LINEAR CONSTRUCTION: Planning and Design of Erosion and Sediment Control

2015 NDWPCC Stormwater Workshop

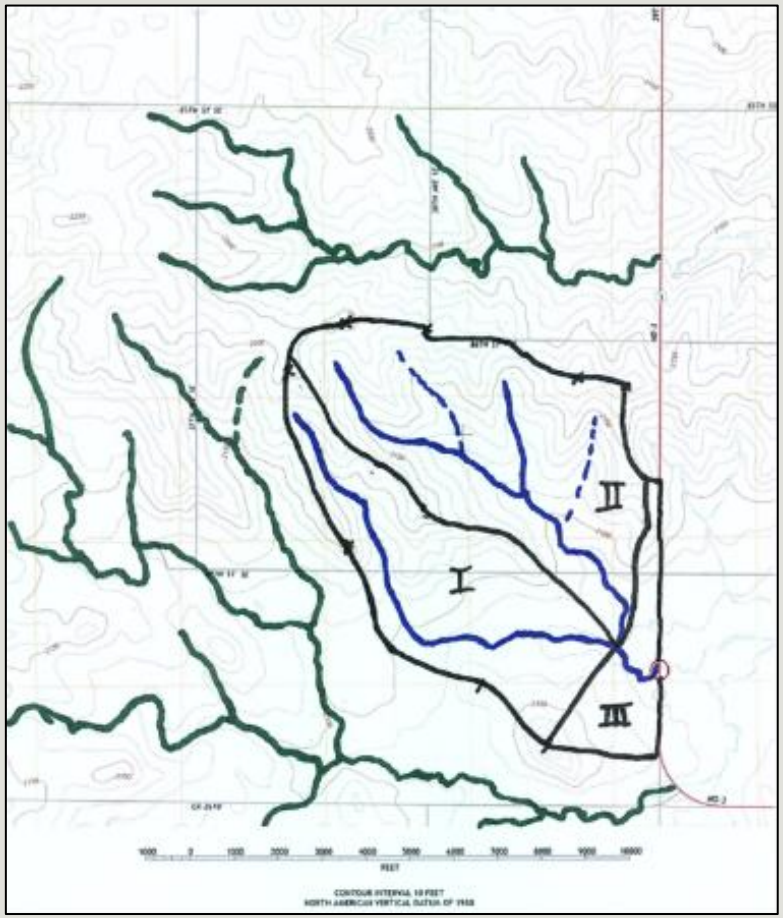
Matthew Stone, Ph.D.
North Dakota State University
Department of Construction Management and Engineering

