Contrasting Radar Signals *in Sand and Till:*
An Example From Grandifolia Sandhills, Eastern LI

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GPR (Ground Penetrating Radar) is a powerful tool for revealing geologic and anthropogenic features of the subsurface (Klein et al. and Winslow et al., this conference). The prevalence of till along the north shore of Long Island generally limits the range of radar propagation properties encountered there. The Grandifolia Sandhills of Baiting Hollow, however, provide an opportunity to study sediments with sharply contrasting radar signatures. Furthermore, a GPR survey there has made it possible for us to test the hypothesis of Engelbright et al. (this conference), who suggest that the Grandifolia Sandhills are SSE-trending late Pleistocene parabolic dunes with sand thicknesses approaching 30 m (100'). Our GPR radargrams along with selective hand auger sampling indicate that a 13 m high ridge we studied consists of a 10-12 m thick layer of sand atop glacial till, consistent with their hypothesis.

A series of GPR profiles were run along the frontal (SE) portion of a relatively small hill and onto the plain to the south. The lobate hill studied is located roughly 650' (200m) south of Long Island Sound in Baiting Hollow, NY, cresting near the eastern end of Warner Court. It has a peak altitude of about 205' (62m) altitude, but the ridge on which we conducted our GPR study is at an altitude of only about 160' (49 m). The top of our profile is thus approximately halfway between the maximum altitude of the hill and the plain to the south, which is at an altitude of 115'-120' (about 36m).

