APPENDIX 12

Analysis of Fossil Record

Brief Description of Fossils found at Dean Forest Road Landfill Borrow Area

May to August, 2006

All fossils came from a dark-gray sandy sediment. The shell deposits occupied a distinct and well-defined zone that may have been on the order of five feet or less in thickness. Shell abundance diminished rapidly toward the east, west and north. Most small shells described here came from sediment interior to larger intact shells. Identification was based on comparable modern species.

Clams

- Macoma sp: shallow waters of quiet bays, subtidal burrowers, salinities as low as 5 ppt. These are very abundant in onsite sediment; very small, fragile shells.
- Quahog ("Round" or "Hard-shelled" clam), Mercenaria sp.: intertidal to subtidal, chiefly in salinities higher than 15 ppt. These are big, massive, ribbed shells. Also quite abundant at site.
- Surf clam (Spisula solidissima): Presently found Nova Scotia to South Carolina, very low intertidal to subtidal. A very common beach clam, favorite of seagulls.
- Ponderous Ark (Noetia ponderosa): subtidal and commonly found on southern beaches. These are asymmetrical, strongly-ribbed and angular medium-sized shells.
- Disk shell (Dosinia discus): subtidal in 6 ft or more of water. These are medium-sized round clam shells with pointed beaks and concentric ridges.
- Great Heart Cockle (Dinocardium robustum): subtidal in 3-90 ft of water, but common on southern beaches. Only one was found. Ribbed like the Arks, but heart-shaped in outline.
- Tagelus sp.: generally intertidal to subtidal burrower, scarce and local within range. Only one was found. Characteristic oblong shell.

Snails

- Oyster Drill (Urosalpinx cinerea): intertidal to subtidal. A strongly-ribbed snail. Those found here are very small, about the right size to account for numerous small holes neatly bored in small clam shells. Moderately abundant at the site.
- Common Auger (Terebra dislocata): generally subtidal, but found washed up on beaches. Long and narrow, but very small. Distinct anterior canal.
- Miniature Moon shell (Natica pusilla): chiefly subtidal. A very small, round snail with completely callus-covered umbilicus.
- Solitary Glassy Bubble (Haminoea solitaria): intertidal pools to subtidal down to 30 ft. Only one was found, small and very fragile but completely distinctive, like partial spiral without apex. Animal is sluglike and shell is mostly covered with tissue in life.

Vertebrates

- Fish vertebrae. Small (1 cm), black. Only two were found.
- Atlas (1st cervical vertebra) and portion of scapula, apparently from an immature whale. Atlas measures 16.5 cm (6.5 in.) across, 5.5 cm (2.25 in.) thick, and weighs 755 gm (1 lb 10 oz). Scapula fragment is 17.5 cm (7 in.) long. Found very near to each other. Both are black in color and appear to be original bone material having mineral deposition within pores.

Interpretation of Environmental Conditions

This was clearly a shallow-water environment, probably shallow subtidal. Dark, fine-grained silty sands point toward a lagoonal setting behind a barrier island. The reducing conditions within this deposit are very evident from their appearance and the results of testing.

The extreme paucity of fossils through most of the dark fine-grained sands in the borrow area indicates conditions that were not favorable to bottom-dwelling aerobic organisms, probably low oxygen content within the basal portion of the water column and shallow sediments. The laterally-restricted shell deposits may be near an ancient inlet channel that afforded a flow of oxygenated water from the ocean. The limited vertical extent is also consistent with that scenario, representing the common occurrence of an inlet forming for a period of time and later filling in as another inlet forms elsewhere along the barrier island. The latter event would have cut off the influx of locally deeper, oxygen-rich water.

The shells described above come from the central part of the borrow area. Fragile shells like Haminoea imply quiet waters and settling with little disturbance from wave action, conditions consistent with locally oxygenated waters within a tidal lagoon. Abundant intact clam shells with upper and lower valves conjoined also indicate an absence of wave action.

Sedimentary structures such as layering and cross-bedding are quite rare. That is known to be typical of sands in temperate zone lagoons, where sediment is redistributed vertically by burrowing organisms. Chemosynthetic sulfur bacteria are abundant in anaerobic sediment layers, and nematode worms eat the bacteria. Many burrowing animals are capable of withstanding low oxygen levels.

Whale remains suggest the possibility of a young animal entering or swept into a lagoon through an inlet channel, becoming trapped by lower tide levels and expiring near the lagoon-side entrance. These bones are heavy and dense, and must be autochthonous; wave action or currents could not have transported them into the fine sandy sediments where they were found.

Coarser sediments were seen at higher elevations farther to the east. Layers of medium to coarse sand appear to overlie silty fine sands, and are accompanied by some broken shell

fragments and layers of well-rounded gravel. Large pieces of petrified wood indicate the proximity of a large watercourse such as the ancestral Savannah or Ogeechee Rivers. These coarse-grained materials suggest a high-energy environment, possibly a back-barrier beach or back-barrier flat composed of materials washed over the barrier island during tidal surges or storms. Thin layers of dark silty and clayey sediments indicate possible marsh conditions with periods of emergence.

Yet farther to the east and at higher elevations, in the southwestern quadrant of the re-excavated landfill, a natural oxidation boundary appears around three to four feet below the original land surface. These sediments are generally similar to those in the central part of the borrow area, but contain occasional burnt organic fragments. Thus, shallow areas of the lagoon, possibly south of flood tide deposits, may have become emergent and vegetated. Based on limited peroxide field tests, these dark-colored sediments appear to contain less sulfur than deeper lagoonal sands in the borrow area. That appears to be consistent with their elevation, implying a longer period of periodic oxidation during low-water table conditions and removal of products such as sulfuric acid through leaching.

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