Environmental Studies Program: Ongoing Study

Study Area(s): Gulf of Mexico OCS

Administered By: Gulf Region, Marine Minerals Program

Title: Assessment of Ship Shoal Borrow Areas for Coastal Restoration of Louisiana Barrier Islands (NSL #GM-14-03-10)

BOEM Information Need(s) to be Addressed: Alterations to seafloor topography associated with excavating outer continental shelf (OCS) sediment resources have the potential to affect oil and gas infrastructure or other resources of concern located proximal to borrow areas. Moreover, the physical evolution of borrow areas post-dredging is important to understand so that temporal aspects of impacts to habitat can be understood. Defining the rate and sedimentary character of borrow area infilling also has implications for renewability of these borrow areas for future use, potentially offsetting impacts that might be felt if pristine areas are dredged. How to best utilize the sand resources and minimize hazards associated with oil and gas infrastructure (Nairn *et al.*, 2005), impacts to sensitive seafloor habitat, and impacts to potential cultural resources (Research Planning *et al.*, 2004) are the interests of Bureau of Ocean Energy Management (BOEM) Marine Minerals Program and the State of Louisiana.

Total BOEM Cost: $460,914 **Period of Performance:** FY 2017–2019
Total non-Federal contribution (LSU): $461,110

Conducting Organization(s): Louisiana State University (LSU) and BOEM

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Description:
Background: Barrier islands are sandy sedimentary environments separated from the mainland by estuary or lagoon environments. The barriers protect the mainland coast and interior wetlands from meteorological and marine forcings and help to regulate estuarine conditions. A major component of the State of Louisiana's effort to manage coastal land loss is to restore degraded barrier shorelines by dredging sand resources from offshore borrow sites to supplement a deficit in the coastal sediment budget. Offshore excavation, however, can impact the sea floor habitat and indirectly compromise protective sediment cover over oil and gas pipelines as the borrow area evolves post-excavation.

Major sand resources on the Louisiana shelf are submarine sandy shoals, such as Ship Shoal, Tiger and Trinity Shoals, and Sabine Bank. These sandy shoals are under the combined influence of wind driven currents, storm waves, tides, and the dynamic Atchafalaya and Mississippi River sediment dispersal systems. They may also provide

spawning, hatching, and foraging ground and serve as important biological habitats for a variety of nekton species (Munnelly, 2016). During the past several decades numerous oil and gas pipelines have been constructed and are often abandoned in place across these sandy shoals. These active and abandoned pipelines must remain buried with three feet of sediment cover. Sand excavation temporarily disrupts seafloor geomorphic equilibrium and post-dredging the borrow area rapidly evolves as it recovers to return to equilibrium under the influence of waves, tides, wind-driven currents, and sediment supply. Physical changes to the seafloor may extend beyond the dredged area during this recovery period and could compromise adjacent sediment cover over pipelines or cultural and biological resources. The timing, character, and geometry of the physical recovery of the borrow area also has implications for seafloor habitat.

Objectives:

1) Quantify borrow area geomorphic evolution by collecting new physical oceanographic, geological, and geophysical data in two borrow areas on Ship Shoal (Whiskey Island borrow area in Ship Shoal Block 88 and Caminada Headland Borrow Area in South Pelto Blocks 12, 13, and 14).
2) Validate/refine existing Nairn *et al.* (2005) predictive numerical model using newly collected data.
3) Quantify and greatly enhance our understanding of dredge area evolution through the development of a conceptual geomorphic evolutionary model.
4) Characterize (*e.g.*, textural properties, percent sand) borrow area infill sediment and quantify accumulation rates.
5) Assess effectiveness of existing mitigations.
6) Provide recommendations for future research and borrow area monitoring protocols (*e.g.*, assigned setback buffers), and suggest mitigations based on empirical measurements.
7) Apply new model framework to predict borrow area evolution, develop a monitoring protocol, and suggest future mitigations.

