RUSLE2

REVISED UNIVERSAL SOIL LOSS EQUATION-Version 2

Predicting Soil Erosion By Water:
A Guide to Conservation Planning

UNIT 1

Course Objectives and Topics

OBJECTIVES

- Understand erosion processes
- Learn RUSLE2 and its software
- Learn field office applications of RUSLE2

UNIT 2

Overview of Erosion

OVERVIEW OF EROSION

- Definition of erosion
- Erosion processes
- Types of erosion
- Why erosion is a concern
- Uses of erosion prediction tools

EROSION

"Erosion is a process of detachment and transport of soil particles by erosive agents."

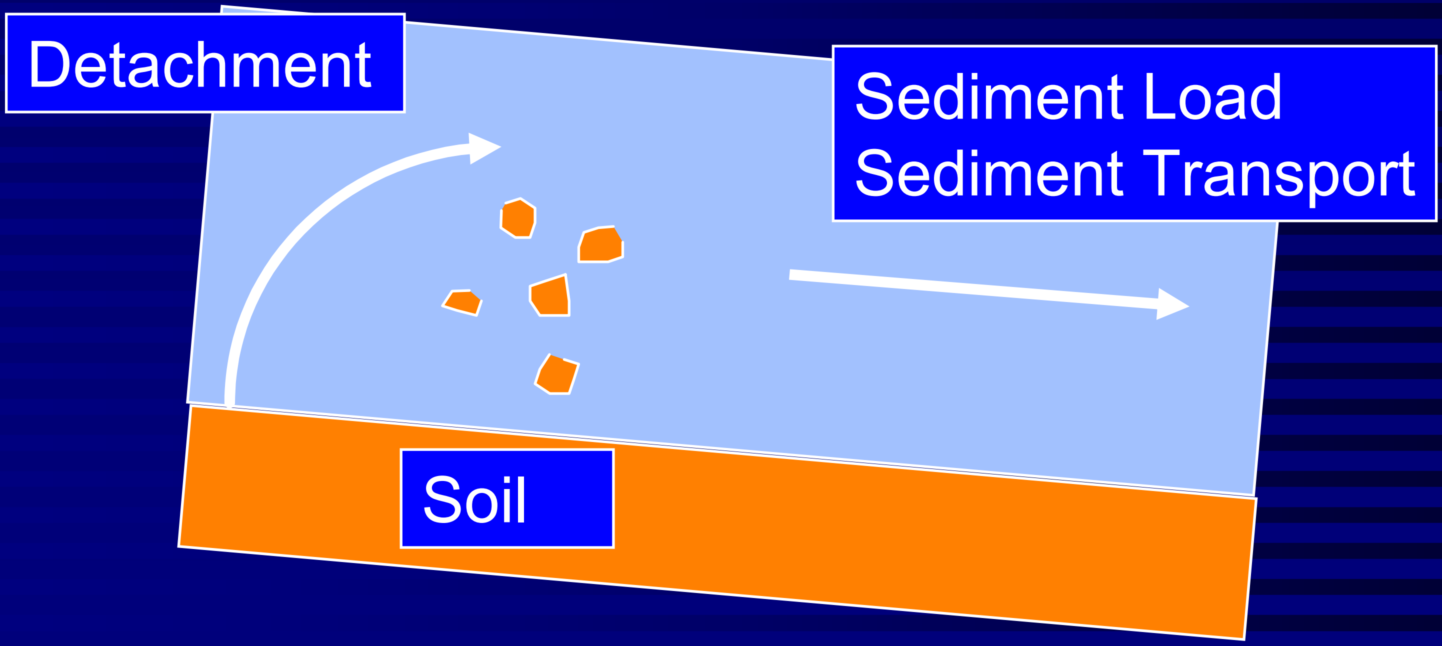
Ellison, 1944

- Erosive Agents
  - Raindrop impact
  - Overland flow surface runoff from rainfall

DETACHMENT

- Separation of soil particles from soil surface
- Adds to the sediment load
  - Sediment load: Rate sediment is transported downslope by runoff

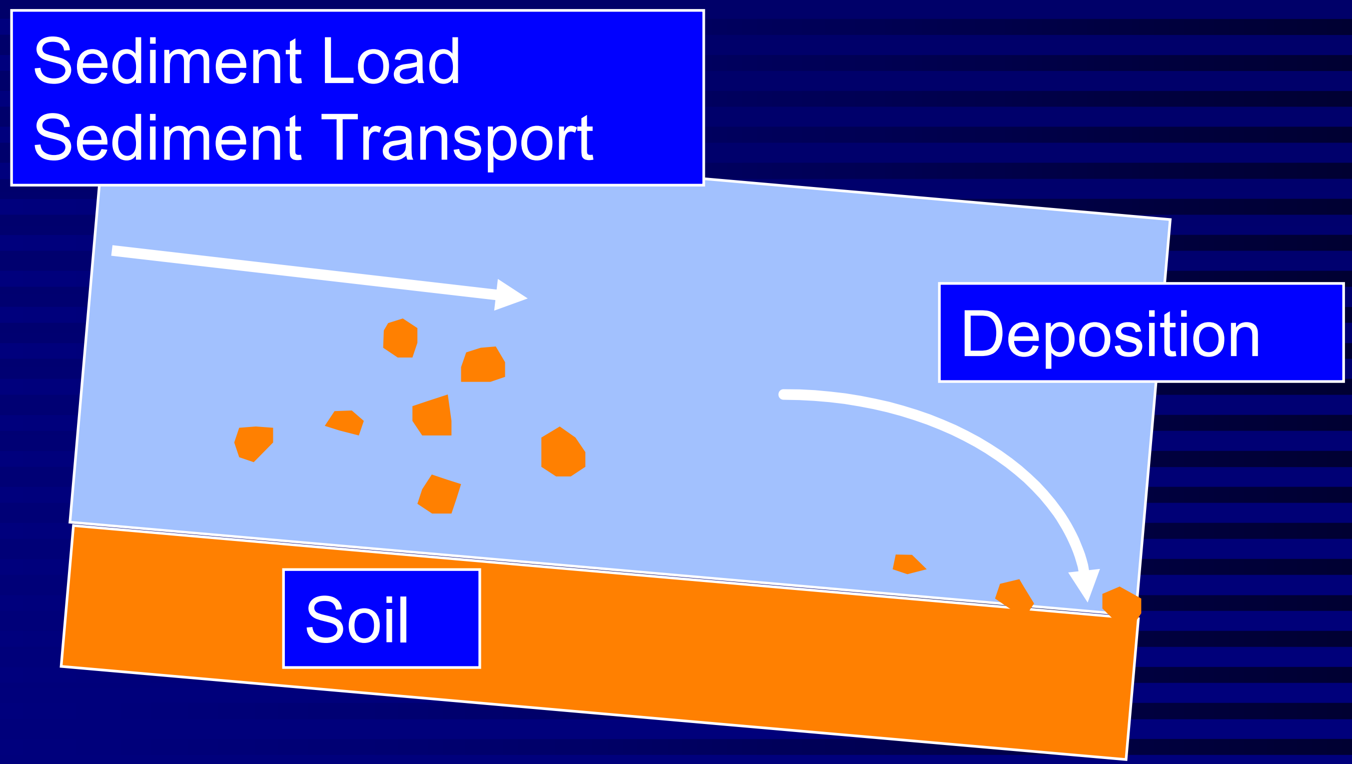
DETACHMENT



DEPOSITION

- Reduces the sediment load
- Adds to the soil mass
- Local deposition
  - Surface roughness depressions
  - Row middles
- Remote deposition
  - Concave slope
  - Strips
  - Terraces

DEPOSITION

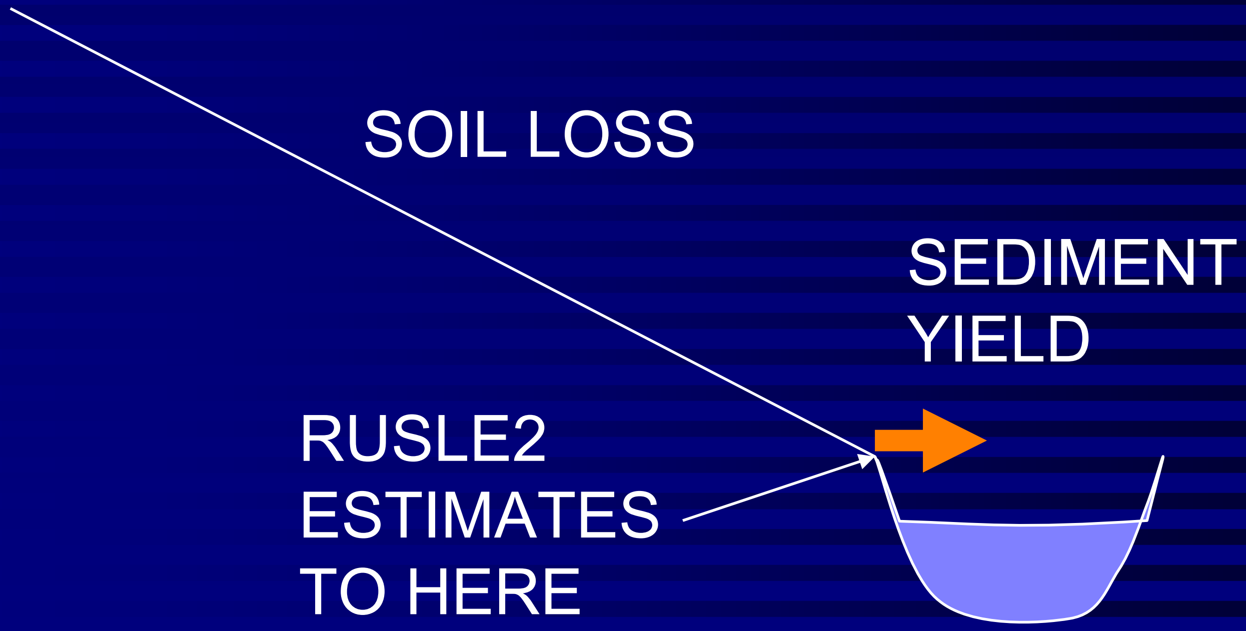


TYPES OF EROSION

- Interrill and rill (sheet-rill)
- Ephemeral gully
- Permanent, incised (classical) gully
- Stream channel
- Mass movement
- Geologic

