Cameron County
Erosion Response Plan

FINAL DRAFT

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Cameron County Erosion Response Plan

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Cameron County Erosion Response Plan

1.0  INTRODUCTION
To further the long-term benefits of effective shoreline management for the environment, the beach-going public, upland property owners, the economy, and the general safety and welfare of the public, Cameron County developed the following Erosion Response Plan (ERP). The County intends to implement plan recommendations once approved by the Texas General Land Office.

1.1  Purpose
In accordance with Texas law, Cameron County has elected to prepare this Erosion Response Plan. The general purpose of this plan is to explore means and methods to improve the safety and welfare of the public and to reduce costs to the people of Cameron County resulting from damage to private property and public infrastructure due to chronic beach erosion and Gulf storms.

In 2007, the Texas Legislature passed House Bill 2819, which as subsequently amended, mandated that each coastal community develop an Erosion Response Plan. Counties and cities that choose not to prepare an Erosion Response Plan are ineligible for State assistance under certain grant programs such as the Coastal Erosion Planning and Response Act. It is in the best interest of Cameron County to develop an Erosion Response Plan in accordance with the statutory and regulatory requirements of Texas Natural Resources Code §33.607 and the Texas Administrative Code, Title 31, §15.17.

In this ERP, the County seeks to promote the following five priorities:

1. Establish a 200-foot building setback line (measured landward from the line of vegetation (LOV)) plus an additional 30-foot wide backside buffer area;

2. Preserve, expand, and enhance the protective dune system seaward of the building setback line to provide protection to future development from a 100-year storm;

3. Facilitate more appropriate and more landward development by assessing the relocation of Park Road 100 currently vulnerable to shoreline retreat;

4. Extend the pedestrian-only traffic beach on Zone 2 in accordance with the Open Beaches Act.

1.2  Scope of the Plan
In this plan, Cameron County has addressed erosion and storm risks along its Gulf-facing beaches. This plan does not cover the area within the City of South Padre Island, which adopted its own
plan. For the purposes of this plan, the County’s Gulf beaches and dunes are divided into the following shoreline reaches:

- **Zone 1** – Boca Chica Beach. The beach and dune area south of Isla Blanca Park, adjacent to Brazos Santiago Pass, to the Rio Grande. There is limited pressure for development in this area. This zone has an average erosion rate of approximately five feet per year. It is also the site of the Space X launch facility.

- **Zone 2** – Park Road 100. The beach and dune area north of the City of South Padre Island to the current end of Park Road 100, a distance of some 6.35 miles. This area has an average erosion rate of approximately ten feet per year. It also has existing road and utilities, and it is the area most likely to see development during the time period covered by this ERP.

- **Zone 3** – North Beaches. The beach and dune area north of the current end of Park Road 100. This area experiences average erosion rates of approximately twelve feet per year and has no utilities or road access, other than along the beach. It is unlikely that development will occur in this area during the time period of this ERP.

In addition to the public beaches in Zones 1-3, the County has three parks with public beaches: Andy Bowie, E.K. Atwood and Isla Blanca. The County directly manages these parks. The County parks are discussed in more detail in Section 6.
In 1994, Cameron County adopted a Dune Protection and Beach Access Plan, (County Dune Plan) which was subsequently amended in 2006, 2010, and 2013¹ and approved by the GLO (31 TAC §15.32). Among other things, the County Dune Plan provides for the use of beach user fee revenues, procedures for establishing pedestrian beaches, permitting, and dune protection. The County has adopted a Dune Protection Line in accordance with the Dune Protection Act, Texas Natural Resources Code §63.012, of 1,000 feet west of the mean high tide line, generally running in a north-south direction. The County’s Dune Protection Line is a moving line that follows the change of mean high tide along the shoreline. The Gulf shorelines in the County are generally eroding (See Appendix A), except for sections of Boca Chica Beach. The County Commissioners Court shall review the location of the Dune Protection Line at least once every five years to determine whether the line is adequately located to achieve its stated purpose. In addition, the Commissioners Court shall review the adequacy of the location of the Dune Protection Line within 90 days after a tropical storm or hurricane affects the County’s Gulf shoreline as indicated in the County’s Dune Protection and Beach Access Plan.

1.3 ERP Requirements

The Texas General Land Office (GLO) has adopted rules that set forth requirements for an Erosion Response Plan (31 TAC §15.17). In general, the rules provide that an ERP may include the following elements:

• Construction setback limits
• Prohibitions on construction seaward of the setback line
• Any exemptions from the setback line
• Requirements for any exempt construction
• Procedures to preserve and enhance public access
• Procedures for protection and enhancement of dunes
• Criteria for voluntary acquisition or buyout
• Post-storm recovery plans

1.4 Process for Development, Adoption, and Certification

The GLO has adopted rules describing the process for development, adoption, and certification of an ERP (31 TAC §15.17(b)-(d)). In preparing this ERP, the County was required to use historical erosion data and other relevant data from the State Coastal Erosion Response Plan and hold at least one public educational meeting on the ERP before implementation. The County must formally adopt the ERP and submit to the GLO for approval as provided by 31 TAC §15.3(o).

¹ Available at www.co.cameron.tx.us/parks/docs/BeachAccessDunePlan.pdf
The County held three public workshops as part of the development of the ERP on October 28 and December 15, 2015, and on February 22, 2016. The County’s project team also met with beachfront landowners on January 22 and February 19, 2016, with the South Padre Island Board of Realtors on December 10, 2015, and with the local chapter of the American Shore & Beach Preservation Association on December 11, 2015. In addition, during the development of this ERP, a project website has been available at www.cameroncountyerp.com where the public has been able to find information and post questions about the development of the ERP.

On April 11, 2016, a draft of this ERP was made available for public review and comment. On August 24th, 2016, the County organized a meeting in Austin of the local legislative delegation and representatives from the Land Office and the Federal Emergency Management Agency to discuss the ERP.

After revising this ERP in response to public and Land Office comment in December 2016, the revised draft of the ERP was approved by the Commissioner’s Court on January 26, 2017, for informal review by the Land Office. The informal review draft was also posted on the ERP Project website and made available for further public comment.

A final draft of the ERP was then prepared in October 16 of 2018, incorporating comments from the Land Office and the public. This final draft was posted on the County project website on **insert date** and made available to the public prior to presenting the final ERP to the Commissioner’s Court. On **insert date**, the Commissioners Court approved this ERP and authorized its submittal to the Land Office.
1.5 Potential Future Land Uses

There are three issues with the potential impact to development and land use in the area of Zone 2 along Park Road 100: the existence of platted parcels, the proposed new causeway to the mainland, and the proposed relocation of Park Road 100. At this time, future development of the North Beaches in Zone 3 is unlikely due to the amount of land available in Zone 2, the lack of road, power, water/sewer, and other utilities north of Park Road 100, and restrictions on extending public infrastructure to undeveloped areas under the federal Coastal Barrier Resources Act (COBRA). Future development also is unlikely in the area of Boca Chica Beach (Zone 1) due to the remoteness of the area, the lands conserved in Brazos Island State Park, and the presence of the Space X launch facility.

1.5.1 Platted Parcels

In Zone 2, seaward of Park Road 100, there is a diverse range of property ownership. Between the northern limits of the City of South Padre Island to Beach Access #6, a distance of some 3.5 miles, there are only a few owners of large tracts that run from the beach to the Laguna Madre. North of Beach Access #6 to the end of Park Road 100, there is a wider range of ownership. Many of the large tracts running across the island from the beach to the Laguna are under single ownership. Some of the tracts, however, have been subdivided with the lots divided among multiple owners. (See Appendix C, Properties Impacted by building setback line).

Where the tracts have been subdivided, some individual lots lie entirely within the public beach. Other lots now appear to be in the Gulf of Mexico and now subsumed into the state-owned submerged lands (Figure 1). Our understanding is that these individual lots were all above high tide when they were subdivided and platted in the 60’s. That so many of these lots are now on the public beach or below the line of mean high tide is evidence of the long-term erosion along these Gulf beaches.

The subdivided tracts included platted streets that run from Park Road 100 to the beach. These streets could be used to provide new, improved beach access points.
1.5.2 Proposed New Causeway

The 2nd Access Project by the Cameron County Regional Mobility Authority would create a new accessway to Padre Island composed of three major components: the mainland roadway, the
crossing of the Laguna Madre, and the roadway on Padre Island. Only the third of those components, the island roadway, is relevant to this ERP.

The 2nd Access Project is currently under development and, once funding is acquired, it is anticipated that it would take three years to complete construction of the new causeway. The preferred alternative for the 2nd Access Project, Alternative 6, is projected to impact 28.31 acres of dunes. The 2nd Access Project is projected to induce an additional 51.6 acres of residential development and 16.2 acres of commercial development by 2030, under the assumptions when the draft environmental impact statement was prepared as adjusted to discount the assumption that the new causeway would be open by 2015. This development would likely occur in the area of Park Road 100 addressed in this ERP. Construction of the new causeway would also improve access to the public beaches in the areas of Park Road 100 (Zone 2) and North Beaches (Zone 3), likely increasing use of those beaches. The landing where the new causeway intersects Park Road 100 would also need to be protected from shoreline change. To date, the project is still under development and construction has not begun.

1.5.3 Possible Relocation of Park Road 100

Currently, Park Road 100 in Zone 2 lies within close proximity to the beach, ranging from 300 to 500 feet landward of the MHHW line. Wind-blown sand regularly encroaches on the road and, in some cases, can create dune ridges which extend into or across the road, disrupting traffic. In its current location, Park Road 100 is vulnerable to shoreline retreat, is costly to clear and maintain, and limits the land area seaward of the road right of way. As shoreline retreat continues, the location of Park Road 100 will significantly impair the protection offered by the dune system, and constrain future development opportunities.

Park Road 100 in its current alignment is vulnerable to flooding during storms, even storms that do not make landfall in South Texas. During recent events, the road flooded during Hurricanes Katrina, Rita, and Ike even though those storms landed on the Upper Texas Coast or in Louisiana. There are seven historical washover areas along Park Road 100 that have consistently flooded during storms.

\[2\] The Draft Environmental Statement for the 2nd Access Project is available at www.ccrmra.org/resources/SPI-DEIS_April_12_Volume-I_complete.pdf
Park Road 100 also is subject to blowing and drifting sand. Currently, there are four areas where the road is exposed to the beach and Gulf with no dunes for protection. These areas allow windblown and drifting sand to blow into and across the road, creating obstructions to travel and allowing the sand to move out of the beach dune system and into the back side of the island. Windblown sand on the road also requires ongoing removal, a cost borne by the Texas Department of Transportation.

The cross-section in Figure 2 illustrates a well-developed dune resting on a +5-ft NAVD88 berm migrating landward toward the road. This dune could be relocated seaward of its present position and vegetated to trap wind-blown sand closer to the beach, providing protection for inland habitats and reducing maintenance of Park Road 100.
Alternatively, the current County Dune Plan recommends that Park Road 100 be relocated to a more westerly alignment from the landing of the second causeway to its present northern terminus and (Figure 3). For most of Zone 2, there is already an existing right-of-way between Park Road 100’s current alignment and the Laguna (Figure 3). Some of the large landowners immediately north of the city limits, where there is no existing right-of-way, have expressed support for the relocation of Park Road 100. Relocating the road will allow space for both dune restoration and economically beneficial upland development while reducing the vulnerability of development and public infrastructure to storms and reducing the ongoing cost for removing sand from the road.
Figure 3. Example of potential westerly relocation of Park Road 100 into existing platted...
2.0 COUNTY FINDINGS & CONCLUSIONS

2.1. Gulf Beach Shoreline Conditions

1. The Zone 1 and Zone 2 Gulf beaches in Cameron County are in a persistent erosive condition, with an annual shoreline retreat rate (1950 to 2012) ranging from over 20 feet per year (in the southern end of Zone 1) to more than 14 feet per year (in the northern end of Zone 2), and a retreat rate of between 6 and 17 feet per year in Zone 3. The Zone 1 annual erosion rate is more than 20 feet per year near the mouth of the Rio Grande, but near the Brazos-Santiago Pass accretion is taking place at up to 4.9 feet per year (UTBEG Change Rate 1950s - 2012).

2. The erosion rates in all zones are expected to continue unless a shoreline stabilization program, such as periodic beach nourishment, is developed, permitted, funded and implemented.

3. According to the Harte Research Institute, Texas A&M Corpus Christi, the shoreline position in Zone 2 will erode back to a position landward of Park Road 100 by 2071. (See http://geohazards.tamucc.edu/southpadre/SPIgeohaz.html)

4. Shoreline retreat is not always a continuous and steady process with the beach eroding at a steady rate each year. Tropical storms and hurricanes along the lower Texas coast can move the shoreline more than 100 feet landward in a day. There is often dramatic recovery for months and years following a storm, but it is often incomplete in an area undergoing long-term retreat, and the shoreline may remain significantly landward of its pre-storm position.

5. Cameron County has lost 474 acres of beachfront land from 1937 to 1995 in the area from the Brazos Santiago Pass to the end of Park Road 100, a distance of approximately 12 miles of Gulf beach shoreline. (See James C. Gibeaut and Thomas A. Tremblay, Final Report: Coastal Hazards Atlas of Texas: A Tool for Hurricane Preparedness and Coastal Management – Volume 3, The South Coast (August 2003), page 12).

6. Cameron County can expect to lose an additional 511 acres of beachfront land in the area from the Brazos Santiago Pass to the end of Park Road 100. (See Coastal Hazards Atlas, Volume 3, page 12).

7. Cameron County lies in a semi-arid climatic zone with relatively low precipitation and is an area subjected to regular and persistent winds which exceed 10 mph 75% of the time. These conditions result in irregular and sparse dune vegetation, increase the
difficulty of dune restoration, and contribute to significant rates or Aeolian or wind-driven sand transport out of the nearshore dune system.

8. As recognized by the Texas Legislature, Land Office, and Cameron County, the coastal dune system is critical to the protection of upland property and is the first line of defense against shoreline storm damage.

9. Vehicles driving on the beach and in the dune system, especially in Zones 1 and 2, adversely impact beach health and dune stability.

10. Vehicular driving on the beach and in the dune system should, where possible, be eliminated over time while preserving and enhancing public beach access in a manner consistent with the Texas Open Beaches Act and the County Beach Access and Dune Protection Plan.

2.2 Upland Risks

1. Based on shoreline erosion rates and the irregular condition of the dune system, construction of habitable structures seaward of the building setback line poses a substantial risk to public health, safety and welfare and should be discouraged.

2. The County finds that the area seaward of the building setback line is a FEMA designated coastal high hazard area for flooding during tropical storms and that any structures built seaward of the building setback line would be at risk of flooding and potential damage from storm surge and storm waves.

3. FEMA has determined that in coastal high hazard areas, including the area seaward of the building setback line, there is a 26% chance that structures built in this area will be damaged by a 100-year storm over the typical 30-year life of a home mortgage.

4. Substantial land losses in Zones 2 and 3 are expected to continue; moderate land loses are expected in portions of the eroding areas of Zone 1.

5. In Zone 2, Park Road 100, a state roadway, is vulnerable to drifting sand, tropical storms, and long-term shoreline retreat.
2.3 Principle Objectives of the ERP

1. Establish a building setback line – Based on the projected shoreline position in 30 years, the County is proposing that a building setback line (BSL) be established to conserve a protected dune line and to limit construction in this high hazard area. The building setback line begins from the existing line of vegetation (LOV) as defined in the Texas Natural Resources Code §61.016-61.017, and extends 200 feet landward. An additional 30-foot dune buffer area is then included to avoid and minimize impacts to the dunes and to allow for natural dune migration, hydrology, and other processes. Therefore, based on the historical erosion rates obtained from the University of Texas Bureau of Economic Geology over 30 years and the desire to conserve a protected dune line, a total building setback line is proposed for the shoreline area extending 230 feet landward from the LOV.

2. Protective dune system enhancement– Preserve, expand, and enhance the protective dune system seaward of the building setback line to provide protection to future development from a 100-year storm.

