CHAPTER D.7
GULF SHORELINE SEDIMENT RESOURCES

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7.1 Summary

This chapter explains how to choose sediments for use in Gulf shoreline restoration projects. The chapter introduces the criteria that must be considered when selecting sediments, and it describes where naturally-occurring sand rich sediments are located throughout Louisiana's coast.

7.2 Introduction

Sediment resources are needed for both the restoration of Louisiana barrier shorelines and the re-establishment of submerged marsh platforms to subaerial conditions. In this context, a sediment resource is any sediment that, regardless of textural character (e.g. sand content), is potentially usable for restoration applications. However, the proposed barrier restoration work relies primarily upon the use of sand-rich sediment, which is of limited supply and usually contained within the fine-grained Holocene stratigraphy of the region. Fine-grained sediment, by contrast, will be important for restoration work in interior wetlands and marsh platforms.

Because of the overall fine-grained, regional stratigraphy of the region, locating volumetrically significant quantities of sand-rich sediment presents a challenge and requires detailed field investigations using direct (e.g. cores) and remote sensing methods (e.g. high-resolution seismic reflection profiles). Ideally, sediment used for restoration projects should be texturally equivalent to the native sediment of the coastal environment that is being restored. The textural character of a shoreline is a reflection of the original sediment source and local hydrodynamic conditions. If fine-grained sediment is added to a relatively coarser-grained beach, it will be unstable and easily eroded by marine processes. The volume of sediment added to a beach system and the longevity of a sediment-fill restoration project will ultimately be reduced if the borrow material is finer and/or contains a greater percentage of silt than the native sediment. Consequently, it is important to thoroughly understand the overall distribution and textural character (e.g. sandiness) of sediment resources within the Holocene sedimentary package of the Louisiana coastal zone so that the most appropriate sediment can be used in restoration projects.

According to the Wentworth grain-size classification, sand is defined as sedimentary particles that range in size between 0.062 mm (very fine sand) and 2.0 mm (very coarse sand) or 4.0 phi and -1.0 phi, a dimensionless measure of particle size (Wentworth 1922, In Hobson 1979). The Wentworth classification boundaries used in this report are shown in Table D.7-1. Values for sorting, a measure of the standard deviation (+) from the mean grain size, are shown in Table D.7-2 (e.g. 68% of the spread of a frequency versus grain-size curve lies within + 1 mm of the mean grain size). The most well-sorted sediment displays a minimum amount of dispersion about the mean grain size of the sediment, approximate to a single size, and possesses low sorting values. A discussion of the grain-size scale and statistics of grain-size characterization is presented in Hobson (1979), King and Galvin (2002), and many sedimentary geology texts.

Table D.7-1. Table D.7-displaying the equivalence of the dimensionless phi grain size scale, metric size measurement, and the grain-size terms of the Wentworth classification scheme (modified from Hobson 1979)

Phi value, ϕ	mm size	Wentworth Classification	
		BOULDER	
-8.0	256.0		
		COBBLE	
-6.0	64.0		
		PEBBLE	
-2.0	4.0		
		GRAVEL	
-1.0	2.0		
		very coarse	SAND
0.0	1.0		
		coarse	
1.0	0.5		
		medium	
2.0	0.25		
		fine	
3.0	0.125		
		very fine	
4.0	0.062		
		SILT	
>8.0	<0.0039		
		CLAY	

Table D.7-2. Measures of sorting used to grain-size analysis. Phi units represent a non-dimensional description of the measure of dispersion about the mean grain size; low values are representative of well-sorted sediments (modified from McManus 1988)

Very well sorted	0.35
Well Sorted	0.35 - 0.50
Moderately well sorted	0.50 - 0.70
Moderately sorted	0.70 - 1.00
Poorly Sorted	1.00 - 2.00
Very poorly sorted	2.00 - 4.00
Extremely poorly sorted	> 4.00

The overall stratigraphic framework of the Mississippi River Deltaic Plain and bordering continental shelf has been studied and discussed in detail by a variety of researchers (e.g. Fisk 1955, 1961; Kolb and Van Lopik 1958; Roberts 1997; Coleman et al. 1998; Penland et al. 1989; and many others). This vast body of work has provided valuable insight to many of the riverine, deltaic, and coastal systems and processes that have distributed sand-rich sediments within the Holocene sedimentary package. The following sections furnish an overview of the types of sand-rich deposits that have been or may be identified as potential sediment resources within the regional stratigraphic package.

7.3 Depositional Environments of Sediment Resources

The distribution of shallow sediment resources within the Louisiana coastal zone is intrinsically linked to the regional Holocene geological history that encompasses the delta cycle. Readers are encouraged to refer to Chapter 2 for a more detailed discussion of the regional geologic history and the geologic processes that helped construct southern Louisiana and the adjacent continental shelf. In brief, the shallow stratigraphic framework of the region is primarily the result of deposition by fluvial and deltaic systems. Marine processes reworked these deposits to create shoreline systems such as tidal inlets, barrier islands, beach-ridge plains, and chenier plains. The coastline of southern Louisiana has been continuously evolving in the Holocene. Ongoing deposition by successive, geographically offset locations of deltaic and marine deposition have led to the burial of deposits created by earlier fluvial, deltaic, and shoreline systems. Consequently, these earlier depositional environments and their resultant sedimentary bodies are now located in the subsurface beneath the sedimentary deposits that form the modern Louisiana coastline and continental shelf. The objective of sediment resources surveys is to identify the location of past depositional systems that are characteristically sand rich and assess their textural suitability for restoration purposes. The following discussion provides an overview of the depositional environments that characteristically contain sediment suitable for restoration purposes.

