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

Center for Dirt and Gravel Road Studies

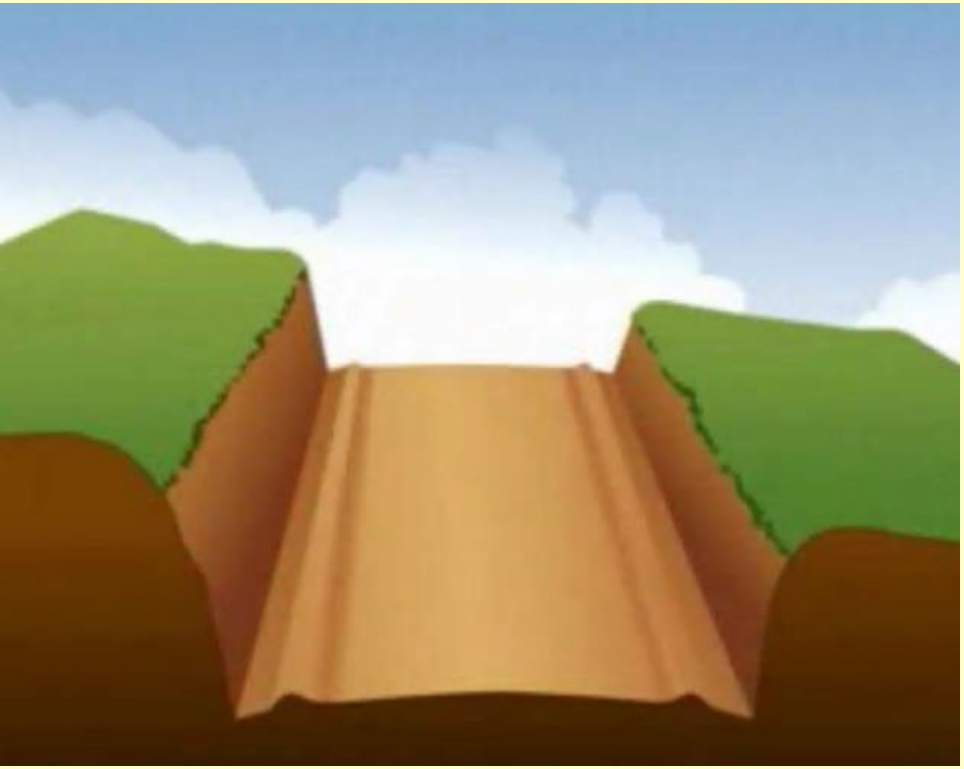
PA State Conservation Commission

PA Dept. of Conservation and Natural Resources **Forestry**

# Entrenched Roads

- **Lower than surrounding ground on both sides**
- **Makes it impossible to get water off the road**

**A 100-year-old road that loses 1/2 inch of material that is not replaced each year will be entrenched 4’ today.**



# Entrenched Roads

Introduction

Traditional Road Maintenance Practices

Environmentally Sensitive Maintenance Practices

# Entrenched Roads

**Traditional Maintenance:**

**Clean ditches and regrade, repeat, repeat, repeat**

**Road gets lower year by year**

**Ditches drain directly to stream**

# Entrenched Roads

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# Entrenched Roads

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Traditional Road Maintenance Practices

Environmentally Sensitive Maintenance Practices

# Entrenched Roads

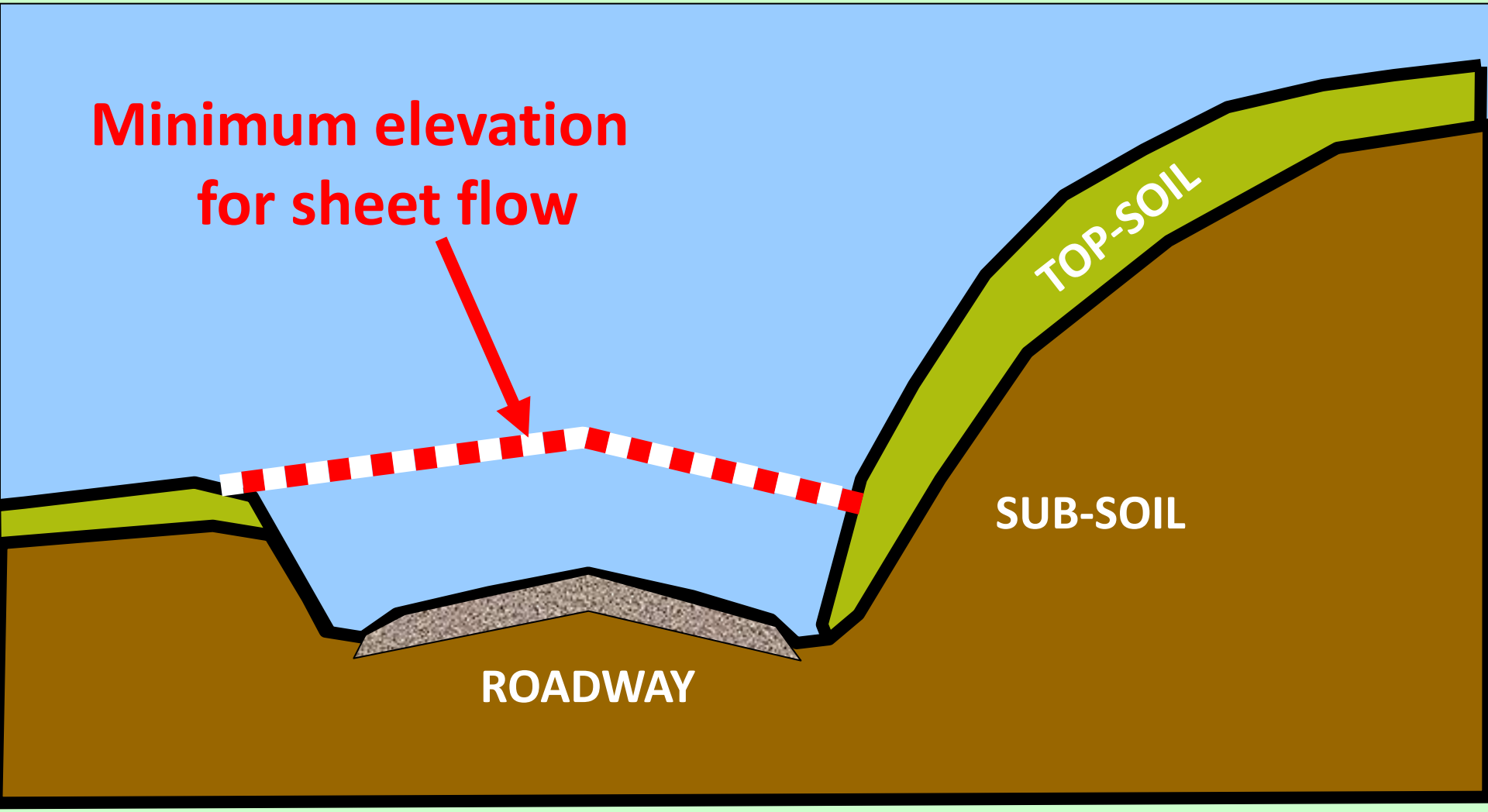
- What is an “entrenched road?”
- **Filling the road cross-section**
  - **Continuous fill**
  - Sectional fill
- Types of Fill
- Introduction to RFQ
- Review of Benefits

**When:**

- Where banks are higher on both sides of the road (entrenched roads)
- To improve base stability
- Shift the road up-slope
- Add road width

