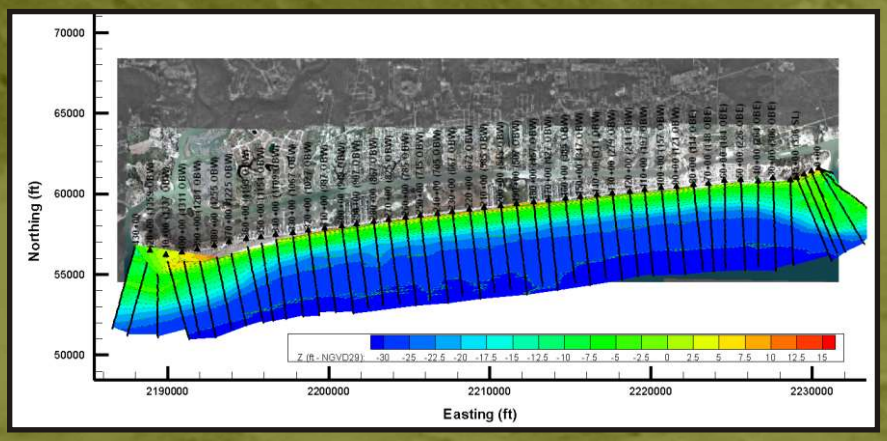
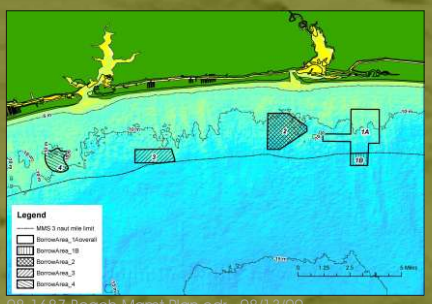
APPENDIX D

HOLDEN BEACH MASTER PLAN

Beach Management Planning
and
Borrow Area Investigation

Prepared For:
Town of Holden Beach, North Carolina





08-1687 Beach Mgmt Plan.cdr 08/13/09

August 2009

APPLIED TECHNOLOGY & MANAGEMENT

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1.0 INTRODUCTION

This study recommends future beach management planning for the Town of Holden Beach based on all available sand investigations proximal to Holden Beach. Existing permits (CAMA PN#14-02, USACE #200500935, DWQ #20011836) are scheduled to expire on December 31, 2009, the Town will be required to develop and apply for a new beach nourishment permit for any major beach nourishment work. Based on conversations with regulatory personnel, additional modifications of the existing permitting vehicle will be allowed; however in a limited capacity for emergency erosional events only.

While the Town's previous shoreline management initiatives have been successful, most of the island's beachfront is still eroding and will continue to do so. Implementation of the beach management planning proposed herein will help the Town sustain a healthy shoreline which is more stable, provides storm protection, supports recreational use and enhances property values.

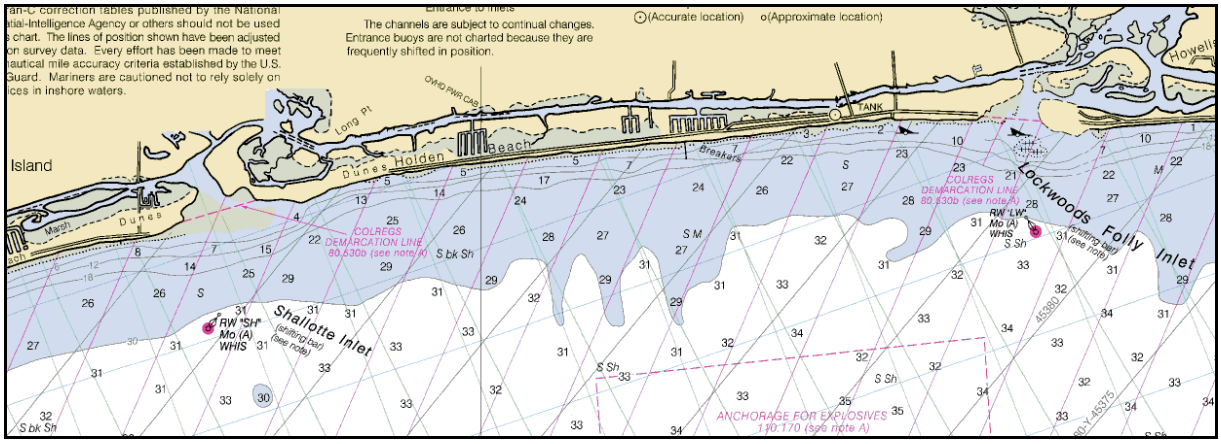

Photo 1-1. Project Location Map of Holden Beach, NC (NOAA Chart 11536)

The Town's updated beach management plan considers the changes which have occurred to the Holden Beach shoreline over the last decade as well as changes in policy that have been adopted by USACE and NCDENR during the course of the existing permit. These changes will impact borrow area sediment compatibility and monitoring requirements. In the past, a new permit typically required the development of either an Environmental Assessment (EA) or an Environmental Impact Statement (EIS). An EA is the preferred option because it involves significantly less work and time

compared to an EIS. However, regulatory personnel have recently begun attempting to streamline typical beach nourishment permitting, and this has been a major issue for the NC Beach and Inlet Management Plan (BIMP) development team. This study takes these recent and proposed policy changes into account and strives to develop the most cost effective beach maintenance plan for the Town of Holden Beach.

2.0 PROJECT HISTORY

The Town of Holden Beach has been proactive in monitoring and maintaining their shoreline, particularly those sections nearest to Lockwood Folly Inlet where erosion rates are the highest. Since 2002, the Town has conducted six relatively small beach nourishment projects utilizing upland borrow sources. The first project was constructed in spring 2002 to extend the USACE Section 933 Project which was part of the Wilmington Harbor Deepening (February 2002). Most recently the Town placed 190,000 cy along ~10,000 linear feet of shoreline in spring 2009.

Table 2-1. Summary of Holden Beach Nourishment Projects since 2001

Date	Primary Sponsor	Beach Stations Nourished	Approximate Volume of Material Placed (cy)	Nourishment Material Source
12/01 – 2/02	USACE	87+00 – 192+00	525,000	Wilmington Harbor Deepening Project
3/7/02 – 4/30/02	Town of Holden Beach (Phase I)	66+00 - 90+00, 175+00 – 217+00	141,800	Oyster Harbor upland site
3/02-4/02	USACE	20+00 – 30+00[1]	32,000	AIWW Maintenance Dredging
Winter 2002-2003	Town of Holden Beach	90+00 – 175+00	30,000	Boyd Street Disposal Area
9/04 – 11/04	USACE	15+00 – 40+00	113,230	Lockwood's Folly Inlet AIWW
12/03 – 4/04	Town of Holden Beach (Phase II)	46+00 – 68+00 and 215+00 – 238+00	123,000	Smith borrow site
5/5/06 – 5/24/06	USACE	15+00 – 40+00	62,853	Lockwood's Folly Inlet AIWW
Spring 2006	Town of Holden Beach	Eastern Reach	42,000	Smith borrow site
Spring 2006	Town of Holden Beach	Western Reach	3,200	Smith borrow site
1/08 – 3/08	Town of Holden Beach	60+00 – 95+00, 245+00 – 270+00	201,000	Smith borrow site
12/08-2/09	USACE	20+00 – 55+00	100,000	Lockwood's Folly Inlet AIWW
3/09-4/09	Town of Holden Beach	55+00 - 110+00, 210+00 - 255+00	190,000	Smith borrow site
		Approximate Total Volume since 2001	1,564,083	

Notes: 1) Lockwood's Folly Inlet Hazard Area

The Town-sponsored projects have *cumulatively* placed 730,900 cy of sandy material on the beach, most of which has been east of station 110+00. Figure 2-1 presents a figure with stationing and approximate placement locations. This represents an annualized rate of 104,400 cubic yards per year (cy/yr) [see Table 2-1 for details].

Besides the Wilmington Harbor deepening, Lockwoods Folly Inlet and certain sections of the Atlantic Intracoastal Waterway (AIWW) have provided sediment for USACE projects. Lockwoods Folly Inlet is a federally authorized navigation channel maintained by the USACE. Channel dredging is accomplished via pipeline, split-hull, or sidecast methods. Based on available information, it is estimated that approximately 40,000 cy/yr of Lockwoods Folly inlet dredged material is placed on the east end of Holden Beach. The remainder is either placed on Long Beach or sidecast.

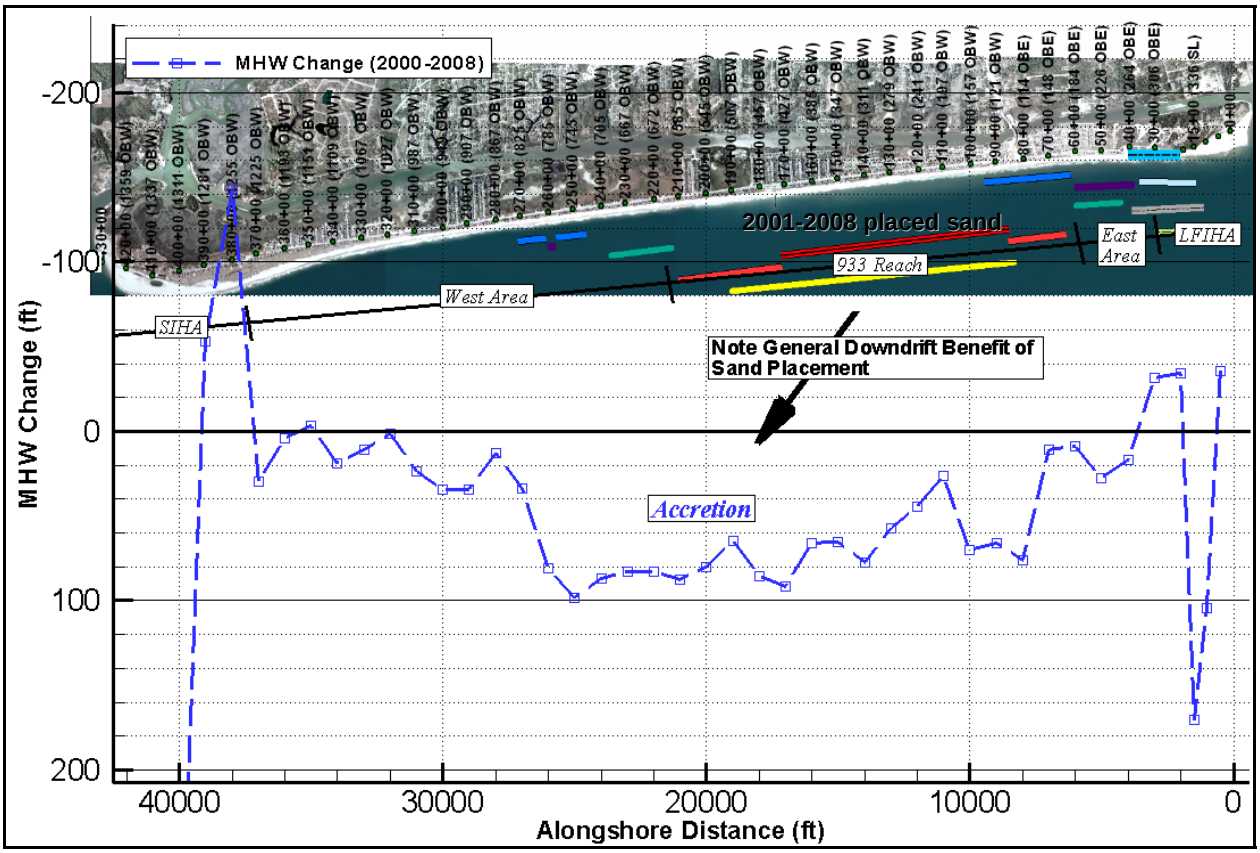

Photo 2-1: Holden Beach MHW change from 2000 to 2008. Note general western drift. For more detail on nourishment events, see Figure 2-1 on the following page.

In total, federal projects since 2001 have placed ~ 833,000 cy on Holden Beach. The total quantity placed since 2001 is ~1.56M cy, or an annualized average of ~195,000 cy/yr. Photo 2-1 presents the placement locations in relation to shoreline growth since 2001. Note the general downdrift benefits from placement on the eastern sections of shoreline.

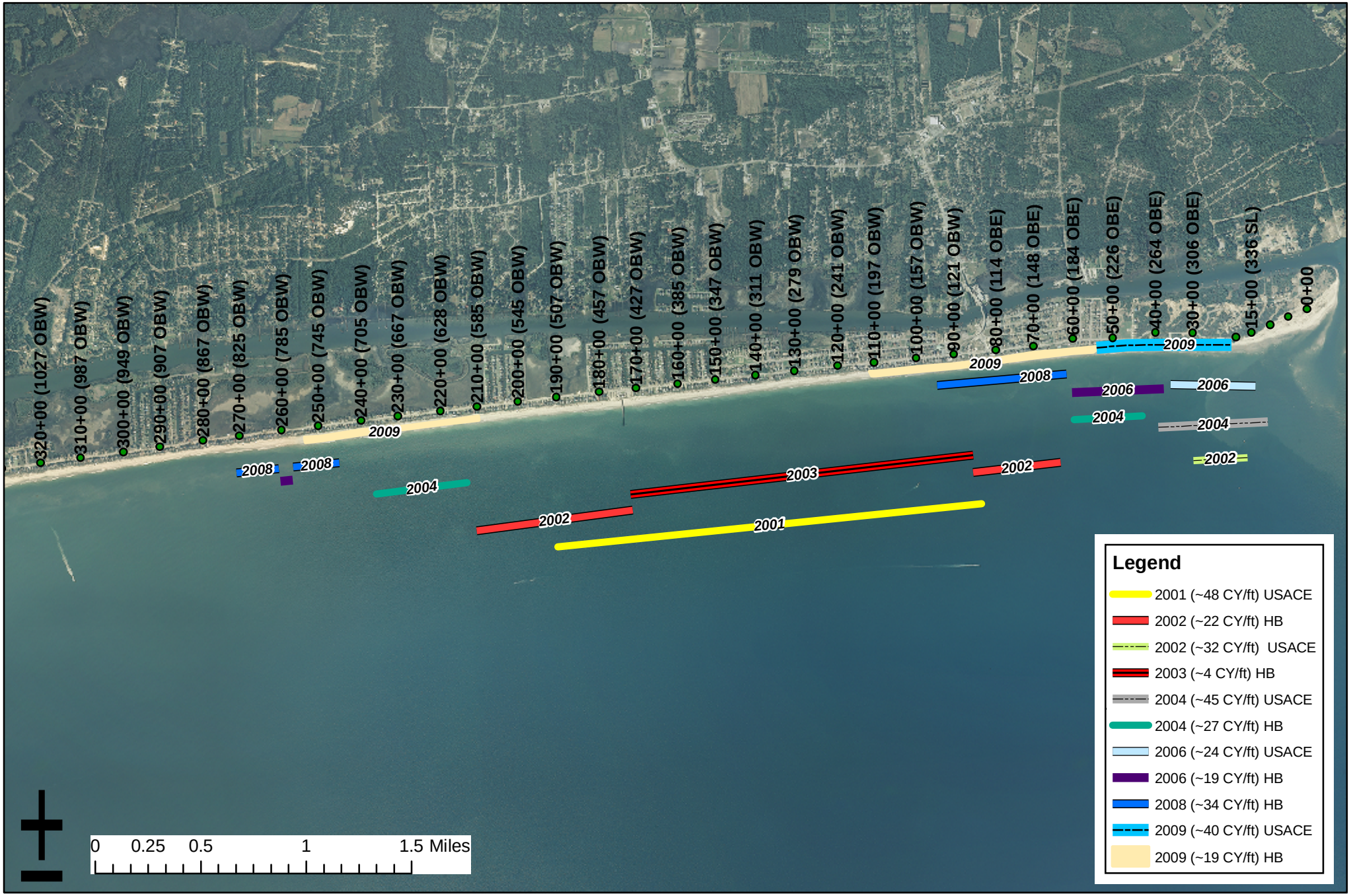

Figure 2-1:
Holden Beach Nourishment Activity Since 2001
(HB=Holden Beach)

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3.0 PROJECT NEED

The primary cause of shoreline retreat along Holden Beach is due to long-term erosion through natural processes of littoral sediment transport, storm related recession and rise in sea level. Tidal currents, wave focusing and storage of sediment in the ebb and flood shoals of surrounding inlets (Shallotte and Lockwoods Folly) have also considerably affected the shoreline history of Holden Beach. Along the eastern end of the island, erosion has been prominent due to the continual shifting and reorientation of the main ebb and flood channel(s) of Lockwoods Folly Inlet. The result has been a starvation of sand along the eastern portion of the island which has caused an "erosional wave" propagating west. Net transport has been estimated to be ~ 228,000 cy/yr to the west (Thompson, 1999).

As described in Section 2 above, the Town has been proactive in monitoring and maintaining their shoreline since 2001. Figures 3-1 and 3-2 present a comparison of the 2008 and 1993 shorelines where the benefits of the Town's management activities can be seen. The Town has funded six truck haul beach nourishment projects ranging in volume from 30,000 to ~200,000 cy, placing unit volumes of 3.5 cy/ft to 35 cy/ft. The recent projects have allowed the Town to keep pace with erosion in many areas (except for the eastern end). However, the process of placing additional sand must continue into the future to ensure the recreational and storm damage protection benefits of a wider sandy beach.

