Development and verification of conceptual models to characterize the fractured bedrock aquifer of the Nashoba terrane, Massachusetts

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Abstract

This dissertation is a composite of several studies. First, three of the most common fracture sampling techniques are tested against each other to evaluate the effectiveness of each method to adequately capture the properties of natural discrete fracture networks (DFNs). Numerical simulation is used to evaluate the single scanline, selection and multiple scanline methods in layered rocks. Using statistics from each of the techniques, DFNs are stochastically generated and compared to another network that represents the natural DFN. This model was built with the exact locations, sizes and orientations of fractures as the natural network. Porosity and permeability results reveal that the most effective method to use is the selection method because this method is consistent and performs as well as the other methods but with less expenditure of time and energy. ^ Second, the influence of lithology and rock fabric on fracture attribute distribution in crystalline rock is assessed. Trace lengths, spacings and orientations of joints and foliation-parallel fractures (FPFs) are used to determine the potential influence of fracture type and distribution on the groundwater flow system. Results show that although both joints and FPFs are common, major orientations and spacings are different for both fracture types. Because FPFs possess identical trace lengths but narrower spacing than joints, numerical modeling experiments indicate that they play an important role in controlling the groundwater flow regime by enhancing the transmissive properties of rocks. ^ Third, conceptual models of DFNs that have unique hydraulic character that are based on fracture configurations and properties are developed with the aid of numerical simulations. Sets of persistently parallel fractures are stochastically generated to assess the effects of fracture size and distribution, intensity, number of sets and intersection angle on the

hydraulic properties of DFNs. Arbitrarily chosen class intervals of the ratio of DFN permeability to that of a single fracture are used to delineate DFNs with similar hydraulic character. Numerous graphs are created for use in the field to determine and delineate DFNs with distinct hydraulic character.^

Subject Area

Geology|Hydrology

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