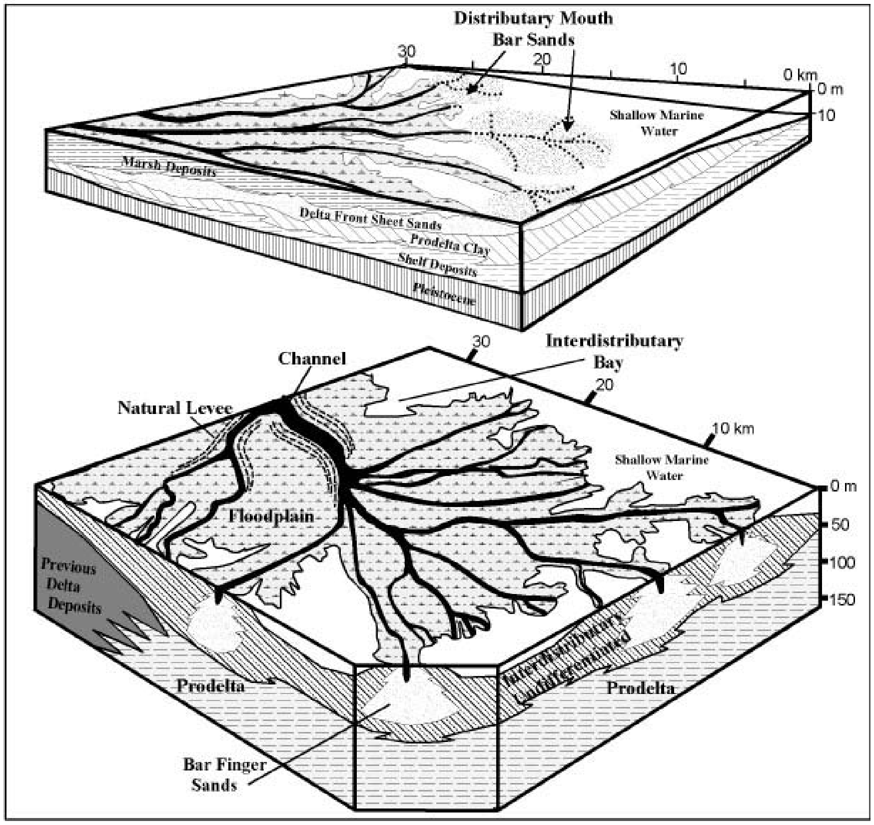

Figure D.7-1. Diagram showing the primary features of a fluvial and deltaic depositional system. The upper diagram indicates the overall geometry of distributary networks and the sand-rich distributary mouth bars for a delta advancing seaward into shallow marine water. The lower diagram depicts the elongated bar-finger sands that characterize the distributary mouth bar sands of the modern Plaquemine/Balize delta (Birdfoot Delta).

7.3.1 Fluvial Environments

The sedimentary package comprising the Mississippi River Deltaic Plain and continental shelf is principally the result of deposition by fluvial and deltaic depositional systems. The term fluvial is used to identify depositional environments that are associated with river systems and includes a suite of genetically related sub environments. Some of these sub environments are: (1.) the channel that is the conduit for water moving through the drainage area; (2.) natural levees that form the banks of the fluvial system, interdistributary bays of open water between adjacent distributaries; and (3.) floodplains, which are areas of land between channels and receive water and sediment discharge when the fluvial system is in a flood stage and unconfined by natural levees (Figure D.7-1). Sediment deposited within each of these settings reflects the availability of sediment within that location and the flow conditions with which the sediment was transported and deposited. For example, sediment deposited within a fluvial channel will be coarser grained than the sediment deposited on a floodplain because the velocity of channel flow is greater than the flow that carries sediment onto a floodplain. In a low-energy setting, such as a floodplain, sandy sediment is not as easily transported as silt and clay due to its smaller grain size; it takes more energy to move larger sediments. Generally, sand-rich deposits within fluvial environments are restricted to relatively narrow bands that extend seaward and are directly linked to the lateral migration and seaward extension of distributary courses. Although the modern Deltaic Plain consists of a complex network of active and abandoned fluvial networks, the greatest potential for sand-rich sediment from fluvial environments is within abandoned fluvial systems located on the inner continental shelf. These networks record the position of former fluvial systems that were actively prograding seaward and/or sea level was at a lower elevation than today. Abandonment of these fluvial systems has resulted in their inundation by marine waters, reworking, and eventually their burial through deposition by subsequent fluvial, deltaic, and coastal systems (Figure D.7-2).

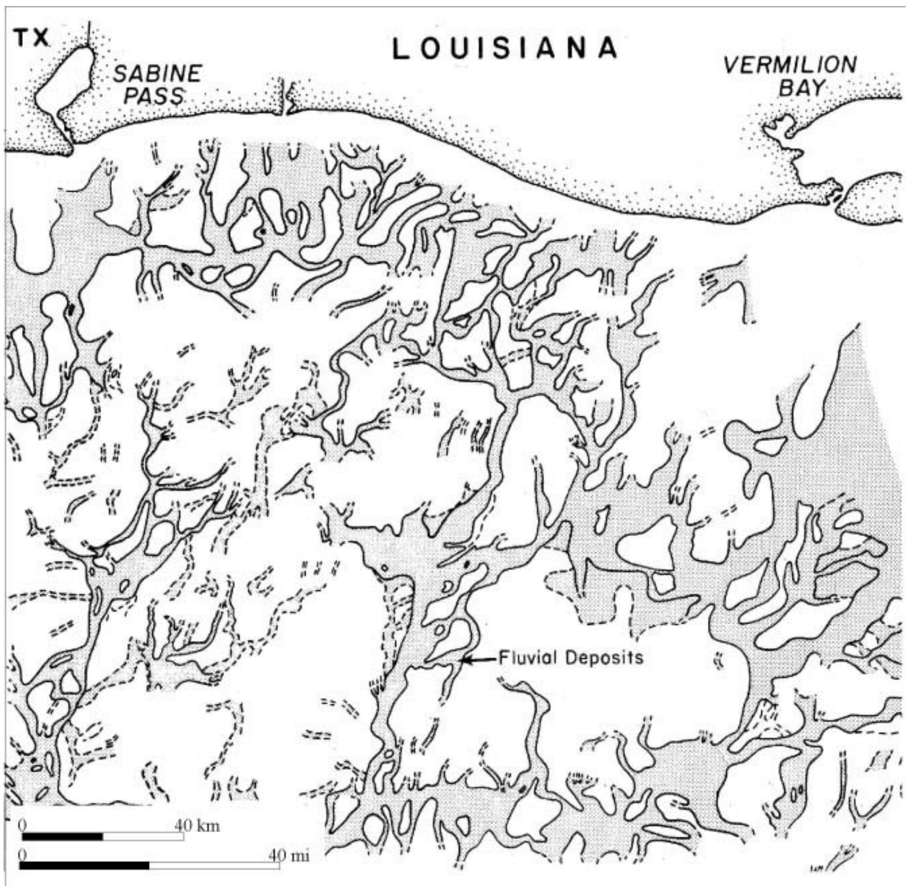

Figure D.7-2. Map of fluvial channels that developed on the western Louisiana shelf during the most recent sea-level low (from Suter et al. 1987).

