



Coastal Hazards & Sea-Level Rise Asset Vulnerability Assessment for Channel Islands National Park

Summary of Results

NPS 159/199591, May 2026



PROGRAM FOR
THE STUDY OF
DEVELOPED
SHORELINES

Western
Carolina
UNIVERSITY

ON THE COVER

Overview of Prisoners Harbor Coastal Wetland, Santa Cruz Island
Photo credit: National Park Service

Coastal Hazards & Sea-Level Rise Asset Vulnerability Assessment for Channel Islands National Park

Summary of Results

NPS 159/199591, May 2026

Program for the Study of Developed Shorelines
Western Carolina University
Cullowhee, North Carolina 28723

This document has been developed by the NPS Climate Change Response Program and Park Facilities Management Division in partnership with Western Carolina University through a Task Agreement with the Southern Appalachian Cooperative Ecosystems Studies Unit.

Please cite this publication as:

Peek, K.M., H.L. Thompson, B.R. Tormey, and R.S. Young. 2026. Coastal Hazards & Sea-Level Rise Asset Vulnerability Assessment for Channel Islands National Park: Summary of Results. NPS 159/199591. Program for the Study of Developed Shorelines, Western Carolina University, Cullowhee, N.C.

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 Channel Island National Park (CHIS) in 2025. 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 99 buildings (including visitor centers, housing, lighthouses, vault toilets, and historic structures) and 70 transportation assets (roads/road segments, a parking lot, trails/trail segments, airstrips, bridges, and waterfronts/piers) at CHIS. Less than one-fifth of the assets evaluated at CHIS have high (4%) or moderate (12%) vulnerability to the evaluated coastal hazards and SLR, while 11% have low vulnerability. The majority (72%) have minimal vulnerability (outside of all hazard zones). Scoring details and results for all assets evaluated at CHIS are reported in the provided Excel sheets.

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.”

CHIS Exposure Results

Exposure is a measure of the character, magnitude, and rate of changes a target may experience (e.g., from the impacts of natural hazards or 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. CHIS exposure indicators and hazard data sources.

Exposure Indicator (Description)	Data (Citation)
Flooding potential (1% annual-chance)	Effective FEMA VE & A zones (FEMA 2005; 2021) USGS CoSMoS 25 cm SLR + 100-year flood zone (Barnard et al. 2018)
Shoreline change (coastal proximity)	25-m shoreline proximity buffer (Peek et al. 2022)
SLR inundation (2050)	NPS 2050 8.5 RCP SLR model, 0.20 m rise (Caffrey et al. 2018) NOAA 1 ft SLR inundation zones (NOAA 2022)
Extreme event flooding (tsunami inundation)	California Tsunami Hazard Areas (Graehl et al. 2022) Tsunami proxy zone (see Unique Considerations)
Reported coastal hazards (historic flooding/active erosion)	Questionnaire results & discussions (Peek et al. 2022)

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.

Six (9%) transportation assets (all waterfronts, docks, and piers) analyzed at CHIS have high exposure to the coastal hazards evaluated and are within all exposure zones (Table 2, and Figures 1-3). None of the 99 buildings/structures analyzed have high exposure. Twenty assets (12%) have moderate exposure and 21 (12%) have low exposure. Almost three-quarters (72%) of assets evaluated at CHIS have minimal exposure, a result of the park's higher elevation leading to lower exposure overall to coastal flooding and SLR.

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

Assets	High Exposure		Moderate Exposure		Low Exposure		Minimal Exposure		Total
	#	%	#	%	#	%	#	%	#
Buildings	0	0%	9	9%	13	13%	77	78%	99
Transportation	6	9%	11	16%	8	11%	45	64%	70
All Assets	6	4%	20	12%	21	12%	122	72%	169



Figure 1. CHIS exposure results in the A) HQ Mainland, B) Santa Barbara Island, and C) Anacapa Island areas. Select assets are labeled. Background is A, B) NAIP 2022 imagery (OCM Partners 2025b) and C) NOAA NGS 2023 imagery (NGS 2025).

