# Environmentally Sensitive Maintenance for Dirt, Gravel, and Low-Volume Roads

PennState
Center for Dirt and Gravel Road Studies

PA State Conservation Commission

PA Dept. of Conservation and Natural Resources
Forestry

# Road Banks

**ESM Modules**

Introduction
**Orientation**
Low Volume Roads
ESMP Intro
Off ROW
Geosynthetics
Road Base
Entrenched Roads
**Road Banks**
Stream Crossings
Stream Stabilization
Surface Maintenance
Ditches
Ditch Outlets
Infiltration
Road Surface

## ENABLE YOU TO RECOGNIZE:

- **Factors that effect the bank stability.**
- **Problems associated with traditional maintenance practices.**
- **Environmentally Sensitive Maintenance practices (ESMPS) for bank stabilization.**

# Road Banks

Introduction

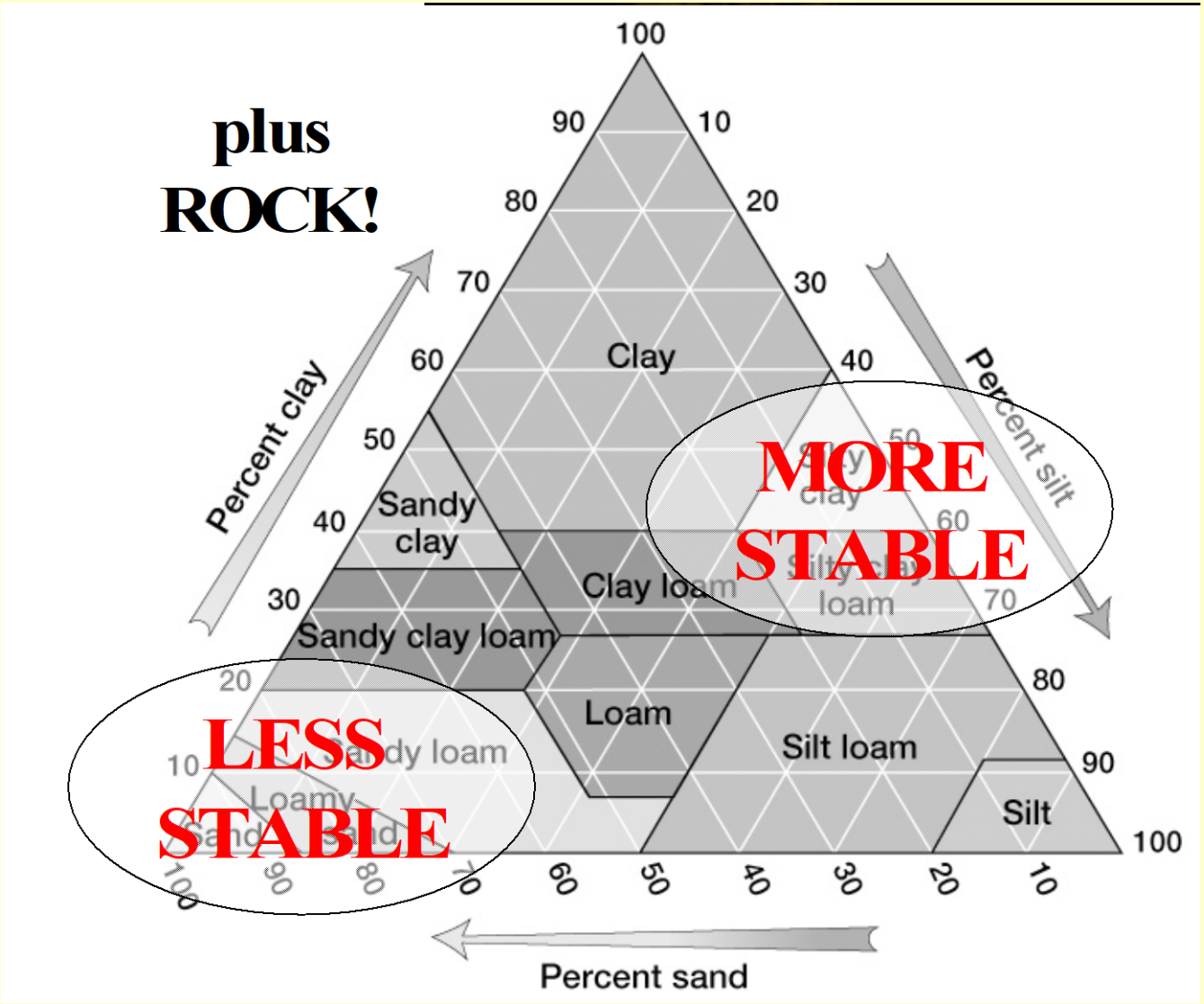
Traditional Road Maintenance Practices

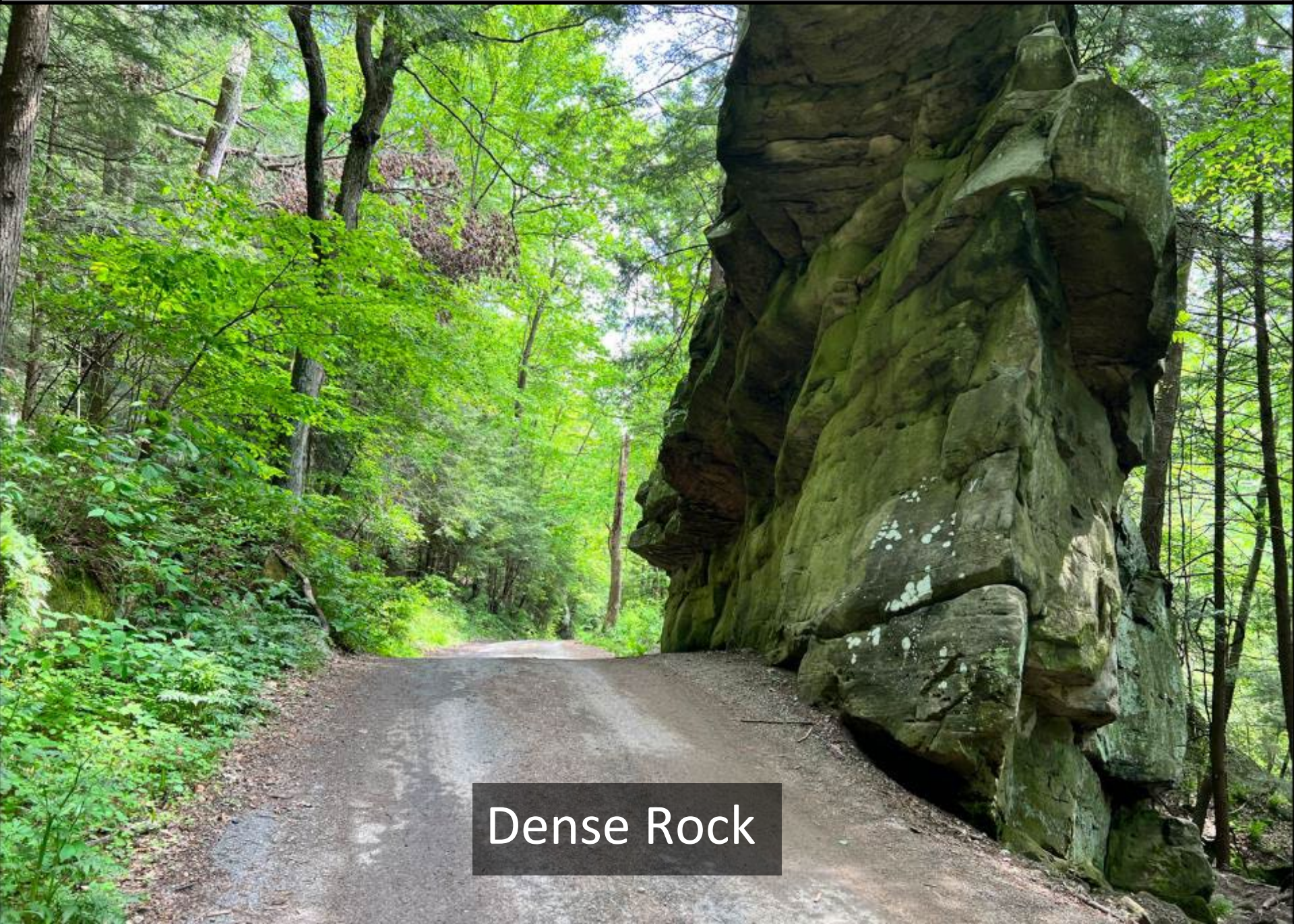
Environmentally Sensitive Maintenance Practices