7.3.2 Channel-fill Deposits

Because an active channel is where flow velocity is consistently the strongest, sediments deposited within channels are typically the sandiest within a fluvial system. However, there is the potential for textural variability within channel systems because once the channel is abandoned as an active conduit, it may be filled with very fine-grained sediments that have settled from the water. Consequently, poorly-sorted sands and silts are commonly found within channels that were once active and have been gradually abandoned. Although seismic reflection profiles are valuable for mapping the location and extent of channels, it is difficult to distinguish sandy channel-deposits from homogeneous clay-rich deposits; direct sampling using cores is necessary to definitively identify channels that contain sand-rich sediment resources. Although the potentially large variability of channel-fill deposits makes it difficult to collectively classify their sedimentary fill, they can locally contain more than 90% sand. Sand-rich intervals of abandoned channels in the region have been identified as containing moderately-sorted sand with a mean grain size of very fine sand (3.5 phi; 0.088 mm); however locally, the sand may be relatively coarse, well-sorted sand.

7.3.3 Deltaic Environments

A delta is a subaerial and subaqueous package of sediment that is deposited where the channels of a fluvial system encounter a body of water. Deltaic deposition occurs because river currents decelerate as they enter and mix with the waterbody. As the capacity and competency of currents diminish, sediment carried by the river flow settles out to form a sedimentary deposit. Factors such as water depth, marine currents, amount of sediment in the water, and flow velocity determine the shape and sedimentary character of a deltaic deposit and the distribution of sediments within a deltaic package. The subaqueous environments of a delta, located seaward of a river mouth, include the delta front and the prodelta (Figure D.7-1). The delta-front environment is of specific interest for sediment resources because of the typically sand-rich sediment that is present within distributary mouth-bar deposits. The prodelta environment, located seaward of the delta front, is an apron of fine-grained sediments that is carried farther seaward beyond the delta front area. The prodelta contains little if any sand-rich sediment.

7.3.4 Distributary Mouth-bar Deposits

Distributary mouth-bar deposits consist of the coarsest sediment within the delta-front environment. The velocity at the mouth of a river decreases quickly upon entering open marine waters. Consequently, sand is deposited in the form of a shoal-like area called a distributary mouth bar. As a delta extends seaward, the delta front and distributary mouth bars advance over the prodelta environment (Figure D.7-1). Thus, the seaward extension of a fluvial and deltaic system results in a stacked set of sedimentary deposits that coarsen upward from fine-grained, clay-rich prodelta deposits into the sand and silt of the overlying distributary mouth bars. In the Holocene Mississippi River system, two types of mouth-bar deposit trends have been identified. These trends primarily reflect deltaic progradation into either shallow or deep-water environments (Figure D.7-1). Thus, the geometry of the sand-rich distributary mouth bars at the modern Plaquemine/Balize Delta (historically referred to as the Birdfoot Delta) are present as thick, linear trends (bar finger sands); whereas the earlier formed deltas constructed in relatively more shallow-water conditions contain thinner, more widespread mouth-bar deposits that coalesce to leave a semi-continuous sand sheet (Fisk 1955, 1961; Coleman and Gagliano 1964; Coleman et al. 1998). Grain size analysis of bar finger sands from the modern delta indicates that these deposits generally consist of moderately to well-sorted, fine to very-fine sand (Fisk et al. 1954; Fisk 1955). Ancient distributary mouth-bar sands have been identified in the subsurface and recognized as potential sand resources (e.g. Kindinger et al. 2001; Kulp et al. 2001). Because of their thickness, extent, and textural character, the bar-finger sands of the modern delta potentially provide an excellent sand-resource but have not yet been targeted as potential borrow sites.

7.3.5 Shoreline Systems

Once an active fluvial and deltaic system is abandoned due to stream avulsion, marine processes such as waves and tides begin to dominate the distribution of sediment (see Chapter 2). Deterioration of the earlier deltaic landscapes results in the reorganization of sand-rich sediment into shoreline systems that may ultimately become buried by renewed fluvial and deltaic deposition. These systems may then be preserved in the subsurface as potential sand-rich sediment resources.

7.3.6 Re-curved Spits, Barrier Systems, Beach Ridges, and Cheniers

Re-curved spits, barrier islands, beach ridges, and cheniers are shoreline depositional systems that develop where there is an abundant supply of unconsolidated sediment, sourced from an updrift erosional shoreline segment. This sediment is mobilized by waves and longshore transport processes to form narrow sedimentary bodies elongated parallel to the trend of the mainland shoreline (Figure D.7-3). These features constitute dynamic depositional environments and undergo frequent changes in shape and composition in response to sea-level rise, sediment supply, and marine processes.

Penland et al. (1989) presented a model for the development of flanking spits and barriers. According to this model, spits and barriers are produced by erosion of abandoned deltaic headlands, which supply the sediment necessary for barrier construction. Re-curved spits are attached to a headland but build downdrift or away from the headland by the continuous along-shore movement of sediment imposed by marine currents (Figure D.7-3). Spit development from a headland results in a semi-continuous ridge of sand that is separated from the mainland by a backbarrier area of open water (bay).

Beach ridges form due to sand accumulation, causing a progradation of the coast. This process occurs when shallow offshore sand bars weld to the shoreline. In some instances, they may develop updrift of a deltaic headland due to the accumulation of sand created by longshore movement next to a distributary promontory (Figure D.7-3). Cheniers have a similar morphology but represent the reworked portion of a mudflat that was formerly located more seaward (see Chapter 2). Regardless of their origin, each of these systems generally contains shore-parallel ridges of sand that may provide suitable sediment resources. Although sediment textures are often quite varied within these deposits of the Louisiana coastal zone, they have been previously identified as potential sand resource targets (e.g. Suter et al. 1991; Kulp et al. 2001). Sand within these deposits is locally as high as 98% of moderately sorted, fine to very-fine sand (0.15 to 0.06 mm; 2.8 to 4.0 phi).

7.3.7 Tidal Inlets and Tidal Deltas

Shoreline systems such as barrier islands are dissected by tidal channels that allow for the exchange of water between the open marine environment and backbarrier bays, lagoons, estuaries, and wetlands (Figure D.7-3). Water flows through these naturally occurring breaches in the shoreline as water levels successively rise and fall during a tidal cycle.

