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2.4.6 Probable Maximum Tsunami Hazards

The following site-specific information describes the potential hazards due to the probable maximum tsunami (PMT).

This subsection examines the tsunamigenic sources and identifies the PMT that could affect the Texas Gulf Coast near VCS in an effort to assess the potential safety hazards to the station. It evaluates potential tsunamigenic source mechanisms, source parameters and tsunami propagation from published studies, and provides information on tsunami water levels expected at the site. Historical tsunami events recorded along the Texas Gulf Coast are also reviewed to support the PMT assessment.

The VCS site is located approximately 36 miles (57.6 kilometers) inland of the Gulf Coast and 4 miles (6.4 kilometers) west of the Guadalupe River. The natural ground at the site varies in elevation from approximately 60 feet (18.3 meters) to above 80 feet (24.4 meters) in North American Vertical Datum of 1988 (NAVD 88). The minimum finished site grade of the power block is elevation 95 feet (29.0 meters) NAVD 88. As the site is situated in relatively high ground and far away from any major water bodies significant to tsunami generation, tsunami events are not expected to pose any hazards to the power block structures, systems, and components at VCS.

2.4.6.1 Probable Maximum Tsunami

Tsunamis can be generated from near-field or far-field sources. Of both source types, submarine landslides and earthquakes are identified as the major tsunamigenic source mechanisms that could affect the Texas Gulf Coast near the VCS site (Reference 2.4.6-1).

The major tsunami sources from far-field landslides include submarine landslide zones along the U.S. Atlantic Margin, the Nova Scotia Margin in the eastern Canada coast northeast of the U.S. border, the Storegga landslide zone in the northern Atlantic Ocean east of Iceland, and the Puerto Rico trench (Reference 2.4.6-1). Based on the locations and mechanisms of these sources provided in Reference 2.4.6-1, submarine landslides along the U.S. Atlantic Margin, from the eastern end of the Georges Bank, New England, to the Blake Spur near the Carolina Trough, would generate the most significant tsunami that may affect the Texas Gulf Coast. Numerical model simulations of tsunami propagation show that the tsunami impact along the Atlantic Coast would be considerably reduced due to the presence of a wide continental shelf (Reference 2.4.6-1). There is currently no literature on tsunami model simulation within the Gulf of Mexico from the U.S. Atlantic Margin sources. However, because tsunami waves from these sources would be dissipated by traveling over the shallow shelf of the Florida Strait to reach the Gulf of Mexico, the tsunami amplitude at the Texas Gulf Coast would be further reduced. A similar behavior of tsunami propagation and dissipation has been reported in computer model simulations of the Puerto Rico trench earthquake-generated tsunamis (Reference 2.4.6-2).

The major tsunami sources from near-field landslides reside within the Gulf of Mexico. The Gulf of Mexico is characterized by three geologic provinces: the Carbonate, Salt, and Canyon/Fan as shown in Figure 2.4.6-1. Evidence of submarine landslides is recorded in all three geological provinces (Reference 2.4.6-1). The largest submarine failures, including that in the Bryant Canyon and Mississippi Fan, are found in the Canyon/Fan Province that were probably active 7000 years ago. The largest failure in the Salt Province is identified offshore of the Rio Grande River (Reference 2.4.6-1), as shown in Figure 2.4.6-2, in an area known as the East Breaks slump (Reference 2.4.6-3). Reference 2.4.6-1 concludes that while the evaluation of potential tsunamis from large Canyon/Fan landslides would require additional research, landslides in other areas are mainly due to salt movement and may not pose a tsunami hazard for the Gulf Coast. Quantitative information on tsunami generation from these sources is very limited. An extensive literature search reveals one conference paper that provides an estimate of the initial tsunami amplitude for the East Breaks slump landslide, which is given as 7.6 meters (24.9 feet) (Reference 2.4.6-3). Although details of the estimation method were not documented in this paper or supported by other studies, a postulated slide in the East Breaks slump is considered as a probable source candidate for the PMT at the Texas Gulf Coast due to its potential to generate high wave amplitude.

Tsunamigenic earthquake sources that may affect the Texas Gulf Coast are located mainly around the Caribbean Basin. Teletsunami sources potentially important to the Gulf Coast are located west of Gibraltar in the Azores-Gibraltar fracture zone near Portugal in the East Atlantic Ocean. Tsunami sources in the Caribbean Basin include the North Panama deformation belt, Northern South-America convergent zone (or South Carribbean Convergence), and the Puerto Rico trench as shown in Figure 2.4.6-3. The simulated peak offshore tsunami amplitude along the Gulf Coast at the 250 meter (820 foot) isobath, i.e., the shelf edge, from these sources was predicted to be no more than 0.7 meters (2.3 feet) (Figure 7-2 of Reference 2.4.6-1) using a linear long-wave model formulation. Propagation of tsunami waves across the continental shelf (water depth less than 250 meters) and runup were not modeled in the referenced study.

Generation and propagation of tsunami waves from postulated severe Caribbean earthquakes were also modeled by the West Coast and Alaska Tsunami Warning Center (WCATWC) using a two-dimensional hydrodynamic model developed at the University of Alaska, Fairbanks (Reference 2.4.6-2). From the four “worst-case” tsunami scenarios simulated, the WCATWC predicted that the peak tsunami amplitude at the Texas Gulf Coast shoreline near the VCS site would be less than 0.35 meters (1.1 feet) (Reference 2.4.6-2).

The 1755 Great Lisbon earthquake, with the epicenter in the Azores-Gibraltar fracture zone west of Gibraltar, generated the most notable historical teletsunami affecting the U.S. East Coast and the Caribbean region. Although no historical data on the U.S. East or Gulf Coast is available from this tsunami event, computer simulations indicated the tsunami amplitude in the Texas Gulf Coast to be less than 1.0 meter or 3.28 feet (Reference 2.4.6-4).

