EQUATIONS FOR ESTIMATING BANKFULL-CHANNEL GEOMETRY AND DISCHARGE FOR STREAMS IN THE NORTHEASTERN UNITED STATES

Gardner C. Bent, Hydrologist, U.S. Geological Survey, 10 Bearfoot Road, Northborough, MA, 01532 gbent@usgs.gov

Abstract: Equations for estimating bankfull-channel geometry (stream width, mean depth, and cross-sectional area) and discharge were developed for streams in the northeastern U.S. Bankfull-channel geometry and discharge information are needed by government agencies and private organizations involved in stream restoration projects that use a natural-channel design approach. Bankfull-channel geometry and discharge information are also useful in addressing issues related to fish habitat, the design of culverts and bridges, and the regulation of stream-buffer zones.

Bankfull-channel geometry and discharge data from for 204 natural-flowing streams in the northeastern U.S. were used in this analysis. Data were from 11 published and 1 ongoing field studies mainly in the following states: Maryland (McCandless and Everett, 2002 and 2003; and McCandless, 2003), Massachusetts (ongoing study), New York (Miller and Davis, 2003; Mulvihill and others, 2005; and Westergard and others, 2005), Pennsylvania (White, 2001; Cinotto, 2003; and Chaplin, 2005), and Vermont (Jaquith and Kline, 2001), with some additional data from adjacent states (U.S. Department of Agriculture, Natural Resources Conservation Service, National Water Management Center, 2004). Coefficients of determination (R^2) for the regression analyses relating bankfull stream width, mean depth, cross-sectional area, and discharge data to drainage area were 0.82, 0.76, 0.90, and 0.80, respectively. The unified regional equations for the northeastern U.S. were:

$$\text{bankfull stream width (ft)} = 13.2635[\text{drainage area (mi}^2)]^{0.4459}, \quad (1)$$

$$\text{bankfull stream mean depth (ft)} = 0.9951[\text{drainage area (mi}^2)]^{0.3012}, \quad (2)$$

$$\text{bankfull stream cross-sectional area in (ft}^2) = 12.8552[\text{drainage area(mi}^2)]^{0.7537}, \text{ and} \quad (3)$$

$$\text{bankfull discharge (ft}^3/\text{s}) = 40.9545[\text{drainage area (mi}^2)]^{0.8448}. \quad (4)$$

To investigate possible subregional differences in the relations of bankfull-channel geometry and discharge to drainage area, individual state and hydrologic-region studies' regression equations were systematically compared to versions of the unified regional regression equation that omitted data from that state or hydrologic region. No statistically significant differences were found between the slopes or intercepts of state or hydrologic-region studies' regression equations and the unified regional equations, with a few exceptions. The exceptions were the intercept of the regression equation for bankfull stream width and bankfull discharge in the Coastal Plain hydrologic region of Maryland (McCandless, 2003) and the intercept of the equation for bankfull discharge in the Piedmont hydrologic region of Maryland (McCandless and Everett, 2002). This analysis indicates that the northeastern U.S. can be adequately represented by one set of regional equations for estimating bankfull-channel geometry (stream width, mean depth, and cross-sectional area) and discharge on the basis of drainage area at natural flowing stream sites.