The Benefits of 20+ Years of Monitoring Shallow Groundwater

Virginia Beach

Kurt McCoy, David Nelms, Jack Eggleston, and Roger Moberg

USGS Virginia/West Virginia Water Science Center

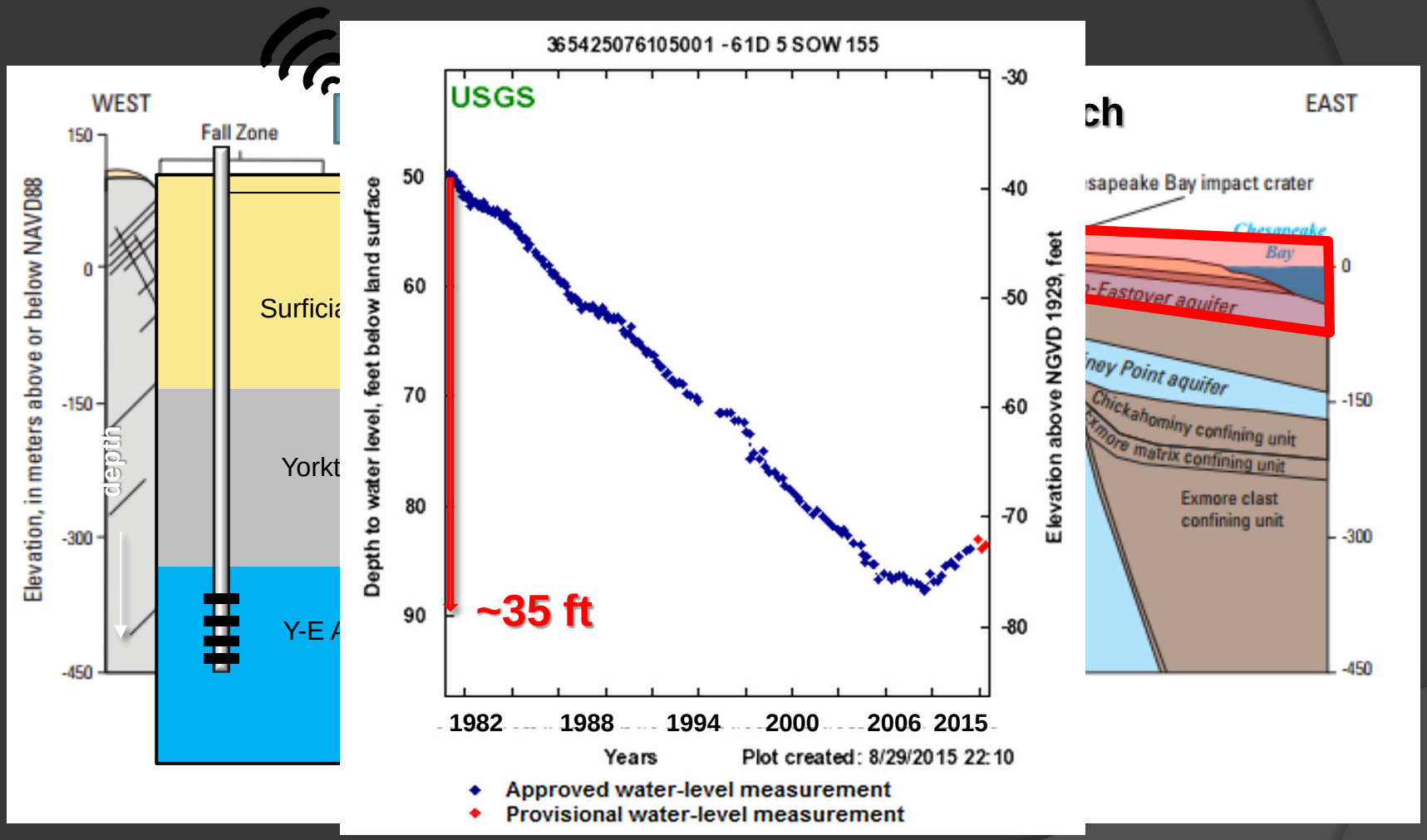
Scott Bruce and Todd Beach

VA DEQ Groundwater Characterization

Steve Poe, David Decker, David She, Peter Pommerenk

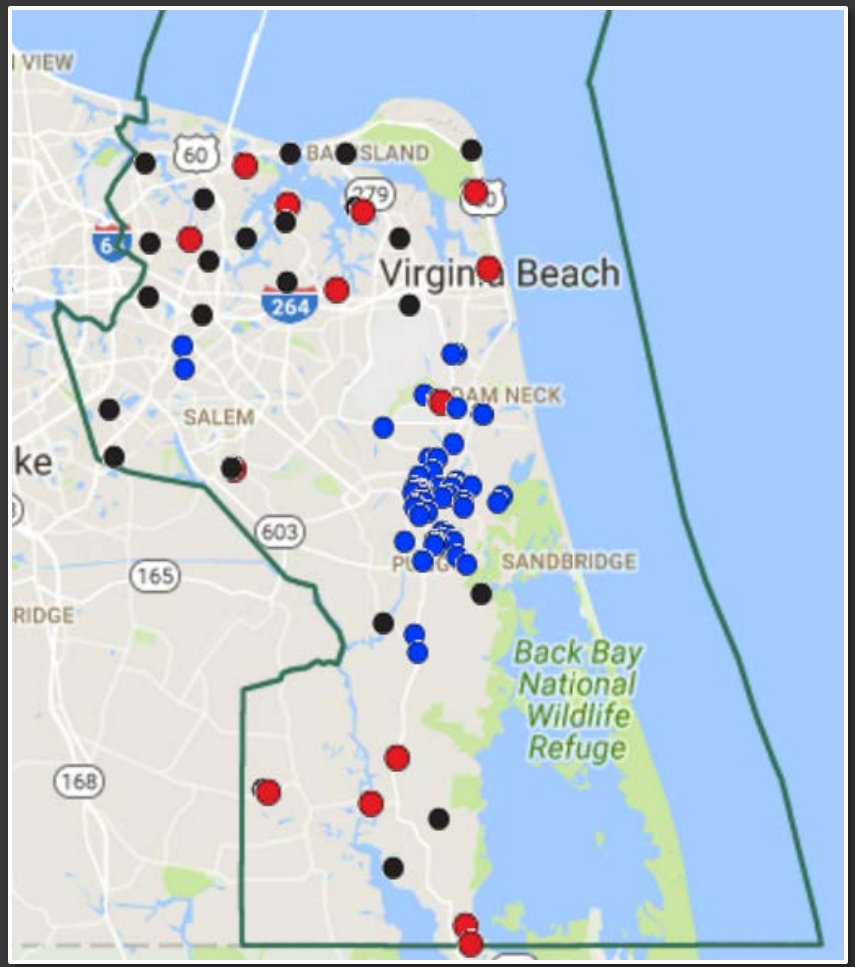
VA Beach Dept of Public Utilities

Virginia Beach Groundwater Monitoring



Virginia Beach

Background



EXPLANATION

- Virginia Beach Boundary
- USGS geophysical log location
- USGS Geoprobe core data
- Betz, Converse, and Murdoch geophysical log location (1981)

REPORT OF
HYDROGEOLOGIC INVESTIGATION
GROUNDWATER DEVELOPMENT PHASE
VIRGINIA BEACH FRESH GROUNDWATER PROJECT
FOR CITY OF VIRGINIA BEACH, VIRGINIA

Prepared For

BETZ . CONVERSE . MURDOCH, INC.

By

CONVERSE WARD DAVIS DIXON, INC.

11 September 1981

ASSESSMENT OF AVAILABILITY
OF BRACKISH GROUND WATER FOR
DESALINATION IN THE CITY
OF VIRGINIA BEACH, VIRGINIA

Prepared for
WILEY & WILSON, INC.

