Florida Aquifer Vulnerability Assessment Phase II
Citrus County, Floridan Aquifer System

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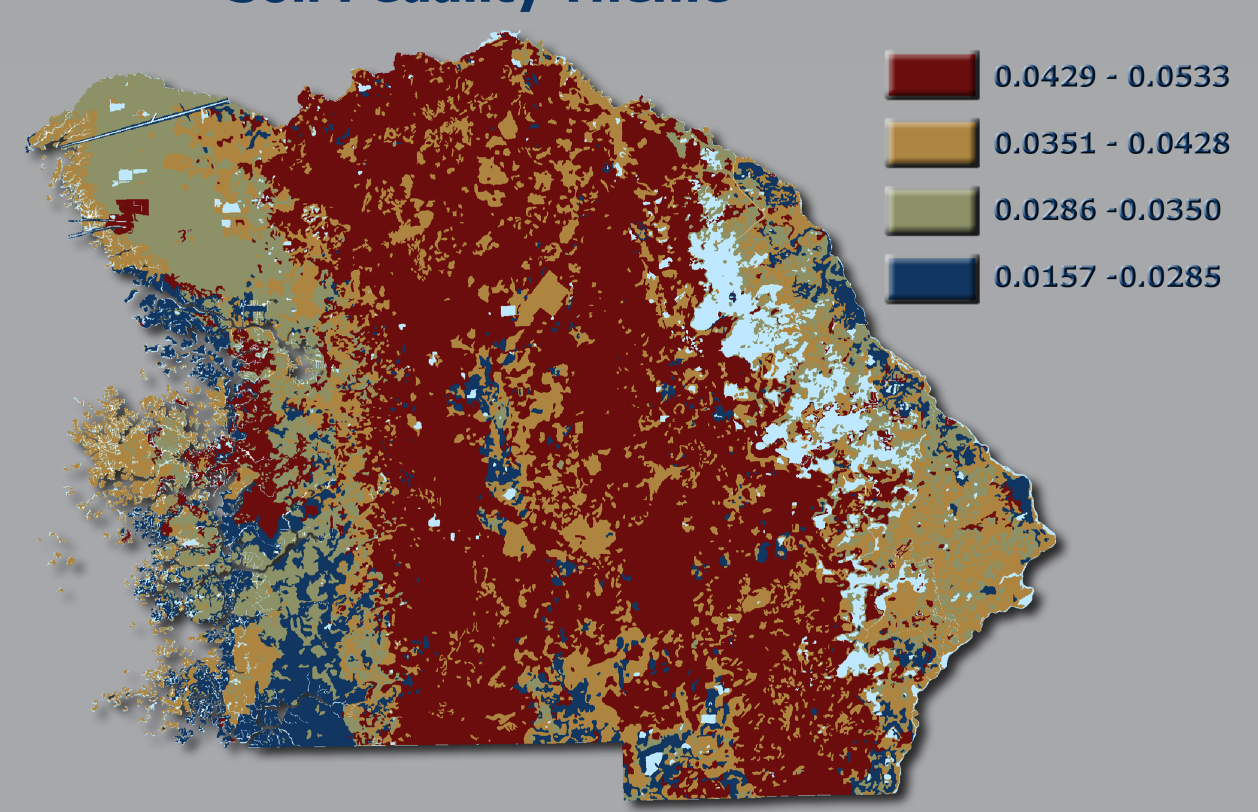
INTRODUCTION

The Floridan aquifer system is the most important and prolific source of fresh water in Citrus County. Groundwater use from the Floridan aquifer system in Citrus County is an estimated 25.56 million gallons of water per day for public supply, agriculture, domestic (self-supply wells), and other uses (SWFWMD, 2006). In addition, numerous fresh water springs and spring groups arise from the Floridan aquifer system in Citrus County and some or all of their springshed boundaries are contained within the county. These valuable resources inc lude Homosassa, Chassahowitzka, Kings Bay, and many others (Scott et al., 2004).

