US Army Corps of Engineers ®
Wilmington District

General Re-evaluation Report and Environmental Assessment Surf City, Onslow and Pender Counties, North Carolina Coastal Storm Risk Management Project

Appendix Q: Geoarchaeology

August 2024

1.0 Geologic Context, Topsail Island and Onslow Bay

The geologic setting offshore of Topsail Island, North Carolina consists of several Oligocene bedrock platforms with scarce surficial sedimentary deposits in the sand starved embayment of Onslow Bay (Meisburger, 1979; McQuarrie, 1998; HDR, 2002; HDR, 2003; Greenhorne and O'Mara, 2004). Oligocene bedrock, commonly referred to as hardbottom, consists of moldic sandy limestone and sandy siltstone that underlies most of Onslow Bay with the platforms dissected by relict infilled fluvial channels, paleochannels (USACE, 2013; Greenhorne and O'Mara, 2004; HDR, 2002; Snyder et al., 1982). The bedrock dips gently to the southeast and creates hardbottom scarps and valleys in an otherwise flat terrain. Previous studies support a series of shore-normal channel features or Rippled Scour Depressions (RSDs) occurring throughout Onslow Bay with sorted bedforms occurring in the nearshore environment and a series of shore perpendicular sediment ridges present offshore (USACE, 2013; Geodynamics, 2012; USACE, 2010; Greenhorne and O'Mara, 2004; HDR, 2003; Cacchione et al., 1984; Theiler et al., 1999; Theiler et al., 2001). The term RSD is synonymous with sorted bedforms, or ripple channel depressions RCDs, as described by McQuarrie (1998) and Murray and Theiler (2004). These bedforms represent "self-perpetuating patches of coarse sediment." Several studies indicate that Oligocene hardbottom is laterally continuous with Topsail Island and that reworked and eroded sediments from these units provide much of the available sediment with surficial sands and gravels captured between escarpments (Cleary and Hosier, 1987; Clark et al., 1986; Riggs et al., 1996; Cleary, 2002; Greenhorne and O'Mara 2004; USACE, 2013).

A series of glacioeustatic sea-level fluctuations occurred during the Last Glacial Maximum which would lead to a series of transgressive sequences in Onslow Bay that would persist into the Holocene (Conery et al., 2021; Greenhorne and O'Mara, 2004; Hine and Snyder, 1985). Hine and Snyder (1985) indicated that the paleochannels located in Onslow Bay could be traced for miles in the subsurface and reached up to 80 ft in depth with Ocean Surveys Inc. reporting in 2003 that these paleochannels "were infilled with estuarine and shelf fossiliferous muds and fluvial sands." Previous studies also indicate that the infilling of these paleochannels would have been completed by the mid-Pleistocene transgressive event and that these channel fill sediments would represent the only shelf stratigraphic record for this area (Greenhorne and O'Mara, 2004; HDR, 2003; Hine and Snyder, 1985; Belknap, 1982). Continued sea-level rise occurring in the Holocene with no significant sediment recharge to Onslow Bay, could explain the limited surficial sediments with those occurring being the result of erosion to the low-relief hardbottom scarps and reworking of existing surficial veneers of sand and gravel (Meisburger, 1979; McQuarrie, 1998; Snyder at al., 1982; Hines and Snyder, 1985; Riggs et al., 1985; HDR, 2002; HDR, 2003).

The Greenhorne and O'Mara (2004) study found for all sand borrow areas that variability of the channel fill sediment was dependent upon the stage of the riverine channel at the time of burial in the Pleistocene with the Holocene transgressive event "beveling off" the upper sections of facies and preserving the deeper fluvial deposits. Furthermore, this study found that quantity of material is not confined to the limits of paleochannel features but is instead controlled by bedrock topography and the subsequent distribution of surficial sands from the Holocene erosive transgression. Given the low fluvial input and the lack of sediment exchange between neighboring bays, contributions to the system after the last Holocene transgression are limited to erosion of hardbottom, scarps, ledges, and platforms which is controlled by the materials relative hardness and reworking of surficial sediments (Cleary and Pilkey, 1968; Milliman et al., 1972; Cleary and Thayer, 1973; Blackwelder et al., 1982; Riggs et al., 1995 and Riggs et al., 1996).

Several of the sand borrow areas limits for the Surf City Coastal Storm Risk Management (CSRM) project encounter the offshore paleofluvial channels: Sand Borrow Areas A, B, C, D, E, G, J, L, O, and N (Figures 1 and 2). Sand Borrow Areas A, B, and C lie within the ancestral New Topsail River paleochannel, P1, which reaches depths greater than 75 ft in the underlying lithology (Figure 3). This area was found to have the highest availability of sediments for beach nourishment with many of the cores reaching below 10 ft of depth. This borrow was found to have the highest relief of all those surveyed in the 2003 Ocean Surveys report and lies within a depression between two rock outcrops with the surficial sediments thinning eastward (Greenhorne and O'Mara, 2004).

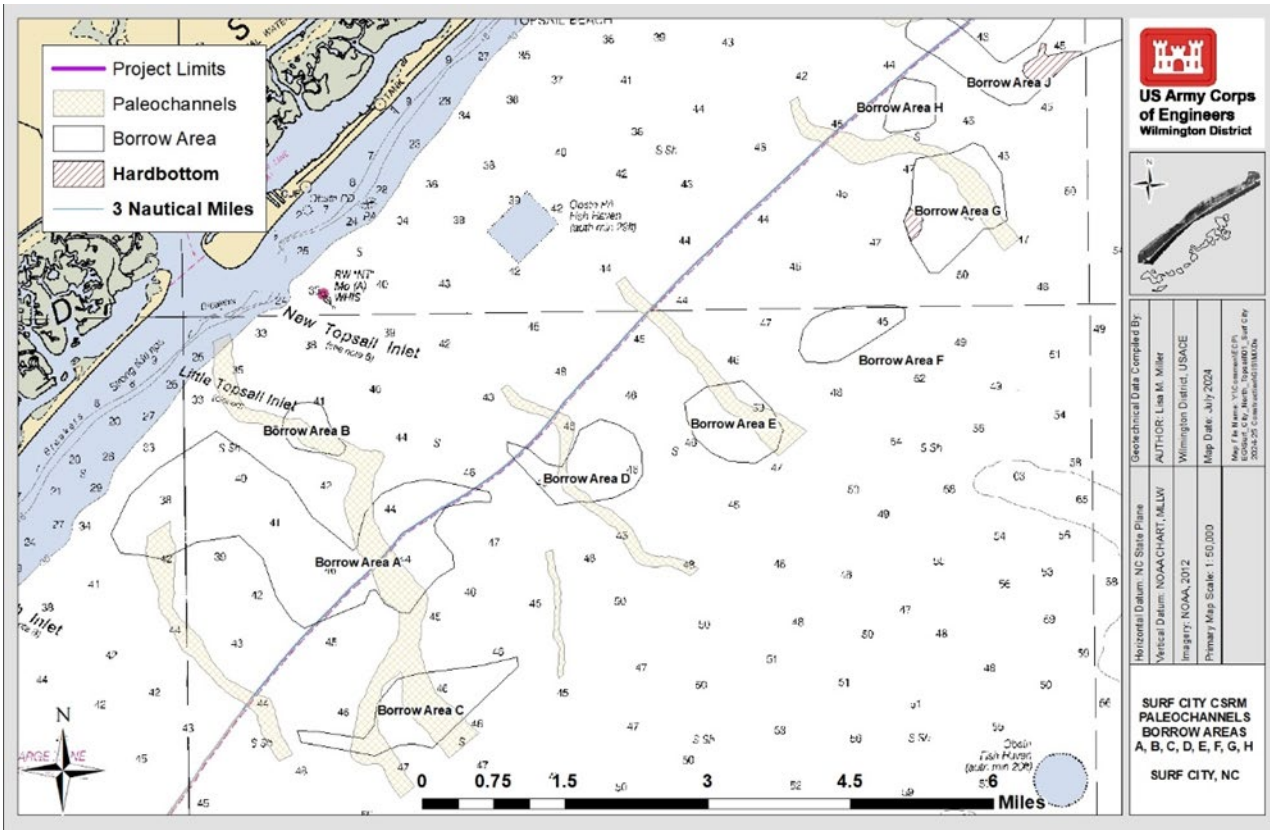

Figure 1. Sand Borrow Areas A, B, C, D, E, F, G, H, J, intersections with identified paleochannels and hardbottom.

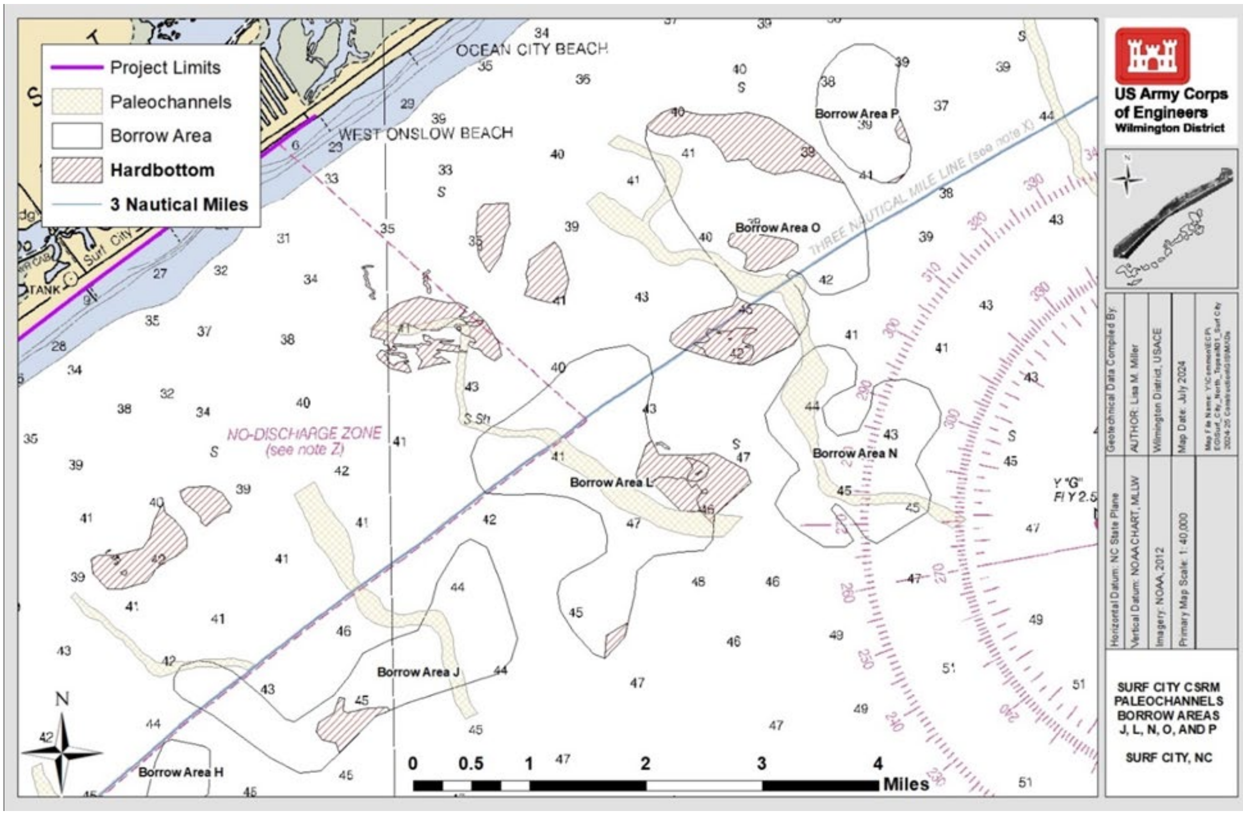

Figure 2. Sand Borrow Areas H, J, L, N, O, P, intersections with identified paleochannels and hardbottom.

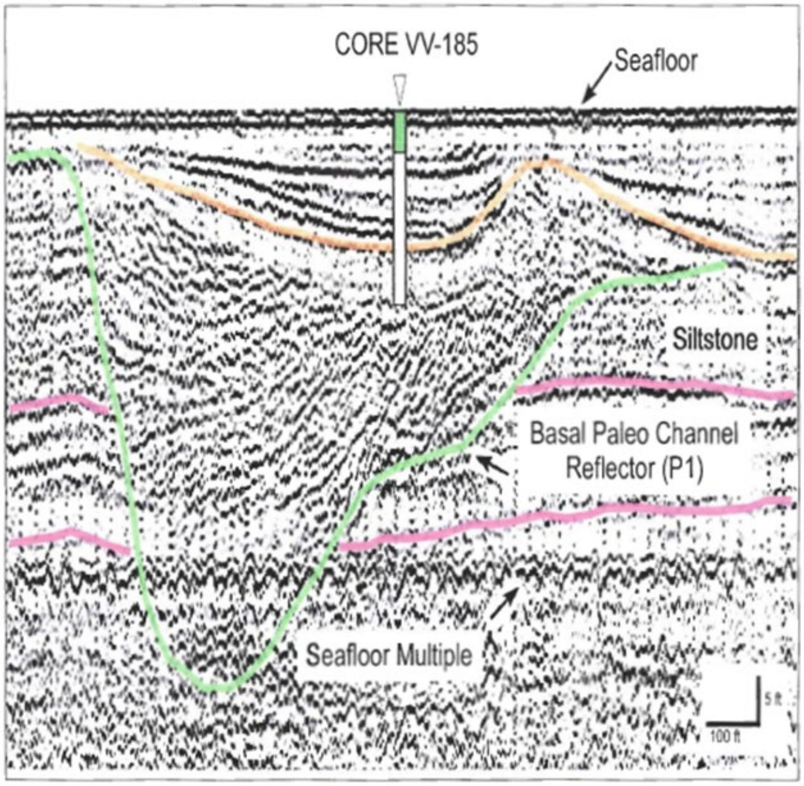

Figure 3. New Topsail River paleochannel reflector profile P1 (Ocean Surveys, 2004; Greenhorne & O'Mara, 2004).

