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TRACING GROUNDWATER FLOWPATHS IN THE EDWARDS AQUIFER RECHARGE ZONE, PANTHER SPRINGS CREEK BASIN, NORTHERN BEXAR COUNTY, TEXAS USA

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Abstract

The Edwards Aquifer Authority injected non-toxic organic dyes into six caves within the recharge zone of the San Antonio Segment of the Edwards Aquifer to trace groundwater flowpaths and measure groundwater flow velocities. The monitoring system consisted of 32 public and private wells, including irrigation wells completed in either the Edwards Aquifer or the underlying Trinity Aquifer.

Results of the tracer tests revealed discrete groundwater flowpaths associated with Panther Springs Creek. During most tests, dye was detected in well 68-28-608; however, dye was also detected in seven additional wells. Groundwater velocities to well 68-28-608 ranged from 1134 to 5283 m/day; velocities to the seven other wells where dye was detected ranged from 13 to 2330 m/day. These are apparent or minimum groundwater velocities since velocities can only be calculated between injection and detection points. The results demonstrate the high groundwater velocities that are characteristic of karst aquifers. The results also indicate that groundwater flows freely between injection points in the upper member of the Glen Rose Formation, the stratigraphic unit that comprises the Upper Trinity Aquifer, and detection points in the Edwards Aquifer. Dye was injected into the upper member of the Glen Rose Formation through Boneyard Pit, Genesis Cave, and Poor Boy Baculum Cave, which penetrate the Edwards Aquifer. Dyes traveling along the flowpaths between the 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, the tracer tests show excellent communication between groundwater in the Upper Trinity Aquifer and the Edwards Aquifer. One trace through soil, in a 1-m^2 interstream upland area where no karst features were evident, was shown to accept 180,000 L (250 L per hour) of recharge over a one-month period that flushed dye to at least two Edwards Aquifer wells. This trace demonstrates that aquifer vulnerability to contamination is not limited to recognizable karst features. 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. These tests also highlighted the anisotropy such as discrete groundwater flowpaths, aquifer characteristics that change with water levels, wide-ranging groundwater velocities, vertical groundwater flow, and rapid response to precipitation that exists in karst aquifers that is often underrated or even ignored while characterizing groundwater systems. Finally, this study demonstrated the diverse data necessary to characterize a karst aquifer system, including tracer tests, hydrophysical surveys, continuous water level measurements, and cave mapping.

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