Designation of Significant Groundwater Recharge Areas

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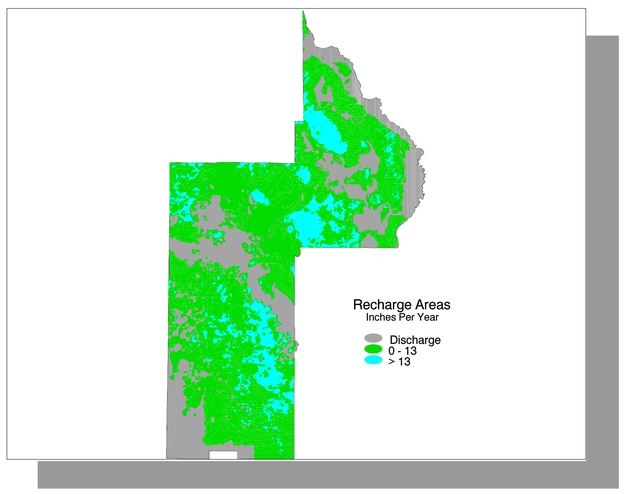
DRAFT

In 1996 the Florida Legislature passed the Bluebelt Act (Section 193.625, Florida Statutes), giving county governments the flexibility to implement voluntary tax assessment programs that protect high-water recharge areas. High-water recharge areas were identified as areas that contribute significant groundwater recharge to aquifer systems based on the hydrologic characteristics of soils and underlying geologic formations. Significant groundwater recharge to the Floridan aquifer was identified by the St. Johns River Water Management District (SJRWMD) using a geographic information system (GIS) coincidence grid model. The model evaluated areas of rapid soil permeabilities and areas greater than the area-weighted recharge rate for the county. The rapid soil permeabilities grid included soils with moderately rapid to very rapid permeability, as mapped in the Natural Resource Conservation Service SSURGO maps.

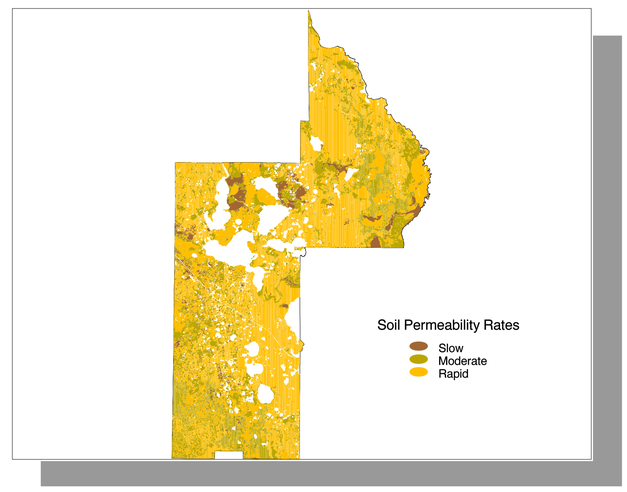
Recharge to the Floridan aquifer was mapped by SJRWMD based on the hydraulic pressure differences between the surficial and Floridan aquifers and on the leakance of the confining unit separating the aquifers. A weighted value analysis of the Lake County recharge grid was used to determine an area-weighted recharge rate of 13 inches per year (in/yr).

The rapid soil permeabilities grid was then overlaid on the grid of areas with recharge rates greater than 13 in/yr. Those areas having rapid soil permeabilities and recharge rates greater than 13 in/yr were identified as "significant" recharge areas.

