Green County Geology and Groundwater

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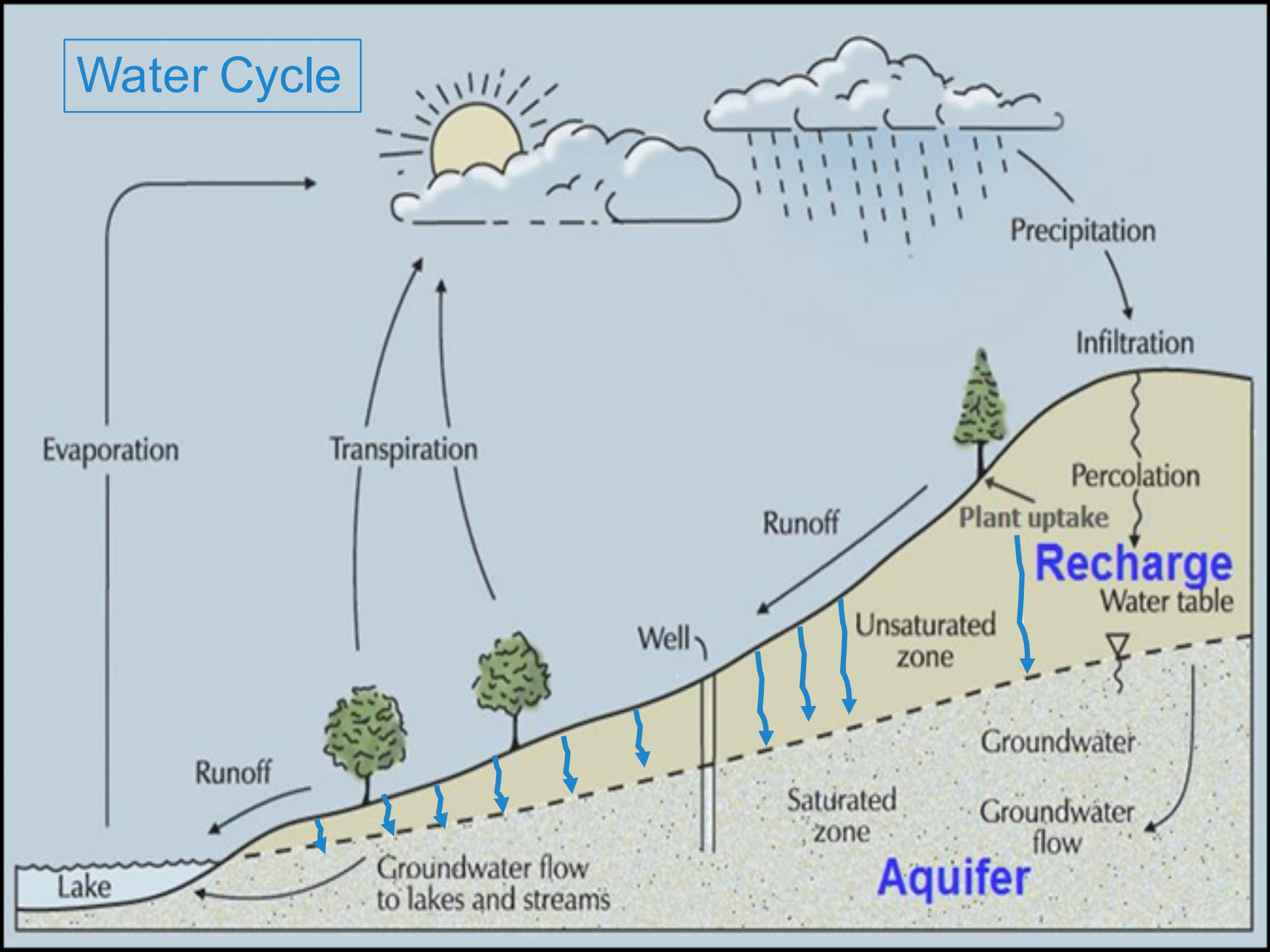
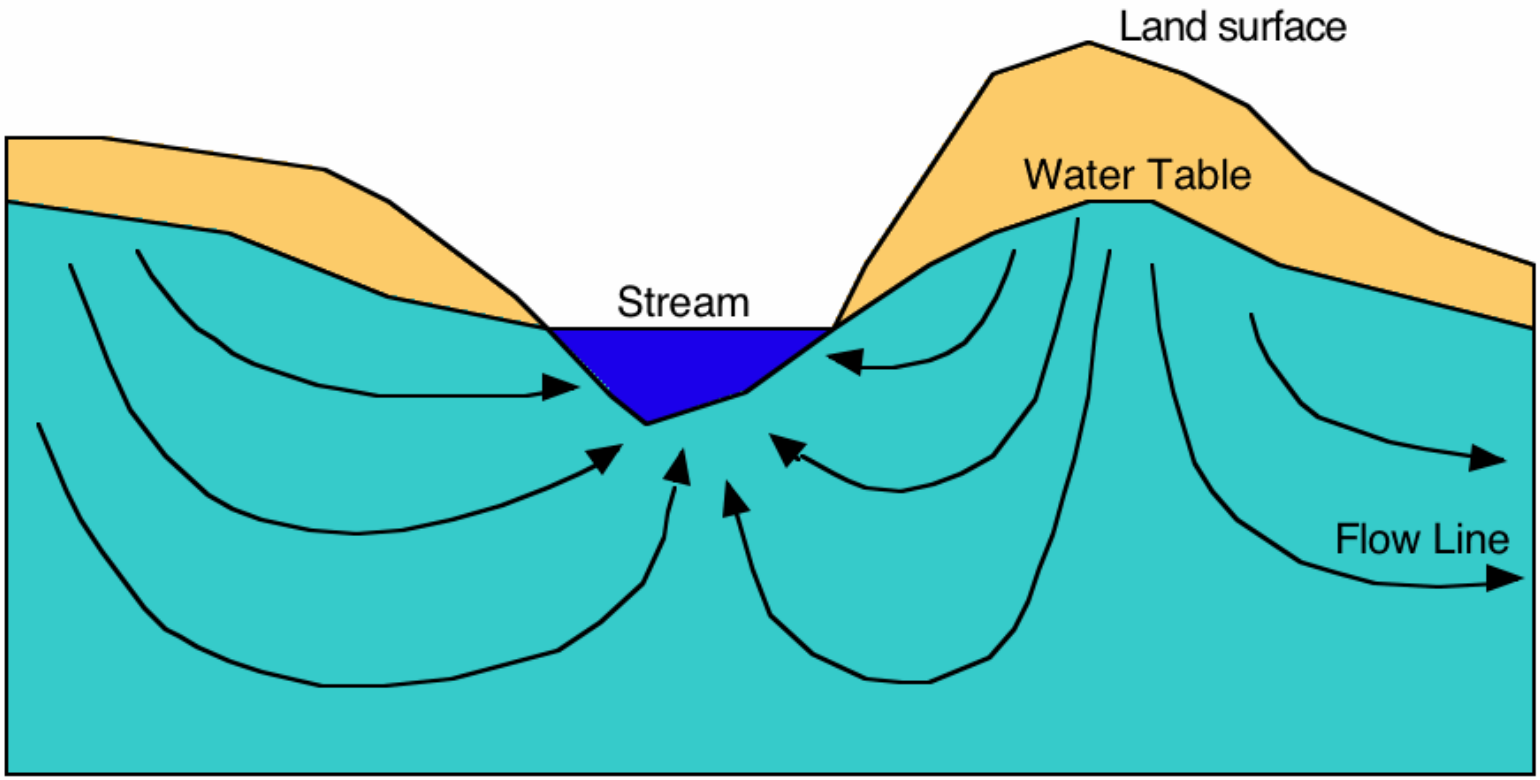
Wisconsin Geological and Natural History Survey

Outline

- Groundwater Primer
- Green County Geology and Groundwater
- Some Examples of Groundwater Mapping in Wisconsin


Water Cycle
Precipitation
Infiltration
Evaporation
Transpiration
Percolation
Runoff
Plant uptake
Recharge
Water table
Well
Unsaturated zone
Groundwater
Runoff
Saturated zone
Groundwater flow
Lake
Groundwater flow to lakes and streams
Aquifer