Site planning

Planning and designing for erosion and sediment control

- Soil loss prediction
- Hydrologic analysis
- Critical areas

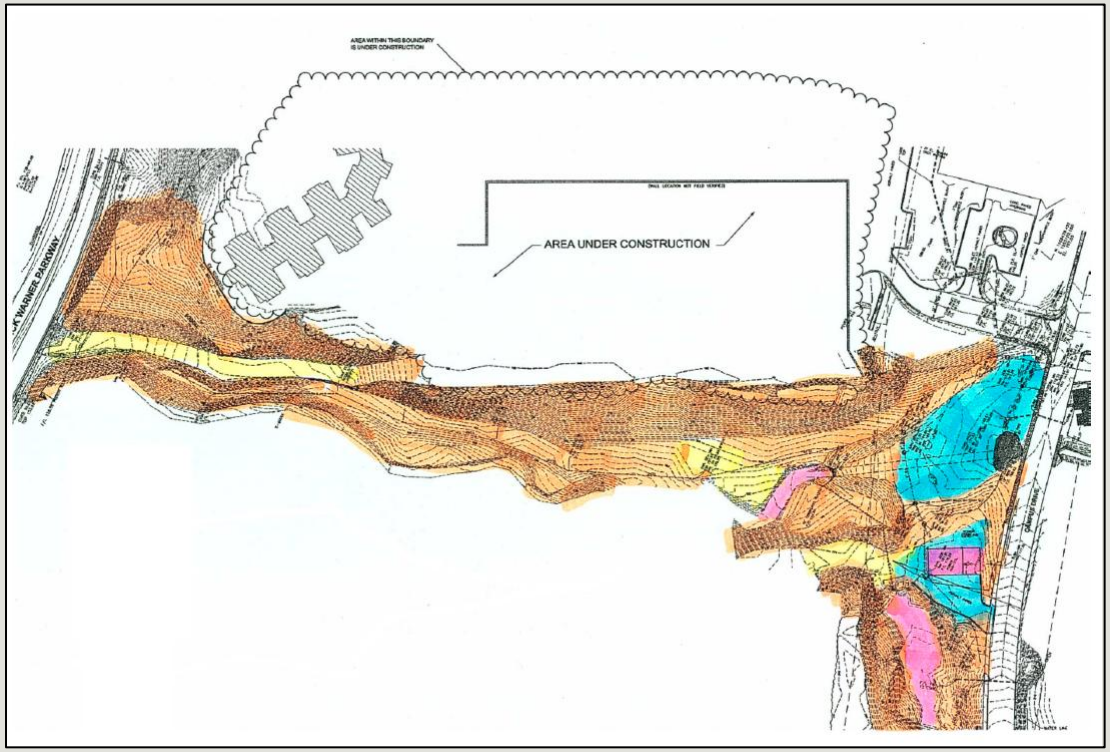
Site visits are important



Critical areas

Identify areas with higher erosion potential

- Slopes
- Soils
- Poor vegetation establishment



Phasing

Amount of disturbed and unprotected ground

- Weather and seasonal considerations

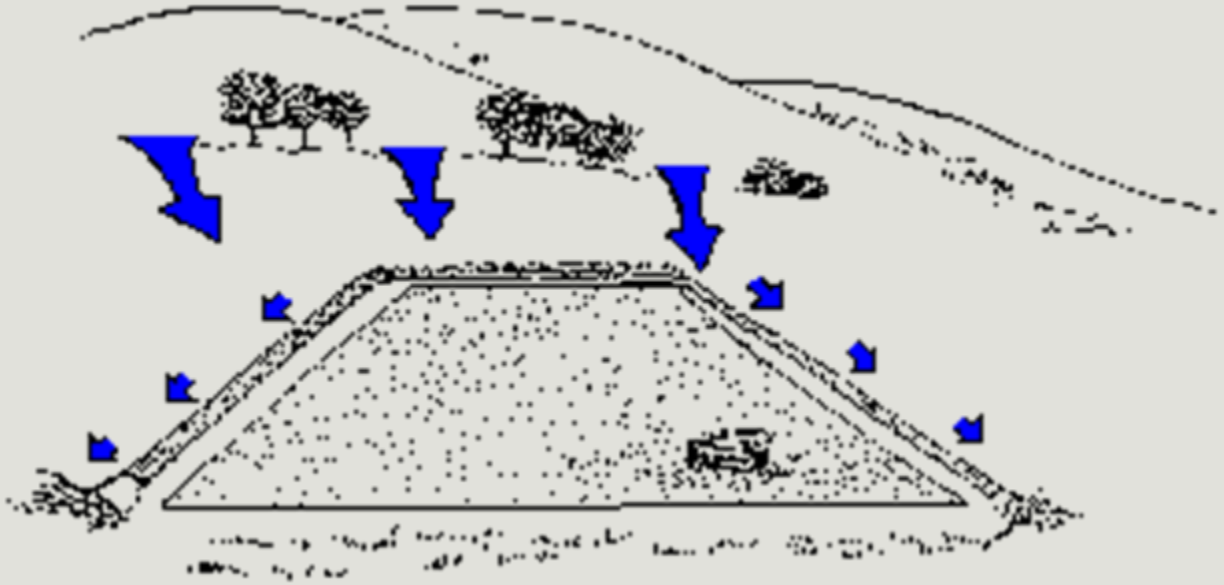
Natural topography

Fit to current topography as much as possible