Earthquakes within the Gulf of Mexico were also recorded with epicenters located within the North American plate boundaries. Such “midplate” earthquakes are less common than earthquakes occurring on faults near plate boundaries (Reference 2.4.6-5). Severe earthquakes from this region occurring in the past 3 decades had the epicenters within the Mississippi Canyon/Fan province west of the Florida Escarpment. The most severe earthquake occurred on September 10, 2006 with an earthquake magnitude of 5.8. The second most significant earthquake in the region in recent time occurred on February 10, 2006 with a magnitude of 5.2. The United States Geological Survey (USGS) concluded that earthquakes of this magnitude are unlikely to produce any destructive tsunami (Reference 2.4.6-5).

In addition to landslide and earthquake generated tsunamis, seiches caused by seismic surface waves from the Great Alaska Earthquake of 1964 have also affected the Texas Gulf Coast. However, the magnitudes of such oscillations were small. Records of seiche occurrences in the Texas Gulf Coast from the 1964 Alaska earthquake indicate a maximum seiche double amplitude of 0.84 feet (0.26 meters) at the Rockport tide station, Texas (Reference 2.4.6-6). The Rockport tide station is located in Aransas Bay, about 26 miles southwest of San Antonio Bay in Texas.

While volcanism and volcanism-based tsunamis have been reported in the Caribbean and Canary Islands (Reference 2.4.6-7), no such tsunamis have been documented in the Gulf of Mexico. The last postulated tsunami in the Atlantic Ocean may have been associated with the eruption and lateral flank failure of the Cumbre Vieja, a volcano on the Island of La Palma in the Canary Islands, about 550,000 years ago (Reference 2.4.6-7). It is, however, not expected to cause a destructive tsunami along the east or Gulf Coast of the U.S as indicated by numerical simulation results (Reference 2.4.6-1).

Because the VCS site is not located on an open coast or a large body of water, sub-aerial slope failure is not expected to generate tsunamis that could affect the site.

Based on the preceding discussions, a near-field submarine landslide event in the East Breaks slump within the Gulf Basin is postulated to be the source mechanism for the generation of the PMT wave that would propagate to the Texas Gulf Coast, even though there has been no record of tsunamis generated from the East Breaks slump or any other landslide within the Gulf Basin. This provides a conservative assessment of the tsunami hazards at the site, as a landslide at the East Breaks slump could potentially generate tsunami water levels at the Texas Gulf Coast much higher than the water levels from a more credible far-field tsunami similar to that generated by the 1755 Great Lisbon Earthquake.

Because the site is located considerably inland and away from the Guadalupe River, the PMT flooding would affect the site only if the tsunami waves propagated upstream through the river from the Gulf of Mexico shoreline. The maximum water level associated with the PMT is discussed in Subsection 2.4.6.5.

2.4.6.2 Historical Tsunami Record

Records of historical tsunami runup events in the Texas Gulf Coast are obtained from the National Geophysical Data Center (NGDC) tsunami database. The NGDC database contains information on source events and runup elevations for worldwide tsunamis from about 2000 B.C. to the present time (Reference 2.4.6-8). A search of the NGDC tsunami database returned three historical tsunamis that have affected the Texas Gulf Coast as indicated in Table 2.4.6-1.

The first recorded tsunami event occurred on October 24, 1918, and was presumed to be caused by an aftershock of the October 11, 1918 earthquake (moment magnitude scale, M_w=7.3) near Puerto Rico (References 2.4.6-8 and 2.4.6-9). The NGDC database did not provide a runup height for this event, although it is classified as a definite tsunami event.

The second tsunami event in the Texas Gulf Coast region occurred on May 2, 1922, and is related to a small earthquake at the Island of Vieques, Puerto Rico. A tsunami runup height of 0.64 meters (2.1 feet) from a tide-gauge measurement at Galveston, Texas was reported. However, according to the NGDC database, the slight shock was unlikely to have been the tsunamigenic source. This event is classified as a doubtful tsunami in the NGDC database.

The third reported tsunami event occurred on March 27, 1964 (in Alaska Standard Time) or March 28, 1964 in Universal Coordinated Time (UCT), and was due to seismic seiche induced by the Great Alaska Earthquake (Reference 2.4.6-6), as discussed in Subsection 2.4.6.1. Although water level oscillations were recorded on several tide stations including Freeport, Texas, no runup height is provided in the NGDC database. However, other data sources indicate that the seiche double amplitudes measured at the Texas Gulf Coast tide stations are in the range of 0.22 to 0.84 feet (0.07 to 0.26 meters), and is 0.66 feet (0.2 meters) at Freeport, Texas (Reference 2.4.6-5).

Other tsunami events affecting the Gulf of Mexico region are mainly from the Caribbean sources (References 2.4.6-9 and 2.4.6-10). However, the Texas Gulf Coast remained mostly unaffected during these tsunamis. An extensive literature search did not reveal any evidence of seismic source induced paleotsunami deposit in the region.

2.4.6.3 Source Generator Characteristics

From the discussion presented above, it is postulated that the tsunami source that could produce a PMT at the Texas Gulf Coast would be a submarine landslide within the Gulf of Mexico. There is no record of tsunamis from this source. The earthquake tsunami sources in the Caribbean Basin frequently generated tsunamis in that region. However, for the Texas Gulf Coast shoreline, the postulated tsunami event due to the hypothetical landslide within the Gulf Basin would be considerably more severe than the earthquake-generated tsunamis.

The largest landslide complex that was mapped by the USGS in the Gulf Basin is in the middle and upper Mississippi Canyon/Fan province (Reference 2.4.6-1). The area of the landslide complex is estimated to be approximately 23,000 square kilometers (8880 square miles), with a maximum thickness of about 100 meters (328 feet), and a total volume of approximately 1725 cubic kilometers (414 cubic miles). However, the characteristic dimensions of the slide that may be used to generate a tsunami in the Gulf of Mexico are not available (Reference 2.4.6-1). The landslide complex is indicated to have ceased being active by mid-Holocene time.