2.0 Sand Borrow Area A

Sand Borrow Area A is located approximately 1.5 miles south of New Topsail Inlet. Two independent paleochannel features intersect the borrow area. A smaller paleochannel intersects a small section of the area to the southwest (Paleochannel P2). An ancestral paleochannel, P1, intersects the eastern side of the borrow area on both the north and south ends. Shore perpendicular sediment ridges are located on the flanks of these paleochannels with a relatively flat ocean floor surface between these areas. Surveys completed by Geodynamics in 2011 found that shore perpendicular sediment ridges were “perched atop deformed bedrock layers represented by folded and tilted subsurface reflectors in the sub-bottom data” and these were found to be extensions of those sorted bedforms found in the nearshore often containing substantial sediment accumulation with the deepest proposed dredge cuts occurring in these areas (10-15 ft). Additionally, no magnetic anomalies or hardbottom areas were found in this borrow area (Hall, 2004) and cores showed no indication of estuarine or land-based remnants, such as peat or organics common in back barrier environments of the southeast (Long et al., 2021).

Paleochannel P2 contains variable sediments with sands and silts located in the western side of the channel and silts located in the eastern side of the channel. Depth in the western portion ranges from near surface depth to approximately 24 ft (Greenhorne & O’Mara, 2004; Geodynamics, 2011). Acoustic values indicate mixed sands and silts similar to the high amplitude, high frequency, mud-rich, aggradational channel fill described in Gibling (2006) and referenced in Long et al. (2021).

Paleochannel P1 depicts a well-developed channel complex with truncation of the basal paleo channel by younger channel sequences. The channel is incised through Oligocene siltstone and contains variably silty sands and gravels that become finer downcore with fine silty sands and some elastic silts occurring near P1 and at depth. Paleochannel depth in the eastern portion ranges from near surface depth to 48 ft. The P1 ancestral channel complex in the subsurface appears similar to both the back barrier paleochannel complex and the fluvial paleovalley described in Long et al. (2021). Greenhorne and O'Mara (2004) describe two horizons within the P1 complex: a basal paleochannel that cuts anywhere from 48 to 60 ft into the underlying bedrock and a younger channel that truncates it. Cores obtained during the 2004 survey work included several cores reaching depths of 20 ft and reports >20 ft of sediment availability within the P1 complex. Geodynamics (2011) interprets the layer below the surficial sediments to be the transgressive surface from the last sea level high stand and notes that reflectance values support reworking and semi-consolidation. Given this evidence, potential preservation could have occurred at depth within these deeper infilled channel deposits but is unlikely to have occurred within the last Holocene transgression. Figures 4-8 depict findings within Sand Borrow Area A (Geodynamics, 2011).

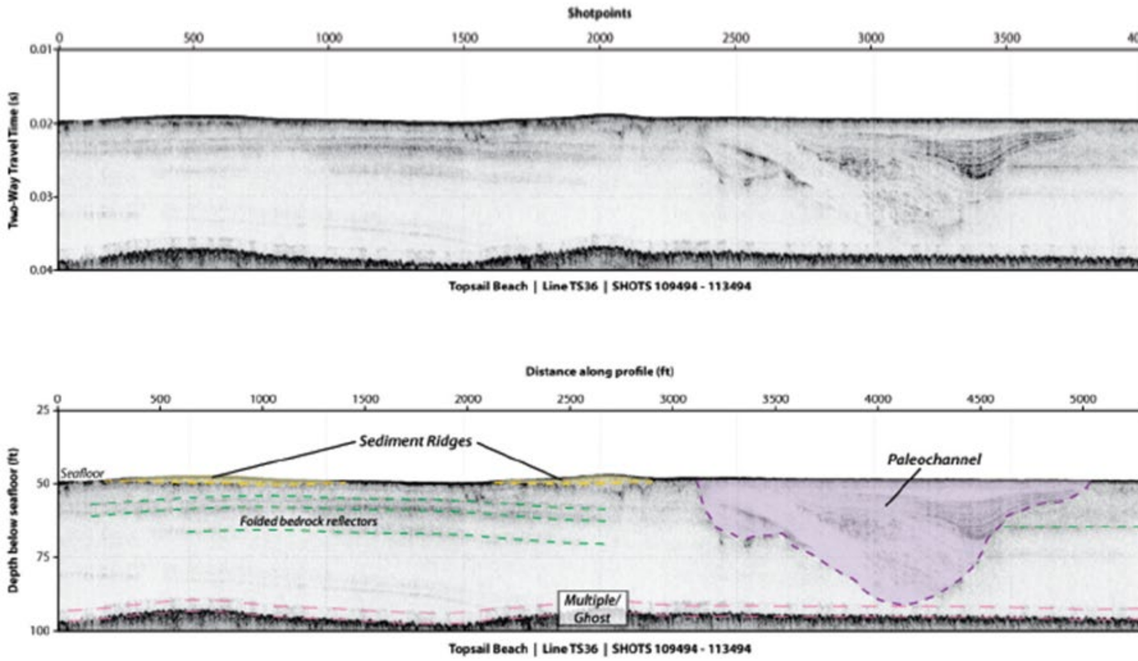

Figure 4. Representative CHIRP sub-bottom profile across Sand Borrow Area A (Geodynamics 2011).

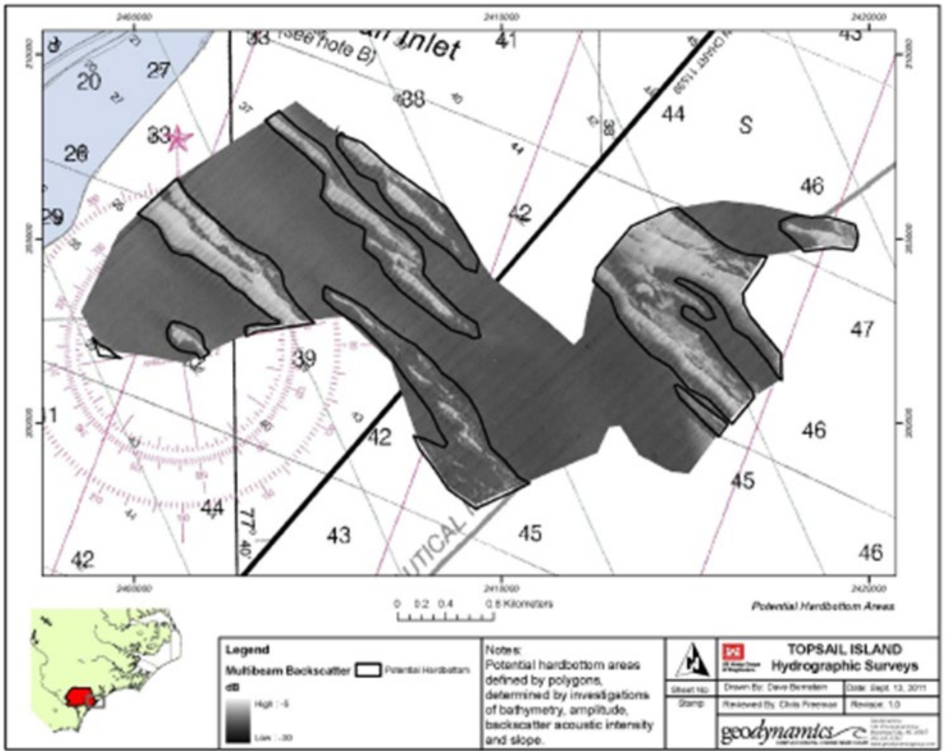

Figure 5. Multibeam backscatter imagery with generalized areas of potential hardbottom within Sand Borrow Area A. Lighter colors represent higher sediment reflectivity (harder, more coarse material; Geodynamics, 2011).

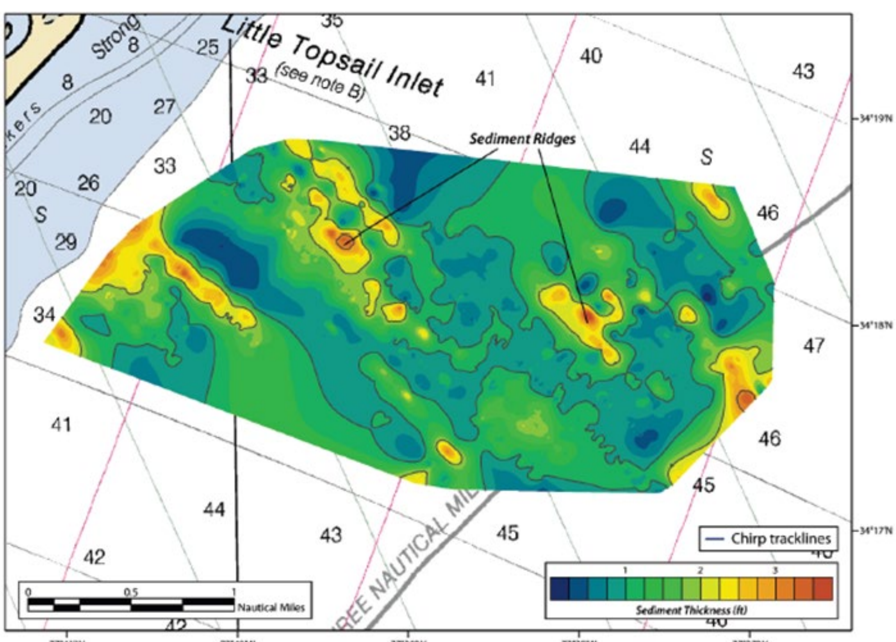

Figure 6. Sediment thickness isopach map for Sand Borrow Area 3 (Geodynamics, 2011).

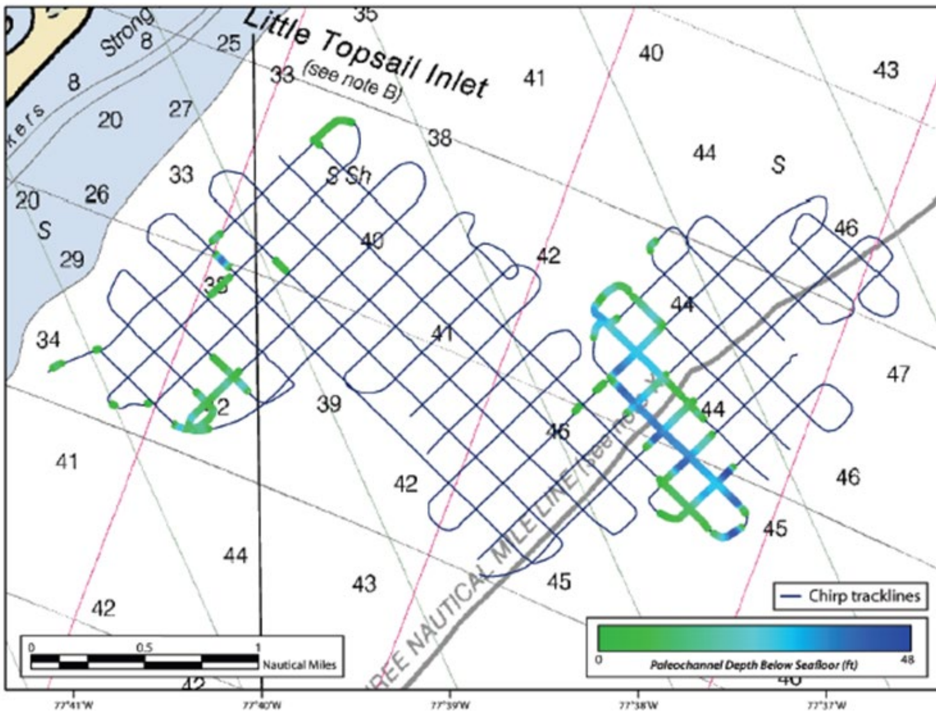

Figure 7. Depth of paleochannel sediment infill for Sand Borrow Area A (Geodynamics, 2011).

