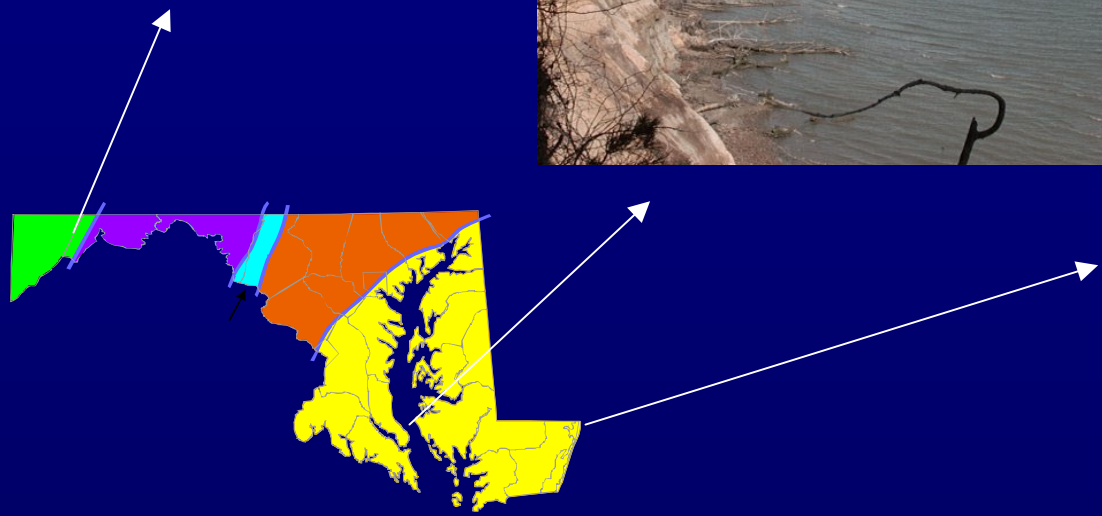
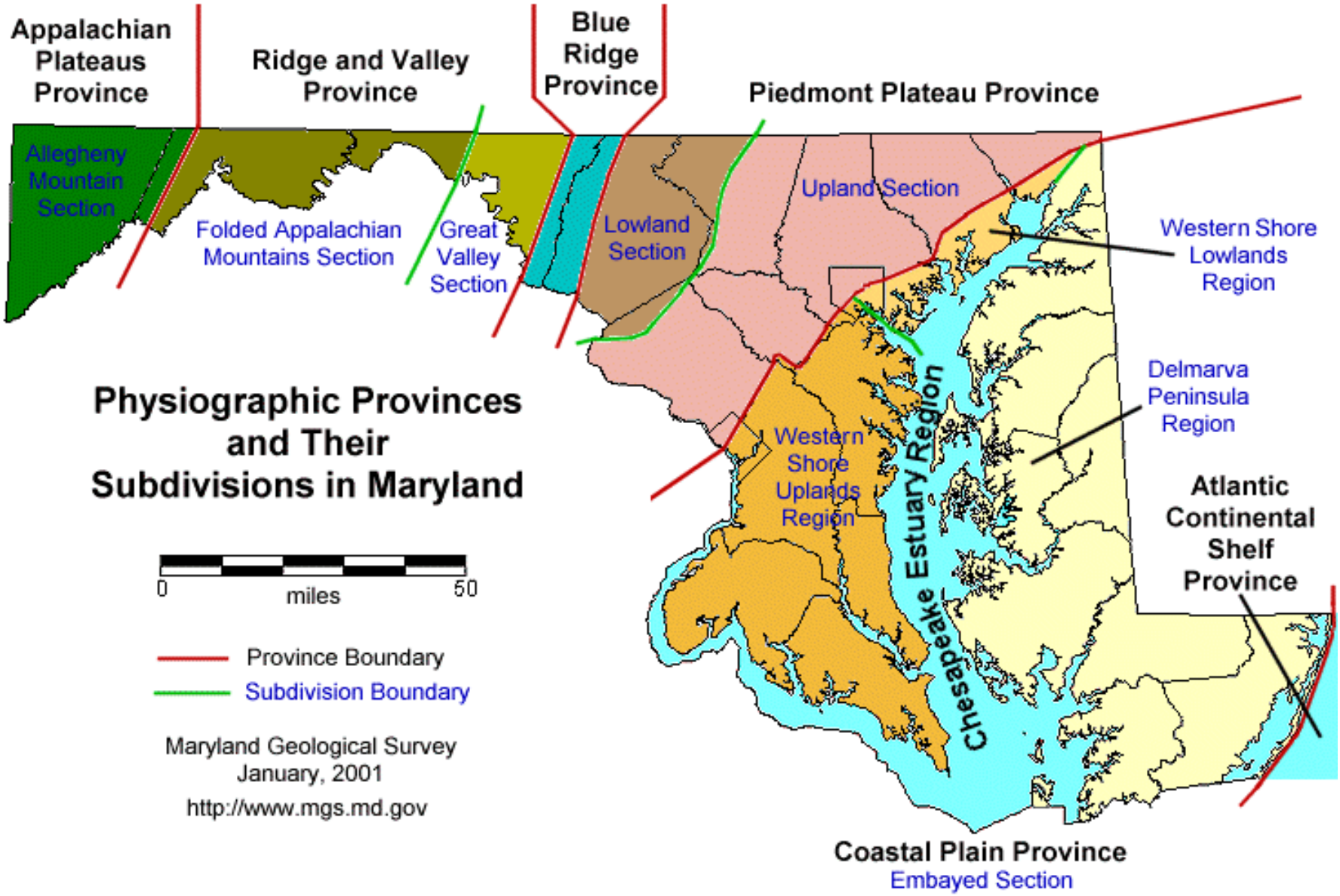
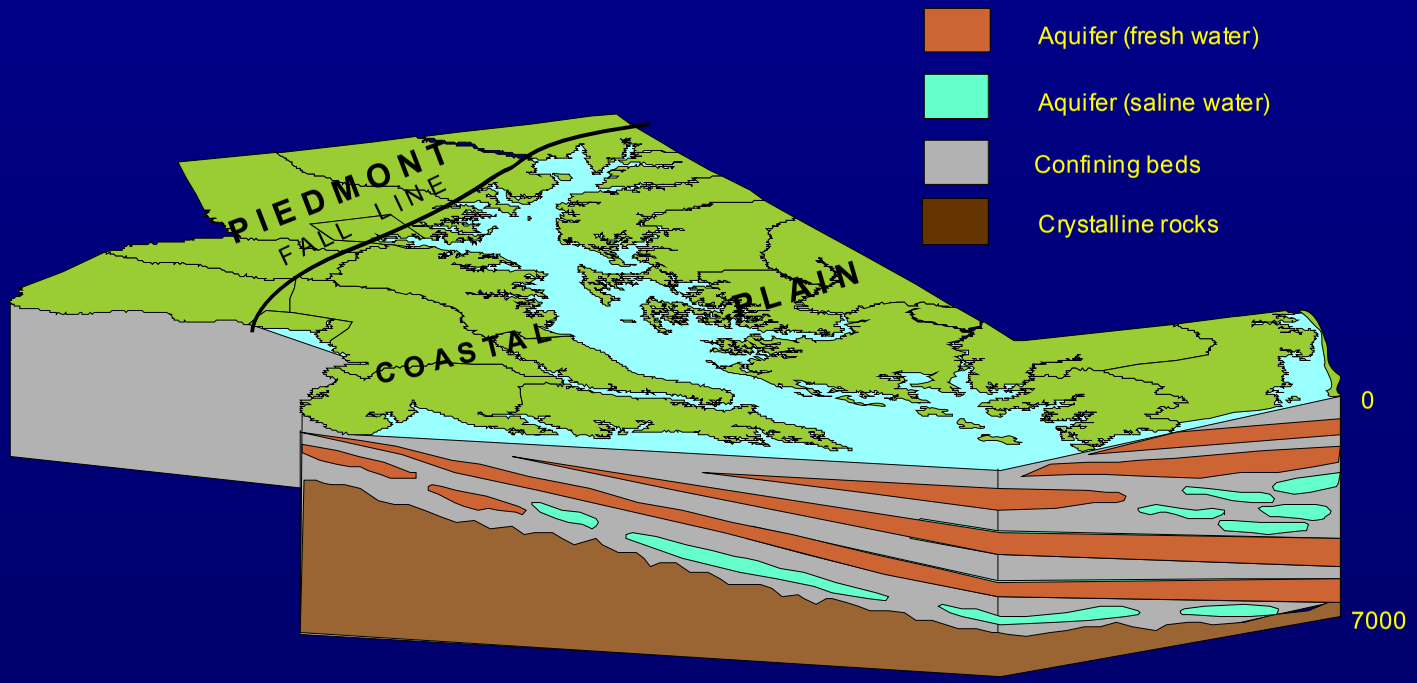
Maryland: "America in miniature"