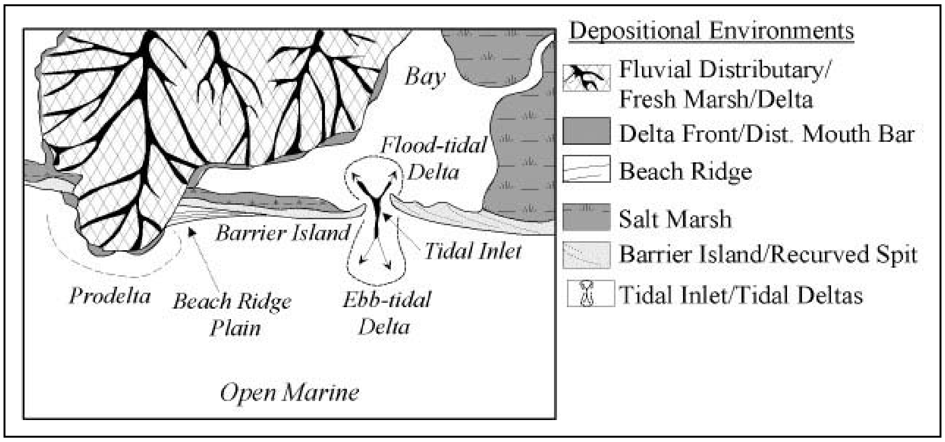

Figure D.7-3. Generalized diagram of the sand-rich shoreline depositional systems discussed in the text.

Relatively high flow velocities typically accompany tidal exchange through inlets and result in the transport of sand-rich sediment. Deposition of the sediment occurs as the velocity of tidal flow decreases. Consequently, channel ebb- and flood-tidal delta deposits usually consist of sand-rich sediment. Sediment carried during the flood interval of a tidal cycle is deposited on the backbarrier side of the tidal inlet as the tidal waters flood into the backbarrier bays and lagoons, resulting in the construction of a flood tidal delta. Ebb tidal deposits form on the open marine side of the tidal inlet as the tidal waters recede from the backbarrier area (Figure D.7-3).

The frequency and magnitude of waves, volume, and velocity of tidal flow, and availability of sediment all influence the geometry and extent of tidal-inlet and flood and ebb-tidal deposits. The stratigraphy and geomorphology of these sedimentary packages have been extensively studied along the world's coastlines. Their predictable and generally sand-rich sediment makes them good potential sediment resources. Analysis of sediments from ebb-tidal deltas located along the Barataria barrier shoreline indicates that these deposits may consist of as much as 99% poorly to moderately-sorted, fine to very-fine-grained sand (0.18 to 0.09 mm; 2.5 and 3.5 phi). Tidal inlets along the Louisiana coastline may contain a large amount of shell material interspersed with moderately well-sorted, very-fine sand (0.25 to 0.06 mm; 2.0 to 4.0 phi).

7.4 Offshore Sand Shoals

Offshore sand shoals of the Louisiana continental shelf represent the reworked remnants of former deltaic lobes that existed on the continental shelf when sea level was lower than it is today. A three-stage conceptual model that explains the development of offshore sand shoals on the Louisiana continental shelf was discussed in Chapter 2. Collectively, these sand shoals constitute a large volume of high sand content sediment that is suitable for coastal restoration purposes (Figure D.7-4). Ship Shoal, located on the south-central Louisiana shelf, is the most well studied of these shoals and is described in detail in this section.

7.4.1 Trinity Shoal

Trinity Shoal is the westernmost member of the Louisiana shelf shoals located offshore of Cheniere Au Tigre and Marsh Island. This shoal is relatively well defined by the –33 ft (-10 m) bathymetric contours of the area (Figure D.7-4). Overall, the shoal is a lunate-shaped feature approximately 18 mi (30 km) long and 3 to 6 mi (5 to 10 km) wide. The shoal is covered by approximately 23 to 32 ft (7 to 10 m) of water and has 6 to 12 ft (2 to 4 m) of relief relative to the surrounding seafloor. Frazier (1974) indicated that the surface of the shoal consists of 75 to 100% very fine sand. Krawiec (1966) identified the sediment of Trinity Shoal as very fine sand (0.09 to 0.07 mm; 3.4 to 3.8 phi) with varied amounts of shell and organics.

7.4.2 Ship Shoal

Ship Shoal, the most studied of any of the Louisiana shelf shoals, is an asymmetric, landward- oriented sedimentary body approximately 31 mi (50-km) long (Figure D.7-4). Widths across the central part of the shoal range between 2.5 to 5 mi (4 and 8 km), whereas on the eastern and western ends, shoal width ranges from 3.1 to 6.2 mi (5 and 10 km). Relative to the surrounding shelf, relief of the shoal varies from approximately 23 ft (7 m) on the western end to approximately 16 ft (5 m) in the central and eastern portions of the shoal. Water depths above the shoal range between approximately 10 ft (3 m) over the western end to 26 ft (8 m) on the eastern-edge. A 9 to 12 mi (15 to 20-km) wide platform lies between the 39 and 66 ft (12 and 20-m) isobaths seaward of Ship Shoal and forms the base of Ship Shoal.

Williams et al. (1989) mapped seven major lithofacies in the Ship Shoal area based on sand content. Quartz sand, consistent with the results of Krawiec (1966), was found to be a primary constituent of the surficial sediment with an average, but highly variable, sand content of 54%. However, much of Ship Shoal contained 90 to 99% sand. Recently, Williams et al. (2003) have begun developing new sediment-distribution maps of the Ship Shoal area, as well as other regions of the Louisiana continental shelf. The maps are being developed through the usSEABED database initiative, a comprehensive database of continental shelf aggregate resource assessment. These efforts have contributed tremendously to our understanding of sediment distribution within Louisiana's offshore sand shoals and have indicated that the shoal crest, shoal front, and shoal base of Ship Shoal are of primary interest for sand resources. Although large amounts of sandy sediments are present on the Ship Shoal deposit, there are also many pipelines, flowlines, and other pieces of oil infrastructure. The presence of this equipment may limit dredging activities in some areas. MMS is currently evaluating the extent of pipeline setbacks and buffer zones around platforms and other oil and gas infrastructure to protect these features prior to any mining operations.

7.4.2.1 Shoal Crest

The upper 13 ft (4 m) of the shoal has been termed the shoal crest. The crest is represented by a shore-parallel accumulation of sand and shell that has been deposited in response to reworking by wave and tidal processes. This portion of the shoal is a high-energy environment where currents and waves winnow and sort the available sediment into a uniform grain size. Sediment comprising the shoal crest consists of very well-sorted, well-rounded, quartz sand with parallel, horizontal to sub-horizontal laminations. Whole and reworked shells are concentrated within this interval, which generally displays a coarsening upward grain size. This section of the shoal locally consists of as much as 99% sand. Mean grain size in this sedimentary facies ranges between 1.5 and 2.7 phi, with a sorting value of 0.5 to 1.6 phi units.