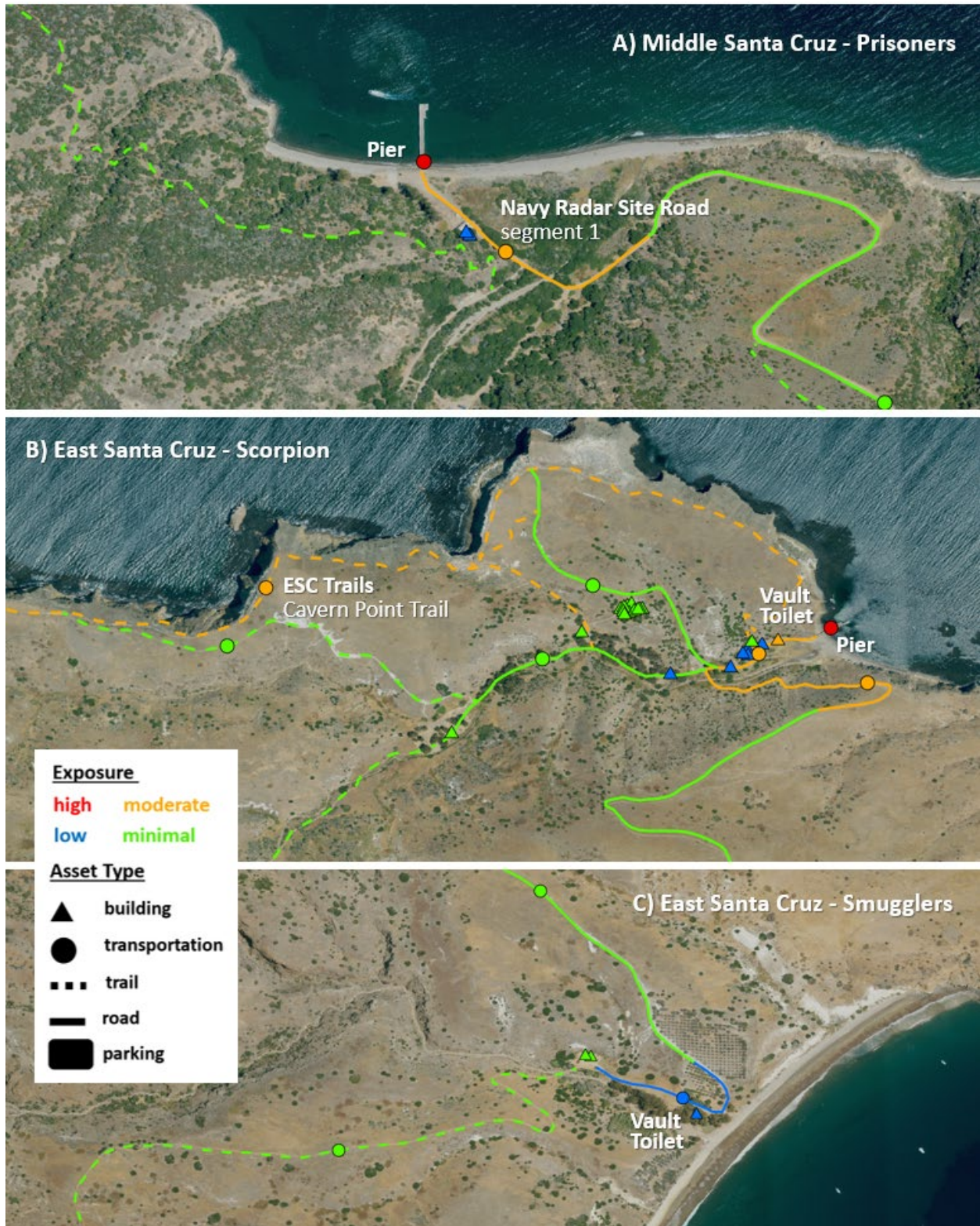


Figure 2. CHIS exposure results in the A) Middle Santa Cruz - Prisoners, B) East Santa Cruz - Scorpion, and C) East Santa Cruz - Smugglers areas. Select assets are labeled. Background is NAIP 2022 imagery (OCM Partners 2025b).