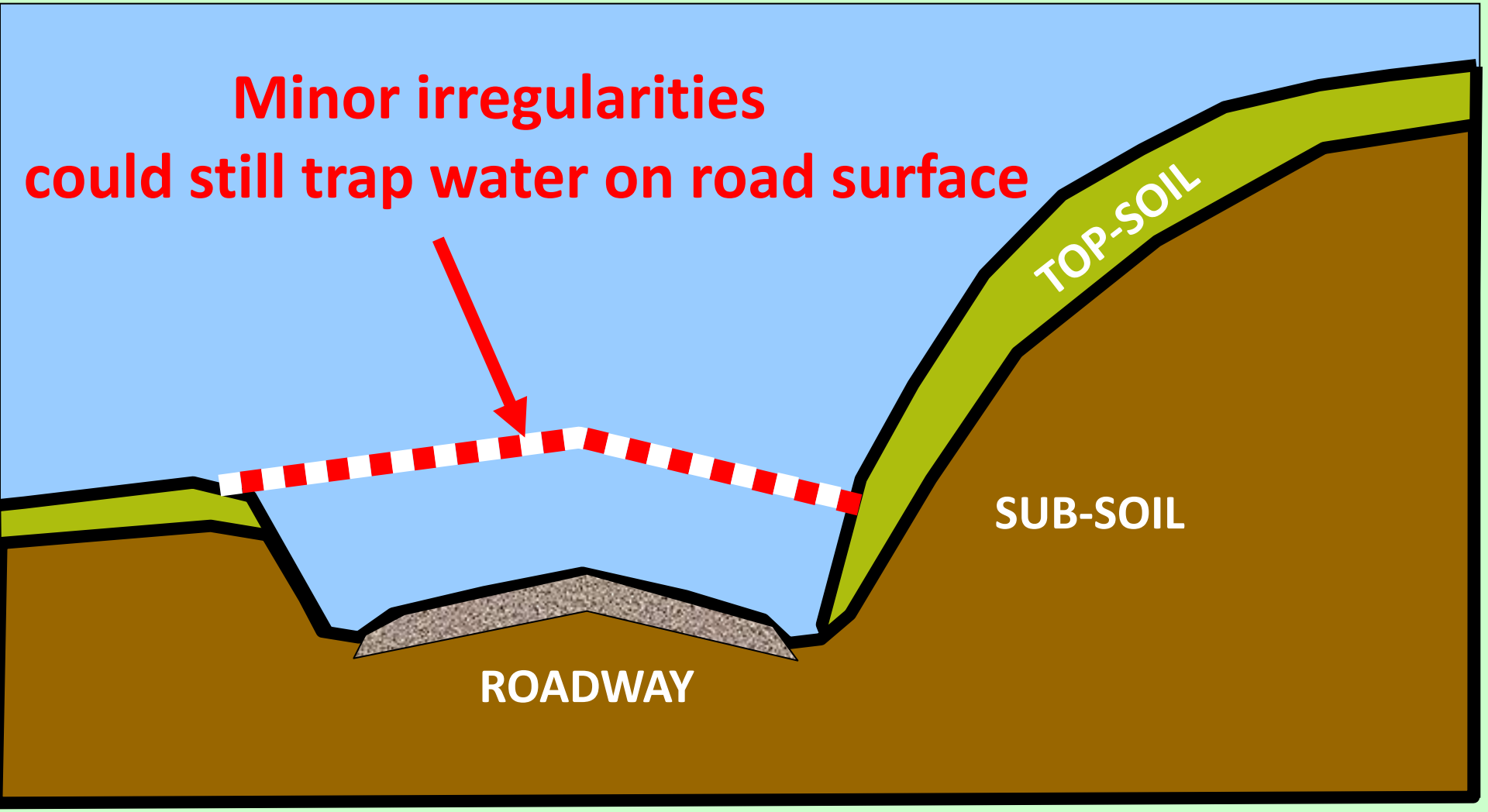
**Page 52 in Field Guide**

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




Page 52 in Field Guide

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




Page 52 in Field Guide

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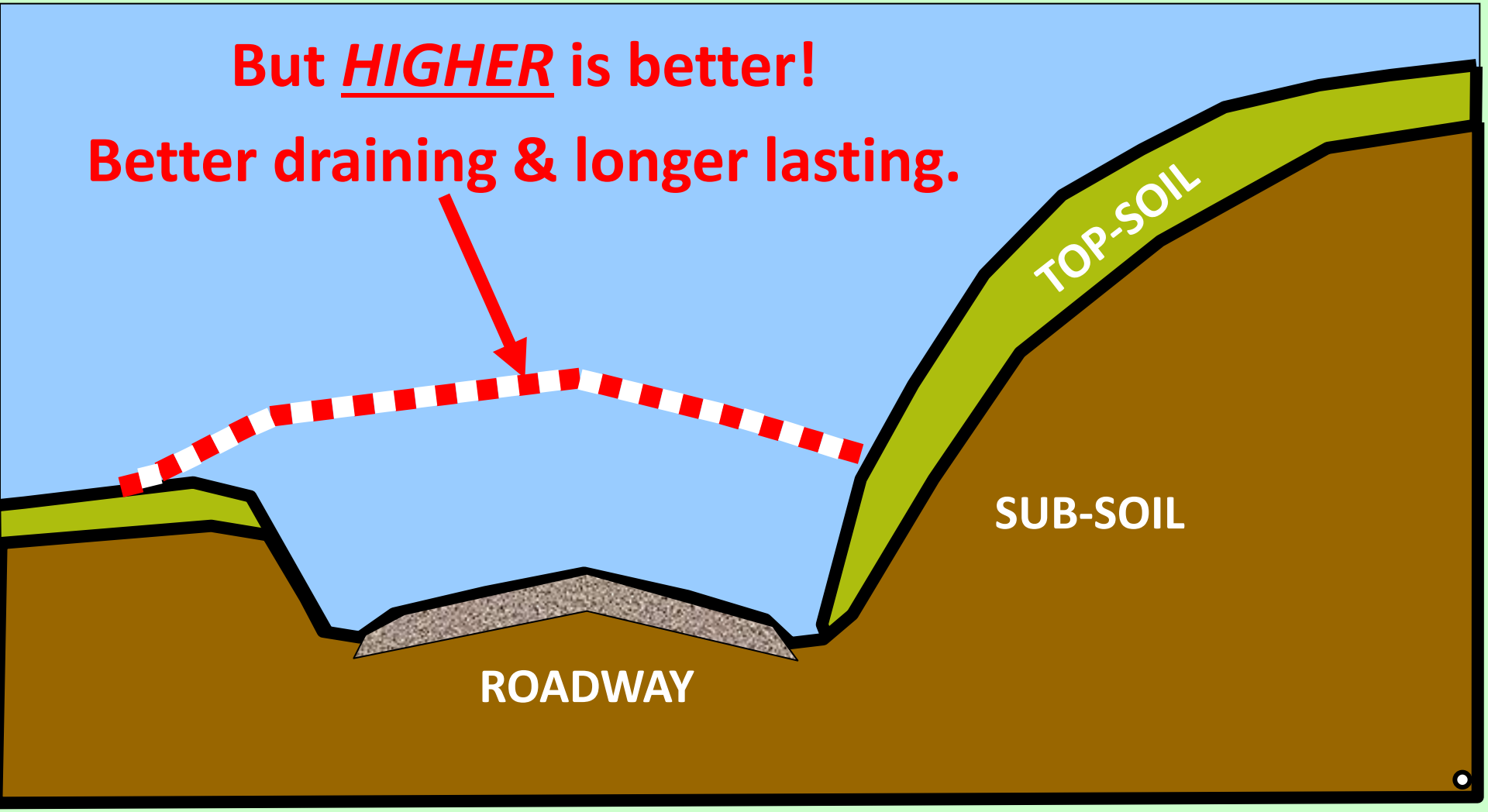
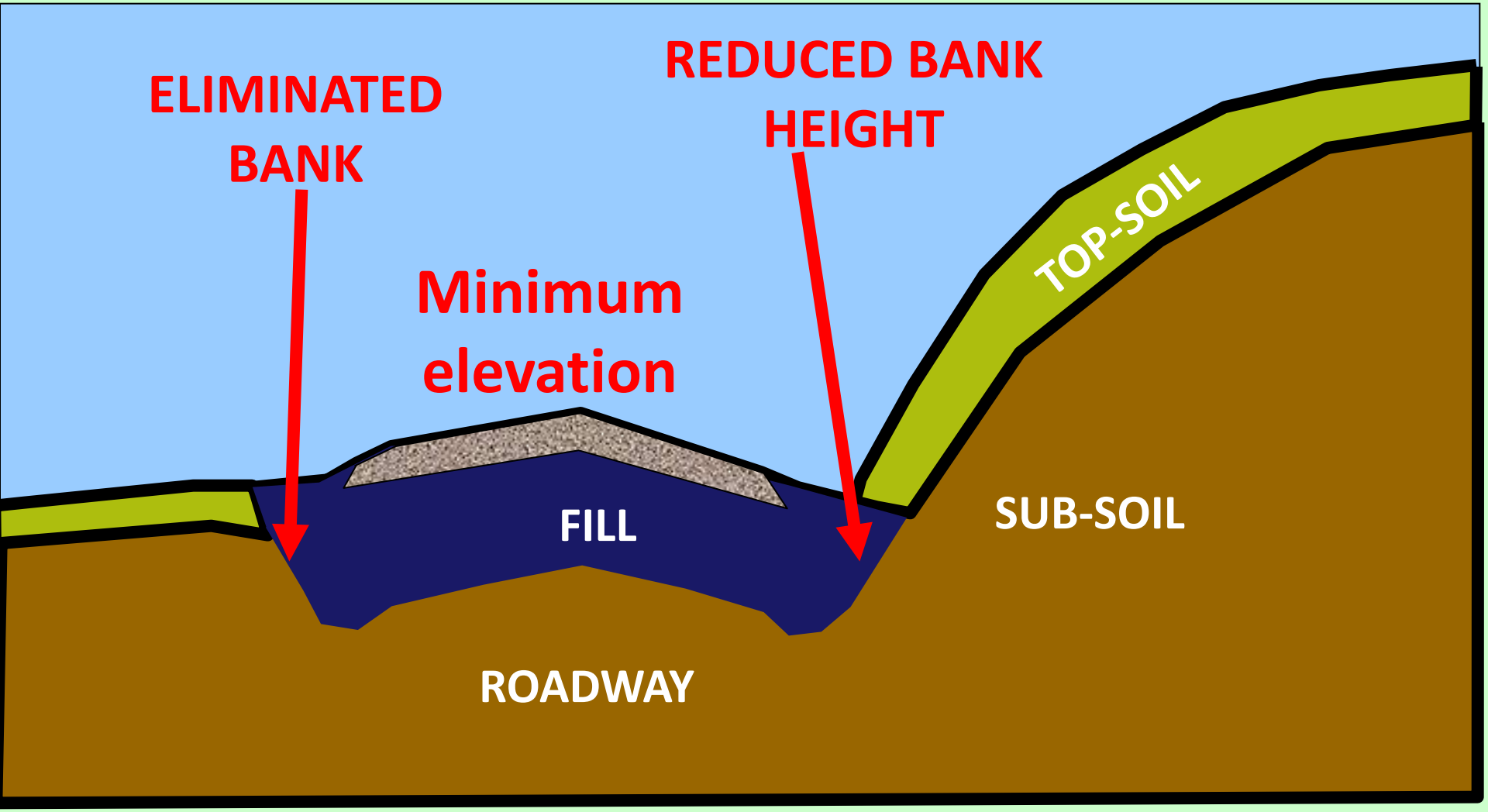



Page 52 in Field Guide

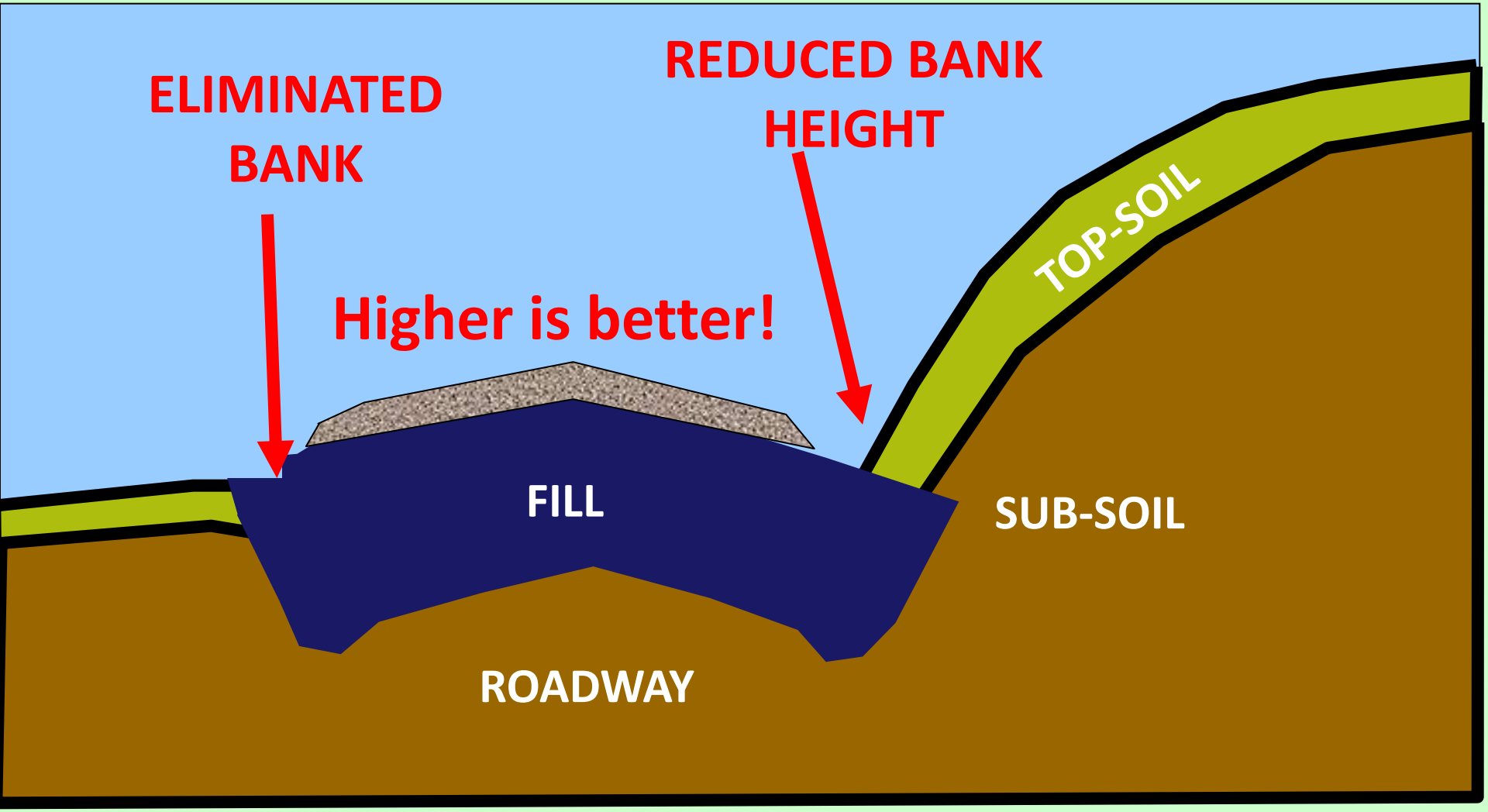
## Filling the Road

**Completed Project (~$100K): Road fill & cross pipes on steep hill**

- **Water is unable to reach ditch or new cross pipes.**
- **Fill higher than lower side of road.**
- **Need grade changes to divert runoff!**




**Page 52 in Field Guide**



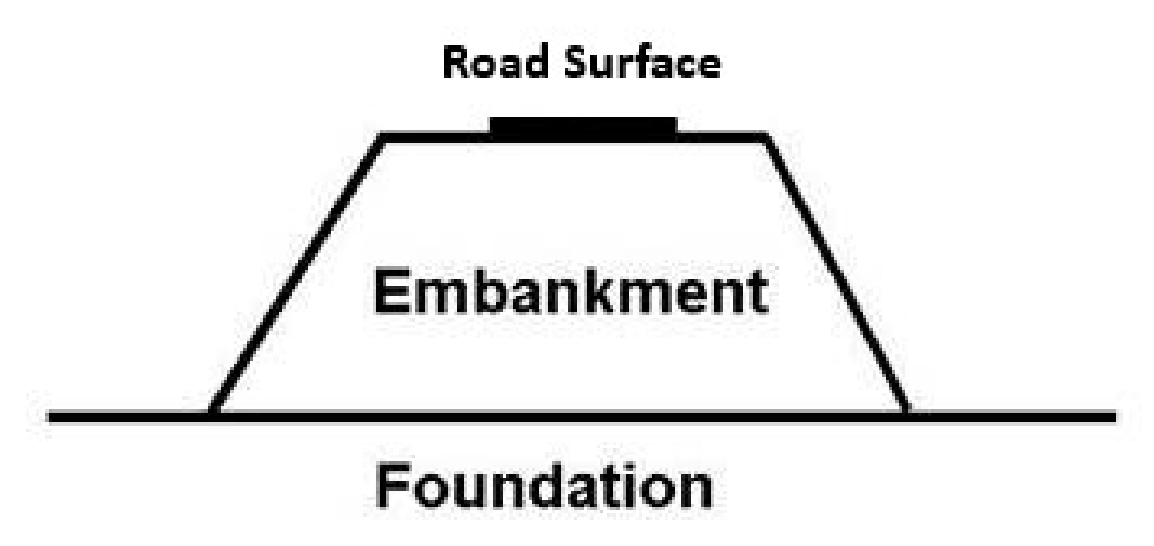

**Page 52 in Field Guide**

## Fill Above Existing Terrain:

- Goal is to promote long-term sheet flow. Consider settling and future erosion.
- Final road elevation should be a foot or more above natural ground for long-term drainage.
- Prevents road from eroding below road berms.
- Over filling is vital to long-term benefits

**Page 52 in Field Guide**

# Fill the hole, build a foundation, and elevate the road surface




*Scale exaggerated to show concept*

**Whenever possible or necessary strive to elevate the road surface by building an embankment**

**There is a reason why most major roads are elevated**
**We can utilize this concept on a smaller scale.**

http://www.envicom.eu/en/portfolio-posts/sizing-and-calculation-of-a-supporting-structure-necessary-to-ensure-stability-of-an-embankment-road-infrastructure-2/

