Surficial Aquifer System Vulnerability Assessment Phase II

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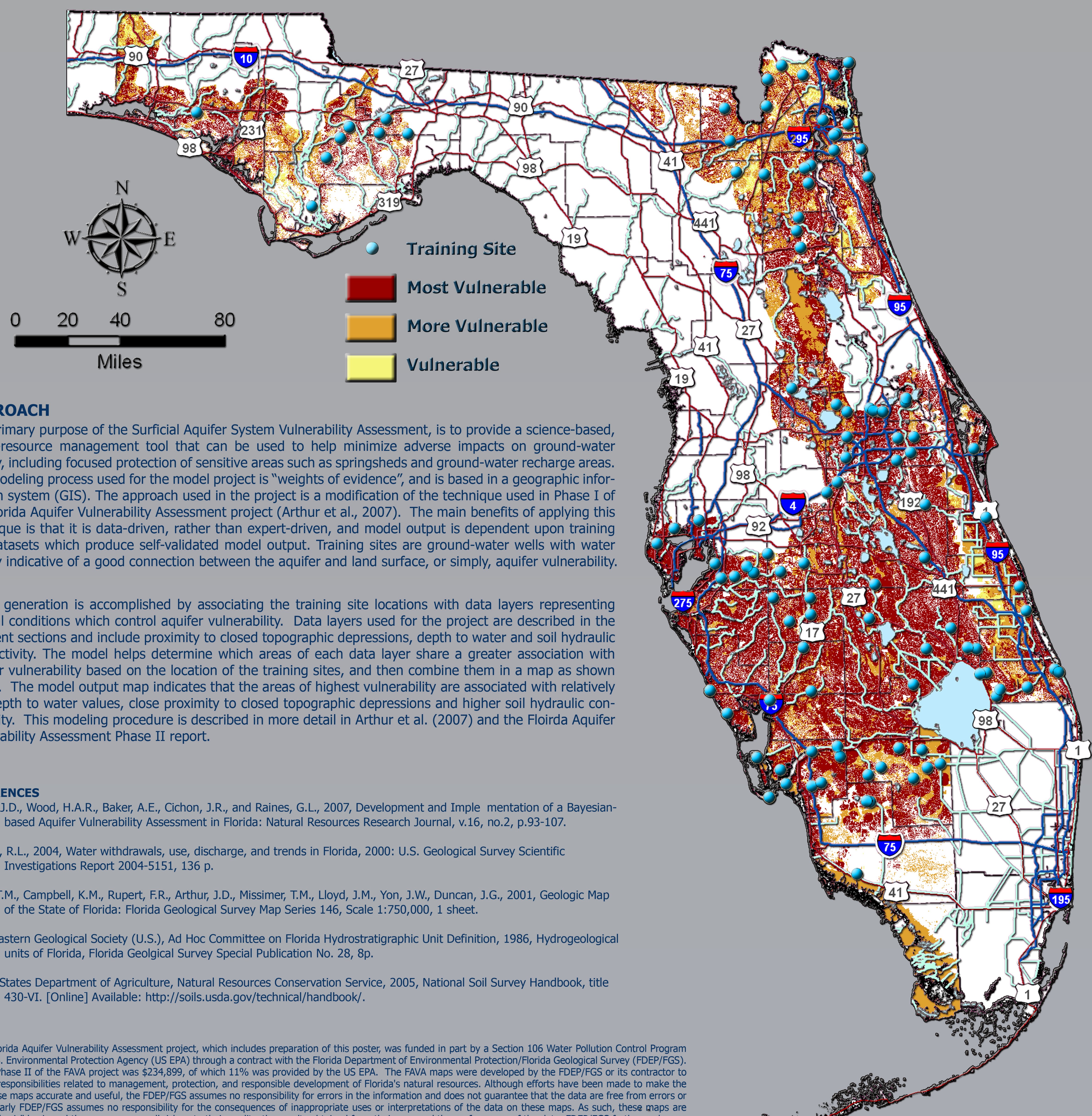
INTRODUCTION

The surficial aquifer system (SAS) is the permeable hydrostratigraphic unit in Florida contiguous with land surface that comprises principally unconsolidated siliciclastic deposits, and to a lesser extent, carbonate rocks. The lower limit of the SAS coincides with less permeable sediments of the top of the IAS (Southeastern Geological Society, 1986). The SAS occurs throughout much of the State and is used extensively in the western panhandle (sand-and-gravel aquifer) and the southeastern peninsula (Biscayne aquifer), however, those areas have been modeled separately and were not included in the analysis. It is mainly used as a secondary source of drinking water with a few exceptions. It is, however, still a major source of ground water for a large portion of the population. Floridians withdrew nearly 600 million gallons of water per day from the surficialaquifer system in 2000 (Marella, 2004).