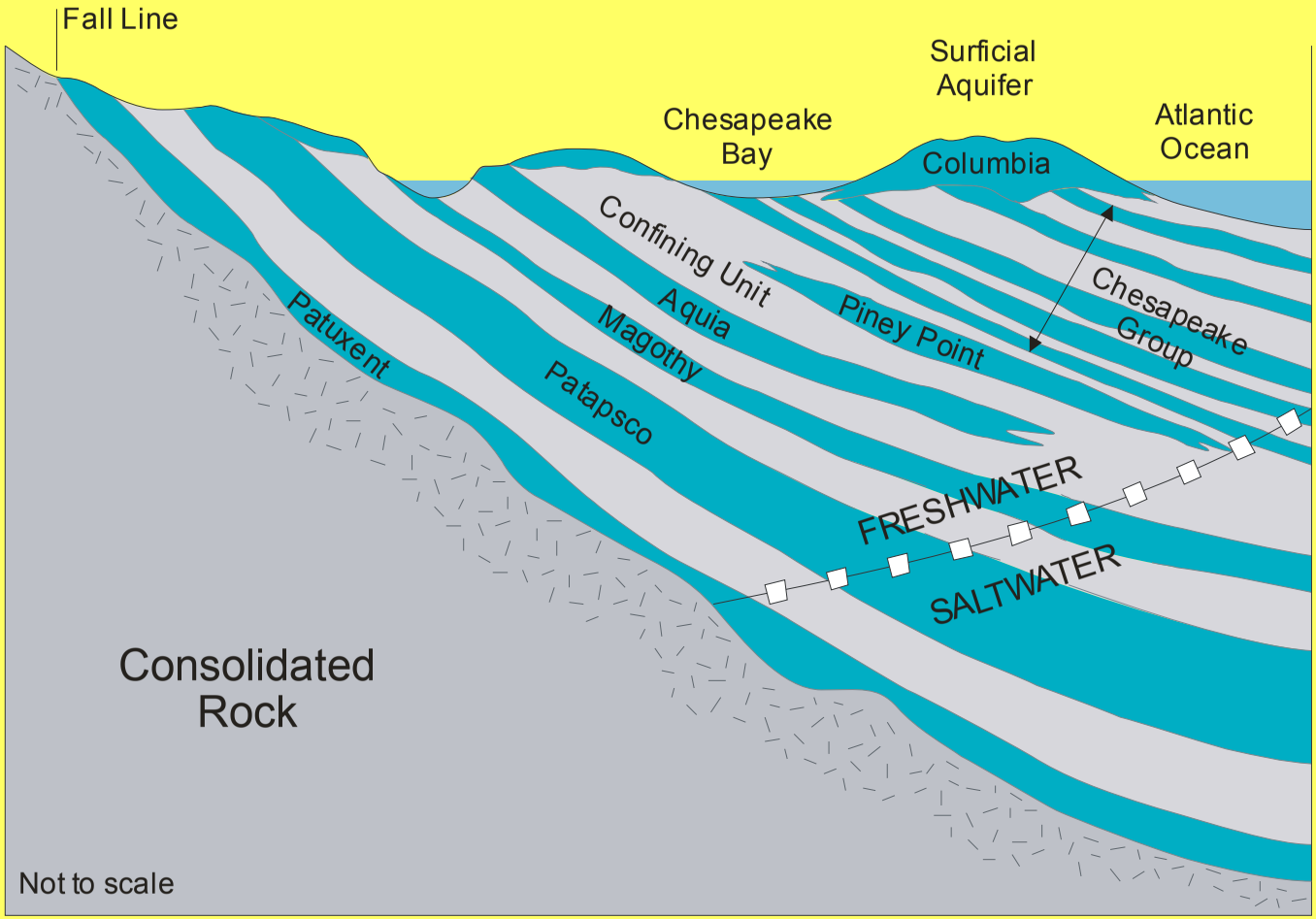

Appalachian Plateaus Province
Ridge and Valley Province
Blue Ridge Province
Piedmont Plateau Province
Allegheny Mountain Section
Folded Appalachian Mountains Section
Great Valley Section
Lowland Section
Upland Section
Western Shore Lowlands Region
Delmarva Peninsula Region
Western Shore Uplands Region
Chesapeake Estuary Region
Atlantic Continental Shelf Province
Physiographic Provinces and Their Subdivisions in Maryland
0
miles
50
Province Boundary
Subdivision Boundary
Maryland Geological Survey
January, 2001
http://www.mgs.md.gov
Coastal Plain Province
Embayed Section

Coastal Plain groundwater characteristics:

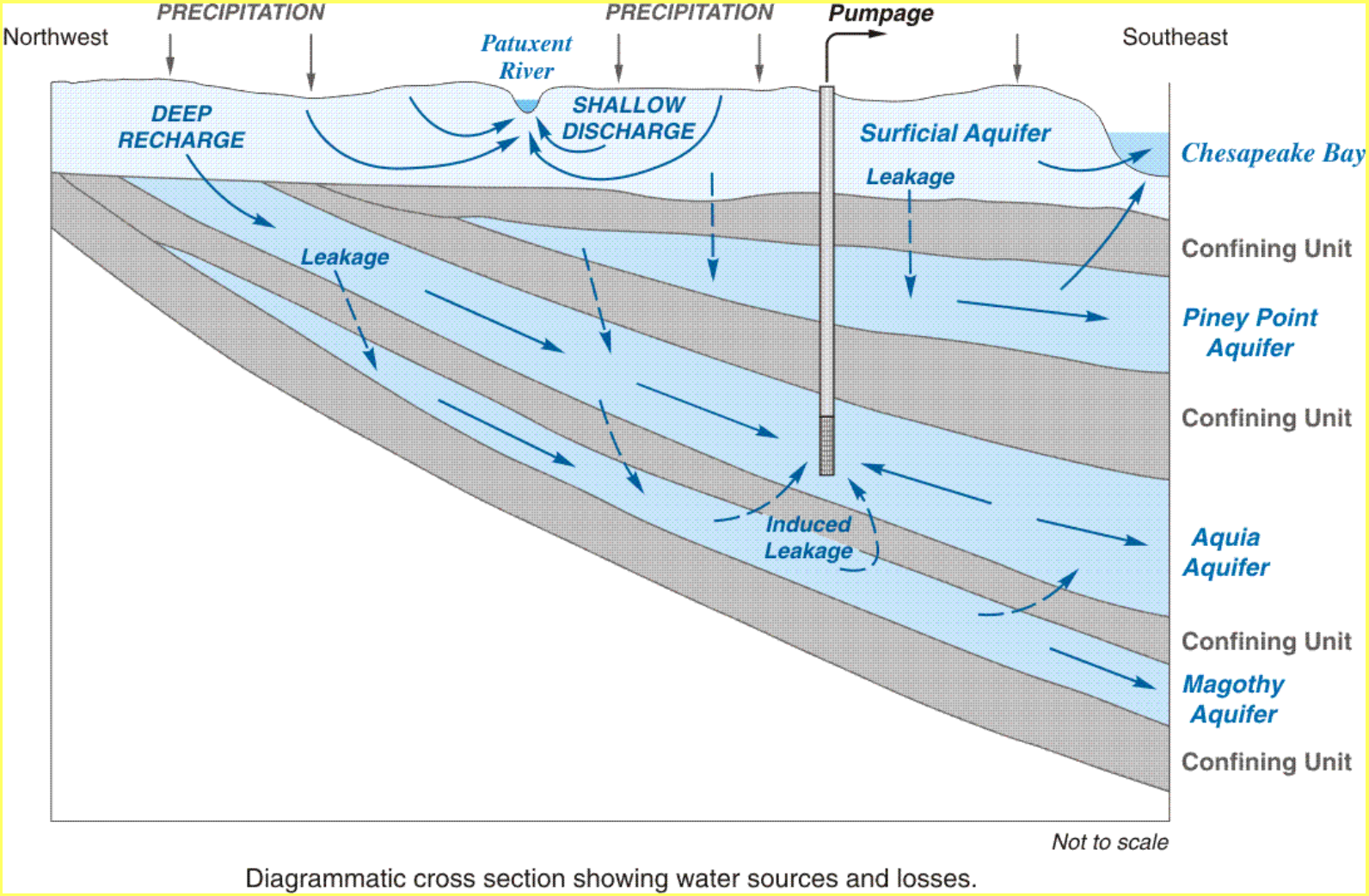
- Unconsolidated sediments
- Confined aquifers
- Usually high well yields