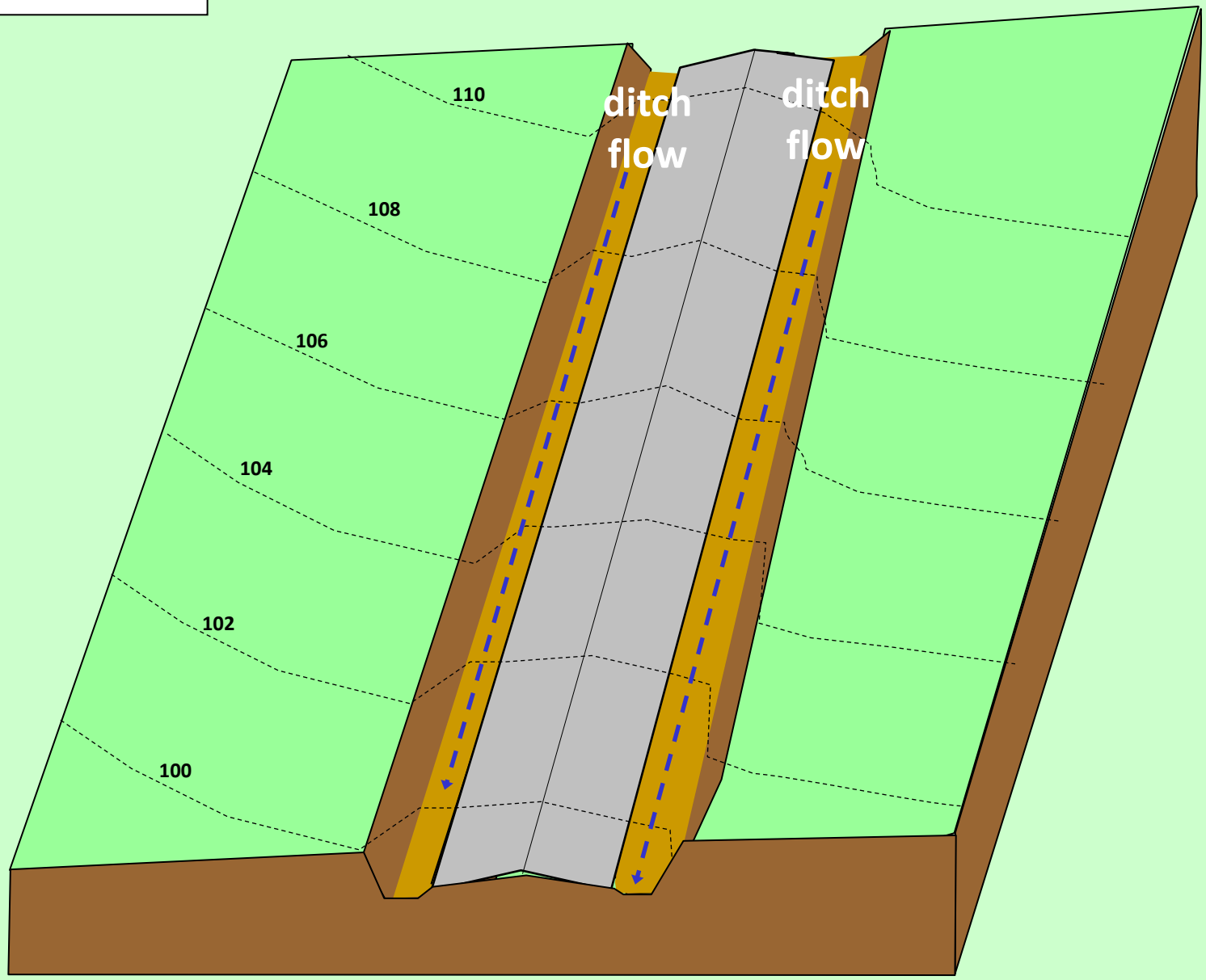
**Whenever possible or necessary, strive to elevate the road surface above the terrain by building an embankment**

# Entrenched Roads: ESMPs

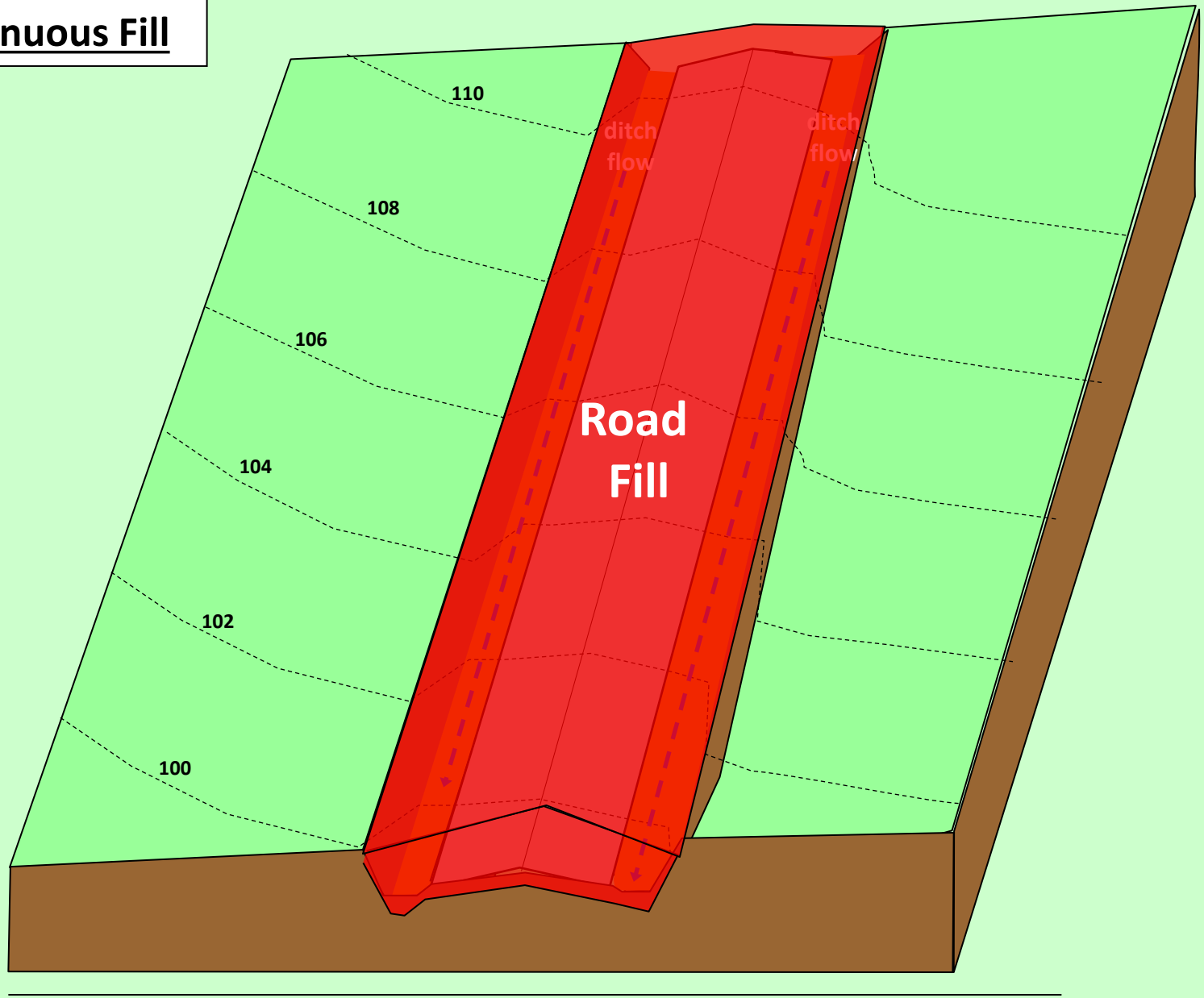
## Filling the Road

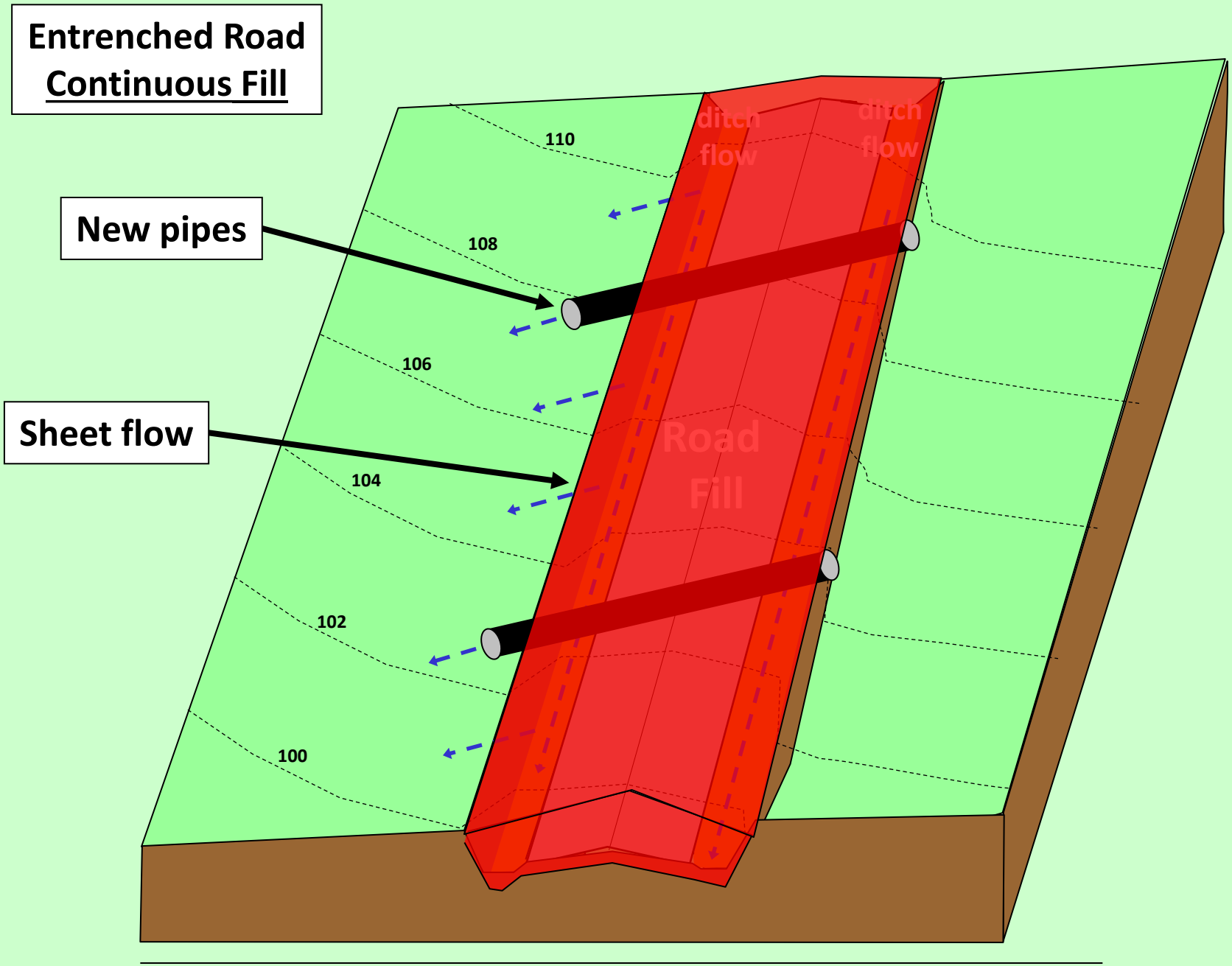
- **Strive to elevate the road surface by building an embankment**
- **Often called “turnpiking”**