Thirty-seven landslides were identified in the Salt province and along the base of the Sigsbee Escarpment (Figure 2.4.6-1) (Reference 2.4.6-1). The largest of these failures occurred in the northwestern Gulf of Mexico, offshore of the Rio Grande River (Figure 2.4.6-2). It was suggested to be the result of a failure of the shelf edge delta forming the river during the last sea level lowstand (Reference 2.4.6-1). The landslide complex, known as the East Breaks slump, is estimated to be 114 kilometers (71 miles) long, 53 kilometers (33 miles) wide, and covers an area of 2250 square kilometers (869 square miles) (Reference 2.4.6-1). However, no further estimates of the slide parameters were established in Reference 2.4.6-1.

Reference 2.4.6-3 characterizes the East Breaks slump to have a 20 kilometer (12.5 miles) wide head scarp at about the 180 meters (590 feet) isobath, and a slide complex area of approximately 3200 square kilometers (1236 square miles). The estimated length of the slide (erosional) is about 55 kilometers (34 miles), and the maximum thickness of the slump is about 70 meters (230 feet). The total estimated volume of the slide is about 50 to 60 cubic kilometers (12 to 14 cubic miles).

2.4.6.4 Tsunami Analysis

The maximum tsunami water level at the Texas Gulf Coast is summarized from the results of published tsunami studies. Detailed water level information for tsunamis generated by potential landslides in the Gulf of Mexico is not available. However, an inference is drawn to computer simulations of a similar landslide scenario for the Currituck slide in the U.S. Atlantic margin near Southern Virginia (Reference 2.4.6-1). Thus, detailed modeling analysis of tsunami amplitude and its propagation are not performed. This qualitative approach is considered adequate in assessing tsunami hazards at the VCS site because the site is not expected to be affected by tsunamis due to its physical location.

2.4.6.5 Tsunami Water Levels

There has been no published study that estimates tsunami wave amplitude near the Texas Gulf Coast shoreline as a result of submarine landslides within the Gulf of Mexico. Although the extent of landslides within the Gulf Basin had been mapped, there is not enough information available to characterize the landslide source mechanisms that could be used to generate tsunamis (Reference 2.4.6-1). Reference 2.4.6-3 reports initial tsunami amplitude of about 7.6 meters (24.9 feet) considering the landslide parameters summarized in Subsection 2.4.6.3 for the East Breaks slump. However, this is the only information available on tsunami generation due to landslides in the Gulf of Mexico Basin.

Reference 2.4.6-1 documents a detailed analysis of the failure mechanism of the Currituck slide, located off the southern Virginia Coast. The results indicate a slide volume between 128 and 165 cubic kilometers (31 and 40 cubic miles) with most of the acceleration phase completed within less than 10 minutes. The average water depth at the base of the slide is estimated to be about 1000 meters (3280 feet). Reference 2.4.6-1 also summarizes preliminary hydrodynamic computations used to estimate the distribution of tsunami amplitude along the nearest Virginia shoreline. The computations were performed using the Cornell University Long and Intermediate Wave Modeling Package (COULWAVE). The COULWAVE package models the propagation and runup of long and intermediate length waves, using fully nonlinear and dispersive wave theory (nonlinear Boussinesq equations). Model simulations were performed for three different geometries of the Currituck slide: down slope sub-event, up slope sub-event, and a composite of the two slide events. The initial and nearshore tsunami amplitudes were found to be the maximum for the composite slide event. Model simulation results, using a failure duration of 10 minutes and a bottom friction coefficient of 2.5×10^{-3}, indicate the maximum initial tsunami amplitude to be approximately 25 meters (82.0 feet) and tsunami amplitude of about 5 meters (16.4 feet) at the nearest shoreline, as shown in Figure 2.4.6-4. The X-axis in Figure 2.4.6-4 represents the cross-shore direction and the Y-axis represents the along-shore direction. The shoreline is represented by X = 100 kilometers in the model. The results also show that the maximum tsunami amplitude would be about 7 meters (23.0 feet) at a water depth of 22 meters (72.2 feet) at a location approximately 20 kilometers (12.5 miles) offshore (as shown in Figure 2.4.6-4(c)).

As shown in Figure 2.4.6-5, the Currituck landslide area is located approximately 100 kilometers (62.5 miles) offshore, at an average water depth of about 1000 meters (3280 feet). These dimensions are similar to the offshore distance of over 100 kilometers (62.5 miles) and average water depth of about 1000 meters (3280 feet) for the East Breaks slump landslide area (off the mouth of the Rio Grande River in the Gulf of Mexico, as indicated in Figure 2.4.6-6). The width of the shallow continental shelf is also comparable between the two locations, as seen in the figures. The similarities in bathymetric characteristics between the two locations are used to draw inferences for tsunami propagation from the East Breaks slump. The estimated slide volume (50-60 cubic kilometers) and initial tsunami amplitude (7.6 meters) of the East Breaks slump landslide are much smaller than the slide volume and initial tsunami amplitude of the Currituck slide (Reference 2.4.6-3). Accordingly, the maximum tsunami amplitude at the Texas Gulf Coast shoreline is hypothesized to be smaller than the amplitude predicted at the Virginia Coast from the Currituck slide. However, the 5 meter (16.4 feet) tsunami amplitude estimated at the shore of the Virginia Coast from the Currituck slide, as shown in Figure 2.4.6-4, is conservatively adopted to represent the PMT wave amplitude at the Texas Gulf Coast shoreline in the assessment of tsunami hazards at the VCS site.

RG 1.59 requires that the 10 percent exceedance astronomical high tide and sea level anomaly be used as the antecedent water level for the storm surge due to a probable maximum hurricane (PMH) event. The same antecedent water level condition is also used to obtain the PMT maximum water level. The 10 percent exceedance high tide at the Texas Gulf Coast shoreline near the site is estimated to be 3.4 feet (1.04 meters) NGVD 29 or about 3.0 feet (0.92 meters) NAVD 88, the average of the 10 percent exceedance high tides calculated at Freeport, Texas and at Corpus Christi, Texas using historical observed tidal records at the two stations. Additionally, the PMH event considers a long-term sea level rise of 1.8 feet (0.55 meters) for the next 100 years as described in Subsection 2.4.5. Combining the 10 percent exceedance high tide (3.0 feet) and the long-term sea level rise (1.8 feet) with the postulated conservative tsunami amplitude at the Texas Gulf Coast near the VCS site (16.4 feet), the PMT maximum water level at the shoreline is 21.2 feet (6.5 meters) NAVD 88.

