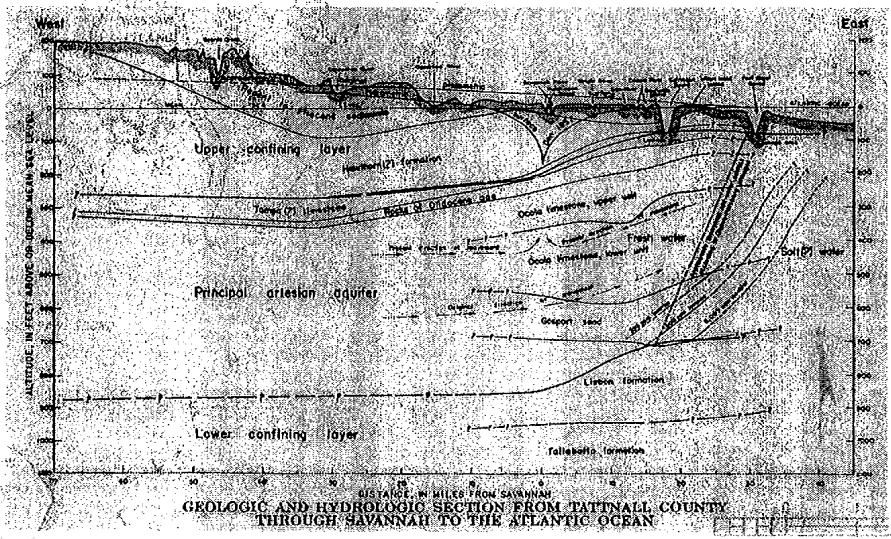
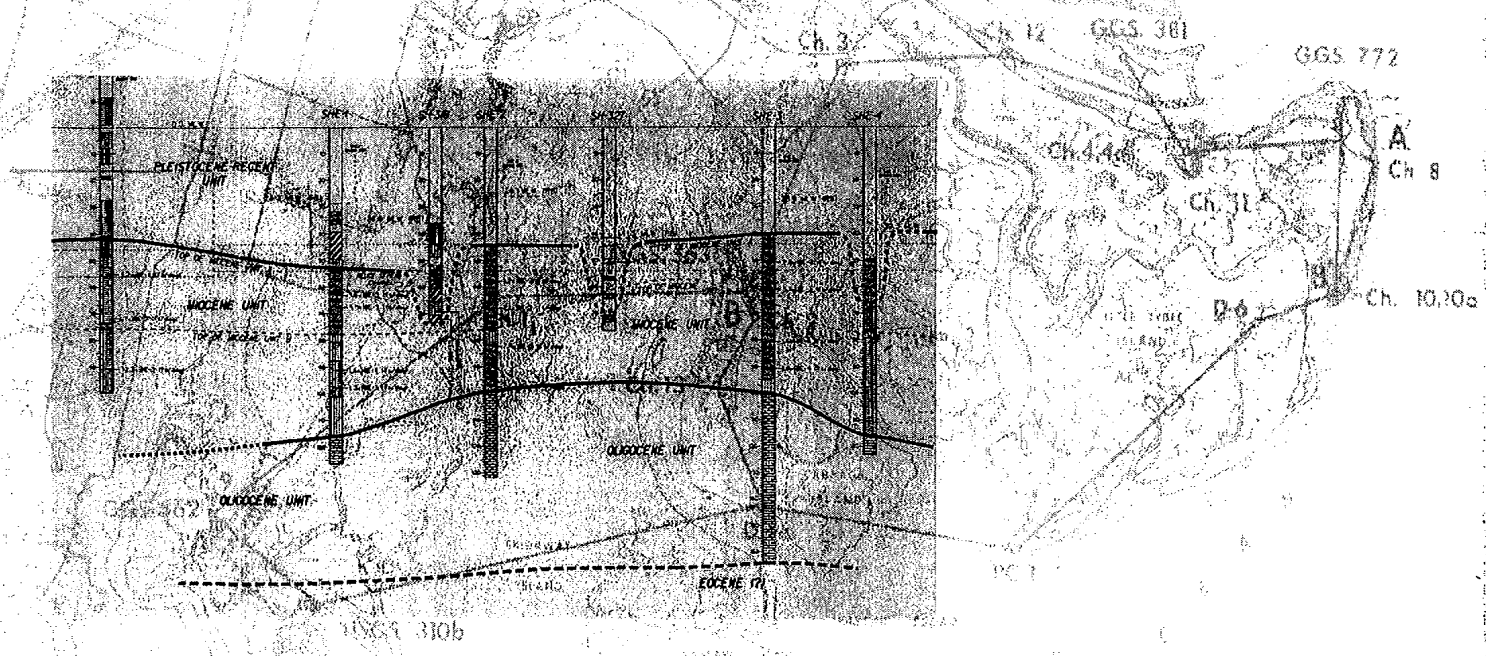


