Fluvial Terms & Tools

Bret A. Robinson, Ph.D.
Hydrologist/Geomorphologist
U.S. Geological Survey

in cooperation with
Indiana Office of Community and Rural Affairs

Photo: Terri Cooper, USGS
Fluvial Terms & Tools

1. Stream channels
   - Non-alluvial
   - Alluvial
   - Semi-alluvial

2. Equilibrium condition

3. Bankfull-channel
   - Discharge
   - Stage
   - Bankfull-channel width***

4. Physiographic regions of Indiana

5. Regional channel-dimension curves (Ind.)

6. StreamStats
   - Drainage areas
   - Bankfull channel-dimensions

Terms

Tools
1. **Alluvium:**

Sediment deposits resulting from the operations of modern rivers and streams
1. **Stream channels**: Non-alluvial

- **Static channel-boundary**

- **Man-made examples**
  (drainage way)
Stream channels: Non-alluvial

Big Oaks National Wildlife Refuge
Stream channels: Non-alluvial
Stream channels: Alluvial

Competent to erode, deposit, and form its boundary
Stream channels: Semi-alluvial

Only a portion of boundary (bed or banks) is alluvium
2. Equilibrium

A condition where channel form and slope are mutually adjusted to transport the water and sediment produced by the contributing watershed.

Bloody Run at Pigeon River FWA, Mongo, Ind.
Equilibrium condition

Little Elkhart Creek at Wolcottville, Ind.
Equilibrium condition...expected sinuosity

White River, southwestern Ind.
3. Bankfull channel...discharge

Pleasant Run Creek at Greenwood, Ind.
Bankfull discharge

Pleasant Run Creek at Greenwood, Ind.
Bankfull stage

Henderson Creek near Gnaw Bone, Ind.
Bankfull stage

Hoosier National Forest
Bankfull-channel width  ***...foundation of FEH mapping***

Anderson River, Hoosier NF

[Image of a stream with rocks and trees in the background]

[USGS logo]
Bankfull-Channel Width?

Little Elkhart Creek at Wolcottville, Ind.
Bankfull-Channel Width?

Unnamed tributary to Bear Creek, Yellowwood SF
Bankfull-channel width?

Rush Creek in Harmony SP, Ind.

Regional Curves!
4. Physiographic divisions of Indiana

Henry Gray, 2000
Channels show contrasting physical characteristics...

North, Central, and South
Regional Bankfull-Channel Dimensions of Non-Urban Wadeable Streams in Indiana

By Bret A. Robinson

Scientific Investigations Report 2013—5078

U.S. Department of the Interior
U.S. Geological Survey

To view this report, visit: http://pubs.usgs.gov/sir/2013/5078/
Stratified sampling within Gray’s physiographic regions of Indiana

- North  (25 sites)
- Central  (31 sites)
- South  (26 sites)
• North
• Central
• South
Table 5. Regression equations for estimating bankfull-channel dimensions of non-urban wadeable streams in Indiana.

[WBF, bankfull width, in feet; DBF, mean bankfull depth, in feet; ABF, bankfull cross-sectional area, in square feet; DA, drainage area, in square miles]

<table>
<thead>
<tr>
<th>Equation number</th>
<th>Equation</th>
<th>Coefficient of determination (r-squared)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Northern Moraine and Lake region</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>$WBF_n = 13.4 \ DA^{0.318}$</td>
<td>0.92</td>
</tr>
<tr>
<td>2</td>
<td>$DBF_n = 1.3 \ DA^{0.176}$</td>
<td>0.75</td>
</tr>
<tr>
<td>3</td>
<td>$ABF_n = 17.0 \ DA^{0.495}$</td>
<td>0.92</td>
</tr>
<tr>
<td></td>
<td>Central Till Plain region</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>$WBF_c = 18.2 \ DA^{0.327}$</td>
<td>0.94</td>
</tr>
<tr>
<td>5</td>
<td>$DBF_c = 1.6 \ DA^{0.159}$</td>
<td>0.56</td>
</tr>
<tr>
<td>6</td>
<td>$ABF_c = 28.8 \ DA^{0.487}$</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>Southern Hills and Lowlands region</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>$WBF_s = 27.2 \ DA^{0.286}$</td>
<td>0.94</td>
</tr>
<tr>
<td>8</td>
<td>$DBF_s = 1.9 \ DA^{0.183}$</td>
<td>0.58</td>
</tr>
<tr>
<td>9</td>
<td>$ABF_s = 50.9 \ DA^{0.468}$</td>
<td>0.87</td>
</tr>
</tbody>
</table>
6. **StreamStats** (...for drainage area & bankfull-channel dimensions)

...zoom in (+) to area of interest.
...then dot tool (●) to delineate the basin
Basin outline ...table tool to select parameters
<table>
<thead>
<tr>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel 10-85 slope in feet per mile</td>
</tr>
<tr>
<td>Contributing drainage area in square miles.</td>
</tr>
<tr>
<td>Region number</td>
</tr>
<tr>
<td>Percent of area covered by water and wetland</td>
</tr>
<tr>
<td>Total drainage area in square miles</td>
</tr>
<tr>
<td>Percent of area covered by urban land cover</td>
</tr>
</tbody>
</table>
Basin Characteristics Report