The Guadalupe River near the VCS site has natural levees and wide floodplains with a maximum elevation of approximately 20 feet (6.1 meters) NAVD 88. According to the National Weather Services floodmark, a historical high water level of 33.92 feet (10.34 meters) above National Geodetic Vertical Datum of 1929 (NGVD 29) was recorded in Bloomington, Texas during the flood of October 20, 1998 (Reference 2.4.6-11). To estimate the PMT water level at the site, it is conservatively assumed that the antecedent water level in the river would be at its historical flood stage of 33.92 feet (10.34 meters) NGVD 29, which is equivalent to 33.5 feet (10.22 meters) NAVD 88, the PMT wave amplitude at the Gulf Coast shoreline would be 21.2 feet (6.5 meters), and the tsunami wave would propagate inland without any dispersion or dissipation. Thus, the maximum PMT still water level near the site would be about (33.5 + 21.2 ≈) 55.0 feet (16.8 meters) NAVD 88. The PMT still water level would be approximately 40.0 feet (12.2 meters) below the minimum finished site grade elevation of the power block of VCS. Coincident wind setup and wave runup, as presented in Subsection 2.4.5, would not affect the power block of the site. Therefore, it is concluded that the PMT event at the Texas Gulf Coast would not cause any flooding of the power block.

The PMT event could also induce a water surface drawdown at the Texas Gulf Coast shoreline. For the Virginia Coast, a maximum tsunami drawdown (trough) of about 3.5 meters (11.5 feet) at a water depth of 22 meters (72.2 feet) was reported (Reference 2.4.6-1). A similar low water condition may also be considered for the Texas Gulf Coast, similar to the tsunami amplitude estimate. Because of the presence of barrier islands (Matagorda Island) on the shoreline near the site, the drawdown water level at the shoreline would have limited effect on the water level within San Antonio Bay. Low water level in the Guadalupe River near the site is controlled by the river flow and by the regulation of the

Lower Guadalupe River Saltwater Barrier and Diversion Dam near Tivoli, Texas. The 50-foot long inflatable dam was designed to prevent salt water intrusion up the river and to maintain the pool level for the diversion of river water to the GBRA canal system (Reference 2.4.6-12). The saltwater barrier is inflated if the water level in the Guadalupe River at Tivoli falls below 4.0 feet (1.2 meters) above mean sea level or NGVD 29, which is equivalent 3.6 feet (1.1 meters) NAVD 88. Consequently, the effect of tsunami drawdown upstream of the saltwater barrier would be prevented by the operation of the barrier dam. Furthermore, because VCS does not rely on the Guadalupe River or its water supply to perform any plant safety-related function, low water levels in the river due to tsunami drawdown would not affect the safety functions of the plant.

2.4.6.6 Hydrography and Harbor or Breakwater Influences on Tsunami

The Victoria County Station is located approximately 4 miles (6.4 kilometers) west of the Guadalupe River and over 36 miles (57.6 kilometers) inland from the Gulf of Mexico shoreline. The PMT water level in the Guadalupe River near the site is conservatively assumed to be unaffected by wave dispersion or bottom friction. Therefore, the effect of hydrography of the area is conservatively considered. There is no harbor or breakwater present in the Guadalupe River near the site that may affect the PMT water level.

2.4.6.7 Effects on Safety-Related Facilities

A very conservative estimate of the PMT still water level in the Guadalupe River near the VCS site is about 55.0 feet (16.8 meters) NAVD 88. The minimum finished site grade of 95 feet (29.0 meters) NAVD 88 for the power block of the station would be much higher than this PMT water level plus the increase in water level due to coincident wind setup and wave runup as presented in Subsection 2.4.5. Because the flood level due to the postulated PMT event would be much lower than the minimum finished site grade at the power block, debris, waterborne projectiles, sediment erosion and deposition would not have adverse impacts to the safety functions of the station.

2.4.6.8 References

2.4.6-1 ten Brink, U. et al., *The Current State of Knowledge Regarding Potential Tsunami Sources Affecting U.S. Atlantic and Gulf Coasts,* USGS, September 2007.

2.4.6-2 Knight, B., *Model Prediction of Gulf and Southern Atlantic Coast Tsunami Impacts from a Distribution of Sources*, Science of Tsunami Hazards, 24(5): 304-312, 2006.

2.4.6-3 Trabant, P., Watts, P., Lettieri, F. and G. Jamieson, *East Breaks Slump, Northwest Gulf of Mexico*, Offshore Technology Conference, OTC paper 12960, 2001.

2.4.6-4 Mader, C.M., *Modeling the 1755 Lisbon Tsunami*, Science of Tsunami Hazards, 19(2): 93-98, 2001.

2.4.6-5 National Earthquake Information Center, *M 5.8 Gulf of Mexico Earthquake of 10 September 2006*, USGS, September 2006.

2.4.6-6 McGarr, A. and R.C. Vorhis, *Seismic Seiches in Bays, Channels, and Estuaries, from The Great Alaska Earthquake of 1964: Oceanography and Coastal Engineering*, ISBN 0-309-1605-3, National Academy of Sciences, Washington, D.C. 25-28, 1972.

2.4.6-7 Ward, S. N. and S. Day, *Cumbre Vieja Volcano – Potential Collapse and Tsunami at La Palma, Canary Islands,* Geophysical Research Letters, 28(17): 3397-3400, 2001.

2.4.6-8 Historical Tsunami Database, Available at http://www.ngdc.noaa.gov/seg/hazard/tsu_db.shtml, accessed February 23, 2008.

2.4.6-9 Lander, J.F., Whiteside, L.S., and P.A. Lockridge, *A Brief History of Tsunamis in the Caribbean Sea*, Science of Tsunami Hazards, 20(2): 57-94, 2002.