The preliminary extent of the SAS was based on the extent of the IAS. Modifications of this preliminary extent were based on the distribution of Miocene-Pliocene clay-rich sediments as mapped by Scott et al. (2001). In areas where sediments of the IAS were not mapped on a regional scale, the SAS was not mapped for this project. Further refinement of the SAS extent was accomplished by omitting areas where laterally continuous SAS sediments were calculated at less than ten feet thick and where IAS sediments were at or near land surface. Maps showing the SAS extent in this report reflect only areas where the SAS is present in a laterally continuous and regional extent. Areas for the Biscayne/Surficial and sand-and-gravel aquifers were omitted from this extent. For modeling purposes, the extent of the SAS was further revised to exclude all areas covered by both permanent and seasonal wetlands.

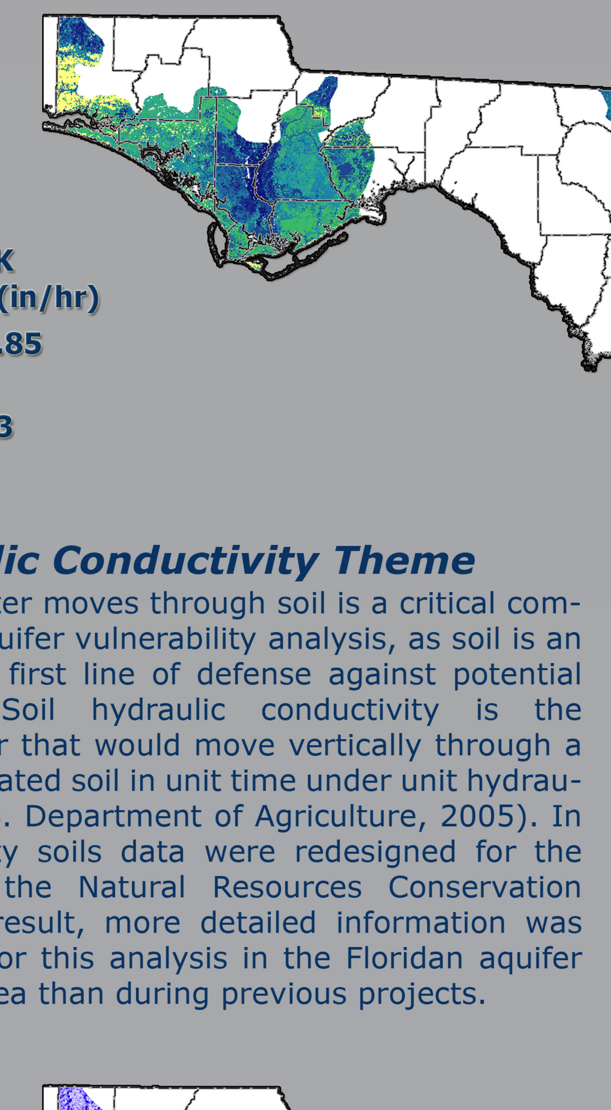
Identifying areas where the surficial aquifer is more vulnerable to contamination from activities at land surface is a critical component of a comprehensive groundwater management program. Protection of the area's aquifer systems is an important measure to take in helping ensure viable, fresh water is available to the residents of the area from the region's aquifer systems for continued future use in Florida. 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.



