

## **River Basin Water Budgets as a Water-Resources Management Tool**

Jerad Bales

U.S. Geological Survey, North Carolina Water Science Center, 3916 Sunset Ridge Road,  
Raleigh, NC 27607

The population of North Carolina is expected to increase about 40 percent between 2006 and 2025, to approximately 12.3 million persons. With this growth in population will come increased economic expansion and demand for electrical power. Additional people, a larger economy, and greater power production will place increasing demands on North Carolina's water resources. Moreover, events during recent droughts (1998 – 2002) and 2006 – 2008, and continuing) indicate that water shortages can develop even with the current (2008) population and economy. Water-resources management in North Carolina is sometimes fragmented. Ground water is generally managed independently from surface water. Water availability for water supply is only loosely linked to water availability for other uses such as wastewater dilution, recreation, and ecological needs. In addition, some withdrawals such as from individual wells and surface water withdrawals less than a specified amount (which differs for agricultural and other uses), are not required to be permitted. As a result, water use is not precisely known. Ongoing knowledge of North Carolina's water assets and use is critical for effective management of the resource. River basin water (or hydrologic) budgets provide a means for evaluating availability and sustainability of a water supply to meet all current or projected needs within a basin. Water budgets also provide a basis for assessing how a natural or human-induced change (for example, agricultural drainage, urban development, ground-water withdrawals, or a changing climate) in one part of the hydrologic budget may affect other aspects of the budget. An understanding of water budgets for river basins in North Carolina is important to maintain and improve the effectiveness of current water-resources management. A water budget is needed, for example, to understand ground-water supply sustainability because of the inter-connectedness of ground water and surface water. Many mistakenly believe that ground-water resources can be safely sustained if withdrawal rates are less than ground-water recharge rates. Ground-water withdrawal, however, affects several aspects of a river basin's hydrologic budget other than simply ground-water storage. Ground-water withdrawals can affect baseflow, recharge rates, aquifer storage characteristics, and perhaps other aspects of the water budget. In order to demonstrate the difficulties in developing a water budget using currently available information, a preliminary budget is developed for the French Broad River basin in North Carolina. Components of the budget include streamflow, surface withdrawals, reservoir storage, ground-water storage, ground-water recharge, surface- and ground-water withdrawals, surface-water return flows, consumptive use, conveyance losses, precipitation, and evapotranspiration. In addition, the concept of virtual water (water that is exported from the basin in a form other than waters, such as apples) is introduced into the basin water budget. The French Broad River basin example demonstrates that numerous components of the water budget are currently unmeasured, or unreported. An important conclusion from this example is that it is difficult to manage that which is not measured.