3. Possible Relocation of Park Road 100 – Park Road 100, a state roadway, encroaches into the dune system, is vulnerable to long-term shoreline retreat, and constrains future development. The County will continue to encourage relocation to a more landward alignment in cooperation with the local landowners and the Texas Department of Transportation.

4. Extension of the Zone 2 Pedestrian Beach – Based on the vulnerability of the shoreline and the adverse impacts of vehicle driving to the beach and dune system, the County will work cooperatively with the General Land Office, affected landowners and stakeholders to extend and expand the pedestrian beach in Zone 2, consistent with the Open Beaches Act.

3.0 RISK REDUCTION STRATEGY

3.1 Building Setback Line
Cameron County seeks to establish a building setback line (BSL), where the area seaward of this line will include a storm protection dune system north of the City of South Padre Island in Zone 2. Dune conservation and management are critical components of the Cameron County ERP because sand exchange between the beach-dune system impacts long-term shoreline response, storm damages, and land use practices. Unvegetated dunes and low-lying washover terraces are common, and wind-blown sand transport is substantial. Soft structure dune design helps maintain
the natural appearance of the coastline and preserve natural shoreline dynamics (NOAA 2010). This allows natural erosion and accretion cycles to occur (Fenster 2005) without interrupting the natural sediment budget.

The BSL and recommended storm protection dune system to be located seaward of it is intended to protect habitat and upland infrastructure from coastal storm impacts. The recommended design of dunes to be constructed and restored seaward of the BSL was based on: 1) natural dune morphology and topography in Zone 2) FEMA guidelines for protection against a single 100-yr storm event (FEMA, 2011) (Figure 4).

The objectives of the BSL for Zone 2 are as follows:

1. Reduce public expenditures for erosion and storm damage losses to public and private property, including public beaches;
2. Provide a beach erosion risk buffer between the public beach and private development, consistent with existing natural dune systems;
3. Assure public beach access through improvements to existing access points and advanced design of future access points;
4. Promote the health and stability of existing dune systems and vegetation;
5. Promote natural recovery of dunes and beaches following storm-induced erosion, and implement dune strategies to maximize sand trapping (vegetative planting and sand fencing).
3.1.1 Designing with Nature – Dune Location, Elevation, and Width

Based on natural variations in dune morphology and topography north of The Shores and along Brazos Island, with emphasis placed on vegetated dune features seaward of Park Road 100, natural dune shape was used to establish dimensions for a recommended dune seaward of the BSL (Figure 6). Considering FEMA (2011) guidelines, the proposed dune was designed to provide protection to inland habitat and infrastructure for a 100-yr storm event.

The recommended reference point used for the seaward boundary of the BSL is the line of vegetation as determined by the Texas Natural Resources Code §61.016-61.017. Final location of the BSL for management purposes will be based on a line of vegetation determination approved by the Texas General Land Office at the time construction is being proposed.

Dune morphology varies considerably along the undeveloped beaches of Cameron County; however, areas with vegetated dunes generally have elevations of between 8 and 16 ft NAVD88 or greater, and dune crest widths of about 60 ft or greater. Dune face slope has large variations as well, but an average slope of 1:5 was common.

3.1.2 Proposed Storm Protection Dune
Given natural dune dimensions in Zone 2 and FEMA storm-protection considerations, the typical storm protection dune cross-section is recommended with the seaward toe located at the line of vegetation in Zone 2. The proposed dune should have a maximum slope of 1:5, a minimum base width of 200 feet, a height of +16 feet NAVD88, and a crest width of 90 feet (Figure 6). Given these dimensions, dune volume above +11 feet NAVD88 (Base Flood Elevation [BFE]) will be approximately 575 cubic feet per foot width of dune face (Figure 6). FEMA (2011) recommends 540 cubic feet per foot width of dune above BFE to provide protection from a single 100-yr storm event. Approximate sand volume required to construct this dune feature will be 1,595 cubic feet (59 cubic yards) per foot width along the dune. Generally, dune restoration should take place in areas with a dune elevation of less than 11 feet NAVD88.

The recommended position of the storm protection dune, with the seaward toe located at the line of vegetation in Zone 2, will ensure that the dune will not encroach on the public beach easement and make the dune less vulnerable to loss. Because basic dune processes often cause transport of sediment inland of the dune crest, the creation of a buffer zone at the inland margin of the dune supports continuity of dune processes, form, and habitat as the dune naturally shifts inland (Psuty and Rohr 2000 suggest a minimum inland dune buffer of at least 30 feet). For management purposes, it is desirable to establish a dune buffer area landward of the storm protection dune to permit some inland extension for natural dune processes.

![Figure 6. Example of the storm protection dune dimensions and buffer area in the area seaward of the Building setback line (not to scale).](image)

To summarize, practical dimensions for a 230-foot wide BSL and storm protection dune should consist of the following:

- The seaward toe of the storm protection dune shall be located at the LOV.
- A 200-foot wide storm protection dune and BSL. Wider dune zones support higher dunes which provide more benefit.
- A 30-foot buffer area landward of the storm protection dune to accommodate natural dune migration.

A dune restoration project may not encroach onto the public beach.
3.2 Dune Management Considerations

Dune management is a critical component of the Cameron County ERP because sand exchange between the beach-dune system impacts long-term shoreline response and land use practices. Beach areas where storm washover is common, wind-blown sand is dominant, and dune vegetation is limited illustrate greater shoreline erosion rates than beach areas where vegetated and elevated dunes are present. Long-term evolution and maintenance of dunes depend on the positioning and morphology of the incipient dune, the sediment budget of the beach-dune system, and natural maintenance by wind transport processes.

Cameron County has relatively high shoreline recession rates, but dunes of varying height and vegetative cover exist along much of its undeveloped coast. The large volume of the sand available for transport within these areas has numerous management implications. For example, on coasts with high volumetric gains in the beach and dune sand, implementing various passive restoration strategies, such as dune fencing and vegetative planting, would hasten foredune development. Caudle et al. (2014) conducted a volumetric analysis from Lidar of the beach and dune systems on South Padre and Brazos Islands for 2000, 2010, and 2013. Their findings and their importance to the ERP for dune design, sand retention and management include:

1. Much less sand is stored in the beach and dune system on Brazos Island than on the whole of South Padre Island (Figure 7).

   **ERP:** Brazos Island (ZONE 1) lacks overwash features for cross-shore sediment input, volume below 4m (12 ft) remains constant; potential advantages include reduced dune design requirements as compared to South Padre.

2. Reduction in sand volume by approximately half with each 1-m (3 ft) increase in threshold elevation is constant throughout the 1- to 6-m (3 to 20 ft) elevation ranges.

   **ERP:** Provides insight for recommended minimum heights, widths, and sand volume for dune designs.
3. The undeveloped areas of South Padre Island have an extensive and mature foredune area (Zones 2 and 3), except in areas of washover, particularly in Zone 3. Storage capacity within these sections (with and without the road) is extremely high owing to the availability of sediment, and lack of development constraining the dune system (Figure 8).

**ERP:** Important for strengthening and enhancing existing dune systems, availability for using “in situ” sand for construction of storm protection dune, and further developing
extensive dune fields through vegetative planting and sand fencing. Generally, all areas seaward of the building setback line with dune elevations less than +11 ft NAVD88 will be priority areas for landowners constructing protective dunes.

4. The undeveloped area of South Padre Island had 2 to 4 times the volume of sand at lower threshold elevations than did the heavily developed southernmost sections.

**ERP:** High potential to trap and capture wind-blown sand because a high base volume of sand is available.
3.2.1 Dune Vegetation

Vegetating newly constructed or existing dunes can be economical and effective in stabilizing features and creating an additional baffle to encourage more deposition. Without vegetation, blowing sand will migrate inland out of the active beach-dune transport zone. Maintaining dense, healthy dune vegetation is one of the best means of stabilizing a dune and enhancing sand deposition.

Certain types of vegetation can tolerate the harsh conditions of heat, aridity, high salinity, and low nutrient availability along the coast. Termed “pioneer plants” they comprise the dune grasses and other plants that colonize the seaward face or crest of the foredunes (Psuty and Rhor 2000). These primary plants are the natural foundation for the creation of dunes. When airborne sand moves across their stems and leaves, wind velocity is decreases and sand is deposited around vegetation, beginning the natural cycle of dune formation. As sand accumulates around primary vegetation, roots and rhizomes spread from which new plants grow. This dense vegetation anchors the dune below the surface and stabilizes sediment on the surface providing a natural barrier to incoming waves. Without the presence of dune vegetation, dunes become extremely vulnerable to the forces that create them (Psuty and Rhor 2000).

Further, vehicles and foot traffic dislodge beach vegetation, disrupting the capacity of plants to capture sand. The primary geomorphic processes affected by vehicular (and pedestrian) traffic are wind erosion, transport, and deposition. Wind velocities decrease near the ground surface, so sand lifted into the air by vehicles and/or rutting of the surface exposes the sand grains to greater wind action. As a result, areas with vehicular traffic have much smoother, flatter, and broader backbeach areas than those without vehicular traffic (Weise and White 1980). Such grading of beaches is detrimental to embryo (coppice) dune formation, as well as to pioneering and colonizing plant species (Baccus and Horton 1982).

It is in the best interest of the landowners to adhere to the following recommendations: the ideal percentage of vegetative cover should start at 100 percent for all disturbed areas due to the severity of wind-blown erosion. Densities should vary on initial planting to provide additional stability on the windward edge to the freshly disturbed sand. One thousand plants should stabilize a 50- by 100-foot strip within a year. These recommendations do not substitute for dune protection standards required under TAC §15.4 that require permittees to mitigate for adverse effects to dunes and dune vegetation at a 1:1 ratio for vegetative cover and dune volume.

Specific recommended guidelines for dune restoration are as follows:

1. The leading edge of the ocean-side dune system should have a row of discontinuous sand fences placed parallel to the beach approximately 20 feet seaward of the line
of vegetation, contingent on the GLO determination that the sands fences will not encroach on the public beach easement, for wind velocity reduction, sand trapping and foot and vehicle traffic control.

2. The dune should be under constant irrigation to prevent wind erosion and to re-establish the minimal percentage of water content for vegetation.

3. The ocean-side, 5 feet prior to the leading edge of the dune, should be planted in Sea Oats and Bitter panicum (equal mix) at a density of 1 foot on center. This plant mix and density should continue up slope for the first 1/3 of the slope.

4. The vegetation should then change to a mix of 85% Sea Oats, 10% Bitter panicum and 5% other species planted at a density of 18” on center. This should continue until within 5 feet of the crest of the dune.

5. From 5 feet below the crest of the ocean-side face of the dune to an area 15 feet back from the crest of the dune the plant mix should be Sea Oats and Bitter Panicum (equally) and planted on a density of 1 foot centers.

6. The remainder of the crest of the dune should be planted in a mix of 95% Sea Oats and 5% Bitter Panicum. This should be on 18” plant spacing and continue to within 5 feet of the landward edge of the crest of the dune.

7. The entire landward edge including the 5 feet left on top and 5 feet past the toe of the dune, should be planted in Sea Oats and Bitter Panicum (equal) on 1 foot spacing.

8. Based on wind conditions at the time of construction and during the first 90 days after planting of vegetation, additional fencing may be required on the front and back edges of the dune crest.

9. The plant species for the initial plantings should include native species including but not limited to:
   - Sea Oats
   - Bitter Panicum
   - Railroad Vine
   - Purslanes
   - Marshhay cordgrass

Subsequent plantings should include but not be limited to:
   - Fimbristylis
   - Seacoast Bluestem
   - Bushy Bluestem
   - Texas Prickly Pear
   - Beach Evening Primrose
   - Camphor Daisy

10. Due to the semi-arid climate conditions in Cameron County, fertilization may greatly increase the survivability of newly planted dune vegetation. Fertilization
may be started at planting, with the introduction of slow release fertilizers applied in-hole with each plant.

11. No mowing may occur seaward of the building setback line or seaward of the Dune Protection Line.

3.3 Beach and Shoreline Management

The amount of sand available within the system is a critical consideration when determining the most appropriate strategy for shoreline management.

3.3.1 Goal: Reduce Sand Volume Losses

Beach sand volume losses result from waves and current processes when the threshold velocity for sand movement is exceeded and transport volumes from a beach area are greater than those entering the same beach area. Alongshore and cross-shore sand transport are most common processes impacting beach sand volume losses, but storm washover and wind-blown sand from the beach to interior portions of SPI are significant transport processes contributing to beach erosion. Washover and wind-blown sand losses from the beach can be captured with appropriate dune management practices, but littoral sand transport along rapidly receding coasts often require beach sand replenishment to mitigate erosion. To reduce beach sand losses, dune, and washover terraces, land use management practices should be implemented to enhance habitat resilience and protect public and private infrastructure.

3.3.2 Sand Volume Requirements for Beach Restoration

Shoreline changes along the undeveloped coast of Cameron County documented average beach erosion for all zones since 1939. If one were interested in restoring the undeveloped beach to the approximate time when sand began to be placed on the beach fronting the City of SPI (1997), about 6.2 million cy would be required for Zone 2 and 12.8 million cy of sand volume placement would be required for Zone 3 (Table 1). This would extend the existing shoreline position seaward to the approximate location of the 1995 shoreline.

<table>
<thead>
<tr>
<th>Table 1. Beach erosion estimates based on average shoreline change rates for the undeveloped coast of Cameron County (Caudle et.al., 2014)</th>
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<tbody>
<tr>
<td>Period/Zone</td>
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<tr>
<td>1939-1995</td>
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3.3.3 Available Sand Resources

A variety of potential sand sources can be considered for long-term planning purposes for both dune and beach sand placement. Sediment characteristics and suitability for different size and time horizons varies among the sources. The following is a general list of possible sand sources for use on beaches in the study area. An offshore sand resource study was completed for SPI (HDR 2008); however, a more detailed sand resource evaluation will be required to identify sand necessary for any proposed beach restoration activities.

- Offshore Cameron County (State and Federal waters)
- Offshore Willacy County (State and Federal waters)
- Land Cut Private Sources
- Other Inland Private Sources

From published tidal datums for NOAA tidal station 8779750 (South Padre Island, Brazos Santiago Pass TX), MHHW equals +0.18 m (0.6 feet) NAVD88. Using 2009 Lidar data, average beach width, the distance between MHHW and a potential vegetation line (as defined by Caudle et al., 2014) for Zone 2 was determined to be 110 feet. Limited beach width can affect the development of full aeolian sediment transport. Davidson-Arnott and Law (1990) found for wind speeds of 12 mph (similar to the SPI average wind speed), a 50-ft wide beach is needed to achieve full sand transport. Therefore, average beach width of 110 ft has more than enough surface area to ensure active sand transport can continue across and along the beach.

The average beach width mentioned above will be used to assess areas where the beach has narrowed due to erosion and will assist the County in prioritizing areas where beach nourishment may be needed to widen the beach.

3.3.4 Sand Volume Requirements for the Storm Protection Dune

A volumetric analysis was completed from 2013 Lidar data of numerous washover terraces segmenting the beach and dune systems along the upper northern beach of Zone 2. This zone includes the beach and dune area north of the City of South Padre Island to the end of Park Road 100, a distance of approximately 6.4 miles. The purpose for conducting the analysis was to confirm the volume of sediment required to meet the storm protection dune volumetric requirements, and determine whether sufficient quantities of sand are available “in situ” or would other sand sources be required that were located “off-site”. Overall, enough sand exists seaward of Highway 100 for
the undeveloped portion of Cameron County to construct a storm protection dune feature seaward of the BSL. This constructed dune would protect inland habitat, future public and private construction, and potentially mitigate high shoreline erosion rates in this area by limiting storm overwash and controlling windblown sand deposition within the active beach-dune system.
4.0 PROCEDURES FOR PRESERVING, RESTORING AND ENHANCING CRITICAL SAND DUNES

The County recognizes that the public beach and the dune system is the first line of defense against storm surge. Through the ERP and administration of the Dune Protection and Beach Access Program, and the Dune Protection Permitting process, the County shall work closely with the property owners to reduce the shoreline erosion rate, maintain the public beach, promote dune restoration and enhancement, and enhance public beach access.