Date: Tue Oct 29 2013 07:33:27 Mountain Daylight Time
NAD27 Latitude: 39.0782 (39 04 42)
NAD27 Longitude: -85.6099 (-85 36 36)
NAD83 Latitude: 39.0783 (39 04 42)
NAD83 Longitude: -85.6099 (-85 36 35)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total drainage area in square miles</td>
<td>143.090</td>
</tr>
<tr>
<td>Percent of area covered by urban land cover</td>
<td>2.34</td>
</tr>
</tbody>
</table>
The StreamStats Program

Indiana

StreamStats for Indiana incorporates regression equations for estimating peak-flow frequency statistics at the 10-, 25-, 50-, 100-, 200-, and 500-year recurrence intervals for unregulated streams throughout Indiana, and equations for estimating bankfull-channel dimensions of width, mean depth, and cross-sectional area for non-urban washable streams in the three largest physiographic regions of Indiana. These equations are implemented by use of two separate interactive map applications, one which provides the peak-flow estimates, and the other which provides the channel-dimension estimates. The separate applications were necessary because flood-frequency estimates for many stream reaches in Indiana have been coordinated by the Indiana Department of Natural Resources, the Natural Resources Conservation Service, the U.S. Army Corps of Engineers, and the USGS. That is, these agencies have agreed on flood-frequency values for selected stream reaches for use in water-resources investigations and planning activities. Custom programming that was required to deliver the coordinated flood-frequency values predates delivery of channel-dimension peak-flow statistics in the same output. Links to the separate applications are provided below. Users of the interactive map for estimating peak-flow statistics who select points along the coordinated stream reaches will be provided with the coordinated discharges instead of flow estimates obtained from regression equations. More information about coordinated discharges can be found here.

Interactive Map for Estimating Peak-Flow Statistics

Interactive Map for Estimating Bankfull-Channel Dimensions

Note that regression equations are developed using streamflow statistics and basin characteristics for USGS-operated streamgages. The equations are applicable with known accuracy when they are applied at locations with basin characteristics that are within the ranges of the basin characteristics for the streamgages used to develop the equations. Estimates for user-selected sites with basin characteristics that are outside of those for the streamgages used to develop the equations are extrapolated. These extrapolated estimates should be used with caution, as their associated errors are unknown and may be large. StreamStats outputs provide the ranges of applicability for each basin characteristic that is used as an explanatory variable in the regression equations, and warnings when those ranges are exceeded.

General information on the Interactive Map applications, as well as specific sources and computation methods for basin characteristics are available here.

Peak-flow equations

The report below documents the peak-flow regression equations, the methods used to develop the equations and to measure the basin characteristics used in the equations, references to GIS data layers used in the analysis, and the errors associated with the estimates obtained from the equations. Users should familiarize themselves with these reports before using StreamStats to obtain estimates of streamflow statistics for ungauged sites.


Stream slope is used as an explanatory variable in the peak-flow regression equations for all hydrologic regions of Indiana except for region 8. The method used by StreamStats to compute stream slope is somewhat different than the method used to develop the dataset used by Rao (2005) for his regression analysis. The average difference between the StreamStats values of stream slope and the values used by Rao is about 4 percent. Thus differences for some individual stations exceed 100 percent.
Estimated bankfull-channel dimensions

...click on $Q^{\text{hat}}$
Table of estimated bankfull-channel dimensions

<table>
<thead>
<tr>
<th>Bankfull Stream Channel Dimensions- AREA in sq. ft DPTH and WDTH In ft - Basin Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bankfull Region number=1567</td>
</tr>
<tr>
<td>100% Bankfull South Hills and Lowlands Region 2013 5078 (143 mi²)</td>
</tr>
<tr>
<td>Parameter</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Drainage Area (square miles)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bankfull Stream Channel Dimensions- AREA in sq. ft DPTH and WDTH in ft - Streamflow Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistic</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>BFAREA</td>
</tr>
<tr>
<td>BFDEPTH</td>
</tr>
<tr>
<td>BFWIDTH</td>
</tr>
</tbody>
</table>

http://water.usgs.gov/osw/streamstats
- North
- Central
- South

186 mi²

0.06 mi²
### Table of estimated bankfull-channel dimensions

#### Streamstats Ungaged Site Report

Date: Tue Oct 29 2013 08:35:34 Mountain Daylight Time  
Site Location: Indiana  
NAD27 Latitude: 39.0782 (30 04 42)  
NAD27 Longitude: -85.6098 (-85 36 35)  
NAD83 Latitude: 39.0783 (30 04 42)  
NAD83 Longitude: -85.6097 (-85 36 35)  
Drainage Area: 143.089 mi²

<table>
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<th>Bankfull Stream Channel Dimensions - AREA in sq. ft DPTH and WDTH in ft</th>
<th>Basin Characteristics</th>
</tr>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Regression Equation Valid Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drainage Area (square miles)</td>
<td></td>
<td>Min 0.05 Max 106</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bankfull Stream Channel Dimensions - AREA in sq. ft DPTH and WDTH in ft</th>
<th>Streamflow Statistics</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Flow (ft³/s)</th>
<th>Estimation Error (percent)</th>
<th>Equivalent years of record</th>
<th>90-Percent Prediction Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>BFAREA</td>
<td>519</td>
<td></td>
<td>4½</td>
<td></td>
</tr>
<tr>
<td>BFDPHT</td>
<td>4.71</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>BFWDTH</td>
<td>112</td>
<td></td>
<td>15</td>
<td></td>
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Questions?