Figure 3. CHIS exposure results in the A) Santa Rosa - Ranch, B) Santa Rosa - East, and C) Santa Rosa - South areas. Select assets are labeled. Background is A) NAIP 2022 imagery (OCM Partners 2025b), B) ESRI World Streaming Imagery, and C) NOAA NGS 2023 imagery (NGS 2025).

CHIS 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, storm resistance and condition, historic damage, and protective engineering. In general, assets with high sensitivity have unfavorable determinations for three or four of these indicators, moderate sensitivity assets have unfavorable determinations for two indicators, and low sensitivity assets have unfavorable determinations for zero or one indicator. Assets with minimal exposure are not analyzed for sensitivity (this is the case for 122 assets at CHIS).

Nine assets (19%) analyzed at CHIS have high sensitivity to the coastal hazards evaluated (Table 3). The majority (77%) of assets have moderate sensitivity, and two assets have low sensitivity. Assets were high sensitivity (versus moderate) due to the condition or historic damage indicators. Most assets were not reported to be storm resistant or have effective protective engineering. Five assets received unfavorable rankings for all sensitivity indicators: SBI Dock Building, SBI Waterfront System, HQ Docks, and SRI East Point Road (east and west segments).

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

Assets	High Sensitivity		Moderate Sensitivity		Low Sensitivity		Total Analyzed	Excluded*
	#	%	#	%	#	%	#	#
Buildings	3	14%	19	86%	0	0%	22	77
Transportation	6	24%	17	68%	2	8%	25	45
All Assets	9	19%	36	77%	2	4%	47	122

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

CHIS 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).

Seven assets (4%) analyzed at CHIS have high vulnerability to the evaluated coastal hazards (Table 4, and Figures 4-9). Four assets have both high exposure and high sensitivity: HQ Docks, SBI Waterfront System, MSC Prisoners Pier, and SRI Bechers Pier. These four assets, as well as the east and west segments of SRI East Point Road, also have both high vulnerability and a high asset priority index ($API \geq 70$, as reported in FMSS). Twenty-one (12%) assets have moderate vulnerability and 19 (11%) have low vulnerability. The majority (72%) of assets have minimal vulnerability (Table 4, and Figures 5-9).

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

Assets	High Vulnerability		Moderate Vulnerability		Low Vulnerability		Minimal Vulnerability		Total
	#	%	#	%	#	%	#	%	#
Buildings	1	1%	10	10%	11	11%	77	78%	99
Transportation	6	9%	11	16%	8	11%	45	64%	70
All Assets	7	4%	21	12%	19	11%	122	72%	169



Figure 4. CHIS vulnerability results in the HQ Mainland area. Select assets are labeled. Background is NAIP 2022 imagery (OCM Partners 2025b).