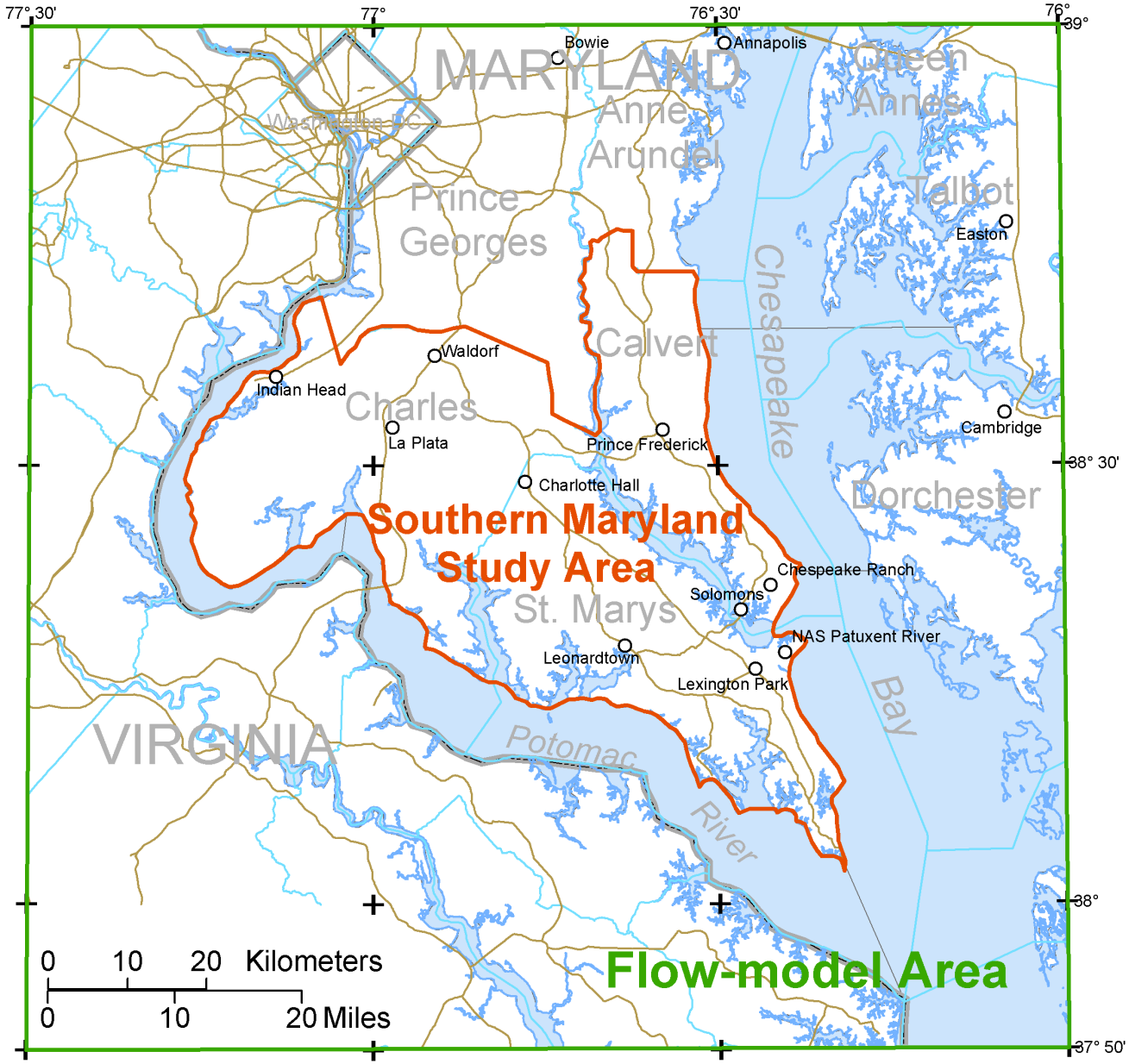
Maryland's Major Coastal Plain Aquifers



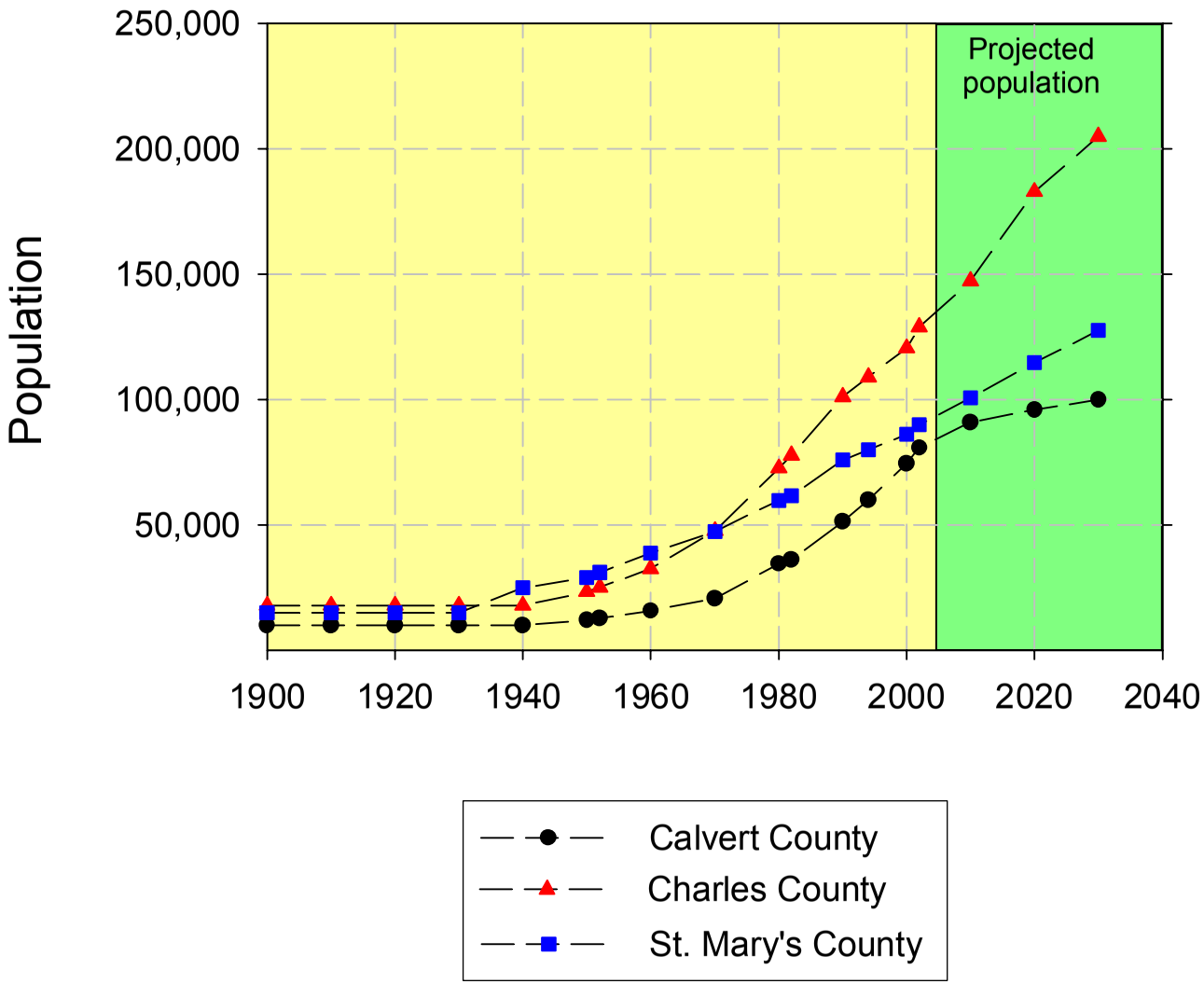
Components of Groundwater Flow



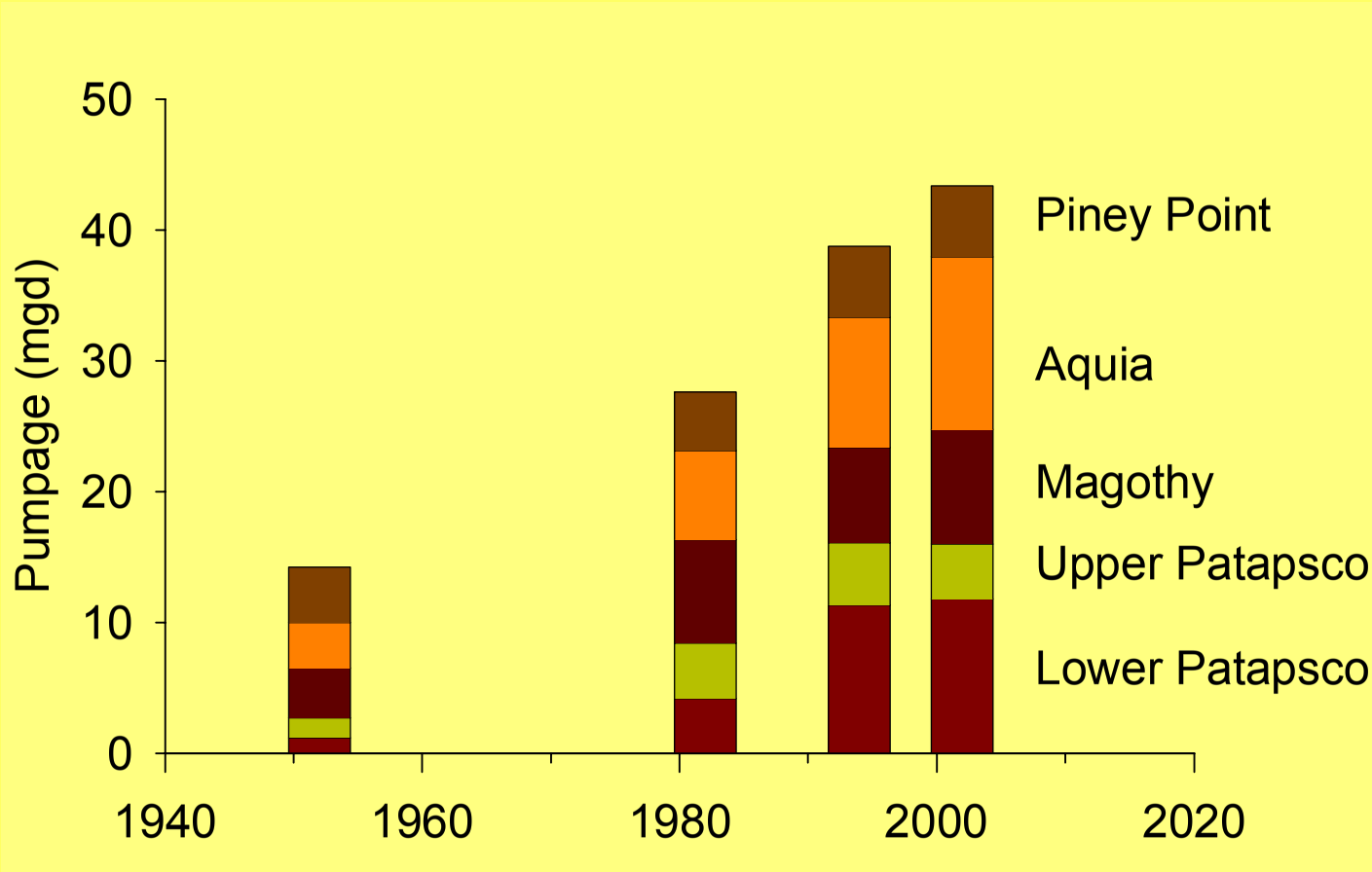
Diagrammatic cross section showing water sources and losses.


77° 30'
77°
76° 30'
76°
39°
38° 30'
38°
37° 50'
MARYLAND
VIRGINIA
Washington DC
Bowie
Annapolis
Queen Annes
Anne Arundel
Talbot
Easton
Prince Georges
Chesapeake
Calvert
Waldorf
Indian Head
Charles
La Plata
Prince Frederick
Cambridge
Charlotte Hall
Dorchester
Southern Maryland Study Area
Chespeake Ranch
Solomons
St. Marys
NAS Patuxent River
Leonardtown
Lexington Park
Bay
Potomac River
0 10 20 Kilometers
0 10 20 Miles
Flow-model Area

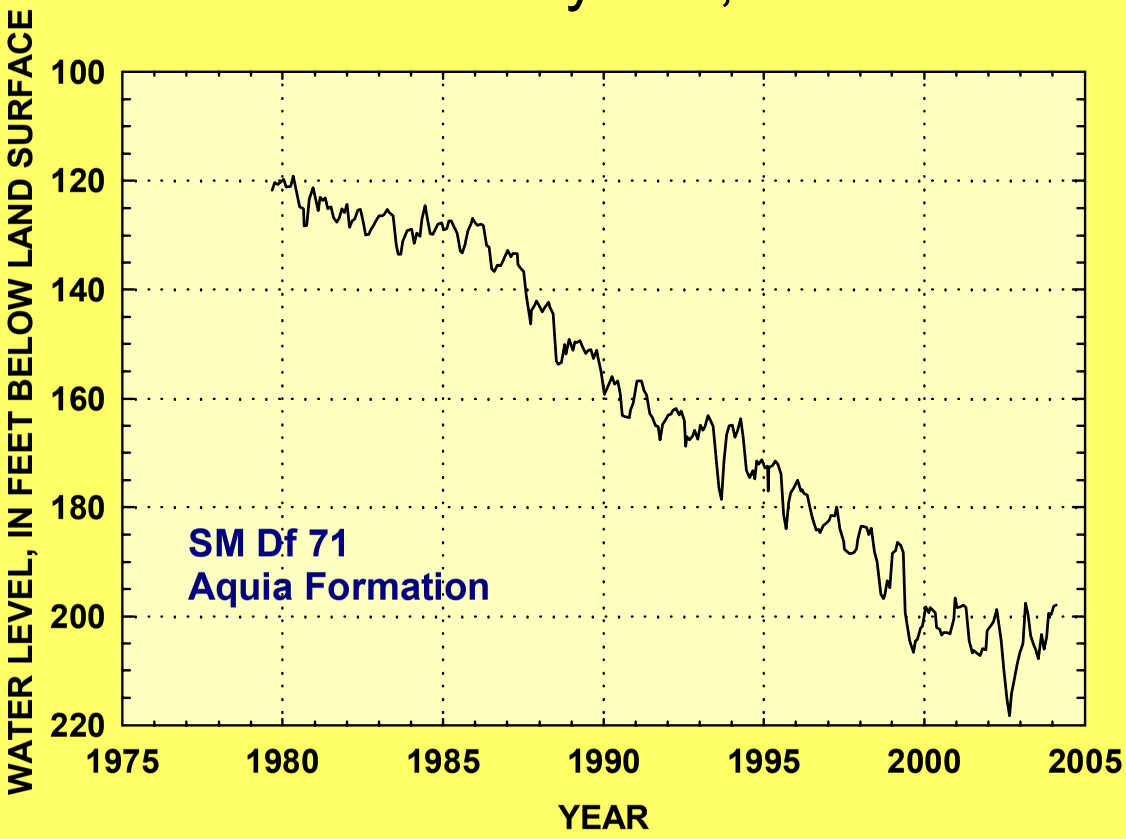
Historic and projected population in Calvert, Charles, and St. Mary's Counties