APPROACH

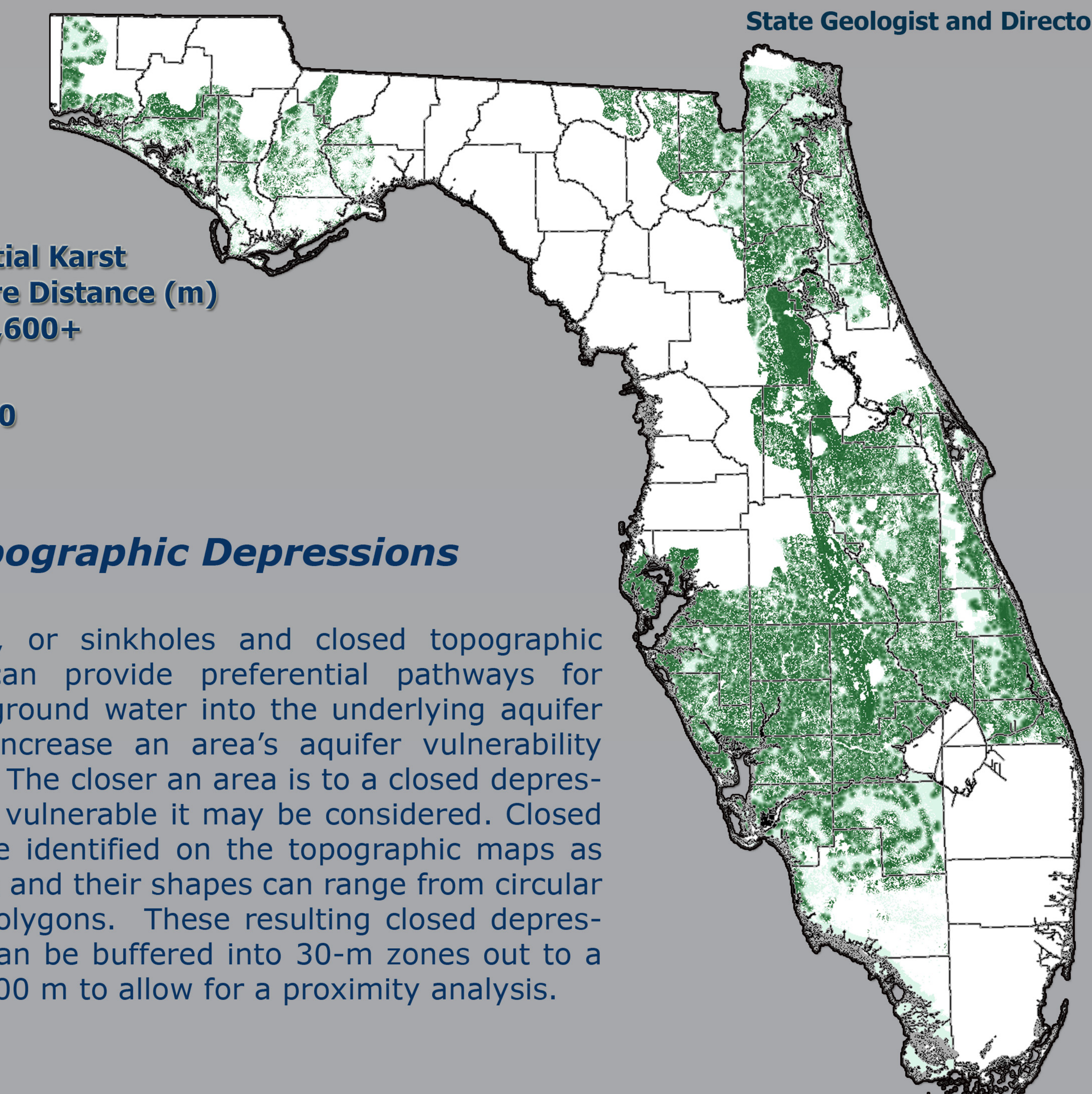
The primary purpose of the Surficial Aquifer System Vulnerability Assessment, is to provide a science-based, water-resource management tool that can be used to help minimize adverse impacts on ground-water quality, including focused protection of sensitive areas such as springsheds and ground-water recharge areas. The modeling process used for the model 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). The main benefits of applying this technique is that it is data-driven, rather than expert-driven, and model output is dependent upon training site datasets which produce self-validated model output. Training sites are ground-water 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 the training site locations with data layers representing natural conditions which control aquifer vulnerability. Data layers used for the project are described in the adjacent sections and include proximity to closed topographic depressions, depth to water and soil hydraulic conductivity. 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 above. The model output map indicates that the areas of highest vulnerability are associated with relatively low depth to water values, close proximity to closed topographic depressions and higher soil hydraulic conductivity. This modeling procedure is described in more detail in Arthur et al. (2007) and the Floirda Aquifer Vulnerability Assessment Phase II report.



