

Groundwater interactions with the Madison lakes, Dane County, Wisconsin

Ken Bradbury

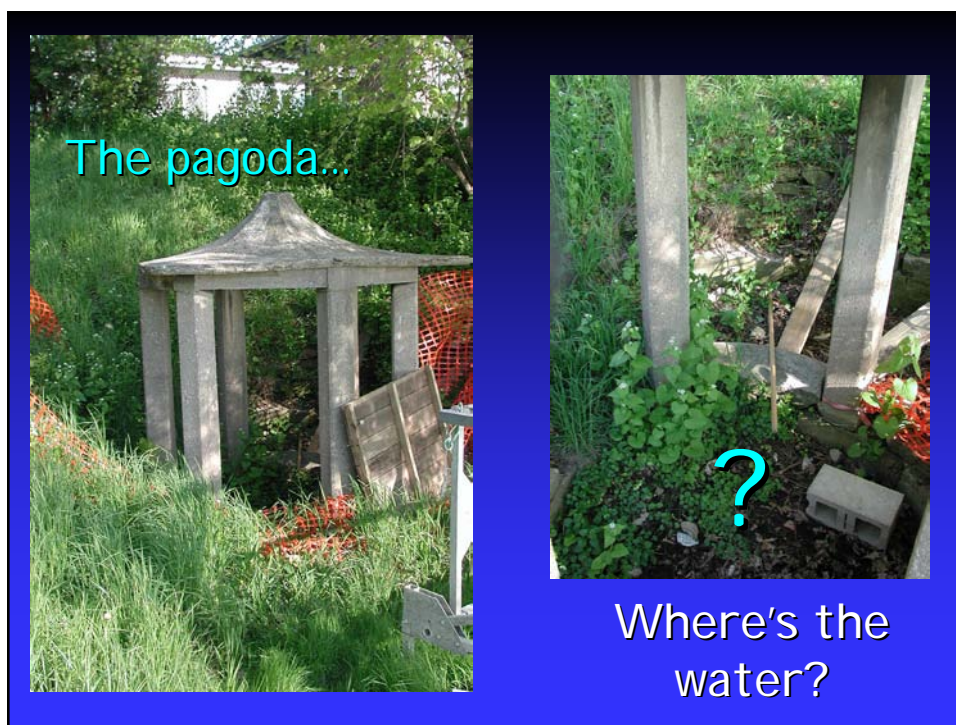
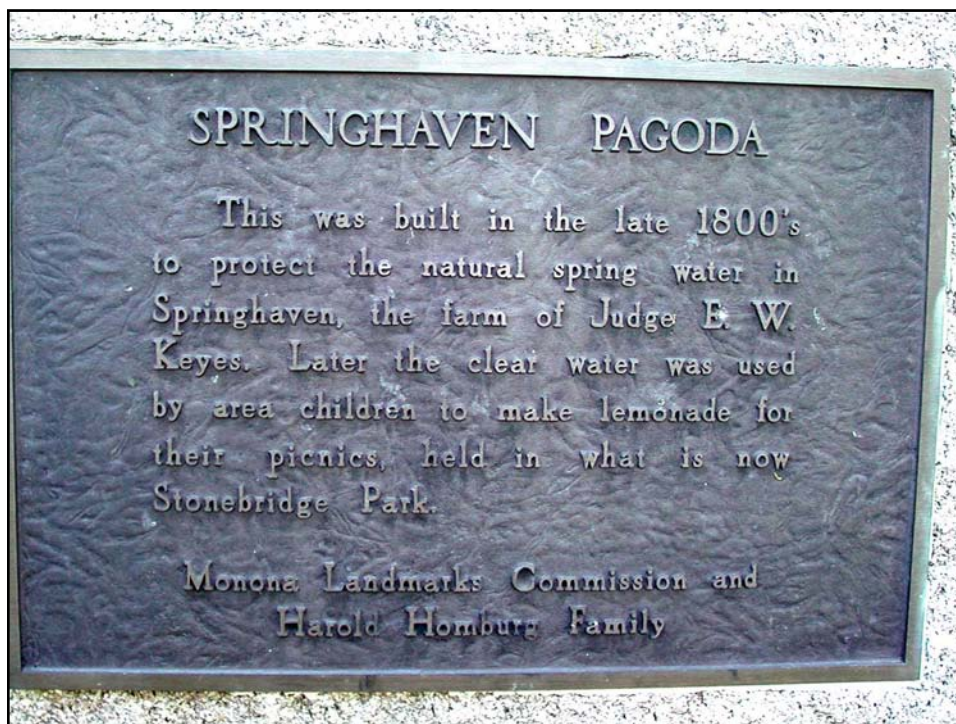
*Wisconsin Geological and Natural History Survey,
UWEX*