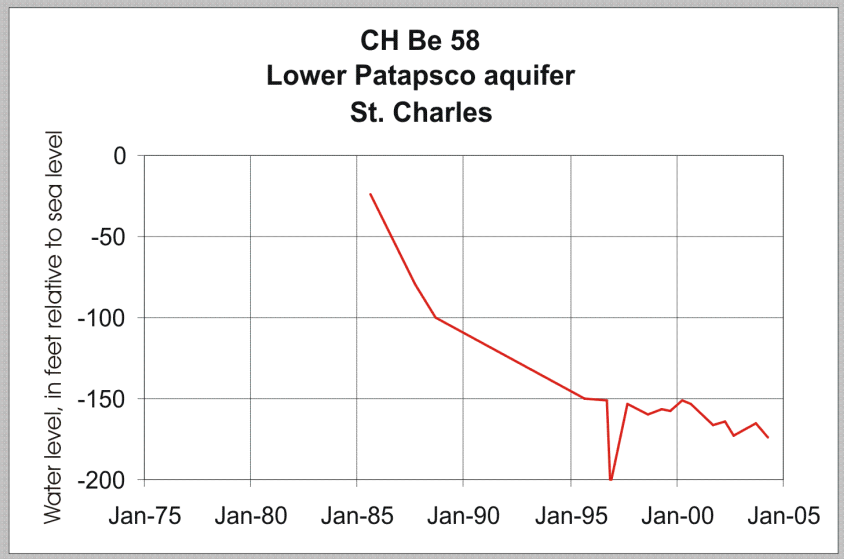
Groundwater withdrawals in Southern Maryland

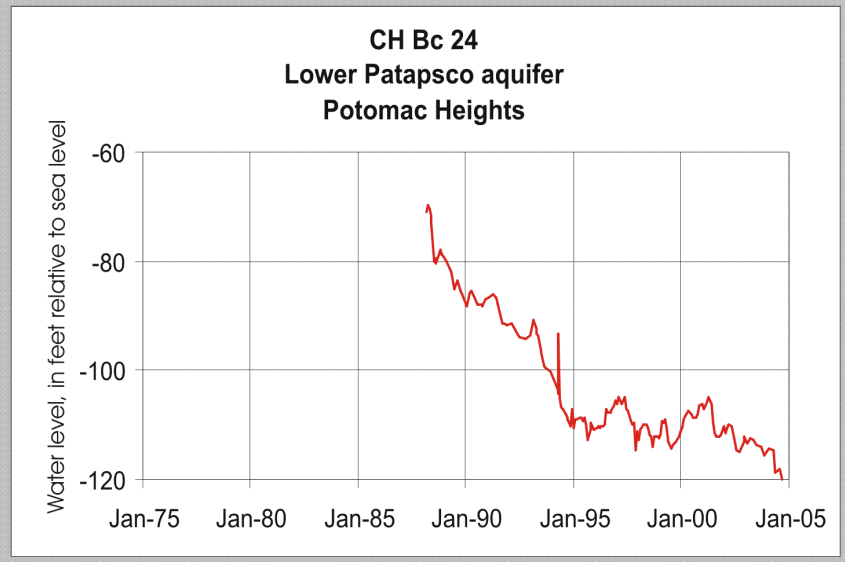


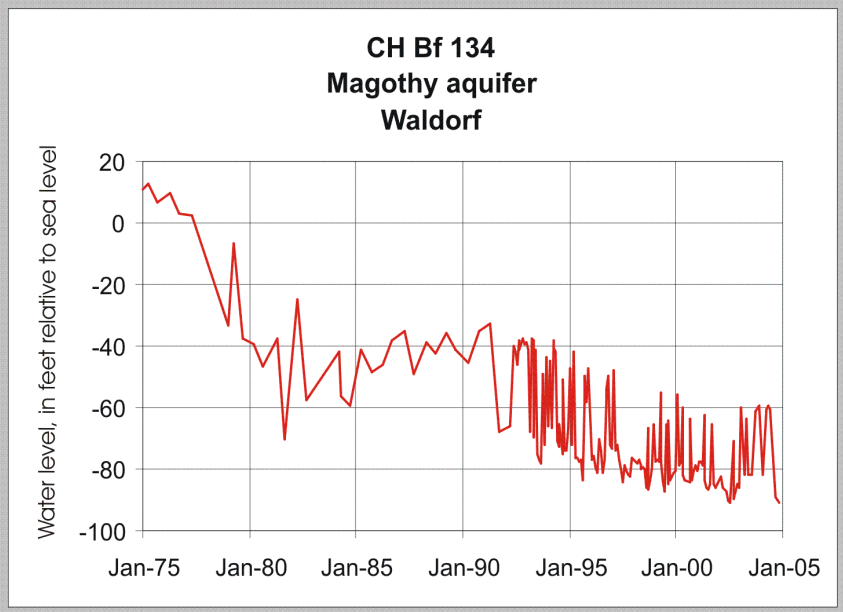
Water Levels in Aquia Aquifer in Southern Maryland, 1980-2004

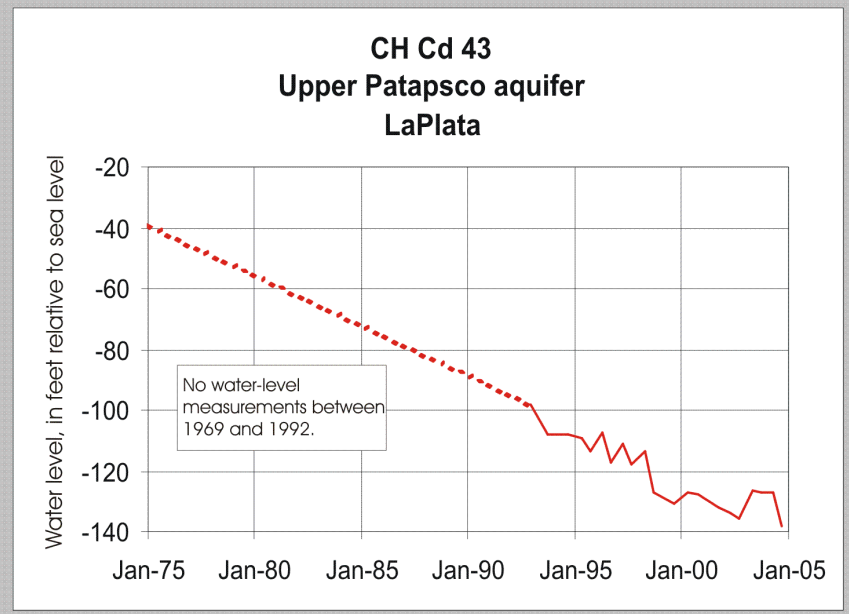


Hydrographs showing long-term water-level trends in Charles County.