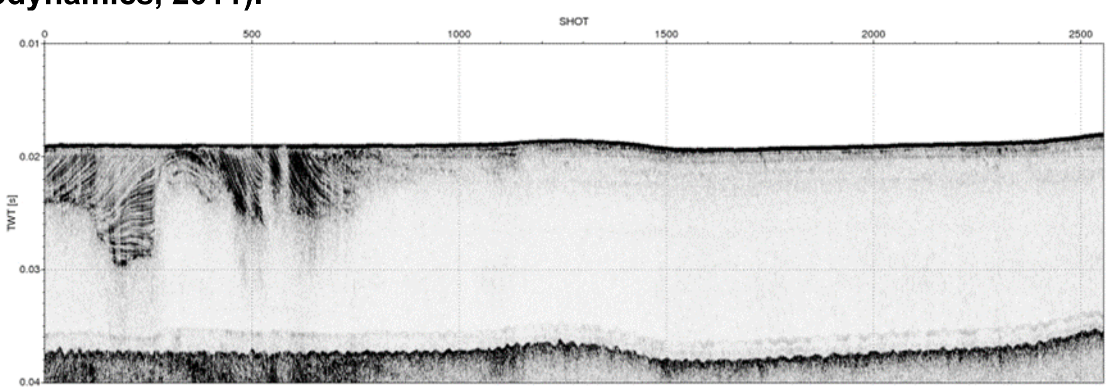

Figure 8. Additional CHIRP sub-bottom profile across Sand Borrow Area A (Geodynamics 2011).

Geophysical Investigations performed in 2003 found through seismic reflection that a younger channel truncated the top of the older basal paleochannel in the complex (Greenhorne and O'Mara, 2004). A number of different sediment facies were found in the acoustic signatures including estuarine silts and clays at depth, and cross bedded or acoustically transparent sands, both at the surface and at depth. Subsurface cores indicate a thin layer of sand and shell at the surface that gets finer below the surface with silty sands interpreted as riverine deposits within the paleochannels which further supports the presence of a reworked sediment package that sits atop the deeper paleochannel reflector.

Additional cores collected in 2023 produced similar results with clays and silts found at or below the surface to a depth of 10 ft. Sediment type in this borrow was found to have extensive lateral variation both within and beyond the paleochannel. A series of borings were obtained near the southwestern paleochannel which were highly variable across 1,000 ft total spacing. Core SC-23-V-014 was found to have approximately 1 ft of sand with silt (SPSM) overlying approximately 5 ft of silty sand (SM 38% fines). Approximately 500 ft away, core SC-23-V-015 was found to have approximately 1 ft of sand (SP) overlying a layer <1 ft thick of silty sand (SM) over the top of approximately 8 ft of laminated silt (ML). Also, approximately 500 ft away, core SC-23-V-016 was found to have 1 ft of sand (SP) overlying approximately 9 ft of variable sand with silt (SPSM 8-10.2% fines). A series of borings collected within this channel were found to have a similar composition ranging from sand (SP) to silty sand (SM 14% fines). No cores were collected in 2023 within the southeastern P1 paleochannel, but several cores taken from the surrounding area were found to have a similar, overall finer, composition of sand with silt (SPSM) and silty sands (SM <20% fines).

Although the U.S. Army Corps Engineers (USACE) Wilmington District (District) is developing final cut depths, preliminary cut depths were developed during 2020. For Borrow Area A, the deepest cut depths occur in areas adjacent to paleochannels, in and around the sediment ridges. Most cut depths are no greater than 10 ft within the paleochannel overlap areas with a few potentially reaching between 12-15 ft below the surface across the whole borrow area. Given the evidence of extensive reworking during the Holocene transgression, the depth of relict sediments, and fining and consolidation with depth, the District does not anticipate encountering ancestral, preserved sands within the designed cut depths for Sand Borrow Area A. Proposed construction within Sand Borrow Area A will have no effect on historic properties, ancient landforms, or other cultural resources.

3.0 Sand Borrow Area B

Sand Borrow Area B is located adjacent to Sand Borrow Area A and nearly parallel with New Topsail Inlet. Paleochannel P1 intersects approximately half of Sand Borrow Area B from the south end to the north end before extending seaward to intersect Sand Borrow Area A and Sand Borrow Area C (Figure 9). No acoustic anomalies or hardbottom areas were found in this borrow (Hall, 2004). Sand Borrow Area B contains only two cores and both are within Paleochannel P1: TI-03-V-132 and TI-03-V-205. Boring TI-03-V-132 contains approximately 2 ft of sand (SP) over sand with silt (SPSM) while boring TI-030V-205 contains approximately 2 ft of sand (SP) over clay (CH) and clayey sand (SC). Field descriptions include shell throughout and approximately 2 ft of dark gray clay. In order to be utilized as a sand source, Sand Borrow Area B would first require additional subsurface investigation which could include additional borings within P1 to further elucidate subsurface conditions. Given the shallow surficial nature of sediments found in this area and the historical transgressive events, the District does not anticipate encountering ancestral preserved sands within designed cut depths. Proposed construction within Sand Borrow Area B will have no effect on historic properties, ancient landforms, or other cultural resources.

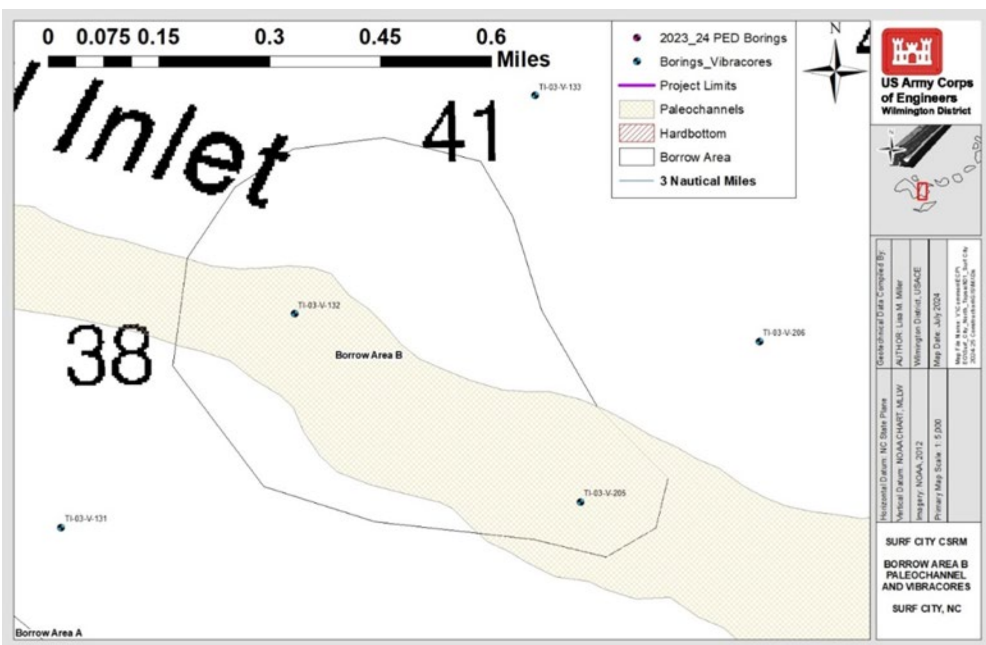

Figure 9. Sand Borrow Area B, intersections with identified paleochannels and hardbottom.

4.0 Sand Borrow Area C

Sand Borrow Area C is located approximately one mile southeast of Sand Borrow Area A. Paleochannel P1, which intersects the north and south portions of Sand Borrow Area A, continues seaward and splits into two lobes which intersect both the northeastern and southwestern ends of Sand Borrow Area C (Figure 10). No acoustic anomalies or hardbottom areas were found in this area (Hall, 2004). The northeastern section of P1 includes approximately 5-7 ft of sand (SP) and sand with silt (SPSM) over approximately 3-5 ft of dark gray clay (CH). The southwestern section of P1 includes approximately 6 ft of sand with silt (SPSM) over approximately 8 ft of sand (SP). In order to be utilized as a sand source, Sand Borrow Area C would first require additional subsurface investigation which could include additional borings within P1 to further elucidate subsurface conditions. Given the depth of this channel in Sand Borrow Area C, the District does not anticipate encountering ancestral preserved sands within the designed dredge cuts. Proposed construction within Sand Borrow Area C will have no effect on historic properties, ancient landforms, or other cultural resources.

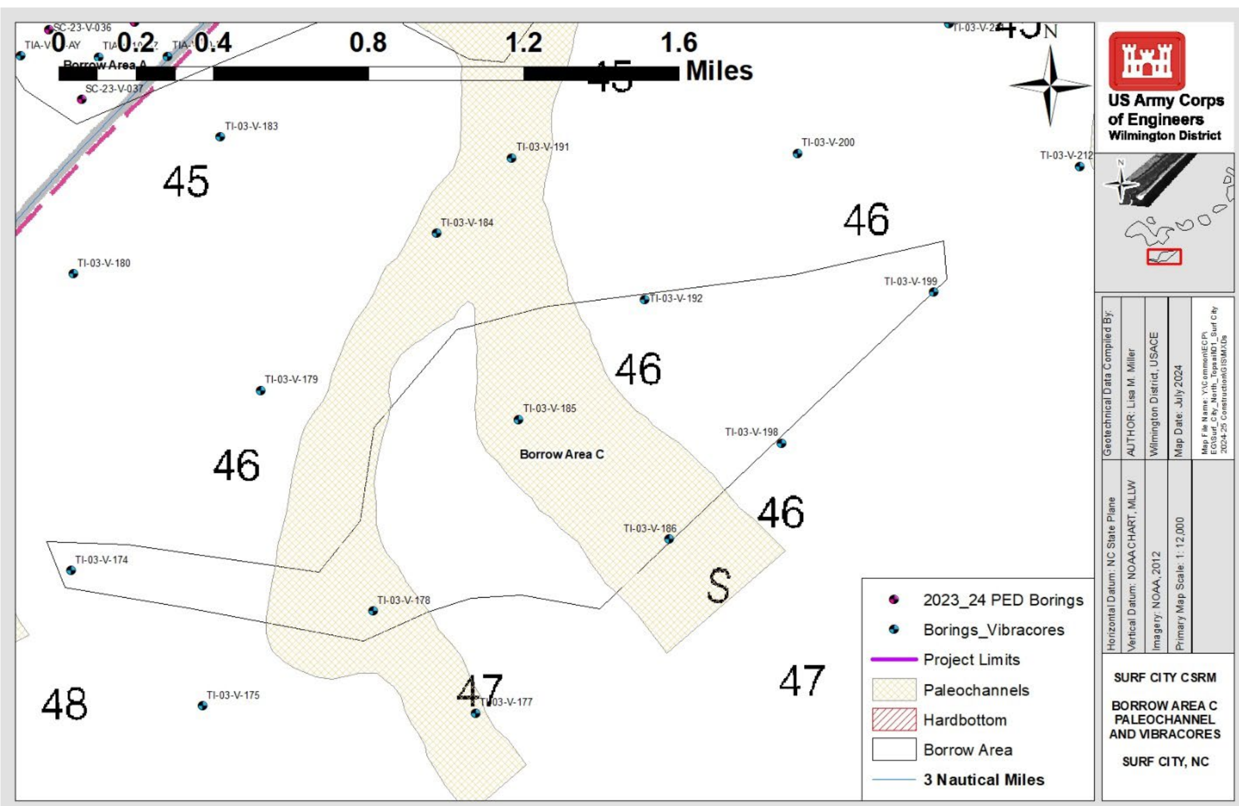

Figure 10. Sand Borrow Area C, intersections with identified paleochannels and hardbottom.

5.0 Sand Borrow Area D

Sand Borrow Area D is located approximately half a mile from the most eastern tip of Sand Borrow Area A and approximately 3.5 miles south of Topsail Beach. No magnetic anomalies or hardbottom were found in this borrow area (Hall, 2004). An independent paleochannel intersects the western side of the borrow area and extends from the north to the south end of the borrow, paleochannel P4 (Greenhorne and O'Mara, 2004; Figure 11). P4 contains a surficial veneer of sand and gravel that is approximately 1-4 ft thick and discontinuous (Greenhorne and O'Mara, 2004; USACE, 2010). Borings support a surficial layer of SP that varies from 0.5 to 3 ft; however, none of these are within the paleochannel. Boring TI-03-V227 is the closest boring within the paleochannel, and this core was found to contain approximately 5 ft of sand with silt overlying silty sand. This suggests that P4 contains muddier sands with a surficial layer of reworked material as suggested by previous studies (Snyder et al., 1982; McQuarrie, 1998; Greenhorne and O’Mara, 2004). In order to be utilized as a sand source, Sand Borrow Area D would first require additional subsurface investigation which could include additional borings and/or surveys within P4 to further elucidate subsurface conditions and a reevaluation of geoarchaeology would be performed to determine the effect, if any, on potential historic properties, ancient landforms, or other cultural resources.