JULY 1979

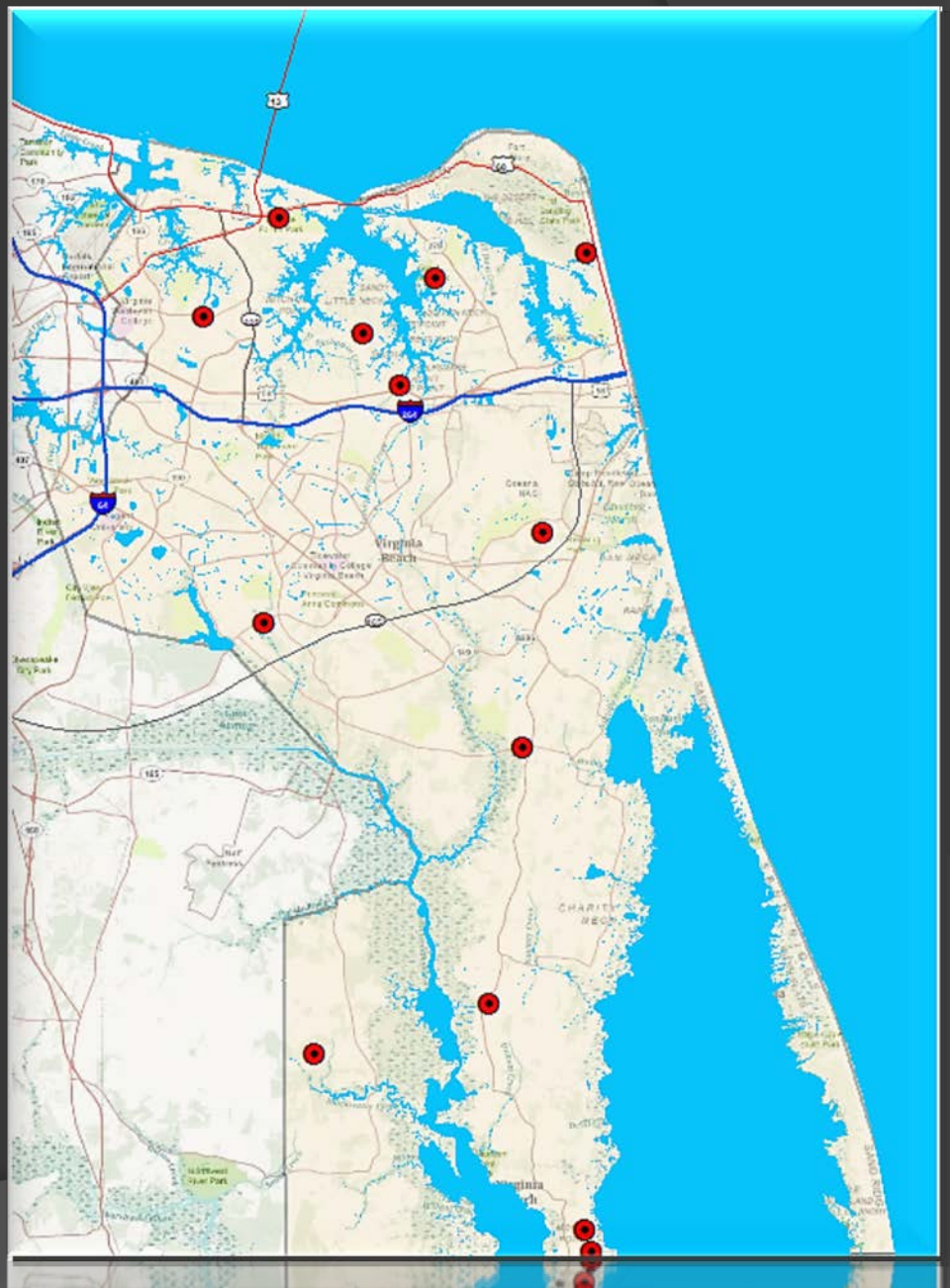
USGS
science for a changing world

USGS Continuous Ground-Water Monitoring 2016

- 30 continuous wells: 20 real-time, 5 conductance probes.
- 33 periodic water levels wells
- 10 water quality samples per year
- 13 Geophysical log monitoring wells

