Evaluation of Saturated Hydraulic Conductivity in Southern Piedmont Landscapes

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Southern Piedmont Soils

Clay, %

Depth, cm
$K_s$ Estimates

![Diagram showing clay content and permeability estimates.](https://example.com/diagram)

- **Clay, %**
  - 0
  - 10
  - 20
  - 30
  - 40
  - 50
  - 60

- **Depth, cm**
  - 0
  - 10
  - 20
  - 30
  - 40
  - 50
  - 60
  - 70
  - 80
  - 90
  - 100
  - 110
  - 120
  - 130
  - 140
  - 150
  - 160
  - 170
  - 180
  - 190

- **Permeability Estimates**
  - low: 77 cm/d
  - moderate: 77 cm/d
  - moderate/high: 77 cm/d

The diagram illustrates the relationship between clay content and depth, indicating permeability estimates.
## Water Movement Rate in Piedmont Soils

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Depth (ft)</th>
<th>Structure</th>
<th>Texture</th>
<th>$K_s$ (cm/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bt</td>
<td>2</td>
<td>Strong</td>
<td>Clay</td>
<td>8</td>
</tr>
<tr>
<td>BC</td>
<td>5</td>
<td>Weak</td>
<td>Sandy clay loam</td>
<td>3</td>
</tr>
<tr>
<td>C</td>
<td>13</td>
<td>Massive</td>
<td>Sandy loam</td>
<td>6</td>
</tr>
</tbody>
</table>
Objectives

- Evaluate $K_s$ for major horizons in soils on Piedmont landscapes
- Evaluate landscape effects on $K_s$
- Suggest morphological/landscape features that indicate exception to trend in data
Methods

- $K_s$ measured in field with constant head permeameter
  - 10 hillslopes
  - 3 transects per hillslope
  - Summit or upper backslope to footslope
  - 7 equally spaced measurement sites per transect
  - 21 locations/hillslope
  - 3 depths - upper Bt, mid to lower Bt, and lower Bt, BC, or C (140 cm)

- Soil described from bucket auger
  - NRCS soil scientists
Hillslope Locations

- Blue Ridge Mountains
- Ridge and Valley
- Piedmont
- Sand Hills
- Coastal Plain
- Atlantic Coast Flatwoods
- Site 1
- Site 2
- Site 3
- Site 4
- Site 5
- Site 6
- Site 7
- Site 8
- Site 9
- Site 10

Distance: 100 km
Methods 2

► 3 pedons described and sampled from pit
  ▪ Range in $K_s$ and landscape position

► Laboratory characterization
  ▪ PSD, bulk density, CEC, porosity
Results
Mean $K_s$ by Site (all depths)
Mean $K_s$ with Depth (all sites)

- Upper
- Middle Depth
- Lower

Mean $K_s$, cm/d
Mean $K_s$ with Depth by Site

- Upper depth (Bt1)
- Middle depth
- Lowest depth (140 cm)
Why?
$K_s$ and Clay

$K_s$, cm/d

Clay, %
Structure?

► Bt1 horizons – moderate (strong) subangular blocky
  - Tendency for low $K_s$ if firm consistence
► Bt2 and Bt3 horizons – moderate subangular blocky
  - Very weak platy?
► BC horizons – weak subangular blocky structure (mostly)
► Horizons with highest $K_s$
  - Bt horizons in more deeply weathered soils
    - 10R hue
  - Sandy loam C horizons
Summary of Field Results

- Upper depth (Bt1 horizon) had highest $K_s$ at 7 of 10 sites
  - 2 sites had uniformly low $K_s$ in all horizons
- Mid and lower depths generally had similar $K_s$
- No difference in $K_s$ with hillslope position
Bt1 horizon $K_s \geq$ subjacent horizons
No difference in $K_s$ with hillslope position
Clay and bulk density ineffective in explaining $K_s$ variation
Structure and/or consistence influencing $K_s$ but not reliable predictors
Bioturbation of upper Bt?
  - Relatively old landscapes
  - Observed in similar soils
## Comparison with $K_s$ Estimates for Piedmont Soils

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Tabular Data</th>
<th>Measured</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$K_s$ (cm/d)</td>
<td></td>
</tr>
<tr>
<td>Bt1</td>
<td>77</td>
<td>7.2</td>
</tr>
<tr>
<td>Bt2, Bt3</td>
<td>77</td>
<td>1.7</td>
</tr>
<tr>
<td>BC</td>
<td>77</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Tabular data from WSS
$\geq 35$ percent clay, soft, slightly hard, very friable or friable, no stress surfaces or slickensides and the clay is subactive after subtracting the quantity $(2 \times (OC \times 1.7)) - 1 - 10 \, \mu m/s \ (8.6 - 86 \, cm/d)$
Is one system applicable to estimate $K_s$ for all soils?

- Probably not
- Local estimates can be incorporated into the database
- With limited data, is this a viable option?
Is There an Alternative?

► 144 MLRA Soil Survey Offices
  - Intelligent, energetic, and interested staff
► Field evaluation of $K_s$ for 1 pedon per month (12 days/year)
  - 1,600+ evaluations per year
  - 8,000 evaluations after 5 years
    - 5 reps per series/map unit = reliable data for 1,500+ series
► Data to populate database
► Data to test/develop pedotransfer functions
► Good use of time?