**Entrenched Road**



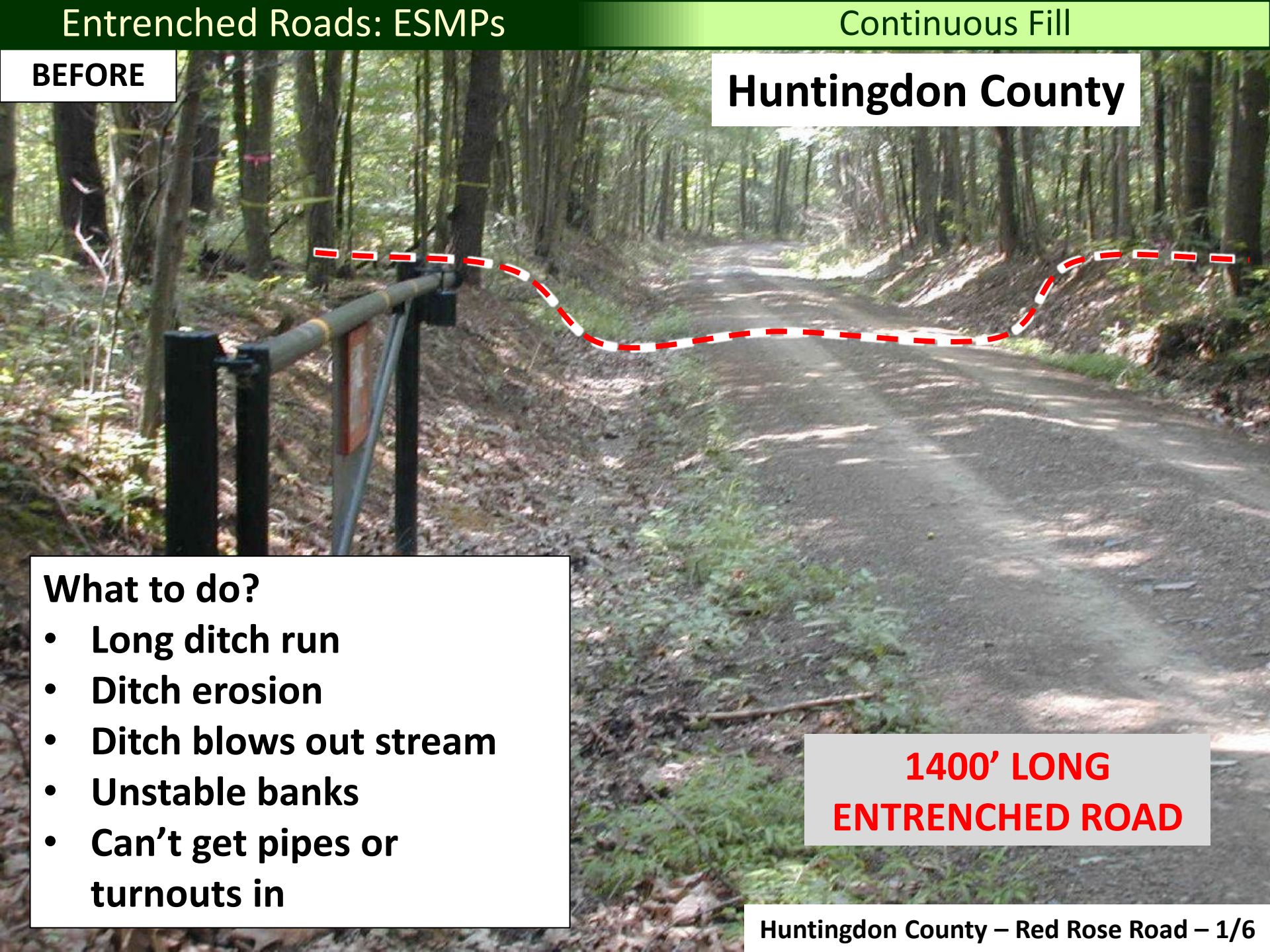
**Entrenched Road**
**Continuous Fill**




Entrenched Road
Continuous Fill
New pipes
Sheet flow
110
108
106
104
102
100
ditch flow
ditch flow
Road Fill

Continuous Fill

BEFORE



## Huntingdon County

**What to do?**

- Long ditch run
- Ditch erosion
- Ditch blows out stream
- Unstable banks
- Can't get pipes or turnouts in

**1400' LONG ENTRENCHED ROAD**

# Entrenched Roads: ESMPs

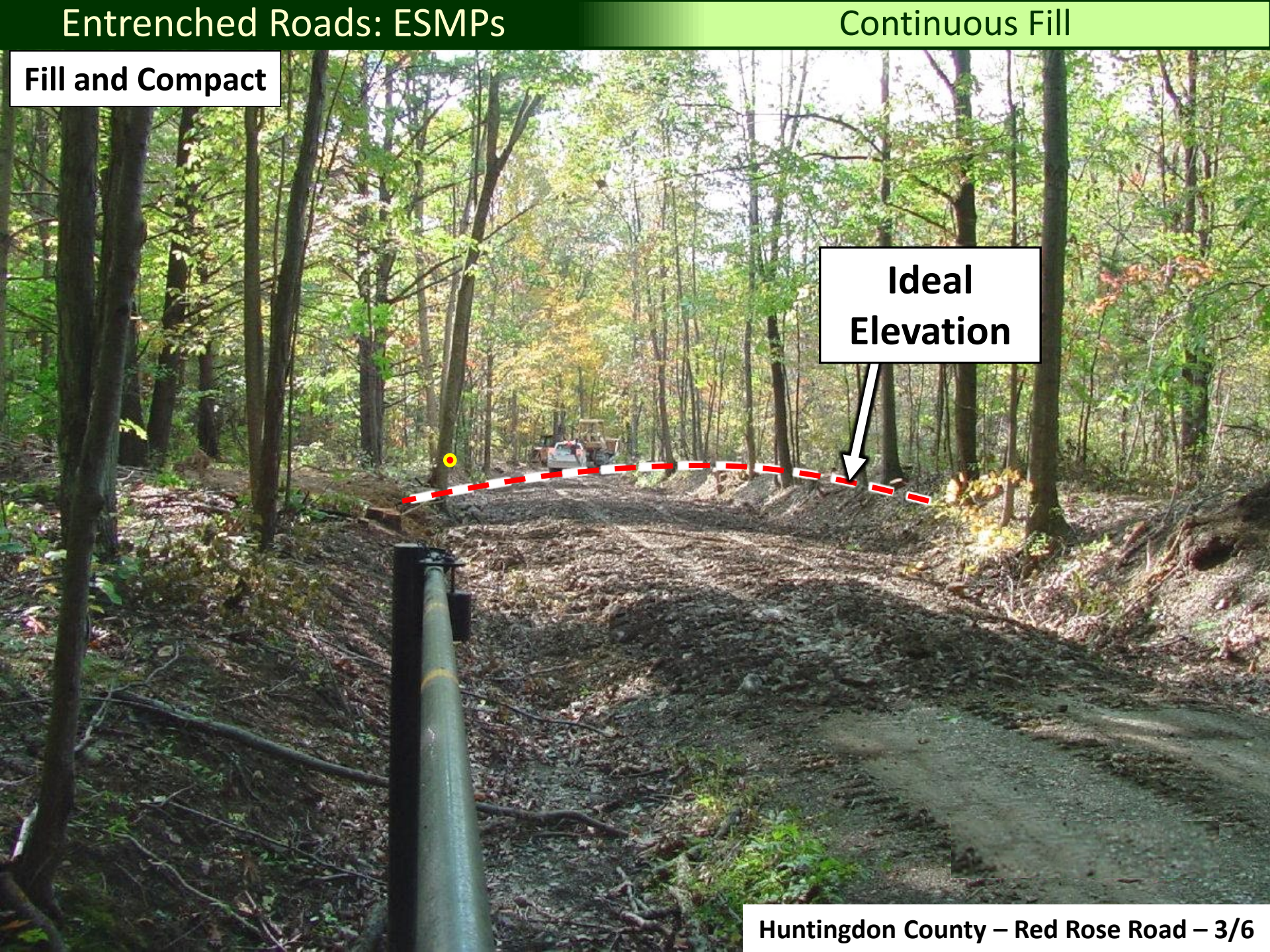
## Continuous Fill


Huntingdon County – Red Rose Road – 2/6

# Entrenched Roads: ESMPs

## Continuous Fill

**Fill and Compact**




**Huntingdon County – Red Rose Road – 3/6**

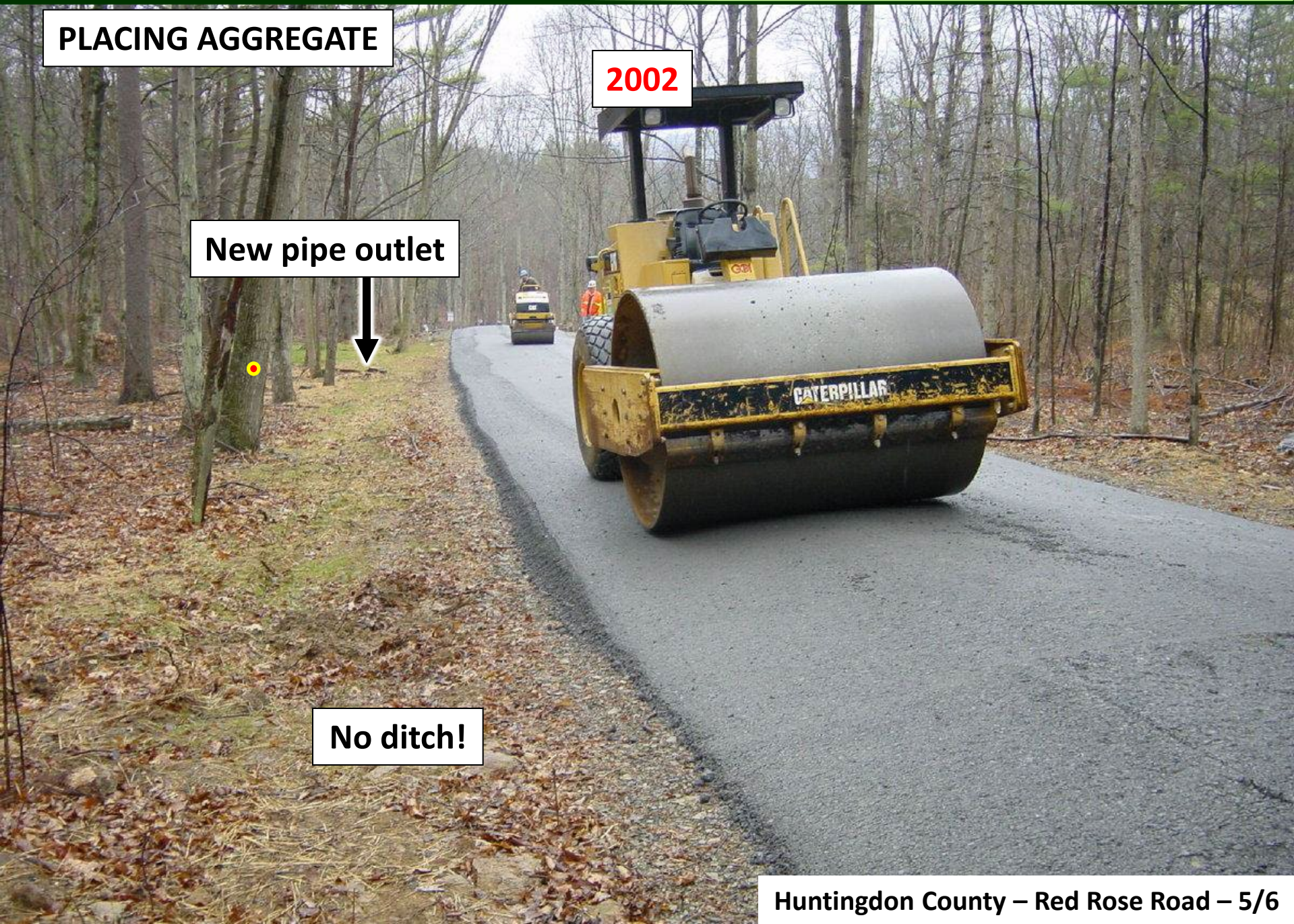
# Entrenched Roads: ESMPs

## Continuous Fill


Huntingdon County – Red Rose Road – 4/6

# Entrenched Roads: ESMPs

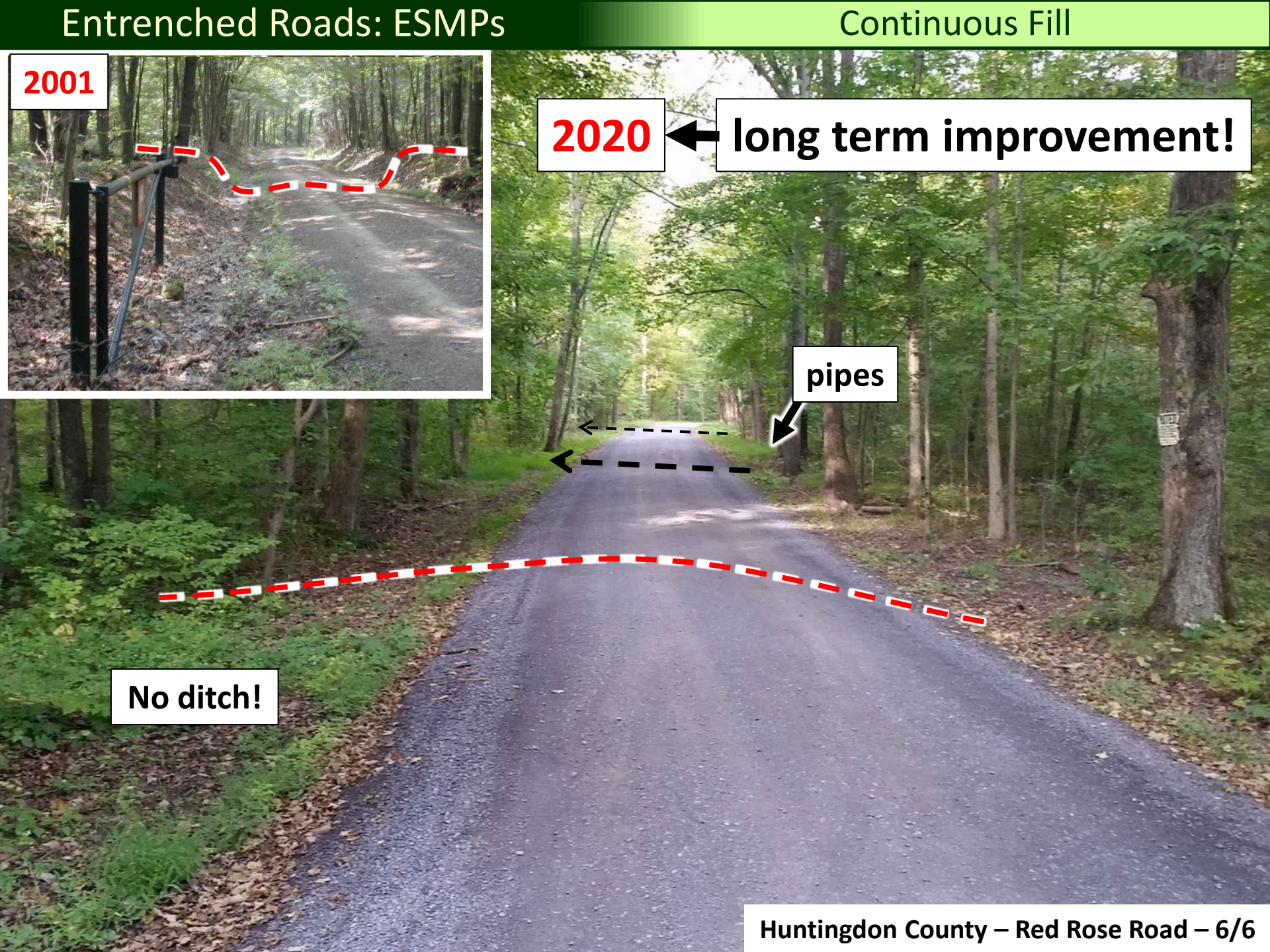
## Continuous Fill




Huntingdon County – Red Rose Road – 5/6

# Entrenched Roads: ESMPs

## Continuous Fill




Huntingdon County – Red Rose Road – 6/6

# Red Rose Road – Huntingdon County - 2020

# Red Rose Road – Huntingdon County

- 8 cross-pipes (7 new!)
- Over 4,100 tons of total fill material (shale and 2A)
- Shale Fill (average of 1 foot of fill over 3,000 feet of road)
- Paver placed 2A for surface (6” loose lift)
- DSA placed (final phase in 2-phase project)