For some time now there has been a growing demand from the residents of Holden Beach, as well as in neighboring Supply, NC, for the Town to abandon truck haul projects and pursue alternate and/or offshore borrow sites. The Town has not been fully satisfied with upland borrow sources for the following reasons:

- Sediment quality from upland sources:
    - Grain size: smaller mean grain size and larger percent fines affects project performance and life cycle
    - Sediment Color: orange/red sediment content negatively impacts shoreline aesthetics and potential negative environmental impacts
- Slow production rates limit the scale of the nourishment projects

- Limitations on seaward placement/extent of fill
- Small scale projects typically not as cost effective or an efficient use of fill material
- Repeated small scale projects may exacerbate environmental impacts
- Frequent upland projects negatively impact traffic, roads, and tourism

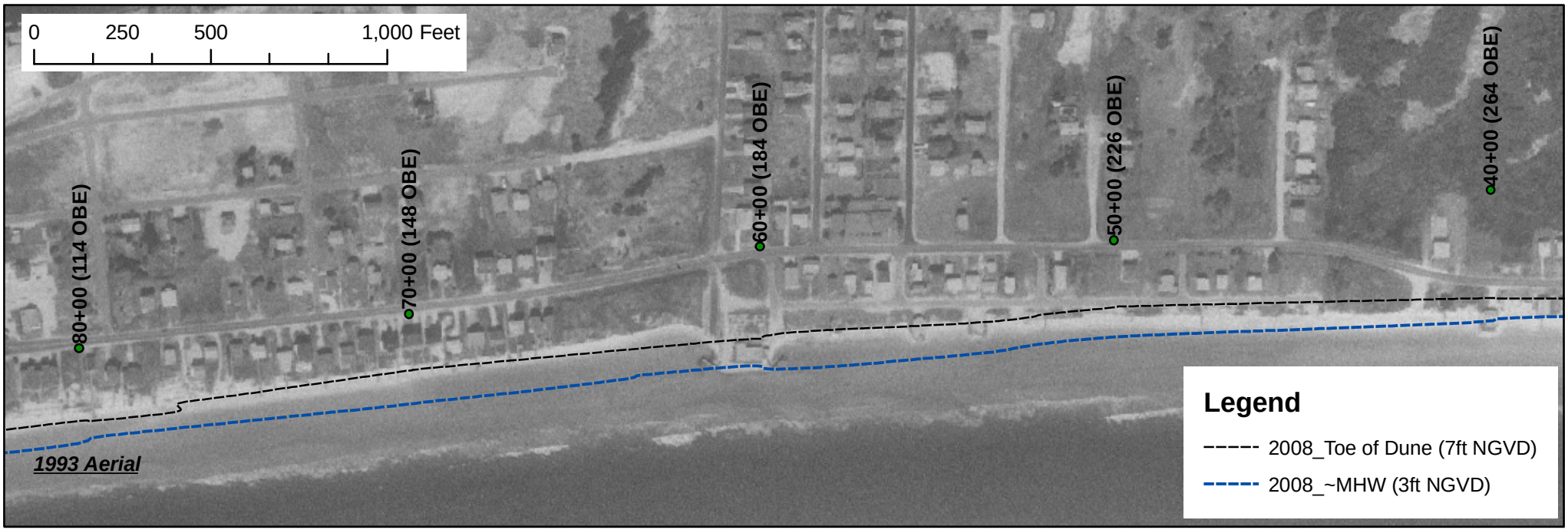

Figure 3-1
1993 and 2008 Aerial Comparison - East End

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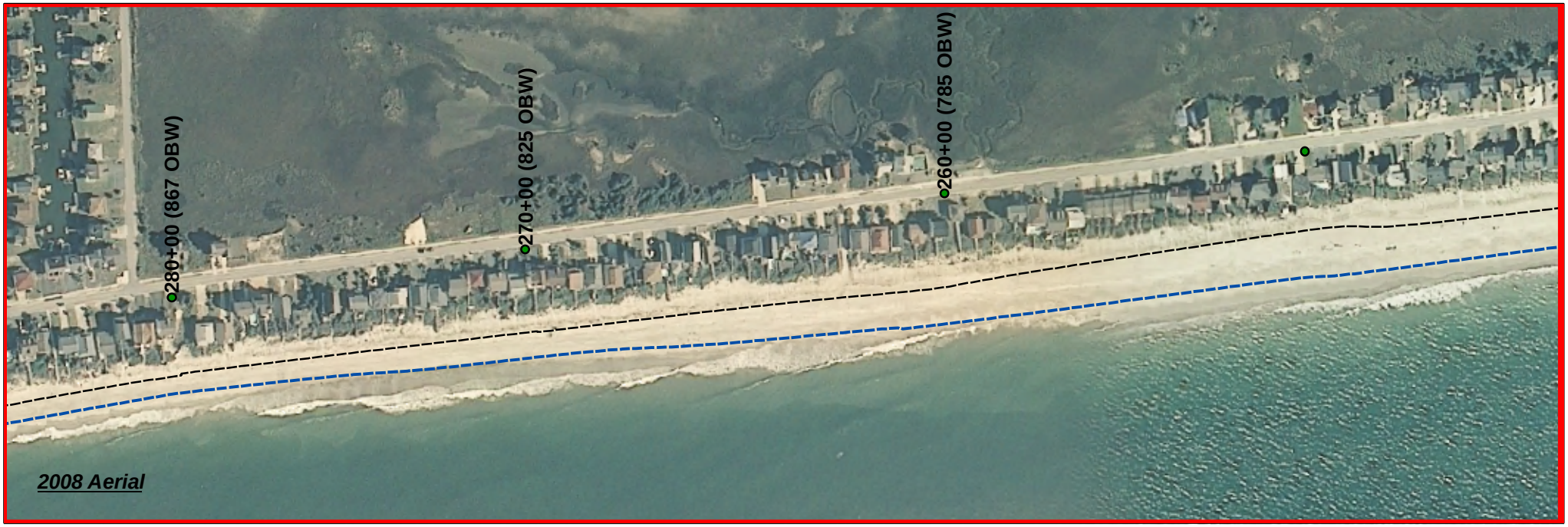

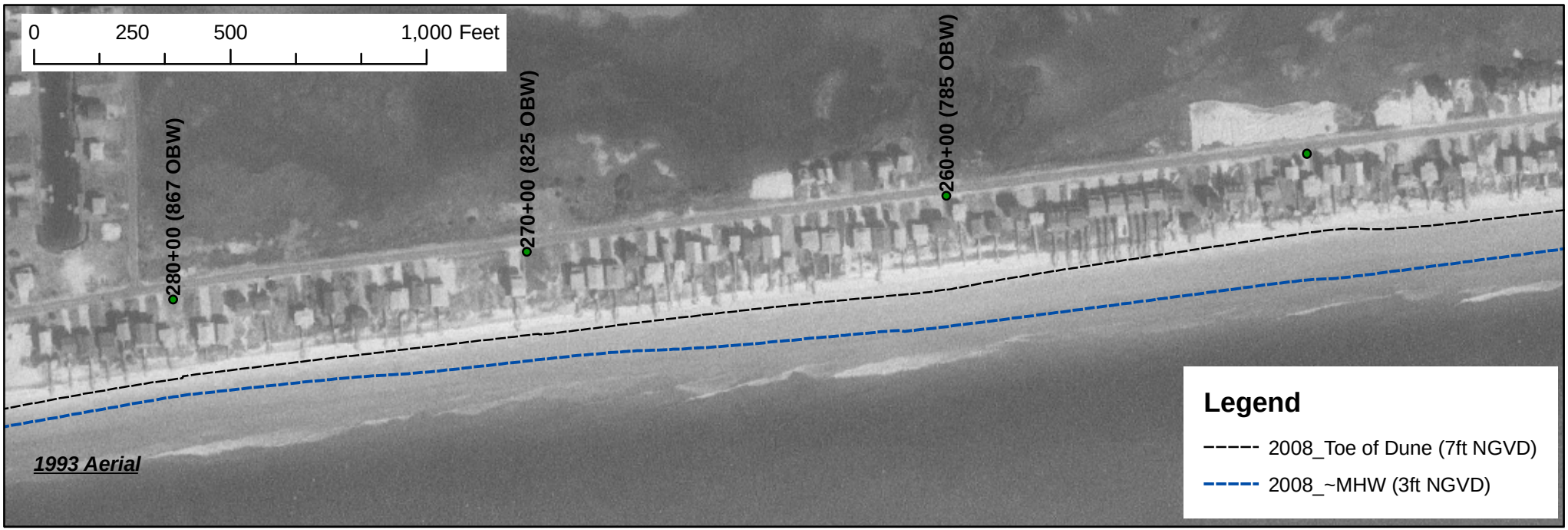

Figure 3-2
1993 and 2008 Aerial Comparison - West End

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4.0 EXISTING PERMIT

Since 2002, Holden Beach has performed beach nourishment activities under CAMA Permit No. 14-02, NCDWQ Permit No. 20011836, and USACE Permits No. 200101101 No. 200500935. The Town most recently modified its existing permits in early 2009 in order to allow a FEMA sponsored nourishment to mitigate for Tropical Storm Hanna damages (See Photo 4-1). The existing permits expire on December 31, 2009.

An additional modification request to extend this permit expiration date has been recommended by both CAMA and USACE regulatory staff. This would allow Holden Beach to have an active permit for emergency use associated with storm events. Volumes associated with these emergency activities are typically less than 100,000 cy (although the 2009 FEMA permit mod was 190,000 cy). Note that once an emergency nourishment is required, additional modifications to the permit pertaining to volume, placement, and possibly borrow sources would be necessary. The Turkey Trap Road and Smith Borrow sites are currently authorized sand sources in the existing permits.

Photo 4-1: 2009 Holden Beach Nourishment Reaches

5.0 CORPS PLANS

The USACE has developed a nourishment schedule where, currently, it is anticipated that Holden Beach will receive approximately 250,000 cy per year in sediment (USACE-CHL, 2008) (See table 5-1). Sediment sources currently consist of Lockwood Folly Inlet and either Jaybird Shoals or Frying Pan shoals.

Table 5-1. USACE Alternatives Analysis (Alt 8 is preferred alternative)

	Holden Beach		Lockwood Folly			
Alts	48 yr total (cy)	Annual (cy/yr)	48 yr total (yr)	Annual (cy/yr)	Notes	Results
Alt 0	-	-	-	-	No action	Severe Erosion
Alt 1	18,624,000	388,000	28,256,000	588,667	49.7 mcy total from LF, Shallotte, Tubbs	downdrift erosion of LF, LF depleted
Alt 2	18,624,000	388,000	24,296,000	506,167	49.7 mcy total, 8.7 mcy from SMP	ebb shoals depleted
Alt 3	8,000,000	166,667	6,000,000	125,000	20.7 mcy total, 8.7 mcy from SMP	ebb shoals recover almost fully
Alt 4	9,000,000	187,500	6,000,000	125,000	same total as 3, but diff placements	
Alt 5	21,831,017	454,813	24,296,000	506,167	similar to Alt 2	ebb shoals depleted
Alt 6	12,207,017	254,313	6,000,000	125,000	same as Alt 4, except initial 3.2 mcy fill	
Alt 7	9,000,000	187,500	7,500,000	156,250	more economical placement (LF goes to HB)	LF and Shallotte dredged 3mcy more because Holden doesn't get 1st SMP nourishment
Alt 8	12,207,017	254,313	7,500,000	156,250	more economical placement (LF goes to HB)	LF must be dredged on a 4-yr cycle (same with Alt7)
Alt 9	6,000,000	125,000	6,000,000	125,000	same as Alt 7-8, except 3mcy less sand	not as ideal
Alt 10	9,207,017	191,813	7,500,000	156,250	same as Alt 7-8, except 3mcy less sand	not as ideal

Notes: Alts 1, 2, & 5 place significantly more sand. All other alts referred to as 'sand-limited options'.
SMP=sand management plan (Jay Bird or Frying Pan Shoal)

It is estimated that 250,000 cy/yr annualized will satisfy Holden Beach sediment deficit requirements; however, USACE beach nourishments are unfortunately susceptible to future budget constraints and variations that can significantly delay or even cancel project execution.

Therefore, despite the outcome of the USACE General Reevaluation Report (GRR) and other USACE and State nourishment studies, it is recommended that the Town continue with its own beach management plan and coordinate closely with federal and state activities. Data collection to support the GRR project permitting began this summer (2009) however; it is estimated that beach placement activities are still several years out.

As seen from Table 5-1, Holden Beach is planned to receive ~254,000 cy of material per year with ~156,000 cy coming from Lockwood Folly. Lockwood Folly is scheduled to be dredged every 4 years; therefore nourishments of approximately 625,000 cy are planned to occur. This represents a significant amount of sand in relation to previous projects and is likely sufficient to maintain the Holden Beach shoreline under typical wave conditions. Conversely, excavating 625,000 cy from Lockwood Folly ebb shoals may be difficult to permit and impacts to nearby shorelines could potentially be significant. Note that Lockwood Folly dredging is not solely devoted to Holden Beach nourishment under all alternatives.

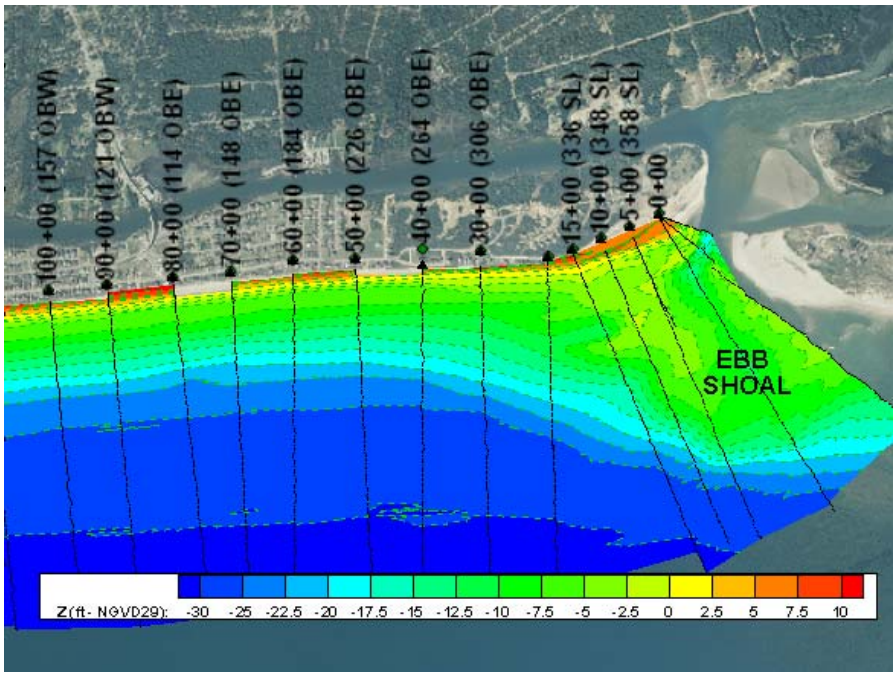

Photo 5-1: Lockwood Folly ebb shoal region. Color contours represent October 2008 beach survey.

6.0 COUNTY ACTIVITIES

Lockwood Folly Aquatic Restoration NOAA grant was submitted in July 2009 and is primarily sponsored by Brunswick County. Permitting has not begun and presumably will not until a decision to fund the grant occurs. The project was originally planned for this winter (2009/2010 dredge window) however permitting can be lengthy and this project may not occur until the following winter. Approximately 90,000 cy of material is to be placed at approximately 30 cy/ft (similar to recent Town project widths). See Photo 6-1 for the preliminary fill template, which overlaps with the Town's latest project in 2009.

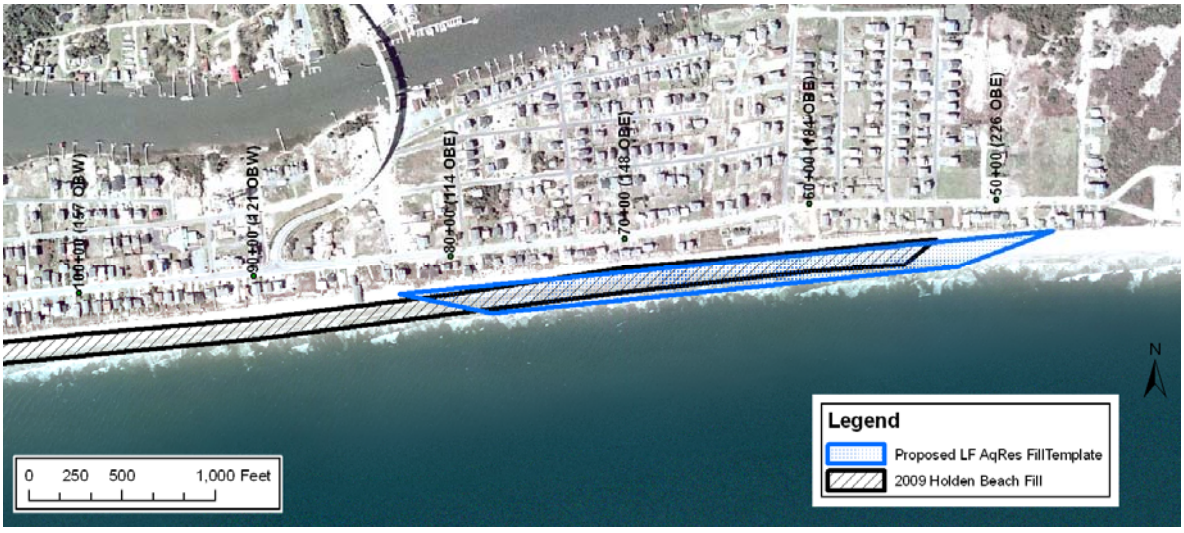

Photo 6-1. Currently proposed fill template using sand from the LF Aquatic Restoration Study. Note overlap with 2009 HB project.

7.0 NEW PERMIT

7.1 BEACH NOURISHMENT VOLUMES AND PLACEMENT

One of the primary goals of this study is to have no net reduction in sand volume from Holden Beach. Additional needs to increase storm protection, increase recreational beach area or address hot spots may also be required.

As of October 2008 (i.e., the last island-wide survey), the eastern half of Holden Beach (Station 30+00 to Station 200+00), excluding the inlet hazard area, remained at a 140,000 cy deficit relative to the post USACE 933 Project survey (June 2002), despite the Town adding nearly 500,000 cy of sediment in periodic small scale nourishment projects during that timeframe.