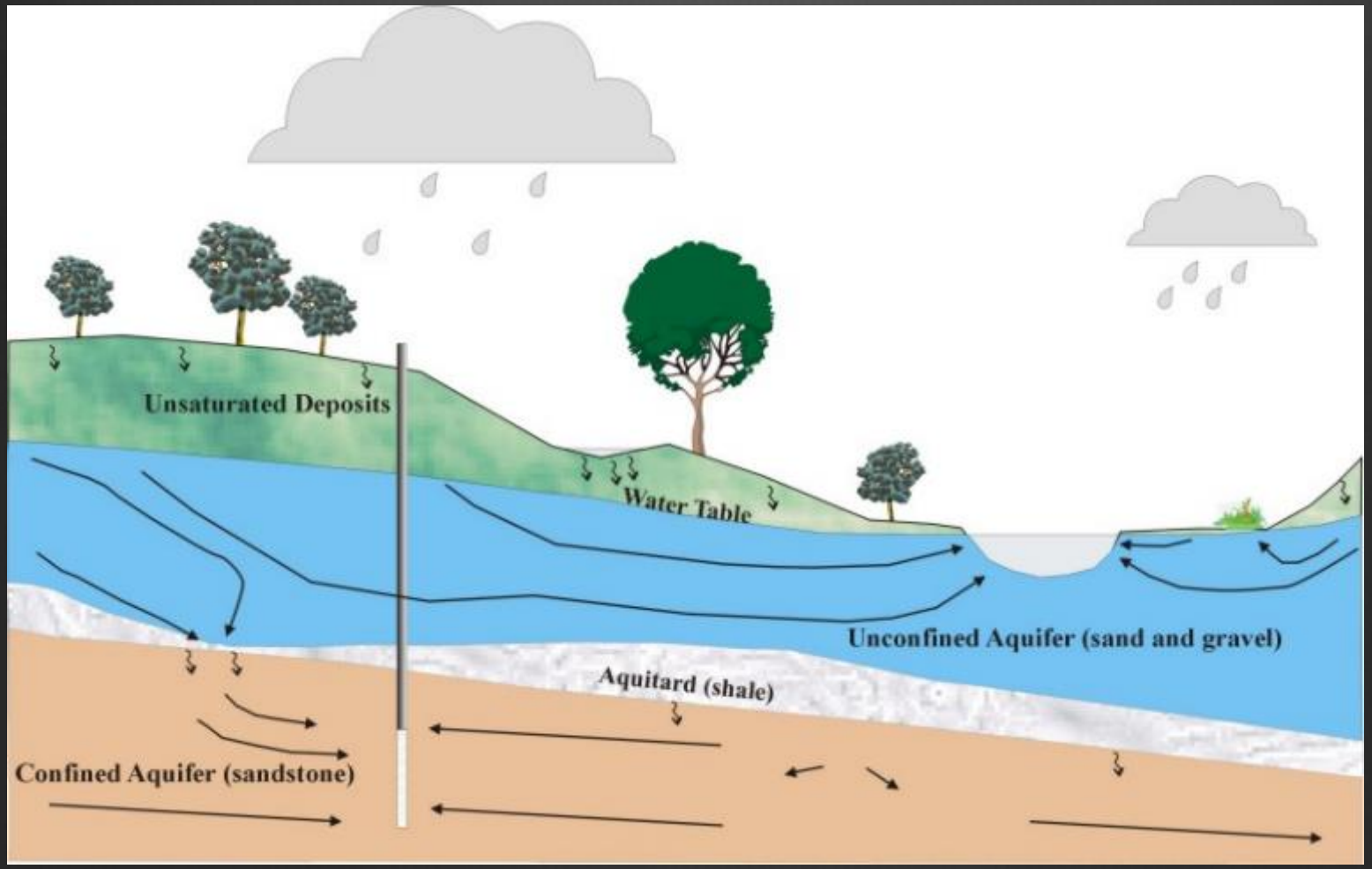
Water table usually follows the land contours. Discharge or flow is to low spots



Water table relief is less than land surface relief

Groundwater Flow System

Recharge → Groundwater Flow →Discharge to Wells or Surface Waters



Daniel Feinstein
USGS


Groundwater discharge to Honey Creek (Sauk Co.) is reason why stream flows even in dry period.

Sustainability versus Availability

- What is sustainability?

Sustainability versus Availability

USGS Publication: Sustainability of Ground-Water Resources
http://pubs.usgs.gov/circ/circ1186/pdf/circ1186.pdf

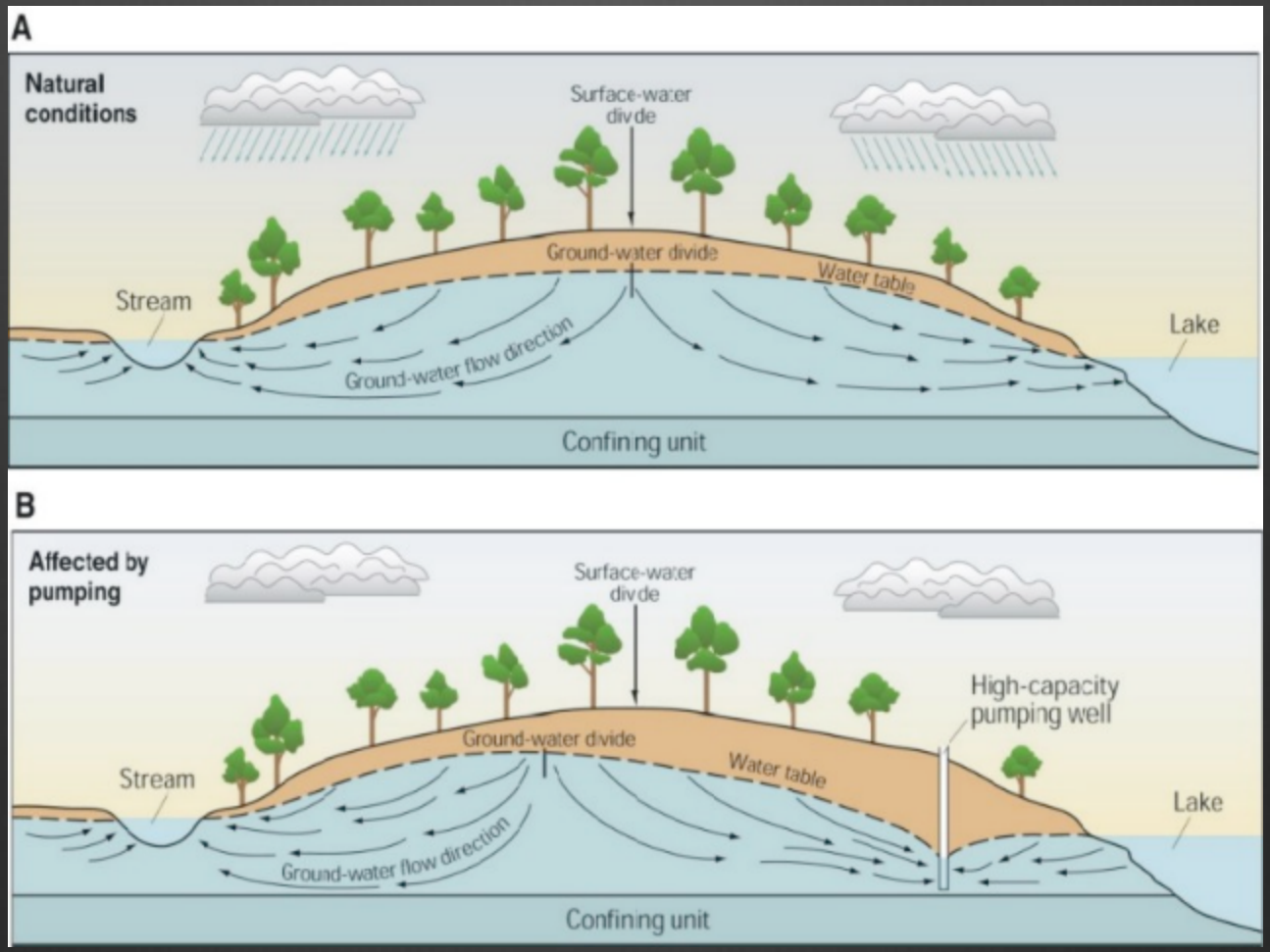
Resource sustainability has proved to be an elusive concept to define in a precise manner and with universal applicability.

In this report, we define ground-water sustainability as development and use of ground water in a manner that can be maintained for an indefinite time without causing unacceptable environmental, economic, or social consequences.

The definition of “unacceptable consequences” is largely subjective and may involve a large number of criteria.

