Intermediate Aquifer System Vulnerability Assessment Phase II

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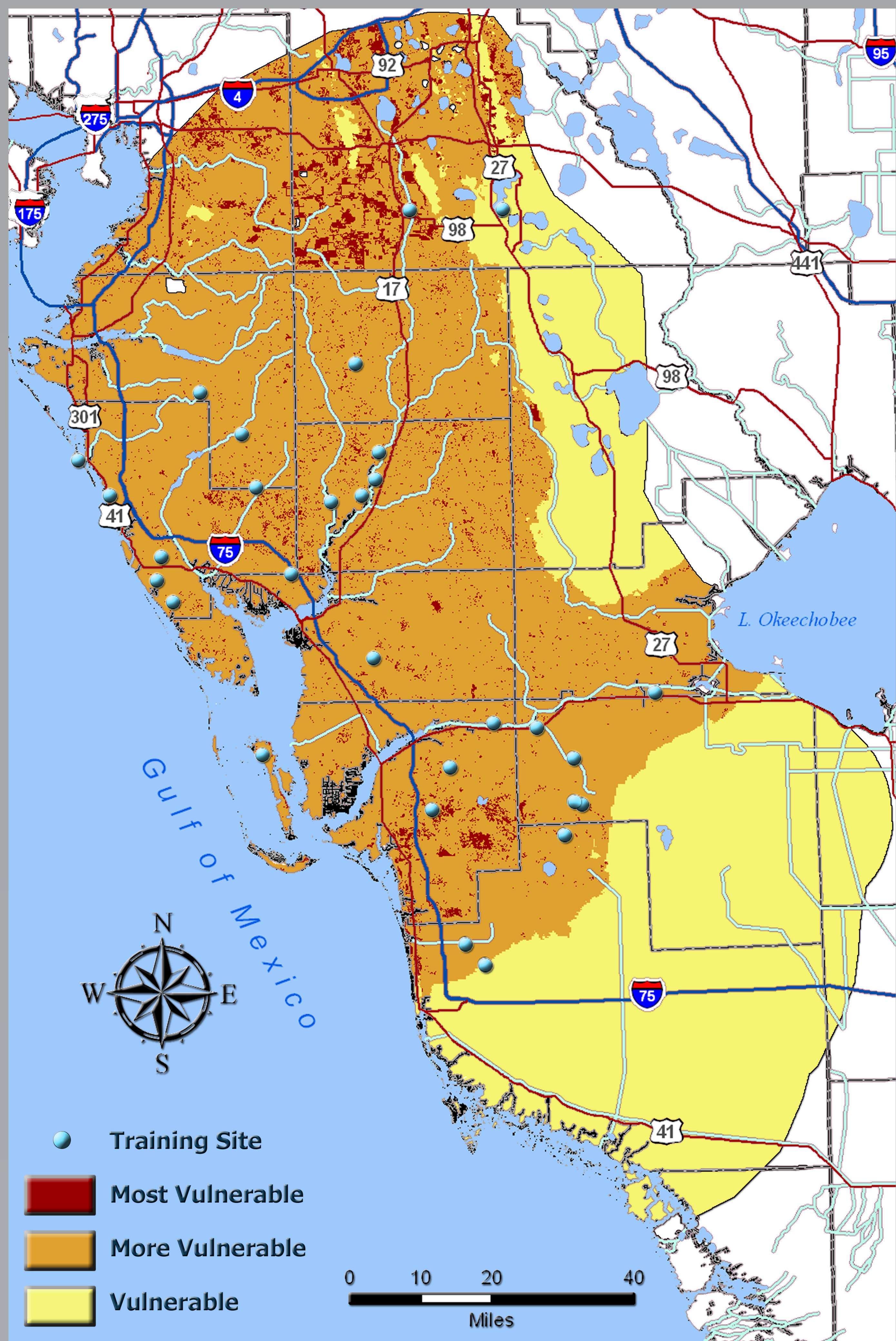