The County also recognizes that at present, no structures have been built adjacent to the beachfront in Zone 1 at Boca Chica beach, Zone 2 along Park Road 100 north of the Shores Subdivision, nor in Zone 3 north of Park Road 100. The County’s current beachfront is eroding and future development will, whenever possible, be permitted only landward of the building setback line and buffer. The County’s fundamental strategy to reduce or minimize future losses and damages due to shoreline retreat and storms is to: (1) limit development of habitable structures to more landward locations, and (2) protect and enhance the dunes seaward of the building setback line and buffer in
order to provide a consistent level of protection against 100-year storm events.

Nonetheless, under limited circumstances the ERP may allow property owners to construct habitable structures seaward of the building setback line and buffer. Beachfront Construction Certificate and Dune Protection Permit must be issued by the County and an Exemption Petition approved as described in this ERP and in the Cameron County Beach Access and Dune Protection Plan for such construction.

The County will apply for Coastal Erosion Planning and Response Act (CEPRA) funding to reduce shoreline beach erosion on the public beach. In lieu of receiving CEPRA funds, the strategy is to work with landowners and developers to achieve this EPR’s intended goals.

4.1 Dune Protection and Management to Protect Public and Private Property from Severe Meteorological Events

The County shall encourage beachfront landowners to protect, manage and restore the dune system in a manner that will protect public and private property from severe meteorological events through the development of a continuous foredune ridge. For the purposes of the ERP, a “severe meteorological event” is defined as a 100-year storm event.

4.1.1 Overview and Goals

Working cooperatively with beachfront landowners, and through establishment and management of a storm protection dune, the County seeks to:

a. Minimize and reduce future storm damage due to inappropriate nearshore construction;
b. Increase coastal resiliency and protect public and private property from future storm and flood impacts;
c. Protect, preserve, and enhance the critical dune system along the Gulf shoreline;
d. Adopt and implement procedures to limit construction seaward of the building setback line and buffer; and
e. Allow development to occur in a manner consistent with sound dune management practices while providing a buffer to accommodate future shoreline retreat.

Specifically, the County’s goal is to promote, restore, enhance and maintain a continuous foredune ridge seaward of the building setback line in order to provide coastal resiliency and protect against the risk of damage from a 100-year storm, in accordance with guidance from the Federal Emergency Management Agency (FEMA).
4.1.2 Landowner Cooperation and Coordination

Under this ERP, the County shall work cooperatively and in coordination with private landowners to plan, design, permit and implement a program to protect and enhance the dune system. The County recognizes that with the exception of limited County park areas, beach accesses, and platted road rights-of-way, portions of the area seaward of the building setback line are privately owned.

The County further recognizes that it cannot independently design, permit, and undertake dune restoration activities on private land without the consent or approval of the land owner.

The County will encourage the landowners to develop and implement the dune restoration, preservation, and enhancement measures outlined in this ERP.

4.1.3 Desired Dune Characteristics

In coordination with private landowners, the County will seek to plan, permit and implement a continuous dune ridge as a coastal crest with the following characteristics:

1. Dune height of at least +16 feet NAVD;
2. Minimum base width of 200 feet measured perpendicular to the beach;
3. Seaward position of the dune must begin at the line of vegetation or in accordance with the provisions outlined in § TAC 15.7(e);
4. Attain a dune configuration and contour with 575 cubic feet of sand volume per linear foot above the FEMA base flood elevation (BFE);
5. Buffer area of 30 feet landward of the building setback line;
6. Install native dune vegetative cover at a density of one thousand plants in a 50- by 100- foot strip using at least three principal native dune plant species: Bitter panicum (*Panicum amarum*), sea oats (*Uniola paniculata*), and Marshhay cordgrass (*Spartina patens*). Other native dune plant species may be utilized if approved;
7. Install sand fencing landward of the line of vegetation in accordance with the most recent version of the “Coastal Dunes: Dune Protection and Improvement Manual for the Texas Coast.”

4.1.4 Identification of Areas in Need of Restoration

The dune areas in need of restoration are those that lack the dune height, volume, and width
specified in the ERP. An assessment of areas in need of restoration was completed in development of the ERP and is included herein and in the Cameron County Erosion Analysis: Study of Future Shoreline Change and Public Cost Implications of Beachfront Development, TGLO Contract No. 10-103-006, Work Order No. 653, Ravella, P. and W.L. “Bill” Worsham, P.E. (Texas #83152), January 31, 2013.

Generally, dune restoration should take place in areas with a dune elevation of less than 16 feet NAVD88. Specific areas of restoration can only be identified in coordination with private landowners and will be undertaken upon certification and in concert with implementation of the ERP. As site conditions on the shoreline and in the dune system are dynamic, specific areas in need of restoration may change over time.

![Dune areas in need of dune restoration (enclosed in red squares).](image)

**Figure 9.** Dune areas in need of dune restoration (enclosed in red squares).

### 4.1.5 Enhanced Dune Protection Measures for Existing Structures

No structures have been constructed within the Zone 2 area seaward of the building setback line, or in Zone 3, therefore, enhanced dune protection measures for existing structures are not included at this time.

### 4.1.6 Seaweed Management

The deposition of Sargassum and other seaweed on the County beaches provides a significant resource for dune restoration activities. The presence of seaweed along the beach is not detrimental to the condition of the shoreline itself but can be a nuisance to beach visitors. The County’s intent is to maximize the benefits that can be obtained by effectively using the seaweed to rebuild dunes, fill dune gaps, and to raise the elevations of the back-beach area, particularly areas prone to
washouts and inundation. The County will coordinate with adjacent upland landowners on the placement of relocated seaweed in a mutually beneficial location.

The goal of the County’s seaweed management program is to remove depositions of seaweed on the beach only when nuisance conditions occur. In removing and relocating seaweed, the County shall:

1. Avoid and minimize damage to the beach when removing and relocating seaweed.
2. Relocate all seaweed collected from the beach to the foredune area to assist with formation of coppice mounds and to aide in dune formation.
3. Promote the formation of a continuous dune system.
4. Separate the seaweed from the sand substrate through the use of hay rakes (tine equipped) or sand sifting machinery to the maximum extent possible.
5. Restrict the use of bulldozers or similar mechanical blades to clear the beach of seaweed deposition unless seaweed deposition is heavy and cannot be cleared with rakes and sand sifting equipment.

The County will seek to limit the location and timing of its seaweed management practices to those areas that warrant seaweed relocation based on the degree of seaweed deposition and the likelihood of heavy public beach use. Areas that have a higher demand are generally more appropriate for seaweed relocation than rarely used beach areas. The County seeks to limit seaweed relocation to circumstances where seaweed coverage and deposition interfere with the public’s use and enjoyment of the beach. This decision is a matter of judgment and experience.

The County will continue to review and adapt its beach management practices to use the most effective methods based on the most up-to-date information.

4.1.7 Limitation of Dune Mowing and Fertilization

Mowing seaward of the building setback line and Dune Protection Line is prohibited. Fertilization may be used during the first year after planting vegetation on the dune to ensure its successful establishment. Approval for fertilizer application will be issued by the County on a case-by-case basis.

Only 12-6-6 fertilizer is allowed at applications rates of not more than 100 lb/Ac and up to four applications during the months of March through May.

4.1.8 Vehicle Restrictions -- Currently, vehicles trespass into the dunes and onto private property from the public beach and from Park Road 100. Vehicles can severely damage dunes, destroy dune vegetation, and contribute to dune weakening, instability, and blowouts. This can
increase the risk for storm surge penetration and otherwise undermine the purpose and objectives of this ERP.

Vehicle trespass into the dunes is prohibited under current law (Texas Natural Resources Code § 63.093 and Title 31, Texas Administrative Code § 15.4(c)(6)).

To address this issue, the County will seek the permission of the Texas Department of Transportation to place signs along Park Road 100 advising the public that driving on the dunes is prohibited. Violators will be subject to maximum penalties. The County will also recommend that landowners install no trespassing signs on private upland dune areas.

4.2 Procedures for Dune Restoration

All dune restoration activities shall be undertaken only if a Beachfront Construction Certificate and Dune Protection Permit has been duly authorized for the activity and, if applicable, the County has approved an Exemption Petition for construction of a habitable structure seaward of the BSL.

4.2.1 Dune Restoration Phasing – The County will coordinate with beachfront landowners to develop site specific dune restoration plans. The County shall encourage dune restoration projects to be designed and permitted in dune segments of at least 500 feet whenever practicable. Dune restoration priorities, phases and segments will be determined on a case-by-case basis depending on the willingness and cooperation of beachfront landowners to undertake restoration, the length of the dune segment proposed for restoration, the current width and condition of the dune system, the beach width, the project cost, and the financial capability of the applicant.

4.2.2 Coordination - Cameron County will work with landowners to make sure that the implementation of the ERP and the Beachfront Construction Certificates, Dune Protection Permits and Exemption Petitions are followed accordingly.
5.0 CONSTRUCTION PROHIBITION AND EXEMPTIONS SEAWARD OF THE BUILDING SETBACK LINE

The Land Office rules provide that an erosion response plan may include “[a] prohibition on new construction seaward of the building setback line” and that “[t]o the maximum extent practicable, all structures should be constructed landward of the building set-back line” (Texas Administrative Code, Title 31, § 15.17(a)(2)).

Construction of structures landward of the building setback line establishes a rebuttable presumption that a permittee has followed the mitigation sequence requirements for avoidance and minimization of effects on dunes and dune vegetation specified in TAC §15.4(f) of the GLO Rules. However, a permittee is not exempt from compliance with mitigation requirements for unavoidable adverse effects on dunes and dune vegetation.

The remainder of this section describes when and how structures may be built seaward of the building setback line by property owners that have no practicable alternatives.

5.1. Prohibition on Construction of Habitable Structures Seaward of the Building Setback Line and Buffer Area

No habitable structures shall be permitted to be constructed seaward of the Building setback line or within the 30-foot buffer area landward of the Building setback line unless, as provided herein, a Beachfront Construction Certificate & Dune Protection Permit and an Exemption Petition for Construction seaward of the Building setback line are duly filed by the applicant and granted by the County.

5.2 Exemptions from Prohibition on Construction Seaward of the Building Setback Line and Buffer Area: Dune Walkovers and Public Beach Access Facilities

Private and public dune walkovers and public beach access facilities may be constructed seaward of the building setback line and buffer area if authorized under a duly issued Beachfront Construction Certificate and Dune Protection Permit. These dune walkovers will be designed and build as per the “Dune Protection and Improvement Manual for the Texas Gulf Coast” published by the General Land Office (5th edition or most recent; http://www.glo.texas.gov/coast/coastal-management/forms/files/dune-protection-manual-gpb.pdf)

Dune walkovers allow access to the beach while reducing impacts to dunes and dune vegetation. Public access facilities designed and constructed by the County are required to provide public access to the beach. By exempting dune walkovers and public access facilities from the prohibition
on construction seaward of the building setback line and buffer, the County seeks to protect the integrity of the dunes, reduce or minimize dune damage and provide for public access to the beach in a manner consistent with state law, the County’s Beach Access and Dune Protection Plan, and this ERP.

5.2.1 Requirements for Exempt Construction

Dune walkovers and all public beach access facilities shall be constructed to avoid and minimize impacts to dunes and dune vegetation seaward of the building setback line and buffer to the greatest extent practicable. All impacts to dune vegetation and dune volume, whether for a walkover or public access facility, shall be mitigated seaward of the Building setback line at the mitigation ratio of 1:1 as required by GLO rules and specified below.

Dune walkovers and public beach access facilities constructed seaward of the building setback line and buffer area must:

1. Comply with all applicable requirements, standards and limitations in the County Beach Access and Dune Protection Plan, GLO rules, and this ERP;
2. Be restricted, to the greatest extent practicable, to the most landward point of the public beach;
3. Aligned and sited so as to avoid and minimize impacts to dunes and designed in a manner that does not diminish the integrity of the dune system and foredune ridge or the hydrology of the beach dune system;
4. Located so that the walkovers or public access facilities will not interfere with or otherwise restrict public use of a beach at normal high tides;
5. Be constructed in a manner that allows, to the greatest extent practicable, for the growth of dune vegetation and the migration of dunes under the walkovers;
6. Ensure that all impacts to dune vegetation and dune volume, including vegetation and dune volume under walkovers and access facilities be mitigated at a ratio of 1:1; and
7. In the event that the public beach migrates landward due to erosion or a storm event, the walkover or access facility must be shortened, relocated, or otherwise modified to eliminate any encroachment on the public beach easement. Modifications to walkovers and public access facilities must be undertaken pursuant to a duly issued Beachfront Construction Certificate & Dune Protection Permit.

5.3 Construction of Habitable Structures Seaward of the Building Setback Line and Buffer Zone is Contrary to this Erosion Response Plan
The County has determined that due to high shoreline erosion rates, construction of habitable structures seaward of the building setback line and buffer is contrary to this Erosion Response Plan. In the event that a property owner wishes to construct a habitable structure seaward of the building setback line and buffer, the property owner must apply for an Exemption Petition in addition to a Beachfront Construction Certificate and Dune Protection Permit, and comply with the requirements set forth herein.

5.3.1 Exemption Petition Procedures and Requirements for Construction Seaward of the Building Setback Line

The County shall consider an Exemption Petition for construction of a habitable structure seaward of the building setback line (200 ft landward of the LOV) and buffer area (an additional 30 ft landward of the setback line.) under the following procedures (Checklist provided in Appendix E):

1. In addition to an application for a Beachfront Construction Certificate & Dune Protection Permit, an applicant shall concurrently submit an Exemption Petition for the construction of a habitable structure seaward of the Building setback line and Buffer Area. The Exemption Petition must demonstrate, to the satisfaction of the County, that no practicable alternatives to construction seaward of the building setback line exist. For purposes of this section, practicable means available and capable of being done after taking into consideration existing building practices, site alternatives, and the footprint of the structure in relation to the area of the buildable portion of the lot and considering the overall development scheme for the property.

2. For projects where the County is considering authorizing an exemption from the prohibition on construction seaward of the building setback line, the Petition and Application materials for construction must demonstrate that the conditions below will be met:

   a. Sealed Plans. Plans and certifications for the structure shall be sealed by a registered professional engineer licensed in the State of Texas, providing evidence of the following:
      i. A minimum of two-foot freeboard above FEMA’s BFE to the finished floor elevation of the lowest habitable floor;
      ii. No enclosures below BFE;
      iii. Consistency with the latest edition of specifications outlined in American Society of Civil Engineers, Structural Engineering Institute, Flood Resistant Design and Construction, ASCE 24-05;
      iv. Feasible relocation of any habitable structure; and
v. All construction shall be designed to minimize impacts to natural hydrology.

b. Location of all construction should be landward of the landward toe of the foredune ridge and as far landward as practicable.

c. The proposed development shall also comply with the current floodplain regulations in the County.

d. The structure must be elevated on pilings; slab on grade construction is prohibited.

e. The proposed construction must strictly comply with the requirements of the Cameron County ERP and Beach Access & Dune Protection Plan and the Land Office’s Beach/Dune rules set forth in Title 31, Texas Administrative Code § 15;

f. The use of concrete or asphalt is prohibited under the footprint of the structure and for the construction of a driveway, parking area or road.

g. In the area seaward of the BSL, all roads, driveways, sidewalks and pathways shall be pervious and constructed with brick pavers, crushed limestone, gravel, or Truegrid pavers.

h. The applicant will be allowed to place unreinforced fibercrete in 4-foot by 4-foot sections, 4 inches thick, separated by expansion joints, beneath the footprint of the habitable structure, not including the area under decks, only if the fibercrete is not structurally attached to the pilings and placement of fibercrete will be entirely undertaken, constructed, and located at least 25 feet from the landward toe of the foredunes. If no dunes exist, placement of fibercrete may only be undertaken, constructed, and located at least 100 feet landward of the line of vegetation, or landward of the building setback line, whichever distance is greater.

i. Construction outside the perimeter of a habitable structure using concrete or other impervious surface with an area that does not exceed 5.0% of the footprint of the habitable structure may be authorized. Concrete curbs may be permitted as part of the 5.0% to preserve the integrity of permeable pavers. Curbs shall not be wider than 6 inches or more than 10 inches high/deep; limited concrete pads may also be permitted as part of the 5.0% if required for utilities, and they should be limited to the minimum dimensions required to meet applicable building codes.

j. Mitigation for damage to dune volume and vegetation shall comply with all applicable standards in the Cameron County Beach Access & Dune Protection Plan, the Land Office Beach/Dune rules, (Texas Administrative Code, Title 31, § 15.4(f)), and this ERP. Mitigation impact analysis shall be further calculated and conducted as follows:

   i. Dune volume mitigation shall be provided for all dune volume impacted;
   ii. Dune plant mitigation shall be strictly limited to native dune plants;
   iii. All dune impacts shall be mitigated on-site to the greatest extent practicable and all mitigation of dune volume and vegetation must occur seaward of the building setback line, even if off-site;
iv. All dune volume impacted, displaced or disturbed by the proposed construction must be used for mitigation and dune restoration seaward of the building setback line and shall not be used for construction fill or any other purpose;

k. Notwithstanding any other provisions, no seawalls, retaining walls, geo-tubes, clay-core dunes, or other structural shore protection projects or shoreline armoring structures may be constructed anywhere seaward of the building setback line.