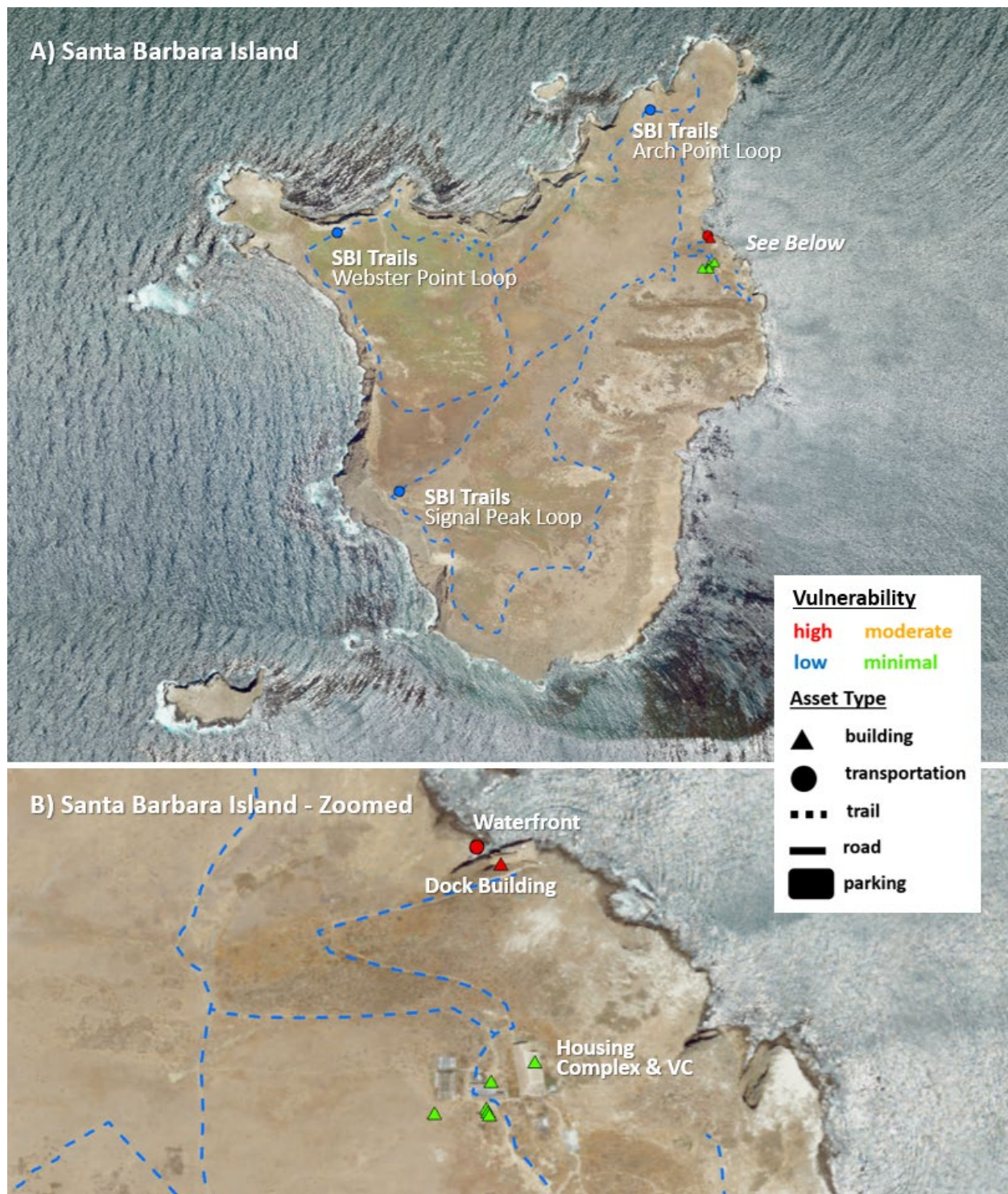


Figure 5. CHIS vulnerability results on Santa Barbara Island. Select assets are labeled. Background is NAIP 2022 imagery (OCM Partners 2025b).

