



# Coastal Hazards & Sea-Level Rise Asset Vulnerability Assessment for De Soto National Memorial

## *Summary of Results*

NPS 388/186745, November 2022



PROGRAM FOR  
THE STUDY OF  
DEVELOPED  
SHORELINES

Western  
Carolina  
UNIVERSITY

**ON THE COVER**

De Soto National Memorial sign

Photo credit: NPS

---

# Coastal Hazards & Sea-Level Rise Asset Vulnerability Assessment for De Soto National Memorial

## *Summary of Results*

NPS 388/186745, November 2022

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. 2022. Coastal Hazards & Sea-Level Rise Asset Vulnerability Assessment for De Soto National Memorial: Summary of Results. NPS 388/186745. 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 De Soto National Memorial (DESO) in 2021. In this VA, we evaluate the vulnerability (as a combination of exposure and sensitivity) of NPS buildings and transportation assets<sup>1</sup> to identified coastal hazards and climate change factors, approximately to the year 2050 (for full methodology, see Peek et al. 2022).

We assessed seven buildings/structures (including a visitor center, maintenance buildings, and chickee huts) and three transportation assets (roads/parking lots and a trail) at DESO. Nine of the 10 assets analyzed have high or moderate vulnerability to the evaluated coastal hazards, while no assets have minimal vulnerability (are not in any of the hazard zones). Scoring details and results for all assets evaluated at DESO 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.

| <b>Exposure Indicator (Description)</b>      | <b>DESO Data (Citation)</b>                              |
|--|--|
| Flooding potential (1% annual-chance)        | Effective FEMA VE & A zones (FEMA 2021)                  |
| 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)   |

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

---

<sup>1</sup> 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.”

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.

Nine of the 10 assets evaluated at DESO have either high or moderate exposure to the assessed coastal hazards (Table 2). These results are primarily a factor of the park’s high exposure to coastal flooding, as indicated by the widespread FEMA VE and AE flood zones (1% annual chance flood, ± wave velocity), and the modeled Category 3 storm surge inundation extent across DESO. The Nature Trail is within all evaluated exposure zones. Only the DESO Maintenance/Administration Building has low exposure.

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

| Assets         | High Exposure |     | Moderate Exposure |     | Low Exposure |     | Minimal Exposure |    | Total |
|----------------|---------------|-----|-------------------|-----|--------------|-----|------------------|----|-------|
|                | #             | %   | #                 | %   | #            | %   | #                | %  | #     |
| Buildings      | 3             | 43% | 3                 | 43% | 1            | 14% | 0                | 0% | 7     |
| Transportation | 1             | 33% | 2                 | 67% | 0            | 0%  | 0                | 0% | 3     |
| All Assets     | 4             | 40% | 5                 | 50% | 1            | 10% | 0                | 0% | 10    |

## 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.

All 10 assets analyzed at DESO have moderate sensitivity to the assessed coastal hazards (Table 3). No assets are elevated or storm resistant, but all are in good condition. Only a few (Interpretive Media Talking Chickee Hut, Visitor Center, and Nature Trail) have protective engineering and one asset (Nature Trail) has been significantly damaged by coastal flooding in the past.

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

| Assets         | High Sensitivity |    | Moderate Sensitivity |      | Low Sensitivity |    | Total Analyzed | Excluded |
|----------------|------------------|----|----------------------|------|-----------------|----|----------------|----------|
|                | #                | %  | #                    | %    | #               | %  | #              | #        |
| Buildings      | 0                | 0% | 7                    | 100% | 0               | 0% | 7              | 0        |
| Transportation | 0                | 0% | 3                    | 100% | 0               | 0% | 3              | 0        |
| All Assets     | 0                | 0% | 10                   | 100% | 0               | 0% | 10             | 0        |

# 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 at DESO are identical to the exposure results, as all assets evaluated scored a moderate for sensitivity (Table 4, and Figure 1). This lack of variability in sensitivity means that the vulnerability of assets at DESO is most influenced by exposure. Nine assets evaluated at DESO have high (four assets) or moderate (five assets) vulnerability to the assessed coastal hazards, and only one asset has low vulnerability. Two of the assets evaluated have high vulnerability and a high asset priority index ( $API \geq 80$ , as reported in FMSS), the Visitor Center and Nature Trail.

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

| Assets         | High Vulnerability |     | Moderate Vulnerability |     | Low Vulnerability |     | Minimal Vulnerability |    | Total # |
|----------------|--------------------|-----|------------------------|-----|-------------------|-----|-----------------------|----|---------|
|                | #                  | %   | #                      | %   | #                 | %   | #                     | %  |         |
| Buildings      | 3                  | 43% | 3                      | 43% | 1                 | 14% | 0                     | 0% | 7       |
| Transportation | 1                  | 33% | 2                      | 67% | 0                 | 0%  | 0                     | 0% | 3       |
| All Assets     | 4                  | 40% | 5                      | 50% | 1                 | 10% | 0                     | 0% | 10      |





**Figure 1.** DESO exposure and vulnerability results. Background is ESRI streaming imagery.

## DESO Unique Considerations

**Shoreline change:** USGS (or other) shoreline erosion rate data are not available for the coastline of DESO. 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).

**Linear assets:** Due to the small geographic footprint of DESO, the NPS-owned roads and trails are also relatively short. These linear features were not segmented, and therefore have 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.

## 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. <https://irma.nps.gov/DataStore/Reference/Profile/2253283> .
- Federal Emergency Management Agency (FEMA). 2021. National Flood Hazard Layer. <https://www.fema.gov/flood-maps/national-flood-hazard-layer>. Accessed August 2021.
- National Park Service (NPS). 2021. Coming to terms with climate change: Working definitions. National Park Service Climate Change Response Program, Fort Collins, Colorado.
- 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. <https://doi.org/10.36967/2293653>



**National Park Service**  
**U.S. Department of the Interior**



**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.

NPS 388/186745, November 2022