INTRODUCTION

The Intermediate Aquifer System (IAS) includes all rocks and sediments that lie between and collectively restrict the exchange of water between the overlying SAS and underlying FAS (Southeastern Geological Society, 1986). This unit generally acts as a confining unit for the FAS where it is present, but also contains localized moderate-yielding aquifers throughout the State. It is also a major source of ground water only in the southwestern part of Florida and comprises a major regional aquifer system for the approximately 3.5 million residents (Bureau of Economic and Business Research, University of Florida, 2008) residing within the 11 county area. Various researchers have identified several production zones within this aquifer system (e.g., Metz, 1993, Torres et al., 2001). Due to the complex and discontinuous nature of these zones, it is not feasible to map them or model their individual vulnerability.

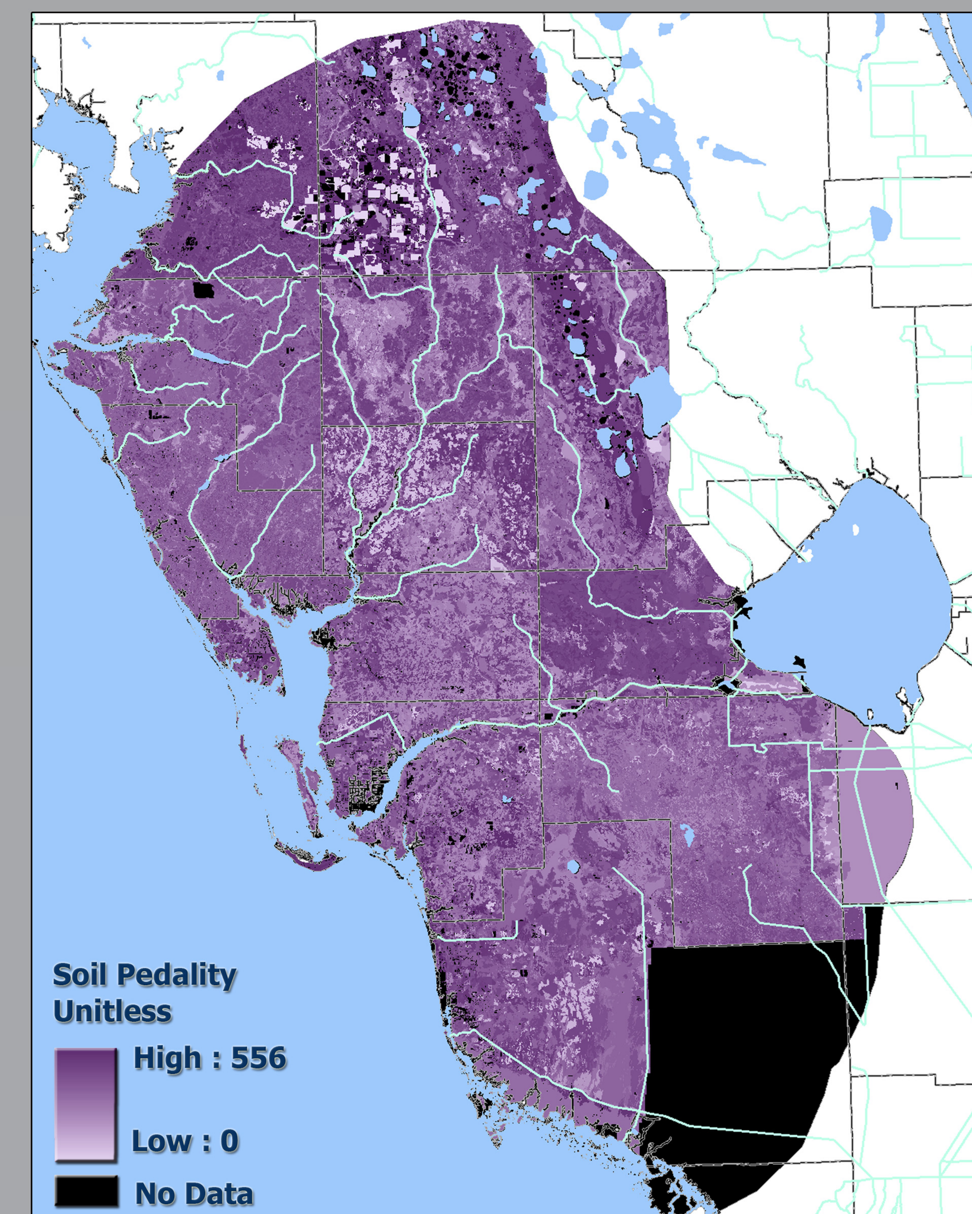
The IAS extent is based on the combined distribution of FDEP public water supply wells and an aquifer extent proposed by Miller (1986). FDEP wells were plotted in a GIS with a 20-km buffer. This method accounted for major production zones of the IAS in the southern part of the region, but did not adequately represent areas where the IAS is a principal aquifer system for domestic supply in Polk, Sarasota, Manatee, and Hardee Counties. For this region, Miller's (1986) extent was applied. By combining these two areas, a comprehensive extent of the IAS where it is predominantly used for public supply was developed.

