TECHNICAL ADVICE SECTION

Approach for Sand Searches On the Southwest Gulf Coast

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Offshore sand resources along the west coast of Florida occur in three main depositional settings: (1) offshore sand ridges, (2) nearshore ebb shoals and (3) nearshore sand sheets. Bathymetrically positive features known as sand ridges that have been used in many nourishment projects along this coast and are the most prominent offshore sand deposit. These offshore sand ridge sands are offshore "mounds of sand" anchored in Hardbottom that are generally composed of mixtures of silicates (quartz) and carbonates (shell fragments, shell hash). Generally silt content increases with penetration depth and rock fragments are encountered in the boundary between the ridge's sandy sediments and the underlying hardbottom but sediment thickness and specific composition varies between ridges within the same field and between ridges located in different geographic locations along the SW Florida coast.

To search for beach quality sand on these sand ridges, a logical sequencing of investigation that differs from those applied along the east and panhandle coasts of Florida is necessary. A logical sequence of offshore sand searches targeting sand ridges along the SW Florida coast should adopt the following steps:

1.1 REVIEW OF HISTORICAL DATA

Using the ROSS database, the investigator can download historical datasets containing seabed relief information, geotechnical data (vibracores, jet probes, sand samples) and geophysical data (sidescan and seismic) to identify initial target areas for more detailed investigations. The gray scale shaded relief image available from ROSS can be used to identify offshore sand ridges occurring near a project area. The geotechnical and geophysical layers can then be turned on to see if any of the sediment data overlie ridges of interest. These data may provide initial information regarding deposit thickness and sediment textural properties. After target ridges are identified and data availability checked, the investigator can design a reconnaissance survey plan.

1.2 RECONNAISSANCE SURVEY PLAN

The reconnaissance survey plan should focus on obtaining better definition of sand ridge geomorphology and sediment characteristics. Commonly, a few offshore sand ridges (*i.e.* more than 5) are selected based on the analysis discussed in Section 5.1. These will be narrowed down to one or two ridges where the final borrow areas will be defined during future detailed field investigations.

The bathymetric data which is used to define the sand ridges of interest in Section 5.1 consists of historical NOAA-NOS data that can be 30 years old or older. Because some sand ridges may migrate and change shape over time, an updated bathymetric survey is a requirement for reconnaissance investigations prior to any seabed sampling. A reconnaissance seismic survey may also be conducted simultaneously with the bathymetric survey to allow for identification of sediment thickness. An experienced geologist/geophysicist can effectively map the sub-bottom hardbottom surface using seismic records obtained from chirp systems (*i.e.* the Edgetech 512i) to obtain information about sediment thickness. Undesirable materials such as rubble layers or presence of fine-grained sediments can also be mapped in the seismic records if calibration data (*i.e.* historical vibracores) are available. The spacing between lines in the reconnaissance surveys depends on the survey area but generally ranges from 1000 to 2000 ft but it can be more or less depending the objective of the investigation.

Traditionally sand quality and thickness in individual ridges may be investigated during preliminary sampling surveys using surface samples and jet probes. Because vibracores are more expensive and time-consuming they are traditionally reserved for detailed phases of an offshore investigation when the search area has been narrowed using other methods.

Sand quality and thickness in individual ridges may be investigated during preliminary sampling surveys using surface samples, jet probes or widely spaced vibracores. Surface grab samples can be deceiving because they only represent sedimentary characteristics of a few inches on the top of the ridges (generally sediment transported by modern processes) and do not show the characteristics of sediments lying below the ridge surface. Jet probes are a cost-effective method to investigate sediment thickness in the ridges. They also provide an indication of sediment quality in under-layers. However, the sediment samples extracted from jet probes are usually disturbed by the water jet and silt content may be underestimated.

One important consideration is that sand quality in the surface of the ridges as indicated by surface samples and widely spaced jet probes may not always be the most adequate procedure to select ridges for further investigation during reconnaissance efforts. Many times it was found that relict sediments underlying the ridge surface contains much cleaner sandy sediments (less shell and rubble fragments and lighter color) than surface sediments. This is because modern sedimentation processes linking the upper layers of sedimentation in a ridge may be significantly different from relict sedimentation processes that originated the ridge and are linked to deeper subsurface layers. Thus it is suggested that during reconnaissance investigations on offshore sand ridges on the SW coast of Florida, consideration is given to obtain at least one undisturbed sample (vibracore) on each offshore sand ridge to supplement jet probe and surface sample data.

Because the reconnaissance sampling plan should be designed to target the crests of the main sand ridges, spacing between samples varies with the size of the area, the total volume targeted, and the project budget.