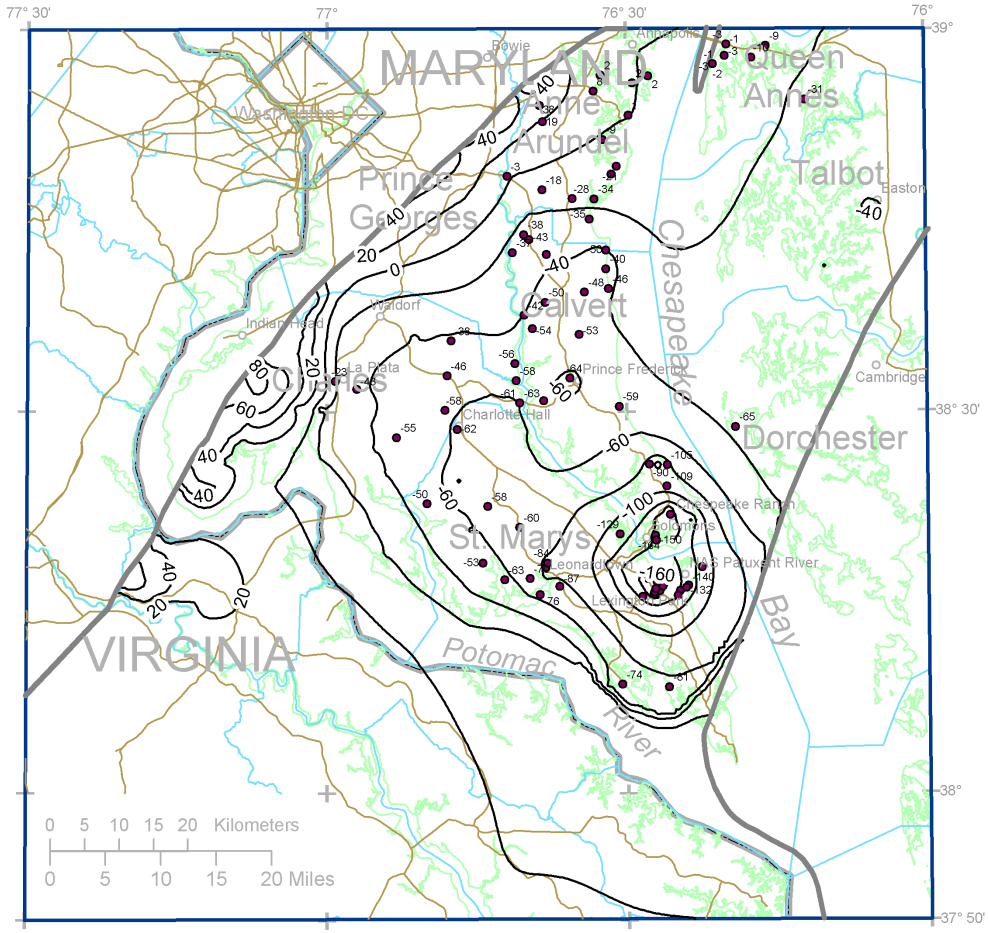








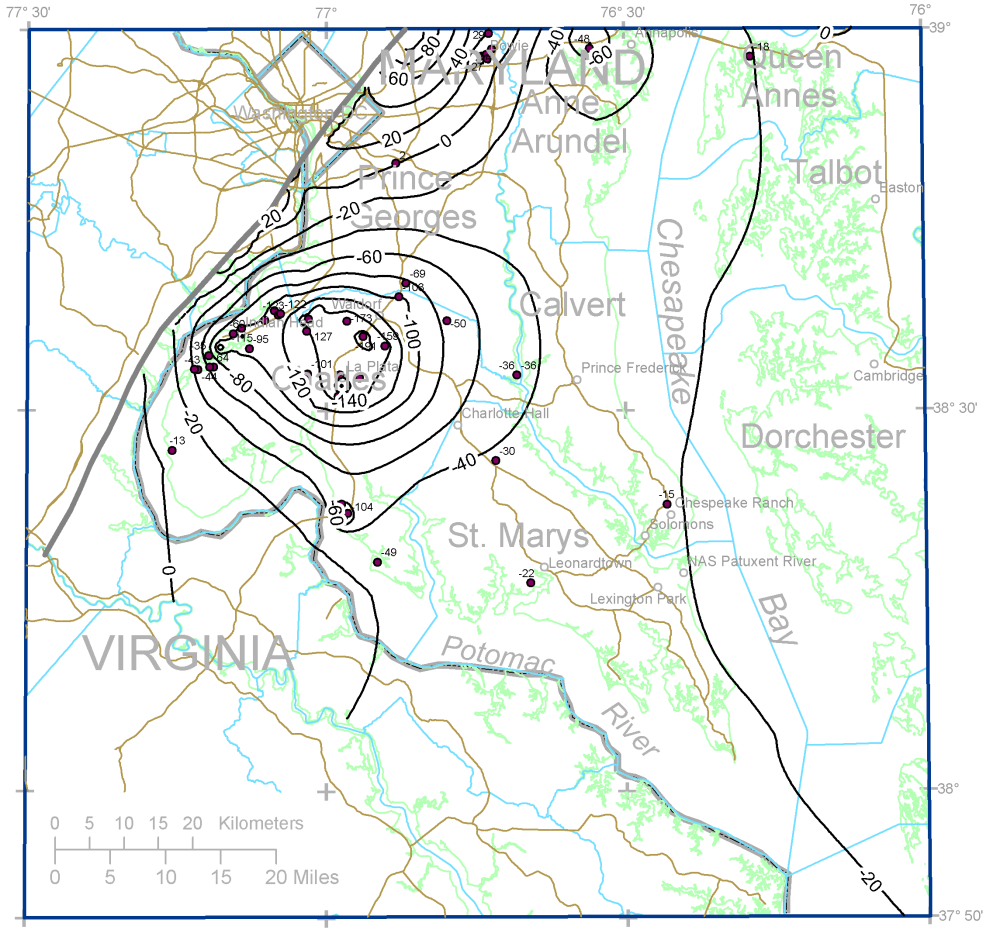
Simulated potentiometric surface in the Aquia aquifer, 2002.



Explanation

- Contour of the simulated potentiometric surface, in feet
- Approximate extent of the Aquia aquifer
- Measured head, in feet

Simulated potentiometric surface in the Lower Patapsco aquifer, 2002.



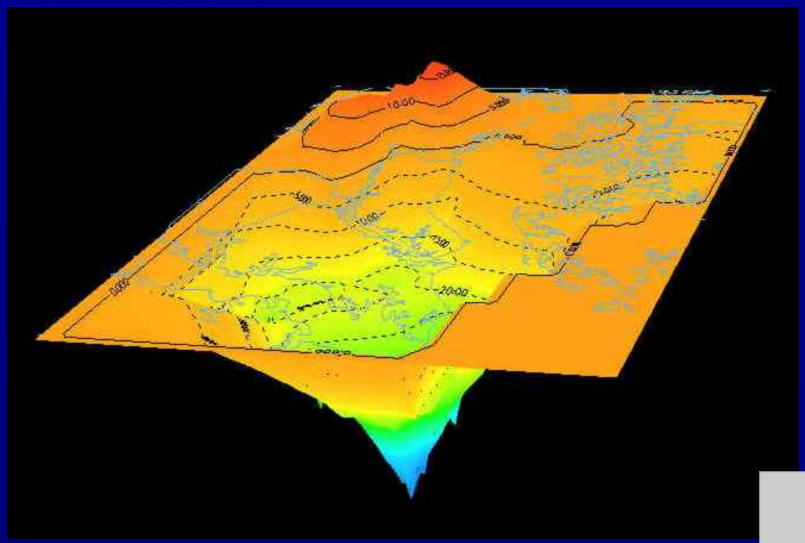
Explanation

- Contour of the simulated potentiometric surface, in feet
- Approximate extent of the Lower Patapsco aquifer
- Measured head, in feet

Potential consequences of declining groundwater levels:

- Greater pump lift, higher energy costs.
- Failed wells (telescoping).
- Exceedence of management levels
- Brackish-water intrusion
- Contaminant migration
- Land subsidence
- Reduced baseflow to streams
- Altered wetland ecology

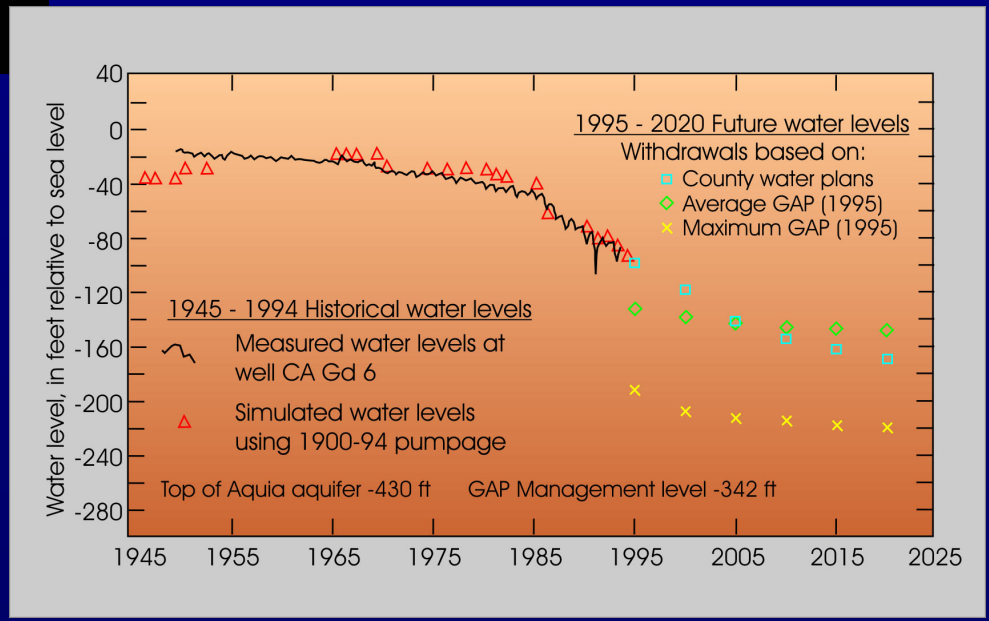
Groundwater Flow Modeling



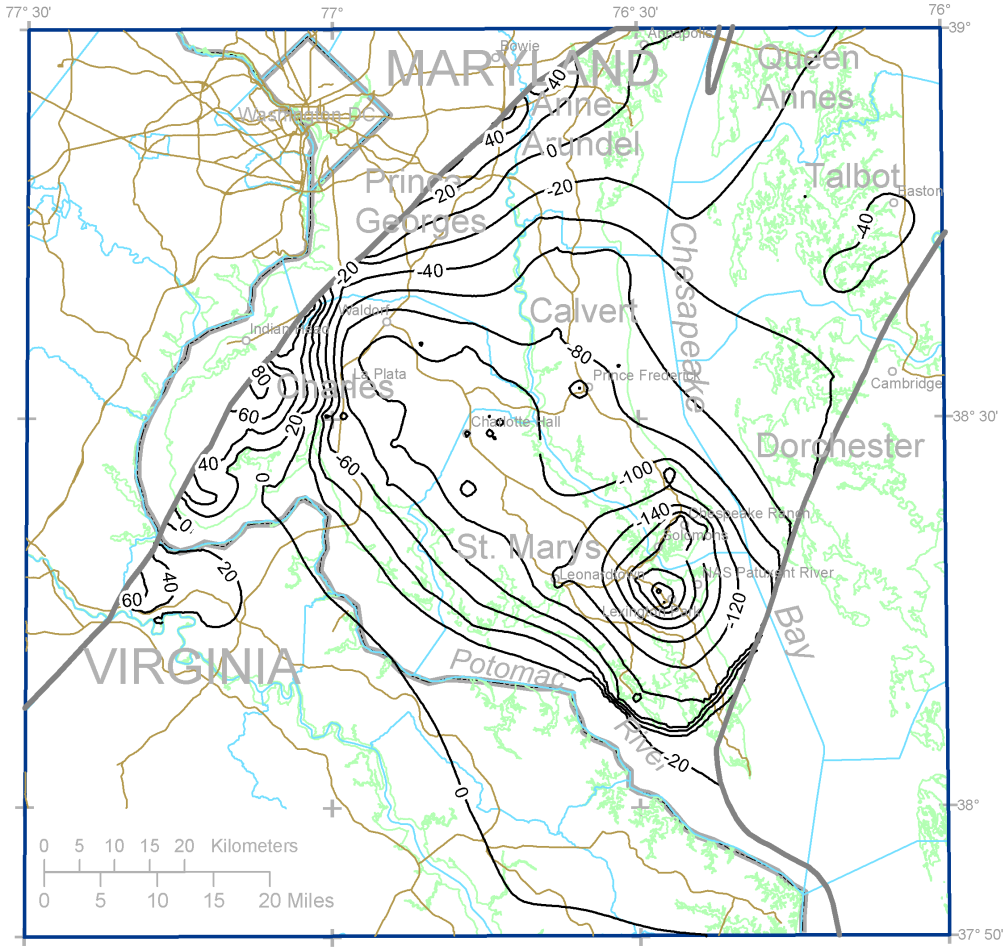
Finite-difference approach

Predictive capabilities

Model calibration critical;
can't be done without
historical water-level data!



