

Eastern Shore of Virginia

USGS Research:

Land Subsidence and Relative Sea-Level Rise in the Southern Chesapeake Bay Region (USGS Circular 1392; 2013)

Sediment Distribution and Hydrologic Conditions of the Potomac Aquifer in Virginia and Parts of Maryland and North Carolina (USGS SIR 2013-5115)

January 2014

Land Subsidence and Relative Sea-Level Rise in the Southern Chesapeake Bay Region

- The lower Chesapeake Bay region is experiencing the highest rates of sea-level rise on the US Atlantic Coast.
- Global sea level rise plus regional land subsidence have resulted in a 1.1 to 4.8 mm/yr (≈ 0.5 to 2 in/decade) relative rate of sea rise in the lower Chesapeake Bay area



Measured
Subsidence in
California

Source of Land Subsidence

- Predominately due to groundwater withdrawals from confined aquifers
- Amount depends on:
 - Water level decline
 - Sediment compressibility
 - Sediment thickness

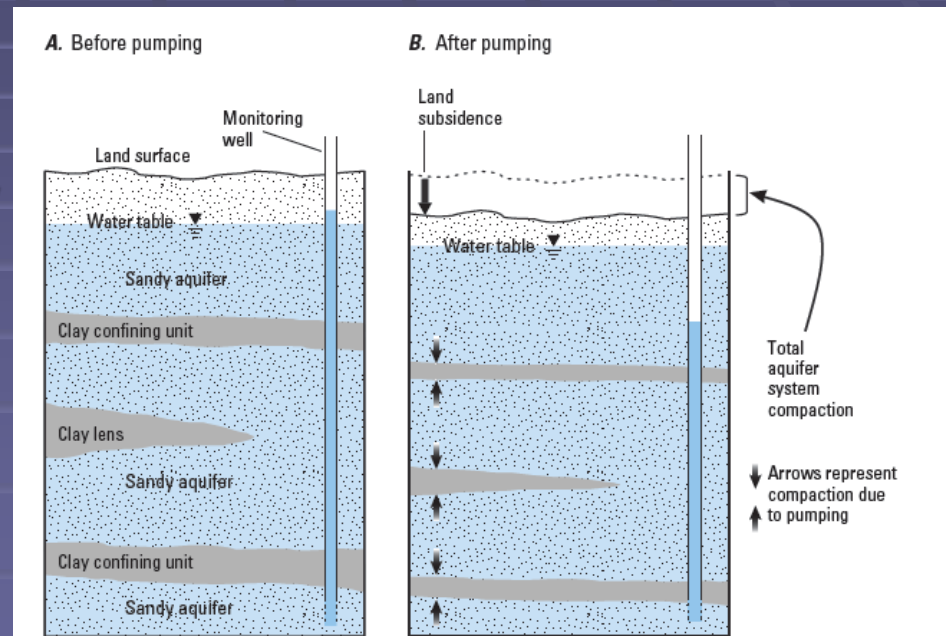


Figure 10. Aquifer-system compaction caused by groundwater withdrawals A, before and B, after pumping. Modified from Galloway and others (1999).

Methods of Measurement

- Borehole Extensometers
- Tidal Stations
- Geodetic Surveys



Table 1. Land subsidence monitoring methods.

[GPS, Global Positioning System; InSAR, interferometric synthetic aperture radar]

Method	Type of data	Measures aquifer-system compaction independently	Spatial coverage	Temporal detail
Borehole extensometer	Aquifer-system thickness at one location, continuous record	Yes	Low	High
Tidal station	Sea elevation at one location, continuous record	No	Low	High
Geodetic surveying	Land elevations at one or several locations, multiple times or continuous record	No	Low to moderate	Low to high
Remote sensing (InSAR)	Land elevations over a wide area, at multiple times	No	High	Moderate

