Title: **Assessment of Geologic Controls on Groundwater Flow and Distribution in Precambrian Bedrock, Central Wisconsin, Using Remote Sensing and Geophysical Analysis (Study No. 44)**

Investigators:

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Period of Contract: July 13, 1987 through June 30, 1989

Objectives: To assess the applicability of digital remote sensing data integrated with geology and geophysics to identify areas of potentially high groundwater yield from crystalline rock wells.

Background/Need: Data on fractures in bedrock units from ground penetrating radar (GPR), Thematic Mapping (TM) Imagery, aeromagnetic and other remote sensing techniques need to be analyzed for their correlative relationship and usefulness in Wisconsin.

Methods: A Landsat TM image was interpreted and several major zones were delineated as having anomalously high moisture content in Precambrian bedrock. Subscene images were produced from the Landsat TM digital tape, enhanced, manipulated and interpreted relative to their full scene counterparts.

Four areas were measured for orientation and density of fractures followed by a reconnaissance fracture study of typical Precambrian exposures throughout the three county area. Tapes of digital information were collected and programmed to be input with remote sensing imagery on an image processing computer system, followed by a series of GPR surveys and resistivity surveys. An investigation was then done of groundwater-flow systems based on pre-existing well data. A potentiometric surface map was produced of wells screened in the Precambrian bedrock.

Results: Major linear features were identified on the regional TM imagery, though smaller segments of these features could not be readily distinguished on the subscene images. Structural analysis indicate units such as amphibolite and metavolcanic rock have extensive closely spaced and interconnected fracture systems. Intrusive igneous rocks tend to be more massive and have fewer fracture orientations. GPR surveys indicated a high abundance of clay minerals in the residual soils and weathered glacial deposits. The resistivity surveys showed an increased water content and greater conductivity due to local fracturing within the narrow zone underlying the axis of the lineament. The potentiometric map reveals the regional hydrologic gradient generally sloping to the south and toward the Wisconsin River.

Conclusions:

Investigators concluded that there is excellent hydraulic connection between the Precambrian bedrock and overlying units. The potential for developing a high quality water supply depends on rock type, depth of weathering, intensity and orientation of fracturing, and local topography on the solid bedrock surface. GPR is generally not effective in a geologic environment dominated by clay rich residual soils and weathered glacial till.

Recommendations/ Implications:

Investigators suggest that further investigation of the usefulness of GPR in conjunction with other techniques may provide another correlative tool for data analysis. Remote sensing data involving aerial and infrared photographs at scales of 1:24,000-1:60,000, as well as the azimuthal resistivity technique for small scale fracture systems which control local flow systems are also recommended for study.

Availability of Report:

Copies of this report can be obtained from:

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This report is available for viewing and loan at:

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Related Publications:

Brown, B.A., Bradbury, K.R. and Davidson, Jr., D.M. The crystalline bedrock aquifer in central Wisconsin: a geological basis for characterization.

Key Words:

Fractured bedrock, geophysical analysis, ground penetrating radar, Precambrian bedrock, remote sensing.

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