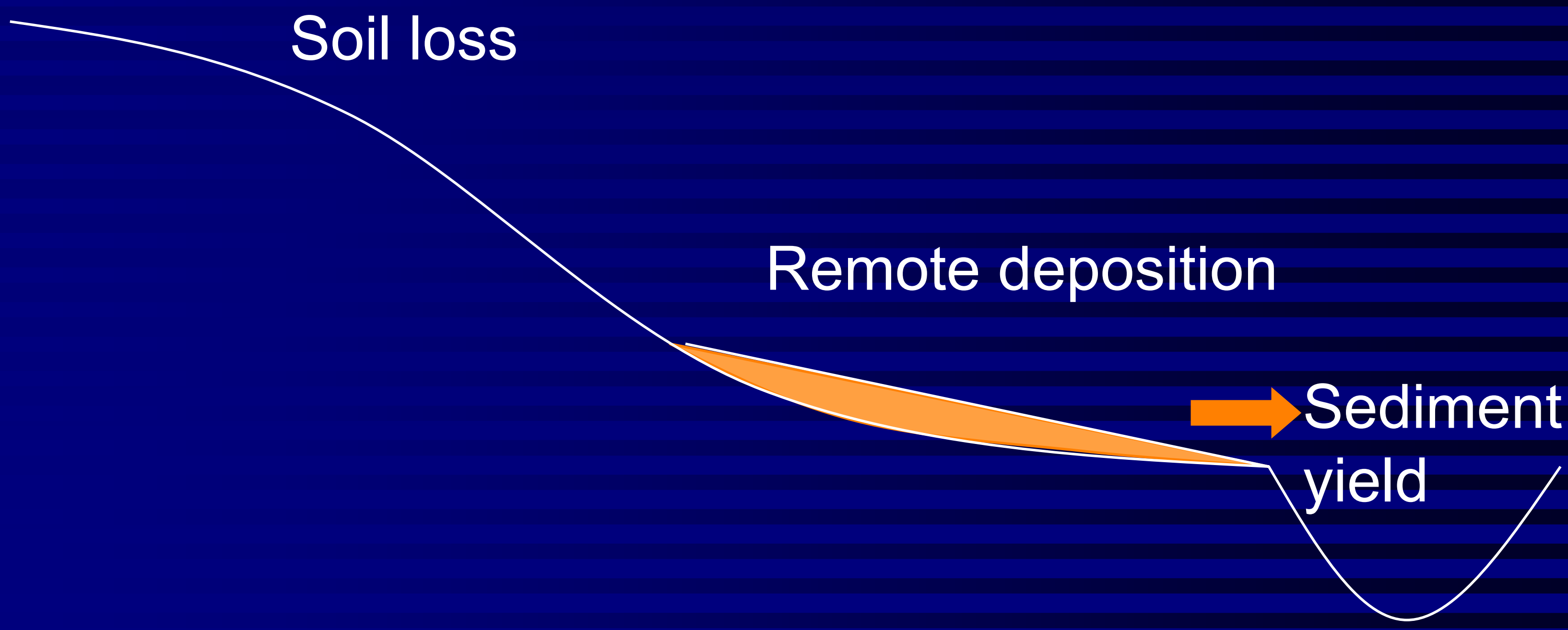
DEFINITIONS

Simple Uniform Slope



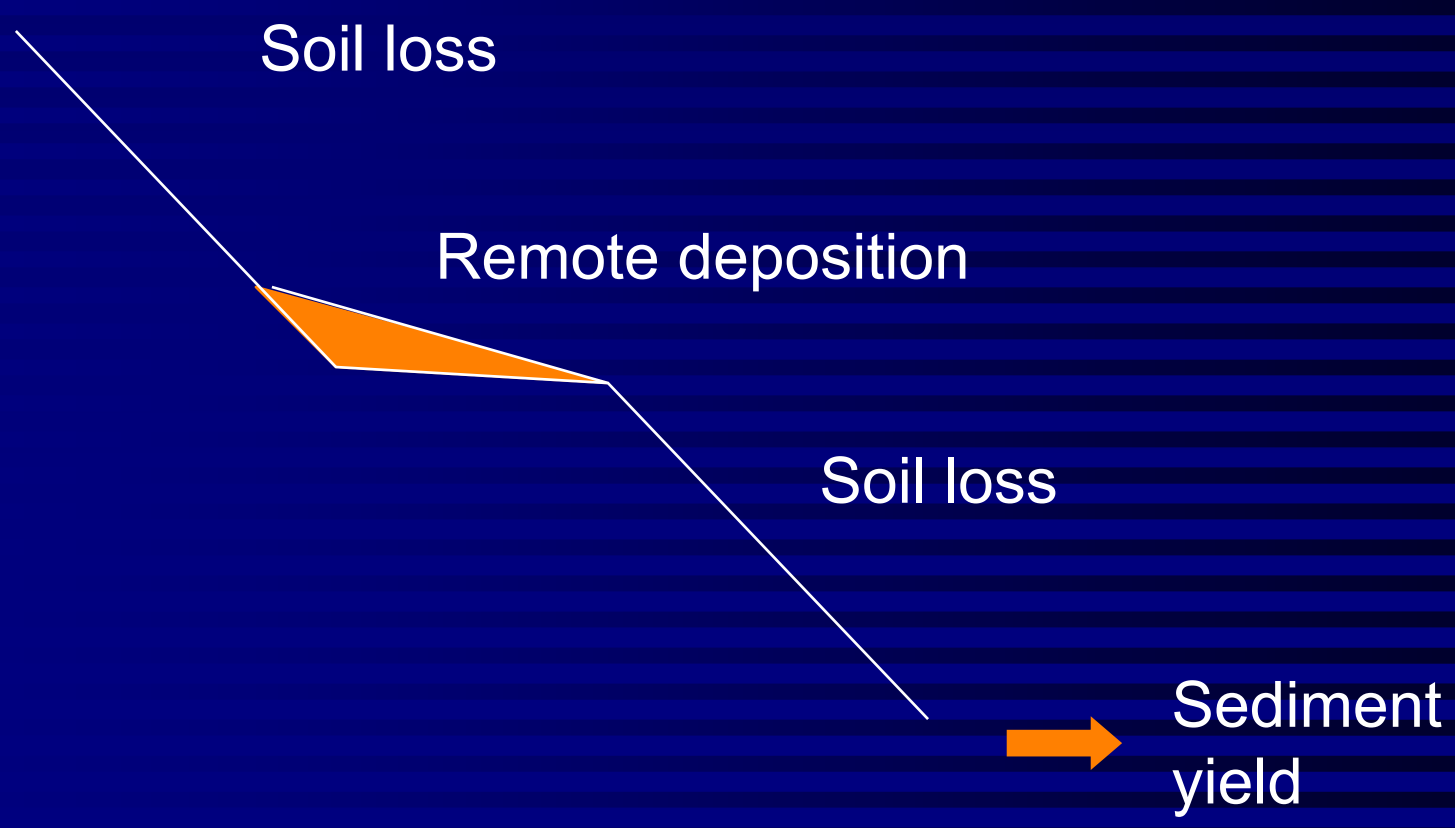
DEFINITIONS

Complex Slope



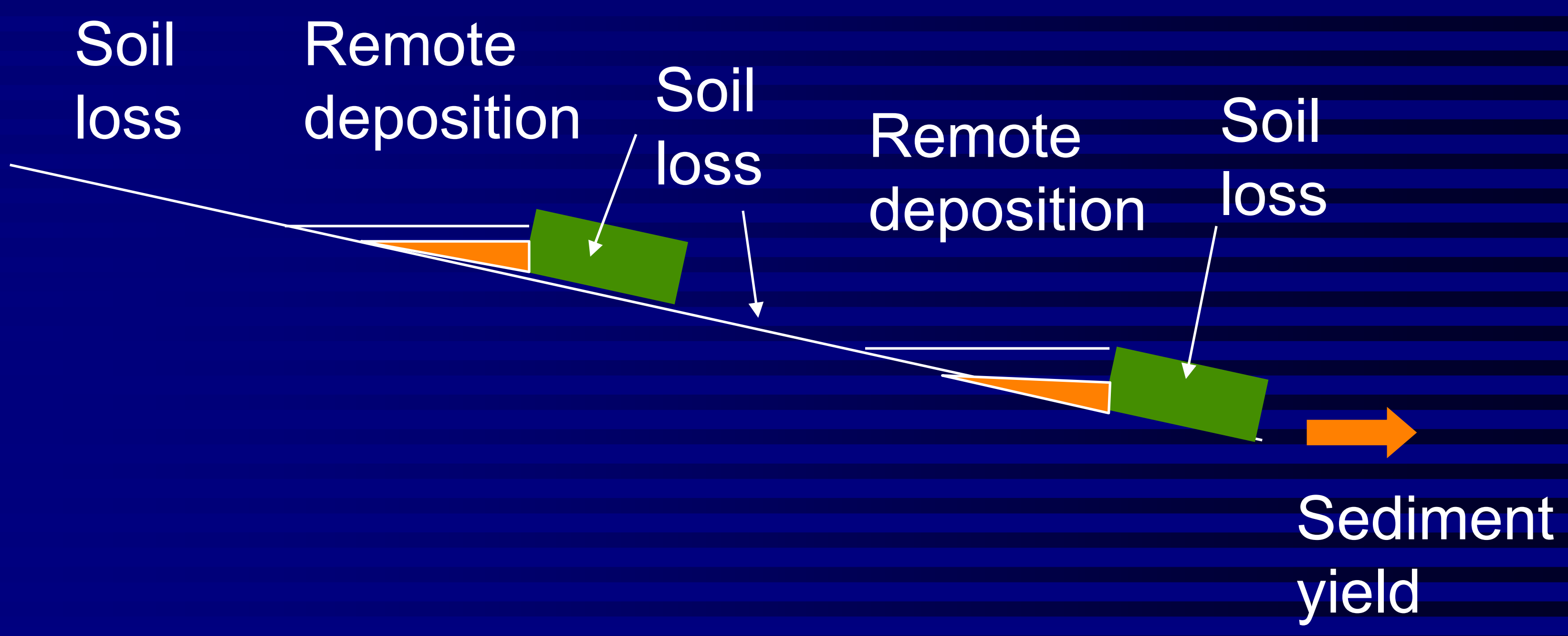
DEFINITIONS

Complex Slope



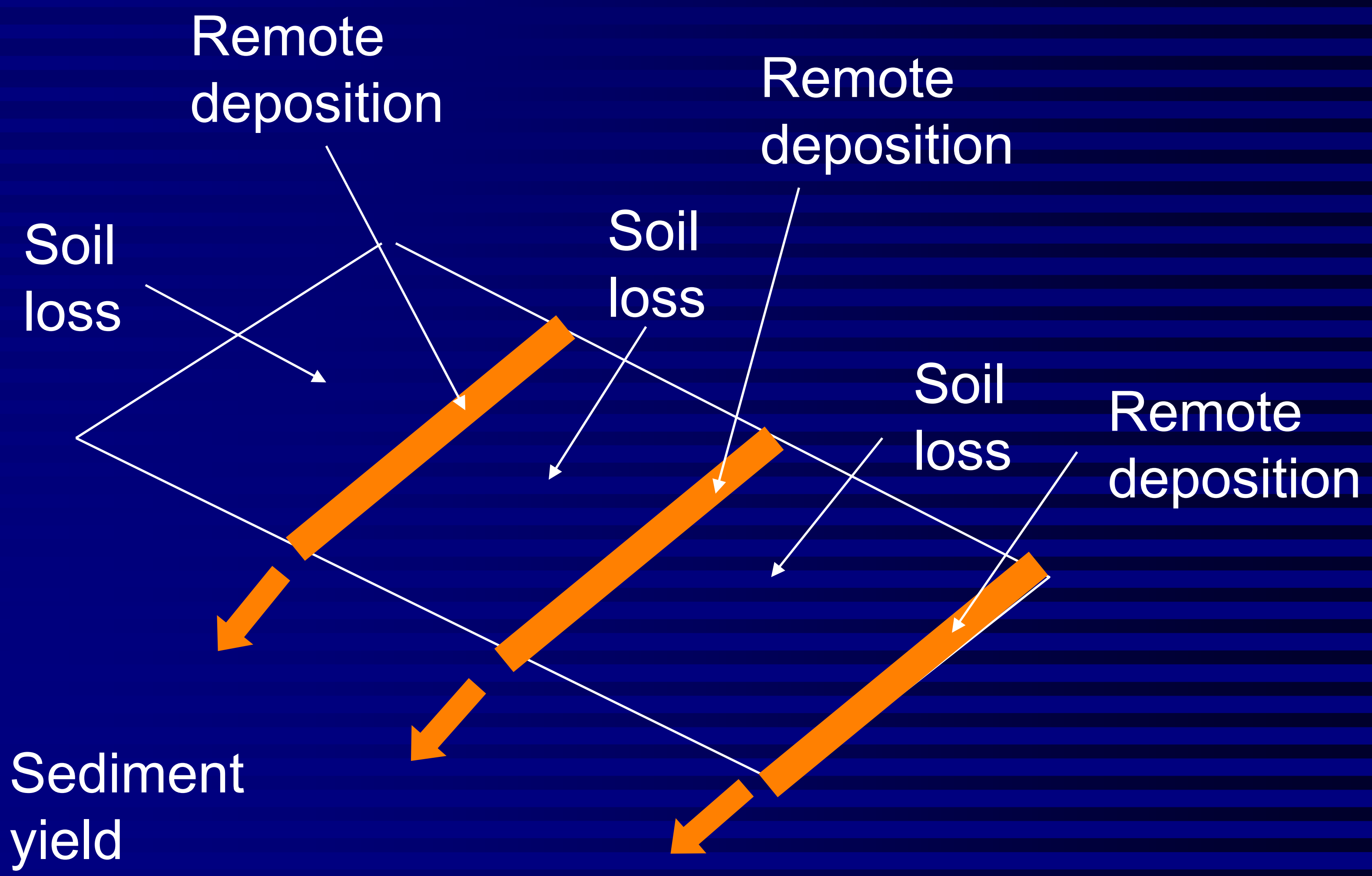
DEFINITIONS

Strips

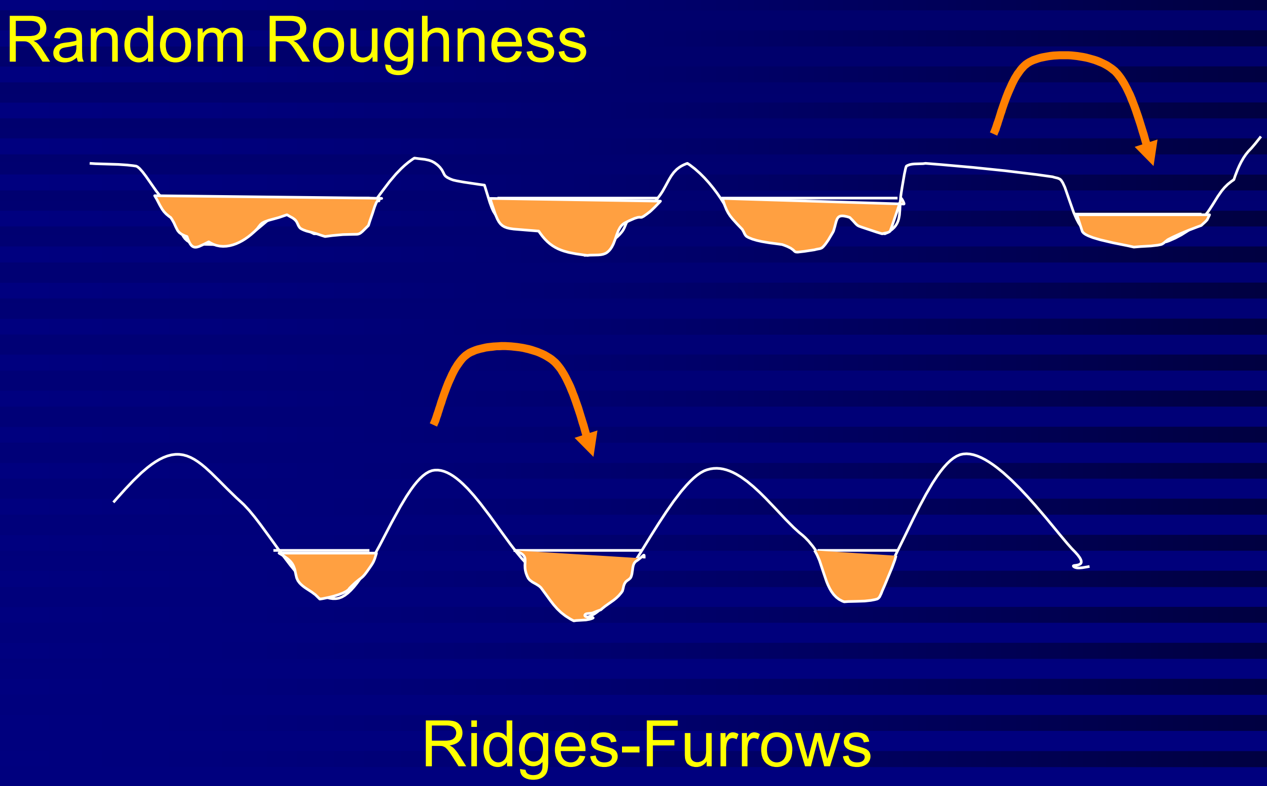


DEFINITIONS

Terraces



LOCAL DEPOSITION



Credit for Deposition

Local Deposition
- Full credit

Remote Deposition
- Partial credit
- Amount
- Location
- Spacing of terraces

SEDIMENT CHARACTERISTICS

- Particle Classes
  - Primary clay, primary silt, small aggregate, large aggregate, primary sand
- At Detachment
  - Distribution of classes function of texture
  - Diameter of small and large aggregates function of texture
- After Deposition
  - Sediment enriched in fines

EROSION IS A CONCERN

- Degrades soil resource
  - Reduces soil productivity
  - Reduces soil organic matter
  - Removes plant nutrients
- Causes downstream sedimentation
- Produces sediment which is a pollutant
- Produces sediment that carries pollutants

WHERE EROSION CAN BE A PROBLEM

- Low residue crops
- Conventional tillage
- Rows up/down steep slopes
- Low maintenance pasture
- Disturbed land with little cover

EROSION PREDICTION AS A TOOL

- Guide management decisions
- Evaluate impact of erosion
- Inventory soil erosion
- Conservation planning

EROSION PREDICTION AS A TOOL

- Concept:
  - Estimate erosion rate
  - Evaluate by ranking
  - Evaluate against quality criteria
- Tool: RUSLE2
- Quality Criteria: Soil loss tolerance

PLANNING VARIABLES

- Soil loss on eroding portions of hillslope
- Detachment (sediment production) on hillslope
- Conservation planning soil loss for hillslope
- Ratio of segment soil loss to soil tolerance adjusted for segment position
- Sediment yield from hillslope/terraces
- Enrichment ratio

UNIT 3

Overview of RUSLE2

OVERVIEW OF RUSLE2

(Revised Universal Soil Loss Equation- Version 2)

- Where RUSLE2 applies
- Major factors affecting erosion
- RUSLE2 factors
- RUSLE2 background

Erosion Types

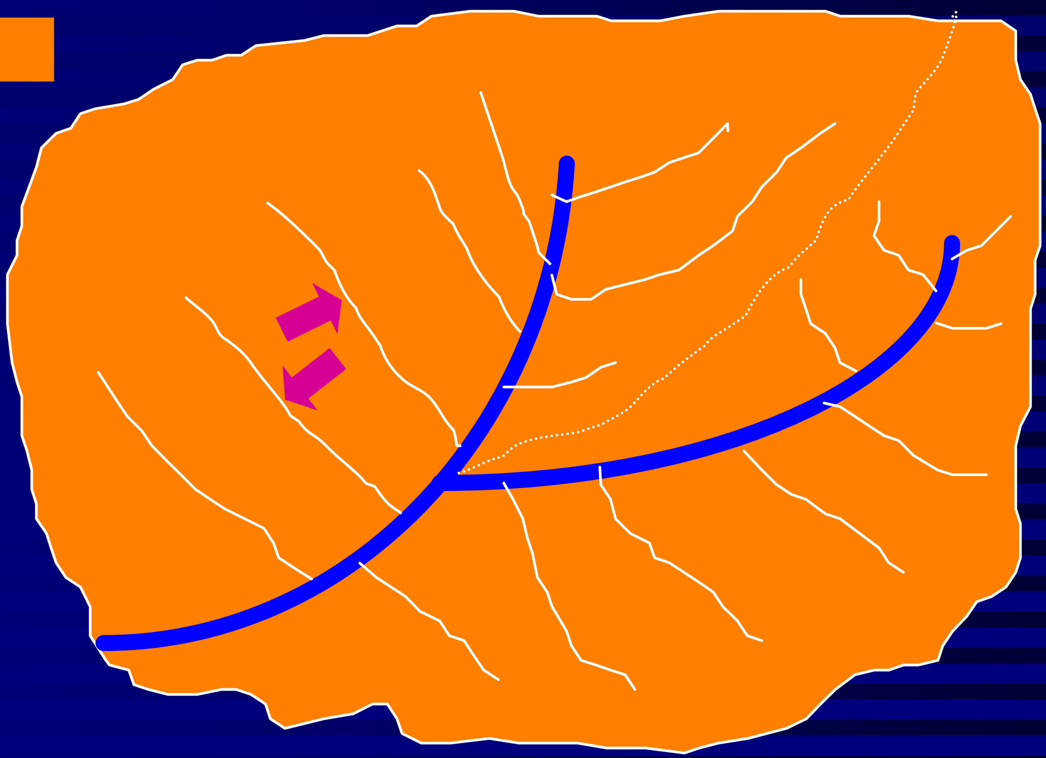
Landscape

Overland flow

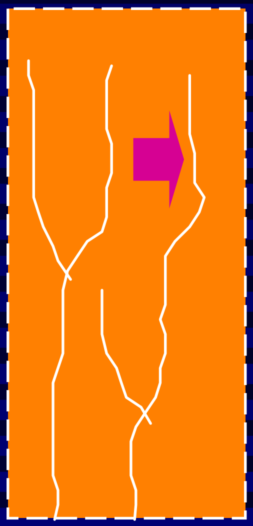
Interrill

Rill

Ephemeral Gully (Concentrated flow)



