PA & WV Subaqueous Soils

2008 NE Cooperative Soil Survey Meeting
Rhode Island

Patrick Drohan, PSU; Jim Thompson, WVU; Rob Brooks and Joe Bishop, PSU Geography.

PA Overall Potential

- 138,403 km of Rivers and Streams
- 3,956 Lakes, reservoirs and ponds
- 1,635 km^2 freshwater wetlands

PADEP

PA Potential Extent in Wetlands

- 200,000 hectares (500,000 acres) of inland wetlands which account for around 2 percent of its surface area.
- This acreage can be further divided as 174,000 hectares (431,000 acres) of vegetated wetlands and 27,000 hectares (67,000 acres) of nonvegetated wetlands, mostly in ponds.

Typically Shallow Depth

Table 2. Median depth to water, maximum depth, minimum depth, and percent time water was within the root zone by disturbance and HGM subclass. Values on top are means and those below are standard error terms. P = pristine, M = moderate disturbance, S = severe disturbance.

HGM Subclass	Median Depth (cm)			Maximum Depth (cm)			Minimum Depth (cm)			% Root Zone		
	P	M	S	P	M	S	P	M	S	P	M	S
Riparian depression	−7 [4]	8 [11]	−9 [11]	11 [15]	18 [17]	25 [15]	−40 [4]	−3 [14]	−52 [23]	83 [8]	100 [0]	67 [13]
Headwater floodplain[1]												
Mainstem floodplain[2]	–	−32 [15]	−60 [23]	–	36 [5]	30 [5]	–	−51 [13]	−80 [7]	–	60 [18]	34 [17]
Slope	−25 [8]	−19 [3]	−27 [9]	4 [4]	9 [3]	5 [1]	−57 [4]	−57 [8]	−27 [11]	56 [13]	56 [6]	46 [22]

[1] There were not enough sites across disturbance classes for a comparison to be made for headwater floodplain wetlands.
[2] There were no pristine mainstem floodplain wetlands.

Cole and Brooks (2000)

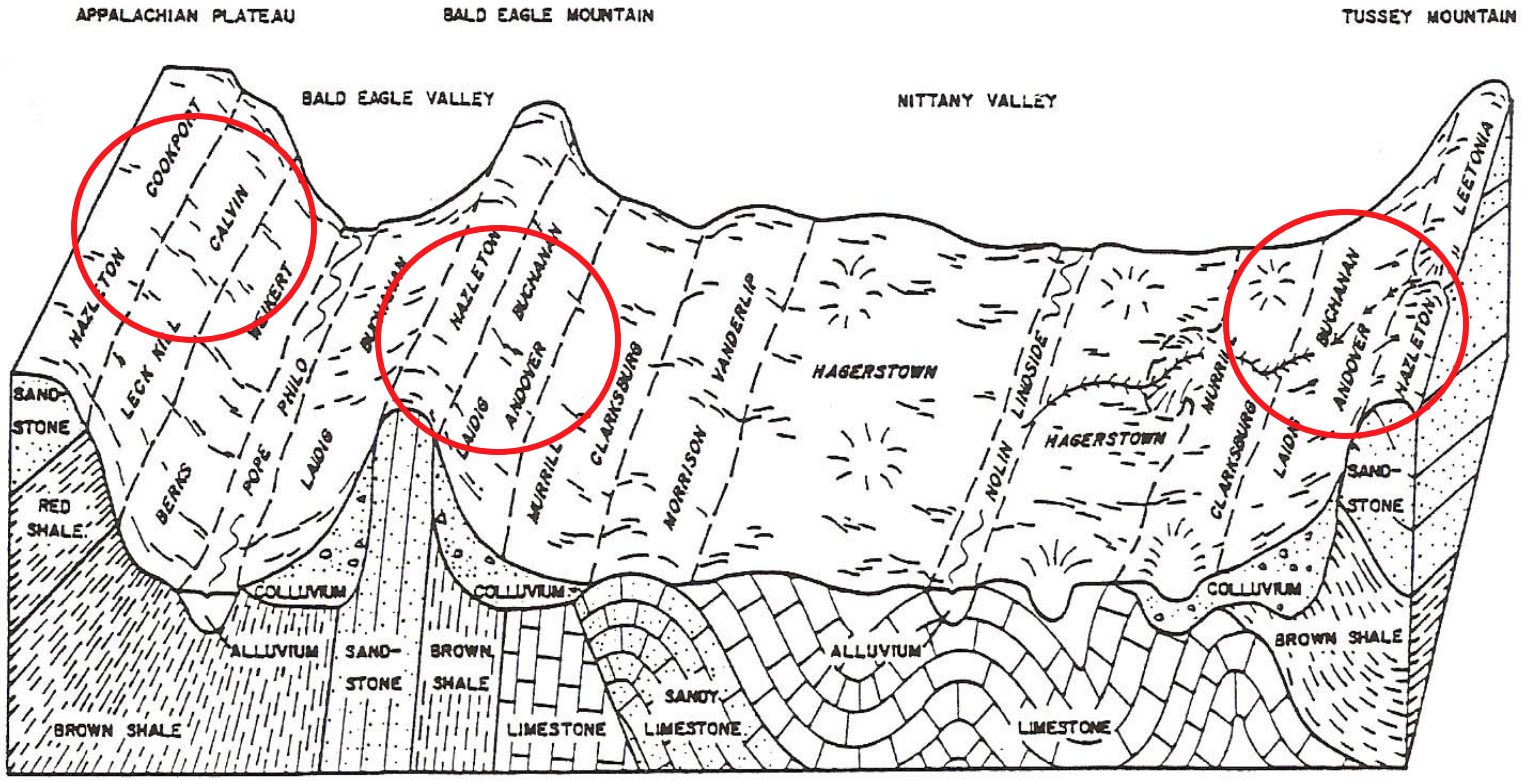
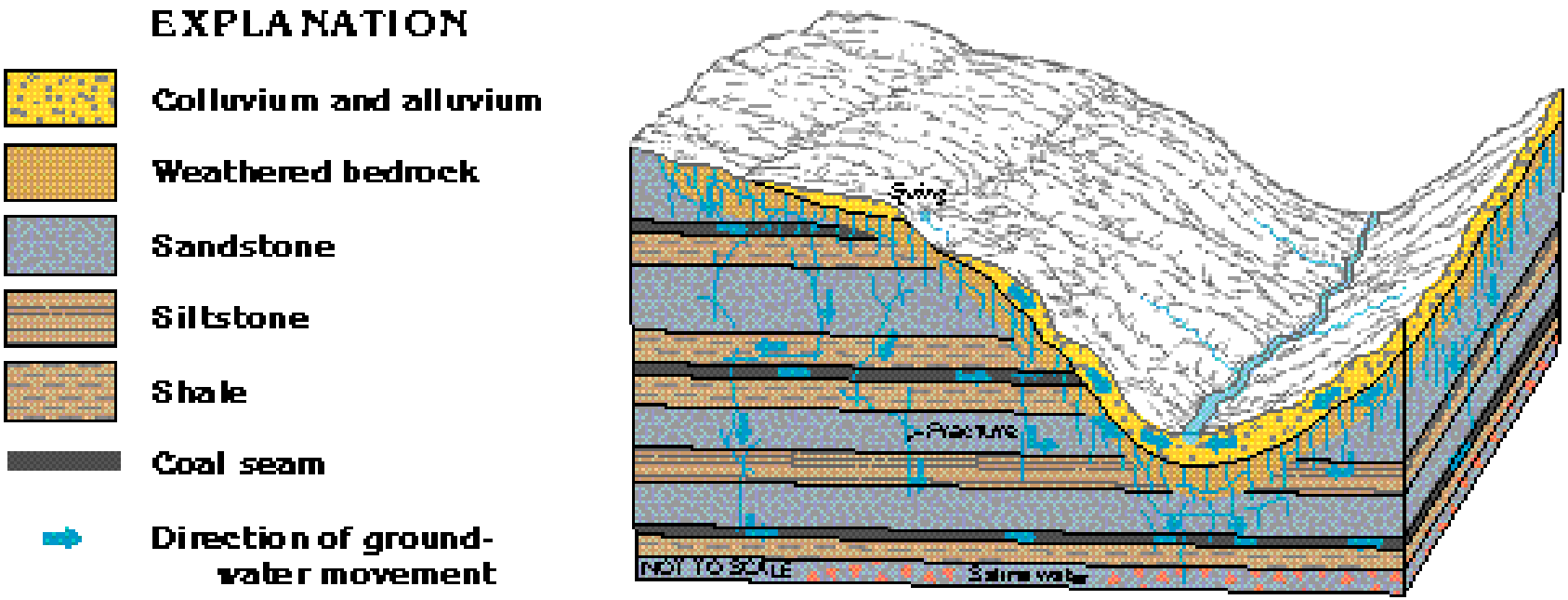