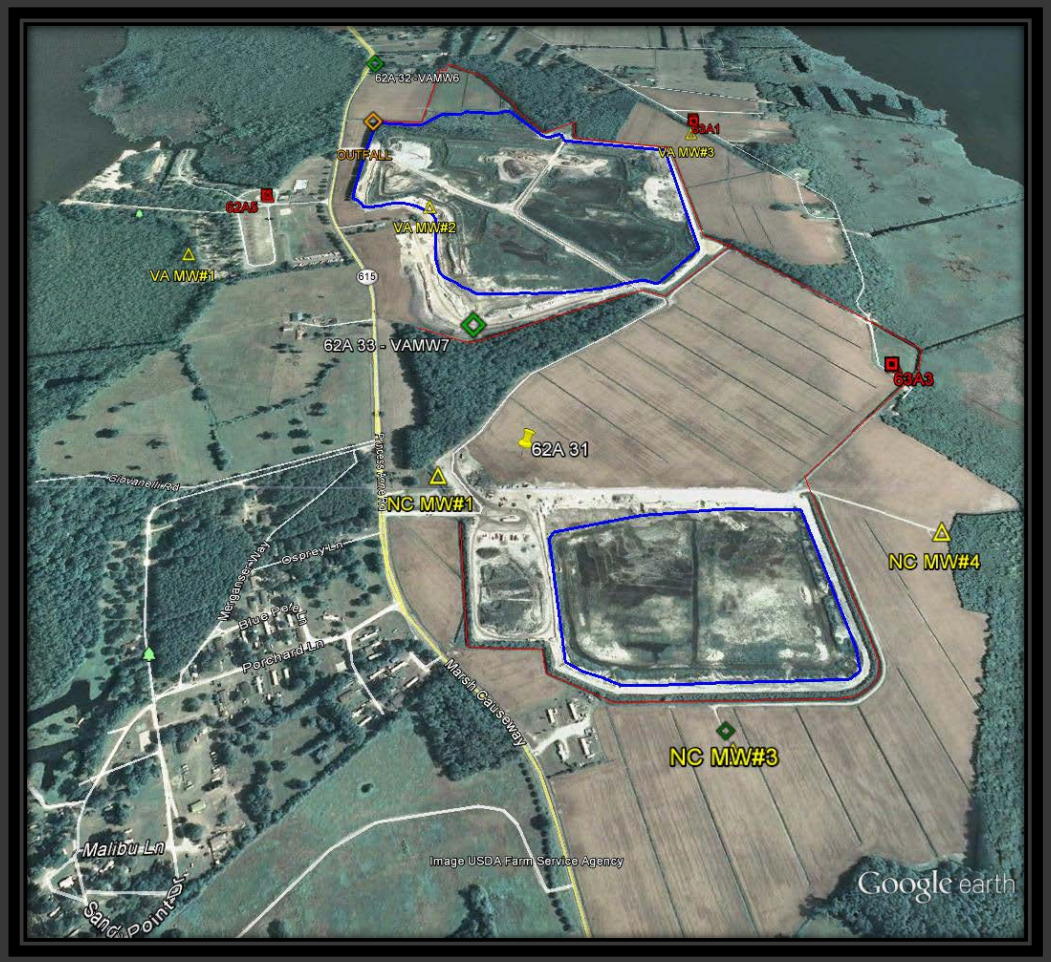
Data Available Online

http://groundwaterwatch.usgs.gov/countymap.asp?sa=VA&cc=810

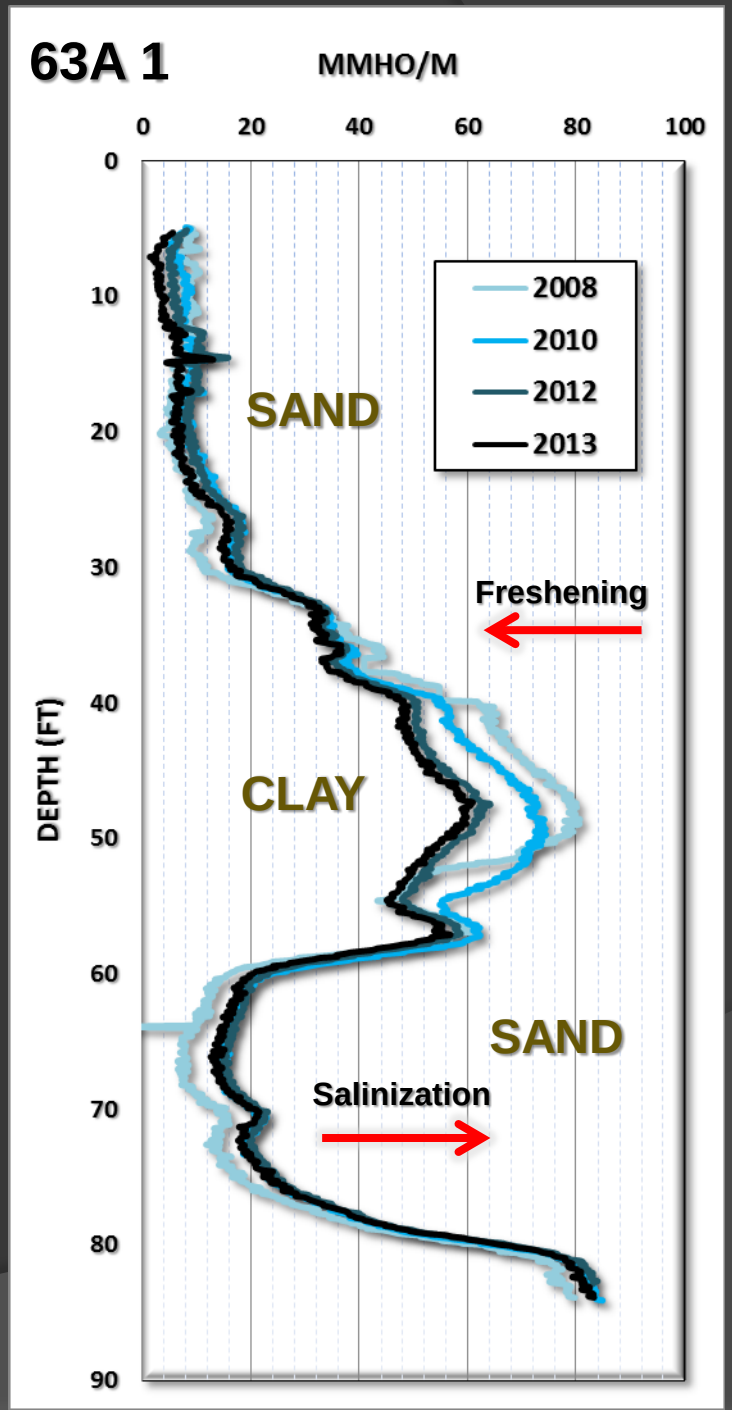


Citizen Science

EM Induction Borehole Logging

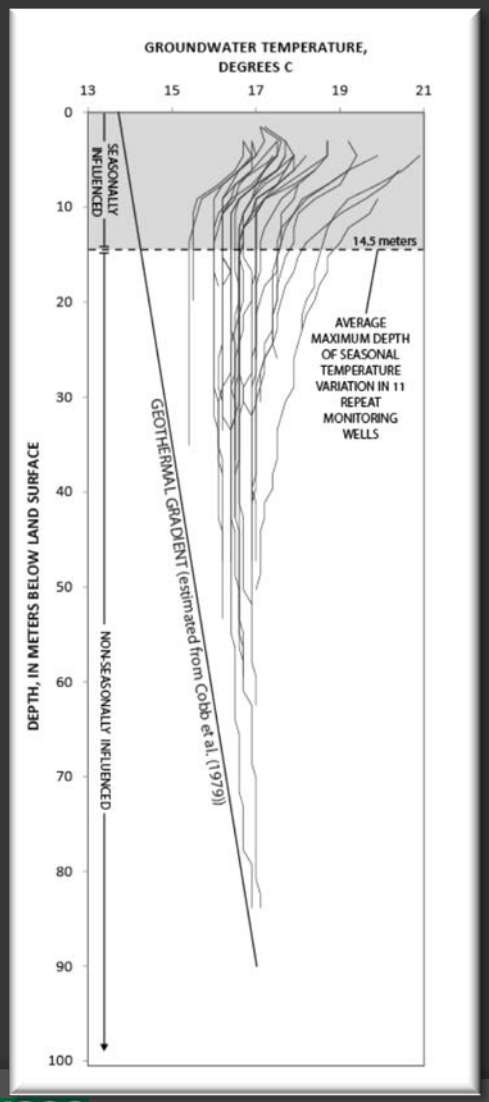


Observations 10 to 50 inches outside the well



Assessing the Magnitude and Timing of Anthropogenic Warming of a Shallow Aquifer:

Case Study from Virginia Beach, Virginia, USA



Original Intent:

Groundwater temperature to map permeable zones

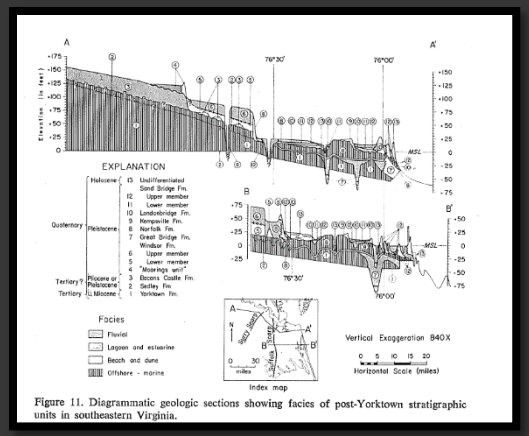
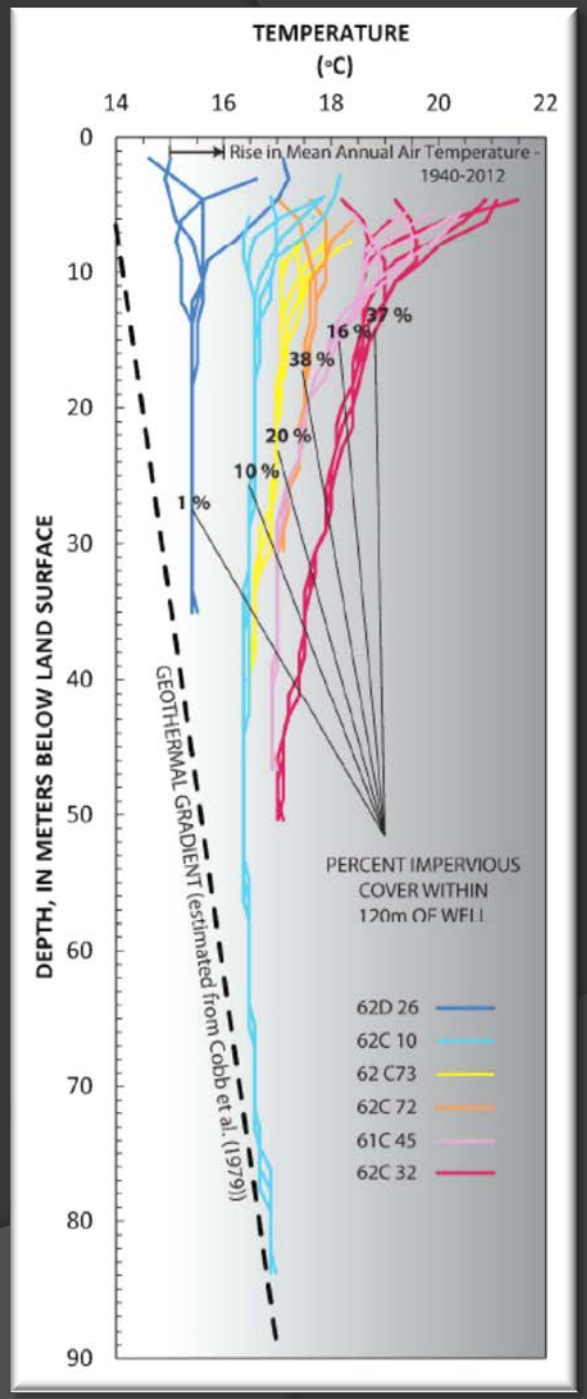


Figure 11. Diagrammatic geologic sections showing facies of post-Yorktown stratigraphic units in southeastern Virginia.

Study Results:

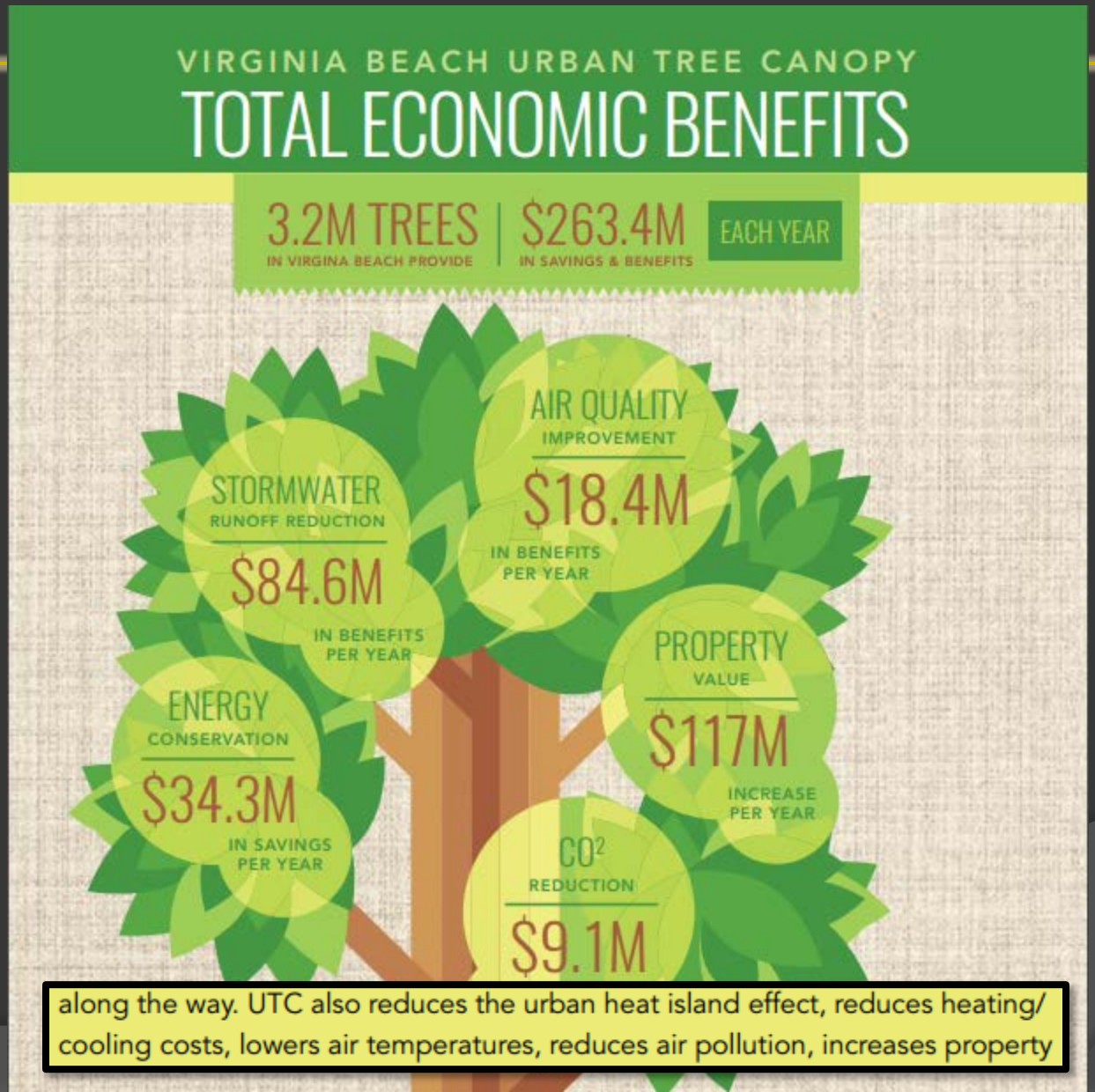
Groundwater temperatures correlated to land use



