DEFINING PERENNIAL, INTERMITTENT AND EPHEMERAL CHANNELS IN EASTERN KENTUCKY: APPLICATION TO FORESTRY BEST MANAGEMENT PRACTICES

J.R. Svec, R.K. Kolka, and J.W. Stringer[1]

In Kentucky stream classification is used to determine which forestry best management practice (BMP) to apply in riparian zones. Kentucky defines stream classes as follows (Stringer and others 1998):

a) perennial streams that hold water throughout the year,
b) intermittent streams that hold water during wet portions of the year, and
c) ephemeral channels that hold water only during and immediately after rain events.

Based on flow duration, these definitions of stream class do not represent the natural variation found in the field. The professional literature shows further discrepancies in stream class definitions based on flow duration (Hewlett 1982). Hedman and Osterkamp (1982) defined perennial streams as those having measurable discharge 80 percent of the time, intermittent 10 to 80 percent of the time, and ephemeral <10 percent of the time while Hewlett (1982) defined perennial streams as having water present ≥90 percent of the time.

Generally, as flow duration increases the potential for nonpoint source pollution also increases and BMPs intensify to protect water quality. In Kentucky, the presence, width, and amount of disturbance allowed within the riparian zone, as well as the distance to major soil disturbances (e.g., roads) are all dependent on streamflow duration. Incorrectly determining stream class leads to either increased nonpoint source pollution from increased activity where flow duration would dictate less disturbance, or costly deferral of revenue from too stringent application of the BMPs.

The common practice for determining stream class is the use of USGS Quadrangle topographic maps. Solid blue lines are considered perennial, dotted lines are considered intermittent and channels not defined on the map are considered ephemeral. Although the USGS monitors thousands of perennial streams, they seldom monitor intermittent or ephemeral streams. The map delineation between perennial-intermittent and intermittent-ephemeral is based on conceptual landscape relationships with very little supportive data, and the accuracy is questionable at the site level. Inaccuracies can be seen when measured flow duration data is compared with the USGS map classification.

An alternative to the above method is to measure stream and watershed properties and develop predictive models that relate streamflow duration to these properties. The objective of this study is to develop these predictive relationships. Our ultimate goal is to provide some easily measurable parameters to forest managers and operators so that they can more appropriately apply forestry BMPs in riparian zones.

Twenty-four streams in the Eastern Coal Field Physiographic province of Kentucky were monitored with semi-continuous stage height recording wells to determine the duration of flow from August 2000 to November 2001. Twelve sites were selected in the University of Kentucky's Robinson Experimental Forest. Several sites in the forest are monitored via weirs and flumes and continuous stage height recorders. Six of these sites were chosen for the study. Six additional sites were chosen within the Clemons Fork watershed on the Forest.

---

[1] Graduate Student (JRS) and Hardwood Silviculturist (JWS), Department of Forestry, University of Kentucky, 125 Thomas Poe Cooper Bldg., Lexington, KY 40546-0073; and Project Leader (RKK), USDA Forest Service, North Central Research Station, 1831 Hwy 169 East, Grand Rapids, MN 55744-3399. JRS is corresponding author: to contact, call (859) 257-2806 or e-mail at jrsvec0@pop.uky.edu.

Citation for proceedings: Van Sambeek, J.W.; Dawson, J.O.; Ponder, F., Jr.; Loewenstein, E.F.; Fralish, J.S., eds. 2003. Proceedings, 13th Central Hardwood Forest conference; 2002 April 1-3; Urbana, IL. Gen. Tech. Rep. NC-234. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 565 p. [Research note from poster presentation].

The sites were chosen to represent a range of flow duration. The Clemons Fork Watershed drains slightly more than 3,400 acres in Breathit County, KY. All 12 sites within the Robinson Experimental Forest are within the Clemons Fork watershed. The mapped classification of the Robinson Experimental Forest sites was eight ephemeral and four perennial sites. The 12 additional sites were scattered throughout eastern Kentucky. Candidates for stream sites were selected at random from USGS quadrangle maps falling completely within the boundaries of the Daniel Boone National Forest. Over 100 sites were specified. A number of randomly chosen sites from each category of stream classification (ephemeral, intermittent, or perennial) were selected and visited.

Considerations for selecting a site were remoteness (avoidance of vandalism), access (travel to sites through public land), terrain (negotiable hill slopes; clear stream reaches for measurement), and drainage (one site should not influence the amount of water passing another site). Of the 11 sites chosen, four sites were mapped as ephemeral, five sites were intermittent, and two sites were perennial. One additional site with an ephemeral classification was selected in Blanton Forest in coordination with another ongoing project.

Stream physical parameters measured included bankfull width, bankfull depth profiles, width:depth ratio, flood-prone width, streambed slope, sinuosity, and depth to bedrock (Rosgen 1996). Watershed parameters collected were drainage area, hillslope percent, and occurrences of disturbed area. Stepwise multiple regression models were developed to determine the physical parameters that have the greatest capability in predicting flow duration.

As expected, a range of flow duration and stream and watershed physical properties were found. Initial results suggest that width, streambed slope, and flood prone width are all related to streamflow duration.

Our research provides a field-based method for classifying streams on site. The developed relationships lessen the confusion resulting from varying definitions of the perennial, intermittent, and ephemeral stream classifications. In addition, these relationships provide forest operators easily measurable parameters with which to define stream types in eastern Kentucky. Our research will lead to improved application of Kentucky's forestry BMP guidelines addressing timber harvesting near streams, assuring that riparian zone BMPs are properly implemented.

LITERATURE CITED

Hedman, E.R.; Osterkamp, W.R. 1982. Streamflow characteristics related to channel geometry of streams in Western United States. Water-Supply Pap. 2193. Washington, DC: U.S. Geological Survey. 7 p.

Hewlett, J.D. 1982. Principles of forest hydrology. University of Georgia Press. 183 p.

Rosgen, D.L. 1996. Applied river morphology. Colorado: Wildland Hydrology.

Stringer, J.; Lowe, L.; Smidt, M.; Perkins, C. 1998. Field guide to best management practices for timber harvesting in Kentucky. Publ. FOR-69. Lexington, KY: University of Kentucky Cooperative Extension Service, Department of Forestry.