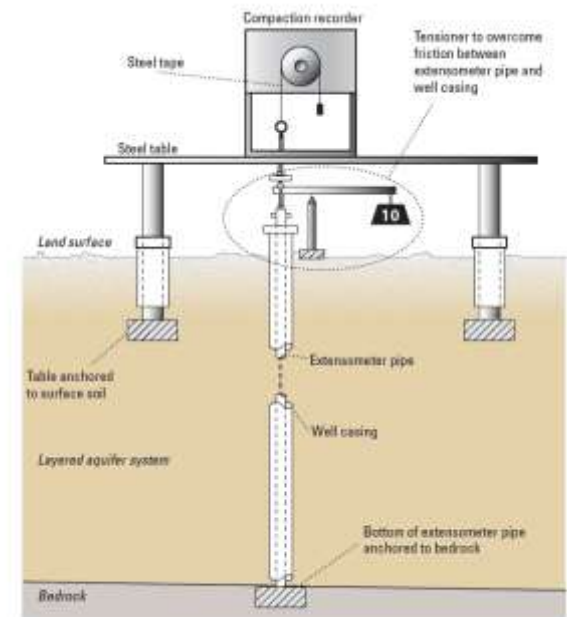
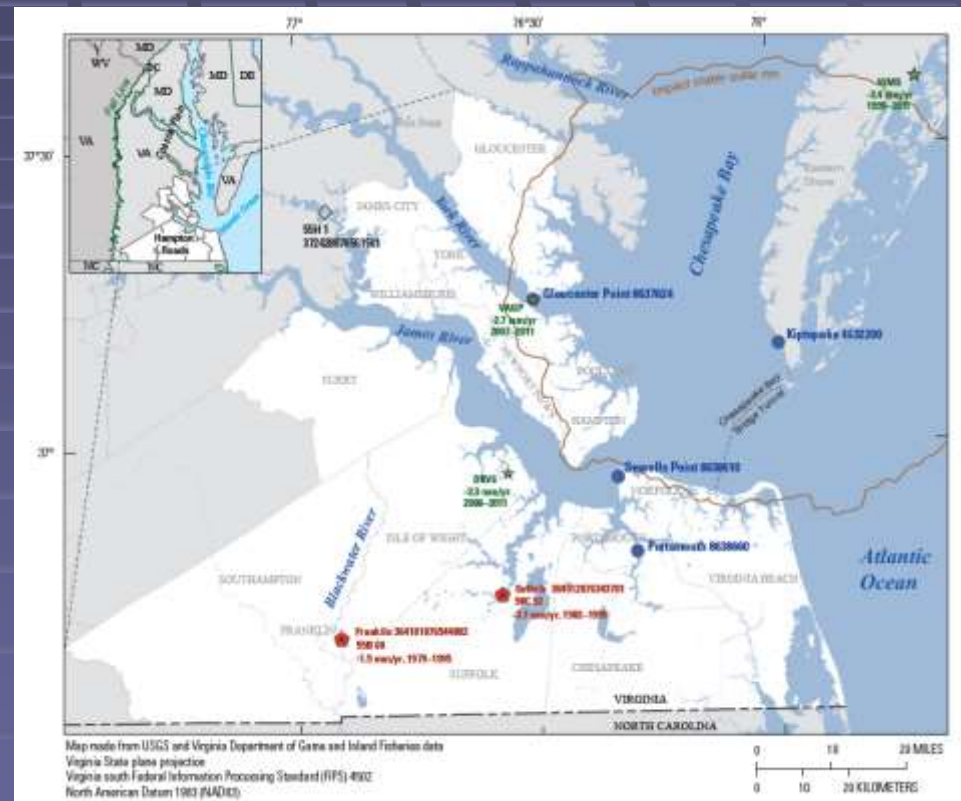


Figure 8. The borehole extensometer in Franklin, Virginia. Modified from Pope (2002).

