

USGS-NYSDEC Study to Assess Groundwater Sustainability of the Long Island Aquifer System Hydrogeologic Framework and Saltwater Intrusion Discussion

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Background/Status

- Project consists of two parts Field Mapping and Groundwater Modeling
- Project has 3 phases:
 - Phase 1-Western LI (Kings, Queens, and Nassau Counties).
 - Phase 2-Eastern LI (Suffolk County).
 - Phase 3-Monitoring.

Project Objectives

- Improve current understanding of the regional hydrogeologic framework.
- Develop a regional groundwater-flow model of the LI aquifer system.
- Provide the hydrologic information needed for a comprehensive assessment of groundwater sustainability under changing conditions.

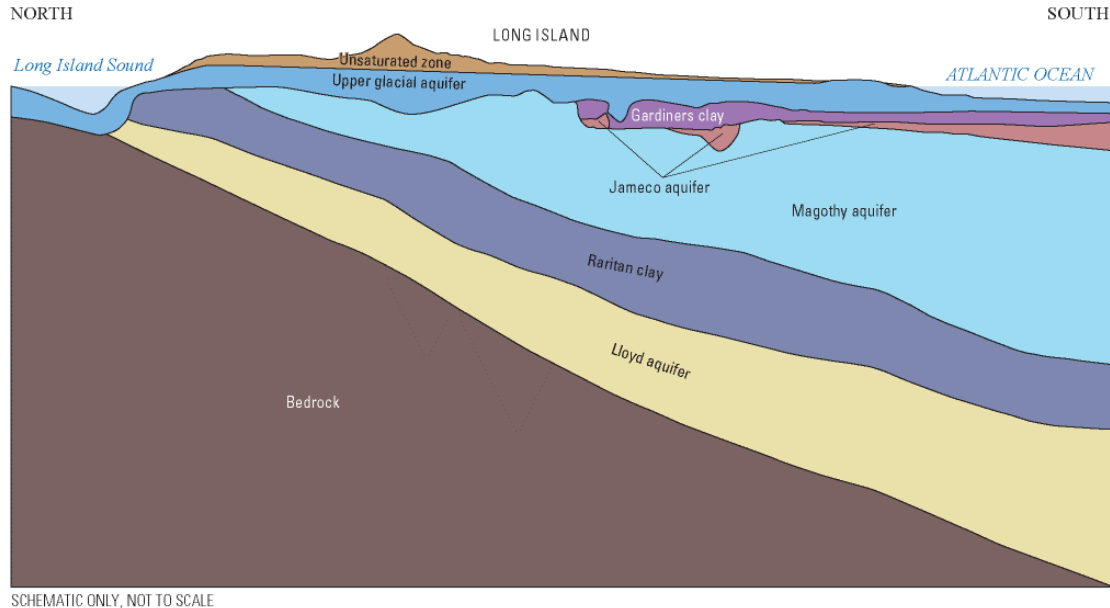
Location of Drilled Wells

EXPLANATION

- 1 Phase 1 drilled wells
- 2 Phase 2 drilled wells
- 3 Phase 3 drilled wells
- 3 Phase 3 proposed wells



Long Island Hydrogeologic Units



Stumm and others, 2024

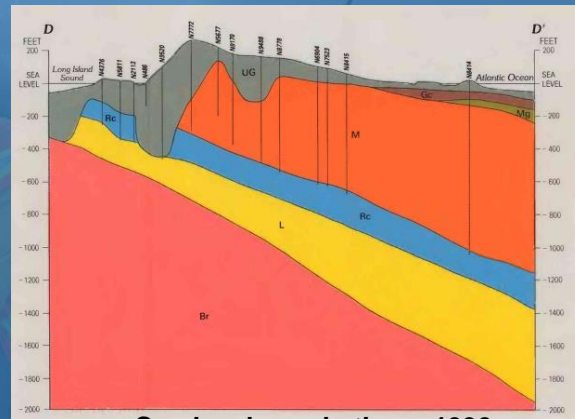
Phase 2 Drilling Completed:

Mapped hydrogeologic units:

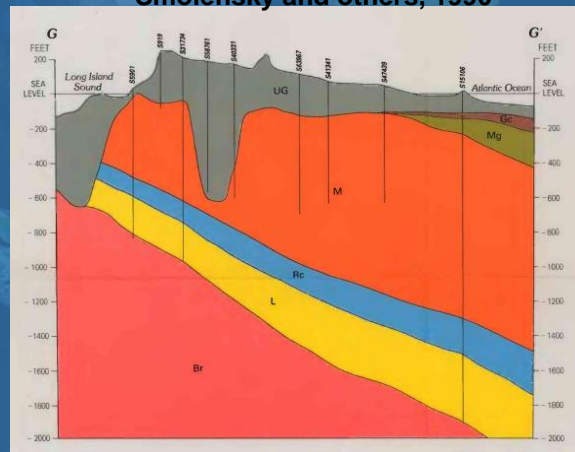
- Gardiners confining unit
- North Shore confining unit
- North Shore aquifer
- Magothy aquifer
- Magothy clay (top and bottom)
- Upper raritan aquifer (also in Phase I)
- Lower raritan confining unit
- Lloyd aquifer
- Bedrock

Datasets for each unit include:

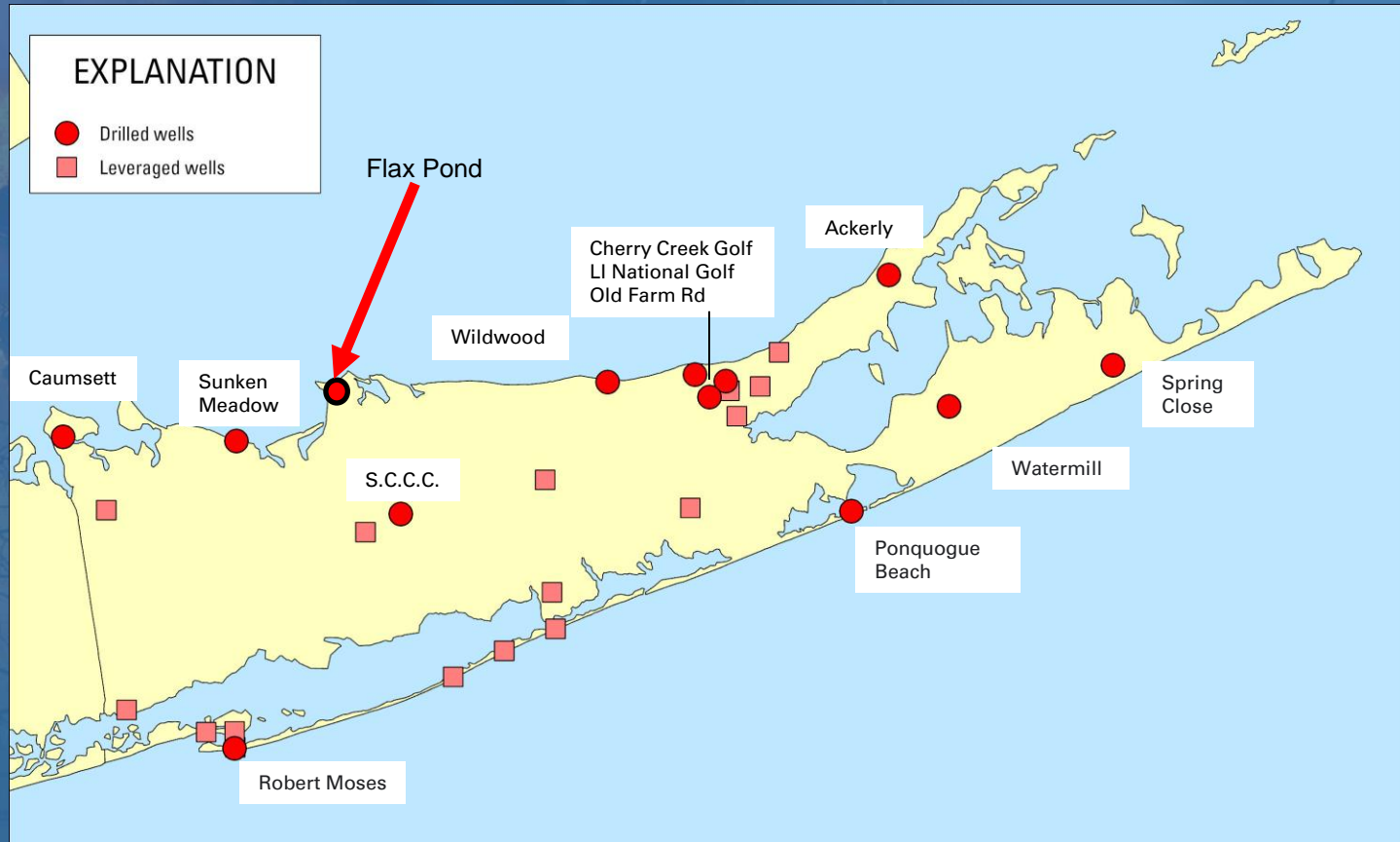
- Data points
- Surface contours
- Extents
- Surface elevation raster interpolation



