Bald Head Island, N.C.

Beach Monitoring Program

Monitoring Report No. 22 (May 2023 to April 2024)

Prepared for:
Village of Bald Head Island

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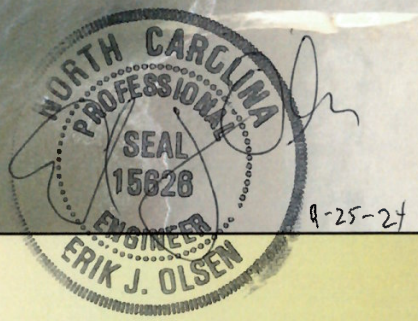

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EXECUTIVE SUMMARY

The most recent Wilmington Harbor Inner Ocean Bar maintenance dredging of Bald Head Shoal Channel Ranges 1 and 2, and the Smith Island Channel range was performed in the months of December 2022 – March 2023. Federal surveys show approximately 1.3 Mcy of sand during that operation were dredged with placement along South Beach pursuant to the terms of the Wilmington Harbor Sand Management Plan (WHSMP). Oak Island will be the recipient of the next tentatively scheduled 2024/25 beach federal disposal operation in accordance with the continued implementation of the present day WHSMP. As a result, the Village will contract for a locally constructed beach renourishment project in the winter of 24/25

It is presently proposed that the next Village sponsored project (in 2024/2025) will seek to place up to 1.0 Mcy of sand along two (2) sections of shoreline located at the opposite ends of South Beach. The final Contract amount will depend upon Bid costs and conditions at the time of construction. The easternmost segment of approximately 0.5 Mcy (Bid as an Option) is intended to briefly address the chronic erosion that's been occurring for a number of years in the vicinity of the Shoals Club at Cape Fear. On the western end of South Beach an estimated 0.5 Mcy fill (Base Bid) will address the filling of the terminal groin template, as well as the section of shoreline extending throughout the limits of the sand tube groinfield. Subsequent to fill placement at that location, the Village will contract to remove and replace thirteen sandtube groins which have reached the end of their effective life. The groinfield was last replaced in its entirety in 2019 concurrent with a Village renourishment project. For purposes of constructing both the Base Bid and a potential Option (totaling up to 1.0 Mcy), a pre-existing (but depleted) borrow site at Jay Bird Shoals has been expanded to the north. As of March 2024, all Permitting had been completed for the proposed project.

Between November 2000 and April 2024, Bald Head Island had received up to 9.9 Mcy, mol of sand from the initial widening/deepening and six (6) subsequent maintenance dredging operations for the Wilmington Harbor Navigation Project entrance channel. Including the 2019 project, the Village has placed another 3.2 Mcy of sand along the West Beach and South Beach shorelines. Accordingly, in the net Bald Head Island has experienced a total *estimated* sand placement volume of approximately 13.1 Mcy since 2000 at those two locations – with South Beach todate receiving 97% or more of the total.

Conversely, the *gross* volumetric sediment *loss* over a November 2000 to April 2024 monitoring timeframe is conservatively computed at -9,166,800 cy, or approximately -398,600 cy per year – on "average". This annualized "loss" addresses the continuous section of Bald Head Island shorefront extending from the marina entrance to the Cape Fear spit. The

assignment of an *average annual* long-term rate of sand loss at Bald Head Island however, has *not* necessarily been a meaningful indicator of navigation project impact. Such an average rate is often temporally biased by periods of beach fill equilibration, groinfield "effectiveness due to gradual deterioration," major storm events (such as Hurricanes Florence, Dorian and Isaias), the occurrence of episodic destabilization dredging events in close proximity to the island, as well as other physiographic phenomena temporally affecting annualized quantities of alongshore sediment transport – from Bald Head Island. In addition, the westernmost segment of the island's littoral system has had to adjust to the quasi-stabilizing effect of the terminal groin at that location in existence only since 2015. Along South Beach per se, there has historically existed a "nodal point" some 7,000 ft. eastward of the terminal groin (approx. STA 116+00). At or close to the nodal point, the directionality of *net littoral transport* on an annual basis changes from West (toward the groin) to East (toward Cape Fear). *Note* – depending on wave climatology, the condition and exposure of the sand tube groinfield, as well as other factors, the effective location of the nodal point can vary slightly along South Beach from year to year. As of April, 2024, within the 22,755 ft of shoreline influenced by sand episodically placed since 2000, up to +3,717,000 cy remain in the littoral system (measured above elevation -16 ft. NGVD 29). This *includes* the most recent 1.3 Mcy beach disposal project completed in early 2023 by the Wilmington District, USACE which beneficially affects this total.

Although not directly impacted by long-term navigation channel improvements and maintenance of the Cape Fear River entrance, the Village Council elected to initiate monitoring of the East Beach shorefront at Bald Head Island beginning in November 2008. Since that time, it is documented that East Beach can undergo strong seasonal variations of beach width and profile volume to a large degree dependent upon storm frequency and intensity, as well as the ever-changing configuration of the Cape Fear spit. For example, the most recent April 2024 survey data show a net shoreline volumetric loss of approximately -87,300 cy (above elevation -16 ft NGVD). throughout the 6,000 ft East Beach shoreline lying northward of Cape Fear over the last 12 months. In the prior year, this reach gained about +18,400 cy. Between November 2008 and April 2024, the shoreline gained +293,800 cy. Most of the East Beach volume increase had been caused by post-storm accretion of the portion of the Cape Fear spit shoreline which fronts Onslow Bay.

