



Coastal Hazards & Sea-Level Rise Asset Vulnerability Assessment for Timucuan Ecological & Historic Preserve and Fort Caroline National Memorial

Summary of Results

NPS 006/186750, NPS 396/186750, November 2022



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Kingsley Plantation and Fort George River at Timucuan Ecological & Historic Preserve

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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 Timucuan Ecological & Historic Preserve and Fort Caroline National Memorial (together referred to as TIMU-FOCA). 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 32 buildings/structures (including visitor centers, offices, housing, comfort stations, towers, fortifications, batteries, monuments) and 35 transportation assets (roads, parking lots, trails, trail bridges, boardwalks, piers, ramps, docks, and waterfronts/seawalls) at TIMU-FOCA. Less than half (46%) of assets assessed have high or moderate vulnerability to the evaluated coastal hazards and SLR, while almost one-third (30%) have minimal vulnerability (are not in any of the evaluated hazard zones). Scoring details and results for all assets evaluated at TIMU-FOCA 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)	TIMU-FOCA Data (Citation)
Flooding potential (1% annual-chance)	Effective FEMA VE & A zones (FEMA 2018)
Shoreline change (coastal proximity)	35-m shoreline proximity buffer (Peek et al. 2022)
SLR inundation (2050)	NPS 8.5 RCP SLR model, 0.25 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)

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.

Just under half (45%) of assets evaluated at TIMU-FOCA have either high or moderate exposure to coastal hazards. (Table 2, Figures 1- 3). Most of the high exposure assets are transportation related (roads, trails, bridges, and marine assets), as only two buildings/structures have high exposure (Fort Exhibit and Round Marsh Overlook Tower). Six assets (two structures and four transportation) at TIMU-FOCA are within all evaluated exposure zones, including the Fort Exhibit, Round Marsh Overlook Tower, Cedar Point Launch Ramp, Broward House Dock, Kingsley Seawall, and Fort Caroline Shoreline Retaining Wall.

Table 2. TIMU-FOCA exposure results. Sum of percentages may not equal 100 due to rounding.

Assets	High Exposure		Moderate Exposure		Low Exposure		Minimal Exposure		Total
	#	%	#	%	#	%	#	%	#
Buildings	2	6%	7	22%	10	31%	13	41%	32
Transportation	14	40%	7	20%	7	20%	7	20%	35
All Assets	16	24%	14	21%	17	25%	20	30%	67

One-quarter of all assets have low exposure and nearly one-third have minimal exposure. Most of the minimal exposure assets are in the Theodore Roosevelt and the Fort Caroline Visitor Center/Maintenance areas.



Figure 1. TIMU-FOCA exposure results for the Fort Caroline area. Only select assets are labeled. Background map is ESRI streaming imagery.