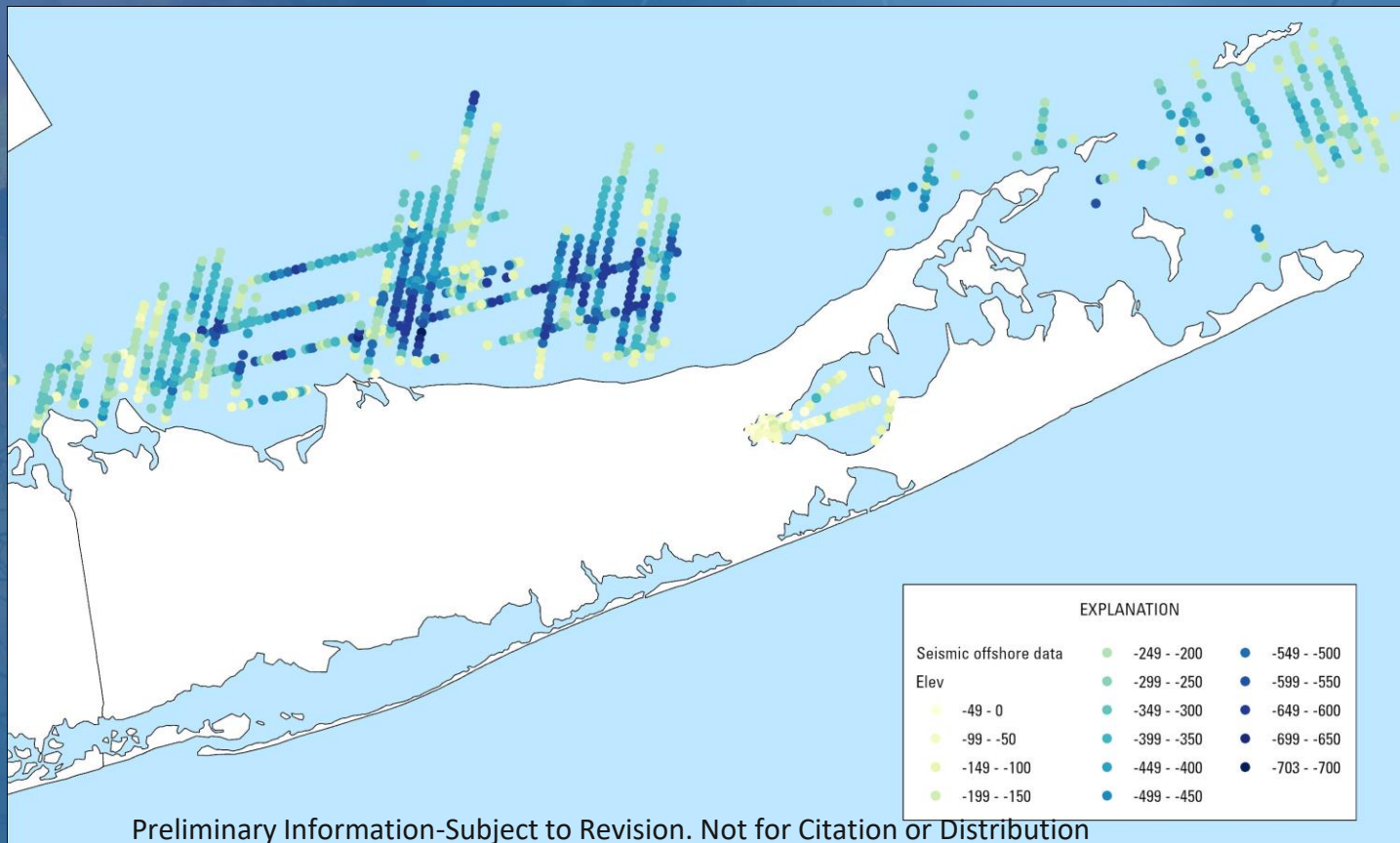
Smolensky and others, 1990



Phase 2 Drilling Location Map

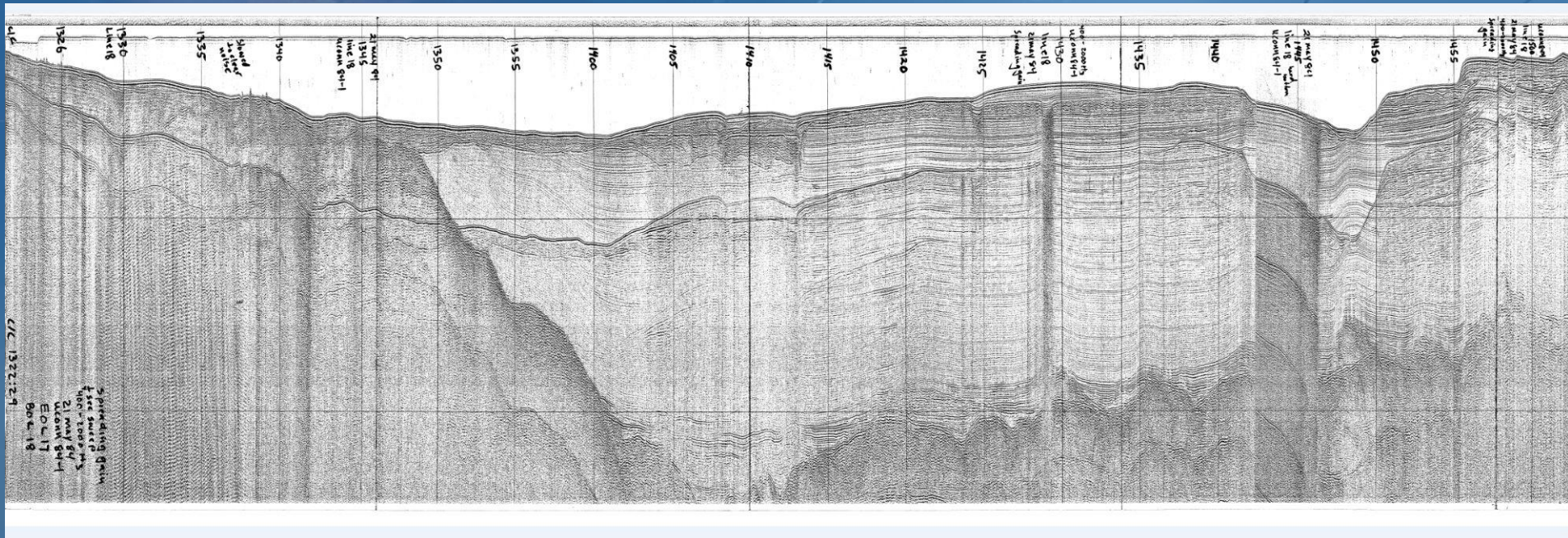


Offshore Seismic Reflection Survey Lines



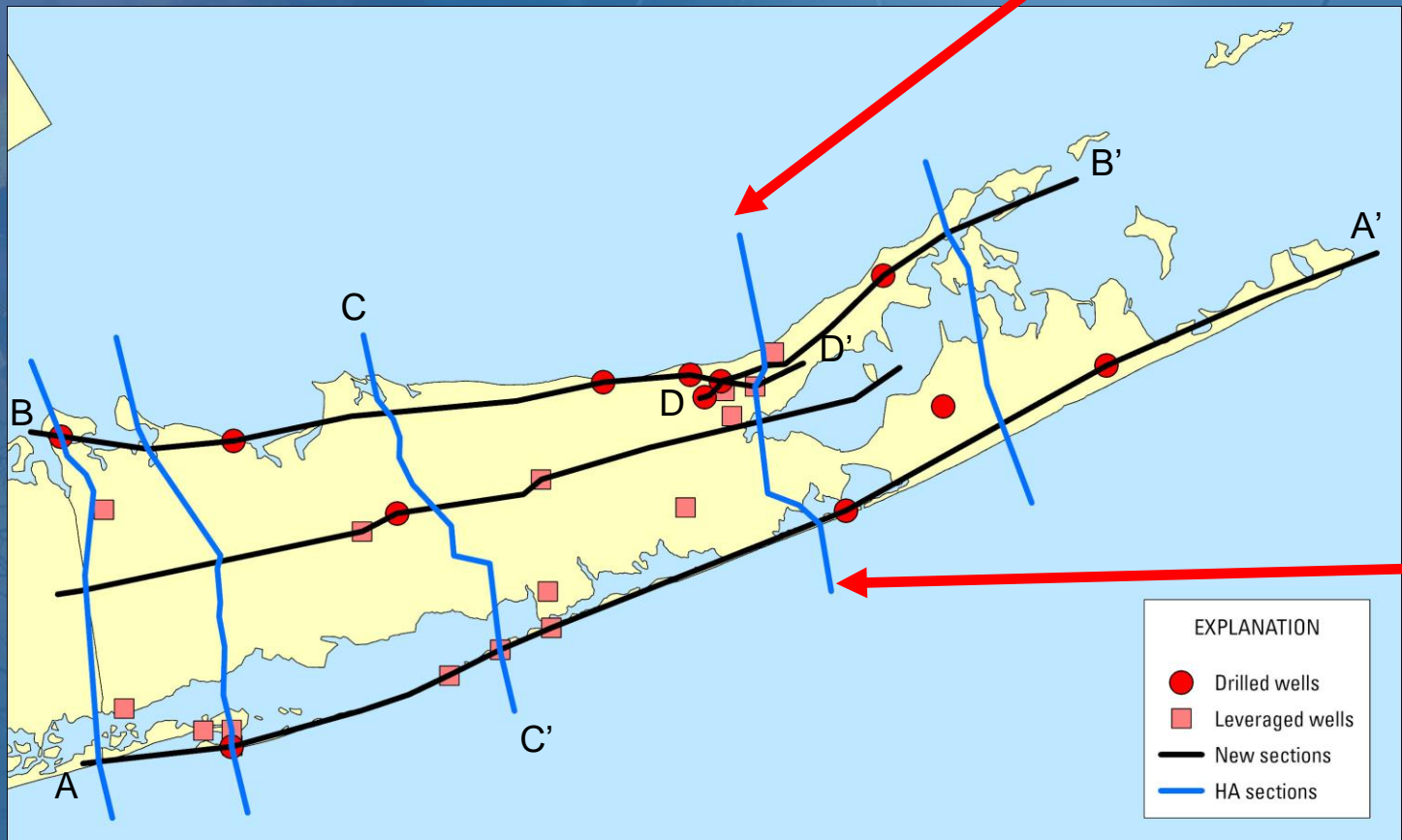
Preliminary Information-Subject to Revision. Not for Citation or Distribution