- Minimize cut and fill

Control surface water

Interceptor ditches and berms



Retain natural vegetation

RUSLE & *RUSLE2*

Soil prediction models

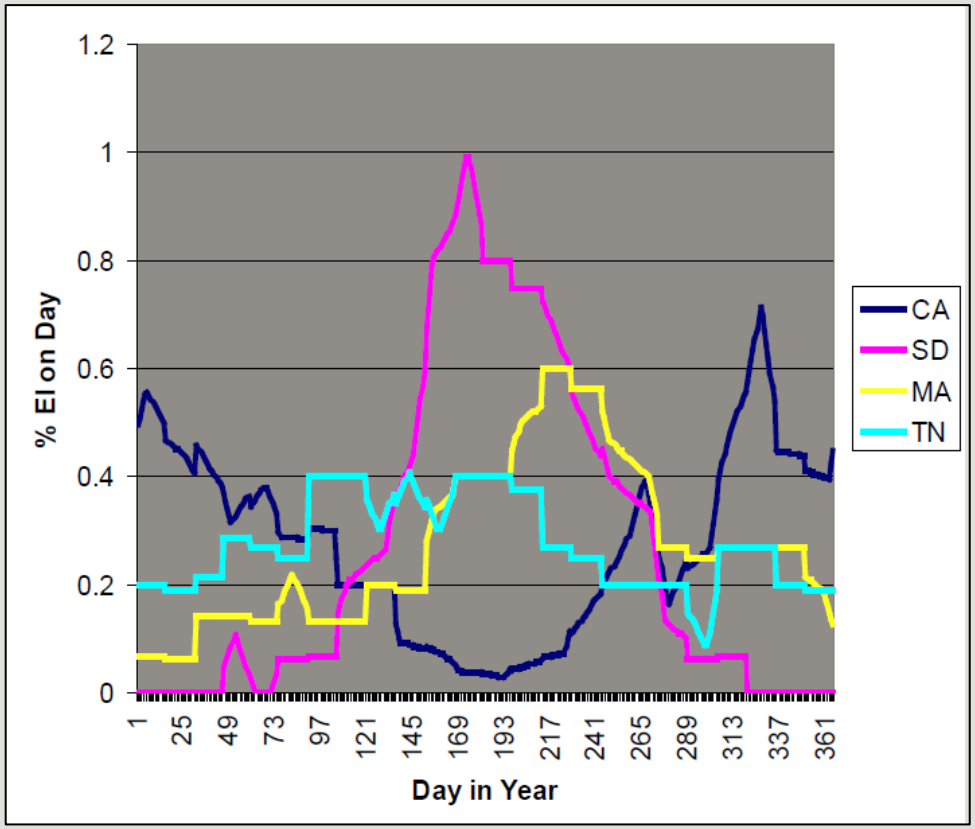
- *USLE* developed in 1965
- *RUSLE* improved several factor estimates
- Rill and interrill erosion

$$A = RKLSCP$$

RUSLE & RUSLE2

R factor: Rainfall-runoff erosivity

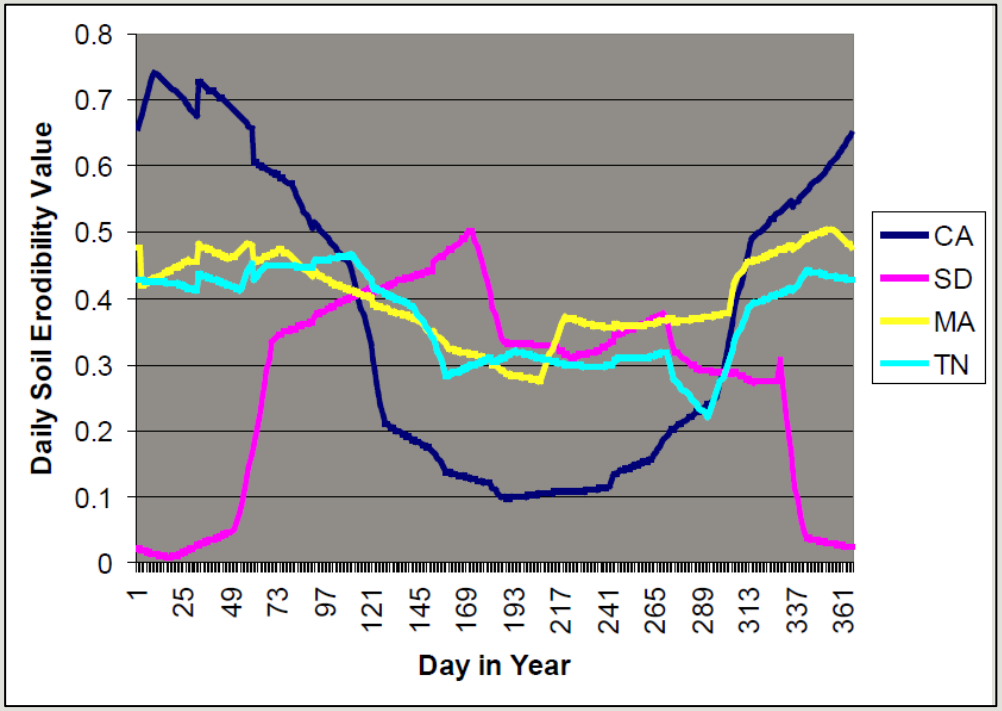
- Function of rainfall amount, intensity, and climate
- Splash erosion contributing factor
- Isoerodent maps