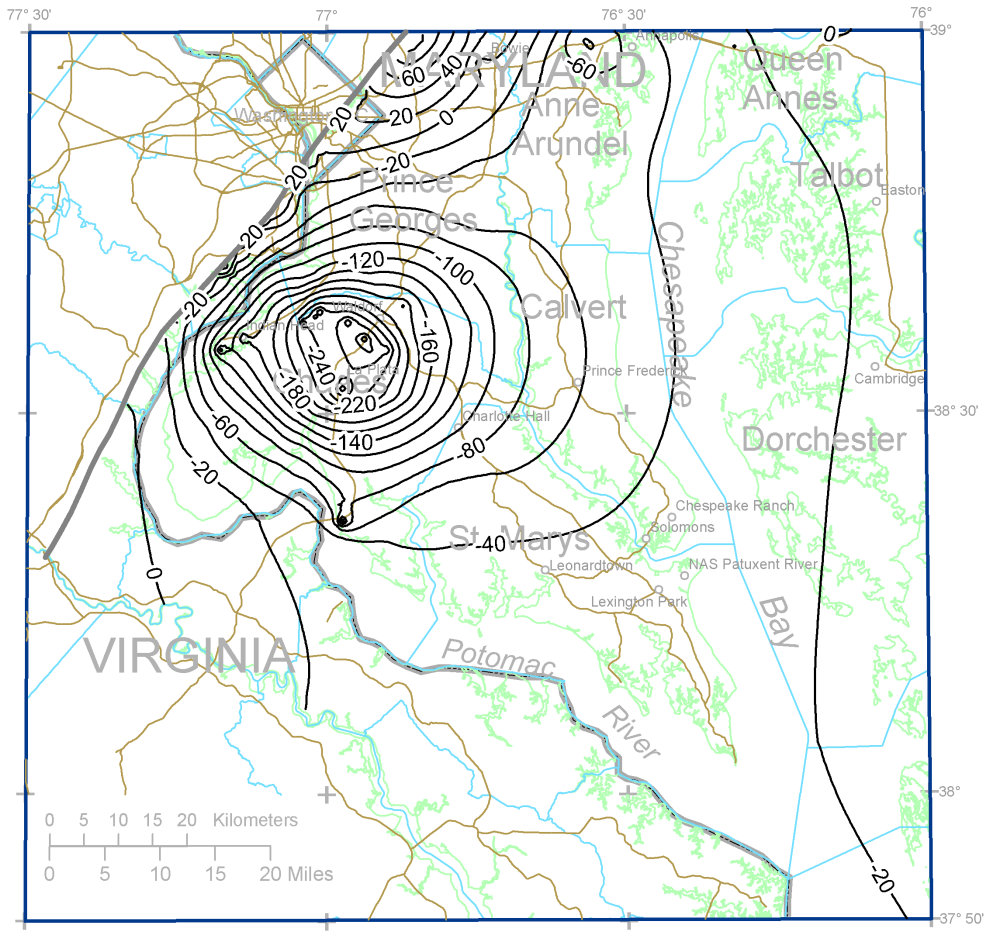
Simulated potentiometric surface in the Aquia aquifer, 2030, based on Scenario 1.



Explanation

- Contour of the simulated potentiometric surface, in feet
- Approximate extent of the Aquia aquifer

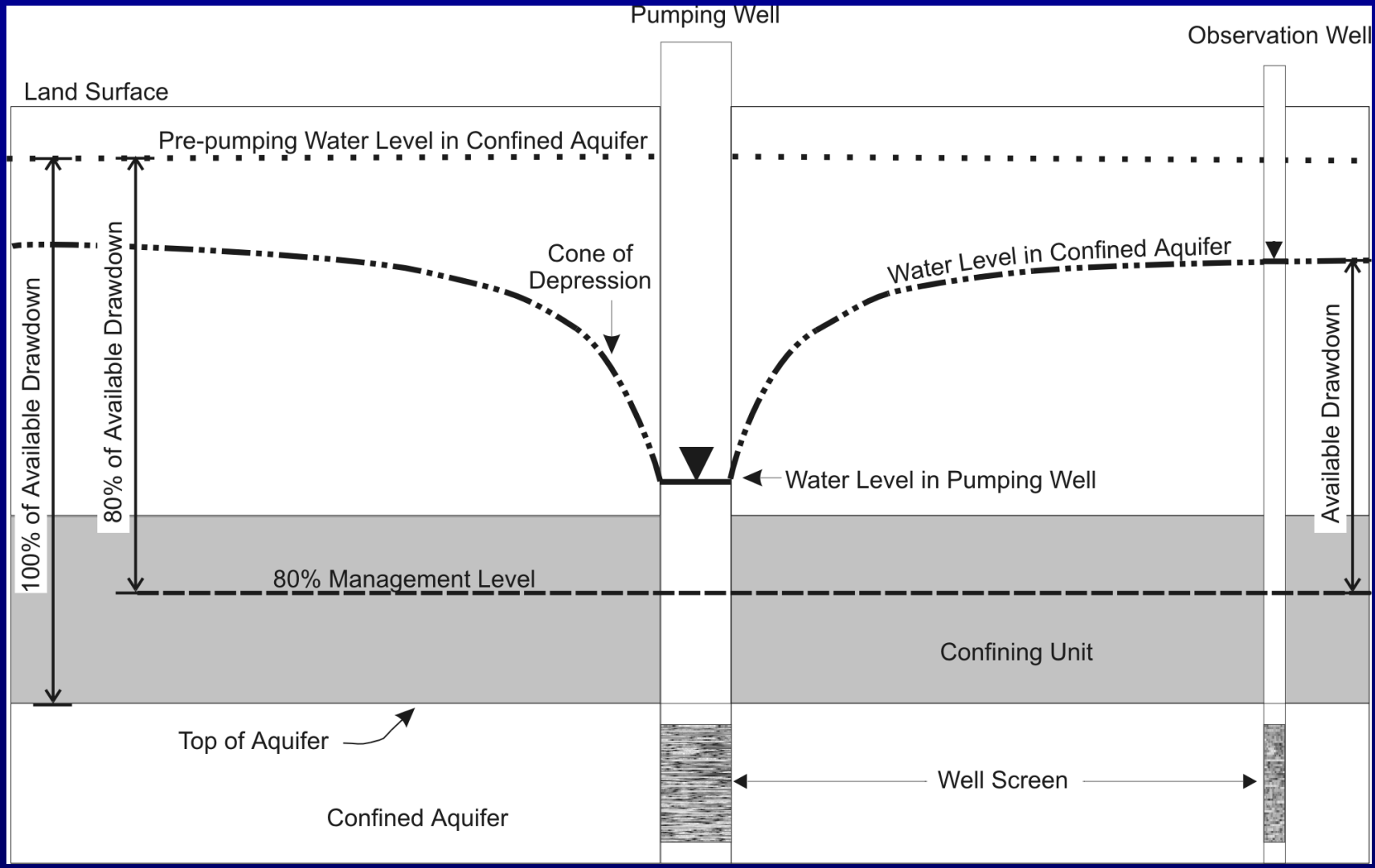
Simulated potentiometric surface in the Lower Patapsco aquifer, 2030, based on Scenario 1.



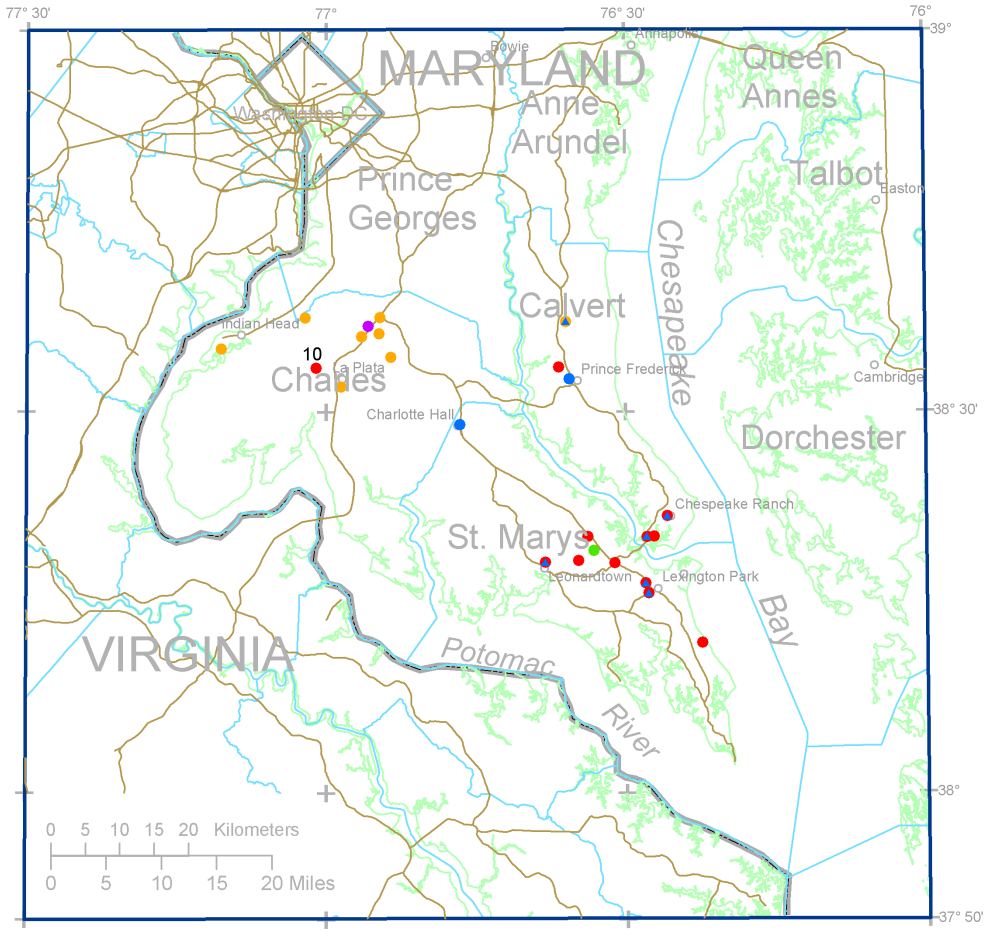
Explanation

- Contour of the simulated potentiometric surface, in feet
- Approximate extent of the Lower Patapsco aquifer

So…what do these declining water levels mean?



Critical locations for model results



Explanation

3 Critical location with model results shown in summary tables

Aquifer codes

- Piney Point
- Aquia
- Magothy
- Two aquifers shown at same location
- Upper Patapsco
- Lower Patapsco

Summary of model results for critical locations in Charles County, 2030

	Management		Simulated Head			Remaining Available Drawdown		
Aquifer	Location	level	Scenario			Scenario		
			1	2b	5b	1	2b	5b
Upper Patapsco	LaPlata	-205	-195	-235	-220	10	-30	-15
Lower Patapsco	LaPlata	-574	-291	-351	-350	282	223	224
Magothy	Waldorf	-177	-216	-270	-112	-39	-93	65
Lower Patapsco	Indian Head	-129	-166	-201	-179	-37	-72	-50
Lower Patapsco	Waldorf	-594	-314	-378	-419	281	216	175
Lower Patapsco	Bensville	-400	-267	-323	-314	133	77	86
Lower Patapsco	Billingsly Road	-693	-234	-282	-309	459	411	384
Lower Patapsco	Waldorf Fire Station	-635	-211	-254	-303	425	381	332
Lower Patapsco	Barrington Drive	-642	-243	-293	-342	399	349	300

