

Going with the Flow: Soil Erosion



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Outline

- Why more of you will become involved
- Basic idea
- Terminology--some of which is useful
- Scales--part of why this is hard
- RUSLE2--how various factors interact

Increasing Concern

- **590 Standard revision**

- a. Nutrients shall not be spread on ... (6) Fields exceeding *tolerable soil loss* (*T*). Erosion controls shall be implemented so that tolerable soil loss (*T*) over the crop rotation will not be exceeded on fields that receive nutrients.

- **NR151**

- **NR 151.02 Sheet, rill and wind erosion.** All land where crops or feed are grown shall be cropped to achieve a soil erosion rate equal to, or less than, the “tolerable” (*T*) rate established for that soil.

ATCP 50 - Soil and Water Resource Management Program

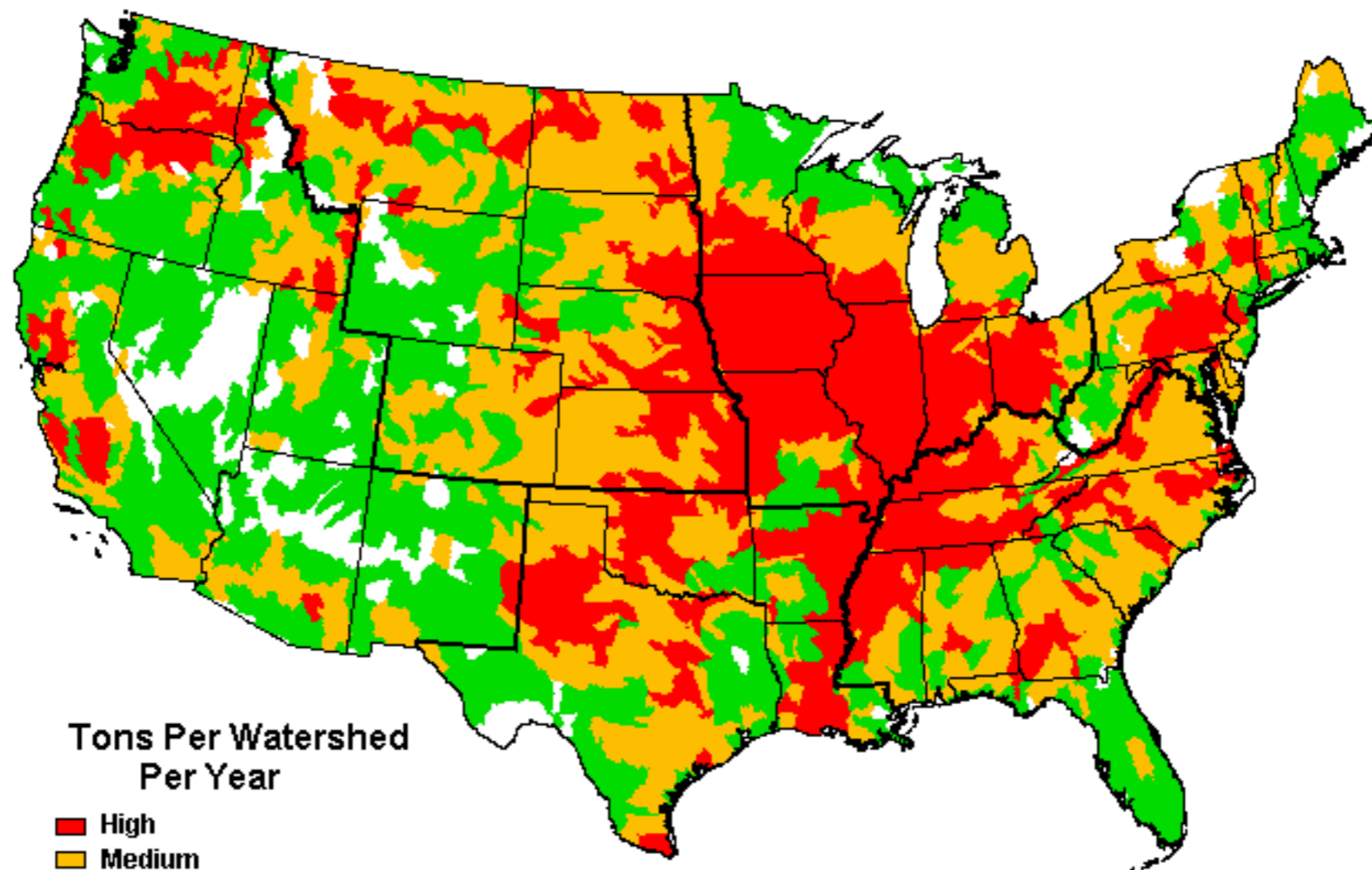
ATCP 50.04 Farm conservation practices. Except as provided in s. ATCP 50.08, a landowner engaged in agricultural practices in this state shall implement the following conservation practices:

(1) NONPOINT SOURCE POLLUTION CONTROL. A landowner shall implement conservation practices that achieve compliance with DNR performance standards under ss. NR 151.02 to 151.08.