# What makes a stable bank?

- **Bank Material**
- Slope
- Hydrology
- Vegetation

**Combination** of soil, organics, and rock that makes up the land surrounding the road




Dense Rock


Loamy Sand

# What makes a stable bank?

- Bank Material
- **Slope**
- Hydrology
- Vegetation

# Road Banks: Introduction

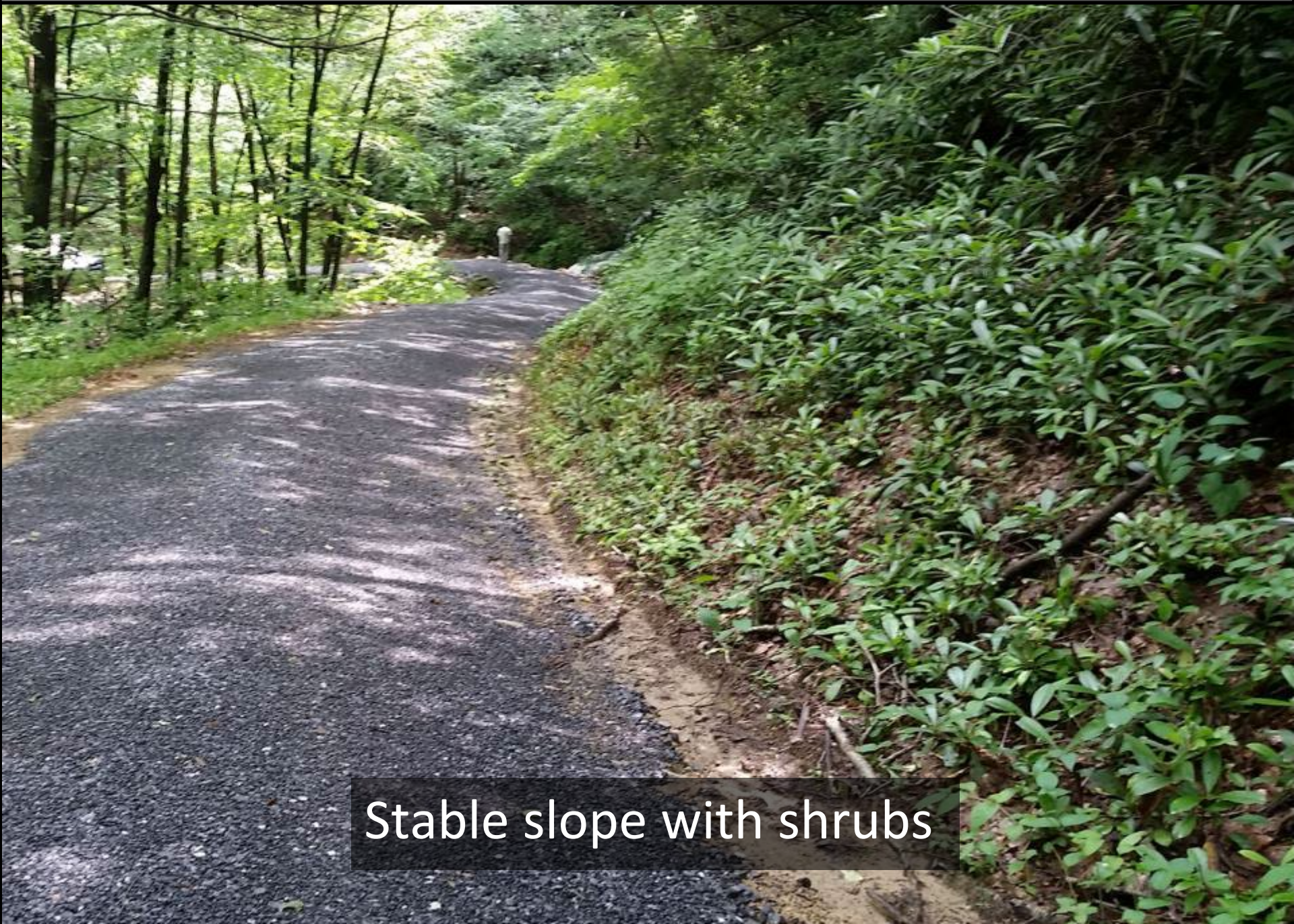
## Slope


**How do you determine a stable slope angle for your bank?**

**LOOK AROUND!**

**Look at stable slopes nearby that have the same soil and cover.**


Stable slope with grass


Stable slope with shrubs


Stable slope with trees – unstable without

# What makes a stable bank?

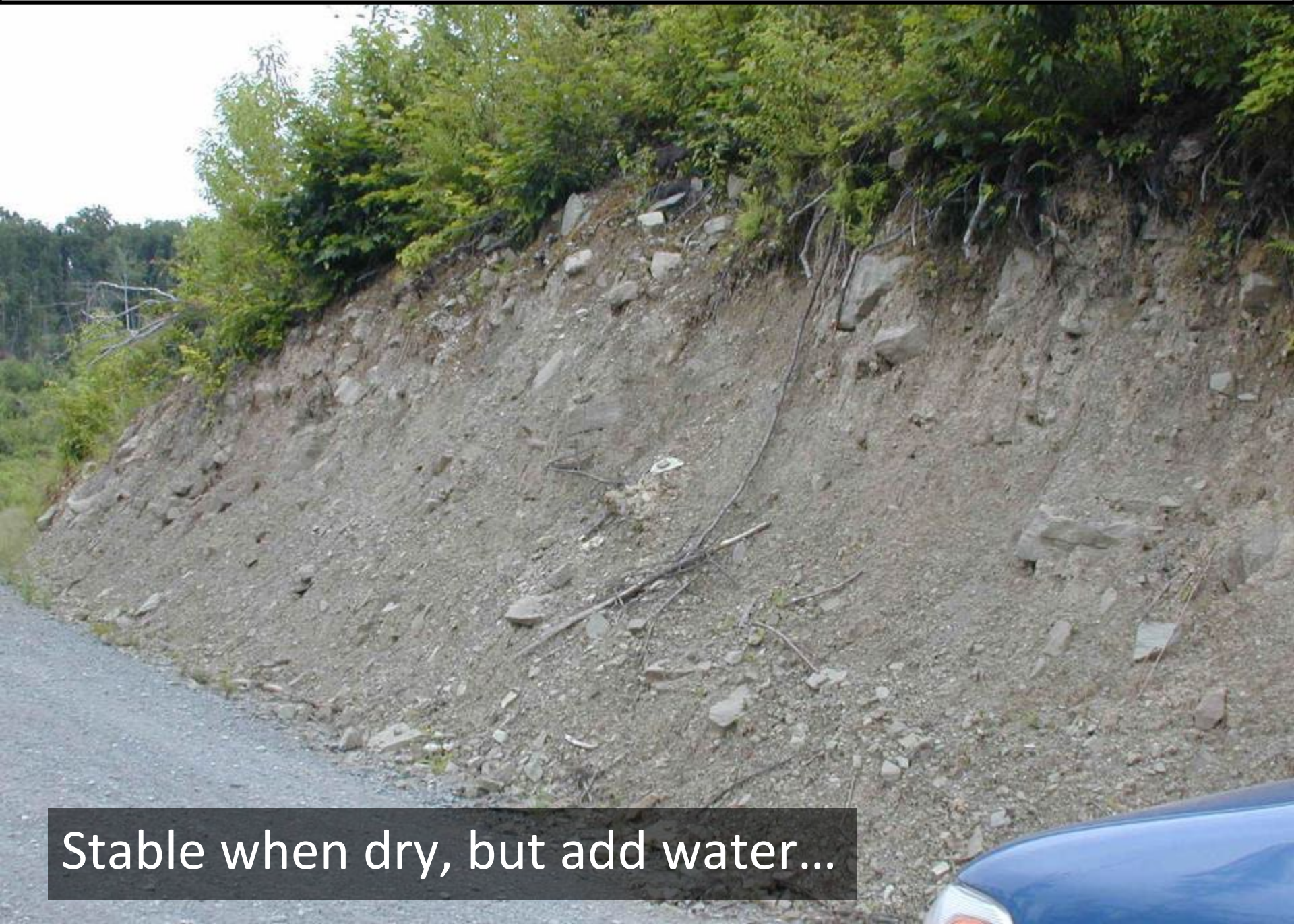
- Bank Material
- Slope
- **Hydrology**
- Vegetation


Always note wet banks

Steep wet banks can spell trouble

# What makes a stable bank?

- Bank Material
- Slope
- Hydrology
- **Vegetation**


Stable when dry, but add water…

Dense vegetation reduces impact and surface erosion


Good woody vegetation binds soils together

# What makes a stable bank?

**A combination of:**

- Bank Material
- Slope
- Hydrology
- Vegetation

# Road Banks

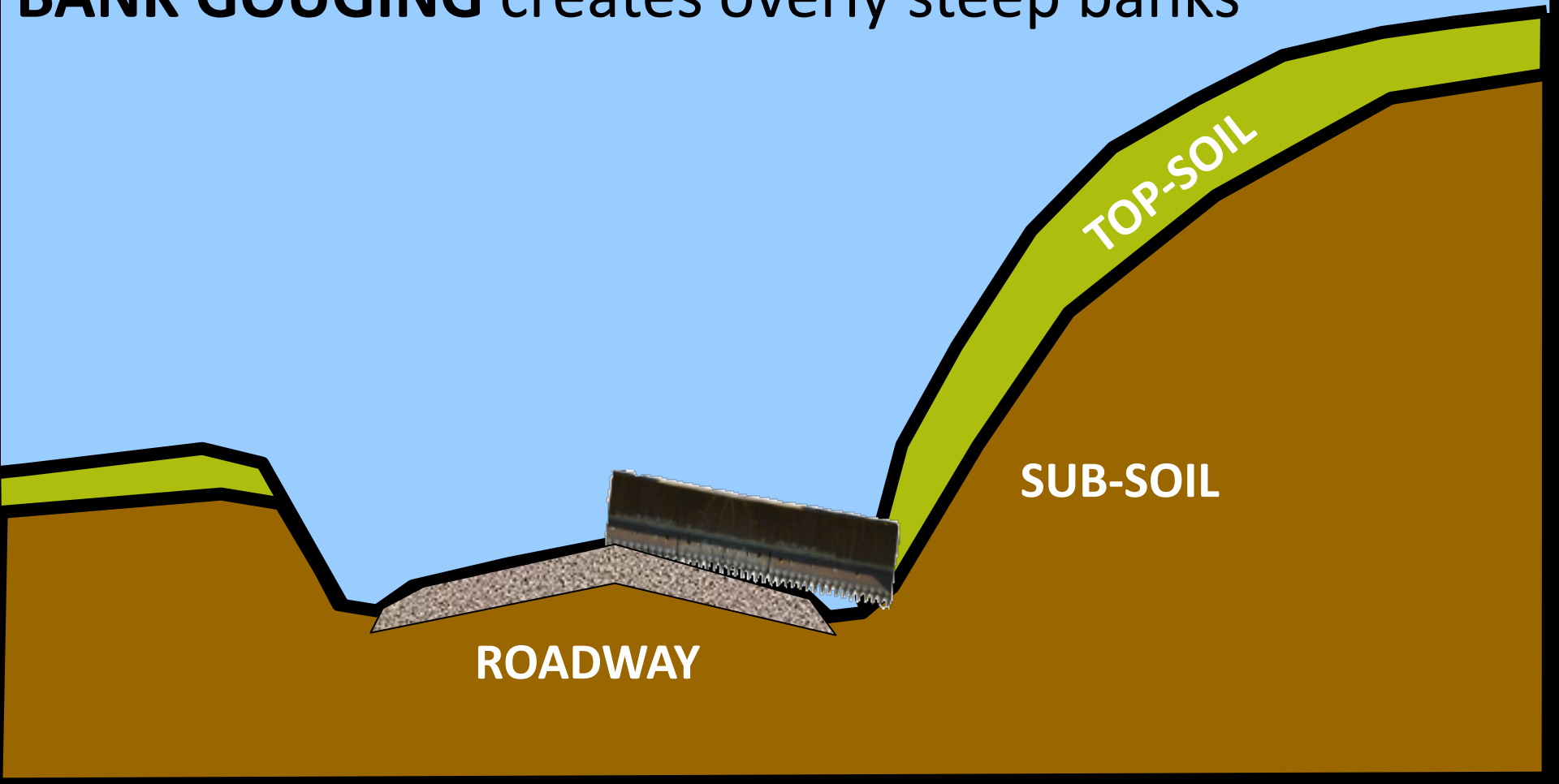
Introduction

Traditional Road Maintenance Practices

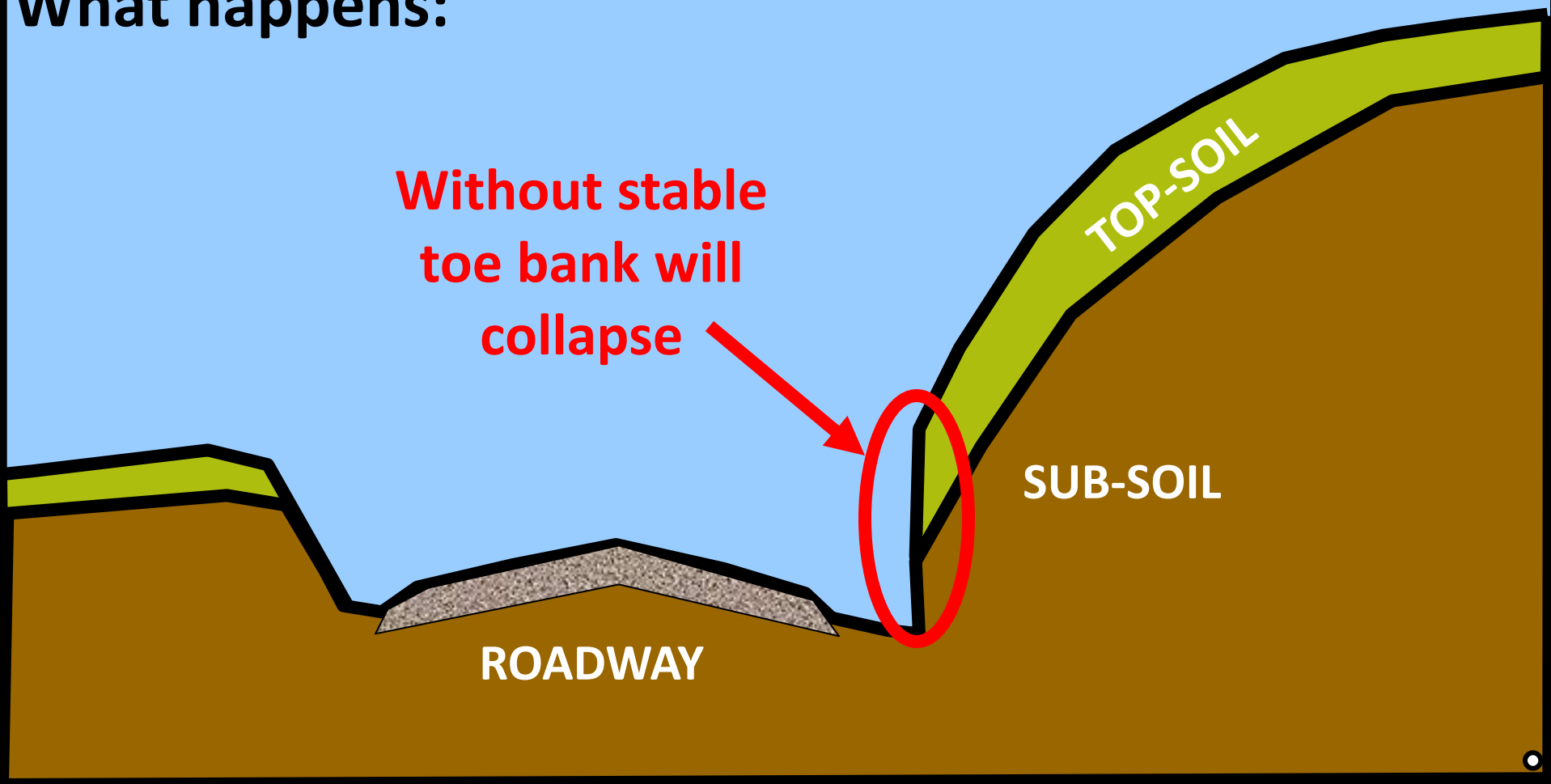
Environmentally Sensitive Maintenance Practices