Identifying areas where the intermediate aquifer system 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 south 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

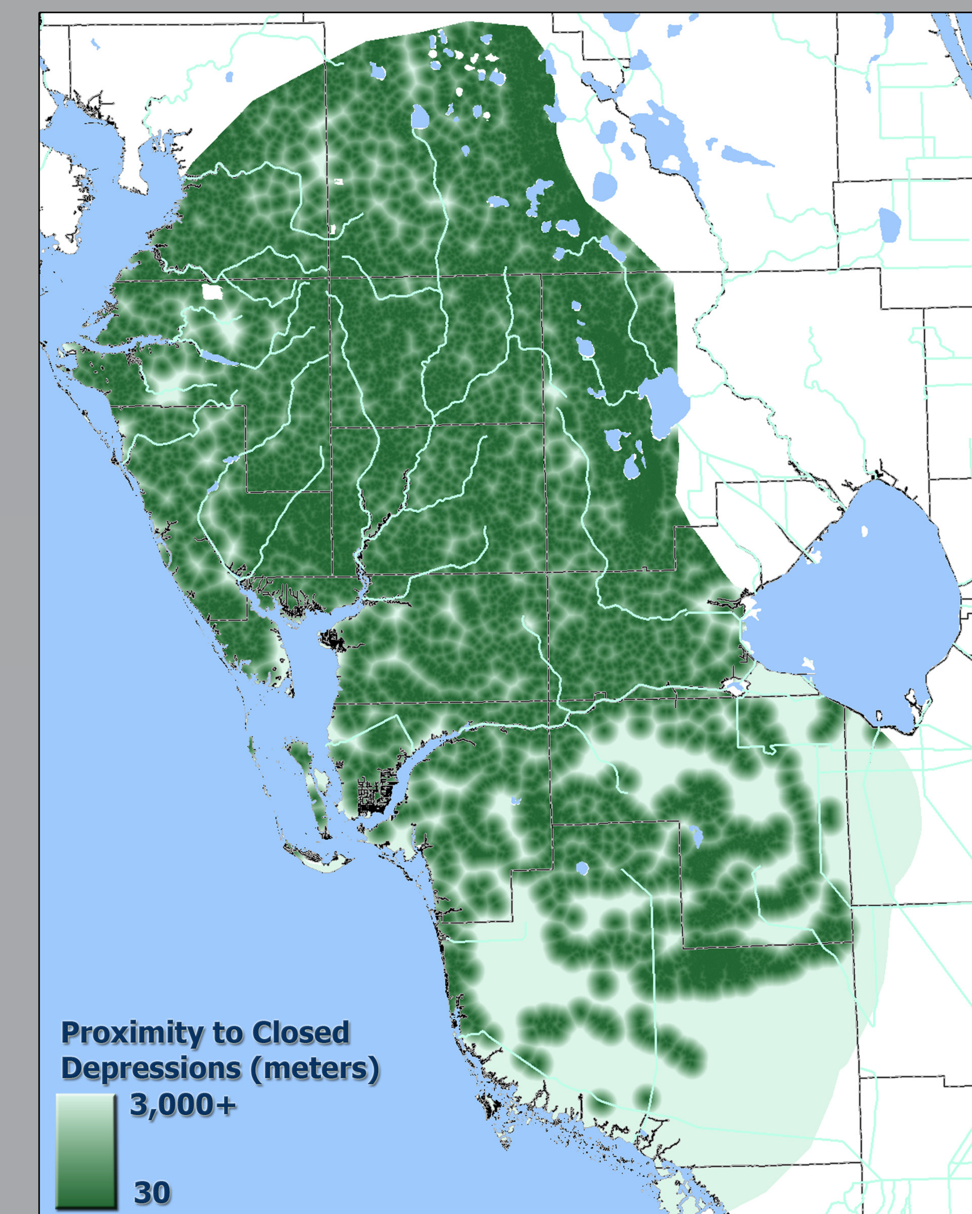
The primary purpose of the intermediate aquifer system Vulnerability Assessment, is to provide a science-based, water-resource management tool that can be used to help minimize adverse impacts on ground-water quality, including focused protection of sensitive areas such as springsheds and ground-water 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 a 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 depressions, overbuden and soil pedality. 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 to the left. The model output map indicates that the areas of highest vulnerability are associated with relatively thin to absent overburden overlying the aquifer systems, close proximity to closed depressions and higher soil pedality. This modeling procedure is described in more detail in Arthur et al. (2007) and the Floirda Aquifer Vulnerability Assessment Phase II report.