APPALACHIAN PLATEAU
BALD EAGLE MOUNTAIN
TUSSEY MOUNTAIN
BALD EAGLE VALLEY
NITTANY VALLEY
COOKPORT
CALVIN
MCKERT
HAZLETON
BUCHANAN
ANDOVER
LAIDIG
MURRILL
CLARKSBURG
MORRISON
VANDERLIP
HAGERSTOWN
NOLIN
LINDSIDE
LEETONIA
SAND-
STONE
RED
SHALE
BERKS
POPE
PHILO
COLLUVIUM
ALLUVIUM
BROWN
SHALE
LIMESTONE
SANDY
BROWN SHALE

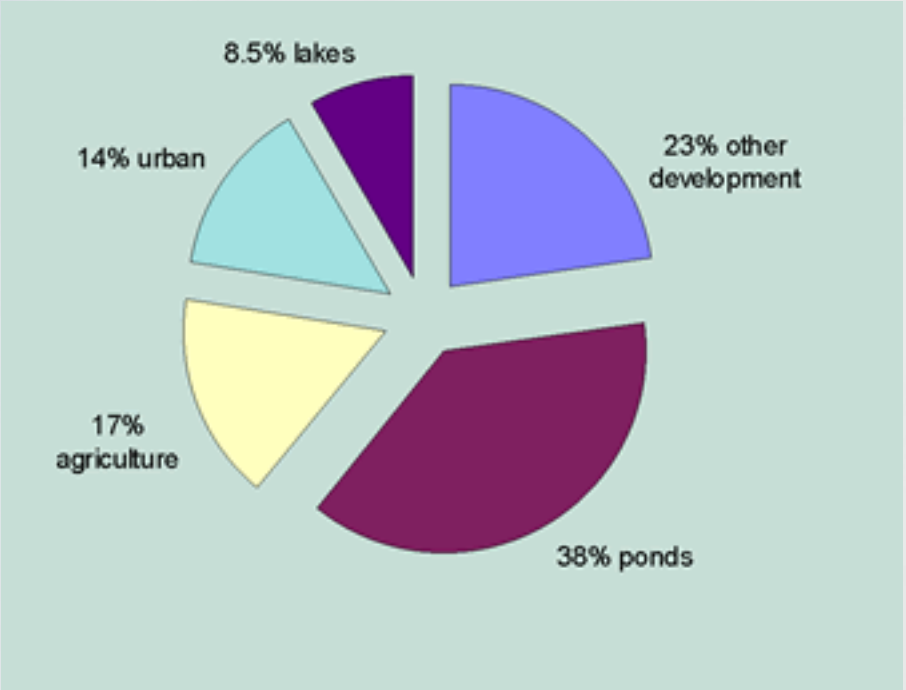
Figure 90. Topography and shallow fracture systems determine ground-water movement in the aquifers of the Appalachian Plateaus. Water infiltrates weathered bedrock and moves mostly through near-surface fractures; some water moves in a steplike fashion vertically along deeper fractures and horizontally through fractured sandstone or coal beds. Because of the absence of deep ground-water circulation and regional flow systems, saline water is at shallow depths.



Modified from Harlow, G.E., Jr., and LeCain, G.D., 1993, Hydraulic characteristics of, and ground-water flow in, coal-bearing rocks of southwestern Virginia: U.S. Geological Survey Water-Supply Paper 2388, 36 p.

Uneven Distribution and Loss

- Wetlands are not evenly distributed throughout the state.
- The northeastern and northwestern corners of the state account for nearly one-half of Pennsylvania's wetlands.



PADEP

Why Are We Looking at SAS?