- **Bank Gouging (toe removal)**
- Laying Banks Back (Soil Removal)
- Vegetation Removal

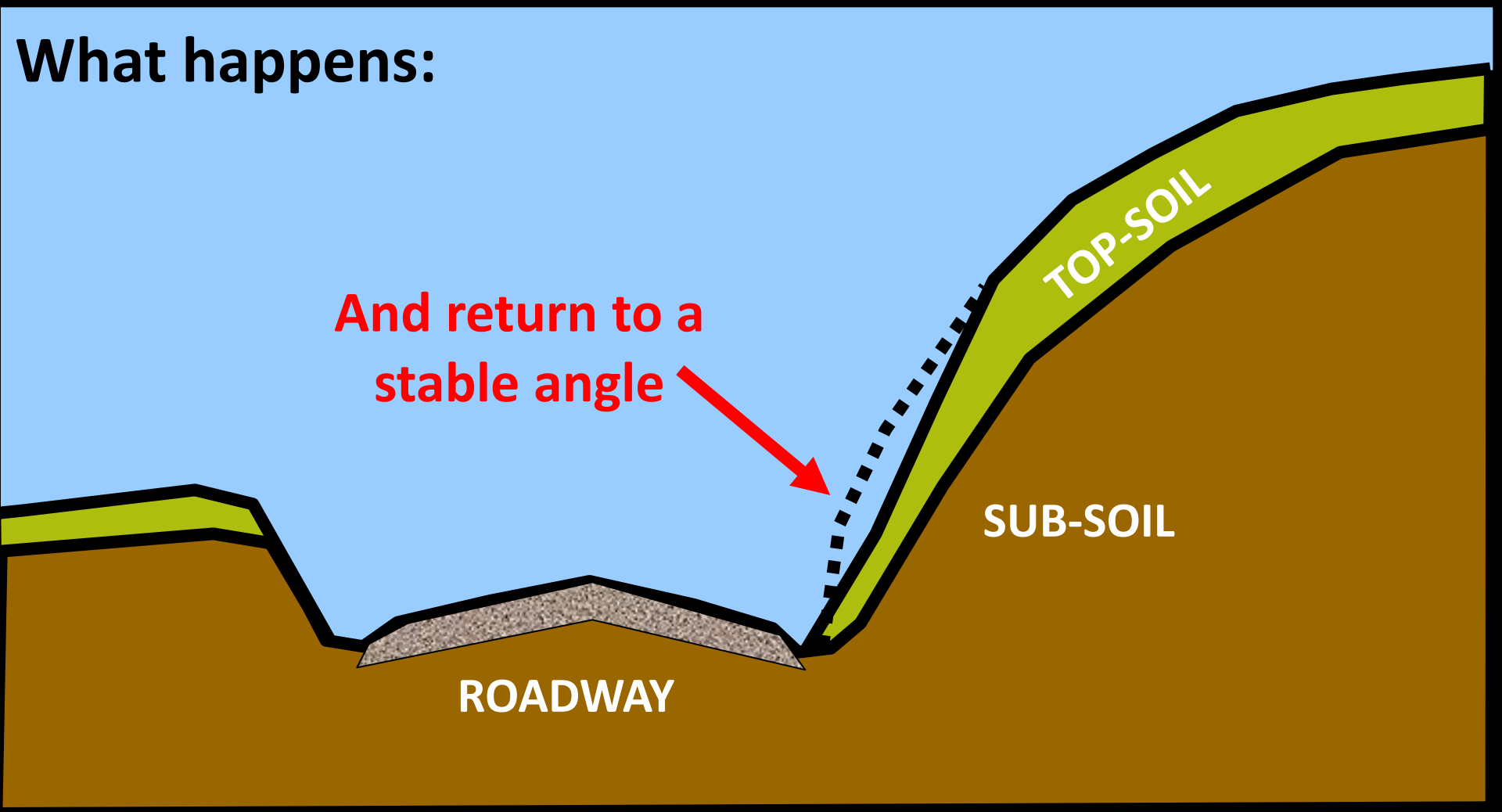
**BANK GOUGING** creates overly steep banks



# What happens:



# What happens:



## Bank Gouging

## WHY IS IT DONE?

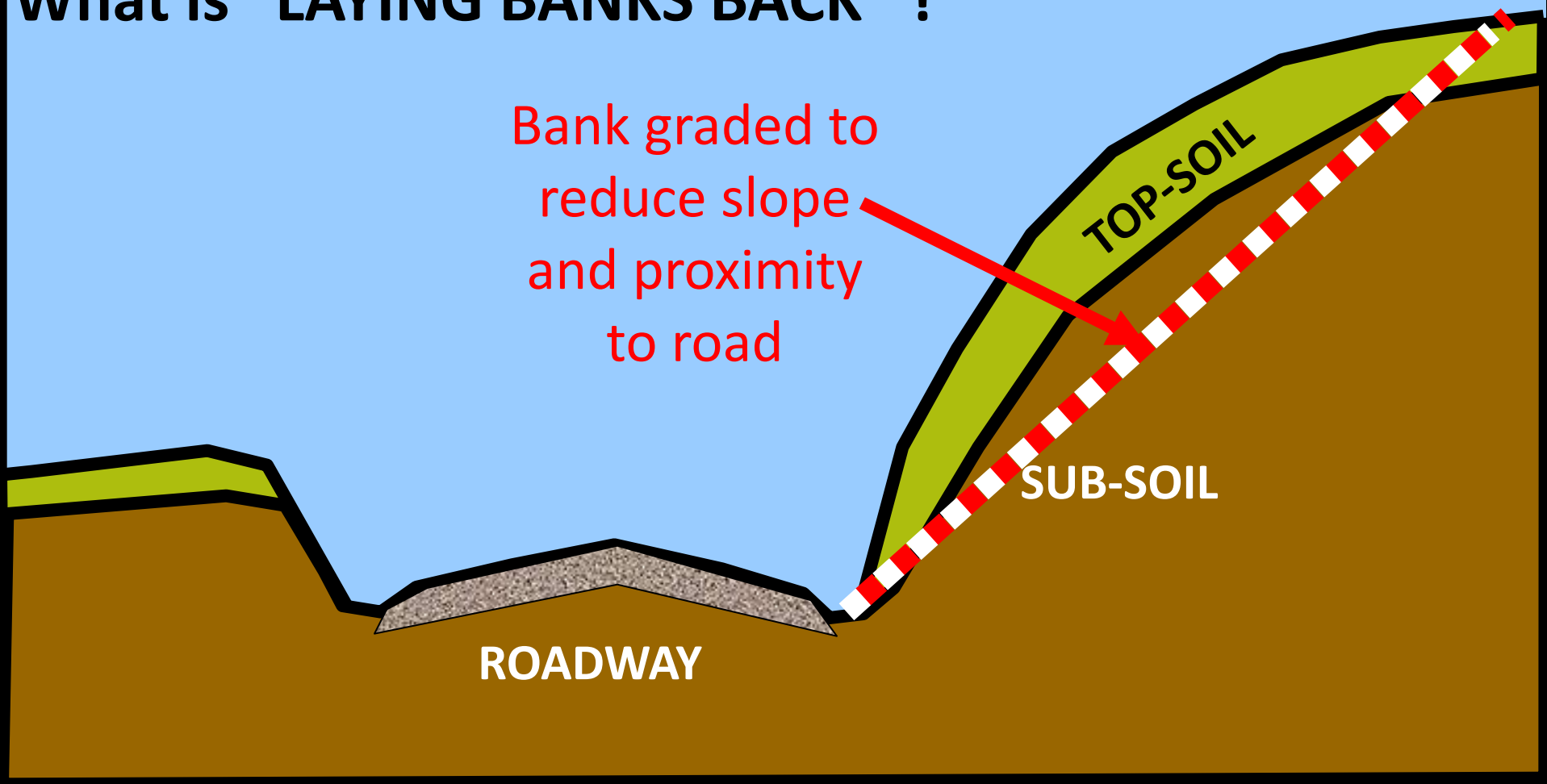
- Result of aggressive ditch cleaning.
- To keep material from rolling off blade when “pulling ditches” with the grader.
- An attempt to widen or shift the road away from failing downslope bank.