7.4.2.2 Shoal front

The shoal-front facies borders the shoal crest facies along the seaward edge, consisting of moderately sorted, fine- to very fine-grained sand. Mean grain size in this facies ranges between 2.7 and 3.1 phi, with a sorting value of 0.5 to 0.9 phi. The shoal front through most of the area has been suggested to be approximately 75 to 95% sand. Sedimentation along the shoal front is primarily the result of storm events that pass over the shoal crest and transport sediment into deeper, off-shoal waters.

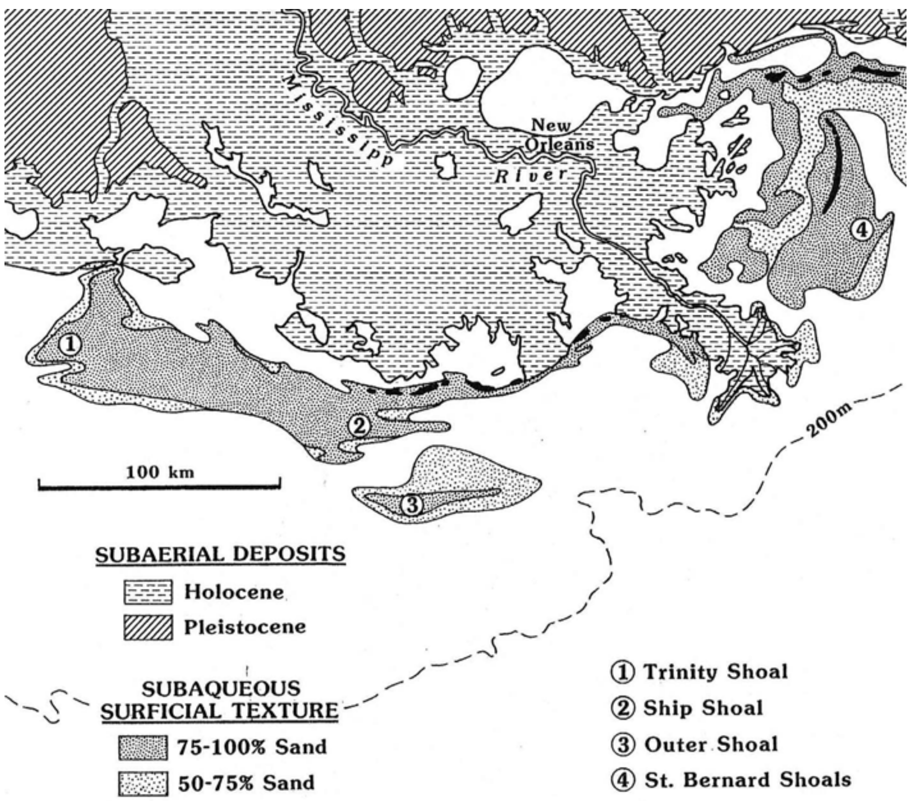

Figure D.7-4. Base map showing the regional distribution of sand-rich shoals on the continental shelf that have been investigated for their use as potential sand-resource targets.

7.4.2.3 Shoal Base

Sediments of the shoal base typically consist of interbedded silty clay and lenticular-to-wavy bedded, poorly sorted, very fine-grained sands. Mean grain size of these sediments ranges between 3.1 and 3.6 phi, with a sorting value of 1.2 to 1.5 phi units. The shoal base contains 50 to 75% sand. The low-energy, shoal-base environment marks the advancing edge of the landward migrating Ship Shoal depositional surface. The shoal base lies between the 26 to 30 ft (8 to 9 m) isobath in the west and the 36 to 39 ft (11 to 12 m) isobath in the east. Because water depths at the shoal base are greater than those at the shoal-front and shoal-crest, sedimentation is even more episodic and primarily the product of storm events.

7.4.3 Outer Shoal

Approximately 16 mi (25 km) seaward of Ship Shoal is another shore-parallel shoal with an inner-shelf relief of only 3 to 6 ft (1 to 2 m) and water depths of approximately 39 to 49 ft (12 to 15 m) above its crest. This feature, termed the Outer Shoal (Penland et al. 1988), is approximately 22-mi (35 km) long and 3 to 6-mi (5 to 10 km) wide (Figure D.7-4). Outer Shoal is best defined on the inner shelf, offshore of the western end of Ship Shoal. The outer shoal lies seaward of Ship Shoal on a broad platform lying between the –60 and –66 ft (18 to 20 m) isobaths. Frazier (1974) mapped the Outer Shoal as high as 75 to 100% fine sand. Samples analyzed by Kraweic (1966) from the Outer Shoal indicated 79 to 96% sand with a median diameter of 0.125 to 0.120 mm (3.0 to 3.1 phi). Sediment cores demonstrate that the Outer Shoal consists of a well sorted, coarsening upward sequence of sand units.

7.4.4 St. Bernard Shoals

The St. Bernard Shoals are low-relief sand bodies about 10 to 12 ft (3 to 4 m) thick, located approximately 20 mi (30 km) offshore of the Chandeleur Islands in 60 ft (20 m) of water (Figure D.7-4). In contrast to the large isolated shoals located on the central and western Louisiana shelf, the St. Bernard Shoals are a set of smaller shoals within a larger inner shelf sand body. Each shoal is 3 to 4 mi (5 to 8 km) wide and aligned along a northward trend. Frazier (1974) showed that the St. Bernard Shoals consist of 75 to 100% fine sand. Ludwick (1964) mapped the St. Bernard Shoals as fine-grained, well-sorted sands with a modal characteristic of 94% terrigenous sand and 6% carbonate sand. The median diameter is 0.11 mm with a sorting coefficient of 1.15. Overall, the St. Bernard shoals appear to coarsen upward and consist of well-sorted marine sands.

7.5 Sediment Resource Research and Regional Distribution

Numerous, previous studies have provided a broad basis for understanding the distribution and character of sediments within the Mississippi River Delta sedimentary package. However, most of these studies were not conducted with the intent of furnishing the information necessary to remove sediment and use it for coastal restoration projects.

Consequently, beginning in the 1980s, the Louisiana Geological Survey in conjunction with the U.S. Geological Survey and MMS began investigating the distribution and character of sand-rich sediment within the shallow stratigraphy (approximately upper 40 ft; 12 m) of the region. Suter et al. (1991) conducted the most regionally extensive and in-depth of these studies between Marsh Island and Sandy Point (Figures D.7-5 to D.7-9, Table D.7-3). In total, they collected approximately 4,600 line-mi (7,500 line-km) of high-resolution single channel seismic reflection data and 152 vibracores for the purpose of identifying and mapping sand-rich sediment resources. A total of 55 nearshore deposits were identified within the different types of sedimentary deposits that have been discussed, including: distributary channels, inner-shelf shoals, re-curved spits, ebb and flood tidal deltas, tidal channels, beach ridges, and buried barrier shoreline trends. Table D.7-3 summarizes the location and textural character of these deposits.