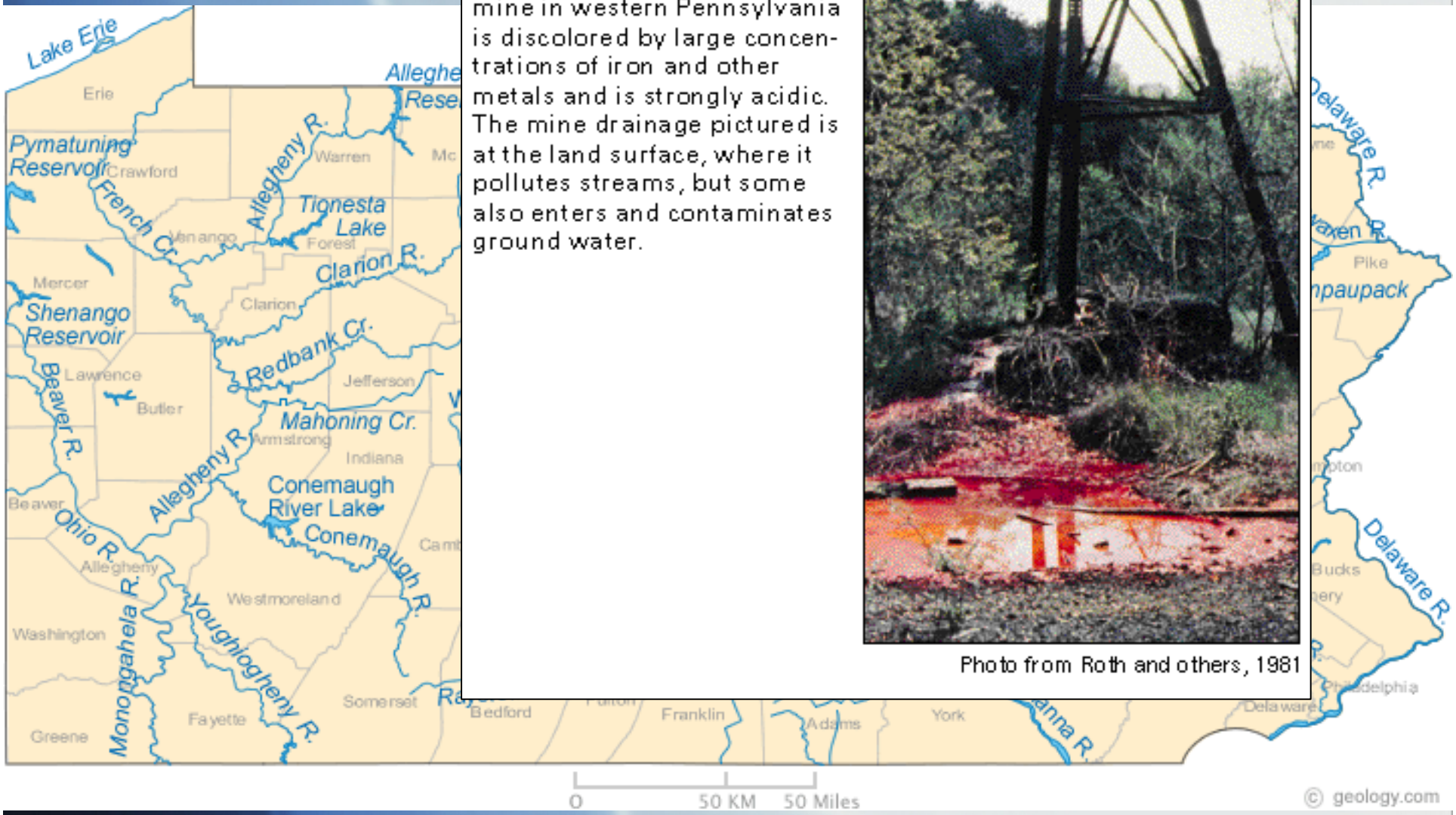
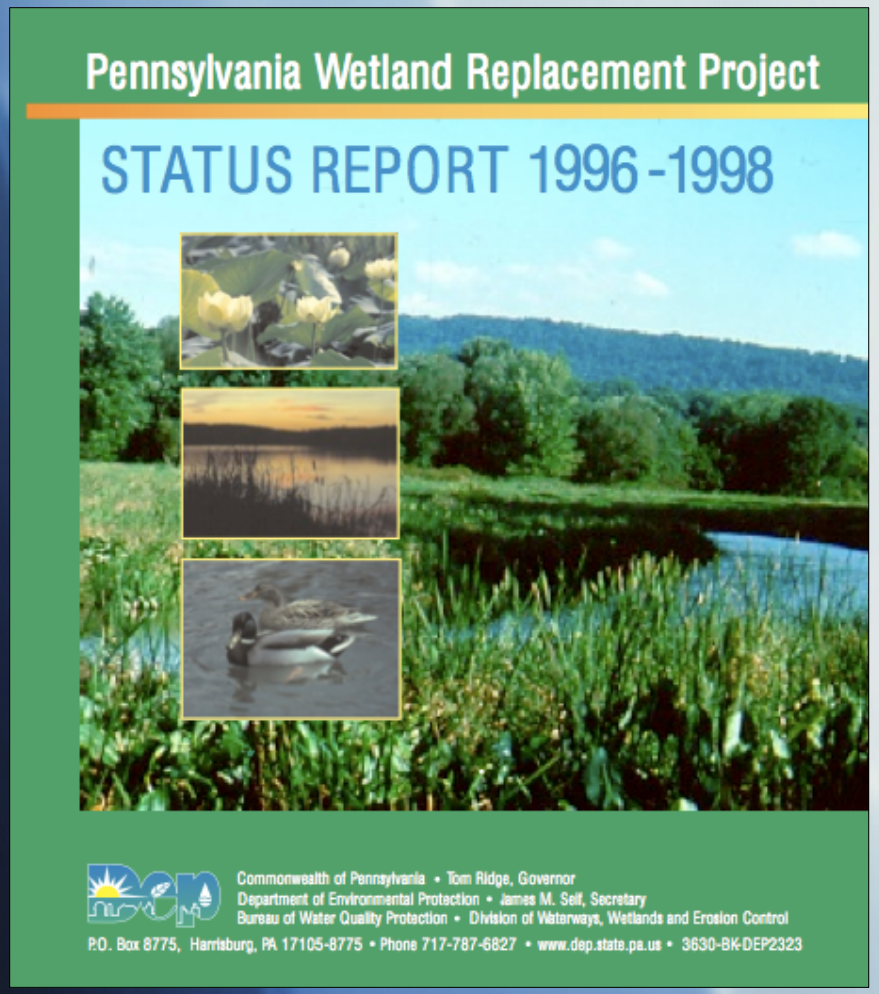