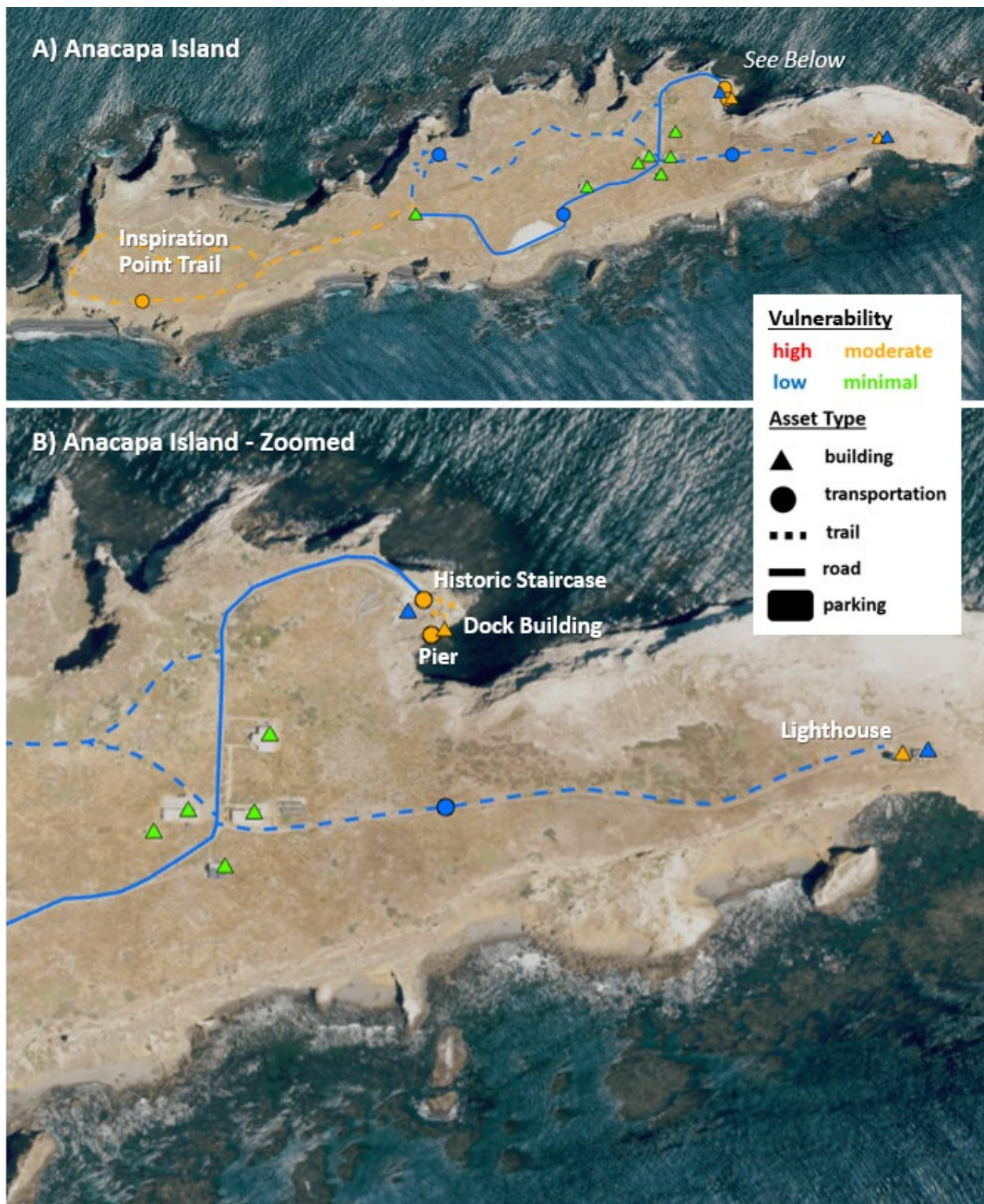


Figure 6. CHIS vulnerability results on Anacapa Island. Select assets are labeled. Background is NAIP 2022 imagery (OCM Partners 2025b).

