Water Availability in the Colorado River Basin:
Incorporating Paleo Hydrology and Climate Projections

The Colorado River Basin occupies an area of approximately 250,000 square miles and serves as a principal source of water for parts of seven states and Mexico. The Colorado River is facing increasing pressure from multiple consumptive and non-consumptive uses while, at the same time, concerns over climate and forest changes bring increased uncertainty regarding the reliability and variability of the river's flows. Since 2000, the Colorado River has experienced the worst drought conditions in the approximately 100 years over which streamflows have been recorded.

Nowhere is concern about the prospect of drought and the potential for drying due to climate change more prominent than in Colorado, where for the last 70 years water suppliers on Colorado's Front Range, which stretches along the eastern side of the Rocky Mountains, have looked across the Continental Divide to the Colorado River to supplement native water supplies. In the fall of 2008 the Colorado Water Conservation Board initiated the Colorado River Water Availability Study (CRWAS) to provide estimates of the amount of water available for development from the Colorado River within Colorado. The study will consider the effect on water availability of recurring drought as well as the projected effects of climate change.

The foundation of a study of water availability is development of estimates of future streamflows. Because of the complex array of water rights that govern use of the Colorado's water, and the web of applicable laws, compacts, court decrees and treaties that govern the State's share of water from the Colorado River (known collectively as the "Law of the River"), the CRWAS will require estimates of monthly time series of naturalized streamflows at more than 200 locations in Colorado, and at 29 major inflow points throughout the Colorado River Basin. AMEC is developing alternative hydrologic scenarios using new statistical techniques to construct sequences of flows from tree-ring data going back more than 1,000 years, and will construct scenarios of future stream flows based on climate conditions projected by models of global air and ocean circulation. Ten different projections of future climate will be used to frame the impact of changed climate in 2040 and 2070. Streamflows are being developed in "ensembles", each containing 100 monthly traces that run for 50 years. These streamflow traces will be used as input to detailed water rights models and to the basin-scale Colorado River Simulation System developed by the Bureau of Reclamation to simulate conditions throughout the Colorado River Basin.

The methods employed by AMEC to develop streamflow scenarios for the CRWAS are based on readily available tools and data and are therefore applicable throughout the continental U.S. and in parts of southern Canada. This presentation will describe the methods used to blend information from paleo hydrology with projections of future climate in order to develop estimates of future streamflows and will discuss some of the challenges such a study presents to engineers, hydrologists, water managers and policy makers.

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