RUSLE2 Area



FACTORS AFFECTING INTERILL-RILL EROSION

- Climate
- Soil
- Topography
- Land use
  - Cultural (cover-management) practices
  - Supporting practices

RUSLE2 FACTORS

Daily Soil Loss

$$a = r\ k\ l\ s\ c\ p$$

Daily Factors

r - Rainfall/Runoff

k - Soil erodibility

l - Slope length

s - Slope steepness

c - Cover-management

p - Supporting practices

Average annual soil loss = sum of daily soil loss values

Different formulation from USLE and RUSLE1

RUSLE FACTORS
(Sediment Production)

- Climate ——— r
- Soil ——— k
- Topography ——— ls
- Land Use and ——— lscp

Management

RUSLE FACTORS

A = *f* (erodibility, erosivity)

- Erosivity – rklscp
- Erodibility - klc

RUSLE FACTORS

(Keep in mind that RUSLE2 operates on a daily basis)

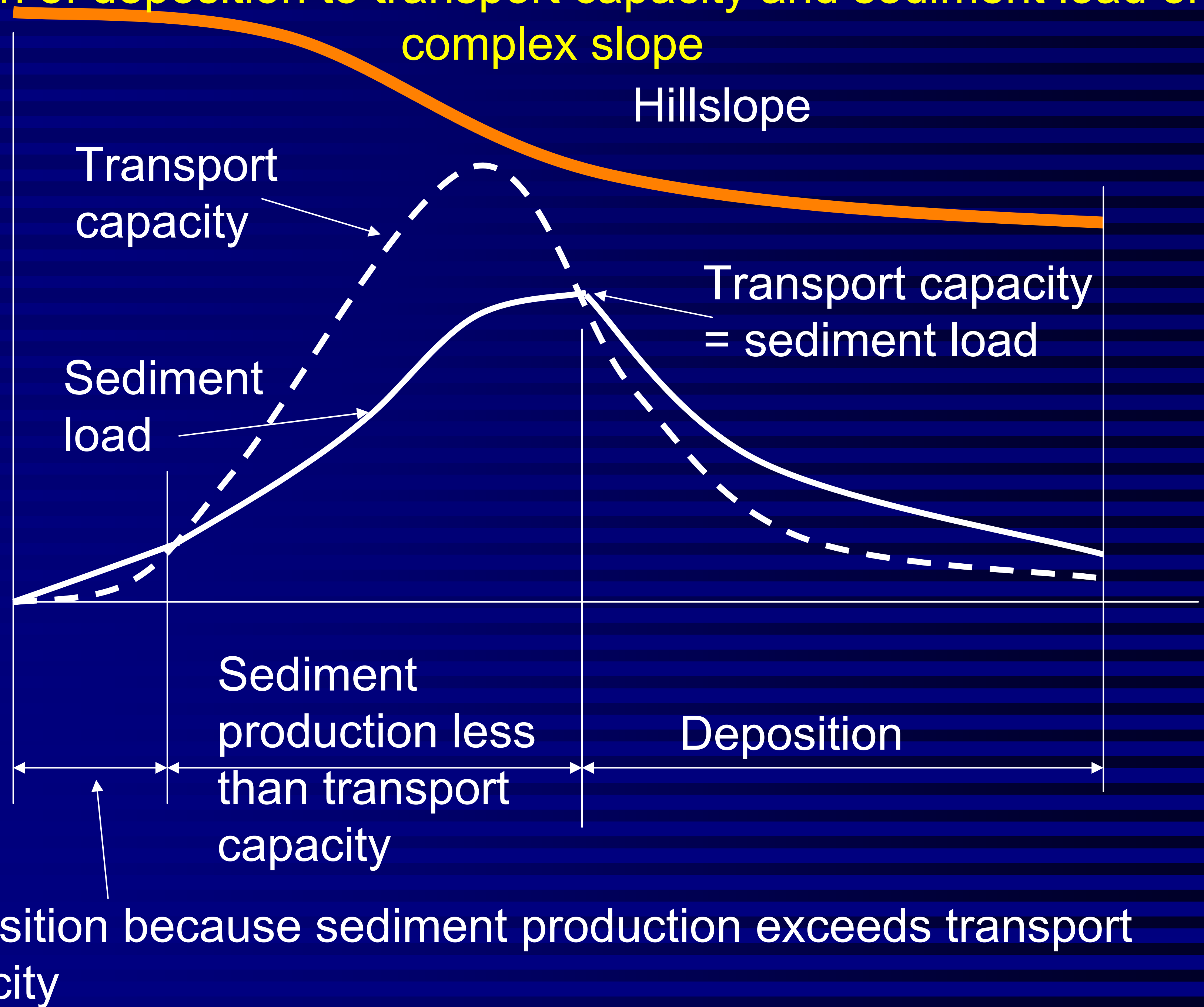
Unit Plot Concept

a = rk lscp

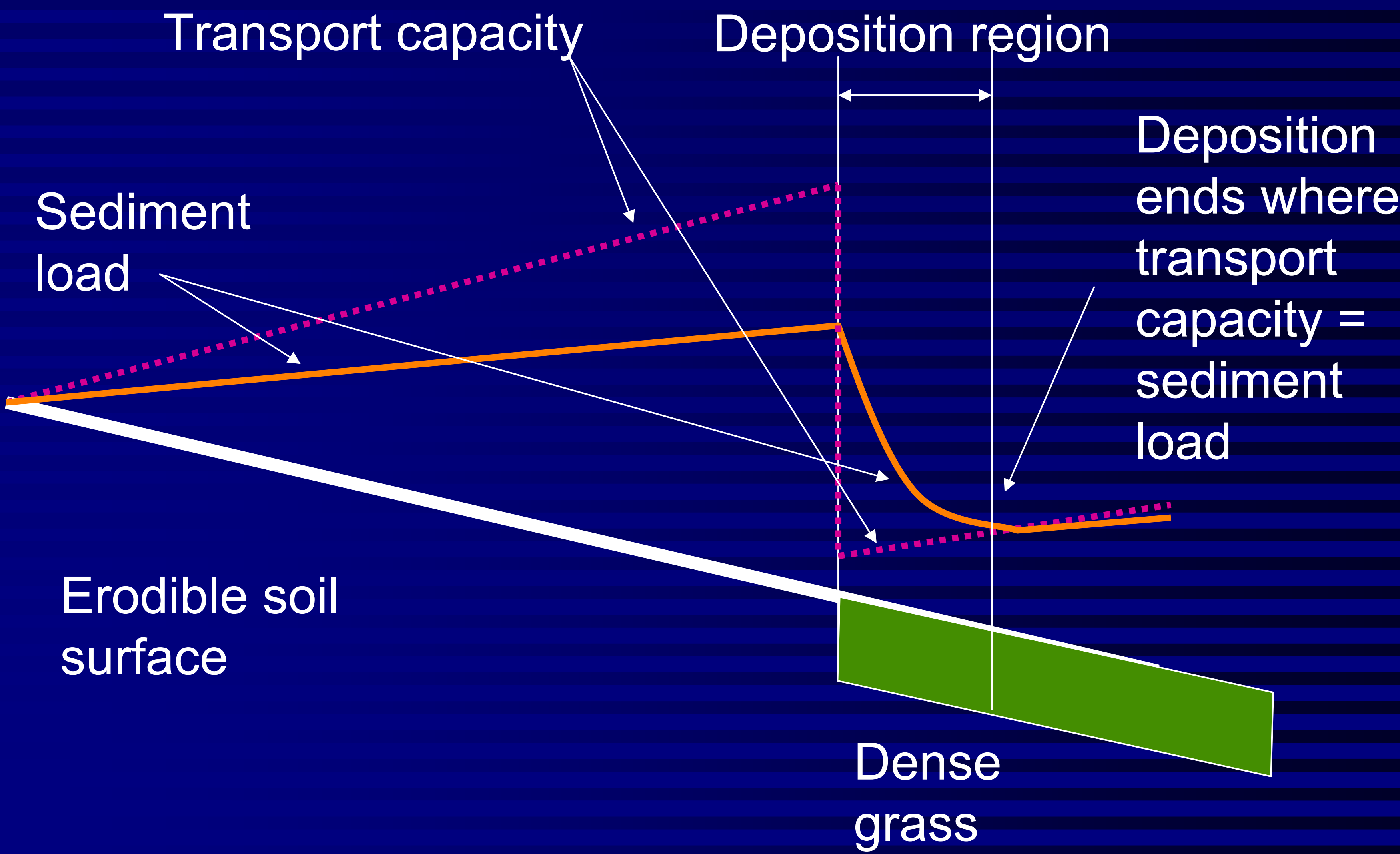
rk - Unit plot soil loss (dimensions)

lscp - Adjusts unit plot soil loss (dimensionless)

Relation of deposition to transport capacity and sediment load on a complex slope



Relationship of Deposition to Transport Capacity and Sediment Load for a Grass Strip



How Deposition at a Grass Strip Affects Sediment Characteristics

Particle class	Before (%)	After (%)
Primary clay	5	22
Primary silt	24	58
Small aggreg.	36	14
Large aggreg.	24	5
Primary sand	7	1

SDR = 0.2

Note how deposition enriches sediment in fines

RUSLE2 BACKGROUND

Combines empirical field data-process based equations (natural runoff and rainfall simulator plots)

- Zingg's equation (1940)
- Smith and Whit's equation (1947)
- AH-282 (1965)
- "Undisturbed land" (1975)
- AH-537 (1978)
- Disturbed forestland (1980)
- RUSLE1 (1992)
- AH703 (1997)
- OSM Manual (mined, reclaimed land, construction sites) (1998)
- RUSLE2 (2001)

RUSLE2 APPLICATIONS

- Cropland
- Pastureland
- Rangeland
- Disturbed forest land
- Construction sites
- Surface mine reclamation
- Military training lands
- Parks
- Waste disposal/landfills

SUMMARY

- Factors affecting erosion
- RUSLE2 factors
- RUSLE2 background

Unit 4

RUSLE2 Factors

RUSLE2 Factors

(Keep in mind that factors are on a daily basis)

- r- erosivity factor
- k- erodibility factor
- l- slope length factor
- s- slope steepness factor
- c- cover-management factor
- p- supporting practices factor

EROSIVITY

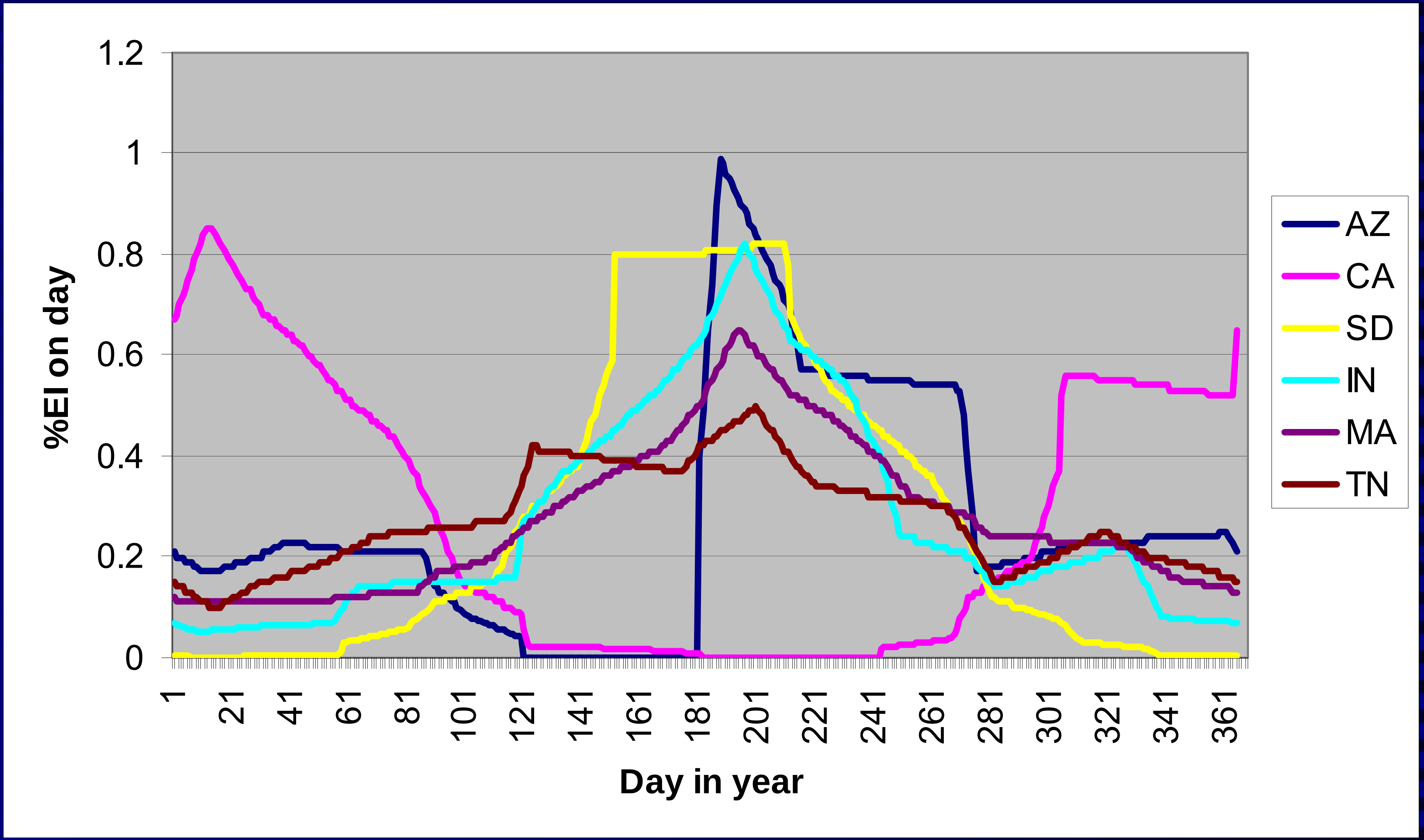
- Single storm
  - Energy x 30 minute intensity
  - Fundamentally product of rainfall amount x intensity
- Annual-sum of daily values
- Average annual-average of annual values
- Daily value=average annual x fraction that occurs on a given day