POTENTIAL GROUND-WATER IMPACTS

SAVANNAH HARBOR EXPANSION FEASIBILITY STUDY



GEOLOGIC AND HYDROLOGIC SECTION FROM TATTNALL COUNTY THROUGH SAVANNAH TO THE ATLANTIC OCEAN

SCALE IN FEET

SAVANNAH HARBOR EXPANSION FEASIBILITY STUDY

Section 1 Page 38 of 38

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Revision Date: 3/13/98

Sponsor: Georgia Ports Authority

Section:4. SUMMARY AND CONCLUSIONS

4. SUMMARY AND CONCLUSIONS

The hydrogeology of Eocene to Recent sediments beneath the project area was evaluated by a combination of: extensive review of previous studies; review of State and Federal (USGS) well-record files; eight new core borings; a sub-bottom geophysical survey; analysis of ground water from new and existing test wells; and laboratory analyses of physical properties of the Miocene confining unit. The major conclusions of the study are summarized in this section. Additional conclusions and supporting data are provided in the body and appendices to the report.

1. Geologic strata to a depth of about 500 ft consist of three broadly defined geologic or hydrogeologic units that have similar water-bearing characteristics. These are the Pleistocene-Recent unit, the Miocene confining unit, and upper Floridan aquifer.

2. The **upper Floridan aquifer**, the most important source of ground water in the study area, has been extensively developed in the Savannah area where some 82 mgd of ground water are withdrawn from this aquifer system. This pumping has created a cone of depression where the potentiometric (artesian pressure) surface of the upper Floridan aquifer is lower than that of aquifer sands within the Pleistocene-Recent unit.

3. The upper Floridan aquifer is overlain by the **Miocene unit**, a confining unit consisting of low-permeability clays, clayey silts, and clayey sands. The Miocene unit consists of two lithologic units, referred to as unit A and unit B. Within unit B in the project area, no permeable sands occur that could be correlated with what has been referred to by the USGS (Clarke and others, 1990) as the "*upper Brunswick aquifer*". Numerous vertical permeability (K') values of the Miocene unit indicate low vertical permeabilities, typically in the range from about 4×10^{-2} ft/d to 6×10^{-4} ft/d.

4. Shallow sands, silts, and clays unconformably overlie the Miocene unit. This **Pleistocene-Recent unit**, typically about 60 to 75 ft thick, contains mainly low-permeability confining beds but contains thin permeable sands in some areas that are mostly used by small irrigation wells. Ground water within these sands occurs under both water-table (unconfined) and artesian (confined) conditions, and the elevation of the water table is typically higher than the heads of underlying aquifers. What little water enters the Miocene is supplied by downward leakage from the Pleistocene.

5. A reasonably comprehensive subbottom geophysical survey was performed in the channel where the proposed dredging will occur. This survey was important because it provided critical stratigraphic and thickness information on strata beneath the proposed dredging areas, thereby reducing the number of core holes drilled in the channel.

6. The focus of this study was on the area along the present navigation channel between approximate stations 20+000 and -23+000. This area is where a local structural feature, the Tybee high, causes strata to be elevated and thinned, which places the top of the upper Floridan aquifer at its highest elevation along the channel (about -95 MLW).