Groundwater Quality in the Maryland Coastal Plain

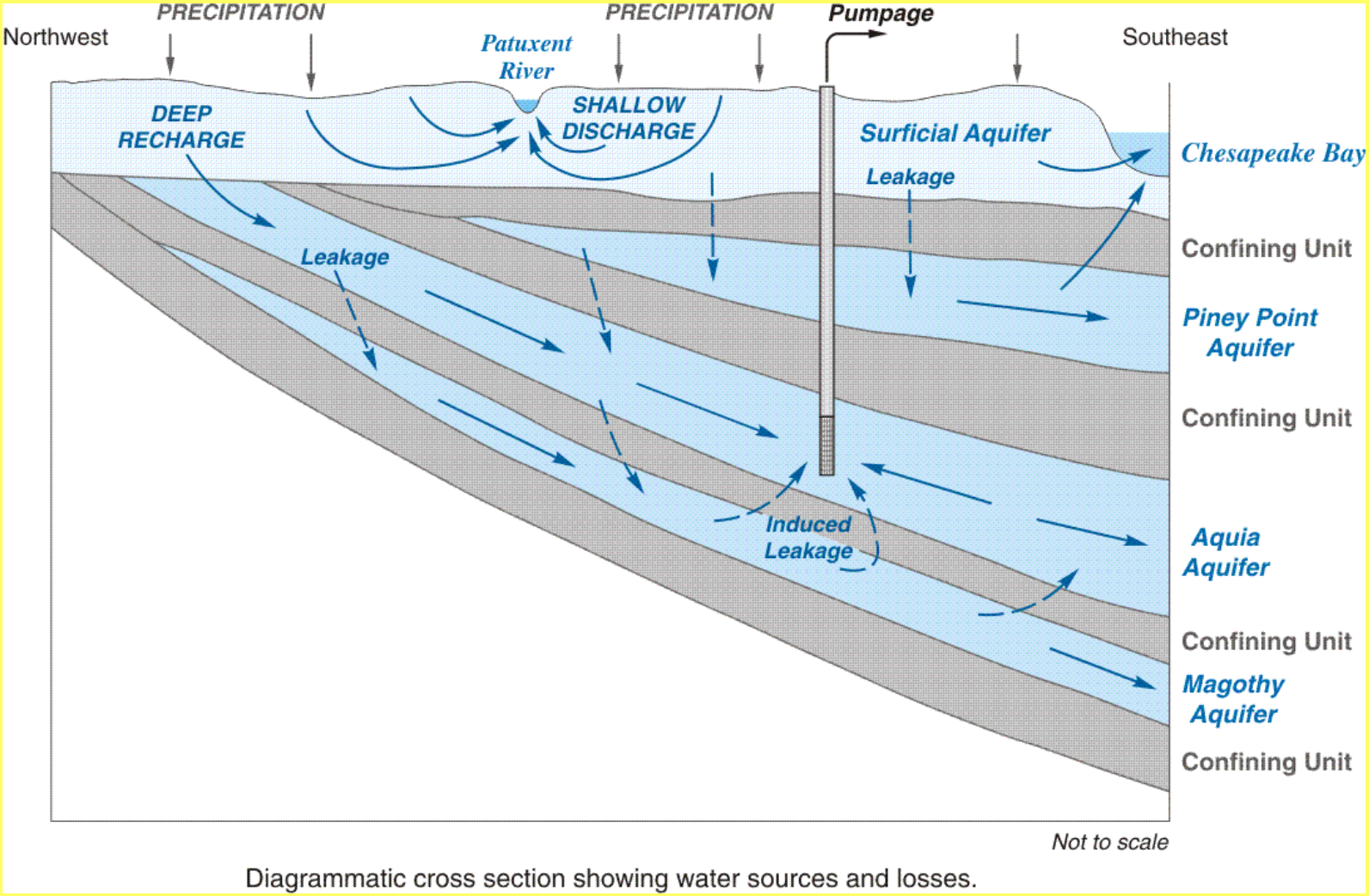
Spatially variable due to:

- Complex flow systems
- Variable and complex mineralogy
- Land use in recharge area
- Oxidation-reduction reactions

Limits on use due to:

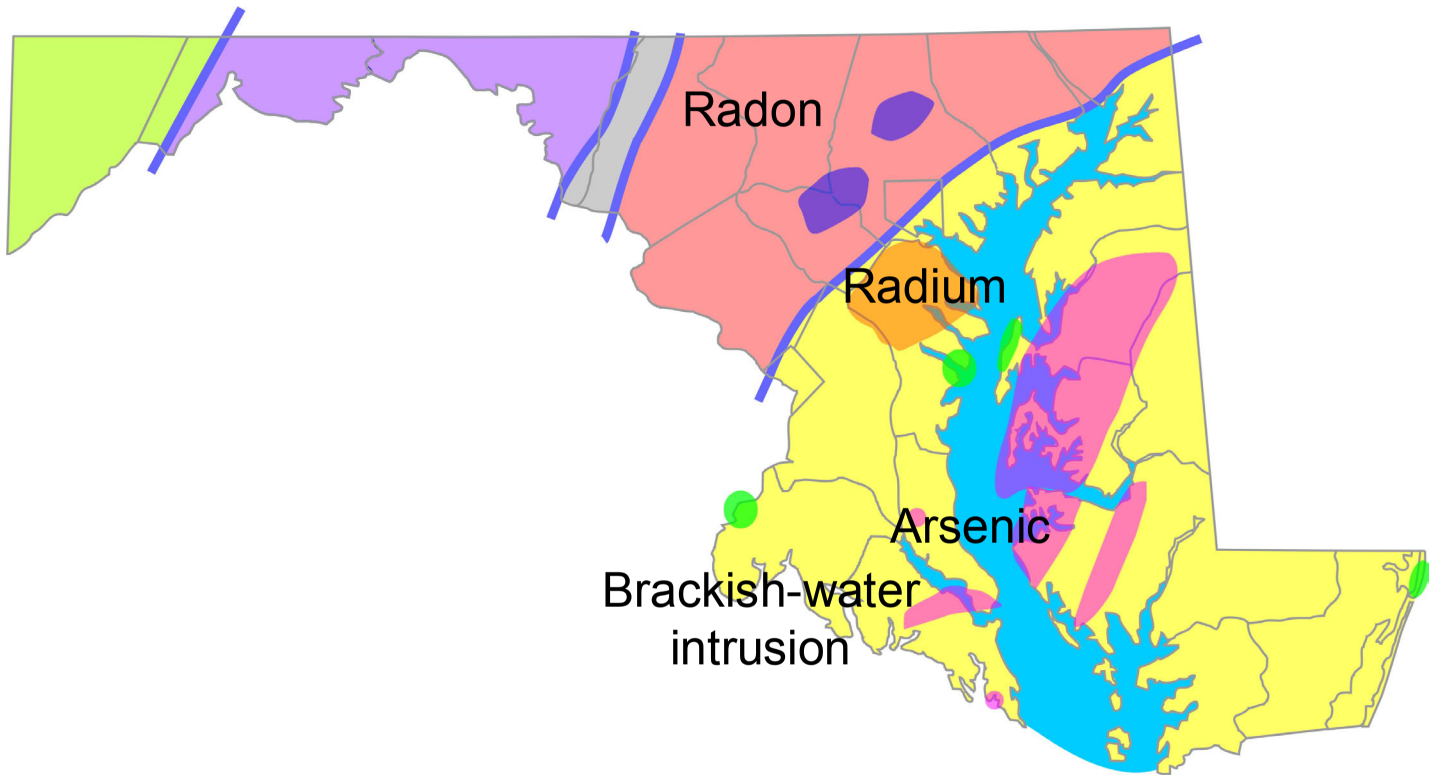
- Health issues (arsenic, radium)
- Aesthetics (pH, iron)
- Unsuitability for particular uses (many constituents)

Groundwater Quality



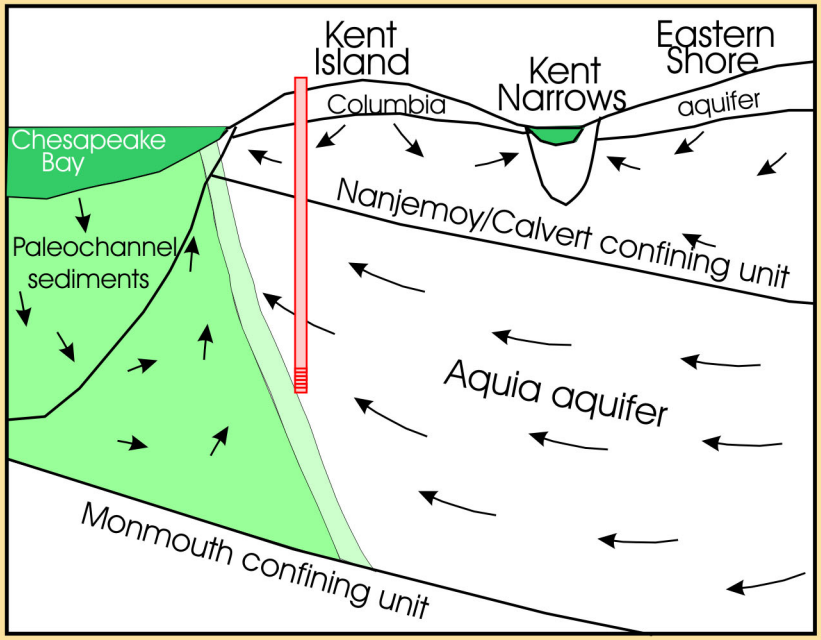
Diagrammatic cross section showing water sources and losses.