The October 2008 survey was performed one month after Tropical Storm Hanna, which was calculated to have eroded approximately 190,000 cy of material from Station 30+00 to 272+00, which represents all sections of beach where Town-sponsored nourishment has occurred.

In general terms, the USACE 933 project advanced the shoreline while all activities since then have been effective at maintaining the shoreline. Therefore based on recent nourishment activities, a range of 125,000 to 250,000 cy/yr is estimated to be needed, under normal wave activity. As previously mentioned, the USACE has recently proposed approximately 250,000 cy/yr, given on-time scheduling and adequate funding.

In terms of Holden Beach permitting volumes and placement, the new permit is recommended to include Stations 30+00 to 300+00, which represents the majority of the shoreline (approximately 5.3 miles) with an average placed volume of 50 cy/ft (similar to the USACE 933 project). This equates to a volume of 1.4 million cubic yards, which would be broken down into manageable phases of work, similar to the original 2001 permitting effort. Note that some research has recommend fill volumes greater than 70 cy/ft because these were found to provide a greater than 70% retention of fill after one year based on review of several projects (Stauble and Hoel, 1986).

Also note that some of the localized erosion rates are beyond the ability to address with fill placement alone. Typically loses greater than 10 ft/year cannot be effectively addressed with fill alone, which is the case adjacent to Lockwood Folly Inlet. In a recent N.C. Coastal Resources Commission (CRC) meeting in February, Dr. William Cleary identified both Lockwood Folly and Shallotte Inlets as good candidates for terminal groins.

7.2 UPDATED PERMITTING REGULATIONS

The new permitting effort for a major beach nourishment activity will likely require an environmental assessment (EA) or environmental impact statement (EIS), depending on the borrow site and the volumes proposed. Holden Beach developed an EA for the 2001 permitting and has since been working off this document via CAMA permit modifications. Because of the significant differences in time and cost in EA versus EIS development, permitting coordination has already begun in order to optimize this process. Nonetheless, several new NCDENR policy changes will affect all nourishment permitting and these include new sediment criteria and a new static vegetation line policy

7.2.1 NEW SEDIMENT CRITERIA

New sediment criteria will increase monitoring efforts and costs; although it would not represent a large increase compared to the current data collection and monitoring programs (as established by the Holden Beach 2001 permitting effort). One significant change is that sand sample collection and analysis is required out to a 20 ft depth, which necessitates a boat as well as increased laboratory analysis. Current sand sample collection only occurs at MLW, MSL, MHW, and at the toe-of-dune. Percent fines, percent shell, and grain size criteria have been increased slightly, however previous Holden Beach nourishment sediment would have satisfied these criteria.

7.2.2 STATIC VEGETATION LINE

Holden Beach has no static vegetation line. The USACE 933 project in 2001 intentionally placed just under 50 cy/ft to avoid the static vegetation line trigger. All subsequent USACE and Holden Beach fills were also small enough to avoid this trigger (i.e., less than 200,000 cy). A recent change to NCDENR policy has eliminated the 50 cy/ft criteria and have increased the volume trigger to beach fills greater than 300,000 cy (i.e., 'large project'). Therefore the next beach fill that is greater than 300,000 cy, either

by the USACE or by the Town, will trigger the establishment of a static vegetation line. Holden Beach setbacks are presented in Photo 7-1. Note that western end of the island is the minimum 60-ft and not completely shown

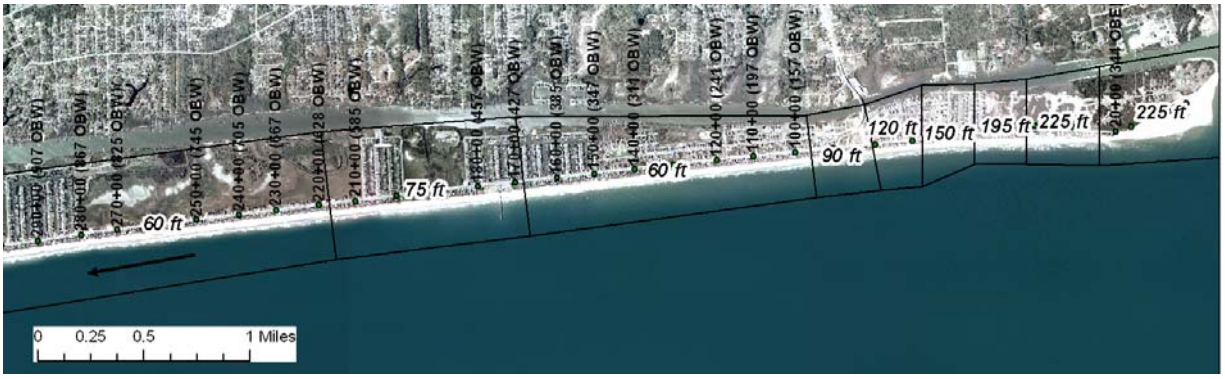

Photo 7-1. 2004 CAMA Setback Zones on Holden Beach.

It is important to note that new rules allow for communities to petition the CRC for a static line exception after 5 years have elapsed since nourishment project construction. The petitioner must develop a 30- year nourishment plan that; (1) identifies the appropriate sand resources for the life of the plan, and (2) identifies realistic monetary resources for the plan. If the static line exception is granted, the oceanfront properties along the community can revert to using the existing vegetation line criteria (which is on a lot-by-lot basis).

This updated policy essentially encourages long-term beach maintenance activities that provide storm mitigation while also allowing for the replacement of older, non-conforming structures with newer, conforming structures.

The future USACE GRR beach fill placements, to occur over the next 50 years, are currently planned as the static vegetation line exception vehicle for several communities, including Carolina Beach and Wrightsville Beach (NCDENR's Jeff Warren, personal communication). Therefore several precedents will likely be established prior to Holden Beach static vegetation line issues. Of course any project-established static vegetation line will be in effect for 5 years at a minimum, before the exception is granted.

In summary, USACE Holden Beach activities are recommended to be used for static line exception in order to reduce costs to Holden Beach. Note that this study has identified up to 25 years worth of sand and more discussion on potential available volumes are discussed in the following Section. Also, the Town does have the necessary funding in place (i.e. the BPART fund); however additional sediment criteria related testing would be immediately required for all 25 years worth of sand.

8.0 POTENTIAL BORROW SITES

Several borrow sources were considered for this study and these generally include: upland, inlet/AIWW dredged disposal areas, offshore, and Lockwood Folly Inlet. All borrow sites were evaluated for sediment quality and quantity as well as permitting and logistical requirements. Figure 8-1 presents a location map showing investigated upland and inlet borrow areas.

8.1 UPLAND BORROW SITES

Given the more stringent constraints on borrow source compatibility (introduced in 2008 and 2009), it is anticipated that permitting the use of upland borrow areas will be more difficult; however, natural resources permitting and post-project monitoring are typically less rigorous when compared to offshore or inlet borrow sources. Many of the reviewing agencies involved in beach nourishment permitting, such as the USFWS and NMFS, are more focused on ocean resources; therefore, upland permitting can be more expedient. Additionally, truck haul projects do not involve the expensive mobilization/demobilization costs associated with dredges and can occur much more quickly.

Of course, sand color, smaller volumes, grain size, and placement methods (i.e. trucking) are potential downsides to this alternative. Additionally, the N.C. Department of Transportation requires permitting and has the ability to shut down operations or require roadway mitigation. Nonetheless, upland borrow sites can be extremely valuable for unplanned/emergency mitigation efforts, such as the 2009 Holden Beach project.

As such, the Town became aware of several new potential upland borrow areas during the 2009 nourishment bid process and further investigation of these sites was performed.

8.1.1 TURKEY TRAP ROAD (PERMITTED)

The Turkey Trap Road Borrow Site is located near the intersection of Turkey Trap Road and Stanbury Road, and is an approximate 3.6 mile drive to the beach strand. The majority of the 38 acre site is medium to densely covered with trees and other vegetation. In early 2005 ATM contracted with Engineering Consulting Services, Inc.

(ECS) to collect 10 soil borings from within the site. The borings were driven to a depth of approximately 35-40 ft below grade. From these 10 borings, 40 composite samples were created and analyzed by ECS according to standard grain size analysis methods.

The soil borings revealed clay lenses throughout the borrow site, varying in thickness between 2 ft and 8 ft, with the larger thicknesses found in the southwest area. Towards the northeast end, clay lenses were less substantial and mean sediment grain sizes generally increased. The sediment is described as light grey, fine to medium sand toward the northeast portion of the borrow site and brownish grey, fine to medium sand and clayey sand toward the southwest. The composite median and mean grain sizes for the borrow site are 0.23 mm and 0.28 mm respectively and the average percent fines (percent of material passing the #200 sieve) is 9.4%.

The Turkey Trap Road Borrow soil is stratified and will require significant sidecasting and sorting of material to extract the best quality for the beach. Additionally, the presence of wetlands will complicate the excavation process. At best, the Turkey Trap Rd Borrow site is only expected to yield ~ 460,000 cy of material. Note that this yield is substantially less than the original 800,000 cy estimate because of increased wetland buffers. Figure 8-2 shows the Turkey Trap Road borrow area (also known as the Kirby Walter site in previous permitting documents). The site has the necessary permits (i.e., NCDENR, USACE, Brunswick County) however an NCDOT driveway permit is still needed and preliminary discussions have indicated that NCDOT may require some roadway upgrades. These upgrades have been estimated at $375,000 by Criser Troutman Tanner Engineering; which will add significantly to the cost of using this borrow area.

8.1.2 SMITH BORROW SITE (PERMITTED)

The Smith site has been tested previously and used in previous years for beach nourishment. The material quality varies depending on location within the property, but has in general been found to be acceptable. The Smith site is an approximate 4.0 mile haul distance from the beach strand. The volume remaining within the Smith site that is of beach quality is currently unknown as additional borings would be required prior to further use of this site. There are some limitations to the Smith site, due to the Owner's development plans that dictate which areas are possible for excavation (and may not

correspond to the best quality sands). The site has also been for sale for residential development and therefore may not be available for future use. For planning purposes, this site cannot be relied upon as a future source, however potentially 200,000 cy of beach compatible material could be obtained under best-case-scenario conditions. Figure 8-3 presents the Smith borrow area.

8.1.3 TRIPP UPLAND SITE

Limited boring information as well as test pit observations indicates that the Tripp site contains potentially a large quantity of light colored beach quality sand. The Tripp site is an approximate 64 acre parcel located off Makatoka Rd in Supply, NC. The site is located west of HWY 17N and is approximately a 13 mile drive from the beach strand. Additional borings are recommended and would likely be required for permitting. Figure 8-4 presents the Tripp site. In comparison to the existing permitted borrow sites; borings indicate that this represents the best upland material in terms of color and grain size. A large pond has been excavated at this site previously and is approximately 55 ft deep, therefore a relatively large amount of material may be available. The site also has an existing mining permit (similar to the existing permitted borrow areas).

Photo 8-1: Tripp Site Test Pit

According to the existing mining permit, approximately 8 acres of land has been designated wetland while the existing lake is also approximately 8 acres. Some areas of clay were also identified during test pit excavation. For estimated sand volumes, it was assumed that 25 acres was available (based on borings, test pits, existing wetland delineation, and USDA soil maps). Assuming a 30 foot cut-depth, this equates to 1.2 million cy available. Section 8.5 summarizes potential volumes available for all alternatives. Also note that the Tripp site is also under consideration for sale and a potential buyer contacted ATM about its use as a borrow area.

8.1.4 OTHER UPLAND SITES

Several other sites were proposed by contractors during the 2009 bidding process; however none were estimated to contain sufficient volumes of beach compatible material without excessive sidecasting and separation of unsuitable material. Color and percent fines were also generally marginal. Future publicized announcements for potential borrow areas are recommended if additional upland sand resources are required.

8.1.5 MONKS ISLAND

Monks Island is a currently inactive dredge spoil site located adjacent to the Atlantic Intracoastal Waterway, on the western end of Holden Beach. The island is long and narrow with roughly uniform topography. The western half of the island has been divided into 5 residential lots which are currently for sale. The eastern end is available for mining. The potential borrow area consists of about 10 acres of land up to an elevation of +20 ft NGVD (~mean sea level). Based on a site visit by ATM and Holden Beach personnel, the material contained within the existing dikes consists of fine to medium grained sand and may be suitable for placement on the beach. However, currently there are no available borings to quantify sediment quality and quantity.

Photo 8-2. Monks Island CDF

Also note that the USACE has recently surveyed this borrow area (new stakes were in place during the July 2009 site visit) and is evaluating it for further disposal. The USACE is also evaluating the possibility of building up the confining berm (which is currently about 30 feet above mean sea level) to increase capacity. According to USACE staff, the site consists of a layered mixture of beach compatible/non-compatible material and is constructed on a wetland base. Therefore its use as a borrow area for beach nourishment is questionable, however it cannot be ruled out. Figure 8-5 presents an image of this location.

8.1.6 SHEEP ISLAND

Sheep Island is a currently inactive dredge spoil site located adjacent to the Atlantic Intracoastal Waterway north of Long Beach (see Figure 8-6). Sheep Island is long and narrow; central portions of the island lie at elevations near or a few feet above sea level while topography peaks at either end where dikes have been constructed by the USACE to contain dredge spoil.

At the western end of the island, the spoil area covers approximately 4 acres and fill reaches a height of +20 ft NGVD. At the eastern end the spoil area covers approximately 28 acres and the fill reaches a height of +20 ft NGVD. Based on an ATM site visit in July 2009, the material contained within the dikes consists of fine to medium

grain sand and may be suitable for placement on the beach. However, currently there are no available borings to quantify sediment quality and quantity.

Photo 8-3: Sheep Island confined disposal facility (CDF)

Similar to Monks Island, Sheep Island was formed by sidecasting and pipelining dredged material onto wetlands decades ago (a practice which is no longer allowed). Therefore the base of Sheep Island consists of cohesive muddy sediment (i.e. wetland soil), while the material within the CDF consists of a layered mixture of compatible and non-compatible material.

As a result, its use as a borrow area for beach nourishment is questionable. Figure 8-6 presents an image of this location.

Also note that the USACE is also preparing this site for non-compatible dredged material disposal this winter (2009/2010) (see Photo 8-4).

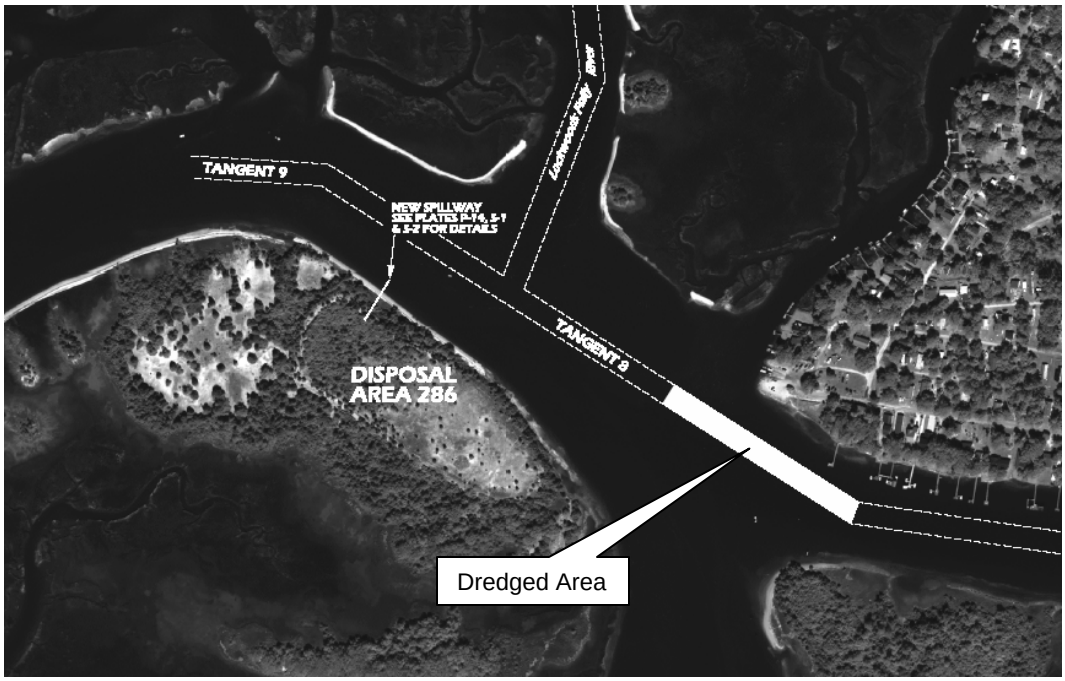

Photo 8-4: Sheep Island confined disposal facility (CDF) planned use for 40,000 cy of non-compatible beach material in 2009/2010.

According to USACE AIWW dredging plans, 40,000 cy of material will be disposed on Sheep Island this winter. Note that borings of the proposed dredge footprint show material quality just outside of acceptable limits (fines in the 10-15% range, when less than ~10% is required). Therefore this sand is suitable for dune reconstruction and could be suitable for beach placement with some processing.

8.2 LOCKWOODS FOLLY INLET

While inlets on the US east coast generally provide good quality sand (which comes from adjacent beaches over time), inlet borrow source permitting can be very costly and time consuming, typically requiring an EIS and extended agency review. Therefore, use of inlet ebb shoals must be approached with caution and fully evaluated. In contrast to permitting inlets as borrow areas, dredging for navigational purposes and placing dredged sand on nearby shorelines as a 'beneficial use' of dredged material is typically much less complex.