2.4.6-10 Lockridge, P.A., Lowell, S.W., and J. F. Lander, *Tsunamis and Tsunami-Like Waves of the Eastern United States*, Science of Tsunami Hazards, 20(3): 120-157, 2002.

2.4.6-11 USGS, 08177520 Guadalupe River near Bloomington, TX, Water-Data Report TX-2005, U.S. Geological Survey, 2007.

2.4.6-12 Guadalupe-Blanco River Authority, *Operating Manual for Diversion System Operator*, Calhoun Canal Division, File No. 20-050-03-0701, 1981 (Revised October 1994).

Table 2.4.6-1
Summary of Historical Tsunami Runup Events in the Texas Gulf Coast

Date	Time hrs	Validity Code[a]	Cause Code[b]	Source Location (lat, long)	Runup Location (lat, long)	Runup Type[c]	Runup Height meters
10/24/1918	03:43	4	1	Puerto Rico (18.5°N 67.5°W)	Galveston, Texas (29.3°N 94.783°W)	2	-
05/02/1922	20:24	2	1	Puerto Rico: Vieques (18.2°N 65.5°W)	Galveston, Texas (29.3°N 94.783°W)	2	0.64
03/28/1964	03:36	4	3	Prince William Sound, Alaska (61.1°N 147.5°W)	Freeport, Texas (28.95°N 95.35°W)	7	-

a. Tsunami Event Validity:

Valid values: 0 to 4

Validity of the actual tsunami occurrence is indicated by a numerical rating of the reports of that event:

- 0 = Erroneous entry
- 1 = Very doubtful tsunami
- 2 = Questionable tsunami
- 3 = Probable tsunami
- 4 = Definite tsunami

b. Tsunami Cause Code:

Valid values: 0 to 11

The source of the tsunami:

- 0 = Unknown Cause
- 1 = Earthquake
- 2 = Questionable Earthquake
- 3 = Earthquake and Landslide
- 4 = Volcano and Earthquake
- 5 = Volcano, Earthquake, and Landslide
- 6 = Volcano
- 7 = Volcano and Landslide
- 8 = Landslide
- 9 = Meteorological
- 10 = Explosion
- 11 = Astronomical Tide

c. Type of Runup Measurement:

Valid values: 1 to 7

- 1 = Water height measurement
- 2 = Tide-gauge measurement
- 3 = Deep ocean gauge
- 4 = Paleodeposit
- 5 = Computer Modeled
- 6 = Atmospheric Pressure Wave
- 7 = Seiche

Source: Reference 2.4.6-6

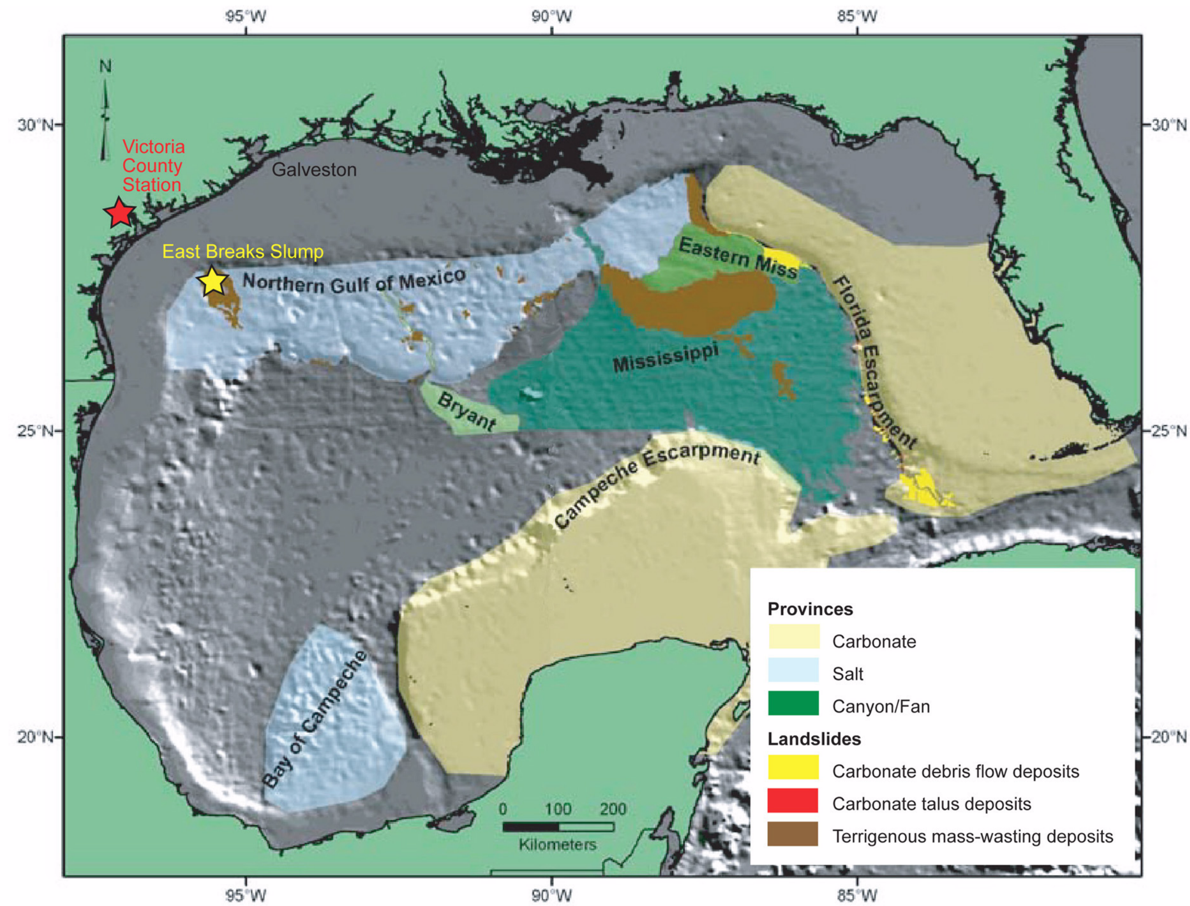


Figure 2.4.6-1 Location Map Showing the Extent of the Geological Provinces in the Gulf of Mexico Basin (Reference 2.4.6-1)

