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NORTH CAROLINA REFERENCE STREAM CHANNEL MORPHOLOGY RELATIONSHIPS

Daniel Clinton, Greg Jennings, William Harman, Jan Patterson, Louise O’Hara, and Jon Williams*

ABSTRACT: Reference stream channel morphology relationships are valuable tools for engineers, hydrologists, and biologists involved in stream restoration and protection. They can be used by designers to determine appropriate stream channel dimension, pattern, and profile for various stream types and watershed conditions. This paper presents empirical relationships for reference stream channel morphology developed from field measurements in western North Carolina. Nine stable rural reference reaches in the Piedmont and Mountains were selected to represent Rosgen stream types B, C, and E. These reaches were surveyed to determine detailed channel dimension, pattern, and profile. Empirical relationships were developed for such parameters as pool cross-sectional area to riffle area, maximum pool depth to bankfull width, and riffle length to bankfull width. These relationships are essential for use in designing restoration or stabilization of unstable reaches in similar hydrophysiographic areas. Techniques for reference reach selection, field measurement, data management, and data analysis are described.

KEY TERMS: stream restoration; bankfull; reference reach.

INTRODUCTION (1st level heading)

Successful stream restoration requires understanding the causes of degradation, specific knowledge of the stream's present state, and understanding the stream's most stable dimension, pattern, and profile based on its present valley type and flow regime. Quantitative knowledge of stable streams is desired to determine the most stable dimension, pattern, and profile. Reference reaches provide the numerical template for unstable reaches. "A reference reach is a stable river segment that represents a stable channel within a particular valley morphology" (Rosgen, 1998). The reference stream is not necessarily "pristine" or completely unimpaired, but instead is a reach that characterizes a stable morphology within its setting. Factors that affect reference reach selection include watershed land use, valley and stream morphology, and flow regime.

This paper describes geomorphic relationships for North Carolina reference streams. Nine reference reach streams from the Blue-Ridge/Piedmont physiographic regions of North Carolina were surveyed to determine their dimension, pattern, and profile for addition to the North Carolina reference stream database.

Study Area (2nd level heading)

Reference reach study reaches were selected if they (1) were unchannelized, (2) lacked evidence of severe bank erosion, and (3) had a consistent land use over the past 60 years (Figure 1). A "stable" stream is defined by Rosgen (1996): "A Stream that over time and present climate transports the flows and sediment produced by its watershed in such a manner that the dimension, pattern, and profile are maintained without either aggrading nor degrading." Although it is not possible to quantitatively determine if a stream

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meets the definition on a single visit. These criteria were used along with Pfankuch channel stability rating system to verify channel stability (Pfankuch, 1975).

Figure 1 would be placed in this area

Figure 1. Locations of Reference Streams. (caption placed below the figure/centered)

Methods (3rd level heading)

After selection as a reference stream, differential level surveying techniques were used to collect reach data. Field measurements included longitudinal profile, cross-section, bed materials, and pattern measurements. Table 1 summarized the classification data for the nine reaches examined in this study.

Table 1. Reference Reach Classification Data. (caption placed above the table/centered)

<table>
<thead>
<tr>
<th>Stream Name</th>
<th>Drainage Area (sq mi)</th>
<th>Stream Type</th>
<th>Bankfull X-Sectional Area (sq ft)</th>
<th>Bankfull Width (ft)</th>
<th>Bankfull Mean Depth (ft)</th>
<th>Water Surface Slope (ft/ft)</th>
<th>D50/D84 (mm)</th>
<th>Flood Prone Area Width (ft)</th>
<th>Sinuosity (ft/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stackrock Creek</td>
<td>1.1</td>
<td>B3a</td>
<td>27.9</td>
<td>24.2</td>
<td>1.2</td>
<td>0.0549</td>
<td>100/3870</td>
<td>51.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Steels Creek</td>
<td>9.2</td>
<td>B3c</td>
<td>95.1</td>
<td>54.0</td>
<td>1.8</td>
<td>0.0159</td>
<td>135/512</td>
<td>74.0</td>
<td>1.2</td>
</tr>
<tr>
<td>Craig Creek</td>
<td>1.8</td>
<td>B4</td>
<td>32.7</td>
<td>28.8</td>
<td>1.1</td>
<td>0.0331</td>
<td>33/370</td>
<td>39.0</td>
<td>1.1</td>
</tr>
<tr>
<td>Mitchell River Headwaters</td>
<td>6.5</td>
<td>B4c</td>
<td>62.5</td>
<td>29.2</td>
<td>2.1</td>
<td>0.0095</td>
<td>40/210</td>
<td>64.2</td>
<td>1.1</td>
</tr>
<tr>
<td>Lost Cove (Edgemont)</td>
<td>24.8</td>
<td>C3</td>
<td>218.0</td>
<td>64.9</td>
<td>3.4</td>
<td>0.0088</td>
<td>144/512</td>
<td>200.0</td>
<td>1.2</td>
</tr>
<tr>
<td>Basin Creek</td>
<td>6.8</td>
<td>C4</td>
<td>57.4</td>
<td>30.7</td>
<td>1.9</td>
<td>0.0141</td>
<td>38/130</td>
<td>85.0</td>
<td>1.02</td>
</tr>
<tr>
<td>Sal's Branch</td>
<td>0.2</td>
<td>E4</td>
<td>10.4</td>
<td>8.7</td>
<td>1.2</td>
<td>0.0109</td>
<td>9.5/30</td>
<td>163.0</td>
<td>1.1</td>
</tr>
<tr>
<td>Spencer Creek</td>
<td>0.5</td>
<td>E4</td>
<td>10.6</td>
<td>8.7</td>
<td>1.2</td>
<td>0.0132</td>
<td>8.6/77</td>
<td>228.5</td>
<td>1.1</td>
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<tr>
<td>Mill Creek</td>
<td>4.7</td>
<td>E4</td>
<td>46.7</td>
<td>24.5</td>
<td>1.9</td>
<td>0.0080</td>
<td>40/110</td>
<td>415.0</td>
<td>1.7</td>
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</tbody>
</table>

ACKNOWLEDGMENTS (1st level heading)

The following individuals provided technical support for this study: Angela Jessup, Dick Everhart, Jean Spooner, Carolyn Mojonnier, Rachel Smith, and Neil Woerner. I would also like to express my appreciation to those who reviewed this paper for AWRA.

REFERENCES (1st level heading)


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