EROSIVITY - R

Measure of erosivity of climate at a location

Las Vegas, NV	6
Phoenix, AZ	23
Denver, CO	30
Syracuse, NY	95
Minneapolis, MN	120
Chicago, IL	160
Richmond, VA	200
St. Louis, MO	200
Dallas, TX	270
Birmingham, AL	380
Charleston, SC	400
New Orleans, LA	630

Erosivity Varies During Year



10 yr 24 hr precip

- Reflects locations where intense, erosive storms occur that have a greater than proportional share of their effect on erosion
  - Effectiveness and failure of contouring
  - Effect of ponding on erosivity
  - Sediment transport capacity

Reduction by Ponding

- Significant water depth reduces erosivity of raindrop impact
- Function of:
  - 10 yr 24 hr precip
  - Land steepness

SOIL ERODIBILITY - K

- Measure of soil erodibility under standard unit plot condition
  - 72.6 ft long, 9% steep, tilled continuous fallow, up and down hill tillage
- ***Independent of management***
- Major factors
  - Texture, organic matter, structure, permeability (runoff potential)

SOIL ERODIBILITY - K

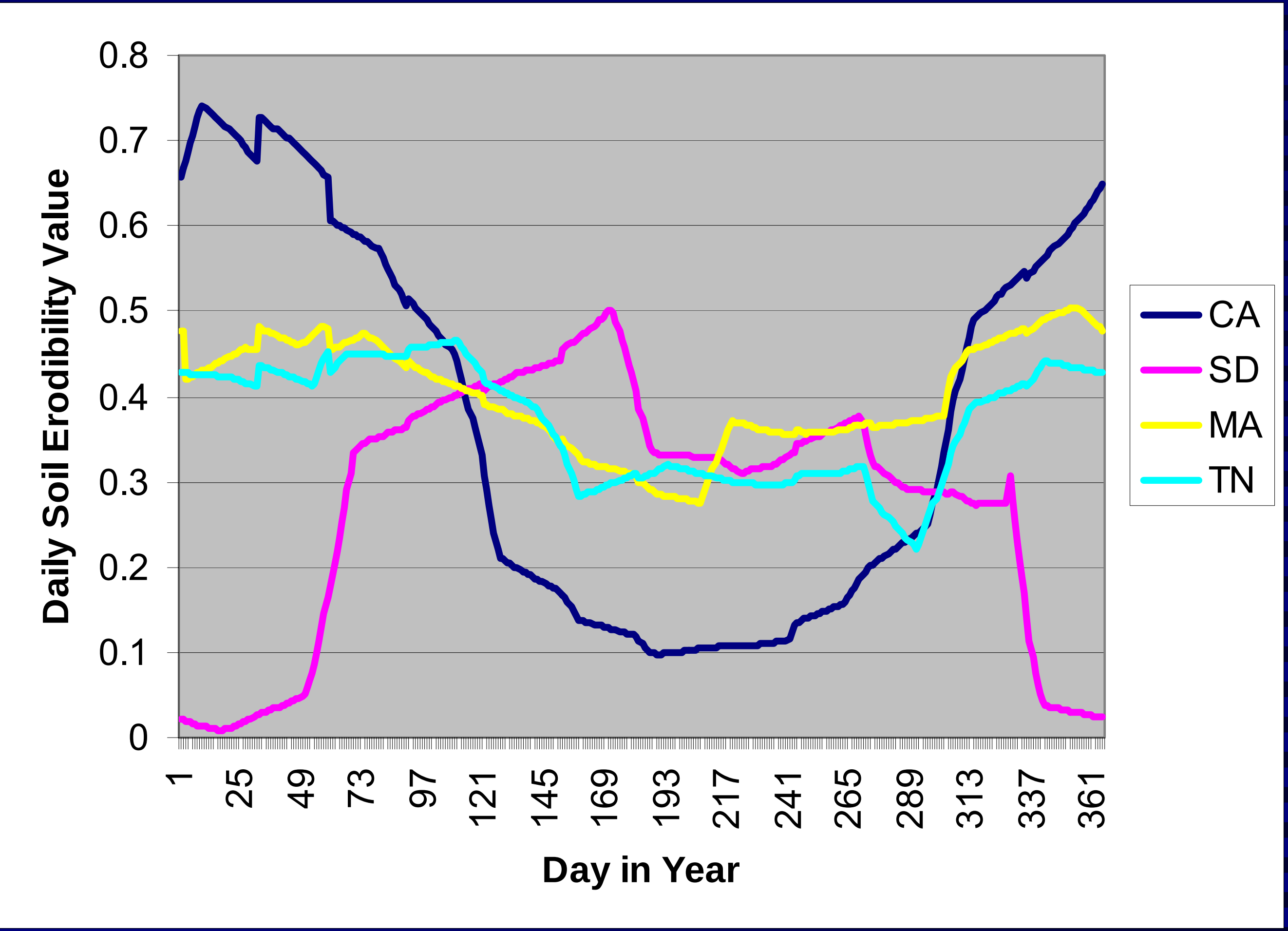
- Effect of texture
  - clay (0.1 - 0.2) resistant to detachment
  - sand (0.05 - 0.15) easily detached, low runoff, large, dense particles not easily transported
  - silt loam (0.3 - 0.5) moderately detachable, moderate to high runoff
  - silt (0.4 -0.6) easily detached, high runoff, small, easily transported sediment

Time Variable K

- Varies during year
- High when rainfall is high
- Low when temperature is high
- Very low below about 25 oF

Time Variable K

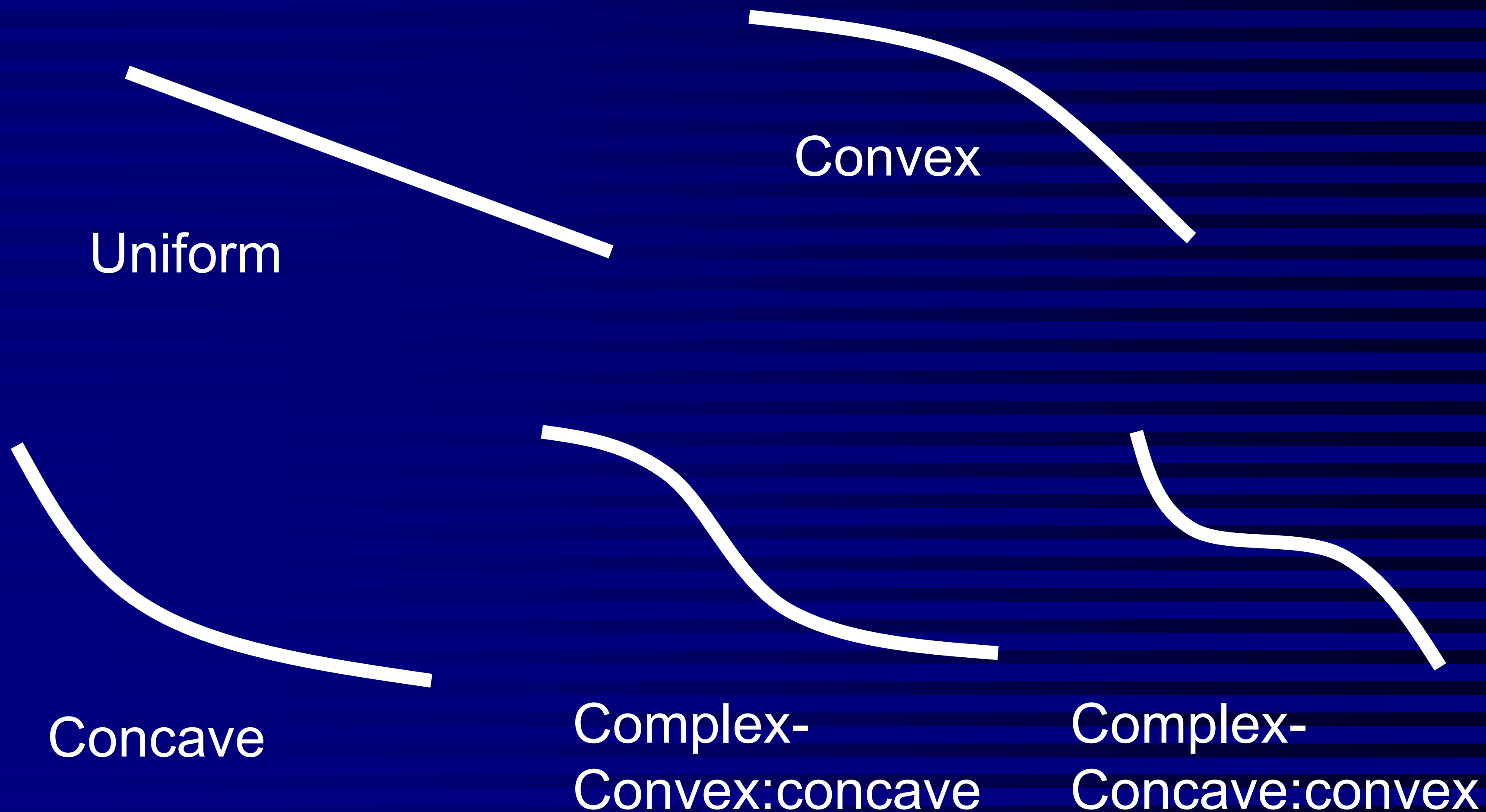
Base K value = 0.37



TOPOGRAPHY

- Overland flow path length
- Slope lengths for eroding portions of hillslopes
- Steepness
- Hillslope shape

Hillslope Shape



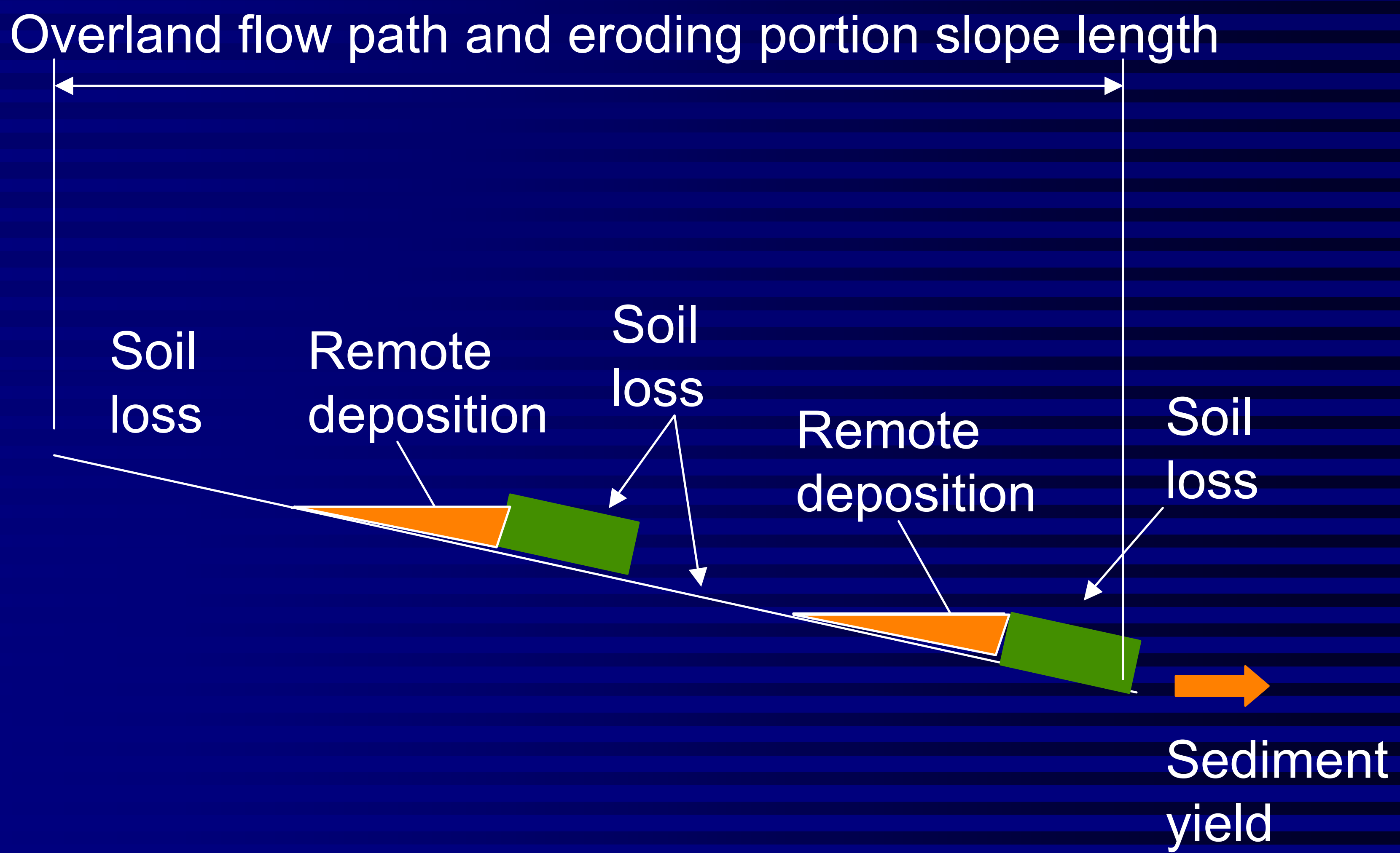
Overland Flow Path Length

- Distance from the origin of overland flow to a concentrated flow area
- This length used when the analysis requires that the entire flow path length be considered.

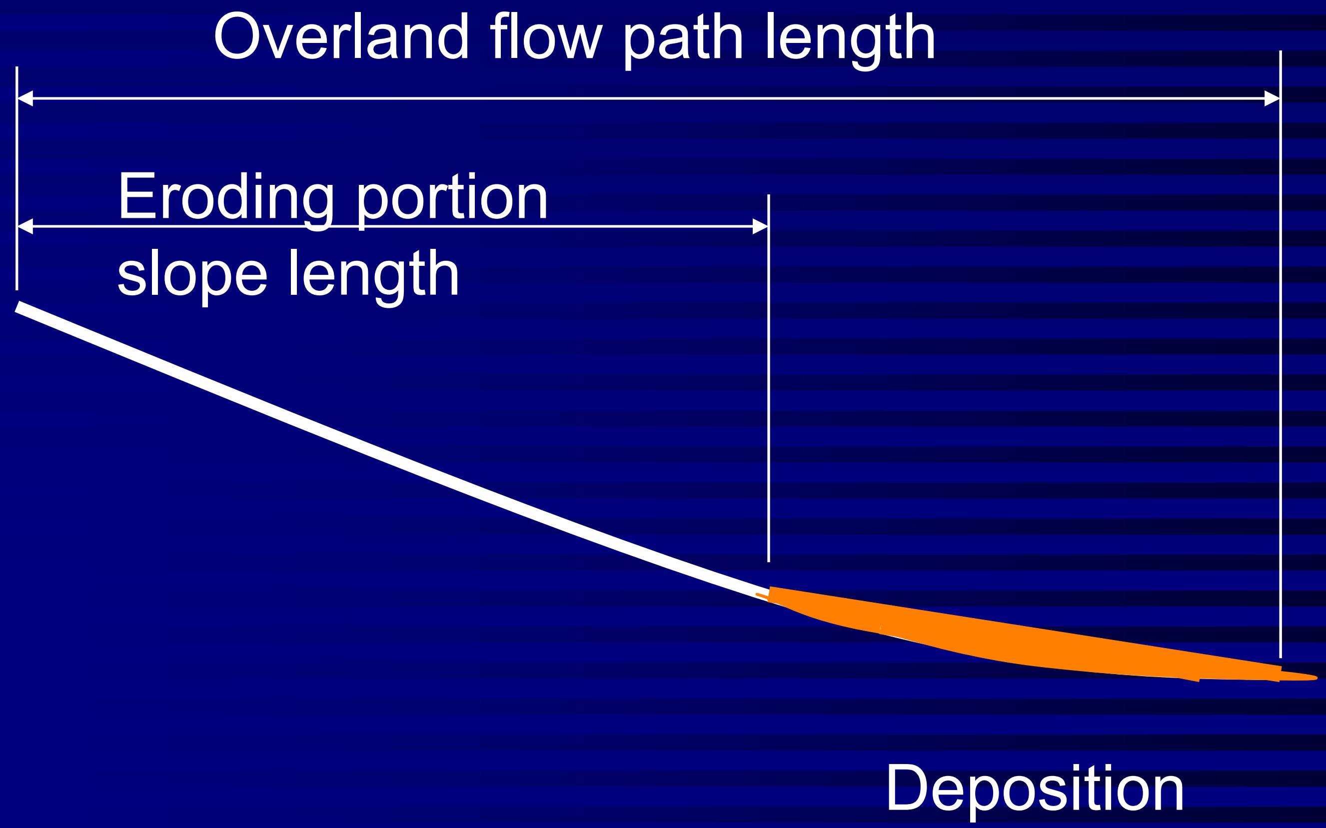
Slope Length for Eroding Portion of Slope