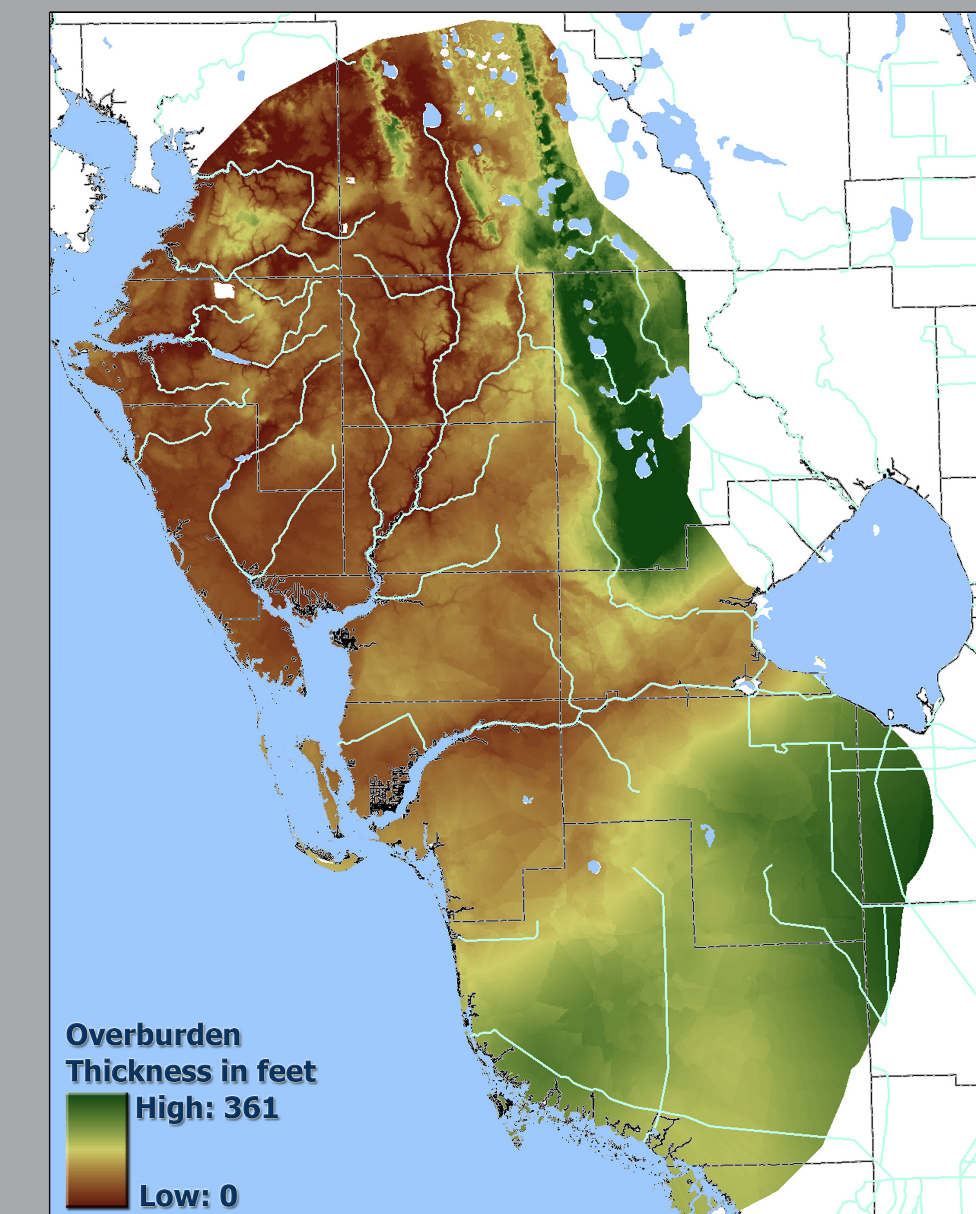
Soil Pedality Theme

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, all county soils data were refined for the study area by the Natural Resources Conservation Service. As