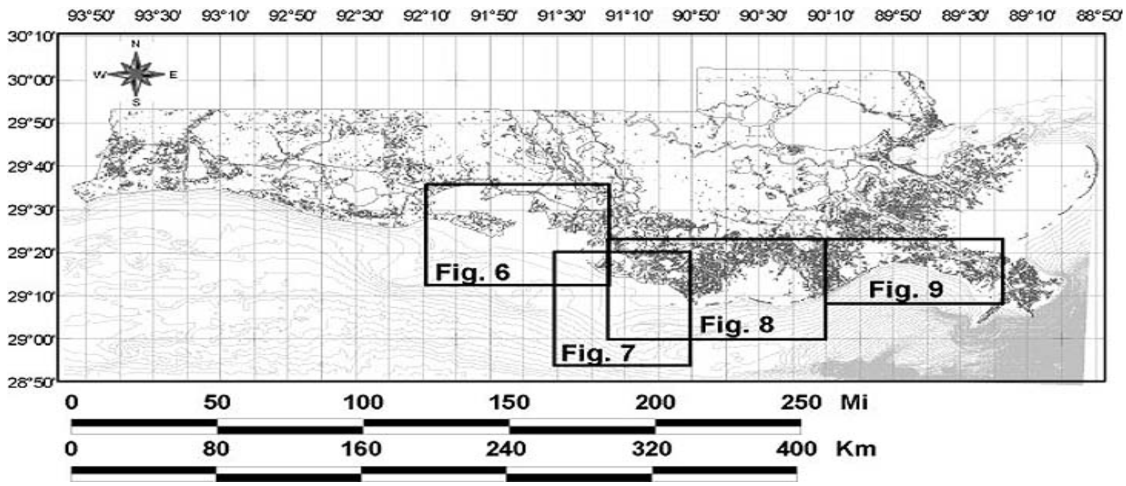

Figure D.7- 5. Base map indicating the locations for Figures 6 to 9.

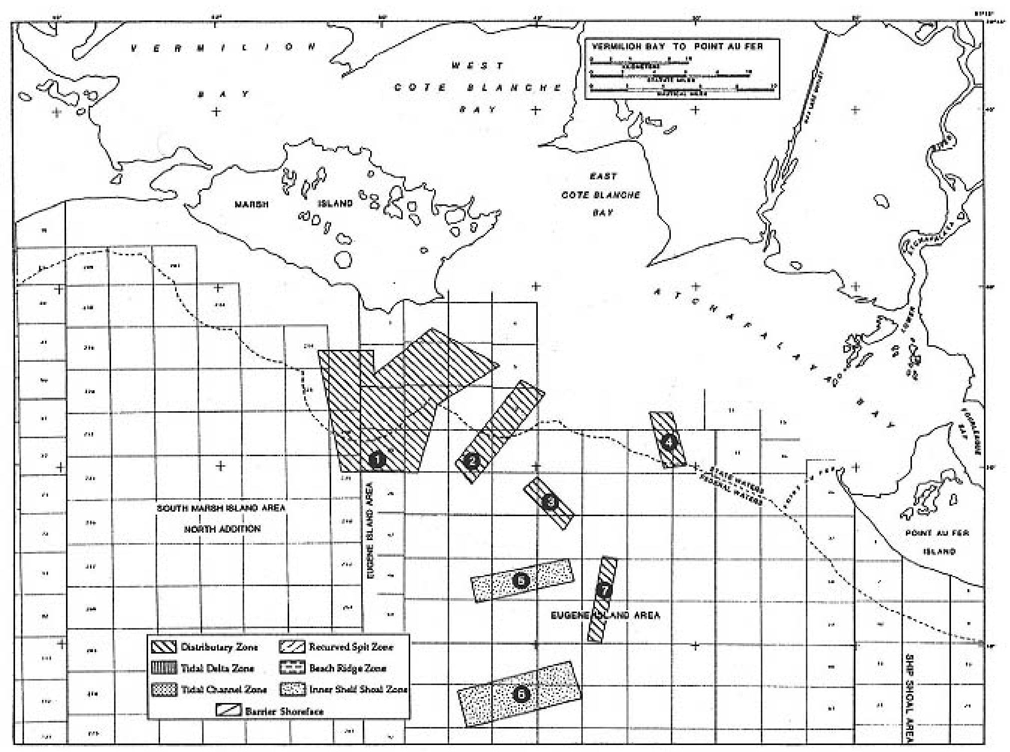

Figure D.7- 6. Map illustrating the distribution of sand-resource targets located between Vermillion Bay and Point Au Fer (from Penland et al. 1990). Location of map shown on Figure D.7-5.