RUSLE & RUSLE2

K factor: Soil erodibility

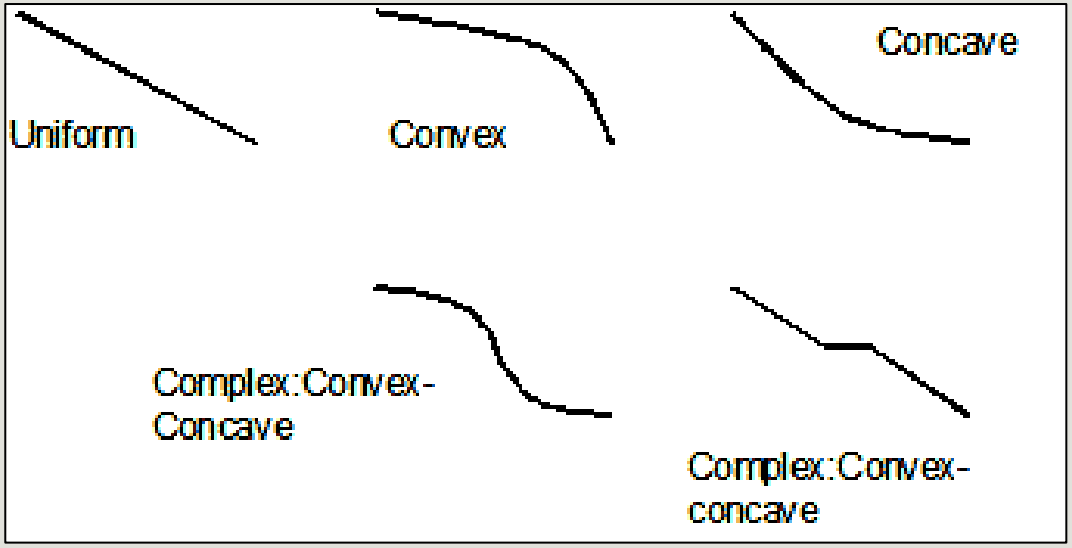
- Soil texture
- Structure
- Permeability



RUSLE & *RUSLE2*

LS factor: Length-slope factor

- Function of horizontal length of slope and percent slope
- Deposition area



RUSLE & RUSLE2

C factor: Cover management

- Multiple types of cover can be analyzed



RUSLE & *RUSLE2*

P factor: Practices

- Vegetated strips, silt fence, sediment basins

RUSLE & RUSLE2

Pre-construction vs. post-construction

Construction phase:

- Changes to topography
- Erosion on bare soil with no protection
- Erosion with combination of control measures