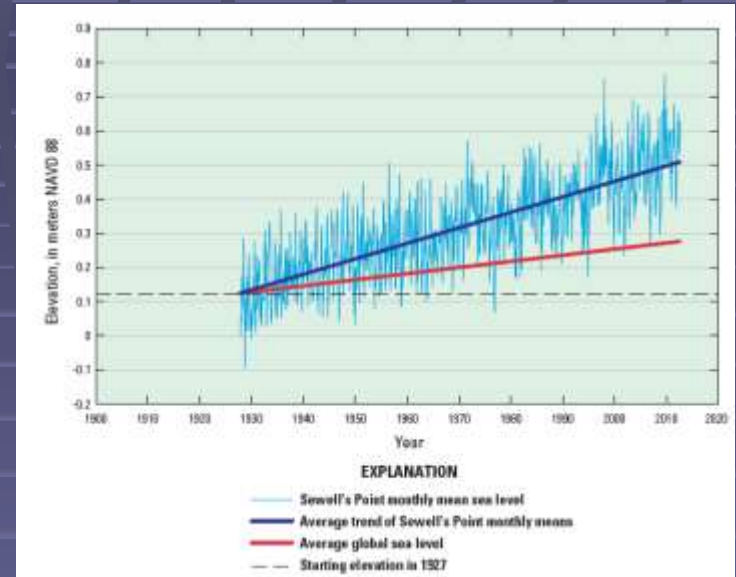
Lower Chesapeake Bay Monitoring Stations

- Extensometers
- Tidal Stations
- Geodetic Survey Station



Relative Sea Level Rise

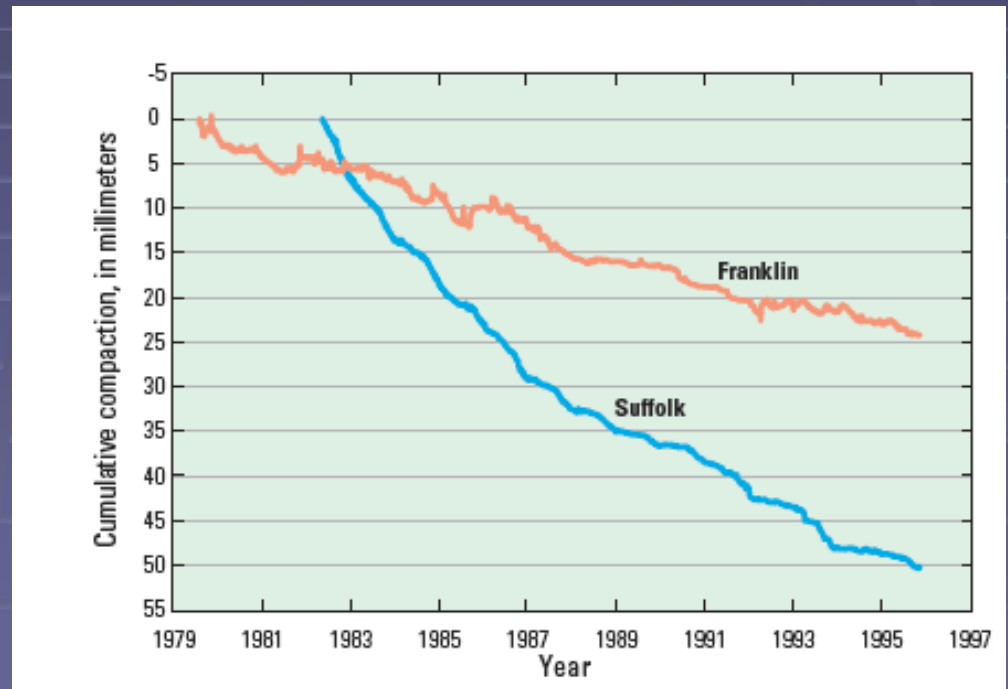
- Tidal Stations



ID	Site name	Period	Rate of relative sea-level rise	
			Measured, (mm/yr)	95% CI
8632200	Kiptopeke, Virginia	1951–2006	3.5	±0.42
8637624	Gloucester Point, Virginia	1950–2006	3.8	±0.47
8638610	Sewells Point, Virginia	1927–2006	4.4	±0.27
8638660	Portsmouth, Virginia	1935–2006	3.8	±0.45
Average			3.9	±0.40