a result, more detailed information is available for soils analysis for the IAS model than during previous projects.



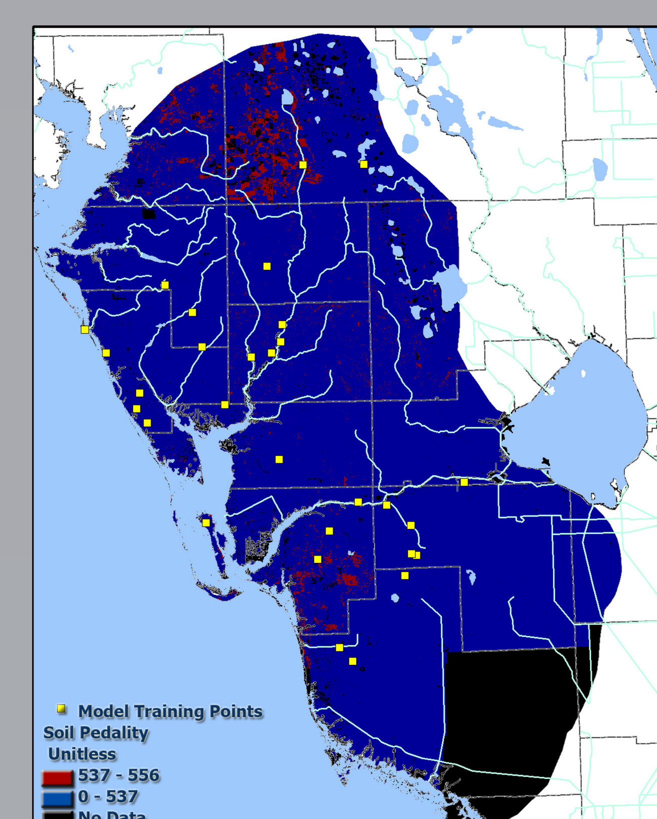
Proximity to Closed Topographic Depressions Theme