**PROBLEMS:**

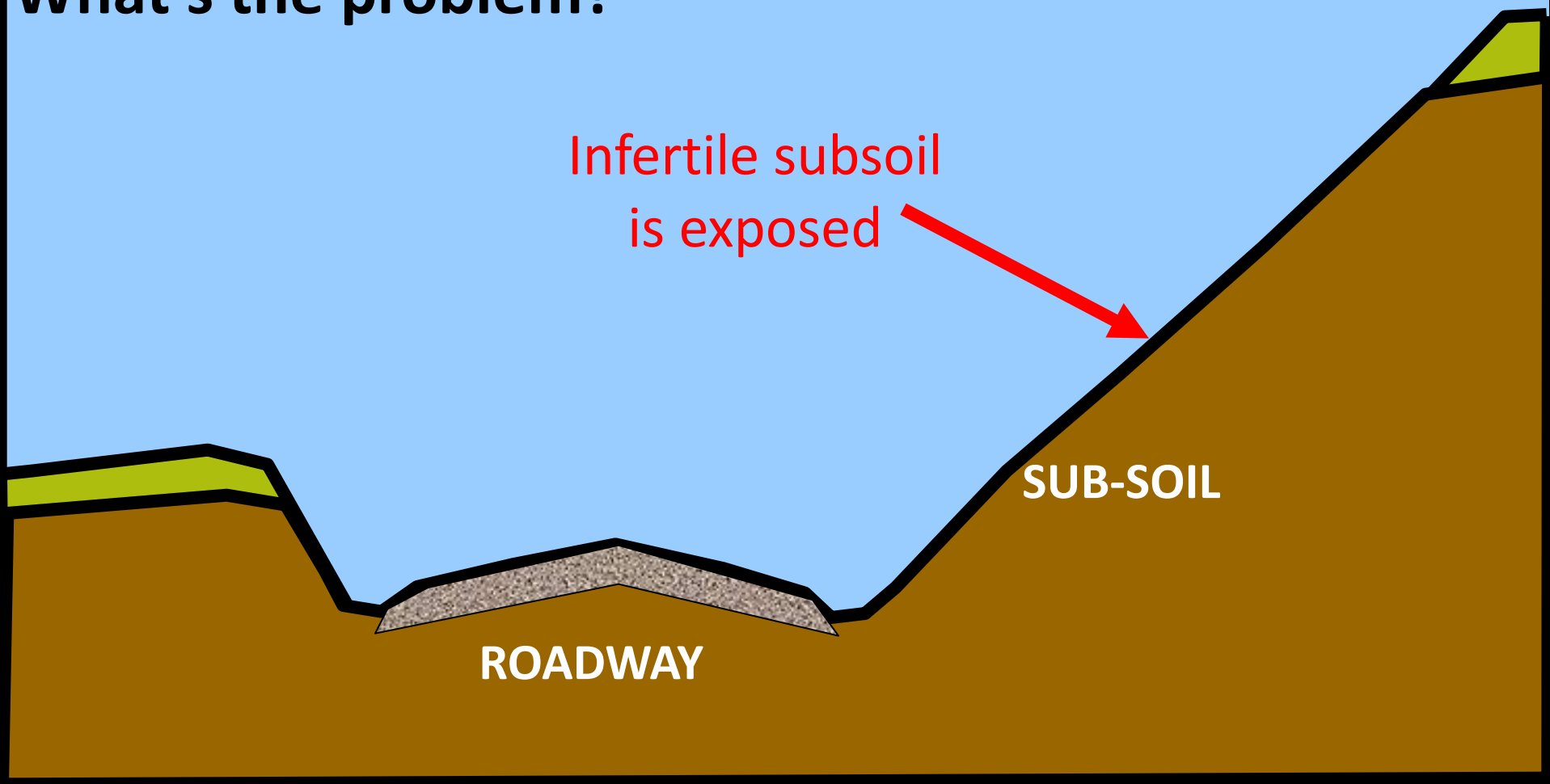
- Destabilizes Bank
- Causes cyclical maintenance
- Creates likelihood of erosion
- Adds sediment to drainage system

- Bank Gouging
- **Laying Banks Back**
- Vegetation Removal

# What is “LAYING BANKS BACK” ?



# What's the problem?




This bank will be hard to stabilize

# Laying Banks Back

## WHY IS IT DONE?

- Improve sight distance
  - Ahead and to the side
- Feeling of increased width
- Snow removal (drifting)

**PROBLEMS:**

- Removes topsoil and beneficial vegetation
  - Difficult to stabilize
  - Sub-soil will not vegetate
  - Increases bank erosion
- Increases speed

- Bank Gouging
- Laying Banks Back
- **Vegetation Removal**

# Banks: Traditional Practices

## Vegetation Removal

# WHY IS IT DONE?

- Improve sight distance
  - Ahead and to the side
- Feeling of increased width
- Dry road out
  - Be careful with this one!

**PROBLEMS:**

- Destabilizes soils
  - Increases impact erosion
  - Eliminates “root rebar”
- Over drying of road
- Under-drying of road bank
- Promotes growth of colonizer trees and unwanted/invasive species
- Increases speed!

# Road Banks

Introduction

Traditional Road Maintenance Practices

Environmentally Sensitive Maintenance Practices

# Road Banks

Environmentally Sensitive Maintenance Practices

1. **Avoid the Banks**
2. **Properly Manage Vegetation**
3. **Fill Road Cross-Section**
4. **Naturalize Bank Shape**
5. **Slope Reinforcement**
6. **Underdrains**
7. **Off-ROW ESMPs**

# 1. Avoid the Banks

**How:**

- Do not over-widen the road
- Do not gouge the toe
- Do not disturb beneficial vegetation
- Use care during routine maintenance


LEAVE BANK AT STABLE SLOPE!
PROPER PROFILE
BANK GOUGING: Unstable vertical bank will collapse
Huntingdon

## Avoid the Banks

# Avoid the Banks


**Benefits:**

- **Stop perpetual ditch cleaning**
- **Keeps loose soil out of drainage system**
- **A stable bank helps to form stable ditch.**

1. Avoid the Banks
2. **Properly Manage Vegetation**

# Roadside Vegetation Management

- Is necessary but often not thought out.
- Don’t overlook benefits of vegetation for bank stability.
- Poor vegetation management can cause unforeseen problems like bank failure, dust, erosion, and road saturation

**Value of roadside vegetation:**

- **Erosion Reduction**
- Bank Stability
- Dust Reduction

# EROSION PREVENTION

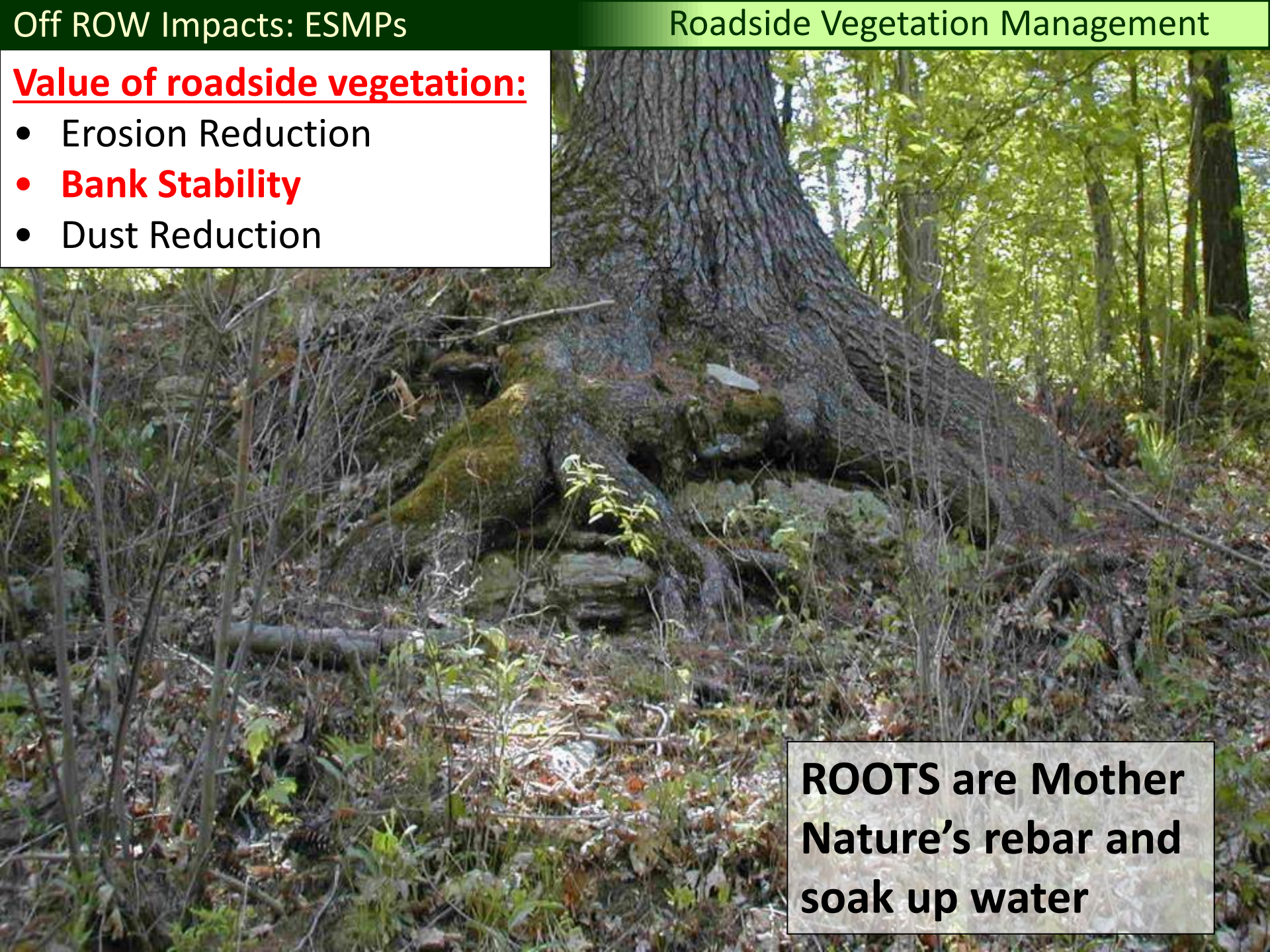
**GROUND COVER**

- **Reduces impact erosion**
- **Slows flow of water**
- **Traps sediment**

# Roadside Vegetation Management

**Value of roadside vegetation:**

- Erosion Reduction
- **Bank Stability**
- Dust Reduction



**ROOTS are Mother Nature's rebar and soak up water**

# Roadside Vegetation Management

**Value of roadside vegetation:**

- Erosion Reduction
- Bank Stability
- **Dust Reduction**

# Roadside Vegetation Management

**Improving roadside vegetation:**

- **Selective Thinning**
- Selective Mowing / Spraying
- Revegetating of Banks

# Roadside Vegetation Management

**Improving roadside vegetation:**

- **Selective Thinning**
- Selective Mowing / Spraying
- Revegetating of Banks

**Daylight selectively**
**Aim for 50% shading**

## Roadside Vegetation Management

**Improving roadside vegetation:**

- **Selective Thinning**
- Selective Mowing / Spraying
- Revegetating of Banks

- **Remove trash trees, hazard trees, and invasives**
- **Leave desirable hardwood species**

# Off ROW Impacts: ESMPs

## Roadside Vegetation Management

**Improving roadside vegetation:**

- **Selective Thinning**
- Selective Mowing / Spraying
- Revegetating of Banks

- **Remove trash tress, hazard trees, and invasives**
- **Leave desirable hardwood species**

# Off ROW Impacts: ESMPs

## Roadside Vegetation Management

**Improving roadside vegetation:**

- **Selective Thinning**
- Selective Mowing / Spraying
- Revegetating of Banks

- **Remove trash trees, hazard trees, and invasives**
- **Leave desirable hardwood species**

# Off ROW Impacts: ESMPs

## Roadside Vegetation Management

**Improving roadside vegetation:**

- **Selective Thinning**
- Selective Mowing / Spraying
- Revegetating of Banks

- **Remove softwood trees, dead trees, and invasives**
- **Leave desirable hardwood species**

# Roadside Vegetation Management

**Improving roadside vegetation:**

- Selective Thinning
- **Selective Mowing / Spraying**
- Revegetating of Banks

- **Mow only where needed**
- **Leave stable vegetation alone**
- **Don't create future problems**

