Today’s topics
• Erosion

Announcements
• Test #1 next Mon (10/13)
• Assignment: Read pp. 177 - 204
• HW#10 due today
• Lab on Thur (10/9) in 214 Scoates
  • Don’t come to the AEPM classroom!
Test #1

- Closed notes / closed book
  - 13 questions so far

- Equation formulas will be given

- Scantron test
  - Scantron sheets will be provided

- Material to be covered
  - Lecture material up to 10/6/14
  - HW#1 – 9
  - Labs 1 - 3
  - Assigned textbook readings
    - Chapters 1, 2 and 5
Soil Erosion and Control Practices

- Soil erosion
  - Major source of pollution in rivers/streams and reservoirs.
  - Source of nonpoint pollution (nutrients, pesticides, bacteria)
  - Reduces soil productivity

- Two Major Types
  - Geologic (Grand Canyon, Niagara Falls)
  - Erosion from human or animal activities
    - Tillage
    - Mining
    - Deforestation
    - Grazing
Factors Affecting Erosion

- **Climate**
  - Temperature, humidity, solar radiation, wind and precipitation

- **Soil**
  - Texture, soil structure, organic matter, water content, density and chemical and biological characteristics

- **Topography**
  - Slope steepness, length and shape
Factors Effecting Soil Erosion

• Vegetation
  1. Protects from raindrop impact
  2. Reduces runoff velocity
  3. Holds soil in place
  4. Improves soil structure
  5. Increases transpiration rates
Types of Erosion

• **Inter-rill**
  – Dominant in shorter, flatter conditions.

• **Rill**
  – Dominant on longer and steeper slopes

• **Gully**

• **Stream Channel**
Inter-rill Erosion

- Area between the rills
- Raindrop Splash
  - Impact of raindrop on soil surface
  - Can be 50 to 90% greater than runoff losses
  - Reduced by crop residue or growing plants
- Shallow Overland flow
  - Sheet flow overland
  - Mainly transport of sediment first detached by raindrops.
- Function of
  - Soil properties
  - Rainfall intensity
  - Slope
  - Runoff rate
Rill Erosion

- Occurs in upland areas near watershed divide
- Detachment and transport of soils by concentrated flow
- Rills are shallow enough to be removed by tillage.
- New rill not in same location
- Depends on:
  - Runoff rate
    - Rainfall intensity
    - Soil infiltration rates
    - Length of Slope.
Gully Erosion

- Down slope away from watershed divide
- Land micro-relief control ceases
- Land macro-relief starts to control erosion
- Produces channels larger than rills.
  - Cannot be removed by tillage.
- Carry water during and immediately following rains.
- Rate depends on:
  - Drainage area
  - Soil characteristics
  - Alignment, size and shape of the gully
  - Slope in the channel.
Stream Channel Erosion

- Channels occur farther down slope
  - Characterized by stable banks
  - Permanent land feature

- Soil removal from stream banks or soil movements in the channel.
  - **Stream bank erosion**
    - Eroded by runoff flowing over the stream bank, scouring and undercutting below the water surface and mass wasting of the banks.
  - **Scour erosion**
    - Influenced by velocity, direction of flow, depth and width of channel and soil texture.
  - Both types influenced by channel alignment.
Deposition

- Can happen anywhere downslope when:
  - Surface runoff transport capacity < soil available for transport
  - Direct function of flow velocity
    - reduce velocity, increase deposition
    - vegetative filters / terrace channels / ponds
USLE

- Describes erosion as a function of:
  - rainfall energy and intensity
  - soil erodibility
  - slope length and steepness
  - soil cover
  - conservation practices
  - based on 10,000 plot years of data

- Revised USLE => RUSLE
  - computerized version w/ new parameters
    - revised slope and slope length factors
    - new data to define cover and management
    - freeze - thaw effects / new rill factors
Class Wrap-up

- Test #1 next Mon (10/13)
- Lab on Thur (10/9) in 214 Scoates
- Next → Test 1 review
Test 1 Review

Figure 1.1 Land use impacts on runoff and erosion.
Figure 2.17. Rainfall rate-duration-frequency distribution for St. Louis, Missouri (Hershfield, 1961 and Weiss, 1962).
Storm Hydrograph
(Surface runoff only / base flow removed)