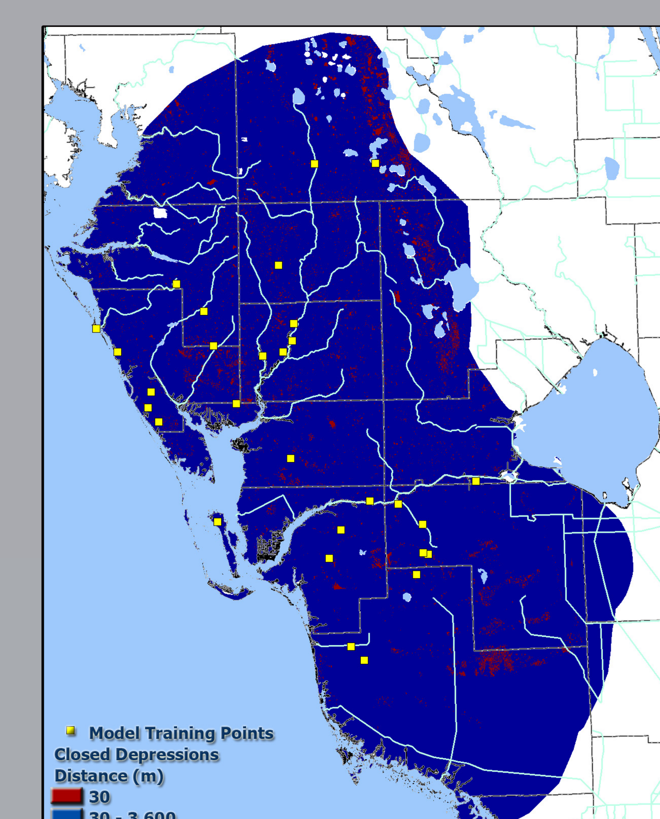
Closed depressions can provide preferential pathways for movement of ground water into the underlying aquifer systems and increase an area's aquifer vulnerability where present. The closer an area is to a closed depression, the more vulnerable it may be considered. Closed depressions are identified on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

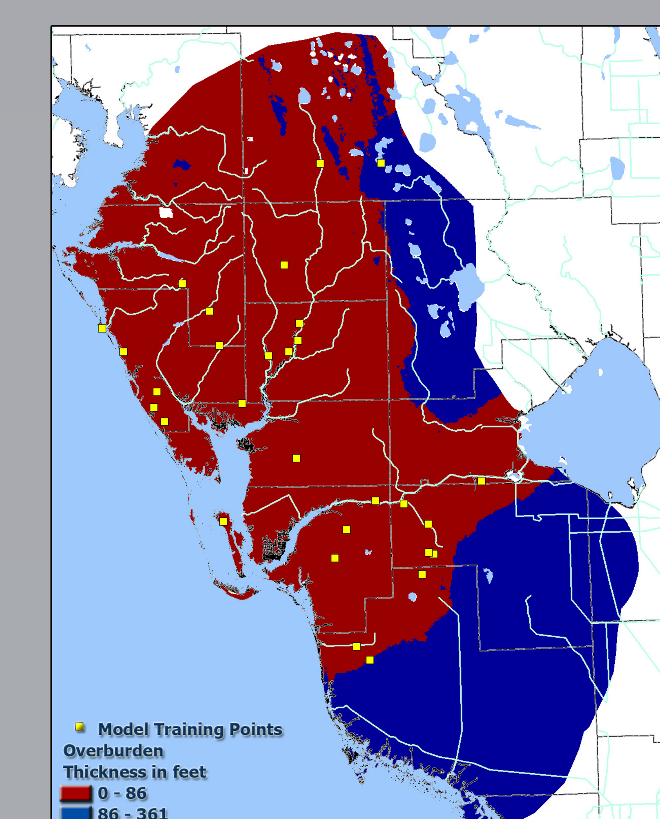


Aquifer Overburden

Aquifer overburden is an estimate or measure of how well buried or 'covered' an aquifer system is. Where this overburden is thick and continuous and the intermdiate aquifer system is deeply buried, as in the western part of study area, aquifer vulnerability is generally lower. On the other hand, in areas of the county where aquifer confinement is thin to absent or breached by closed topographic depressions, the vulnerability of the underlying aquifer is generally higher, primarily because it is present at or near the land 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 intermediate 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 Pedality ranges from 0 to 556 (unitless) across the study area. Modeling indicated that areas underlain by soils with a value from 537 - 556 were more associated with higher aquifer vulnerability. The overburden ranges from 0 to 361 feet thick thick across the study area, and the analysis revealed that areas with less than 86 feet of overburden were more associated with higher aquifer vulnerability. Finally, the analysis indicated that areas within 30 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 to the left.

REFERENCES

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Qualifications:

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