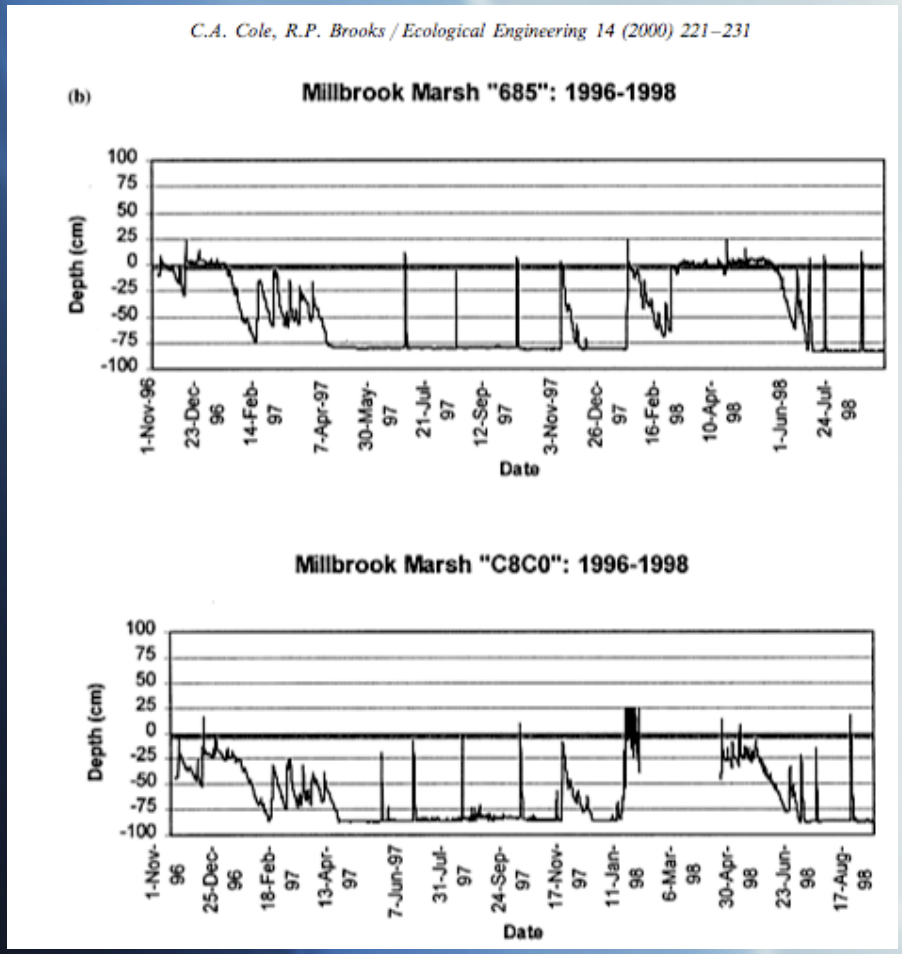
Figure 95. Drainage from an abandoned underground coal mine in western Pennsylvania is discolored by large concentrations of iron and other metals and is strongly acidic. The mine drainage pictured is at the land surface, where it pollutes streams, but some also enters and contaminates ground water.

