Article 78

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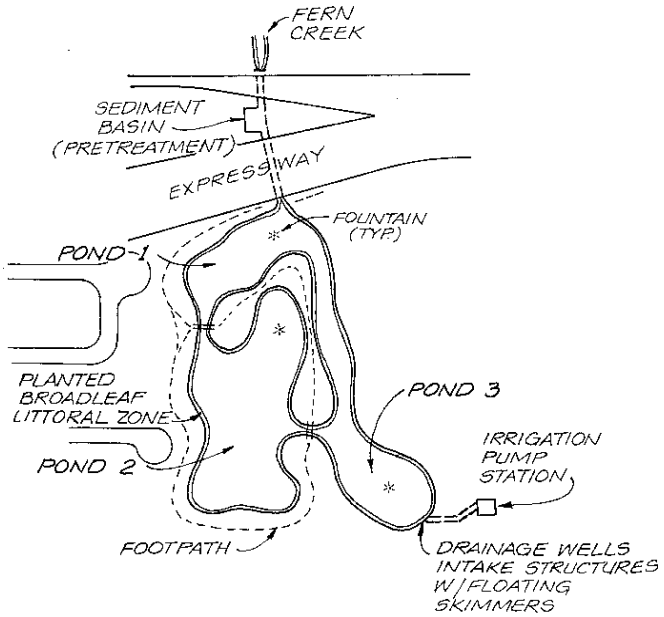
Influence of Groundwater on Performance of Stormwater Ponds in Florida

Stormwater quality treatment and flood control can be difficult in Central Florida. Flat topography and a high water table make it very difficult to separate stormwater from groundwater. A common stormwater management approach in this low-relief environment has been to construct regional ponds or wetlands. These are typically excavated below the water table to provide the required pool storage for pollutant removal. Weirs above the pool are used to create additional storage needed to protect residents from flooding caused by the intense rainfall for which the region is noted. Many regional ponds serve very large drainage areas—from one to two square miles in size. Consequently, the regional ponds are located "online" and are fed by base and storm flow from canals and ditches.

Several concerns have been raised about the performance of regional ponds and wetlands in such environments. First, will a regional pond's performance decline because the permanent pool is supplied by groundwater rather than stormwater? And, second, since groundwater is a more significant component of a regional pond's water budget, will the ponds prove effective in removing pollutants during dry weather conditions? Some intriguing answers to these questions have emerged from three recent monitoring studies in Central Florida.

In the first study, Kevin McCann and Lee Olson investigated the pollutant removal performance of a retrofit pond located in Orlando, Florida. The retrofit, known as Greenwood, was truly a "deluxe" model of a pond system. Greenwood consisted of a sediment basin that pre-treated runoff before entering a three-cell pond system with broad wetland benches. More than 13 acres in area, the pond had many innovative design features such as water reuse (for landscaping irrigation), four fountains to aerate deeper pools, and skimmers near the outlet (see Figure 1). The entire system was extensively landscaped, including a riverine floodplain and broadleaf marsh, creating a park area with a trail network for passive recreation. The pond had a drainage area of some 572 acres where land use was more than 50% residential, and a water quality treatment volume of 1.25 watershed inches. Like many Florida ponds, it was formed by excavating well below the normal water table (Table 1).

Figure 1: Schematic of the Greenwood Pond System (McCann and Olson, 1994)



The Greenwood pond had a unique water budget. The pond actually discharged into the Flordian aquifer through drain wells. The drain wells and low topographic position of the pond created a positive gradient for groundwater movement, thereby "attracting" groundwater inflows from an area five times greater than its "surface runoff" watershed. As a result, groundwater inflows dominated the water budget of the pond, with 46.7% of the total outflow from the pond estimated to be groundwater seepage. Of the remaining outflow, about 75% was from stormflow and 25% from surface baseflow.

McCann and Olson sampled flow and pollutant concentration at three stations above and below the pond during 11 storm events and eight baseflow periods. Pollutant removal was computed based on the reduction of mass loads during both storms and dry weather for the entire pond system. For the sediment basin, removals were based on the mean of storm EMC reductions. Results are shown for the sediment basin and the entire pond system in Table 2.