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**Balancing Water Use, Water Rights,
Endangered Species And Economics;
A Multi-Objective, System Operations Optimization Approach.**

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The Virgin River Operations Optimization Model (VROOM) will allow the user to optimize the Virgin River Water Resource System in light of meeting M&I, agriculture, hydropower, environmental and water right, flow requirements. This modeling system will maximize fish habitat and minimize costs, which are the competing objectives, thus demonstrating the utility in using a state of the art multi-objective optimization program with long-range water resources planning. A trade off surface or Pareto front will be developed between cost and habitat; additionally uncertainty estimates for key model parameters can be made. Existing models were modified to help analyze the impacts of different water operational scenarios and to analyze impacts to the fishes of the Virgin River. These models include a system mass balance model, a physical habitat based model for fish, a water temperature model, and an optimization model.

In the arid and semi-arid western United States, the development of water resources has been commonly followed by changes in riverine habitat and the subsequent designation of aquatic species as threatened or endangered; the Virgin River study area is no exception. Washington County is located in far southwestern Utah lying mostly in the Virgin River Basin and is characterized by hot dry summers and mild winters. The endangered fish species of the Virgin River do not constitute sport fisheries and minnow and sucker species represent the native fish community. Concurrent with the continued development of M&I and agriculture water uses, fisheries have deteriorated due to resulting reduced flows and higher water temperatures. Options are being considered to reduce water temperatures and increase flows in the main stem Virgin River. A tool is needed that would allow users to evaluate different water management options including new infrastructure and reallocated water rights.

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