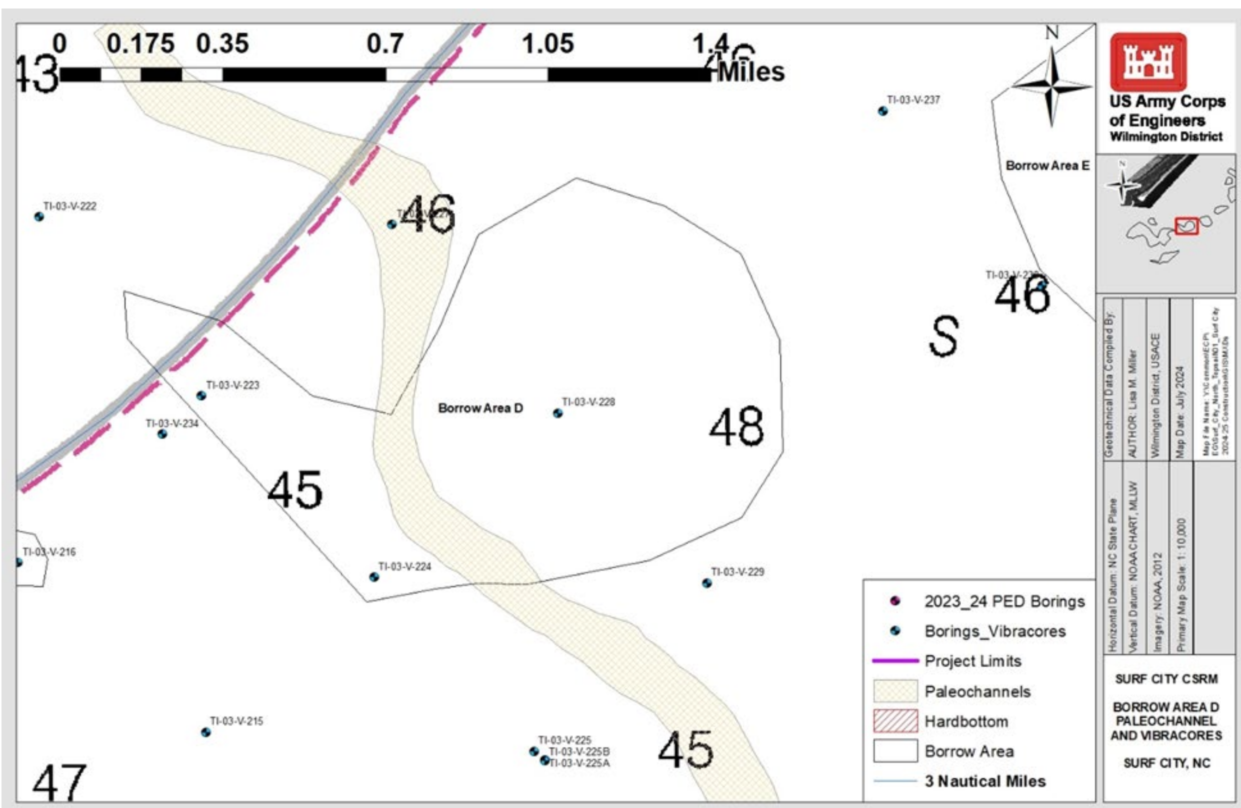

Figure 11. Sand Borrow Area D, intersections with identified paleochannels and hardbottom.

6.0 Sand Borrow Area E

Sand Borrow Area E is located approximately half a mile from the eastern side of Sand Borrow Area D. An independent paleochannel intersects the eastern side of the borrow area and extends from the north to the south end of the borrow, paleochannel P5 (Figure 12). No magnetic anomalies or hardbottom were found in this borrow area (Hall, 2004). Sand Borrow Area E was observed to have a thin veneer of sand (SP) and sand with silt (SPSM), less than 2 ft thick, at the surface that transitions to silty sand (SM 13-28% fines). Fence diagrams E2 and E3 (Appendix C) depict a thin layer of SP/SPSM over silty sand with boring logs indicating that SC-13-V-56 and SC-13-V62 were terminated in rock. Borings SC-13-V-53 and TI-03-V-240 depict a slightly thicker but still thin veneer of SP underlain by SPSM. Boring SC-13-V-53 indicates a suspected termination in rock with cemented sand occurring near the bottom of the core in SM. See Figures 13-15 for Sand Borrow Area E borings data. Paleochannel P5 intersects the borrow on the eastern side and is approximately 25 ft deep (Greenhorne and O'Mara, 2004). Although previous studies place this paleochannel within Borrow Area E, sub-bottom profiles did not indicate its presence (Geodynamics, 2013; Figure 16). The increased fines content at depth, the surficial nature of sandier materials, and the presence of poorly cemented gravels at depth indicate a package of reworked semi-consolidated material at depth in this borrow. If this borrow were to be utilized for sand nourishment, the District does not anticipate encountering ancestral preserved sands within designed cut depths. Proposed construction within Sand Borrow Area E will have no effect on historic properties, ancient landforms, or other cultural resources.

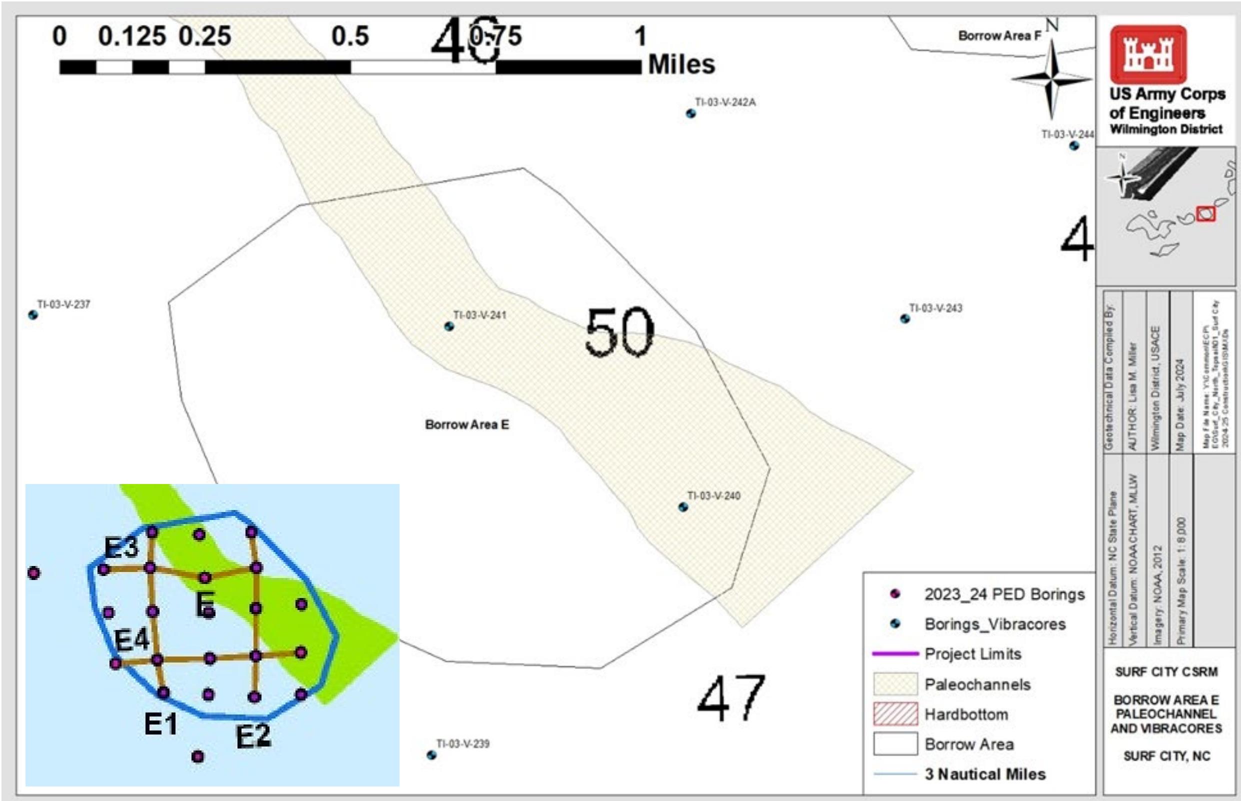

Figure 12. Sand Borrow Area E, intersections with identified paleochannels and hardbottom.

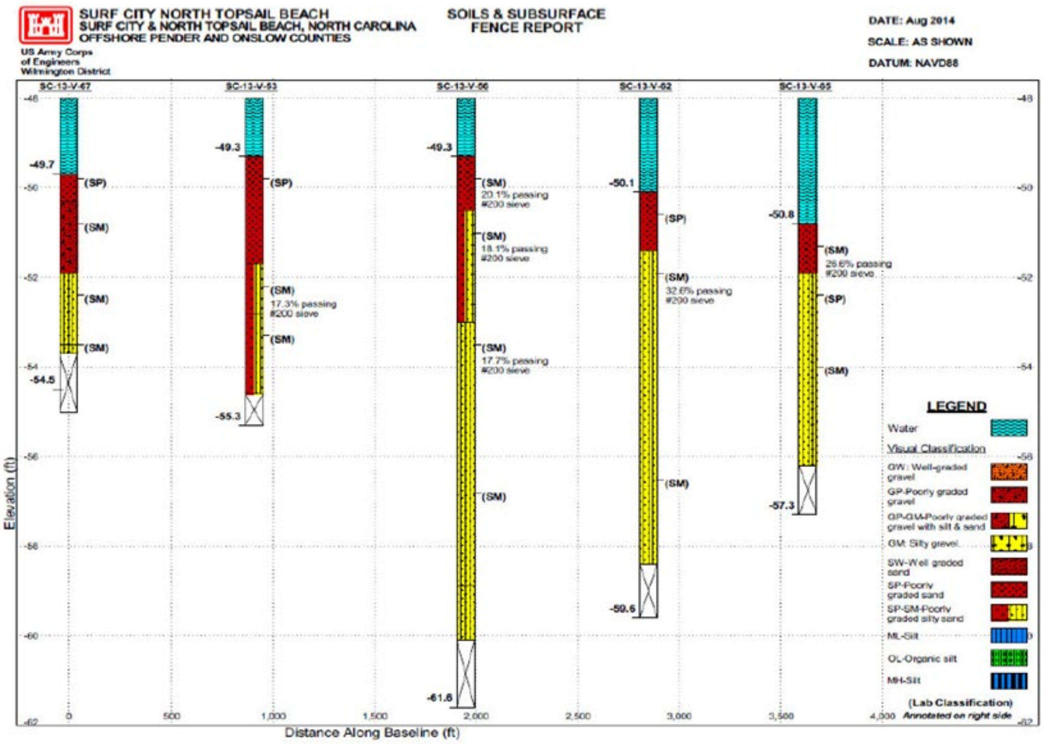

Figure 13. Geologic cross section in Sand Borrow Area E, 1 of 3.

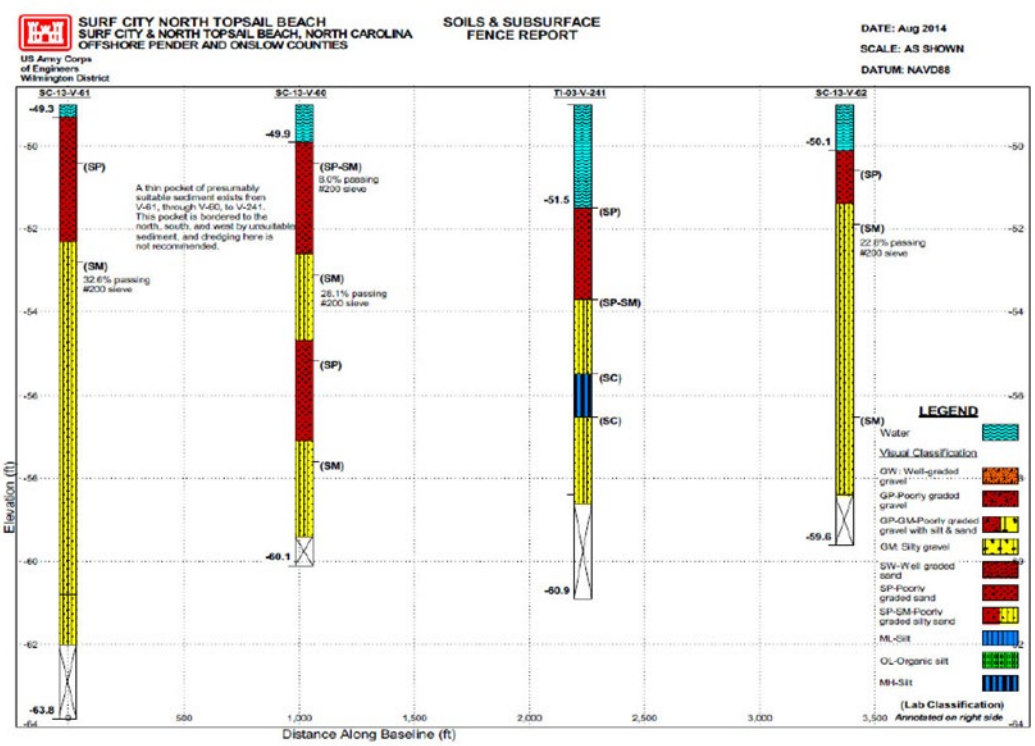

Figure 14. Geologic cross section in Sand Borrow Area E, 2 of 3.

