Numerical simulation of reactive transport provides an important framework for the integration of hydrologic and biogeochemical conceptual process models into a quantitative description of subsurface behaviors. The ultimate goal for the development of these modeling analyses, however, is to assess risk and remediation performance for waste management decision-making. This will require an additional and commensurate effort to characterize and quantify uncertainty in the model predictions and assessments. Experience in groundwater hydrology has demonstrated the total uncertainty of a model simulation consists of both the the uncertainty of the the parameters and the uncertainty in the conceptual model with represents the scientific understanding of a particular hydrogeologic environment. Moreover, it has been demonstrated the conceptual uncertainty of groundwater flow modeling dominates the total simulation uncertainty. This project will assess the parametric and conceptual model uncertainty of hexavalent U(VI) transport at both the Naturita UMTRA site and the Rifle FRC. The parameter and conceptual model uncertainty will be evaluated using a maximum likelihood formulation of Bayseian model averging. The focus of the work at the Naturita site will be to investigate how conceptual model uncertainty varies across scales ranging from column tests to the plume scale. These will results will provide a fundamental understanding of the uncertainty associated with upscaling models from laboratory conditions to a field setting. The work at the Rifle site evaluate the parameter and conceptual model uncertainty for the stimulated bioreduction of U(VI) by microbial processes. The uncertainty analyses will also be extended to evaluate the value of new data in reducing prediction uncertainty. Together, the research at these two sites will provide complementary results which together can provide DOE with a quantitative understanding of how various scales and processes impacted simulation uncertainty.