3. In addition to the information required in the Beachfront Construction Certificate and Dune Protection Permit Application, the Exemption Petition shall include the following:

a. The site-specific erosion rates seaward of the parcel and at least 1,000 feet on either side of the parcel based on published data from the UT Bureau of Economic Geology;

b. A detailed site plan showing all proposed improvements, proposed dune alternations, and pre-construction and post-construction dune contours at 1-foot intervals, and the projected shoreline position, including:

   i. The surveyed Line of Vegetation subject to review and approval by the Land Office;
   ii. The surveyed line of mean higher high water (MHHW);
   iii. The surveyed location of the building setback line and buffer area as defined herein; and
   iv. The future projected shoreline position at 10, 20, 30 and 50 years from the year of the application, based on multiplying the erosion rate for the parcel times the number of applicable years covering an area of at least 1,000 feet on either side of the parcel and including the parcel;

c. A detailed site plan based on a recent survey of the parcel, including the following:

   i. One-foot dune elevation contours within the parcel and within the area of construction impact;
   ii. The extent of vegetative cover expressed as a percentage of the area or sub-area and in square footage, (documented by color photos and the survey) on the parcel and within the area of construction impact;
   iii. Complete calculation of all impacts to dune volume (cubic yards) and dune vegetation (square footage) of the project;
iv. A dune mitigation plan ensuring mitigation of all impacts to dune volume and dune vegetation will be completed seaward of the building setback line;

v. The Dune Mitigation Plan shall include:
   a) a survey of the proposed mitigation area prior to modification;
   b) Calculation of dune mitigation volume in cubic yards at a ratio of 1:1 of impact. Total dune volume shall be calculated starting at the elevation of the base of the dune within the area of construction impacting the dunes;
   c) Dune vegetation area in square feet at a ratio of 1:1 of impact;
   d) The proposed post-mitigation dune shape, location, height, width and contours;
   e) The proposed dune planting plan including the plant species to be installed on at least one foot on center, the plant source and location within the dune mitigation area, and the location and design of sand fencing, if applicable;

d. An assessment of the risks to the structure, adjacent structures, utilities, and other improvements in the event of a 100-year storm event if the project is constructed as proposed and taking into account the proposed mitigation plan;

e. An assessment of the risks to the structure, adjacent structures, utilities, and other improvements due to predicted shoreline retreat determined by multiplying the erosion rate times 10 years, 20 years, 30 years and 50 years;

4. Where a Dune Mitigation Plan is required, the applicant shall provide the contact information and addresses for all landowners immediately adjacent to the tract and affirmation that the adjacent landowners will be provided with notice of the County Commissioners Court hearing at least 10 days prior to the hearing on the Application and Petition.

5.3.2 Factors Governing Consideration of an Exemption Petition.
When considering an Exemption Petition, the Dune Protection Committee and County Engineer and Parks Director shall take into consideration the following:

1. The Beachfront Construction Certificate and Dune Protection Permit Application, the Exemption Petition, comments of the public and adjoining owners, comments from the Land Office;
2. The erosion rates seaward of the parcel and at least 1,000 feet on either side of the parcel based on published data from the UT Bureau of Economic Geology,
3. The projected position of the shoreline at 10, 20, 30 and 50 years in the future;
4. The likelihood that the proposed structure may encroach on the public beach in the future;
5. The condition, height, volume, width and extent of the dunes and dune vegetation on the parcel and seaward of the proposed structure;
6. The extent to which the proposed construction will impact dune integrity, including dune volume, shape, height, and dune vegetation;
7. The extent to which the proposed construction would adversely impact the stability, integrity, and resiliency of the dune system, dune hydrology, or cause other environmental impacts,
8. The sufficiency of the petitioner’s proposed plan to avoid and mitigate dune and dune vegetation impacts and to improve the dunes seaward of the proposed construction,
9. Any risks to adjacent structures, properties, or public infrastructure, if any;
10. Consideration of whether there are no practicable alternatives to construction seaward of the building setback line, and the availability of alternative construction designs and sites;
11. Such other factors and considerations identified in the petition or as deemed appropriate by the County and generally within the scope of Open Beaches Act, Dune Protection Act, implementing state regulations, and the County Beach Access and Dune Protection Plan, as amended.

After all the previous considerations, the Dune Protection Committee, the Parks Department Director and County Engineer will issue a recommendation to the Commissioners Court, who will issue a decision.

5.4 Review and Action on an Exemption Petition.

1. Completeness and Consistency Review – The Exemption Petition and Beachfront Construction Certificate and Dune Protection Permit Application shall be reviewed by the Cameron County Engineer and/or the Parks Director within a 15-business day period following submission of the applications. If all the required information is contained within the submission and is consistent with this ERP, then the Petition, Application and the applicant’s public hearing notice shall be forwarded to the General Land Office for their review. If the Petition and/or Application is incomplete and/or inconsistent, the County Engineer and/or the Parks Director shall make note of such requirements in letters to the applicant within 15-business days of the date of the application submission or resubmittal.

2. Land Office – Following the review by the County Parks Department & Engineering Department, the preliminary determination will be transmitted to the Land Office for review and comment. The County will allow 10 or 30 business days (in case of a large construction project) for receipt of comments from the Land Office.
3. Preliminary Determination by Dune Protection Committee – Once the Land Office has provided comments, the Petition and Application will be presented to the Dune Protection Committee. The Committee may request clarification of the submissions, request additional information, find that changes or modifications to the site plans are required, and shall ensure the Exemption Petition and Application are compliant with all applicable provisions of the ERP, Beach Access and Dune Protection Plan, Beach and Dune Rules, and other applicable requirements. After review, the Committee shall issue a preliminary written determination of consistency with this ERP and other applicable requirements regarding the Exemption Petition and Beachfront Construction Certificate and Dune Protection Permit Application.

4. Recommendation for Commissioners Court Action – Based on comments from the Dune Protection Committee, the County Parks Department & Engineering Department, and the GLO, the Parks Department may place the Petition and Application on the agenda for the Cameron County Commissioners Court with a recommendation to approve, deny, or approve with conditions the Petition and Application.

5. Commissioners’ Court Action – Before the 15th calendar day before the date of the hearing, notice of the time and place of the hearing must be published in a newspaper of general circulation in Cameron County. Following public hearing and testimony, the Commissioner’s Court may approve, deny, or approve with conditions the petition/application. A written Order will be released within 14 calendar days following consideration by the Court.

   a) If the petition/application is denied, the petitioner/applicant may request reconsideration by the Court of the Order within 30 days, providing a reasoned justification. In the alternative, the petitioner/applicant may submit a modified application addressing the basis of the denial.

   b) An Order will become final upon either the expiration of 30 days following issuance, if there is no requested reconsideration or modified petition, or a decision by the Commissioners’ Court on a requested reconsideration or a modified petition.

   c) A final Order on an exemption petition may be reviewed in any court of competent jurisdiction in Cameron County.

All granted Permits and approval of Exemption Petitions are valid for three (3) years and may be renewed for two (2) consecutive ninety-day periods thereafter.
6.0 PROCEDURES TO PRESERVE AND ENHANCE PUBLIC ACCESS

The County operates a system of coastal parks that serve both the residents of the County as well as visitors to the area. The County’s park system includes a series of coastal parks that are located along the Gulf of Mexico on South Padre Island. These parks are among the most popular and heavily used in the entire system. These coastal parks are key elements of the Cameron County Parks System.

The County’s coastal parks share spectacular locations and provide everyday access to some of the best beaches in Texas. Visitors come to these parks from Texas, the U.S., Mexico, and all parts of the globe. The high level of visitation experienced by the County’s coastal parks, combined with the rugged climate conditions, impact the facilities within the parks.

With a view toward improving the park experience for all visitors, the Cameron County Commissioners Court ordered that a coastal parks master plan be developed. Initiated in 2014, completed in May 2015, and updated in May 2016, the plan is a living document used to guide future park improvements. The coastal parks master plan prioritizes improvements needed in the near term to serve the County’s existing park users and identifies opportunities for improved recreation and park use in the future.

As mandated by Texas Natural Resources Code § 33.607, Cameron County is committed to developing park improvement plans in a manner that reduces public expenditures for erosion and storm damage losses to public and private property, including public beaches. The County is further committed to ensuring that the upgrades to its coastal parks and public access facilities employ construction methods and designs that will reduce post-storm repair costs. The new park improvements are subject to the Beach Access and Dune Protection permitting process, and specific designs will be reviewed and evaluated with the full participation of the Land Office as the park improvement designs are developed and advanced through the permitting process.

This ERP includes a general schedule for public access design improvements which will be updated on an on-going basis as improvement designs are advanced. The inventory of existing access facilities to support future FEMA post-storm funding claims was completed as part of the coastal parks master plan and will continue to be updated as designs for new facilities move forward. The updated inventory will be completed in 2019. Finally, this ERP establishes post-storm beach access assessment procedures so that future damages can be catalogued.

6.1 Evaluation of Current Public Access Facilities

Through the coastal parks master plan process and this ERP, the County has evaluated the condition of existing beach access improvements and assessed their vulnerability to damage from erosion and storm events. Cameron County is in the process of amending its Dune Protection and Beach
Access Plan that assesses the needs for public access improvements to preserve and enhance the public’s right to access and use the public beaches fronting along the Gulf of Mexico. Currently, the beaches in Zones 1, 2, and 3 are accessed by driving onto the beaches. Portions of Zone 1 and Zone 2 beaches seaward of Park Road 100 are pedestrian only and the County (See Appendix D) will continue to work closely with the Land Office to ensure upland parking areas, access fees, and facilities are in compliance with state access standards. The County will ensure, in partnership with the GLO, that all public access points, including necessary parking areas, are consistent with state standards.

There are currently seven existing beach access points that are owned and maintained by Cameron County. Three of the seven access points have public facilities and improvements. The remaining four access points are unimproved and provide off-beach parking areas. The County’s three improved beach access parks are Isla Blanca Park, Andy Bowie Park, and E.K. Atwood Park. The County Coastal Parks Master Plan included conceptual plans for improvements to the three improved beach access parks. These parks will be upgraded and improved in 2017-2019 following authorization of a $30 million park improvement bond.

The main goals of the coastal parks master plan are to provide quality amenities and public access to serve the high volume of visitors to the parks. The coastal parks master plan creates a road map for both short term and longer-term improvements to all the coastal parks. It guides the new development of facilities in each park and responds to new opportunities and events that may take place on the island with its growth. Park improvements under consideration and development at this time include:

- Improved park entry areas
- New or improved restrooms
- Traffic circulation improvements at Isla Blanca and Andy Bowie parks
- Expanded day parking areas
- Improved RV parking at Isla Blanca and Andy Bowie parks
- Improved maintenance facilities
- Improved concessions, picnic/shade pavilions, rental cabanas
- Special attraction facilities (i.e. SpaceX rocket viewing areas)

With extensive Land Office involvement, the permit to improve E.K. Atwood Park was issued and the project was completed in early 2018. Improvements to Isla Blanca Park and Andy Bowie Park are in the design phase at this time and will be subject to full Land Office review through the Beach-Dune permitting process.

The ERP recognizes that public access facilities are permitted to be located seaward of the Building setback line in Zone 2. However, in the park improvement designs under development at this time, Cameron County has incorporated design standards and objectives specifically intended to reduce
potential public expenditures for erosion and storm damage losses and will work closely with the Land Office to review these designs to ensure risks to storm damage and losses are minimized to the greatest extent possible. In the development of coastal park improvements, the County will:

1. Avoid and minimize impacts to dunes and dune vegetation to the maximum extent practicable;
2. Fully account for any dune and dune vegetation impacts from park facility improvements and ensure full on-site dune mitigation and restoration at a 1:1 ratio;
3. Employ permeable parking surfacing materials such as TrueGrid system for all new parking area and pathways, to the maximum extent practicable;
4. Locate new parking areas to avoid and minimize dune impacts and in a landward location to the maximum extent practicable;
5. Elevate new park facility structures above base flood elevation; and
6. Ensure dune walkovers are located as far landward of the public beach easement while ensuring adequate public access.

The updated inventory and evaluation below serves as the basis for improvement priorities and determining appropriate funding for projects and FEMA post-storm funding qualifications.

• **Beach Access 1, Isla Blanca Park** - Located at the south end of the island, adjacent to the Brazos-Santiago Pass, Isla Blanca Park includes direct access to approximately 3,150 feet of Gulf beach and 3,500 feet of access along the Brazos Santiago Pass shoreline. Isla Blanca has facilities for a wide variety of activities for all ages and beach goers. It includes a public boat launch, making it a favorite for fisherman along with the mile long jetty and bay area beach access. There are more than 600 RV sites and 933 paved parking spaces inside Isla Blanca Park that receive an annual influx of residents during the cooler months and weekend residents during the summer months. There are two large pavilions with concessions, restrooms and rinse stations where summer users like to relax and picnic in the shade just a few steps from the beach. The Dolphin Cove area is used primarily for gatherings and group events.

Today the park is heavily used year-round and although the facilities are adequate, much of the park is showing the toll from heavy use and needs renovation and upgrades. This will not only improve the quality of user experience, but also continue to provide a cost-effective location for beach-going families, RV park enthusiasts, and fishermen.

The park includes an existing sea wall and intermittent and irregular dune field that is up to 200 feet wide in some locations. The dune system is in need of enhancement and protection from visitor impact and development of the dune improvement plan is underway as part of the overall park facilities improvement design, which is scheduled to be completed in the second quarter of 2020.

Isla Blanca park facilities have deteriorated over many years due to the wear and tear expected
from heavy public use, occasional stormy weather, and the mostly sunny salt air seaside environment. Park facility structures have to be able to withstand heavy public use, heavy weather events, and the maintenance challenges presented by the seaside environment. All existing facilities are candidates for replacement or expansion, but there are several other amenities that the park is lacking in order to make the user experience the best it can be for all groups that visit the park.

1. Park circulation and parking  
2. Entry gate improvements  
3. Proposed park gateway feature  
4. Restroom facility improvements  
5. Large pavilion improvements  
6. Picnic pavilion improvements  
7. RV site improvements  
8. Proposed beach boardwalk  
9. Rental cabana improvements  
10. Dolphin Cove peninsula improvements  
11. Other park amenities improvements under development  
12. Playground Improvements  
13. Sea Ranch area improvements  
14. Concession improvements  
15. Boardwalk, rinse stations and dune walkover improvements

Beach access and dune impacts of the Isla Blanca Park improvements and consideration of storm impact risks were fully assessed and addressed in consultation with the Land Office in the design and permitting process.

