Surface Water to Groundwater Connections: The "Significant Nexus"

Presented to

District Representatives
Groundwater Management Area 12
Post Oak Savannah GCD
Fayette County GCD
Lost Pines GCD
Mid-East Texas GCD
Brazos Valley GCD

Milano Civic Center
120 west Avenue E
Milano, Texas

by

T. Barret Lyne, PhD.
March 27, 2015 – 10:00 a.m.

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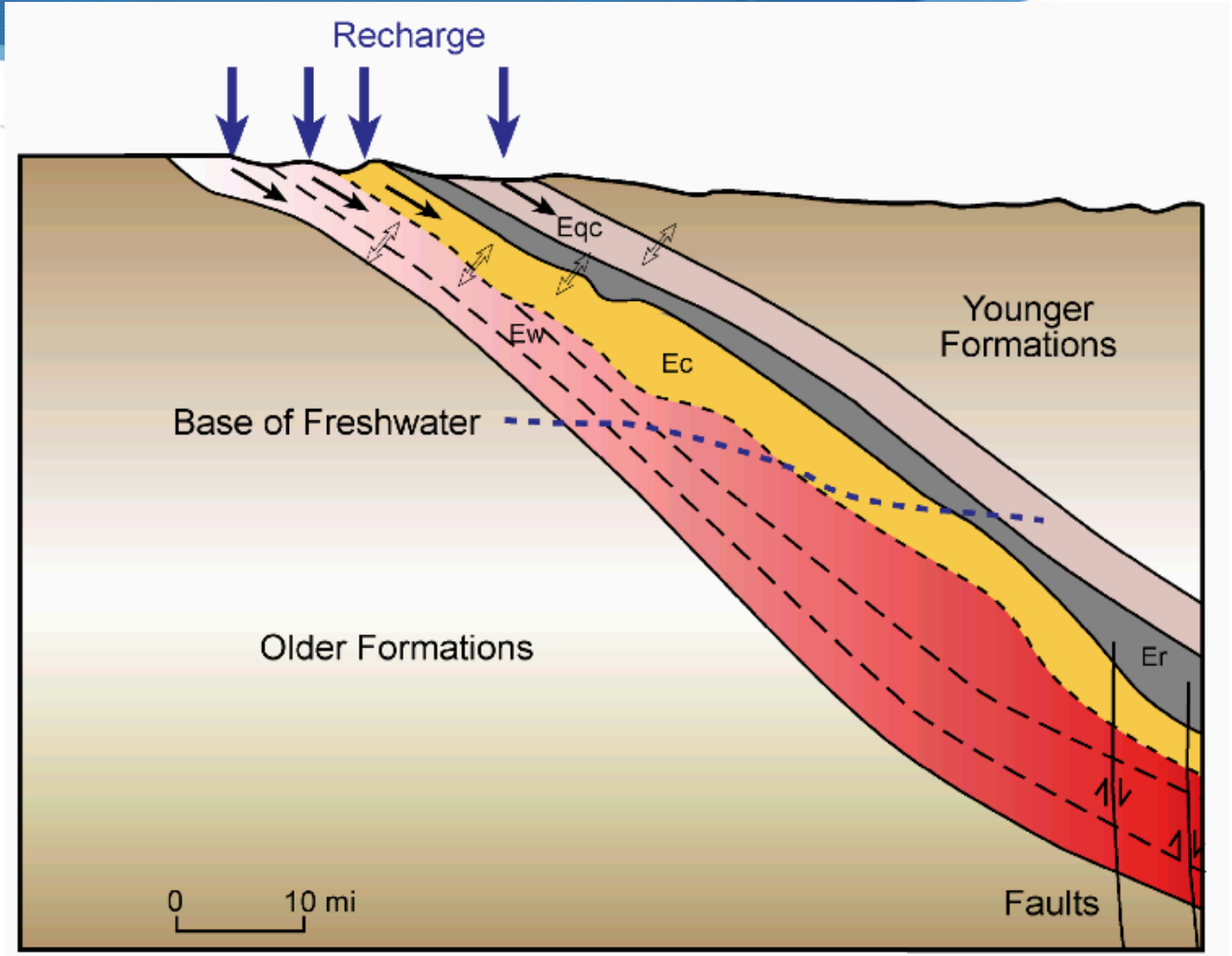
Surface Water to Groundwater Connections