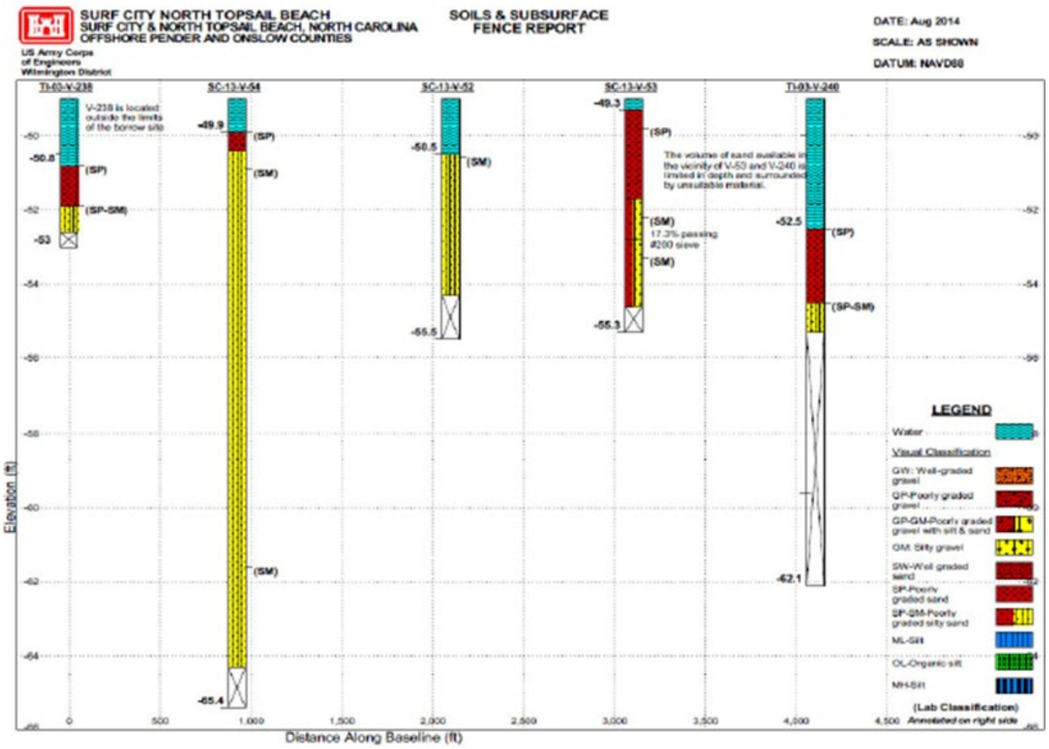

Figure 15. Geologic cross section in Sand Borrow Area E, 3 of 3.

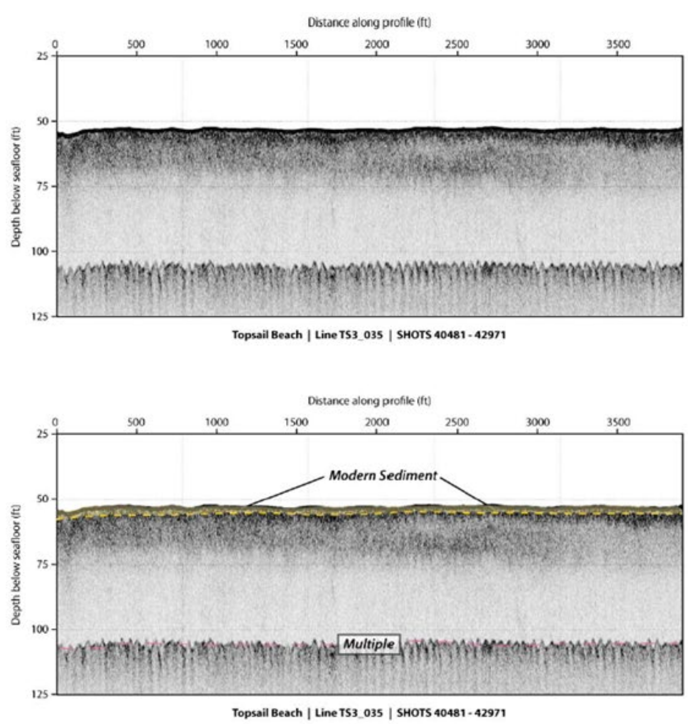

Figure 16. CHIRP sub-bottom profile across Sand Borrow Area E (Geodynamics 2013).

7.0 Sand Borrow Area G

Sand Borrow Area G is located approximately four miles from the southern end of Surf City. An independent paleochannel intersects the eastern side of the borrow area and extends across the borrow from the north to the south end, paleochannel P6 (Greenhorne & O'Mara, 2004; OSI, 2004; Figures 17-19). No magnetic anomalies were found in this borrow area (Hall, 2004). A suspected hardbottom area was found in this borrow area with moderate acoustic returns found on the southwestern side. Grab samples indicated that this area contained coarser sands like those found in the sand ridge, sorted bedforms of Sand Borrow Area A (Geodynamics, 2011; Geodynamics, 2013). Cores collected in 2011 indicated the presence of cemented sands and gravels at depth with a veneer of sand (SP) and sand with silt (SPSM) at the surface (Figures 20-22). Due to the presence of consolidation and/or cementation this part of the borrow is being avoided, treated as rock and/or hardbottom, and includes a low-relief buffer.

Surficial sediments range from 2-3 ft in thickness and become finer and consolidated at depth. The dredge cuts delineated in 2013 indicated a maximum dredge depth of approximately 6 ft. High confidence volumes developed in 2020 agreed with a maximum dredging depth of approximately 6 ft. Relict sediments were estimated to range from 10-15 ft within Paleochannel P6. Acoustic signatures were "chaotic" indicating mixed sediments at the surface and with depth or a reworked sediment package both of which resulting in a low potential for preservation. Given these characteristics, the District does not anticipate encountering ancestral preserved sands within designed cut depths. Proposed construction within Sand Borrow Area G will have no effect on historic properties, ancient landforms, or other cultural resources.

8.0 Sand Borrow Area H

Sand Borrow Area H is located approximately half a mile north-northeast of Sand Borrow Area G (Figure 17). The southeastern side of the borrow is directly adjacent to the paleochannel that intersects Sand Borrow Area G but does not directly encounter this paleochannel. Proposed construction within Sand Borrow Area H will have no effect on historic properties, ancient landforms, or other cultural resources.

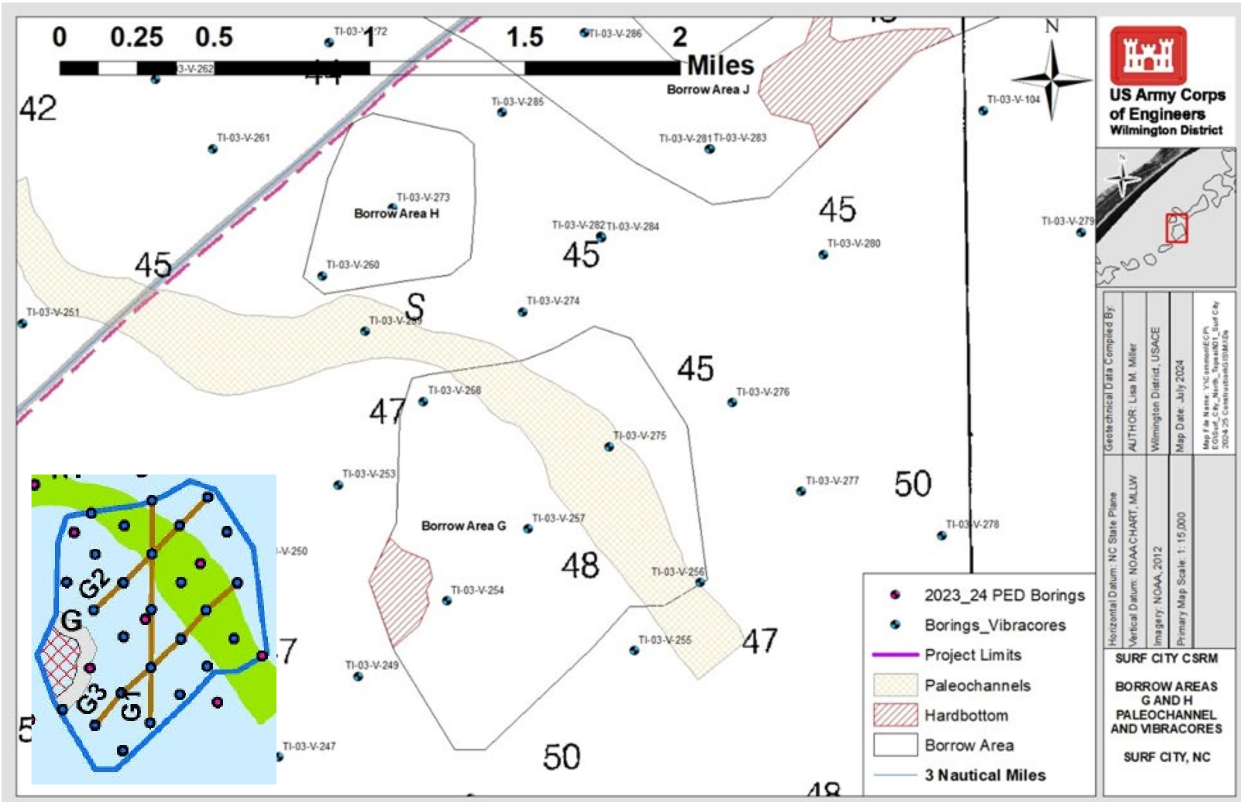

Figure 17. Sand Borrow Areas G and H, intersections with identified paleochannels and hardbottom.

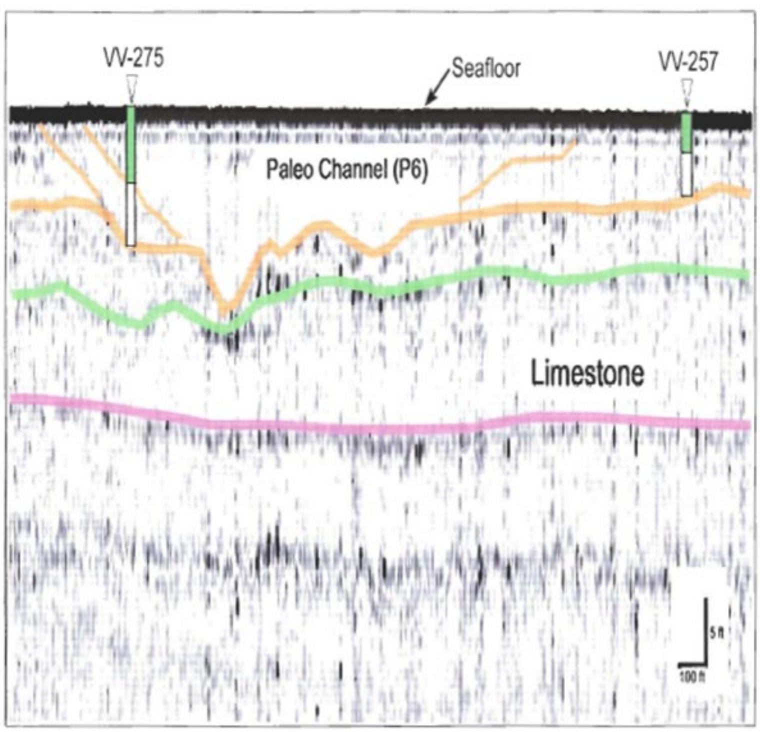

Figure 18. CHIRP provide of shallow paleochannel P6 (Ocean Surveys, Inc., 2004; Greenhorne & O'Mara, 2004).

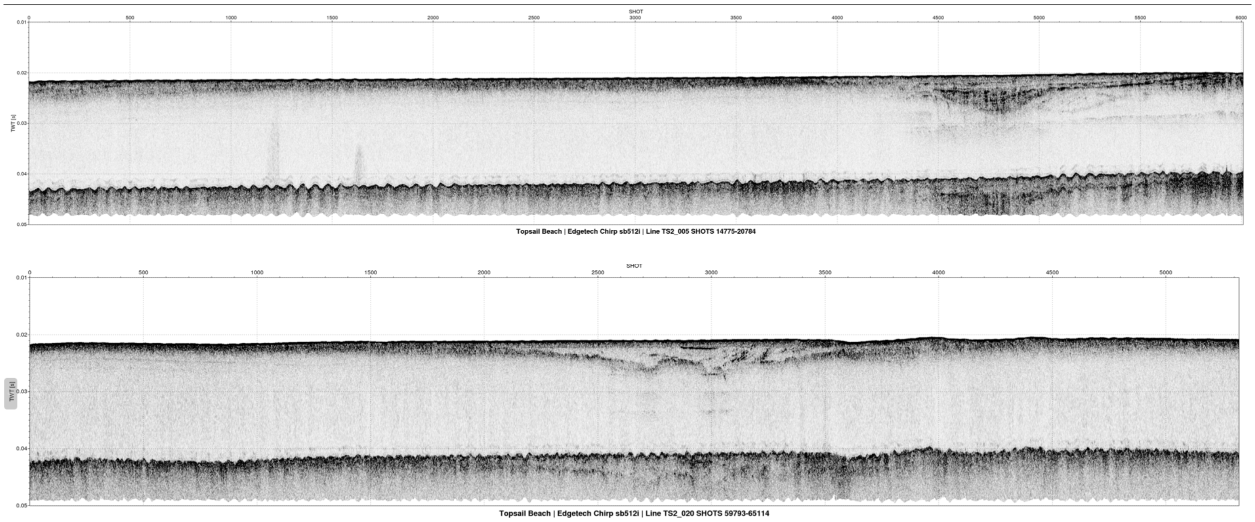

Figure 19. CHIRP sub-bottom profile across Sand Borrow Areas G, H, J, L, O, P (Geodynamics 2012).