# Off ROW Impacts: ESMPs

## Improving roadside vegetation:

- Selective Thinning
- **Selective Mowing / Spraying**
- Revegetating of Banks

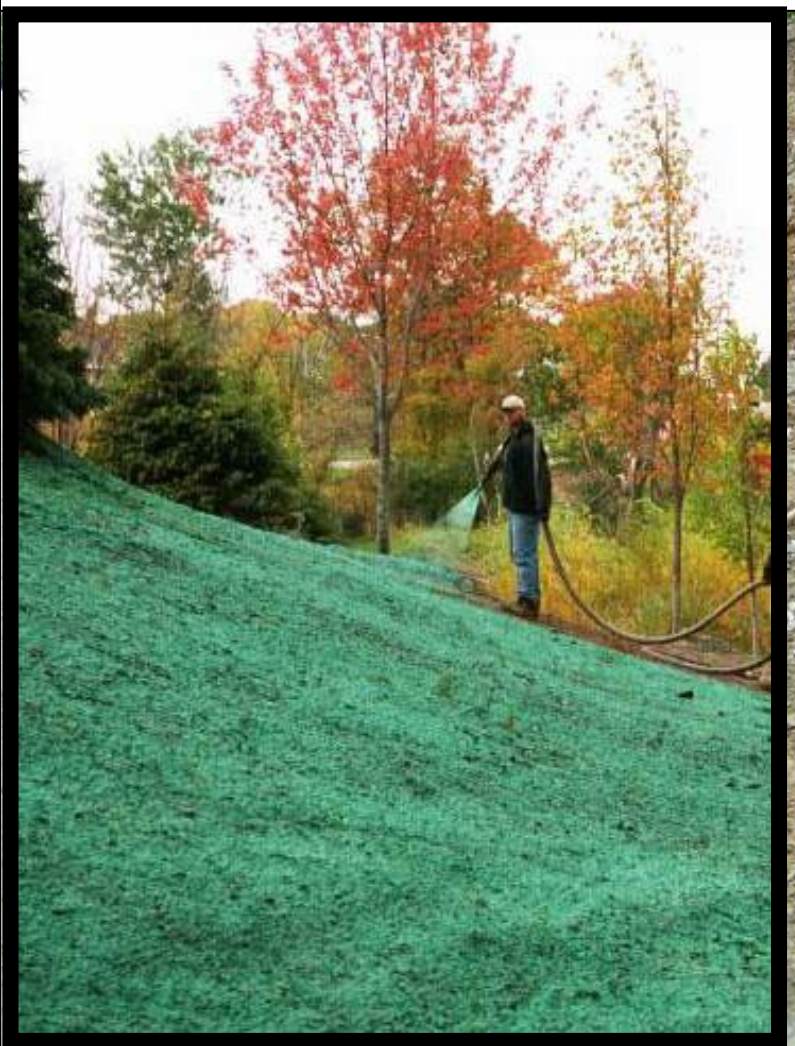
# Roadside Vegetation Management

- **Mow only where needed**
- **Leave stable vegetation alone**
- **Don’t mow it because it’s there**

# Roadside Vegetation Management

**Improving roadside vegetation:**

- Selective Thinning
- Selective Mowing / Spraying
- **Revegetating of Banks**



**Always revegetate disturbed areas!**

# Roadside Vegetation Management

**Improving roadside vegetation:**

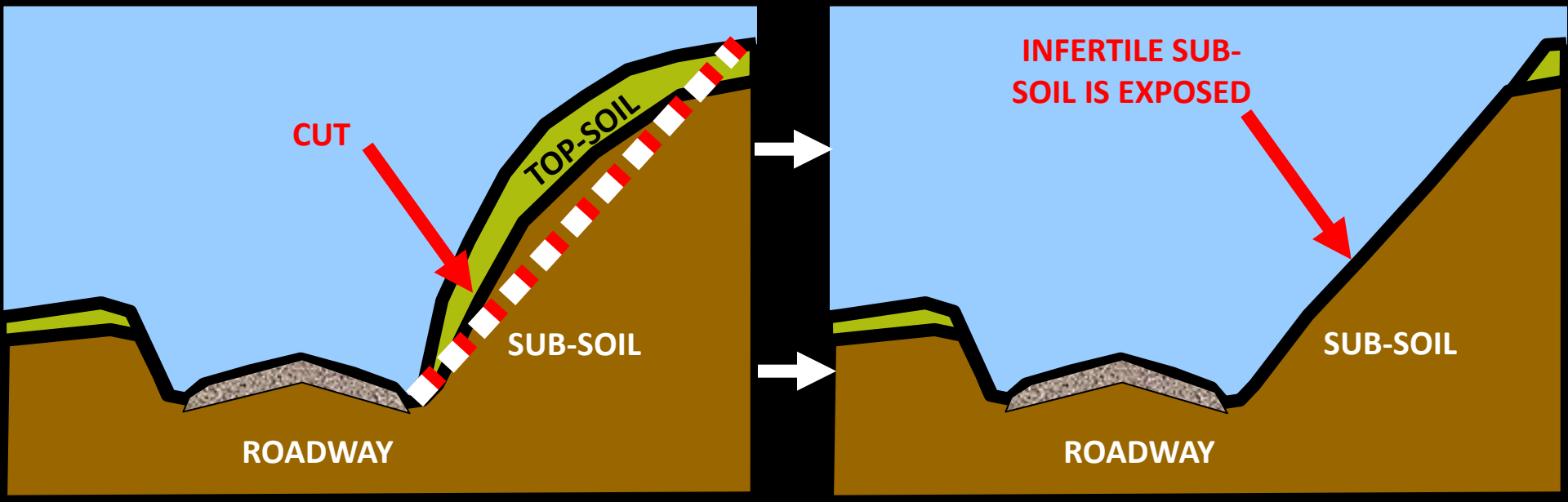
- Selective Thinning
- Selective Mowing / Spraying
- **Revegetating of Banks**

**Always revegetate disturbed areas!**

**Consider native seed mixes**

Credit PA DCNR

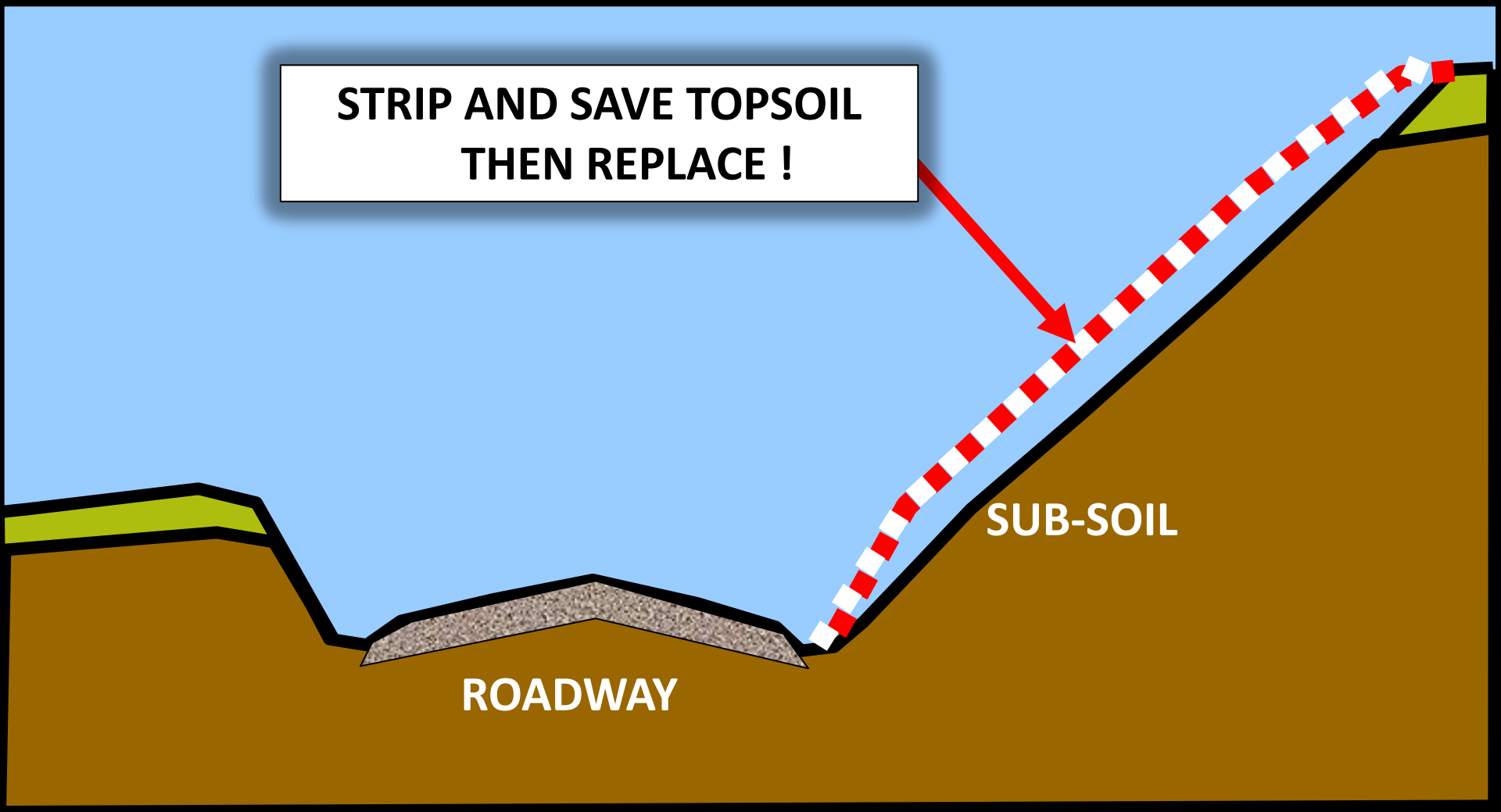
# If you plan to lay back a bank for good reason




## WHY NOT REPLACE THE TOPSOIL?

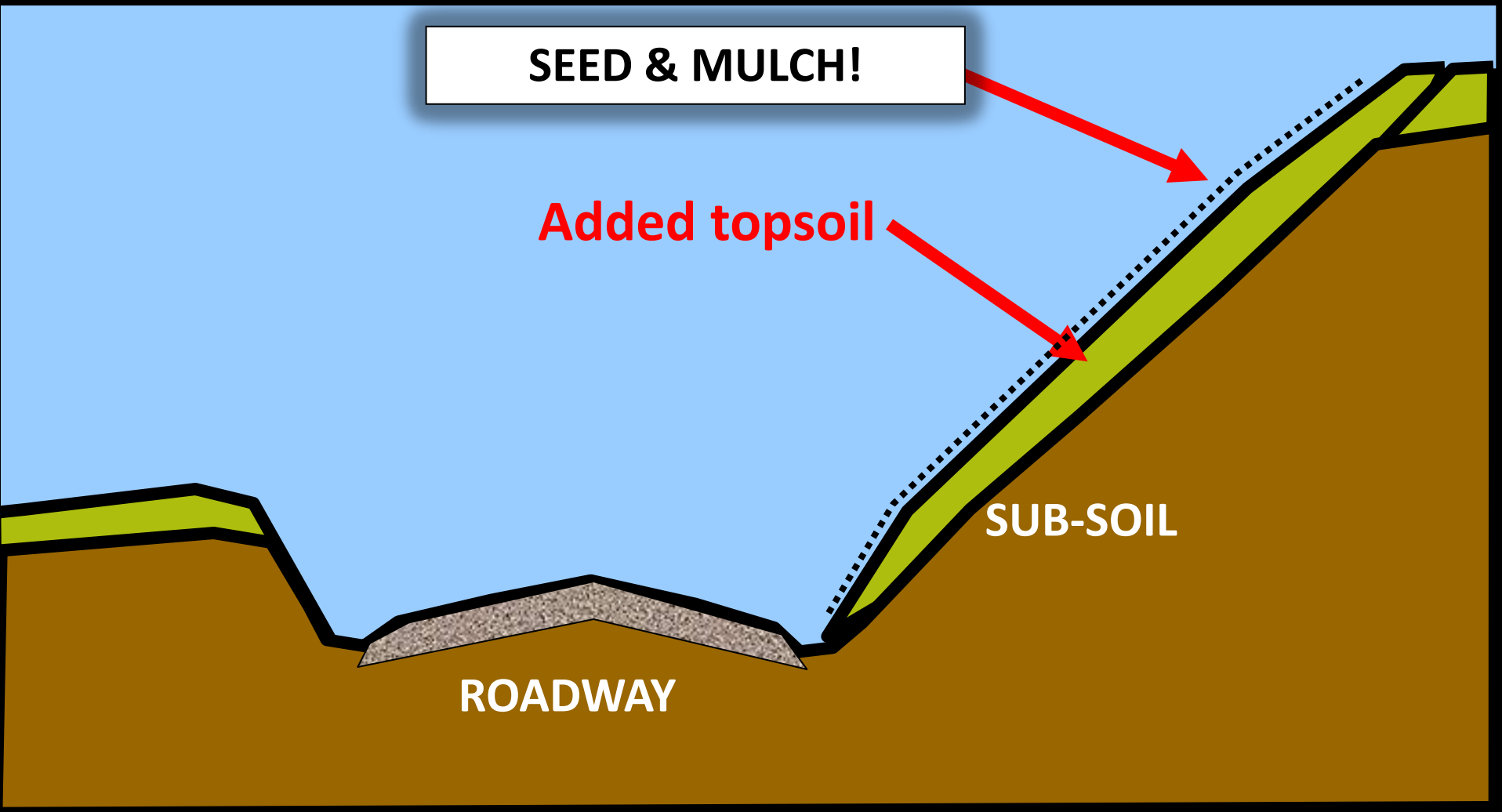
**Improving roadside vegetation:**

- **Replacing Topsoil**




**Improving roadside vegetation:**

- **Replacing Topsoil**




**Improving roadside vegetation:**

- **Replacing Topsoil**


Save and add topsoil to give seed a start

**When to add topsoil:**

- Where infertile subsoil is exposed
- After “laying the banks back”
- On any newly created bank

