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The Hydrologic, Legal, and Economic Allocations of the Water in A Shared Transboundary River Basin

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The historical origins of the water allocation in a transboundary basin like the Colorado River Basin are complex and multiscalar. Geological and climatic forces and timescales created a hydrologic river network allocating flow from mountains in Colorado and Wyoming to the river delta at the Gulf of California. Legal river agreements between transboundary human stakeholders over the past century created an anthropocentric reallocation of flows to regional human populations and away from the environmental and cultural uses on the mainstem of the Colorado. At much shorter business investment and transactional timescales (ranging from days to years), individual municipalities, businesses, and households utilize this water to produce and trade valuable water-derived goods and services, allocating the water to a constantly adapting and boundary-free economic river network that provides "virtual water" flows and provide indirect access to the river's water by any party- anywhere- that is willing and able to pay for those goods and services. In this paper we employ hydrologic, legal, and economic datasets to map these three rivers, employing county-level water infrastructure and virtual water analysis. The results document an effective allocation to urban populations in California of the Colorado River's water-derived goods and services, such that California is an even larger user of the economic river than the legal river. This mapping provides valuable visualization information for legal and economic management decisions in this transboundary river basin, for example by revealing the transboundary economic impacts of a water emergency declaration on the Lower Colorado River. Whereas geological and climatic forces are ever-shifting the hydrologic allocation, and transboundary reallocation of surface water rights is not easily revisited due to socio-infrastructural "lock-in" and unrecoverable political capital sunk in the original treaties, economic policy and business decisions are shown to be substantially effective in shifting the transboundary economic allocation. Economic water use policies and short-term business supply chain decisions are therefore a valuable adaptive tool for water scarcity and governance problems in transboundary river basins.