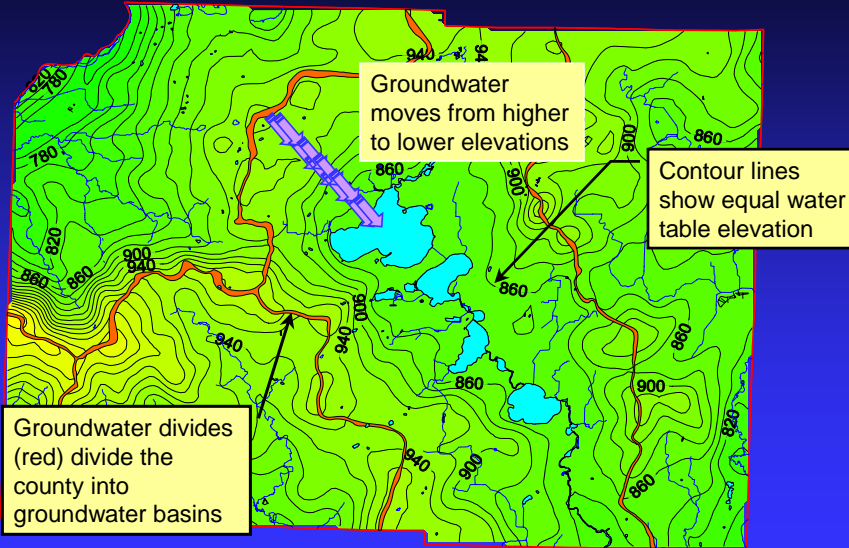
Summary

- Groundwater is an integral part of the water budget of the Madison lakes system
- Historically, the lakes were sinks (discharge points) for groundwater
- Today, groundwater pumping has dramatically altered the groundwater budget of the lakes, and the lakes lose water to the groundwater system



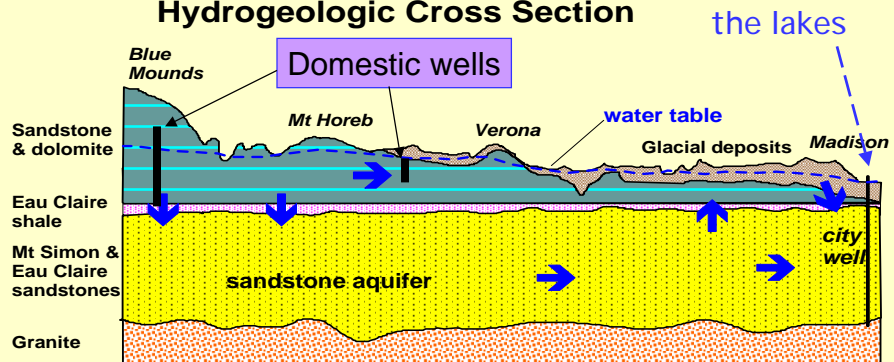


The *water table* is the top of the saturated zone



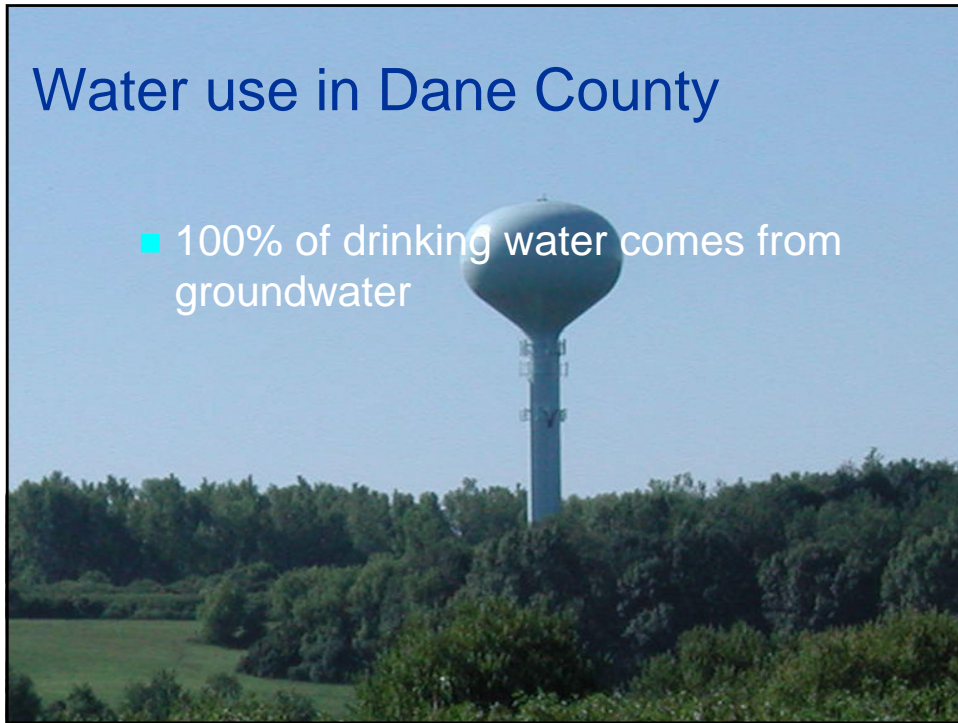
Groundwater moves downward and laterally through Dane County's aquifers...