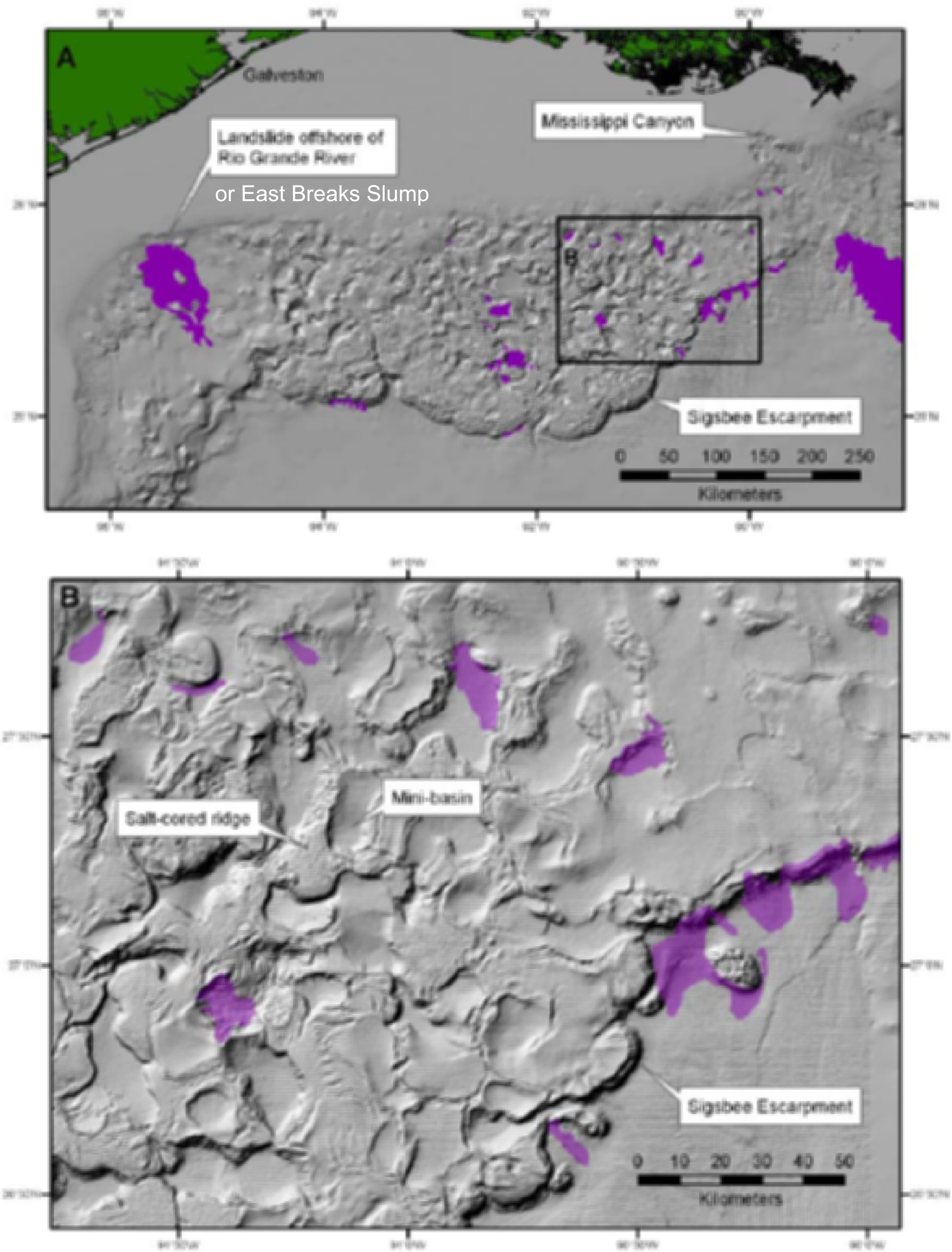


Figure 2.4.6-2 (A) Landslide Area (Purple Shade) Offshore of the Rio Grande River (East Breaks Slump) and Other Portions of the Gulf of Mexico, (B) An Enlarged View of Landslide Zones Near Sigsbee Escarpment (Reference 2.4.6-1)