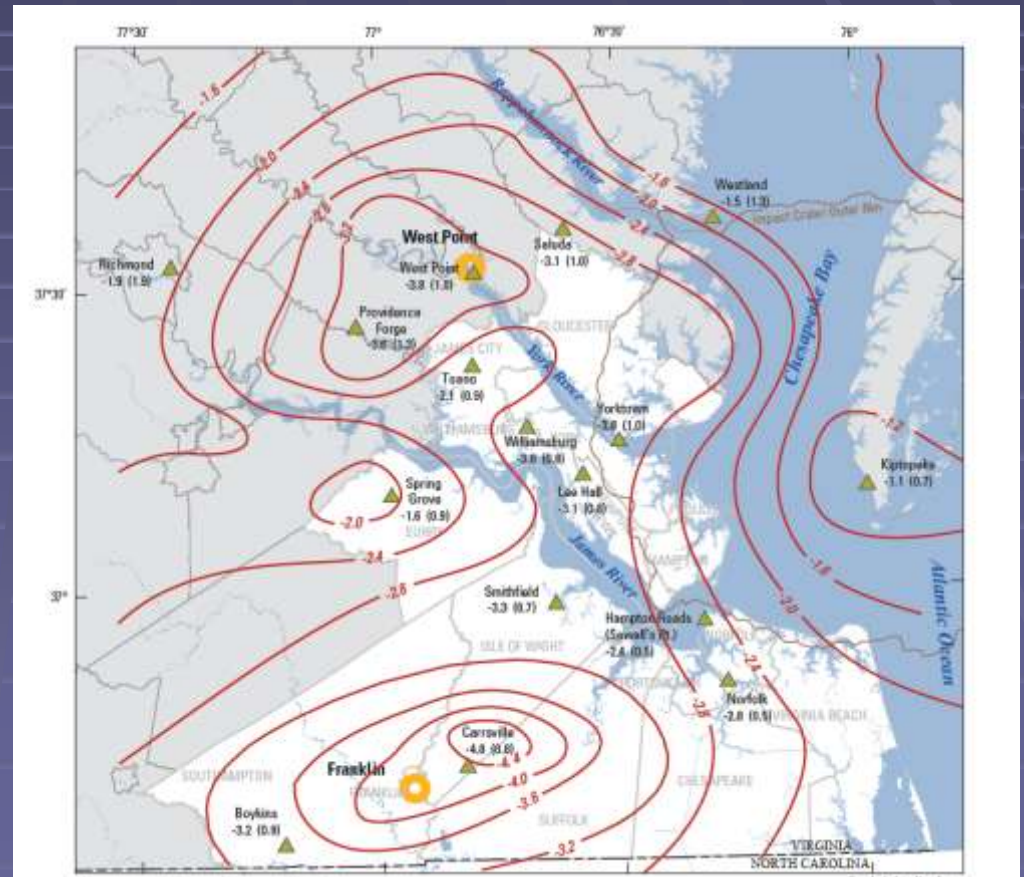
Land Subsidence

- Extensometers