1.3 DETAILED SURVEY PLAN AND PRELIMINARY BORROW AREA DESIGN

Following analysis of the data collected in during the reconnaissance survey plan, Section 5.2, a plan to conduct detailed investigations over a smaller area should be prepared. This detailed investigation plan aims at obtaining enough information to define the quality and quantity of sand in the study area and map the vertical and horizontal continuity of the sand layers. This level of investigation also provides enough information to identify layers of undesirable sediments within the study area that should be avoided during borrow area design. The detailed investigations usually consist of detailed bathymetry, sidescan and seismic surveys at spacings generally ranging from 200 to 300 ft with vibracores obtained at 1000 ft centers. Analysis of the information obtained in these detailed surveys allows for preliminary design of the offshore borrow area and mapping of surface features (*i.e.* environmental resources and possible obstructions to dredging) that occur in or near the borrow. Tools to assist in visualization of deposit morphology and sediment thickness and characteristics of sand borrow areas include geological cross-sections and fence diagrams, 3D isopach maps and bathymetric maps, color-coded interpretation of seismic records, *etc.*

Although these detailed investigations allow for preliminary borrow area design, they are usually adequate to meet the requirements of borrow area design. It must be appreciated that characteristics of mineral reserves such as offshore sand are geologically well known sites that are subject to sources of error directly linked to spatial and temporal variability of natural environments.

1.4 CULTURAL RESOURCE INVESTIGATIONS

Once the limits of the borrow area are defined, detailed geophysical investigations with 98 ft (30 m) line spacing should be used to investigate the presence of cultural resources within proposed borrow limits. The cultural resource surveys generally consist of magnetometer, sidescan and seismic surveys. Because these investigations must be conducted at 98 ft (30 m) intervals, the geophysical investigations discussed in Section 5.3 are generally conducted in multiples of 98 ft (30) m *viz.,* 196 ft (60) or 294 ft (90 m) so the cultural resource investigation can make use of data and lay additional tracklines between the lines previously run. Optimally, the cultural resource investigations are conducted using the same type of geophysical equipment as discussed in Section 5.3, so borrow area design can be refined using the additional data obtained. If any significant cultural resources (*i.e.* shipwrecks, large cultural artifacts *etc.*) are mapped within the limits of the proposed borrow area, the borrow design has to be modified to avoid disturbing the mapped features. This is usually done by adding 200 ft no-dredge buffers around the cultural resource feature or by modifying margins of the borrow area (when the cultural resource features occur near the borders of the borrow).

1.5 BORROW AREA IMPACT ANALYSIS (ENVIRONMENTAL INVESTIGATION AND NUMERICAL MODELING)

Data from the detailed survey plan and preliminary borrow area design (Section 5.3) and the cultural resource investigations (Section 5.4) may also be used to map any sensitive environmental resource (*e.g.* hardbottoms) occurring near the proposed borrow site. If sensitive environmental resources appear too close to the proposed dredge site, the borrow area design is modified.

In addition to cultural resource and environmental consideration, there is a need to evaluate whether the proposed borrow sites will significantly affect the nearshore wave climate and cause additional erosion of adjacent beaches. This evaluation can be done using a range of numerical models that simulate wave transformation over the borrow sites and can also simulate wave-induced currents, sediment transport, shoreline change and beach morphology change. Several wave models evaluate borrow area impacts on nearshore wave climates. In order to properly evaluate borrow area impact on nearshore waves, spectral wave models that incorporate most of the relevant physical processes of wave transformation (*e.g.* wave refraction, bottom friction and to a lesser extent diffraction) are recommended. While proposed borrows may induce changes in the nearshore wave climate, these changes may not necessarily cause additional erosion of adjacent beaches. To evaluate whether the impacts of borrow areas on nearshore waves is significant in terms of beach erosion and deposition patterns, shoreline change models or beach morphology change models can be used. These models can be either empiric (*i.e.* sediment transport is calculated based on the output of a wave transformation model that feeds empirical sediment transport formulas) or process-based (output from a wave transformation model is used to calculate wave-induced currents and these are in turn used to calculate bed-load and suspended load sediment transport). Simulations are run for scenarios with and without the proposed dredging. By comparing the with/without dredging scenarios, the investigator can evaluate the impact of dredging on the beach deposition and erosion patterns. If numerical modeling indicates that significant undesirable impacts are expect on adjacent beaches due to borrow area dredging, borrow area design modifications may be required.

1.6 FINAL BORROW AREA DESIGN

The final borrow area design, and the borrow area plans and specifications are prepared when all the concerns regarding the sediment quality within the borrow area, the cultural resource potential, the environmental consideration and the physical considerations are addressed. The final borrow area design shape and cut depths may differ significantly from the design prepared at the end of the survey plan and borrow area design (Section 5.3) due to the implementation of no-dredge buffers that reduce negative impacts from dredging.