- Only works for simple slopes
- Traditional definition
  - Distance from origin of overland flow to concentrated flow or to where deposition begins
  - Definition is flawed for strips and concave:convex slopes
- Best approach: Use overland flow path length and examine RUSLE2 segment erosion rate values

Slope Lengths for Strips



Slope Length for Concave Slope



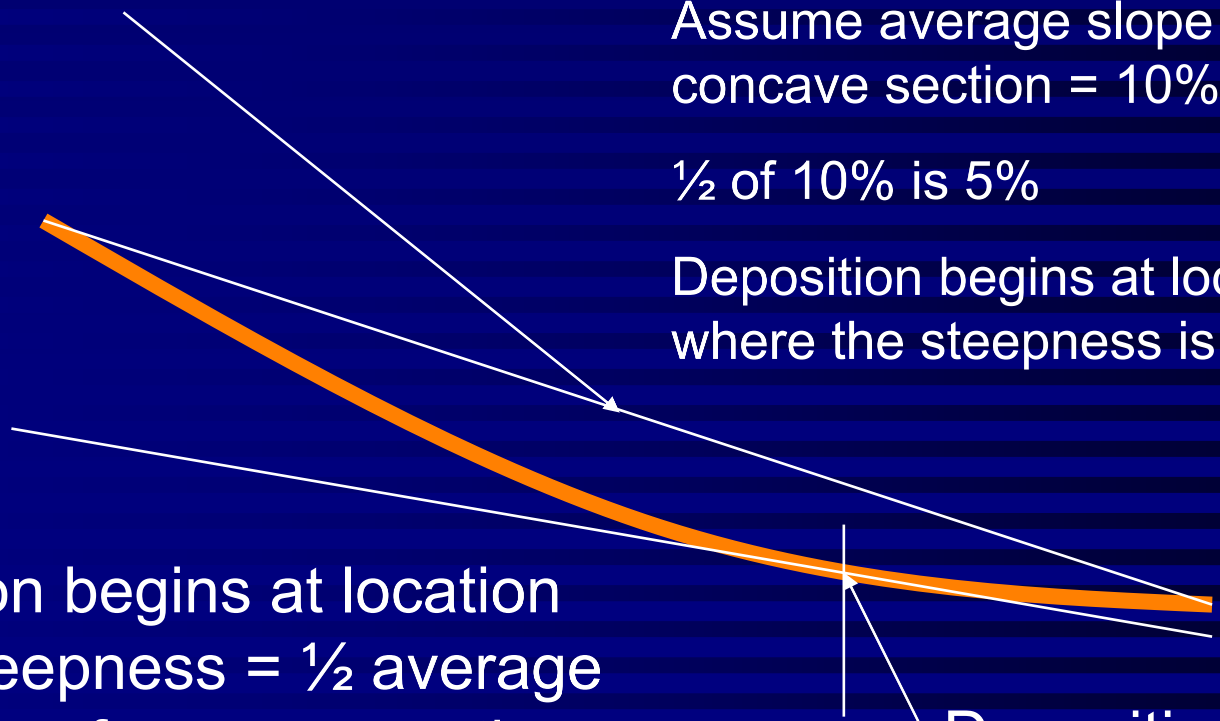
Rule of Thumb for Deposition Beginning on Concave Slopes

Example:

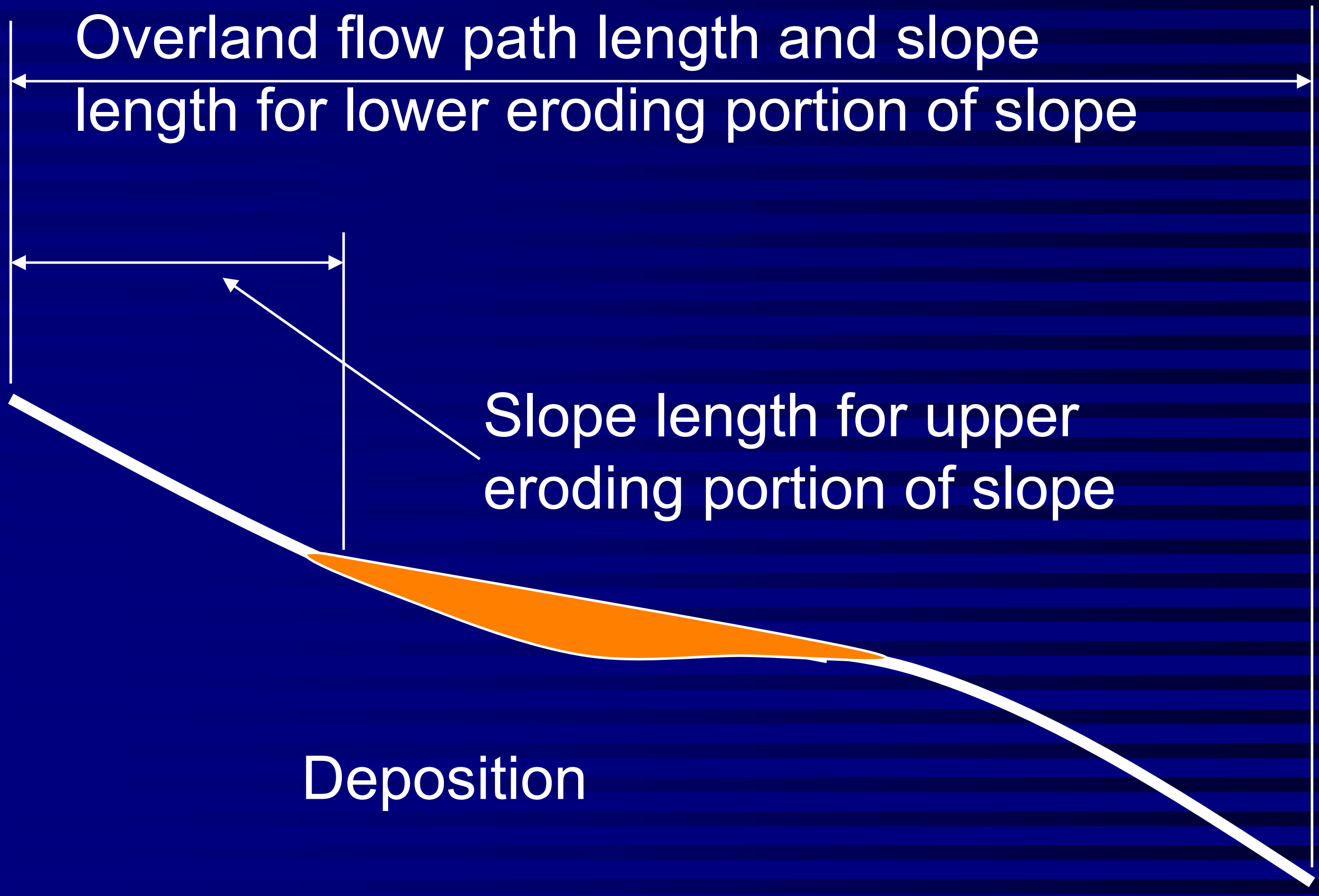
Assume average slope of concave section = 10%

½ of 10% is 5%

Deposition begins at location where the steepness is 5%



Slope Length for Concave:Convex Slope



Insert figures from AH703 to illustrate field slope lengths

Basic Principles

- Sediment load accumulates along the slope because of detachment
- Transport capacity function of distance along slope (runoff), steepness at slope location, cover-management, storm severity (10 yr 24 hr precip)
- Deposition occurs where sediment load becomes greater than transport capacity

Detachment Proportional to Slope Length Factor

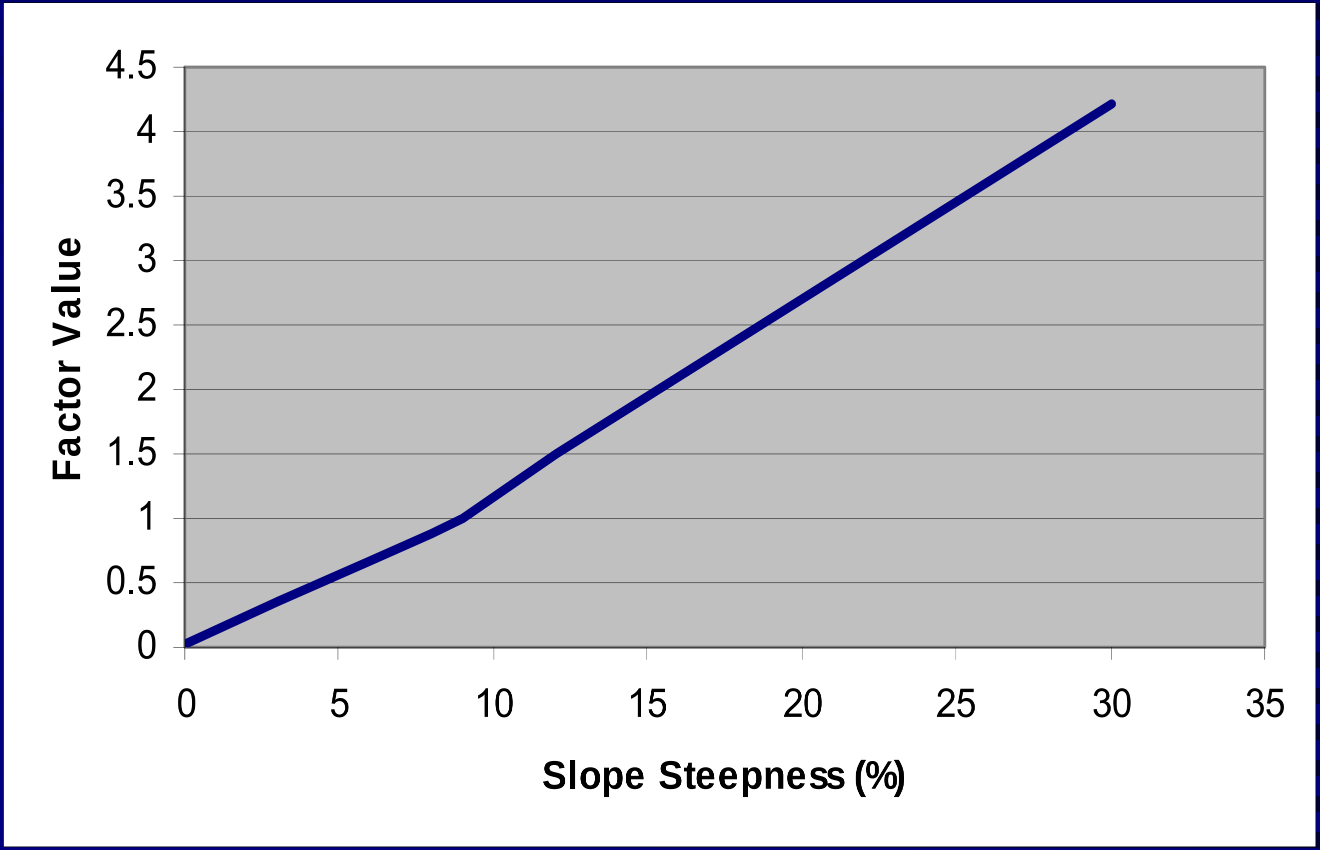
- Slope length effect
  - $l = (x/72.6)^n$
  - x = location on slope
  - n = slope length exponent
- Slope length exponent
  - Related to rill:interrill ratio
  - Slope steepness, rill:interrill erodibility, ground cover, soil biomass, soil consolidation
- Slope length factor varies on a daily basis

Slope Length Effects

- Slope length effect is greater on slopes where rill erosion is greater relative to interrill erosion
- Examples:
  - Steep slopes
  - Soils susceptible to rill erosion
  - Soils recently tilled
  - Low soil biomass

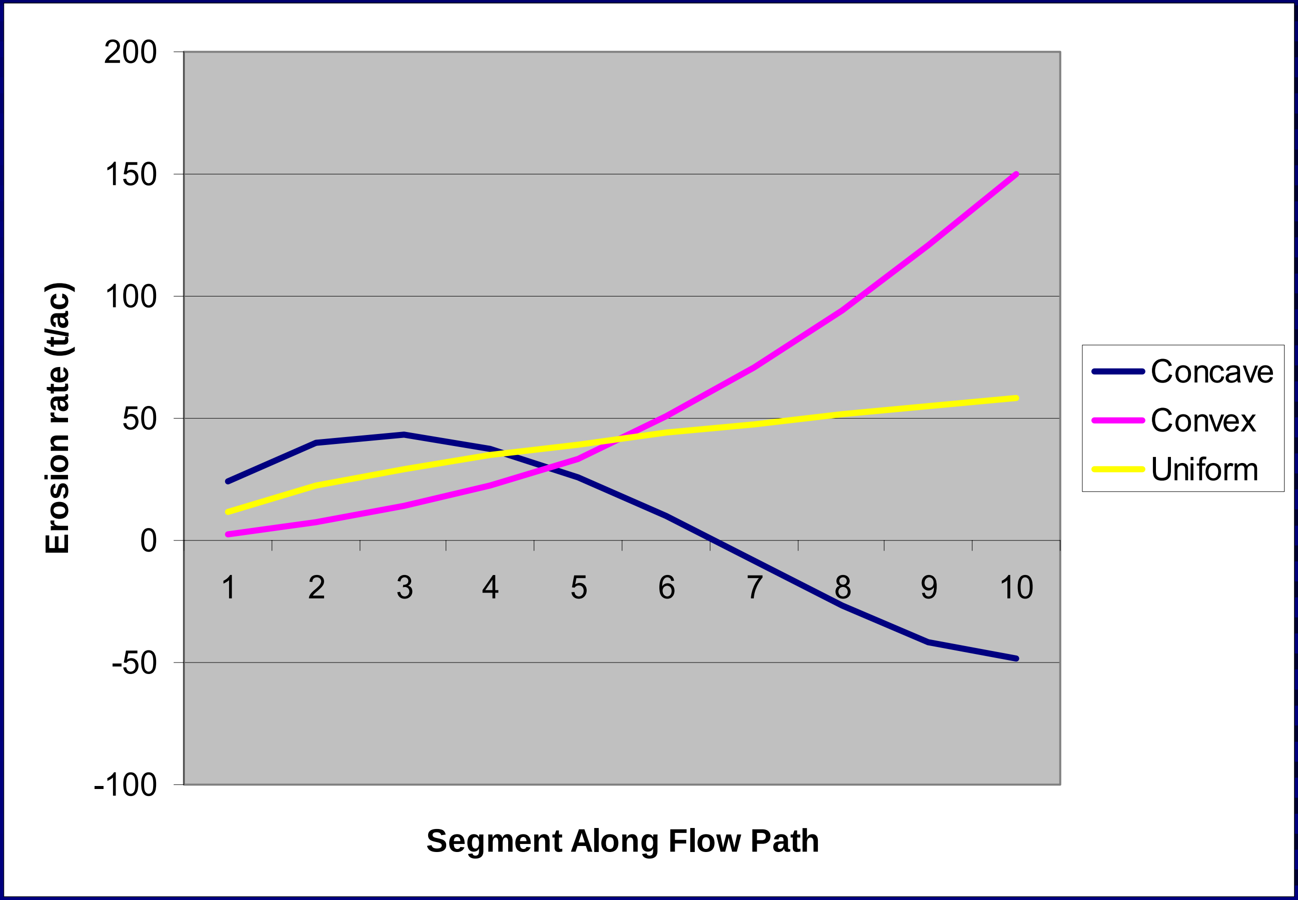
Detachment Proportional to Slope Steepness Factor