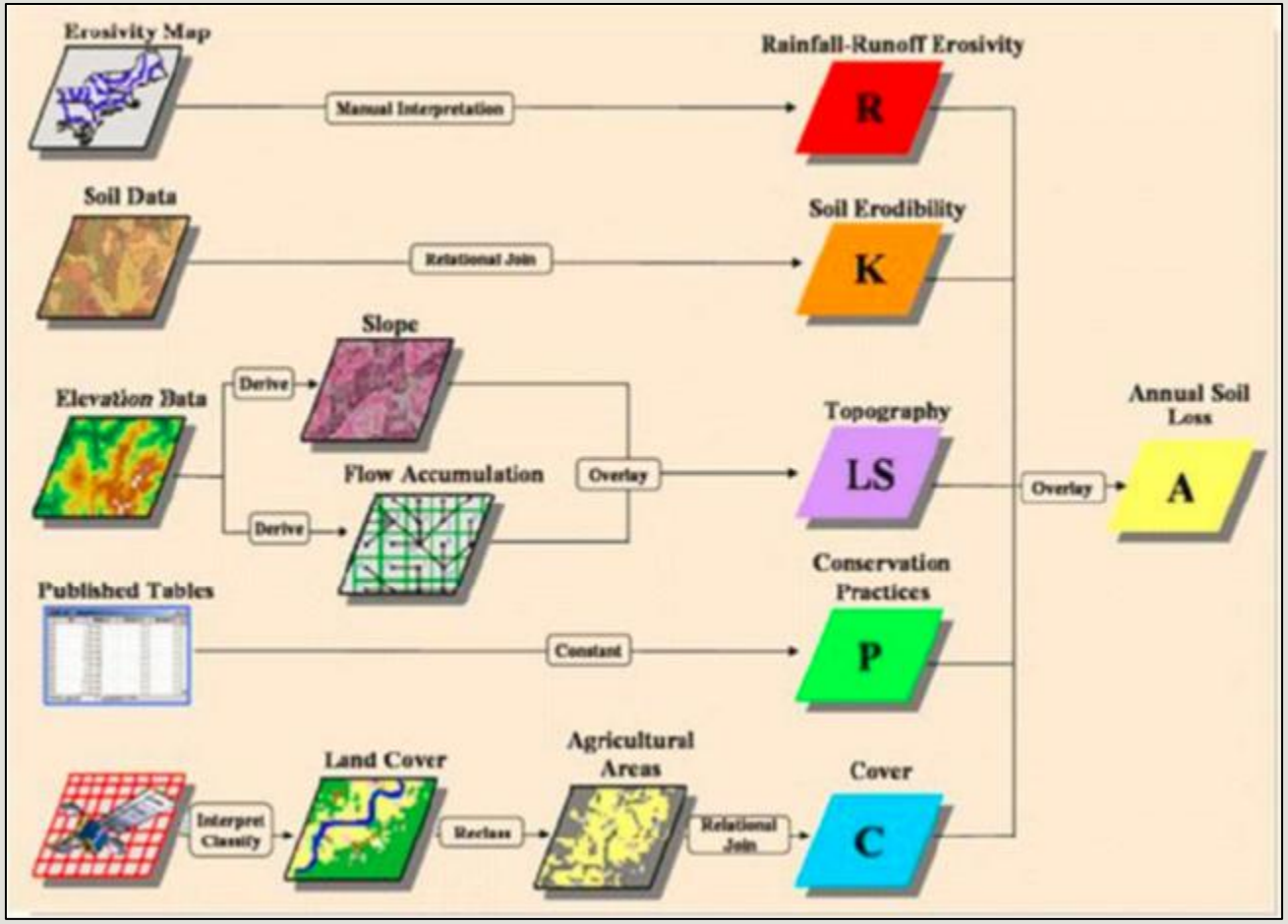
Initial Clearing and Grubbing

Site Area	Area Description	Land Area (acres)	*R* for Phase Period (May 1 to June 1)	Soil Factor, *K*	Length Slope Factor, *LS*	Cover Factor, *C*	Calculated Unit Area Soil Loss, *A* (tons/acre/period)	Calculated Total Area Soil Loss (tons/period)
1	Undisturbed area (L=100, S=4%)	3.2	2.84	0.15	0.55	0.01	0.002	0.01
2	Ramp (L=1,000, S=4%)	0.92	2.84	0.32	1.86	0.05	0.08	0.08
3	Main embankment, active construction (L=300, S=10%)	2.1	2.84	0.28	3.09	1.0	2.46	5.2
4	Side slope (L=50, S=15%)	0.7	2.84	0.21	1.52	0.07	0.06	0.0
							Total Tons =	**5.29**

