SHORELINES – January 2008

As presented to the *Island Review* Magazine

State of the Beach - 2007

Last month (November 2007), Coastal Science & Engineering (CSE) presented the key results and main conclusions regarding our local Beach and Nearshore Surveying Program to the Carteret County Beach Commission. In 1999, CSE first established 111 shore-perpendicular profiles along Bogue Banks to gain baseline information and begin assessing the overall health of the beach in the wake of the hurricanes that impacted the region in the 1990s. Elevations of the dry and underwater (nearshore) portion of the beach have been obtained along these same profiles on a routine basis since 1999 and with these data in hand; the annual report provided to the Beach Commission is often considered as our "State of the Beach" address. Actually the monitoring program has grown since the formative years and now includes 120 profiles along Bogue Banks (Fig. 1), in addition to 24 profiles along Shackleford Banks, and 18 along Bear Island, located east and west of Bogue Banks, respectively. The beaches are surveyed in May or June every year.

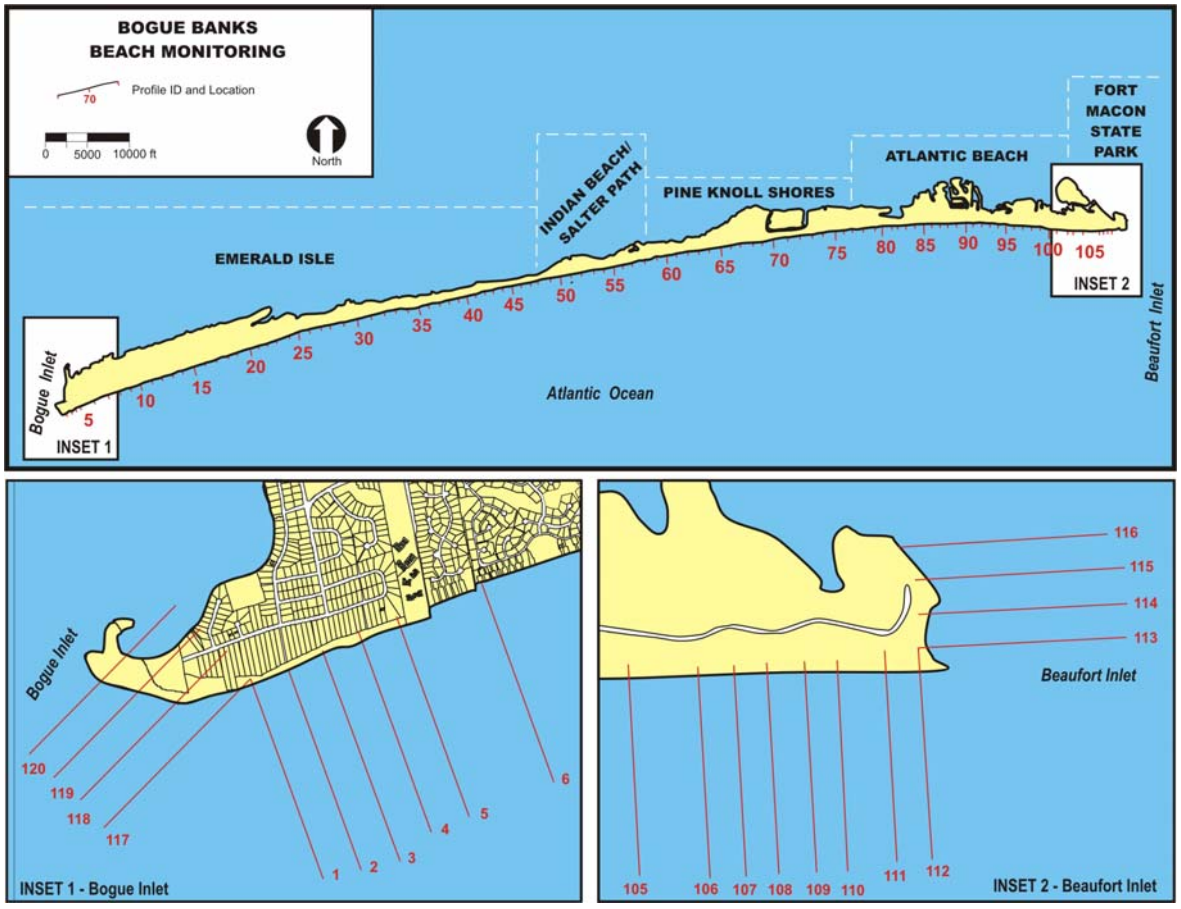

Fig. 1 – Site map depicting the location and identification scheme of the 120 profiles positioned along Bogue Banks utilized for beach / nearshore monitoring purposes.