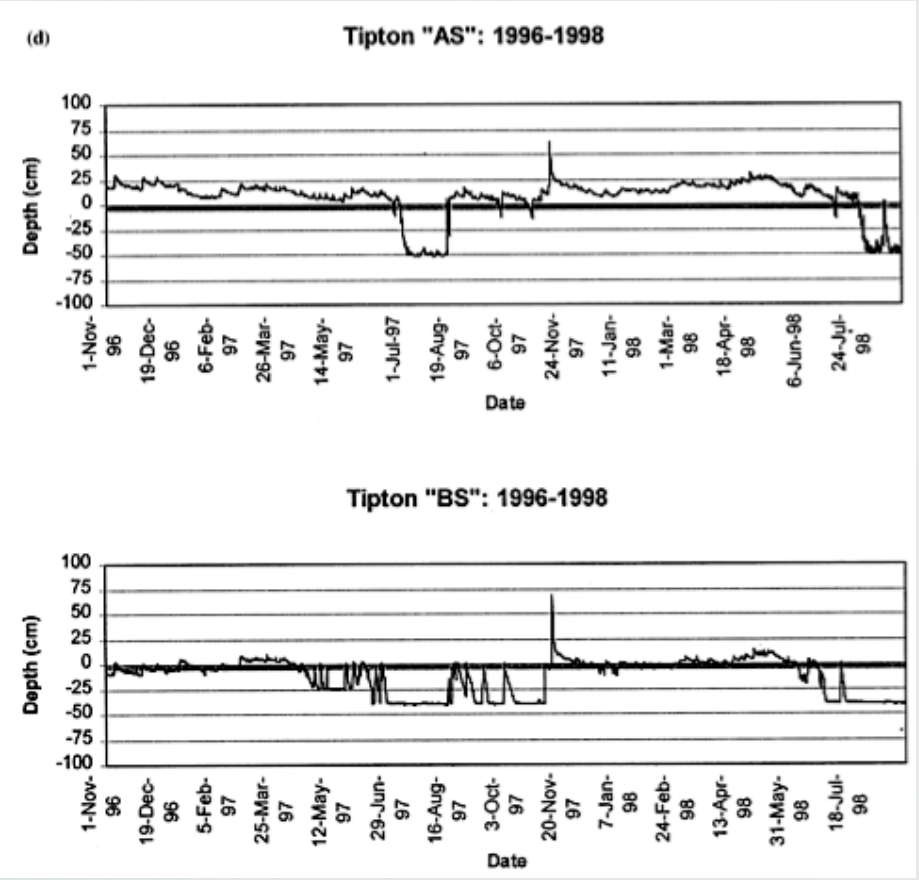
Photo from Roth and others, 1981

Focus on Mitigation & Construction



Understanding Construction





Natural

Constructed

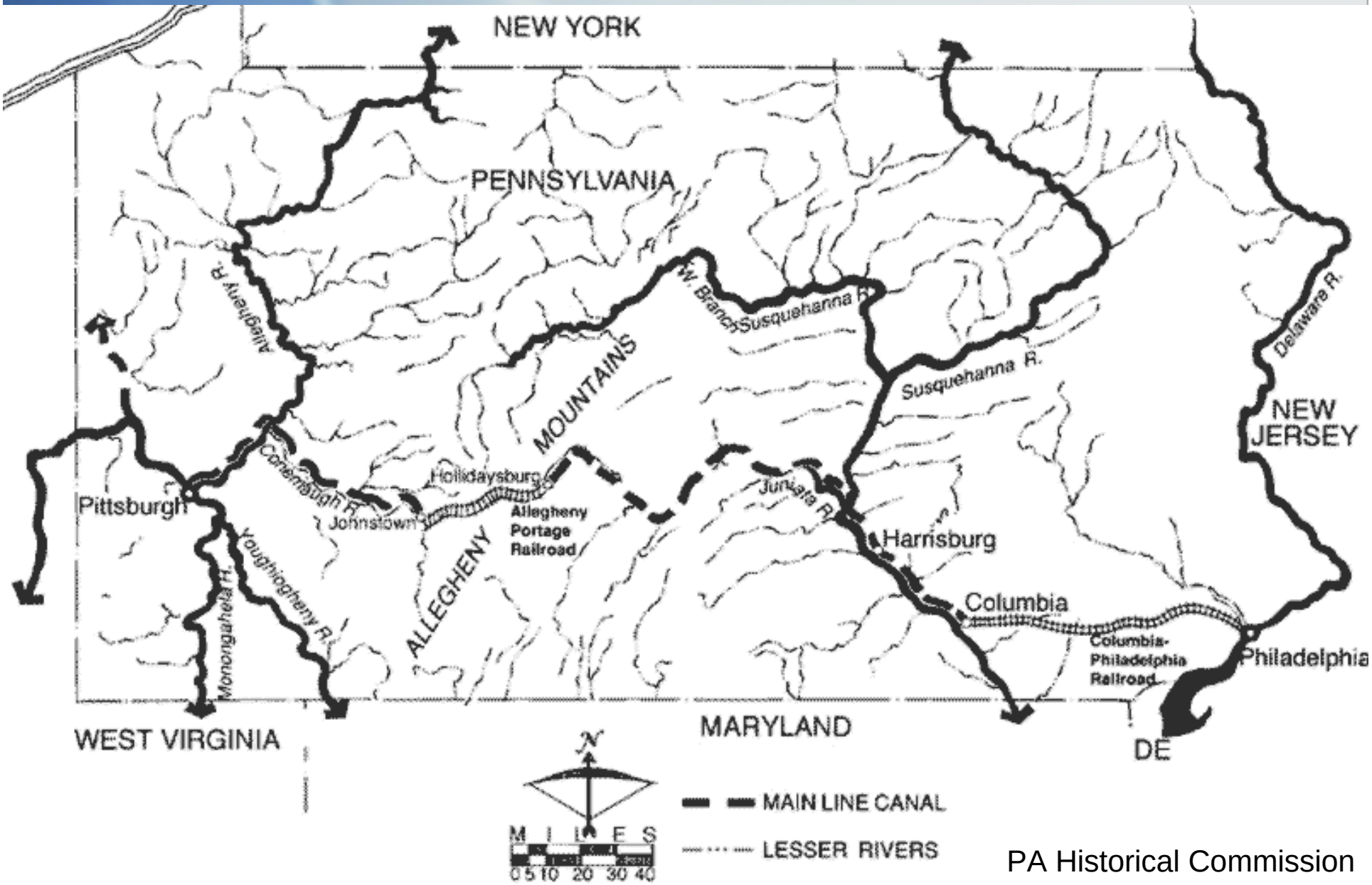
Carbon Storage and Credits

Table 1
Site characteristics of created wetlands in central Pennsylvania[a]

HGM subclass[b]	Site	Age[c]	Median depth of water (cm) relative to ground level	%RZ[d]	*n*	AG	BG	Total	BG:AG	% Soil organic matter
Isolated depression	Duncansville	20	1.3	85	7	1472 (128)	1925 (471)	3396 (396)	1.31	6.5[f]
Isolated depression	Sproul	20	1.3	100	6	1378 (251)	3495 (1198)	4873 (1295)	2.54	4.2[e]
Mainstem floodplain	Mount Eagle	11	−46.5	7	7	520 (106)	1028 (233)	1548 (248)	1.98	4.6[e]
Slope	Snowshoe	8	−4.7	84	6	1068 (108)	3658 (988)	4726 (962)	3.42	2.8[e]
Mainstem floodplain	Tipton	7	−1.0	86	8	676 (110)	2195 (618)	2871 (636)	3.25	2.3[f]
Mainstem floodplain	PIPA	6	1.1	100	8	1067 (240)	3441 (1332)	4507 (1539)	3.23	4.8[f]
Mainstem floodplain	Route 220	5	−6.4	83	8	1694 (632)	3470 (966)	5164 (1144)	2.05	4.3[f]
Reference PEM[e] SOM										21%
Reference PEM[f] SOM										12%

[a] Mean biomass is reported as (g/m^2) for above-ground (AG) and below-ground (BG). Values below are standard errors of the mean
[b] We followed the HGM key in Cole et al. (1997) as closely as possible, but that key was not developed with created wetlands in mind.
[c] Age of the wetland as of September 1998.
[d] Percent time water was within the root zone (30 cm from surface).
[e] From Bishel (1994).
[f] From Campbell (1996).

Cole et al. (2001)
Ecological Engineering 17 (2001) 423 – 428



PA Historical Commission

How/Should we Map SAS in PA?

- Small size, Remote
- Appropriate for Soil Survey?
- Order 1 guidelines more realistic?

Idea 1: Brinson's HGM Classification

- Classifies wetlands based on three characteristics:
  - geomorphic setting
  - water source and transport
  - hydrodynamics

SAS ID via HGM Classification

Figure 8. Key for hydrogeomorphic classification of wetlands into classes and subclasses in Pennsylvania. Underlined items are HGM subclasses. Source: Cole et al. 1997.

1. Wetland associated with a stream or river ..... Floodplain or depression 2
1. Wetland not associated with a stream or river ..... Fringing, slope, or depression 14

2. Wetland located within defined banks or channel of stream or river ..... Floodplain in-stream
2. Wetland does not occur within defined banks or channel of stream or river 3

3. Equivalent stream order is 1st or 2nd order Floodplain, headwater (H) 4
3. Equivalent stream order is 3rd or larger Floodplain, mainstem (M) 9

4. Wetland is impounded ..... Headwater Impoundment (HI) 5
4. Wetland is not impounded 6

5. Wetland impounded by beaver activities ..... Beaver, HI
5. Wetland impounded by human activities ..... Human, HI

6. Wetland has evidence of recent flooding ..... Headwater floodplain
6. Wetland has no evidence of recent flooding 7

7. Wetland located on a topographic slope with unidirectional flow of water ..... Slope
7. Wetland located in a topographic depression ..... Depression, headwater (H) 8

8. Wetland located in a topographic depression with discernable inlets or outlets where primary source is groundwater ..... Riparian depression (H)
8. Wetland located in a topographic depression with discernable inlets or outlets and with organic soil ..... Organic depression (H)
8. Wetland located in a topographic depression with discernable inlets and outlets and where primary sources of water are overland flow or interflow ..... Surface water depression (H)

9. Wetland is impounded ..... Mainstem impoundment (MI) 10
9. Wetland is not impounded 11

10. Wetland impounded by beaver activities ..... Beaver, MI
10. Wetland impounded by human activities ..... Human, MI

11. Wetland has evidence of frequent flooding ..... Mainstem floodplain
11. Wetland has no evidence of frequent flooding 12

Figure 8 (continued). Key for hydrogeomorphic classification of wetlands into classes and subclasses in Pennsylvania. Underlined items are HGM subclasses. Source: Cole et al. 1997.