Huntingdon County – Red Rose Road Ph2 – 2/8

# Red Rose Road – Huntingdon County

## Before

## After

**No concentrated flow**

# Red Rose Road – Huntingdon County

**Local shale was placed & compacted to promote sheet flow and provide ditch outlet opportunities**

# Red Rose Road – Huntingdon County


Huntingdon County – Red Rose Road Ph2 – 5/8

# Red Rose Road – Huntingdon County



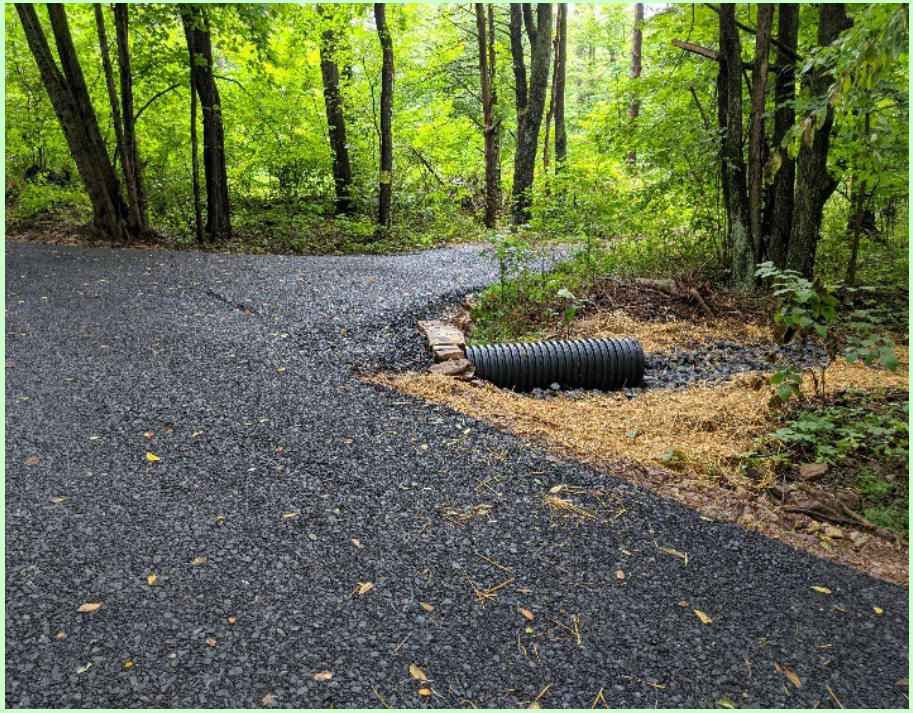
**Downslope driveway accounted for:**

- **Tie in (smooth transition)**
- **Drainage: Sheet flow established on downslope ditch**
- **Drainage: New cross pipe outlets water below the driveway intersection**

# Red Rose Road – Huntingdon County

**Shallow cross-pipes were installed in the compacted shale before the 2A surface was placed.**

# Red Rose Road – Huntingdon County



**Outlet of new cross-pipe at downslope driveway**

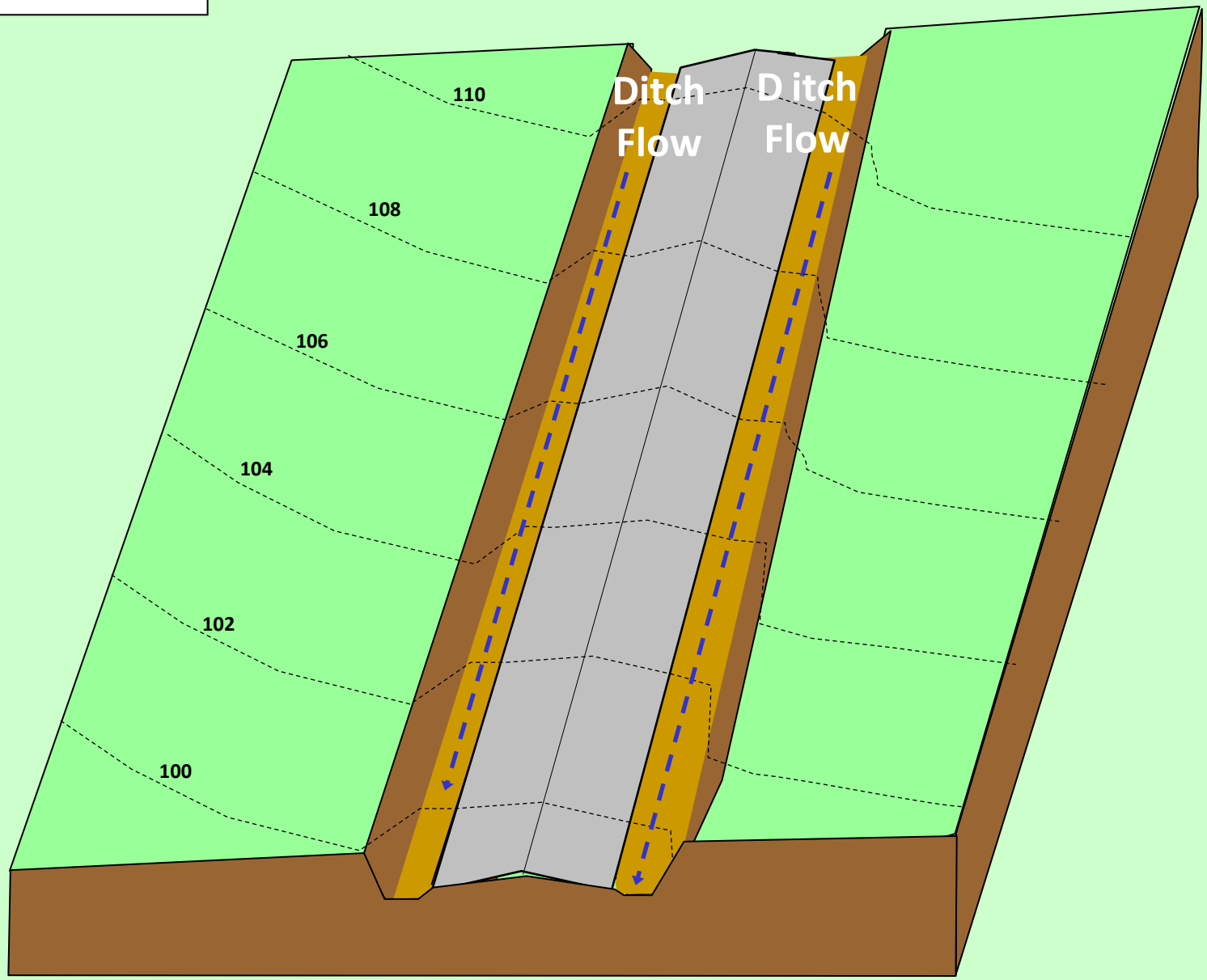
# Entrenched Roads

- What is an “entrenched road?”
- **Filling the road cross-section**
  - Continuous fill
  - **Sectional fill**
- Types of Fill
- Introduction to RFQ
- Review of Benefits

## Sectional Fill:

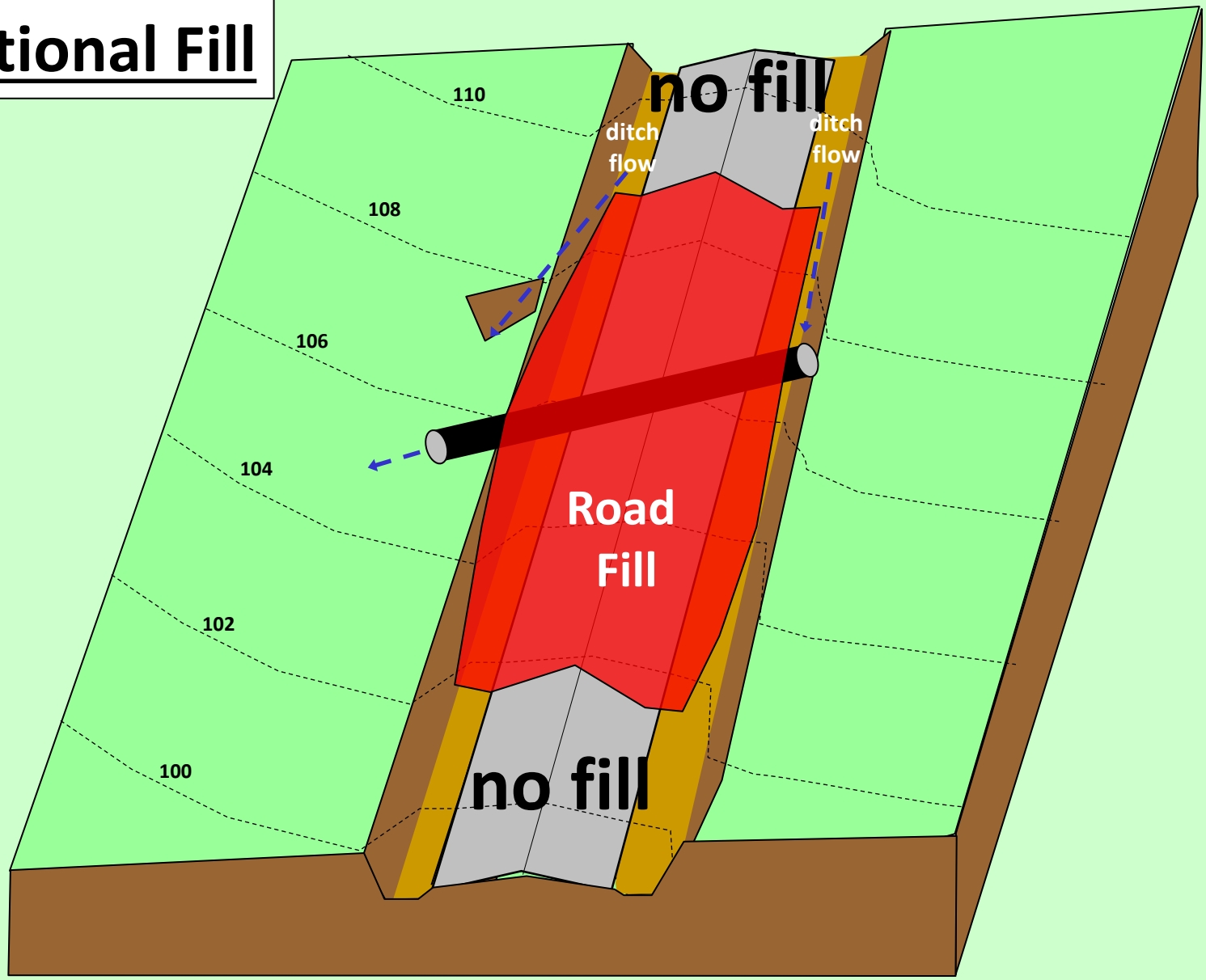
- When you can't fill the entire road due to logistics, lack of material, and/or cost
- Transition into and out of road fill
- Short section of fill forces ditch turnout and provides cover for a new cross pipe.

