SHORELINE MORPHOLOGY AND SEDIMENT DYNAMICS ALONG THE INDIANA LAKE MICHIGAN COAST: REGIONAL TRENDS AND A BURNS DITCH CASE STUDY

by

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ABSTRACT

Sediment transport along the Indiana coast of Lake Michigan is highly complex and difficult to track. The integration of multi-method monitoring approaches, including single-beam sonar, backpack LiDAR, and wading surveys, combined to completely profile the entire dune and nearshore area establish a foundation for shoreline categorization and site-specific monitoring. Along with cross-shore profiling, this study also used sediment sampling and wave and current profiling to characterize the hydrodynamic, wave, and other physical processes. Historical nourishment efforts are evaluated to contextualize the importance of continued monitoring campaigns. Shoreline metrics across the 45-mile Indiana coast reinforced the existence of five distinct spatial areas. Each reach contains unique characteristics such as slope (0.5-6%), sandbar formation, and deviation from classical equilibrium profiles, based largely on their proximity to shoreline infrastructure. A Burns Ditch case study, in which 49,683 m^3 of sediment was dredged and placed in the nearshore environment, demonstrated challenges in tracking placed sediments related to irregular depositions, large storm events, ice cover, and topobathymetric accuracy. Analysis of the placed sediment using hydrodynamic conditions, sediment size data, and morphological change observations revealed varying responses. Placed sediment mounds saw upwards of 60% dispersal and deflation throughout the transport zone and centroid movement of over 25 m. These morphological changes were driven by the bi-directional sediment flow patterns in the complex study environment. By combining shore-wide assessment with a site-specific study, this work provides a comprehensive framework for analyzing shoreline dynamics, guiding management practices, and supporting long-term nourishment efforts along Indiana's Lake Michigan coast.