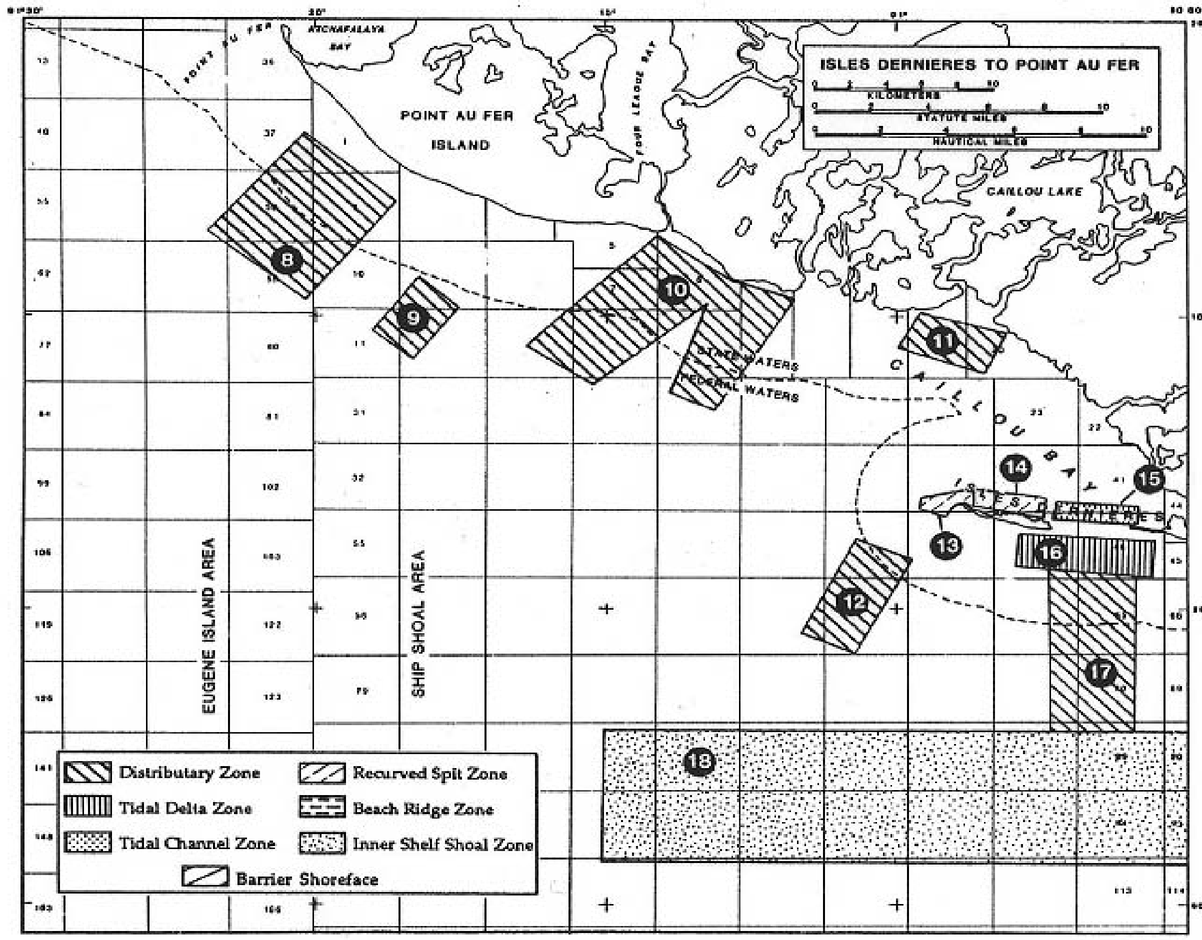

Figure D.7- 7. Map showing the distribution of sand-resource targets located between Point Au Fer and the Isles Dernieres barrier island system (from Penland et al. 1990). Location of map shown on Figure D.7-5.

Additional studies completed by the Louisiana and U.S. GeologicalSurvey and MMShave significantly expanded the knowledge base of sand-rich sediment distributions, and thus have helped develop comprehensive sediment inventories. These sediment-resource surveys constitute seminal efforts to identify and characterize Louisiana's coastal zone sediment resources. However, recent studies have shown that the complexity of sediment relationships and prevalence of fine-grained sediment requires more site-specific investigations prior to dredging and moving this material onshore to restoration projects (e.g. Kindinger et al. 2001). Further studies undertaken in support of CWPPRA restoration efforts (e.g. Coastal Planning and Engineering 2001; Kindinger et al. 2001; Kulp and Penland 2001; Kulp et al. 2001; Roberts and Stone, Ocean Surveys 2002) have focused on many of the sites identified in the 1980s through the Louisiana and US Geological Survey cooperative studies. The new studies have resulted in very detailed and comprehensive analyses of many of the earlier recognized sediment-resource locations. Efforts are currently underway to develop robust databases that incorporate all of the available sediment resource data and will provide information critical to the success of the regional restoration efforts.

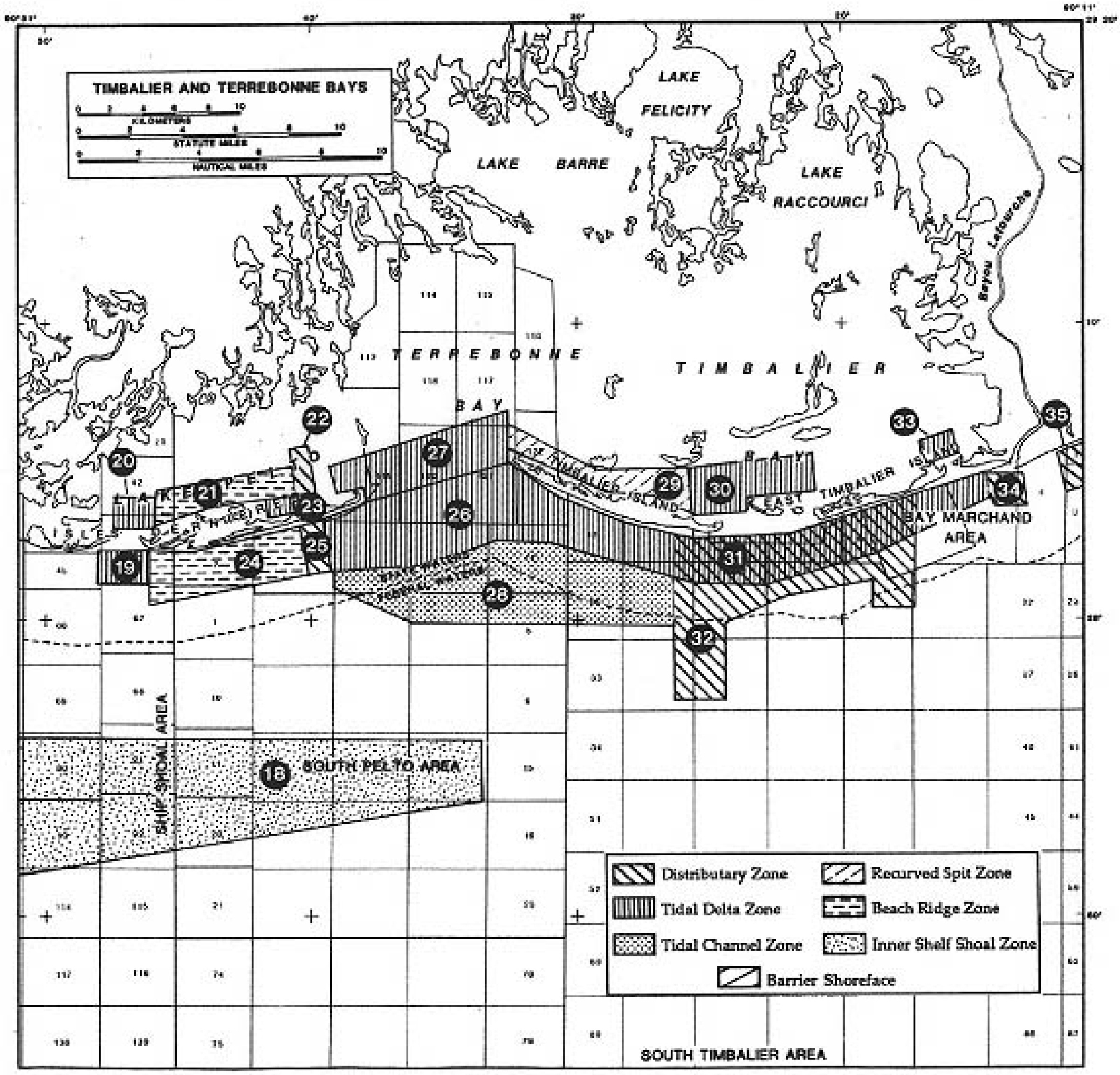

Figure D.7- 8. Map indicating the distribution of sand-resource targets located offshore of the Barataria barrier shoreline (from Penland et al. 1990). Location of map shown on Figure D.7-5.

