Spatial and Temporal Recharge Variability Related to Groundwater Interconnection of the Edwards and Trinity Aquifers,
Camp Bullis, Bexar and Comal Counties, Texas

Marcus Gary[1], George Veni[2], Beverly Shade[1], and Robin Gary[3]
[1]Zara Environmental LLC; [2]National Cave and Karst Research Institute;
[3]Barton Springs/Edwards Aquifer Conservation District

Camp Bullis military training site in northern Bexar and southern Comal Counties, Texas, includes over 113 km^2 of limestone outcrop of the Trinity and Edwards Aquifers. These Cretaceous carbonate aquifers are within the Glen Rose Formation (Trinity), and Person and Kainer Formations (Edwards). Both groups are characterized by well developed secondary porosity, including significant karstification, which has altered recharge and transmissivity properties of the aquifers. Intensive karst surveys have identified and mapped over 1200 caves and potential recharge features in Camp Bullis. This karst dataset has been integrated with the mapped geologic members of the Glen Rose and Kainer Formations to produce karst feature density zones (KFDZs) that identify specific areas which have undergone more speleogenetic diagenesis than other areas (**Figure 1**). Independent spatial analysis of the karst feature density distribution compares closely to airborne electrical geophysical surveys conducted by the USGS, corresponding with areas of high resistivity which had been previously interpreted exclusively as lithologic and structural anomalies (**Figure 2)**.

Studies focused on upland recharge by monitoring vadose drip waters in two caves, creating a detailed temporal dataset of recharge dynamics. These data reveal a strong control on effective recharge from antecedent conditions; more recharge during wet conditions (8.6 liters/m^2) than in dry conditions (0.1 liters/m^2) (**Figure 3**). Applying these values to the KFDZs identified across Camp Bullis yields variation in total effective recharge in upland areas that varies from 4.212% - 0.067% of rainfall which falls on the area, depending on the antecedent conditions and karst density (**Figure 4**). Nineteen phreatic dye trace experiments indicate that water entering karst features at Camp Bullis can move rapidly, primarily in a south-southeast vector, and crosses faults moving directly from the Trinity to the Edwards Aquifer.

Implications from the analysis and interpretation of these individual studies may have significant impact on groundwater resource management in the region, as it indicates that the Trinity Aquifer directly recharges the Edwards Aquifer with variable rates depending on antecedent conditions, and thus could affect groundwater flow models and environmental regulatory practices in the region.

