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Hydraulic entrapment of relict saline water within semi-confined aquifers in Southwest Florida

Isolated occurrences of saline water within semi-confined, predominantly freshwater aquifers in southwest Florida have long presented problems to water managers and users. These rather linear-oriented bodies of saline water occur within parts of the Sandstone Aquifer in Lee, Hendry, and Glades counties and within parts of the Lower Tamiami Aquifer in Lee and Collier counties. Water managers have commonly attributed these features to anthropogenic causes, particularly pumping-induced saline-water intrusion or vertical movement of saline water through improperly constructed wells. New hydrogeologic evidence and the use of solute-transport groundwater modeling shows that these features are the result of hydraulic entrapment of relict saline water, left unflushed from the aquifer from the last high sea level stand.

Modern discharge features, such as stream and wetland sloughs, occurring in lower topographic areas cause the potentiometric surface of the surficial aquifer and the underlying semi-confined aquifer to be locally depressed. These narrow, linear depressions in the potentiometric surface of the semi-confined aquifer cause the flow field to be constricted, thereby trapping saline water. In areas away from the surface topographic depressions, flow through the semi-confined aquifers in the horizontal plane has no constrictions and recharge is directed downward through the overlying confining beds. Beneath and adjacent to modern drainage features, flow through the semi-confined aquifers is constricted in the horizontal plane and reversed in the vertical plane with potential upward movement. The combination of the gradient change and flow constriction reduces the flushing rate and produces the saline water distribution pattern observed in the field. This is an example of an aquifer hydraulic trap based on flow constriction.