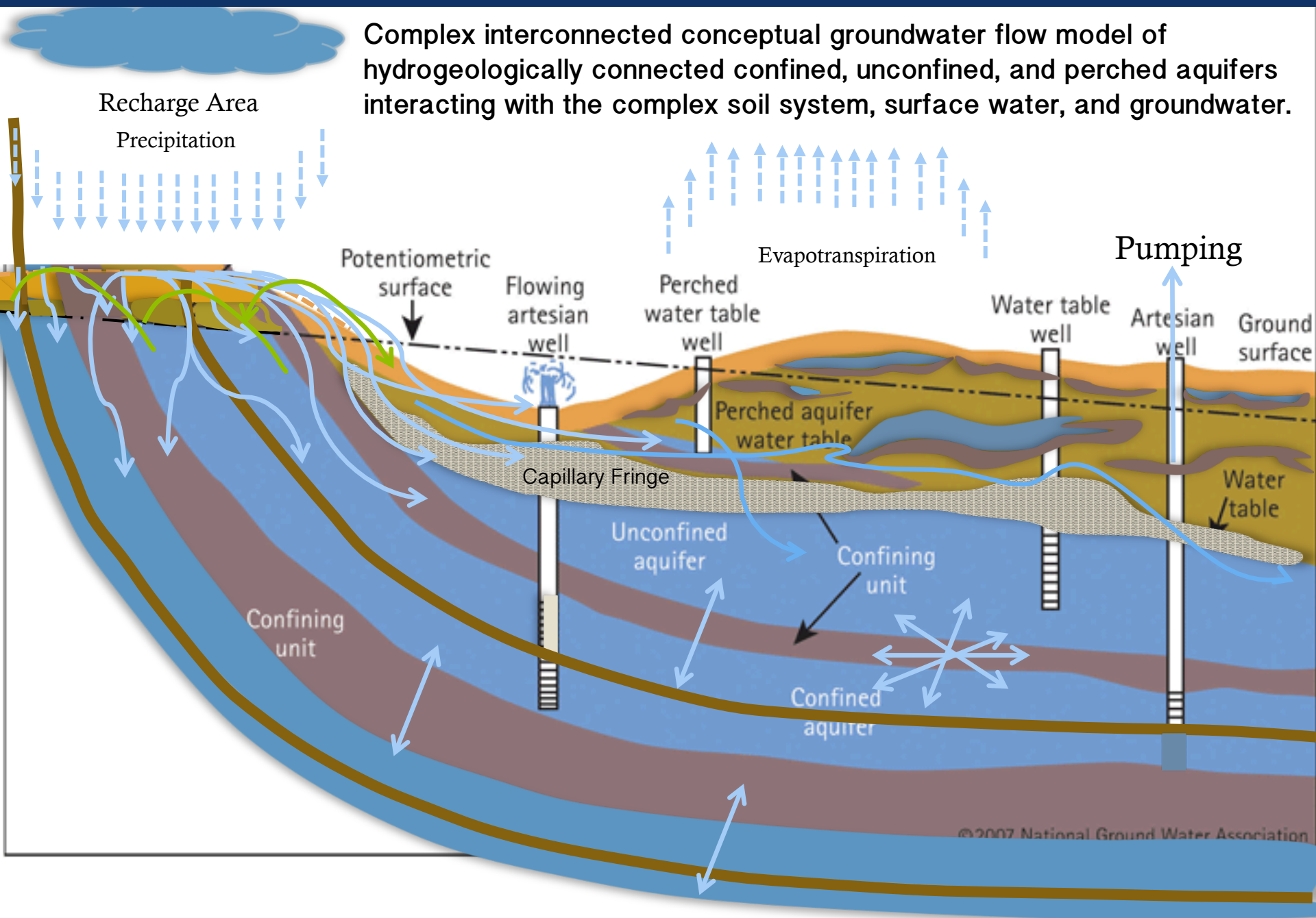
Simple and isolated conceptual groundwater flow model of hydrogeologically connected confined aquifers but with no hydrogeological interactions with unconfined aquifers, perched aquifers, the soil system, nor surface water to groundwater connections.