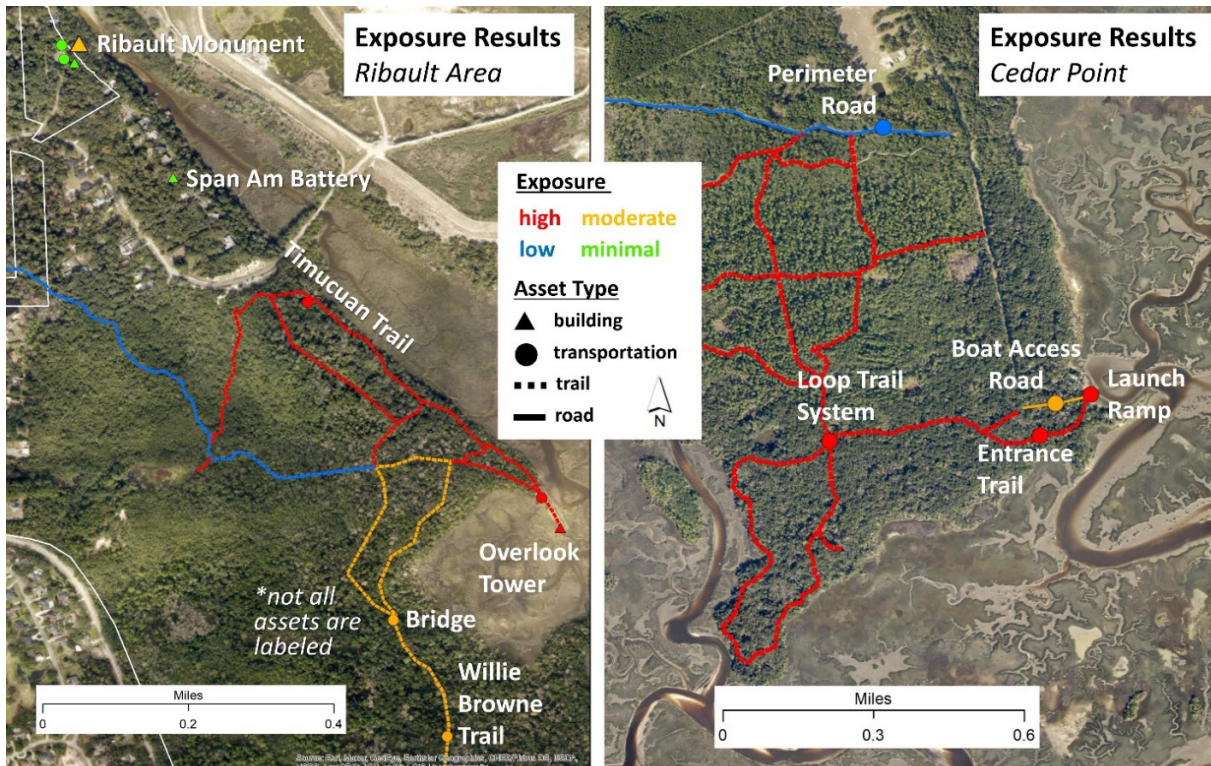


Figure 2. TIMU-FOCA exposure results for the Ribault (left) and Cedar Point (right) areas. Only select assets are labeled. Background map is ESRI streaming imagery.