Beach Volume

One of the means to quantify beach health is to compare the volume of sand lost or gained over time along Bogue Banks and the adjacent islands. Engineers and scientists most often use the measuring unit of a cubic yard to describe volume change, which can simply be envisioned as a 3 ft. by 3 ft. by 3 ft. block of sand – that's 27 ft^3, or again a single cubic yard. A standard dump truck holds roughly 15 cubic yards. By utilizing a volumetric approach, we can review the past year or any other time slice in a sand debit - credit mindset. Generally, storms and other high-energy events serve as large "debits" and beach nourishment is envisioned as a "credit".

Since 1999 Bogue Banks has gained ~7.4 million cubic yards of sand, which is mostly attributed to the many beach nourishment projects that have been constructed along the island beginning in 2001. Actually a total of ~10.3 million cubic yards have been placed on Bogue Banks as a result of beach nourishment, meaning that ~2.9 million cubic yards have since eroded off the beach (10.3 million placed on the beach *minus* 7.4 million cubic yards remaining). Interestingly, 2.25 million cubic yards were lost in 2005-06 alone, and most of these losses appears to be directly correlated to the notorious slow moving Hurricane *Ophelia* that impacted Bogue Banks for several days in September 2005.

If we average the volume loss across the entire 128,392 foot of Bogue Banks oceanfront, the island has lost sand at a rate of almost 3 cubic yards per linear foot per year (-3 cy/ft/yr) since 1999. This number is essentially our "background erosion rate". The background erosion rate reported for 1999 to 2006 was also close to -3 cy/ft/yr, meaning the erosion rate has remained relatively stable over the past year. Interestingly, a loss of approximately 1.5 million cubic yards of sand can be directly attributed to *Ophelia* in 2005. Without this storm and the associated sand losses, the background erosion rate would be closer to 1.5 cy/ft/yr.

Another noteworthy statistic to mention is the entire island substantially meets the target minimum volumetric threshold established for Bogue Banks. That's a mouthful to say and may sound confusing, but when Hurricane *Floyd* impacted Bogue Banks in 1999, we noticed Atlantic Beach was relatively unscathed while the remaining island communities sustained significant dune erosion and property damage. Atlantic Beach was a traditional recipient of beach nourishment projects associated with the dredging of the Morehead City Harbor prior to 1999, and if we averaged the volume of sand residing in Atlantic Beach from the toe of the dune to -11 foot, we generated an average number of over 225 cubic yards per linear foot (225 cy/ft). We soon noticed the remaining Bogue Banks municipalities that never received substantial beach nourishment prior to 1999 all averaged below this 225 cy/ft figure. Accordingly we have since utilized 225 cy/ft as the benchmark for beach health or as our "minimum volumetric threshold".

Pine Knoll Shores was the only municipality that did not meet the volumetric threshold along Bogue Banks in 2006, but two separate beach nourishment projects in the early stages of 2007 added roughly 770,000 cubic yards to this corridor of shoreline and remedied this volume deficiency (Fig. 2). An additional ~1.0 million cubic yards of sand was placed along the shorelines of Indian Beach/Salter Path and Emerald Isle in 2007 as well. Atlantic Beach was the only oceanfront subdivision that encountered a loss of sand for the reporting period (May 2006 to May 2007) but remains above the target volumetric threshold.