Wells in Flow Systems
How much pumping is sustainable?

Not as much water is flowing into the stream because the divide has shifted

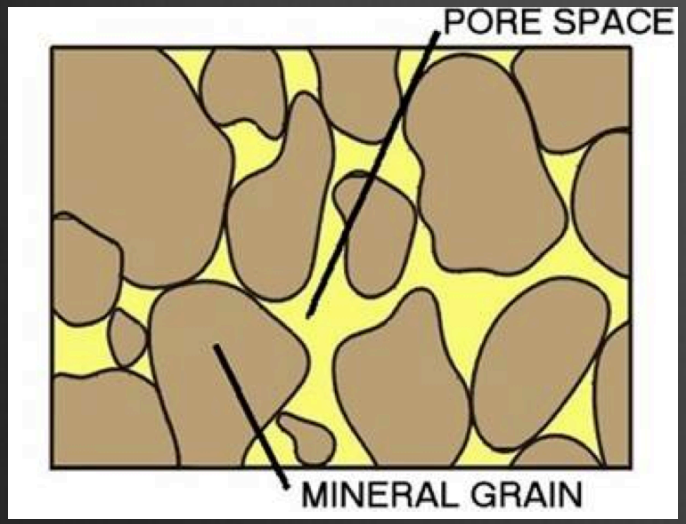


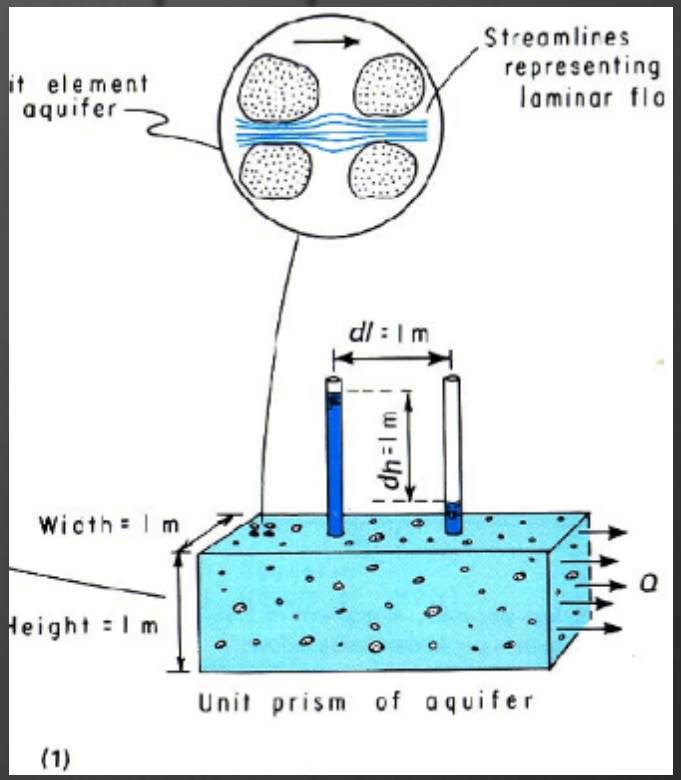
USGS, 2000

Lake is losing water to the well

Wells decrease water levels and divert groundwater from discharging to surface water

Different rocks and sediment have different hydraulic properties





Porosity – percent of void spaces in rock or sediment

Hydraulic conductivity - the ease with which water can move through pore spaces or fractures

Different rocks and sediment have different hydraulic properties

- Sandstone – ↑ porosity, ↑ conductivity

- Shale – ↑porosity, ↓ conductivity

- Dolomite – ↓ porosity, ↑ conductivity (fractures)

- Crystalline Bedrock – ↓ porosity, ↓ conductivity

BEDROCK GEOLOGY OF WISCONSIN

UNIVERSITY OF WISCONSIN–EXTENSION

Geological and Natural History Survey

APRIL 1981
REVISED 2005

EXPLANATION

DEVONIAN

- D — dolomite and shale

SILURIAN

- Sd — dolomite

ORDOVICIAN

- Om — Maquoketa Formation—shale and dolomite
- Os — Sinnipee Group—dolomite with some limestone and shale
- Osp — St. Peter Formation—sandstone with some limestone shale and conglomerate
- Opc — Prairie du Chien Group—dolomite with some sandstone and shale

CAMBRIAN

- € — sandstone with some dolomite and shale

MIDDLE PROTEROZOIC

- ss, v, t — Keweenawan rock—
  - ss, sandstone
  - v, basaltic to rhyolitic lava flows
  - t, gabbroic, anorthositic and granitic rock
- g, a — Wolf River rock—
  - g, rapakivi granite, granite, and syenite
  - a, anorthosite and gabbro

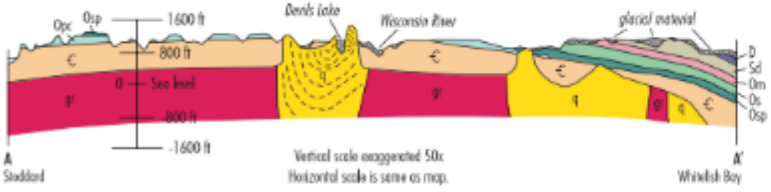
LOWER PROTEROZOIC

- q — quartzite
- gr — granite, diorite, and gneiss
- s, vo, ga — s, metasedimentary rock, argillite, siltstone, quartzite, greywacke, and iron formation; vo, basaltic to rhyolitic metavolcanic rock with some metasedimentary rock; ga, meta-gabbro and hornblende diorite

