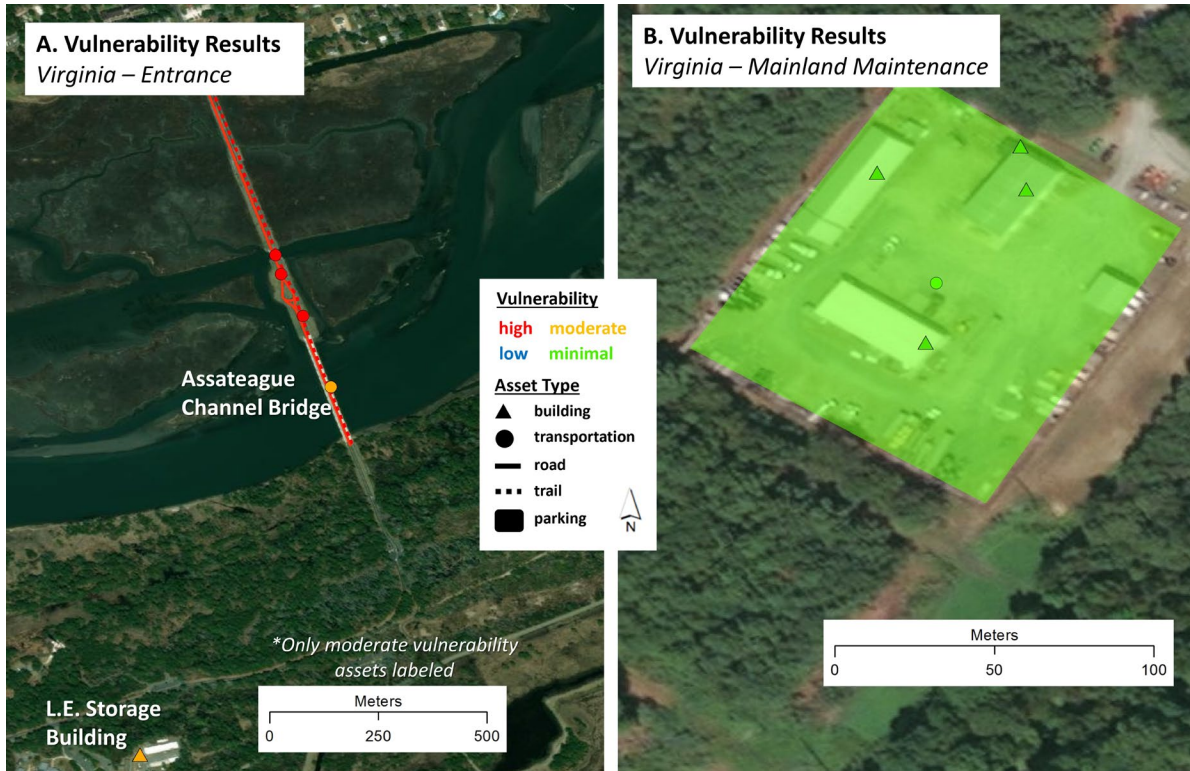
Figure 6. ASIS vulnerability results for the Maryland Oceanside Campground, Old Ferry, and South Beach areas. Only high vulnerability assets and areas are labeled. Background map is ESRI streaming imagery.

Figure 7. ASIS vulnerability results for the Natural Zone area (both Maryland and Virginia). Only select areas are labeled. Background map is ESRI streaming imagery.

Figure 8. ASIS vulnerability results for the A) Toms Cove and B) USCG areas in Virginia. Only moderate vulnerability assets are labeled. Background maps are ESRI streaming imagery.

Figure 9. ASIS vulnerability results for the A) Entrance and B) Mainland Maintenance areas in Virginia. Only moderate vulnerability assets are labeled. Background maps are ESRI streaming imagery.

ASIS Unique Considerations

Shoreline change: We used short-term (1996-2013) shoreline change rate data (NPS 2015) and 2021 shorelines (NPS 2016) to create erosion buffer zones for the oceanfront shorelines of ASIS. For the soundside shorelines, we used a simple 30-m proximity buffer. This proximity buffer accommodates an erosion rate up to 1m/year and assumes that infrastructure near the coast is likely to experience multiple coastal hazards within the 30-year (approximately 2050) timeframe of this analysis (see Peek et al. 2022).

SLR data: We used the 2100 4.5 Representative Concentration Pathway SLR projections and inundation model from Caffrey et al. (2018) developed specifically for NPS units to score exposure for this indicator (0.63 m rise for ASIS). These data are used as a proxy for 2050 SLR to accommodate higher SLR projections recently released by the National Oceanic and Atmospheric Administration (see Peek et al. 2022).

Non-FMSS assets: At the request of the park, we evaluated one non-FMSS listed asset in the ASIS area, the Verrazano Bridge. This bridge (owned by the State of Maryland) is imperative to the park as it connects the Maryland mainland to the north part of Assateague Island. All statistics in the results and within this report include this asset.

Threshold elevation: We incorporated building threshold elevation data (collected by the NPS Information System Services) into the Flood Damage Potential sensitivity indicator for 26 assets at ASIS (see Peek et al. 2022).

Linear assets: Due to the length and exposure variability of Bayside Drive, we divided this road into two 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). All other roads and trails were not segmented, as most are already relatively short features or have similar exposure. Each of these roads or trails has only one score for exposure, sensitivity, and vulnerability. Any statistics or estimates of value represent the entire road, even if only a small portion has high exposure or vulnerability.

National Bridge Inventory data: Three of the five bridges evaluated at ASIS (Verrazano, Sheepshead Creek, and Assateague Channel) are in the National Bridge Inventory (NBI), which contains several attributes that were used as additional sensitivity indicators (clearance, scour rating, condition, and age). We use a different scoring system (see Peek et al. 2022) for bridges with additional NBI sensitivity indicators.

References

Caffrey, M., R.L. Beavers, and C. Hawkins Hoffman. 2018. Sea level rise and storm surge projections for the National Park Service. Natural Resource Report. NPS/NRSS/NRR—2018/1648. National Park Service. Fort Collins, Colorado. Available at: https://irma.nps.gov/DataStore/Reference/Profile/2253283.

Federal Emergency Management Agency (FEMA). 2020. National Flood Hazard Layer. Worcester County, Maryland. https://www.fema.gov/flood-maps/national-flood-hazard-layer. Accessed April 2022.

FEMA. 2021. National Flood Hazard Layer. Accomack County, Virginia. https://www.fema.gov/flood-maps/national-flood-hazard-layer. Accessed April 2022.

National Park Service (NPS). 2021. Coming to terms with climate change: Working definitions. National Park Service Climate Change Response Program, Fort Collins, Colorado.

NPS. 2015. ASIS shoreline change rates (1996-2013). https://asis-nps.opendata.arcgis.com/datasets/nps::asis-shoreline-change-rate/about.

NPS. 2016. ASIS fall shoreline, 2021. https://asis-nps.opendata.arcgis.com/datasets/nps::asis-fall-shoreline-202111/about.

Peek, K.M., B.R. Tormey, H.L. Thompson, and R.S. Young. 2022. Coastal hazards & sea-level rise asset vulnerability assessment protocol: Updated project description & methodology. Natural Resource Report. NPS/NRSS/CCRP/NRR—2022/2427. National Park Service. Fort Collins, Colorado. Available at: https://doi.org/10.36967/2293653.

National Park Service
U.S. Department of the Interior