

An evaluation of 2-D vs 3-D hydraulic analyses investigating the effects of whitewater parks on fish passage

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Abstract. Whitewater parks (WWPs) are popular recreational amenities, particularly in Colorado. These in-stream structures create waves, typically by constricting the channel to form a hydraulic jump. Many completed projects have shown WWPs can promote positive connections between users and the natural environment while providing a valuable boost to the local economy. However, concerns remain that WWPs may act as a complete or partial barrier to fish passage. Although natural resource managers are called upon to review WWP designs and assess how the structures might affect upstream fish movement, and consequently longitudinal habitat connectivity, there is a paucity of scientific information available to them. This study builds on prior work which combines hydraulic conditions with movement data from PIT-tagged brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*) to model fish passage through three unique WWP structures on the St. Vrain River at Lyons, CO. The model identifies parameters that are strong predictors of fish passage – thus attempting to explain the physical processes that limit upstream movement. In this study, Flow3D outputs and MATLAB code from the 3-D model are altered to create a 2-D model. Regression analysis is then conducted to determine if a 2-D model provides enough hydraulic description to adequately predict fish passage, relative to the 3-D model. A simplification of the original 3-D model would mean that fewer resources (i.e. time and money) would be required to conduct a preliminary analysis of WWP effects; therefore increasing the potential for this novel, informative modeling process to be utilized.