• **Beach Access 2, Andy Bowie Park** - Located approximately a half-mile inside the northern city limits of the City of South Padre Island, Andy Bowie Park has a half-mile of beach with 301 paved parking spaces, concession buildings, two pavilions, two restroom and shower facilities, a toll collection booth and a park ranger station. The park has a dune field that is some 400 feet wide with two pedestrian paths through the dunes.

This area is the second most popular county coastal park on the island. It is a popular place for families and day users as well as RV enthusiasts that want a more secluded campsite. It does not have automobile access to the beach, but for many beach goers that is a positive aspect of the park.
The land owned by the county also includes the Convention Center as well as the adjoining sand flats on the Laguna Madre side of the island.

Andy Bowie Park is strategically located near the proposed Causeway location, and as such is anticipated to have increased numbers of visitors when the second causeway is built.

Existing site and facilities- Amenities at this park are more extensive than other beach access points in the area, but are still fairly limited. There are adequate restrooms and a shade pavilion, but the majority of the users are solely there for access to a less populated beach experience, which is only a short walk from the parking area. The 18 RV sites are somewhat less exclusive than the Isla Blanca sites, but include their own restroom facility and beach access and shade pavilion. The sand flats area is used year-round for fishing and kite surfing and is a natural tidal area.

Just south of the park, but included with it, is the Hilton Garden Inn, which is developed on park lands that have been leased from the county. It is a full-service hotel that many of the park users of this park prefer because of its convenient location.

Key park needs – Cameron County is currently evaluating, planning and designing specific improvements to Andy Bowie Park. As specified above, the park design will locate new facilities landward of the foredune ridge, employ pervious surfacing materials such as TrueGrid for parking and pathway areas, and include strategies to avoid and minimize impacts to dunes and dune vegetation. Dune impacts will be mitigated on-site at a ratio of at least 1:1. Based on the coastal parks master plan, expected improvements are likely to include:

1. Increased Parking – The county seeks to increase the number of parking spaces within Andy Bowie Park in areas landward of the foredune ridge.

2. Restroom Renovations – Restroom and changing facilities are generally adequate, but are dated and dark. While retaining the existing structure, upgrades to furnishings, fixtures, lighting and entryways are expected. The restroom roof structures will be updated to adopt the architectural theme selected for Isla Blanca Park. Solar and wind energy features may be added to generate power for additional lighting in the park restrooms.

3. Pavilion Enhancements – The existing pavilion is generally in good condition and offers good views of the beach. The County is considering replacement of the pavilion shade structures to increase the shaded area and provide more roof support reinforcement.

4. Park Entry Building Renovations – Restorations to the entry building are expected, including upgrades to air conditioning units and the replacement of windows and roofing. A second entrance lane is expected to be included for peak visitation periods.

5. Main Access Walkover – The County will replace pavement to the main access pathway
and replace the path with one or more ADA compliant walkovers.

6. Concession Building Renovation – Interior renovations to the concession building are expected to attract new concessions to the site. Additional shaded eating areas on either side of the concession building should be developed.

Many of the proposed improvements for Andy Bowie Park are similar to those at Isla Blanca Park, just on a smaller scale. The current facilities are adequate but rapidly aging. Additional public parking is needed. Parking, shade pavilion, and restroom facilities will be updated or expanded to accommodate the growing number of users. The RV sites will be improved along with increasing the number of spaces to meet increased demand. There is also an opportunity to create cabanas for overnight rentals for visitors to stay in for the weekend. The beach area is beautiful in its current condition. An improved boardwalk and access to the beach would improve its accessibility, and there is also an opportunity to add small rental pavilions along the beach for day use. Expected facility upgrades to Andy Bowie Park will be finalized in the design and permitting process and likely to include:

1. Beach access walkover(s)
2. Parking areas upgrade and increased capacity
3. Pavilion and restroom facility improvements
4. Entry gate improvements
5. RV site improvements and expansion from 18 to up to 70
6. Restroom and pavilion facility improvements
7. Investigation of potential fishing pier
8. Park ranger station improvements.

• Beach Access 3 - Located north of the city limits and approximately a quarter-mile north of Andy Bowie Park, Beach Access 3 offers pedestrian beach access via a dune walkover and has approximately 143 unimproved parking spaces. Free access is provided during non-peak season, which is immediately after Labor Day Weekend through March 1st. The dune field is seaward of access 3 is approximately 100 feet wide.

Through the coastal parks master plan and working with the Dune Protection Committee and in consultation with the Land Office, the County is planning to improve Beach Access 3. The improvements are currently in the preliminary design stage, and the schedule for improvements to this access point has not been finalized at this time. Likely improvements include:

1. Shade pavilion
2. Restroom facility
3. Community rinse stations
4. Expand and improve pervious parking area
5. Upgrade the existing beach access walkover
6. Dune restoration and enhancement

**Beach Access 4** - located 1-mile north of Andy Bowie Park. This is not a vehicular accessible access point, but allows public pedestrian access to the beach. This access area provides 54 (49 regular and 5 ADA accessible) public Gulf-side parking spaces and 66 spaces on the west side of Park Road 100. This access area provides an ADA accessible dune walkover with interpretive signs that allows access to the beach. The dune walkover was funded with the assistance of the Texas General Land Office CMP program. The total construction cost for the dune walkover was $180,533.00, split between CMP Funds: $96,000 and County funds: $84,533.00. This beach access area also provides police surveillance, seasonal lifeguards/beach patrol and portable restrooms. Cameron County has plans in the near future to extend water and sewer services to this beach access for the development of restrooms and rinse stations.

• **Beach Access 5, E.K. Atwood Park** - located approximately 1.6 miles north of Andy Bowie Park and being a vehicular beach accessible point, but allows public accessibility to this beach access through all-weather roads with approximately 128 public Gulf side parking spaces, including 5 ADA parking spaces, and 4 food truck parking concession spaces; and 58 spaces on the west side of Park Road 100. Facilities provided at this park or access point number five are: public restrooms, five (5) large covered pavilions with picnic tables, community rinse stations, two ADA accessible dune walkovers, police surveillance and seasonal lifeguards/beach patrol. *Free parking is provided directly across this park on the bay side (West) of Park Road 100. On average 100,000 passenger cars and motorcycles, and 10 busses visit this park and beach access each year.

• **Beach Access 6** - The County Park Department provides vehicular beach access through Access Point Number Six (6) located 4.5 miles north of Andy Bowie Park which provides only seasonal roadway maintenance and staffing for public safety, security and emergency purposes. Free access is provided during non-peak season, which is immediately after Labor Day Weekend through March 1st. The rest of the year a BUF is enforced. On average 24,000 passenger cars and motorcycles, and 10 buses visit this access point.

• **Beach Access 7** - Located on Brazos Island where State Highway 4 (Boca Chica Boulevard) ends on Boca Chica Beach. This is a free vehicular access point with no structures. The County intends to maintain this access as a vehicular access point. No new facilities are anticipated at Beach Access 7 at this time.
6.2 Access Improvements: Isla Blanca Park, Andy Bowie Park, and E.K. Atwood Park

The following table shows the proposed beach access improvements goals and schedules for overall access improvements and management and park improvements to Isla Blanca Park, Andy Bowie Park, and E.K. Atwood Park. This schedule is subject to modification as the planning process continues. Design and permitting for improvements to E.K. Atwood Park have been completed and construction is expected to be completed in 2018. In all cases, park and access improvements will be undertaken in coordination with the Dune Protection Committee and in consultation with the Land Office, following the planning guidance in the coastal parks master plan. All improvements must be permitted consistent with the requirements of the County’s Beach Access and Dune Protection Plan and in coordination with the Land Office.

All access improvements will be designed and constructed in a manner to reduce costs related to maintenance, repair, and replacement. Structures will be located as far landward as possible and, where applicable, will be raised above the base flood elevation. The designs will avoid and minimize impacts to dunes and dune vegetation and mitigate any remaining impacts on-site. Dune walkovers will be accessible under the Americans with Disabilities Act and will designed to minimize shading of dune vegetation and to strictly avoid encroachment on the public beach. Parking areas will be constructed with pervious parking using TrueGrid or a similar pervious paving system, where practicable. Any new or improved vehicular access road will, if feasible, incorporate a raised berm to minimize the chance of a washover through the roadway.

The Land Office has adopted rules for the creation of pedestrian beaches that require that the county construct a public beach access area and parking area no more than a half-mile apart with one parking space required for each 15 linear feet of pedestrian beach (see 31 TAC §15.7(h). Closure of a half-mile of beach to vehicles (2,640 feet) would require 176 parking spaces on either end of the pedestrian beach. An average parking area for 176 spaces including entrance and exit lanes and two handicap parking spots is one acre. If the beach access way is to include restrooms and other amenities, an allotment of at least an additional one and a half acres is expected. Access ways for pedestrian beaches may be constructed prior to or concurrent with the development of upland areas adjacent to a proposed pedestrian beach. Pedestrian beaches should be implemented gradually in stages as new beach access ways are constructed. This will also provide beach users with time to transition to a pedestrian only beach and will be easier to regulate. Bollards would be used to separate pedestrian beaches from vehicular beaches.

6.3 Schedule for Access Improvements

<table>
<thead>
<tr>
<th>Cameron County Erosion Response Plan</th>
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<tr>
<td>Table 2: Public Access Improvement Goals and Schedule</td>
</tr>
<tr>
<td>Goal 1</td>
</tr>
</tbody>
</table>
Goal 2 | Complete and implement plans to upgrade Isla Blanca Park, Andy Bowie Park & EK Atwood Park
---|---
Goal 3 | Expand pedestrian beach area in Zone 2 in a manner consistent with state requirements and GLO certification of BD Plan amendments
Goal 4 | Maintain Vehicular Access to Boca Chica Beach; evaluate potential access facility improvements
Goal 5 | Monitor and maintain dunes seaward of all County beachfront parks and access points

<table>
<thead>
<tr>
<th>Item</th>
<th>Within 2 Years of Plan Certification</th>
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<tbody>
<tr>
<td>1.1</td>
<td>Develop off-beach parking plan for progressive expansion of Zone 2 pedestrian beaches in line with OBA, DPA and applicable rules</td>
</tr>
<tr>
<td>1.2</td>
<td>Update inventory and evaluation of all public beach access facilities as improvements are made</td>
</tr>
<tr>
<td>1.3</td>
<td>Reevaluate and improve Beach Access 6 as a vehicular access point</td>
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<tr>
<td>2</td>
<td>Complete construction of Isla Blanca Park improvements</td>
</tr>
<tr>
<td>3</td>
<td>Complete Design and Permitting of Isla Blanca Park Improvements</td>
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<tr>
<th>Item</th>
<th>Within 3 to 5 Years of Plan Certification</th>
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<tbody>
<tr>
<td>1</td>
<td>Evaluate potential properties for new upland parking areas between Beach Access 5 &amp; 6</td>
</tr>
<tr>
<td>2</td>
<td>Evaluate improvements to public access facilities on Boca Chica Beach, initiate planning and design if warranted</td>
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<tr>
<th>Item</th>
<th>Within 6 to 8 Years of Plan Certification</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Depending on funding availability, undertake gradual and coordinated expansion of pedestrian beach area in Zone 2 up to Beach Access 6</td>
</tr>
<tr>
<td>2</td>
<td>Complete Design and Permitting of Andy Bowie Park Improvements (depending upon funding availability)</td>
</tr>
<tr>
<td>3</td>
<td>Complete Design and Permitting of improvements at Beach Access 3 (depending upon funding availability)</td>
</tr>
<tr>
<td>4</td>
<td>Evaluate improvements to public access facilities on Boca Chica Beach, initiate planning and design if warranted</td>
</tr>
</tbody>
</table>

Under this plan, the County will keep the north beaches in Zone 3, the beaches beyond the end of Park Road 100, as vehicle accessible, drive-on beaches. Presently, the County provides and will continue to maintain vehicle access through Beach Access 5, E.K. Atwood Park, and through Beach Access 6; however, in the future vehicle access plans may be modified, and additional pedestrian beach areas created, if upland parking areas can be identified, secured, and improved consistent with state law.

The County recognizes that approval from the Land Office is required before the County may modify beach access, close a public beach to vehicles, or expand pedestrian beach areas. At this time, the County is not proposing to expand pedestrian beach areas. Should such modifications be desirable, the County will prepare beach access improvement and vehicular control plans in accordance with state law and, if approved by the Commissioners’ Court, submit the plans to the Land Office for review and certification.
6.4 Post-Storm Monitoring

In the event of a tropical storm or other significant meteorological event impacting the beach, the County will conduct a preliminary inspection of all beach parks and access points within ten days after it has been found safe to return to the beach. Access facilities will be inspected in order of priority based on the facilities present at the access point and the degree of impact sustained. Priority will be given to the assessment and inspection of Isla Blanca Park, Andy Bowie Park, and E.K. Atwood Park, and Beach Access 3 as these access points include facilities, structures, and/or improvements. Preliminary inspection of all access points, including parking areas, walkovers, and dunes, will be completed within ten days following a storm event.

The County Parks and Engineering department will oversee, direct and manage post-storm inspection and assessment activities and regularly update the Commissioners Court on all actions. Coordination with appropriate state and federal agencies, particularly the Land Office, Division of Emergency Management, and FEMA, will be undertaken in accordance with applicable post-storm procedures.

In the post storm inspection and assessment, the County will:

1. Within ten days of the storm event-
   a. Inspect the structural integrity and condition of all improvements, including but not limited to structures, restrooms, showers, pavilions, roadways, RV pads, utilities, parking facilities, walkovers, beach access pathways, and the dune system;
   b. Document any facilities in unsafe condition and order and schedule, if warranted, additional engineering inspections or surveys;
   c. Undertake emergency repairs or, if necessary and after consultation with the Land Office, temporarily restrict access to facilities deemed unsafe so as to ensure public health and safety;
   d. Identify any structures, walkovers, or facilities within the public beach easement or that otherwise restrict and/or interfere with public use and access to the beach and immediately notify the Land Office in writing;

2. Within 30 days of the storm event-
   a. Prepare a preliminary plan to repair, remove, and/or replace impacted facilities including cost estimates, documentation, and engineering reports;
   b. Specifically determine if removal and/or modification of dune walkovers, structures or facilities is warranted due to encroachment on the public beach easement and notify the Land Office thereof;

3. Within 60 days of the event or as soon as reasonable, refine facility repair or replacement costs and assess the funding available to carry-out the needed repairs;
4. If appropriate and available, prepare requests for financial assistance in accordance with state or FEMA post-storm recovery procedures;

5. Identify funds and/or opportunities for funding through local funds, grants, capital improvement reserves, or other sources to undertake repair of public access facilities;

6. As expeditiously as possible and in accordance with permitting and regulatory standards and procedures, develop a priority and schedule to design, permit and implement beach access facility repairs based on available funding.

Given the wide range of potential storm impacts, including major hurricanes, the post-storm inspection and assessment procedures included herein are necessarily subject to modification.
7.0 ERP IMPLEMENTATION

7.1 Conceptual Funding Strategy

As the strategies and schedules for implementing the ERP are refined, the County will seek to develop a funding strategy to support implementation of the ERP. In general, the County will seek to develop a funding plan that broadly reflects the following principles:

- Seek to develop a long-term funding strategy that is stable, predictable, and sufficient to support current and future shoreline management needs.
- Seek to maximize state and federal support for the County, particularly seeking ongoing CEPRA and CMP grant funds whenever possible as well as RESTORE Act grants, state and federal hazard mitigation grants, and similar funding sources.
- Seek to work cooperatively with property owners who wish to develop a property in a manner consistent with this ERP.

7.2 Acquisition of Parcels Seaward of the Building Setback Line

The County has developed criteria for identifying properties for voluntary acquisition of fee simple title or a lesser interest acquisition by donation. In general, land parcels which are located entirely seaward of the building setback line, in blowout areas, or are sparsely or irregularly vegetated are a priority for acquisition. Large, contiguous parcels extending from the beach and landward past the building setback line are also a priority for acquisition.