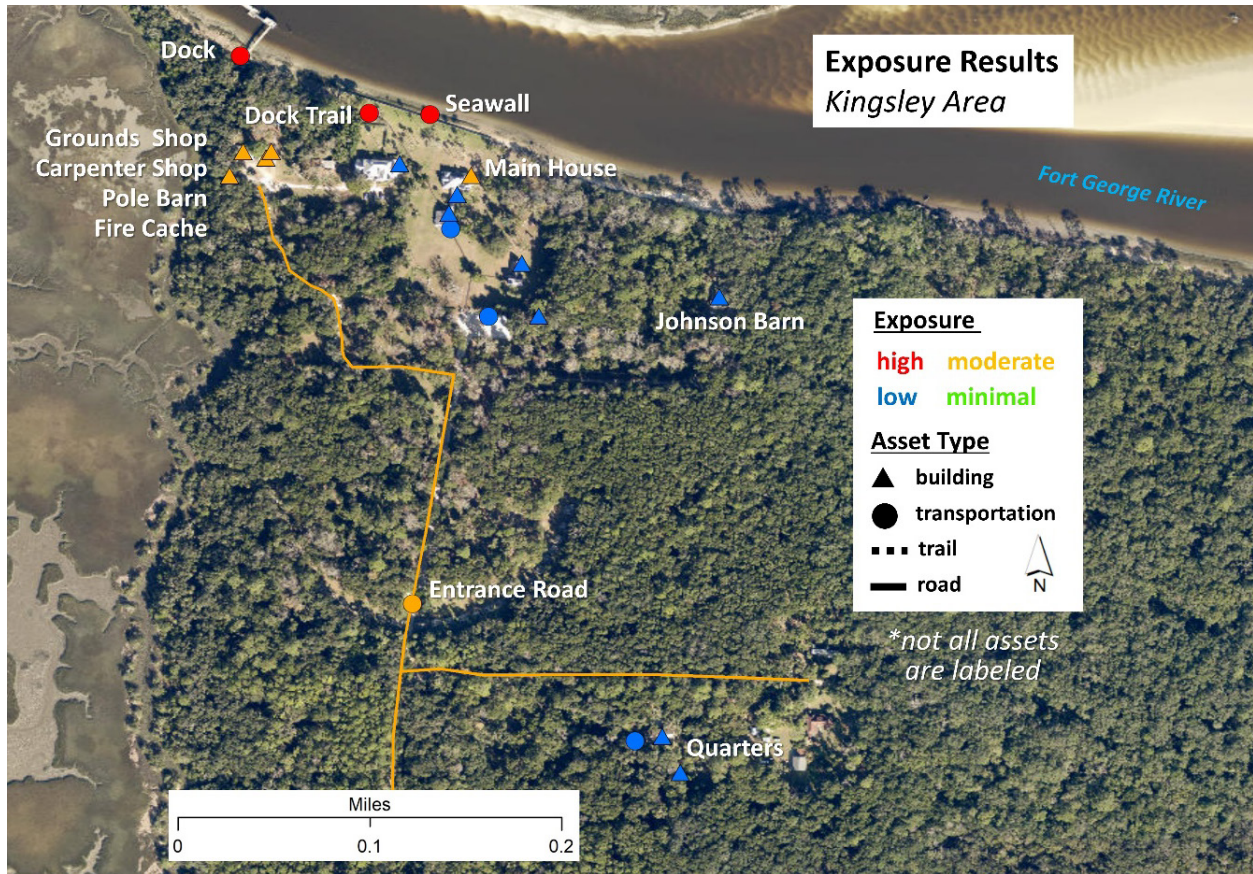


Figure 3. TIMU-FOCA exposure results for the Kingsley area. Only select assets are labeled. Background map is ESRI streaming imagery.

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 20 assets at TIMU-FOCA).

Only five assets analyzed at TIMU-FOCA have high sensitivity to coastal hazards and SLR, including the Fort Exhibit, Timucuan Trail, Kingsley Carpenter Shop, Kingsley Pump House, and Cedar Point Boat Access Road (unpaved). The majority (83%) of assets analyzed at TIMU-FOCA have moderate sensitivity, and only three assets have low sensitivity (Table 3). In general, most assets have not been damaged in the past by coastal floods and are in good condition, while only a few are elevated, storm resistant, or protected by engineering structures.

Table 3. TIMU-FOCA sensitivity results. Sum of percentages may not equal 100 due to rounding.

Assets	High Sensitivity		Moderate Sensitivity		Low Sensitivity		Total Analyzed	Excluded*
	#	%	#	%	#	%	#	#
Buildings	3	16%	16	84%	0	0%	19	13
Transportation	2	7%	23	82%	3	11%	28	7
All Assets	5	11%	39	83%	3	6%	47	20

*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).

The vulnerability results for TIMU-FOCA are distributed relatively evenly between the high, moderate, low, and minimal rankings (Table 4, and Figures 4-7). Just under half of assets evaluated have either high or moderate vulnerability to coastal hazards and SLR (22% and 24%, respectively). Reflecting their high exposure, more transportation assets have high vulnerability compared to buildings/structures. The Fort Exhibit, Round Marsh Overlook Tower, and Kingsley Carpenter Shop are the only structures with high vulnerability at TIMU-FOCA. Transportation assets with high vulnerability include the Fixed Pier, Hammock/Natural Trail Bridge, and French Memorial Trail at Fort Caroline; the Launch Ramp, Boat Access Road, and Loop Trail System at Cedar Point; the Dock, Dock Trail, and Entrance Trail at Kingsley; the Timucuan Trail and Round Marsh Trail in the Theodore Roosevelt Area; and the roads at the Thomas Creek Area.