SAVANNAH HARBOR EXPANSION FEASIBILITY STUDY

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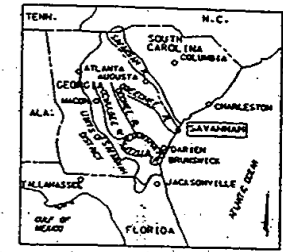
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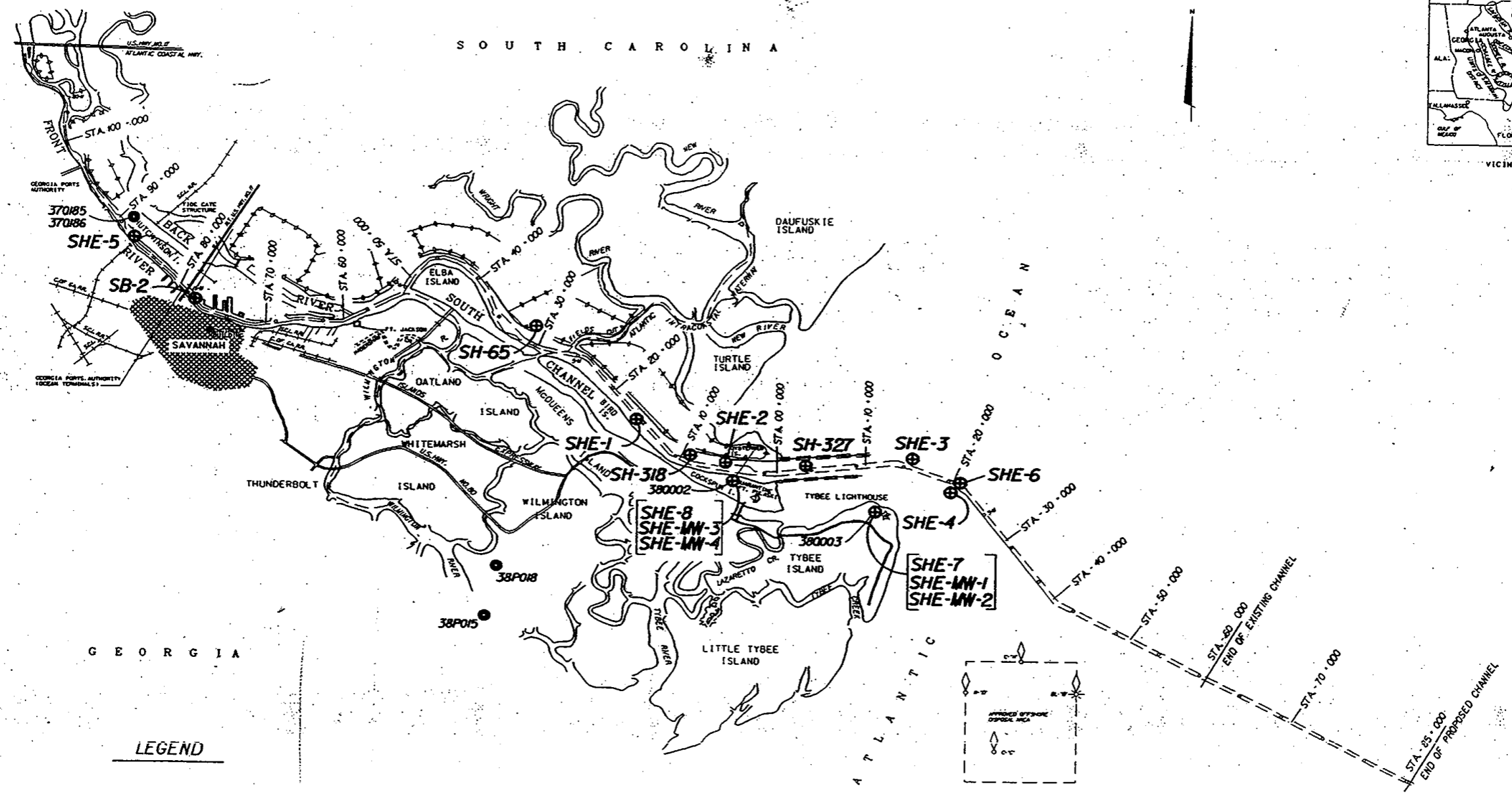
Section:4.	SUMMARY AND CONCLUSIONS
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Paleochannel 5 (at SH-327) in this area has cut down about 23 ft below the existing channel into the thinned Miocene confining unit above the Floridan. From the focus area westward towards Savannah, the Miocene confining unit becomes thicker and the upper Floridan is much deeper (about -200 MLW). From the focus area eastward to offshore as far as Sta. - 85+000, the confining unit is generally exposed in the existing channel bottom and continues at a thickness of about 50 ft, with a slight increase in thickness in the offshore direction.

7. Using average values for permeability (K_a), confining bed thickness (b), and hydraulic gradient (dh'/dl'), various leakage rates were computed for water moving vertically downward through the Miocene confining unit (and paleochannel/Miocene unit) into the upper Floridan aquifer. This quantity of water (Q_c) is only a small fraction of the quantity of water moving laterally through the upper Floridan aquifer. Therefore, the proposed dredging will have no noticeable affect on the quality and quantity of ground water within the upper Floridan aquifer.