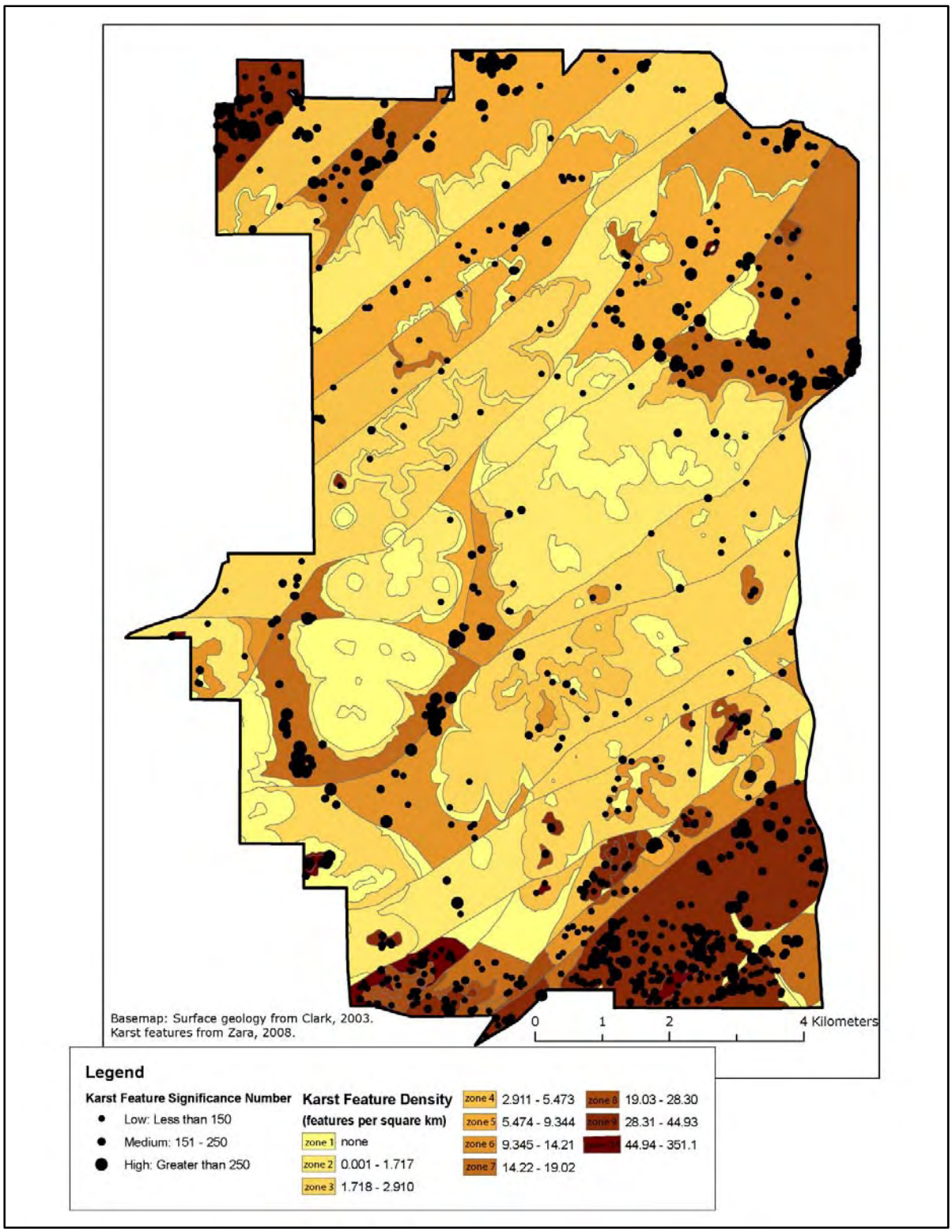

Figure 1. Karst feature density zones (KFDZs) identifying areas which have undergone more speleogenetic diagenesis than other areas at Camp Bullis.