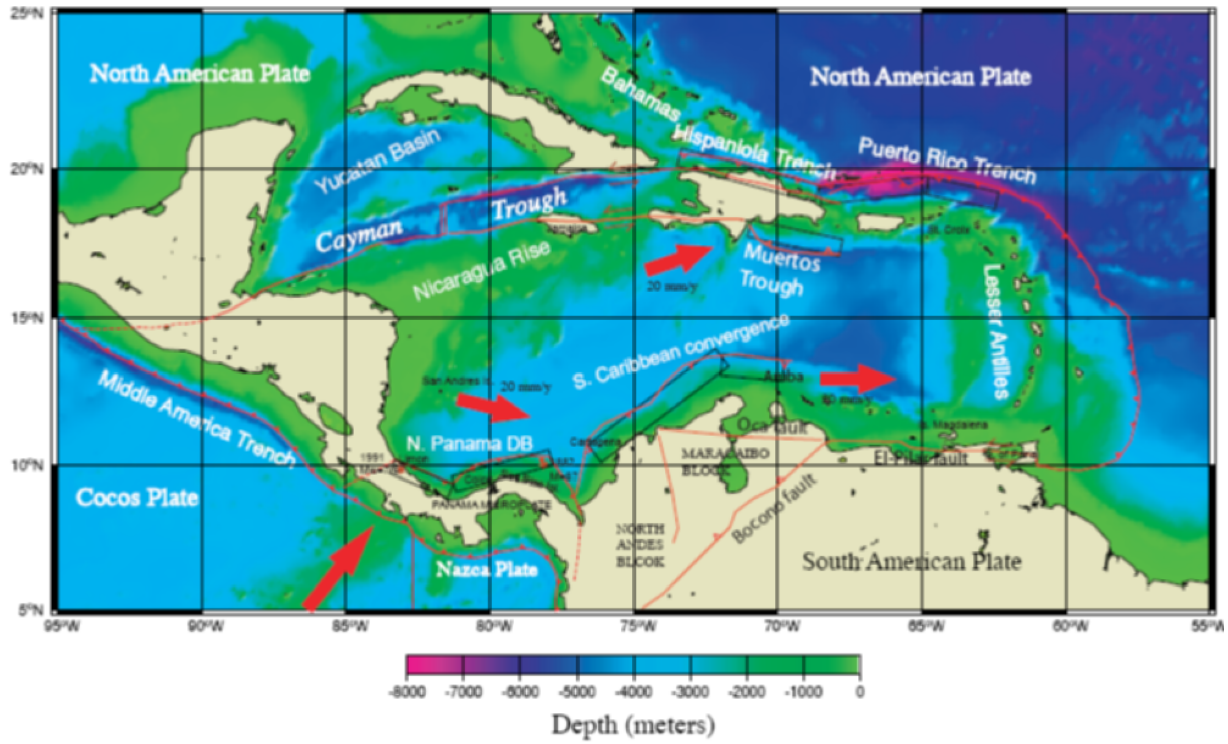


Figure 2.4.6-3 The Caribbean Plate Boundary and its Tectonic Elements (Reference 2.4.6-1)

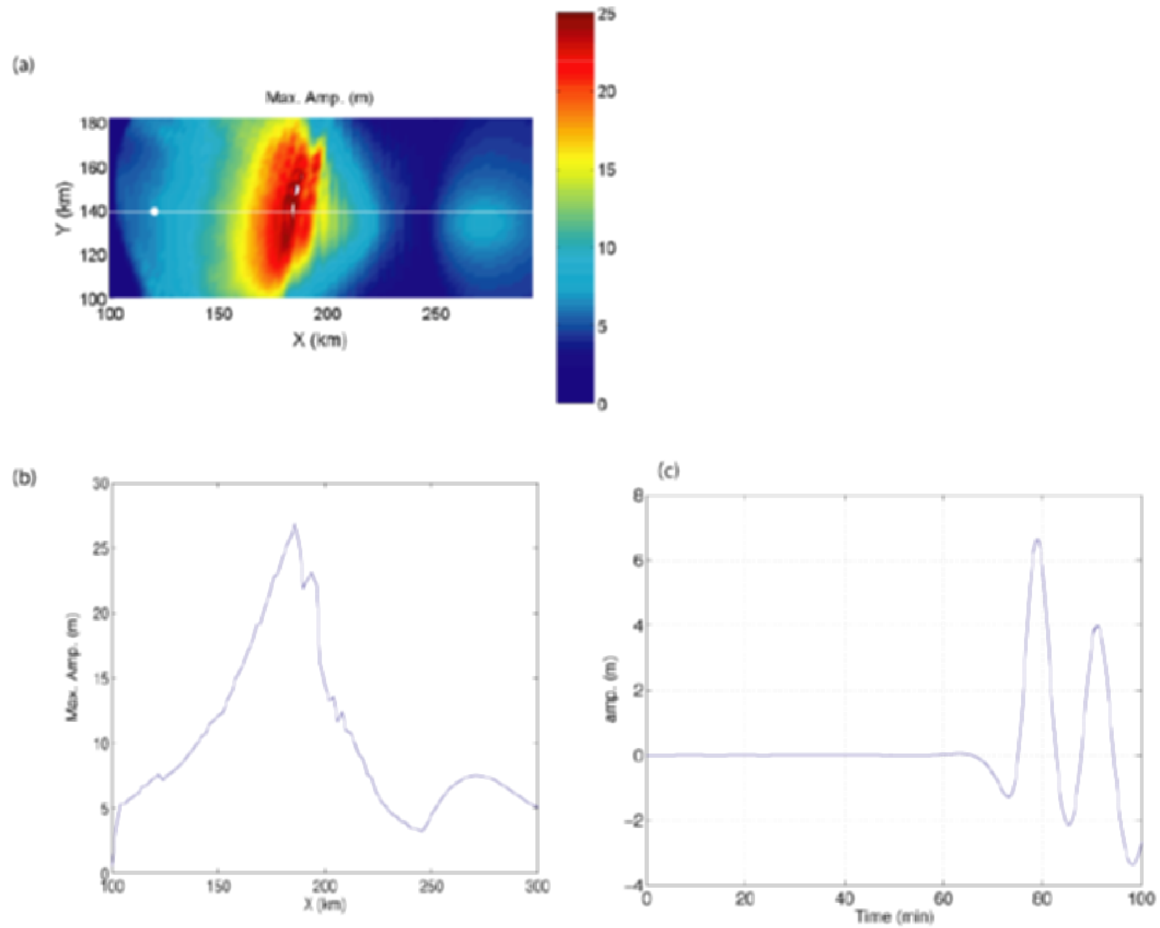
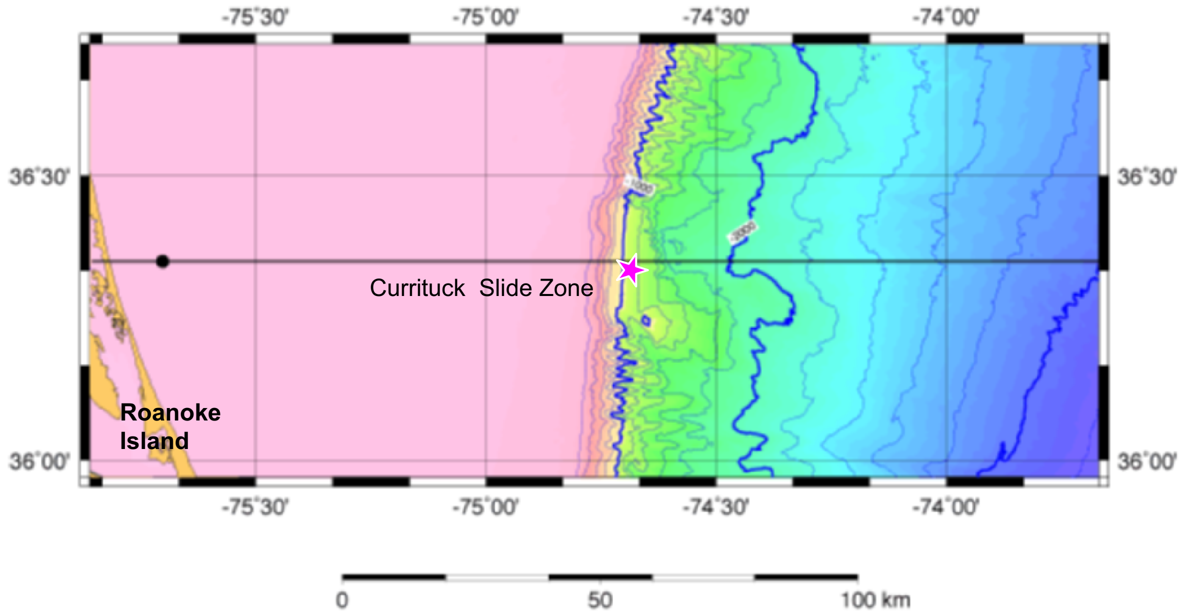