(2) CROPLAND SOIL EROSION CONTROL. A landowner shall manage croplands and cropping practices so that soil erosion rates on cropped soils, determined according to RUSLE 2 equation, do not exceed *T* – value.

Note: See s. 92.025 (1), Stats., and s. NR 151.02. Soil erosion includes erosion caused by wind or water. For most soils, “*T* – value” is equivalent to 3 to 5 tons of soil loss per acre per year. The RUSLE 2 equation is published by NRCS, and is available from NRCS. Copies are on file with the department, the secretary of state and the revisor of statutes.

ATCP 50.16 Farmland preservation program; conservation standards. **(1) STANDARDS REQUIRED.** (a) A county land conservation committee shall adopt soil and water conservation standards, under s. 92.105, Stats., for all lands for which landowners claim farmland preservation tax credits under subch. IX of ch. 71, Stats. The standards shall incorporate and be consistent with the farm conservation practices required under s. ATCP 50.04.



**Tons Per Watershed
Per Year**

- High
- Medium
- Low
- Zero
- NRCs Region Boundaries



U.S. Department of Agriculture
Natural Resource Conservation Service
Resource Assessment and Strategic Planning
Washington D.C. June 1997



The Obvious...

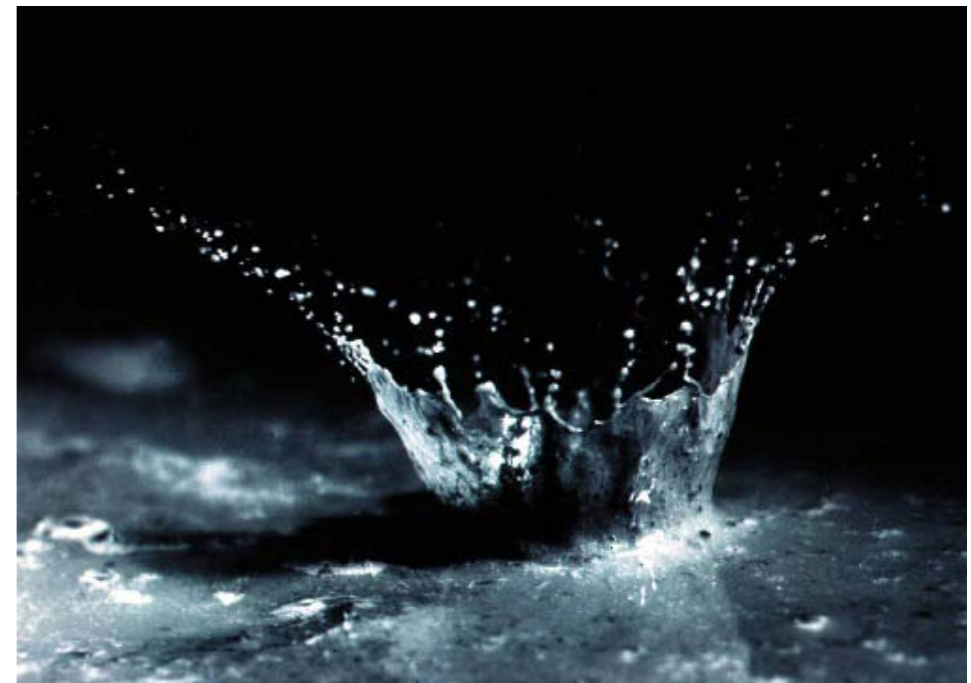
- Loose soil will wash away in heavy rains
- Flat soil doesn't wash far
- Plants protect soil
- Our fathers could have told us this...
- **BUT IT STILL HAPPENS TOO MUCH**

The basic idea...

- goal is get the water that doesn't infiltrate away without dragging soil along
- sometimes rain comes too fast, sometimes there is no more room in the soil
- sometimes both in same field and storm

Key Processes

- Detachment - separation of soil particles from soil body
- Entrainment - particles of size-density swept into moving water
- Transport - flowing water moves particles
- Deposition - particles settle out of flow, depending on size and density



Terminology



- sheet-rill: based on increasing severity idea
- “spatial context” terms:
 - interrill-rill-ephemeral gully-PIG-stream
 - interrill movement < 3 ft: looking for rills
 - rills: obliterated by normal tillage

Terminology

- **erosivity** of water in motion: measure of the forces applied to the soil that cause erosion
- **erodibility** of soil: measure of susceptibility of soil to erosive forces
- examples
 - no-till reduces both erosivity and erodibility
 - heavy rains have high erosivity

The 10-ton term: T

- T, the “soil loss tolerance”:
 - “denotes the maximum level of erosion that will permit a high level of crop productivity to be sustained economically and indefinitely”
(Wischmeier and Smith 1978)
- great, unless you are a fish

Scientific basis?