Eggleston and McCoy, 2014
Hydrogeology Journal

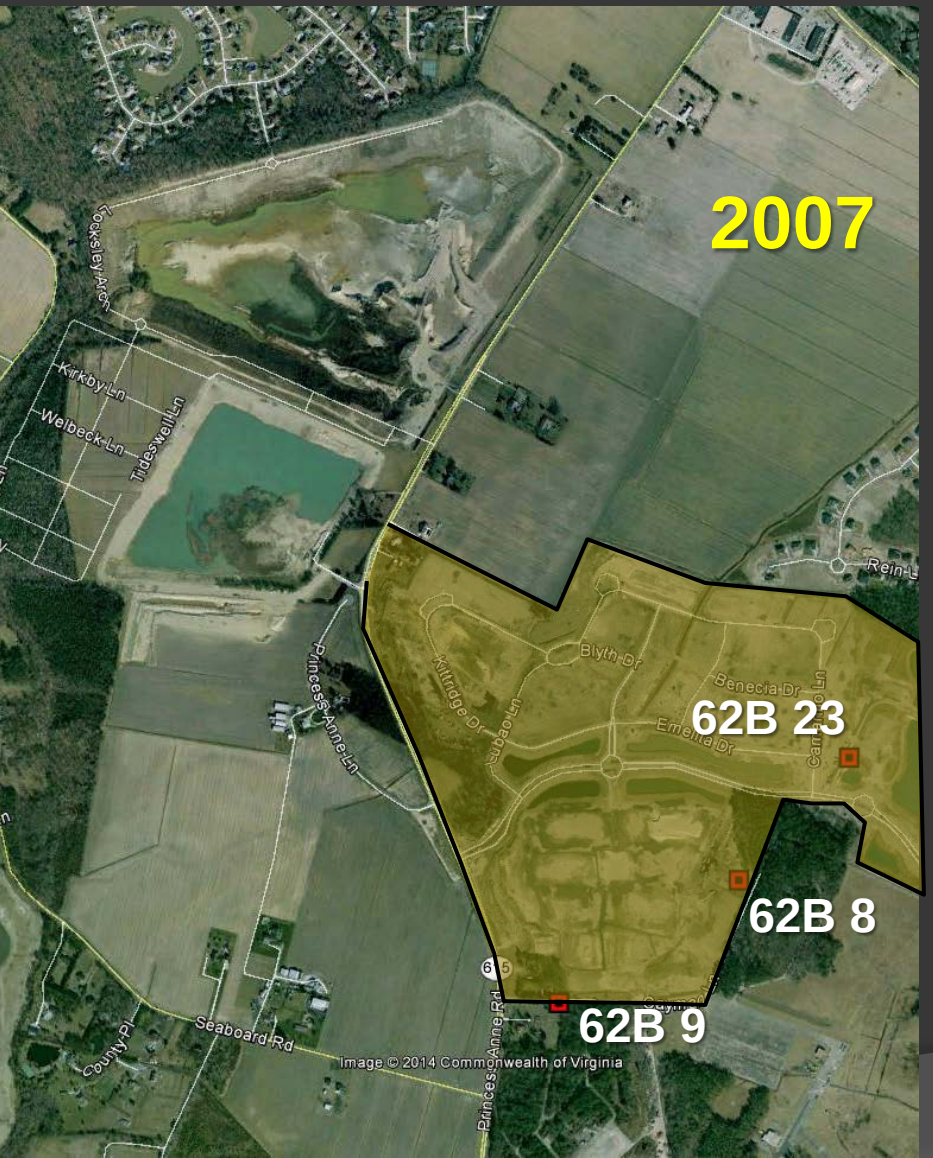
USGS science for a changing world

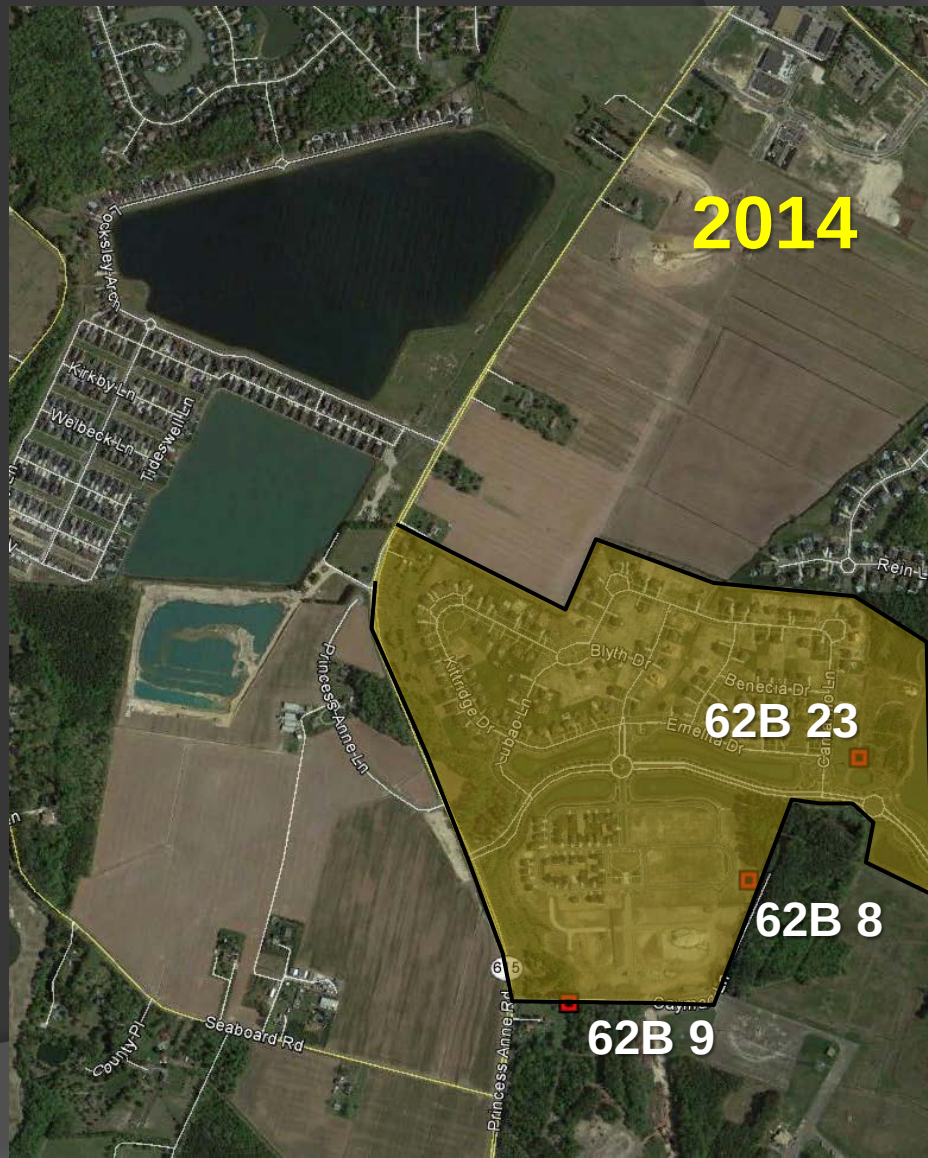
Assessing the Magnitude and Timing of Anthropogenic Warming of a Shallow Aquifer:



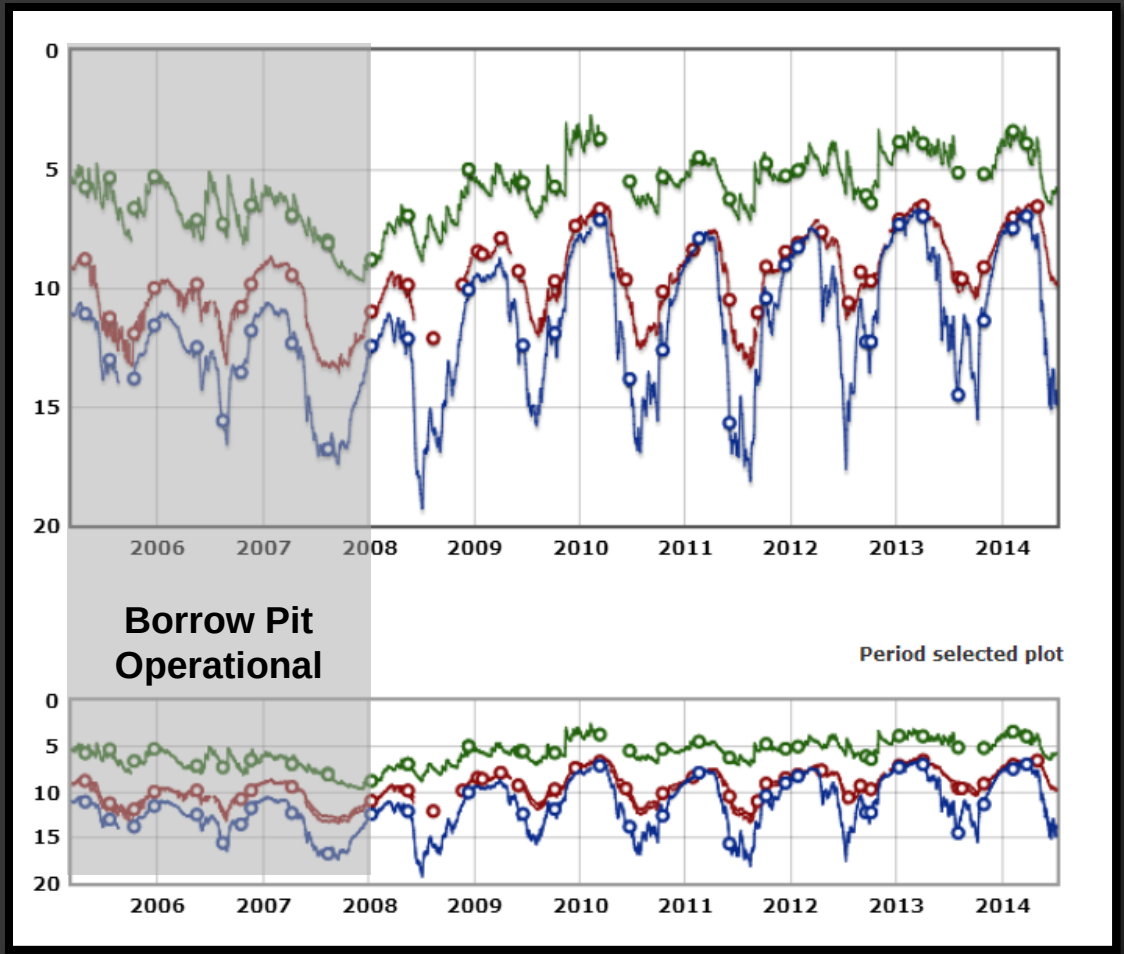
along the way. UTC also reduces the urban heat island effect, reduces heating/ cooling costs, lowers air temperatures, reduces air pollution, increases property

