Land Subsidence in Hampton Roads

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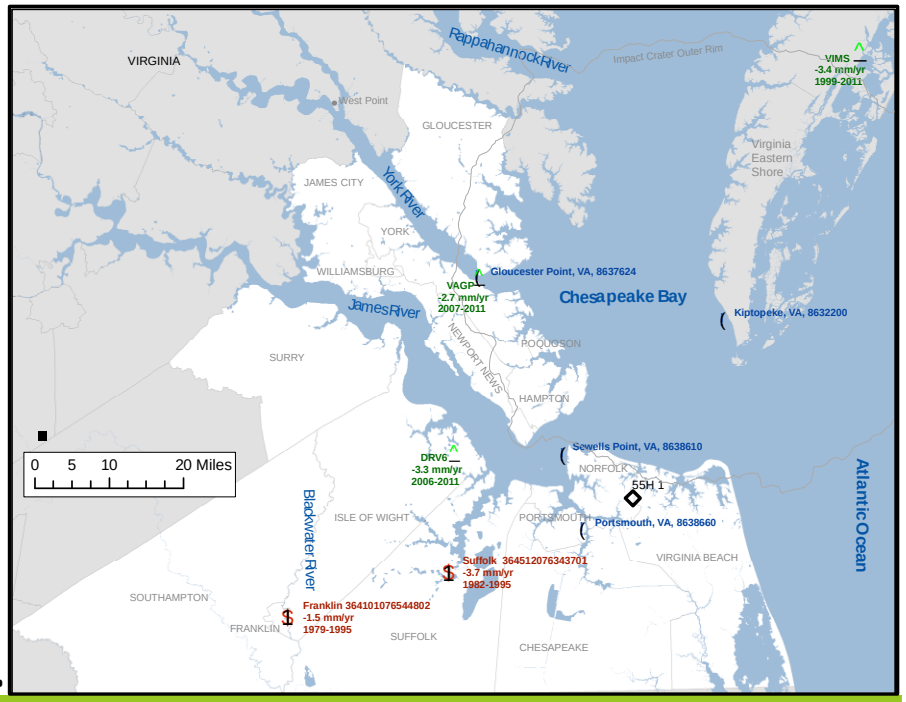
Tidal station measurements of sea levels do not distinguish between water that is rising and land that is sinking.



Relative sea-level rise at NOAA tidal stations.

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

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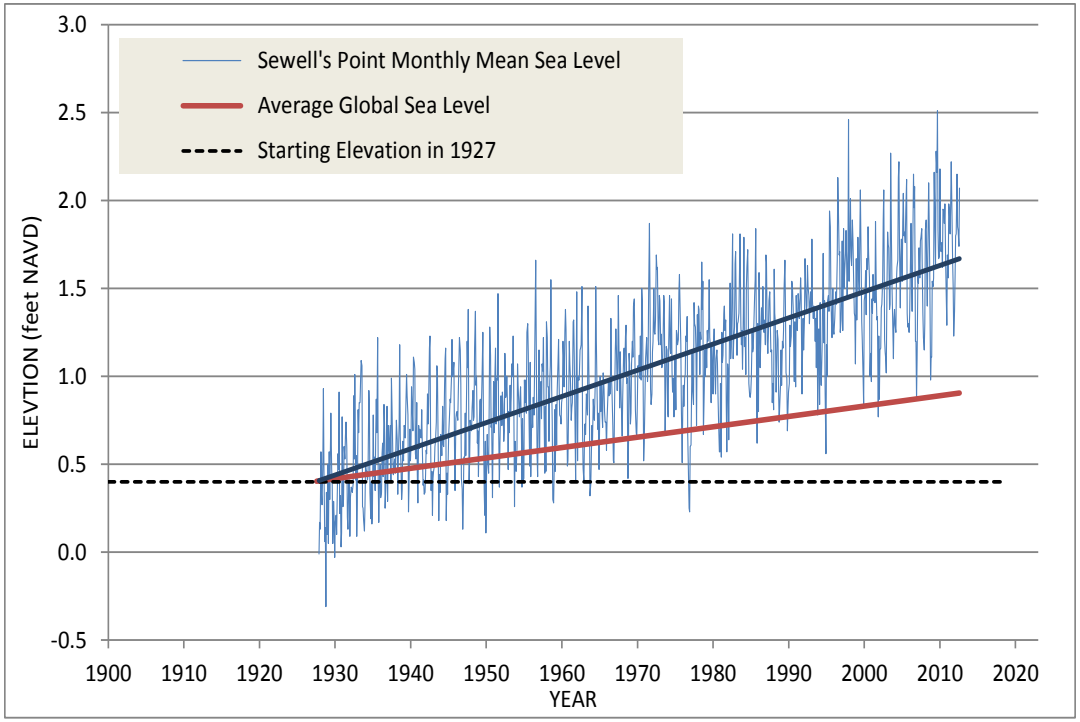
High rate of relative sea level rise in Hampton Roads

- Relative sea level rise in region is 3.9 mm/year compared to global average of 1.8 mm/year.
- Land subsidence was theorized to be the reason regional rates are roughly 2x greater than global average.



