

Downward Migration of Saltwater in the Savannah, Georgia, and Hilton Head Island, South Carolina, Area

by

Camille Ransom, III
and
A.D. Park

SC DHEC CONTRIBUTIONS to the
GEORGIA SOUND SCIENCE INITIATIVE

in cooperation with

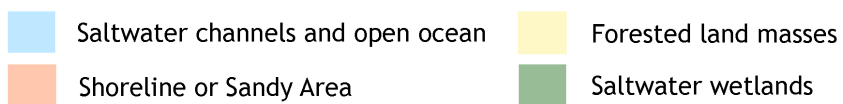
The CITY OF SAVANNAH, GEORGIA
AND
The BEAUFORT-JASPER WATER AND SEWER AUTHORITY



Purpose of Investigation

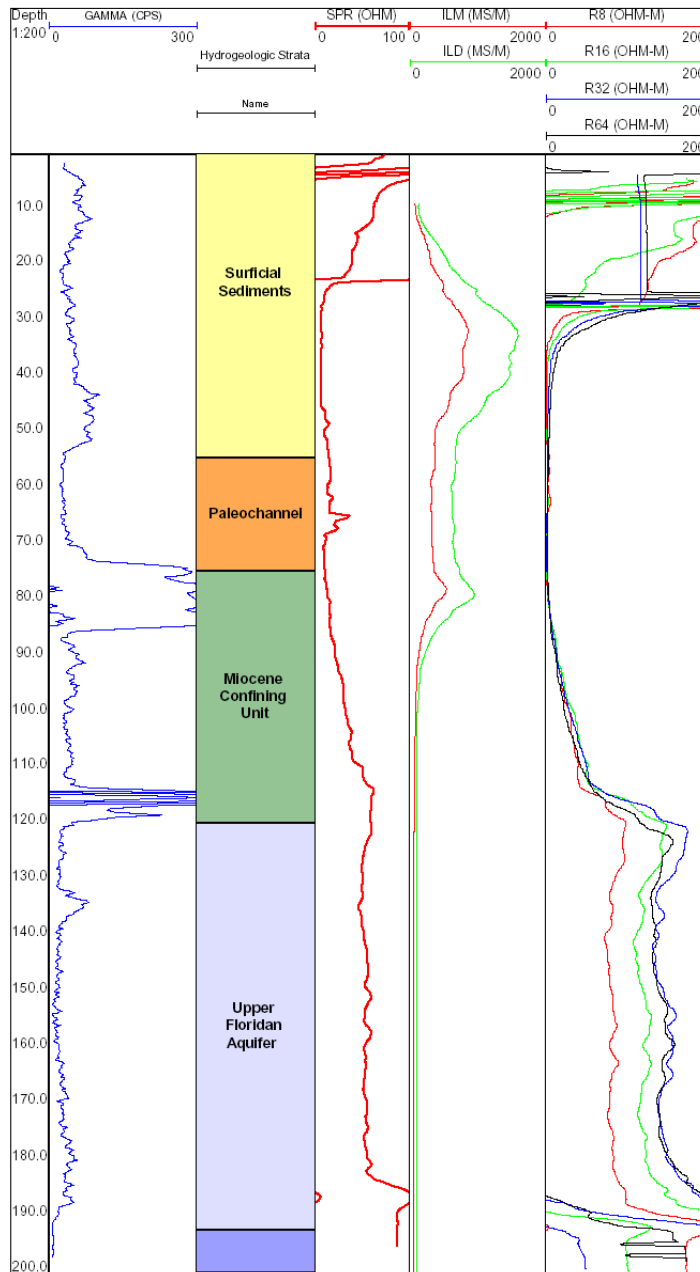
- Determine if salty water from overlying marshes, tidal rivers, and the Atlantic Ocean is migrating downward through the upper confining unit as a result of pumpage from the underlying Upper Floridan aquifer