VICINITY MAP



GEORGIA

SOUTH CAROLINA

LEGEND

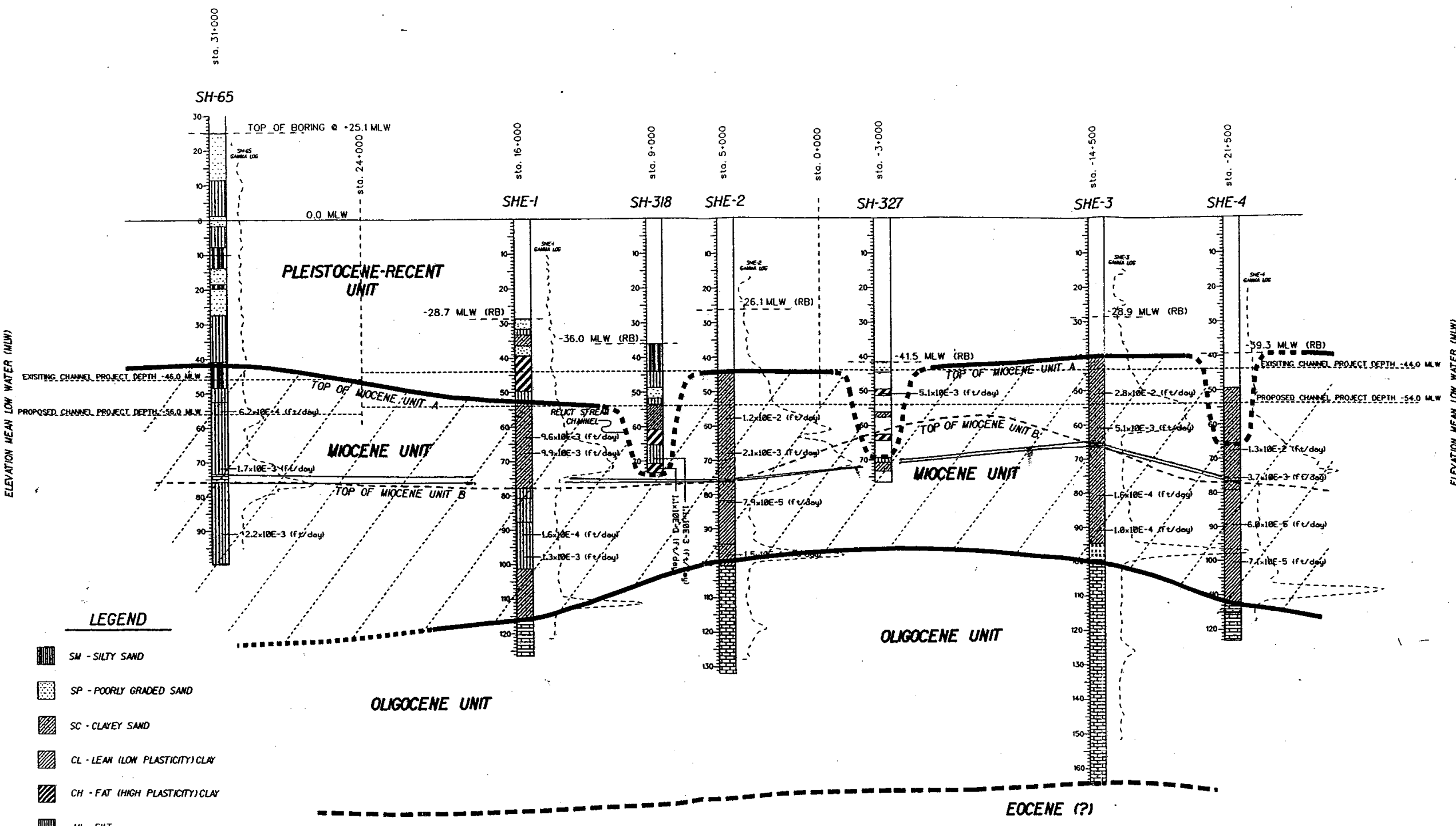
- SHE-6 ⊕ STRATIGRAPHIC CORE BORING
- [SHE-7
SHE-MW-1
SHE-MW-2] ⊕ STRATIGRAPHIC CORE BORING AND TEST WELL CLUSTER
- 38P015 ● LOCATION OF OTHER SELECTED TEST WELLS (USGS)