Two assets at TIMU-FOCA (Fort Exhibit and Timucuan Trail) have both high exposure and high sensitivity. Only two assets evaluated (Cedar Point Launch Ramp and Boat Access Road) have high vulnerability and a high asset priority index (API > 70 as reported in FMSS).

Table 4. TIMU-FOCA vulnerability results. Sum of percentages may not equal 100 due to rounding.

Assets	High Vulnerability		Moderate Vulnerability		Low Vulnerability		Minimal Vulnerability		Total
	#	%	#	%	#	%	#	%	#
Buildings	3	9%	7	22%	9	28%	13	41%	32
Transportation	12	34%	9	26%	7	20%	7	20%	35
All Assets	15	22%	16	24%	16	24%	20	30%	67

The park is currently evaluating potential adaptation and future planning projects to reduce infrastructure vulnerability. Multiple adaptation strategies have been explored for the Fort Caroline Exhibit, including relocation to lower exposure, as well as engineering protection, site elevation, and redesign to reduce sensitivity. The park is also preparing a Development Concept Plan (NPS 2022) for Kingsley Plantation which will guide development and use of the site over the next 20 years. This plan focuses on visitor access and resource protection, but also considers the future impacts of storm surge, coastal flooding, and SLR on infrastructure. Planning efforts include the proposed relocation of the maintenance area (e.g., Carpenter Shop in Figure 6) to a less exposed site to the east.



Figure 4. TIMU-FOCA vulnerability results for the Fort Caroline area. Only select assets are labeled. Background is ESRI streaming imagery.