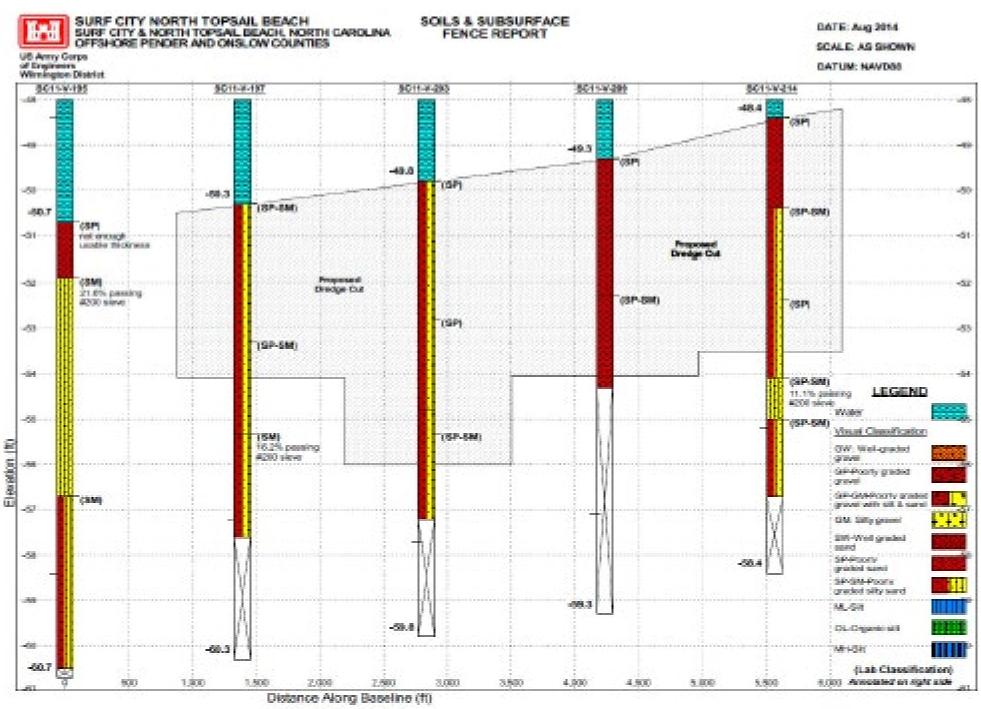

Figure 20. Geologic cross section in Sand Borrow Area G, 1 of 3.

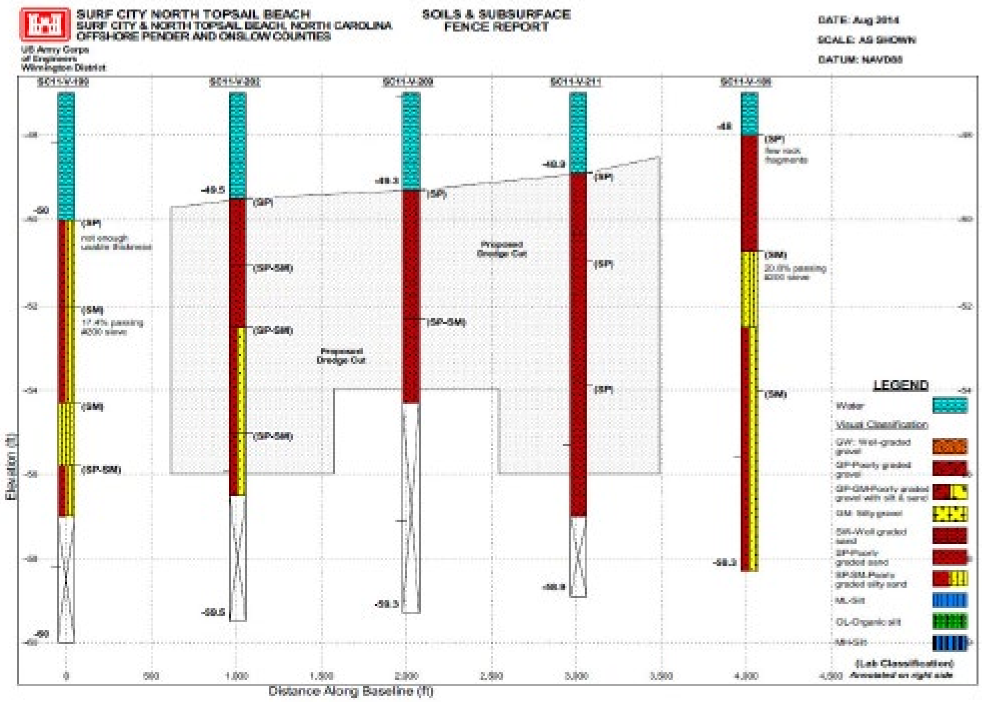

Figure 21. Geologic cross section in Sand Borrow Area G, 2 of 3.

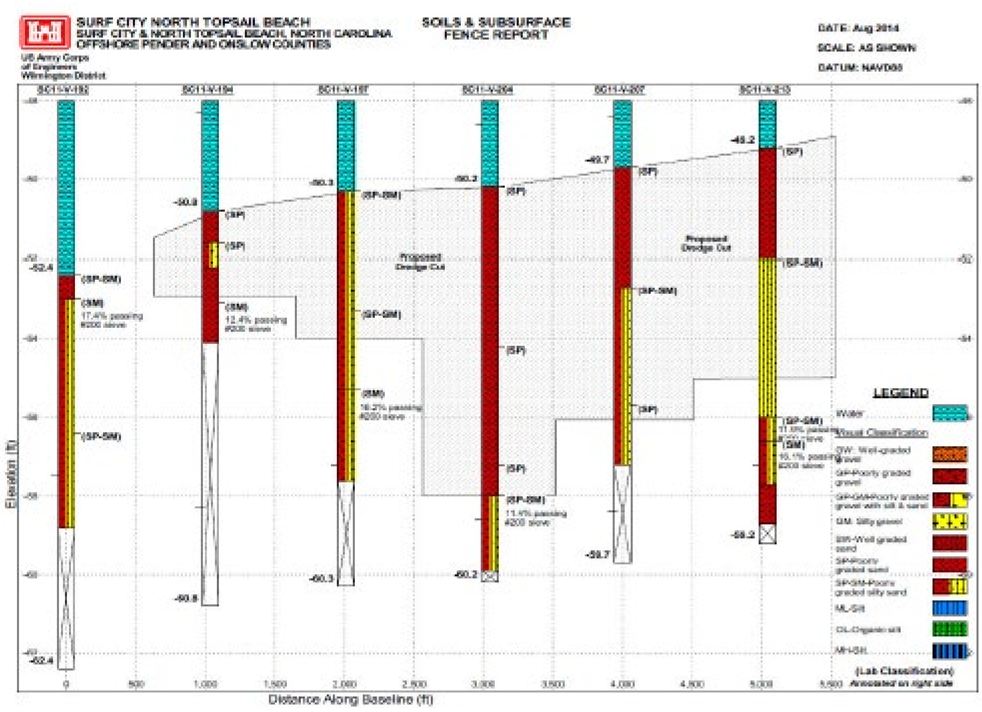

Figure 22. Geologic cross section in Sand Borrow Area G, 3 of 3.

Sand Borrow Area J

Sand Borrow Area J is located approximately three to four miles seaward of central Surf City. Two independent paleochannels intersect the borrow area, one on the western end and one on the eastern end (Figure 23). The western paleochannel, P7, intersects a very small portion of the north end of the western side of the borrow area along the edge of the borrow. The eastern paleochannel, P8, intersects both the north and the south end of this portion of the borrow (Greenhorne & O'Mara, 2004). Paleochannels in this area were found to "show a mix of well-defined, acoustically laminated infill and transparent to chaotic infill" (Geodynamics, 2012). Core samples indicated the presence of gravel and cemented sands within the channel fill areas at depth resulting in the reduction of estimated volumes with a high level of confidence in quantity and quality. High confidence volume estimates avoided most encounters of paleochannels except a small portion of the northwestern side of the borrow. This section includes a shallow dredge cut of approximately 5 ft. For these reasons, the District does not anticipate encountering preserved ancestral sands within the designed dredge cuts. Proposed construction within Sand Borrow Area J will have no effect on historic properties, ancient landforms, or other cultural resources.

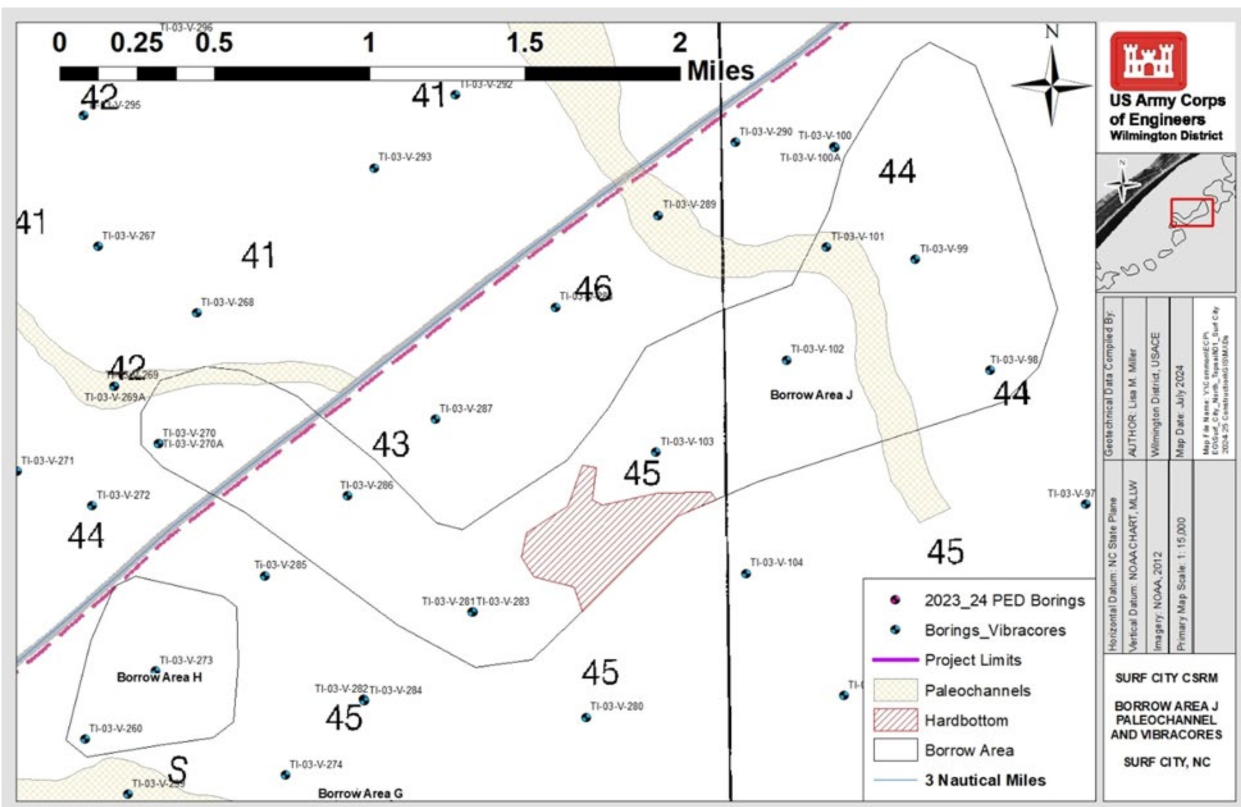

Figure 23. Sand Borrow Area J, intersections with identified paleochannels and hardbottom.

9.0 Sand Borrow Area L

Sand Borrow Area L is located approximately half a mile from the eastern end of Sand Borrow Area J and is parallel to the north end of the Surf City limits. An independent paleochannel intersects the borrow area on the western side of the borrow and extends across the length of the borrow area before intersecting the eastern end, paleochannel P9 (Greenhorne & O'Mara, 2004). This borrow was found to have shore perpendicular sediment ridges consisting of coarser grained sorted bedforms similar to Borrow Area A. Surveys conducted in 2012 indicated a modern sediment thickness across the borrow of 2-4 ft with the largest accumulation along these sediment ridges (Geodynamics, 2012; Figures 24-26). Relict sediments within the paleochannel were found to have depths ranging from 5 to greater than 15 ft with the approximate depth of the channel ranging from 43-85 ft across the borrow. Although dredge cuts are relatively shallow, they do encounter relict paleochannel sands. Acoustic signatures indicate a variability in sediment type while core logs indicate a higher fines content, gravel, and consolidation at depth. For these reasons, the District does not anticipate encountering ancestral preserved sands within the designed dredge cuts. Proposed construction within Sand Borrow Area L will have no effect on historic properties, ancient landforms, or other cultural resources.

