Three-dimensional models of shallow aquifer systems derived from interpolation of lithologic descriptions in water well logs; Lake Rim area, northwest Indiana

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We have been exploring the use of lithology data extracted from water well logs to develop three-dimensional models of aquifer systems in the glacial and lacustrine depositional environments of northwestern Indiana. Our methodology involves classifying all lithologic units within a sample log on the basis of their (inferred) equivalent hydraulic conductivity. We recognize six categories (labeled 1 through 6) with each category value representing the negative log of its equivalent hydraulic conductivity. Initial analyses using ordinary kriging to interpolate the distribution of material types indicated that kriging facilitates identification of the main aquifer(s) in an area of study (i.e., their basic extent and connectivity). However, a statistical comparison between the frequency distributions of material types in the well logs and the distribution derived from the results of the kriging revealed a discrepancy. The kriged data exhibited a unimodal distribution with the highest frequency associated with intermediate material types (equivalent conductivity category 4). In contrast, the well log data has a bimodal distribution with the intermediate material types having a relatively low frequency of occurrence. A post-processing algorithm has been developed that screens all intermediate material types in the kriged data set. If the intermediate value occurs outside of a specified search radius (250 meters), its value was altered by adding or subtracting one standard deviation of apparent hydraulic conductivity based on the empirical frequency distribution. Distributions altered in this way matched those of the well log data more closely.