Seismic Reflection Profile

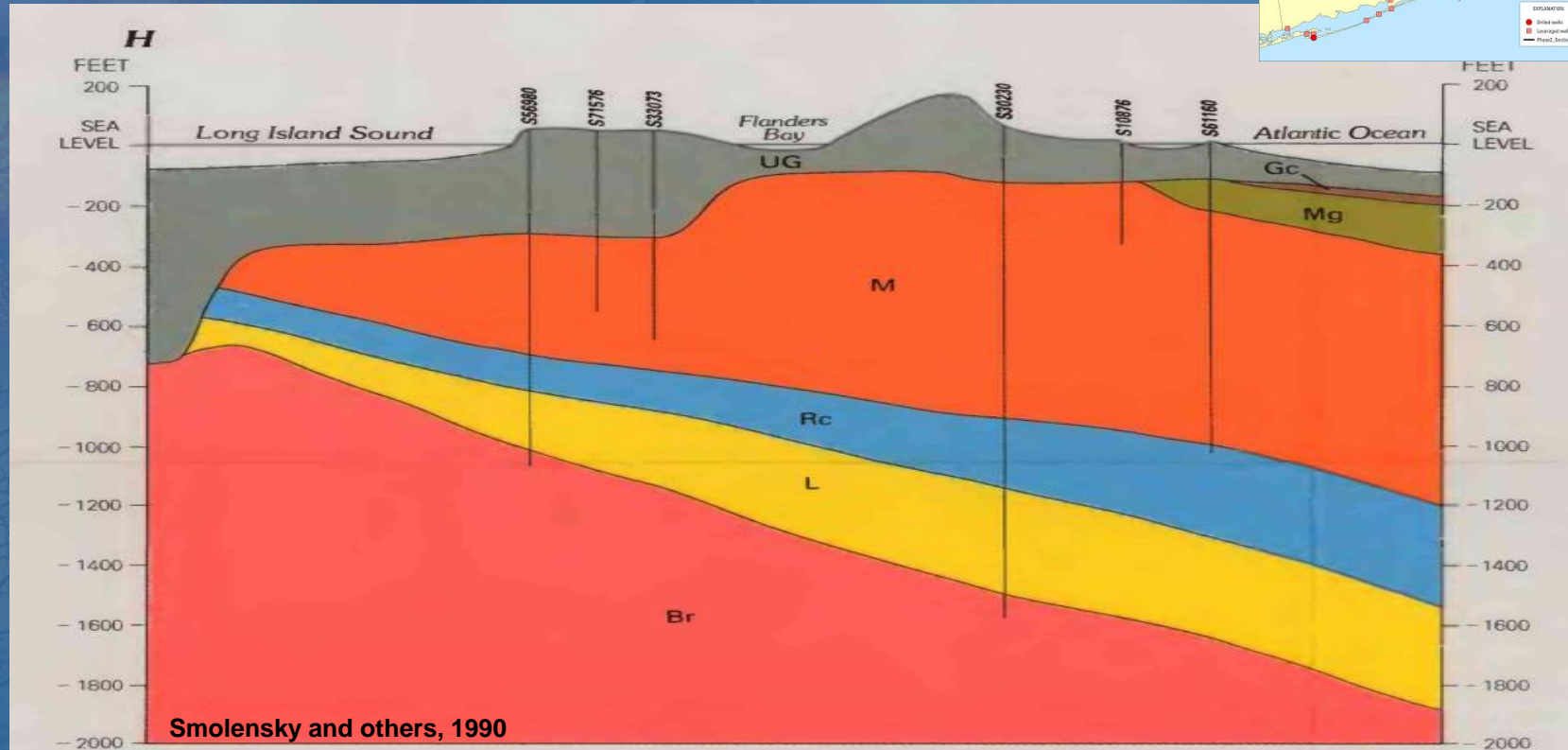


Lewis and Stone, 1991

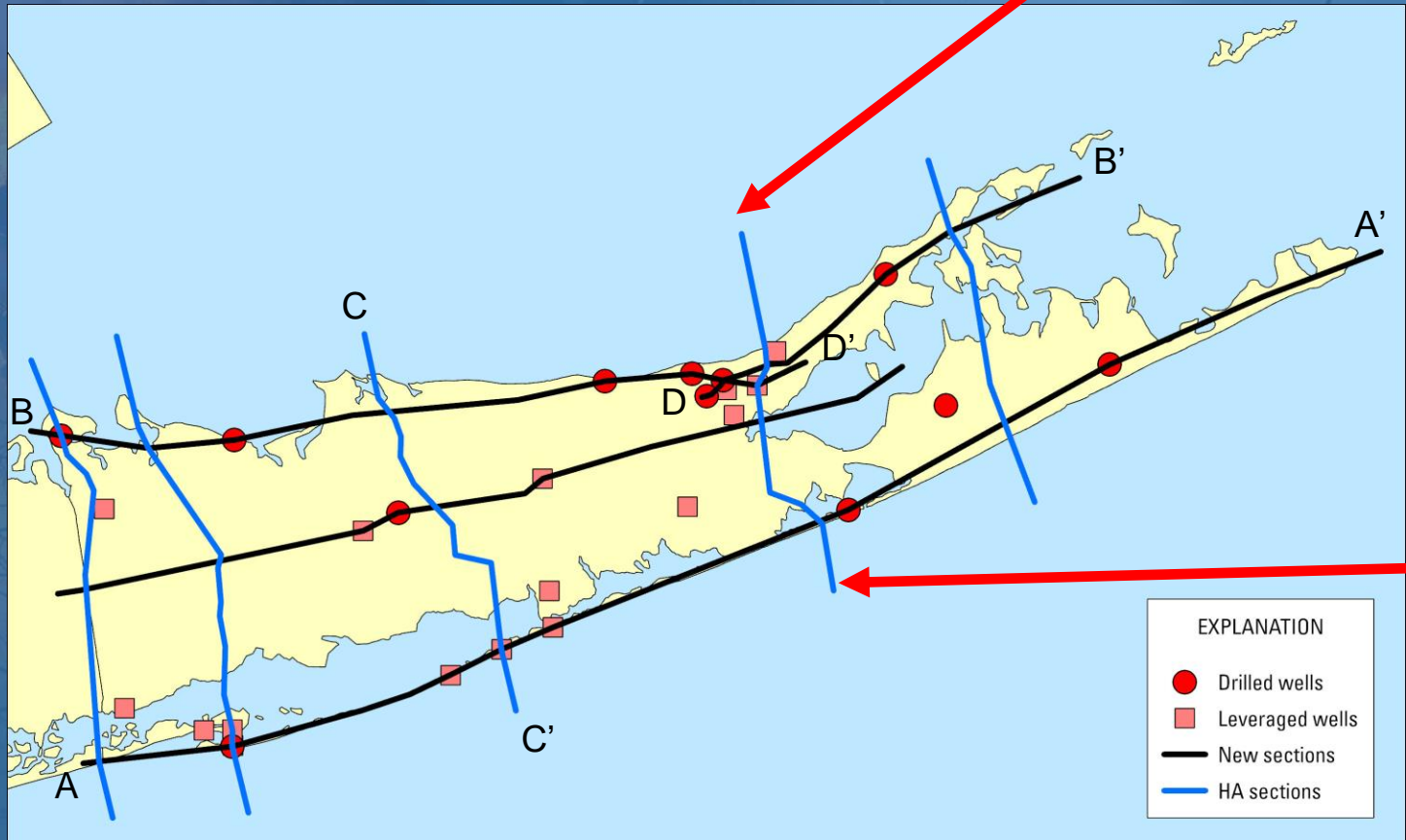
Section Line



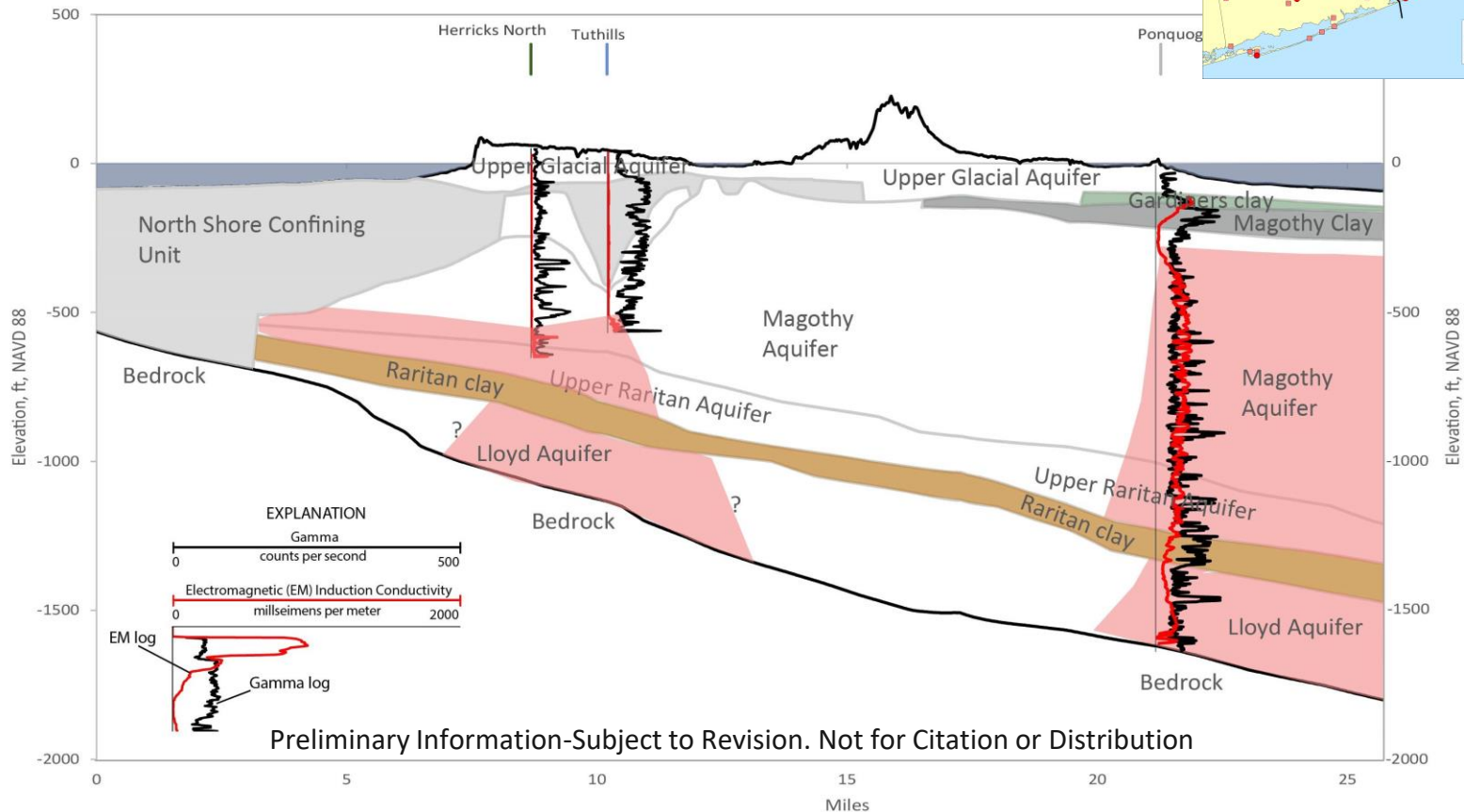
Section Line



Section Line

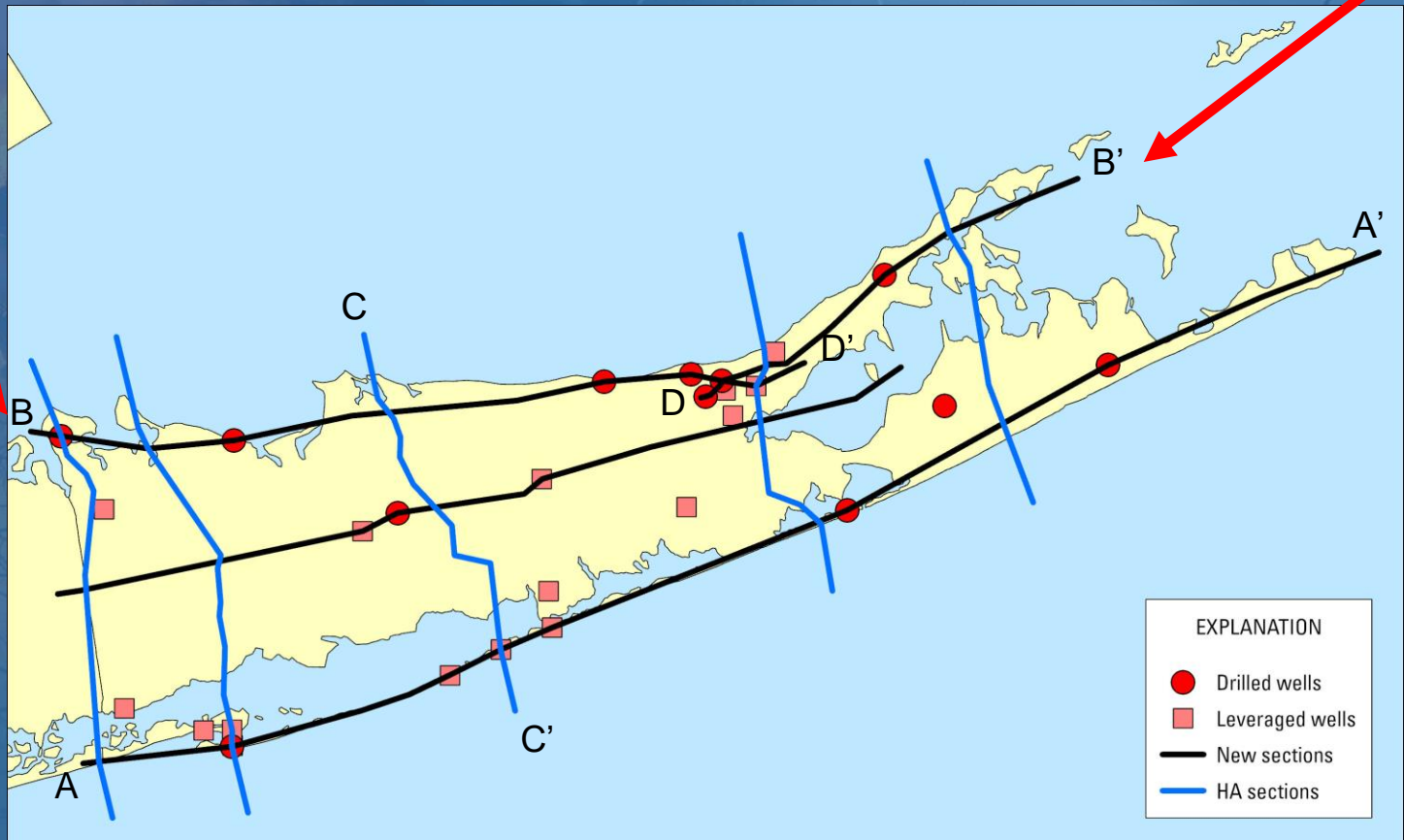


Section Line

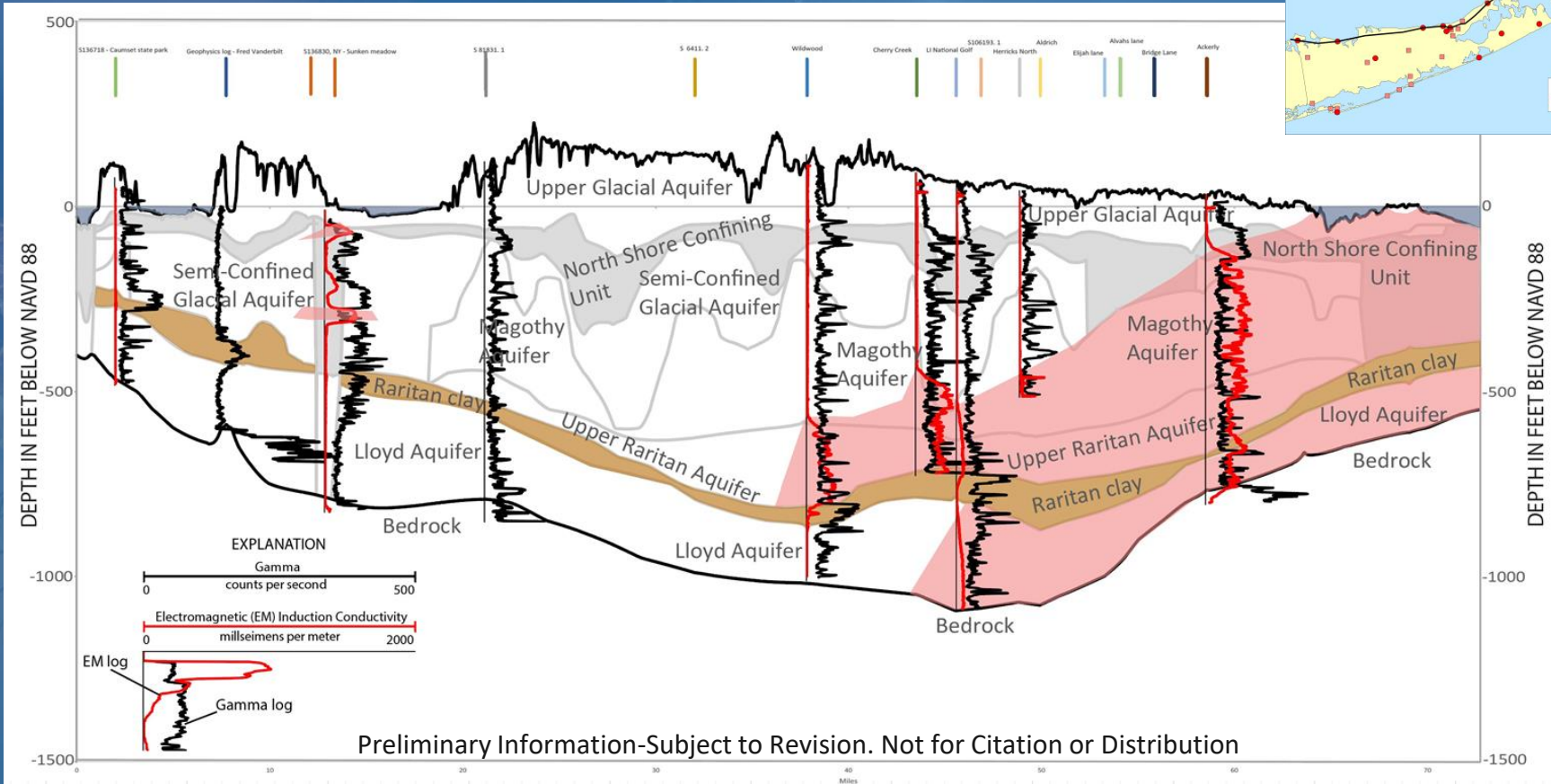


Preliminary Information-Subject to Revision. Not for Citation or Distribution

Section Line B to B'

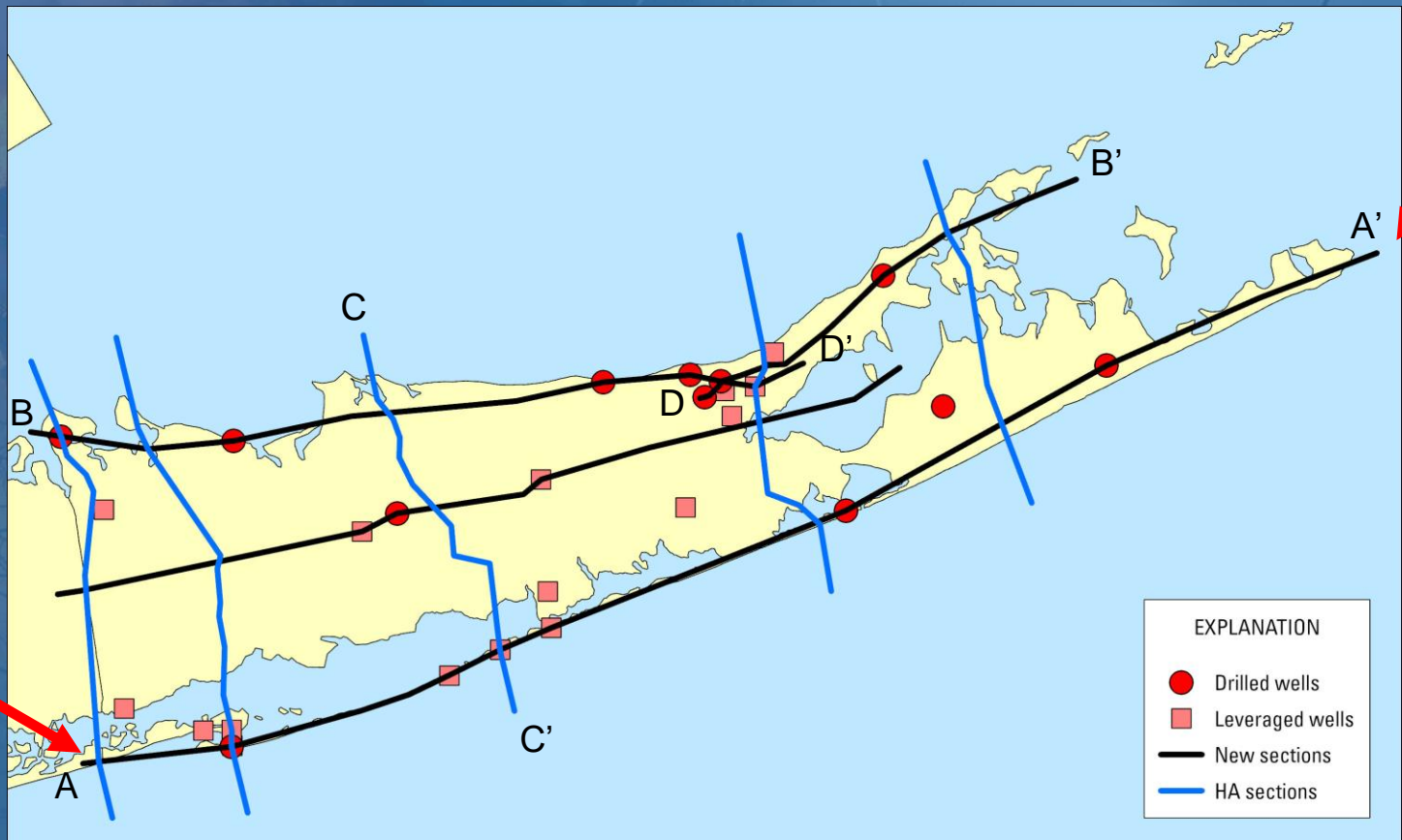


Section Line B to B'

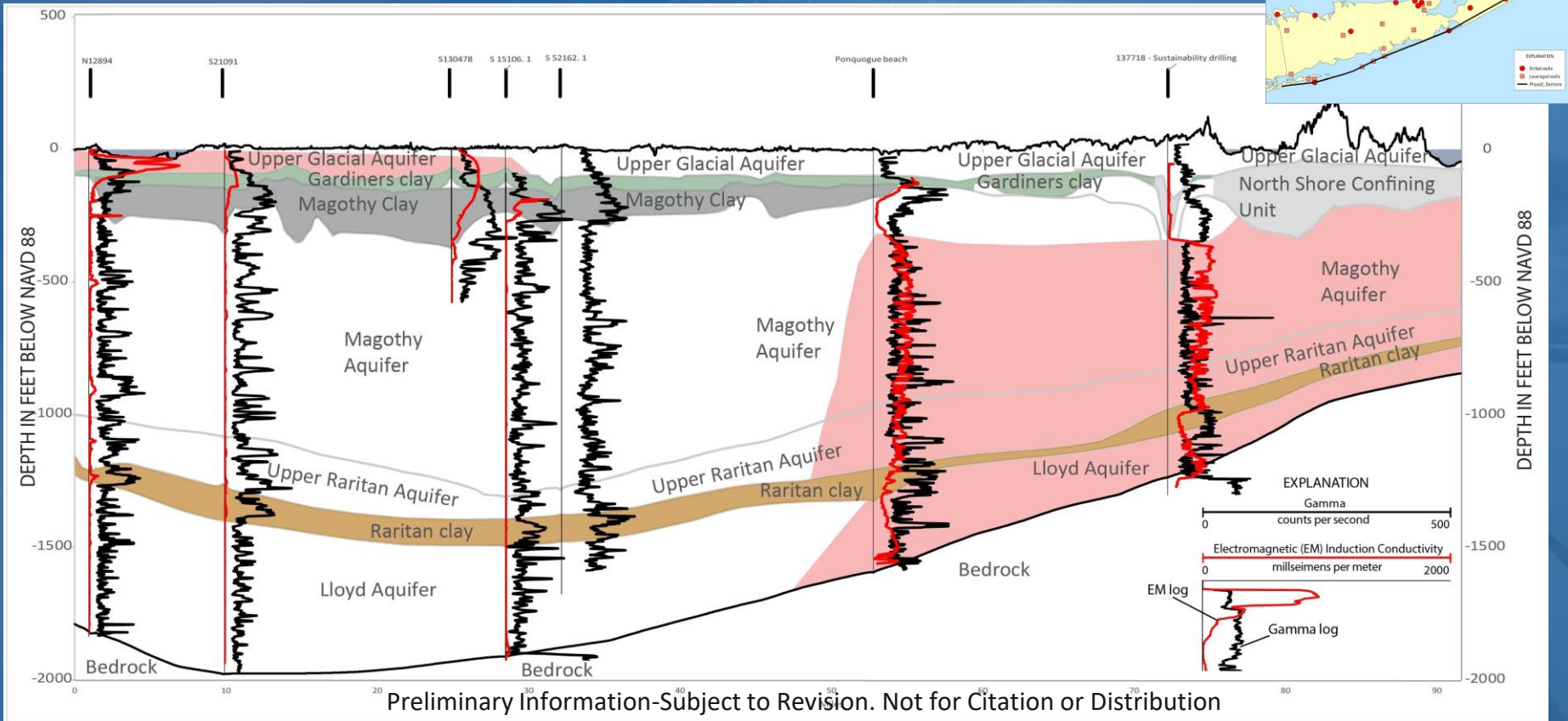


Preliminary Information-Subject to Revision. Not for Citation or Distribution

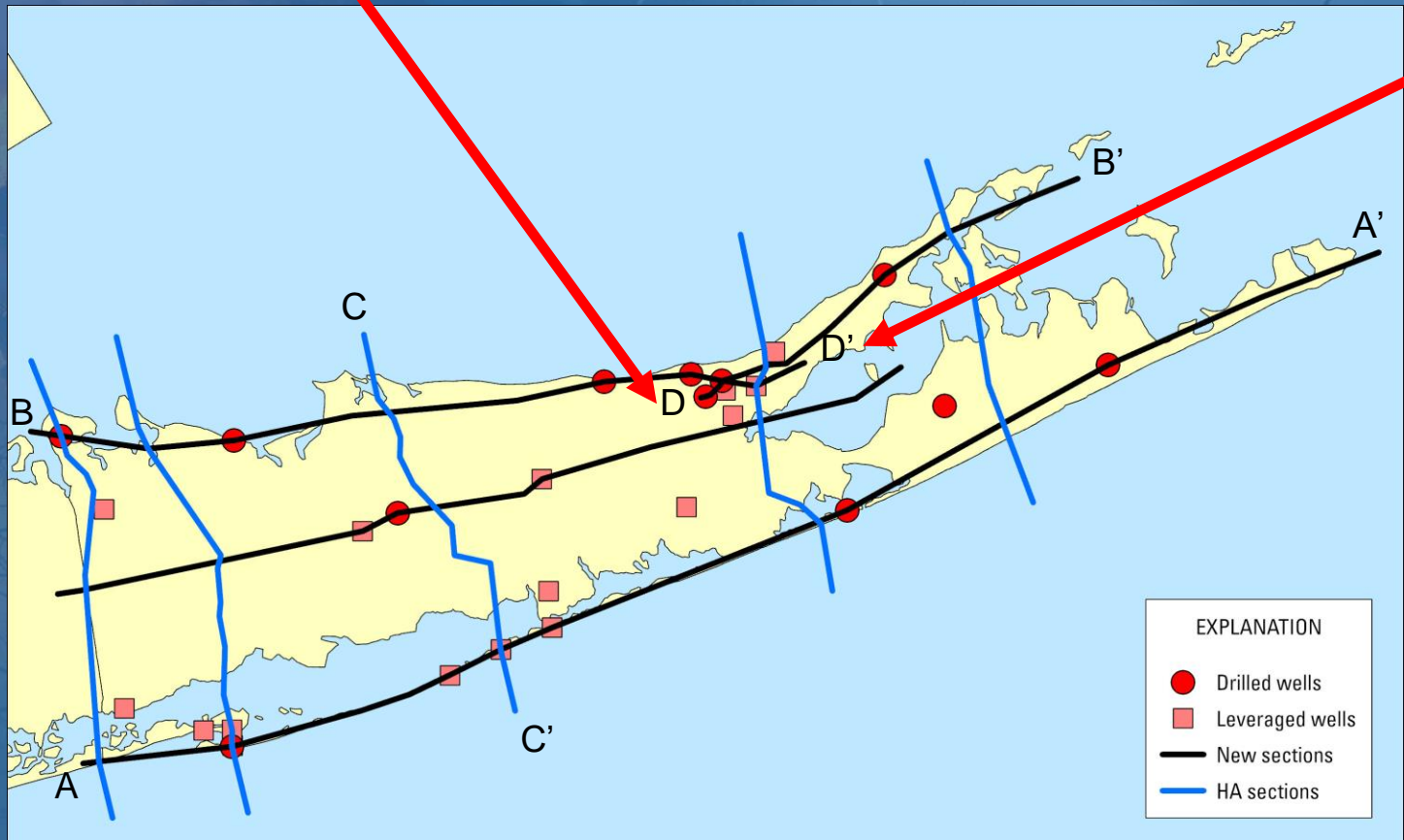
Section Line A to A'



