

MEMORANDUM – COASTAL ENGINEERING REVIEW PAIS – DOWN ISLAND CABIN CONSTRUCTION TAR 19802

21 April 2021

Project Background:

Padre Island National Seashore (PAIS) is located on Padre Island off the coast of South Texas and separates the Gulf of Mexico from the Laguna Madre, one of a few hypersaline lagoons in the world. The island is also considered the most important nesting beach for the Kemp's Ridley sea turtle within the continental United States. NPS plans to construct a ranger observation station cabin approximately 40 miles from the south end of Park Road 22 to support field operations and replace a severely deteriorated station in the vicinity. The new cabin would be a "shelf ready" design moved inland off the primary dune line to protect from more severe storms that occasionally strike the island. PAIS has a need to determine the likely longevity of the structure to meet NPS sustainability standards and goals in coastal environments. PAIS has requested an analysis of the proposed cabin location and elevation similar to the recent analysis performed for the park's housing project.

The Gulf coastline at PAIS is 66 miles long with most of the park development near the Visitor Center and HQ. The existing cabin is the only NPS structure at the southern end of the island and is used in spring and summer by the Sea Turtle Program, while at other times researchers, Resources Management, and emergency services may use the facility. The existing cabin (built in 2000) and the replacement location are positioned near the 40-mile marker. The existing cabin (A in Figure 1) is no longer suitable for the needs of the park, due to sustained damage and deterioration. The proposed new cabin (B in Figure 1) will provide sufficient space and accommodations for housing park seasonal staff, supplies, and equipment while reducing operation and maintenance costs as the new structure will be located behind the primary dune line.

Further information was provided during a conference call with NPS and PAIS site staff on March 16, 2021. This included PAIS plans to utilize "Mobi Mat" or similar type deployable protection to provide beach access from the proposed cabin (product link provided: <https://www.mobi-mat-chair-beach-access-dms.com/vehicle-roll-out-portable-access-mats/>). This access point would be immediately adjacent to the north side of the existing cabin location, ensuring no further impact to the existing dunes. Equipment storage will be located beneath the cabin and parking will be in a separate, nearby area and is not planned for underneath the cabin, as insufficient height is expected. The anticipated design life of the structure is around 30 years, with PAIS officially requiring evacuation of the cabin should any projected storm greater than a Category 1 Hurricane be forecast to impact the site.

This memorandum summarizes the EA team's review of the proposed cabin facility materials and the investigation of the overall site regarding existing conditions and future impacts due to climate change associated factors. This perspective is limited to the information provided by NPS and any external reference material noted within this memorandum. EA was not tasked with, nor did the team review engineering calculations or similar background design information in detail.

Sea Level Rise Impacts:

NPS coastal guidance on sea level rise and storm surge projections (2018) provide an estimated sea level rise as +0.43 ft in 2030, +0.72 ft in 2050, and +1.84 ft in 2100. In also reviewing the USACE online tools (https://cwbi-app.sec.usace.army.mil/rccslc/slcc_calc.html), we utilized the NOAA intermediate values for sea level rise. These provide an estimated sea level rise as +0.27 ft in 2030, +0.99 ft in 2050, and +3.55 ft in 2100. The NOAA intermediate values provide a more conservative estimate and are therefore be used for the impact analysis as presented in the cross section below. This provides a 100-year flood elevation (with wave runoff) of 10.67 ft currently, 10.94 ft in 2030, 11.66 ft in 2050, and 14.22 ft in 2100. Refer to Figure 2 below for an elevation comparison. The existing and proposed cabin elevations shown are for the grade elevations and do not account for foundation elements.

Summary of Proposed Cabin Materials and Siting:

PAIS proposes to use a “shelf ready” cabin design, where the overall structure of the cabin, framework, and materials have been designed and tested by the manufacturer. The specific cabin plans are the A090-M1 Blair by Hudson Home Designs LLC, and the notes on the plan stipulate the final design should be reviewed and signed by a licensed structural engineer prior to construction. The plans are for a 3-bedroom, 2-bath, single story cabin, that will not be ADA compliant but will meet all county and state structural code and hurricane design code. The cabin is proposed to be built atop an elevated foundation platform with 6 feet of clearance between the bottom of the platform and the existing grade on-site. The provided All-Rite Construction, Inc. proposal includes a review by a structural engineer for the overall cabin work including the engineering and analysis of the pile supported platform proposed for the cabin foundation.

Siting the proposed cabin behind the initial dune line will help protect the structure from direct wave exposure, which has likely accelerated the existing cabin’s deterioration. Photographs reviewed during the conference call with PAIS site staff showed conditions after Hurricane Hanna, which resulted in substantial deposition of debris and sand beneath and around the existing cabin even though the existing cabin was built above grade. The proposed location moves the cabin outside the current 100-year flood elevation, with the additional 6-foot clearance provided by the pile foundation providing sufficient resiliency for projected SLR to the year 2050 combined with increased storm intensity. Reviewing elevation data near the proposed location reveals a 1- to 3- foot grade which could complicate construction. Dune lines are traditionally migratory features, and the dune may migrate towards the mainland during the design life of the structure. Localized heavy erosion events, such as seen during Hurricane Hanna, can cause significant shifting of the dune features and may erode material around the proposed pile supports.