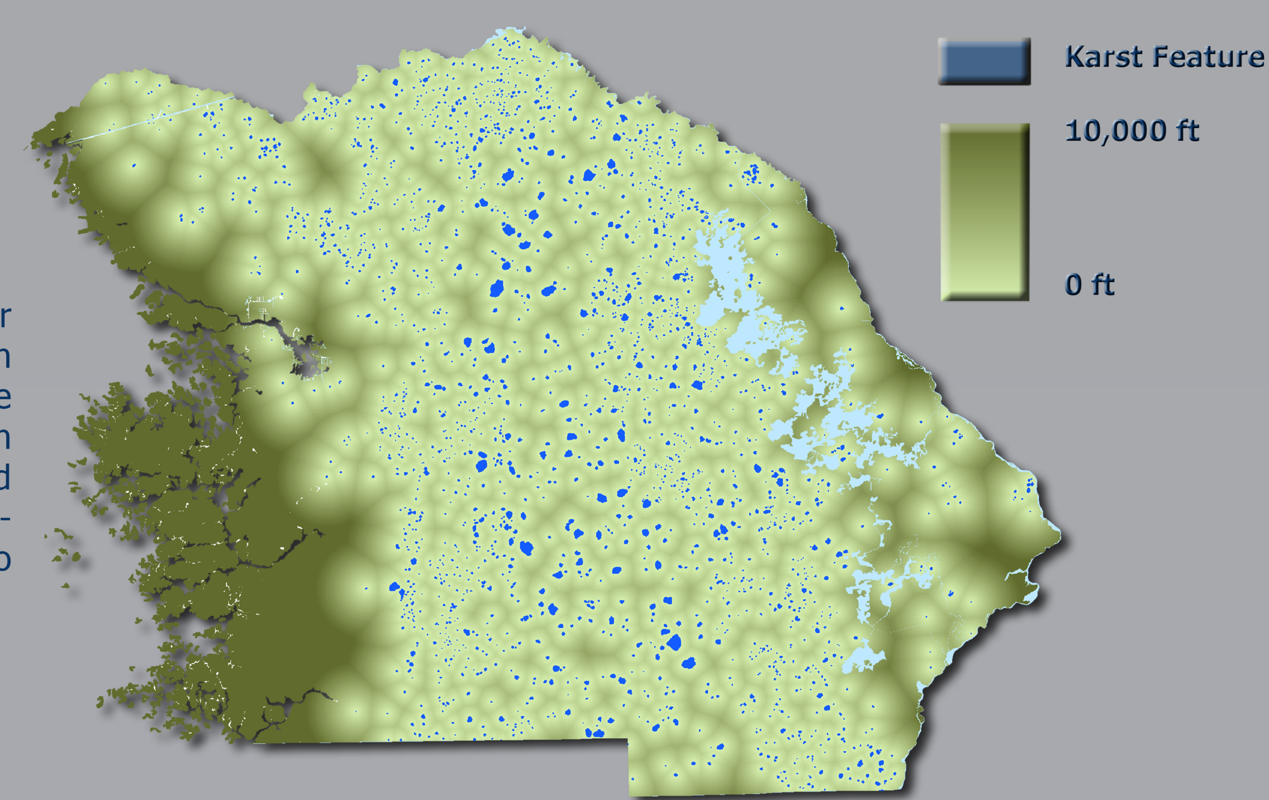
Identifying areas of Citrus County where the Floridan Aquifer System is more vulnerable to contamination from activities at land surface is a critical component of a comprehensive ground water management program. Protection of the Floridan Aquifer System is an important measure to take in helping ensure viable, fresh water is available from the Floridan Aquifer System for continued future use in the Citrus County study area. Aquifer vulnerability modeling allows for a pro-active approach to protection of aquifer systems, which can save significant time and increase the value of protection efforts. Maps of four types of data were used to determine aquifer vulnerablity in Citrus County: soil pedality, karst features, aquifer confinement and recharge potential. Maps explaining these data are displayed below.