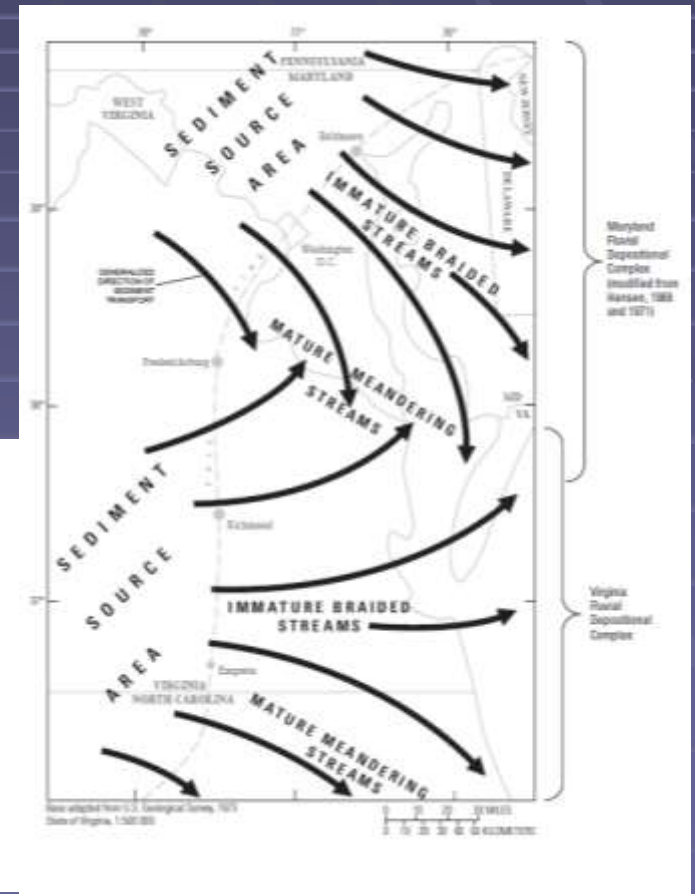
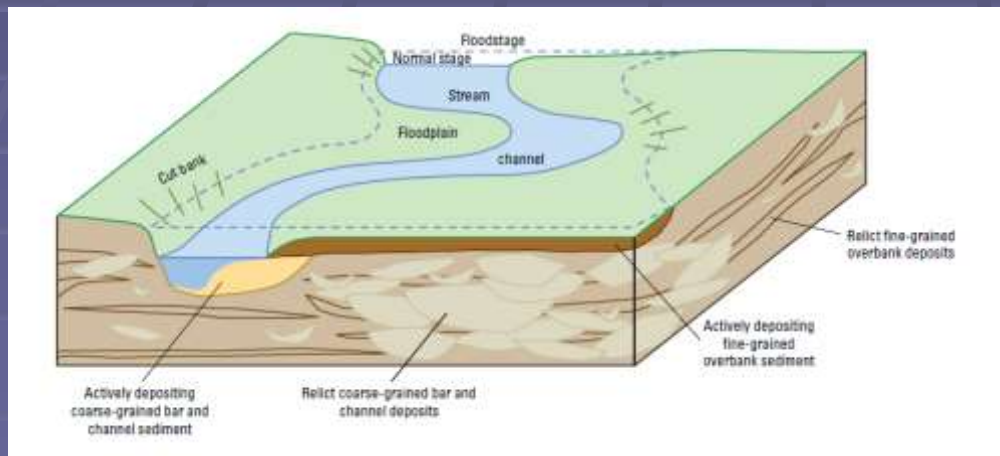
Relative Sea Level Rise