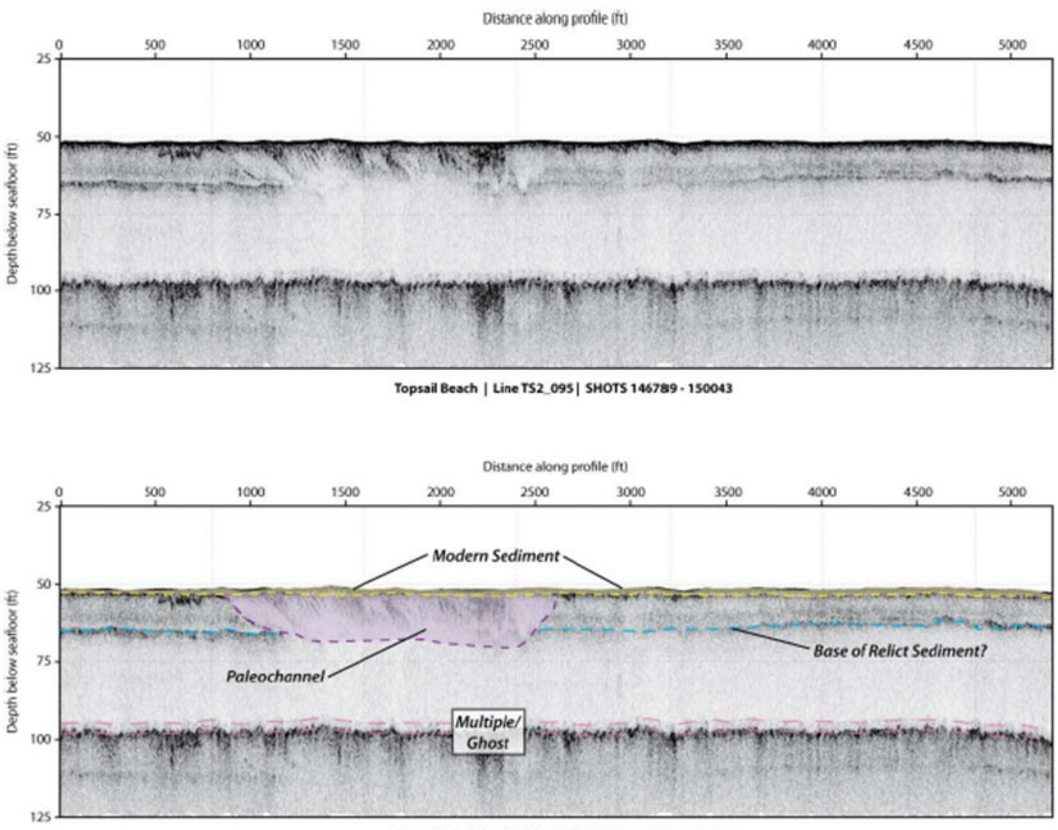

Figure 24. CHIRP sub-bottom profile across Sand Borrow Area L (Geodynamics 2012).

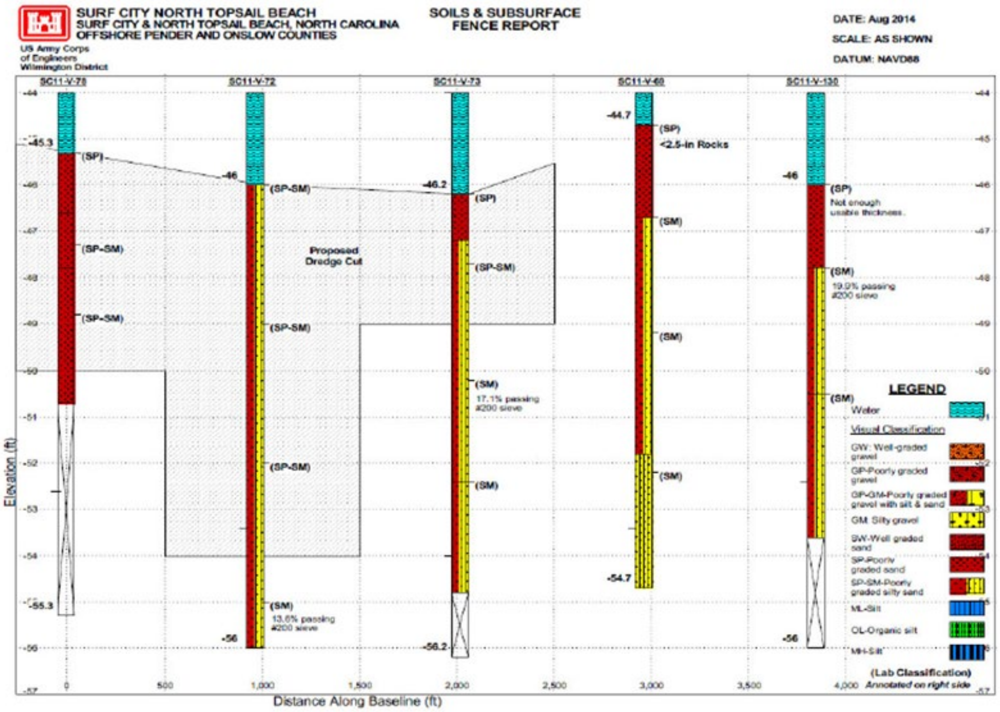

Figure 25. Geologic cross section in Sand Borrow Area L, 1 of 2.

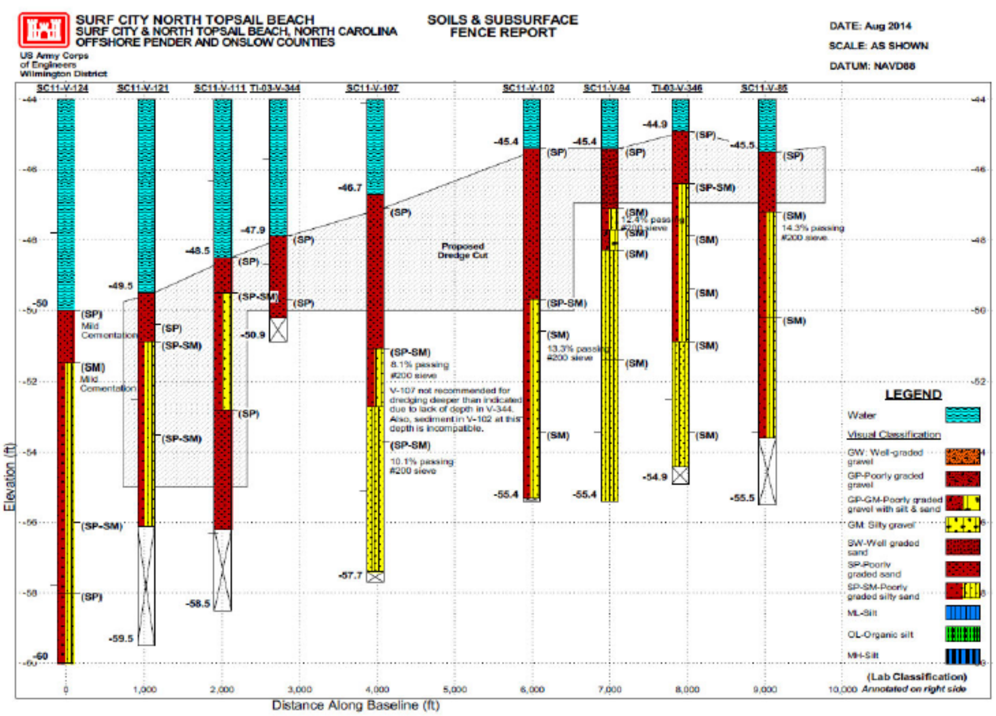

Figure 26. Geologic cross section in Sand Borrow Area L, 2 of 2.

10.0 Sand Borrow Area N

Sand Borrow Area N is located approximately 4-6 miles from the northern end of Surf City and is less than half a mile south of Borrow Area O. An independent paleochannel, P10, intersects the borrow area on the northeastern side and extends across the length of the borrow area before intersecting the southeastern end (Greenhorne & O'Mara, 2004; Figure 27). Surveys conducted by Geodynamics in 2013 reported a "complex morphology" with 3 distinct areas described as follows:

> *"The northwestern portion has a very low relief and is mostly complex due to the presence of small ripple scour features in the backscatter mosaic. These features wean out to an expansive open area of homogenous seafloor with minimal surficial features and almost no relief. The southwestern portion of Area N has a broken up portion of ledge-like features evident in the bathymetry and backscatter data. The northeastern region of Area N is dominated by ridge-like features of high intensity backscatter and elevation changes of 1-2 ft across these features. To the southwest of these ridge-like features is an area of higher intensity backscatter and slightly less elevation surrounded by small ripple scour features, similar to a signature of a previously dredged area."*

The 2013 survey also found that the most extensive accumulation of modern sediment occurred near P10 with the channel incised to depths of approximately 75 ft. These two studies found that the subsurface is highly variable within this borrow area. Several sub-bottom profiles have been included which demonstrate this variability with several of them depicting a P10 that is not well defined in the subsurface. Sorted bedforms and reworked material appears to dominate the modern sediments while the relict horizon shows a high intensity indicative of sand or rock at depth. Core logs indicate consolidation at depth with cemented sand and gravel reported in the field descriptions. Given the highly variable complex morphology and the chaotic signatures of the modern sediment, the potential for preservation within this part of P10 is low. For these reasons, the District does not anticipate encountering ancestral preserved sands within the designed dredge cuts. Proposed construction within Sand Borrow Area N will have no effect on historic properties, ancient landforms, or other cultural resources.

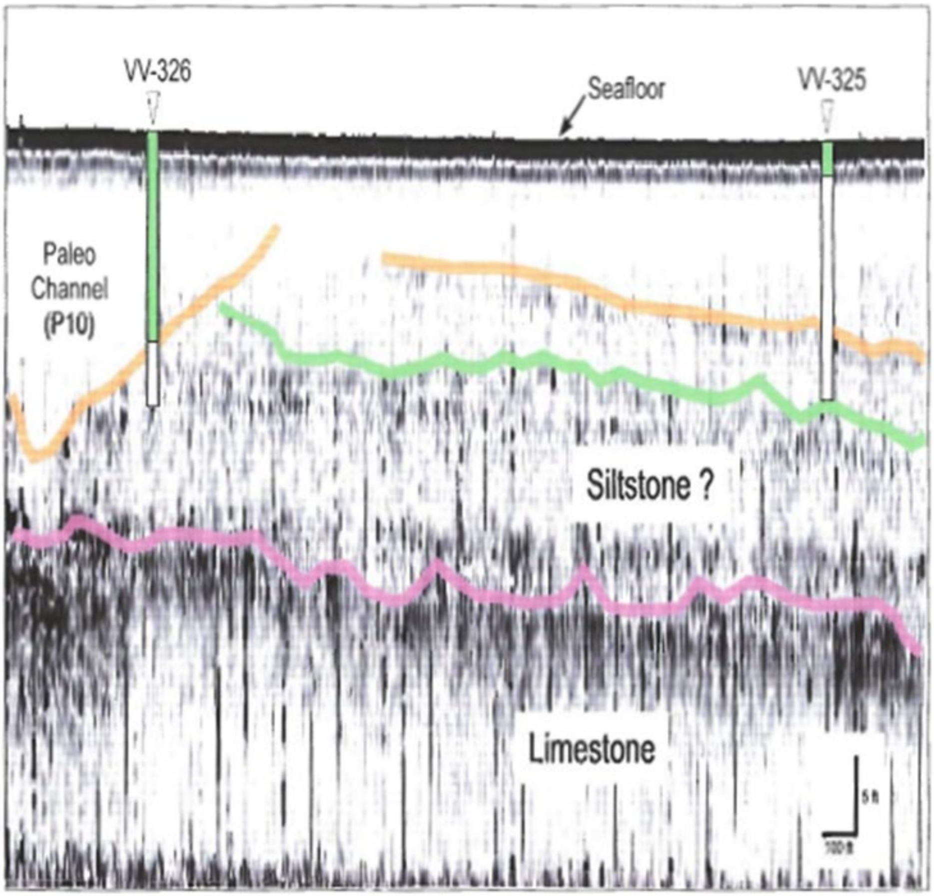

Figure 27. CHIRP provide of shallow paleochannel P10 (Ocean Surveys, Inc., 2004; Greenhorne & O'Mara, 2004).