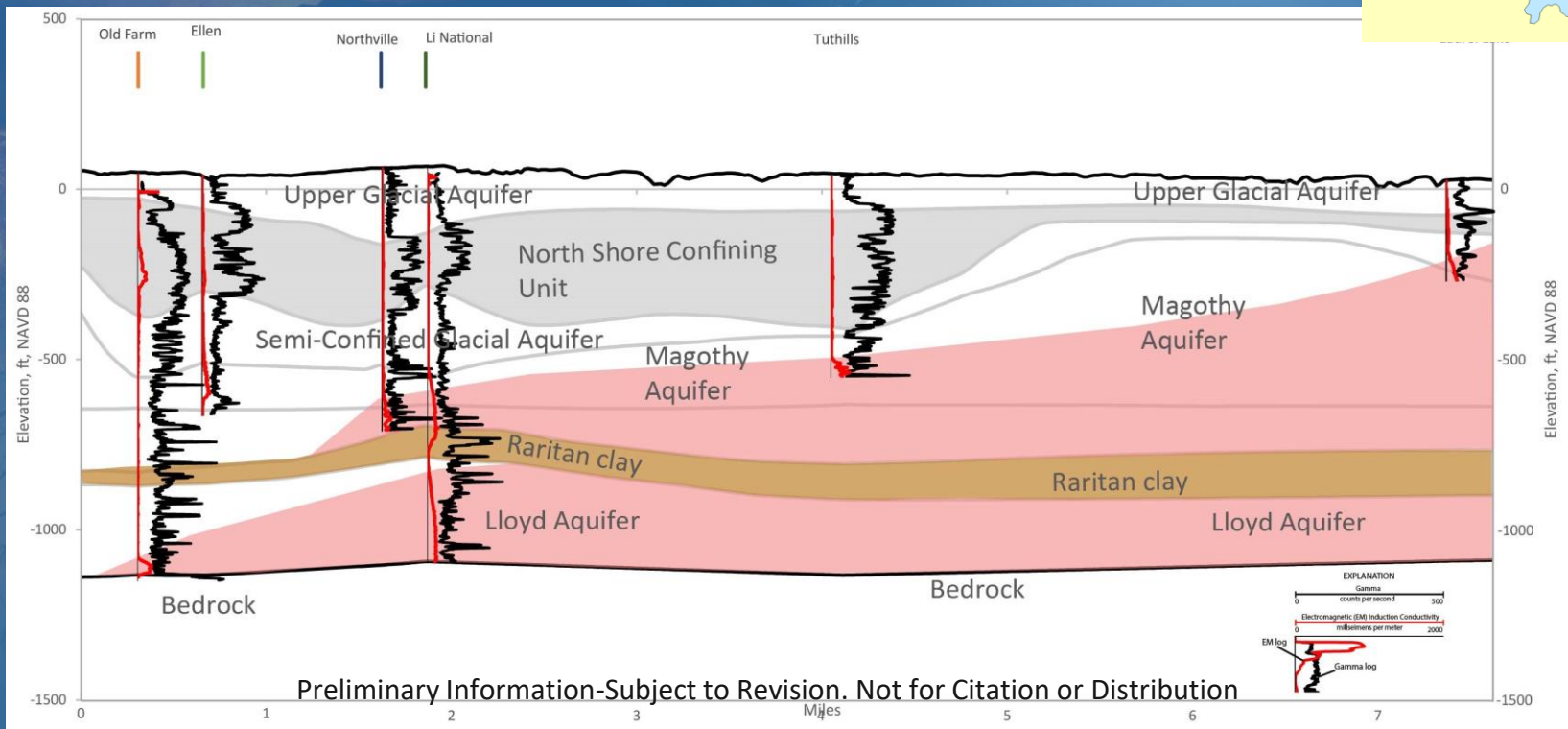
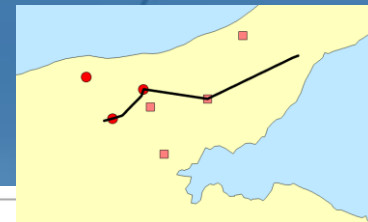
Section Line A to A'



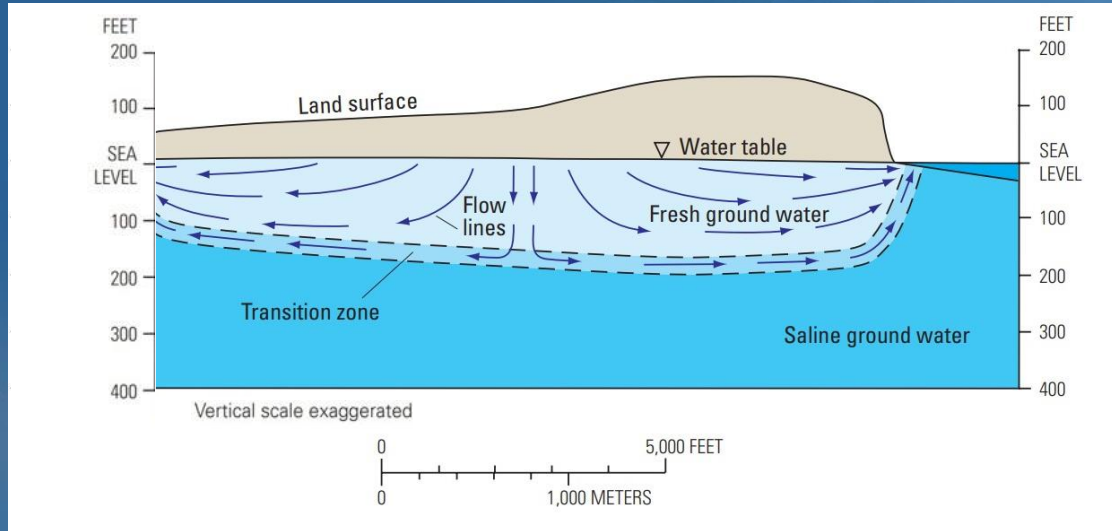
Section Line D to D'



Section Line D to D'



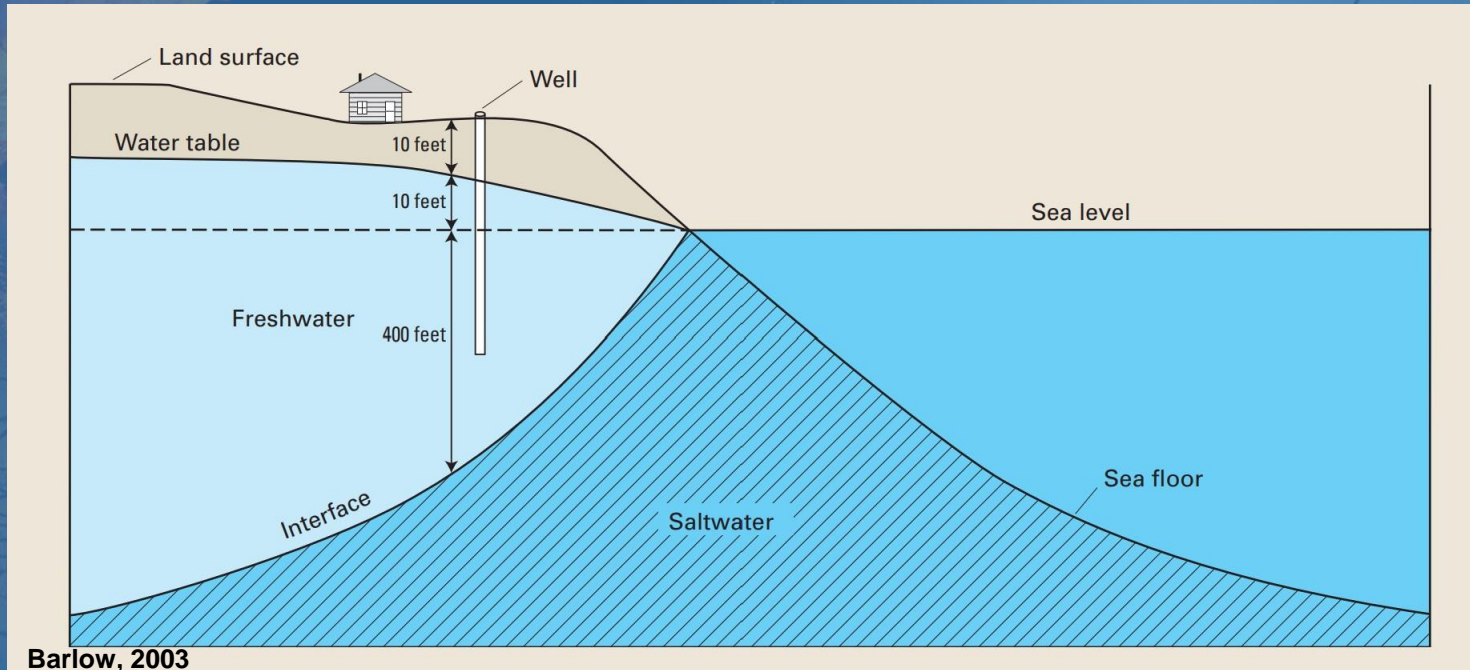
Freshwater-Saltwater Interface



Modified from LeBlanc and others, 1986

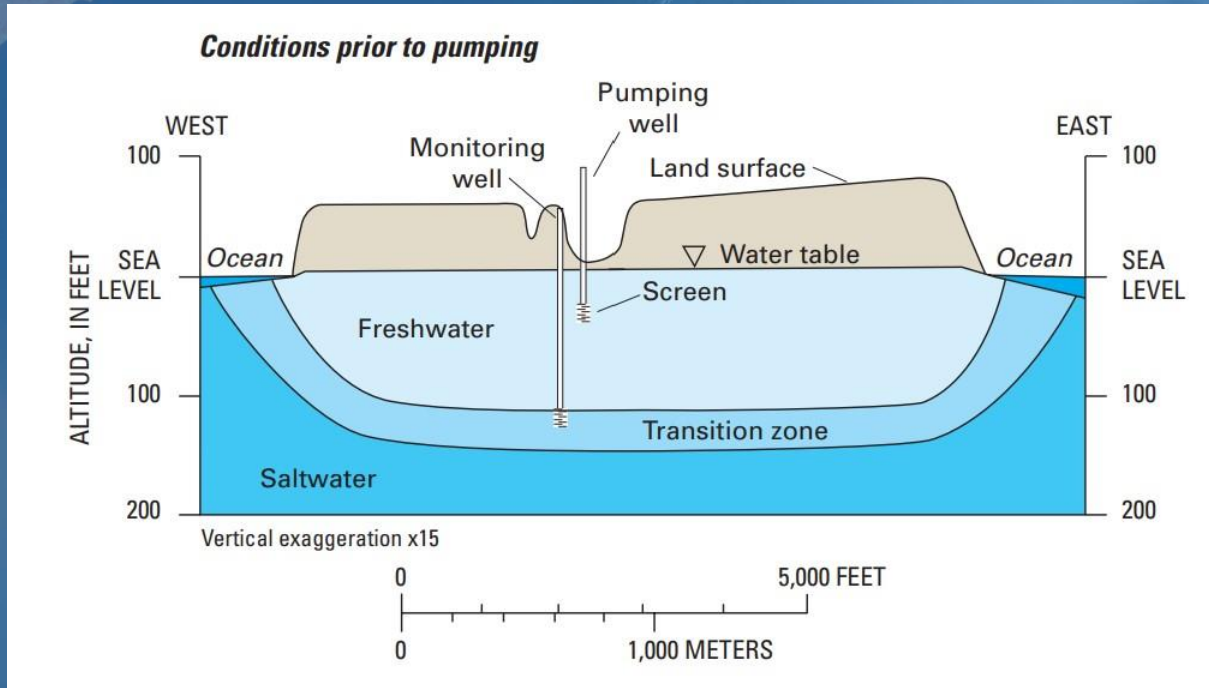
Results in a freshwater bubble

Freshwater-Saltwater Interface



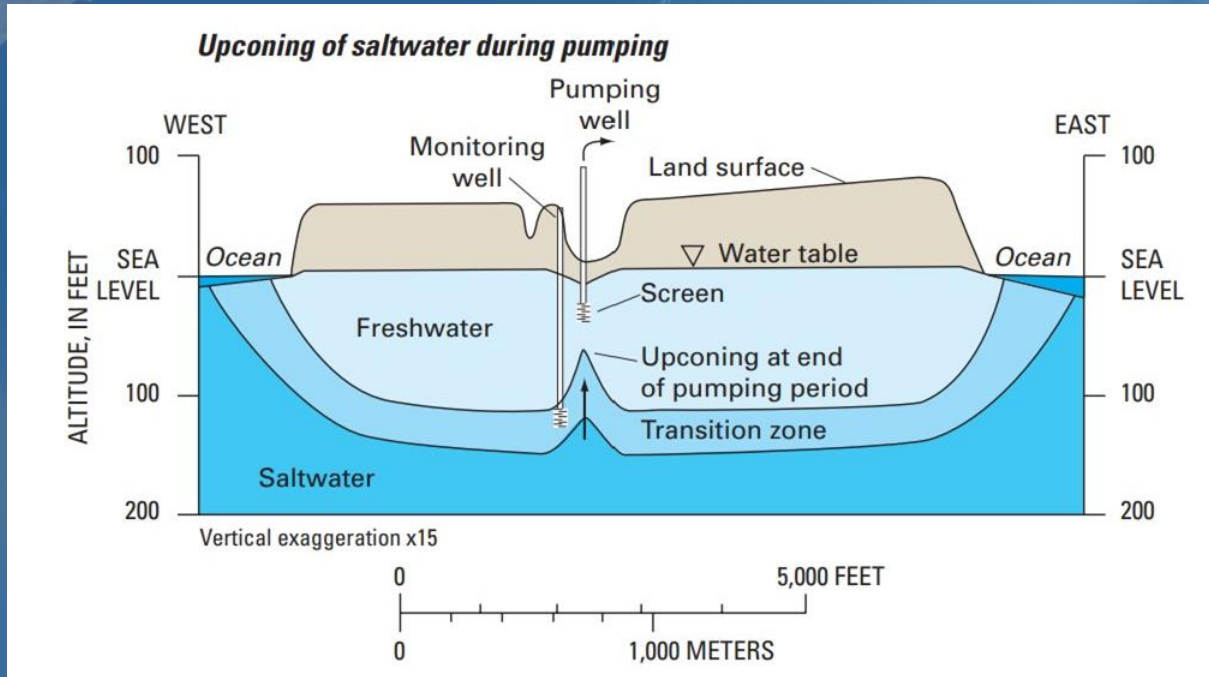
Ghyben-Herzberg Method (40 ft of freshwater below every 1 ft above sea level)