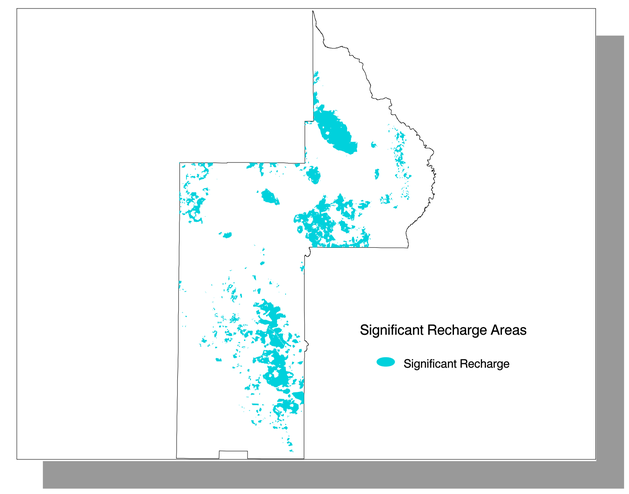
Recharge to the Floridan Aquifer



Soil Permeability Ratings



Significant Recharge within Lake County



RECHARGE TO THE FLORIDAN AQUIFER

The hydrogeologic characteristics of the surficial aquifer system, the upper confining unit of the Floridan aquifer, and the Floridan aquifer system control rates of recharge to the Floridan aquifer in SJRWMD. The surficial aquifer system extends from the land surface downward to the top of the upper confining unit of the Floridan aquifer. The water table of the surficial aquifer is the upper surface of the zone of saturation (see cross-section).

The upper confining unit of the Floridan aquifer, where present, retards the movement of water between the surficial and Floridan aquifers. Rates of leakage of water through the upper confining unit are dependent on the thickness and hydraulic conductivity of the upper confining unit.

The amount of water available as recharge to the Floridan aquifer is that part of rainfall, after losses to runoff and evapotranspiration, that infiltrates to the water table and continues to move downward to the Floridan aquifer system. Soils having high infiltration potential with little or no runoff due to a lack of surface drainage features are most conducive to recharging ground water systems.

Recharge to the Floridan aquifer occurs in areas where the elevation of the water table of the surficial aquifer is higher than the elevation of the potentiometric surface of the Floridan aquifer. In these areas, water moves from the surficial aquifer in a downward direction through the upper confining unit to the Floridan aquifer. Recharge rates are highest in areas where hydraulic pressure difference and leakance are greatest. Recharge also occurs directly from infiltrating rainfall where limestones of the Floridan aquifer are at or near land surface. In addition, significant local recharge may occur where sinkholes have breached the upper confining unit.

Discharge from the Floridan aquifer occurs in areas where the elevation of the Floridan aquifer potentiometric surface is higher than the elevation of the water table of the surficial aquifer. In these areas, water moves from the Floridan aquifer in an upward direction through the upper confining unit to the surficial aquifer. Where the elevation of the Floridan aquifer potentiometric surface is higher than land surface, springs and free-flowing artesian wells occur.

The recharge area data sets are taken from the GIS data product of the Floridan aquifer recharge mapping project. Measured Z values for water levels and geologic features from discrete well locations with XY coordinates were used. Triangulated irregular networks (TINs) were developed for conversion to GRIDs, interpolating values for areas without data points. The recharge data has a 116 meter cell size and has 5 classes indicating discharge areas and areas of 0-4, 4-8, 8-12, and 12 or more inches of recharge per year (SJRWMD Technical Publication SJ93-5).

The area (in acres) within each 1 inch per year (in/yr) recharge rate interval was tabulated from the grid analysis and multiplied by the percent of recharge area for that interval to determine the area weighted recharge rate of 13 in/yr for Lake County.

REFERENCES

Boniol, D., M. Williams, and D. Munch, 1993. *Mapping Recharge To The Floridan Aquifer Using A Geographic Information System.* Technical Publication SJ93-5. Palatka, Fla.: St. Johns River Water Management District.

Kinser, P., and M. Minno, 1995. *Estimating The Likelihood of Harm To Native Vegetation From Groundwater Withdrawals, St. Johns River Water Management District.* Technical Publication SJ95-8. Palatka, Fla.: St. Johns River Water Management District.

(SCS) Soil Conservations Services, 1983. *National soils handbook.* U.S. Department of Agriculture. Washington, D.C.: Government Printing Office.

