The Aquatic Systems Continuum
Linking ground water, surface water, and atmospheric water

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Biographical Sketch
Thomas C. Winter is a Senior Research Hydrologist with the U.S. Geological Survey in Denver, Colorado. He earned BA and MS degrees in Geology and a PhD in Hydrogeology at the University of Minnesota. From 1961 to 1972 he conducted geological and water-resource studies in Minnesota, and was in charge of USGS ground-water studies there from 1968 to 1972. Since 1973 he has conducted research on the hydrology of lakes and wetlands, with emphasis on their interaction with ground water and evaporation. In the late 1970s he helped establish, and has since been a principal investigator at, four long-term field research sites; the Mirror Lake watershed in New Hampshire, the Shingobee River headwaters area in Minnesota, the Cottonwood Lake wetland complex in North Dakota, and the Island Lake area of the Crescent Lake National Wildlife Refuge in Nebraska. He also has been involved with lake and wetland studies in Washington, California, Colorado, Wisconsin, Massachusetts, and Florida. He has received the Distinguished Service Award from the U.S. Department of the Interior, the M. King Hubbert Award from the National Ground Water Association, and the W.R. Boggess Award from the American Water Resources Association, the Lifetime Achievement Award from the Society of Wetland Scientists, the O.E. Meinzer Award from the Geological Society of America, and the Outstanding Achievement Award from the University of Minnesota.

Abstract
The aquatic systems continuum is a concept that combines the wetland continuum concept with the hydrologic landscapes concept. The wetland continuum concept was developed as a result of field studies of a prairie pothole wetland complex in North Dakota. The concept is based on geochemical and biological responses to the water regime of wetlands, which, in turn, is based on the relations of wetlands to ground water flow systems and to climate variability. Hydrologic landscapes are the conceptualized movement of water, including its exchange with the atmosphere, in all types of terrane. Through multivariate statistics and GIS methods, hydrologic landscapes have been mapped for the United States. By combining these two concepts, it is possible to describe the geochemical and biological characteristics of aquatic ecosystems with respect to (1) their position within ground-water flow systems, (2) their location within streams, (3) their response to the interaction of ground water and surface water, and (4) their response to climate variability. Such information is useful for setting priorities for research on ecosystems, design of environmental monitoring programs, and as a basis for environmental management.