Saltwater Upconing



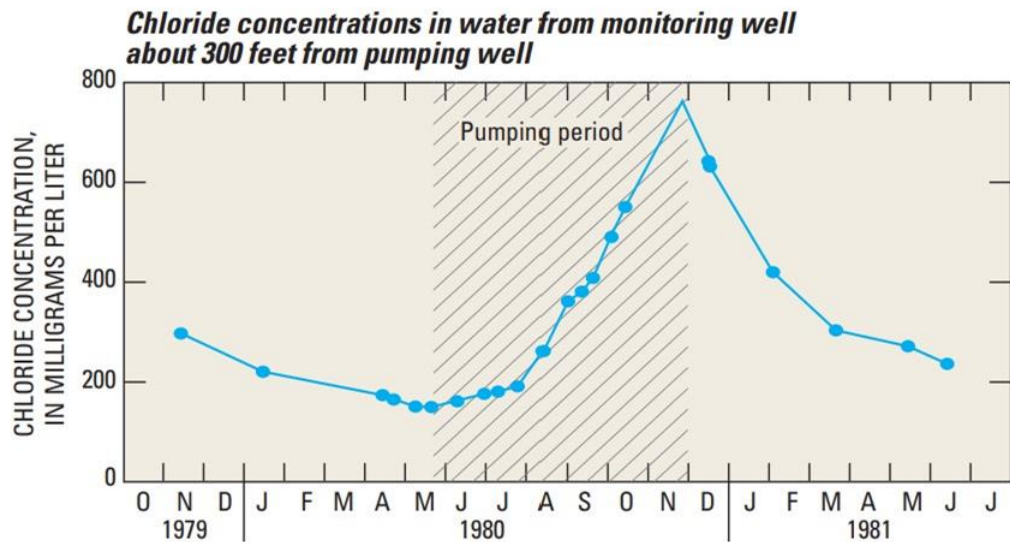
Modified from LeBlanc and others, 1986

Saltwater Upconing



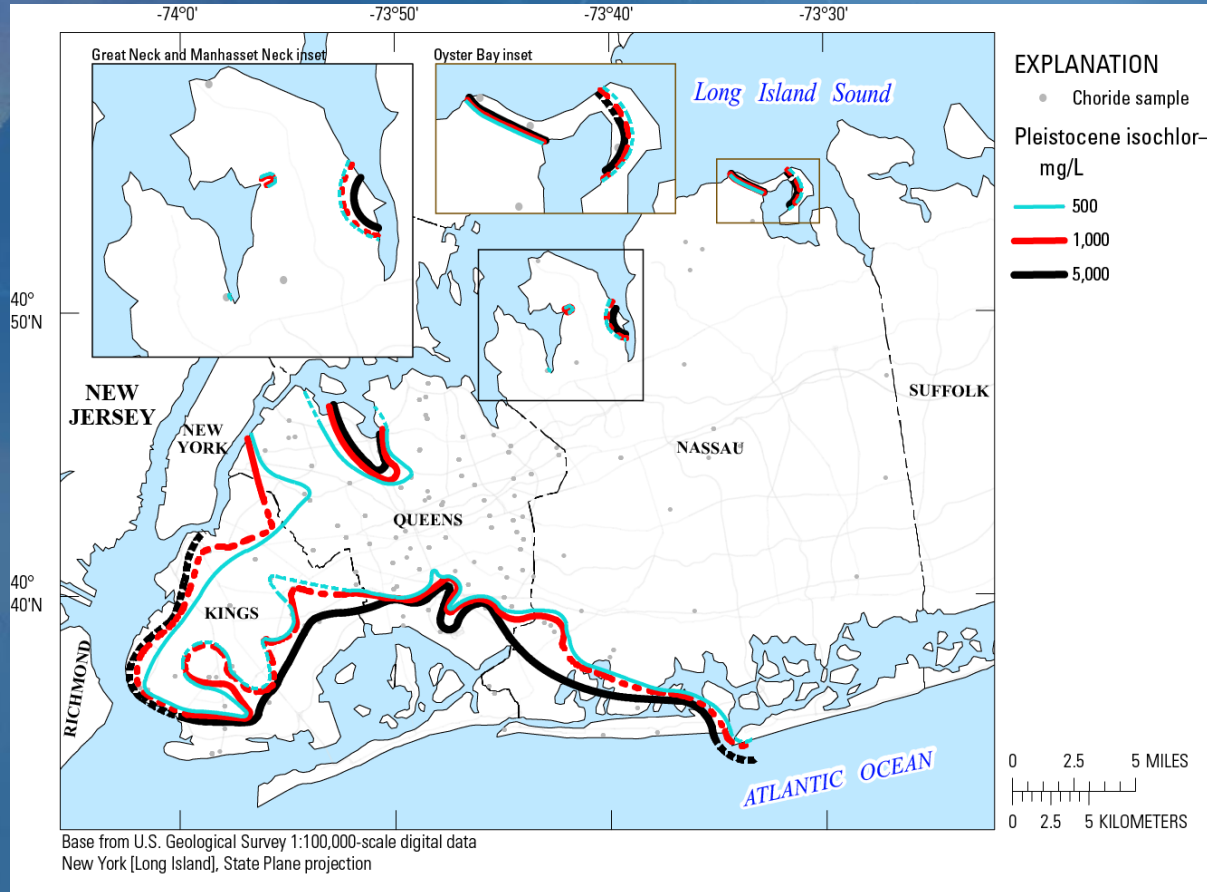
Modified from LeBlanc and others, 1986

Effects of Saltwater Upconing

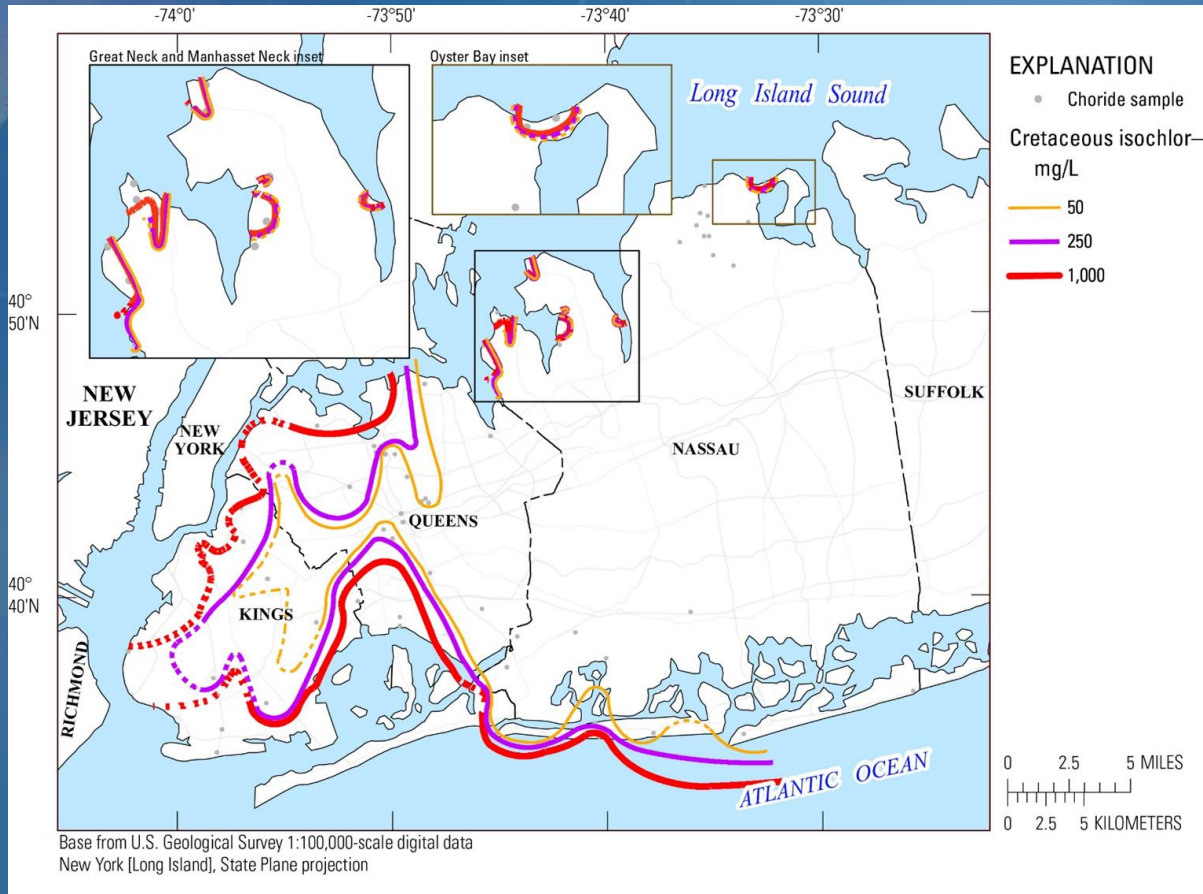


Figures modified from LeBlanc and others (1986)

Shallow Aquifer Saltwater Intrusion in Western LI



Deep Aquifer Saltwater Intrusion in Western LI



Borehole Geophysical Logging



Borehole Geophysical Logs

Gamma Log

Clay

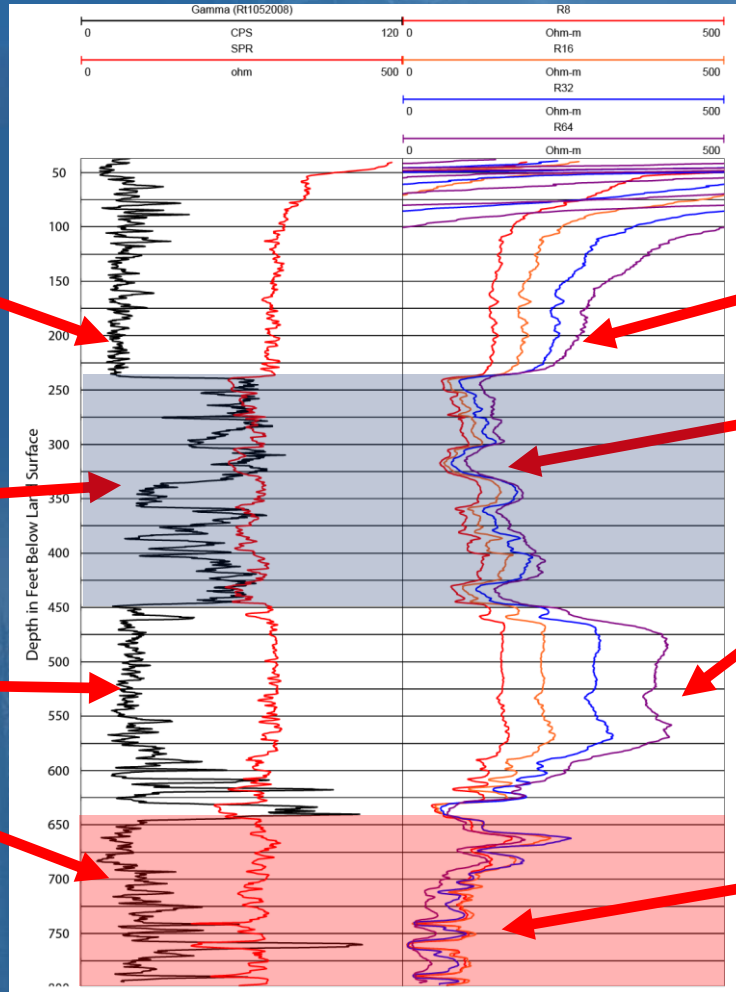
Sand (Aquifer)

Resistivity Logs

Clay (conductive)

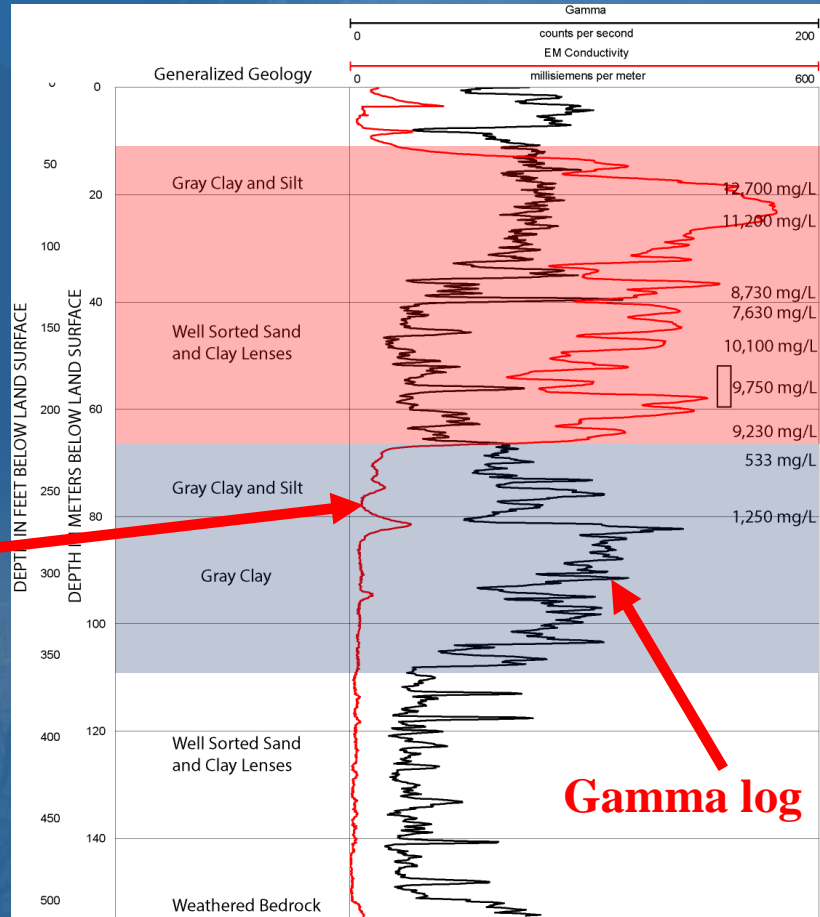
Freshwater (resistive)

Saltwater (conductive)



Monitoring Saltwater Intrusion Using EM Logs

EM log



Gamma log

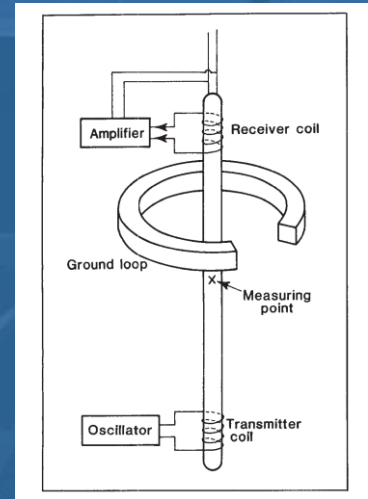
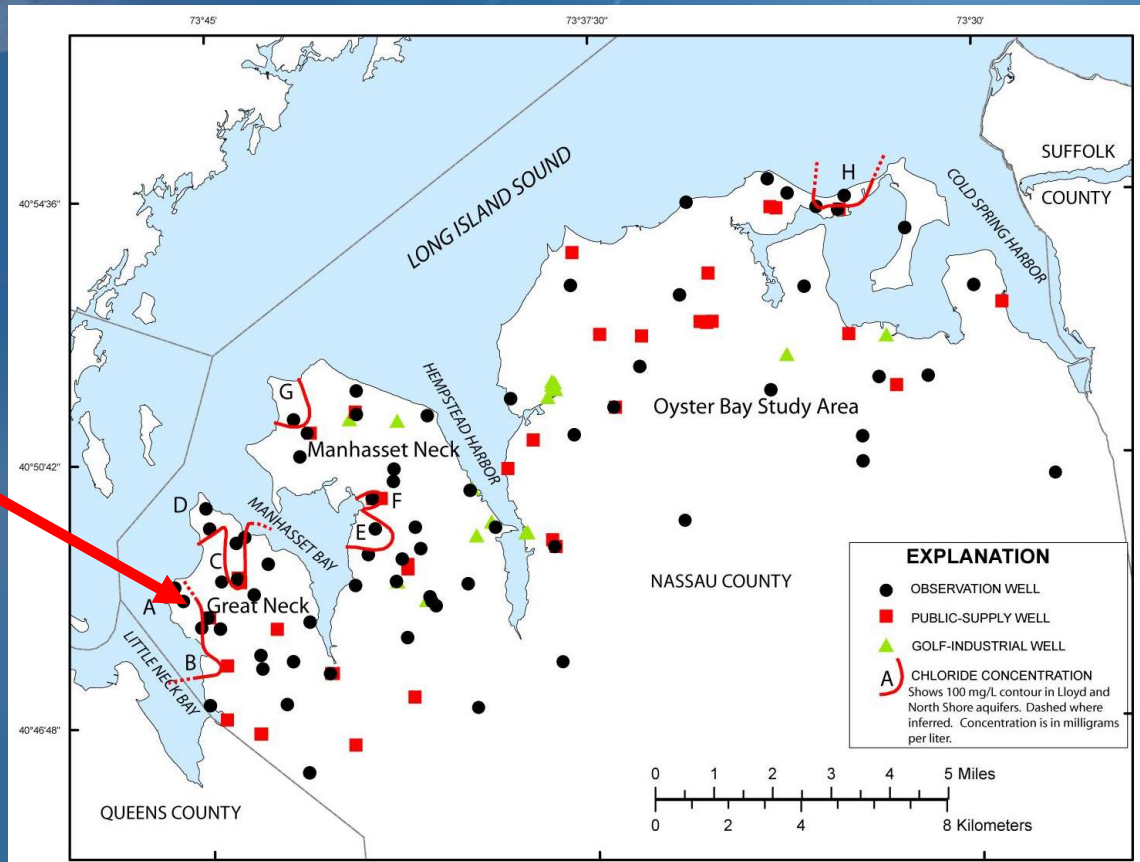
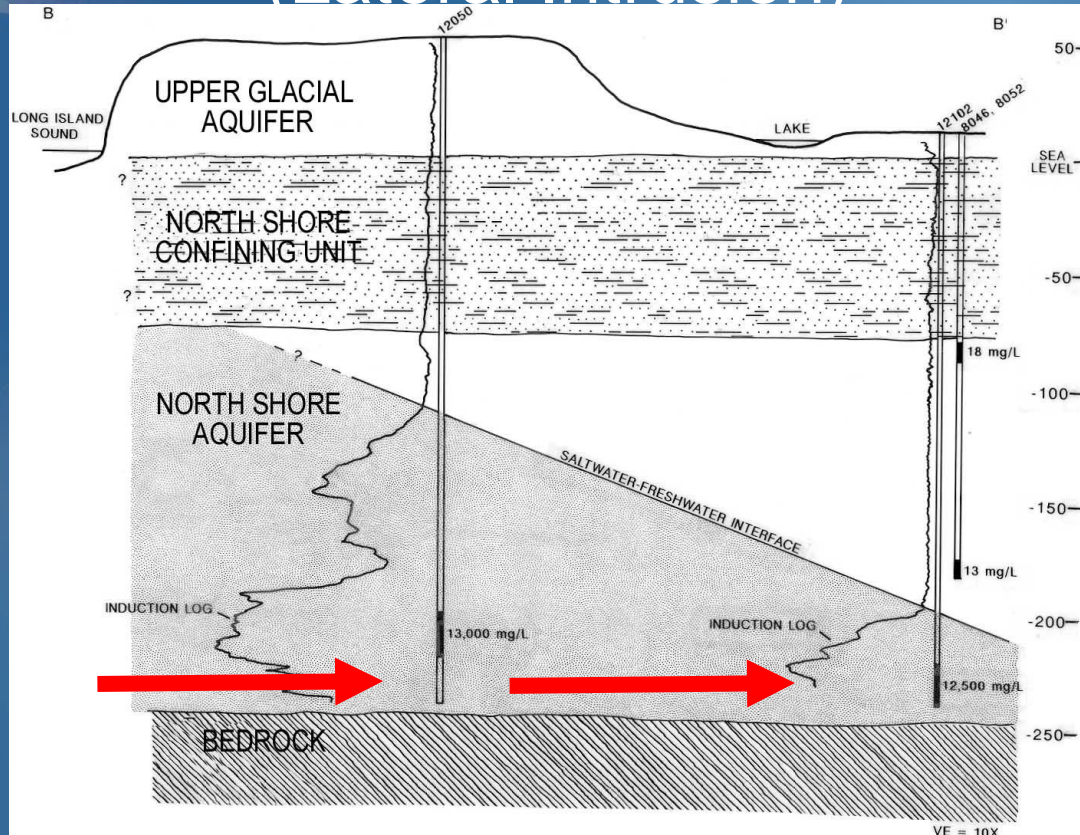