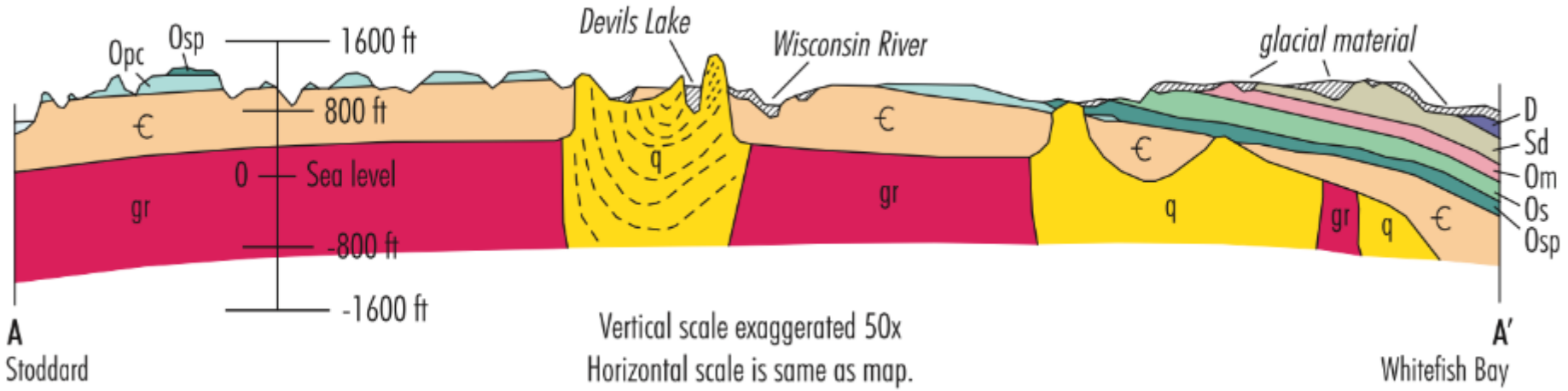
LOWER PROTEROZOIC OR UPPER ARCHEAN

- mv, gn — mv, metavolcanic rock; gn, granite, gneiss, and amphibolite

0 30 60 mi
0 50 100 km

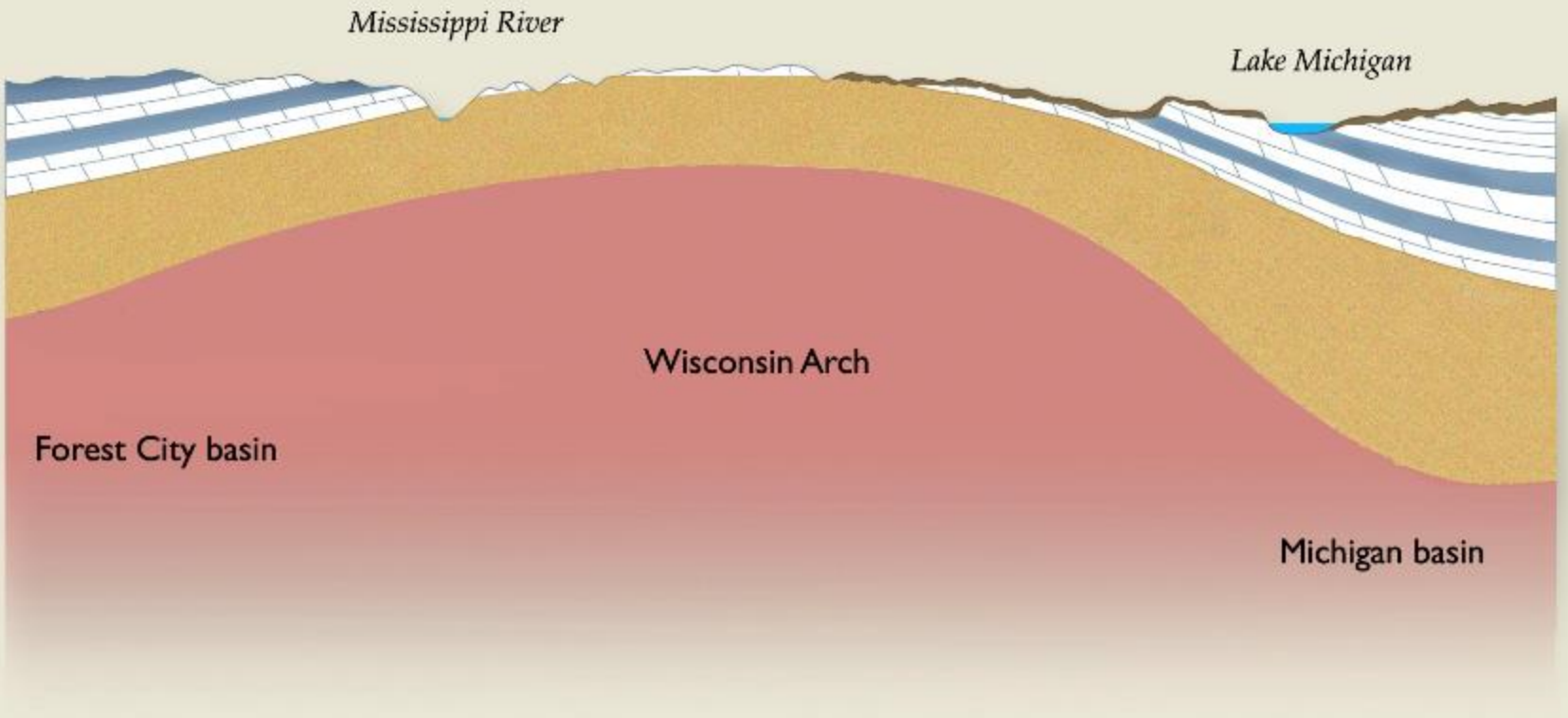


More Wisconsin Geology

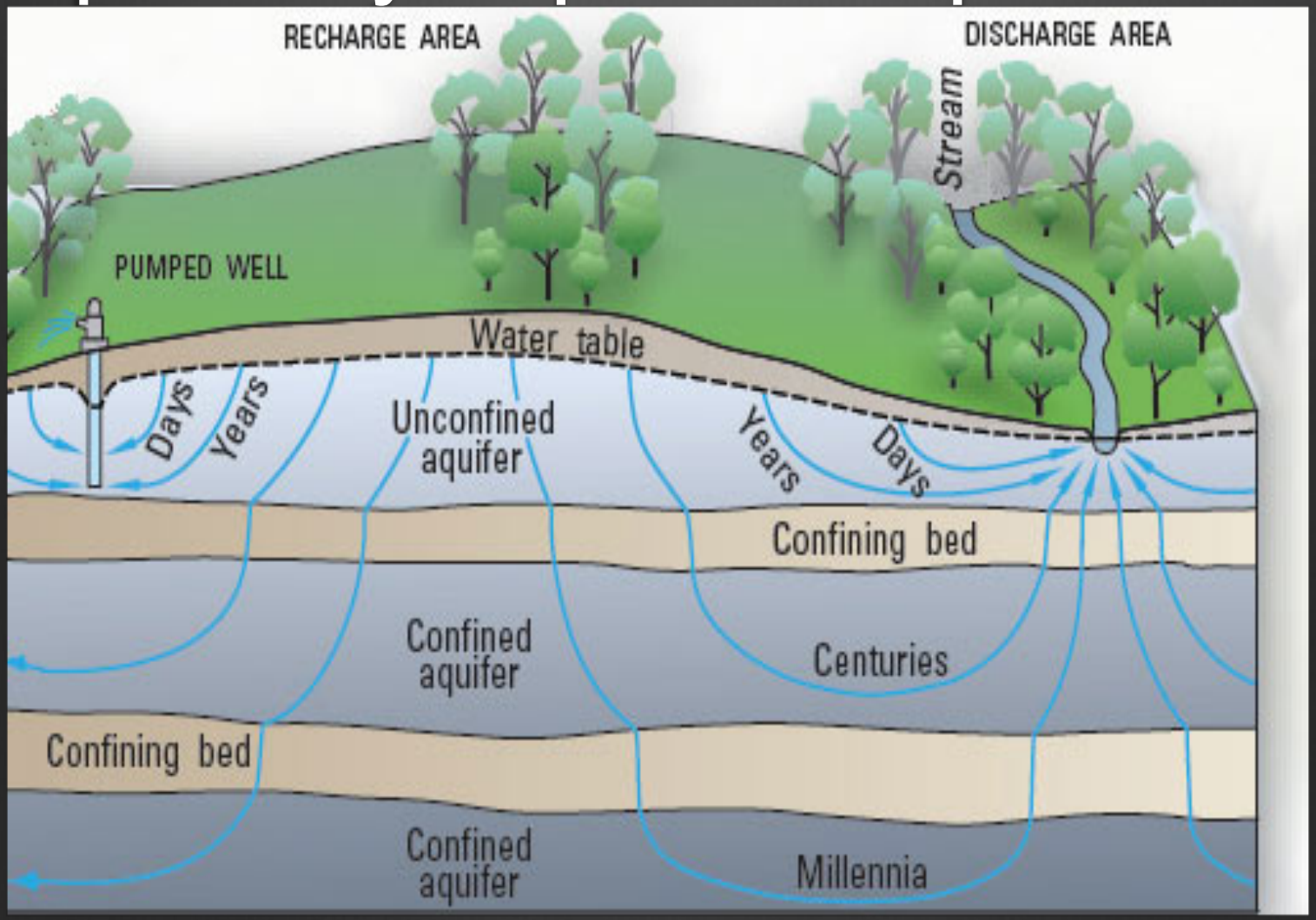