Discharge (Q) in cfs

Time (T) in Hr

200

1

4
<table>
<thead>
<tr>
<th>Land Use Description</th>
<th>Hydrologic Soil Group</th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Commercial, row houses and townhouses</td>
<td>A 80</td>
<td>B 85</td>
<td>C 90</td>
<td>D 95</td>
</tr>
<tr>
<td>Fallow, poor condition</td>
<td>A 77</td>
<td>B 86</td>
<td>C 91</td>
<td>D 94</td>
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<tr>
<td>Cultivated with conventional tillage</td>
<td>A 72</td>
<td>B 81</td>
<td>C 88</td>
<td>D 91</td>
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<tr>
<td>Cultivated with conservation tillage</td>
<td>A 62</td>
<td>B 71</td>
<td>C 78</td>
<td>D 81</td>
</tr>
<tr>
<td>Lawns, poor condition</td>
<td>A 58</td>
<td>B 74</td>
<td>C 82</td>
<td>D 86</td>
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<tr>
<td>Lawns, good condition</td>
<td>A 39</td>
<td>B 61</td>
<td>C 74</td>
<td>D 80</td>
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<tr>
<td>Pasture or range, poor condition</td>
<td>A 68</td>
<td>B 79</td>
<td>C 86</td>
<td>D 89</td>
</tr>
<tr>
<td>Pasture or range, good condition</td>
<td>A 39</td>
<td>B 61</td>
<td>C 74</td>
<td>D 80</td>
</tr>
<tr>
<td>Meadow</td>
<td>A 30</td>
<td>B 58</td>
<td>C 71</td>
<td>D 78</td>
</tr>
<tr>
<td>Pavement and roofs</td>
<td>A 100</td>
<td>B 100</td>
<td>C 100</td>
<td>D 100</td>
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<tr>
<td>Woods or forest thin stand, poor cover</td>
<td>A 45</td>
<td>B 66</td>
<td>C 77</td>
<td>D 83</td>
</tr>
<tr>
<td>Woods or forest, good cover</td>
<td>A 25</td>
<td>B 55</td>
<td>C 70</td>
<td>D 77</td>
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<td>Farmsteads</td>
<td>A 59</td>
<td>B 74</td>
<td>C 82</td>
<td>D 86</td>
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<tr>
<td>Residential 1/4 acre lot, poor condition</td>
<td>A 73</td>
<td>B 83</td>
<td>C 88</td>
<td>D 91</td>
</tr>
<tr>
<td>Residential 1/4 acre lot, good condition</td>
<td>A 61</td>
<td>B 75</td>
<td>C 83</td>
<td>D 87</td>
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<tr>
<td>Residential 1/2 acre lot, poor condition</td>
<td>A 67</td>
<td>B 80</td>
<td>C 86</td>
<td>D 89</td>
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<td>Residential 1/2 acre lot, good condition</td>
<td>A 53</td>
<td>B 70</td>
<td>C 80</td>
<td>D 85</td>
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<tr>
<td>Residential 2 acre lot, poor condition</td>
<td>A 63</td>
<td>B 77</td>
<td>C 84</td>
<td>D 87</td>
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<tr>
<td>Residential 2 acre lot, good condition</td>
<td>A 47</td>
<td>B 66</td>
<td>C 77</td>
<td>D 81</td>
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<tr>
<td>Roads</td>
<td>A 74</td>
<td>B 84</td>
<td>C 90</td>
<td>D 92</td>
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Table 5.3. Runoff coefficients, C, for use in the Rational Equation (Erie and Niagara Counties Regional Planning Board, 1981).

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Hydrologic Soil Group and Slope Range</th>
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<tbody>
<tr>
<td></td>
<td>0-2%</td>
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<tr>
<td>Industrial</td>
<td>0.67(^1)</td>
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<tr>
<td></td>
<td>0.85(^2)</td>
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<tr>
<td>Commercial</td>
<td>0.71</td>
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<td></td>
<td>0.88</td>
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<tr>
<td>High Density(^3)</td>
<td>0.47</td>
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<tr>
<td>Residential</td>
<td>0.58</td>
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<tr>
<td>Medium Density(^4)</td>
<td>0.25</td>
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<tr>
<td>Residential</td>
<td>0.33</td>
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<tr>
<td>Low Density(^5)</td>
<td>0.14</td>
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<tr>
<td>Residential</td>
<td>0.22</td>
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<tr>
<td>Agricultural</td>
<td>0.08</td>
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<tr>
<td></td>
<td>0.14</td>
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<tr>
<td>Open Space(^6) (Grass/Forest)</td>
<td>0.05</td>
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<tr>
<td></td>
<td>0.11</td>
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<tr>
<td>Freeways and</td>
<td>0.57</td>
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<tr>
<td>Expressways</td>
<td>0.70</td>
</tr>
</tbody>
</table>

1. Lower runoff coefficients for use with storm recurrence intervals less than 25 years.
2. Higher runoff coefficients for use with storm recurrence intervals of 25 years or more.
3. High density residential areas have more than 15 dwelling units per acre.
4. Medium density residential areas have 4 to 15 dwelling units per acre.
5. Low density residential areas have 1 to 4 dwelling units per acre.
6. For pastures and forests we recommend using the lower runoff coefficients which are listed for open spaces (our addition to original source).
Test 1 Review

- Possible test questions
  - How to calculate an area on the map using the map scale
  - How to calculate the average runoff using the Thiessen polygon method

- Good luck!