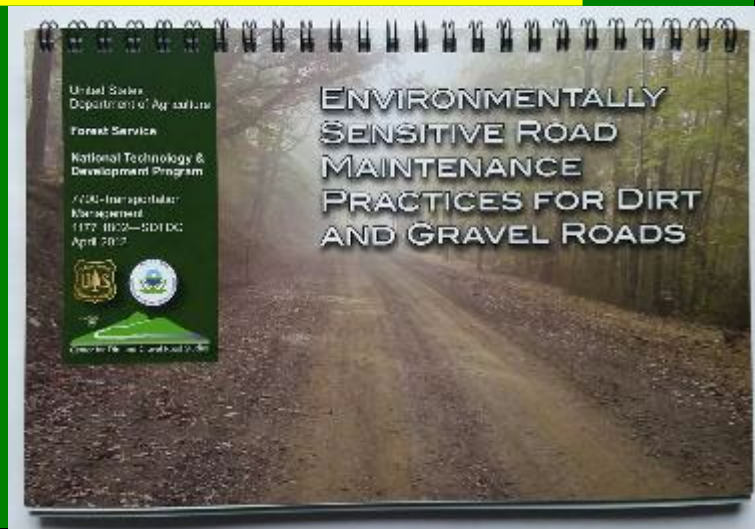
# Roadside Vegetation Management

# In Summary…….

**Work with your vegetation, don’t fight it, or else…**

1. Avoid the Banks
2. Properly Manage Vegetation
3. **Fill Road Cross-Section**

**Page 52 in Field Guide**



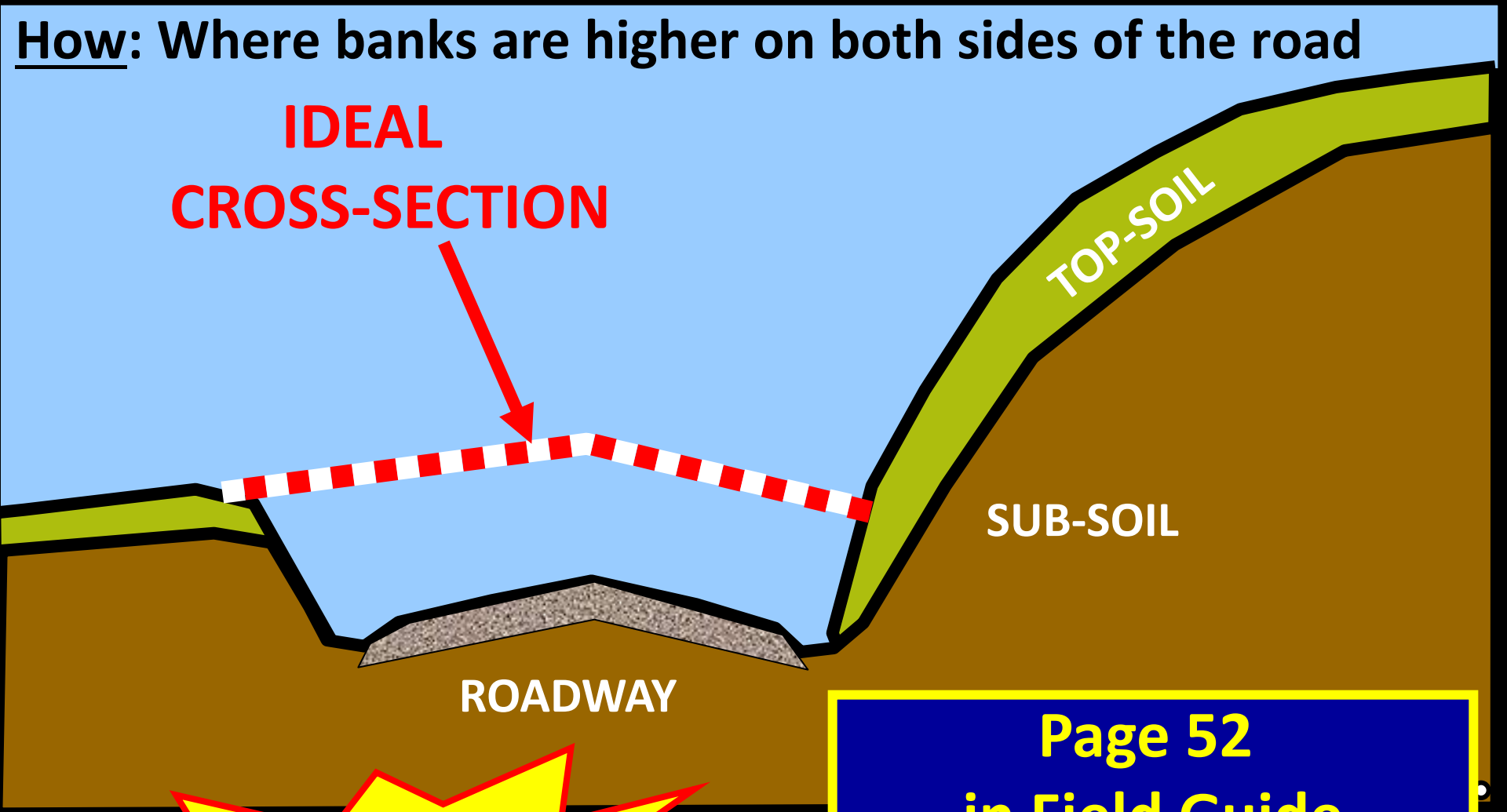
**When:**

- Where banks are higher on both sides of the road
- When road bank lacks a stable toe
- When you want to add road width

**Covered in "Entrenched Roads"**

**Page 52 in Field Guide**

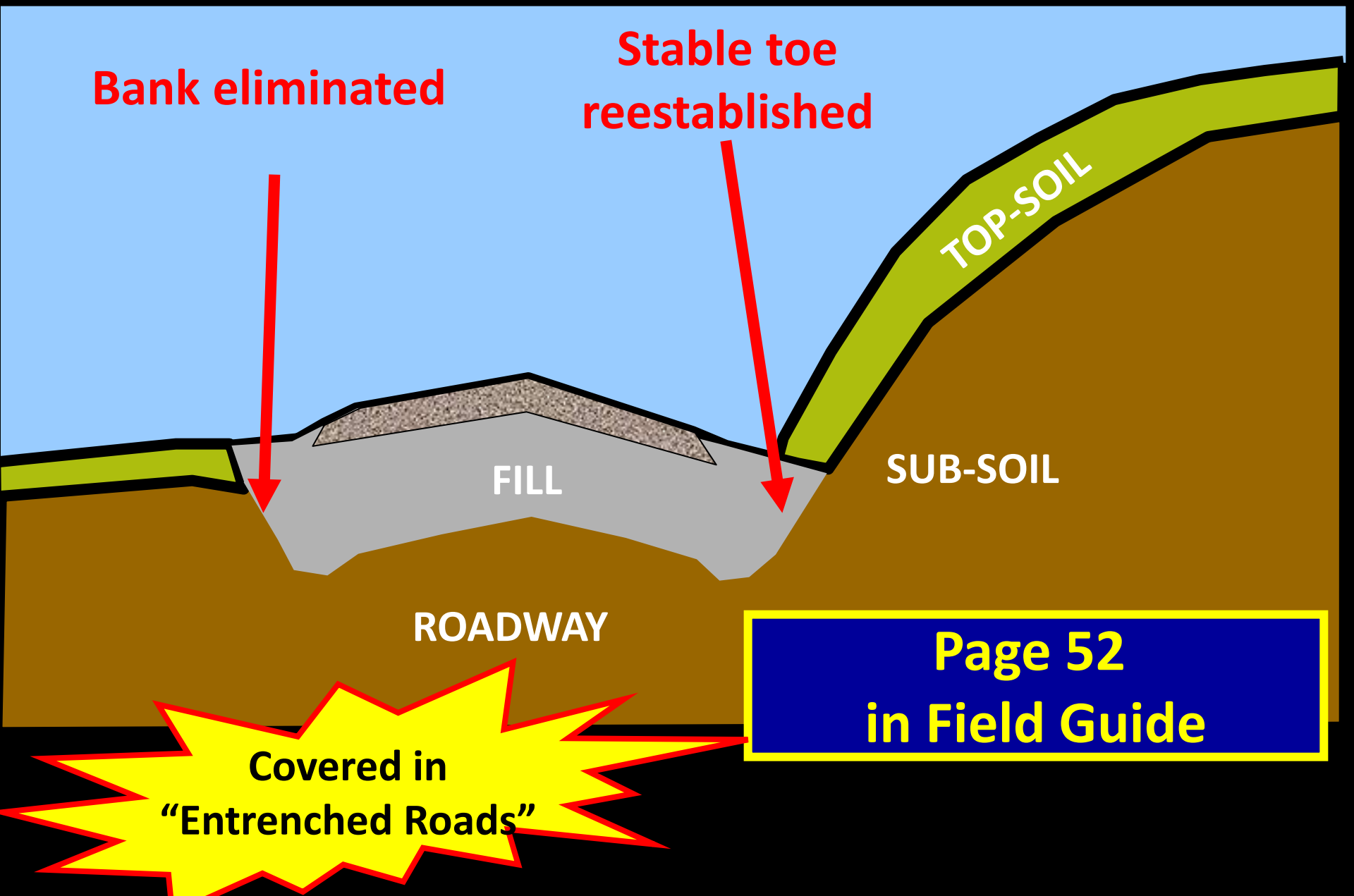
**How: Where banks are higher on both sides of the road**