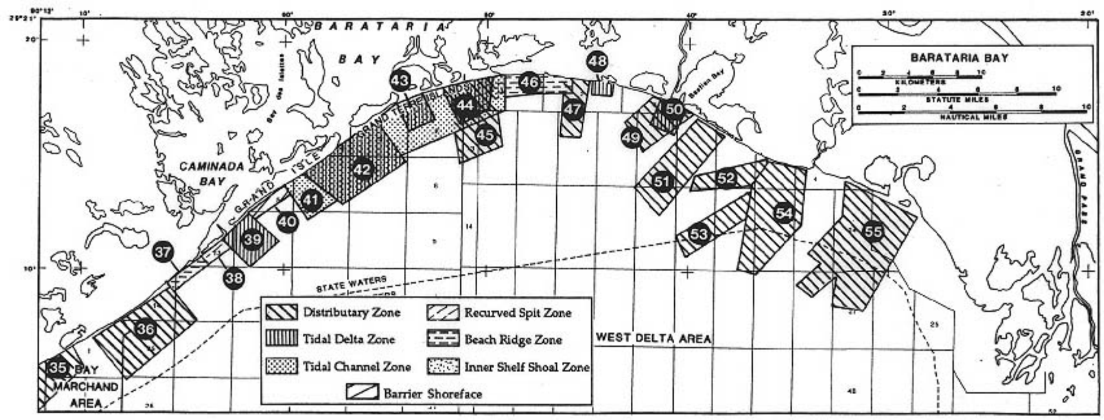

Figure D.7- 9. Map defining the distribution of sand-resource targets located between Vermilion Bay and Point Au Fer (from Penland et al. 1990). Location of map shown on Figure D.7-5.

Table D.7-3 Characteristics of offshore sand resources shown in Figures 6 to 9 (from Penland et al. 1990).

SAND RESOURCE TARGET			SAND BODY PARAMETERS			OVERBURDEN	
No.	Name	Area mi^2 (km^2)	Avg. Thickness ft (m)	% Sand	Est. Vol. $x10^6$ yd ($x10^6$ m^3)	Type	Avg. Thickness ft (m)
1	Marsh Island Dist.	59 (153)	49 (15)	64	974 (745)	S, Sl, Cl, Sh	13 (4)
2	Western Shell Reef Dist. Channel	11 (29)	30 (9)	94	98 (75)	Cl, Sl	16 (5)
3	Central Shell Reef Dist. Channel	4 (11)	30 (9)	cf. #2	38 (29)	cf. #2	7-10 (2-3)
4	Central Shell Reef Dist. Channel	5 (13)	30 (9.0)	cf. #2	43 (33)	cf. #2	7-10 (2-3)
5	Marsh Is. Shoal 1	10 (26)	7 (2.0)	94	51 (39)	S, Cl	0.3 (1)
6	Marsh Is. Shoal 2	18 (46)	7 (2.0)	97	121 (93)	-	0 (0)
7	Southern Shell Reef Dist. Channel	5 (13)	30 (9.0)	95	44 (34)	S, Sl, Cl	13 (4)
8	Western Point Au Fer Dist. Channel	21 (55)	26 (8.0)	cf. #7	159 (122)	Sl, Cl	10-13 (3-4)
9	Central Point Au Fer Dist. Channel	5 (12)	0.2 (0.6)	cf. #7	26 (20)	Sl, Cl	10-13 (3-4)
10	Eastern Point Au Fer Dist. Channel	28 (73)	30 (9.0)	cf. #7	252 (193)	Sl, Cl	35 (11)
11	Grand Caillou Dist. Channel/Ebb Delta	5 (12)	26 (8.0)	64	35 (27)	-	0 (0)
12	Raccoon Point Dist. Channel	8 (22)	20 (6.0)	-75	50 (38)	cf. #10	cf. #10
13	Raccoon Point Recurved Spit	1 (3)	7 (2.0)	>75	8 (6)	-	0 (0)
14	Relict Raccoon Point Recurved Spit	2 (4)	7 (2.0)	>75	12 (9)	Sl, Cl	0.3 (1)
15	Coupe Colin Flood Tidal Delta	2 (5)	5 (1.5)	>75	10 (8)	-	0 (0)
16	Coupe Colin Ebb Tidal Delta	6 (16)	7 (2.0)	98	42 (32)	-	0 (0)
17	Ship Shoal Dist. Channel	18 (47)	30 (9.0)	75	160 (123)	Sl, Cl	5 (1.5)
18	Ship Shoal	167 (433)	(4.0)	99	2.3 (1.7)	-	0 (0)
19	Whiskey Pass Ebb Tidal Delta	2 (6)	(2.0)	90	16 (12)	-	0 (0)
20	Whiskey Pass Flood Tidal Delta	2 (5)	5 (1.5)	>75	9 (7)	-	0 (0)
21	Lake Pelto Beach Ridges	6 (15)	5 (1.5)	>75	14 (11)	Cl	3-7 (1-2)
22	Lake Pelto Dist. Channel	1 (3)	30 (9.0)	cf. #25	12 (9)	Sl, Cl	3-7 (1-2)
23	Coupe Carmen Flood Tidal Delta	1 (2)	5 (1.5)	>75	3 (2)	-	0 (0)
24	Cheniere Caillou Beach Ridges	11 (29)	5 (1.5)	95	24 (18)	-	0 (0)
25	Caillou Dist. Channel	2 (5)	20 (6.0)	>75	10 (8)	S, Cl	5 (1.5)
26	Cat Island Pass Ebb Tidal Delta	28 (73)	7 (2.0)	88	190 (145)	-	0 (0)
27	Cat Island Pass Flood Tidal Delta	12 (31)	5 (1.5)	>75	60 (46)	-	0 (0)