Environmental Studies Program: Ongoing Study

Title	Development of a Monitoring Program for Water Quality and Biogeochemical Processes of Louisiana Sediment Borrow Areas (GM-14-03-12)
Administered by	Gulf of Mexico OCS Region
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Procurement Type(s)	Cooperative Agreement
Conducting Organizations(s)	Louisiana State University and BOEM
Total BOEM Cost	$579,100
Performance Period	FY 2018–2020
Final Report Due	August 30, 2020
Date Revised	August 27, 2021
PICOC Summary	
Problem	State, Local and Federal Government would be affected in that this information may assist assessing impacts of dredging OCS sands for coastal restoration projects.
Intervention	Analyze physical evolution of an OCS borrow area to evaluate the temporal evolution in respects to habitat.
Comparison	Quantify borrow area geomorphic evolution by collecting new physical oceanographic, geological, and geophysical data in two borrow areas on Ship Shoal
Outcome	Quantify and greatly enhance our understanding of dredge area evolution through the development of a conceptual geomorphic evolutionary model.
Context	Gulf of Mexico

BOEM Information Need(s): Alterations to seafloor topography from dredging OCS sediment resources have the potential to affect water quality, sediment biogeochemical processes, and physical oceanographic process. Preliminary results from existing physical processes and geomorphic studies BOEM is conducting at borrow areas suggests that these excavations infill rapidly, so it is assumed that indirect impacts from dredging offshore are temporary (<10 yrs) and localized to the vicinity of the borrow area. However, there are no studies to document the character and magnitude of these temporary alterations to water quality, hydrodynamics, and benthic habitat at borrow areas on the Gulf of Mexico OCS. Moreover, parameters governing borrow area recovery are locally specific, and therefore site-specific conditions must be considered, especially offshore Louisiana where river discharge plays a major role in governing water quality and sediment biogeochemestry. BOEM has invested significant research funds to predict and observe how borrow areas offshore the northern Gulf Coast will recover in terms of geomorphic and sedimentologic evolution (Nairn et al. 2005; 2007; Stone et al., 2009; Xu et al., 2015), however there has been no focused effort by BOEM to validate predictions related to water quality and habitat recovery with empirical data. The existing predictive studies on borrow area physical recovery funded by BOEM have been important for informing management decisions within BOEM (e.g. dredge setback distances from pipelines or potential cultural resources) and

during consultations with resource managing agencies (e.g. essential fish habitat consultation with National Marine Fisheries Service), but without understanding the short term and localized effects on habitat and water quality it is not clear if these predictions are accurate and if the attendant mitigations are effective. Results of this study will increase BOEM's and other state and federal natural resource agencies' decision making ability regarding safety and protecting environmental and cultural resources and develop a monitoring protocol for various borrow area scenarios to inform management of OCS mineral resources and associated habitats.

Background: Barrier islands are separated from the mainland by estuary, lagoon, or tidal environments. They protect the mainland coast and interior wetlands from meteorological and marine forcings and regulate estuarine physical processes, water quality, and biology. Along the Louisiana coast, a deficit in coastal sand supply is forcing rapid disintegration of barrier islands, compromising stability of estuarine systems and the socioeconomic benefits they provide to the nation. A major component of Louisiana's Coastal Protection and Restoration Master Plan is to restore degraded barrier island systems by introducing new sand to the coastal system from OCS borrow areas. This directly benefits barrier island, estuarine, and wetland habitat and reduces storm risk to coastal infrastructure and communities. However, our knowledge of the impacts of offshore sediment excavation on water quality, biogeochemical processes, and habitat function is rather limited. In recent years, the Louisiana Coastal Protection and Restoration Authority (CPRA) initiated the comprehensive Borrow Area Management and Monitoring (BAMM) Program. This program studied physical evolution and water quality at multiple borrow areas (only one of which was on the OCS) with the intention of providing recommendations on future borrow area location, depth of dredging, and borrow area design. Results from BAMM show that dissolved oxygen levels measured in three (out of six) identified borrow areas decreased due to physical processes interacting with borrow pits, but some oxygen levels fell within a wider regional hypoxic zone or recovered quickly (Sonders et al., 2014). These datasets alone, however, do not explain the driving mechanisms of hypoxia, or provide a defined set of standards for borrow area location determination and design. There is still a lack of Louisiana- or Gulf-wide monitoring protocols for sediment borrow areas and this topic is of interest to CPRA and BOEM.

Objectives:

1. Document the chemical and biological processes that drive the development of hypoxia locally within two types of dredge pits: one of the sandy shelf (Ship Shoal/Caminada and one on the muddy shelf (Sandy Point).
2. Acquire empirical data to validate predictive models.
3. Further develop a coupled physical-biogeochemical model on hydrodynamics, water quality, and sediment transport processes; use this model to test the sensitivity of hypoxia to varying dredging depths; quantify the impact of dredge pit to dissolved oxygen and the possible dispersal of pit water to surrounding areas during energetic events.
4. Provide recommendations for pit water quality monitoring protocols as well as suggest mitigations for various.

Methods: A deeper dredge pit on the muddy shelf (Sandy Point dredge pit) will be sampled in spring and summer of Year 1 and a borrow area on the sandier shelf (Ship Shoal) will be sampled in spring and summer of Year 2. At each site samples will be collected in the dredge pit and adjacent to the pit. Water column samples will be collected using regular Niskin bottles from surface, midwater and near bottom depths will be analyzed for dissolved oxygen, salinity, dissolved nutrients (NO_3, PO_4, NH_4, SiO_4 and

DOC), plankton communities, and TSS and TVS. Sedimentation processes will be studied using multicores collected inside and outside the pits; water quality and sediment condition will also be investigated using numerical model with inputs from field measurements.

Sediment cores will be collected and sliced at 1 cm interval and analyzed for sedimentation rates (via 7Be, 234Th, and 210Pb geochronology, as appropriate; (O'Connor, 2017), grain size, sediment layering and bioturbation (via X-radiography of cores), as well as organic carbon, total nitrogen and phosphorus content. Water quality and sediment condition will also be investigated using numerical model with inputs from field measurements, tripod time series measurement; the coupled ROMS hydrodynamics, sediment transport and water quality model.

A numerical model will employ field observational data to validate the model for the year 2013 (data from BAMM), 2018 and 2019 (data collected by this project). The model will be run for fair weather, moderate-energy and high-energy conditions to test Hypothesis 4a and using varying depth configurations, for 0 (no pit), 0.2H, 0.4H, 0.6H, 0.8H and H (actual excavated pit) where H is the excavation depth.

Results from the various components of this research and attendant dredge pit physical processes and evolution research will be incorporated to develop a long-term monitoring program for a spectrum of dredge pit types in locations typical in the north-central Gulf of Mexico shallow shelf. Key parameters that should be tracked will be identified and a monitoring component will be developed for each.

Specific Research Question(s): Evaluate the physical evolution of an OCS borrow area to understand the temporal aspects of impacts to habitat.

Current Status: All data collection and analysis has been completed. Final report is pending review.

Publications Completed: Obelcz et al. 2018, Wang et al. 2018

Affiliated WWW Sites: N/A

References:

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