William Oliver Wells – Sherwood Lakes



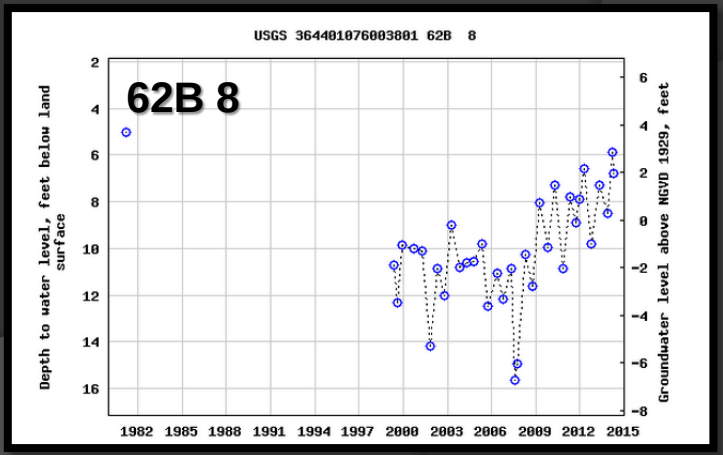


William Oliver Wells – Sherwood Lakes

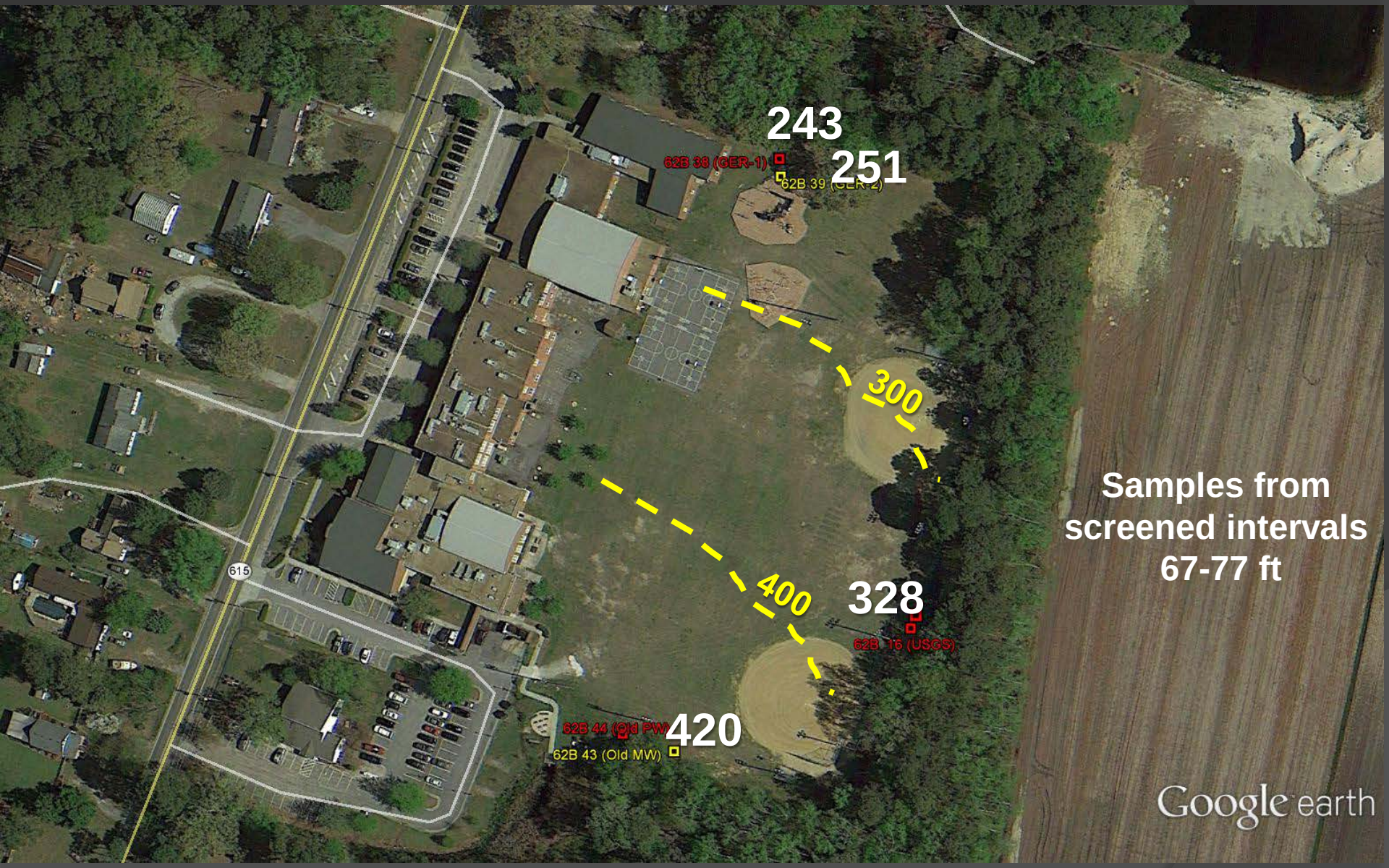


Water Level Rise 3 to 5 ft

- 62B 9
- 62B 23
- 62B 22 (1 mile south)



CREEDS ELEMENTARY
December 2013 Specific Conductance



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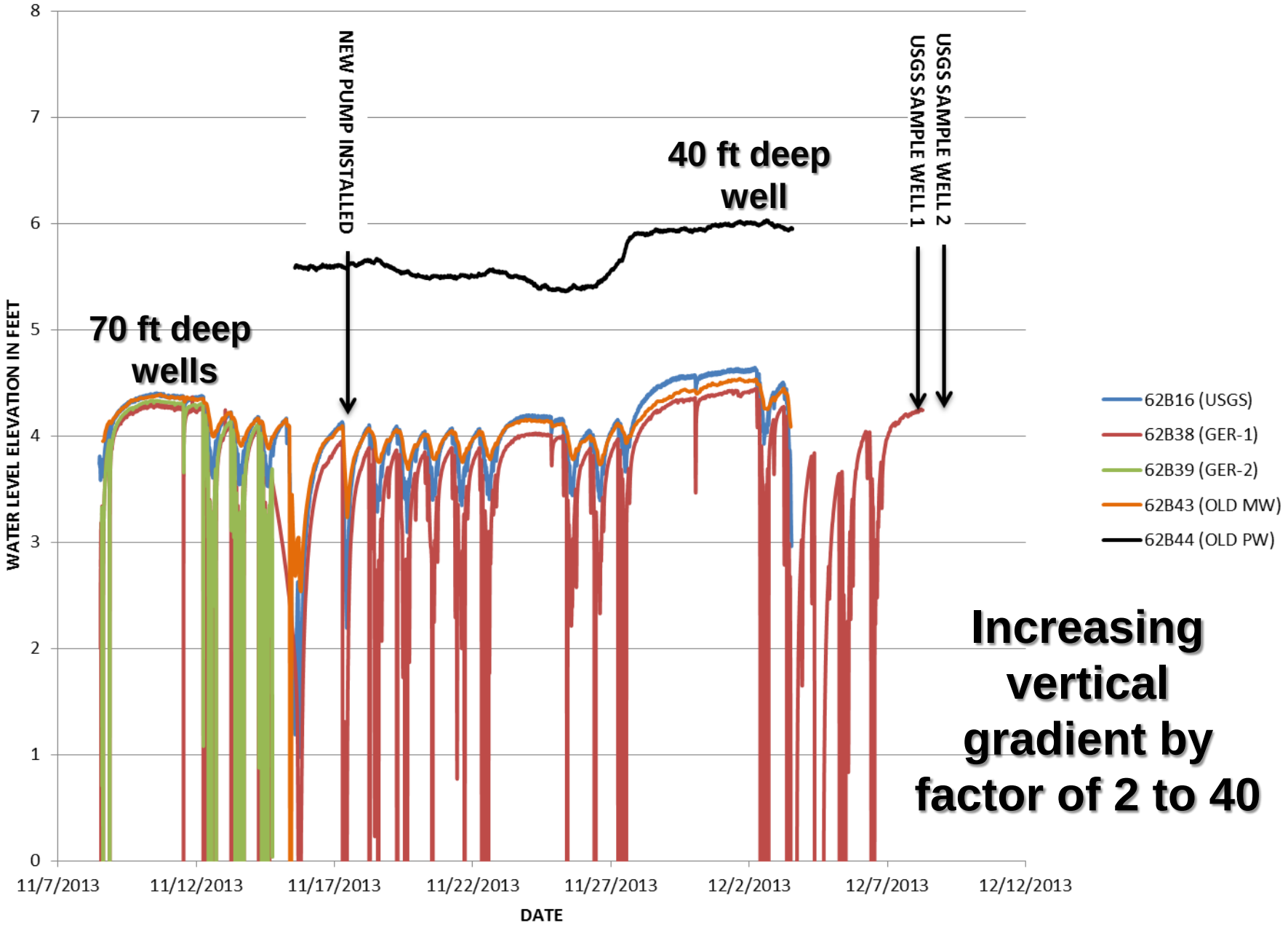
Water Levels



