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Assessing surface water resource availability for oil shale development using the WARMF model

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Oil shale is one of the largest fossil energy resources in the western United States. Reserves of recoverable shale oil are estimated at 1.5 trillion barrels in the Piceance Basin alone. This is nearly six times more oil than the proven oil reserves in Saudi Arabia (267 billion barrels). However, oil shale development is energy intensive and not carbon neutral without carbon capture and sequestration, and oil shale development may require as much as 1 to 3 barrels of water per barrel of upgraded shale oil produced, depending on processing technology and energy input. Although water amounts required for oil shale development are within the Colorado River upper basin compact allocation, this new demand for water could disproportionately impact flows in the White and Upper Colorado Rivers. In addition, average river flows do not capture the role of climate variability, which significantly reduces supply in times of drought. We have begun to examine the impacts of energy production, climate variability, and climate change on water resources in the White and Colorado Rivers using the WARMF model. WARMF is a physics-based energy, water, and chemical balance and transport model that predicts runoff in streams and rivers from meteorological inputs. Because WARMF handles reservoir and river diversion operations, we are also analyzing how operations may be modified to optimize flows to meet supply needs (including environmental flows) as water demand grows and climate change impacts intensify.