- USGS report "Land Subsidence and Relative Sea-Level Rise in the Southern Chesapeake Bay Region" summarizes available measurements of land subsidence.

Measurements of land subsidence in Hampton Roads

What was measured	Monitoring technique	Number of stations	Period	Average Rate (mm/year)
Aquifer compaction	Extensometer	2	1979-1995	-2.6
Land subsidence	Geodetic survey	17	1940-1971	-2.8
Land subsidence	Fixed GPS	3	2006-2011	-3.1

"There are some inconsistencies between measured subsidence rates, which are expected given the variety of data, the different times of measurement, and the multiple locations measured. However, the data paint a clear overall picture of land subsidence in the region during the past 75 years.

Relative sea level rise has been 3.5 to 4.5 mm/yr. Land subsidence, measured to be 1.1 to 4.8 mm/yr, causes more than half the relative sea level rise. Aquifer compaction estimated to be 1.5 to 3.7 mm/yr can explain the majority of observed land subsidence."

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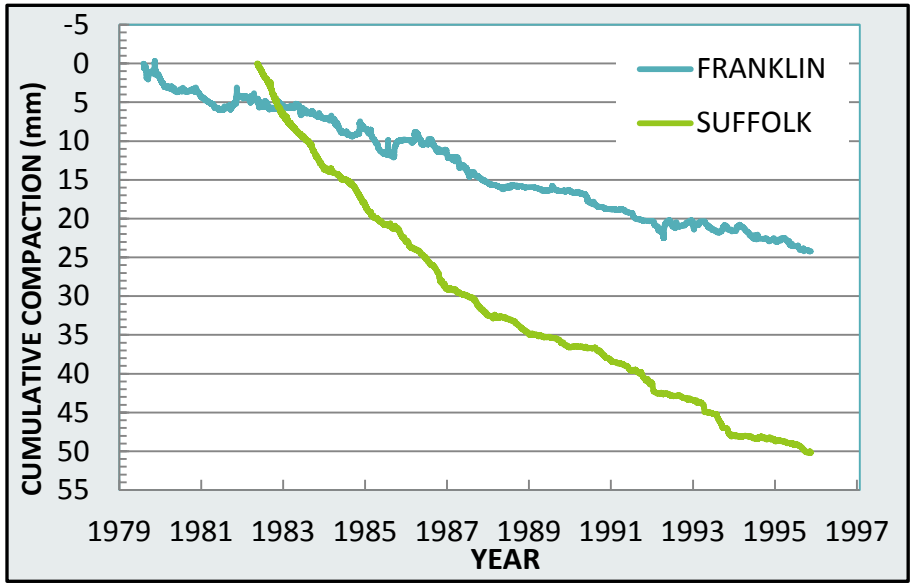
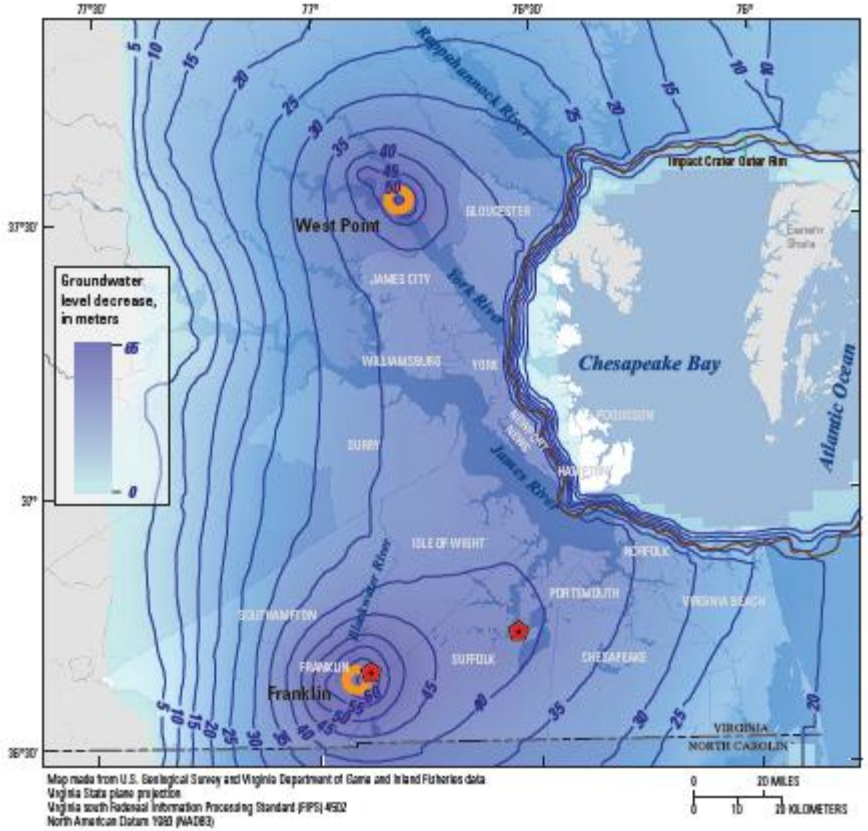
Measurements of Aquifer compaction in Hampton Roads





- Equipment was installed in two locations and monitored for roughly 15 years.
- Measurements in Franklin showed 24 mm of compaction (0.9 inches)
- Measurements in Suffolk showed 50 mm of compaction (2 inches)

Monitoring locations were chosen because they are near the largest groundwater withdrawal in region.