Not affected by any other variable



Effect of Slope Shape on Erosion

100 ft long, 1% to 19% steepness range



Land Use

- Cover-management
- Supporting practices

Cover-Management

- Vegetative community
- Crop
- Crop rotation
- Conservation tillage
- Application of surface and buried materials (mulch, manure)
- Increasing random roughness

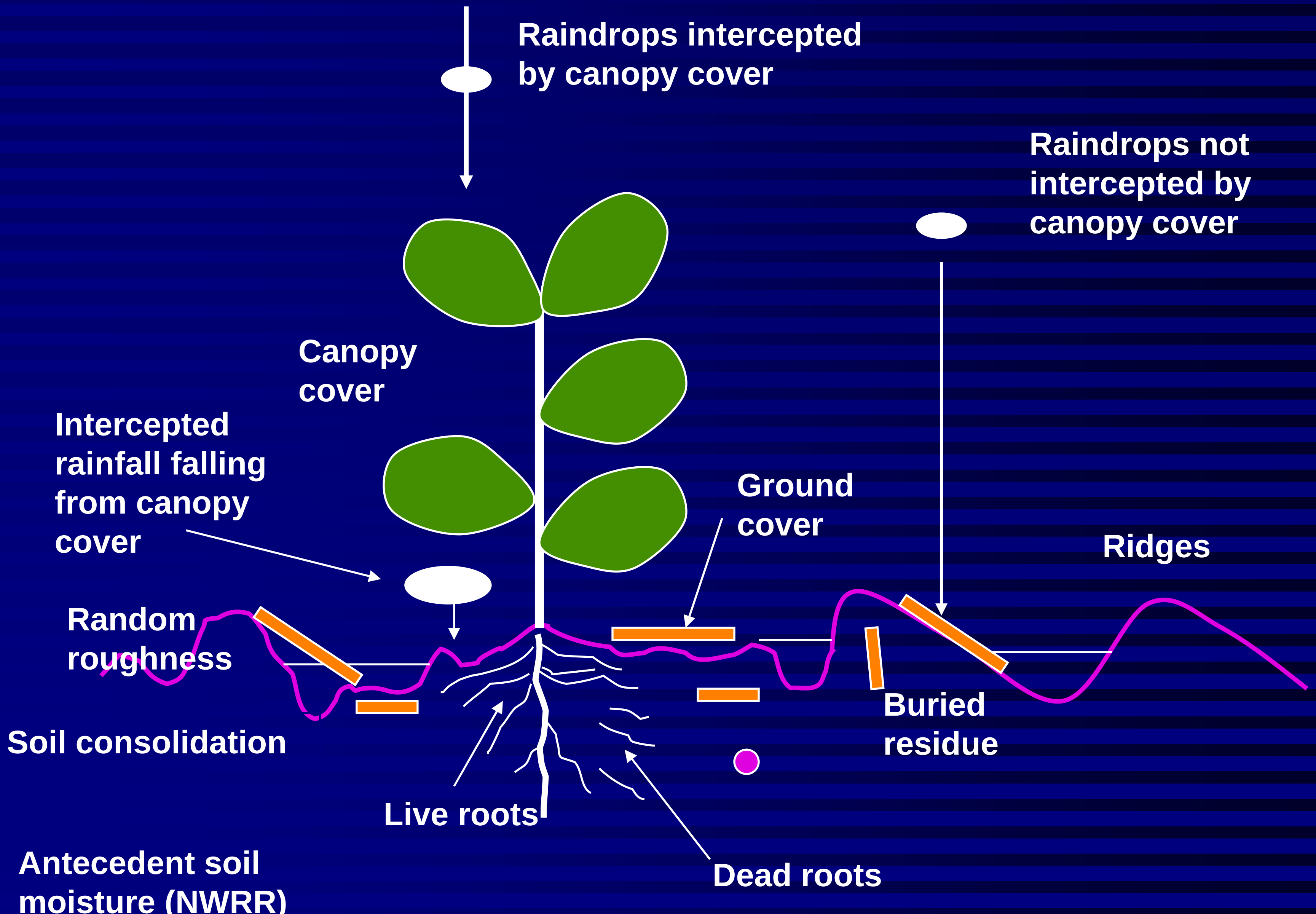
Supporting Practices

- Contouring
- Strip systems
  - Buffer, filter, strip cropping, barriers
- Terrace/Diversion
- Impoundments
- Subsurface drainage

Cover-Management Subfactors

- Canopy
- Ground cover
- Surface Roughness
- Ridges
- Below ground biomass
  - Live roots, dead roots, buried residue
- Soil consolidation
- Antecedent soil moisture (NWRR only)

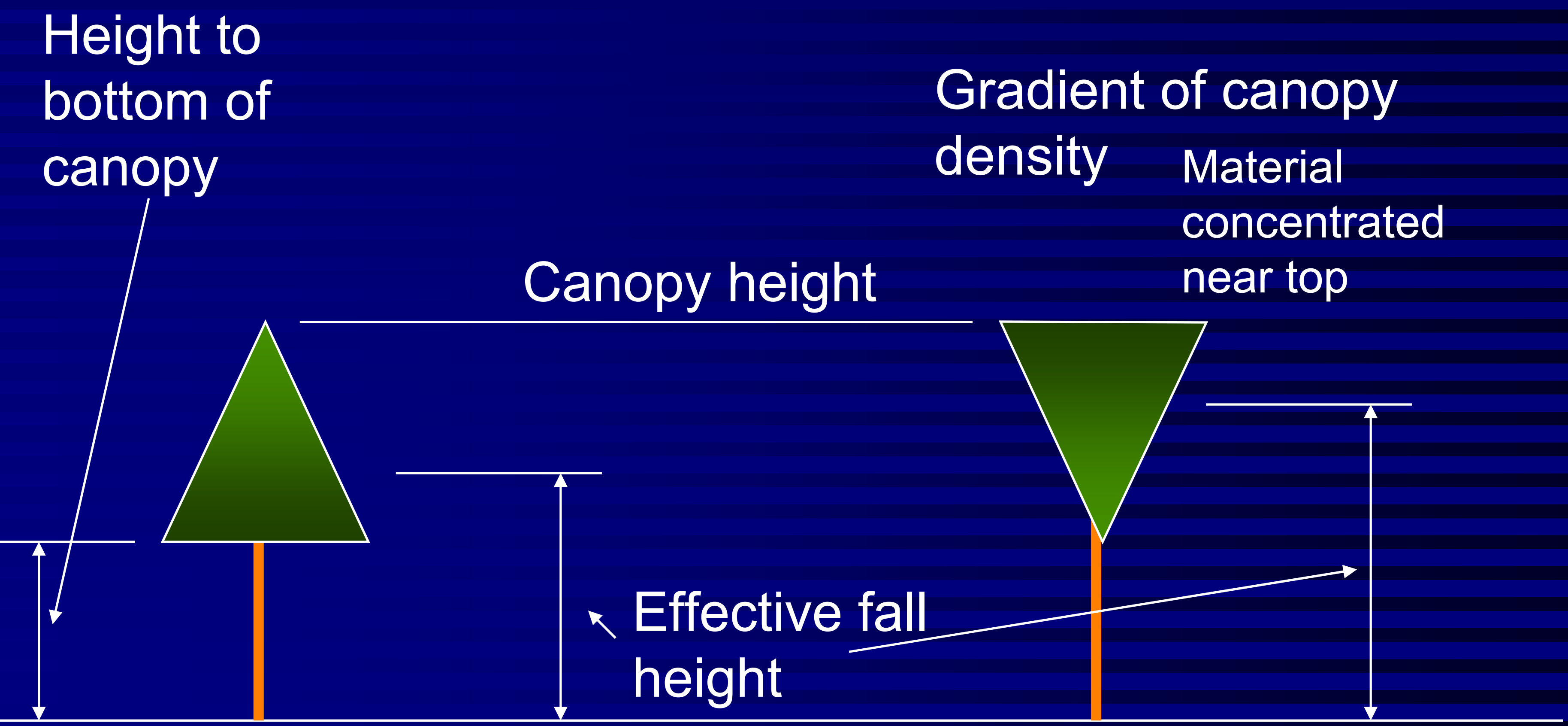
Cover-Management Effects



Canopy

- Cover above soil surface that intercepts rainfall but does not touch soil surface to affect surface flow
- Main variables
  - Percent of surface covered by canopy
  - Effective fall height

Effective Fall Height



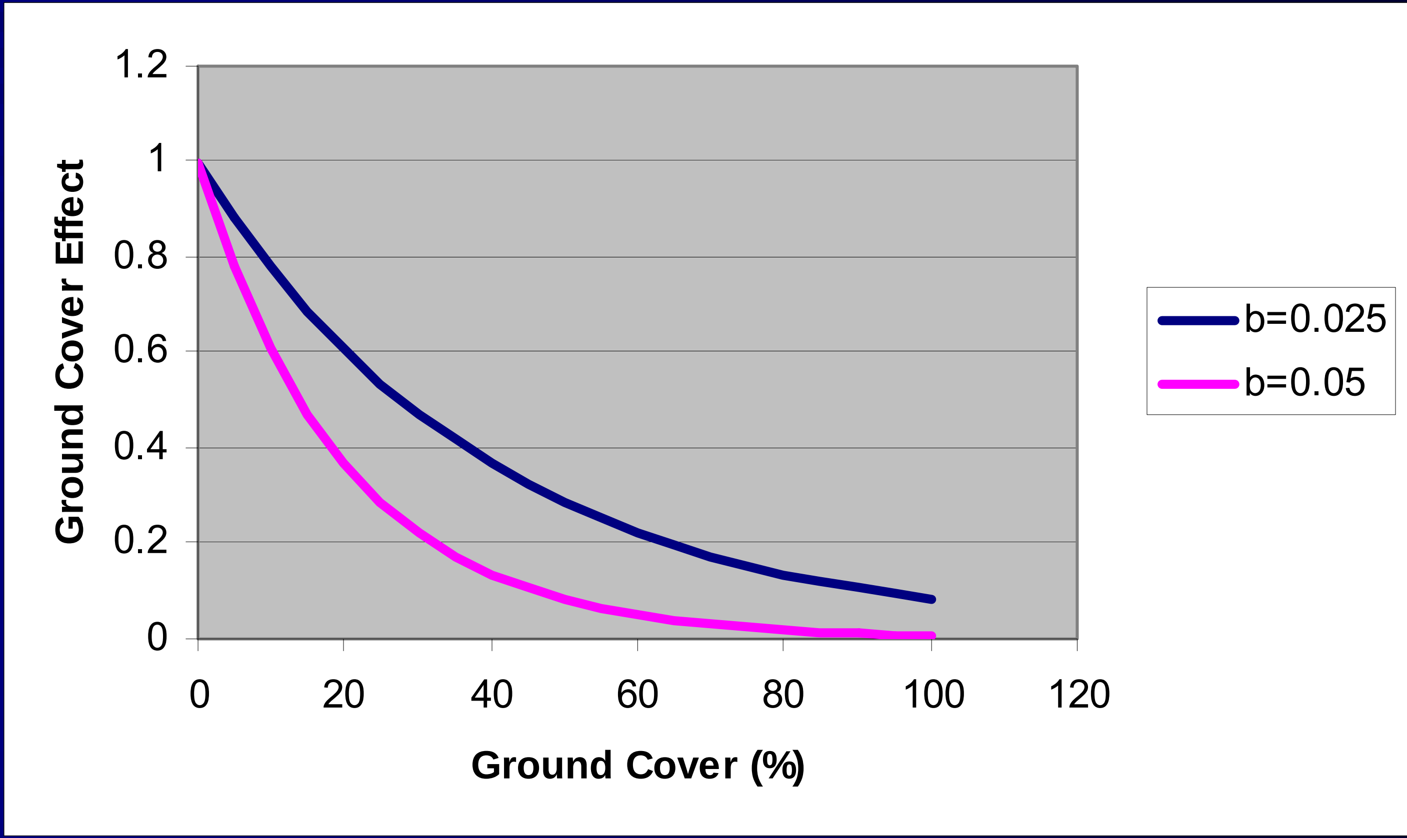
Ground Cover

- Cover directly in contact with soil surface that intercepts raindrops, slows runoff, increases infiltration
- Examples
  - Live plant material
  - Plant residue and litter
  - Applied mulch
  - Stones

Ground Cover Effect

Eff = exp(-b x %grd cov)

b greater when rill erosion more dominant than interrill erosion



Ground Cover

- Live cover depends on type of vegetation, production level, and stage
- Residue
  - Amount added by senescence, flattening, and falling by decomposition at base
  - Decomposition
    - Rainfall amount
    - Temperature

Interaction of Ground Cover and Canopy

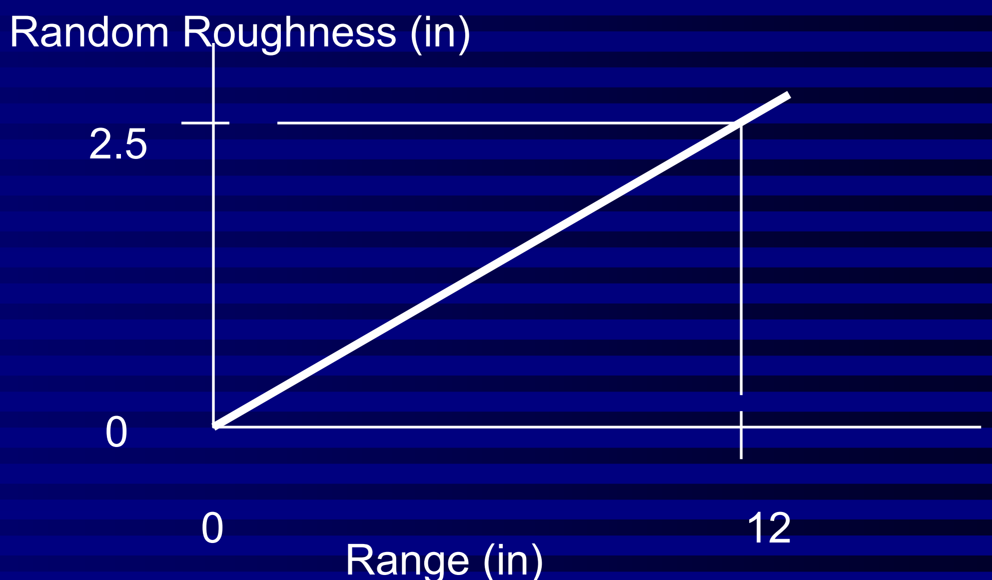
- Canopy over ground cover is considered to be non-effective
- As fall height approaches zero, canopy behaves like ground cover

Random Roughness

- Creates depressions
- Usually creates erosion resistant clods
- Increases infiltration
- Increases hydraulic roughness that slows runoff, reducing detachment and transport capacity