**Entrenched Road**



**Entrenched Road**

# sectional Fill

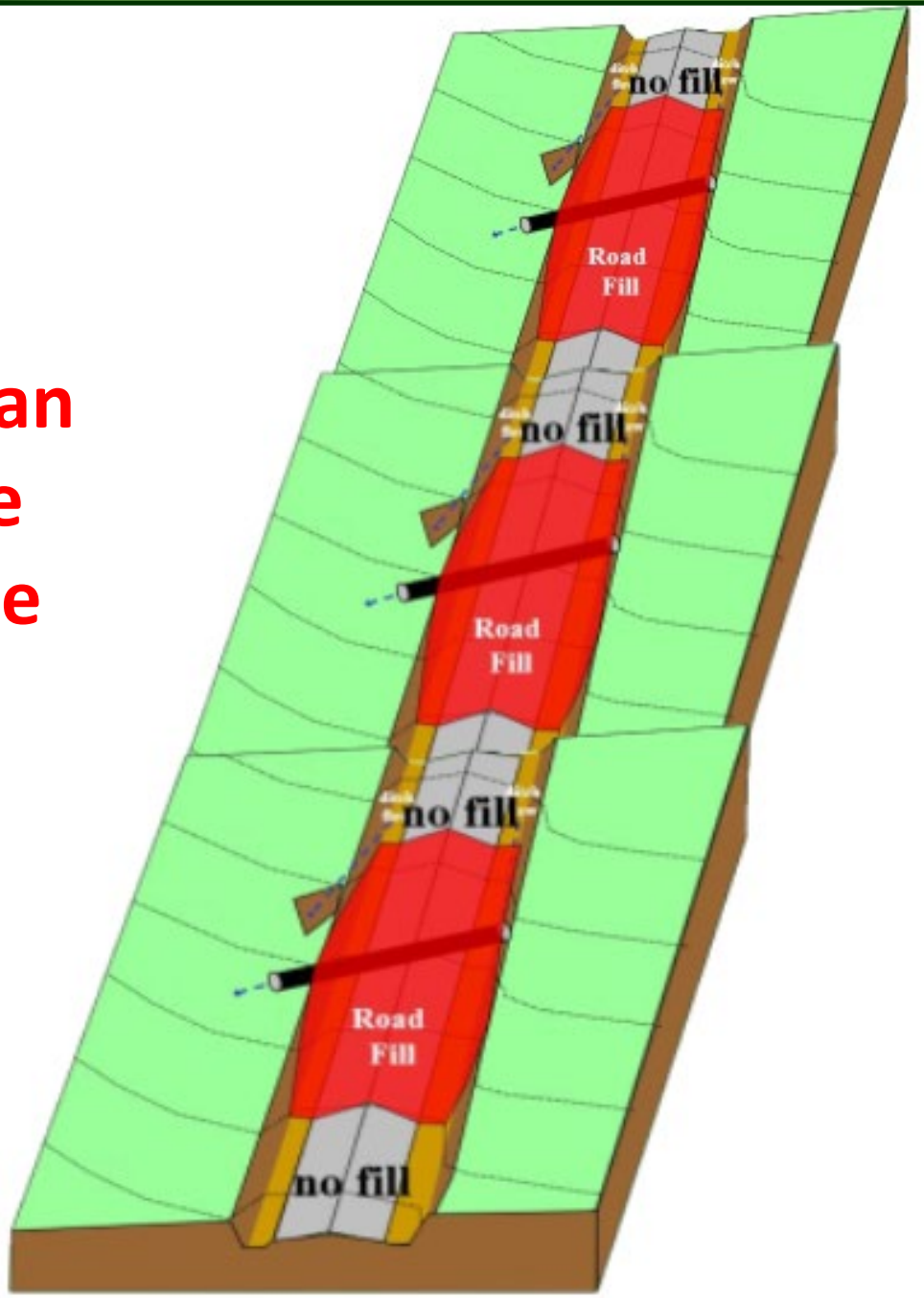


Entrenched Road

# Sectional Fill

**On hills, a series of sectional fill sections can be less costly and more effective than filling the full road length**

**Limitations on steep slopes**



# Entrenched Roads: ESMPs

## Sectional Fill

# Entrenched Roads: ESMPs

## Sectional Fill


McKean City – Prospect Rd – 2/8i

# Entrenched Roads: ESMPs

## Sectional Fill

BEFORE

**McKean Cty – Prospect Rd – 3/8**

## Sectional Fill

**Adding Fill**

**Enough fill used to**

- **build crown**
- **reestablish ditch function**
- **reduce the flow volume reaching stream**

**McKean Cty – Prospect Rd – 4/8**

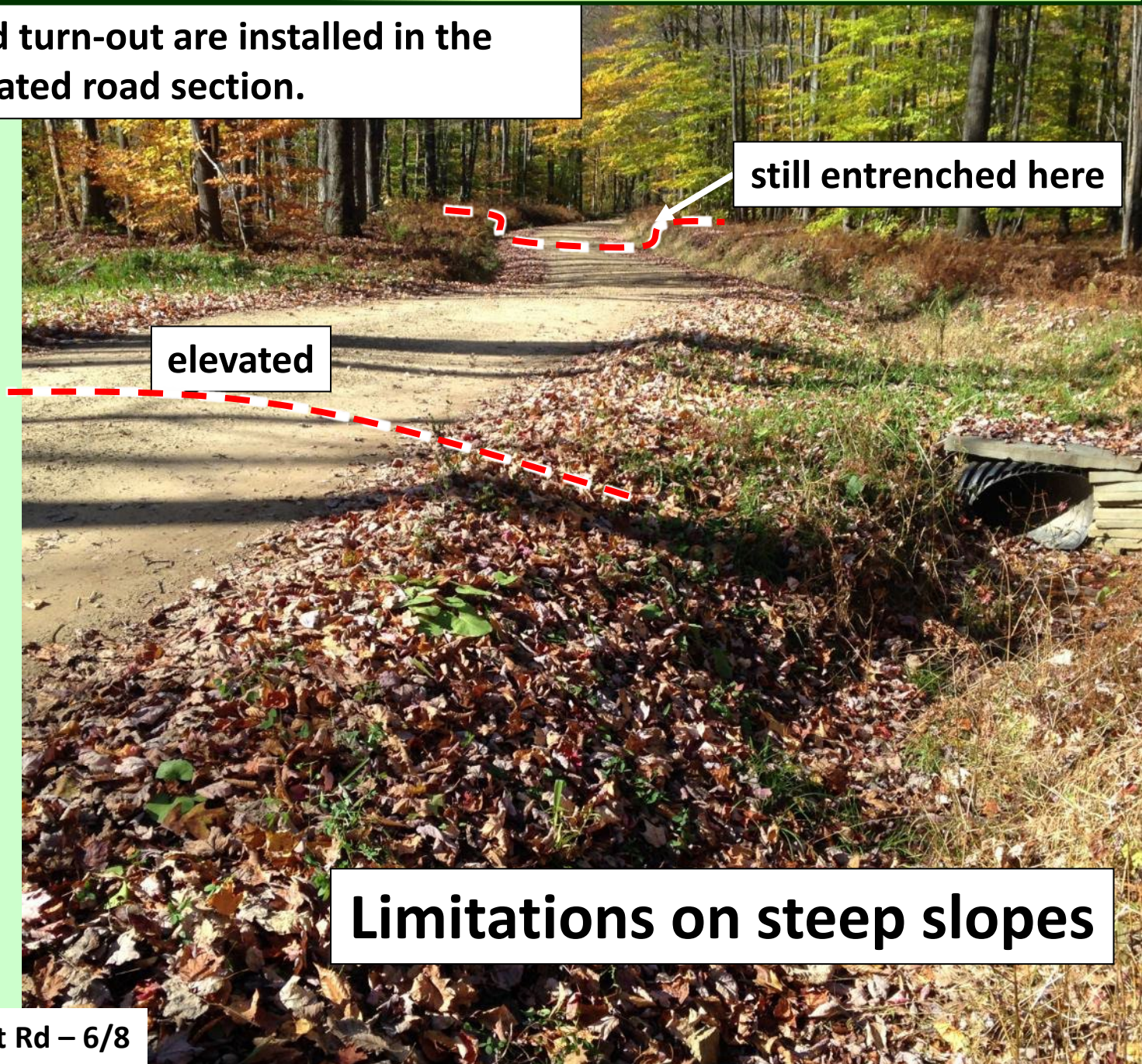
## Sectional Fill

**At a select location near the project midpoint enough fill is used to create ditch outlets.**

**McKean Cty – Prospect Rd – 5/8**

**A crosspipe and turn-out are installed in the elevated road section.**

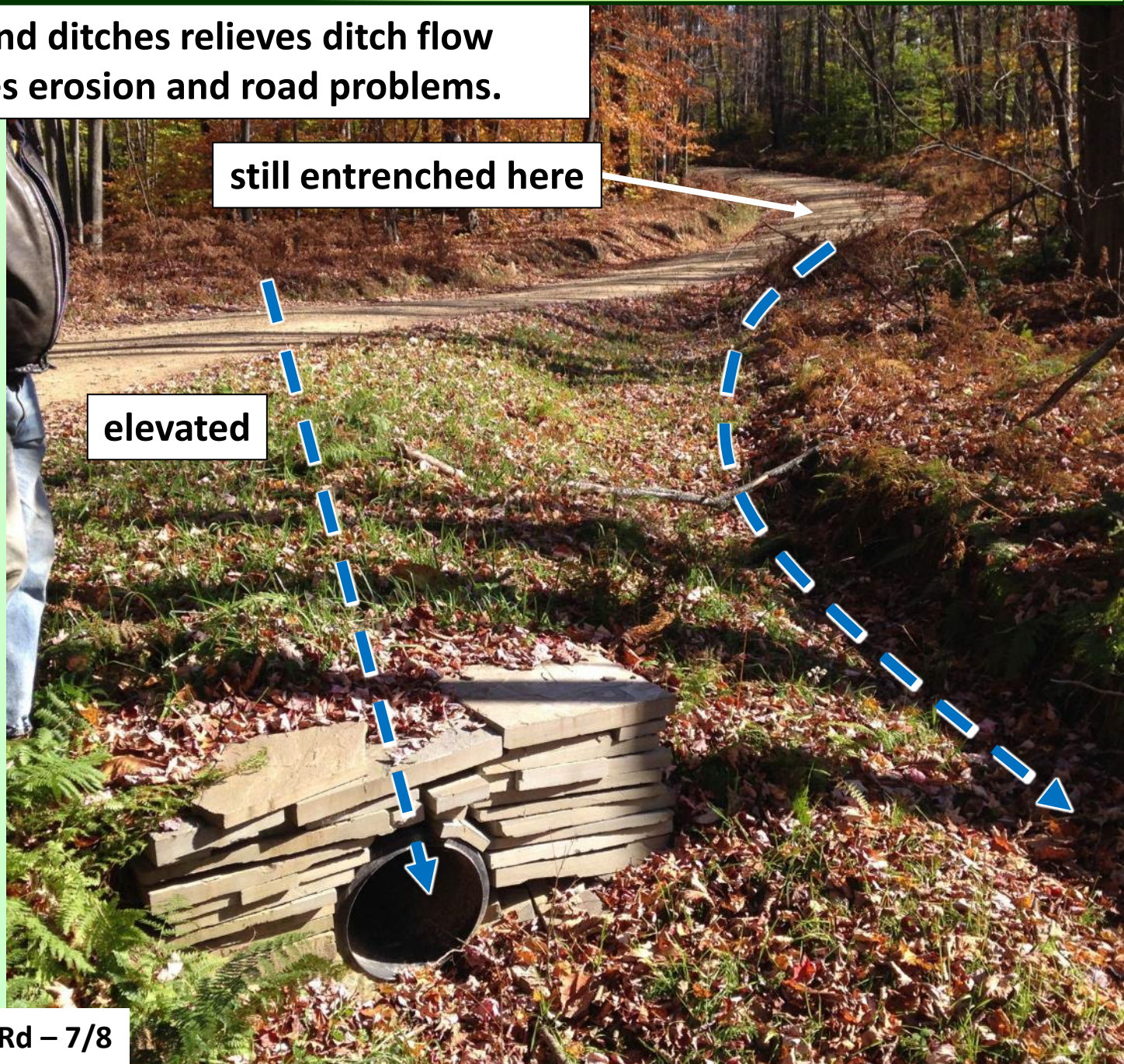
**AFTER**




McKean Cty – Prospect Rd – 6/8

**Elevated road and ditches relieves ditch flow volumes, reduces erosion and road problems.**

**AFTER**




McKean Cty – Prospect Rd – 7/8

**Elevated road and ditches relieves ditch flow volumes, reduces erosion and road problems.**

**AFTER**


**McKean Cty – Prospect Rd – 8/8**

**Susquehanna County**
Road Fill Overview

BEFORE

AFTER

# Too costly?

**Filling the road is a long-term solution that solves a host of problems.**

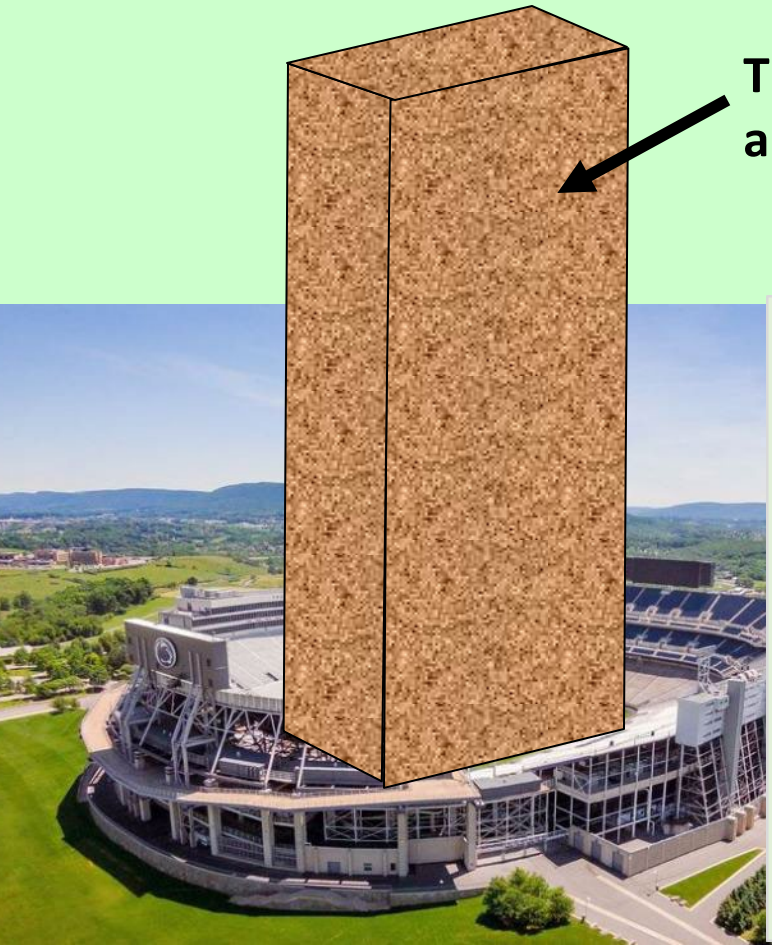
- Eliminates ditches and need for rip-rap.
- Reduces bank heights and constant resurfacing.
- Creates drainage outlets.
- Easier to plow snow off the roadway.