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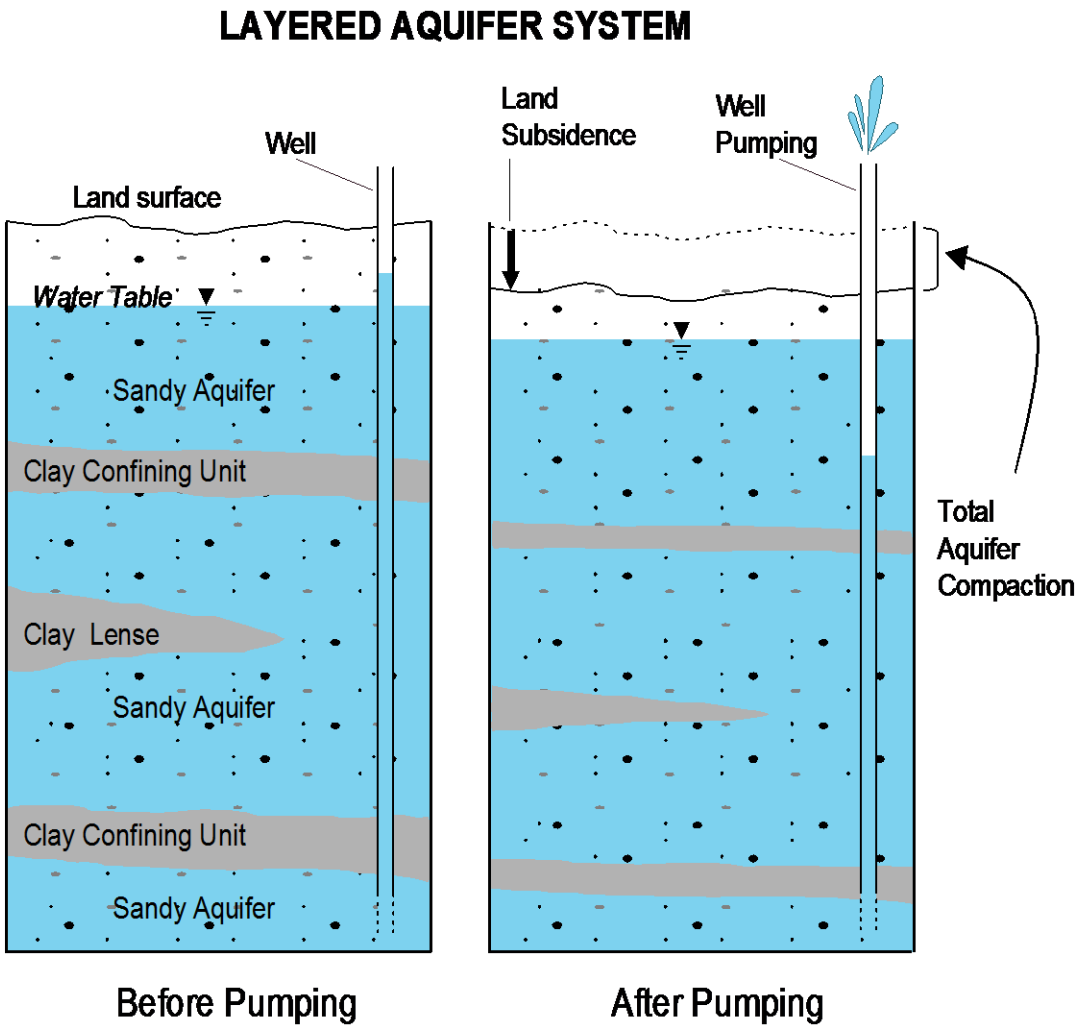
Why do groundwater withdrawals cause subsidence?



In Hampton Roads, the aquifer system is a stack of sand and clay layers.

Pumping from aquifers reduces water pressure in the clay layers and allows them to compress.

Why should we measure land subsidence?

- To develop better predictions of future rates of land subsidence.
- To understand where land subsidence is likely to occur.

Options

1. HRPDC could fund USGS to assess the methods of monitoring land subsidence and develop cost estimates. The resulting report could be used to support a state budget request or future grant opportunities. Estimated costs = $50,000.
2. HRPDC could issue a request for proposals for InSar analysis. The analysis would compare land elevations from the 1990s to 2000s to create a map of historic land subsidence across the region. Estimated costs = $250,000.

Recommended Action

Approve the development of a project to assess land subsidence and select Option 1 or 2.

If the Commission votes for Option 2, the Commission should approve a revenue source such as requesting state funding through legislation or a local government special assessment.

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