EVALUATION OF A MITIGATION STRATEGY TO COMBAT BEACH EROSION AT NEGRIL

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Abstract Over the past 5-10 years the problem of coastal erosion along the beaches of Negril has received much media exposure. There are believed to be several factors that have contributed to the problem, such as a series of damaging hurricanes and severe swell events, as well as the construction of tourism-based infrastructure close to, or at, the waters edge, poor water quality, degrading seagrass beds and declining coral reef health. The beach is typically sheltered from the Trade Winds, but when it is exposed to passing storms, the beach exhibits a noticeable response. Extensive investigative work on the Negril Beach erosion problem has been carried out for the Negril Coral Reef Preservation Society in a recent Preliminary Engineering study entitled "Beach Restoration Works at Negril". Part of the work applied detailed coastal engineering analyses to understand the prevailing coastal processes and develop remedial engineering solutions that address the problem of beach erosion along the shoreline. The recommended Beach Restoration Works comprise the most technically viable, least-cost solution to the problem and include a first stage of beach nourishment in tandem with the implementation of nine (9) submerged breakwaters, which are intended to increase the stability of the sand.

This paper presents an evaluation of the proposed nearshore protective breakwaters using MIKE21, which is one of the most advanced coastal process models available. This model was used to simulate the short-term beach response to a swell event in order to evaluate the efficiency of the proposed breakwaters. MIKE21 works in a morphological manner and is able to simulate the real beach response by updating the seabed topography as it is modified by the computed sediment transport characteristics. For example, during a storm, beach erosion often carries sand offshore where a sandbar is formed. This sandbar affects the incoming waves, forcing them to break further offshore. This actually helps to protect the beach from further erosion and MIKE21 is able to simulate these processes.

Figure 1 presents the computational mesh that was used, with the proposed breakwaters in place. The geometric details of the protective structures include a crest elevation 0.7m below MSL, a crest width of 10m and the side slopes of 1:2 (V:H). A total of 3600m of submerged structures are proposed for Long Bay, equal to approximately 50% of the total shoreline length. At the south end of Long Bay (Figure 1c), the breakwaters act as beach stabilizers, whereas in the central and northern zones (Figure 1a, 1b), they function as reef reinforcement.

During November 2006 a moderate swell event passed north of Jamaica, resulting in noticeable beach erosion, particularly near the mouth of the Negril River. A wave recorder that had been deployed was able to measure the wave conditions. Before and after photographs were used to evaluate the extent of the beach response and beach profile measurements quantified the depth of erosion. This event provided a suitable test case to verify the model inputs and to provide a basis for evaluating the effectiveness of the proposed breakwaters. The three-day swell event moved sediment to the south, eroded the high berm of the beach and deposited sand seaward of the beach slope. The modeling approach correctly predicted the extent and magnitude of the observed beach erosion.

The model was then used to find out what would have happened had the proposed breakwaters been installed. A comparison of the results between the existing situation and proposed solution revealed that the breakwaters reduced the wave heights by 0.1 to 0.3m and caused a 30% reduction in the nearshore current speeds. Most importantly, the proposed breakwaters reduced the beach erosion by up to 50% along the shore and especially in the southern sections of Long Bay where the erosion was at maximum at the mouth of the Negril River. The breakwaters reduced beach erosion to less than 0.15m throughout Long Bay, whereas without the breakwaters, erosion was typically 0.25 to 0.30m. The model demonstrated significant decreases in the alongshore sediment transport rates at the shoreline due to wave and current sheltering effects in the lee of the proposed breakwaters.

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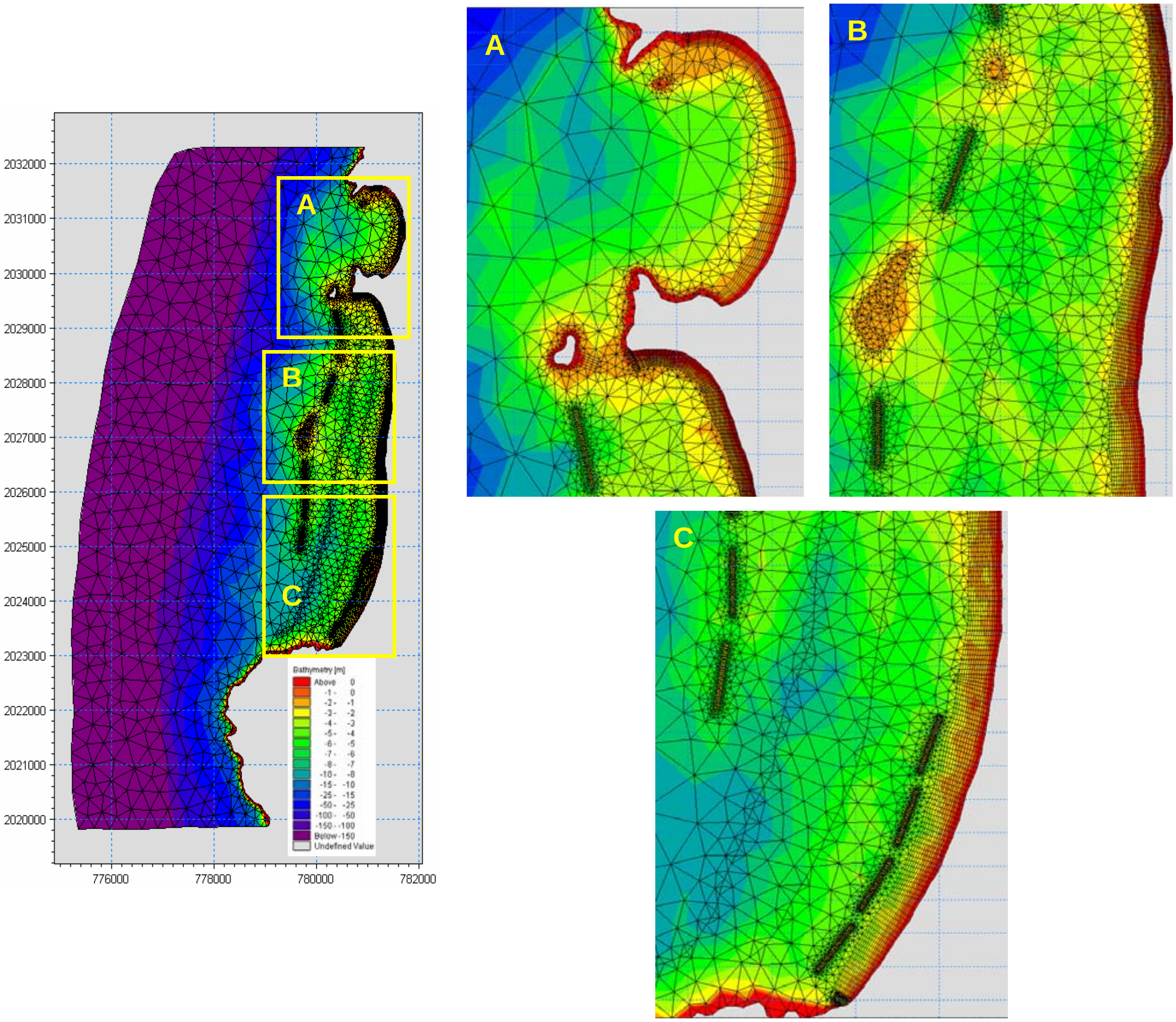

Figure 1 Computational mesh with proposed breakwaters