APPLICATION OF GEOLOGIC MAPPING AND GEOGRAPHIC INFORMATION SYSTEMS TO DELINEATE SENSITIVE KARST AREAS FOR LAND-USE DECISIONS

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The Problem: The Floridan aquifer system (FAS), a thick sequence of Tertiary carbonates, is the major fresh water resource in the Florida panhandle. The expanding population of the State places an ever-growing demand on the fresh-water resources through increased land and water use. Overburden comprised of surficial aquifer sediments or intermediate confining unit (ICU) sediments may act to protect the FAS from potential contamination sources where it is present. This overburden can be several hundred feet thick where it provides variable confinement for the FAS, or it can be thin to absent in areas where carbonate units comprising the FAS are exposed at or near land surface. In areas where the overburden is thin to absent, the potential for karst terrain development is increased. Sinkholes and collapse features are more common and occur at a much greater rate than in well-confined areas. The nature of karst terrain provides preferential flow paths for surface water to enter the underlying aquifer system, and therefore aquifer systems underlying karst terrain are at a greater risk to surface contamination potential.

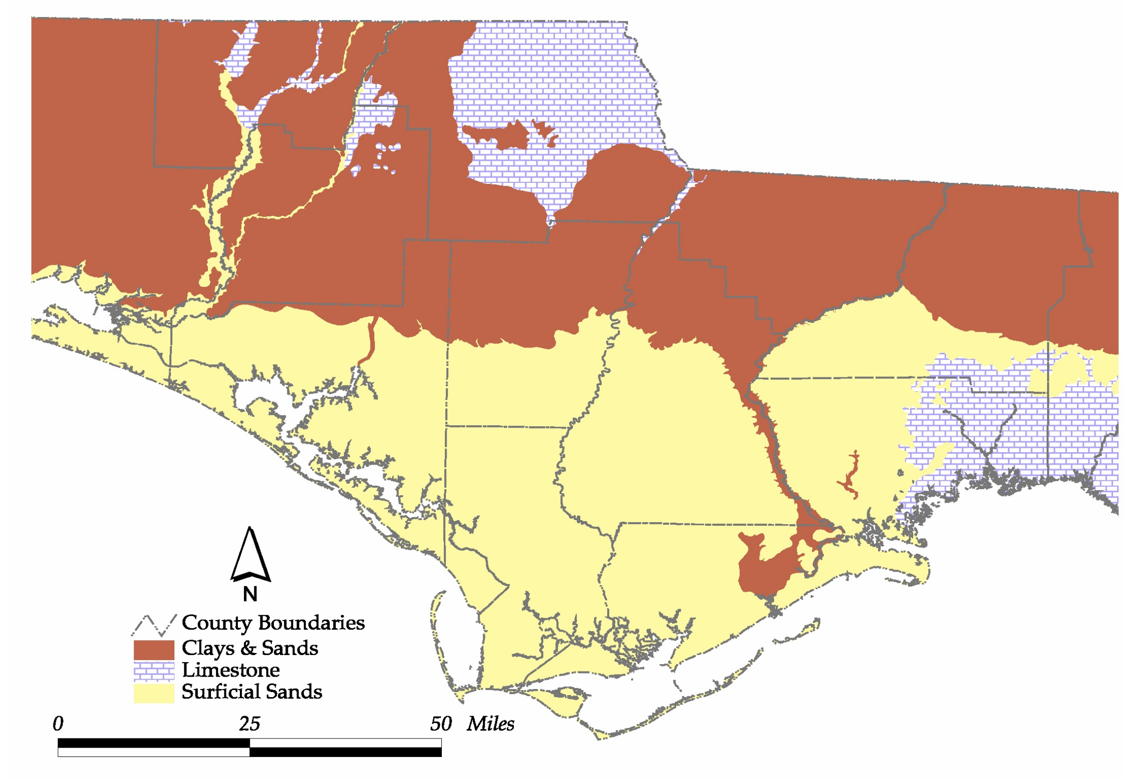

Figure 1: Generalized geologic map of northwestern Florida (modified from Scott, et al. 2001).

The Geologic Map: In Florida, areas of karst topography are associated with, but not limited to shallow and exposed carbonate rocks. The state geologic map of Florida and associated cross-sections provide this detailed lithologic information (Scott, et al, 2001). Generalization of this map (Figure 1) provides the information regarding shallow and exposed carbonates. By examining geological data (e.g., cores, well cuttings, and wireline logs) and incorporation of lithostratigraphic data from geologic maps (i.e., STATEMAP products) we are also able to identify areas of karst topography where carbonates are at much greater depths. These areas contain discontinuous or no ICU confinement and less than 100 feet of FAS overburden (Figure 2). Sensitive Karst Areas (SKA) are then delineated by combining the overburden coverage with areas of karst topography (Figure 3).