## Filling the Road

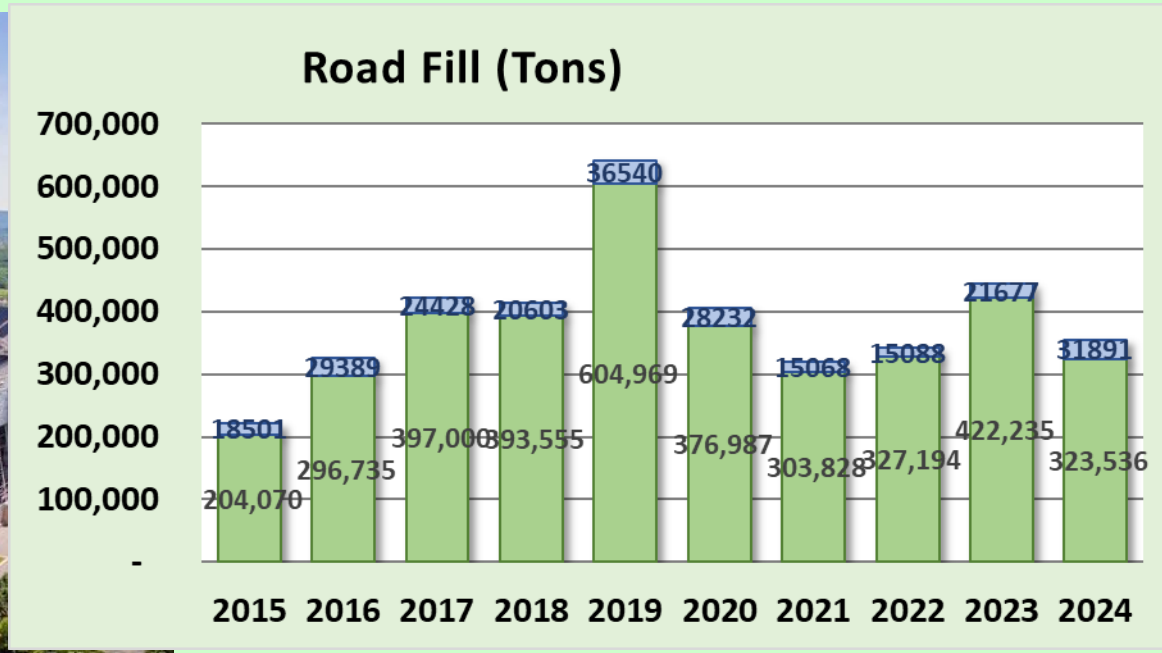
# Challenges of wider roads:

- Maintaining Crown
- More re-graveling, grading, plowing, and money $$$
- Increased traffic speed
- Faster surface degradation
- More dust

# Program has averaged 400,000 tons of fill per year the last 7-years



That's enough material to fill a football field almost 1,000 feet over 7-years.



# Entrenched Roads

- What is an “entrenched road?”
- Filling the road cross-section
  - Continuous fill
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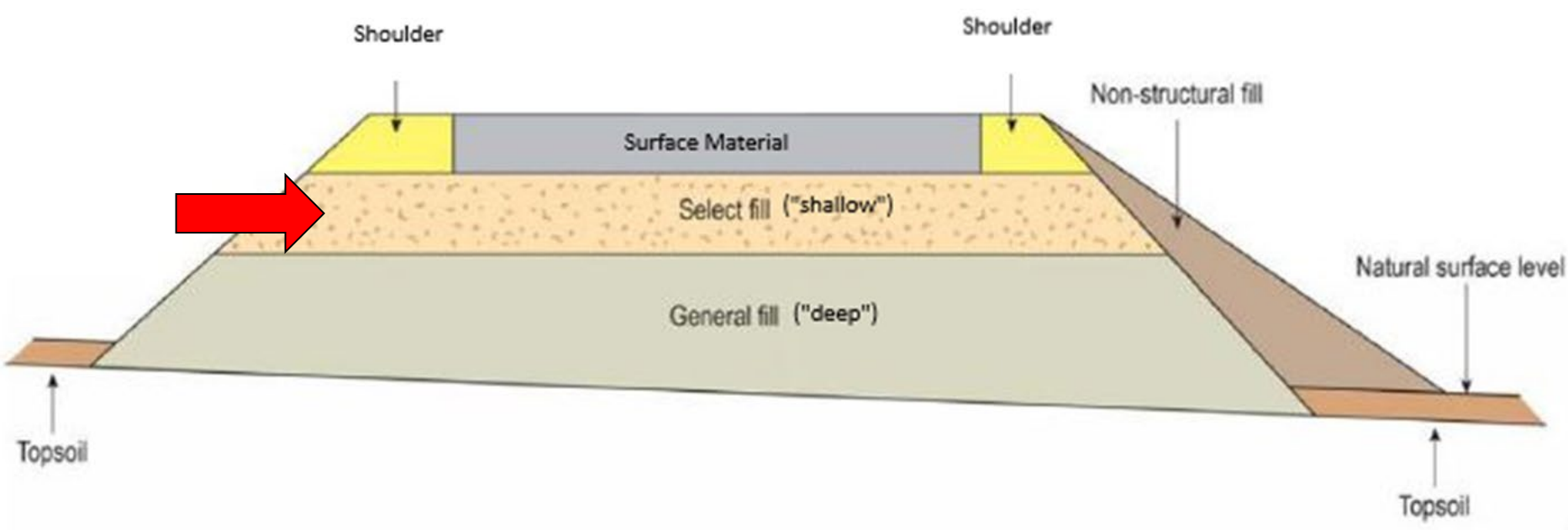
- **Types of Fill**
- Introduction to RFQ
- Review of Benefits

# What is fill?

- **Aggregate, rock, or subsoil with minimal organic matter.**
- **Uneven or excessive settling of fill can result in damage to road surface and drainage features.**
- **Fill must have sufficient strength to hold form when installed and compacted.**

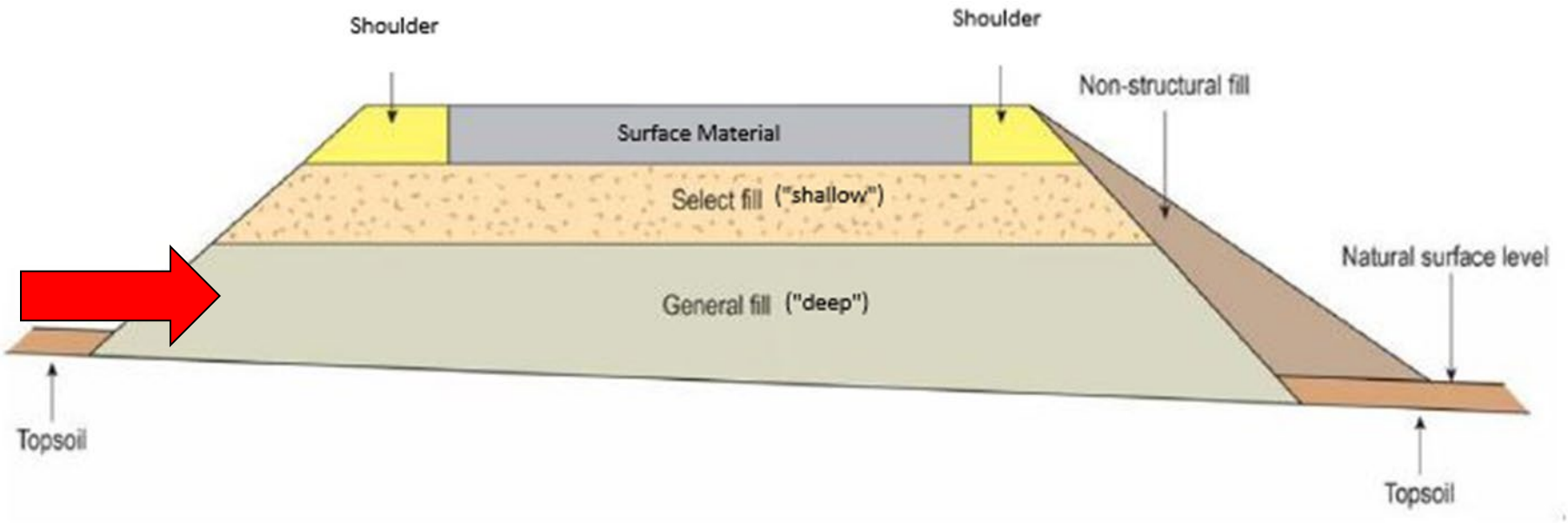
# Select / Shallow Fill – less than 30” from surface

- Pipe and culvert backfill
- Layer beneath pavement / driving surface
- Typically 2A, 3A, 2RC, 4-inch minus, shale...



# General / Deep Fill – greater than 30”

- Provide a stable base for shallow fill
- Can be lower quality material than shallow fill
- Typically shale, poorly graded gravel (bank run), quarry overburden, soil with minimal clay or organics, etc.

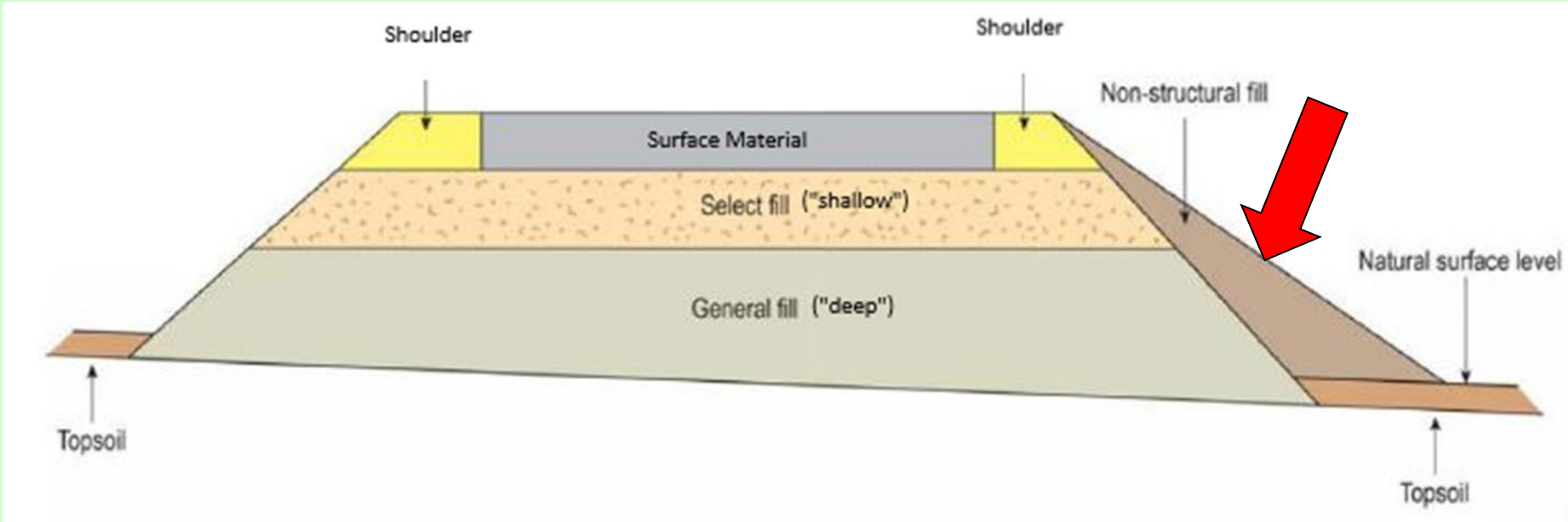


# Rock Fill / Permeable Fill

- **Bridge Rock, French mattress**
- **Use where road base is saturated or over very poor base soils**
- **Typically AASHTO #1, R3, etc.**