Figure 1: Location of Existing Cabin and Proposed New Cabin (NPS 2021)

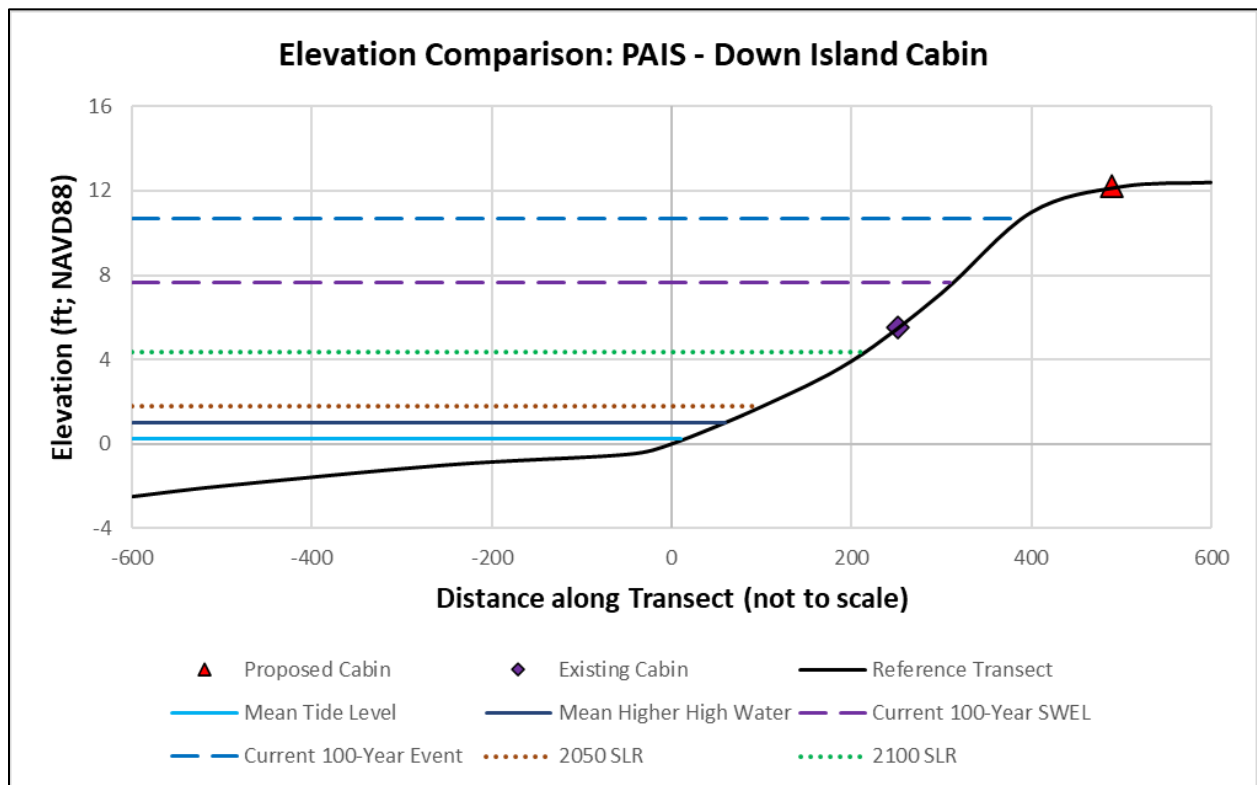


Figure 2: Elevation Comparison Cross Section for PAIS Down Island Cabin

Conclusions:

Based upon our review of the provided data, EA has the following comments:

- Elevating the proposed cabin by the proposed 6 feet will greatly reduce direct inundation exposure, both to current storm events and future storm events.
- Care should be taken in siting the cabin to allow for adequate dune migration over the design life of the structure to prevent the dune from passing underneath and allowing direct wave runoff to impact the structure.
- Further research would be required to determine the erosion impacts from significant storm events, such as the recent Hurricane Hanna.

Additionally, EA would like to comment that typical construction for a pile foundation such as that proposed here would involve the construction contractor estimating a required timber pile length and installing those piles. This type of estimation does not always provide sufficient redundancy in the system during hurricane or other significant events. It is understood that a base level of geotechnical investigation will be completed to determine adequate bearing capacity and depth of installation for the pile foundation system by the selected contractor.

Recommendations:

As discussed on the March 16th conference call, it is not recommended to conduct an erosion or dune migration analysis of the site. The lack of historic survey information in this region of the park, along with the difficulty in georeferencing available aerial imagery, would make such an analysis costly, with little benefit for a structure with the design life indicated. PAIS staff will need to develop a proactive maintenance plan should sand begin to accumulate beneath the structure, as it was indicated this area will be utilized for equipment storage.

The photographs reviewed indicated the need for a fuel storage and refueling facility at the cabin, to allow park vehicles to refuel while deployed there. These assets will not be part of the current scope of work but should be designed to adequately resist the anticipated flood and storm forces at the site.

The requirements and usability of the cabin, namely that it may be occupied up to (but not exceeding) the definition of a Category 2 Hurricane, should be stated clearly in the Scope of Work to minimize overdesign and additional costs associated with heavier storm proofing.

References:

Mobi-mat Deschamps Mat Systems Inc®. Vehicle roll out portable access mats. <https://www.mobi-mat-chair-beach-access-dms.com/vehicle-roll-out-portable-access-mats/>

USACE. Sea-Level Change Curve Calculator (Version 2021.12). https://cwbi-app.sec.usace.army.mil/rcslc/slcc_calc.html