Random Roughness

- Standard deviation of micro-elevations
- Roughness at tillage function of:
  - Implement
  - Roughness at time of disturbance and tillage intensity
  - Soil texture
  - Soil biomass
- Decays with:
  - Rainfall amount
  - Interrill erosion



Ridges

- Ridges up and downhill increase soil loss by increasing interrill erosion
- Function of:
  - Effect increases with ridge height
  - Effect decreases with slope steepness above 6%
- Ridge height decays with rainfall amount and interrill erosion
- Effect shifts from increasing soil loss when up and downhill to decreasing soil loss when on the contour

Dead Biomass Pools

- Killing vegetation converts live standing to dead standing and live roots to dead roots
- Operations
  - Flatten standing residue to flat residue (ground cover)
  - Bury flat residue
  - Resurface buried residue
  - Redistribute dead roots in soil
  - Material spread on surface
  - Material incorporated (lower one half of depth of disturbance)
- Decomposition at base causes standing residue to fall

Decomposition of Dead Biomass

- Function of:
  - Rainfall
  - Temperature
  - Type of material
  - Standing residue decays much more slowly

Below ground biomass

- Live roots
  - Distributed non-uniformly within soil
- Dead roots
- Buried residue
  - Half of material decomposed on surface is added to upper 2 inches
  - Incorporated biomass

Effect of Below Ground Biomass

- Roots mechanically hold the soil
- Add organic matter that improves soil quality, reduces erodibility, increases infiltration
- Affect rill erosion more than interrill erosion
- Effect of roots considered over upper 10 inches
- Effect of buried residue over upper 3 inches, but depth decreases to 1 inch as soil consolidates (e.g. no-till)

Soil Consolidation

- Overall, freshly tilled soil is about twice as erodible as a fully consolidated soil
- Erodibility decreases with time
  - Seven years in the Eastern US
  - Depends on rainfall in Western US, up to 25 years

Width of Disturbance

- Width of disturbance taken into account in surface cover, random roughness, and soil consolidation

Antecedent Soil Moisture (NWRR)

- Soil loss depends on how much moisture previous cropping systems have removed from soil

Supporting Practices

- Contouring/Cross-slope farming
- Strips/barriers
  - Rotational strip cropping, buffer strips, filter strips, grass hedges, filter fence, straw bales, gravel bags
- Terraces/diversions
- Impoundments

Contouring/Cross Slope Farming

- Redirects runoff
- Fail at long slope lengths
- Effectiveness depends on ridge height
  - (no ridge height—no contouring effect)

Contouring/Cross Slope Farming (continued)

- Function of:
  - Ridge height
  - Row grade
  - Cover-management
  - Hydrologic soil group
  - Storm severity (10 yr EI)
- Varies with time
  - Tillage that form ridges
  - Decay of ridges

Critical Slope Length

- If slope length longer than critical slope length, contouring fails allowing excessive rill erosion
- Function of:
  - Storm severity, slope steepness, cover-management, EI distribution
- Critical slope length extensions below strips depend on degree that strip spreads runoff
- Terraces are used if changing cover-management or strips are not sufficient
- Soil disturbance required to restore failed contouring

Buffer/Filter Strips

- Narrow strips of dense vegetation (usually permanent grass) on contour
  - Effective by inducing deposition (partial credit) and spreading runoff
  - Most of deposition is in backwater above strip
- Buffer strips
  - Multiple strips
  - Either at bottom or not a strip at bottom
  - Water quality-must have strip at bottom and this strip twice as wide as others
- Filter strip-single strip at bottom

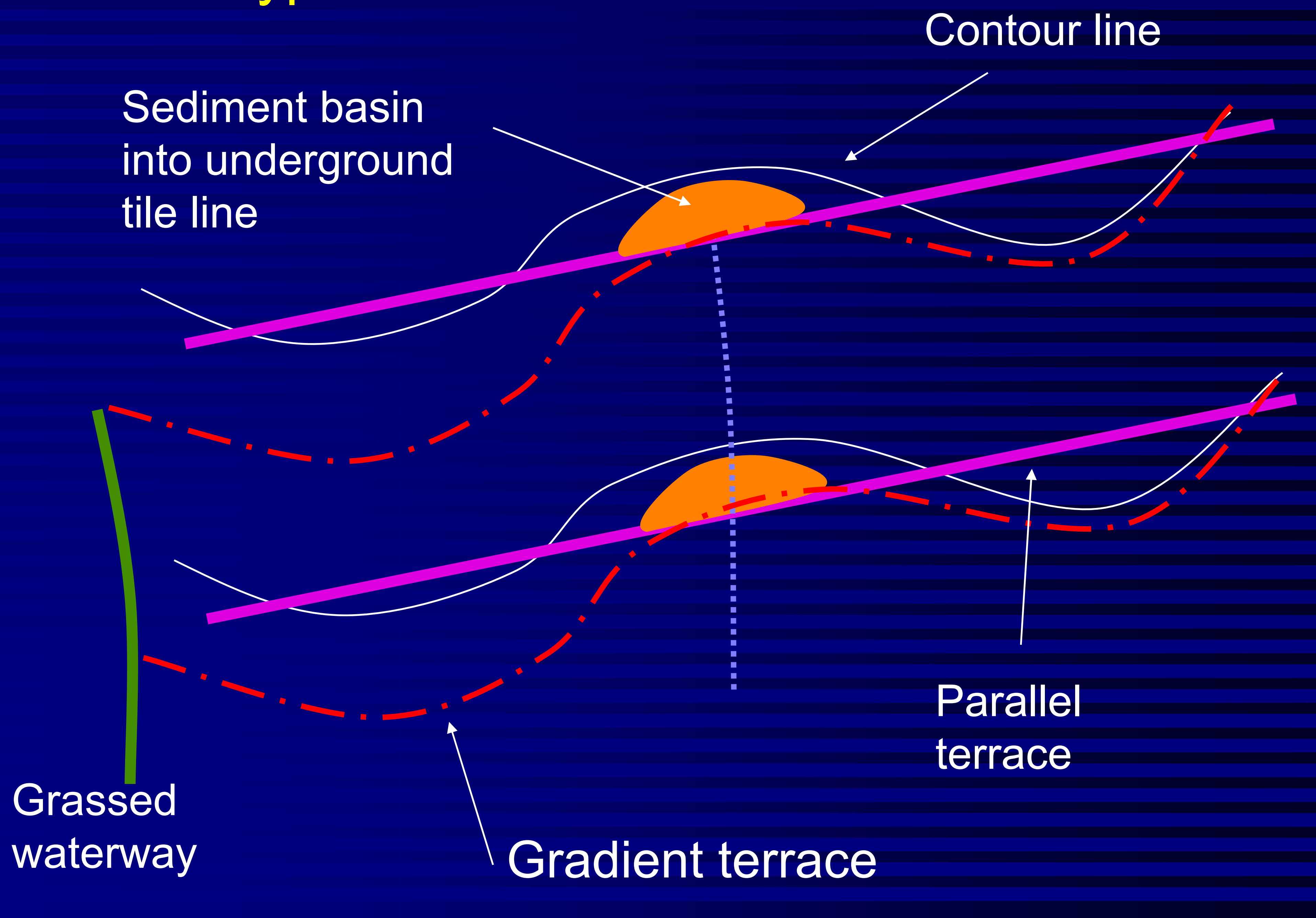
Rotational Strip Cropping

- Equal width strips on contour
- Strips are rotated through a crop rotation cycle
- Offset starting dates among strips so that strips of close growing vegetation separate erodible strips
- Benefit:
  - Deposition (full credit)
  - Spreading runoff
  - Reduced ephemeral gully erosion not credited in RUSLE2

Terraces

- Ridges and channels periodically placed along hillslope that divides hillslope into shorter slope lengths except for widely spaced parallel terraces that may have not effect on slope length
- Benefit:
  - Shorten slope length and trap sediment
  - Runoff management system
- Evenly spaced
  - May or may have a terrace at bottom
- Maintenance required to deal with deposition

Types of Terraces



Deposition in Terraces

- Deposition occurs when sediment load is greater than transport capacity
- Sediment load from sediment entering from overland area
- Transport capacity function of grade and storm erosivity
- Deposition depends on sediment characteristics
- Deposition enriches sediment in fines

Diversions

- Ridges and channels placed at strategic locations on hillslope to shorten slope length
  - Reduce runoff rate and rill erosion
- Generally designed with a steepness sufficiently steep that no deposition occurs but not so steep that erosion occurs

Impoundments (Small sediment control basins)

- Deposition by settling process
- Function of:
  - Sediment characteristic of sediment load reaching impoundment

Sequencing of Hydraulic Elements

- Hydraulic elements-channels and impoundments
- Can create a system
- Can put channels-impoundments in sequence
- Examples:
  - Tile outlet terrace—channel:impoundment
  - Impoundments in series—impoundment:impoundment

Benefit of Deposition

- Depends on type of deposition
  - Local deposition gets full credit
  - Remote deposition gets partial credit
- Credit for remote deposition
  - Depends on location on hillslope
  - Deposition at end gets almost no credit

Subsurface Drainage Systems

- Reflects effects of deep drainage systems
  - Tile drainage systems
  - Lateral, deep drainage ditches
- Describe by:
  - Assigning hydrologic soil group for undrained and drained soil
  - Fraction of area drained

Unit 5
Databases

- Worksheets
- Profiles
- Climate
- EI distribution
- Soil
- Management
- Operations
- Vegetation
- Residue

- Contouring
- Strips
- Diversion/terrace, sediment basin systems
- Sequence of hydraulic elements

Profiles

- Central part of a RUSLE2 soil loss estimate
  - Profile is reference to a hillslope profile
- Five things describe a profile
  - Location, soil, topography, management, supporting practice
  - Topography described with segments
  - Can specify segments by length and steepness for topography, segments by length for soil, segments by length for management
- Name and save with a name

Worksheets

- Three parts: Alternative managements, practices; Alternative profiles; Profiles for a field or watershed
- Alternative management, practices
  - Compare alternatives for a single hillslope profile
- Alternative profiles
  - Compare specific hillslope profiles
- Name and save worksheets

Plan View

- Profiles for a field or watershed
- Field/Watershed
  - Compute weighted average soil loss/sediment yield for a field or watershed
- Name and save plan views

Concept of Core Database

- RUSLE2 has been calibrated to experimental erosion data using assumed data values for such things as cover-mass, residue at harvest, decomposition coefficient, root biomass, burial ratios, etc.
- The data used in this calibration are core calibration values
  - Data used in RUSLE2 applications must be consistent with these values
- Core databases were set up for vegetation, residue, and operations
  - NRCS data manager maintains these databases
- Working databases developed from the core databases

Critical RUSLE2 Rules

- **RUSLE2 DEFINITIONS, RULES, PROCEDURES, and CORE DATA MUST BE FOLLOWED FOR GOOD RESULTS.**
- **Can’t independently change one set of data without recalibrating.**
- **Must let RUSLE2 factors and subfactors represent what they were intended to represent.**
  - **For example, the K factor values are not to be modified to represent the effect of organic farming. The cover-management subfactors represent the effects of organic farming.**
- **Don’t like these rules—then don’t use RUSLE2 because results won’t be good.**

Climate

- Input values for values used to described weather at a location, county, management zone
- Principal values
  - Erosivity density value, 10 yr 24 hr precip, monthly precip, monthly temperature
- Designate as Req zone and corresponding values
- Data available from NRCS
- Name and save by location, county average, or precip zone

Soil

- Data describes base soil conditions for unit plot conditions
- Data include erodibility value, soil texture, hydrologic soil group of undrained soil, hydrologic soil group of drained soil, time to full soil consolidation, rock cover
- Erodibility nomograph available to estimate soil erodibility factor K
- Data available from NRCS soil survey database
- Name and same

Management

- Array of dates, operations, vegetations
- Specify if list of operations is a rotation
  - Rotation is a cycle when operations begin to repeat
  - Rotations used in cropping
  - Rotations often not used immediately after land disturbances like construction and logging during recovery period
  - Length of rotation
- Yield, (depth and speeds of operations optional)
- Added materials and amounts
- NRCS databases, Extension Service
- Name and save

Operations

- Operations describe events that change soil, vegetation, and residue conditions
- Mechanical soil disturbance, tillage, planting, seeding, frost, burning, harvest
- Describe using effects and the sequence of effects
- Speed and depth
- Source of data: Research core database, NRCS core database, working databases
- Name and save

Operation Effects

- No effect
- Begin growth
- Kill vegetation
- Flatten standing residue
- Disturb surface
- Live biomass removed
- Remove residue/other cover
- Add other cover
- Add nonerodible cover
- Remove nonerodible cover

Operation Effects (cont)

- No effect
  - Primarily used to obtain output at particular times or to add fallow years when not operation occurs in that year
- Begin growth
  - Tells RUSLE2 to begin using data for particular vegetation starting at day zero
  - Typically associated with planting and seeding operations
- Kill vegetation
  - Transfers mass of above ground live vegetation into standing residue pool
  - Transfers mass live roots into dead root pool
  - Typically used in harvest and plant killing operations

Operation Effects (cont)

- Flatten standing residue
  - Transfer residue mass from standing pool to flat, ground surface pool
  - Based on a flattening ratio that is a function of residue type
  - Used in harvest operations to determine fraction of residue left standing after harvest
  - Used in tillage and other operations involving traffic to determine fraction of residue left standing after operation

Operation Effects (cont)

- Disturb surface
  - For mechanical soil disturbance that loosens soil
  - Tillage type (inversion, mixing+some inversion, mixing only, lifting fracturing, compression) determines where residue is placed in soil and how residue and roots are redistributed within soil
  - Buries and resurfaces residue based on ratios that depend on residue type
  - Tillage intensity (degree that existing roughness is obliterated)
  - Recommended, minimum, maximum depths
  - Initial ridge height
  - Initial, final roughness (for the base condition)
  - Fraction surface area disturbed (tilled strips)

Operation Effects (cont)

- Live biomass removed
  - Fraction removed
  - Fraction of that removed that is “lost” and left as ground cover (flat residue)
  - Used with hay and silage harvest operations
- Remove residue/other cover
  - All surface residues affected or only most recent one?
  - Fraction of standing cover removed
  - Fraction of flat cover removed
  - Used in baling straw, burning operations

Operation Effects (cont)

- Add other cover
  - Fraction added to surface versus fraction placed in soil
  - Unless all mass added to surface, must be accompanied by disturbed soil effect (that is, mass can not be placed in soil without disturbance)
  - Mass placed in soil is placed between ½ and maximum depth
  - Used to add mulch and manure to surface, inject manure into soil

Operation Effects (cont)