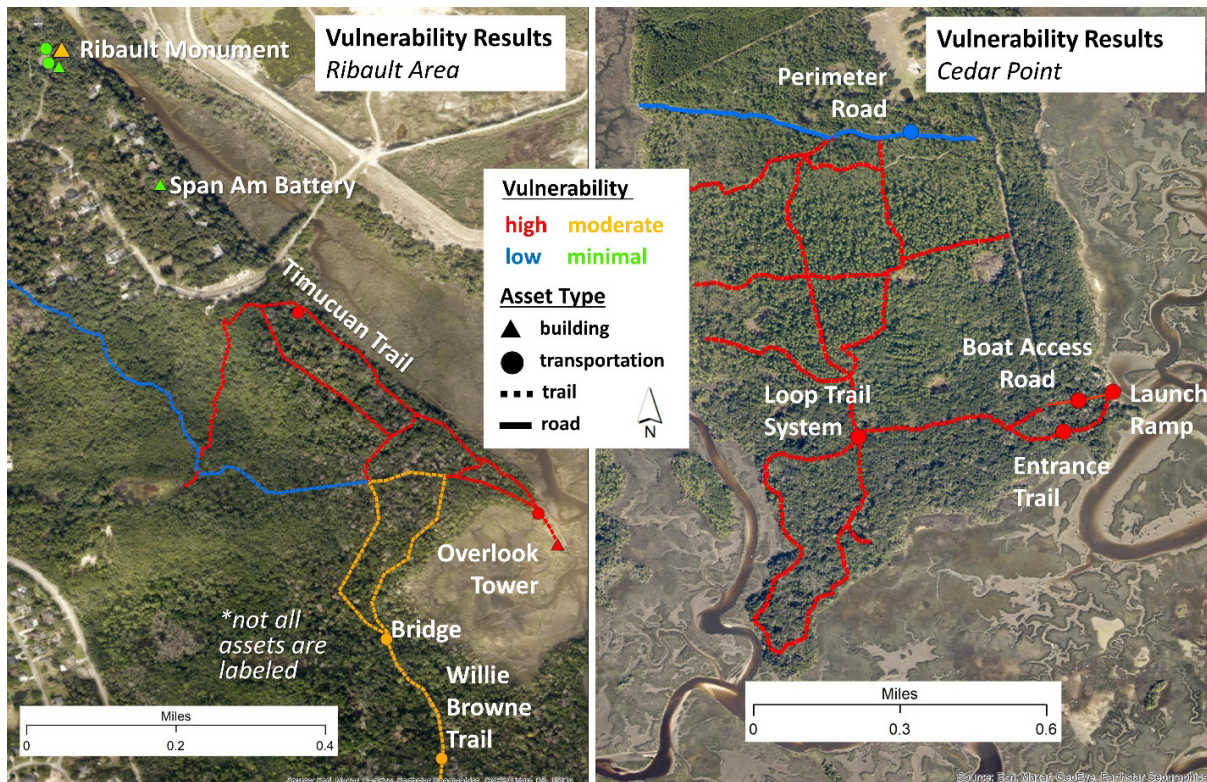


Figure 5. TIMU-FOCA vulnerability results for the Ribault (left) and Cedar Point (right) areas. Only select assets are labeled. Background is ESRI streaming imagery.

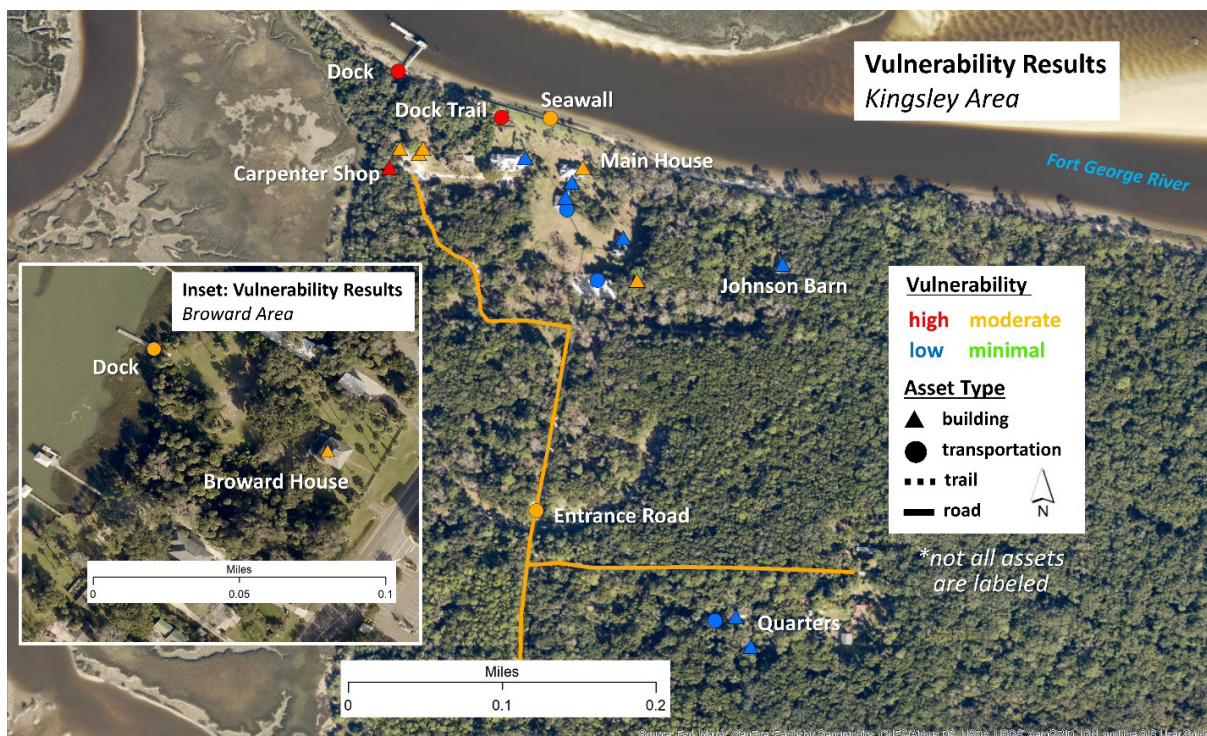


Figure 6. TIMU-FOCA vulnerability results for Kingsley and Broward (inset) areas. Only select assets are labeled. Background is ESRI streaming imagery.