Lockwoods Folly Inlet contains a federally authorized navigation channel and the USACE performs routine maintenance dredging for navigation using pipeline (i.e.,

cutterhead), split-hull hopper and side-cast dredges. Unlike Shallotte Inlet, there is no defined dredge template and dredging activities are restricted to “deep water”. This restriction limits the ability for the USACE to perform advanced dredging; consequently, dredging within Lockwoods Folly Inlet itself generally occurs 2 - 3 times per year. Several shipwrecks also exist at this inlet that must be avoided. The shoaling rate has been estimated between 125,000 cy/yr (OCTI, 2008) and 140,000 cy/yr (Machemehl, et al., 1977). An additional concern of the “following deep water” dredging practice is that the channel is currently very close to the Holden Beach shoreline, which can exacerbate erosion. A more centrally located channel would provide more shoreline stability.

Borings collected within the inlet and inlet crossing indicate beach quality sediment layer thicknesses between 3 and 7 ft. The conceptual Lockwoods Folly Borrow Area covers approximately 22 acres (see Figure 8-7); assuming an average layer thickness of 3 ft it is estimated that this borrow area may yield up to 130,000 cy on an annual basis. Note that this would confine dredging to the navigation channel only and would occur under existing navigation-related permitting, which is a favorable option from a permitting perspective.

In addition to ocean-side inlet areas, the AIWW portion of Lockwood Folly Inlet has proven to be a valuable source of beach compatible material. Lockwood Folly Inlet was dredged in January 2009 by the USACE and approximately 100,000 cy of sand was placed on Holden Beach. The USACE is planning a similar project for the upcoming winter 2009/2010 dredging window; where 150,000 cy of material will be dredged from the AIWW and placed on the eastern reach of Holden Beach. Figure 8-8 presents both USACE projects. Note that 150,000 cy of dredged material in the channel equates to approximately 120,000 cy of material on the beach (due to dredging losses, in-situ water content, etc.).

The recent beneficial use of this dredged material by the USACE for beach placement is an effective inlet management plan and this is planned to occur in the future. If the USACE discontinues this practice, then it is recommended that Holden Beach become involved in Lockwood Folly Inlet management. Initial studies (USACE-CHL, 2008) have proposed to dredge approximately 625,000 cy of sandy material from the ebb shoal

(i.e. ocean-side) every 4 years; which may be difficult to permit and may result in impacts to nearby shorelines.

8.3 SHALLOTTE INLET

Shallotte Inlet maintenance dredging material has typically gone to Ocean Isle, which represents the downdrift shoreline. Shallotte inlet has a deeper authorized dredge depth to -15 feet NGVD and has a wider channel; therefore more material is generally available. Figure 8-9 presents this inlet. The Shallotte Inlet dredged area represents approximately 113 acres. In 2001, approximately 1.8 million cy was dredged from this inlet for beach nourishment. According to the 2008 USACE-CHL study, the preferred alternative includes dredging approximately 625,000 cy every 4 years from Shallotte, which is identical to proposed Lockwood Folly Inlet management.

8.4 OFFSHORE

Offshore borrow areas represent an attractive alternative because larger volumes can be placed at higher production rates with less equipment on the beach. Additionally, offshore borrow areas tend to have relatively large volumes of compatible sand which can sustain multiple nourishment cycles. However, USACE, USGS, and UNCW exploration offshore of Holden Beach (and most of northern Long Bay) has revealed little to no feasible sand sources for renourishment. Most of the offshore region has been characterized as hardbottom with a thin veneer of sand, with the exception of the extensive shoals at Cape Fear and Jay Bird Shoals. However, many of these research projects have been on a regional scale, and ATM coordinated with applicable agencies in order to develop a literature and data review specific to the needs of Holden Beach.

Over the past two decades the USACE, Wilmington District (SAW), has funded numerous geotechnical investigations in the offshore, inlets, Atlantic Intracoastal Waterway (AIWW) and historic dredge spoil sites of Brunswick County, NC. The coverage has primarily focused on the inlets (Tubbs, Shallotte, and Lockwoods Folly), offshore of the inlets, offshore of Ocean Isle Beach, offshore of Oak Island, Yellow Banks dredge spoil site, Jaybird Shoals, Lockwoods Folly River, and the Eastern Channel of Lockwoods Folly Inlet. Vibracore spacing varies dramatically between localities, ranging from 100 to more than 2,000 ft. The following is a list of known vibracore and boring datasets:

Table 8-1 Known Vibracore and Boring Datasets

Borrow Area	Year	No. Test Locations	Sampling Region
Brunswick County Beaches	1971	Not Provided	Offshore
Brunswick County Beaches	1971	Not Provided	Onshore
Ocean Isle	1994	65	Offshore
Tubbs Inlet	1994	17	Inlet
Brunswick County Beaches	1998	16	Offshore
Lockwoods Folly Inlet	1998	11	Inlet
Yellow Banks	1998	11	Upland Spoil Site
Jaybird Shoals	1998	21	Offshore
Shallotte Inlet	1998	13	Inlet
Yellow Banks	2001	27	Upland Spoil Site
Eastern Channel	2002	15	Lockwoods Folly Inlet
Lockwoods Folly Inlet	2002	28	Inlet
Lockwoods Folly River	2002	10	River
Brunswick County Beaches	2002	20	Offshore
Brunswick County Beaches	2003	92	Offshore
Cleary Borrow Area	2004	23	Offshore
TED	2004	6	Offshore
Ocean Isle	2005	13	Offshore

Subsurface investigations have also been performed. Under contract with the SAW, C&C Technologies performed geophysical sub-bottom profiling and mapping offshore of Ocean Isle in 1999 and of Holden Beach and Oak Island in 2003. The 1999 study focused on the 1.0 to 3.5 mile range offshore of Ocean Isle, while the 2003 study focused on the 2.5 to 6.0 mile range offshore of Holden Beach and Oak Island. It is noted that beyond the 3 nautical mile limit (~3.5 statute miles), borrowing of soils falls under the additional jurisdiction of the Minerals Management Service (MMS).

The offshore mapping by C&C Technologies consisted of single beam soundings to identify areas that may contain significant surface sediment layers and to delineate such areas as potential sediment sources. Various surface bottom types were mapped: Top of Rock, Reworked Sands and Channels. The investigators identified a large region offshore of Lockwoods Folly Inlet and Oak Island, containing lenses of reworked sands overlain on relic flood plain channels, as a “suggested sediment borrow area” (See Figure 8-10). The authors estimated upwards of 90 million cy of sediments existing in these historic offshore channels overlain by roughly 60 million cy of “reworked sediments”, which are largely remnants of retreating beaches, barrier islands and spits.

In viewing vibracore results for this area, the material generally contains higher fines (>12%) and therefore is not beach compatible according to sediment criteria.

Based on review of all the available offshore vibracores (as well as seismic and sidescan data), ATM has delineated several potential regions of interest (see Figure 8-11). Within these, several areas are recommended for further investigation and are discussed below. There are only a few areas that have lenses of beach quality sediment that exceed 4-5 ft thickness. However, there are areas offshore that could be potential borrow sources if the proper equipment is used.

Little River Borrow Area

An example of such a project is the recent North Myrtle Beach nourishment project, where offshore sediments were dredged from relatively thin veneers averaging approximately 2 feet in depth, using a hopper dredge, to construct a successful 700,000 cy project in 2007/2008. The Little River Borrow Area is presented in Figures 8-12 and 8-13. Recent borrow site investigations (USACE, 2007) show that the Little River borrow area contains at least 11.2 million cubic yards of quality borrow material and has been used several times since being permitted in 1993. The site extends from approximately 1.5 to 4 miles offshore and contains approximately 6,400 acres of ocean bottom. Vibracore data was studied from this site in analyzing sediment data offshore of Holden Beach.

Note that offshore borrow area studies typically begin with seismic sub-bottom profiling and sidescan sonar deployment in order to establish areas where vibracoring should occur. However just because seismic and sidescan studies do not reveal significant sources of sand does not mean that there is no sand. This is the case for the Little River borrow area and this is generally the case for offshore of Holden Beach. Figure 8-13 shows unfavorable sand thickness based on USGS seismic and sidescan data (USGS, 2005), however sand is available and this borrow are has been successfully used two times since it was originally permitted in the early 1990's. In general, vibracores represent the most reliable data.

Holden Beach Offshore Borrow Areas

Five primary offshore sites were established based on vibracore, seismic, and sidescan data and are pictured in Figure 8-11 (borrow areas 1A, 1B, 2, 3, & 4). A brief description of each site is found below. A hopper dredge would most likely be used for the offshore borrow areas proposed. Hopper dredges are typically used for offshore areas and excavate sediment directly onboard, then travel to a nearshore transfer station to pump material to the beach.

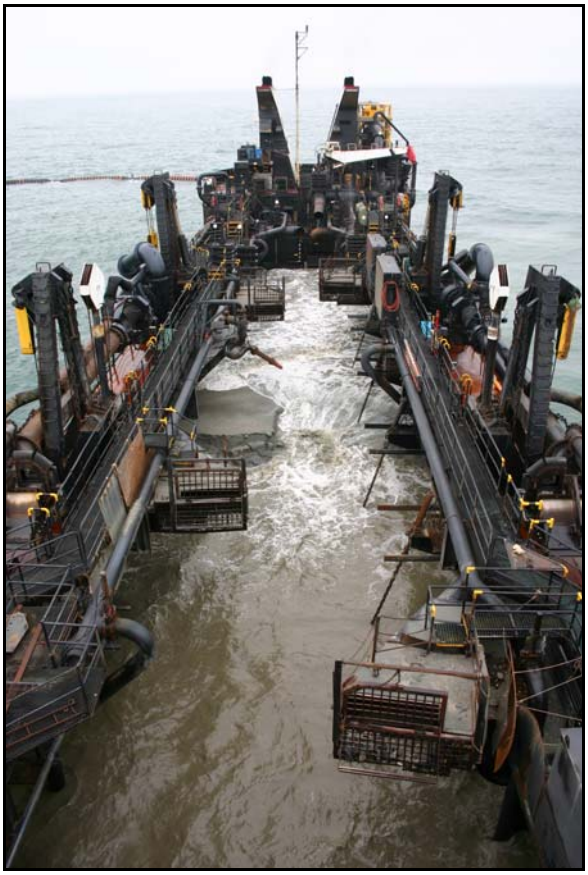

Photo 8.4-1: Hopper dredge with transfer pipeline in the distance.

Proposed Conceptual Offshore Site 1A

Offshore Site 1A consists of approximately 1,669 acres located just southeast of Lockwoods Folly Inlet between 1.25 and 3 miles offshore. Borings indicate beach quality sediment layer thicknesses of 1.5-4 ft. Assuming an average layer thickness of 1.5 ft, it is estimated that this borrow area may yield up to 4M cy. Figure 8-14 presents estimated sand thickness from vibracore borings for borrow area sites 1A and 1B.

Proposed Conceptual Offshore Site 1B

Offshore Site 1B consists of approximately 268 acres located just southeast of Lockwoods Folly Inlet between 3 and 4 miles offshore. Borings indicate beach quality sediment layer thicknesses of 1.5-4 ft. Assuming an average layer thickness of 1.5 ft, it is estimated that this borrow area may yield up to 648,000 cubic yards of sediment. Note this site is located beyond the 3-mile limit and would require additional permit approval from the Minerals Management Service.

Proposed Conceptual Offshore Site 2

Offshore Site 2 consists of approximately 1,100 acres south of Lockwoods Folly Inlet between 1.5 and 3 miles offshore. Borings indicate beach quality sediment layer thicknesses of 1.5-3.5 ft. Assuming an average layer thickness of 1.5 ft, it is estimated that this borrow area may yield up to 2.7M cy. Figure 8-15 presents beach compatible sand thickness from vibracore data for this site.

Proposed Conceptual Offshore Site 3

Offshore Site 3 consists of approximately 646 acres and is located directly south of Holden Beach and is between 2.5 and 3.5 miles offshore. Available borings indicate sediment layer thicknesses of 1-4.5 ft. Assuming an average layer thickness of 1.5 ft, it is estimated that this borrow area may yield up to 1.6M cy. Figure 8-16 presents vibracore results for borrow area 3. Sand channels and other results from the 1999 and 2003 seismic studies are also presented. Sand channels may or may not indicate beach quality sand (i.e., <10% fines, median grain size similar to native beach, etc.); however they do generally warrant further investigation.

Proposed Conceptual Offshore Site 4

Offshore Site 4 consists of approximately 527 acres and is located southwest of Shallotte Inlet between 2 and 3 miles offshore. Available borings indicate sediment layer thicknesses of 1.5-4.5 ft. The volume yield of this borrow area is currently estimated at 1.3M cy. Figure 8-17 presents vibracore results for borrow area 4. Seismic tracklines from 1999 are also presented, however no sand channels were identified in this area (C&C, 1999).

8.5 BORROW AREA VOLUMES

A summary table of all potential borrow area volumes is presented in Table 8-2. Note that the 'estimated yield' represents a realistic volume; however each estimate is based on varying amounts of information and subject to change. Over 11 million cubic yards of material has been estimated from the identified borrow areas. Assuming that Holden Beach requires 250,000 cy/yr to maintain a healthy and stable beach, this volume amounts to approximately 46 years worth of *potential* sediment available.

Table 8-2: Potential Borrow Area Volumes

Borrow Area	Acreage	Est. Avg. Thickness (ft)	Estimated Yield (cy)
Turkey Trap Road Borrow Area	10	0-30	200,000
Smith Borrow Area	Unknown	Unknown	0
Proposed Tripp Borrow Area	25	10-55	403,000
Sheep Island Borrow Area	28	10-20	452,000
Monk Island Borrow Area	10	10-20	161,000
Lockwoods Folly Inlet Borrow Area	22	3	106,000
Offshore Borrow Area 1A	1,669	1.5-4	4,039,000
Offshore Borrow Area 1B	268	1.5-4	649,000
Offshore Borrow Area 2	1,103	1.5-3.5	2,669,000
Offshore Borrow Area 3	646	1.5-4	1,563,000
Offshore Borrow Area 4	527	1.5-3	1,275,000
		Total	11,517,000

Sites Recommended for Further Investigation

Four sites have been located which are recommended for immediate future investigation. These sites are preferred areas within the proposed borrow areas mentioned above and are presented in Figure 8-18.

The preferred area within borrow area 1A is similar to the borrow area recommended by Dr. Cleary following 1999 offshore investigations and is presented in Figure 8-19. Note that Dr. Cleary's suggested borrow area was established prior to some of the vibracore results presented in Figure 8-19 and the area is not as promising based on the latest data.

Borrow area 1A vibracore spacing is approximately 2,000 ft while regulatory agencies require spacing of no more than 1,000 ft (or 1 core for every 23 acres). This area is

offshore of Oak Island, however the proposed shallow cut-depth (2-3 ft) and the distance from shore is anticipated to result in negligible shoreline impacts; although some coordination and wave modeling may be necessary.

The preferred areas within borrow areas 2 and 3 are directly offshore of Holden Beach, however; less information is available for these sites and these sites would therefore require the most vibracoring. Future use of these sites is highly dependent on the results of these vibracores.

The preferred area within borrow area 4 represents the most reliable source of sediment and this general area was identified by the USACE following the 2003 studies. Vibracore spacing is 1,000 ft, therefore no additional vibracores are required (according to NCDENR standards). This area is offshore of Ocean Isle; however given the shallow cut-depth and the distance offshore, it is anticipated that dredging this site will result in negligible shoreline impacts.

In order to satisfy permitting requirements, some additional seismic, sidescan and magnetometer research will be needed for all of the preferred areas for further investigation. Previous seismic and sidescan studies were exploratory in nature and did not perform transect spacing as required for permitting.

Table 8-3: Recommended Offshore Sites – Potential Borrow Area Volumes

Borrow Area	Acreage	Est. Avg. Thickness (ft)	Estimated Yield (cy)
Subset Borrow Area 1A	660	1.5-4	1,597,000
Subset Borrow Area 2	350	1.5-3.5	847,000
Subset Borrow Area 3	240	1.5-4	581,000
Subset Borrow Area 4	265	1.5-3	641,000
		Total	3,666,000

Table 8-3 presents estimated volumes from the offshore borrow sites that are recommended for further investigation. As previously mentioned, a nourishment of approximately 500,000 cy to 600,000 cy (similar to the USACE 933 project) is recommended; therefore each of these sites are estimated to be available for at least one and possibly two nourishment events.

