

Overbank flow analysis of the Bosque reach of the middle Rio Grande

Theodore R. Bender And Pierre Y. Julien

Department of Civil and Environmental Engineering, Colorado State University

Abstract. The headwaters of the Rio Grande form in southern Colorado and flow south to the Gulf of Mexico. The Middle Rio Grande, located in central New Mexico, has undergone many changes in its recent history. Several flood and sediment control dams, diversion dams, and levees have been constructed as well as water withdrawal and channelization projects. In addition the Bosque reach of the Middle Rio Grande has experienced a long term aggradational trend with periods of degradation. Sediment plugs have also formed in this reach. The combination of these river changes has led the United States Bureau of Reclamation (Reclamation) to contract with the Colorado State University Engineering Research Center to complete a hydraulic analysis of this reach. The goal of this analysis is to determine how the flow that will overtop the banks of the Bosque reach vary both spatially and temporally. These results will aid Reclamation in their management of this river reach and possible identification of sediment plugs which may in turn help mitigate their formation in the future. The Bosque reach, as defined in this study, is approximately 23 miles long, stretching from the Arroyo de las Cañas to the southern boundary of the Bosque del Apache National Wildlife Refuge. This analysis uses HECRAS, a 1-dimensional hydraulic model, to determine the water surface elevation profiles. This study includes simulations for 25 flow discharges varying in increments of 200 cfs up to 5,000 cfs. To better understand the historical overbank flow throughout this reach, the analysis was repeated for a total of four different bed geometry conditions using geometric data for 1962, 1972, 1992, and 2002. ArcGIS was also used to analyze aerial photographs and river planform layers to help determine hydraulic parameters and distances between cross-sections. A total of 100 different hydraulic simulations have been completed and analyzed in this final Bosque reach overbank flow report. Included in this reach report are comparisons of the following data: water surface elevation (WSE), overbank flow discharge, at-a-station hydraulic geometry, and cross-section geometry. The water surface elevation profiles, in conjunction with the low top of bank elevations, allow for a direct comparison of flow that will overtop the river banks. The data show how the overbank flow varies over time and location. The HEC-RAS model produced a low overbank flow value of 1,800 cfs and 1,400 cfs in 1962 and 2002, respectively. These data show a trend of decreasing capacity over time in sections of the river. These sections have low banks and or have experienced bed aggradation which can force water overbank into the floodplain. The 2002 data support the location of a sediment plug that formed in the Bosque reach in 2008. 1972 data are similar to the 1962 data, with a low overtopping flow of 2,000 cfs. The 1992 data set succeeded a period of higher flows and greater channel capacity. The 1962, 1972, and 2002 data all succeed a period of drought and show lower overbank flow values. Overall, the data show a decreased flow capacity of the Bosque reach over time.

Keywords: Overbank Flow, Rio Grande, Hydraulic Model, HEC-RAS