12. Wetland located on a topographic slope with unidirectional flow of water ..... Slope
12. Wetland located in a topographic depression ..... Depression, mainstem (M) 13

13. Wetland located in a topographic depression with discernable inlets or outlets and where primary source is ground-water ..... Riparian depression (M)
13. Wetland located in a topographic depression with discernable inlets or outlets and with organic soil ..... Organic depression (M)
13. Wetland located in a topographic depression with discernable inlets or outlets and where primary sources of water are overland or interflow ..... Surface water depression (M)

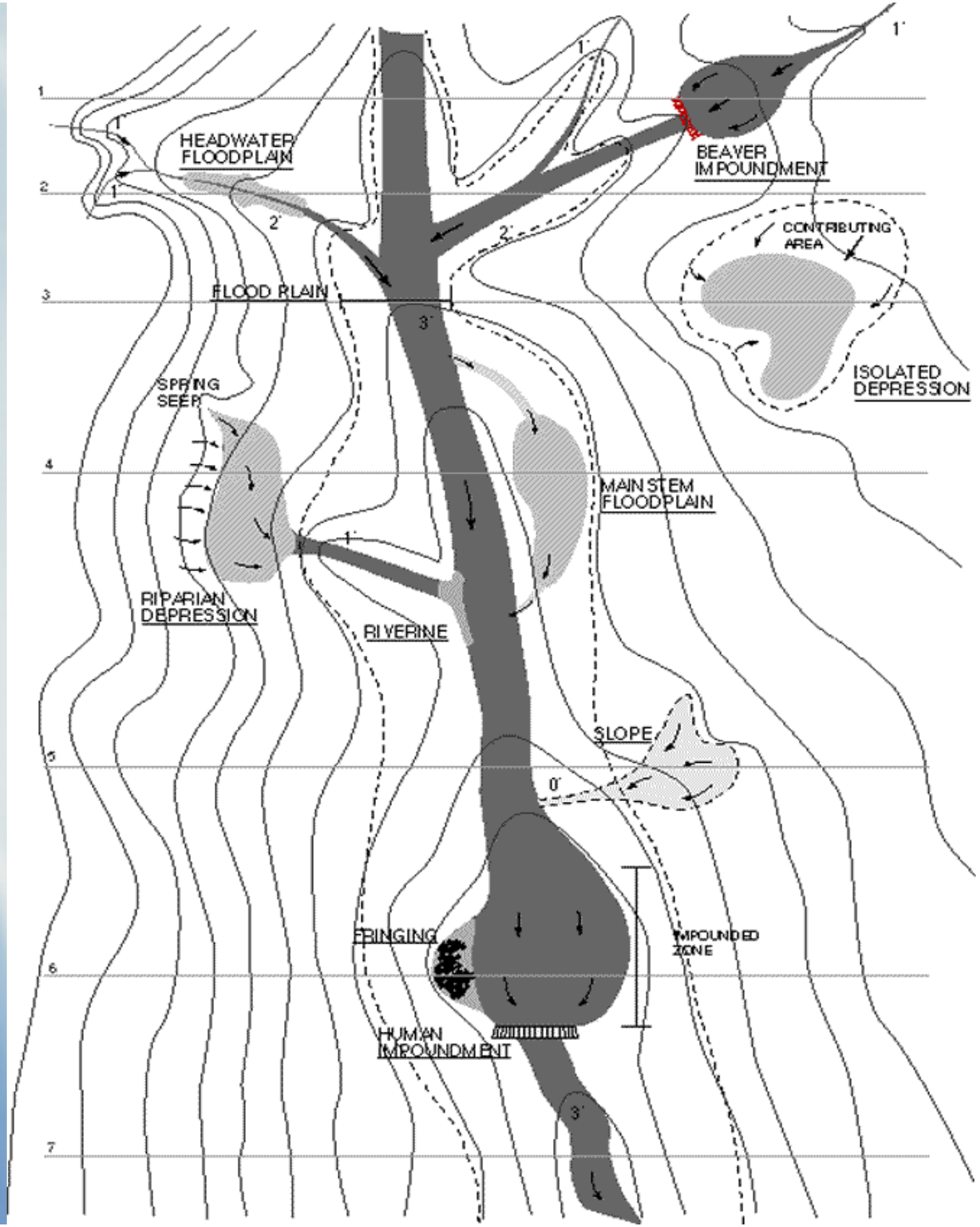
14. Wetland associated with a lake, reservoir, or large pond ..... Fringing
14. Wetland not associated with a lake, reservoir, or large pond 15

15. Wetland located on a topographic slope with unidirectional flow of water ..... Slope
15. Wetland located in a topographic depression without discernable surface water inlets or outlets ..... Isolated depression (I) 16

16. Wetland located in a topographic depression without discernable surface water inlets or outlets and with organic soil ..... Organic depression (I)
16. Wetland located in a topographic depression without discernable surface water inlets or outlets where primary sources of water are overland flow or interflow ..... Surface water depression (I)