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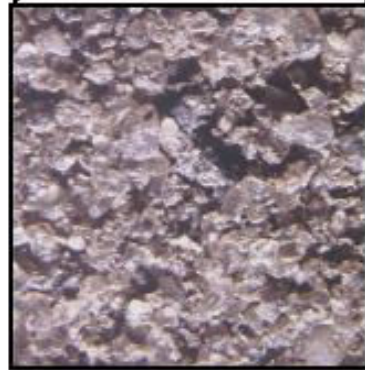
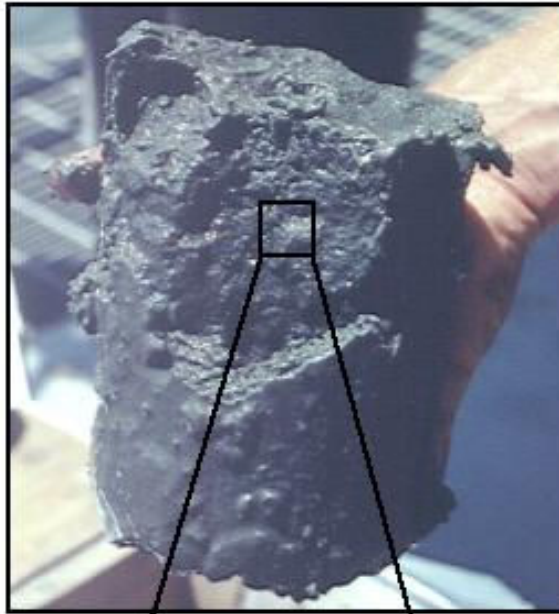
Location of study area.

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Relationship of geophysical logs to general geology (after Ransom and others, 2006)

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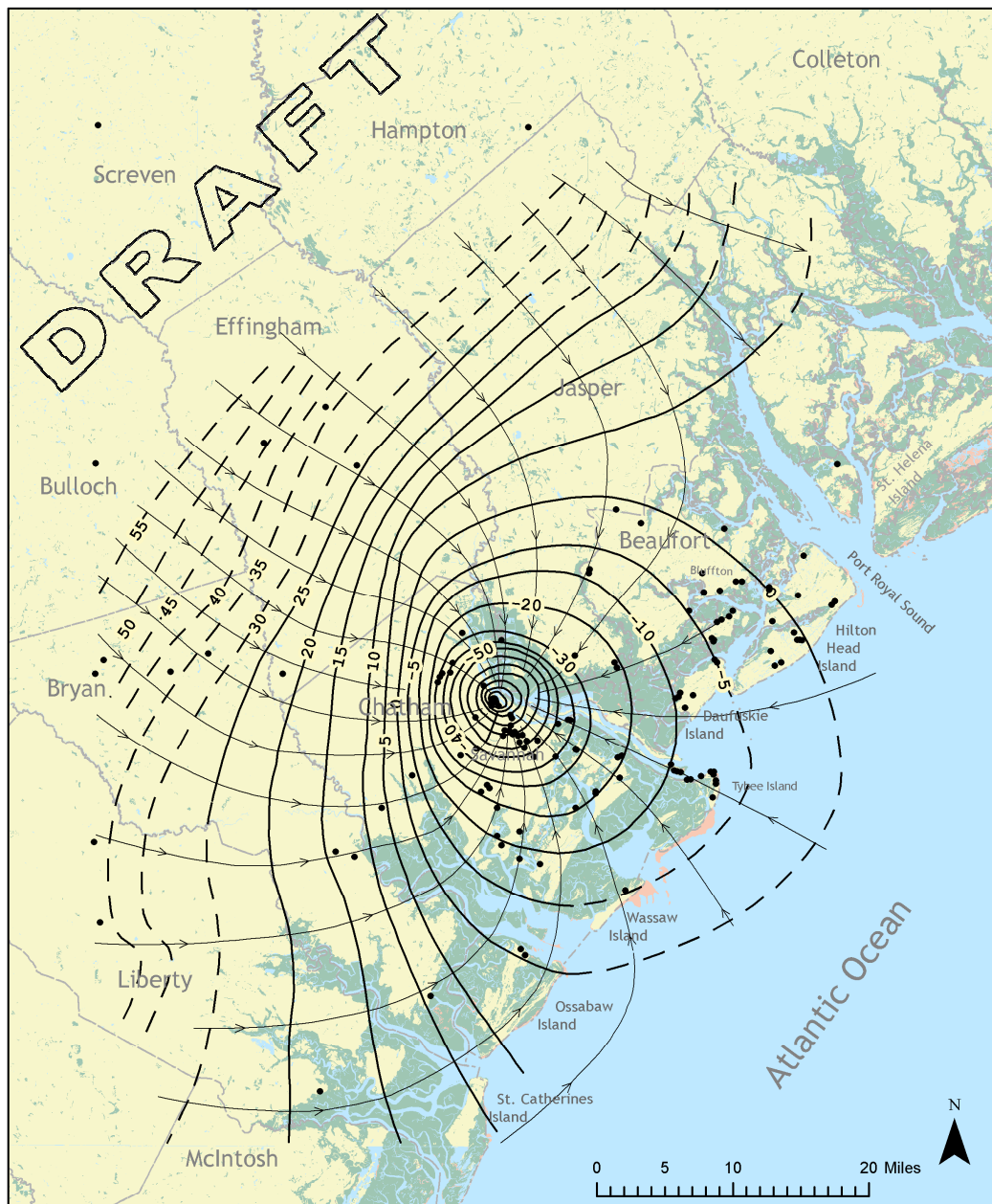


Magnified 10x

Geologic core of the upper confining unit taken beneath Port Royal Sound (photograph by C. Ransom III, 1988).