- 1956 workshop set up the idea of T
- considered: formation, soil depth, erosion impact on yields, ..., availability of alternative practices
- science, technology, economics...now unfortunately difficult to update T values

Scale

- scale refers relative size
- erosion tough problem partly because several scales important, and different things matter at each
 - raindrop/stalk remnant
 - slope segment, say 10-100s of feet
 - fields, with converging water flow
 - watershed and included water bodies



Predicting Erosion

- Tough & Public problem: means we need fair ways to assess for regulation and \$\$
- We can do some scales better than others
 - raindrop/stalk remnant & hillslope OK
 - tougher are fields, with converging water flow
 - ultimate challenge is watershed scale

Hillslope Scale



- most effort so far - captures smaller scales and some topography
- USLE--PSU and UW professors:
 - “excellent example of applied research”
 - “appalling example of oversimplification”
- RUSLE - like Bucky @ MSU - a no-show

RUSLE2



- Latest version of computer-based tools, still being developed
- Has capability for hillslopes with breaks/bends, which reduce soil loss
- Not for the faint of heart, but in WI we have...

SNAP Plus

The screenshot shows the SNAP Plus software interface. At the top, there are menu options: File, Edit, Tools, Reports, Options, Help. Below that, the 'Farm Name' is 'Joe's farm'. The 'Field Name' is '09'. The 'County' is 'W Lafayette', 'Acres' is '5.1', 'Slope' is '4', 'Soil Name' is 'TAMA', and 'Soil Symbol' is 'TAb2'. The 'Soil Test Date' is '8/30/2004'. The 'pH' is '6.8', 'OM %' is '3.0', 'P (ppm)' is '65', and 'K (ppm)' is '121'. The main table shows crop rotation and fertilizer recommendations for years 2004 through 2008. The crops are 'Alfalfa' for 2004-2005 and 'Corn grain' for 2006-2008. The fertilizer recommendations are shown in a table with columns for N, P205, and K20. The 'Annual Total P Index' is 1.7 for 2004-2005 and 2.4 for 2006-2008. Summary results for 2005-2011 show an average soil loss of 1.8 t/acre and an average P index of 3.9. Summary results for 2005-2008 show a balance of -109 b/acre for P205.

	2004			2005			2006			2007			2008		
Crop	Alfalfa			Alfalfa			Corn grain			Corn grain			Corn grain		
Yield Goal	4.5-5.5			4.5-5.5			4.5-5.5			170-190			170-190		
Tillage	None			None			None			Spring Chisel			Fall Chisel		
Soil Test Date	8/30/2004			8/30/2004			8/30/2004			8/30/2004			8/30/2004		
Recommendation	N P205 K20			N P205 K20			N P205 K20			N P205 K20			N P205 K20		
	0	0	125	0	0	125	0	0	125	160	0	20	160	0	20
Prior years legume credit	0			0			0			190			50		
Prior years manure credit	0			0			0			0			25		
Plan manure applications	0			0			0			74			101		
Plan fertilizer applications	0			0			0			9			9		
Total credits	0			0			0			273			104		
Adjusted nutrient need	0			0			0			-113			-24		
Annual Total P Index	1.7			1.7			1.7			2.8			2.4		

- You'll hear plenty about it this afternoon
- Inside it is much, but not all, of RUSLE2
- captures climate, soils, crop/residue, slope and slope length
- no slope bends or rotation hangovers

Soil Loss from S+

- Paul (S+ programmer) and I did over 700 combinations of slope, length, crop and yield, tillage type and direction
- now you get to sort out the lessons...

Sorting through the #s

- in groups of 2-4 (everyone must participate to receive CEUs-really, Kelling's orders)
- Your group will be assigned a set of factors:
 - tillage type and direction
 - crop type and yield
 - soil type
 - field slope and length

Group Reports

- how do your factors affect erosion?
- do the results match your experience?
- what's missing?
- is there too much erosion? if yes, why?

More Observations

- soil type
- field slope and length

Summary



- Erosion happens, and regulations are evolving
- Multiple spatial scales make it complex
- RUSLE2 model is emerging as standard
- Parts of RUSLE2 are in Snap Plus, new tool for nutrient planning