NOT TO SCALE

SAVANNAH HARBOR, GEORGIA
EXPANSION FEASIBILITY STUDY

STUDY AREA
WITH CORE BORING AND TEST WELL
LOCATION PLAN

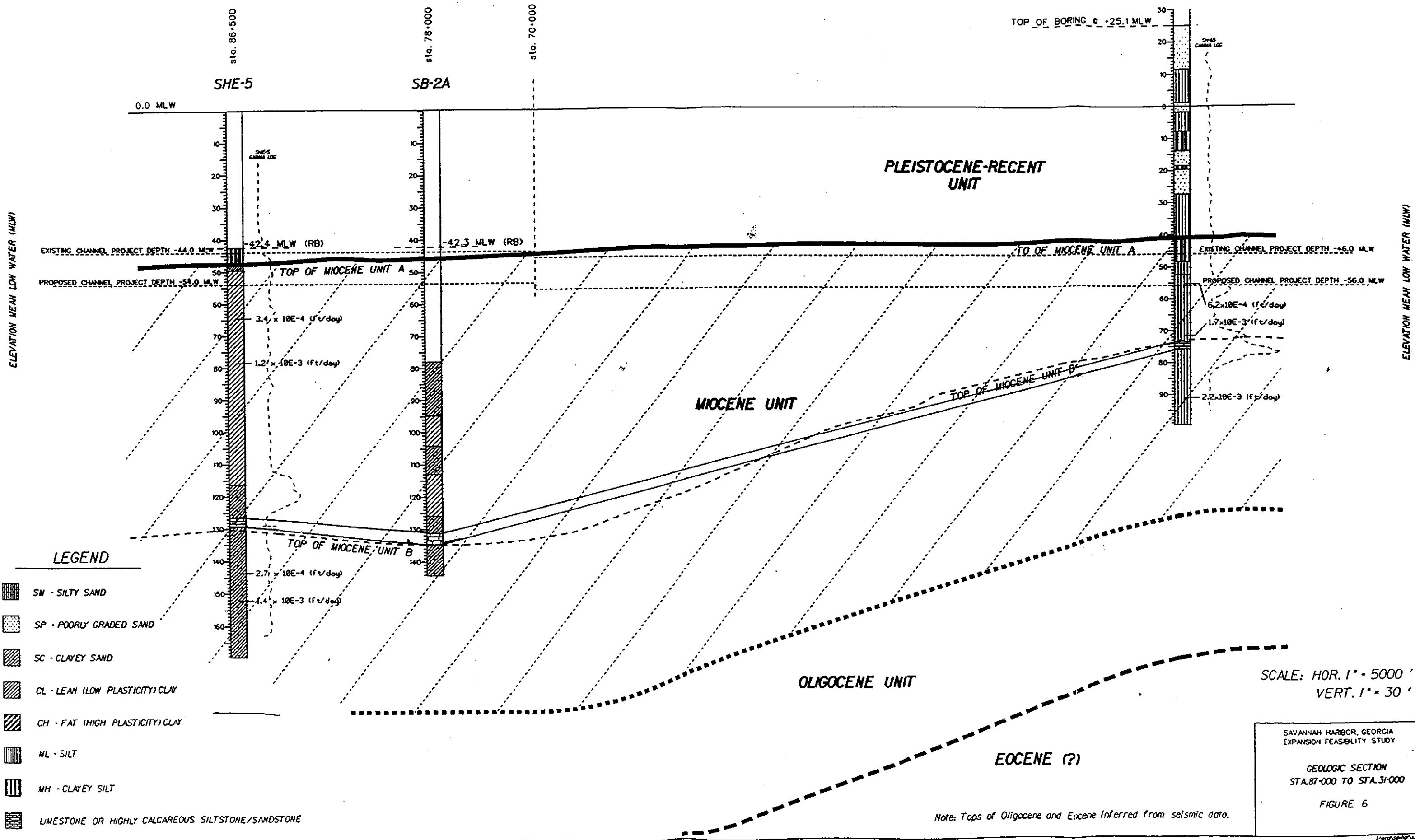
FIGURE 1



SAVANNAH HARBOR, GEORGIA
EXPANSION FEASIBILITY STUDY

GEOLOGIC SECTION
STA. 31+000 TO STA. 21+500

FIGURE 5



LEGEND

- SM - SILTY SAND
- SP - POORLY GRADED SAND
- SC - CLAYEY SAND
- CL - LEAN (LOW PLASTICITY) CLAY
- CH - FAT (HIGH PLASTICITY) CLAY
- ML - SILT
- MH - CLAYEY SILT
- LIMESTONE OR HIGHLY CALCAREOUS SILTSTONE/SANDSTONE