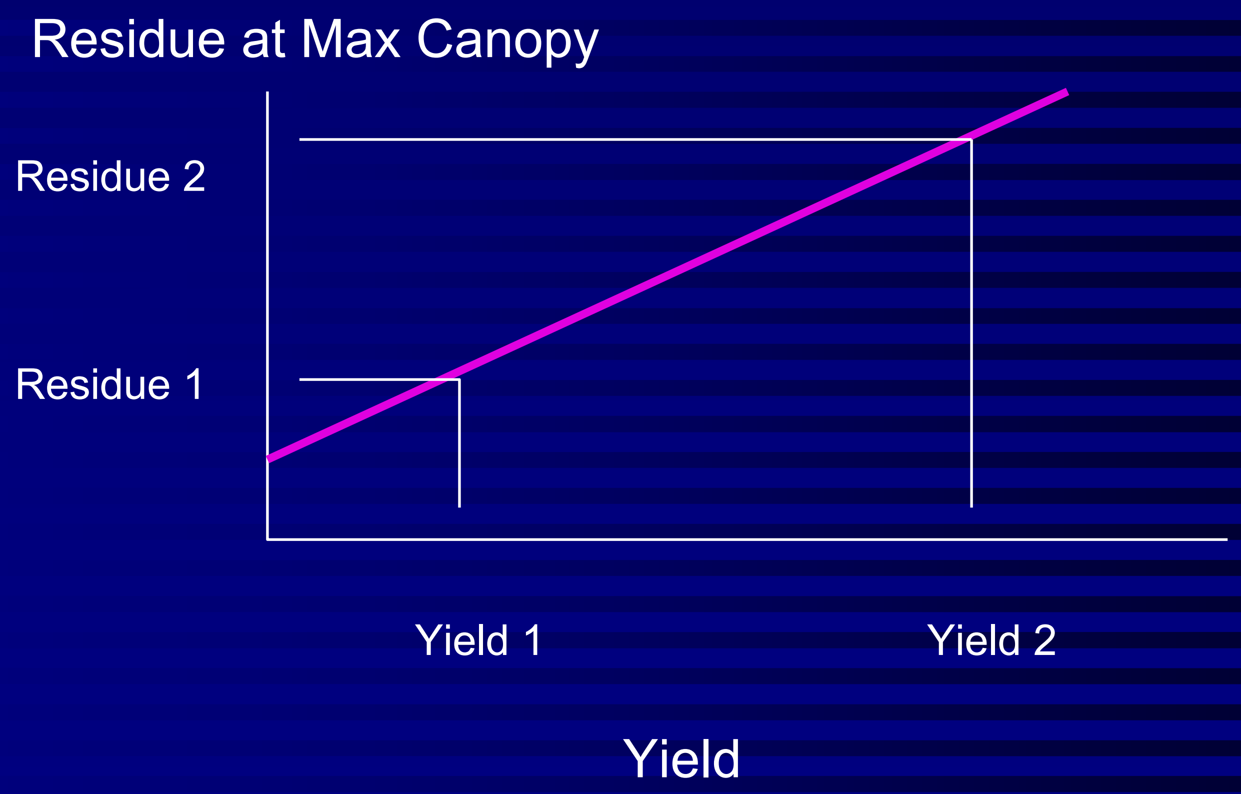
- Add nonerodible cover
  - Erosion zero for portion of surface covered
  - Cover decays over time
  - Used with plastic cover, water cover, snow cover to eliminate erosion
- Remove nonerodible cover

Vegetation

- Live plant material
- Static variables include:
  - Residue name, yield, retardance, senescence, moisture depletion for NWRR
- Time varying variables
  - Root biomass in upper 4 inches
  - Canopy cover percent
  - Fall height
  - Live ground (surface) cover cover percent
- Source of data: Research core database, NRCS core database, working databases
- Name and save

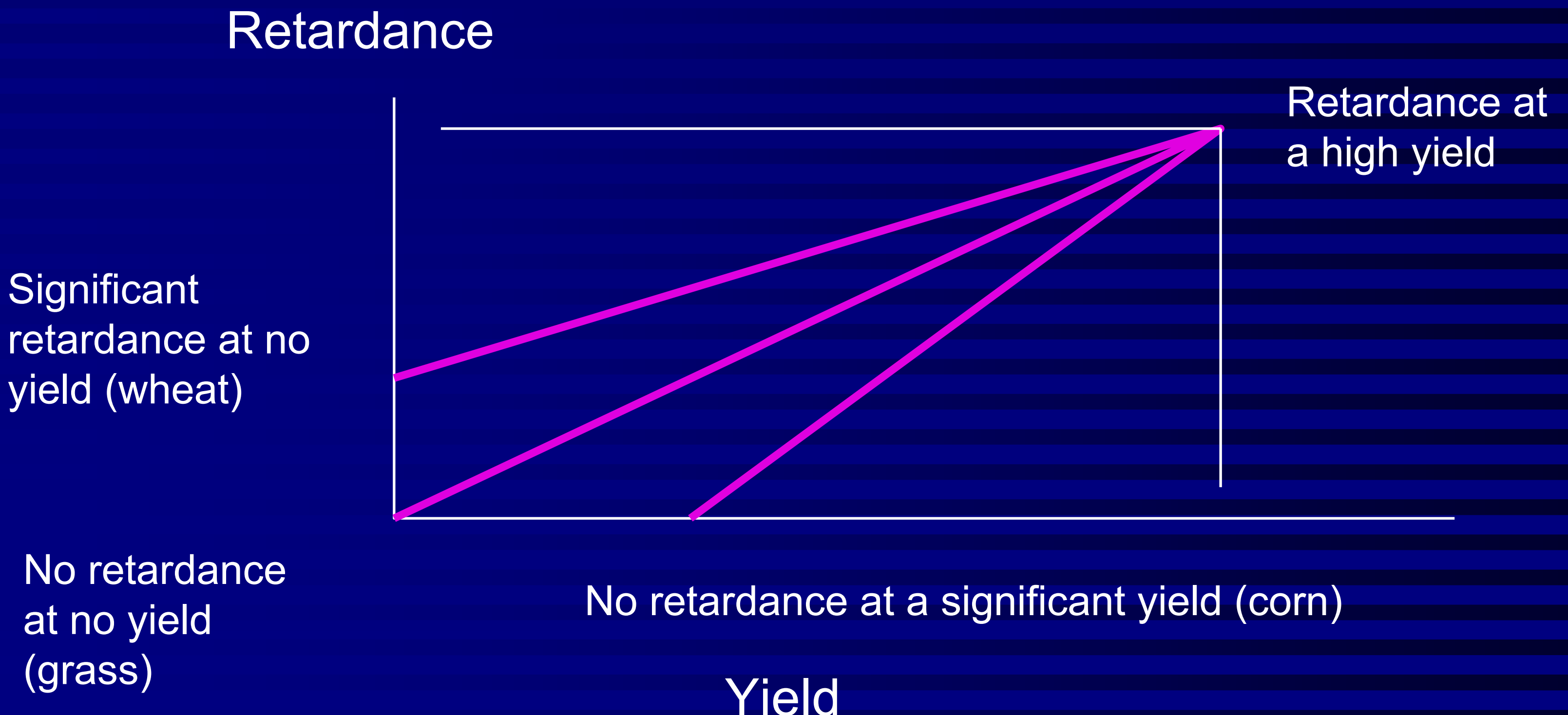
Yield-Residue Relationship

- Residue at max canopy function of yield



Yield-Retardance Relationship

- Retardance function of yield, on contour, and up and down hill



Retardance for Up and Downhill

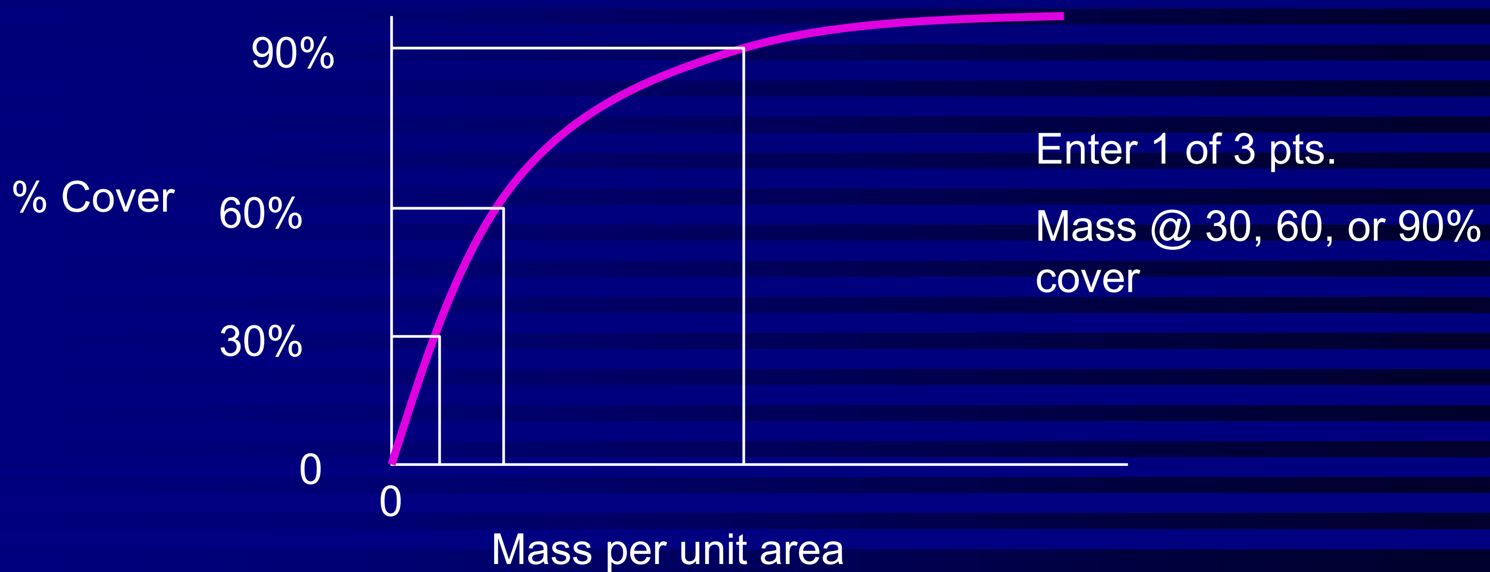
- RUSLE2 chooses retardance based on row spacing and the retardance selected for a strip of the vegetation on the contour
  - How does vegetation slow the runoff?
- Row spacing
  - Vegetation on ridge-no retardance effect
  - Wide row-no retardance effect (> 30 inches spacing)
  - No rows, broadcast-same as strip on contour
  - Narrow row-small grain in about 7 inch spacing
  - Very narrow-same as narrow row except leaves lay in row middle to slow runoff
  - Moderate-about 15 to 20 inches spacing

Long Term Vegetation

- Constructs growth data
- Starts from zero and evolves to mature condition
- Data varies in a cyclic pattern
- Timing of pattern can be varied
- Ratios of annual root biomass production to above ground annual biomass available in program for several rangeland plant communities

Residue

- Size, toughness
  - 5 types: small, fragile (soybeans); moderate size, moderately fragile (wheat); large size, nonfragile (corn); large size, tough (woody debris); gravel, small stones
- Decomposition (coefficient, halflife)
- Mass-cover values
- Source: NRCS databases
- Name and save



Senescence

- Input the fraction of the biomass at max canopy that falls to soil surface when canopy decreases from its max value to its min value.
- Input the minimum canopy value that corresponds to fraction that experiences senescence
- Mass that falls is computed from difference in canopy percentages and nonlinear relationship between canopy percent and canopy mass

Contouring/Cross Slope Farming

- To have contouring, must have ridge heights
  - To have ridge height, must have operation
  - Ridge height assigned in operation
- Row grade
  - Relative row grade (preferred) or absolute
- Create contouring practices based on relative row grade (row grade/land slope)
  - Perfect (0%), exceeds NRCS specs (5%), meets specs (10%), Cross slope (25%), Cross slope (50%)
- Name and save contouring practice

Strips/Barriers

- Types
  - Filter, buffer, rotational strip cropping
- Filter
  - Specify width and management on strip
- Buffer
  - Specify number, whether strip at bottom, for erosion or water quality control, width, strip management
- Rotational strip cropping
  - Specify number, timing of rotation on each strip
- Name and save

Hydraulic Elements and Their Sequence

- Channels
  - Specify grade
- Impoundments
  - Nothing to specify
- Specific order of elements
- Name and save sequence

System of Hydraulic Elements

- System composed of named sequence of hydraulic elements
- Number of systems on overland flow path
- Is the last one at the end of the overland flow path?
- Name and save systems

Subsurface Drainage Systems

- Represented by:
  - Hydrologic soil group for soil when it is well drained
    - Entered in soil input
  - Fraction of area that is drained
- Name and save

UNIT 6

Applicability

LIMITS OF APPLICABILITY

- How well does RUSLE apply to this situation?
  - Erosion Processes
  - Land Uses
  - Geographic Regions
  - Temporal Scale
  - Uncertainty in computed values

APPLICABLE PROCESSES

- Yes: Interrill and rill erosion
- Yes: Sediment yield from overland flow slope length
- Yes: Sediment yield from terrace channels and simple sediment control basins
- No: Ephemeral or permanent incised gully erosion
- No: Stream channel erosion
- No: Mass wasting

Applicable Land Uses

- All land uses where overland flow and interrill-rill erosion occurs
- Land use independent
- Best: Cropland
- Moderate: Disturbed lands like military lands, construction sites, landfills, reclaimed lands
- Acceptable: Rangelands, disturbed forestlands, parks and recreational areas

Cropland Applications

- Best: Clean tilled corn, soybean, wheat crops
- Moderate: Conservation tillage, rotations involving hay
- Acceptable: Hay, pasture
- Most variable: Support practices, especially contouring

MOST APPLICABLE GEOGRAPHIC REGIONS

- Rainfall occurs regularly
- Rainfall predominant precipitation
- Rainfall exceeds 20 inches
- Northwest Wheat and Range Region (NWRR) special case
- West problem area because of infrequent storms and snow cover in higher elevation

APPLICABLE SOILS

- Best: Medium Texture
- Moderate: Fine Texture
- Acceptable: Coarse Texture
- **NO**: Organic

APPLICABLE TOPOGRAPHY

- Slope Length
  - Best: 50 - 300 feet
  - Moderate: 0 - 50 ft , 300 - 600 ft.
  - Acceptable: 600 - 1000 feet
  - **NO**: >1000 feet

APPLICABLE TOPOGRAPHY

- Slope Steepness
  - Best: 3 - 20%
  - Moderate: 0 - 3%, 20 - 35%
  - Acceptable: 35 - 100%
  - **NO**: >100%

UNCERTAINTY

Confidence in Result

- Best (±25%): 4 < A < 30 t/ac/yr
- Moderate (±50%): 1 < A < 4
  30 < A < 50
- Least (>±100%): A < 1
  (>±50%): A > 50

Significant Change

- Rule of thumb:
  - A change in a RUSLE2 soil loss estimate by more than 10% is considered significant and meaningful in terms of representing main effect.
  - An change less than 10% is not considered significant in general
- The accuracy for RUSLE2 representing how main effects affect soil loss is much better than the absolute accuracy for RUSLE2 estimating soil loss at any particular location and landscape condition.

TEMPORAL APPLICABILITY

- Best: Average annual, average annual season, average annual single day
- Least: Single storm provided great care used, generally not recommended

Sensitivity

- Change in soil loss per unit change in a particular variable
- Select a base condition
- Vary input values for a variables about base condition
- Sensitivity varies according to condition
- Variables with greatest sensitivity require greatest attention

Examples of Sensitivity

- Some variables have a linear effect
  - Erosivity factor R
  - Slope steepness
- Effect of most variables is nonlinear
  - Ground cover
  - Below ground biomass
  - Roughness

Examples of Sensitivity (cont)

- Low sensitivity
  - Slope length at flat slopes (0.5%) A= 4.6 t/a at λ = 150 ft, 5.2 t/a at λ = 500 ft, 5.5 t/a at κ = 1000 ft
- Moderate sensitivity
  - Slope length at steep slopes (20%) A = 129 t/a at λ = 50 ft, A = 202 t/a at λ = 100 ft, A = 317 t/a at λ = 200 ft.

Examples of Sensitivity (cont)

- High sensitivity-Ground cover single most important
  - Adding mulch
- Most variables interrelated
  - Ground cover at planting not as much as expected
- Sequence of operations
  - Effect of depth for a tandem disk
  - Depends on whether proceeded by moldboard plow

SUMMARY

- RUSLE varies in its applicability
- Results from RUSLE must be judged
- Degree of confidence in results varies