Figure 8-1
Upland and Inlet Conceptual Borrow Areas (BAs)

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Figure 8-2
Turkey Trap Road Permitted Borrow Area

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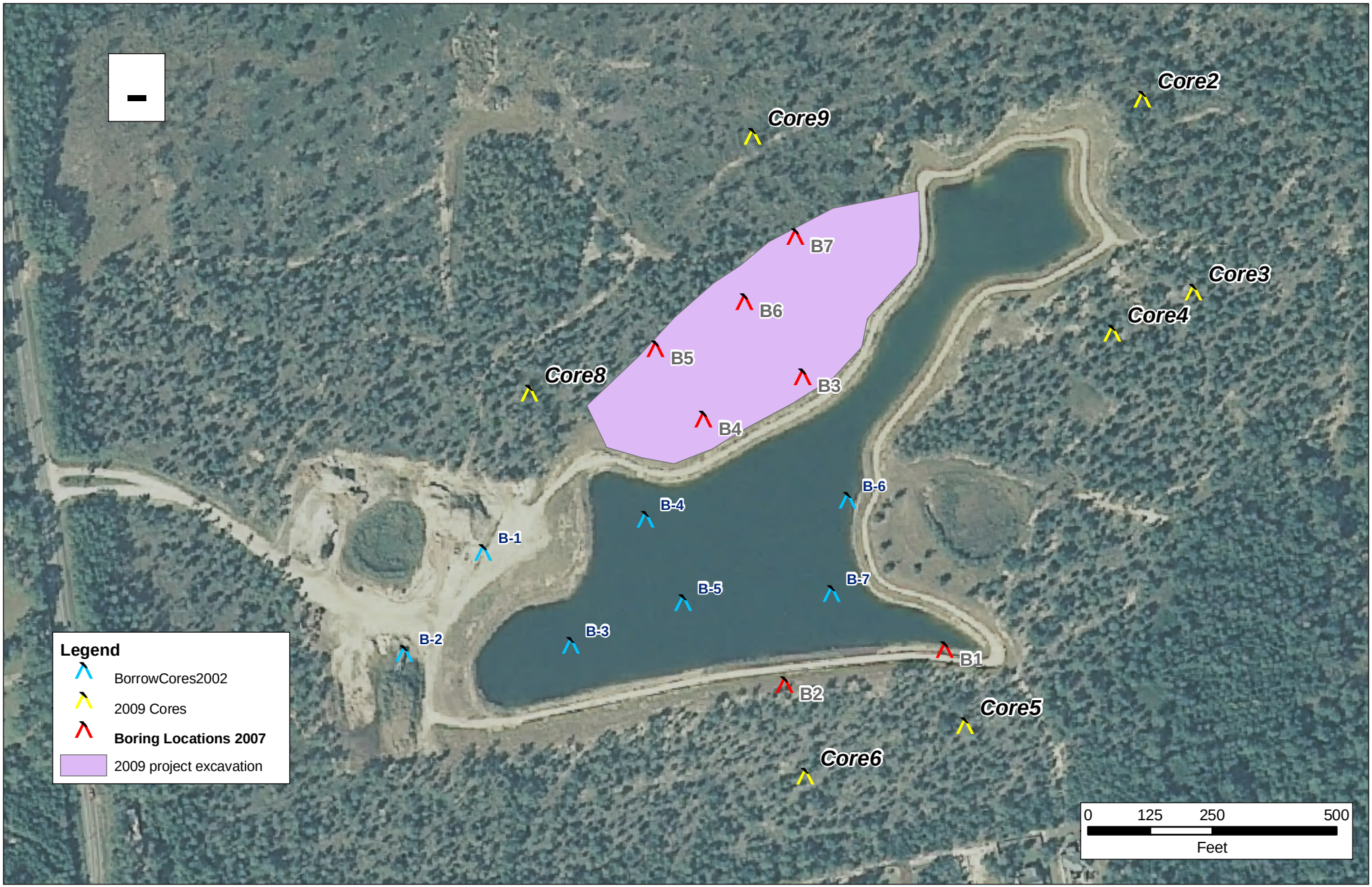

Figure 8-3
Smith Borrow Site showing 2009 excavation

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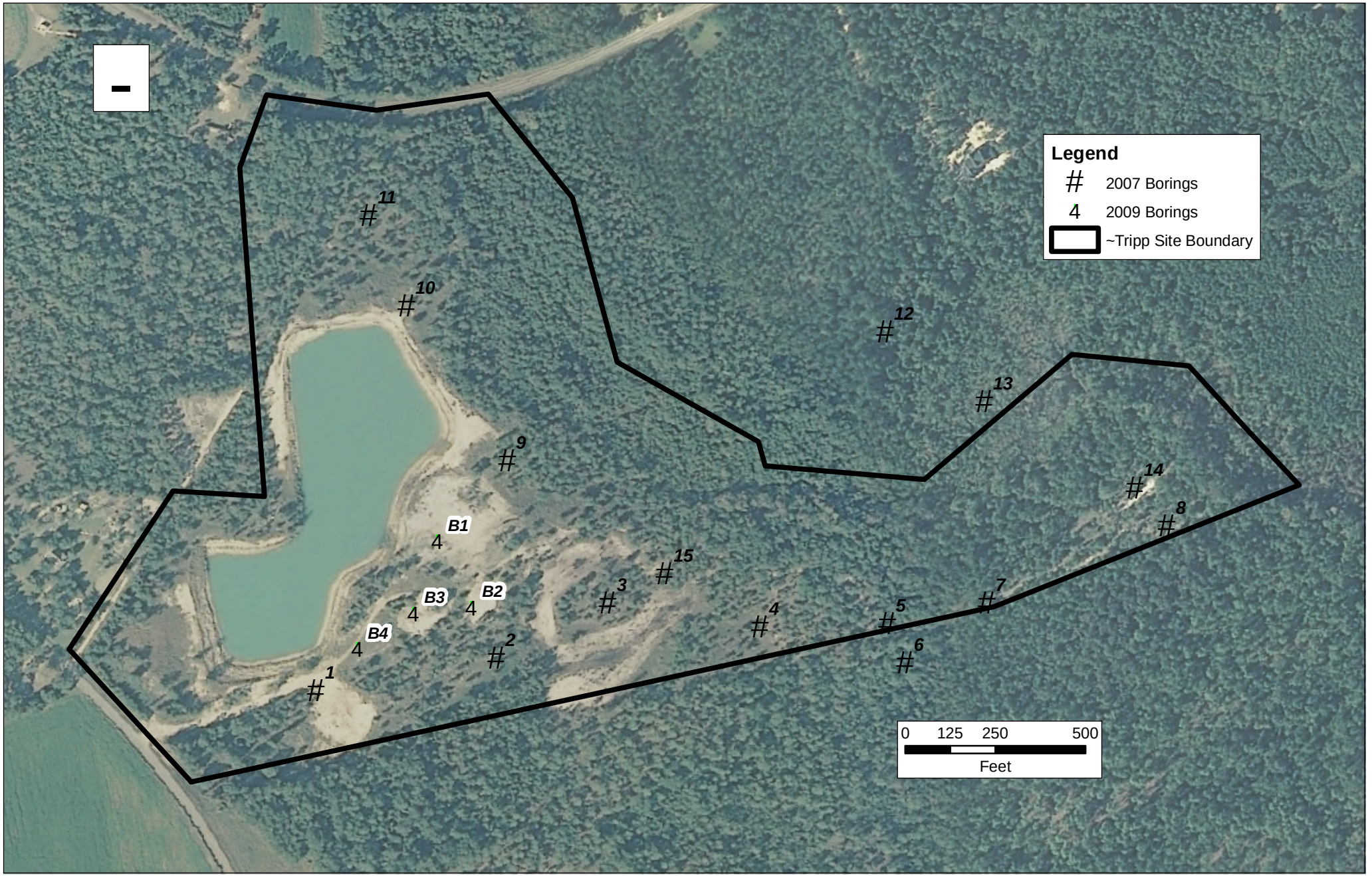

Figure 8-4
Tripp Site Boundary and Boring Locations.
Note that adjacent properties may also be available.

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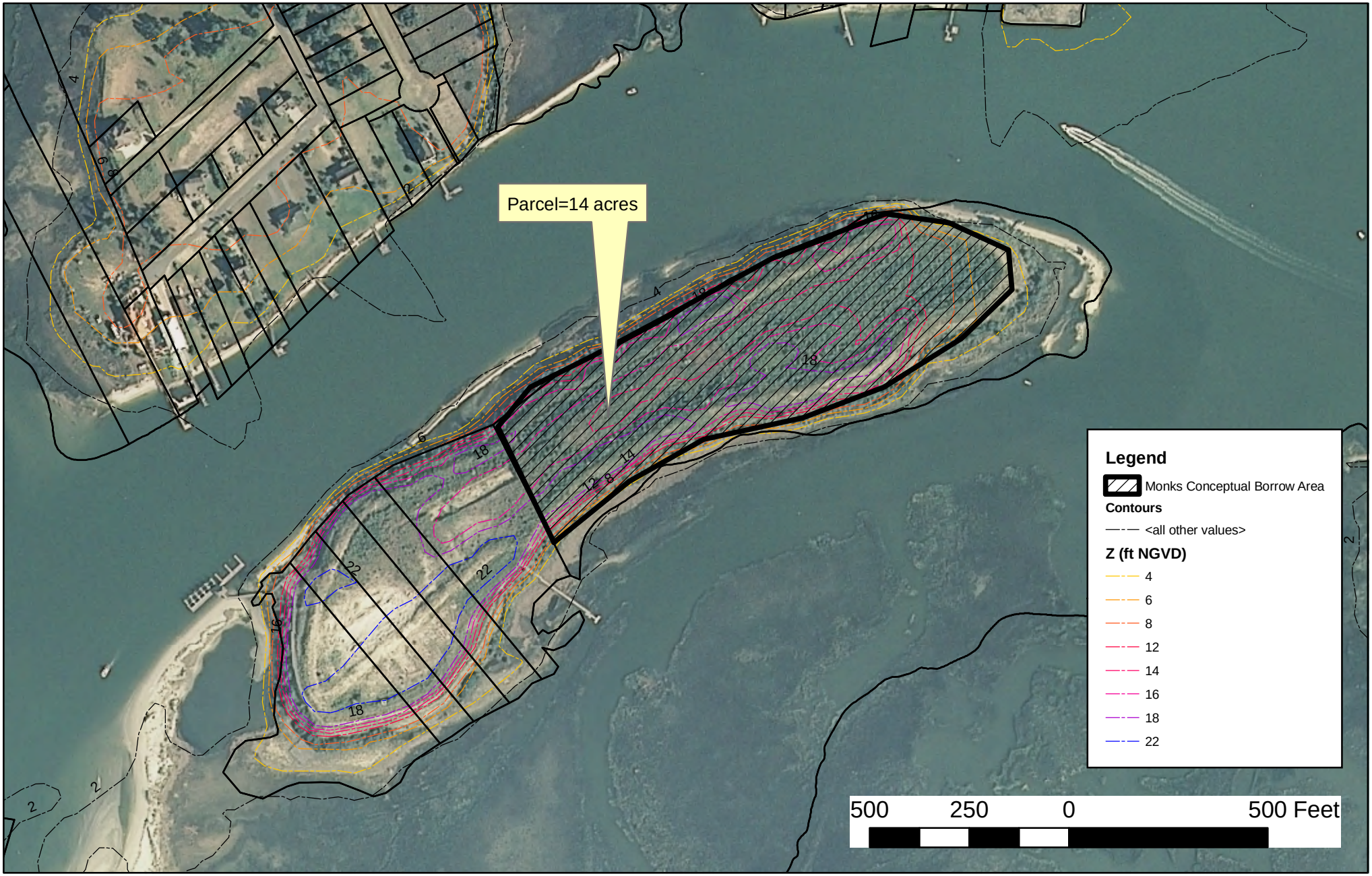

Figure 8-5
Monks Island conceptual borrow area

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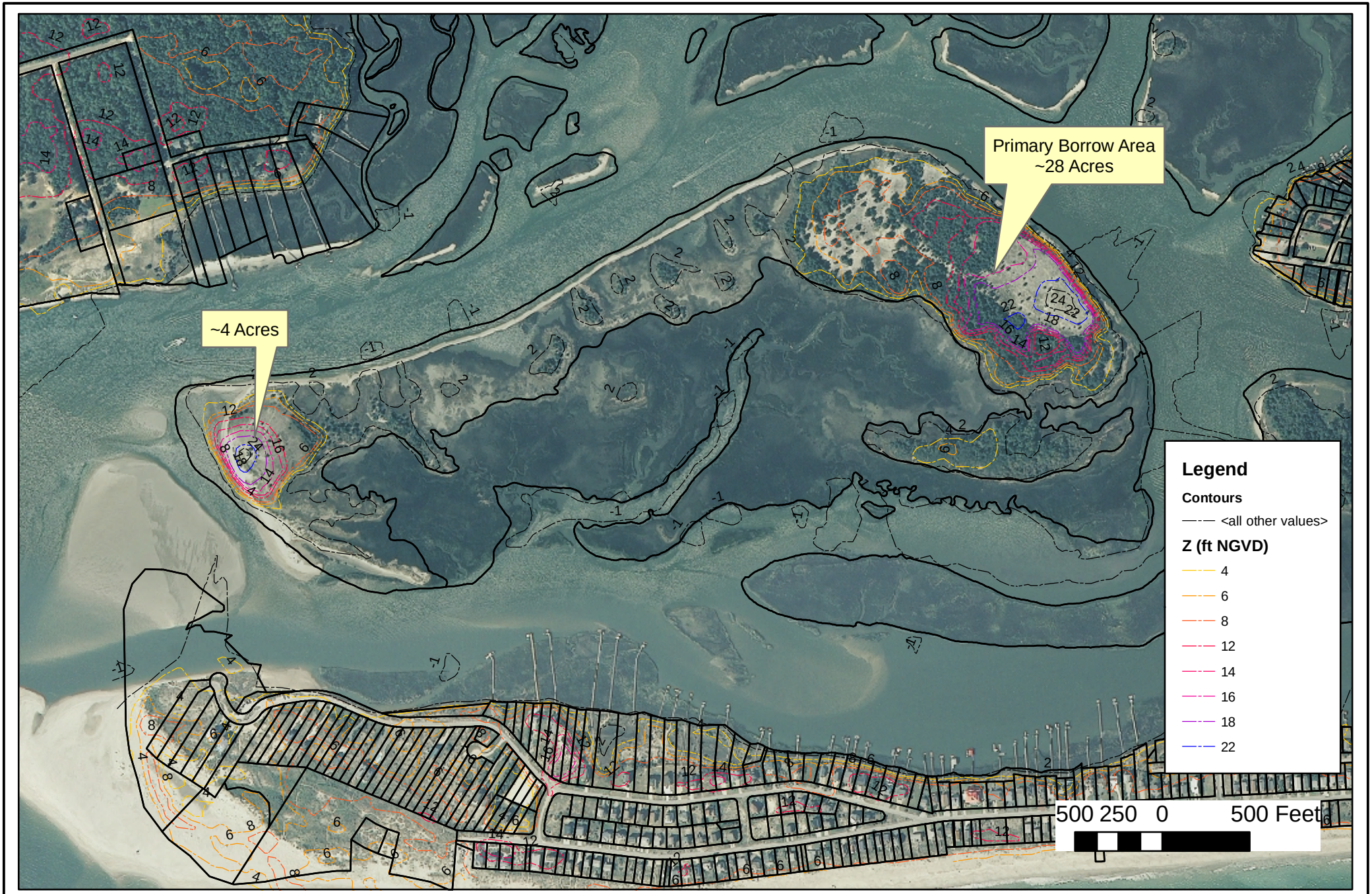

Figure 8-6:
Sheep Island Conceptual Borrow Areas

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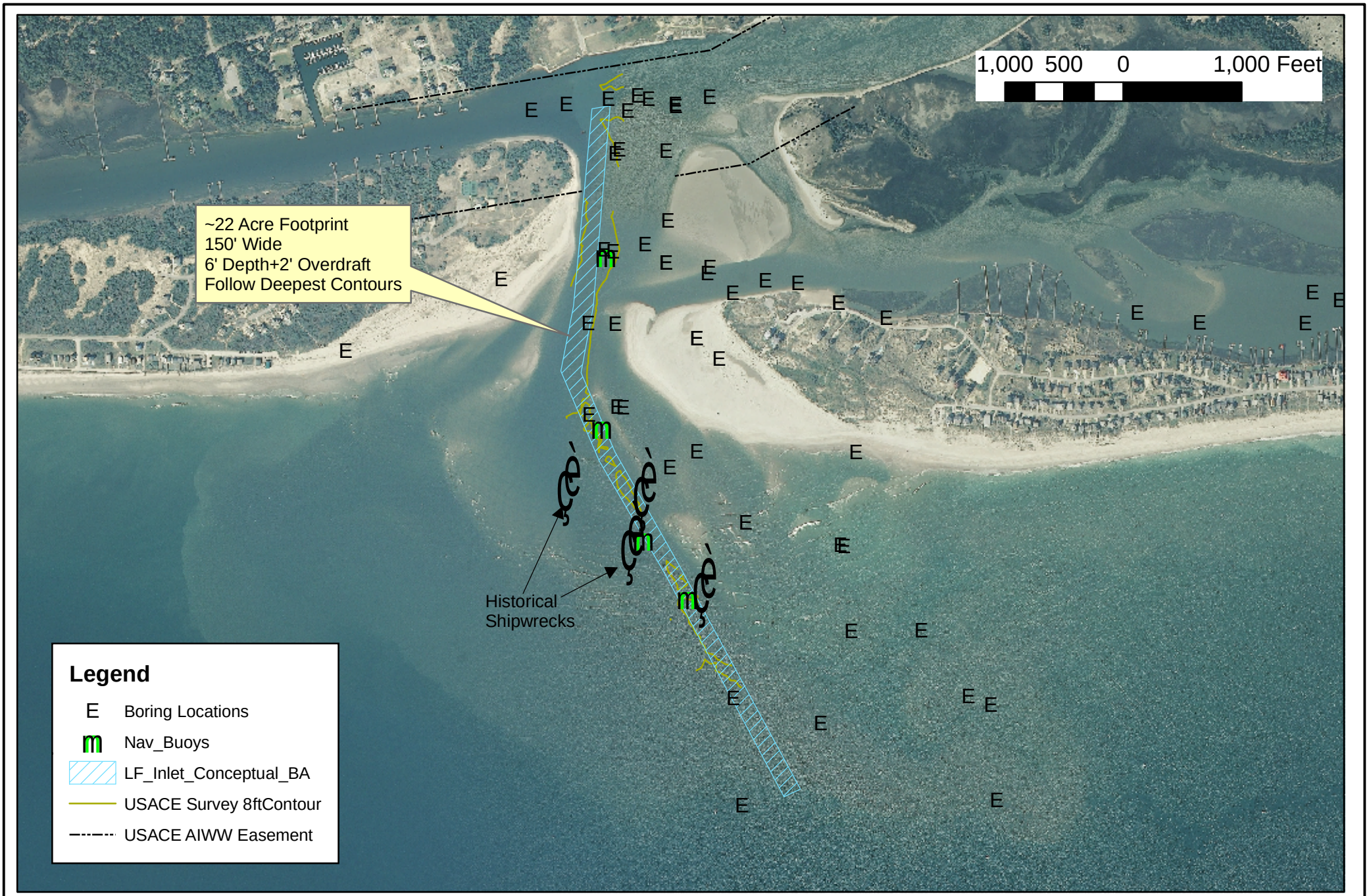