Figure 3. Generalized geology, natural gamma log, EM conductivity log, and chloride concentrations (milligrams per liter) in observation well N-12506 Long Island, NY. (Location shown in figure 2)

Saltwater Intrusion Monitoring Well



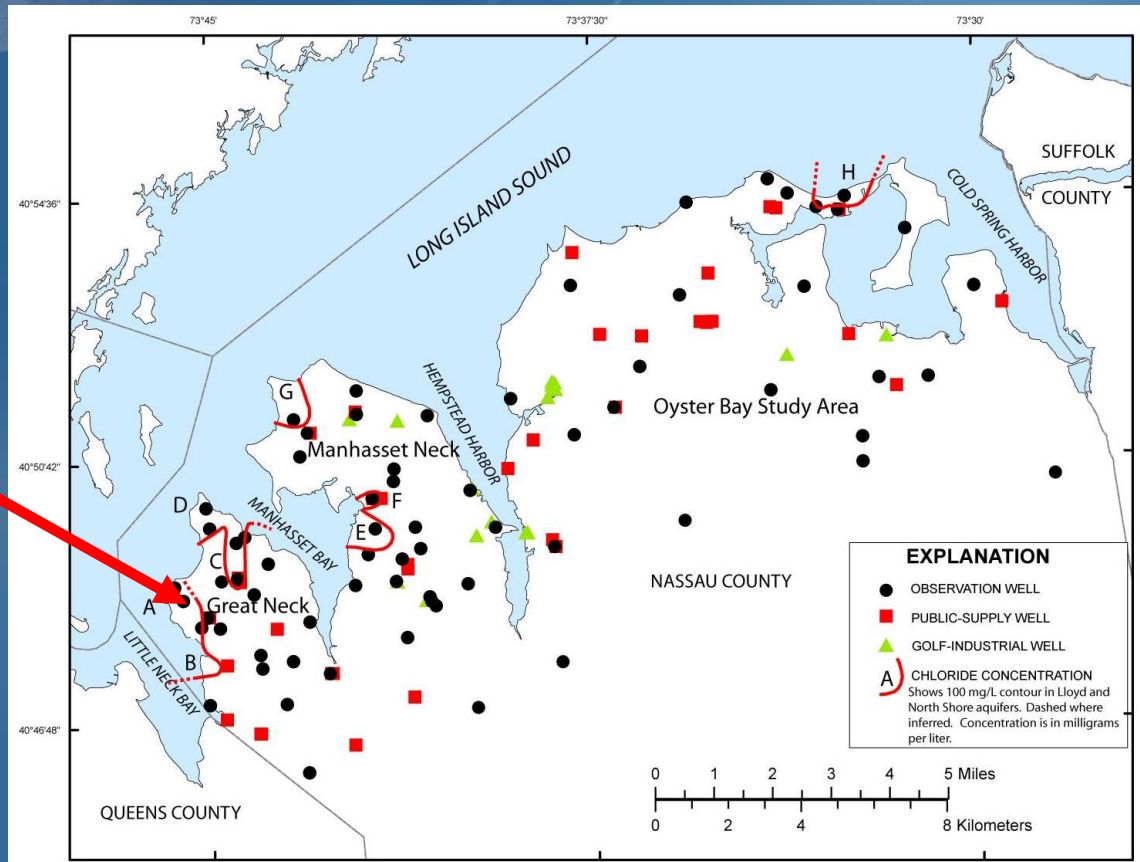
Cross Section of a Saltwater Wedge (Lateral Intrusion)



Long
Island
Sound

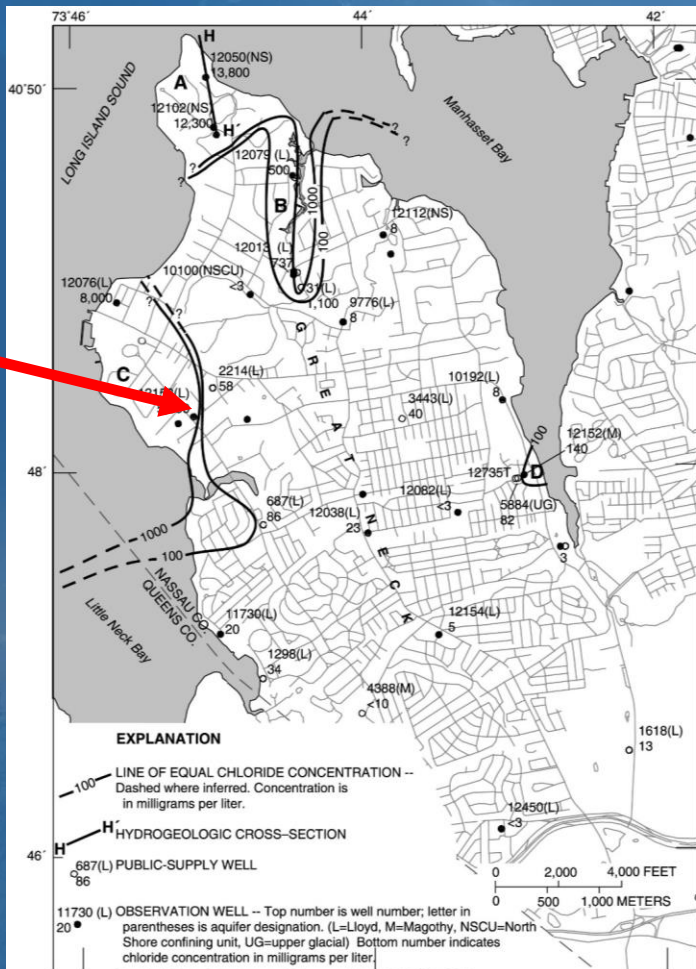
Public
Supply
Wells

Saltwater Intrusion Monitoring Well

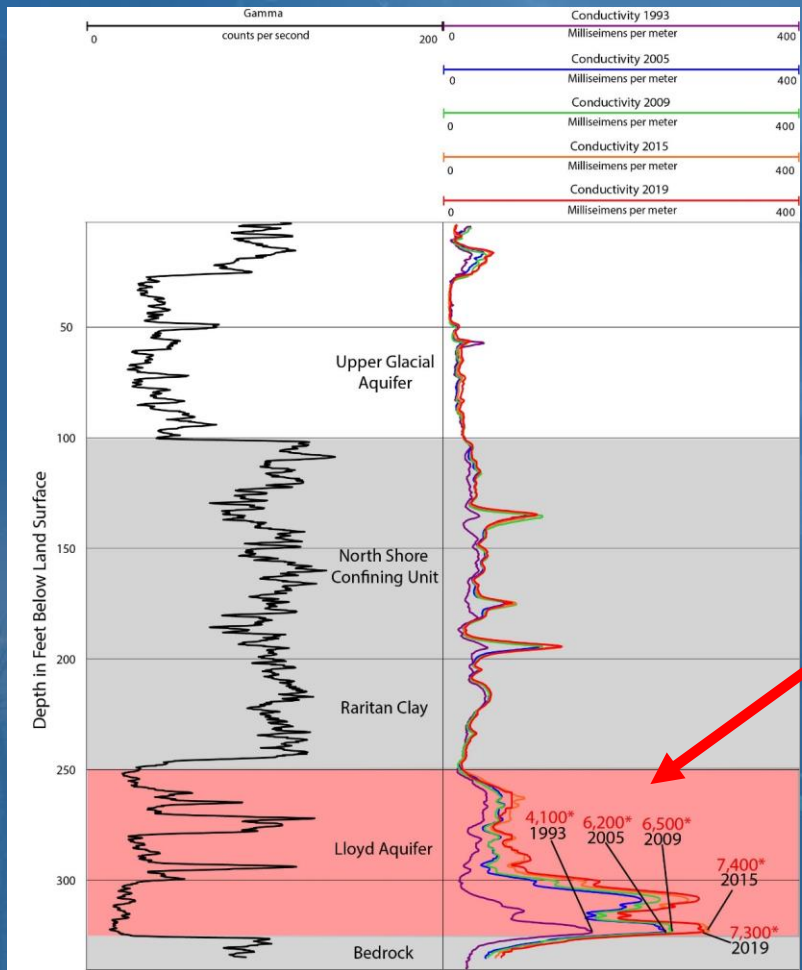


Saltwater Intrusion Monitoring Well N-12153.1

Delineation and Monitoring of Saltwater Intrusion in Outpost Wells Using EM Logs



Saltwater Intrusion Monitoring Well N-12153.1



Saltwater Wedge

Surface Geophysical Methods

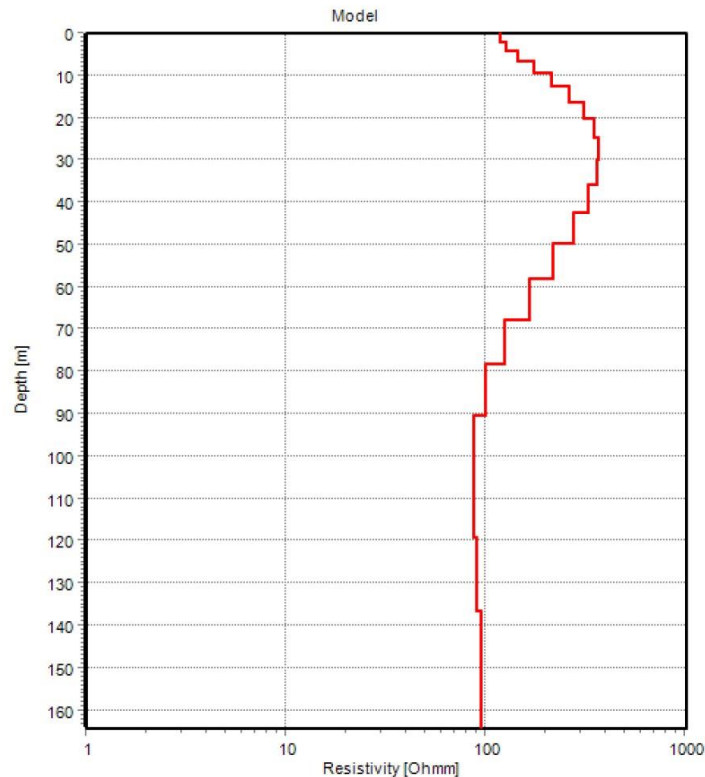
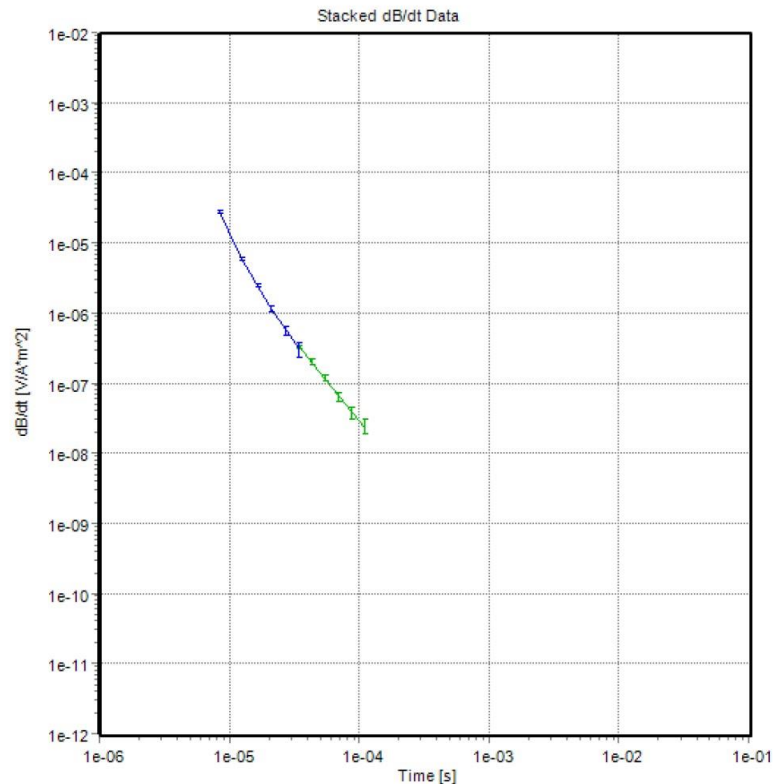


Time Domain Electromagnetic Method

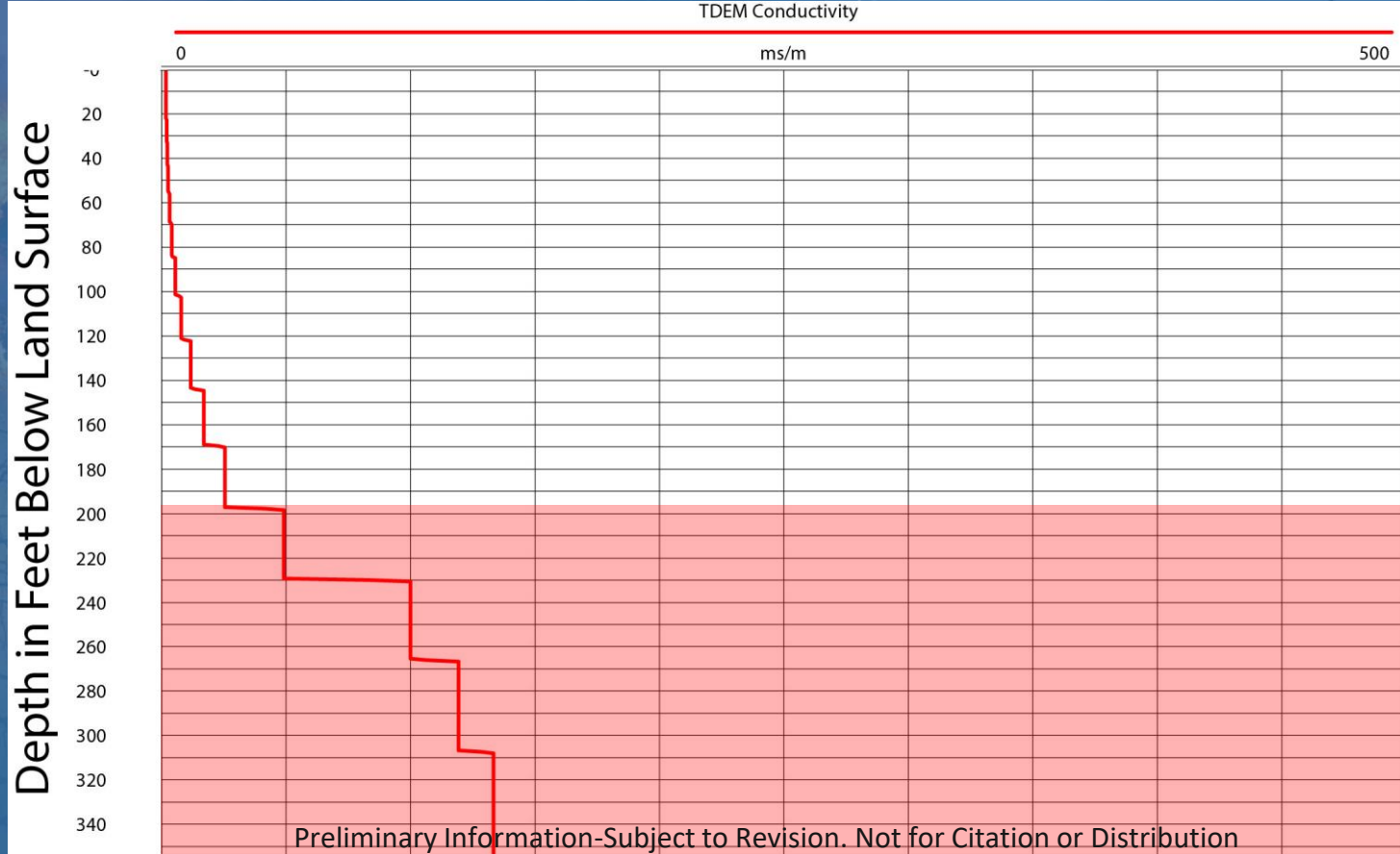


- Current sent through 20 to 100m square wire. Larger square deeper data.
- Generates primary EM field induces eddy currents into subsurface
- Eddy currents produce secondary EM field propagate downward/outward
- Depth is determined by inversion of time of Rx measurement during Tx off time