- Greatest:
 - Franklin
 - West Point
- Lowest:
 - Kiptopeke

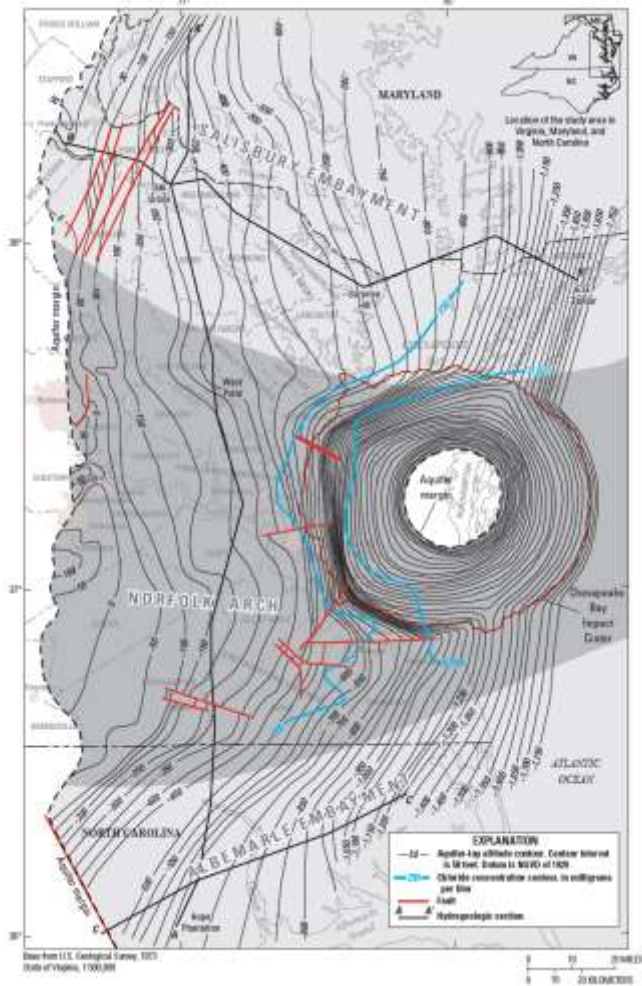


Sediment Distribution and Hydrologic Conditions of the Potomac Aquifer in Virginia and Parts of Maryland and North Carolina

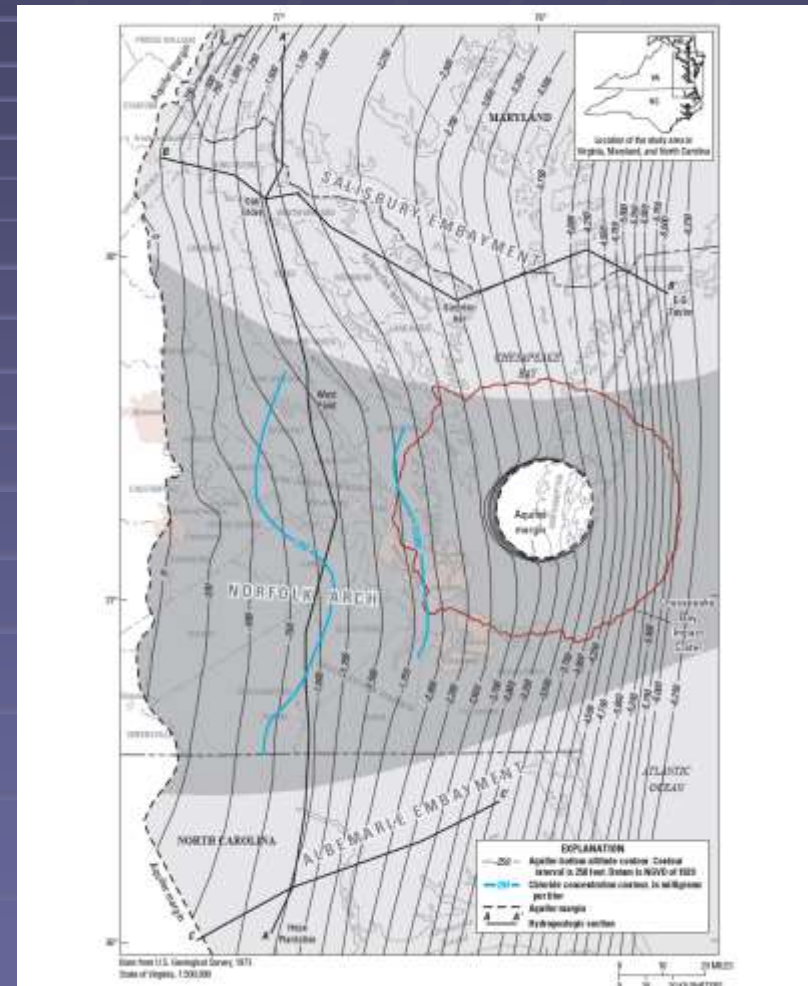
- Evaluated depositional environment on aquifer characteristics



Sediment Distribution and Hydrologic Conditions of the Potomac Aquifer in Virginia and Parts of Maryland and North Carolina