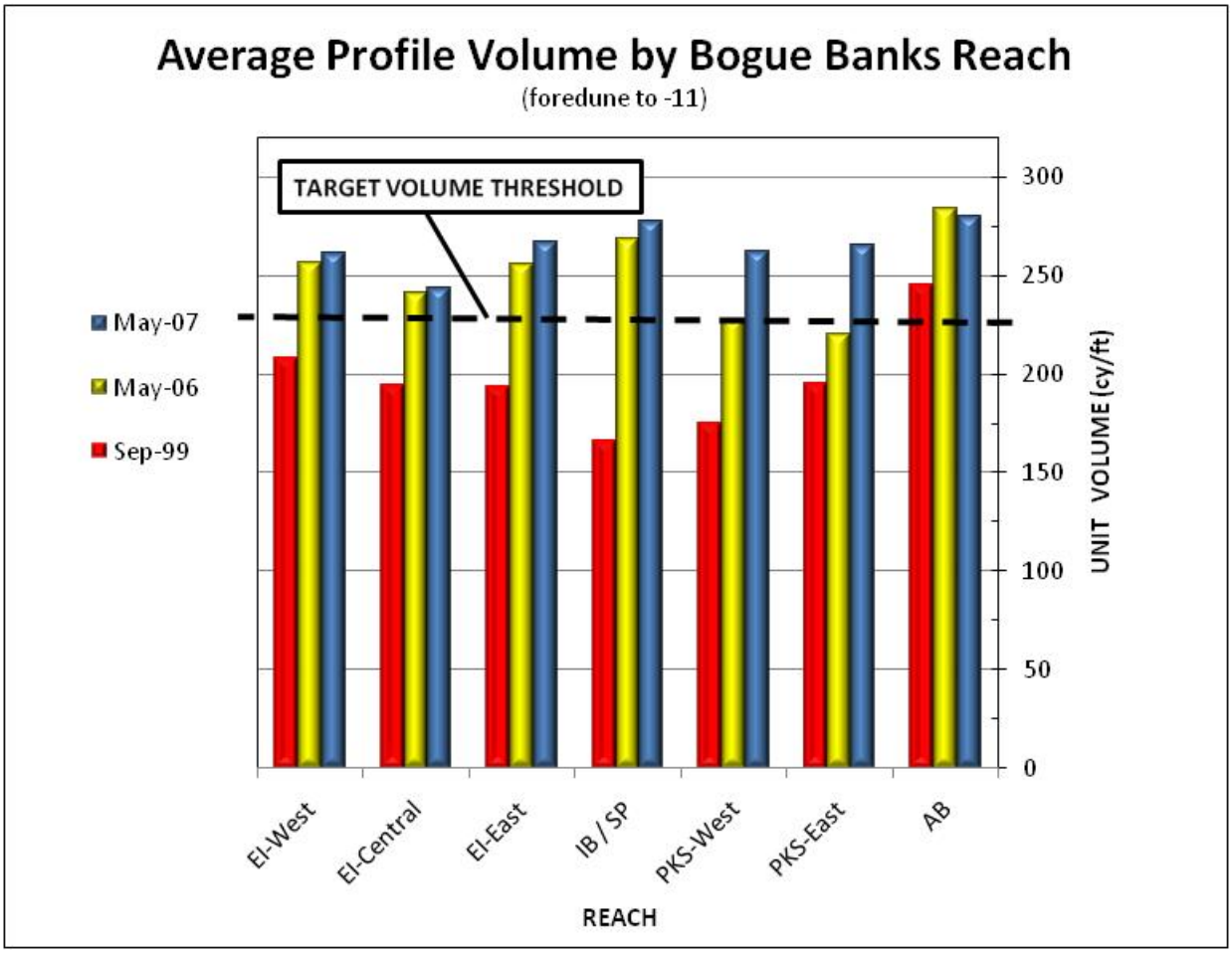

Fig. 2 – Average profile volumes for September 1999, May 2006, and May 2007 for seven oceanfront reaches along Bogue Banks. A target volume threshold of 225 cubic yards per linear foot (cy/ft) was established in 1999 as a benchmark for beach health.

Shoreline Change

Another measurement of beach health is shoreline change. This barometer for beach health is less cerebral and more visual than the beach volume method as we can actually put our finger on the shoreline – the magical place where land meets the sea. To quantify and consistently compare shoreline positions over time, the "shoreline" is demarcated as the mean high water elevation established at +2 foot above sea level. This measurement parameter is sometimes referred to as a "datum-derived shoreline".

Utilizing a datum-derived shoreline, the average net shoreline change for Bogue Banks is +78 foot seaward from June 1999 to May 2007, and is obviously an expression of nourishment projects, storms, and background erosion/accretion that have occurred along the island in the past 8 years. The eastern half of Pine Knoll Shores and Atlantic Beach had the highest and lowest average shoreline change rates over the 8-year time period at +123 foot and +30 foot, respectively, with the exception of Ft. Macon (+13 foot). To no surprise, there appears to be a direct correlation regarding the rate of volume change and shoreline change reported along Bogue Banks, i.e., more nourishment (volume) equates to larger shoreline gains (Fig 3).

Reach	Profiles	Average Shoreline Change (June 1999 – May 2007)	Volume Change (June 1999 – May 2007)
Emerald Isle - West	8 – 25	75 foot seaward	53.1 cy/ft
Emerald Isle - Central	25 - 36	100 foot seaward	49.0 cy/ft
Emerald Isle - East	36 - 48	104 foot seaward	73.4 cy/ft
Indian Beach/Salter Path	48 - 58	99 foot seaward	89.0 cy/ft
Pine Knoll Shores - West	58 - 65	102 foot seaward	74.1 cy/ft
Pine Knoll Shores - East	65 - 76	123 foot seaward	72.6 cy/ft
Atlantic Beach	76 - 102	30 foot seaward	45.4 cy/ft
Fort Macon	102 - 112	13 foot seaward	28.5 cy/ft
Totals	8 - 112	78 foot seaward	59.5 cy/ft

Fig. 3 – Average shoreline and volume changes from June 1999 to May 2007 for the eight oceanfront reaches positioned along Bogue Banks.

If you want to get into the nitty-gritty of the 2007 Monitoring Report, please visit http://www.protectthebeach.com/Monitoring/monitoring.htm. The entire report by sections is available on-line approximately half-way down the webpage. Have a great Holiday Season.