Understanding the groundwater flow in karst aquifers and the effect of best management practices (BMPs) on nitrate reduction in spring discharge is critical for effective management and protection of karst water resources. However, the control on the conduit network's impacts on spring discharge and nitrate concentration is not fully understood, and the cumulative effects of BMP on reducing nitrate in karst groundwater systems have not been evaluated at the basin scale. In this dissertation, a coupled Conduit Flow Process (CFPv2) and Conduit Mass Three-Dimensional (CMT3D) model was applied to evaluate the biosorption-activated media (BAM)-based BMP on nitrate removal in Silver Springs in Florida. It is found that the effect of BMP by implementing BAM blanket filters in twenty-six stormwater retention basins is limited; whereas, for implementing BAM blanket filters in 50% of the urban area, the nitrate-N concentration in spring discharge would be decreased by 10.7% in a normal hydrologic year. The controls on the contribution of conduit flow to spring discharge are evaluated. For aquifer with turbulent flow in a single conduit, the effects of three dimensionless numbers (Reynolds number, relative surface roughness, and hydraulic conductivity ratio) and recharge on conduit flow contribution are quantified. Moreover, the effects of conduit geometry and density on conduit flow contribution are evaluated for conduit networks. Finally, the prediction of long-term average discharge in ungauged basins is assessed for improving recharge estimation.