Figure 2.4.6-4 Results of Hydrodynamic Simulation for the Currituck Slide, (a) Maximum Wave Height During 100 min. of Propagation Time, (b) Maximum Wave Height Profile Along Centerline of Landslide (white line in a), and (c) Time Series of Tsunami Amplitude at a Nearshore Location (white dot in a) Broadside from the Landslide in 22 meters (72.2 feet) of Water (Reference 2.4.6-1)



Note: Primary contour (thick blue line) Interval of 1000 meters (3280 feet) and Secondary Contour (thin blue line) Interval of 200 meters (656 feet).

Figure 2.4.6-5 High Resolution DEM (Digital Elevation Model) of the Currituck Landslide and Nearshore Region Representing the Model Domain (Reference 2.4.6-1).

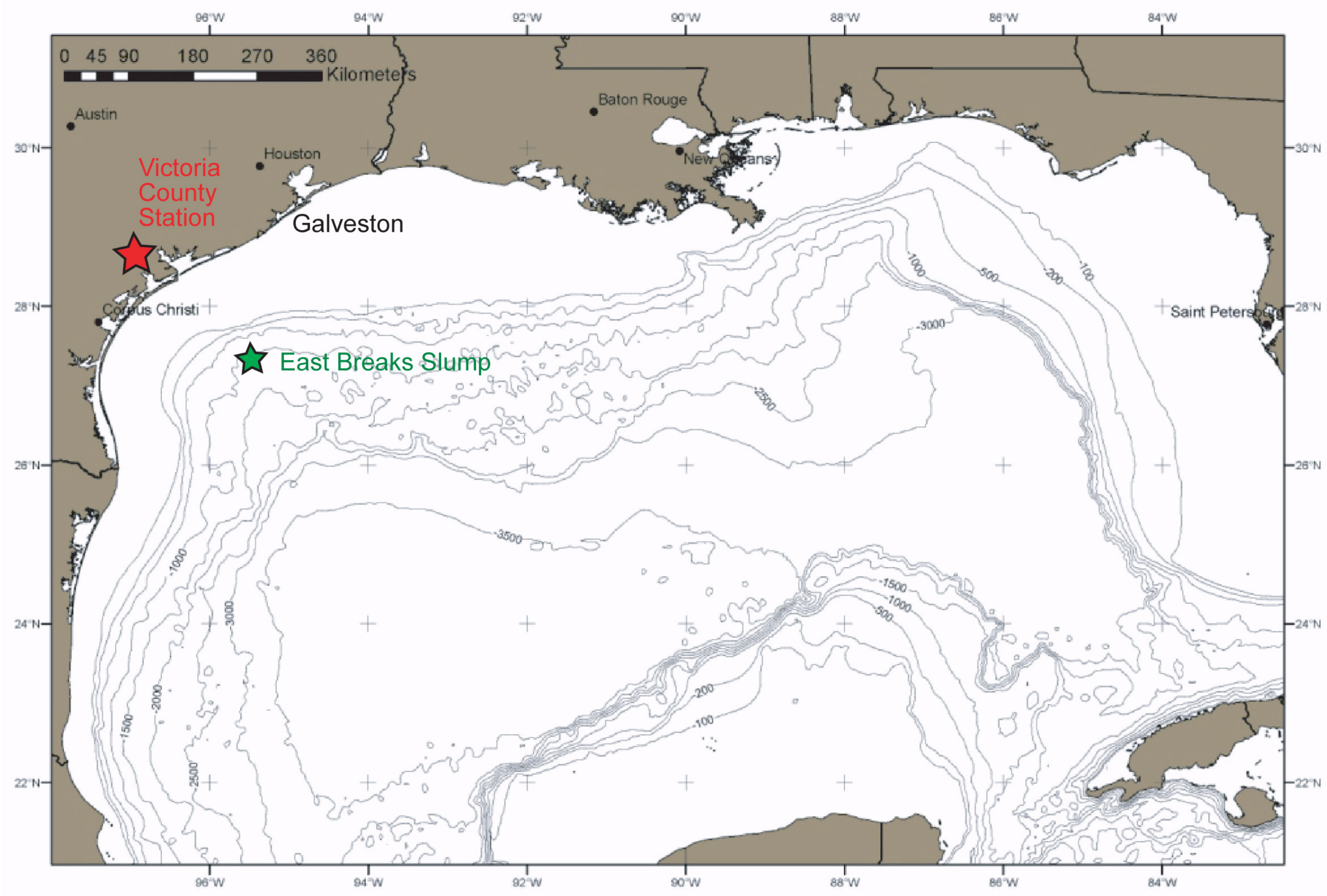


Figure 2.4.6-6 Bathymetry Contours (in meters) of the Gulf of Mexico (Reference 2.4.6-1)