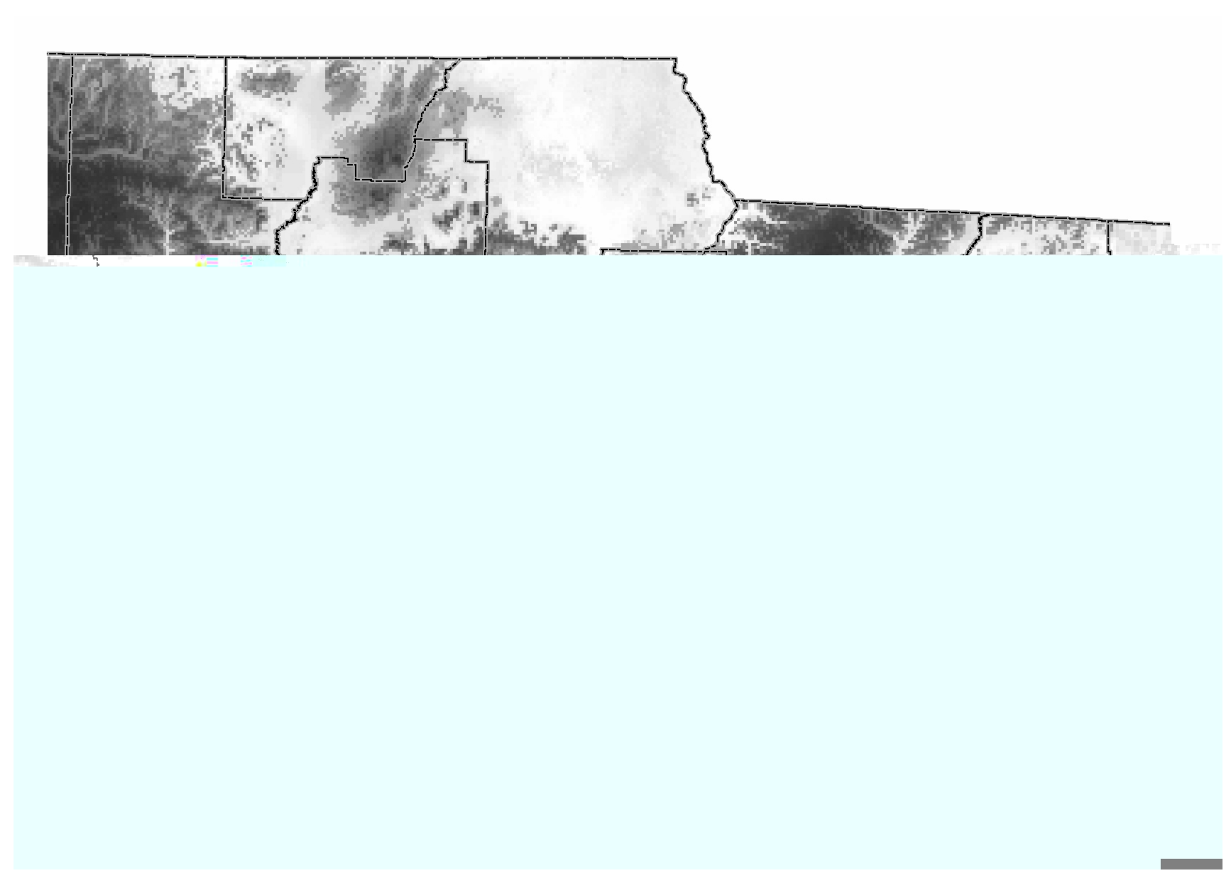

Figure 2: Overburden thickness of northwestern Florida, calculated by subtracting elevation from the top of Floridan Aquifer System (Pratt, et al. 1996).

Application of the Geologic Map: Utilizing the geologic map, surface topography maps and derived overburden thickness maps, the FGS developed a derivative SKA map to delineate those areas most susceptible to karst development, and thus, most vulnerable to contamination of the FAS from surface water runoff. These areas are characterized as regions of high recharge and are prone to dissolution of the underly limestone as well as sinkhole development. Maps used as input for the SKA are the digital elevation model (DEM), the residual geologic map products and the top of FAS map. Employing a geographic information system (GIS) the top of FAS was subtracted from the DEM to yield a thickness coverage of the ICU. Geologic map data and a GIS coverage of closed depressions outline areas dominated by karst topography.