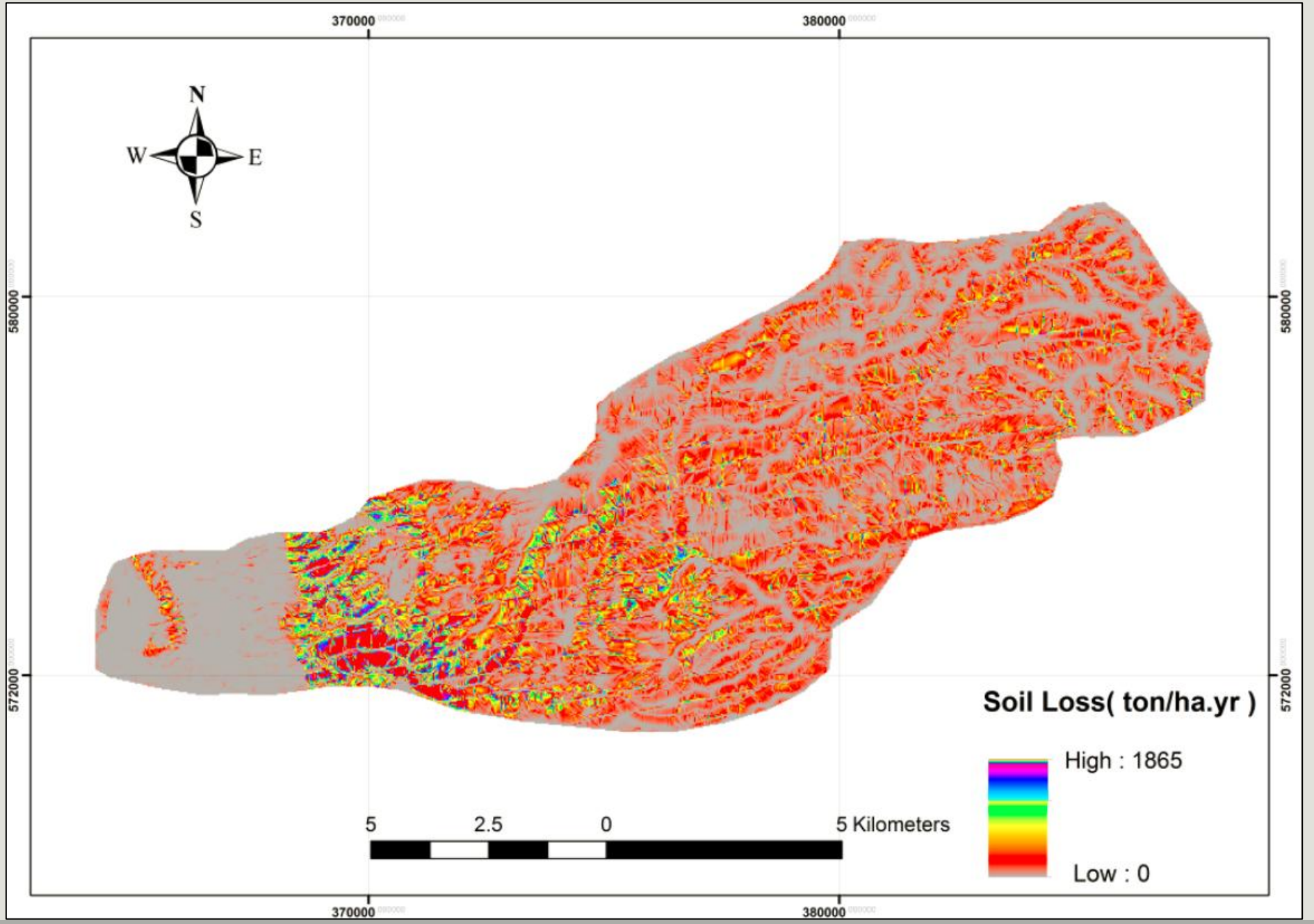
Rough Grading

Site Area	Area Description	Land Area (acres)	*R* for Phase Period (June 1 to Sept 30)	Soil Factor, *K*	Length Slope Factor, *LS*	Cover Factor, *C*	Calculated Unit Area Soil Loss, *A* (tons/acre/period)	Calculated Total Area Soil Loss (tons/period)
1	Undisturbed area (L=100, S=4%)	3.2	63.19	0.15	0.55	0.01	0.05	0.17
2A	Ramp, active construction (L=500, S=5%)	0.46	63.19	0.47	1.71	1.0	50.79	23.36
2B	Ramp (L=250, S=3%)	0.23	63.19	0.39	0.64	0.2	3.15	0.73
2C	Ramp (L=250, S=1%)	0.23	63.19	0.33	0.19	0.2	0.79	0.18
3A	Main embankment, active construction (L=300, S=15%)	1.6	63.19	0.25	5.63	1.0	88.94	142.30
3B	Main embankment (L=100, S=25%)	0.5	63.19	0.22	4.59	0.02	1.28	0.64
4	Side slope (L=50, S=15%)	0.7	63.19	0.21	1.47	0.06	1.17	0.82
							Total Tons =	**168.20**

RUSLE & GIS



Source: Soo Huey The (2011). Soil erosion modeling using RUSLE and GIS on Cameron Highlands, Malaysia for hydropower development, Master's Thesis, University of Iceland & University of Akureyri



Source: Farhan, Y., Zregat, D., and Farhan, I. (2013). Spatial estimation of soil erosion risk using RUSLE approach, RS, and GIS techniques: a case study of Kufranja watershed, Northern Jordan. *J. Water Res. and Protection*, (5) 1247-1261

Design of ESC Measures

Information from site visit and *RUSLE*

- More detail for critical area (soil samples, etc.)

Manufacturer charts and data are a great place to start but should always consider requirements