Soil Pedality Theme



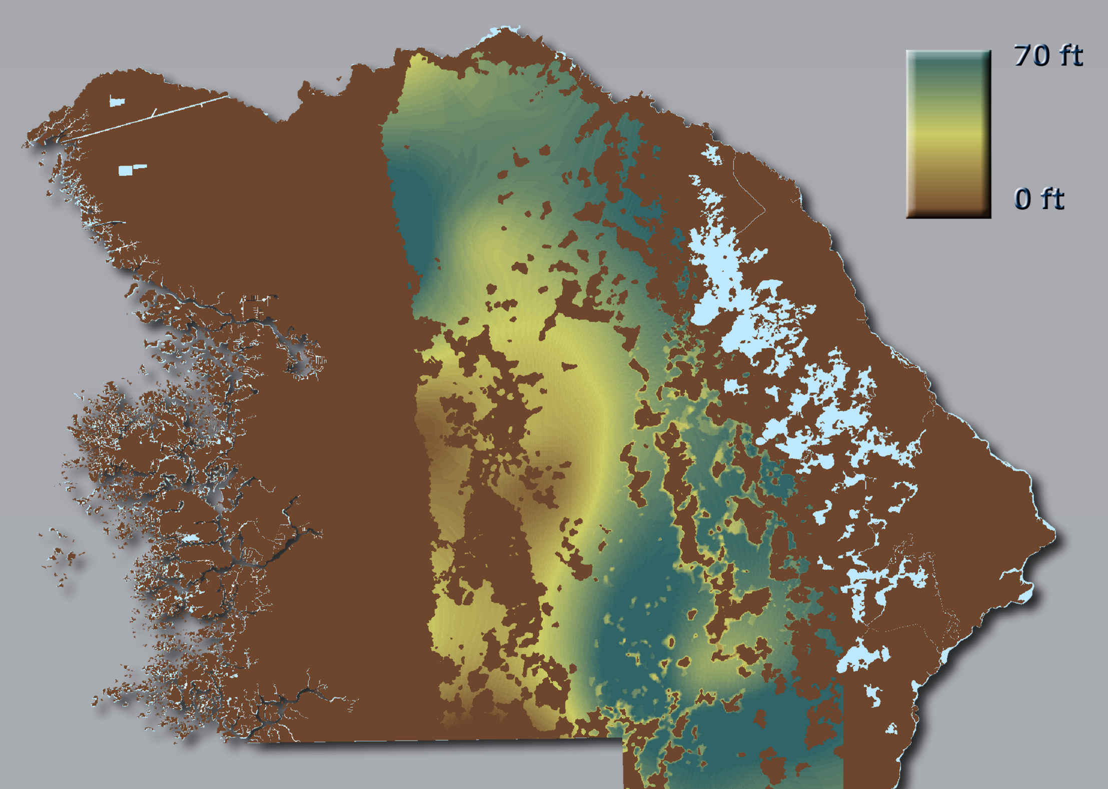
Soil pedality is a relatively new concept used to estimate how water moves through soil (Lin et al. 1999). The rate that water moves through soil is a critical component of any aquifer vulnerability analysis, as soil is an aquifer system's first line of defense against potential contamination. Soil pedality values, which are calculated based on soil type, soil grade, and soil structure, are unitless, and higher values correspond to higher flow rates and therefore higher aquifer vulnerability. In 2006, Citrus County soils data were redesigned for the study area by the Natural Resources Conservation Service. As a result, more detailed information is available for soils analysis for the CAVA project than during previous projects.