In Zone 2, several of the tracts have been subdivided so that some parcels may be wholly seaward of the building setback line. The state rules allow local governments to develop criteria governing the voluntary acquisition or buyout of beachfront parcels. Currently, there are no habitable structures seaward of Park Road 100 in Zone 2. In evaluating any undeveloped parcels to be acquired, the County will consider the following factors:

1. Whether the parcel has been subsumed into the state-owned submerged lands beneath the Gulf of Mexico.
2. Whether the parcel is subject to the public beach easement.
3. Whether the parcel is in or adjacent to a public beach access point or an area proposed as a pedestrian beach, and
4. Whether acquisition of the parcel would further a dune restoration or beach nourishment project.
5. Whether the parcel falls seaward of the Building setback line.

In addition, the County declares as a policy for acquisitions to:
1. Accept land donations for property located seaward of the Building setback line,
2. Accept land donations for future public beach access,
3. Seek exchanges of development rights where feasible, such as along the right-of-way for Park Road 100, and

The County’s acquisition process will generally consist of the following steps:

1. Coordination with willing landowners
2. Assess level of interest in voluntary donation to the County
3. Identification of potential property for acquisition
4. Negotiation of terms of acquisition
5. Identification of available funding including potential grants,
6. Agreement to acquire
7. Execution
LITERATURE CITED


Price W. A., 1954. Dynamic environments: Reconnaissance mapping, geologic and geomorphic, of continental shelf of Gulf of Mexico. Trans Gulf Coast Assoc Geol Soc. 8:41-75


Psuty, N. P., and E. Rohr, 2000: Coastal Dunes: A Primer for Dune Management with Models of Dune Response to Storm Frequencies, Institute of Marine and Coastal Sciences, Rutgers – The State University of New Jersey, 40 pp


Appendix A – Draft ERP Fact Sheets
Erosion Response Plan
Cameron County, Texas
Managing Beach Erosion

Develop effective shoreline management strategies for the general safety and welfare of the beach-going public and coastal property owners, and to reduce costs resulting from storm damage to public infrastructure and private property.

For the Cameron County Erosion Response Plan (ERP), Gulf beaches and dunes are divided into three zones:

- **Zone 1 - Bosa Chica Beach**: The beach and dune area includes Isla Blanca Park and the beach south of Bosa Santiago Pass to the Rio Grande, where there is limited pressure for residential development. This zone has a long-term erosion rate of approximately 3 feet per year. It also is the site of the planned Space X launch facility.

- **Zone 2 - Park Road 100**: The beach and dune area north of the City of South Padre Island to the end of Park Road 100, a distance of approximately 6.4 miles. This zone has a long-term erosion rate of about 10 feet per year and is the area most likely to be developed in accordance with shoreline management strategies set forth in the ERP.

- **Zone 3 - North Beaches**: The beach and dune area north of the end of Park Road 100 to the County line. This area experiences long-term erosion rates of approximately 12 feet per year and has no utilities or road access. This is the highest risk shoreline in the county and will likely be the most costly to manage. Zone 3 is suitable for beach driving.

Management Goals

1. Ensure public beach access and respect private property rights within the context of established shoreline management strategies aimed at coastal resilience, economic feasibility, and public safety.

2. Use form and location of natural features for coastal resilience design.

3. Develop beach and shoreline management strategies based on long-term survey data.

4. Establish a Dune Conservation Zone for storm protection and beach erosion management.

5. Establish vegetated dune systems, consistent with existing natural dunes, to enhance sand trapping and exchange between dune, beach, and nearshore environments.

6. Reduce risk through erosion management planning.
Approach

Cameron County seeks to acquire the Dune Conservation Zone.

Dune conservation and management are critical components of the Cameron County ERP because sand exchange between the beach-dune system impacts long-term shoreline response, storm damages, and land use practices. Unvegetated and low lying washover channels are common and wind-blown sand transport is substantial. These conditions lead to sand loss, greater beach erosion and inland flooding.

The County seeks to protect existing dunes and enhance the dune system to create a consistent vegetated and elevated dune in Zone 2. The recommended dune design is to provide storm protection to inland property and infrastructure from a 100-yr storm event.
1) Continue coordinated efforts between Cameron County and the City of South Padre Island to beneficially use sand removed from Bracken-Santiago Pass for preserving and restoring beaches.

2) Implement shoreline management strategies that enhance coastal resilience.
   - Establish dune systems consistent with resilient natural dunes, and implement dune strategies to maximize sand trapping (e.g., vegetative planting and sand fencing).
   - Establish sand management strategies to reduce long-term beach erosion rates (e.g., beach restoration).

3) Establish a Dune Conservation Zone north of the City of South Padre Island.
   - Provide a beach erosion risk buffer between public beach and private development, consistent with the existing natural dune systems.
   - Work with private property owners and regulators to establish construction exceptions that will not jeopardize the integrity of erosion management strategies aimed at reducing risk.

4) Relocate Park Road 100 to improve coastal resilience.
   - PR 100 is at high risk and maintenance costs are substantial due to close proximity to the active beach/dune system, with windblown sand transport and dune migration across the road.
   - The shoreline fronting the road erodes at a rate of approximately 10 feet per year. Present road alignment is vulnerable to flooding during storms, even storms that do not make landfall in South Texas.
   - Location of Park Road 100 interferes with erosion management strategies where the Dune Conservation Zone is on or in close proximity to the road/causeway footprint, magnifying infrastructure risk concerns.

5) Preserve and enhance public access
   - Acquire new access ways, spaced ¼ to ½ mile apart
   - 88 to 100 off-beach parking spaces per access
   - Create dune walkovers
   - Phased implementation - convert Zone 2 to a pedestrian beach as public access points are acquired and improved
The Future of Cameron County’s Barrier Island Shoreline
Special Opportunities, Risks, and Need for Pro-active Partnerships

“By working together as a region combining and coordinating local, state and federal resources, we will directly address ongoing threats to the Texas coast for future generations.”
- George P. Bush, Texas Land Commissioner

Development of a comprehensive and stakeholder-driven BMP can provide the basis for long-term sustainable resource use and protection. Given the strategic importance and intrinsic appeal of living along the Texas coastline, local, state, and federal government entities should continue to invest in restoration and protection plans with the aim of reducing long-term environmental impacts while continuing an appropriate level of economic sustainability. However, in practice, many of these coastal zone activities have resulted in greater shoreline vulnerability and less resilience due to lack of a unified vision and uncoordinated efforts related to planning and management of sediment resources.

Our situation in Cameron County is unique. Our barrier island beaches include the longest privately held and undeveloped Gulf shoreline in Texas. This shoreline presents tremendous opportunities for public use and future development, but these same beaches are eroding at more than 10 feet per year, one of the highest rates in the state. Along with other coastal communities, the Cameron County shoreline encapsulates the great risks and opportunities for future development on barrier islands.

Cameron County is ready to work with you – our State and Federal partners – to accomplish these critical goals if we are to responsibly realize the promise of our coast.
Appendix B – Shoreline Methodology

Six outer coast shoreline datasets were used for documenting historical shoreline change for the Cameron County coast between the Rio Grande (south) and Mansfield Pass (north) for the period 1854/67/80 to 2014. Shoreline change was quantified for four time periods specific to natural processes and engineering activities influencing the magnitude and direction of change.

### Shoreline source data characteristics.

<table>
<thead>
<tr>
<th>Date</th>
<th>Data Source</th>
<th>Comments and Map Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1854/67/80</td>
<td>USC&amp;GS Topographic Maps; 1:20,000</td>
<td>First regional shoreline survey throughout study area using standard planetable surveying techniques; 1854 - Rio Grande to Brazos Santiago (T-453); 1867 - Brazos Santiago entrance northward (T-1045), 1880 - Padre Island (T-1476a, T-1476b, T-1477a, T-1477b).</td>
</tr>
<tr>
<td>June 1939</td>
<td>USC&amp;GS Topographic Maps; 1:10,000, 1:20,000 (all others)</td>
<td>Second regional shoreline survey throughout study area using standard planetable surveying techniques; June 1939 - Rio Grande to Boca Chica (T-6704b), Brazos Santiago (T-6707), Padre Island (T-6706a, T-6705b, T-6705a, T-6704b).</td>
</tr>
<tr>
<td>February 1995</td>
<td>Aerial Imagery; 1-meter resolution</td>
<td>Digital Ortho Quarter Quads (DOQQs) interpreted by Applied Coastal; February 1995 - Rio Grande to Padre Island.</td>
</tr>
</tbody>
</table>

The first four surveys were compiled by the U.S. Coast & Geodetic Survey (USC&GS; presently the National Ocean Service [NOS]) in 1854, 1867, 1880, and 1939. The 1995 shoreline was interpreted from Digital Ortho Quarter Quads (DOQQs), and the 2014 shoreline was derived from National Agriculture Imagery Program (NAIP) high-resolution orthoimagery. Digital shoreline data for 1854/67/80 and 1939 were compiled at Applied Coastal from scanned USC&GS topographic sheets using techniques described in Byrnes and Baker (2003) and Baker and Byrnes (2004). The 1995 and 2014 shorelines were delineated as the interpreted high-water shoreline (wet/dry line) from imagery. The high-water shoreline is recognized as the landward limit of wave runup at the time of local high tide. Finally, utilizing techniques described by Byrnes et al. (1991)
and Byrnes et al. (2012), a computer-based shoreline mapping methodology, within a GIS framework, was used to compile and analyze changes.

**References**


Appendix C – Properties Potentially Affected by Building setback line

A preliminary review was conducted to determine what properties may be affected by the building setback line. The results of that preliminary review are summarized below.

<table>
<thead>
<tr>
<th>ERP Parcel Categories</th>
<th># of Parcels</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Setback Line &amp; Buffer Zone Impacts</td>
<td>Only Impacted by the BSL</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>Only Impacted by the Buffer Zone</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Impacted by Buffer Zone &amp; BSL</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>153</td>
</tr>
<tr>
<td>Orientation of Parcels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Parcels &gt;25' landward of buffer</td>
<td>56</td>
<td>31%</td>
</tr>
<tr>
<td>Parcels wholly outside buffer</td>
<td>25</td>
<td>14%</td>
</tr>
<tr>
<td>Parcels within buffer &amp; BSL</td>
<td>13</td>
<td>7%</td>
</tr>
<tr>
<td>Parcels wholly seaward of BSL</td>
<td>84</td>
<td>47%</td>
</tr>
<tr>
<td>Total</td>
<td>178</td>
<td>100%</td>
</tr>
</tbody>
</table>

CONCLUSION: There are a total of 81 parcels (45%) that are partially affected by the buffer and building setback line in place.

All measures are approximate; based on Cameron County appraisal parcels displayed in Google Earth.
Appendix D – Coastal Cameron County Regional Coastal Setting

Cameron County is the southernmost county of Texas. The County coastline is approximately 35 miles (mi) long, bordered to the north at the Willacy County line, to the west by the Laguna Madre estuary, and to the south by the Rio Grande River outlet/Mexican border (Figure 4). The county coastline divides into two sections at the Brazos Santiago Pass (BSP) jetties; an inlet between the Gulf of Mexico and the lower Laguna Madre allowing ship traffic to access the Gulf Intracoastal Waterway and Brownsville Ship Channel. Within the southern portion of Cameron County lies the City of South Padre Island (SPI), a low lying and relatively narrow barrier island community that extends approximately 6 mile north of Isla Blanc Park. South of Isla Blanca, the County extends for approximately 8 mile terminating at the ocean outlet of the Rio Grande.

This ERP is primarily focused on two undeveloped areas of Cameron County: the shoreline 8 miles south of Isla Blanc Park, just north of BRAZOS SANTIAGO PASS (Zone 1) and a 20 mile portion north of SPI within its Extra-Territorial Jurisdiction (ETJ) (Zones 2 & 3) (Figure 4). These geographical delineations for the ERP stem from the fact that SPI has an approved ERP, and thus recommendations for the Cameron County ERP will not include that area. The SPI ERP was adopted and implemented in 2012, and addresses erosion and storm risks within the current city limits, excluding the undeveloped areas in the ETJ.
The Texas coast encompasses four major climatic zones. Cameron County is located in the subtropical, semi-arid climate zone (Figure 1). This part of the Texas coast receives less rainfall and has experienced prolonged droughts that have affected the growth/development and viability of coastal vegetation that help hold sand in place within the beach-dune system. Climatic diversity controls regional variations in net annual precipitation. Average annual rainfall minus potential evapotranspiration reveals the more humid northeast portions have +12 inches/year (in/yr) in contrast to the semiarid south of -28 in/yr (Fisher et al. 1972).
The project area originated from sediments eroded from the Rio Grande Delta roughly 3,400 to 1,900 years before present (Brown and Hartmann 1980). Reworked by waves and currents, sediments formed offshore bars that coalesced and transgressed landward. Eventually these shoals attached and formed a peninsula emanating from the Rio Grande deltaic headland. As sea-level rose, the area landward of the mainland beach ridge became submerged, subsequently forming Laguna Madre. Morphological and sedimentological evidence suggest that the Gulf shoreline was at one time (modern Holocene ~ 11,000 years ago to present) approximately 15 to 25 miles seaward of its current position (Price 1954; Morton and Winkler 1979). Historically, sediment on South Padre Island was largely supplied from the Rio Grande River Delta, but reductions in flow and reservoir damming since the turn of the century, have led to a substantial loss of sediment to Brazos and South Padre Islands (Morton and Pieper 1975; Mathewson and Minter 1976).

The modern barrier islands consist of a thin sand wedge, approximately 9 to 15 feet (ft) thick (not including dunes), and its deposits extend to a depth of 9 ft below sea level (Morton 1994). Island sediment is composed of well-sorted, mostly fine-grained quartz sand. Grain sizes range from fine
to very fine sand (Kraus et al. 1996), with a slight tendency for increased grain size from south to north. Mean grain size is approximately 0.2 millimeters (mm). The coast is characterized as microtidal, with a mean tidal range of 1.5 ft, and relative sea-level rise is 3.66 mm/yr (0.012 ft/yr) (Gibeaut and Tremblay 2003).

Strong southeasterly winds and waves in the summer result in a predominately-northerly littoral drift direction. With the exception of extreme storms, the events with largest transport potential occur through fall and winter in response to frontal storms that tend to be accompanied by a storm surge (Houser and Mathew 2011). Storm surge associated with these events floods the broad sand flats along the northernmost part of the coast, causing considerable alongshore variations in dune height and width resulting in a beach that is prone to overwash. For example, at least 60 overwash channels were opened during successive hurricanes in 1933, and an equal number were reported following hurricanes Beulah and Allen (USACE 1981).

1.1. Dominant Coastal Processes

Understanding long-term evolution of coastal systems requires a regional assessment of dominant coastal processes, including winds, waves, and wave-generated currents, all of which affect local sediment transport magnitude and direction. Episodic events, such as hurricanes and storms, result in greatest changes in water levels, winds, and waves, causing large-scale changes along barrier island beach and dune systems. Even though storms are short in duration, they tend to be the dominant physical process producing sediment transport along the vast majority of coasts (Mathewson 2001).

1.1.1. Wind

Sand movement by wind is dependent on wind speed, direction, duration, and sediment particle size. Research on the effect of wind speed on sediment transport indicates that sand grains begin to move when wind speed reaches a certain threshold (Bagnold 1954; Belly 1964). This threshold speed varies with the sediment grain size because larger amounts of energy are required to move larger sediment particles. Bagnold (1954) indicated that the basic threshold value for the initiation of sand movement by wind is approximately 14 feet per second (fps), or about 10 miles per hour (mph). Predominant southeast winds for the Cameron County coast have an average speed of 5.3 meters per second (mps) or about 12 mph (Del Angel 2012). The southeastern quadrant of the wind rose depicts speeds of 10 to 20 mph occurring approximately 50 percent of the time (Figure 5). In spring and summer months, wind direction is almost exclusively from the southeast, and in winter months, winds become bimodal with a large frequency of wind approaching from the north-northwest. Relatively mild southeasterly winds are dominant in frequency, while intense northerly winds are dominant in velocity (Mathewson 2001).
Sand movement occurs as wind transfers momentum to sand particles, resulting in suspension, saltation, or creep (Figure 4). Saltation is the predominant form of transport, accounting for 75 to 80 percent of the total weight of sand moving past a fixed point per second (Bagnold 1941).
Another important factor affecting wind transport is the sand moisture content. Moisture on the beach is caused by elevated tide levels, precipitation, and low evaporation. Moisture makes sediment more cohesive and may increase the threshold wind velocity necessary to initiate saltation.