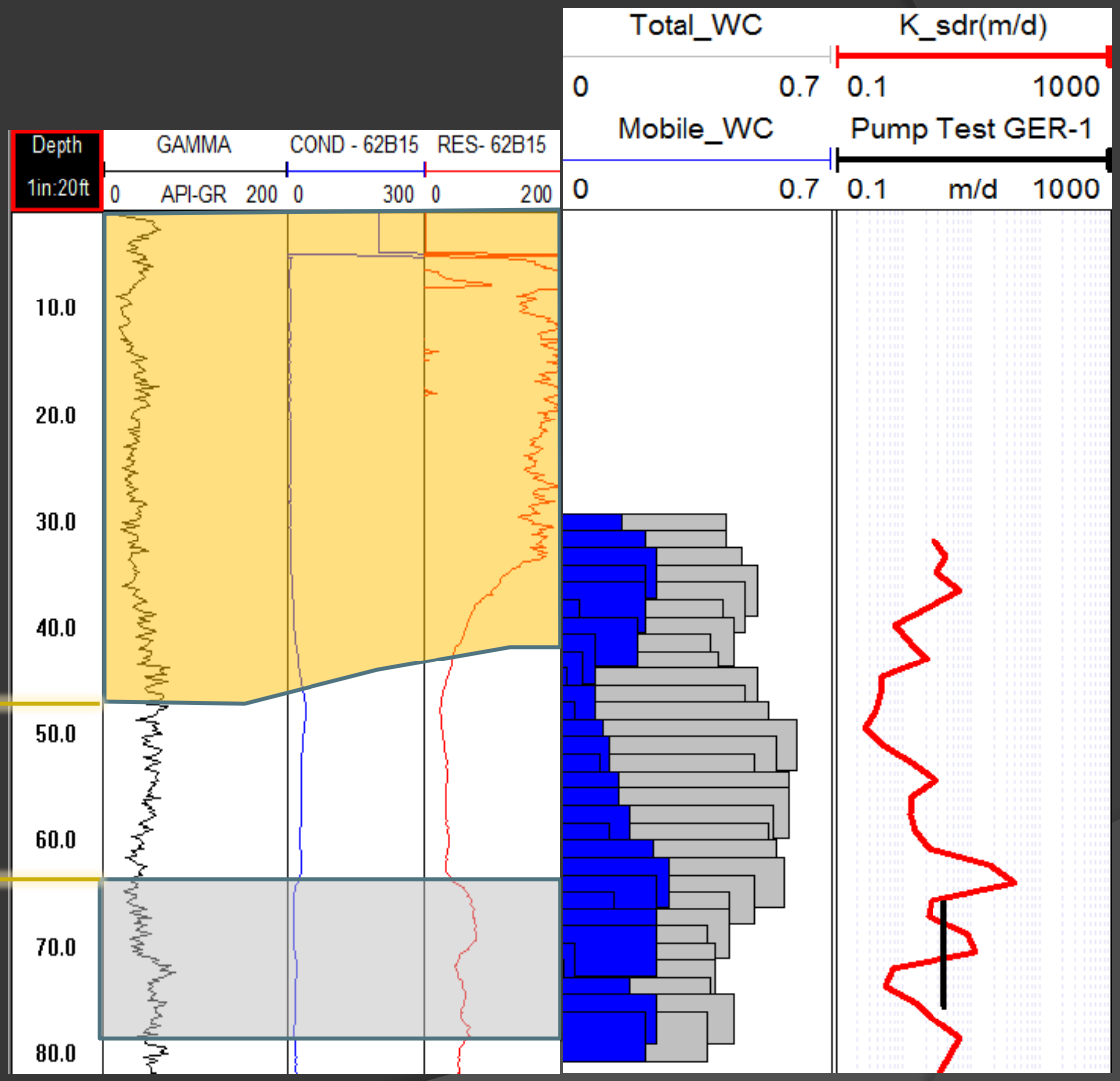
Increasing vertical gradient by factor of 2 to 40

Surficial Aquifer and the Water Table

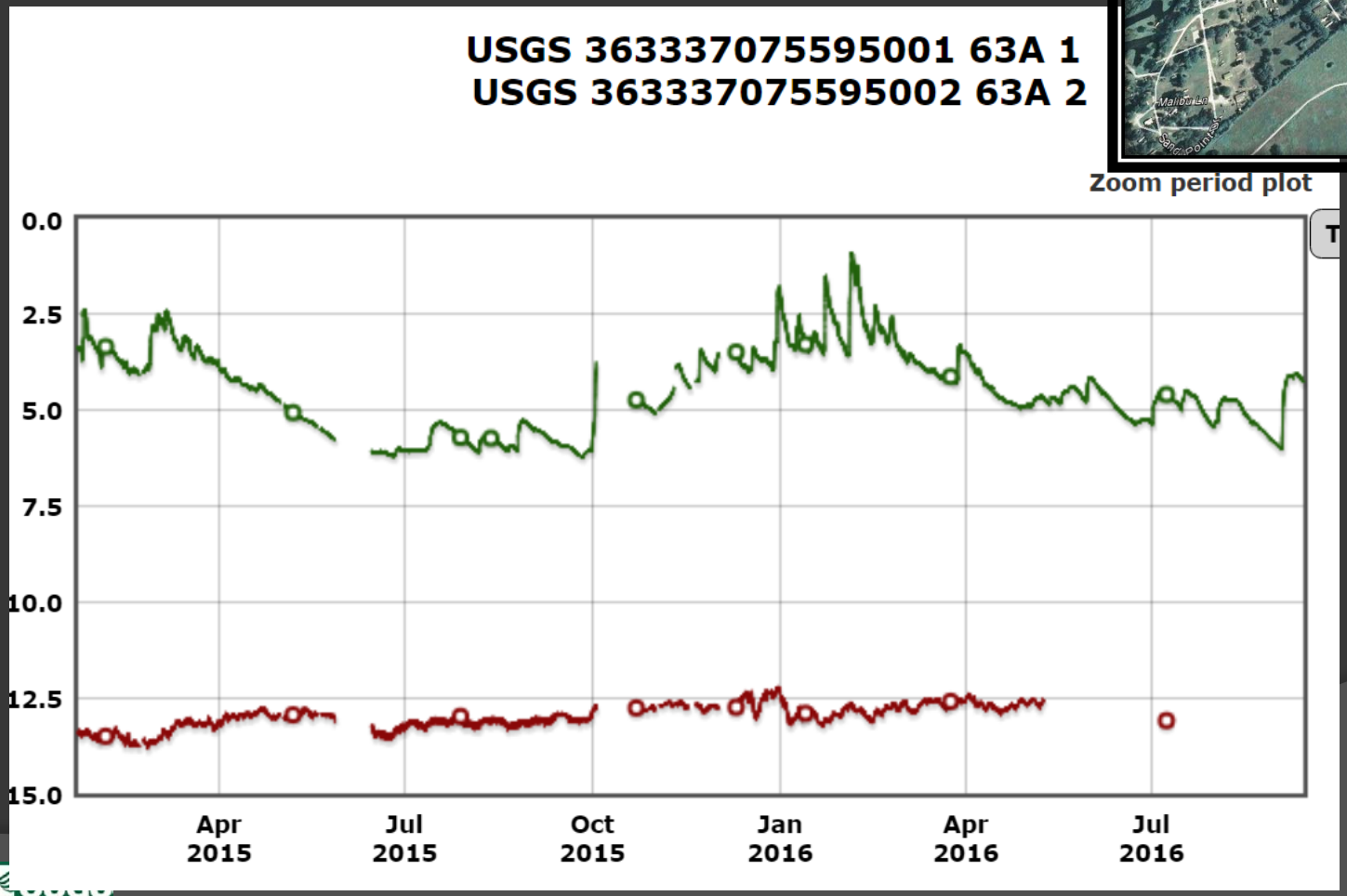
Surficial Sands (0-45 ft)

Confining Zone? (45-62 ft)