Potential Karst Feature Theme



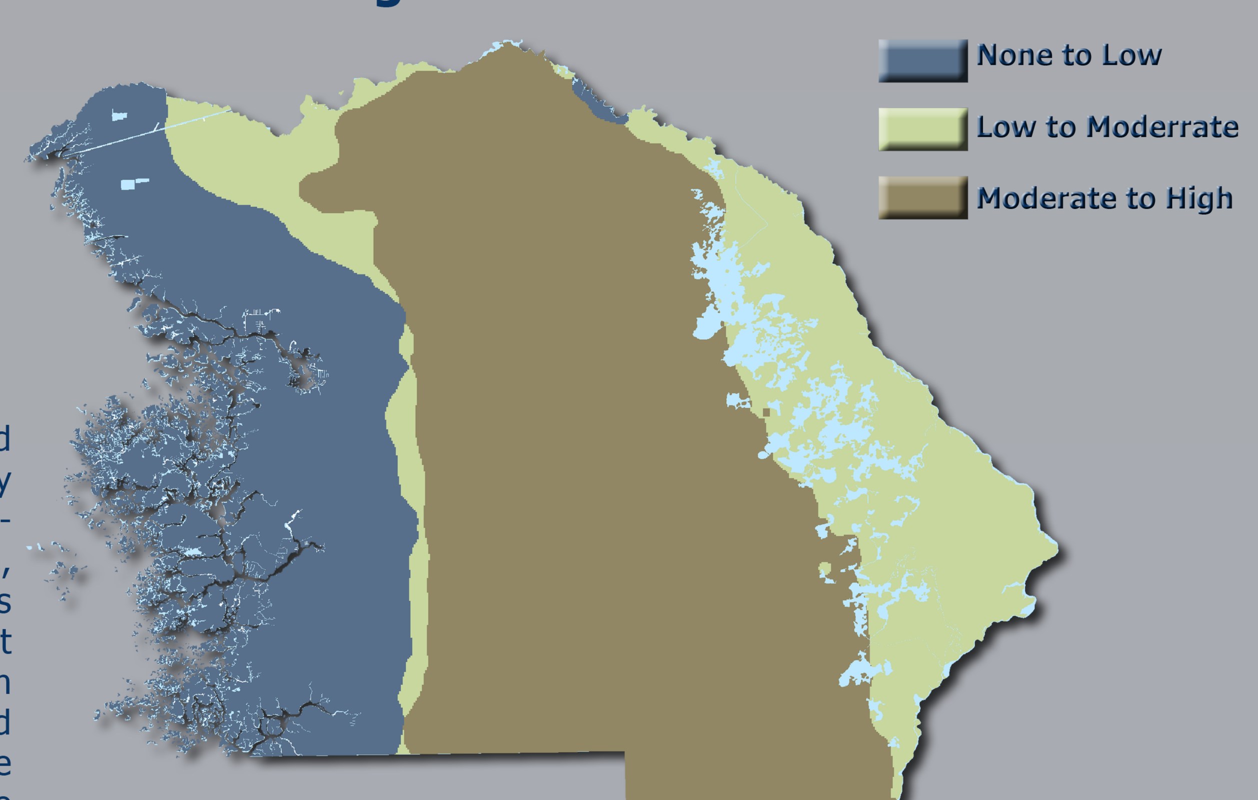
Karst features, or sinkholes and depressions, can provide preferential pathways for movement of surface water into the underlying Floridan aquifer system and increase an area's aquifer vulnerability where present. The closer an area is to a karst feature, the more vulnerable it may be considered. Karst features tend to be generally circular in nature (in contrast to non-karstic depressional features which may not be circular) and can be identified and extracted from a digital elevation model based on this characteristic. These resulting effective karst features can be buffered into zones as shown here to allow for a relative distance analysis.

Aquifer Confinement Theme



The degree to which an aquifer system is buried or 'covered' is known as aquifer confinement. Where this confinement is thick and continuous and the Floridan Aquifer System is deeply buried, aquifer vulnerability is generally lower. On the other hand, in areas of the county where aquifer confinement is thin to absent or breached by sinkholes, the vulnerability of the underlying aquifer is generally higher, primarily because it is present at or near the land surface.

