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Abstract: Water quality issues related to the transport of nutrients and trace elements in irrigated agricultural systems have become a key concern to both regulators and stakeholders around the world. At high concentrations, these solutes have the potential to negatively impact aquatic life, livestock, and human health. To better understand these systems and to evaluate how best management practices (BMPs) can be used to improve water quality, a numerical model has been developed to simulate flow and solute reactive transport. The groundwater model MODFLOW-UZF is used along with the streamflow routing (SFR2) package to model flow in irrigated stream-aquifer systems. To model reactive transport, the coupled RT3D-OTIS model is utilized. The reactive transport model uses simulated flows from MODFLOW-SFR2 in computing the exchange of solutes between the aquifer and streams on a daily time step. The coupled model is applied to an approximately 540 km² study region in the Lower Arkansas River Valley (LARV) near Lamar, Colorado to investigate the current distribution of nitrate, selenium, and uranium. Multiple hydrogeochemical processes that impact interaction among these solutes are accounted for, and results are compared with those from another study region further upstream in the LARV. Additionally, work is underway to apply the model to evaluate the impact of proposed alternative land and water BMPs on concentrations in groundwater, mass loading to the Arkansas River system, and concentrations within the river system to achieve closer compliance with Colorado's water quality regulations.

***Keywords**:* nitrate; selenium; uranium; reactive transport modelling; best management practices;