Figure 8-7:
Lockwood Folly Inlet conceptual borrow area

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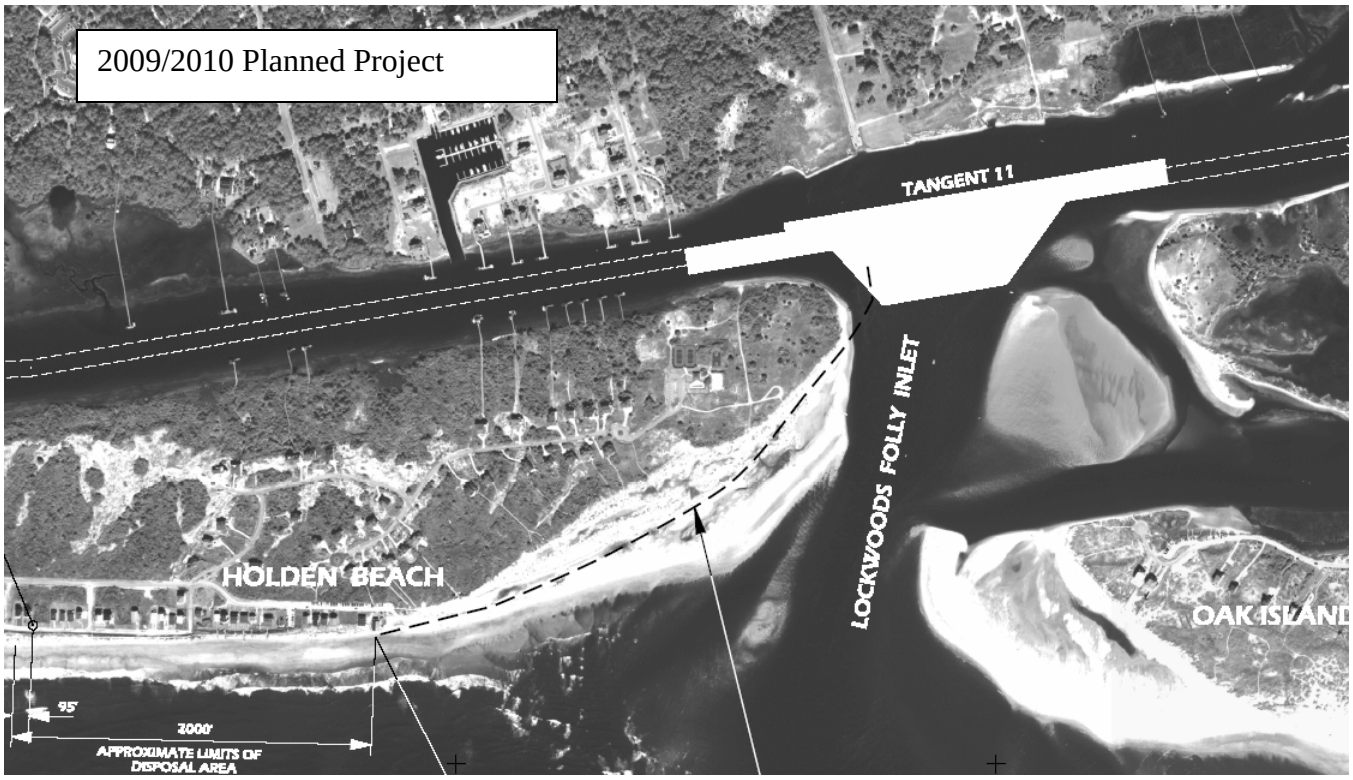

Figure 8-8:
Lockwood Folly AIWW dredging plans. Note that 2008/2009 beach placement extended over approximately 3,500 feet. It is recommended that the planned placement also extends farther west.

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Figure 8-9:
Shallotte Inlet historical borrow area

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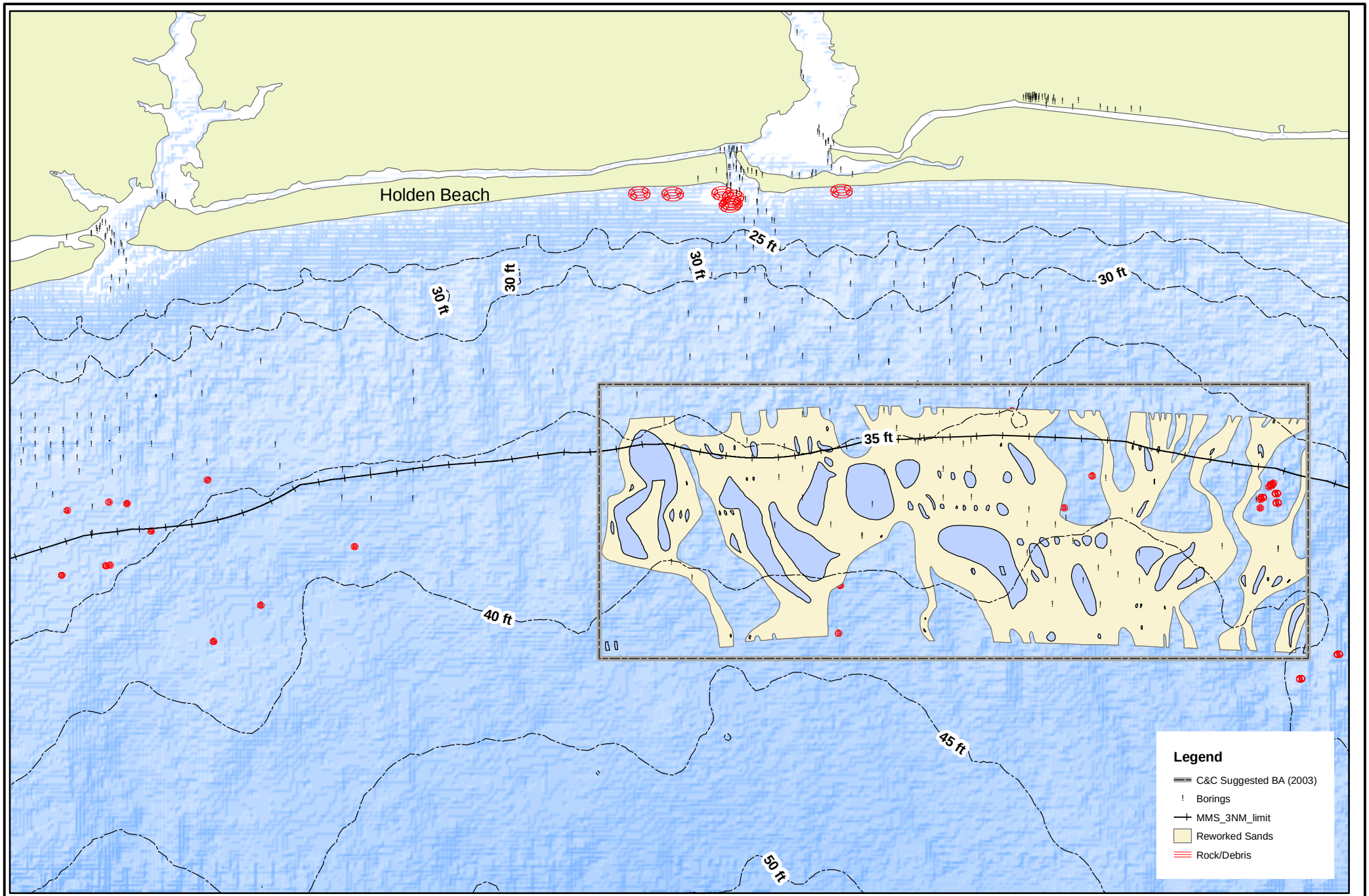

Figure 8-10:
C&C Suggested Borrow Area (2003)

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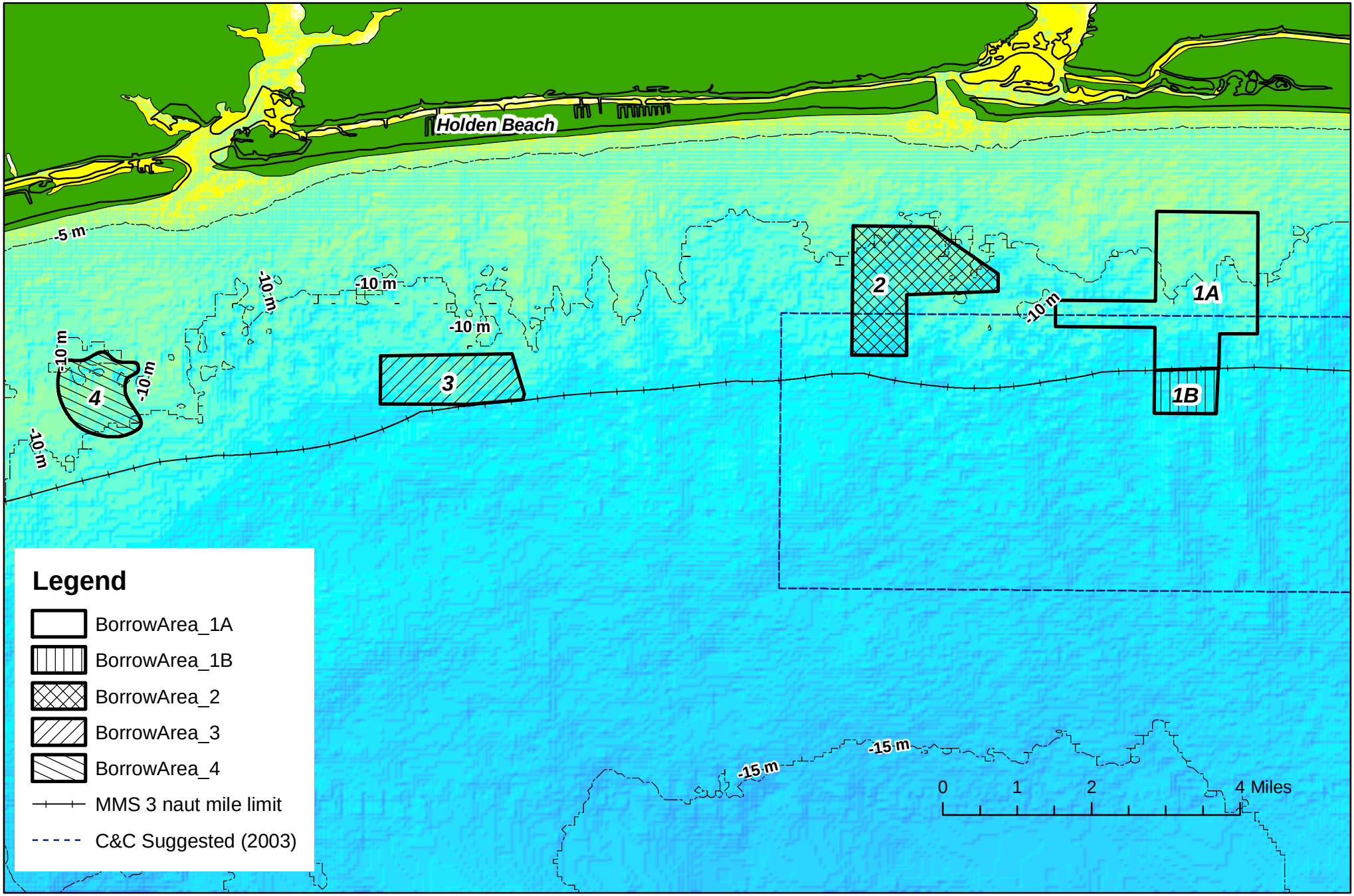

Figure 8-11:
Conceptual Borrow Areas for Holden Beach

APPLIED TECHNOLOGY & MANAGEMENT

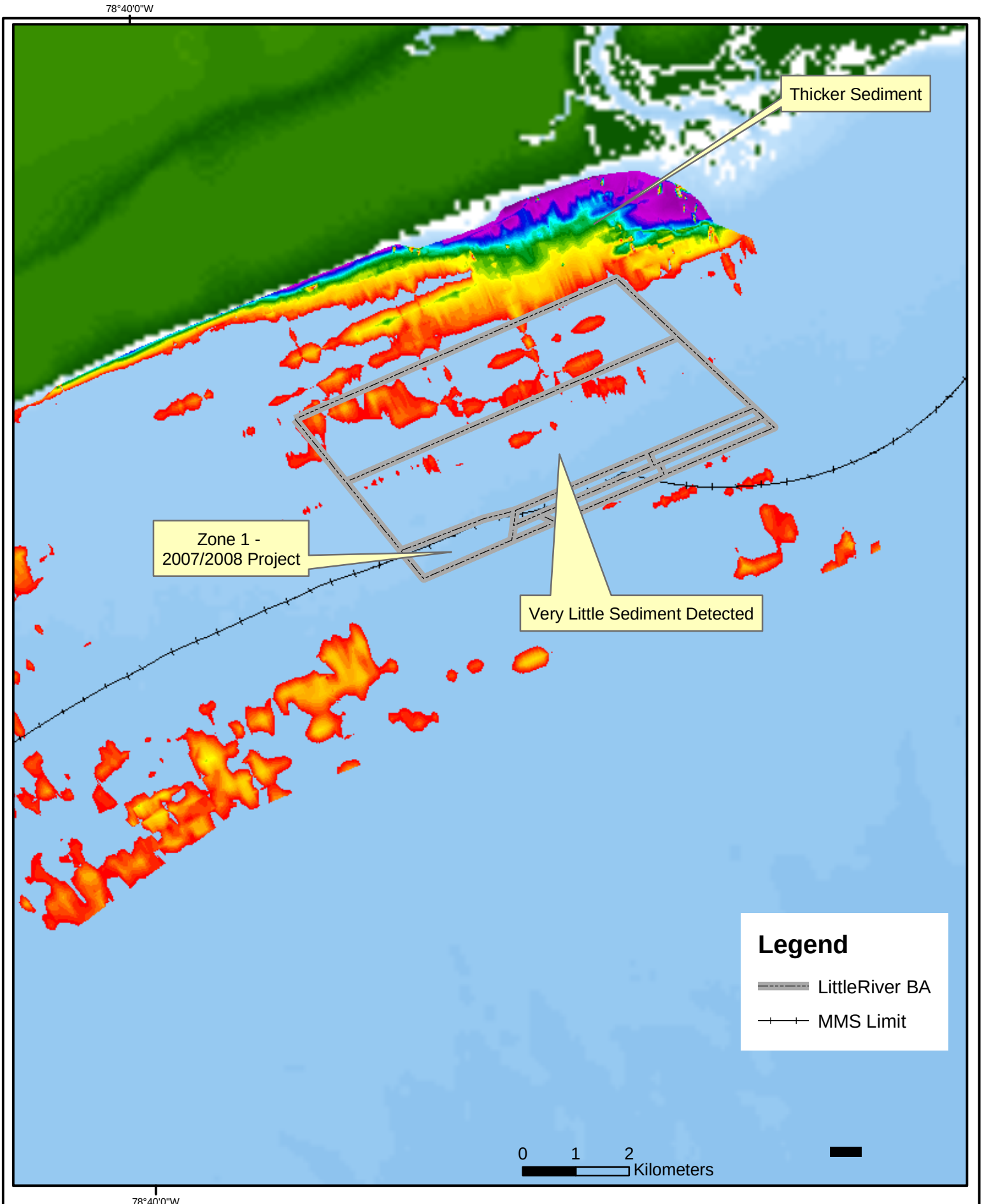

FIGURE 8-12:
Little River Borrow Area
Available Sand according to Seismic Studies

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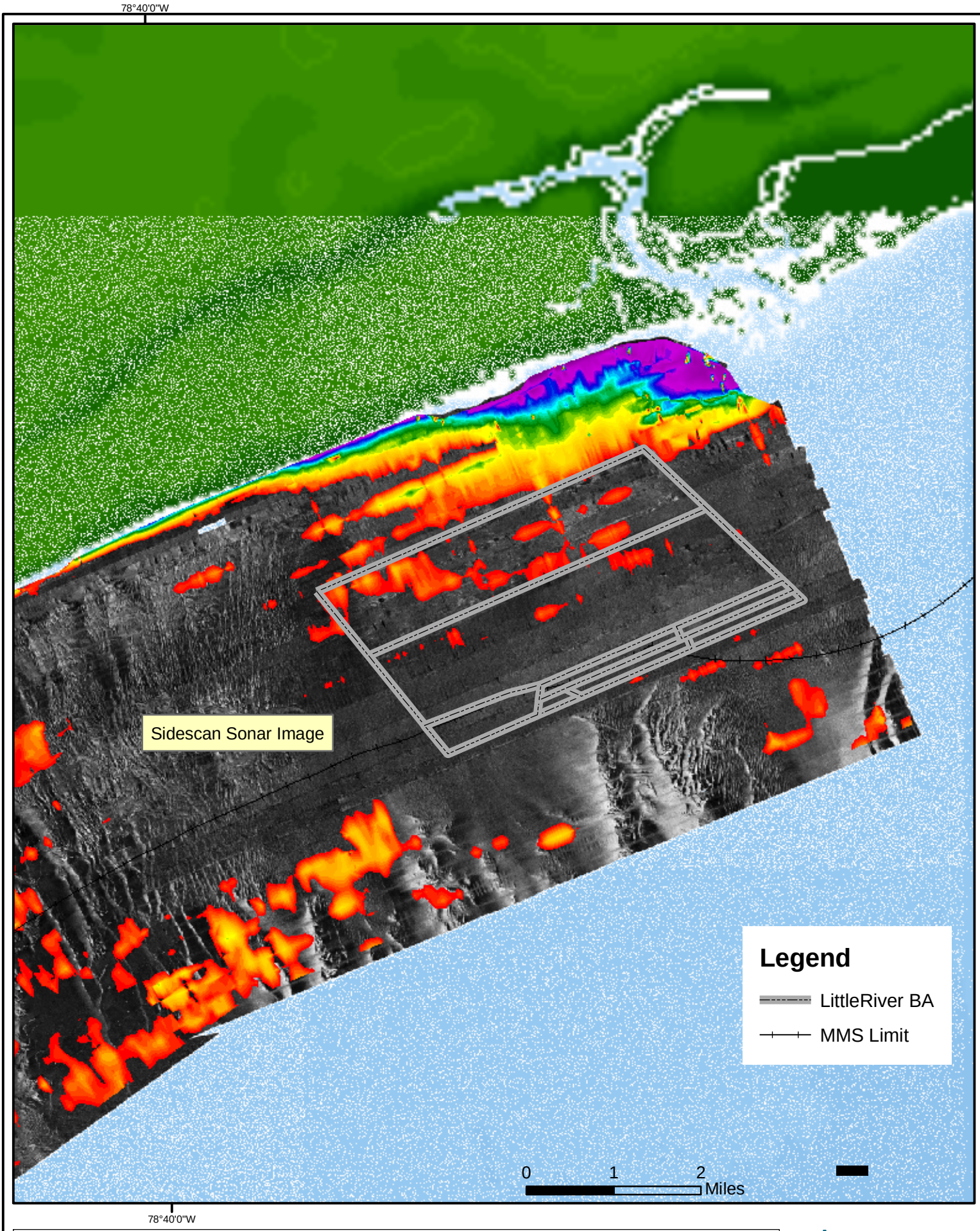