Methods: Field data collection methods include:

1) hydrodynamic observation and hydrographic/water quality data collection (waves, currents, temperature, salinity, turbidity and dissolved oxygen *etc.*) using bottom-mounted acoustic Doppler current profiles (ADCPs), vessel-based transect surveys, and conductivity-temperature-depth (CTD) casts across the borrow areas. In addition, BOEM has just funded a project (P.I. Chunyan Li) to reactivate a real-time observation station (CSI 5) which is very close to the Ship Shoal study site. Wave-Current-Surge Information System (WAVCIS) will provide unique background weather and physical oceanography time-series data for the interpretation of the sediment transport and associated geomorphological changes;

2) Tripod-based time-series observations of bottom boundary layer near the borrow areas using acoustic and optical sensors (sea bed elevation change, velocity, sediment concentration, and flux);

3) shallow geophysical surveys using high-resolution swath bathymetry, side-scan sonar, and seismic sub-bottom profiler; and

4) collection of vibracores and multicores and texture and radionuclide analyses of coring sediment.

Eight days of fieldwork at Caminada dredging pit in Year 1, 15 days of fieldwork at Caminada and Block 88 in Year 2, and 15 days of fieldwork at Caminada and Block 88 in Year 3 are proposed. Tripod fieldwork will be performed at Caminada only in Year 2 and Block 88 only in Year 3. The R/V *Coastal Profiler* (berthed at Louisiana Universities Marine Consortium [LUMCON]) from Coastal Studies Institute (CSI) of LSU will be used to collect data during daytime only. Horizontal and vertical controls of geophysical surveys are key to the success of our proposed project.

Over the last 15 years, LSU Center for GeoInformatics (C4G) & the Louisiana Spatial Reference Center have established a Louisiana statewide network of over 70 Continuously Operating Reference Stations (CORS), 26 of which are National CORS providing the data that tie Louisiana into the National Spatial Reference System. This is a consistent national coordinate system that specifies latitude, longitude, height, scale, gravity, and orientation throughout the Nation, as well as how these values change with time (from http://c4gnet.lsu.edu/). As of now, Caminada and Block 88 dredging pits are all under the spatial coverage of C4G network. All the bathymetric data collected in this project will be referenced to North American Vertical Datum of 1988 (NAVD88). The LSU CSI Field Support Group uses several options for subscription-based survey-grade positioning during offshore geophysical studies.

The R/V *Coastal Profiler* is equipped with a Fugro Marinestar satellite-based global positioning system (GPS) correction that provides decimeter accuracy and precision for both vertical and horizontal position. Our swath bathymetry is corrected for vessel motion, with all necessary corrections for antenna and sensor locations accounted for.

References

Munnelly, R., 2016, Fishes Associated With Oil and Gas Platforms In Louisiana's River-Influenced Nearshore Waters, Masters' Thesis, Louisiana State University, Baton Rouge, LA. pp. 166.

Nairn, R.B., Lu, Q., Langendyk, S.K., and Michel, J., 2005, A study to Address the Issue of Seafloor Stability and the Impact on Oil and Gas Infrastructure in the Gulf of Mexico: U.S. Department of Interior, Minerals Management Service, Gulf of Mexico Region, New Orleans, LA, OCS Study, MMS 2005-043, 179 p. with appendices.

Research Planning, Inc., Tidewater Atlantic Research, Inc., and Baird & Associates Ltd., 2004. Archaeological Damage from Offshore Dredging: Recommendations for Pre-Operational Surveys and Mitigation During Dredging to Avoid Adverse Impacts. U.S. Department of the Interior, Minerals Management Service, Sand

and Gravel Unit, Leasing Division, Herndon, VA. OCS Report MMS 2004-005, 75 pp. + appendices.

Current Status: Year 1 research cruises and instrument deployments were successfully completed and data were processed and are presently being analyzed and interpreted. Year 2 research cruises and deployments are being planned for summer 2018 and will coincide with work being conducted under the new study: Development of a Monitoring Program for Water Quality and Biogeochemical Processes of Louisiana Sediment Borrow Areas (GM-14-03-12).

Final Report Due: 2019

Publications Completed: none

Affiliated WWW Sites: none

Revised Date: February 16, 2018