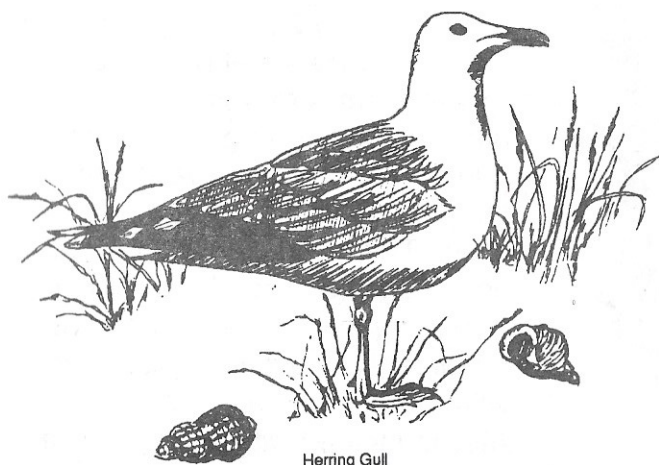


THE REACH

The Raritan Bay shorefront within Middletown contains the last examples of an undisturbed beach ecosystem which was physically developed through a combination of many processes. The beach is a dynamic environment created by water currents which are driven by wind and fresh water discharges from the rivers. Wind itself also plays an important role by creating waves and directly moving sediment on the exposed land surface.

The beach consists of coarse, heavy sand which shows the high energy environment. The origin of the sand was partly from the glacially-derived sediment which was transported and deposited by glacial meltwater streams flowing across the exposed continental shelf. Waves and currents reworked the sediment removing the lighter, finer-sized particles and concentrating the heavier sand along the high energy beach. As sea level rose the shoreline advanced landward along with the sediment-sorting action of the waves and currents.

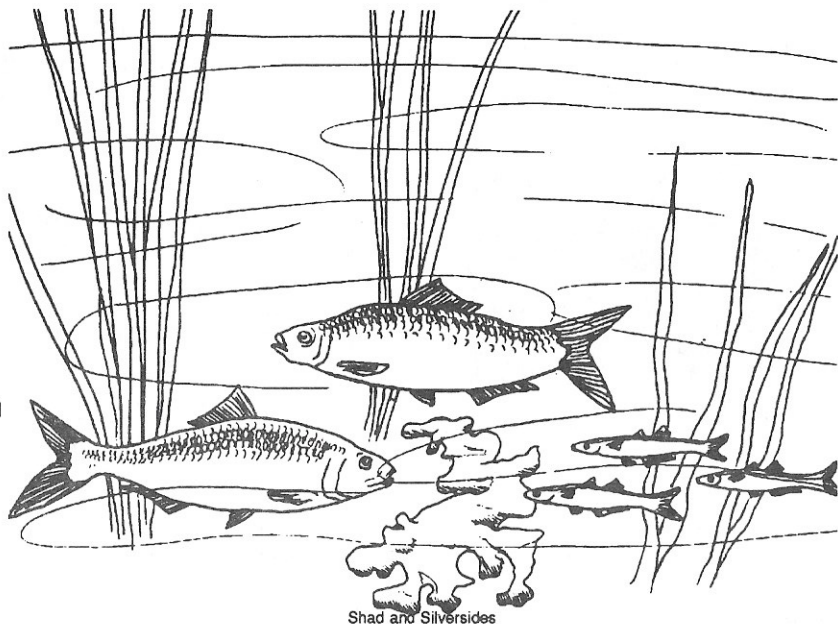


Herring Gull

Another sediment source for the beach was the exposed cliffs of Coastal Plain sediments at Atlantic Highlands. These deposits, older than the glacial sediments, were attacked directly by wave action from the Atlantic Ocean. The incoming waves would strike the bluffs at an angle and be deflected westward, carrying sediment to the present

Middletown shoreline. Through time Sandy Hook was created by the northward movement of sand along the Atlantic shore. Eventually Sandy Hook grew to where it acted as a natural breakwater, stopping the erosive wave action against the Atlantic Highlands cliffs and eliminating a sand source to the bayshore beaches.

The present bayshore beach environment is one where sediment is in constant movement. Fine clay particles originate from the Raritan and Hudson Rivers during high flow periods and are carried in suspension by the less dense fresh water which moves over the denser salt water of Raritan Bay. Under certain meteorological conditions, turbid Hudson River flood waters exit the Narrows of New York Harbor and progress southward until they strike and get deflected by Middletown's bayshore beach. Such turbid fresh water flows have been documented rounding Sandy Hook as a plume into the Atlantic Ocean. Although clay-sized sediment is transported to the bayshore beach, little, if any, is deposited in the high energy environment.



Shad and Silversides

The sands are moving along the shorefront by currents and wave action. Wave action is a local short duration sand mover influenced by wind-generating meteorological events. Wave action is usually an erosive force whose short term impacts are erased by the long term effects of currents. Large scale circulation patterns within Raritan Bay are generated by the exchange of fresh and salt water and tidal currents. Off the Middletown bayshore is a circular current which moves in a clockwise direction. This current is driven by exiting fresh water from the Raritan River which hugs the southern bayshore until it is deflected toward deeper water by Point Comfort in Keansburg. Local littoral currents are also moving sand. Timber and stone jetties and groins built perpendicular to the shoreline provide clues to the local currents. The currents lose their energy and sand-carrying capacity when they confront these structures. This energy loss causes the sand to be deposited on the upcurrent side, creating a wider



Church Street Bridge, Belford

beach. East of the Spy House Museum, jetties have a sand buildup on their west sides showing an eastward moving littoral current. Such movement is also highlighted by the sand accumulation on the west side of the Leonardo Marina. West of the Spy House, the Pews Creek jetty has sand accumulated on its east side showing a westward moving littoral current. This westward moving current continues along Ideal Beach towards Keansburg. The Spy House is an

area where the littoral currents change direction. Such an area is called a nodal point.