Pumping Interval (67-77 ft)



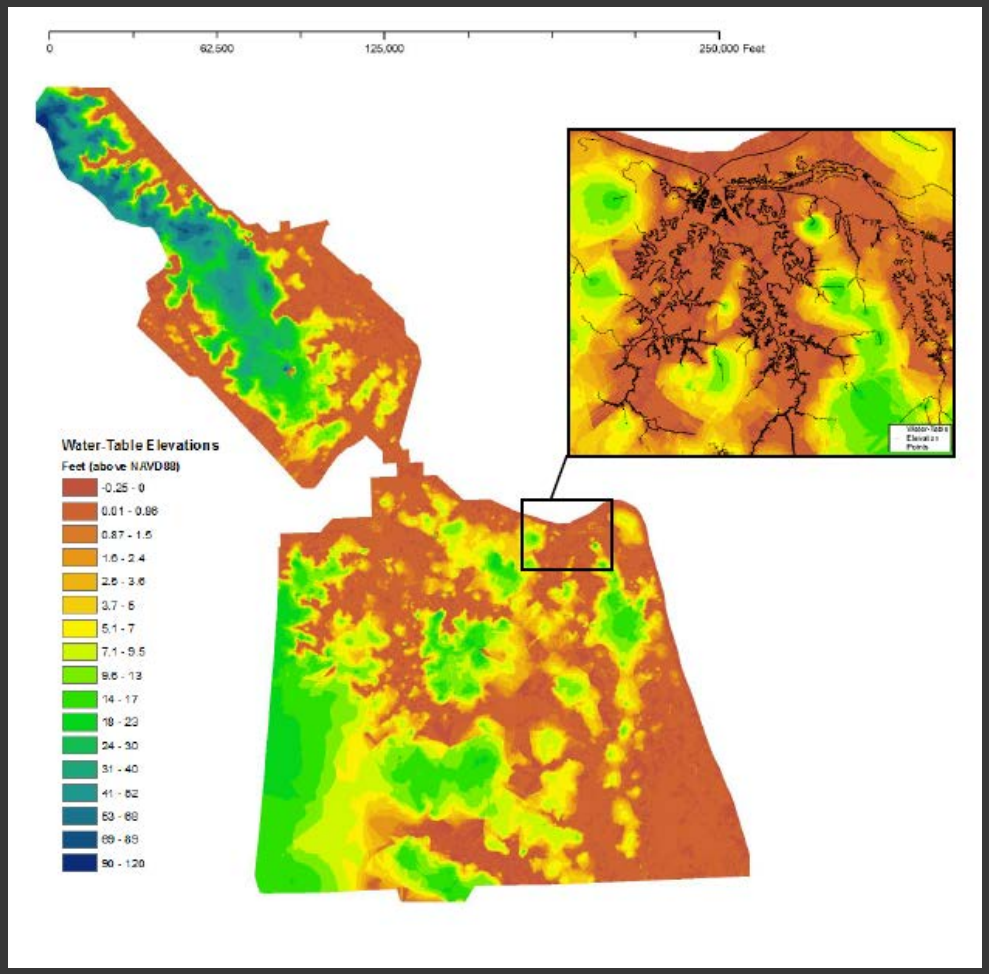
Surficial Aquifer and the Water Table



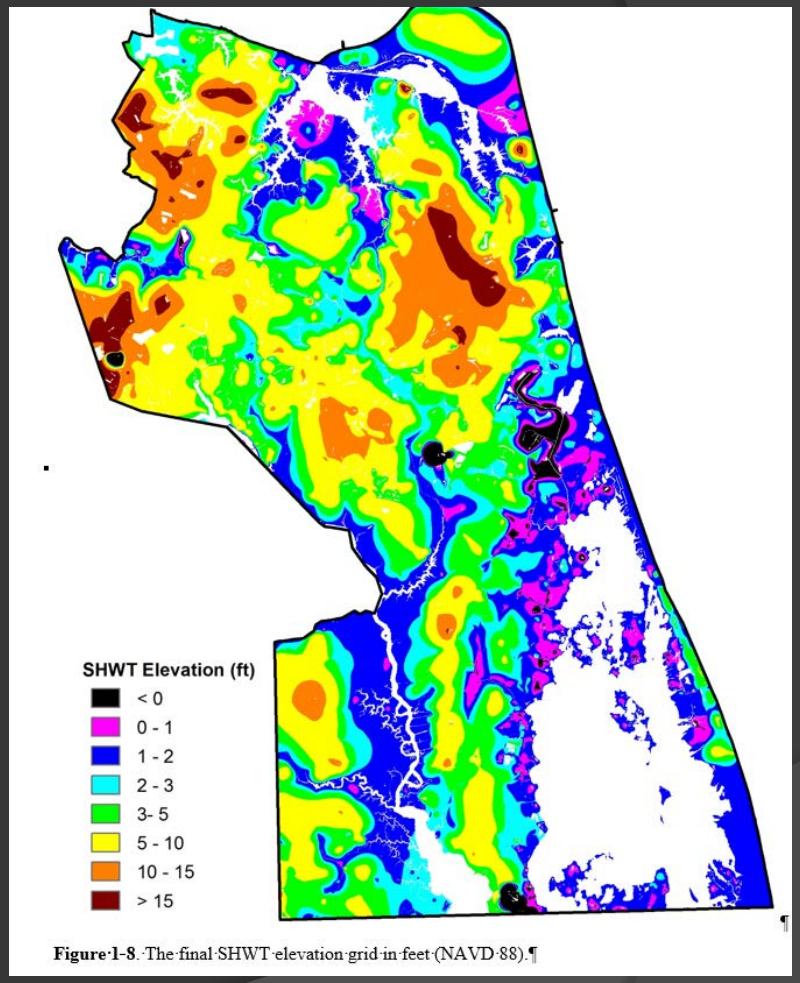
Well completed at 29 ft

Well completed at 87 ft

Mapping the Water Table

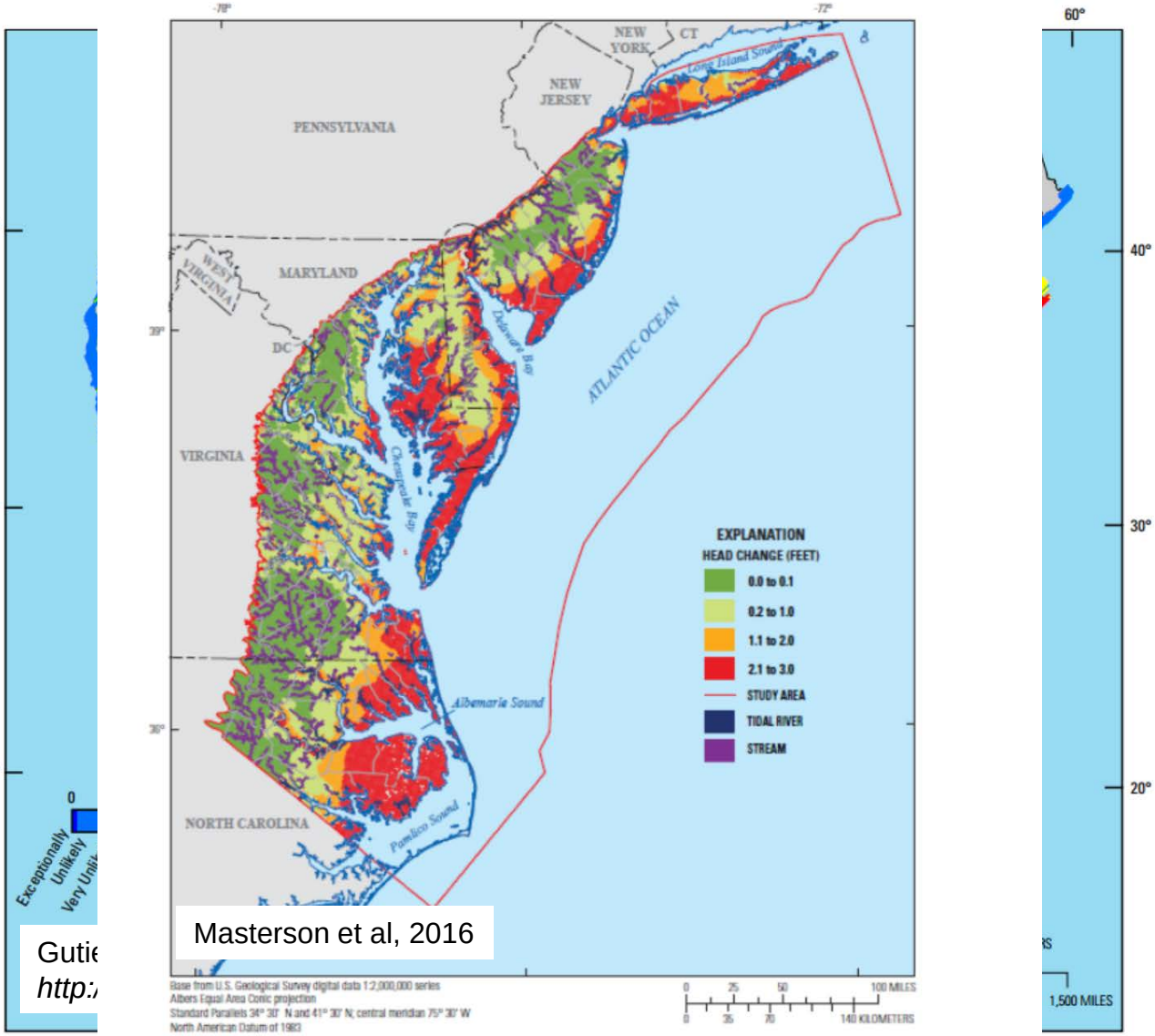


Moss (2016)