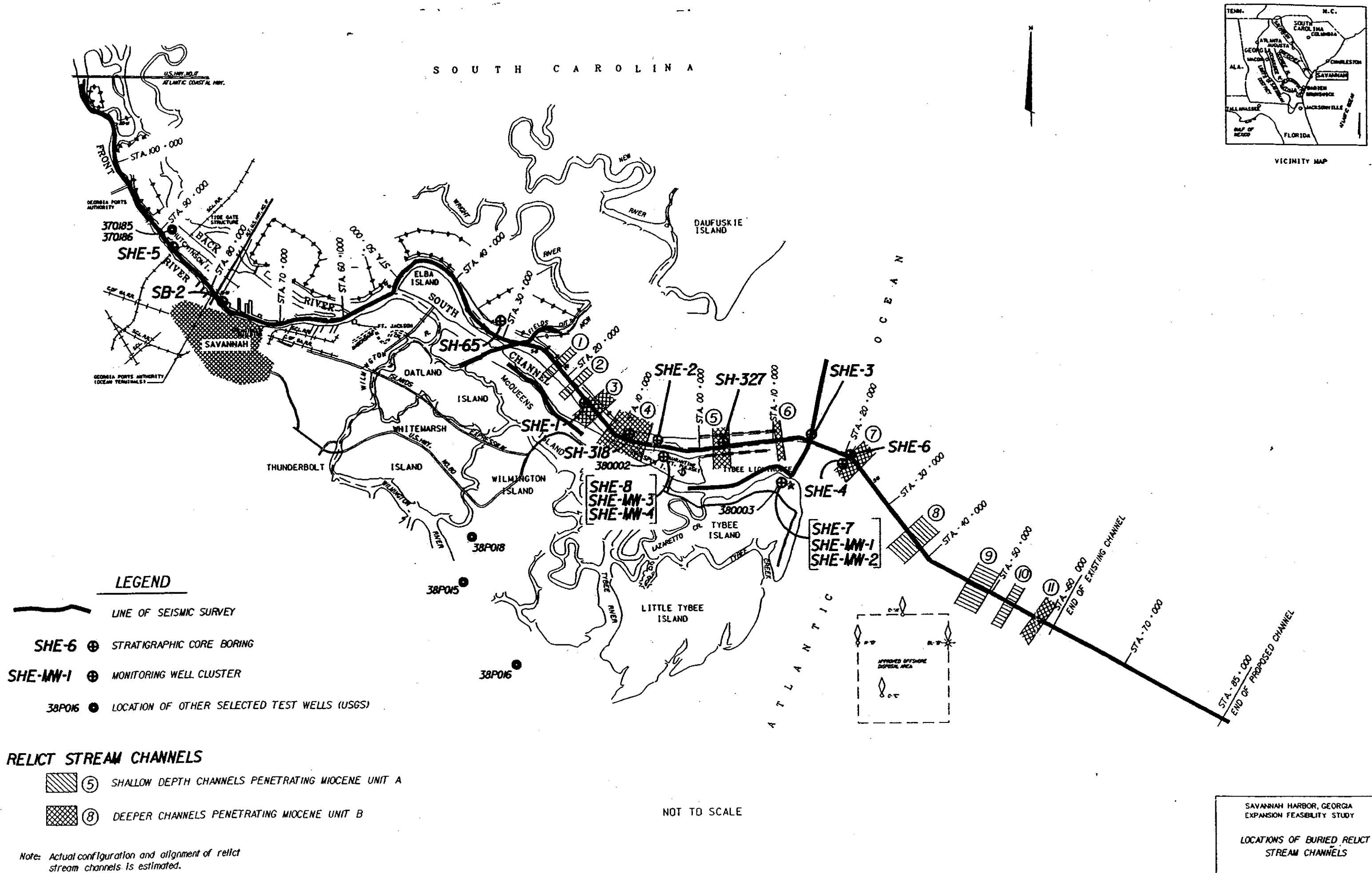
SCALE: HOR. 1" = 5000'
VERT. 1" = 30'

SAVANNAH HARBOR, GEORGIA
EXPANSION FEASIBILITY STUDY

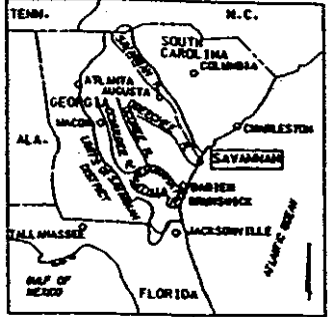
GEOLOGIC SECTION
STA. 87+000 TO STA. 31+000

FIGURE 6

Note: Tops of Oligocene and Eocene Inferred from seismic data.