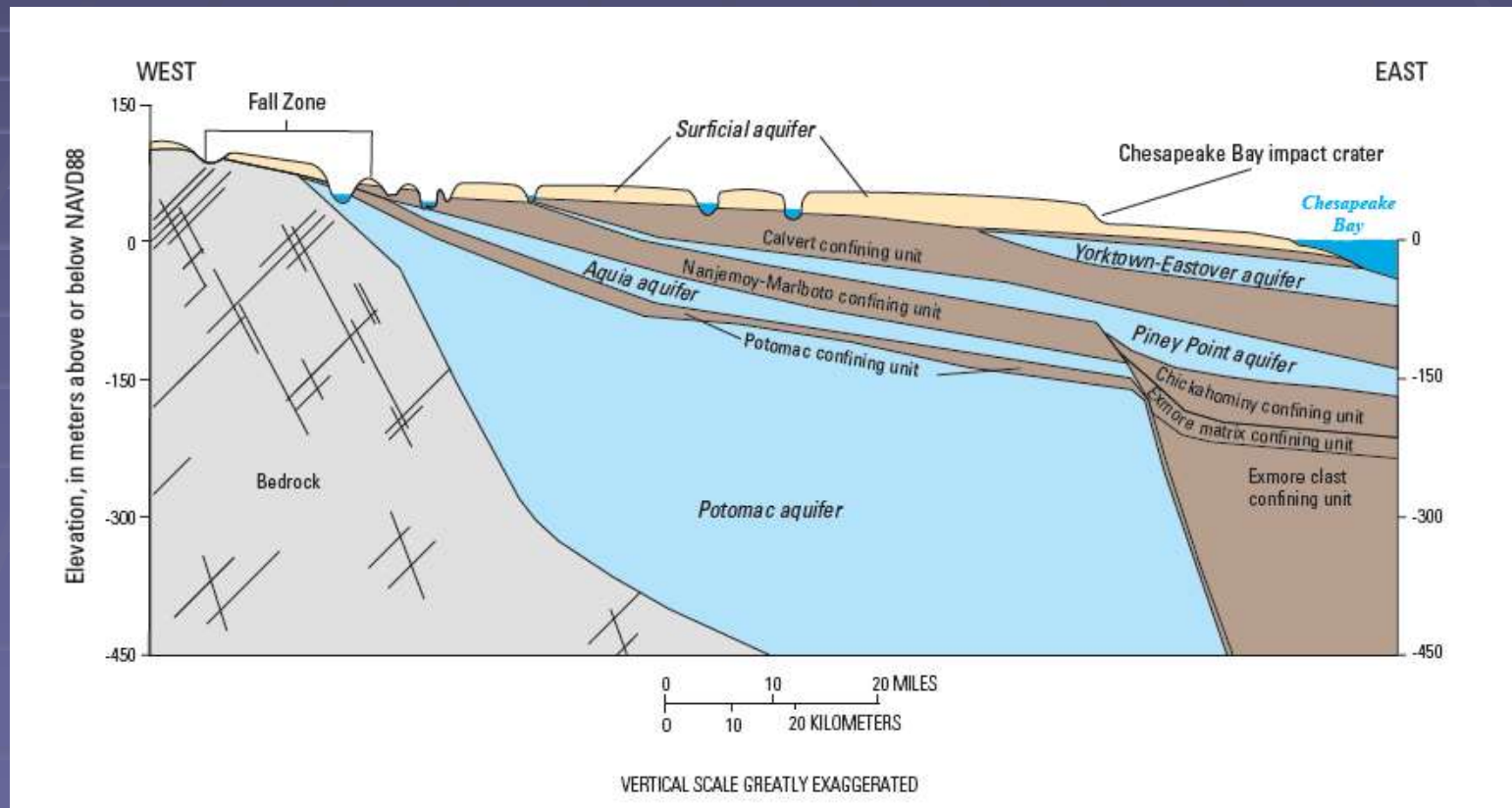
Top of Potomac Aquifer



Bottom of Potomac Aquifer

Potomac Aquifer System

- Generalized – best represents sediments in Norfolk Arch area
- Immature , high gradient braided streams deposited longitudinal bars and channel fills



Cross-Section Across Northern Accomack

- Sediments part of Salisbury Embayment
- Mature, medium to low gradient meandering streams deposited medium to coarse grained channel fills and point bars