Recharge Potential Theme



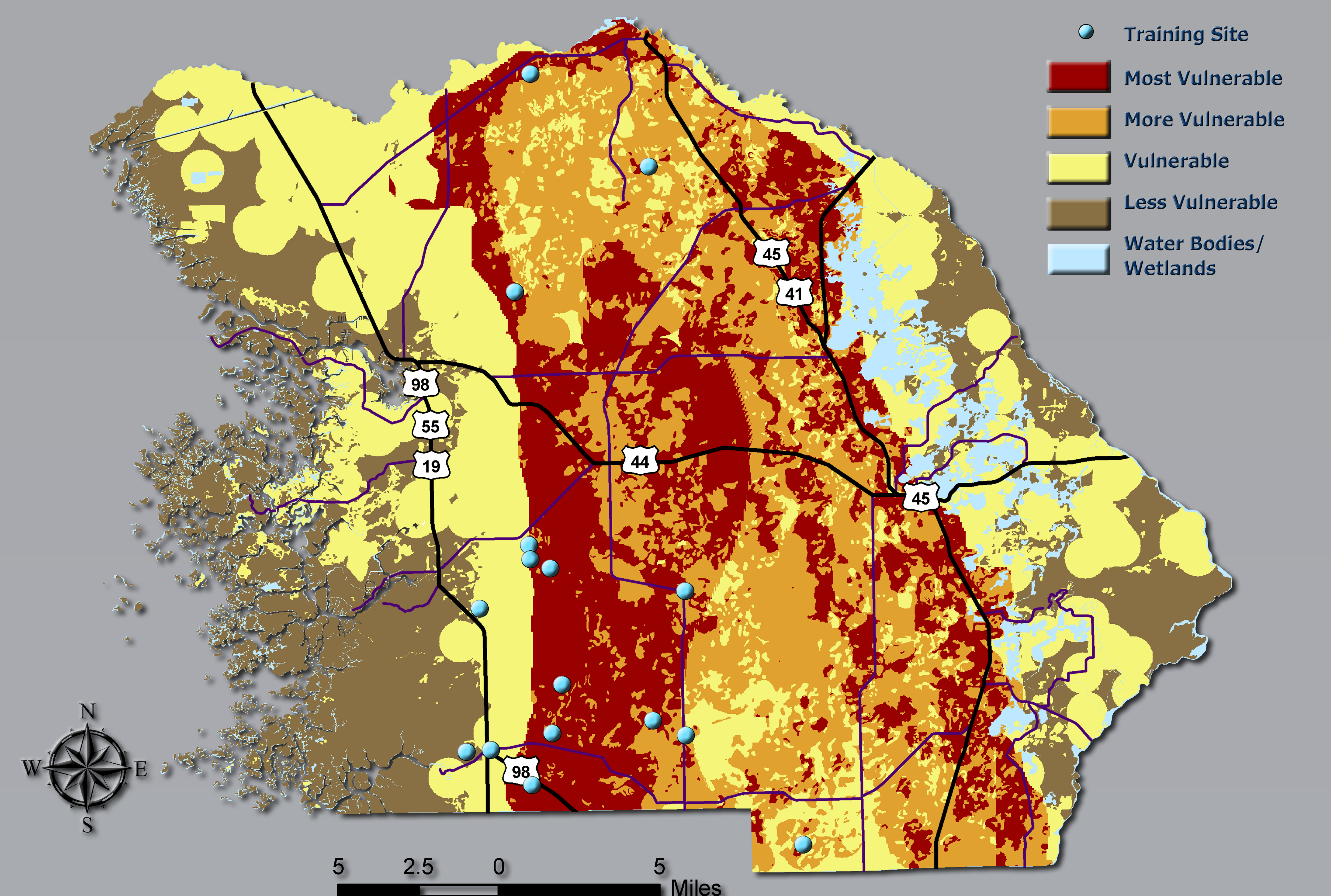
In Copeland et al. (1991), the area of the Brooksville Ridge in central Florida is defined as having higher recharge potential than adjacent areas. The Brooksville Ridge is chiefly composed of Undifferentiated Hawthorn Group sediments which are poorly to moderately consolidated clayey sands and silty clays (Scott et al., 2001). In the study area, these sediments can reach in excess of 100 feet of calculated thickness. In other areas of Florida, Hawthorn Group sediments forming the Intermediate Confining Unit normally provide an effective confining or semi-confining unit for the underlying FAS. In Citrus County, however, these sediments are generally highly weathered, leaky, thin and intensely breached by karst features. These factors combine to increase the recharge potential to the FAS in the study area where these sediments are present. Where recharge potential is high, aquifer vulnerability is increased.