Hydrogeologic Cross Section

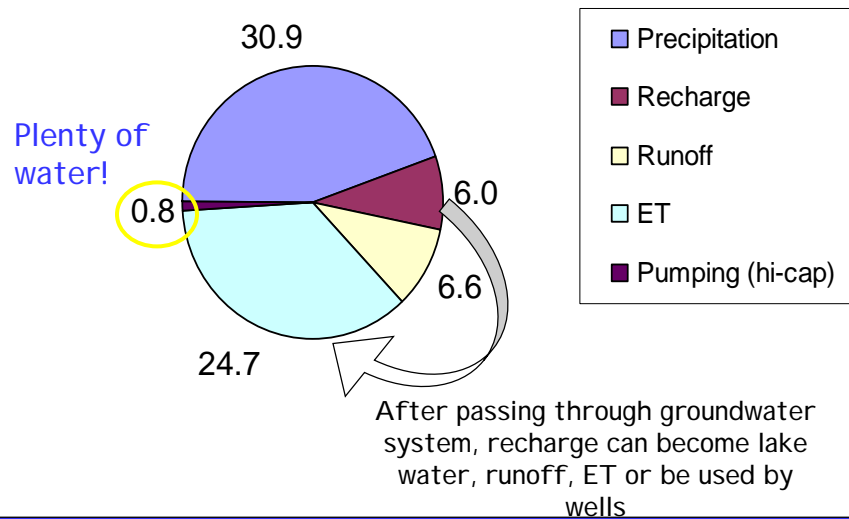


Water use in Dane County

- 100% of drinking water comes from groundwater

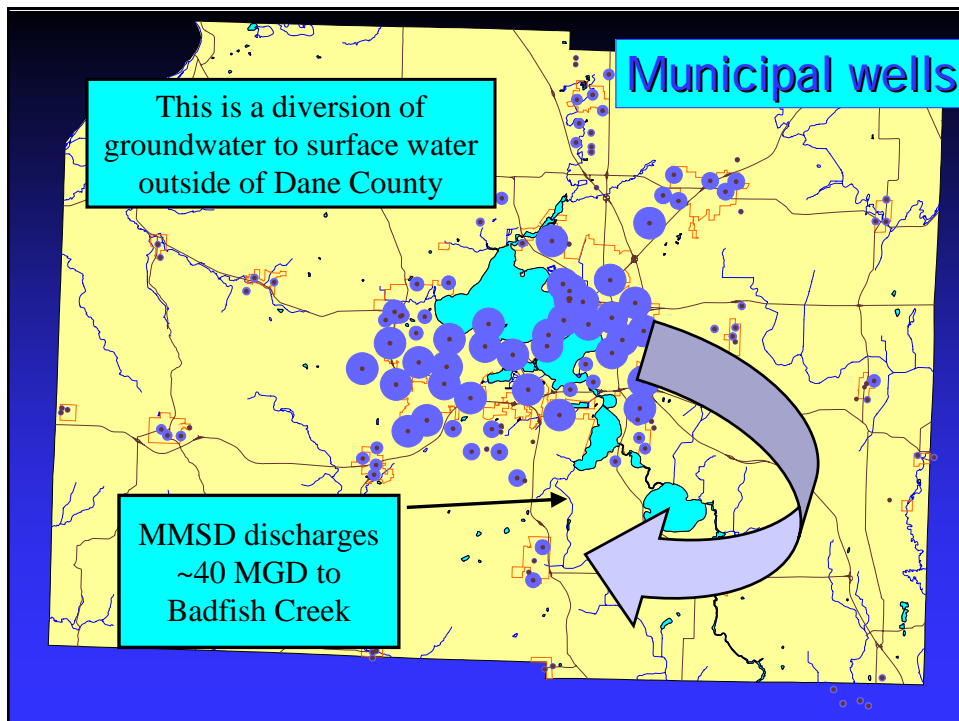


Dane County water budget, inches per year

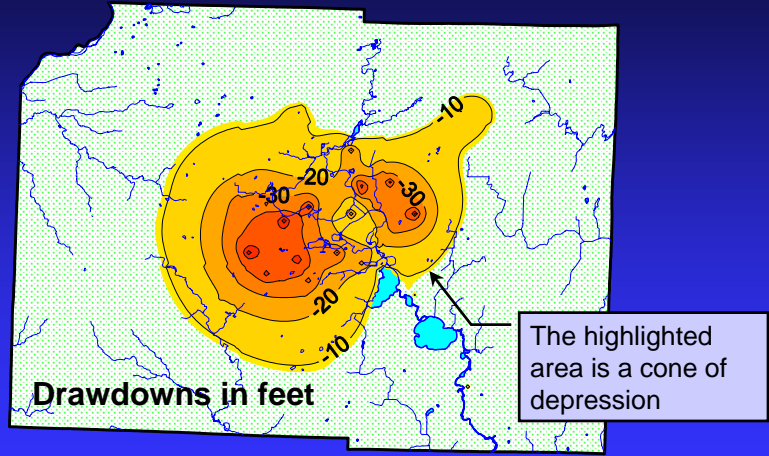


Groundwater use in Dane County

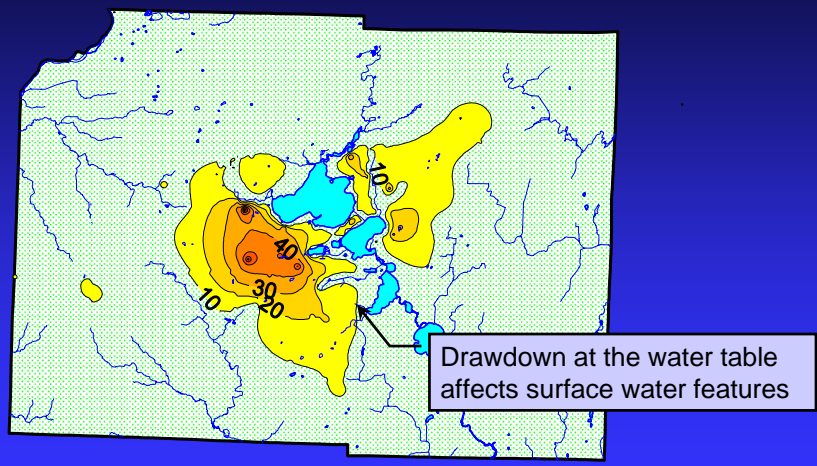
- Municipal and Industrial water use:
 - ◆ About 50 million gallons per day (MGD)
 - ◆ Or...about 75 cubic feet per second (CFS)