1.1.2. Waves

Prevailing southeast and less frequent north/northwest wind directions initiate sediment movement (littoral drift) by a current produced by waves breaking at an angle to the shoreline and moving adjacent to the shoreline within the surf zone (Figure 5). Changes in wave crest angles are responsible for the bi-directional movement of alongshore sediment (Figure 6).
Waves approaching from southeast induces a littoral current that results in...

Figure 5 Waves approaching from southeast induces a littoral current that results in...

Figure 6 Waves approaching from the southeast and northeast, which in turn move sediment in those directions along the beach (Weise and White 1980).
The predominate wave approach angle for the Cameron County outer coast is from the southeast (Figure 6). Significant wave height is approximately 5 feet, and mean-peak wave period is 6.8 seconds (sec). Average monthly wave height is greater in the winter months (December and January) at 5.6 feet and lowest in July, August, and September at 3.9, 4.3, and 3.9 feet, respectively (Kraus et al. 1996). Estimates of net longshore sediment transport rates at SPI range from 100,000 to 150,000 cubic yards per year (cy/yr) northward (Heilman and Kraus 1996). South of SPI at the Rio Grande River mouth, net sediment transport rates have been estimated from numerical modeling to be approximately 75,000 cy/yr northward (Tschirky and Shelden 2003).

1.1.3. Storms

Barrier islands are typically the first land feature in the path of storm surge. Where a well-developed foredune exists, the barrier helps to block surge and dissipate large amounts of wave and current energy (Weise and White 1980). Although wave action is the dominant coastal process in the area, catastrophic storms (primarily hurricanes) play an important role in nearshore sedimentation. Normal, day-to-day physical processes along the Cameron County coast are relatively low energy. The areas low-tidal amplitude (1.5 feet) and broad, low gradient continental
shelf serves to dissipate much incident wave energy. In this environment, storm related processes are usually dominant. The Cameron County coast is affected by two types of storms: extratropical cold fronts ("northers") and tropical cyclones (tropical storms and hurricanes; Figure 8). Tropical storms (max sustained winds over 39 mph) have a recurrence interval of 8.3 year, and hurricanes (max sustained winds of over 74 mph) have a shorter recurrence interval of 6.2 year.

The historical tropical cyclone season extends from June 1st through November 30th. Most hurricanes impacting the Texas coast originate in the Caribbean Sea or Gulf of Mexico (Weise and White 1980). In the northern hemisphere, hurricane counterclockwise rotation develops a larger storm surge on its right side as it approaches the coastline.

Storm surge and wave heights are affected by the configuration and bathymetry of the ocean bottom. Storm surge along the lower Texas coast is normally much lower than along the upper Texas coast due to a wider continental shelf along the northern coast (Figure 9). Storm surge from Hurricane Allen was 8 to 12 feet for the southern coast instead of 15 to 20 feet that would have occurred to the north. Elevation differences exist because in deeper water, surge can be dispersed down and away from the shoreline. However, upon entering a shallow, gently sloping shelf, storm surge cannot be dispersed, but is driven ashore by hurricane wind stresses (Figure 10).

Figure 8 Tropical Storms and Hurricanes (44) with 25 hurricanes and 19 Tropical Storms. (https://coast.noaa.gov/hurricanes/)
Figure 9 Visual approximations showing the differences in width of the Continental shelf—northern vs southern Texas coast. [http://en.wikipedia.org/wiki/Storm_surge](http://en.wikipedia.org/wiki/Storm_surge)

Figure 10 Illustration of how coastal depth impacts storm surge (Williams and AMS Weather Book, American Meteorological Society, 2009).
An examination of hurricane pathways in the Gulf shows that most enter and/or track from the southeast, and curve north and northeast through eastern and central portions of Texas or strike the lower coastline on a more westward track. Ten major storms since 1960 that followed a westward track were Carla (1961), Beulah (1967), Celia (1970), Caroline (1975), Amelia (1978), Allen (1980), Arlene (1993), Bret (1999), Emily (2005), and Dolly (2008) (Table 1 and Figure 13). Hurricanes Allen and Beulah had the highest storm surge recorded for this area reaching approximately 8 feet and 20 feet respectively (Roth 2000), with peak wave heights of over 24 feet (Kraus et al. 1996). These two storms resulted in over 70 overwash channels. Tide gauge data indicate a time lag of some 14 hours on the rising storm tide between the Gulf of Mexico and south Laguna Madre. This time lag set up a cross-barrier water level differential of up to 5 feet (Suter et al. 1982).

<table>
<thead>
<tr>
<th>Date</th>
<th>Storm Name</th>
<th>Category at Landfall</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 1961</td>
<td>Carla</td>
<td>Hurricane - 4</td>
</tr>
<tr>
<td>September 1967</td>
<td>*Beulah</td>
<td>Hurricane - 5</td>
</tr>
<tr>
<td>August 1970</td>
<td>Celia</td>
<td>Hurricane - 3</td>
</tr>
<tr>
<td>August 1975</td>
<td>Caroline</td>
<td>Hurricane - 3</td>
</tr>
<tr>
<td>July 1978</td>
<td>Amelia</td>
<td>Tropical Storm</td>
</tr>
<tr>
<td>August 1980</td>
<td>*Allen</td>
<td>Hurricane - 3</td>
</tr>
<tr>
<td>June 1993</td>
<td>Arlene</td>
<td>Tropical Storm</td>
</tr>
<tr>
<td>August 1999</td>
<td>*Bret</td>
<td>Hurricane - 4</td>
</tr>
<tr>
<td>July 2005</td>
<td>Emily</td>
<td>Hurricane - 3</td>
</tr>
<tr>
<td>July 2008</td>
<td>*Dolly</td>
<td>Hurricane - 1</td>
</tr>
</tbody>
</table>

*directly impacted Padre Island
Northers are extratropical mid- to high-latitude winter storms driven by masses of cold Arctic air that generally travel from west to east. These storm fronts can occur about every week to ten days from November through April (Morton 2003). Northers cause rapid changes in water levels and associated wave erosion. Preceding passage of a cold front, strong onshore winds elevate nearshore waves and coastal water levels, flooding beaches and exposing the coast to strong wave attack. As the front passes the coast, strong winds are directed offshore driving water back across the backbarrier flats towards the ocean. Frequent oscillation in water levels and waves results in shoreline change on both sides of the barrier island. In general, these winter storms cause much less land loss and/or property damage than do hurricanes.

The Cameron County shoreline exemplifies a typical wave–dominated, microtidal coast that experiences dramatic morphological changes resulting from tropical storms. Low-frequency, high-energy events intensify physical processes surpassing normal sediment transport thresholds, thus accelerating coastal change. During major storms, the surf zone widens, wave heights increase, longshore currents accelerate, and sediment transport significantly increases along the shoreface (Morton 1981; Snedden et al. 1988).

Douglas 1985, through numerical modeling attempted to quantify the influence of storms (both tropical and extratropical) on longshore sediment transport in the vicinity of Ocean City, Maryland. His results showed that approximately 50 percent of total longshore sediment transport occurs for 5 percent of the record, and 90 percent of the transport occurs during 35 percent of the days (Figure 12). These data results are relative to the ERP study area, and emphasize how a few storm events account for large-scale magnitudes of sediment movement and redistribution in a relatively short period of time.
1.2. Coastal Dunes

Coastal dunes are elevated features along the backshore portion of a beach and are part of the sand sharing system that actively exchanges sand between the dune, the beach, and offshore bars (Figure 13). Understanding natural processes that influence creation of coastal dunes, the interaction of dunes with the beach, and their relationship with the coastal sediment budget, guide recommendations for dune management strategies.

Figure 12 The influence of storms (both tropical and extratropical) on longshore sediment transport, from hindcast data (Douglas 1985).

Figure 13 Exchange of sand within the sand-sharing system (Psuty 2008).
1.2.1. Dune Morphology

Coastal dunes are windblown features inland of a beach and are sites of sand accumulation and storage. Dune formation and migration depends on the transfer of sand between beach and dune systems. Dunes exist because more sand deposits at their locations by wind and wave processes than is removed (Psuty 2008).

Under storm conditions (onshore winds), short, steep, erosional waves move sand from the beach and the dune to an offshore bar (Figure 14). Beach erosion and deposition of sand offshore creates a wide shallow platform, that helps dissipate increased wave energy. This often results in a loss of dune sediment. Under such conditions, raised water levels and increased wave heights may cause a breach and/or overwash of the dune. Sediment is deposited in the form of washover fans, which are considered temporary storage areas from which sediment is eventually redistributed by wind to the dunes (Figure 15) (Fisher and Stauble 1978).

After storm passage, more gentle waves gradually return eroded sand from offshore back to the beach. Dune recovery depends on beach recovery through the onshore migration of sand (Figure 19), followed by accretion on the backshore by wind transport to create a new dune or add to an existing dune system (Figure 17) (Morton 1994; Aagaard et al. 2004).

Figure 14 Storm profile (http://www.dunestrust.org.nz/dune-restoration/how-dunes-work/).
**Figure 15** Diagram showing plan view of a washover fan. (McGowan and Scott 1975).

**Figure 16** Post storm profile-Beach Recovery (http://www.dunestrust.org.nz/dune-restoration/how-dunes-work/).
Dune morphology on a storm-dominated, eroding barrier island (e.g., Cameron County) is highly influenced by the frequency and recovery from storm events. A conceptual model developed by Ritchie and Penland (1988) for Louisiana barrier islands relates storm return period to a beach-dune sediment budget (Figure 18). After a storm event, the beach and dune recover volumetrically and morphologically with the aid of re-established vegetation. Beach and dune recovery continues until the occurrence of the next storm event (Del Angel 2012). The hurricane return period for SPI is approximately 6 years.
1.2.2. Dune Topography

The regions semi-arid climate plays an important role in dune topography along the coast (Figure 2). Prolonged droughts affect the growth/development and viability of vegetation that help hold sand in place within the beach-dune system. Vegetation type and percent cover directly affects dune morphology by influencing the location and pattern of sand deposition. The percentage of vegetation varies with seasonal precipitation, ranging from 30-75 percent (Del Angel 2012). Two primary types of dunes exist within Cameron County. The first type are stable foredune clusters up to 25 feet high, moderately well-vegetated but discontinuous because overwash channels create wide breaks in the dunes. Theses hummocky dunes occur in oval shaped clusters that form the highest barrier elevations (Morton 1993) (Figure 19). These stable clusters of dunes also constrict storm floodwaters that flow through adjacent overwash channels. The second dune type contains low (3 to 15 feet high) crescent-shaped features that are sparsely vegetated to unvegetated and migrate to the north-northwest by predominate southeasterly winds. These small coppice dunes of unstable sand near the shoreline are relatively undeveloped, having accumulated since the last major storm (Morton 1993).
1.3. Historical Shoreline Change

Six outer coast shoreline datasets were used for documenting historical shoreline change for the Cameron County coast between the Rio Grande (south) and Mansfield Pass (north) for the period 1854/67/80 to 2014 (Table 2). Shoreline change was quantified for four time periods specific to natural processes and engineering activities influencing the magnitude and direction of change. The shoreline change methodology is described in Appendix B.
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</tr>
<tr>
<td>June 1939</td>
<td>USC&amp;GS Topographic Maps; 1:10,000 (T-6707), 1:20,000 (all others)</td>
<td>Second regional shoreline survey throughout study area using standard planetable surveying techniques; June 1939 - Rio Grande to Boca Chica (T-6704b), Brazos Santiago (T-6707), Padre Island (T-6706a, T-6705b, T-6705a, T-6704b).</td>
</tr>
<tr>
<td>February 1995</td>
<td>Aerial Photography; 1 meter resolution</td>
<td>Digital Ortho Quarter Quads (DOQQs) interpreted by Applied Coastal; February 1995 - Rio Grande to Padre Island.</td>
</tr>
<tr>
<td>May 2014</td>
<td>NAIP Aerial Photography; 1 meter resolution</td>
<td>National Agriculture Imagery Program (NAIP) digital ortho imagery interpreted by Applied Coastal; 4 May 2014 - Rio Grande, Brazos Santiago and South Padre Island, 15 May 2014 - Padre Island north of Long Point.</td>
</tr>
</tbody>
</table>

Each time period reflects changes in engineering activities that potentially influenced the direction and magnitude of shoreline change along the Cameron County coast. Initial shoreline surveys were conducted in 1854/67/80 followed by another regional survey in 1939 (Table 2). Although the USACE attempted to stabilize Brazos Santiago Pass and provide a navigable channel during the periods 1882 to 1884 and 1926 to 1928, the original stone dikes on either side of the entrance failed and the dredged channel was abandoned due to excessive shoaling (Sargent and Bottin 1989). Jetties on either side of the entrance channel were constructed between 1933 and 1935 and extended offshore to the 25-ft depth contour. As such, the initial shoreline change analysis period primarily reflected natural beach changes prior to significant engineering activities.

Between 1939 and 1995, sand transport on Brazos Island and SPI was directly influenced by jetty placement at Brazos Santiago Pass. Channel maintenance occurred regularly during this time, but all sand dredged from the channel was placed in offshore locations (HDR 2010). It was not until 1997 that sand dredged from the channel was placed directly on the beach. As such, the 1995 to 2014 shoreline change analysis period records beach response directly influenced by sand placement along SPI. The final analysis period (1939 to 2014) documents shoreline position changes that occurred post-jetty construction, including channel navigation activities and
beneficial use of sand dredged from the pass and placed on or seaward of Cameron County beaches.

Prior to major engineering activities influencing shoreline change along the Gulf coast of Cameron County (1800s to 1939), beaches north of Brazos Santiago Pass were strongly erosional and Brazos Island beaches were net accretional (Figure 20). In fact, greatest rates of shoreline recession were recorded just north of Brazos Santiago Pass where beach changes approximately 2 miles north of the pass peaked at about -18 ft/yr tapering off to between -7 and -10 ft/yr 8 Brazos Santiago Pass miles north of the pass to the county line. Net accretion south of the pass increased steadily toward the Rio Grande River mouth where sediment supplied to the coast was reworked and transport northward. Peak deposition north of the river mouth was greater than 15 ft/yr transitioning to slight erosion just south of the pass.

The large amount of shoreline recession just north of the entrance is not a response to jetty placement; shoreline change in this area between 1867 and 1917 illustrates substantial recession prior to jetty placement (Figure 21), and changes between 1917 and 1939 exhibit slight accretion. Further, shoreline change in this area between 1939 and 1995 (after jetty construction) documents net accretion to about three miles north of the north jetty with erosion increasing to about 10 ft/yr.
and greater at about 8 Brazos Santiago Pass miles north of the jetty to the County Line. Shoreline erosion south of the jetty mirrored accretion trends prior to 1939, indicating that damming within the Rio Grande drainage basin after 1939 had considerable influence on sediment and water availability at the coast (Paine and Morton 1989). Drought conditions in the Rio Grande, reservoir development, and water diversions for irrigation limited river flows, beginning a sharp decline in total discharge and sand supply to Gulf beaches.

Beginning in 1997, a portion of the sand dredged from Brazos Santiago Pass was placed on the developed beach north of the pass. This had substantial impact on shoreline recession rates along the beaches fronting the incorporated portion of SPI (Figure 22). Although net erosion was recorded within 2 Brazos Santiago Pass miles of the north jetty (as compared with net accretion between 1939 and 1995), beaches north of this point to the northern limit of developed beach were relatively stable with alternating zones of minor erosion and accretion. North of The Shores development to the County Line, shoreline recession rates increased substantially to -7 to -17 ft/yr. Although the peaks in shoreline recession were slightly greater at specific locations between 1995 and 2014, average recession rates appear consistent with those recorded for the 1939 to 1995 period north of the developed shoreline.