TDEM 20 Layer Resistivity Model

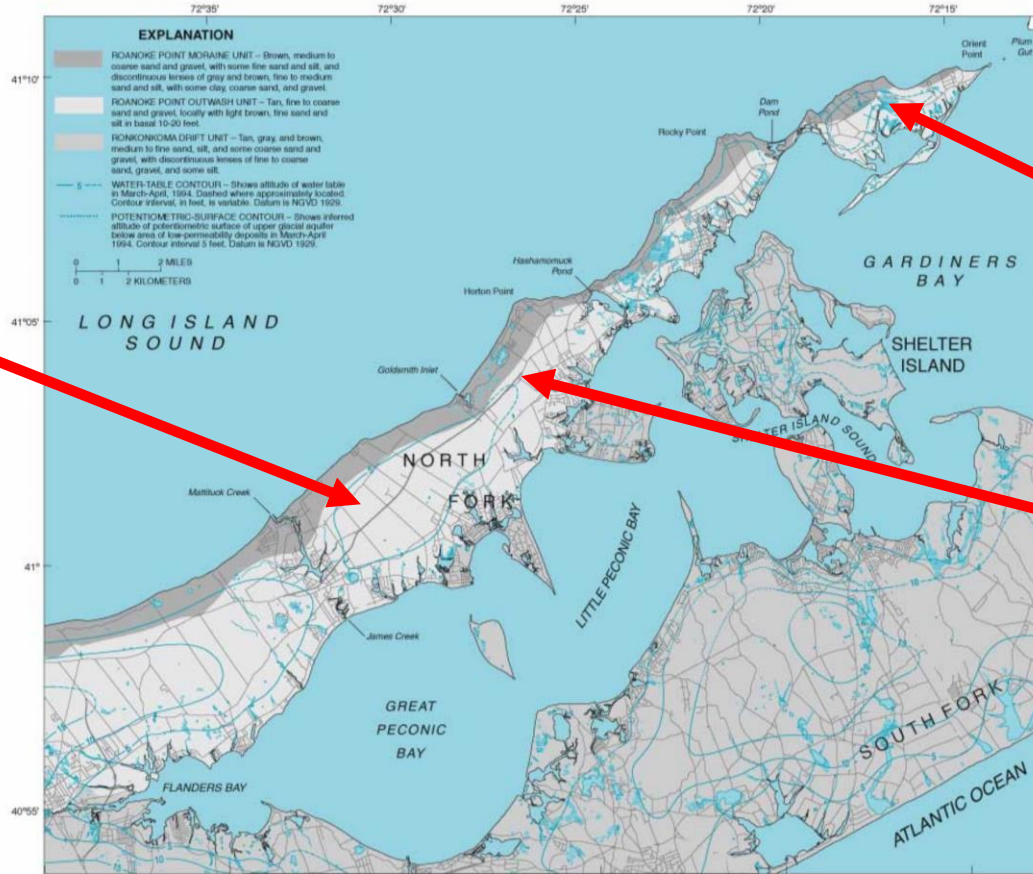


TDEM Conductivity Model

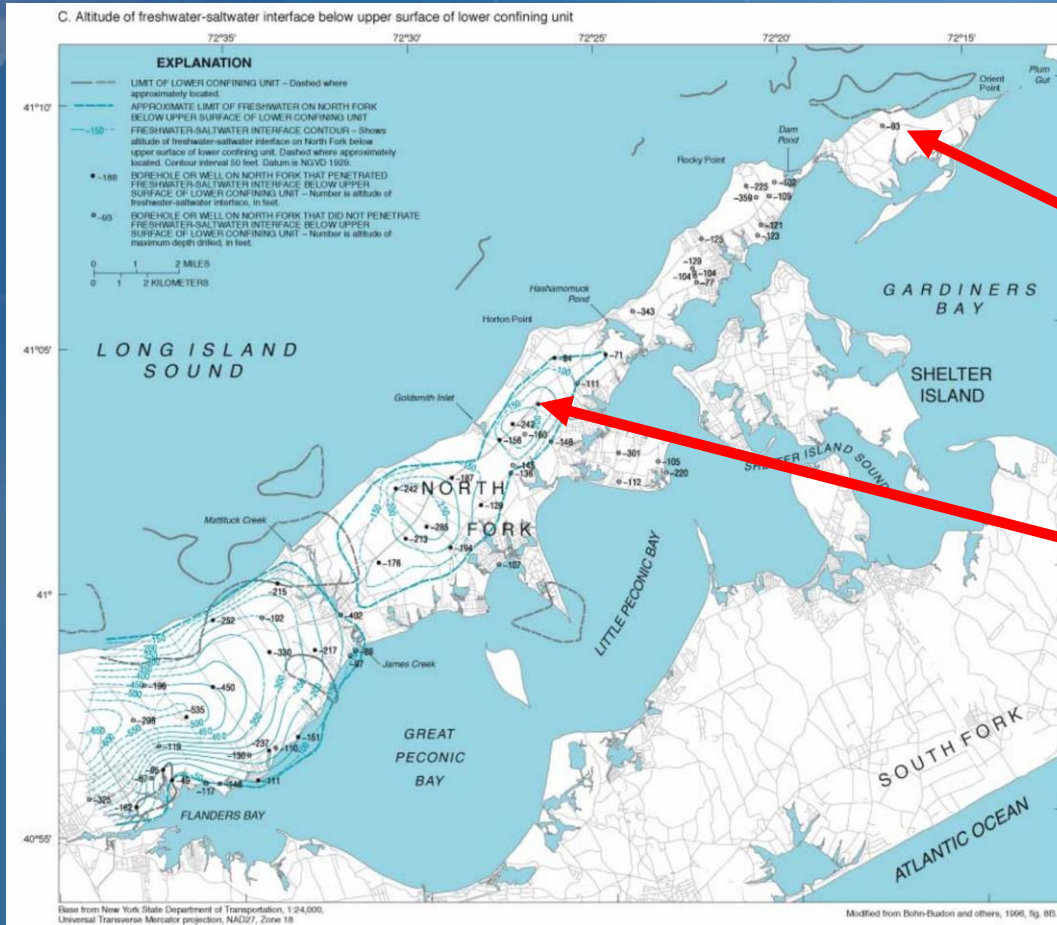


Elevation of the Water-Table

A. Surficial hydrogeologic units and water-table altitude in March-April 1994

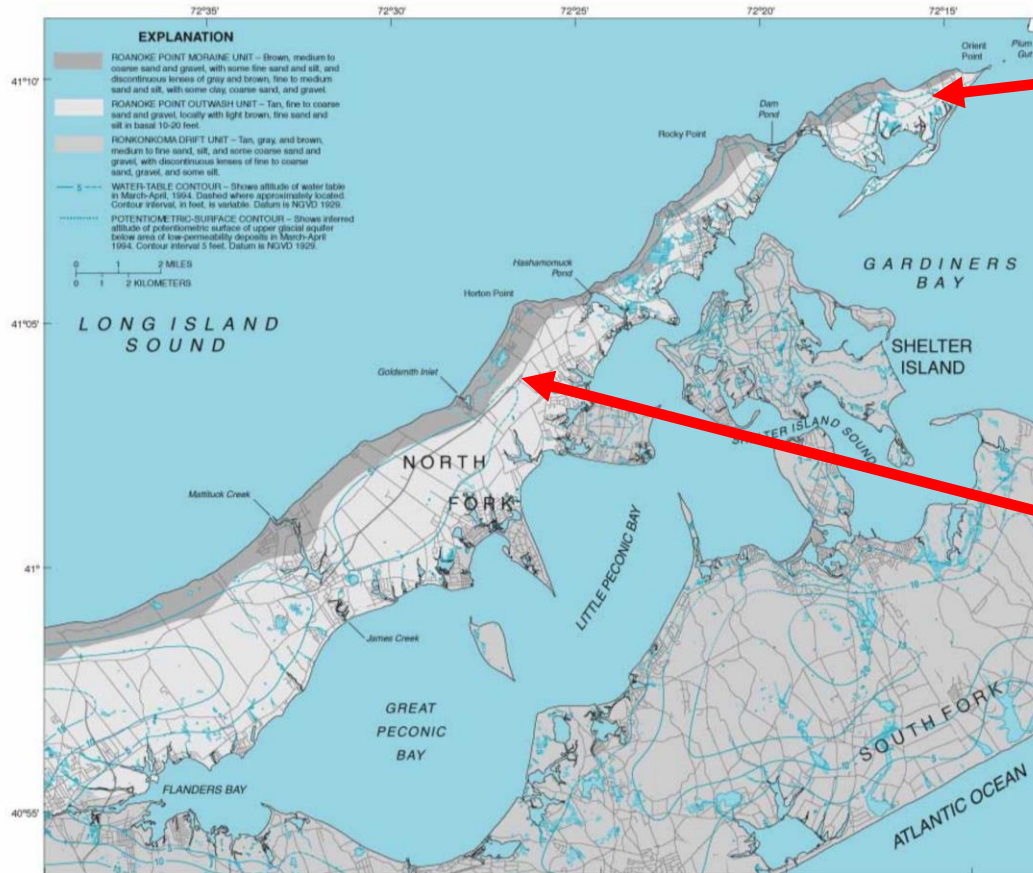


Elevation of the Saltwater Interface



Elevation of the Water-Table

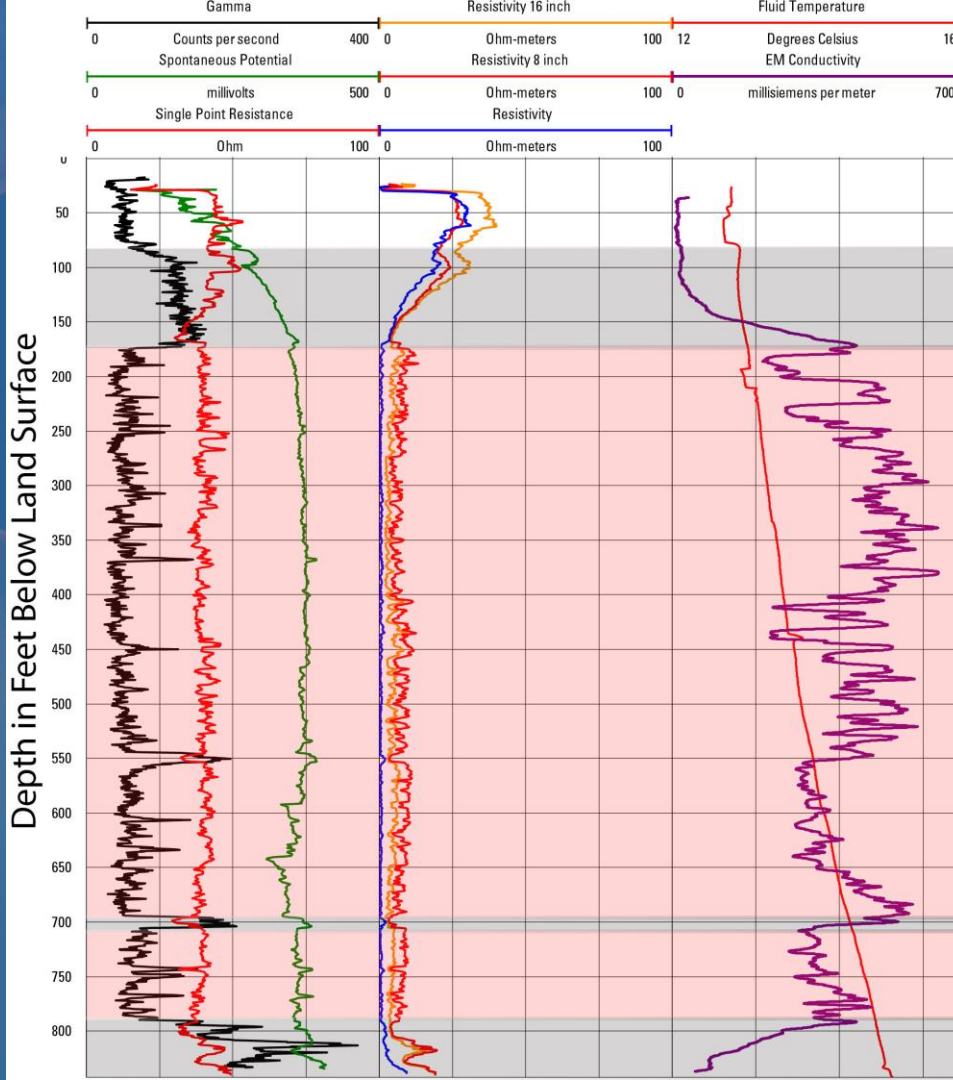
A. Surficial hydrogeologic units and water-table altitude in March-April 1994



