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Benjamin L. Harding
Hydrosphere Resource Consultants

Subhrendu Gangopadhyay
Hydrosphere Resource Consultants

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RELIABILITY AS A PERFORMANCE METRIC FOR WATER RESOURCES MANAGEMENT

Benjamin L. Harding, **Subhrendu Gangopadhyay**, Hydrosphere Resource Consultants, 1002 Walnut Street, Suite 200, Boulder, Co 80302;
bharding@hydrosphere.com
(303) 443-7839

This paper describes the historical development of methods of quantitative water resource analysis, and illustrates modern reliability-based approaches with some examples.

Analysis of the yield of water resources systems has had a firm analytical framework since at least 1883 when Rippl proposed his mass curve approach. This and related methods remained a mainstay of the first generation of water resources planning well into the 1970's, and systems designed using these first-generation methods have operated continuously and reliably for over a century. The advent of computerized simulation techniques represented the beginning of the second generation of water resources planning, and allowed the representation of much more complex, integrated systems of reservoirs and delivery systems with correspondingly more sophisticated operating rules. The customary application of second-generation water resources models has been to calculate a design yield, often referred to as "firm yield," which serves to represent the capacity of the water supply system.

Today, the third generation of water resources planning methods extended second-generation approaches by offering the ability to incorporate the effect of uncertainty and variability in planning and operations analyses and to express system reliability quantitatively. These methods offer substantial planning, operational and policy advantages to water management organizations.

On some river systems, recent droughts have made real the risk of system failure that is in the subtext of the concept of firm yield. Good planning and policy development requires that this implicit risk be made explicit, quantified, and considered. Vogel (1987) suggested adoption of a risk-based approach to water system planning by applying synthetic hydrology techniques to extrapolate the risk of extreme drought. The complexity of the system configuration and its operation that could be addressed by Vogel's approach was limited due to the computing capabilities available twenty years ago. Today, performing a risk analysis on complex systems is feasible even for relatively small water provider organizations.

To illustrate the reliability-based approaches, we describe the third-generation analytical methods that are available to quantify system reliability for the purpose of both planning and operation. We provide examples, including a basin-wide analysis of the Colorado River system using paleohydrology.

Contact: Benjamin L. Harding, Subhrendu Gangopadhyay, Hydrosphere Resource Consultants, 1002 Walnut Street, Suite 200, Boulder, Co 80302;
bharding@hydrosphere.com, (303) 443-7839