ACCURACY OF HEC-RAS TO CALCULATE FLOW DEPTHS AND TOTAL ENERGY LOSS WITH AND WITHOUT BENDWAY WEIRS IN A MEANDER BEND

Prepared for

U.S. Department of the Interior
Bureau of Reclamation
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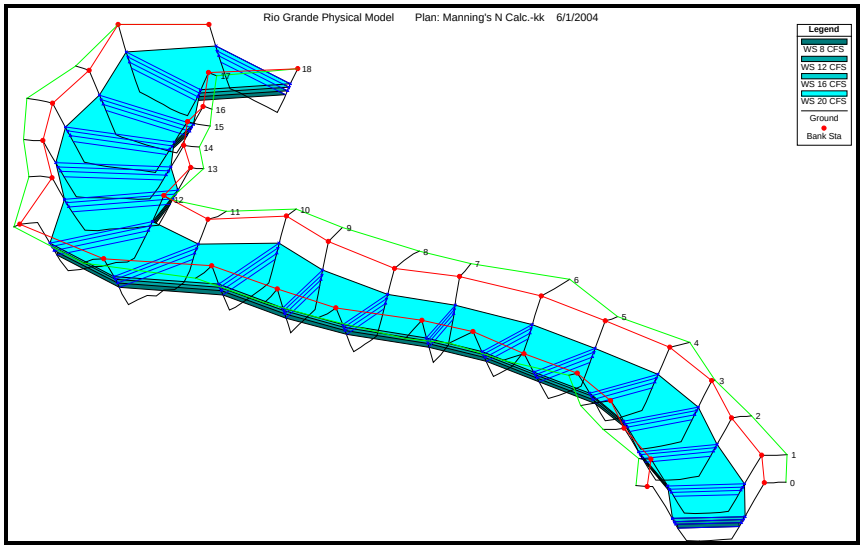

December 2005

Colorado State University
Daryl B. Simons Building *at the*
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EXECUTIVE SUMMARY

River systems are interconnected waterways that often change to reach a state of dynamic equilibrium. Dynamic equilibrium is a fragile balance between flow conditions, sediment transport, and environmental habitat in a river system. To study river systems in detail, complex hydraulic models have been developed. Hydraulic models calculate flow depths and energy loss through a river system and are defined as 1-, 2-, or 3-dimensional (1-D, 2-D, or 3-D, respectively) models. Differences between each model type depend on assumptions used to build the model. A 1-D model assumes the primary component of a 3-D velocity profile is along the x-coordinate axis. Therefore, the velocity components along the y- and z-coordinate axes are assumed insignificant.

In 1-D analysis, Hydrologic Engineering Center's River Analysis System (HEC-RAS) is a common hydraulic model used to study flow depths and total energy loss along a study reach of a river system. HEC-RAS is a 1-D model that performs calculations for steady or unsteady flow in gradually-varied or rapidly-varied flow analysis. Even though HEC-RAS is a 1-D hydraulic model, it is commonly used to model flow patterns where the velocity along the y- or z-coordinate axes are significant. For instance, HEC-RAS is used to study meander bends. Meander bends are undulating segments in a river system where the dominant direction of velocity is not necessarily along the x-coordinate axis. An added level of complexity develops when bank-stabilization features such as bendway weirs are added to a HEC-RAS model. Bendway weirs are bank-stabilization features

built of local rock material. Bendway weirs are constructed along the outer bank of a meander bend in order to reduce bank erosion by directing high velocities along the outer bank to the center of the channel. While protecting the stream bank, bendway weirs support viable aquatic habitats and riparian vegetation along a meander bend.

Since HEC-RAS is often used to model 3-D velocity profiles with and without bendway weirs, research needs to be completed to determine the accuracy of HEC-RAS. Included in this study was an analysis to determine the accuracy of HEC-RAS to model flow depths and total energy loss along a meander bend with or without bendway weirs and a methodology to best estimate total energy loss given HEC-RAS output.

A study was conducted using HEC-RAS to research hydraulic characteristics of meander bends in the physical model with and without bendway weirs. Objectives of this research were to: 1) determine feasibility of HEC-RAS to sufficiently calculate flow depths and total energy loss through meander bends without bendway weirs; 2) determine feasibility of HEC-RAS to sufficiently calculate flow depths and total energy loss through meander bends with bendway weirs; and 3) outline appropriate methodology in order to use HEC-RAS to calculate flow depths and total energy loss through a meander bend with and without bendway weirs.