View of a Cross Section

Wisconsin arch



Aquitards (confining unit) can partially separate aquifers



USGS http://water.usgs.gov/edu/watercyclegwdischarge.html

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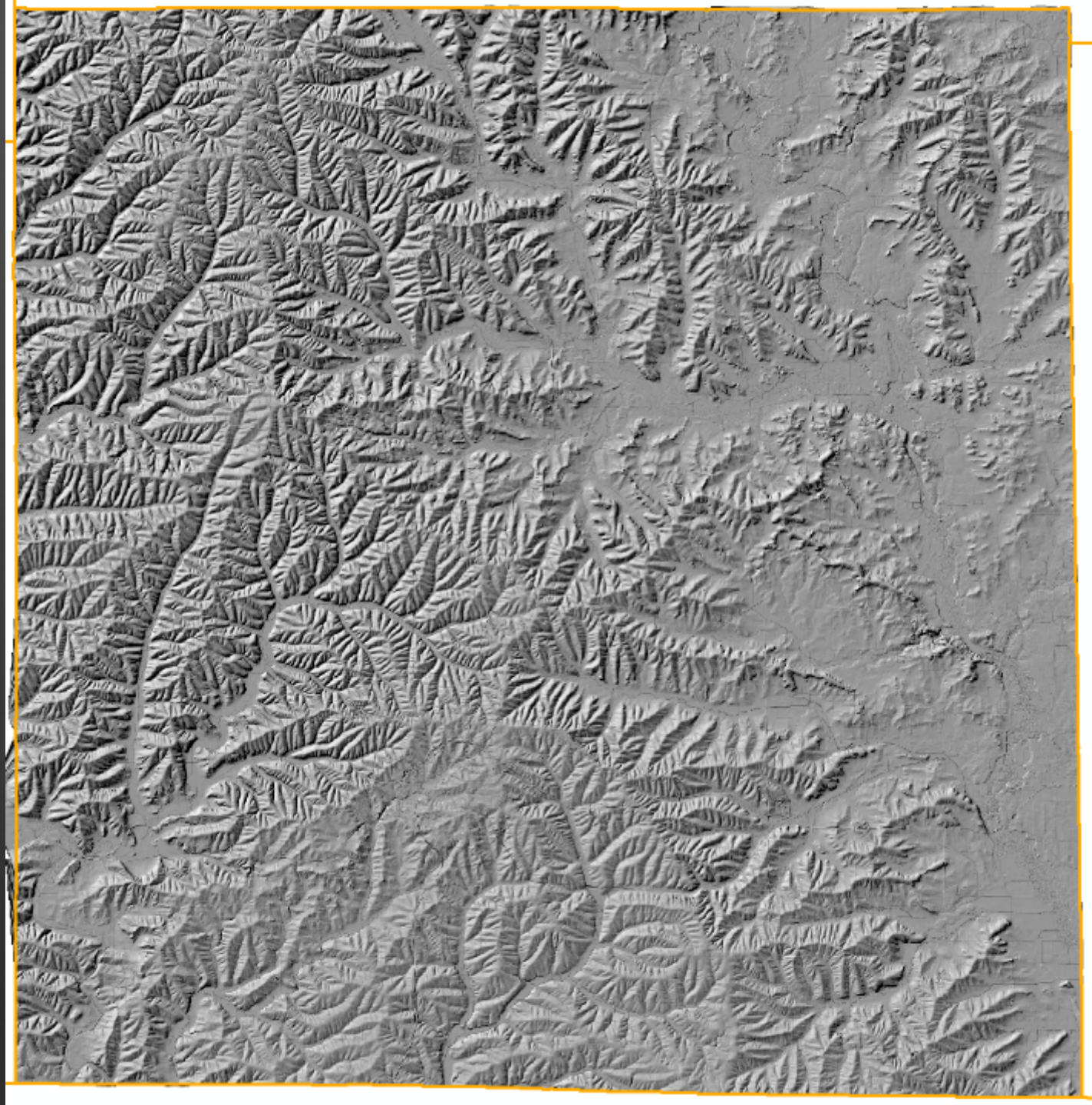
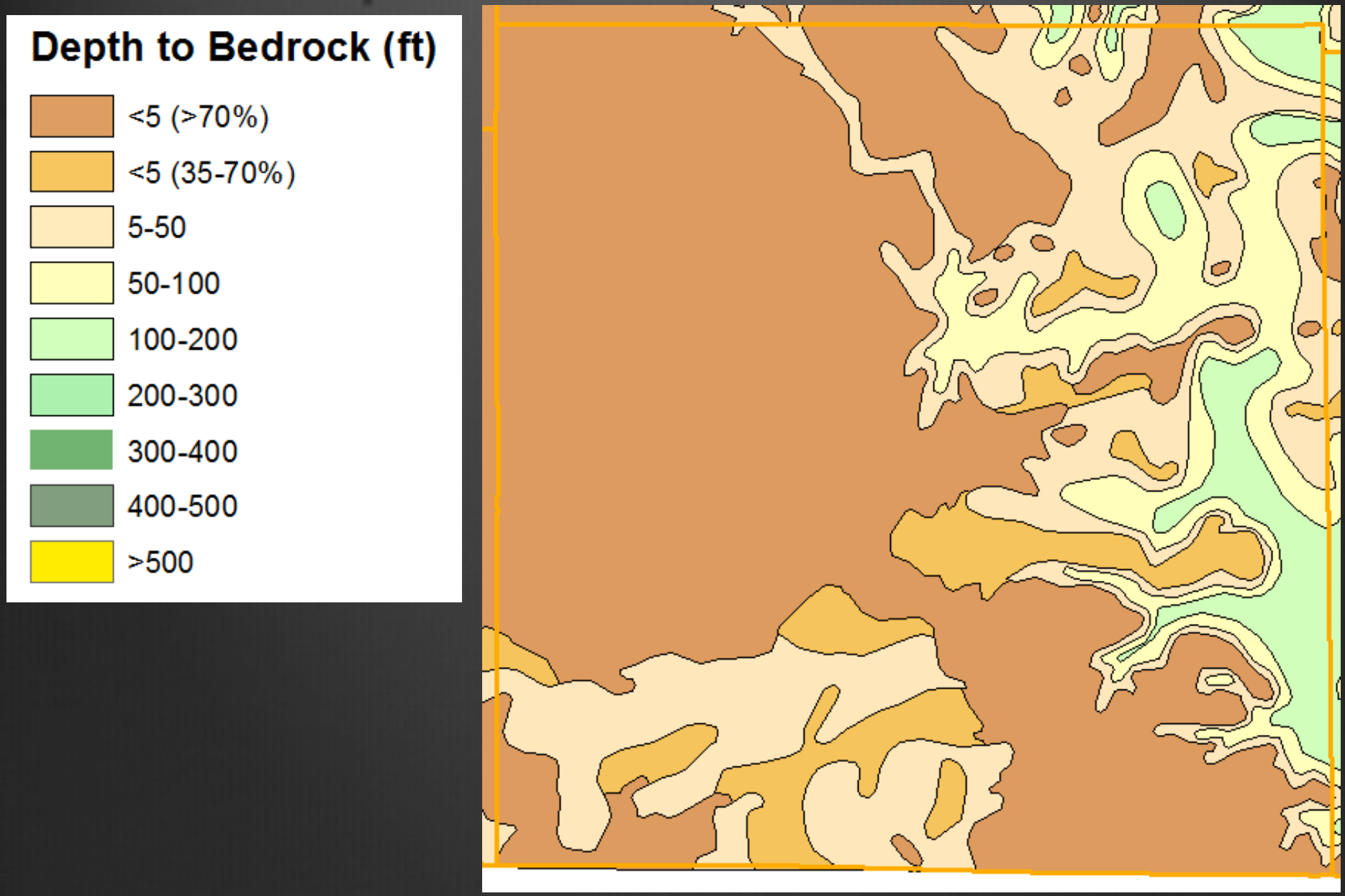