Typically, periods of episodic accretional configurations of the Cape Fear spit deemed beneficial to East Beach have corresponded to a high rate of erosion and duneline recession along the easternmost section of South Beach – directly seaward and westward of the Shoals Club facility. For example, between 2000 and 2020, the average MHWL erosion rate at that general location has been over -20 ft/yr – due to sand losses either directly or indirectly associated with the configuration of the Cape Fear spit formation. Although a 2021 federal beach disposal project placed fill within 2,000 ft. mol. of the Shoals Club and Cape Fear, erosion has continued to the point that the Club was required to install a sandbag revetment seaward of the property in May/June 2022. That revetment requires continuing maintenance due to episodic beach profile lowering at that location and the effects of storms.

In 2024, the Village performed monitoring of the Jay Bird Shoals borrow site utilized to construct the non-federal 1.85 Mcy beach fill sponsored by the Village in 2009/10 and the 1.10 Mcy beach constructed in 2018/19. During the monitoring period (May 2023 to April 2024), the fifth year following the 2018/19 project excavation, the entire permitted borrow site lost -27,400 cy (inclusive of the exclusion and buffer zones). As of April 2024, there is theoretically 1,360,400 Mcy of material located within the originally *permitted borrow site limits* above the permitted design cut elevation (-22 ft-NGVD). Most of that material is *not* however practically available for dredging at this time. Hence, an extension of the original JBS borrow site limits was required to act as a fill source for the upcoming Village beach fill project to be constructed in 24/25.

After an extension of the two marina entrance channel jetties in 2015, temporarily reduced shoaling within the navigation channel resulted in a corresponding reduced volume of disposal sand being place along the Row Boat Row shoreline. Although the Village had planned to continue to proactively bypass sand from the south jetty fillet (located at the distal end of West Beach) to the Row Boat Row shorefront, it became clear that the existing four (4) low level timber groins were not capable of providing an acceptable level of shoreline stabilization at that location.

Hence, near the end of the 2017 monitoring period, the Village initiated construction of two (2) shore parallel detached rock breakwaters located north of the marina entrance seaward of the Row Boat Row shoreline. The placement of breakwaters between existing groins northward of the marina entrance was intended to combine the attributes of each of the two types of stabilization structure so as to reduce the rate of sediment transport from the eroding shoreline caused principally by ferry/barge generated waves. The subject expanded shore stabilization project (detached breakwaters *and* existing groinfield) was designed to have a sand fill prior to construction. Since construction multiple channel maintenance/sand bypass operations have occurred – most with increasing volumes dredged. Typically, dredging is required twice a year on average. This is primarily due to an increasing northerly rate of sediment transport along West Beach caused by a continuing reconfiguration of the Point

In the spring of 2019, the Village resubmitted permit applications accompanied by indepth geotechnical studies and environmental analyses intended to develop a long term (and large scale) supplementary borrow site located within Frying Pan Shoals. The purpose of such a borrow site would be to both ensure compliance with Permit conditions necessitating the maintenance of the updrift fillet associated with the 2015 terminal groin project and to provide an interim source of beach quality material sufficient to meet future South Beach renourishment requirements – when pursuant to the existing tenets of the Wilmington Harbor Sand Management Plan, beach quality channel maintenance material excavated would be placed at Oak Island. In 2021, a pre-project fisheries monitoring plan was submitted for purposes of addressing regulatory agency concerns. In April 2022, the Village acknowledged certain regulatory "concerns" may not be resolved in the near future. Subsequently, the Village authorized work intended to expand the Jay Bird Shoals borrow site for purposes of providing a sand source for the next Village sponsored fill event – when federal beach disposal is contractually redirected to Oak Island.

The original Permits for construction of the terminal groin at Bald Head Island stipulated that *if* the permittee elected to dredge more than 250,000 cy from the Jay Bird Shoals borrow site after 2015, limited monitoring of the eastern end of Oak Island must be performed. Accordingly, in November 2018, the Village initiated the requisite monitoring at Oak Island (Caswell Beach). The first report of findings for Oak Island followed a November 2019 monitoring survey. A second-year monitoring report was issued in December 2020. In early 2021 it was formally agreed by DCM and the USACE that based upon the results of the Year 2 report, the *Village's responsibility for continued monitoring of Oak Island has terminated*. It is important to note that a specific Permit term associated with the northern extension of the Jay Bird Shoals borrow site has included a requirement that the Village reinitiate its monitoring program for Caswell Beach for some indeterminant period of time. Said monitoring will begin at/or after the proposed beach renourishment project scheduled for completion prior to 1 April 2025.

It should be noted that exacerbated sand losses throughout a portion of the sand tube groin field occurred over the 1-year monitoring period addressed herein. Although not specifically quantified by this report, coincident degradation and failure of several sand tube groins has occurred (as of September 2024). Surveys show that the measured sand loss throughout the proposed limits of beach fill in 2024/2025 within the westernmost segment of the South Beach project exceeds 400,000 cy – through April 2024. Visual observation of shoreline sand losses since that date indicate that the proposed 500,000 cy Segment A beach fill at the location may not be sufficient to allow for coverage of existing groins required for successful sand-tube replacement. As a result, it may be necessary for the Village to consider increasing the placement sand volume within Segment A (west end of South Beach) and coincidently reduce the contracted Segment B sand volume proposed for placement updrift of Cape Fear (east end of South Beach).