Figure 8-13:
Little River Borrow Area Sidescan
Seafloor is characterized as mixture of hardbottom and sand

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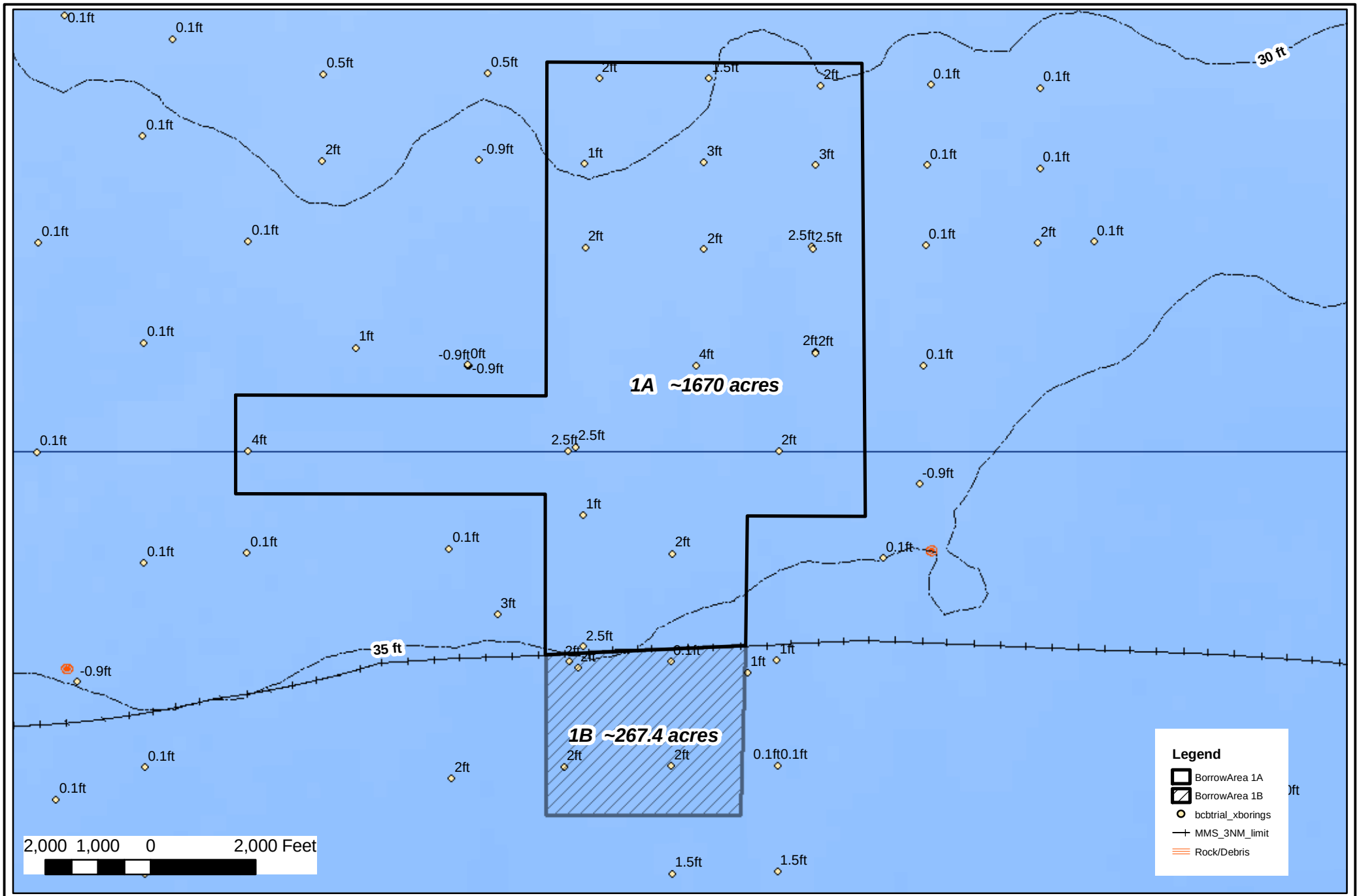

Figure 8-14:
Proposed Borrow Areas 1A and 1B
Vibracore results showing beach compatible sand thickness

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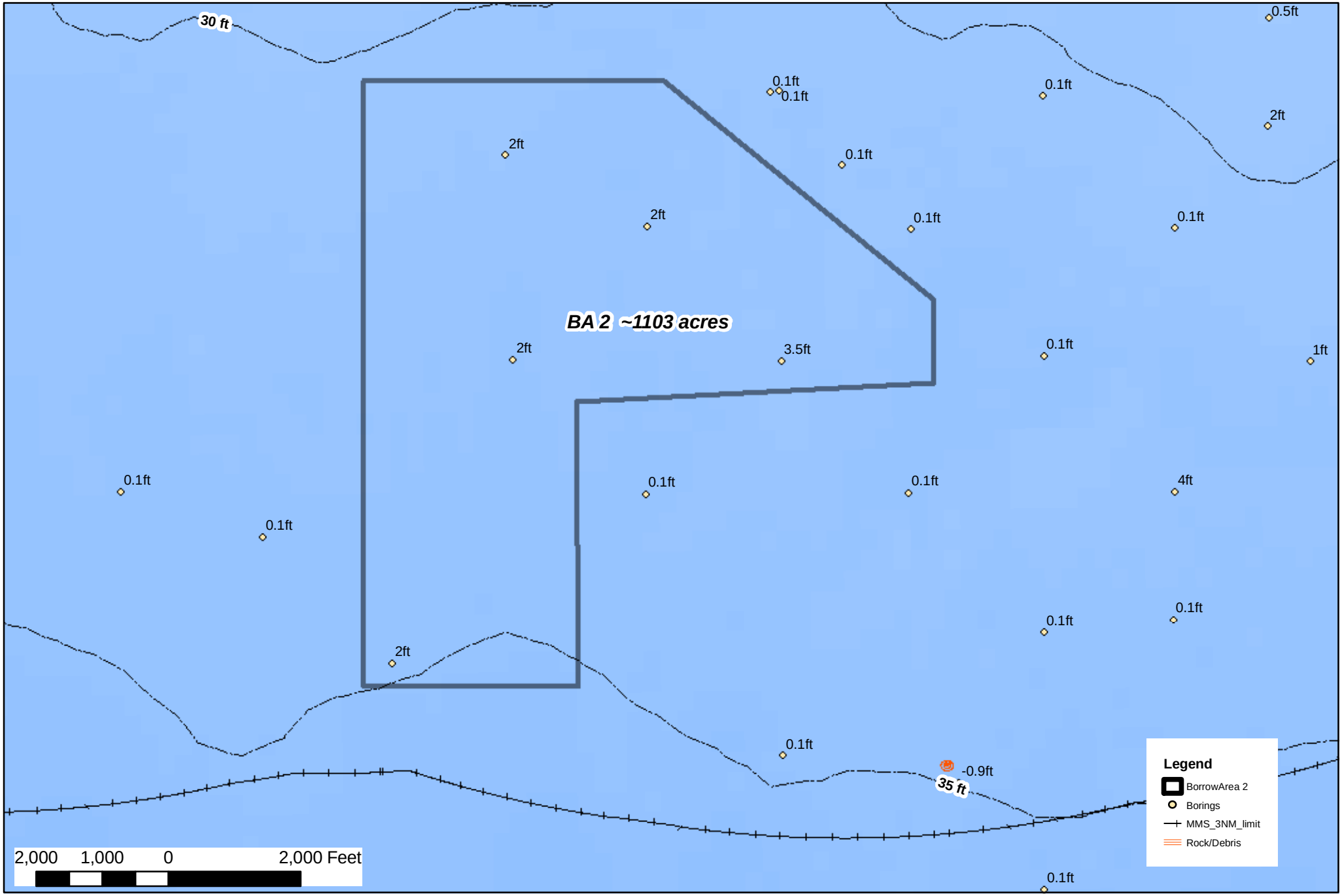

Figure 8-15:
Proposed Borrow Area 2
Vibracore Results presenting Beach Compatible Sand Thickness

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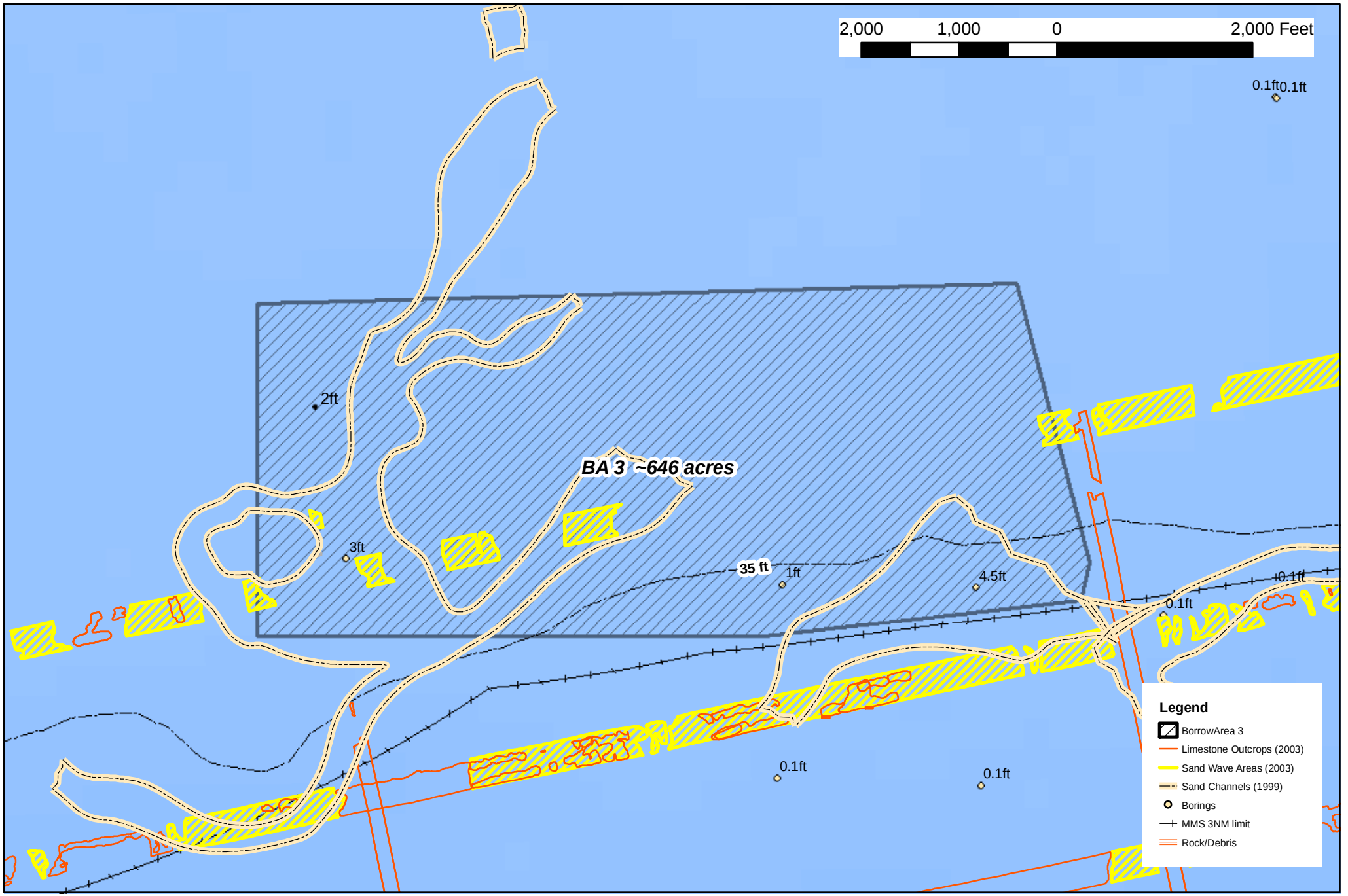

Figure 8-16:
Proposed Borrow Area 3 Vibracore Thickness
Sand Channels and Limestone Outcrops (from Seismic Study) also plotted

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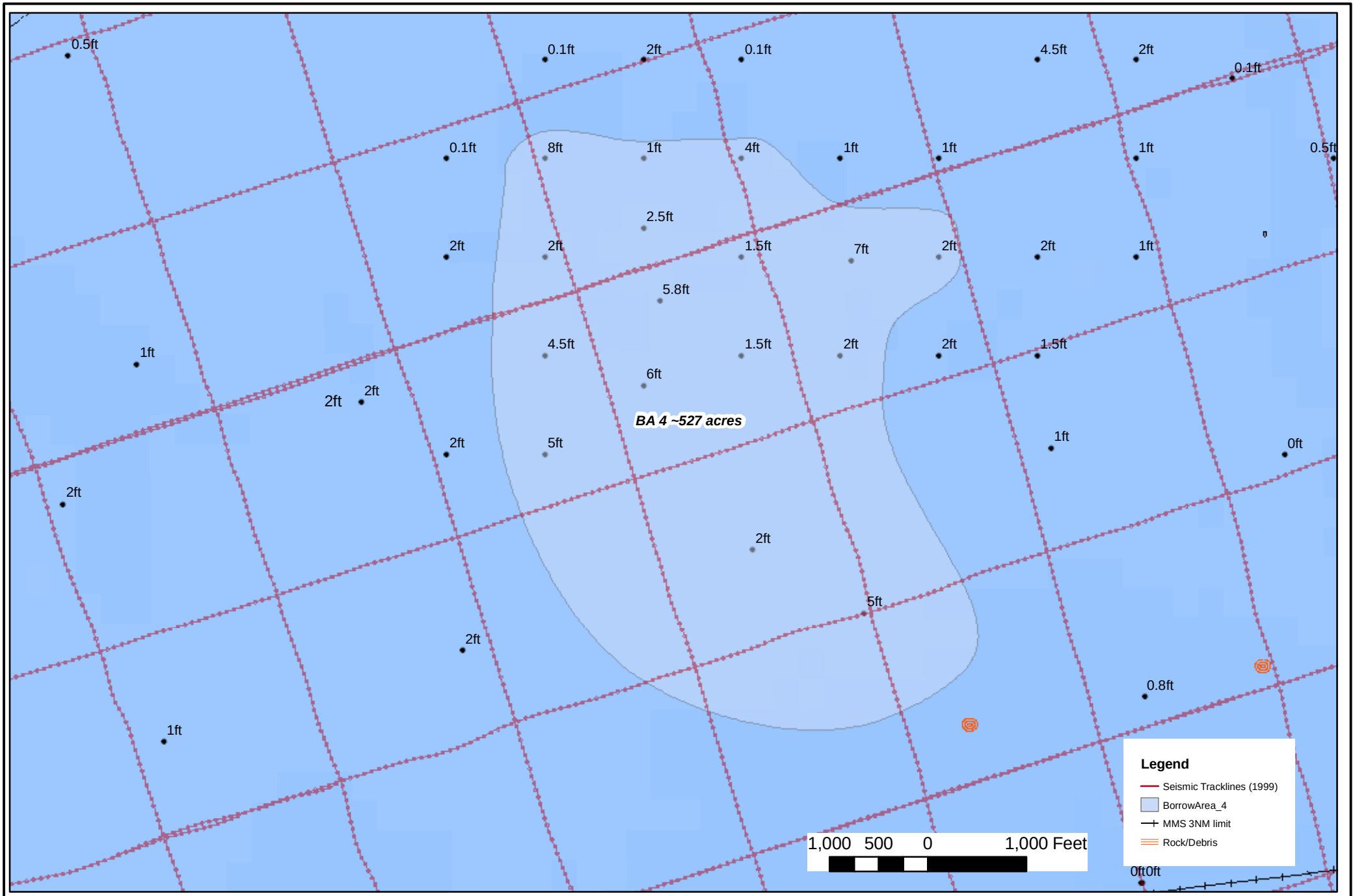

Figure 8-17:
Proposed Borrow Area 4 Vibracore Sand Thickness
1999 Seismic tracklines also plotted (no sand channels were identified)