APPROACH TO MODEL DEVELOPMENT

The primary purpose of the Citrus County Aquifer Vulnerability Assessment, or CAVA, is to provide a science-based, water-resource management tool that can be used to help minimize adverse impacts on groundwater quality, including focused protection of sensitive areas such as springsheds and groundwater recharge areas. The modeling process used for the CAVA project is "weights of evidence", and is based in a geographic information system (GIS). The approach used in the project is a modification of the technique used in Phase I of the Florida Aquifer Vulnerability Assessment project (Arthur et al., 2007). One of the main benefits of applying this technique to the CAVA project is that it is data-driven, rather than expert-driven, and model output is dependent upon a training site dataset, which produces self-validated model output. For CAVA, training sites are groundwater wells with water quality indicative of a good connection between the aquifer and land surface, or simply, aquifer vulnerability.

Model generation is accomplished by associating training site locations with data layers representing natural conditions which control aquifer vulnerability. Data layers used for the CAVA project are described on the lower left side of this poster and include karst features, aquifer confinement, soil pedality, and recharge potential. The model helps determine which areas of each data layer share a greater association with aquifer vulnerability based on the location of the training sites, and then combine them in a map as shown here. The model results are an estimate of the natural vulnerability of the aquifer system; land use types and human activities are not used as input. The CAVA output map indicates that the areas of highest vulnerability are associated with thin to absent aquifer confinement, dense karst-feature distribution, higher soil pedality values and areas having a higher recharge potential.

VULNERABILITY OF THE FLORIDAN AQUIFER SYSTEM, CITRUS COUNTY



REFERENCES

Arthur, J.D., Wood, H.A.R., Baker, A.E., Cichon, J.R., and Raines, G.L., 2007, Development and Implementation of a Bayesian-based Aquifer Vulnerability Assessment in Florida: Natural Resources Research Journal, v.16, no.2, p93-107.

Copeland, R., Scott, T.M., Lloyd, J.M., 1991, Florida's Ground Water Quality Monitoring Program: Hydrogeological Framework: Florida Geological Survey Special Publication No. 32, 97 p.

Lin, H.S., McInnes, K.J., Wilding, L.P., and Hallmark, C.T., 1999, Effect of Soil Morphology on Hydraulic Properties: I. Quantification of Soil Morphology, Soil Science Society of America Journal, v. 63, p. 948-954.

Scott, T.M., Means, G.H., Meegan, R.P., Means, R.C., Upchurch, S.B., Copeland, R.E., Jones, J., Roberts, T., and Willet, A., 2004, Springs of Florida: Florida Geological Survey Bulletin No. 66, 377 p.

Scott, T.M., Campbell, K.M., Rupert, F.R., Arthur, J.D., Missimer, T.M., Lloyd, J.M., Yon, J.W., Duncan, J.G., 2001, Geologic Map of the State of Florida: Florida Geological Survey Map Series 146, Scale 1:750,000, 1 sheet.

Southwest Florida Water Management District, 2006, 2003 (Revised) and 2004 Estimated Water Use Reports: Southwest Florida Water Management District, 471 p.

Qualifications:
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