Since there is a constant everyday movement of sand along the shorefront, where is it coming from and going to? The sand buildup along the jetties shows diverging littoral currents at the Spy House nodal point. Such a point would be a source of sand and coincides with topographically higher ground which divides the Pews and Comptons Creek tidal marshes (see Figure 1). This higher ground, or headland, would continue to provide sand to the diverging currents as continued sea level rise pushes the beach landward, eroding the headland. Where does the sand go? Some of it is lost from the littoral currents to the creeks through transport by tidal currents. Flood tide currents enter the creeks removing sand from the littoral currents. The tidal currents diminish with the change in tide, depositing the sand within the creek channel. Ebb tide currents are not as strong as the flood tide currents and are unable to remove all the sand that was deposited during flood tide. The creek channel would not clog due to higher tidal currents passing through the constricted channel. However, man's use of the creeks for boating requires navigable waters, and shoaling within the channels would eliminate that use. Periodic dredging of the channels is required to remove the tidally deposited sand. The sand, once dredged, is usually pumped back to the beach where it continues its movement down the beach via the littoral currents.

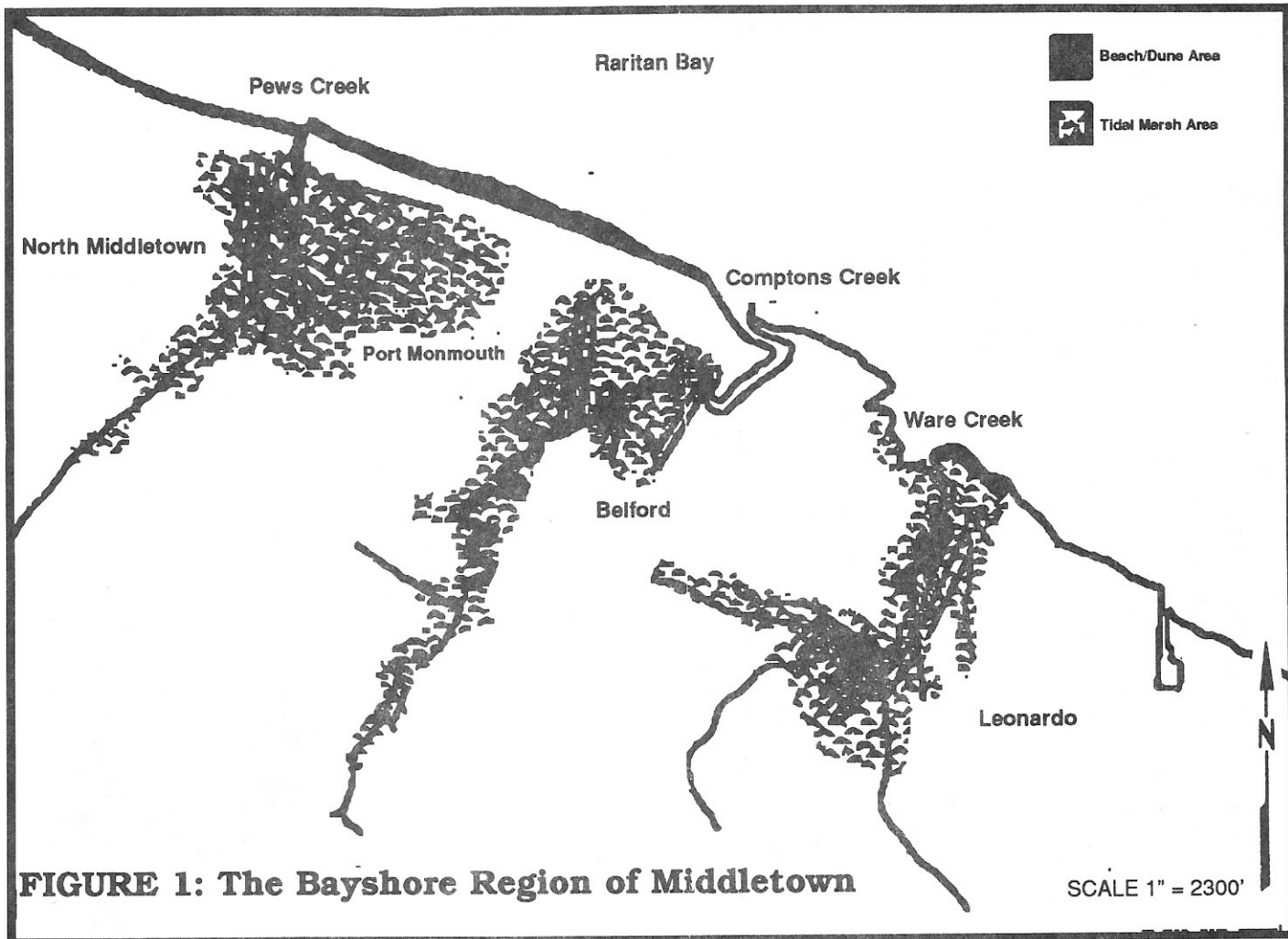


FIGURE 1: The Bayshore Region of Middletown

SCALE 1" = 2300'