Regional groundwater quality issues in Maryland

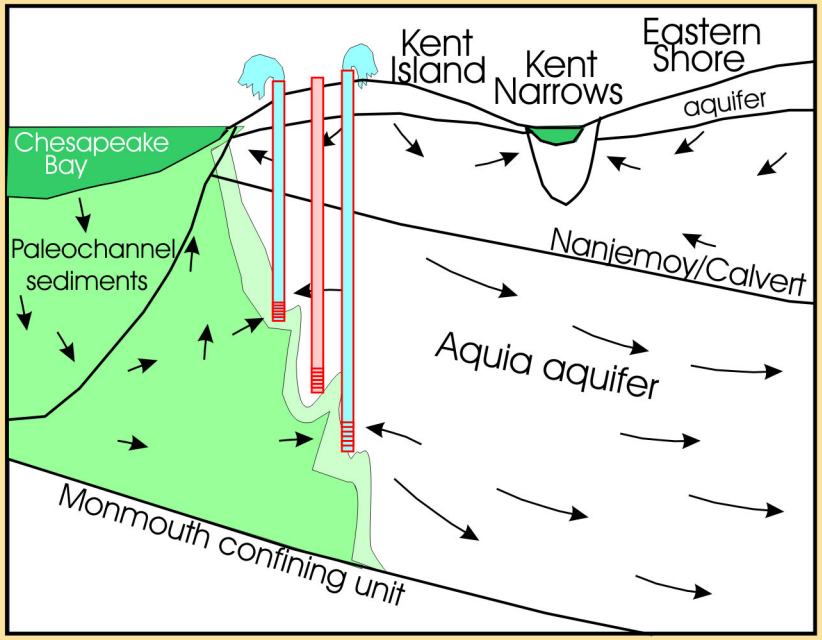


Brackish-water intrusion

Central Kent Island

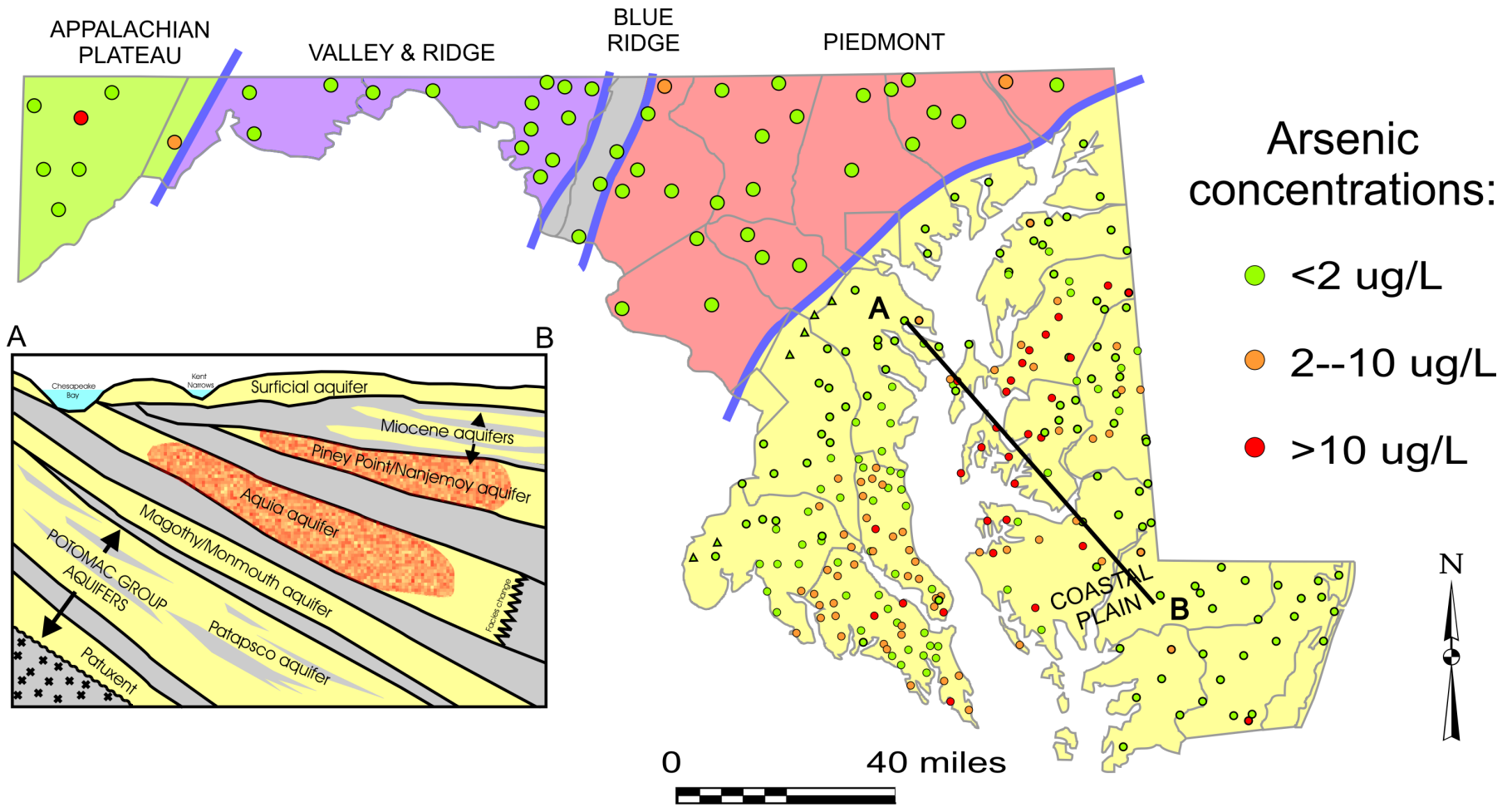


Prepumping conditions

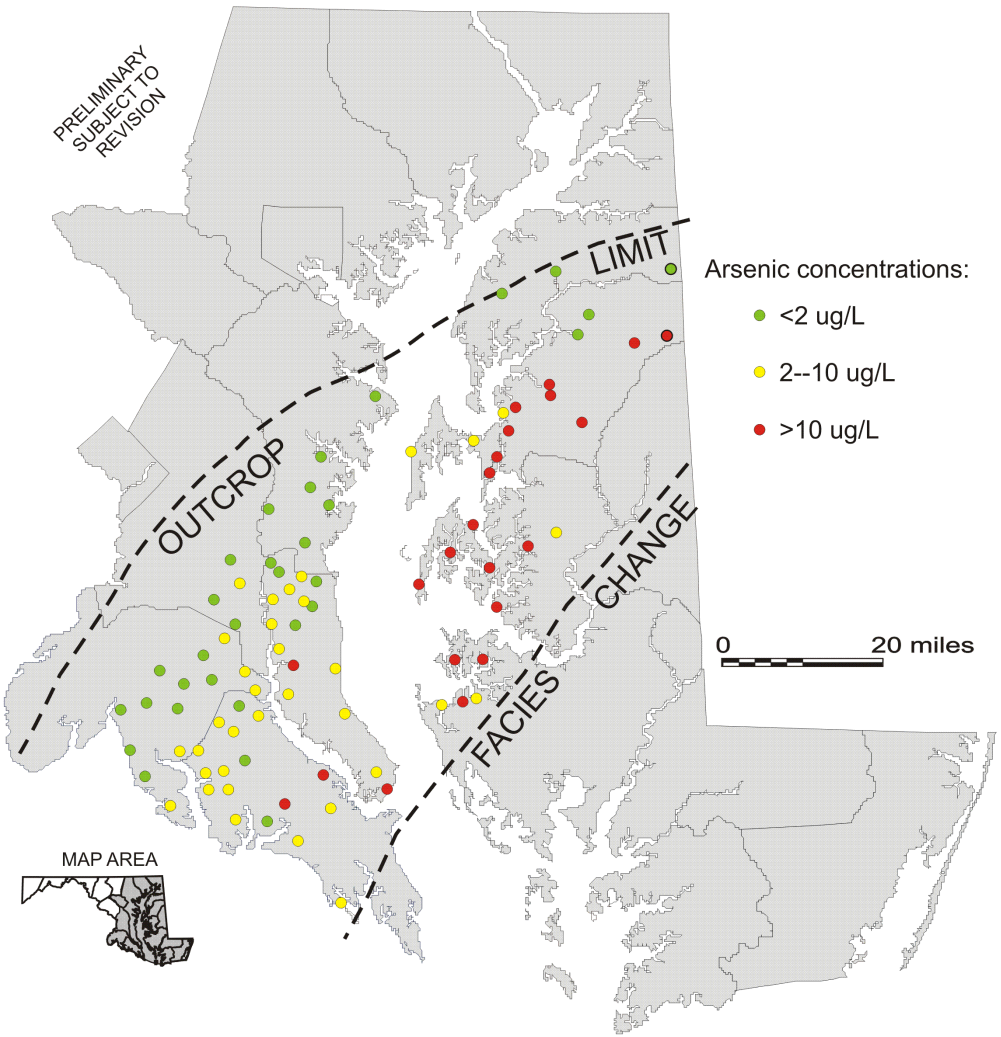


Pumping near the interface

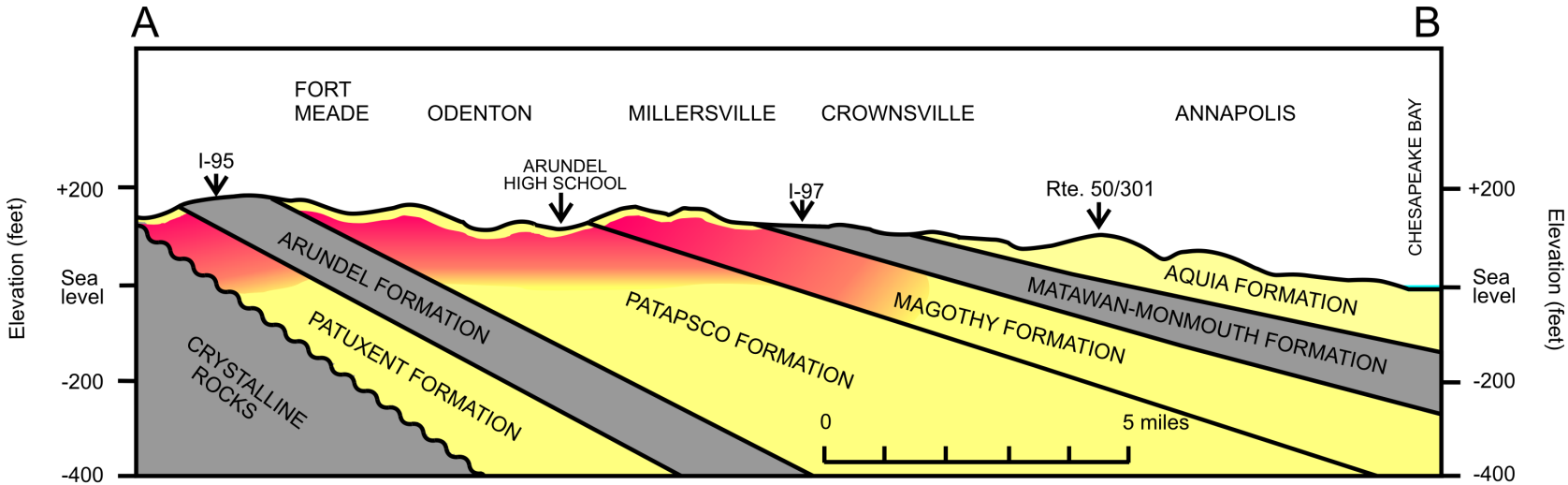
Arsenic in Aquia/Piney Point aquifers

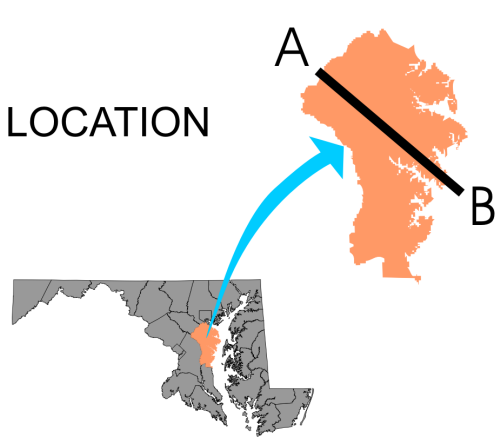


Arsenic concentrations in the Aquia aquifer, 2001-02.



Radium in Potomac Group/Magothy aquifers





Radium concentrations potentially greater than Federal Drinking Water standard

Major aquifers in Anne Arundel County

Minor aquifers and non-water-bearing zones

Maryland Coastal Plain Regional Aquifer Assessment

- Recommended by Governor's Advisory Committee
- Funded through Governor's Water-Supply Initiative
- Current partners:
  - Maryland Department of Environment
  - Maryland Geological Survey
  - U.S. Geological Survey
- Start-up in 2006; multi-year effort