Some basic generalized geologic and hydrogeologic information for Green County
Unglaciated
Glaciated

Green County Topography

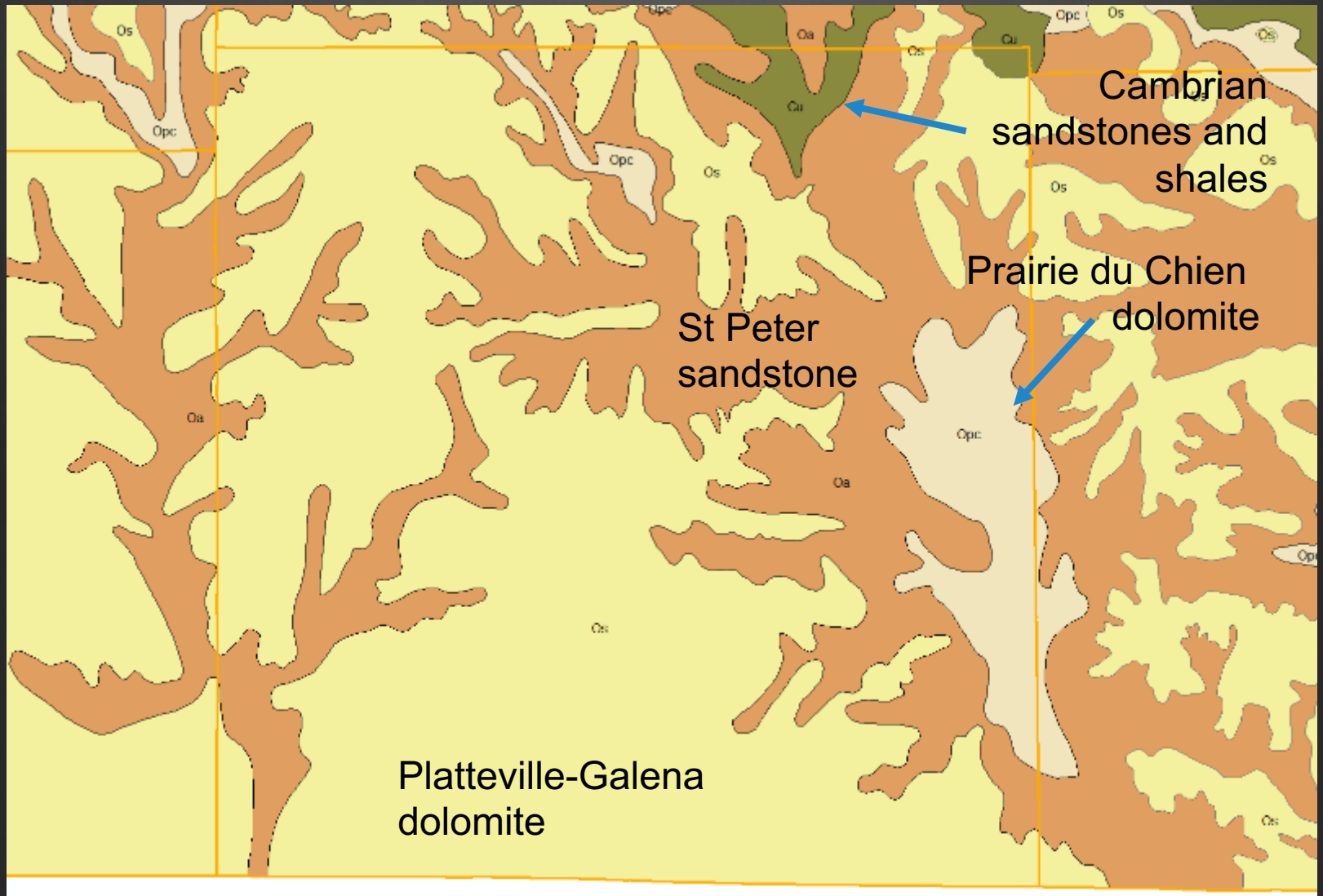
No Glaciers to West so ridges and valleys not ground up by glacier or eroded by melt water in Sugar River