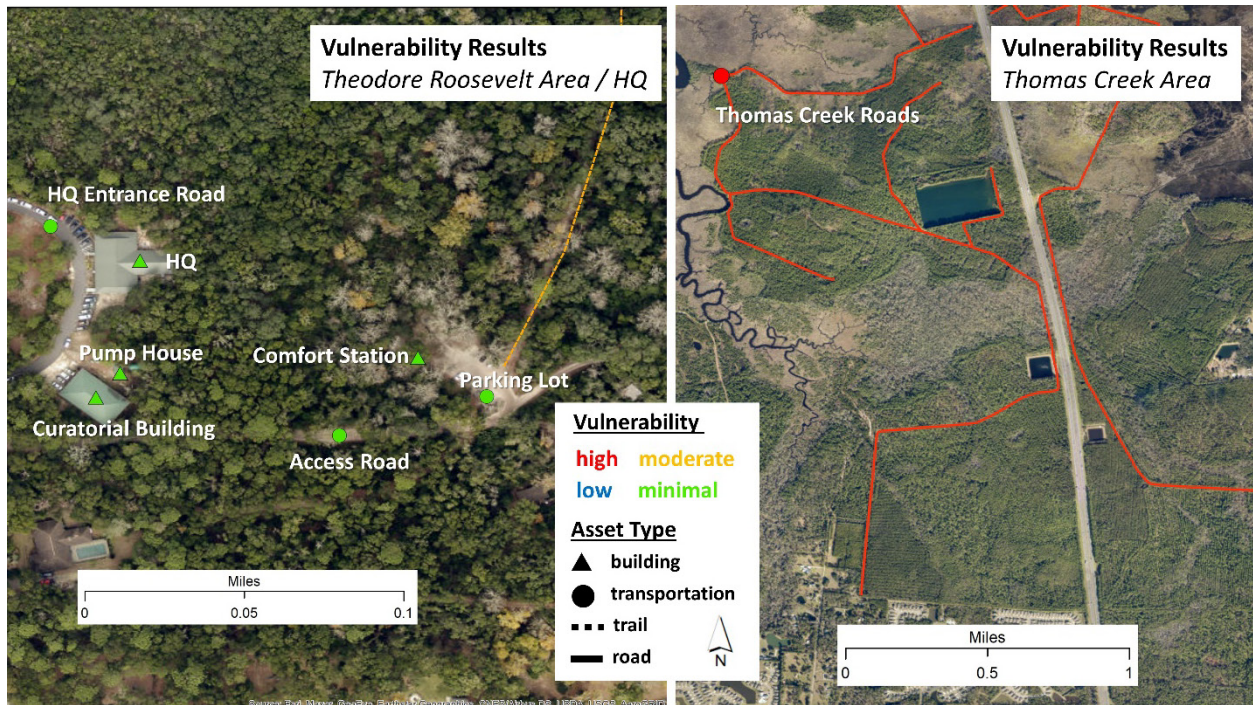


Figure 7. TIMU-FOCA vulnerability results for Theodore Roosevelt (left) and Thomas Creek (right) areas. Only select assets are labeled. Background is ESRI streaming imagery.

TIMU-FOCA Unique Considerations

Shoreline change: USGS (or other) shoreline erosion rate data are not available for the non-oceanfront coastlines of TIMU-FOCA. 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 2050 8.5 RCP SLR projection (0.25 m rise) and inundation model (Caffrey et al. 2018) developed specifically for NPS units to score exposure for this indicator. However, we also provided alternate scores using the 2100 4.5 SLR projection (0.56 m rise) for comparison (see Peek et al. 2022).

Linear assets: NPS-owned roads and trails at TIMU-FOCA were not segmented, as most are already relatively short features (only the Thomas Creek and Sohn Property roads are > 1 mile in length). Therefore, each road or trail 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.

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