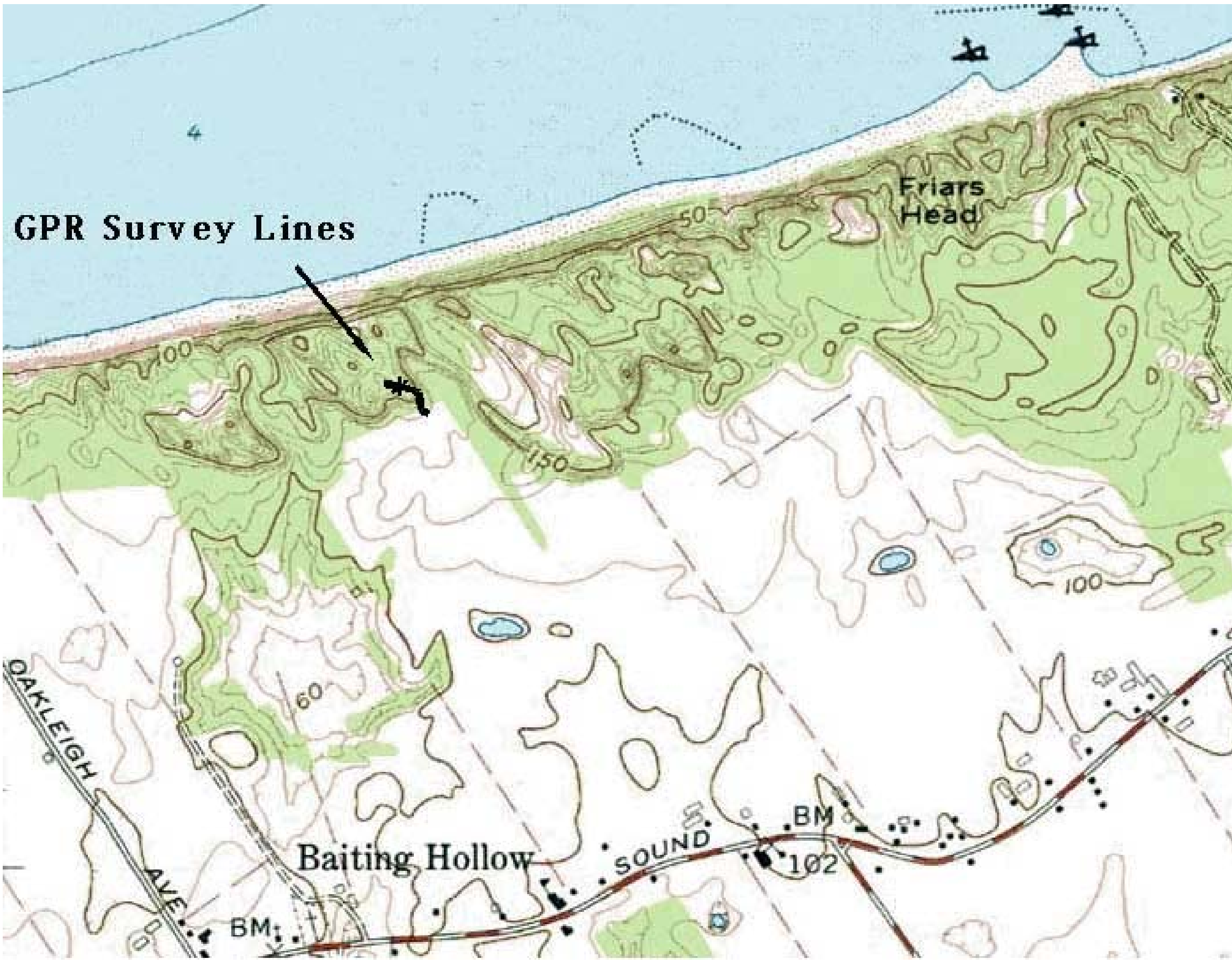

Fig. 1 Location of ground penetrating radar survey lines in Grandifolia Sandhills, Baiting Hollow, NY

Analysis of signals from tree root systems detected by high frequency antennas (400 and 200 MHz) allowed estimation of the radar velocity near the surface, and migration of the data helped to constrain the velocity at greater depth. A very strong subhorizontal reflector runs beneath the entire ridge at a radar depth of 160-190ns. Above that strong reflector, we found velocities of 130±20 mm/ns, so we conclude that the strong reflector is at a depth of 10-12m. Such high velocities are characteristic of relatively dry and porous material such as sand. The sediments there show distinct sets of reflectors with apparent dips toward the SE end of the line. Short cross-lines and inflections in the main transect line yield a variety of apparent dips, allowing determination of the 3-D geometry of the dipping reflectors. They appear to be nearly planar, and the plane that provides the best fit to all measurements has an ENE strike and a dip of about 20° to the SSE. This is consistent with the layering expected in a subaerial dune in the presence of strong winds from the NNW. The angular relationships between the dip domains of these reflectors are also suggestive of aeolian deposition.

Using a hand auger, we penetrated 3.6 m (almost 12') into the hill (about 1/3 of the way to the strong reflector), and we had nearly 100% sample recovery to that depth. The sediments consisted entirely of well- to very well sorted subrounded to rounded sand, with subtle variations in mineralogy that apparently reflect variations in source. Our auger holes were located so as to sample a part of the radar stratigraphy that is observed to extend down dip to the strong reflector at 10-12 m depth. The transect extends down the steep frontal face of the hill and onto the plain to the south. Radar returns from south of the hill are replete with the hyperbolas that are characteristic of boulders and are very familiar aspects of radargrams in till. T his identification of the base of the hill as very poorly sorted till is reinforced by the presence there (in sharp contrast to the hill) of readily visible boulders and cobbles at the surface, as well as variable but relatively slow radar velocities (90±20 mm/ns). Migration of the radar data from the ridge suggests that similarly low velocities extend below the strong reflector there.

We placed an additional set of auger holes just above the base of the hill. Above the strong radar reflector, the sediments consisted entirely of the same well-sorted sand as in the auger holes atop the hill. The layer responsible for the strong radar reflector consists of 50-60 cm of very fine silt-to-clay sediment, with cobbles but little or no sand. The largest of the recovered cobbles was close to the 5 cm maximum recoverable size. Sediment below this horizon was till, with relatively poorly sorted sand and occasional cobbles. It was impossible to collect samples beyond a short distance into this lower till layer, apparently because the auger encountered too large a cobble for further penetration. The silt and clay layer and the sand directly above it were wet, indicative of poor drainage. This sharp contrast in sediment properties (from sand to till), combined with the perched water, explains the unusual prominence of the reflector that we found 10-12 m beneath the entire imaged portion of the ridge.

In summary, we have used GPF imagery and selective hand auger sampling to determine the internal structure of a (relatively small) 13 m high ridge near the western end of the Grandifolia Sandhills. We find 10-12 m of sand, with internal layers of subtly differing mineralogy and degrees of sorting. The well sorted and generally rounded nature of this sand and the orientation of the layers within it (dipping 20° to the SSE) are consistent with dune formation in the presence of prevailing winds from the NNW. A very strong radar reflector at the base of the sand is a fine-grained layer capping the thick basal till. All of these results are consistent with Engelbright et al.'s hypothesis that the Grandifolia Sandhills are thick subaerial parabolic dunes lying atop glacial till. This survey illustrates how, in combination with other geologic techniques, GPR makes it possible to shed new light on Long Island's near-surface geology.