Estimated potentiometric surface of the Upper Floridan aquifer and direction of groundwater flow prior to 1880 (after Counts and Donsky, 1963).



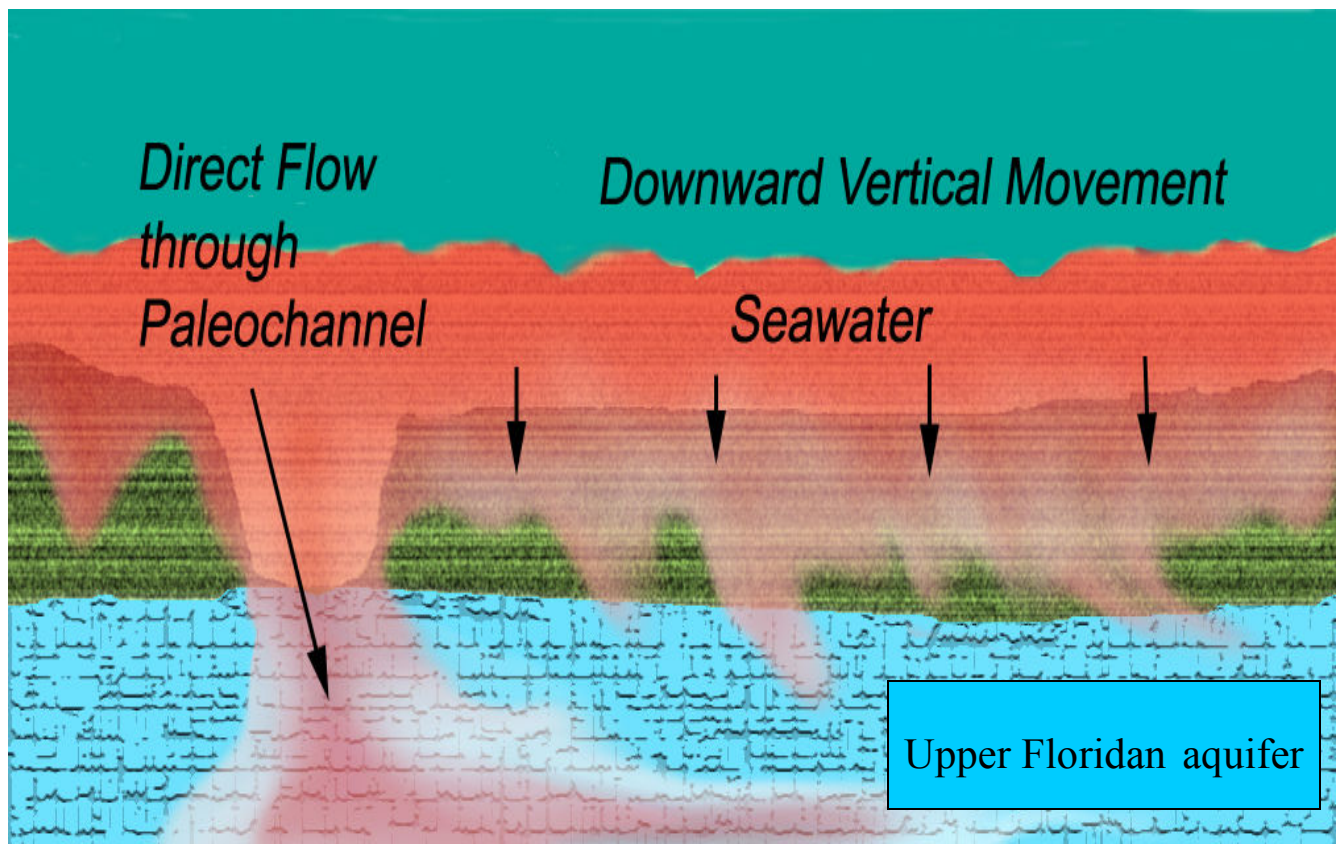
EXPLANATION

- 10— Potentiometric contour. Shows altitude in feet above and below sea level. Dashed where approximate. Contour interval 5 and 10 feet. Datum is NGVD29.
- Groundwater-flow path.