Freeze, R.A., 1971. Three-dimensional, transient, saturated-unsaturated flow in a groundwater basin: Water Resources Research, Vol. 7, No. 2, p. 347-366.

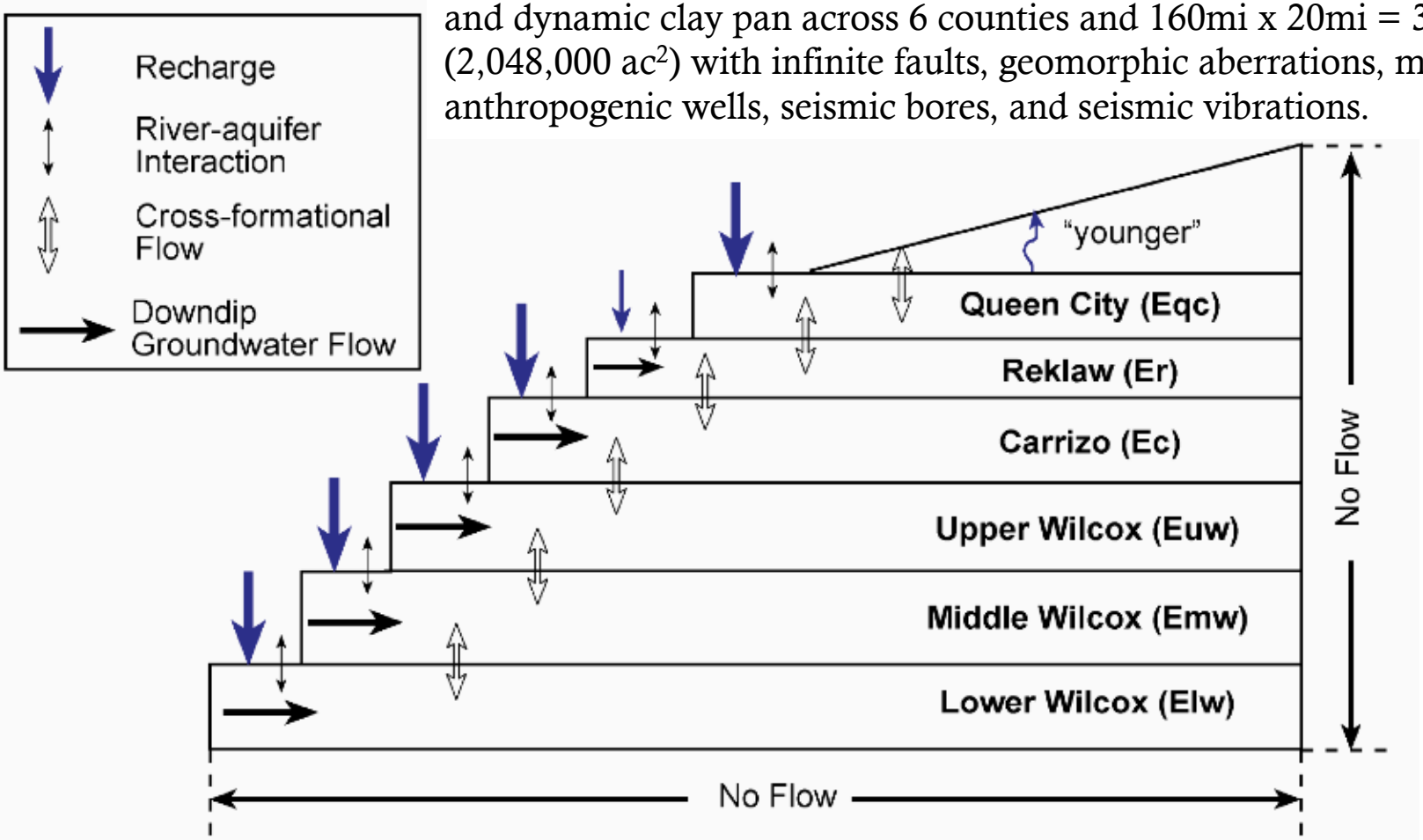
Surface Water to Groundwater Connections

Complex interconnected conceptual groundwater flow model of hydrogeologically connected confined, unconfined, and perched aquifers interacting with the complex soil system, surface water, and groundwater.