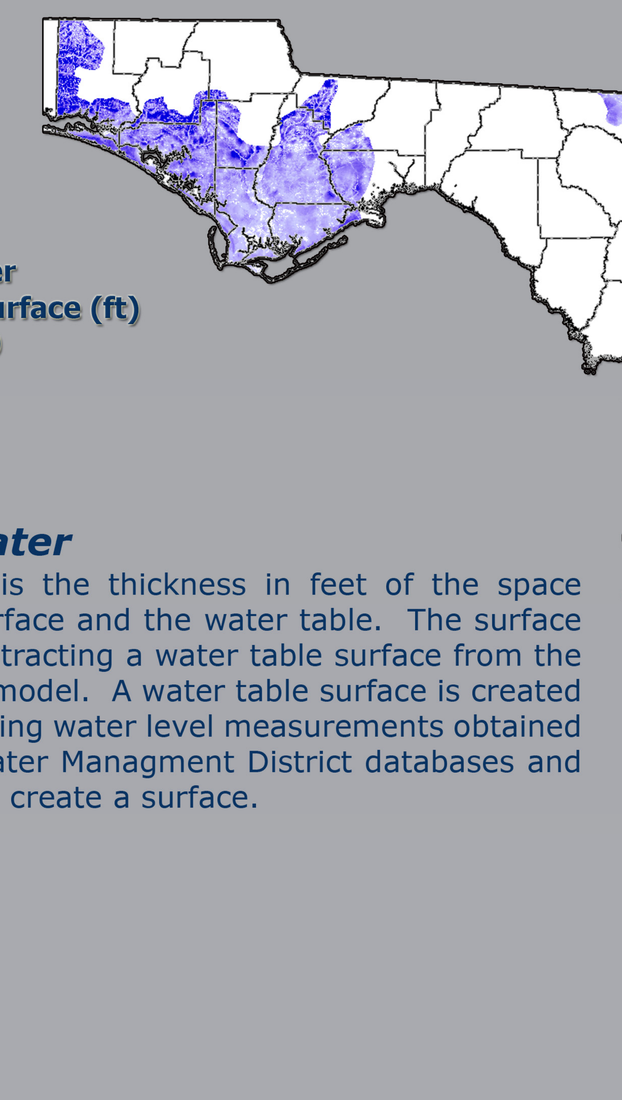
Soil Hydraulic Conductivity Theme

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 hydraulic conductivity is the "amount of water that would move vertically through a unit area of saturated soil in unit time under unit hydraulic gradient" (U.S. Department of Agriculture, 2005). In 2006, the County soils data were redesigned for the study area by the Natural Resources Conservation Service. As a result, more detailed information was made available for this analysis in the Floridan aquifer system model area than during previous projects.



Closed Topographic Depressions Theme

Karst features, or sinkholes and closed topographic depressions, can provide preferential pathways for movement of ground water into the underlying aquifer systems and increase an area's aquifer vulnerability where present. The closer an area is to a closed depression, the more vulnerable it may be considered. Closed depressions are identified on the topographic maps as hatchured lines and their shapes can range from circular to elongated polygons. These resulting closed depression features can be buffered into 30-m zones out to a distance of 3,000 m to allow for a proximity analysis.