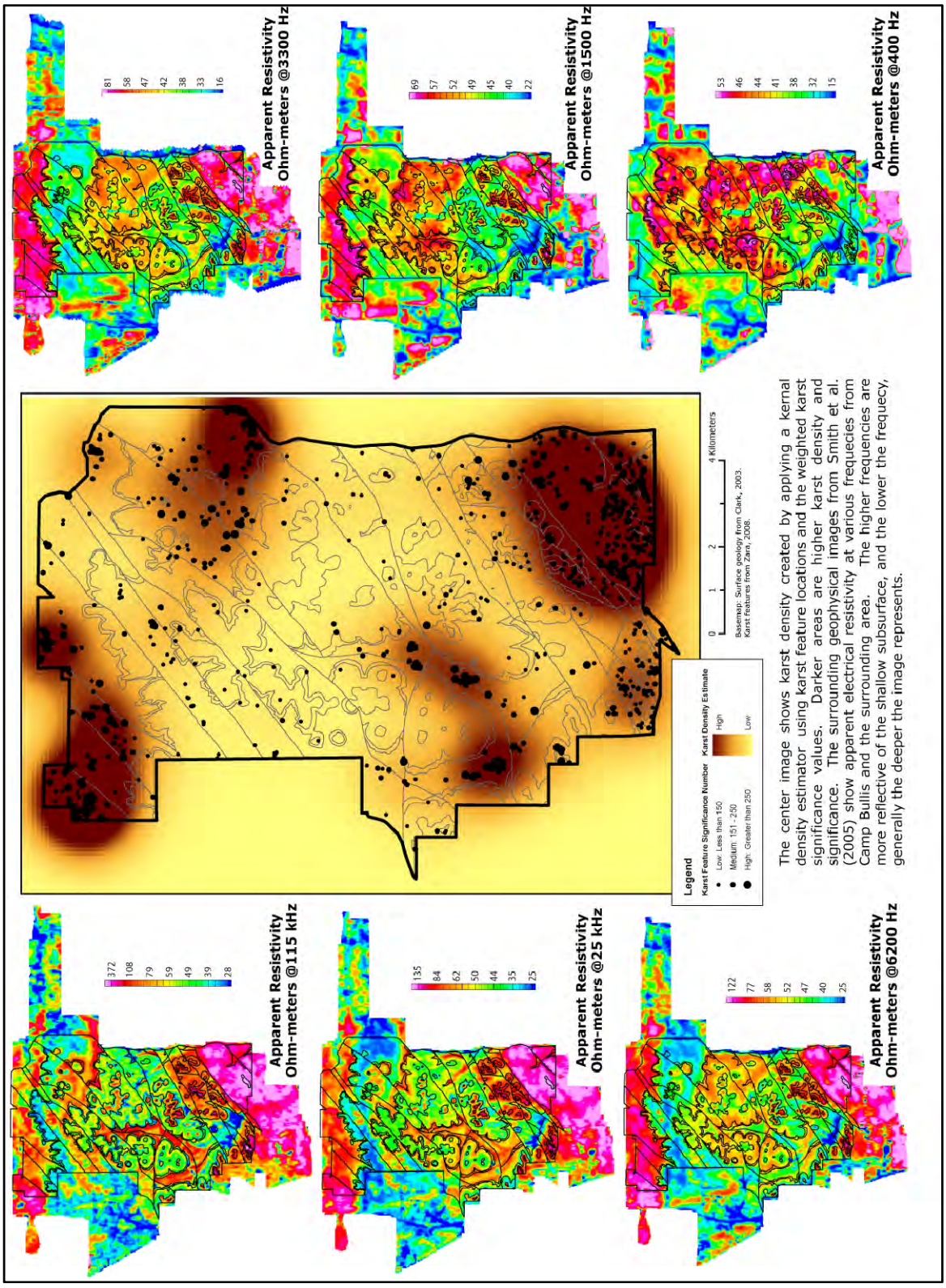

Figure 2. Spatial analysis of karst feature density within Camp Bullis is shown in the middle map. Surrounding maps are from an airborne geophysical study completed by the USGS in 2005.

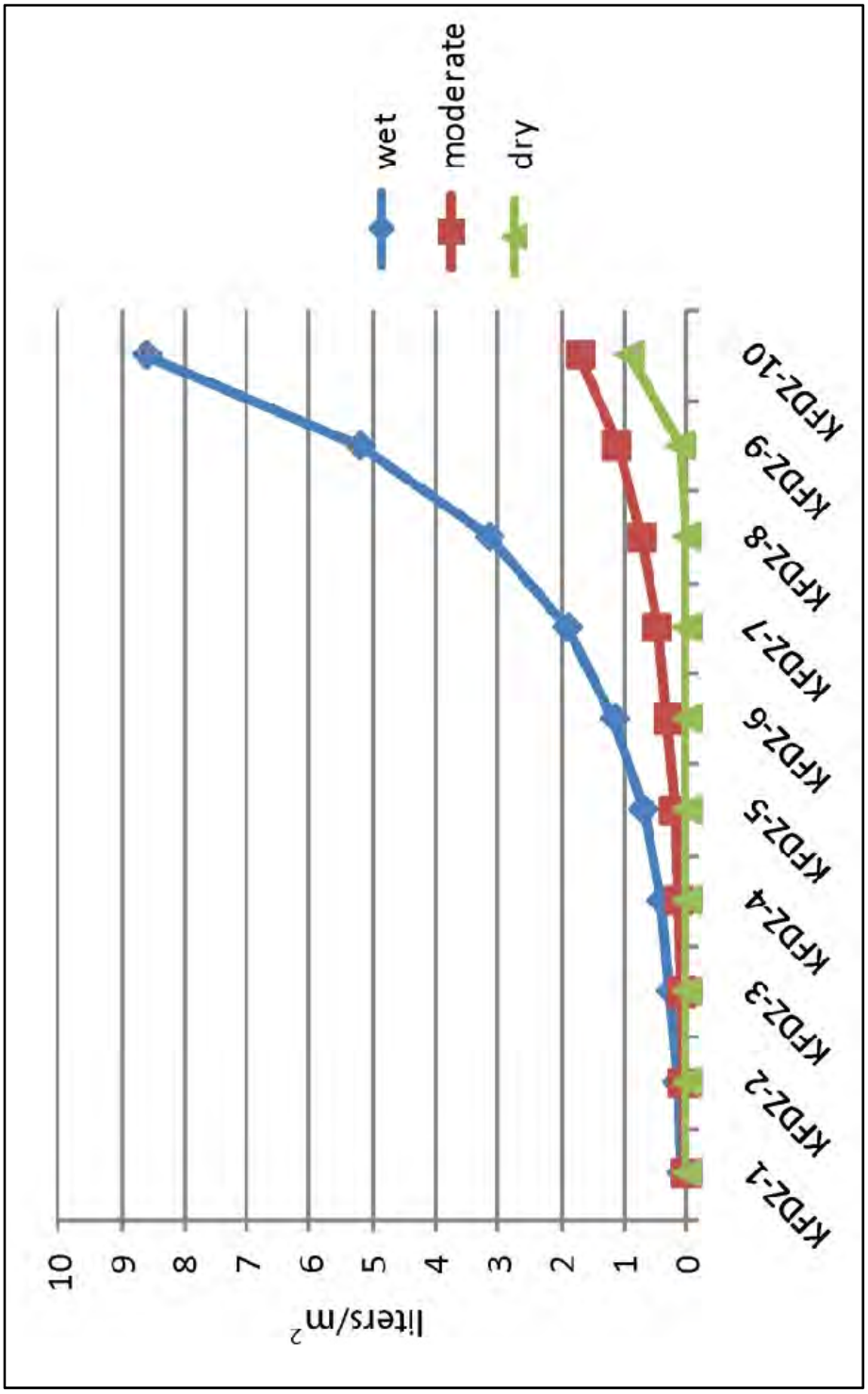

Figure 3. Estimated effective recharge rates (liters/m2) for each of the karst features density zones of Camp Bullis (Figure 1) for three antecedent conditions (wet, moderate, dry).