SOIL PERMEABILITY

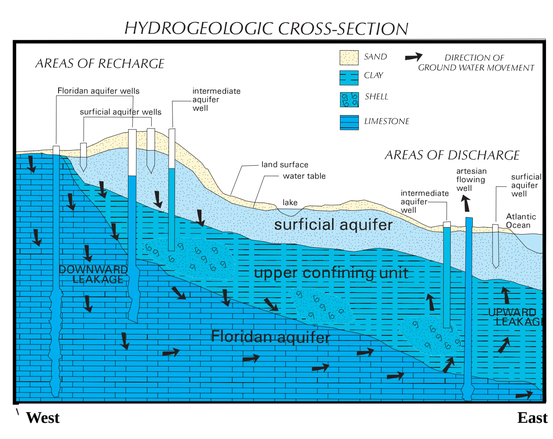
The soils data set was developed by Natural Resource Conservation Service (NRCS) soils scientists who interpreted various soils types and locations utilizing county boundaries as mapping units. The soils delineation was performed on 1:24,000 scale, USGS 7.5 minute series quadrangle basemaps, then converted to digital vector format and joined to create county boundary-based data sets. The interpretation was augmented by measurements during the ground-truthing step in the data development process. The soils data used in this analysis resulted from joining all of the county-based data sets and then converting the vector data to ARC/INFO GRID format with a 50 meter cell size. The 50 meter cell size was chosen as a reasonable compromise between minimizing the spatial and thematic data degradation inherent in converting vector data to raster data and the available disk space.

During the conversion process, the soil permeability values were aggregated by SJRWMD staff from the rating classes developed by the NRCS. The NRCS estimated the number of inches of water per hour that can move downward through a saturated soil (SCS 1983, 603-19). Seven different permeability classes were identified:

very slow (less than 0.06 inches/hour [in/hr])
slow (0.06 - 0.2 in/hr)
moderately slow (0.2 - 0.6 in/hr)
moderate (0.6 - 2.0 in/hr)
moderately rapid (2.0 - 6.0 in/hr)
rapid (6.0 - 20 in/hr)
very rapid (more than 20 in/hr)

SJRWMD staff (SJRWMD Technical Publication SJ95-8) aggregated the classifications to:

slow (less than 0.06 in/hr - 0.2 in/hr)
moderate (0.2 - 6.0 in/hr)
rapid (6.0 - >20 in/hr)

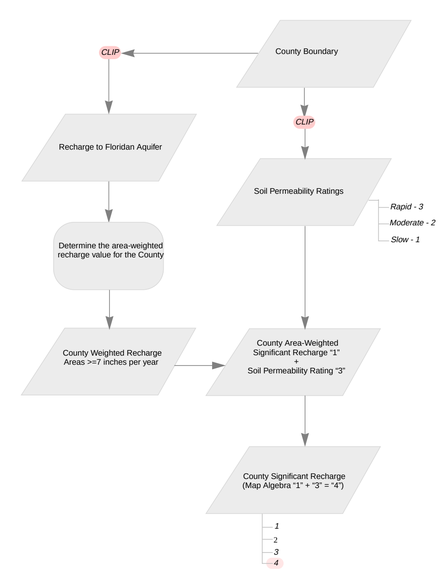


SIGNIFICANT RECHARGE AREAS

Significant groundwater recharge to the Floridan aquifer was identified by SJRWMD staff using a GIS coincidence grid model. The rapid soil permeabilities grid was overlaid on the grid of areas with recharge rates greater than 13 in/yr. Those areas having rapid soil permeabilities and recharge rates greater than 13 in/yr were identified as "significant" recharge areas.

ARC/INFO METHODOLOGY

For this GIS coincidence model, two input GRIDs describing soil permeability and recharge areas, respectively, were evaluated to produce a third GRID which describes areas of significant recharge within Lakee County. The project used the ARC/INFO and ArcView GIS software applications for data management, display, query, and analysis. The ARC/INFO GRID module's Map Algebra was used in analyzing the data. Map Algebra is an algebraic, high-level computational language for performing cartographic spatial analysis on rasterized (or "GRID-ed") data which uses math-like expressions that evaluate numeric values supplied by input GRID data sets, and then returns numeric values which are assigned to an output GRID data set.



This data is intended as a regional planning tool. It should be used only as a general guide to Lake County significant recharge areas of the Floridan aquifer. The map is subject to all limitations normally associated with the creation of maps by interpretation of geologic and hydrologic data.

The St. Johns River Water Management District prepares and uses this information for its own purposes and this information may not be suitable for other purposes. This information is provided "as is." Further documentation of this data can be obtained by contacting: St. Johns River Water Management District, Dept. of Resource Management, Div. of Groundwater Programs, P.O. Box 1429, Palatka, Florida 32178-1429. (904)329-4507

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