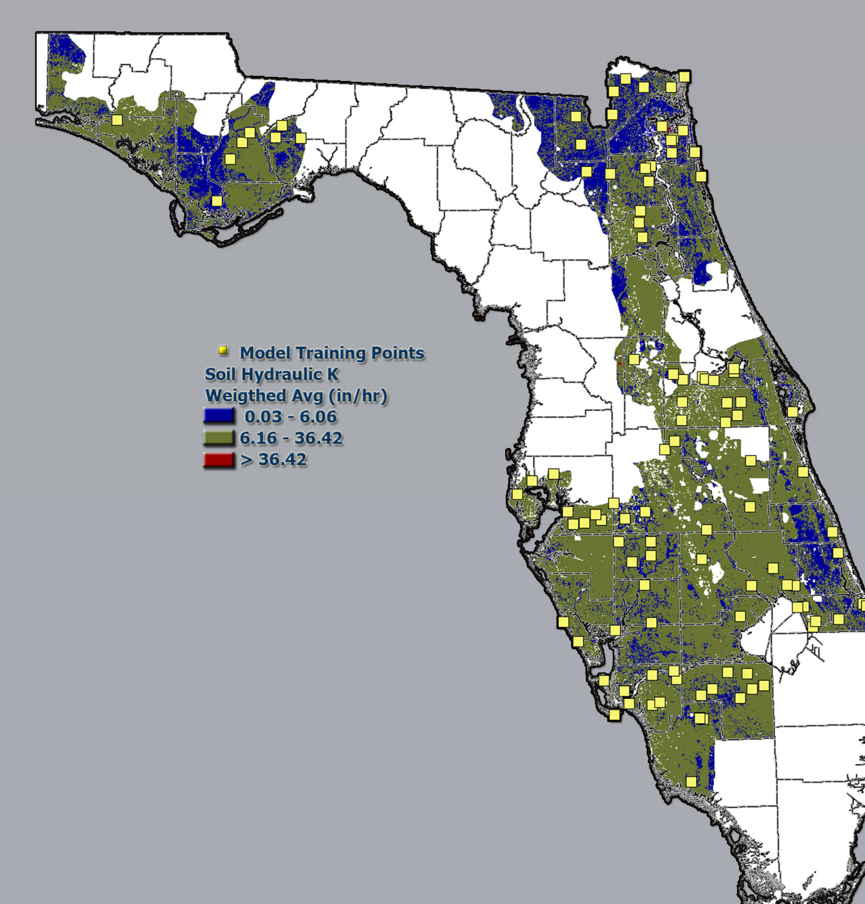
Depth to Water

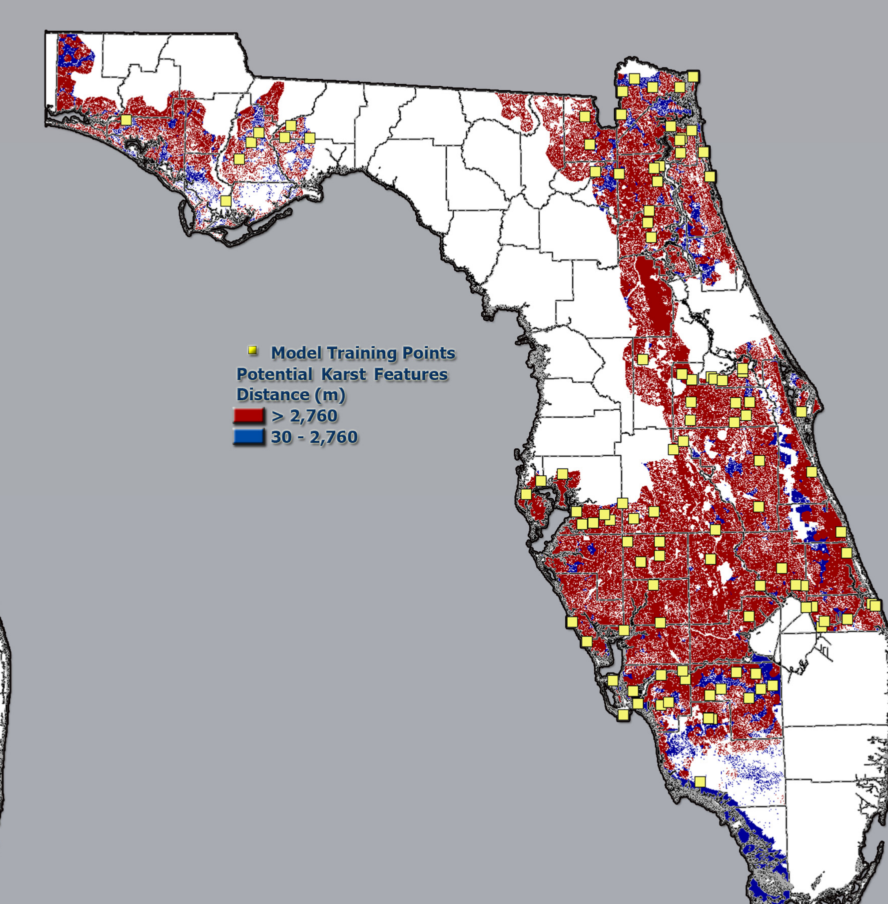
Depth to water is the thickness in feet of the space between land surface and the water table. The surface is created by subtracting a water table surface from the digital elevation model. A water table surface is created for the aquifer using water level measurements obtained from Florida's Water Managment District databases and utilizes kriging to create a surface.