- | | |
|---|---|
| Saltwater channels and open ocean | Forested land masses |
| Shoreline or Sandy Area | Saltwater wetlands |



Potentiometric surface of the Upper Floridan aquifer, 1958 (after Counts and Donsky, 1963).



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Diagram illustrating downward saltwater migration through the upper confining unit.

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



Current Questions:

- What is the rate of downward saltwater migration through the upper confining unit?
- When will chlorides begin increasing in the Upper Floridan aquifer?
- When will chloride concentrations impact wells that withdraw water from the Upper Floridan aquifer?



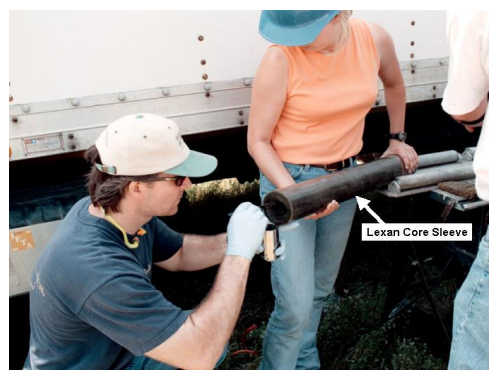
Data Source: U.S. Census Bureau,
National Wetlands Inventory

0 5 10 20 Miles

- | | |
|---|--|
|  Saltwater channels and open ocean |  Forested land masses |
|  Shoreline or Sandy Area |  Saltwater wetlands |



Location of Bull River test site for
pore- water extraction.



Procedure for pore water extraction

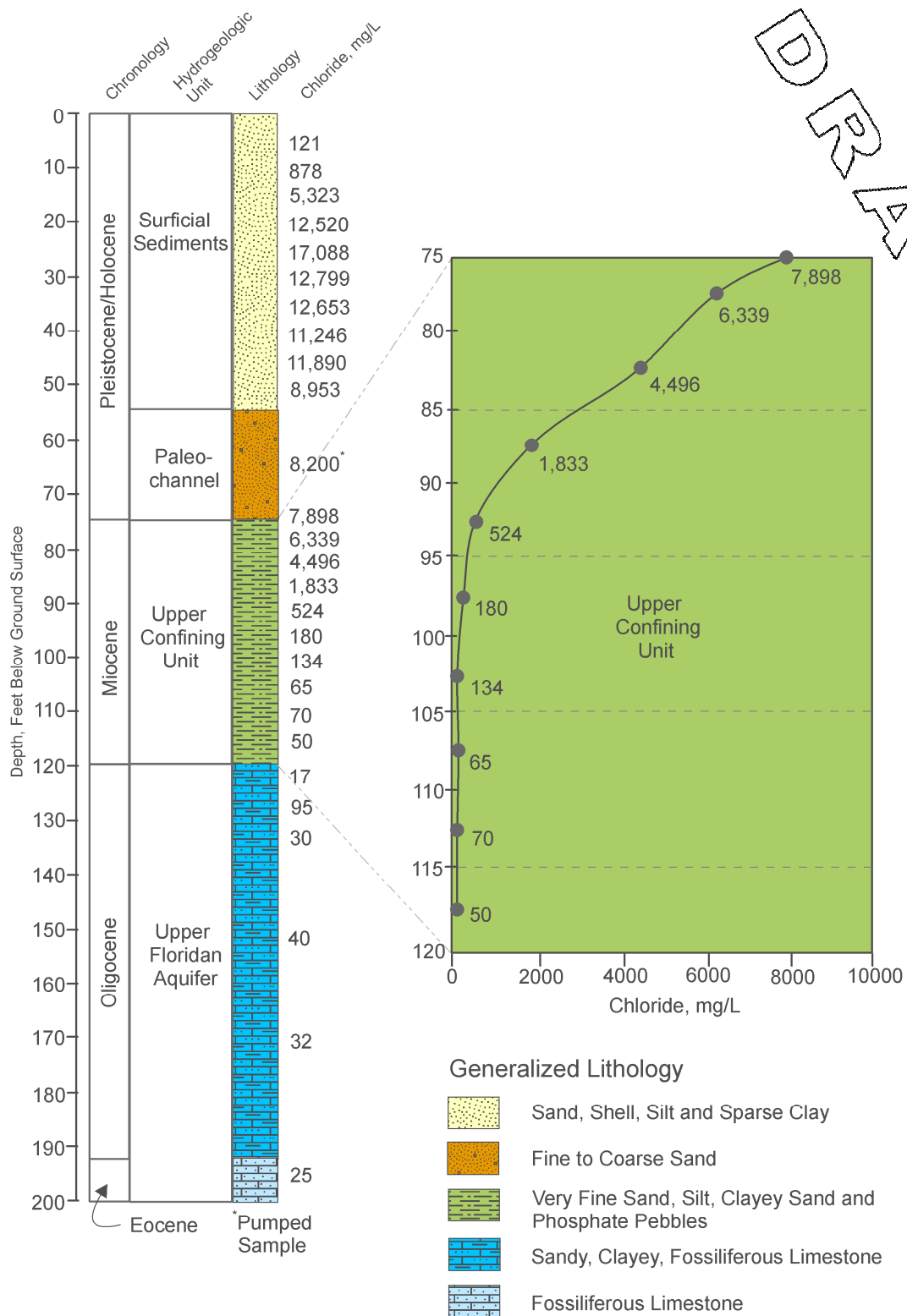
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5 mLs of Porewater