- For comparison:
 - ◆ Wingra Creek at Beld St: ~2 CFS
 - ◆ Badger Mill Creek at Verona: ~13 CFS
 - ◆ Black Earth Creek at Black Earth: ~27 CFS



Municipal water use in the Madison area causes significant drawdown, or lowering of water levels, in the deep sandstone aquifer...



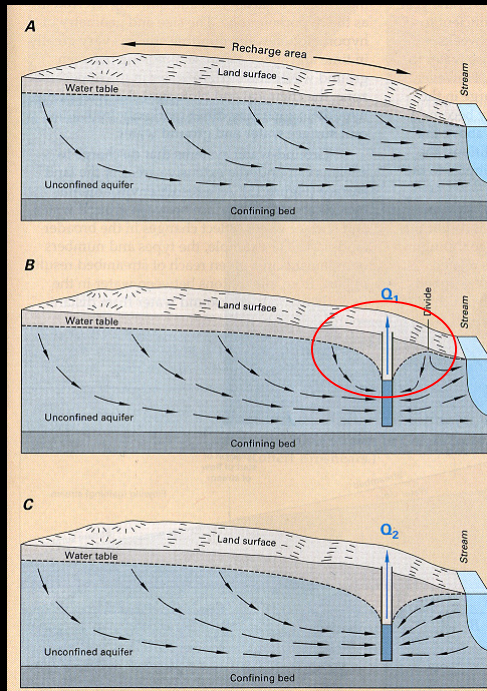
Drawdowns in the deep aquifer can affect the water table...reducing flow in streams and water levels in wetlands



