APPLYING BATHYMETRIC GPR, BOREHOLE LOGGING, PASSIVE SEISMIC, LIDAR, AND STRUCTURE-FROM-MOTION METHODS IN HYDROGEOLOGIC STUDIES OF THE DEVILS RIVER, SOUTHWESTERN TEXAS

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We are conducting surface and borehole geophysics, airborne topographic and bathymetric lidar, and drone-based structure-from-motion (SfM) surveys in the Devils River area in southwestern Texas to better characterize the hydrology and hydrogeology of lower Cretaceous strata that host the Edwards–Trinity aquifer and associated springs, and of overlying coarse, unconsolidated alluvial deposits. The aquifer and its springs sustain the perennial river and are an important water supply. The river, which flows within a deep valley incised into the Edwards Plateau, provides habitat for endangered aquatic species and is a highly valued recreational resource. Airborne topographic and bathymetric lidar surveys were flown along the Devils River to map river bottom and adjacent topography. Waterborne GPR surveys were employed to establish depths to riverbed-forming limestone bedrock and alluvium in areas where the lidar survey did not detect the water bottom owing to the presence of aquatic vegetation. For the bathymetric GPR survey, 200-MHz antennas were placed on the bottom of an inflatable boat that was rowed across gap and non-gap areas in the bathymetric lidar-derived riverbottom surface. GPR reflections were observed in water depths as great as 4 m in areas where neither lidar nor sonar produced clear riverbed returns. Borehole spectral gamma and induction logs were acquired in two upslope and plateau-top water wells to detect lithologic boundaries within the Edwards Group limestones that host the aquifer. Gamma logs through the Edwards limestones are being correlated to lithologic units exposed on cliff faces that were imaged using SfM drone flights. Lidar-derived elevation data are enabling GIS-based mapping of geologic units, lineaments, and potential karst sinkholes and closed depressions. Finally, passive horizontal-to-vertical spectral ratio (HVSR) seismic measurements acquired on unconsolidated Quaternary terraces adjacent to the river are providing thickness estimates for these gravel-dominated deposits. These data are being used to construct an aquifer framework and revise the hydrogeologic conceptual model as it relates to springs and riverflow gains and losses.