Conceptual groundwater flow model: But what is really out there?

Estimated Recharge Rates of 0.2 – 1.3 inches per year at outcrop from 7 boreholes through variable sandy, sandy loam to clay soils over a variable and dynamic clay pan across 6 counties and 160mi x 20mi = 3,200 miles^2 (2,048,000 ac^2) with infinite faults, geomorphic aberrations, macropores, anthropogenic wells, seismic bores, and seismic vibrations.



1. Freeze, R.A., 1971. Three-dimensional, transient, saturated-unsaturated flow in a groundwater basin: Water Resources Research, Vol. 7, No. 2, p. 347-366.
2. TWDB, February 2003. Groundwater Availability Model for the Central Part of the Carrizo-Wilcox Aquifer in Texas, Final Technical Report 2001-483-378, A-1.

Surface Water to Groundwater Connections: The "Significant Nexus"

by Justice Kennedy, U.S. Supreme Court, 2006

Justice Kennedy redefined Surface Water to Groundwater connections, in *Rapanos vs. U.S.*, 126 S.Ct. 2208 (S.Ct. 2006), to be: "The cumulative effect of hydrological and geological connections upon the chemical, physical, and biological integrity of navigable waters, *the significant nexus.*"

Kusler, J., P. Parenteau, E. A, Thomas. Significant Nexus and Clean Water Act Jurisdiction. Discussion Paper, Association of State Wetland Managers, Inc. March, 5, 2007.

Surface Water to Groundwater Connections: The "Significant Nexus" by Justice Kennedy, U.S. Supreme Court, 2006

Significant Nexus Definition

1. Significant = the singular or cumulative effect of surface water to groundwater connections.
2. Nexus = hydrological and geological connections between surface water to groundwater.
3. Effect = chemical, physical, and biological factors working on the integrity of navigable waters.

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The significant nexus helps create and maintain the soil moisture regime for sustainability of indigenous species.

Soil Moisture Regime

1. Aquic (Latin, aqua. Water) Saturated reducing soil free of oxygen.
2. Ustic (Latin, ustus. Burnt; implying dryness) Limited moisture but presents moisture over time interval when conditions are suitable for plant growth. Supplies plant growth with appropriate water concentration for growth over 90 consecutive days or for 180 cumulative days. Common in monsoon climates of torrential intermittent rainfall.
3. Udic (Latin, udus. Humid) Soil profile is not dry in any part for 90 cumulative days in normal years. Common in humid climates with well distributed rainfall.
4. Xeric (Greek, xeros. Dry) Mediteranean climates with moist and cool winters and warm and dry summers.

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An indigenous species that has evolved in this significant nexus environment, unique to the GMA 12 region, is the Navasota Ladies'-tresses orchid. This orchid has been found and monitored in Brazos, Burleson, Fayette, Freestone, Grimes, Jasper, Leon, Madison, Milam, Robertson, and Washington counties and no where else on planet earth. This evolution was made possible by the unique surface water to groundwater interactions in the clay pan soils connected with the aquifers. This interaction of water and soils created and maintained a variable ustic moisture regime supplying the appropriate soil moisture and temperature, for the required period of time, conducive to seed germination by the symbiotic relationship between the dust seeds of an orchid and the filamentous growth of a soil fungal hyphae. This complex surface water to groundwater connection, interacting with the unique soil system could only happen in the Regional Water Planning Group G, associated with the Groundwater Management Area 12, over the Carrizo-Wilcox aquifer. If this unique area is dried out by over pumping of the aquifers, the Navasota Ladies'-tresses could disappear forever. Her death, indicating a significant and adverse anthropogenic impact on the surface water to groundwater connections. This magnificent lady is not "just a little flower," but a uniquely beneficial bioindicator of the healthy well being of the aquifer and associated clay pan soils upon which we all depend for commerce and health here at home.

T. Barret Lyne, PhD. March 27, 2015