GROUNDWATER AND SURFACE-WATER INTERACTION

Virtually every surface-water feature in the state, including rivers, lakes, wetlands, and estuaries, interacts with adjacent groundwater. This interaction affects the water quality and quantity in both surface water and groundwater. Groundwater and surface-water interaction affects water chemistry, especially acidity, temperature, dissolved solids, dissolved oxygen, and reduction-oxidation potential. As land and water resource development increases in the state, it is becoming readily apparent that groundwater and surface-water interaction must be considered in establishing water management policies. This interaction can take many forms but the most common interactions are between aquifers and stream water, lakes, and wetlands. In coastal areas, interactions between aquifers and seawater occur. All of these interactions occur in Florida.

Streams interact with aquifers in two ways: either they receive water from groundwater inflow or they lose water to aquifers by seepage through the streambed. For many streams in Florida, the flow direction between the stream and aquifer can vary a great deal, sometimes over very short timeframes or distances in response to rapid rises in stream stage or stream flow, commonly from storm runoff. If the rise in stream stage is great enough to overtop the banks and flood large areas of land surface, widespread recharge to groundwater may occur throughout the flooded areas.

The presence of karst features sometimes makes streams and aquifer interaction even more obvious. Karst is a type of topography that is characterized by caves, sinkholes, springs, and other types of openings caused by dissolution of limestone. One of the largest karst environments in the country occurs from the central portion of the Florida peninsula to the big bend portion of the panhandle. In this area the Santa Fe River, a major tributary to the Suwannee River, completely goes underground, becoming part of the groundwater flow system before reemerging as a river three miles downgradient. Interaction between surface water and groundwater in this highly porous karst aquifer system is quite rapid and can significantly impact water quality. The water quality of streams flowing over this karst terrain can be improved or degraded by the addition of groundwater from large springs such as in the lower Suwannee River basin, depending upon the composition of the groundwater. In the Suwannee River a significant portion of the nitrogen load is being contributed from groundwater discharging to the river. During low flow periods in the river, groundwater is the predominant if not sole contributor of water to the river, introducing low dissolved oxygen concentrations which change the river's chemical conditions enough to significantly influence the movement of fish populations in portions of the river. In the St. Johns River basin, over half of the flow in the Ocklawaha River, a major tributary to the St. Johns, is groundwater from Silver Springs.

Aquifer and lake interaction frequently occurs when lakes receive groundwater inflow through part of their bed and have seepage to groundwater through other parts of their bed. Some lakes receive substantial amounts of their water from groundwater. The water levels in lakes generally do not change as rapidly as water levels in streams. Evaporation has a greater effect on lake levels than on stream levels because the surface area of lakes is greater and lake water is not replenished as readily as stream water.

Lake levels can be reduced by groundwater withdrawals and can be increased by groundwater return flows from irrigation and other applications of water to the land surface. The accounting of the groundwater components can be difficult and controversial. In the west central portion of the state, the drying of lakes has been attributed to excessive groundwater pumpage to meet the

public water supply needs. As these needs increase in west central Florida, the possibility of transporting water from nearby watersheds is being considered, namely from the lower Suwannee River watershed. Concern for the Suwannee River and its direct connection with the Upper Floridan aquifer is driving recent research to determine potential groundwater pumpage effects on stream flow in the Suwannee River.

Similar to streams, wetlands can receive groundwater inflow, recharge to groundwater, or do both. In Florida, wetlands have interactions with groundwater similar to streams and lakes. Many wetlands are present along streams, especially slow-moving streams. Wetlands along streams and in coastal areas have complex hydrological interactions because they are subject to periodic water level changes. Some wetlands in coastal areas are affected by predictable tidal cycles. Other coastal wetlands are more affected by predictable tidal cycles. Other coastal wetlands are more affected by seasonal water level changes and by flooding. A major difference between lakes and wetlands is that lakes commonly have a shallow zone around their perimeter, permitting waves to remove fine-grained sediments. In wetlands, fine-grained and organic sediments commonly extend to their shoreline (border), resulting in reduced transfer of water between groundwater and surface water in the wetlands.

In coastal areas in south Florida, rapid population growth has greatly increased the demand for water. If too much fresh water is pumped out of the Biscayne aquifer to meet this demand, sea water intrudes to replace the freshwater, contaminating the water supply. Canals constructed to prevent flooding in southern Florida rapidly remove excess surface water and groundwater from inland parts of the aquifer to coastal areas. Control structures near the mouths of canals allow groundwater levels near the canals in coastal areas to remain high enough to retard saltwater encroachment during periods of less than normal rainfall. However, this connection also means that pollutants in canal water from inland areas and saltwater from coastal areas can move through the canals and into the aquifer. The extensive canal system has also altered inland biologic communities dependent on shallow groundwater in the Everglades and wetland areas. Efforts are underway to better understand the interaction between groundwater and sea water in south Florida, so that further contamination can be prevented. This improved understanding can be applied to the management of the system of canals, levees, control structures, pumping stations, and water conservation (storage) areas to preserve the freshwater resources of southern Florida.

Study Questions

1. What are the two ways that streams interact with aquifers?
2. What is karst topography?
3. Geographically, where is the major karst area located in Florida?