Using Tracer Testing Data for Resource Management Planning

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This report presents the findings of investigations by the Edwards Aquifer Authority (Authority) of groundwater flowpaths, velocities, and hydrostratigraphy in the Panther Springs Creek groundwater basin, northern Bexar County, Texas.

The Authority injected nontoxic organic dyes into six caves within the San Antonio segment of the Edwards Aquifer to trace groundwater flowpaths and measure groundwater-flow velocities (**Figure 1**). The monitoring array consisted of 32 public and private wells, including irrigation wells at the Club at Sonterra, Bexar Metropolitan Water District public water supply wells in the Hollywood Park area, and Authority monitor wells. The wells were completed in either the Edwards or the Trinity aquifers.

Results of tracer tests revealed discrete groundwater flowpaths near Panther Springs Creek. Dyes were detected primarily in well 68-28-608 and at lower concentrations in seven other wells. Groundwater velocities to well 68-28-608 ranged from 1,134 to 5,300 meters per day (m/d). Velocities to the seven other wells where dye was detected ranged from 13 to 2,330 m/d. Results demonstrate the rapid groundwater velocities that are characteristic of karst aquifers and also demonstrate that groundwater flows freely between injection points in the upper member of the Glen Rose Formation (the hydrostratigraphic unit that comprises the Upper Trinity Aquifer) and detection points in the Edwards Aquifer. Dye was injected into Boneyard Pit and Poor Boy Baculum Cave, which penetrate approximately 40 m of unsaturated Edwards Limestone, then into the upper member of the Glen Rose Formation. Blanco Road Cave probably extends through the Edwards Limestone to the Glen Rose Formation, although the full vertical extent of Blanco Road Cave could not be entered. Seven of the wells where dye was detected are completed in the Edwards Aquifer, and one is completed in the Trinity Aquifer. Dyes traveling along flowpaths between caves and wells crossed several northeast-southwest-trending faults in which members of the Edwards and Glen Rose formations are juxtaposed. Faults with up to 104 m of vertical displacement did not impede groundwater flow. Consequently, tracer tests demonstrate excellent communication between groundwater in the Upper Trinity Aquifer and the Edwards Aquifer in the study area. One trace was also initiated through a 1-m2 site thinly covered by soil in an interstream upland area with no observable karst features such as sinkholes, dissolutioned fractures, or caves. Dye was injected in this site followed by 180,000 L of water (at an average rate of 250 L per hour) over a one-month period. Dye was subsequently detected in two wells. This trace demonstrates that vulnerability to contamination is not limited to recognizable karst landforms such as caves and sinkholes.

The study revealed the three-dimensional groundwater flow system in the Edwards Aquifer in the Panther Springs Creek area. Groundwater flowpaths shift laterally and vertically in response to changing aquifer conditions (**Figure 2**). Rapid groundwater velocities (>100 m/d) is typical in karst aquifers. Finally, this study demonstrates that large and diverse data sets are required for an adequate characterization of karst aquifers, including tracer tests, hydrophysical surveys, continuous water level measurements, cave mapping, and high-frequency water sampling.