“Hockey Puck”





Chloride concentrations with depth at the Bull River test site (after Ransom and others, 2006).

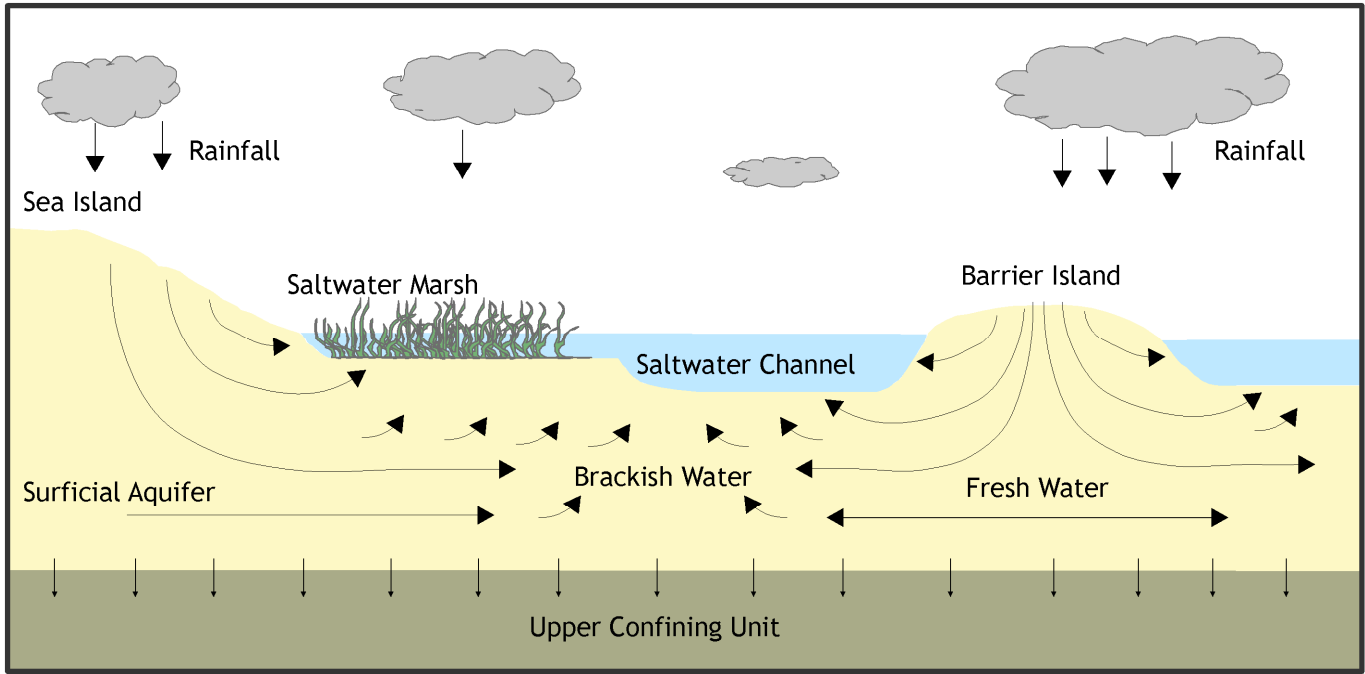


Diagram illustrating direction of groundwater flow in the surficial aquifer in response to recharge and discharge.