SOUTH CAROLINA





VICINITY MAP

LEGEND

-  LINE OF SEISMIC SURVEY
- SHE-6**  STRATIGRAPHIC CORE BORING
- SHE-MW-1**  MONITORING WELL CLUSTER
- 38P016**  LOCATION OF OTHER SELECTED TEST WELLS (USGS)

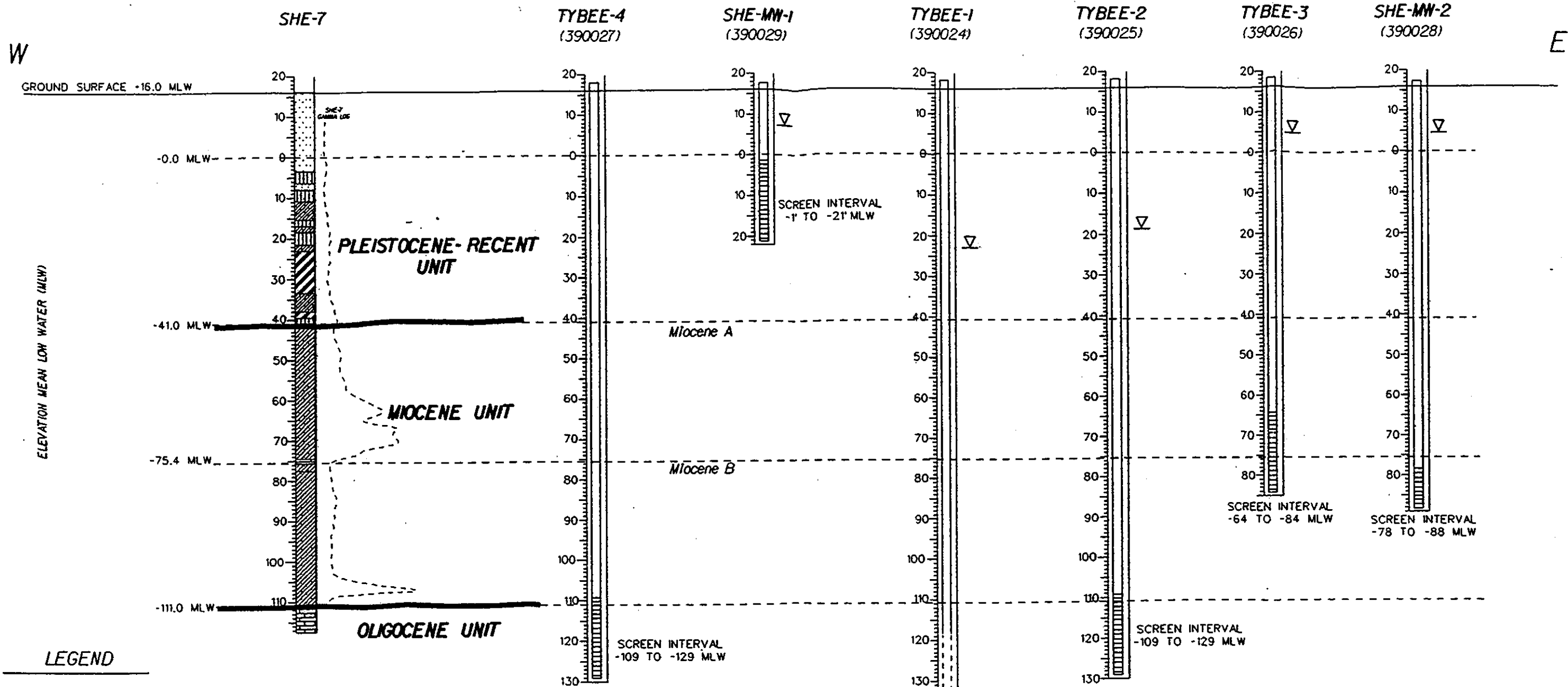
RELICT STREAM CHANNELS

-  ⑤ SHALLOW DEPTH CHANNELS PENETRATING MIOCENE UNIT A
-  ⑧ DEEPER CHANNELS PENETRATING MIOCENE UNIT B

Note: Actual configuration and alignment of relict stream channels is estimated.