4 feet above sea level

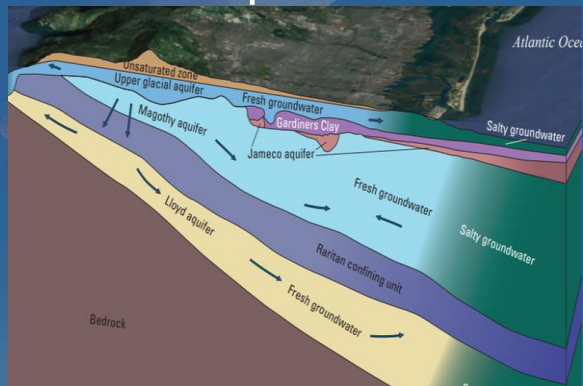
4 feet above sea level

S138119.1 Ackerly Test Well

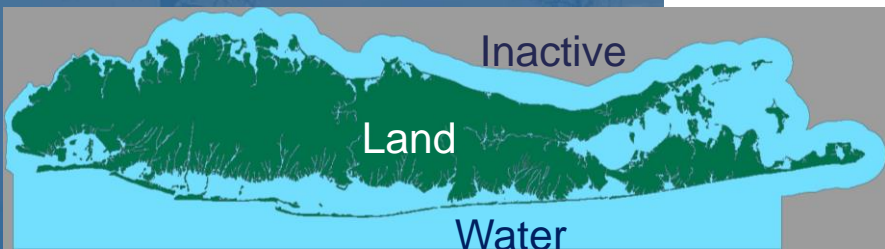


Development of Regional Model for 1900-2019

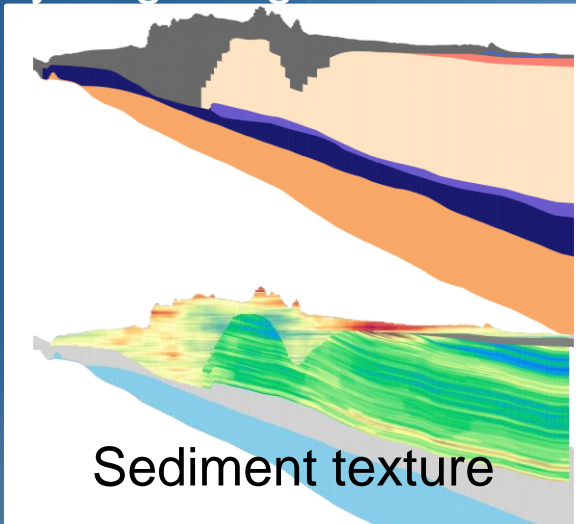
Conceptual model



Model Grid Extent

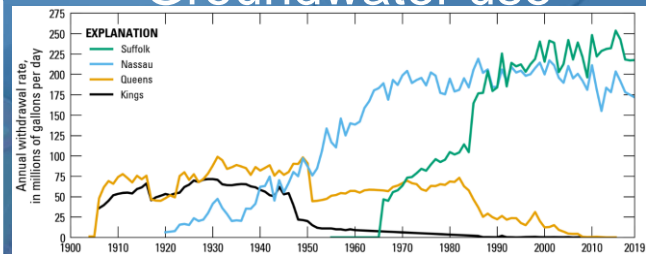


Hydrogeologic Framework



Sediment texture

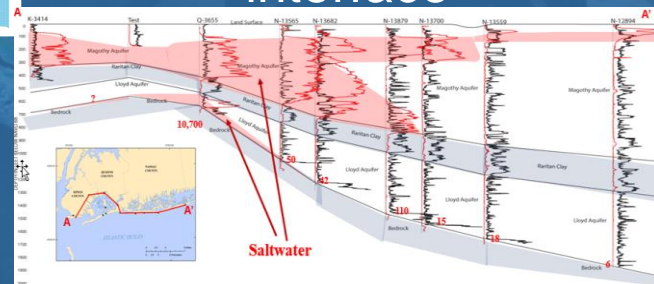
Groundwater use



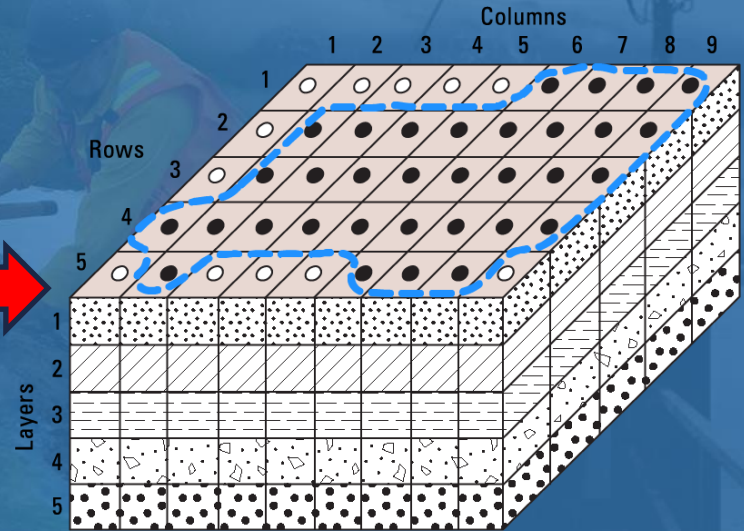
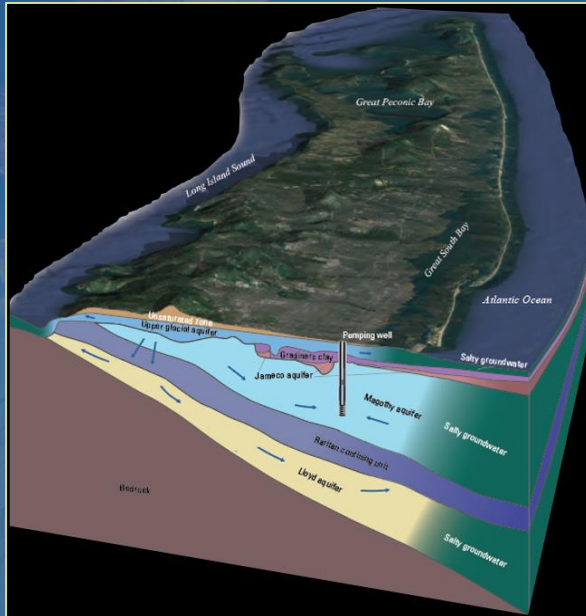
Groundwater recharge



Freshwater-saltwater interface



Groundwater Flow Model: MODFLOW

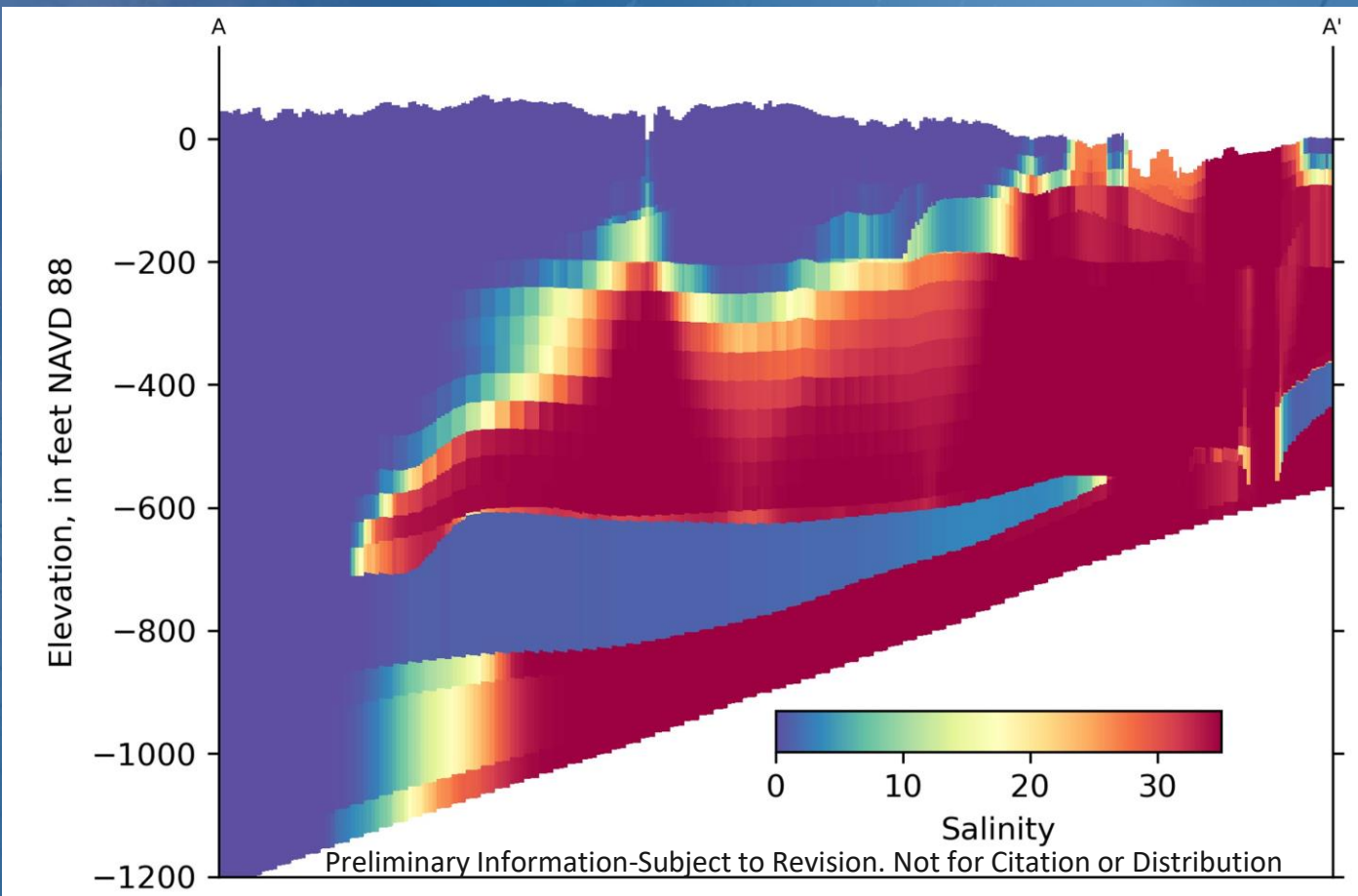


LI Regional Model:
348 rows, 1309 columns, 20 layers
Total model cells: 9,110,640



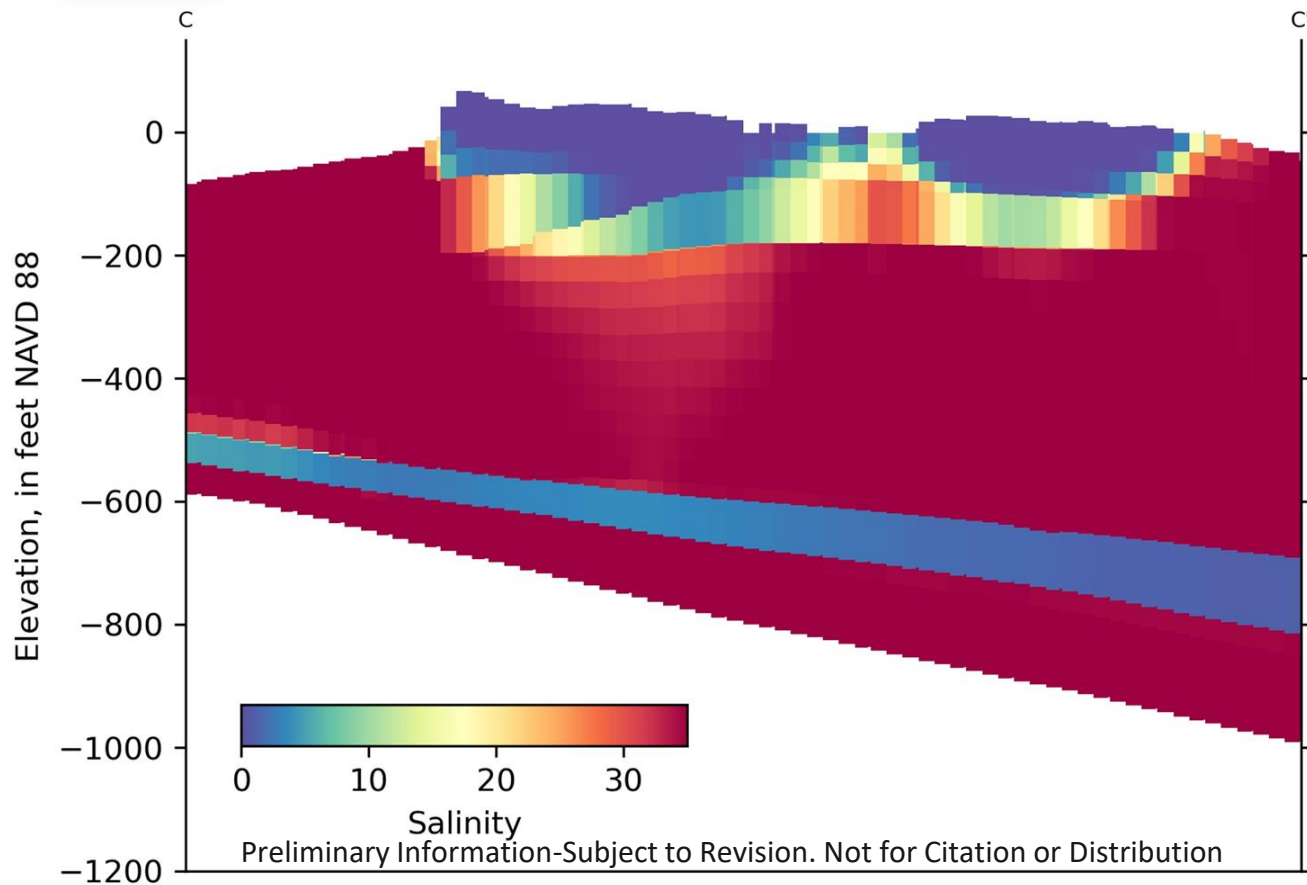
letter
A
B
C

Salinity Model Section A to A'





Salinity Model Section C to C'

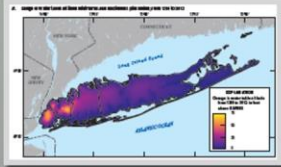
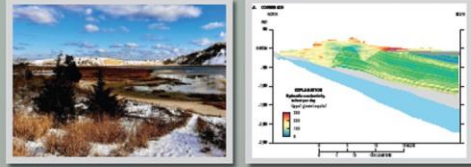


Interactive Results Viewer



Prepared in cooperation with the New York State Department of Environmental Conservation

Simulation of Groundwater Flow in the Long Island, New York Regional Aquifer System for Pumping and Recharge Conditions From 1900 To 2019



Scientific Investigations Report 2024–5044

U.S. Department of the Interior
U.S. Geological Survey

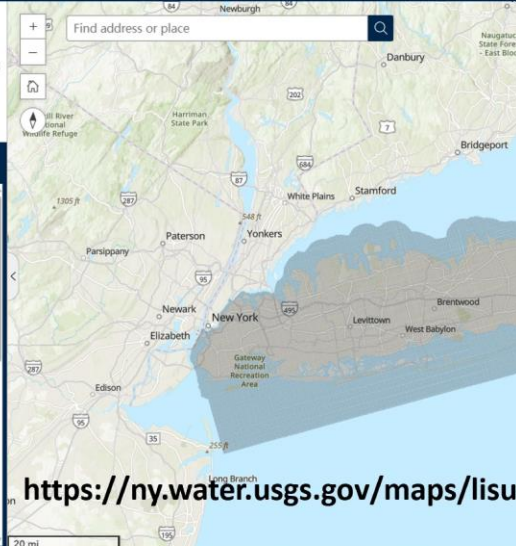


Long Island Groundwater Sustainability - Phase 1 Simulation Outputs

About the Web Map

This web map was produced in cooperation with the New York State Department of Environmental Conservation to provide easy access to georeferenced results from numerical models developed as a part of the Long Island Sustainability groundwater study for Long Island, New York. The map displays contoured output of simulated historical chloride conditions and thirteen (13) model simulations that show changes in hydrologic conditions relative to

Data Layers	Explanation
<input checked="" type="checkbox"/> Model grid	
<input type="checkbox"/> Simulated historical chloride	
<input type="checkbox"/> (1a) Average 2010-2019 baseline annual conditions	
<input type="checkbox"/> (1aa) Average 2010-2019 baseline seasonal conditions	
<input type="checkbox"/> (1b) Average 2010-2019 annual conditions with increased natural recharge and 3ft rise in sea level	
<input type="checkbox"/> (2a) Increase in peak season pumping from public supply wells	
<input type="checkbox"/> (2b) Increase in peak season pumping from public supply wells with increased natural recharge and 3ft sea level rise	
<input type="checkbox"/> (3a) Decrease in peak season pumping from public supply wells	



<https://ny.water.usgs.gov/maps/lisustainabilitysimulationoutputs/>

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Prepared in cooperation with the New York State Department of Environmental Conservation

Hydrogeologic Framework and Extent of Saltwater Intrusion in Kings, Queens, and Nassau Counties, Long Island, New York



Scientific Investigations Report 2024–5048

U.S. Department of the Interior
U.S. Geological Survey

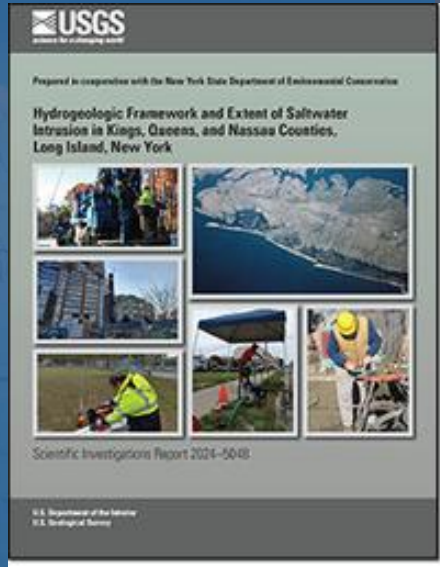
Esri, CGIAR, USGS | Esri, TomTom, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, USFWS | Powered by Esri

Summary

- Western LI Hydrogeologic Framework has been mapped and report published. Eastern LI mapping is nearly completed.
- TDEM surveys, EM logs of wells, and cores collected and analyzed to produce the framework and map extent of saltwater intrusion.
- Saltwater Intrusion is caused by increased pumpage of groundwater and the amount of freshwater above sea level at a location.
- Climate change and sea level rise will increase areas vulnerable to saltwater intrusion.
- Phase 3 of this project focuses on monitoring the saltwater interface; combined with the regional groundwater model, these efforts provide tools to manage the resource.

Long Island
Sustainability
Project
Contact Info:
fstumm@usgs.gov

Questions?



<https://pubs.usgs.gov/publication/sir20245048>