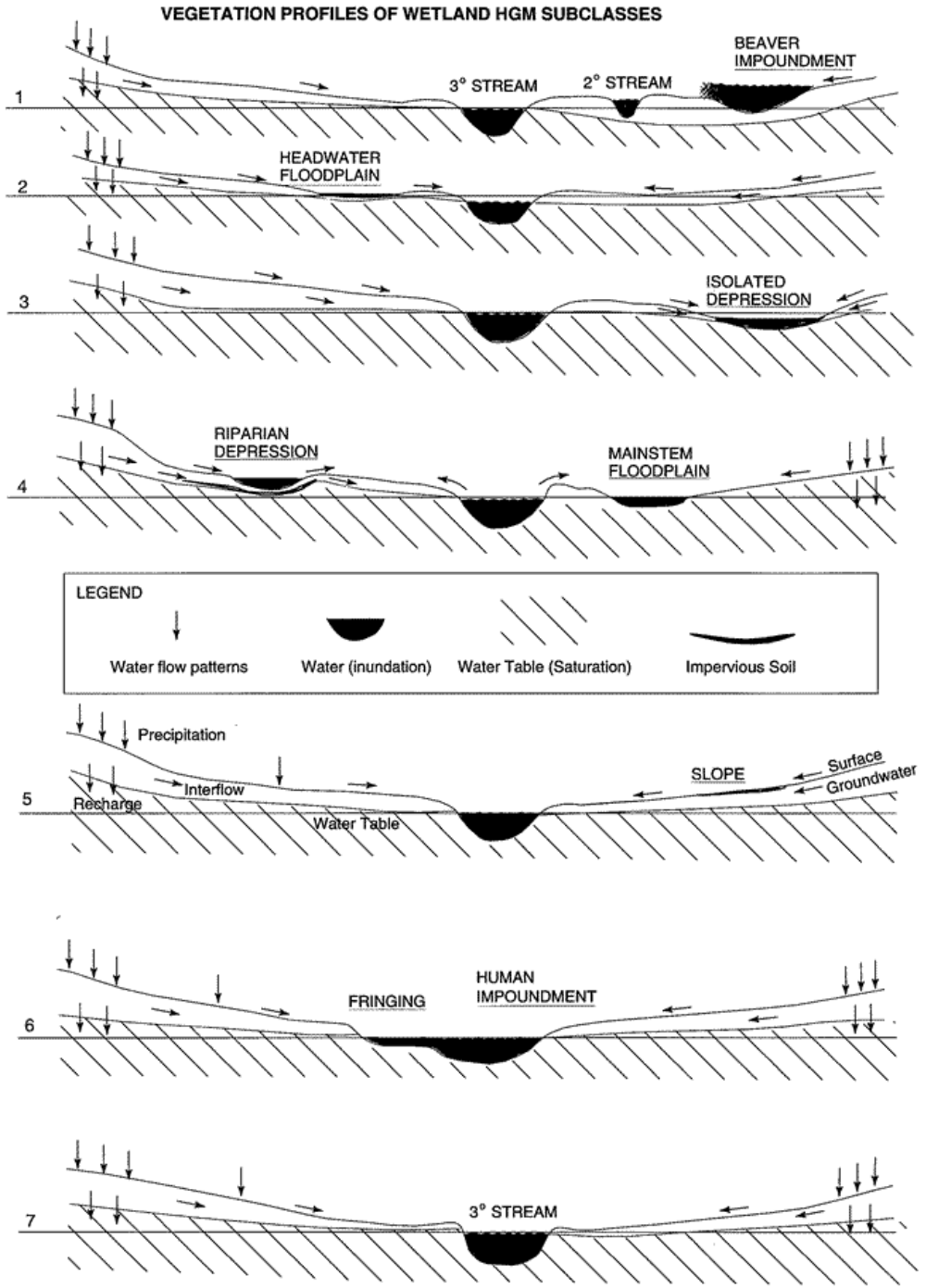
Schematic of HGM Subclasses of Wetlands in Pennsylvania

Captures issue of scale with PA SAS's



Vegetation Profiles of Wetland HGM Subclasses in Pennsylvania

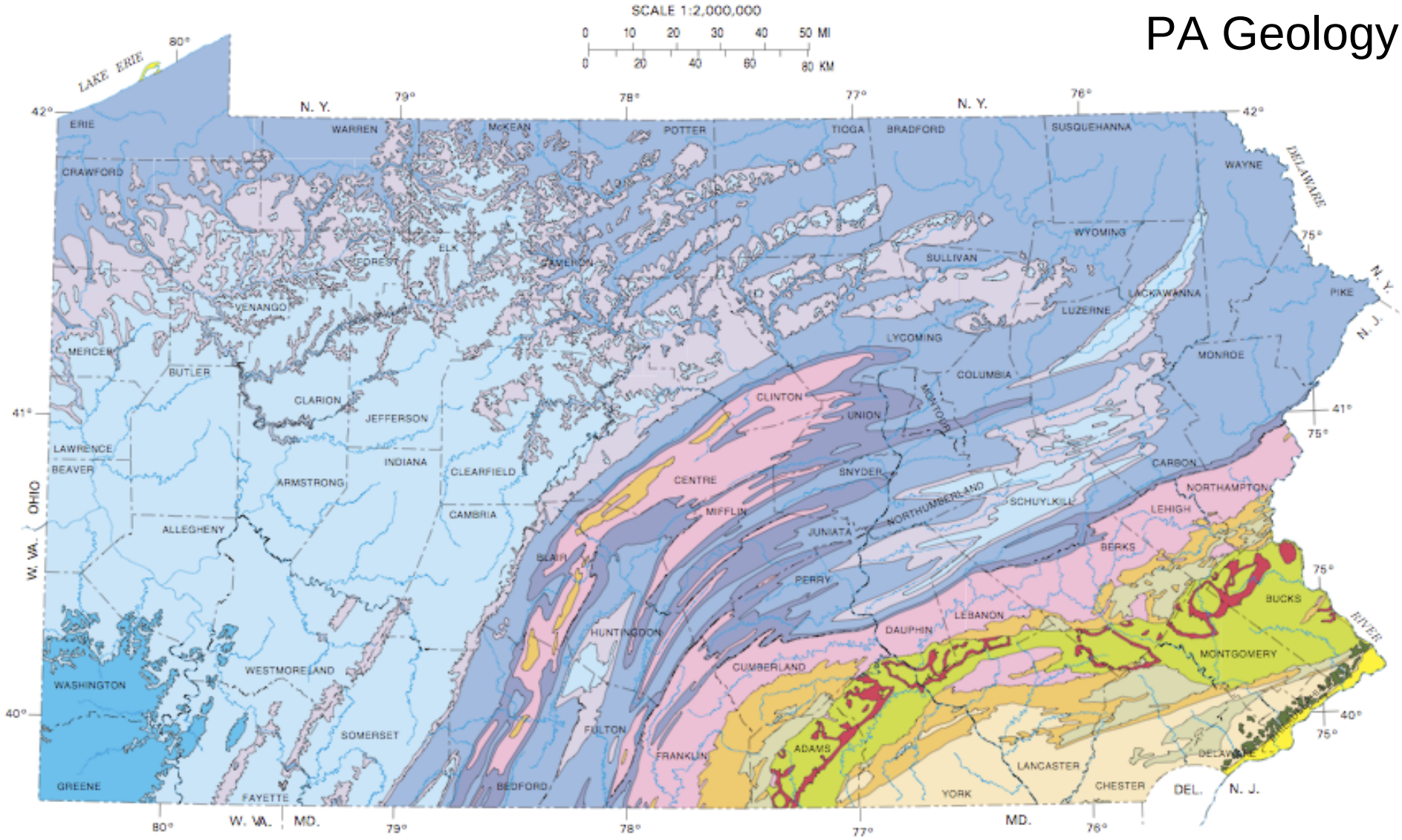
Related to typical mapping model a soil mapper would use…intuitive



Mapping SAS's

- Order 2 vs < Order 2 Mapping Guidelines
- Start mapping based on dominant types of water bodies. Use main examples of what is likely out there.
- Next stratify by soil forming factors; parent materials (texture affecting SAV) and time (short lived vs stable subaqueous soils) likely two main influences.