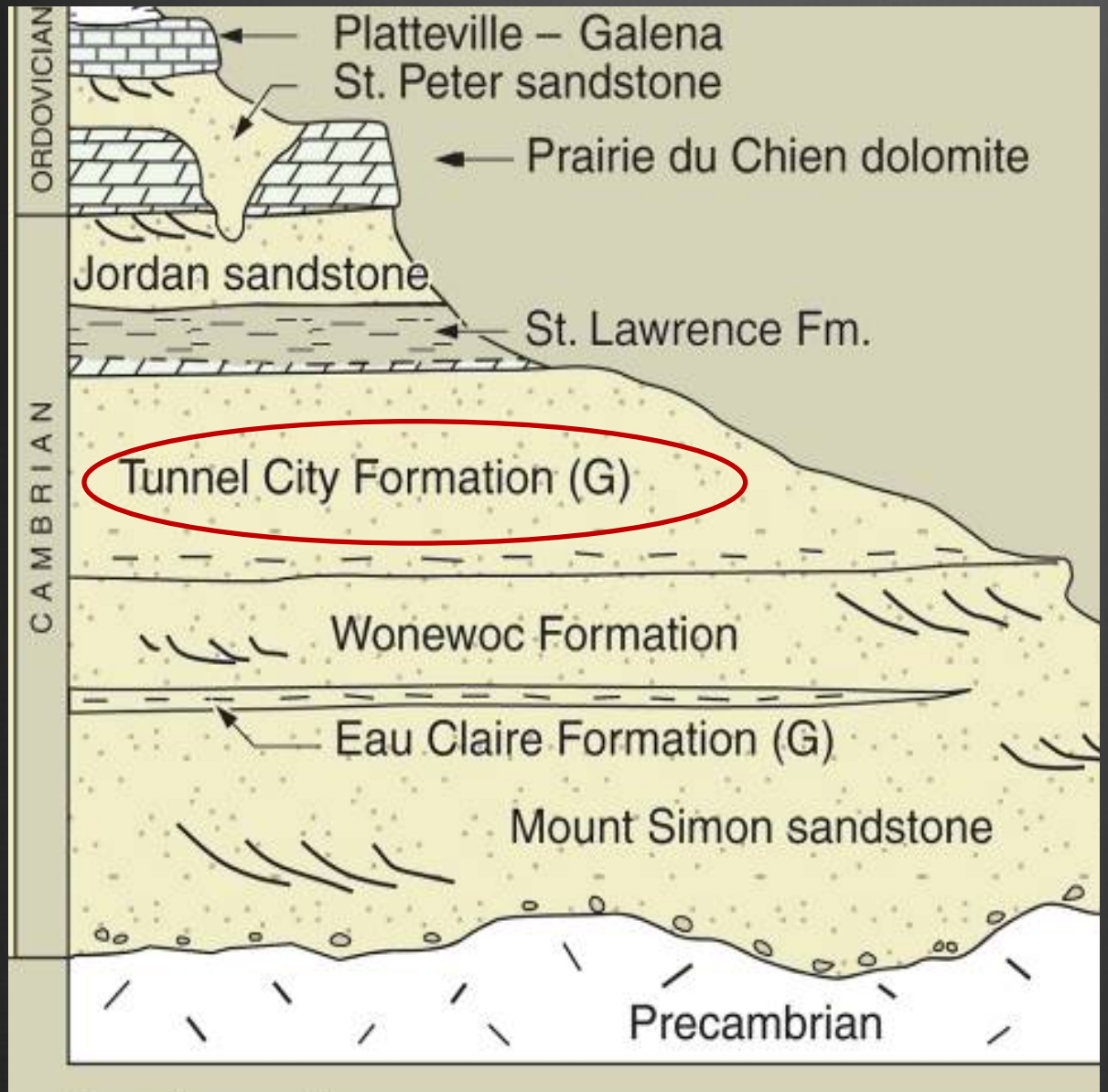
Depth to Bedrock



Green Co Bedrock Geology



Bedrock is in layers beneath Green County



Dolomite aquifer
Sandstone aquifer
Dolomite aquifer

Sandstone aquifer

Tunnel City
Base is aquitard

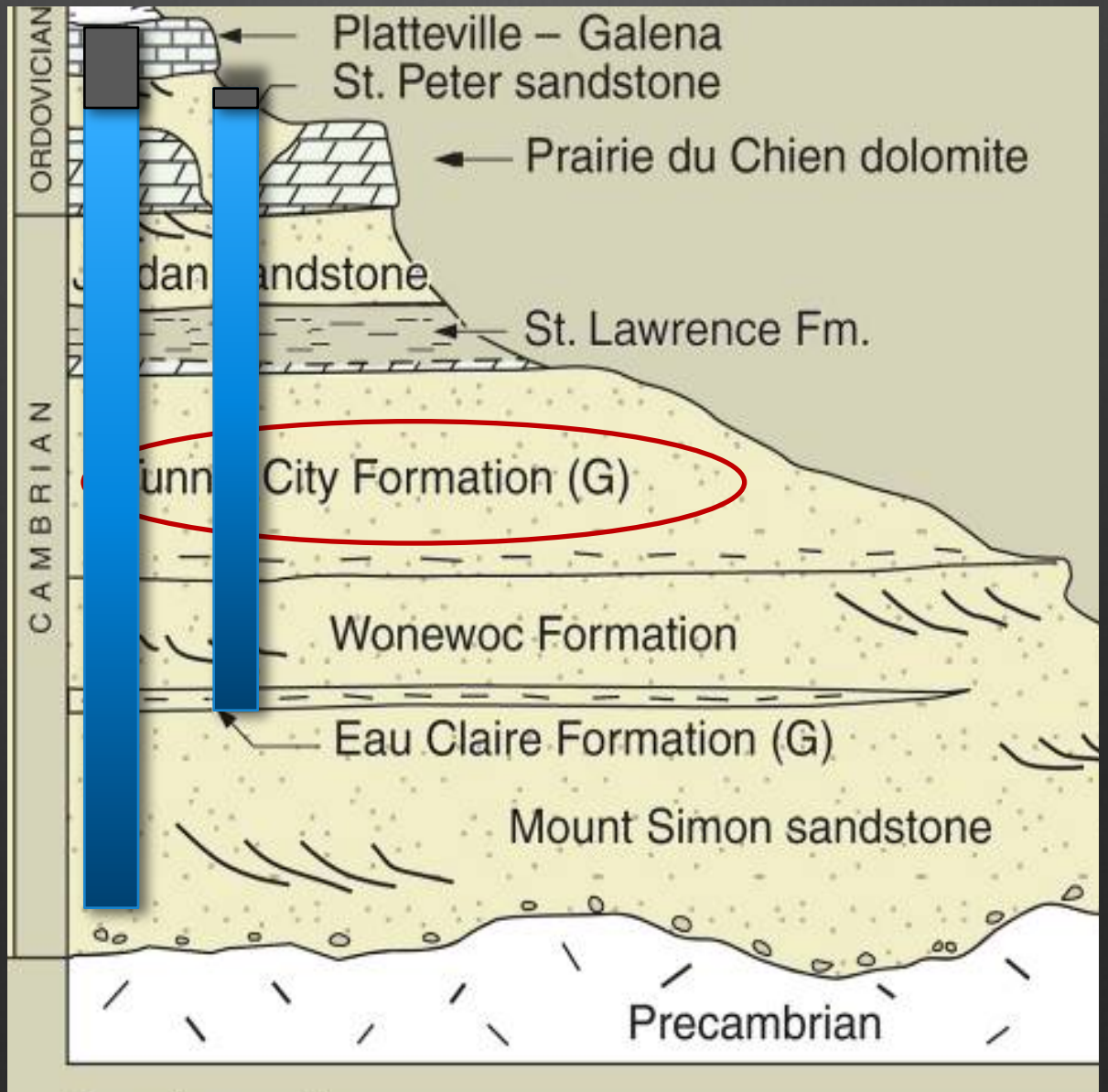
Sandstone aquifer
Shale aquitard

Sandstone aquifer

Depths not to scale

Monroe Well #6
1766 feet deep

Albany Well #2
376 feet deep



Albany Village Well #2

UNIVERSITY OF WISCONSIN GEOLOGICAL & NATURAL HISTORY SURVEY
1815 University Avenue, Madison, Wisconsin 53706

Log No. D3-Gn-72

Well name Albany Village Well #2

County: Green

Owner.... Village of Albany
Address.. Village Hall
Albany,WI 53502
Driller.. Layne - Northwest Co.
Engineer. Green Engineering Co.,Inc.
Middleton, Wisconsin

Completed... 9/73
Field check. WGS - R.M.Peters
Altitude.... 824'
Use..... Municipal
Static w.l.. 10.5'
Spec. cap... 4.9 GPM/ft

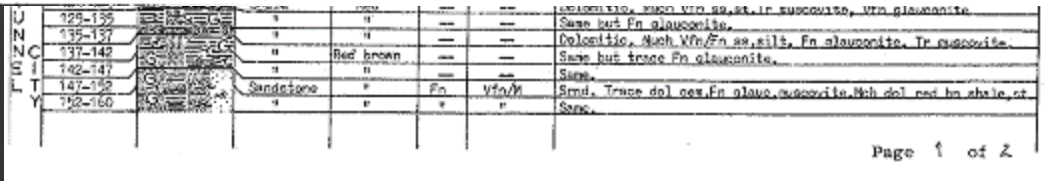
R. 9E.
T 3 N.
Sec. 28

Location: SW¼,NW¼,SW¼,SE¼,NW¼, Sec. 28, T3N, R9E

Quad. Albany 7½'

Drill Hole						Casing & Liner Pipe or Curbing					
Dia.	from	to	Dia.	from	to	Dia.	Wgt.& Kind	from	to	Dia.	Wgt.& Kind	from	to
22"	0	41'				22"	New steel 3/8" wall A53-B	+22"	41'				
21"	41'	216.5'				16"	3/8"						
15"	216.5'	376'											

Drill Hole						Casing & Liner Pipe or Curbing
EAU CLAIRE 58'	318-323	"	"	Fn	Vfn/C	Subrounded. Trace dolomite cement,silt,pyrite.
	323-328	"	"	"	"	Same but little silt.
	328-333	"	Light gry	"	"	Subrounded. Trace dolomite cement,pl green shale. Little clay.
	333-337	"	"	Vfn	"	Subrounded.Trace dol cem,pale green shale,fos frags.ltl st,cl.
	337-342	"	"	Fn	"	Same plus trace muscovite.
	342-348	"	"	"	"	Same.
	348-355	"	"	"	Vfn/M	Srnd. Trace dol cem,fossil fragments. Much light gry sh. ltl
	355-360	SS & shale	Gray	"	"	Sang. Trace fossil fragments? pale green shale.
	360-365	Shale	"	--	--	Siliceous. Little sandstone, silt. Trace silt size pyrite.
	365-370	"	"	--	--	Siliceous. Little silt. Trace sandstone, silt size pyrite.
	370-376	"	"	--	--	Same plus little Fn/M glauconite.



Water Use Comparison

City/Village	Yearly Use (gallons)	Average Use (gpm)	Population (2010)	Per capita use (gallons per day per person)
Monroe (5 wells)	605,821,000	1150	10827	150
Albany (2 wells)	25,350,000	48	1017	70

- Typical daily home use for Wisconsin is 50-60 gallons per person per day.
- The per capita numbers represent all water uses in the municipality so it seems likely that Monroe has significant water use beyond domestic supply.
- Comparison: 5000 dairy cows x 50 gallons per cow per day x 365 days = 91,250,000 gallons yearly use.
- 50 gallons per cow per day is approximate and includes both drinking and wash/processing water.