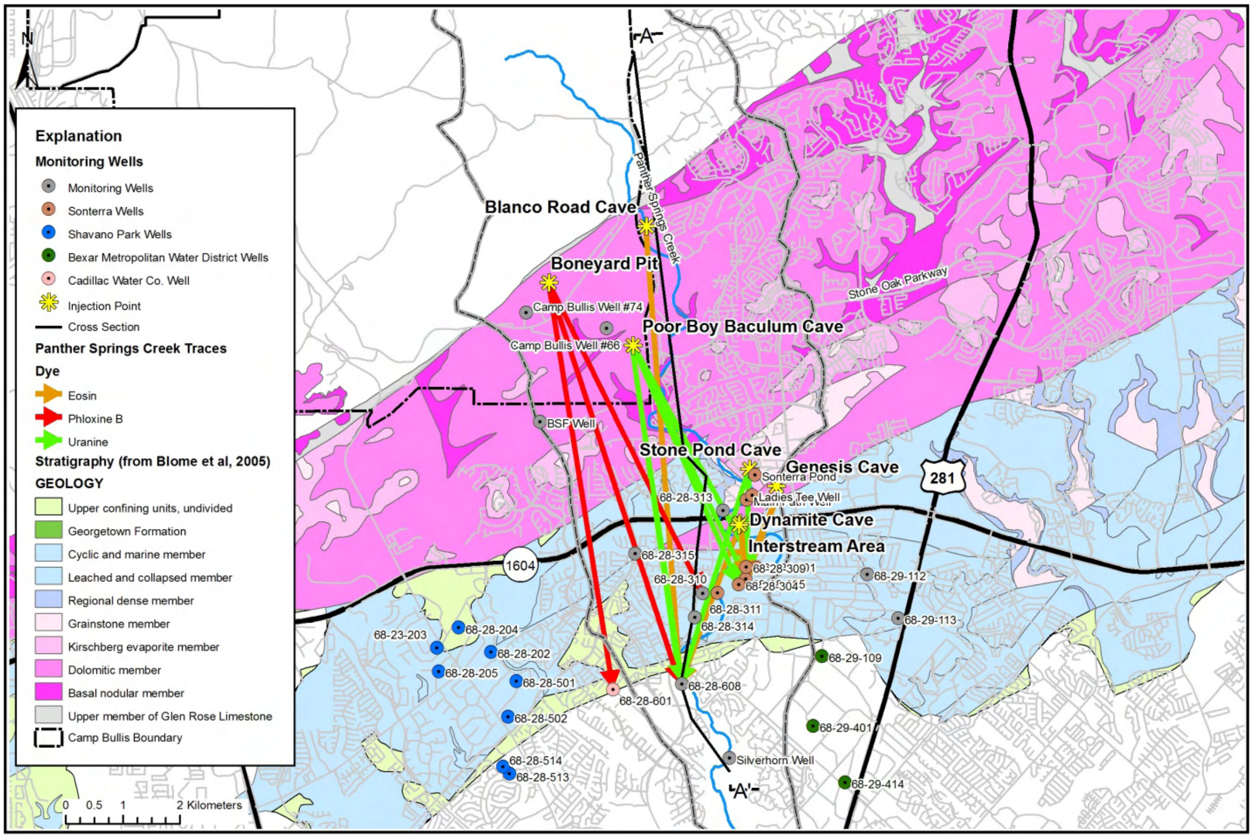

Figure 1. Map showing regional geology, monitor wells, and dye trace results.

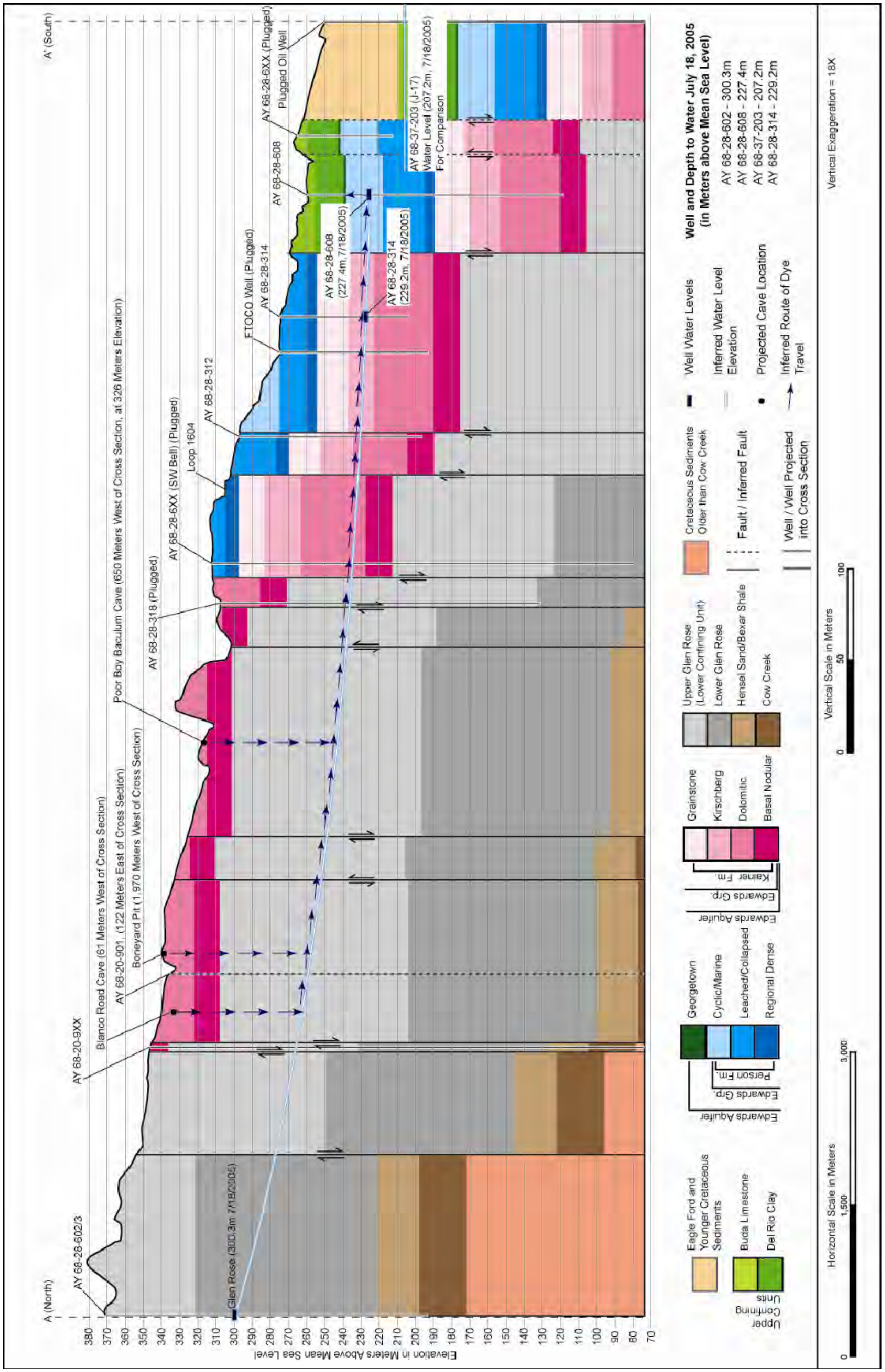

Figure 2. Cross section showing stratigraphy and estimated dye trace paths.