PA Geology



EXPLANATION

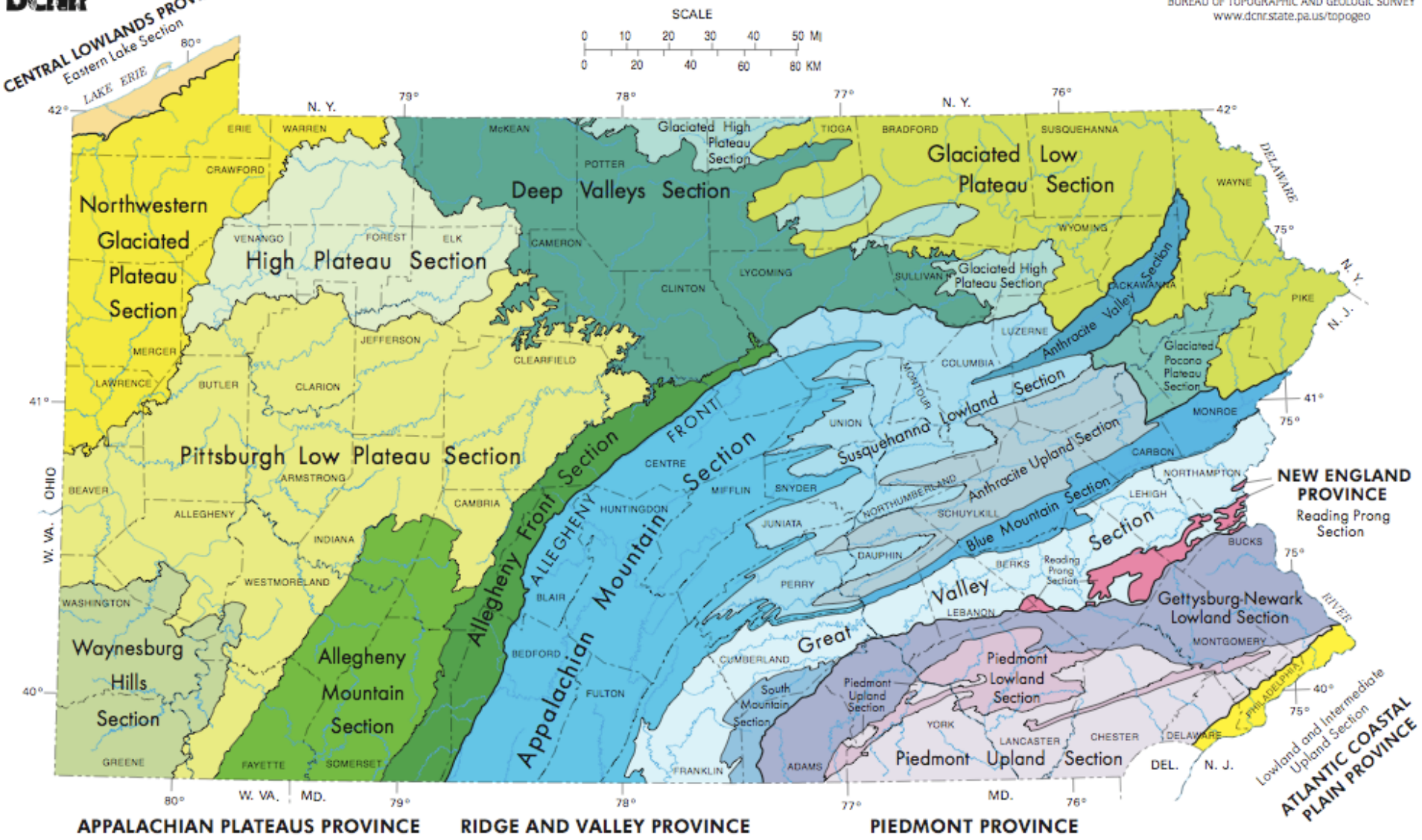
QUATERNARY (0–1.8 mil. yrs.) Sand, gravel, and silt.	TERTIARY (1.8–65 mil. yrs.) Sand, gravel, silt, and clay.	* JURASSIC AND TRIASSIC (144–248 mil. yrs.) Red sandstone, shale, and conglomerate (green), intruded by diabase (red).	PERMIAN (248–290 mil. yrs.) Cyclic sequences of shale, sandstone, limestone, and coal.	PENNSYLVANIAN (290–323 mil. yrs.) Cyclic sequences of sandstone, red and gray shale, conglomerate, clay, coal, and limestone.	MISSISSIPPIAN (323–354 mil. yrs.) Red and gray sandstone, shale, and limestone.	DEVONIAN (354–417 mil. yrs.) Red sandstone, gray shale, black shale, limestone, and chert.	SILURIAN (417–443 mil. yrs.) Red and gray sandstone, conglomerate, shale, and limestone.	ORDOVICIAN (443–490 mil. yrs.) Shale, limestone, dolomite, and sandstone.	CAMBRIAN (490–570 mil. yrs.) Limestone, dolomite, sandstone, shale, quartzite, and phyllite.	LOWER PALEOZOIC (443–570 mil. yrs.) Metamorphic rocks (metasedimentary and meta-igneous): schist, gneiss, quartzite, serpentine, slate, and marble.	PRECAMBRIAN (older than 570 mil. yrs.) Gneiss, granite, anorthosite, metadiabase, metabasalt, metarhyolite, and marble.

*Cretaceous rocks, which are present in small areas of southern Montgomery County, cannot be shown at the scale of this map.

MAP 13

PHYSIOGRAPHIC PROVINCES OF PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF
CONSERVATION AND NATURAL RESOURCES
BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
www.dcnr.state.pa.us/topogeo



Using Existing Soil Survey Data