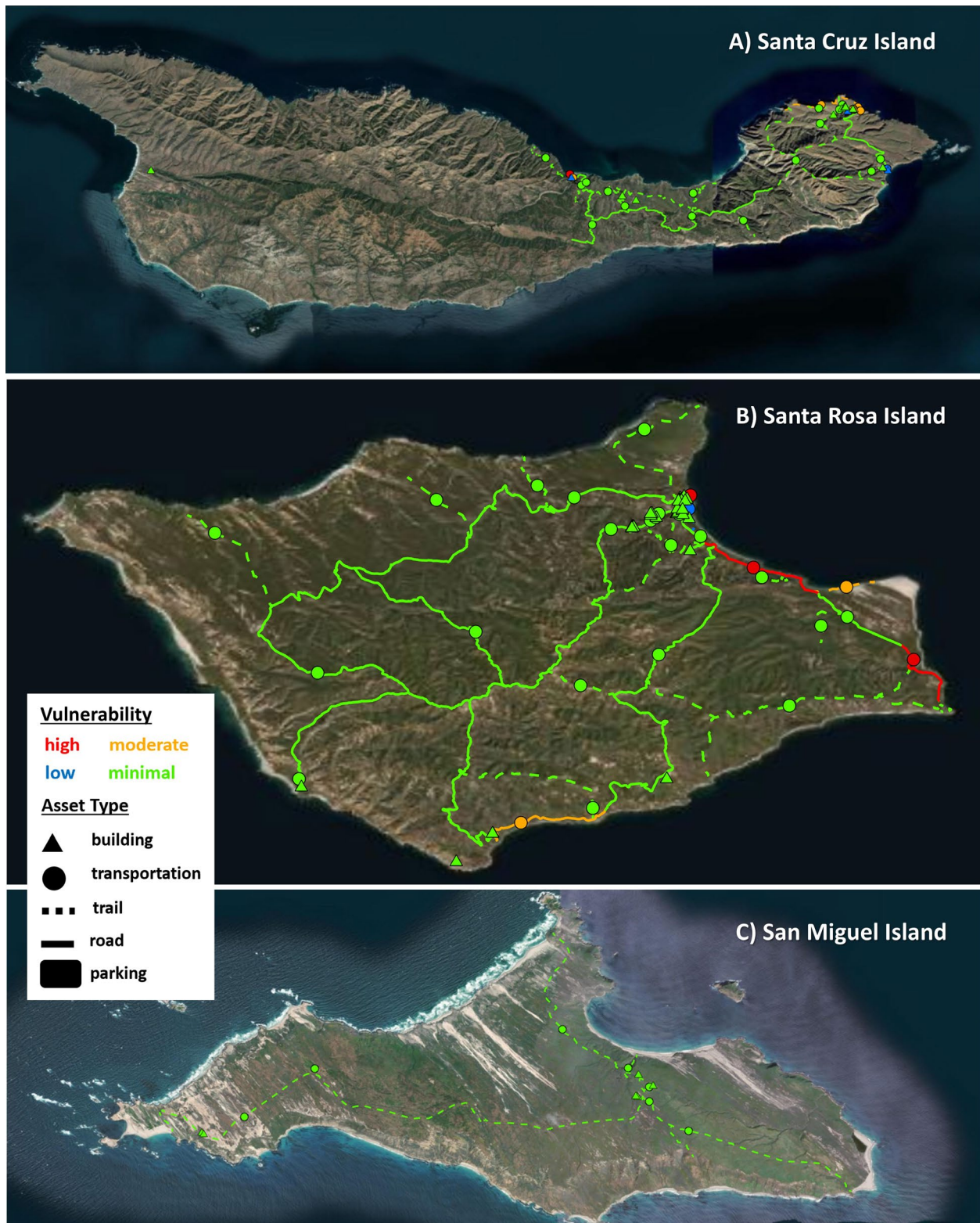


Figure 7. Overview of vulnerability results on Santa Cruz, Santa Rosa, and San Miguel islands. Background is ESRI World Streaming Imagery.



Figure 8. CHIS vulnerability results on Santa Cruz Island. Select assets are labeled. Background is NAIP 2022 imagery (OCM Partners 2025b).



Figure 9. CHIS vulnerability results on A) Santa Rosa - Ranch, B) Santa Rosa - East, and C) Santa Rosa - South areas. Select assets are labeled. Background is A) NAIP 2022 imagery (OCM Partners 2025b), B) ESRI World Streaming Imagery, and C) NOAA NGS 2023 imagery (NGS 2025).

CHIS Unique Considerations

FMSS assets: We analyzed one asset at CHIS that is not listed in FMSS, the Cal State Channel Islands Lab on Santa Rosa Island.