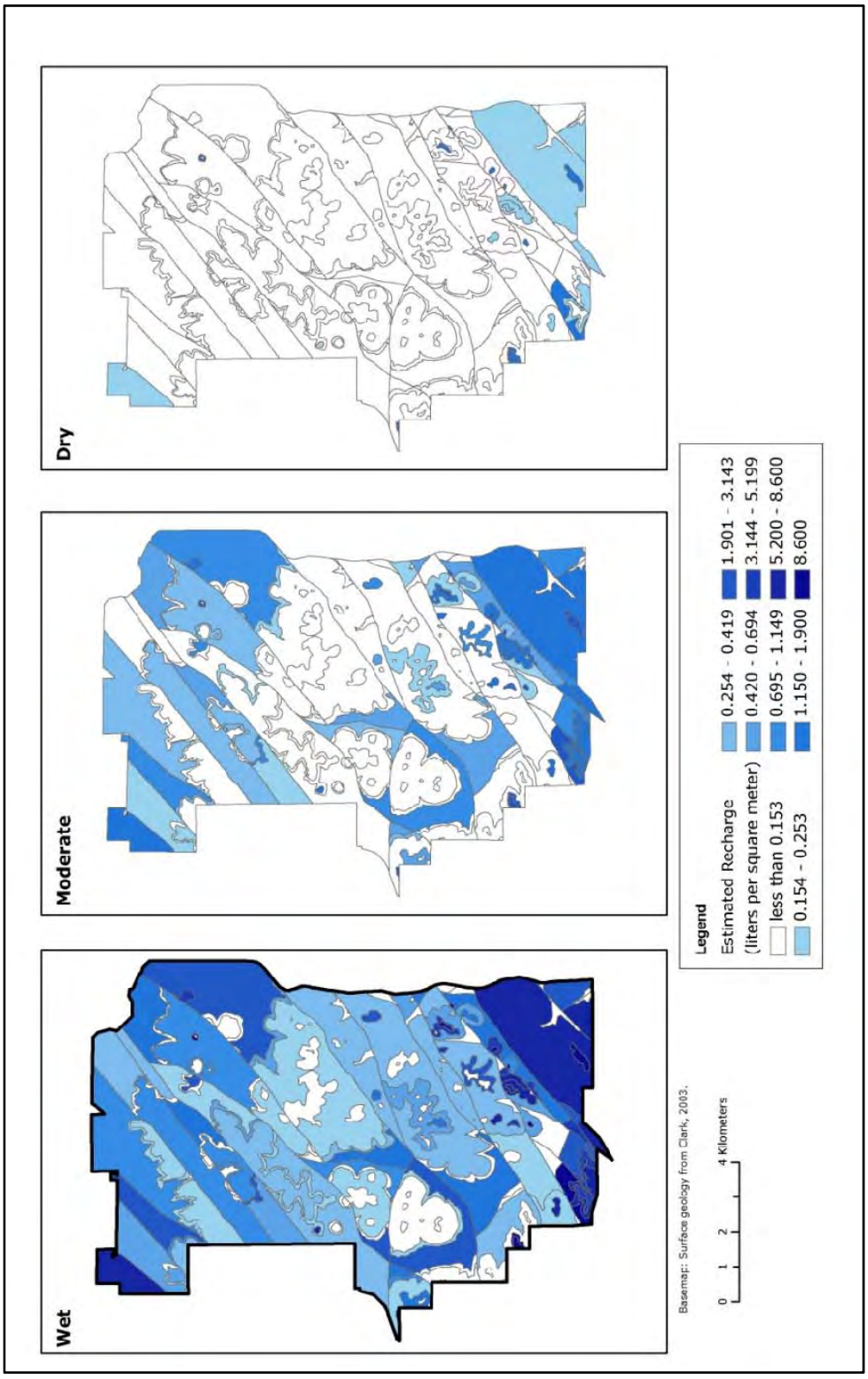

Figure 4. Maps of estimated effective recharge rates based on karst feature density map (Figure 1) for Camp Bullis for three antecedent conditions.