Bankfull-Channel Dimensions and Channel-Migration Rates of Indiana Streams

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In cooperation with
Indiana Office of Community and Rural Affairs
Outline of Slides

Introduction to Fluvial Erosion Hazards (FEH)

- Lateral channel migration images
- Lateral channel migration impacts
- Indiana’s FEH program

Two USGS tools for Indiana streams

- Regional bankfull-channel dimensions
- Channel-migration rates
Whitewater River near Metamora, Ind.

Lateral channel-migration
Lateral channel migration — Continued

Eel River near Clay City, Ind.
Lateral channel migration — Continued

LiDArt

created by
Matt Johnson
Indiana Geological Survey
Ag-land Loss

East Fork White River near Brownstown, Ind.

FEH Impacts

Little Raccoon Creek near Ladoga, Ind.
Residential Property Loss

Honey Creek at Smith Valley, Ind.
Threats to infrastructure
Migrated 390 ft in 7 years
Bridge Failures
(Rare)

Troy Ave at Buck Creek, 1991

Indianapolis, Ind.

Keystone Ave at Haverstick Creek, 2011
Indiana’s FEH Program

Indiana Silver Jackets

Program direction discussions

FEH Study Team

Indiana Univ. / Purdue Univ. at Indianapolis (IUPUI)
- Center for Earth and Environmental Science
  - Education / Outreach
- The Polis Center
  - FEH Mapping

U.S. Geological Survey
- Science Tools
  - Bridge Screening
  - Bank assessments
  - StreamStats updates
  - Bankfull Indicators
  - Bankfull dimensions
  - Migration rates
Two U.S. Geological Survey reports

**Scientific Investigations Report 2013-5078**
Regional bankfull-channel dimensions of Indiana streams

**Scientific Investigations Report 2013-5168**
Channel-migration rates of selected Indiana streams
Channel Dimensions = $f(Drainage\ area)$
82 Data-collection sites
Bankfull Width

Mean Depth

Cross-sectional area
RC-314 Unnamed tributary to Anderson River
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>
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</thead>
<tbody>
<tr>
<td><strong>Northern Moraine and Lake region</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>$WBF_n = 13.4 \text{ DA}^{0.318}$</td>
<td>0.92</td>
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<tr>
<td>2</td>
<td>$DBF_n = 1.3 \text{ DA}^{0.176}$</td>
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<td>3</td>
<td>$ABF_n = 17.0 \text{ DA}^{0.495}$</td>
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<tr>
<td><strong>Central Till Plain region</strong></td>
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<tr>
<td>4</td>
<td>$WBF_c = 18.2 \text{ DA}^{0.327}$</td>
<td>0.94</td>
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<tr>
<td>5</td>
<td>$DBF_c = 1.6 \text{ DA}^{0.159}$</td>
<td>0.56</td>
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<tr>
<td>6</td>
<td>$ABF_c = 28.8 \text{ DA}^{0.487}$</td>
<td>0.88</td>
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<tr>
<td><strong>Southern Hills and Lowlands region</strong></td>
<td></td>
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<tr>
<td>7</td>
<td>$WBF_s = 27.2 \text{ DA}^{0.286}$</td>
<td>0.94</td>
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<tr>
<td>8</td>
<td>$DBF_s = 1.9 \text{ DA}^{0.183}$</td>
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<tr>
<td>9</td>
<td>$ABF_s = 50.9 \text{ DA}^{0.468}$</td>
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Regional Bankfull-Channel Dimensions of Non-Urban Wadeable Streams in Indiana

By Bret A. Robinson


Scientific Investigations Report 2013—5078

To view this report, visit: http://pubs.usgs.gov/sir/2013/5078/
Indiana Streams...

**Actively Migrating....**
- Raw and failing cutbanks
- Non-vegetated point bars

**Recently Stationary....**
- Both banks stable
- With mature trees
Channel-migration rates?
Coal Creek
from Mouth to Veedersburg

Coal-1
Coal-2
Coal-3
Coal-20
At each selected meander.....

White Lick Creek at Mooresville, Ind.  (WHITELICK—17)

Historical imagery: 1998 to 2012

April, 1998
Aug, 2012

\[
12 \left( \frac{865 \text{ ft} - 620 \text{ ft}}{172 \text{ months}} \right) = 17 \text{ ft/yr}
\]

(...over the past 14 yrs)
Some meanders are relatively stationary...

Tippecanoe River (TIPPY-2)

Rate <1 ft/yr

March, 1992
Feb, 2012
(...20 yrs)
Within Indiana

Investigating 38 largest streams

970 meanders measured
Summary Statistics

- 65% of measured sites are stationary
- 85% of measured sites migrating <10 ft/yr
- 3% of measured sites migrating >20 ft/yr
Determine 75th Percentile

<table>
<thead>
<tr>
<th>Site</th>
<th>Rate (ft/yr)</th>
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<tbody>
<tr>
<td>COAL-7</td>
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<tr>
<td>COAL-16</td>
<td>&lt;1.0</td>
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</tbody>
</table>

(25% are greater than...)

Coal Creek = 4.6 ft/yr

75% are less than...
Distribution of stationary and actively-migrating streams
Recent (circa 1998 to 2011) Channel-Migration Rates of Selected Streams in Indiana

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Scientific Investigations Report 2013—5168

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

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FEH Program in Indiana

Science Tools (2/6)
- Channel-dimension curves
- Channel-migration rates

FEH Avoidance Mapping

Presentations & Workshops

USGS
The Polis Center
Center for Earth and Environmental Science
Questions?

• Indiana’s FEH Program
• Regional Bankfull-Channel Dimensions
• Recent Channel-Migration Rates