# Non-structural fill – Shoulder backup, non-driving surfaces

- Used in non-structural zones
  - Shoulder backup
  - Non-driveable surfaces
- Topsoil, subsoil



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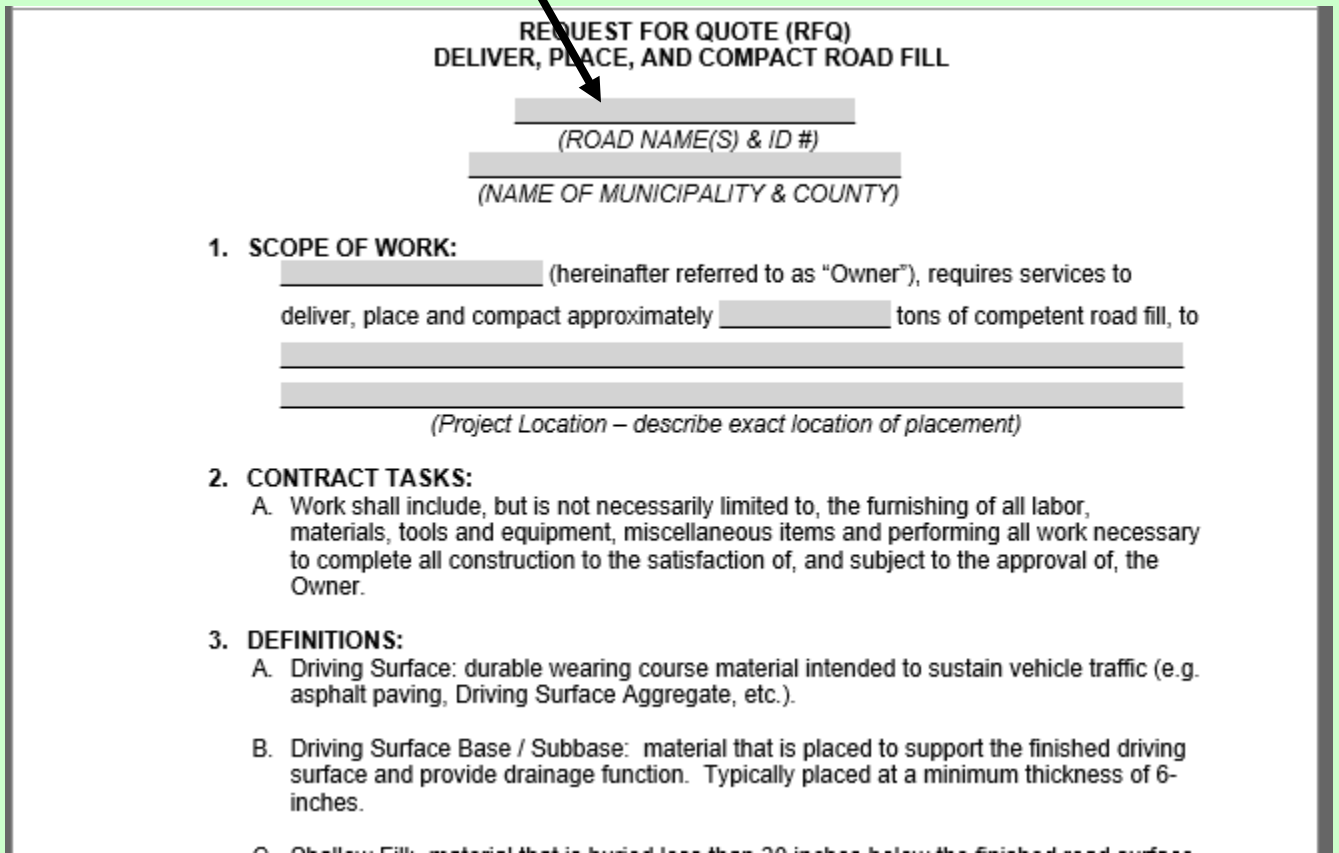
- **Use is Optional**
- **Provides ability to review and accept/reject material.**
- **RFQ is based on overcoming common problems**
- **Can be tailored to site(s) to obtain quality fill.**
- **RFQ can allow for lower costs on deep fill projects**
  - **Specify lower quality material for deep fill where frost and abrasion are not an issue.**
- **RFQ holds a contractor accountable for the quality and placement of fill material.**

# Introduction to RFQ

- **Available online in Word format**
- **You can tailor it to your needs**
- **Has blanks for you to fill in data**



**REQUEST FOR QUOTE (RFQ)**
**DELIVER, PLACE, AND COMPACT ROAD FILL**

_____
*(ROAD NAME(S) & ID #)*

_____
*(NAME OF MUNICIPALITY & COUNTY)*

1. **SCOPE OF WORK:**
   _____ (hereinafter referred to as "Owner"), requires services to deliver, place and compact approximately _____ tons of competent road fill, to

   _____

   _____
   *(Project Location – describe exact location of placement)*

2. **CONTRACT TASKS:**
   A. Work shall include, but is not necessarily limited to, the furnishing of all labor, materials, tools and equipment, miscellaneous items and performing all work necessary to complete all construction to the satisfaction of, and subject to the approval of, the Owner.

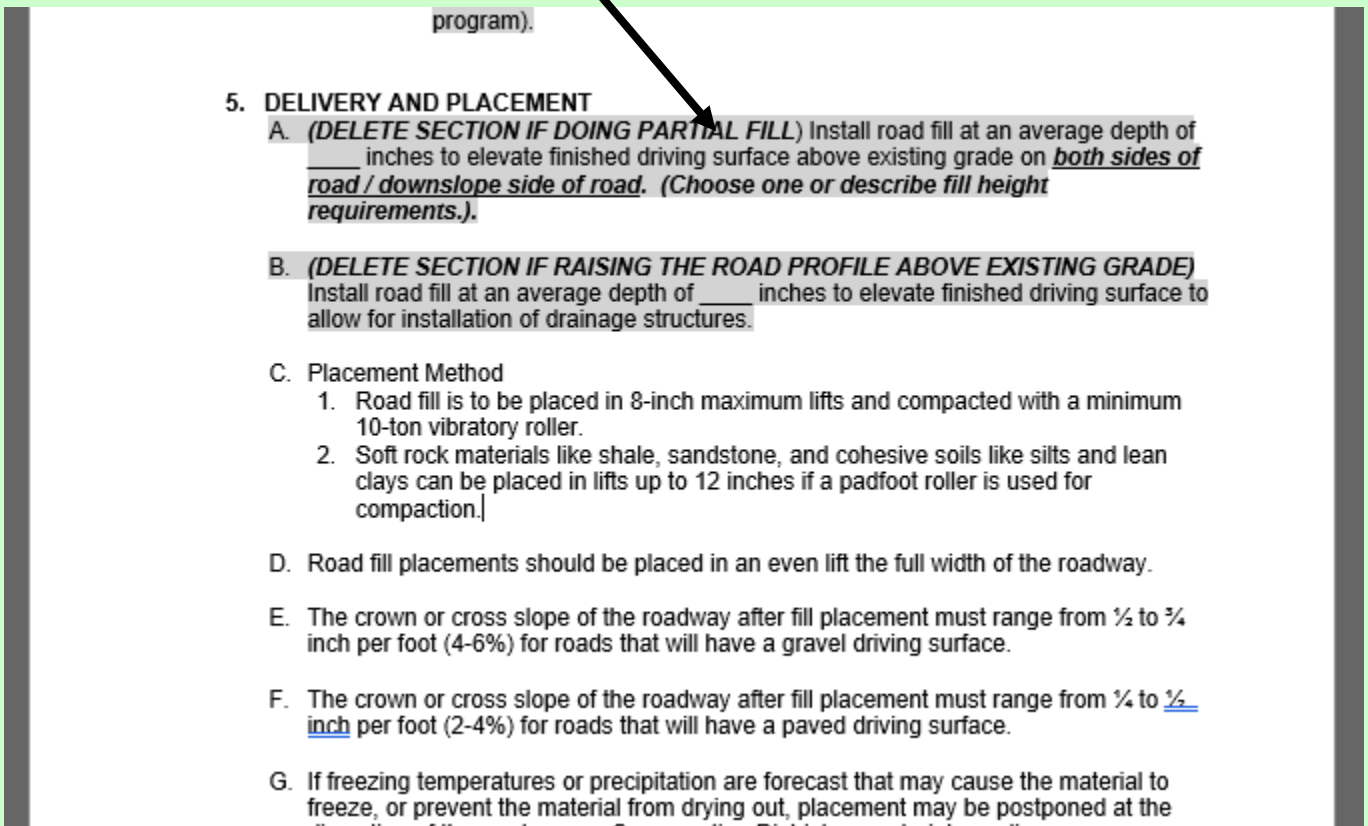
3. **DEFINITIONS:**
   A. Driving Surface: durable wearing course material intended to sustain vehicle traffic (e.g. asphalt paving, Driving Surface Aggregate, etc.).

   B. Driving Surface Base / Subbase: material that is placed to support the finished driving surface and provide drainage function. Typically placed at a minimum thickness of 6-inches.

   C. Shallow Fill: material that is buried less than 30 inches below the finished road surface

# Introduction to RFQ

- **Available online in Word format**
- **Has optional information or information you choose based on project**



program).

5. DELIVERY AND PLACEMENT

A. ***(DELETE SECTION IF DOING PARTIAL FILL)*** Install road fill at an average depth of ____ inches to elevate finished driving surface above existing grade on ***both sides of road / downslope side of road. (Choose one or describe fill height requirements.).***

B. ***(DELETE SECTION IF RAISING THE ROAD PROFILE ABOVE EXISTING GRADE)*** Install road fill at an average depth of ____ inches to elevate finished driving surface to allow for installation of drainage structures.

C. Placement Method
   1. Road fill is to be placed in 8-inch maximum lifts and compacted with a minimum 10-ton vibratory roller.
   2. Soft rock materials like shale, sandstone, and cohesive soils like silts and lean clays can be placed in lifts up to 12 inches if a padfoot roller is used for compaction.

D. Road fill placements should be placed in an even lift the full width of the roadway.

E. The crown or cross slope of the roadway after fill placement must range from ½ to ¾ inch per foot (4-6%) for roads that will have a gravel driving surface.

F. The crown or cross slope of the roadway after fill placement must range from ¼ to ½ inch per foot (2-4%) for roads that will have a paved driving surface.

G. If freezing temperatures or precipitation are forecast that may cause the material to freeze, or prevent the material from drying out, placement may be postponed at the

# Introduction to RFQ - Placement

***Section 5 – Delivery and Placement.***

***Section D. Road fill placements should be placed in an even lift the full width of the roadway.***

- **RFQ specifies complete, even, and consistent compaction to reduce future settling of material.**
- **Can specify crown and cross slope of sub-base to prep for final driving surface.**
- **Deep ditches may need to be filled & compacted before the road can be raised.**

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- What is an “entrenched road?”
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# Benefits of Road Fill

- Provides cover for drainage
- Eliminates downslope ditch
- Promotes sheet flow
- Improves road base
- Reduces bank instabilities
- Helps winter maintenance
- Improves subsurface drainage
- Widens road
- **LONG TERM solutions to many road issues**


**2017: DGR Project** 1/2

Armstrong County, Gibson School Road

$56K Spent, $56K in kind

**Summary:**

- Nearly **10,000 tons** of fill
- New pipes

**BEFORE**

**AFTER**

Worked with landowner to outlet some pipes on other side of hay field in woods.

Township placed **9,800 tons** of fill (6,300 tons of soil and shale, 3,500 tons of limestone).

**3 new pipe headwall**


BEFORE
2017: DGR Project 2/2
Armstrong County, Gibson School Rd
$56K Spent, $56K in kind
Summary:
• Nearly 10,000 tons of fill
• New pipes
AFTER
Worked with landowner to outlet some pipes on other side of hay field into woods.
New pipe headwalls

BEFORE

AFTER

**2018 DGR** **1/1**

Centre County, Yeager Hollow Road

$35K Grant

**Summary:**

- **Frequently flooded and soft section of road**
- Large French Mattress and road fill

DURING

DURING

DURING



**2018 DGR** **1/1**

Wayne County, Adams Pond Road

$92K Grants, $17K In-kind

**Summary:**

- Mile long site with poor base
- 9 New shallow crosspipes installed, ditches reshaped and stabilized
- Base improvement and DSA




**2018 DG** **1/1**

Bradford County, Jung Road

$92K Grants, $15K In-kind

**Summary:**

- **Severely entrenched saturated road**
- ~9,000 tons fill added to achieve sheet flow
- **1,300 feet of underdrain, new pipes, ditch stabilization**


# Jefferson County

# Entrenched Roads

**ADDITIONAL RESOURCES:**

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

next chapter:
**Road Banks**