Executive Summary

In April 2007, a routine bathymetric survey at Mel Price Lock and Dam detected scour holes immediately upstream of the dam piers. Additional surveys revealed that some of the scour holes were up to 22 ft deep and presented a serious risk of undermining the dam. Repairs were attempted twice at the total cost of over a million dollars. However, the scour holes reoccurred within a year of each repair. Similar surveys conducted at two other locks and dams within the St. Louis District revealed that the upstream scour issue was not limited to Mel Price. Significant upstream scour and exposed piles were found at Locks and Dams 24 and 25. Currently, Lock and Dam 25 is undergoing repair for these issues while Lock and Dam 24's repairs are planned to start in fiscal year 2012.

The decision was made to investigate the mechanism of upstream scour using scale physical and numerical models of Mel Price Lock and Dam. The physical model was constructed at the U.S. Army Corps of Engineers Engineer Research and Development Center (ERDC) in Vicksburg, MS. The numerical models were developed at the U.S. Army's Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, NH.

Numerical modeling supported the assertion of the Mel Price staff that ice thickness at the dam gates reaches 20 feet. Applying this information to the physical model revealed that ice cover is a significant factor in causing upstream scour, and that ice approaching thicknesses greater than 13 feet is capable of scouring an armored bed similar to the scour found at the prototype location. Physical modeling also showed that gate operations at and above the 12 foot opening can cause scour with the necessary ice cover. Tests demonstrated that operation of multiple adjacent gates reduces bed velocity. Numerous methods to prevent further scour at the design elevation were tested, but none were found to be satisfactory (including 14,000 lb grout-filled bags). Use of a new lower design elevation for the stone bed protection (370 ft. in place of 375 ft.) was tested and found to be stable for the placement of multiple stone gradations