**Page 52 in Field Guide**

**Covered in "Entrenched Roads"**

# Filling Road Cross-Section

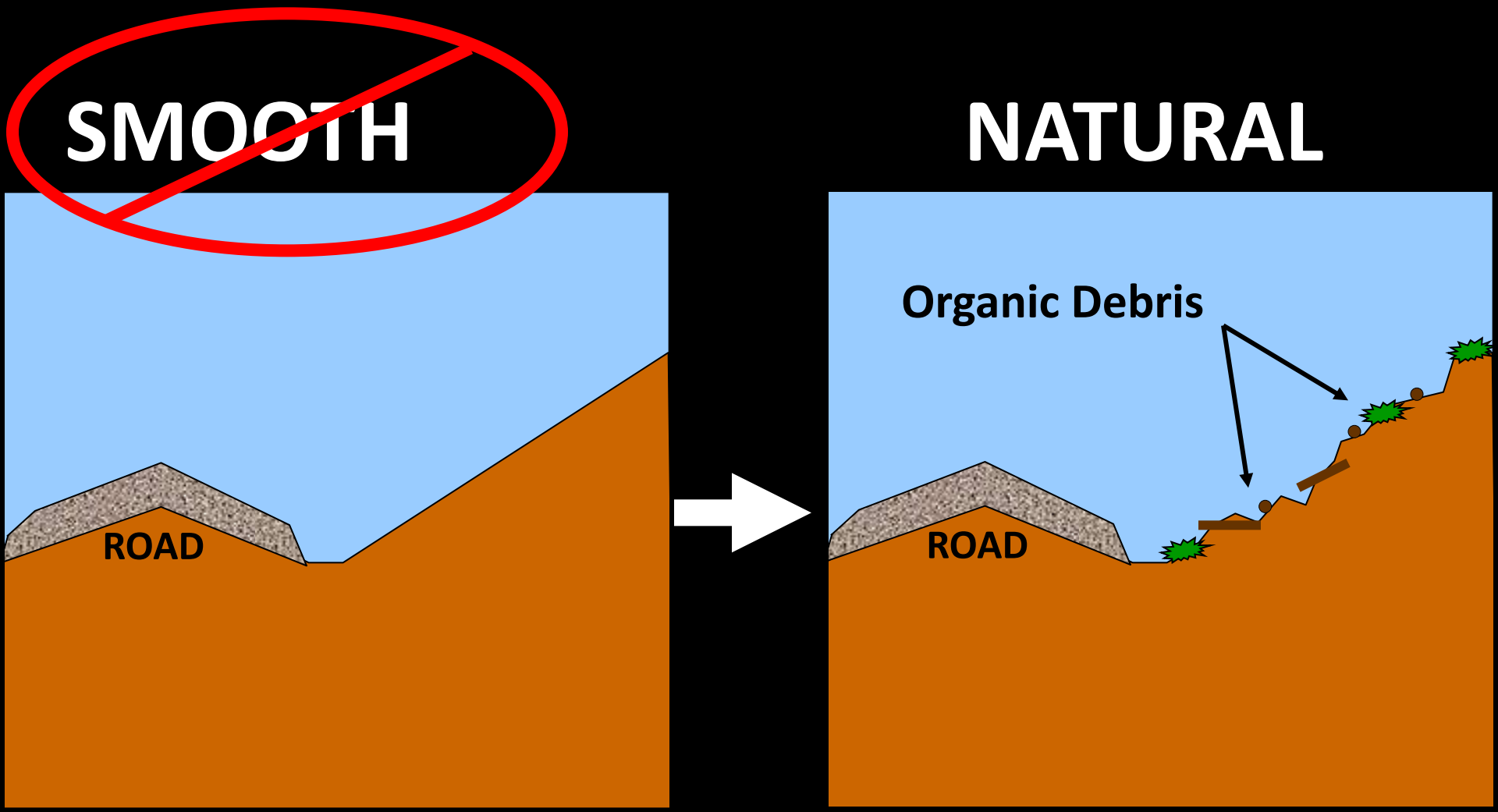


# Road Banks



1. Avoid the Banks
2. Managing Vegetation
3. Fill Road Cross-Section
4. **Naturalize Bank Shape**

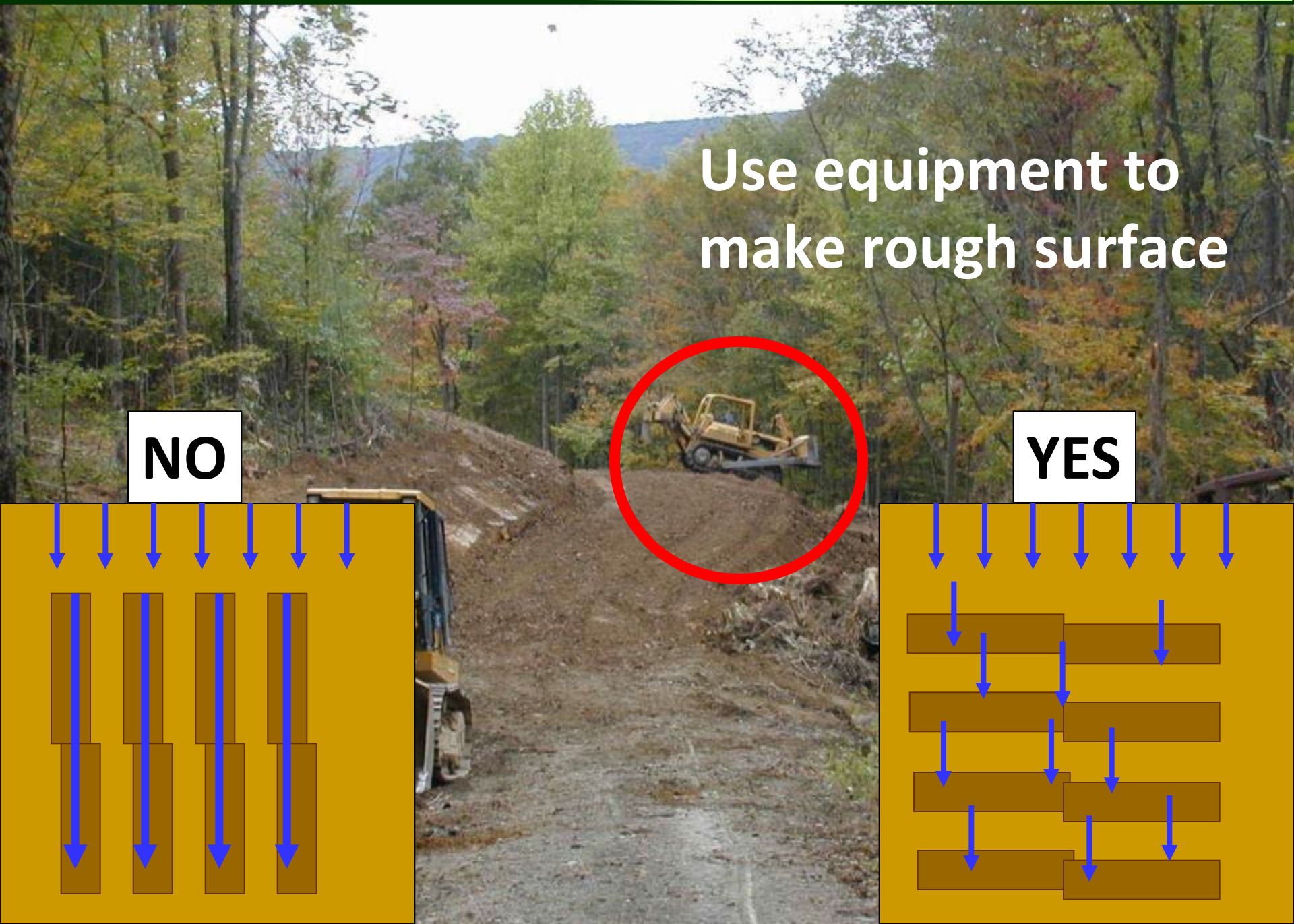
## Naturalize Bank Shape




- Avoid making a smooth bank
- Create surface irregularities

## Naturalize Bank Shape

# Naturalize Bank Shape



**Benefits:**

- Cheap and easy
- Increases seed retention and germination
- Irregular shape slows water flowing on bank

1. Avoid the Banks
2. Managing Vegetation
3. Fill Road Cross-Section
4. Naturalize Bank Shape
5. **Slope Reinforcement**

**How:**

**Add material to slope:**

- Vegetation
- Rock
- Geo-synthetic products

**When:**

- Where stabilization is required to keep road open and safe
- Where bank is unstable or will become unstable and threatens the road

## Slope Reinforcement - Upslope

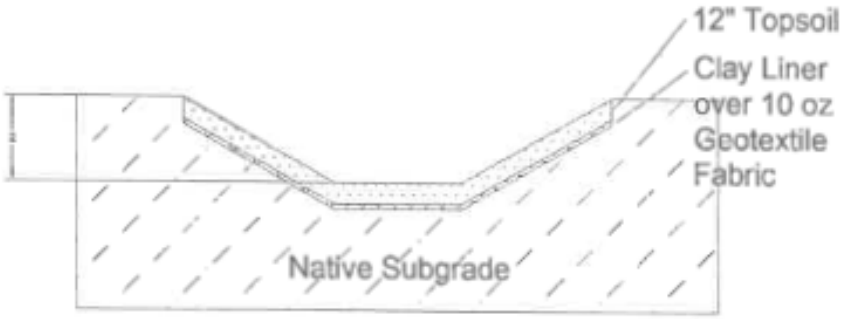
# Slope Reinforcement - Upslope

**Make a plan using proven practices**

## Concrete Barrier Backed with Rip Rap Detail

*N.T.S.*

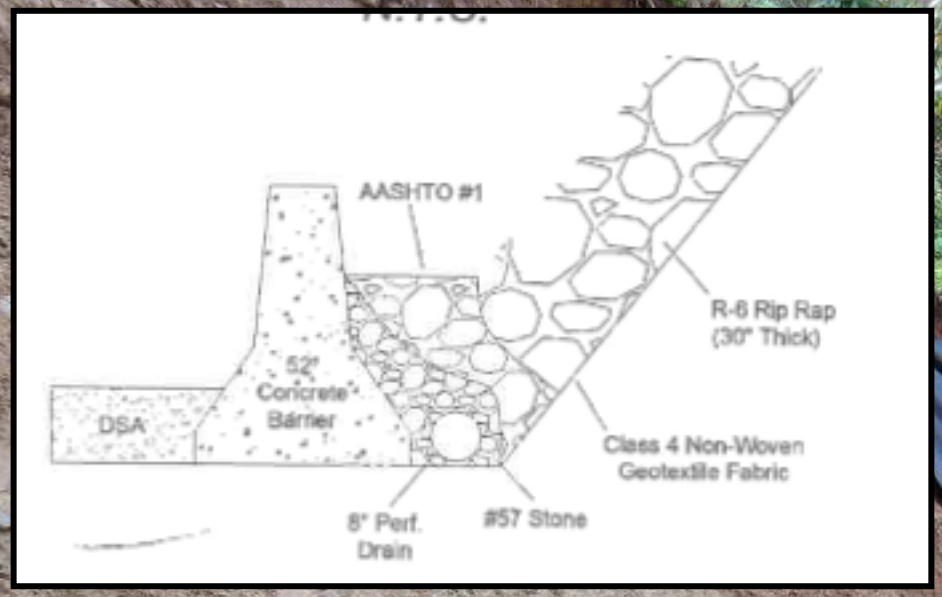

## Clay Lined Swale Detail




*Clay Liner to be Bentomat SDN
N.T.S.