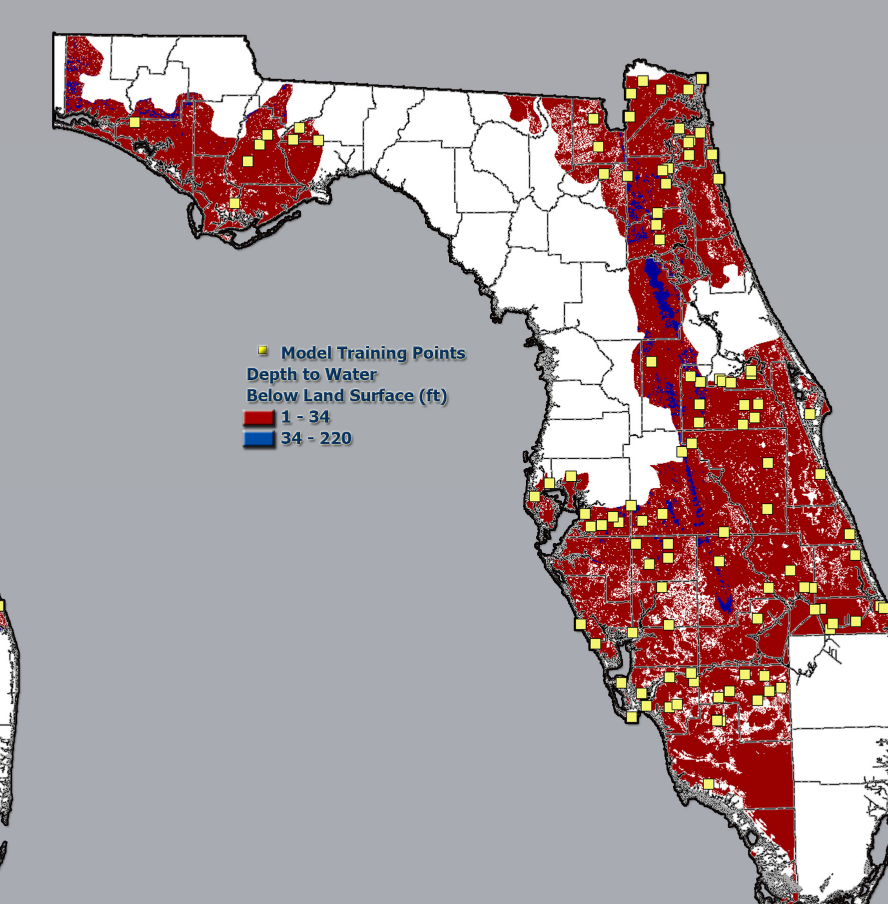
Generalization of Input Data

The modeling process involves generalizing input layers to evaluate which areas of each data layer share a greater association with locations of training sites, or, simply, aquifer vulnerability. Essentially, this process helps to determine the threshold or thresholds that maximize the spatial association between the patterns in the input data layers and the training sites pattern. For the surficial aquifer system model, a binary break was typically defined by the modeling analysis for each data layer which creates two spatial categories: one with stronger association with the training points and one with weaker association.

Soil Hydraulic Conductivity ranges from 0.03 to 59.85 in/hr) across the study area. Modeling indicated that areas underlain by soils with hydraulic conductivites higher than 36.42 were more associated with higher aquifer vulnerability. Areas underlain by soils with hydraulic conductivites between 6.06 - 36.42 are moderately associated with aquifer vulnerability and values below 6.06 are less associated with aquifer vulnerability. The depth to water ranges from 1 to just 220 feet thick across the study area, and the analysis revealed that areas with 34 feet or less of depth to water were more associated with higher aquifer vulnerability. Finally, the analysis indicated that areas within 2,760 meters of a closed topographic depression were more associated with higher aquifer vulnerability. These generalized themes are used to generate the final model output as shown below.







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