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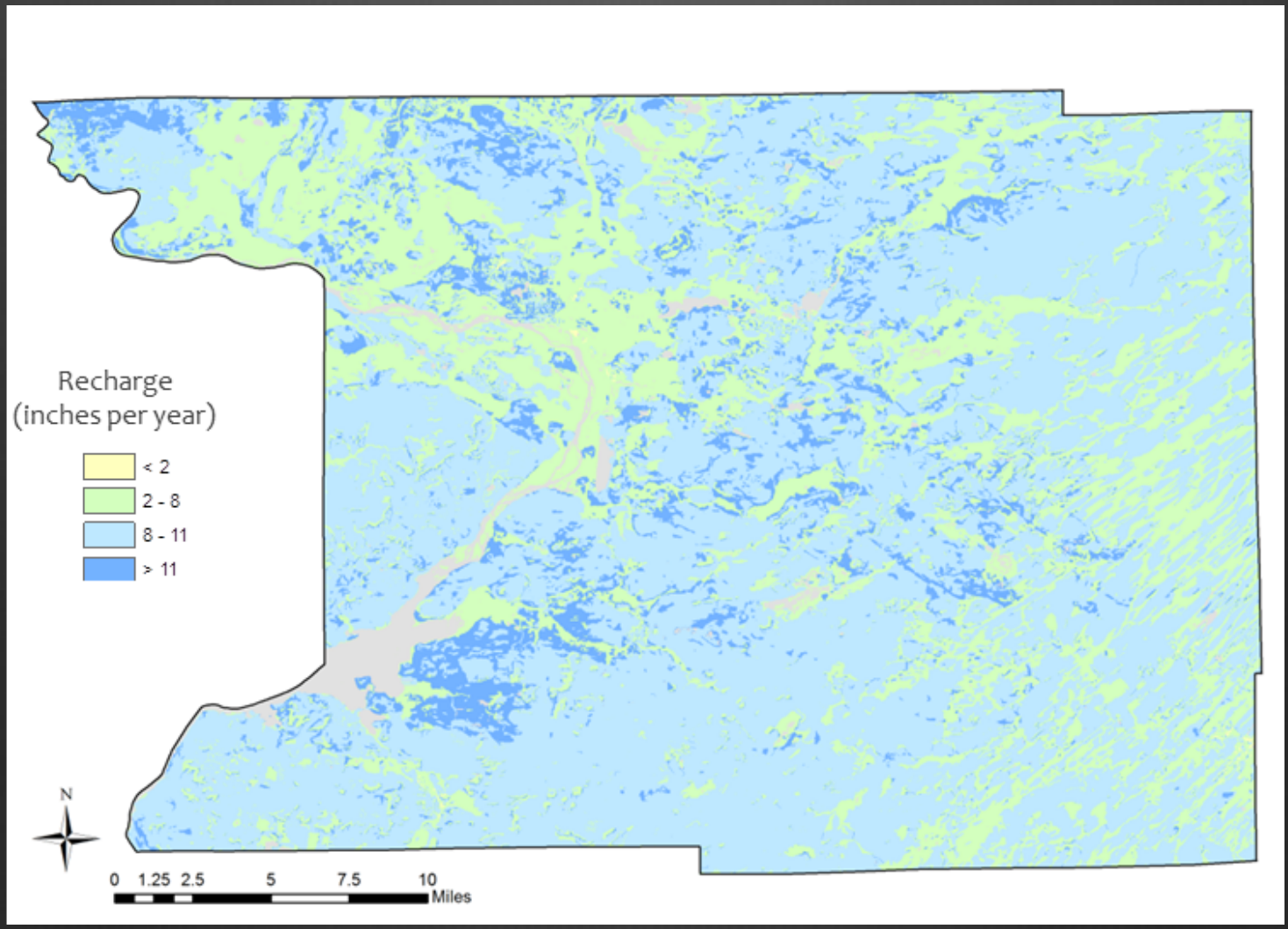
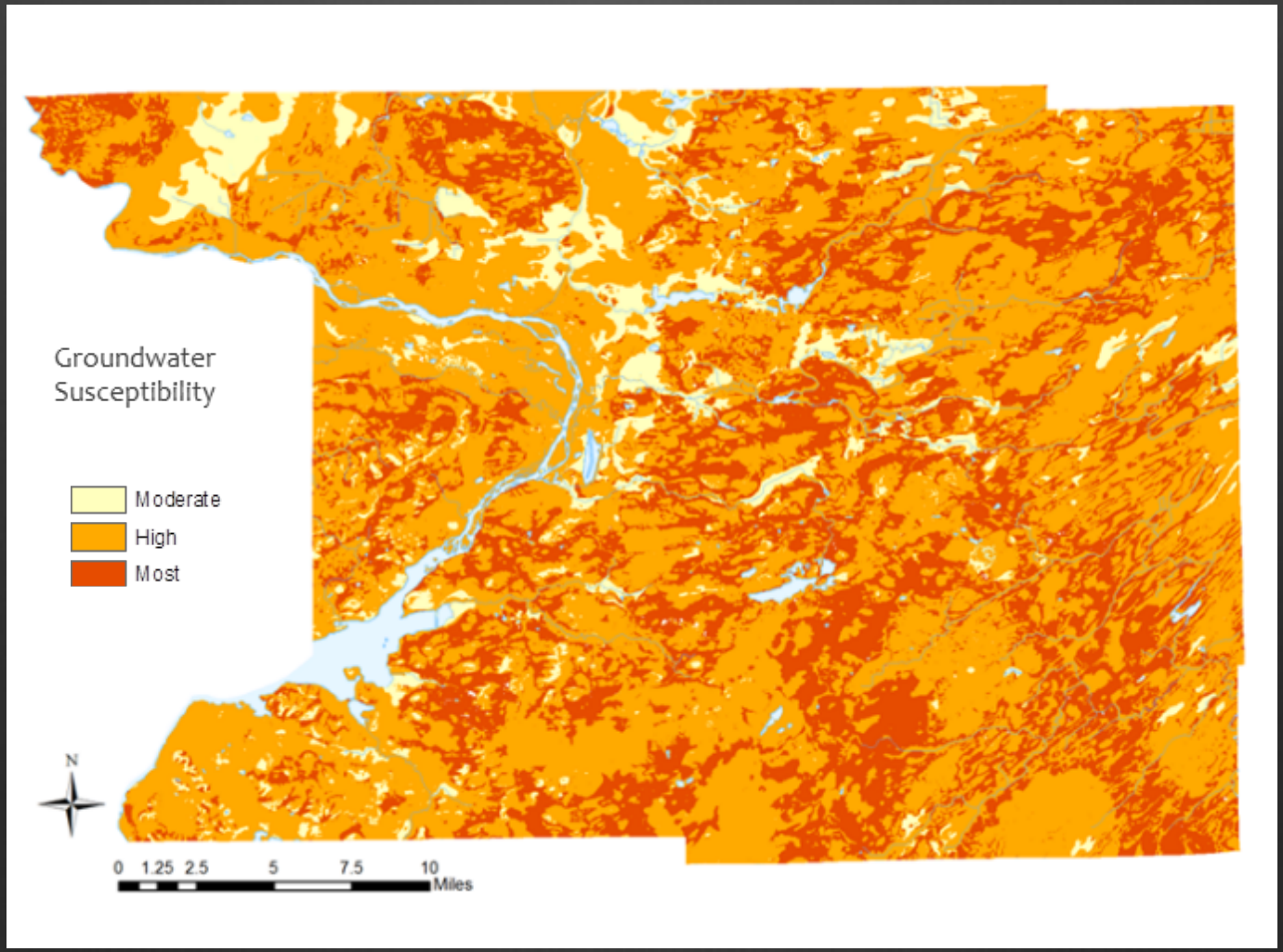
Groundwater Recharge



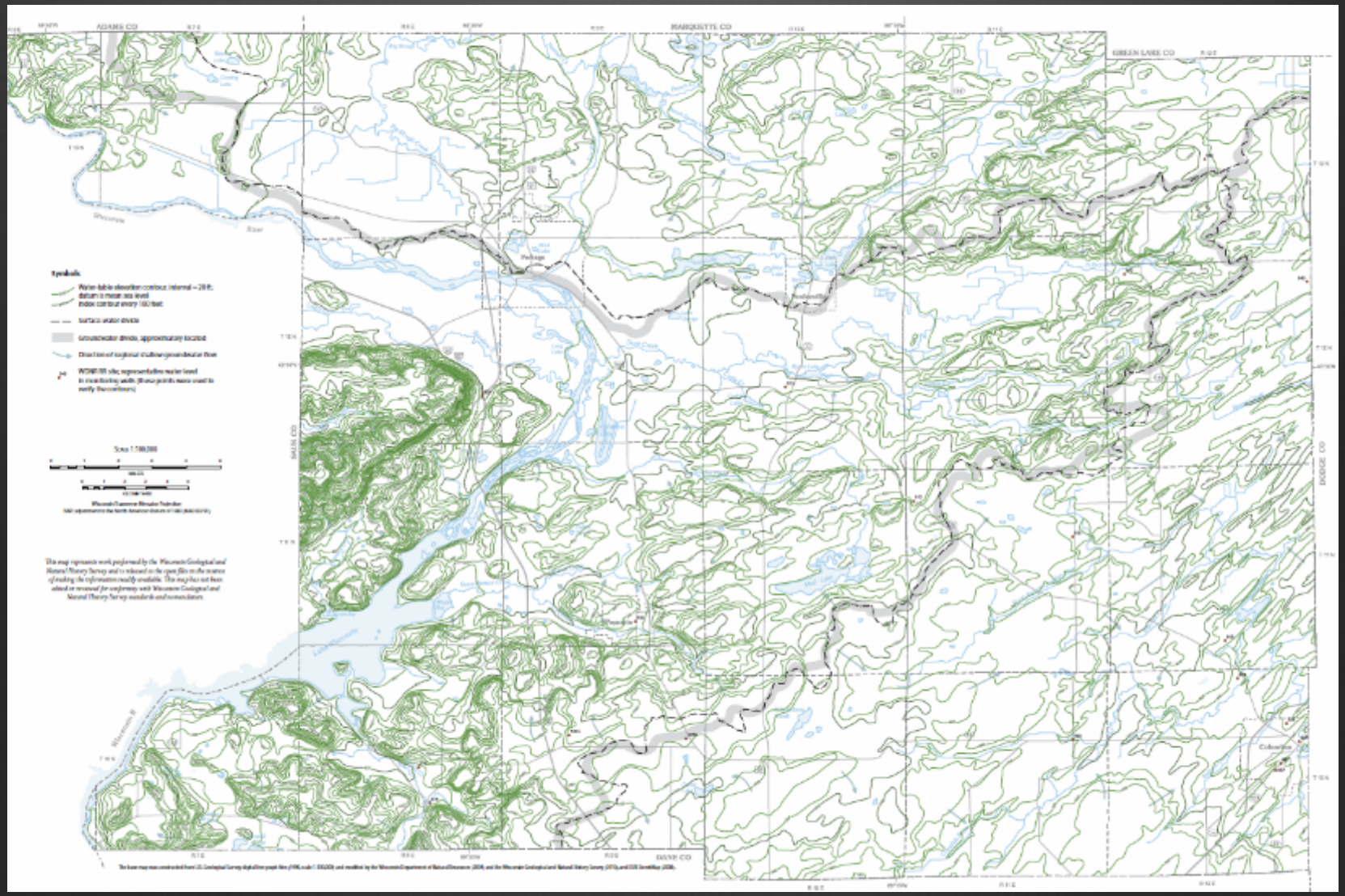
Where does groundwater enter the system?

Groundwater Susceptibility



Where can groundwater be most easily contaminated?

Water Table Elevation



Which direction is groundwater moving?

Questions?