Figure 23: Historical shoreline change for at Brazos Santiago Pass between 1854/67/80 and 1995 illustrating net accretion on both sides of the pass since 1917.
Between 1939 and 2014, beach changes associated with jetty construction and placement of sand dredged from the Brazos Santiago Pass navigation channel in nearshore sites and on the beach were well illustrated adjacent to the channel and along the developed beaches of SPI. South of Brazos Santiago Pass, net deposition occurred within about 2 to 3 miles of the south jetty; however, from this point south to the Rio Grande River mouth, net shoreline recession was dominant and increased steadily toward the river mouth where peak shoreline recession rates exceeded 20 ft/yr. Beach deposition also was dominant north of Brazos Santiago Pass for about three miles during this same period, possibly due to onshore transport of sand from the pre-jetty ebb tidal shoal complex associated with the pass (Morton 1993). Net shoreline recession consistently increased to the north of this deposition zone for the length of the developed shore of SPI. North of the incorporated city of SPI, net shoreline recession remained at between 10 and 13 ft/yr to the county line. Although less variable, this trend in net shoreline recession is consistent with beach erosion trends recorded for all time periods after construction of the jetties at BSP.

1.3.1 Average Shoreline Change by Reach

Average shoreline change rates were determined for each of these reaches based on the post-jetty construction analysis periods presented in the Introduction. The purpose of this analysis was to quantify average shoreline change beach volumes for different time periods, and assist with the landward placement of a storm protection dune. The following three sections will examine shoreline change during three periods: 1939 to 1995, 1995 to 2014 when SPI began beach nourishment, and the overall time from 1939 to 2014.
1.3.1.1 - 1939 to 1995

This 56-year period encompasses numerous anthropogenic (man-made) activities that have affected beach sediment transport. Stabilization of the natural inlet with jetties in 1935, dredging of the ship channel and maintenance dredging between these jetties since 1935, reduced flow and coastal sand supply from the Rio Grande River (Paine and Morton 1989), and initiation of beneficial use of sand dredged from the Brazos Santiago Pass commenced in 1988 (HDR 2010).

Additionally, the width of the beach and dune system within the developed section of South Padre Island is limited owing to the retaining walls serving as the fixed back dune line (Caudle et al. 2014). A line of retaining walls that front most existing and developed properties were built after hurricane Beulah in 1967 (Morton 1988). Nearly all buildings along the developed coast were constructed at or seaward of the vegetation line and were equipped with low, reinforced concrete bulkheads or seawalls to protect their foundations (Figure 22) (Morton 1988). Although these protective structures potentially limit sand transport to the north under erosive storm conditions, the City of SPI has been active in maintaining a recreational beach and protective dune system seaward of the structures, providing ample sand for transport to the north.

For a distance of approximately ten miles south of Brazos Santiago Pass, Boca Chica Beach (Brazos Island) (Zone 1) recorded net deposition just south of the jetty and net shoreline recession south of this point to the Rio Grande (Figure 11). Shoreline advance adjacent to the south jetty reached about 8 ft/yr, and net shoreline recession adjacent to the Rio Grande peaked at about 25 ft/yr.

Overall, average shoreline change for Zone 1 during this period was net erosional at 5.55 ft/yr.

The Shores to Park Road 100 reach (Zone 2) illustrates a relatively consistent net erosion rate that averages approximately 10.2 ft/yr (Figure 26), a little more than a foot per year greater on average than recorded during the pre-jetty period (see Figure 23). The adjacent North Beaches reach (Zone 3) documents an average change rate of approximately -12.5 ft/yr, an increase of about 4 ft/yr erosion compared with natural changes recorded prior to 1939. Moreover, this is a 2 ft/yr higher erosion rate than the adjacent Zone 2 reach. In the middle of Zone 3, two areas of erosion are prominent with rates exceeding 15 ft/yr. This shoreline section has numerous storm-induced overwash channels and significant alongshore variability in dune crest elevations, both of which result in dune instability and greater susceptibility to storm-induced change (Houser 2013).
1.3.1.2 - **1995 to 2014**

During this 19-year period, a majority of sediment dredged from the Brazos Santiago Pass was placed on South Padre Island beaches or within a nearshore berm. Sand from the channel was placed in the nearshore berm in 1988 and placed directly on the beach beginning in 1997. From 1988 to 2014, 20 placement events (about 7.9 million cy) were completed (Table 3). Of these 20 events, 11 placed material in the nearshore berm (4.4 million cy) and 9 placed sand directly on the beach (3.5 million cy). Material placed in the nearshore berm since 1995 is approximately 3.6 million cy and includes sediment dredged from reaches of the channel containing a high percentage of silt and clay. Annual beach and nearshore surveys have not been able to document whether this material has migrated directly on to the beach (HDR 2015). However, the developed SPI shoreline has averaged stable to accretional over the last 19 years, a significant change in shoreline response for the northern half of the developed coast prior to sand placement on the beach (Figure 27).

Table 3. Dredged material placement history for South Padre Island (from HDR 2015).

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Addition of sand to the beach has reduced fluctuations in shoreline change within the SPI city limits by approximately half. Data from annual beach profile surveys between 1995 and 2015, record an average change rate of 2.33 ft/yr (HDR 2015).
The Boca Chica reach (Zone 1) is net accretional within 3 miles of the BRAZOS SANTIAGO PASS south jetty. From this point south to the Rio Grande, net shoreline recession is dominant, resulting in an average shoreline change rate of -3 ft/yr for the Boca Chica reach (Figure 27), about 2.5 ft/yr less than the 1939 to 1995 period. Average shoreline change rates in Zones 2 and 3 illustrated substantial change relative to the previous time period; however, longshore variations in beach changes were less dramatic. Average shoreline change for Zone 2 was -9.0 ft/yr, whereas average change north of Highway 100 to the county line was -10.3 ft/yr. Fairly consistent average shoreline erosion rates on undeveloped Cameron County beaches persisted since 1939, indicating that SPI sand management practices are more localized between 1995 to 2014. As sand management practices continue along the developed beach of SPI, sand may be transported north to the benefit of beaches north of The Shores.

1.3.1.3 - 1939 to 2014

Based on shoreline change results from the previous two time periods, the entire period of record, during and after engineering activities, was analyzed to establish average beach erosion trends. Although small variations in average shoreline change rates between periods was documented for
each zone, the long-term, less variable erosion record was selected to estimate average shoreline change rates for undeveloped Gulf beaches in Cameron County to establish reasonable setback distances for restricting construction and establishing dune habitat.

South of Brazos Santiago Pass (Zone 1), shoreline change rates averaged about -5.0 ft/yr with consistent accretion within 3 miles of the south jetty (Figure 28). North of the City of SPI, average shoreline change was about -9.9 ft/yr in Zone 2 and -11.9 ft/yr in Zone 3. Although short-term shoreline change rates (1995 to 2014) were slightly lower than long-term changes, all average change rates are consistent for each of the analysis periods (Table 4). The 1939 to 2014 period provides long-term shoreline change rates that encompass a wide range of event-driven processes, contain less short-term variability, and maintain average change characteristics for all periods.

![Shoreline Position Change: 1939 to 2014](image)

*Figure 25 Shoreline position changes from 1939 to 2014. Besides the location of the BRAZOS SANTIAGO PASS north jetty (0 on the graph), three reference locations denote the northern limit of the developed portion of SPI (The Shores), the northern limit of Highway 100, and the County Line.*
Table 4. Location zone and average shoreline change rates since 1939.

<table>
<thead>
<tr>
<th>Dates</th>
<th>Description</th>
<th>Location (Zone) Average Change (ft/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1*</td>
</tr>
<tr>
<td>1939-1995</td>
<td>Engineering Alterations</td>
<td>-5.55</td>
</tr>
<tr>
<td>1995-2014</td>
<td>Post Sand Management</td>
<td>-3.04</td>
</tr>
<tr>
<td>1939-2014</td>
<td>Post man-made activities</td>
<td><strong>Beach/Dune Management</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>-5</strong></td>
</tr>
</tbody>
</table>

*Does not include Isla Blanca Park
Appendix E – Construction Certificate Checklist and Additional Requirements for Exemption Petition for Construction Seaward of the Building Setback Line

Construction Certificate Checklist
1) Copy of Application for a Beachfront Construction Certificate & Dune Protection Permit

2) Detailed Site Plan
   - Show all proposed improvements, proposed dune alternations, and pre-construction and post-construction dune contours at 1-foot intervals, and the projected shoreline position
   - The surveyed Line of Vegetation subject to review and approval by the Land Office;
   - The surveyed line of mean higher high water (MHHW)
   - The surveyed location of the building setback line and buffer area as defined herein
   - The future projected shoreline position at 10, 20, 30 and 50 years from the year of the application, based on multiplying the erosion rate for the parcel times the number of applicable years covering an area of at least 1,000 feet on either side of the parcel and including the parcel
   - One-foot dune elevation contours within the parcel and within the area of construction impact
   - The extent of vegetative cover expressed as a percentage of the area or sub-area and in square footage, (documented by color photos and the survey) on the parcel and within the area of construction impact
   - Complete calculation of all impacts to dune volume (cubic yards) and dune vegetation (square footage) of the project

3) Dune Mitigation Plan
   - Mitigation for damage to dune volume and vegetation shall comply with all applicable standards in the Cameron County Beach Access & Dune Protection Plan, the Land Office Beach/Dune rules, (Texas Administrative Code, Title 31, § 15.4(f)), and this ERP.
   - Dune plant mitigation shall be strictly limited to native dune plants
   - All dune volume impacted, displaced or disturbed by the proposed construction must be used for mitigation and dune restoration seaward of the building setback line and shall not be used for construction fill or any other purpose
   - Ensure mitigation of all impacts to dune volume and dune vegetation will be completed seaward of the building setback line
   - Survey of the proposed mitigation area prior to modification
   - Dune mitigation volume in cubic yards at a ratio of 1:1 of impact
   - Dune vegetation area in square feet at a ratio of 1:1 of impact
   - Proposed post-mitigation dune shape, location, height, width and contours
square proposed dune planting plan including the plant species to be installed on at least one foot on center, the plant source and location within the dune mitigation area, and the location and design of sand fencing, if applicable

square Where a Dune Mitigation Plan is required, the applicant shall provide the contact information and addresses for all landowners immediately adjacent to the tract and affirmation that the adjacent landowners will be provided with notice of the County Commissioners Court hearing at least 10 days prior to the hearing on the Application and Petition.

Additional Requirements for Exemption Petition for Construction Seaward of the Building Setback Line

5. For projects where the County is considering authorizing an exemption from the prohibition on construction seaward of the building setback line, the Petition and Application materials for construction must demonstrate that the conditions below will be met:

a. Sealed Plans. Plans and certifications for the structure shall be sealed by a registered professional engineer licensed in the State of Texas, providing evidence of the following:
   i. A minimum of two-foot freeboard above FEMA’s BFE to the finished floor elevation of the lowest habitable floor;
   ii. No enclosures below BFE;
   iii. Consistency with the latest edition of specifications outlined in American Society of Civil Engineers, Structural Engineering Institute, Flood Resistant Design and Construction, ASCE 24-05;
   iv. Feasible relocation of any habitable structure; and
   v. All construction shall be designed to minimize impacts to natural hydrology.

b. Location of all construction should be landward of the landward toe of the foredune ridge and as far landward as practicable.

c. The proposed development shall also comply with the current floodplain regulations in the County.

d. The structure must be elevated on pilings; slab on grade construction is prohibited;

e. The proposed construction must strictly comply with the requirements of the Cameron County ERP and Beach Access & Dune Protection Plan and the Land Office’s Beach/Dune rules set forth in Title 31, Texas Administrative Code § 15;

f. The use of concrete or asphalt is prohibited under the footprint of the structure and for the construction of a driveway, parking area or road.
g. In the area seaward of 230 feet from the line of vegetation, all roads, driveways, sidewalks and pathways shall be pervious and constructed with brick pavers, crushed limestone, gravel, or Truegrid pavers.

h. The applicant will be allowed to place unreinforced fibercrete in 4-foot by 4-foot sections, 4 inches thick, separated by expansion joints, beneath the footprint of the habitable structure, not including the area under decks, only if the fibercrete is not structurally attached to the pilings and placement of fibercrete will be entirely undertaken, constructed, and located at least 25 feet from the landward toe of the foredunes. If no dunes exist, placement of fibercrete may only be undertaken, constructed, and located at least 100 feet landward of the line of vegetation, or landward of the building setback line, whichever distance is greater.

i. Construction outside the perimeter of a habitable structure using concrete or other impervious surface with an area that does not exceed 5.0% of the footprint of the habitable structure may be authorized. Concrete curbs may be permitted as part of the 5.0% to preserve the integrity of permeable pavers. Curbs shall not be wider than 6 inches or more than 10 inches high/deep; limited concrete pads may also be permitted as part of the 5.0% if required for utilities, and they should be limited to the minimum dimensions required to meet applicable building codes.

j. Mitigation for damage to dune volume and vegetation shall comply with all applicable standards in the Cameron County Beach Access & Dune Protection Plan, the Land Office Beach/Dune rules, (Texas Administrative Code, Title 31, § 15.4(f)), and this ERP. Mitigation impact analysis shall be further calculated and conducted as follows:

v. Dune volume mitigation shall be provided for all dune volume impacted;

vi. Dune plant mitigation shall be strictly limited to native dune plants;

vii. All dune impacts shall be mitigated on-site to the greatest extent practicable and all mitigation of dune volume and vegetation must occur seaward of the building setback line, even if off-site;

viii. All dune volume impacted, displaced or disturbed by the proposed construction must be used for mitigation and dune restoration seaward of the building setback line and shall not be used for construction fill or any other purpose;

Notwithstanding any other provisions, no seawalls, retaining walls, geo-tubes, clay-core dunes, or other structural shore protection projects or shoreline armoring structures may be constructed anywhere seaward of the building setback line.

k. The site-specific erosion rates seaward of the parcel and at least 1,000 feet on either side of the parcel based on published data from the UT Bureau of Economic Geology;
1. A detailed site plan showing all proposed improvements, proposed dune alternations, and pre-construction and post-construction dune contours at 1-foot intervals, and the projected shoreline position, including:

i. The surveyed Line of Vegetation subject to review and approval by the Land Office;

ii. The surveyed line of mean higher high water (MHHW);

iii. The surveyed location of the building setback line and buffer area as defined herein; and

iv. The future projected shoreline position at 10, 20, 30 and 50 years from the year of the application, based on multiplying the erosion rate for the parcel times the number of applicable years covering an area of at least 1,000 feet on either side of the parcel and including the parcel;

m. A detailed site plan based on a recent survey of the parcel, including the following:

i. One-foot dune elevation contours within the parcel and within the area of construction impact;

ii. The extent of vegetative cover expressed as a percentage of the area or sub-area and in square footage, (documented by color photos and the survey) on the parcel and within the area of construction impact;

iii. Complete calculation of all impacts to dune volume (cubic yards) and dune vegetation (square footage) of the project;

iv. A dune mitigation plan ensuring mitigation of all impacts to dune volume and dune vegetation will be completed seaward of the building setback line;

v. The Dune Mitigation Plan shall include:

f) a survey of the proposed mitigation area prior to modification;

g) Calculation of dune mitigation volume in cubic yards at a ratio of 1:1 of impact. Total dune volume shall be calculated starting at the elevation of the base of the dune within the area of construction impacting the dunes;

h) Dune vegetation area in square feet at a ratio of 1:1 of impact;

i) The proposed post-mitigation dune shape, location, height, width and contours;

j) The proposed dune planting plan including the plant species to be installed on at least one foot on center, the plant source and location within the dune mitigation area, and the location and design of sand fencing, if applicable;
n. An assessment of the risks to the structure, adjacent structures, utilities, and other improvements in the event of a 100-year storm event if the project is constructed as proposed and taking into account the proposed mitigation plan;

o. An assessment of the risks to the structure, adjacent structures, utilities, and other improvements due to predicted shoreline retreat determined by multiplying the erosion rate times 10 years, 20 years, 30 years and 50 years;