Pumping wells affect groundwater movement

The well causes a cone of depression

Well pumping can reduce flow to surface water

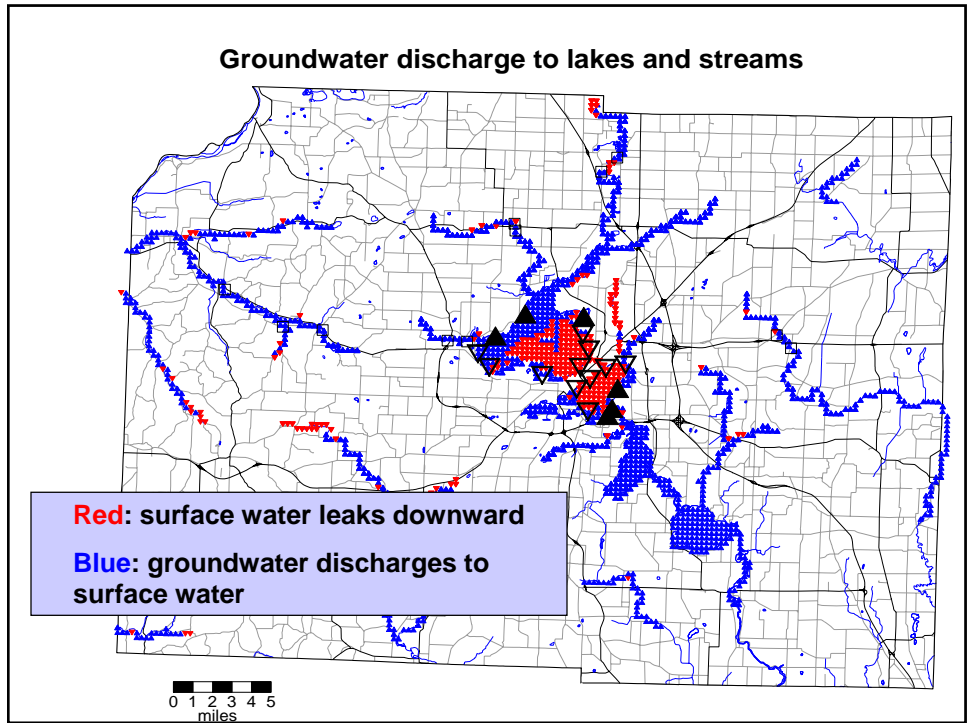


Lake groundwater budgets

| Lake | historic (cfs) | current (cfs) | change (cfs) | pct change |
|--------------|-------------------|------------------|-----------------|-------------|
| Mendota | 23.9 | 4.4 | -19.5 | -82% |
| Monona | 8.7 | -1.5 | -10.2 | -117% |
| Waubesa | 10.3 | 6.5 | -3.8 | -37% |
| Kegonsa | 10.2 | 8.8 | -1.4 | -14% |
| Wingra | 3.3 | 1.2 | -2.1 | -64% |
| total | 56.4 | 19.4 | -37 | -66% |

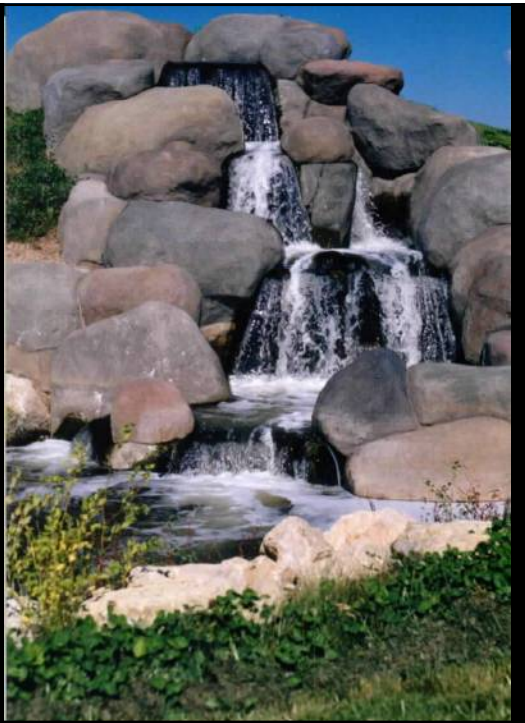
Simulated changes in direct groundwater contribution to Madison Lakes resulting from onshore pumping (note that total Dane Co pumping is about 75 CFS)

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Drawdown could be alleviated, in part, by returning water to the basin

Treated effluent return flow to Badger Mill Creek near Verona



Summary



- Pumping is influencing *lake budgets*
- Increased lakebed seepage has little impact on lake levels, but does affect downstream baseflow in the Yahara River
- Long-term water management should emphasize returning effluent to the basin and promoting groundwater recharge

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