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Integrated Surface Water and Groundwater Modeling for Streamflow Restoration and Climate Change Assessment in a Mountain Basin Watershed in Eastern Washington State

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In January, 2018, the State of Washington passed the Streamflow Restoration Law (RCW 90.94) that requires the development of watershed plans to offset impacts to instream flows associated with surface water and groundwater diversions. To address these requirements in eastern Washington, Earthfx developed a fully integrated surface water and groundwater model of the Little Spokane River (LSR) watershed using the USGS GSFLOW model. This model was subsequently used for the assessment of streamflow losses, evaluation of aquifer storage and recovery (ASR) offset projects, and the simulation of snowpack drought and future climate change water budget scenarios.

The LSR mountain watershed is a snowpack/snowmelt-dominated hydrologic and hydrogeologic setting. The central basin includes multiple basalt layers and complex sand and gravel aquifer systems that have been subject to significant glacial meltwater erosion. The uplands, including Mount Spokane, are a granitic setting with an extensive network of intermittent headwater tributaries. These headwater streams route the spring snowmelt to the aquifer systems that sustain summer streamflow and water use.

To comprehensively address the various climatic and headwater stream issues, the GSFLOW model was developed to cover the entire watershed, from the mountain top watershed divides to the outfall into the main Spokane River. The development of the mountaintop geologic and snowpack models, and calibration to the system response lag (celerity), was particularly challenging, but ultimately resulted in a model that could address the entire water budget and future snowpack drought scenarios.

The model simulations indicate that the effects of climate change will overwhelm all existing water rights offset requirements identified under the Streamflow Restoration Law. Multiple ASR projects have been evaluated and are pending implementation, but more importantly, the scope of the future water management challenge under a changing climate has now been quantified.