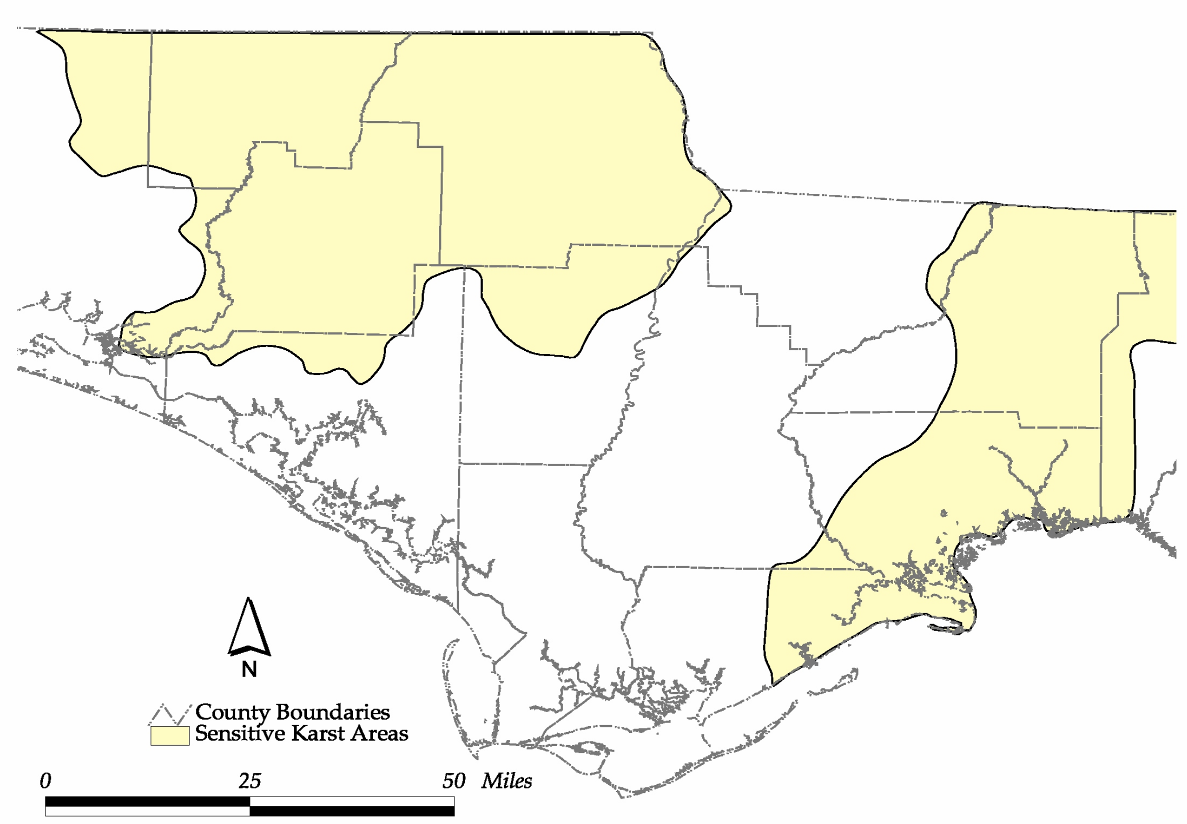

Figure 3: "Sensitive Karst Areas" map (SKA).

Conclusion: The state geologic map, borehole and topographic data were utilized within a GIS to delineate sensitive karst areas. During the analysis, areas were identified that had the potential for karst feature development. Data collected during the creation of the geologic map enabled analysis in the 3rd dimension using a GIS. Surface grids can be created to represent hydrostratigraphic boundaries for further development of products related to the role of karst aquifer vulnerability assessments.

References: Pratt, Thomas R., Richards, Christopher J., Milla, Katherine A., Wagner, Jeffrey R., Johnson, Jay L., and Curry, Ross J. 1996 (October), NWFWMD Water Resources Special Report 96-4 , pp. (46, 60, 74, 88).

Scott, T.M., 1991, A geological overview of Florida, in: Florida's ground water quality monitoring program Hydrogeological framework, Scott, T.M., Lloyd. J.M., and Maddox, G., (eds.), Florida Geological Survey Special Publication No.32, pp. 97.