APPLIED TECHNOLOGY & MANAGEMENT

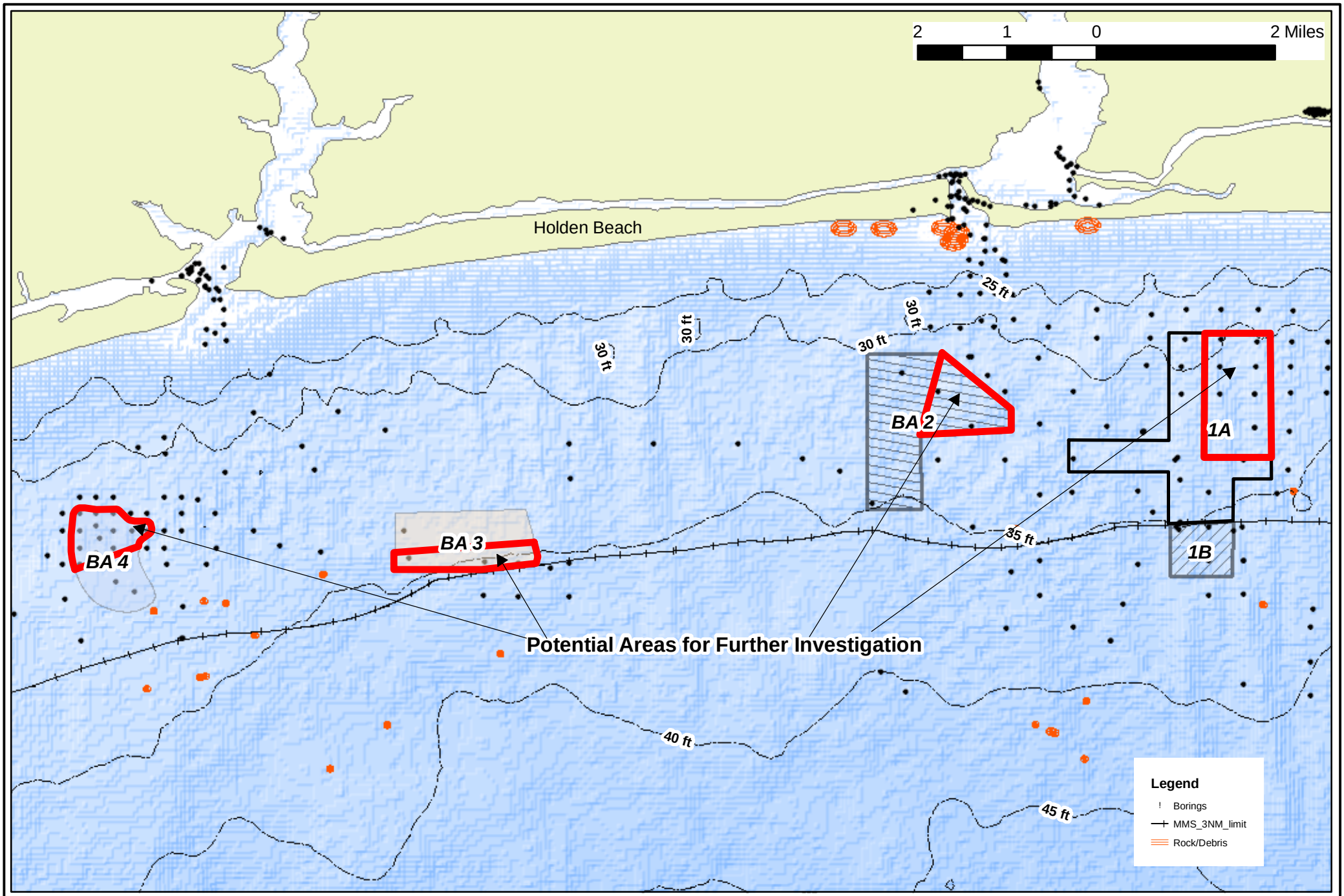

Figure 8-18:
Recommended Areas for Further Investigation

APPLIED TECHNOLOGY & MANAGEMENT

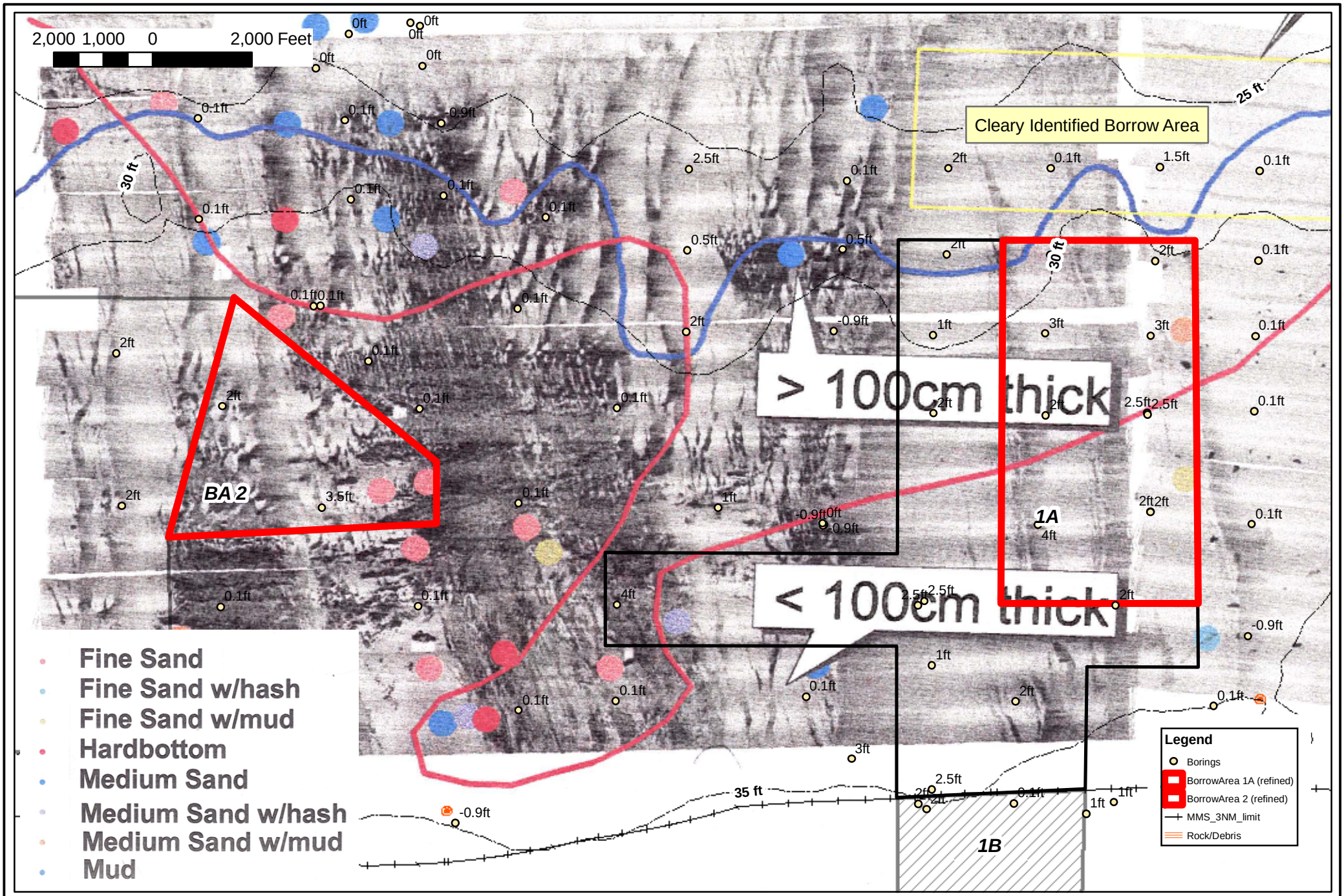

Figure 8-19
Borrow Areas 1A and 2 in relation to Cleary sidescan and
Cleary identified borrow area (provided by USACE,1999).

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9.0 COSTS

A basic presentation of costs associated with all proposed alternatives is discussed in this section. Pre-project data collection, permitting, project construction and post-project monitoring costs represent the primary areas where costs figure prominently. Beach nourishments utilizing offshore sources require a significant up-front cost, although these costs are typically similar to smaller project costs on an annualized basis because of longer nourishment intervals. Note that the costs presented below are based on recent experience and similar projects however are conceptual only. A more detailed cost analysis can be provided after selection of a preferred alternative(s).

Data Collection

In terms of borrow site investigations required for permitting; the type of data collection and site investigation is dependent upon the preferred borrow area(s). Offshore and inlet borrow areas typically require bathymetry, seismic profiling, magnetometer and sidescan studies as well as vibracoring. Upland borrow areas typically require borings and wetland delineations. New sediment criteria require vibracore/boring spacing every 1,000 feet (or 1 core every 23 acres). Offshore borrow areas are typically much larger than upland borrow areas, in terms of acreage, therefore more vibracores are needed. Both water and land-based borrow areas will require laboratory sediment analysis.

Based on recent offshore borrow area costs for similar borrow areas (which included bathymetry, seismic, sidescan, and limited vibracores), the costs of investigating one of the recommended borrow areas are estimated at $40,000 -$60,000. This cost is highly dependent upon the number of vibracores needed. Upland borrow area investigations should be similar in cost to Smith and Turkey Trap Road investigations, ranging from $10,000-$20,000 (depending on wetlands, etc.).

Permitting

As previously mentioned, the level of permitting is dependent upon the selected borrow area(s). Upland and offshore borrow areas have typically only required EA development; while inlet or nearshore borrow areas have typically required EIS documents. EIS document development requires significantly more time and effort. The

USACE is currently utilizing the inner portions of Lockwood Folly for navigation/nourishment and plans to utilize the ebb shoal of Lockwood Folly for the GRR project. As a result, the Town can most likely avoid the EIS permitting that is likely associated with the proposed ebb shoal borrow area and allow the USACE to lead this effort. If USACE plans change, then the Town may have to reevaluate the feasibility of this alternative.

Project Construction

Mobilization/Demobilization costs of offshore dredges require larger scale nourishment projects. For planning purposes, offshore dredge mobilization costs can be conservatively estimated at $2,000,000. Any use of an offshore site needs to be justified on a cost basis relative to other alternatives. Therefore a 500,000 cy to 600,000 cy project would be needed in order to achieve a cost in the $10/cy to $12/cy range.

Previous upland fill placements have been under $9/cy; however several major limitations may occur with the Turkey Trap Road and Tripp sites. The NCDOT has requested upgrades to all secondary roads totaling approximately $375,000 for the Turkey Trap Road site. The Tripp site represents an approximate 13 mile drive, which is three times farther than the Smith or Turkey Trap sites. This increases truck travel time which slows production. In order to maintain similar levels of production as previous projects, more trucks would be needed, most likely increasing costs.

Monitoring

Post-project monitoring costs will likely be greatest for inlet and nearshore borrow areas. Offshore borrow areas can also require a significant level of monitoring if extensive hardbottom is nearby. Note that a 500-meter buffer for hardbottom is normally required. Upland borrow area monitoring typically requires the least amount of effort.

"206 Project" Funding Mechanism

The Town's BPART fund has been instrumental in providing timely funding for beach nourishment projects. The recent FEMA project, where initial funds were required by the Town for later reimbursement by FEMA is a good example of this. Additionally, USACE projects typically require a 65/35 fund sharing agreement, with the State, the County,

and the Town covering the 35% “local sponsor” cost. Of course Town-sponsored nourishments are entirely covered by the BPART fund.

Depending on USACE project scheduling and funding, another option for the Town is a “206 Project” alternative. Section 206 of the 1992 Water Resources Development Act gives all local sponsors the opportunity to construct their own federally-authorized beach nourishment projects and still receive federal funding for both engineering and project construction. Essentially, the local sponsors, most likely led by the Town, would fund the entire permitting and construction of a large nourishment project and would receive reimbursement for the 65% federal share.

There is some additional coordination with the USACE required; similar to the FEMA reimbursable project that the Town performed earlier this year. Also note that congressional authorization is also required for reimbursement. The 206 project option is common in Florida, where communities frustrated with USACE project delays have developed programs with the necessary financial backing to place sand on the beach in a more expedient and timely manner.

10.0 SUMMARY & PATH FORWARD

10.1 SUMMARY

Holden Beach remains proactive in its beach management and plans to continue its sand placement activities by identifying multiple potential borrow areas for long-term planning purposes. Upland-based fills have proven effective over the last 9 years, however these projects are relatively small, typically less than 200,000 cy, and the community desires to explore offshore and inlet opportunities. In terms of logistics, inlet or offshore projects offer the advantages of (1) improved borrow material quality – color and grain size; (2) enabling dredges to more effectively transport and place the sand on the beach; and (3) allowing for larger, more effective and efficient beach nourishment projects.

The general goal of this beach management plan is to maintain a healthy, wide beach. At a minimum, the goal is no net reduction in sand volume; however it is recommended that a larger nourishment occur to "get ahead" of the background erosion and increase the current beach widths. The backbone of all nourishment activities since 2001 was the Federal 933 project associated with the Wilmington Harbor deepening. The Town's smaller-project approach has proven effective and is most likely viable in the future; however this is dependent on USACE fill activities which are subject to delays and funding shortages. As such, the Town wants to look longer term, in the 10-30 year horizon to identify potential sources and to "be ready" when long-term and storm-induced nourishment needs arise. If offshore sediment is used, then future nourishment volumes similar to the 933 project, which placed ~525,000 cy of sand are needed.

To summarize the basic borrow areas available:

Upland sources –

- Good for small projects (< 200,000 cy) and to supplement other larger fill projects
- Good for dune rebuilding and creation
- Sand color and quality not as good typically as in-water sources
- Slow production rates and shorter life-cycles (every 1-2 years)
- Truck and DOT/road issues

- Turkey Trap Road site and Smith site are currently permitted

Dredge Spoil Islands along the AIWW (i.e. CDFs) –

- Consist of layered material that would require separation of beach compatible and non-beach compatible material
- Reuse of this material would increase CDF disposal capacity and allow continued disposal operations
- Islands have become valuable for natural resources, recreation, and in some cases, development

Offshore sources-

- Good for larger projects, typically more economic with larger volumes (due to mobilization fees).
- Generally “sand-starved” offshore region; however North Myrtle Beach/Little River borrow area project has successfully performed shallow-cut hopper excavation
- Typically better quality sand due to its “pre washed” nature

Lockwoods Folly Inlet –

- Currently not fully utilized because of sidecasting operation and only following “deep-water” permit criteria
- USACE AIWW related navigation dredging has placed approximately 300,000 cy of material on the beach since 2002 (~ 45,000 cy/yr)
- USACE regional analysis supports placement of 156,000 cy/yr (625k cy every 4 years) from LWF ebb shoals on Holden Beach
- Remains a key to long-term management
- channel alignment and shoaling patterns have been documented to cause problems to adjacent shorelines

Note that at the extreme east end Holden, beach erosion rates have been historically larger than practical to treat with fill alone (primarily associated with inlet effects). A terminal structure would help to stabilize this area; however the level of effort in permitting and monitoring is currently unknown. In conversations with regulatory personnel, several communities are currently preparing terminal structure documentation

in order to begin permitting as soon as possible if regulatory changes occur. Therefore a precedent will most likely be set before the Town deliberates this option. In any case, a feasibility level study should be performed prior to permitting to establish benefits and costs as well as evaluate alternatives. The feasibility study would form the basis of any permitting effort.

10.2 PATH FORWARD

The suggested path forward has been developed based on ATM and Holden Beach conversations with NCDENR and USACE regulatory staff, as well as with USACE beach nourishment and navigation personnel.

1. Continue with Post-Project and Annual Monitoring - Post-project monitoring is required by permit conditions and consists of biological sampling, sand sampling and surveying of pre-established project and control reaches. Annual island-wide assessments of beach conditions are the basis of the Town's ongoing beach monitoring program and include all tasks sufficient to satisfy FEMA guidelines for receiving federal funds to restore beaches recognized during federally declared disasters. Annual island-wide monitoring and post-project monitoring can often be performed simultaneously to minimize costs and both events are scheduled to occur in October, 2009.

2. Extend Existing Permit- The existing permits expire on December 31, 2009 and both CAMA and USACE regulatory agencies have recommended requesting extensions. This will primarily serve as a safeguard to allow the Town to respond to future emergency erosional events in a timely manner. The Town has at least one permitted upland site (i.e., Turkey Trap Road) and it is recommended that the Town continue to have an upland site reserved for smaller nourishment projects (including dune construction). Note that once a future emergency event occurs, additional modifications related to volume and placement will be necessary.

3. Begin New Permitting Program – This program will include a suite of projects/responses/triggers and include several borrow areas from the upland and offshore. Beach nourishment permitting typically includes identifying more volume than needed and in many cases more than one borrow area. This study has summarized all known current options and is presented to the Town for review. The recommended offshore borrow area is Borrow Area 4, while the Tripp upland borrow site is also recommended for smaller projects. The Turkey Trap Road site should also continue to be included.

4. Scoping Meeting with Regulatory Agencies – As soon as preferred borrow areas are selected; the Town and ATM will present its preferred suite of alternatives for a pre-application meeting. This will be followed by necessary data collection and permit application.

During this process, the Town and ATM will continue to engage the USACE with respect to proposed nourishment plans. Lockwood Folly navigation dredging and beach maintenance is a key component in this process. The USACE has been dredging Lockwood Folly for navigation and placing material on the beach in amounts ranging from 30,000 cy to 120,000 cy. The Town and ATM have been actively engaging USACE personnel in order expand these activities to reach the ~150,000 cy/yr goal.

The Town can maximize flexibility in beach nourishment activities by completing permitting as soon as possible. This allows for increased leverage in negotiating with dredgers as well as for planning around major USACE fill placement activities. If USACE fill activities proceed on schedule and with adequate funding, then large-scale nourishments by the Town may not be necessary. However complete reliance upon USACE plans can be risky and the Town's historical beach management activities over the last decade have been essential in maintaining storm protection and recreational beach width.

As mentioned in Section 9, an available funding option for placing sand on the beach while also retaining the 65% federal cost sharing is the "206 Project" alternative. The Section 206 of the 1992 Water Resources Development Act gives all local sponsors the opportunity to construct their own federally-authorized beach nourishment projects and

still receive federal funding for both engineering and project construction. The 206 Project option is common in Florida, where communities have been frustrated with USACE project delays. Essentially, the local sponsors, most likely led by the Town, would fund the entire permitting and construction of a large nourishment project and would receive reimbursement for the 65% federal share.

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