Johnson et al (*in review*)

SLR – Latest Updates



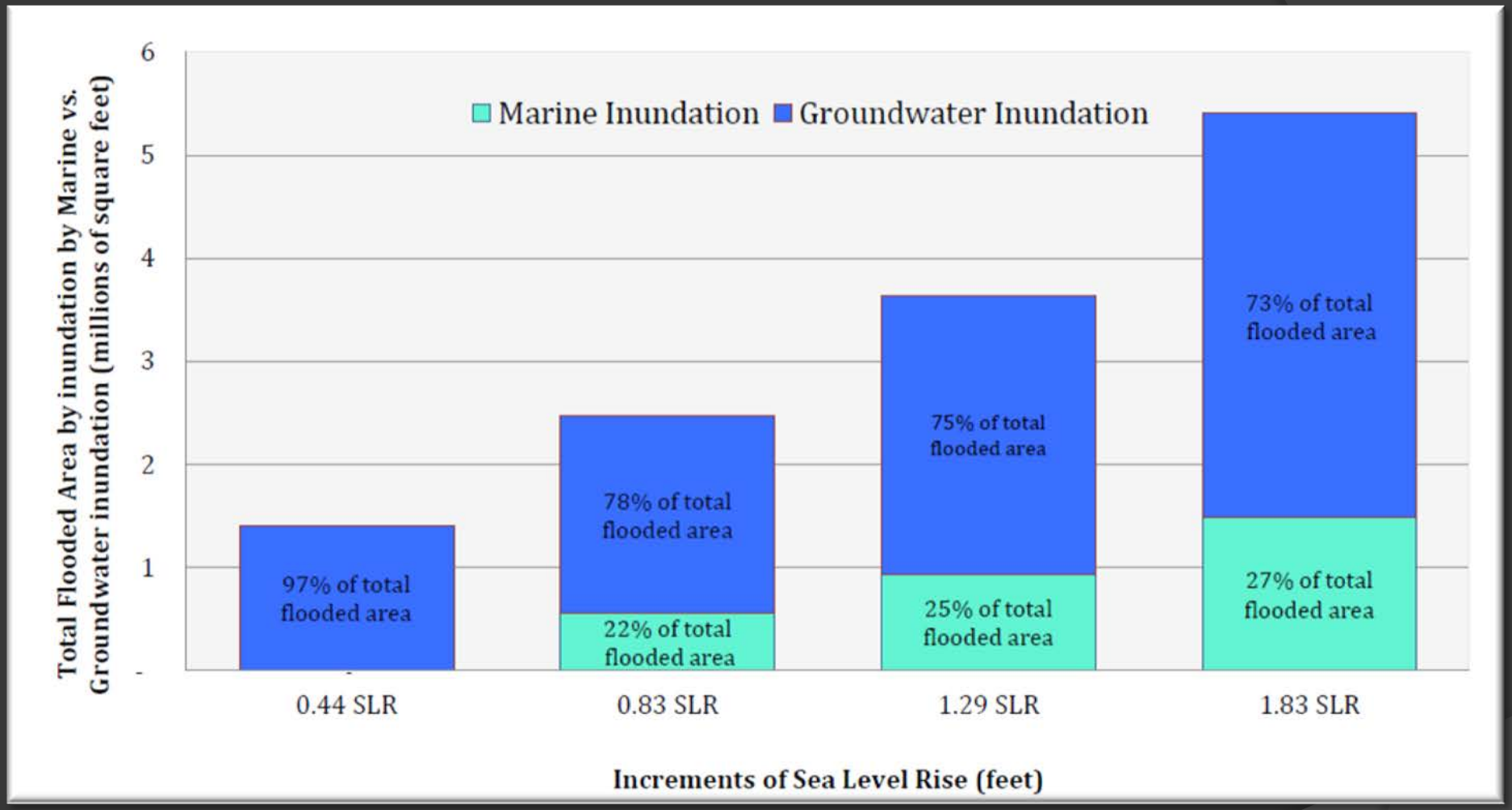
Masterson et al, 2016

Gutie
http:/

Figure 43: Increased water levels in the Surficial aquifer in response to 3-feet of increase in the current (2013) sea-level position across the Northern Atlantic Coastal Plain aquifer system.

Figure 14
per year. T
terminolog

meter
lihood


Marine Inundation
Groundwater Inundation
Total Flooded Area by inundation by Marine vs. Groundwater inundation (millions of square feet)
6
5
4
3
2
1
-
97% of total flooded area
78% of total flooded area
22% of total flooded area
75% of total flooded area
25% of total flooded area
73% of total flooded area
27% of total flooded area
0.44 SLR
0.83 SLR
1.29 SLR
1.83 SLR
Increments of Sea Level Rise (feet)

Moss, 2016

Recurr

Model
elevat

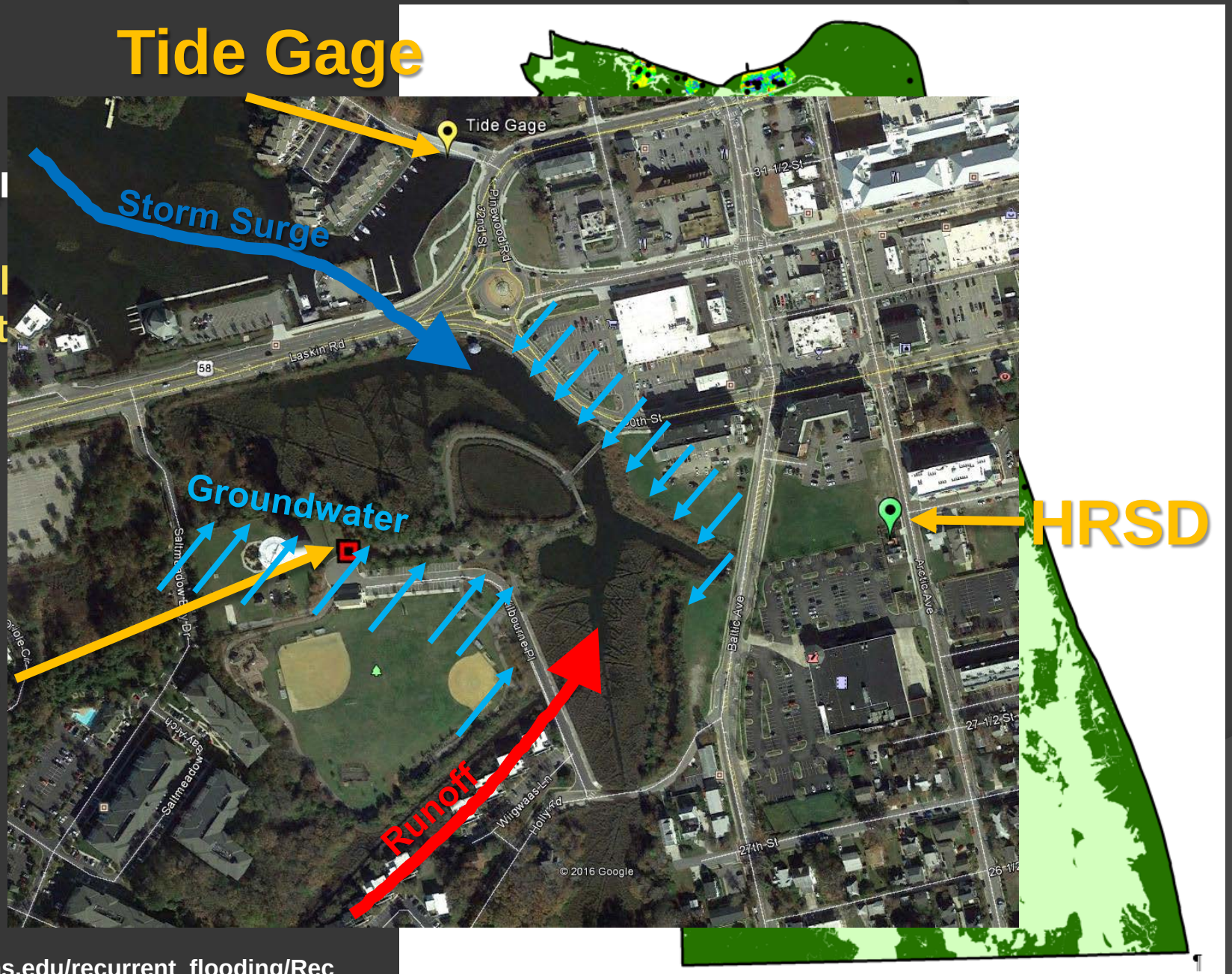


Figure 1-10. The SHWT depth grid filtered according to flood report density greater than 4 per

http://ccrm.vims.edu/recurrent_flooding/Recurrent_Flooding_Study_web.pdf

Johnson et al (*in review*)

Conclusions

1. Flexible yet Robust groundwater monitoring network

2. Shallow Groundwater is garnering attention
   a) VaTech, ODU
   b) HRPDC, HRSD, VaBeach Public Works

3. Water table will be first to respond to SLR and climate change