- 2-yr, 24-hr storm event

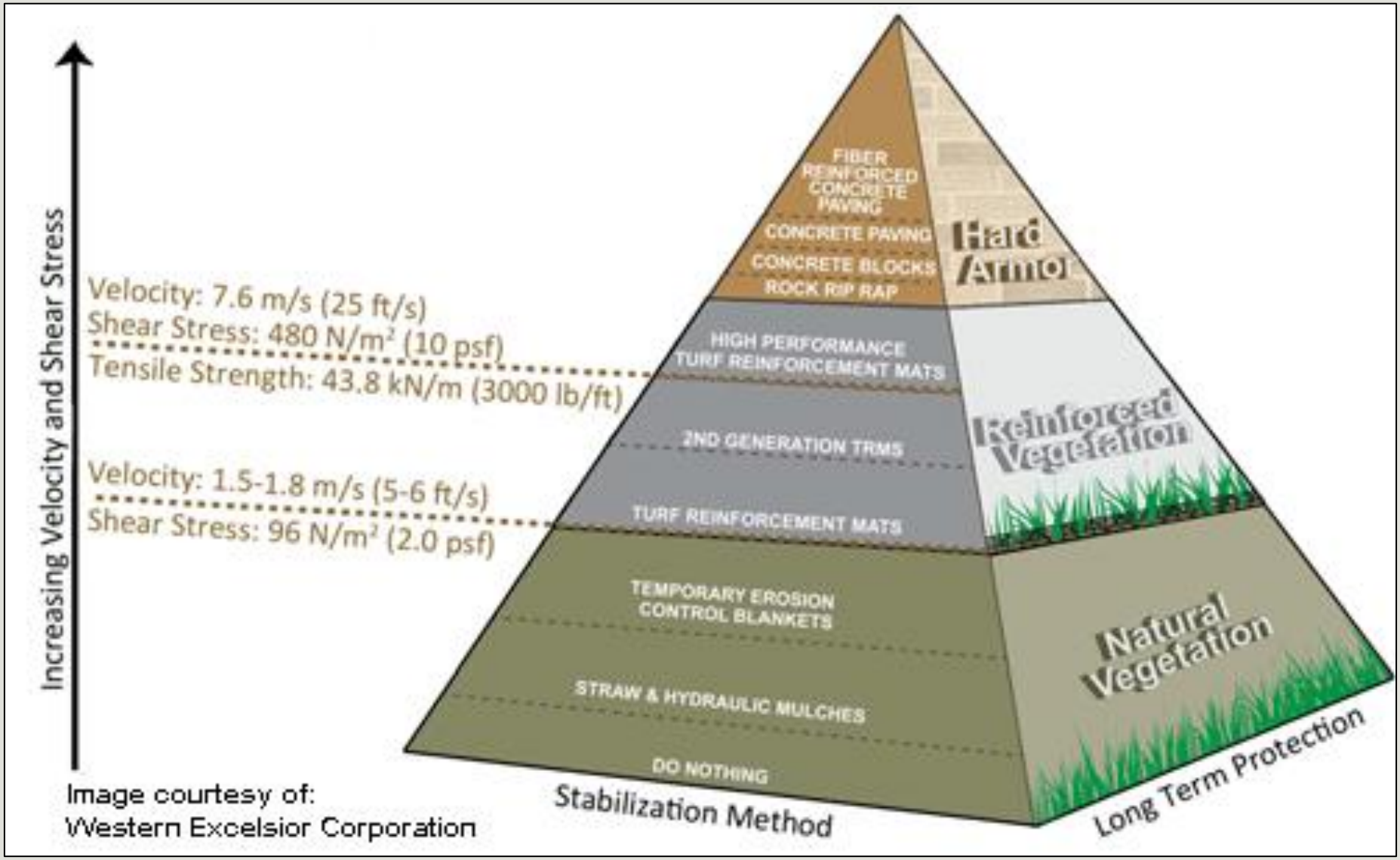


Image courtesy of:
Western Excelsior Corporation

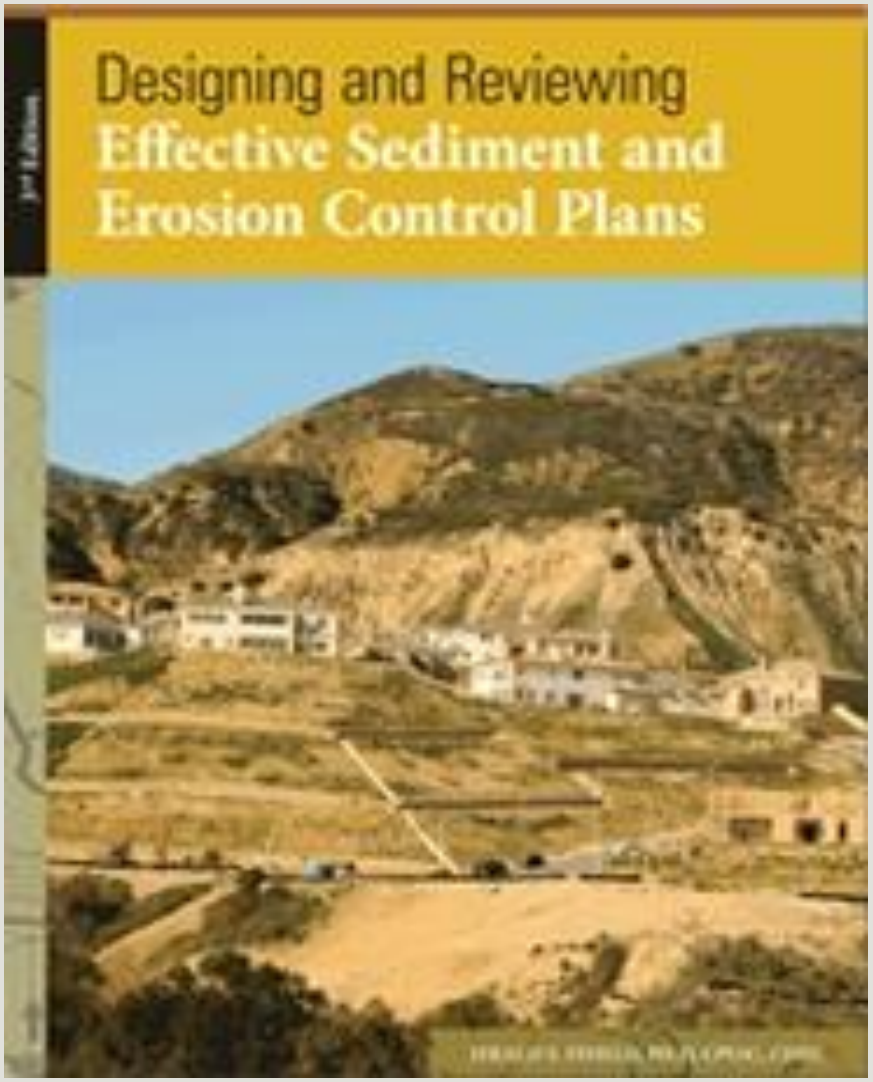
Design of ESC Measures

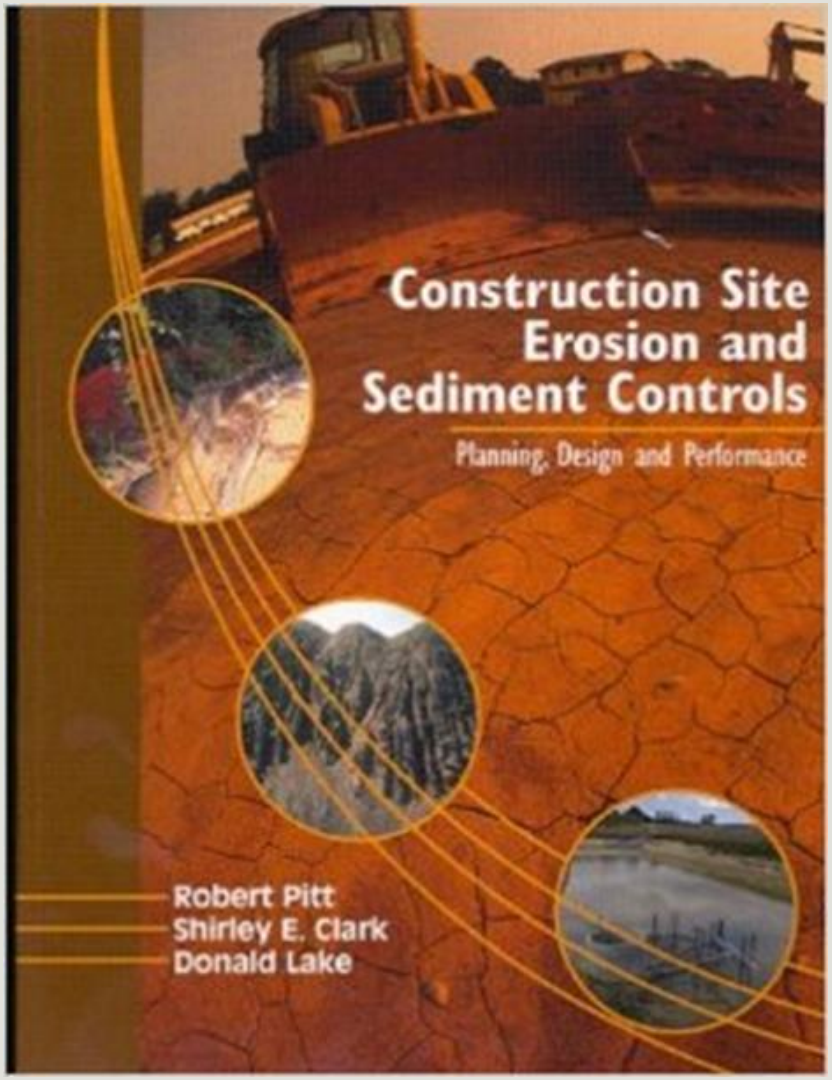
Technical resources and testing:

- ECTC
- USDA
- FHWA
- AASHTO NTPEP

Software options (from manufacturers):

- ECMDS
- ErosionWorks


Designing and Reviewing
Effective Sediment and
Erosion Control Plans


Construction Site
Erosion and
Sediment Controls
Planning, Design and Performance
Robert Pitt
Shirley E. Clark
Donald Lake

Design of ESC Measures

Avoid "cookie-cutter" plans

Monitor performance of design

- During and after construction

Communication is key!

Source: Georgia Soil and Water Conservation Commission

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Questions?