NOT TO SCALE

SAVANNAH HARBOR, GEORGIA
EXPANSION FEASIBILITY STUDY
LOCATIONS OF BURIED RELICT
STREAM CHANNELS
FIGURE 13

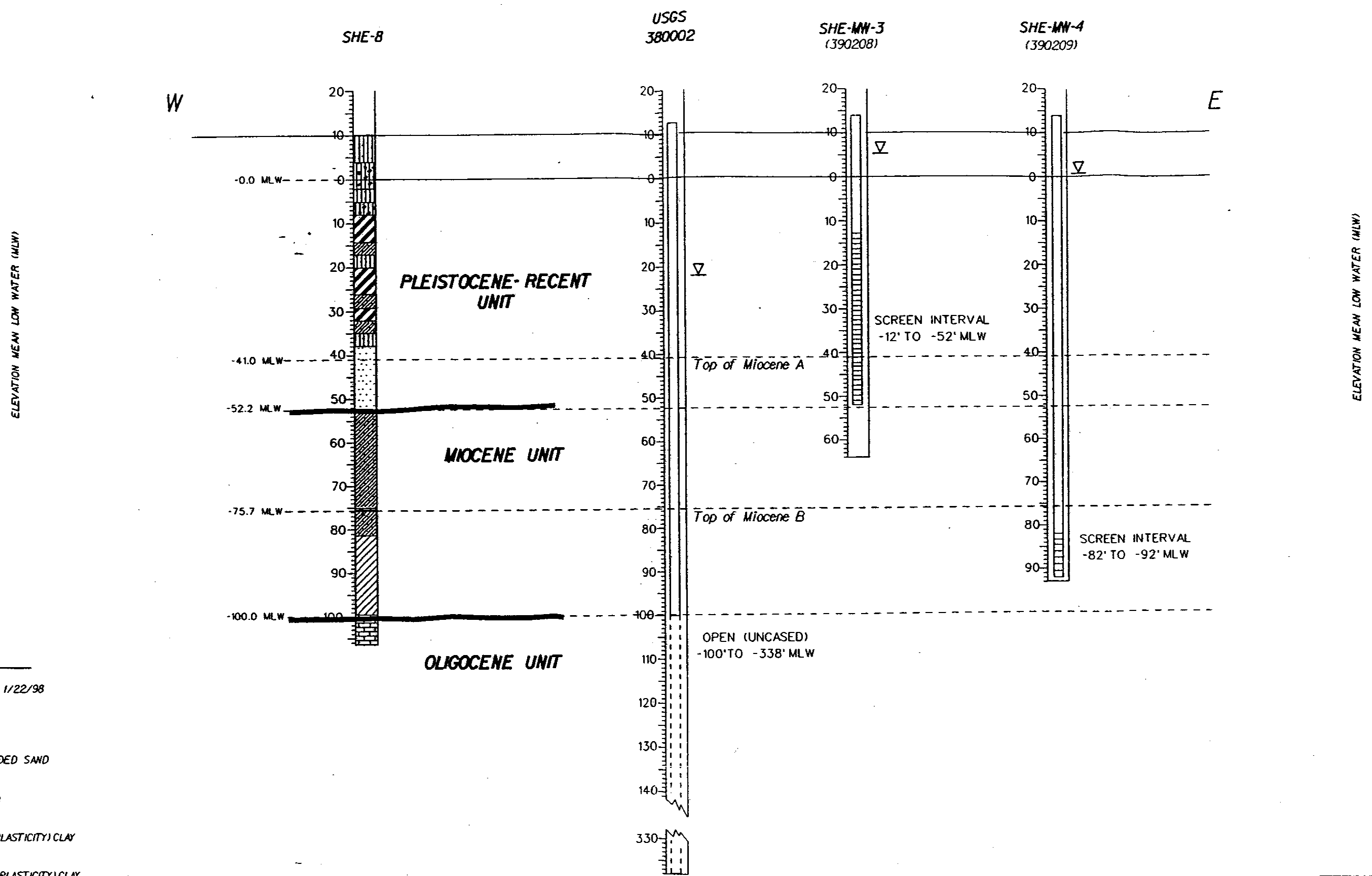


LEGEND

- ▽ WATER LEVEL ON 1/22/98
- SM - SILTY SAND
- SP - POORLY GRADED SAND
- SC - CLAYEY SAND
- CL - LEAN (LOW PLASTICITY) CLAY
- CH - FAT (HIGH PLASTICITY) CLAY
- ML - SILT
- MH - CLAYEY SILT
- LIMESTONE OR HIGHLY CALCAREOUS SILTSTONE/SANDSTONE

(SECTION ON NORTH END OF TYBEE ISLAND, APPROX. 5000 FEET SOUTH OF EXISTING NAVIGATION CHANNEL STA.-12-000)

SAVANNAH HARBOR, GEORGIA
 EXPANSION FEASIBILITY STUDY
 GEOLOGIC SECTION
 AT TYBEE ISLAND WELL CLUSTER
 FIGURE 14



(SECTION AT FT. PULASKI HARBOR PILOTS DOCK, APPROX. 750 FEET SOUTH OF EXISTING NAVIGATION CHANNEL STA. 4+000)

SAVANNAH HARBOR, GEORGIA
EXPANSION FEASIBILITY STUDY

GEOLOGIC SECTION
AT FORT PULASKI WELL CLUSTER

FIGURE 15