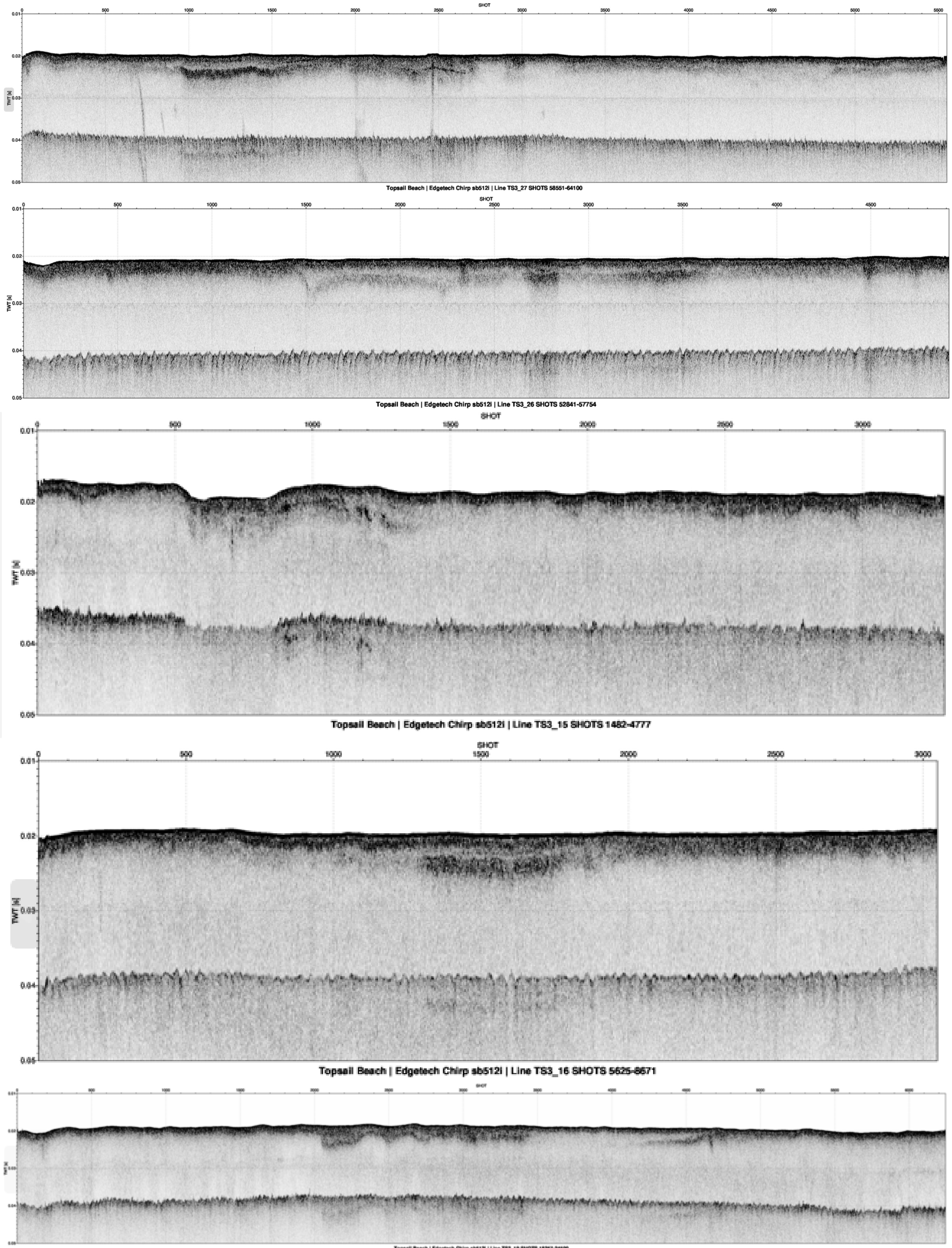

Figure 28. CHIRP sub-bottom profile across Sand Borrow Area N (Geodynamics 2013).

11.0 Sand Borrow Area O

Sand Borrow Area O is located less than half a mile shoreward of Borrow Area N. Paleochannel P10 continues landward from Borrow Area N intersecting the southwestern lobe of Borrow Area O with a smaller arm of P10 intersecting the northwestern edge of the borrow (Greenhorne & O'Mara, 2004; Figure 29). Like other borrows in Onslow Bay, Borrow Area O was found to have the thickest accumulation of sand within shore perpendicular sorted bedform ridges closer to shore (Geodynamics, 2012; Figures 29-31). The southwestern portion of P10 lies between two hardbottom outcrops with a variety of infill material from clean sand consolidated at depth, sands that become finer and consolidated with depth, and clay near the eastern edges of the channel. Acoustic signatures in the southern part of P10 appear less likely for preservation with chaotic signatures indicative of reworked material with consolidation at depth and clay to the eastern side. Acoustic signatures appear to support preservation on the northern part of P10 with this part of the channel extending to approximately 85 ft of depth; however, this part of the channel does not intersect preliminary dredge cut boxes for this part of the borrow. High-confidence preliminary dredge cuts for the northern portion range from 6-13 ft while the southern portion ranges from 2-10 ft. Although dredge cuts may encounter paleochannel sands, the District does not anticipate encountering ancestral preserved sands within the first 15 ft. Proposed construction within Sand Borrow Area O will have no effect on historic properties, ancient landforms, or other cultural resources.

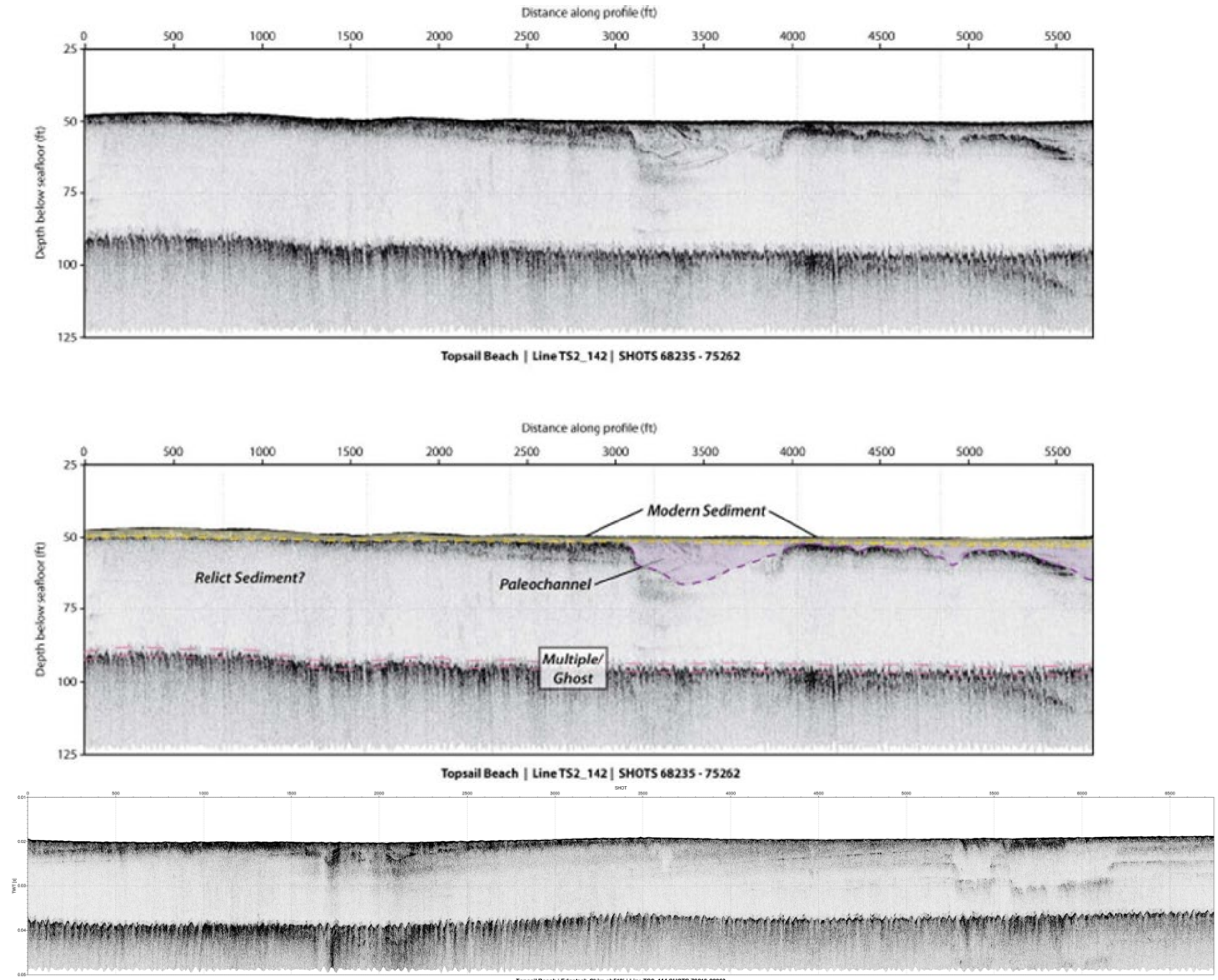

Figure 29. CHIRP sub-bottom profile across Sand Borrow Area O (Geodynamics 2012).

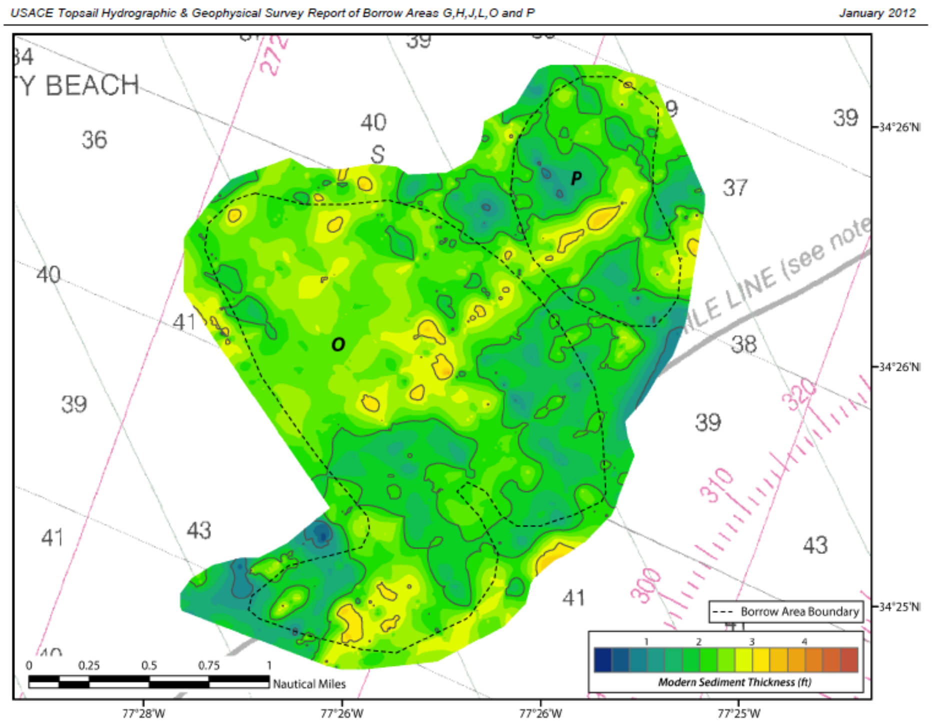

Figure 30. Modern sediment thickness isopach map for Sand Borrow Areas O and P, 1 of 2 (Geodynamics, 2012).

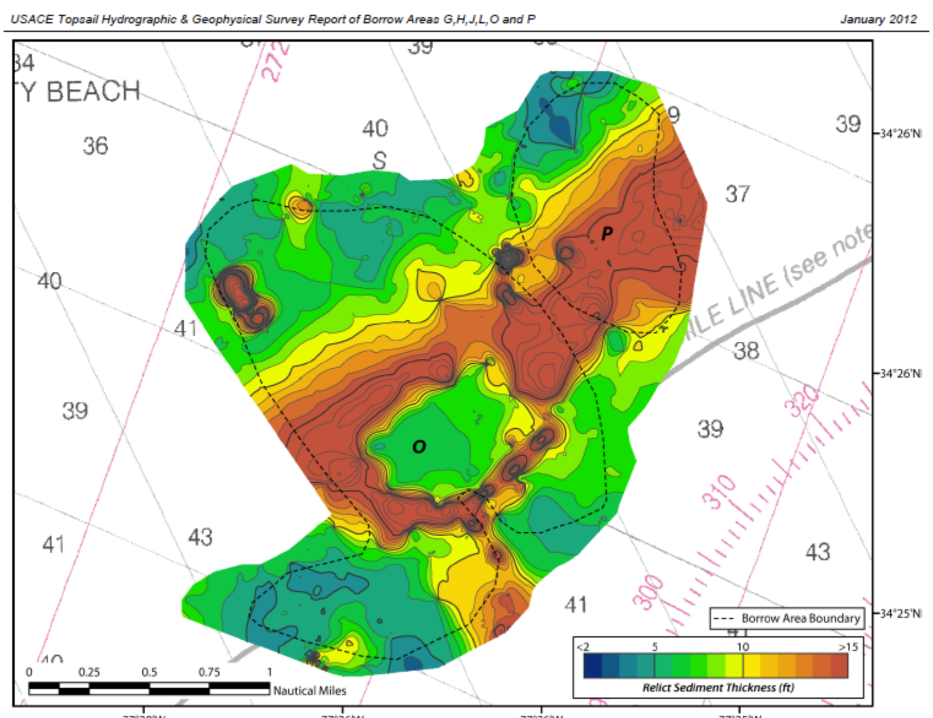

Figure 31. Modern sediment thickness isopach map for Sand Borrow Areas O and P, 2 of 2 (Geodynamics, 2012).

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