# Slope Reinforcement - Upslope

# Slope Reinforcement - Upslope




**Remove Water**

## Slope Reinforcement - Upslope

## Slope Reinforcement - Upslope

# Slope Reinforcement - Upslope

## Slope Reinforcement - Upslope

# Slope Reinforcement - Upslope

**No need to be fancy – just effective**

# DOWNSLOPE STABILIZATION

# DOWNSLOPE STABILIZATION

**How:**

- Utilize proven practices to address site specific issues
- Seek experienced advice

**When:**

- Where downhill supporting bank is failing and road is threatened
- Where you need to shift or widen the road

# Slope Reinforcement - Toe

**BEFORE**

**Example Downslope Reinforcement: Dauphin County**


**Ellendale Forge Rd 1/5**

# Slope Reinforcement - Toe

**DURING**

# Slope Reinforcement - Toe

**DURING**

Ellendale Forge Rd 3/5

# Slope Reinforcement - Toe

**DURING**

# Slope Reinforcement - Toe

# Slope Reinforcement - Nails

**BEFORE**

**Example Downslope Reinforcement: Lycoming County**

**Slate Run Road – 1/5**

# Slope Reinforcement - Nails

**DURING**

**Slate Run Road – 2/5**

# Slope Reinforcement - Nails

**DURING**

**Slate Run Road – 3/5**

# Slope Reinforcement - Nails

**DURING**

**Slate Run Road – 4/5**

# Slope Reinforcement - Nails

**DURING**

**Slate Run Road – 5/5**

## Slope Reinforcement - Geo

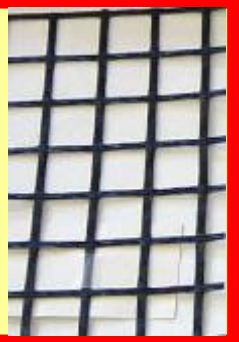
**Upslope**

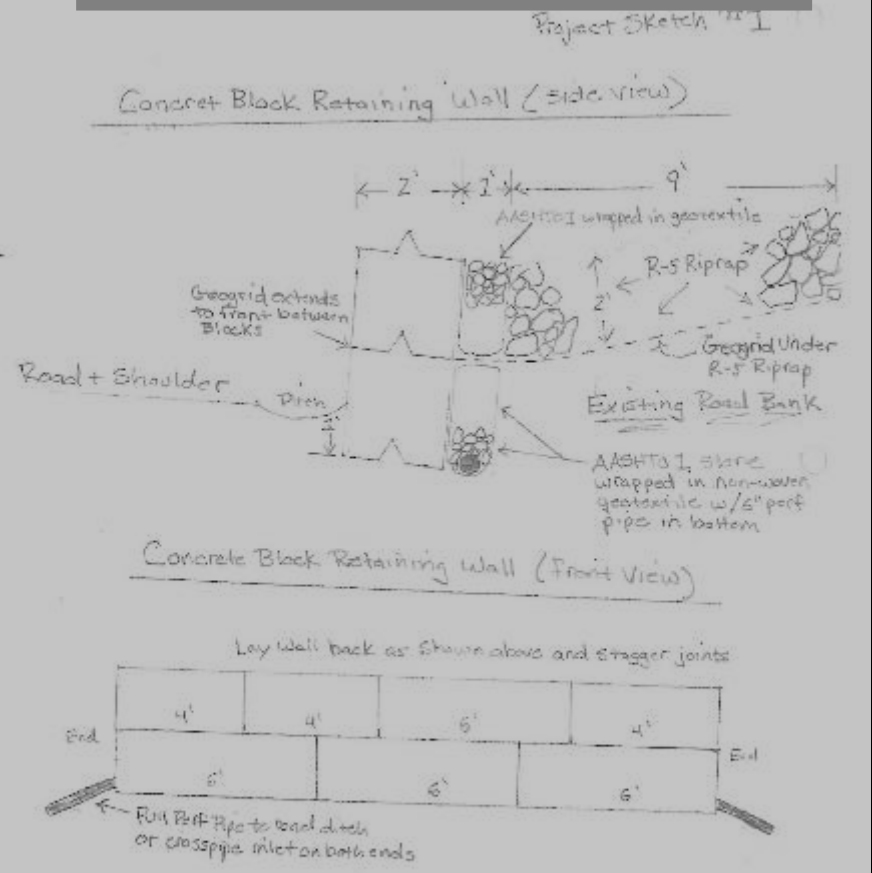
**Geo-GRID**

**-"snowshoe"**

**- spreads load**

**- strong support**



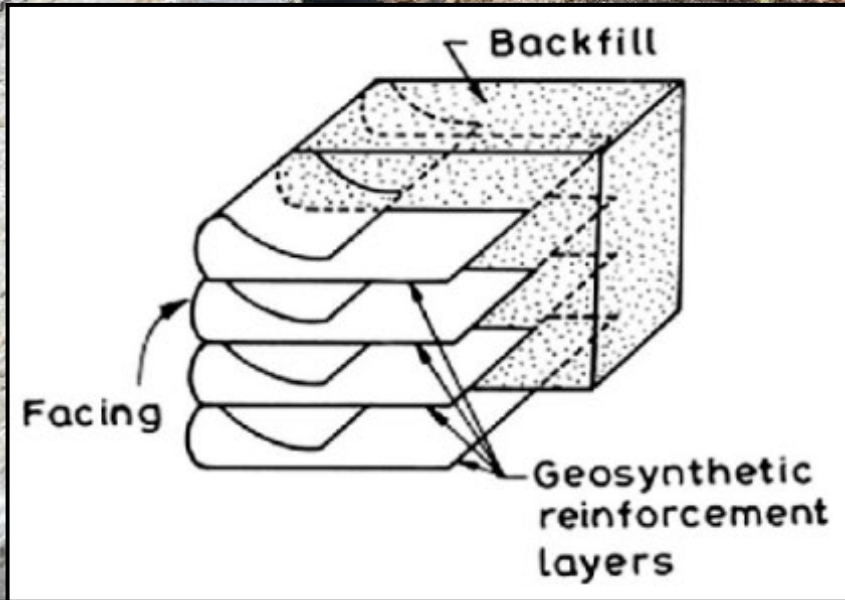


## Slope Reinforcement - Geo

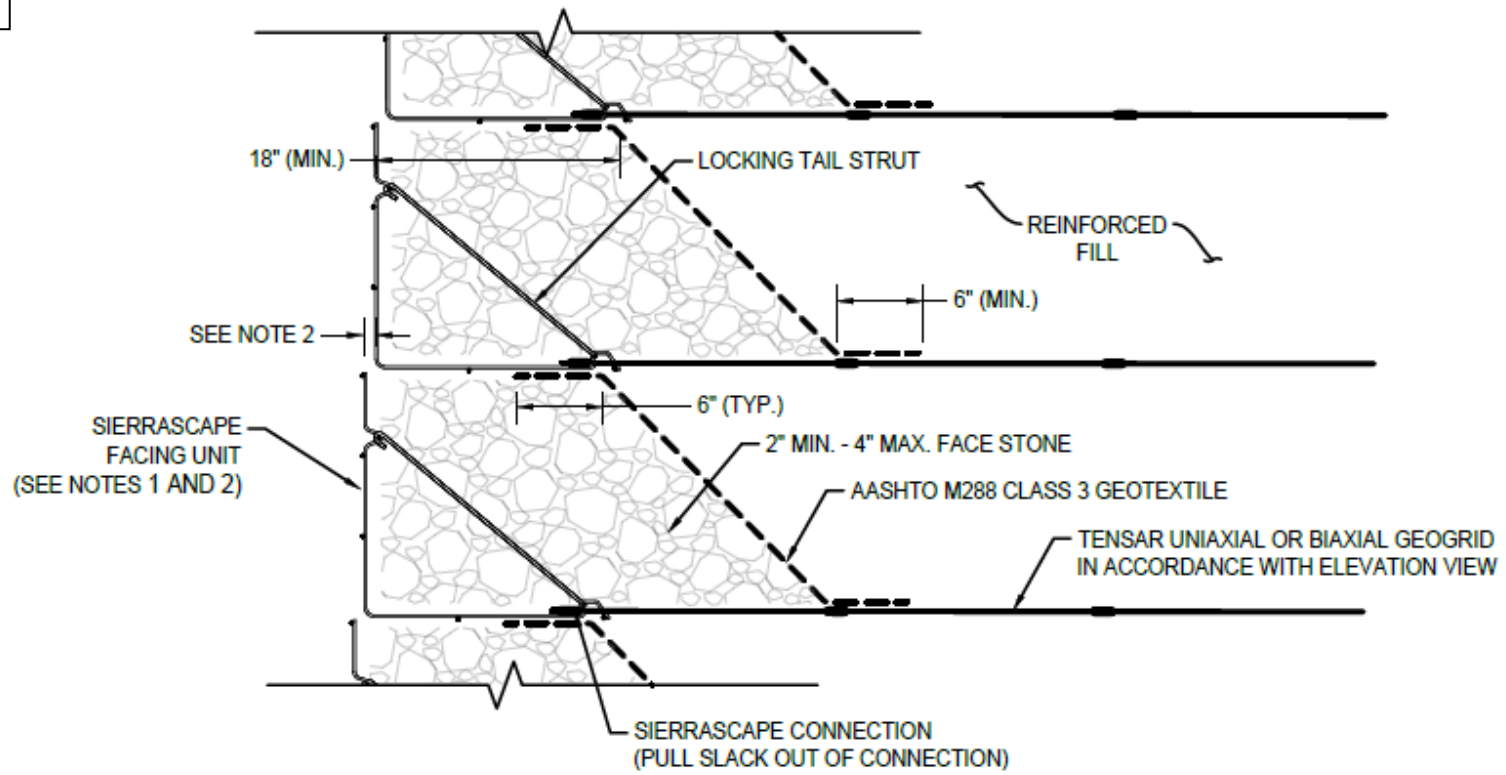
**Downslope**

**Separation Fabric**

- separates
- spreads load
- some support



## Plan View




NOTES:

1. SEE SIERRASCAPE FACING UNIT DETAIL FOR FACING MATERIAL AND DIMENSIONS.
2. OFFSET AS NEEDED TO ACHIEVE OVERALL BATTER AS SHOWN IN THE CROSS-SECTIONS.
3. OPTIONAL - A THIN LAYER (2" MIN.) OF FINER STONE (1/4"-1") MAY BE PLACED AT THE TOP OF EACH UNIT TO PROVIDE A LEVEL SURFACE FOR THE UNIT ABOVE.

**SIERRASCAPE STONE FACING DETAIL**

NOT TO SCALE

# Slope Reinforcement - Geo

**On the ground**

**Emerging Technologies**

# Road Banks: ESMPs

## Slope Reinforcement - Geo

On the ground

Emerging Technologies

**Benefits:**

- Allows road to exist where it otherwise would not
- May allow more cartway width
- Reduces loose material/sediment in drainage system
- Reduces cyclical maintenance
- Does not disturb uphill bank

**Considerations:**

- Larger reinforcements likely require contractor and engineer
- Larger reinforcement may be costly
- Potential permitting issues
- Off ROW landowner issues

1. Avoid the Banks
2. Managing Vegetation
3. Fill Road Cross-Section
4. Naturalize Bank Shape
5. Slope Reinforcement
6. **Underdrains**

**Page 12
in Field Guide**


**Underdrain : A buried drainpipe that collects subsurface water before it surfaces on the road and directs it to a stable outlet.**

**Covered in "Base"**

Page 12 in Field Guide

# Underdrains

**When TO USE:**

**To keep the toe of the bank dry in wet ditches**

**and in**

**ANY CONSISTENTLY WET AREA**

# Road Banks

Environmentally Sensitive Maintenance Practices

1. Avoid the Banks
2. Managing Vegetation
3. Fill Road Cross-Section
4. Naturalize Bank Shape
5. Slope Reinforcement
6. Underdrains
7. **Off-ROW ESMPs**
    1. Diversion Swales
    2. Low Gradient Bank Benches

## Interceptor Swales

## Bank Benches

# Road Banks

## ADDITIONAL RESOURCES:

- Your Conservation District
- Your Municipal Engineer
- www.dirtandgravelroads.org

next chapter:
**Stream Crossing Replacements**