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Offshore drill rig used to obtain discrete water samples above the upper confining unit.

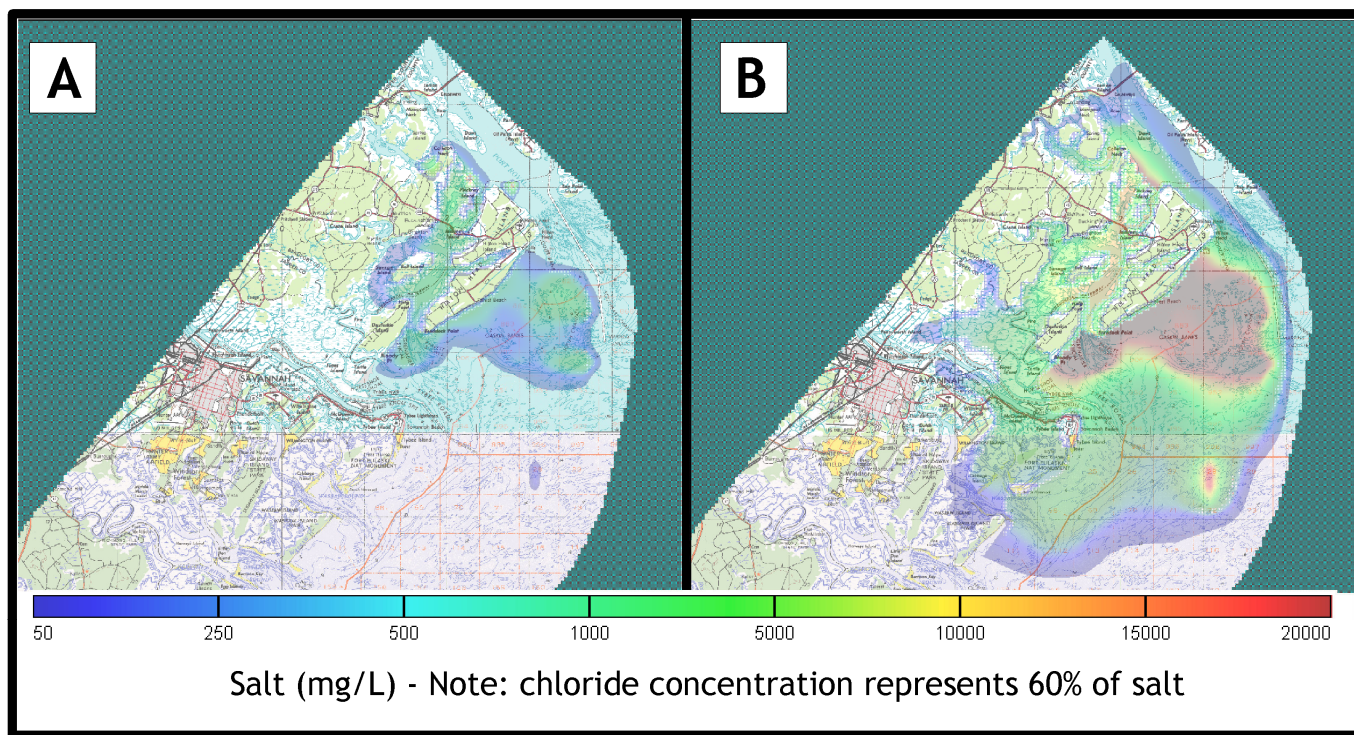
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- Saltwater wetlands
 - Forested land masses
 - Saltwater channels and open ocean
 - Test sites with chloride concentrations (mg/L)
- 9,200



Map showing chloride concentrations near the base of the surficial aquifer (chloride concentration of saltwater is about 19,000 mg/L chloride; Hem, 1970).



Model simulation for the year 2050 simulating saltwater in the (a) Upper Floridan aquifer and (b) midway through the upper confining unit.

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SAVANNAH HARBOR EXPANSION AQUIFER STUDIES

Savannah District



Savannah Harbor (courtesy of US Army Corps of Engineers).

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SAVANNAH HARBOR EXPANSION AQUIFER STUDIES

Savannah District



Savannah Harbor showing general general
geology (courtesy of US Army Corps of Engineers)

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Conclusions

Saltwater is moving downward into the Upper Floridan aquifer where the potentiometric surface is below sea level.

Higher concentrations of chlorides are present in where the upper confining unit is thinnest.

Saltwater will continue to migrate downward until the vertical gradient across the upper confining unit is reversed.