Linear assets: Due to exposure variability, we segmented five roads at CHIS: ESC Scorpion to Smugglers (three segments), MSC Navy Radar Site Road (two segments), ESC Campground Road (two segments), SRI East Point Road (three segments), and SRI South Road (two segments). We also segmented six trails: SBI Trails (three segments), ESC Trails (five segments), MSC Trails (five segments), SMI Trails (five segments), SRI Trails (11 segments), and AI Trails (three segments). We evaluated each segment individually for exposure, sensitivity, and vulnerability, and assigned each segment a modified location code. Any statistics or estimates of value represent the entire road or trail, even if only a small portion has high exposure or vulnerability.

Flood potential data: In addition to the effective Federal Emergency Management Agency (FEMA) data for Santa Barbara (2005) and Ventura (2021) counties, we used the United States Geological Survey (USGS) CoSMoS 25 cm SLR plus 100-year flood zone (Barnard et al. 2018).

Shoreline Change data: USGS California shoreline change data (Barnard et al. 2020) was consulted for the HQ Mainland area. No shoreline change data were available for the island areas of the park.

SLR data: We used two sources for the SLR indicator: 1) National Oceanic and Atmospheric Administration (NOAA) 1 ft SLR model (2022), and 2) NPS 2050 8.5 Representative Concentration Pathway SLR projection and inundation model (Caffrey et al. 2018; 0.20 m or 0.66 ft rise for CHIS).

Tsunami data: Tsunami Hazard Areas (Graehl et al. 2022) are only available for the HQ Mainland area of CHIS. For the islands we created a tsunami proxy zone, which includes areas less than 20 ft in elevation (chosen based on the elevations near the inland extent of the Tsunami Hazard Areas). All elevation data were obtained from the 2010 USGS digital elevation model (OCM Partners 2025a).

References

- Barnard, P.L., L.H. Erikson, A.C. Foxgrover, P.W. Limber, A.C. O'Neill, and S. Vitousek. 2018. Coastal Storm Modeling System (CoSMoS) for Southern California, v3.0, Phase 2 (ver. 1g, May 2018): U.S. Geological Survey data release. <https://doi.org/10.5066/F7T151Q4>.
- Barnard, P.L., S.A. Smith, and A.C. Foxgrover. 2020. California shorelines and shoreline change data, 1998-2016: U.S. Geological Survey data release. <https://doi.org/10.5066/P91QSGXF>
- 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). 2005. National Flood Hazard Layer. Santa Barbara County, CA. <https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html>. Accessed April 2025.
- FEMA. 2021. National Flood Hazard Layer. Ventura County, CA. <https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html>. Accessed April 2025.
- Graehl, N., J. Patton, J. Bott, R. Wilson, Y. LaDuke, and K. Miller. 2022. Tsunami Hazard Area Map. California Geological Survey and the California Governor's Office of Emergency Services. Accessed April 2025.
- National Geodetic Survey (NGS). 2025. 2023 NOAA NGS Aerial Imagery for Situational Awareness: Central California, <https://www.fisheries.noaa.gov/inport/item/69185>. Accessed April 2025.
- National Oceanic and Atmospheric Administration (NOAA). 2022. Sea Level Rise Viewer. Available at: <https://coast.noaa.gov/slr/>. Accessed April 2025.
- National Park Service (NPS). 2021. Coming to terms with climate change: Working definitions. National Park Service Climate Change Response Program, Fort Collins, Colorado.
- OCM Partners. 2025a. 2010 U.S. Geological Survey (USGS) Topographic Lidar: Channel Islands, California from 2010-06-15 to 2010-08-15. NOAA National Centers for Environmental Information. <https://www.fisheries.noaa.gov/inport/item/50117>. Accessed April 2025.
- OCM Partners. 2025b. 2022 California NAIP 4-Band 8 Bit Imagery from 2010-06-15 to 2010-08-15. NOAA National Centers for Environmental Information. <https://www.fisheries.noaa.gov/inport/item/70527>. Accessed April 2025.
- 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>.



EXPERIENCE YOUR AMERICA™

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.