
Estimate of Vertical Anisotropy of Hydraulic Conductivity for Western Louisiana Aquifers from Grain-Size Data

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ABSTRACT

Vertical anisotropy of hydraulic conductivity is one of the most difficult properties of an aquifer to quantify. Often it is determined by either running a series of pressure tests (packer tests) at multiple positions vertically within the aquifer or by analysis using a groundwater model, where there is a significant vertical gradient of head as observed by numerous piezometers with different vertical positions within the aquifer. Both of these techniques are expensive. In western Louisiana, neither of these sets of data/ observations are available. However, there are approximately 4500 grain-size analyses results available. These grain-size samples were usually collected every 10 to 20 ft from municipal wells where the screened interval of the well is often over 100 ft. The grain-size data is analyzed to derive hydraulic conductivity (K) values using seven published equations that relate grain-size with K. With three to ten or more values of K within a sand interval, it is possible to determine as defined, the effective horizontal hydraulic conductivity (K_h) and the effective vertical hydraulic conductivity (K_v). Lastly, the vertical anisotropy of hydraulic conductivity is determined from the ratio of K_h / K_v .

The number of resulting anisotropy ratios depends on the technique used for analysis. Five of the published equations involved grain-sizes at the 10 percent rank (d_{10}) and two equations at the 17 percent rank (d_{17}). Equations based on diameter of d_{10} value yield fewer resulting ratios than those based on diameter of d_{17} value. For this reason, the number resulting ratios determined for sand layers within each of the major aquifers in western Louisiana are: Sparta 109 and 182, Upper Chicot 56 to 72, Evangeline 38 to 67, undifferentiated Chicot 40 to 65, Carrizo-Wilcox 35 to 64, Jasper 37 to 59, Chicot (500 foot sand) 25 to 48, Catahoula 29 to 43, Cockfield 20 to 40, Lower Chicot 19 to 30, Mississippi River Alluvial 13 to 30, and Upland Terrace 22 to 29. Typically these values are determined from a series of three to six grain size analyses across a screen interval, but there are approximately 115 wells with 10 or more grain-size tests with 69% of these being Chicot wells.