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**

Driving Surface Aggregate

Traditional Road Maintenance Practices

Environmentally Sensitive Maintenance Practices

Traditional Aggregates

2A

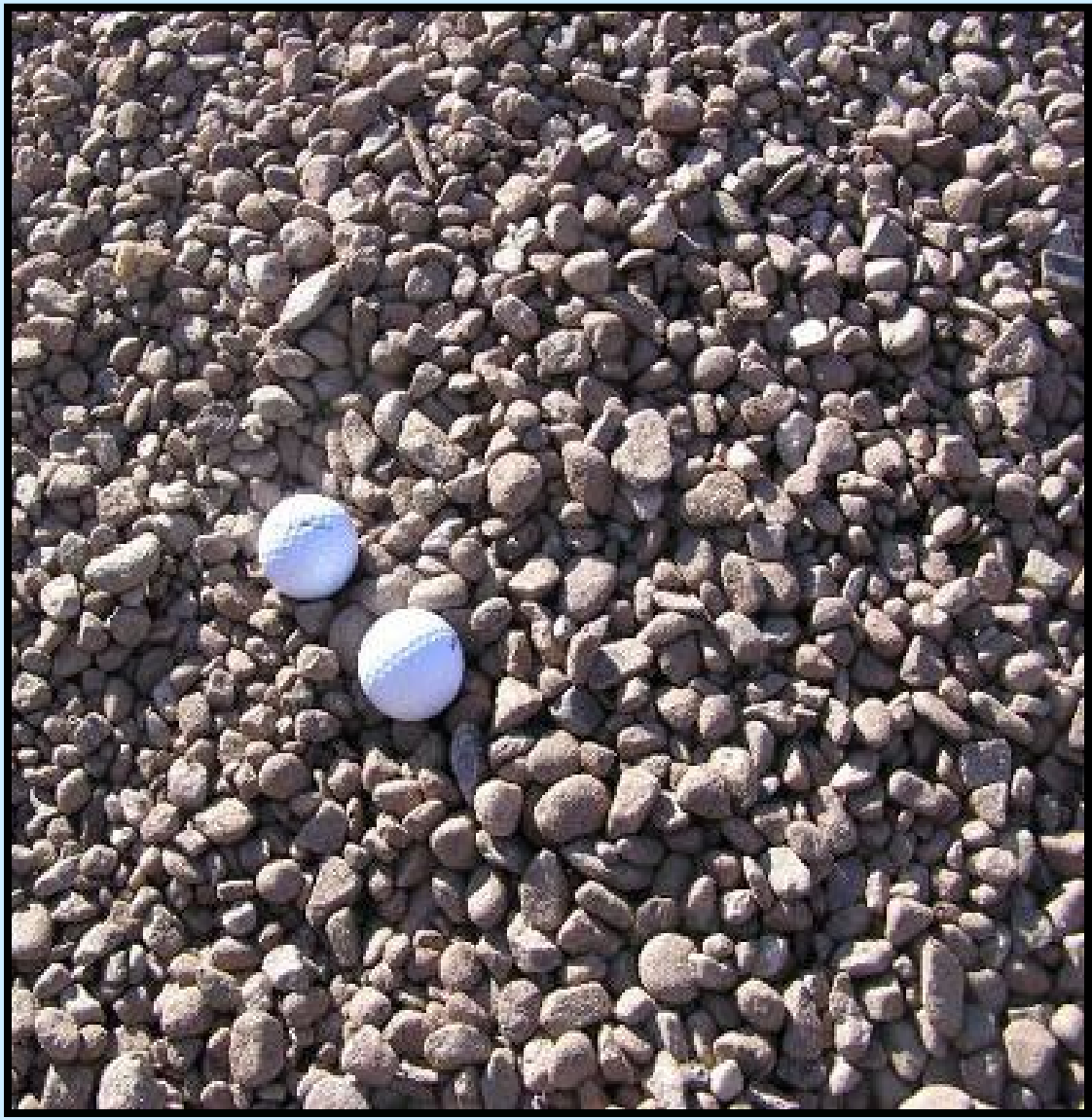
- Very few “fine” particles
- Designed as base for pavement
  (designed for drainage, not compaction)

2RC

- More “fine” particles
- Fines can be clay or soil
- Very broad specification range

Bankrun Gravel

- Varies in top size
- Unless crushed, it is ROUND!
- Does not compact well
- Quality and usefulness varies greatly



Most road aggregates used today were created for use in drainage under pavements and were *NOT* intended to be used as a driving surface.

THIS IS WHY WE HAVE CREATED A

DRIVING SURFACE AGGREGATE!

Driving Surface Aggregate

Traditional Road Maintenance Practices

Environmentally Sensitive Maintenance Practices

Introduction

- **What is DSA?**
- Details of DSA

DRIVING SURFACE AGGREGATE

An aggregate specification created by the Dirt and Gravel Road Program for use as a wearing course on unpaved roads

WHAT IS DSA?

Comparable to PennDOT's "2A", but:

- Smaller top size, more fine material for better compaction, placement method requirements
- Strict specifications (size, hardness, moisture, etc.)

Aggregate Comparison :

- DSA and 2A placed with a paver
- 6” depth after compaction
- Placed November 2002

Picture taken **during** aggregate placement with a paver

DSA

2A

Picture taken **<u>just after</u>** aggregate placement and compaction

DSA

2A

Picture taken a week **after traffic**

DSA **2A**

WHAT IS DSA?

- Tighter specification (narrower gradation, more fines, hardness, clay limitations)

- Not just an aggregate!
  - Designed to be a driving surface

DSA is a ***PROCESS***, not just a product!!!

Introduction

- What is DSA?
- **Details of DSA**
- Sampling & Testing DSA

SCC DSA Specification/Standard

PA State Conservation Commission
Driving Surface Aggregate Standard and Specification

I. **Definition -** This document is for the purchase and placement of Driving Surface Aggregate (DSA) for the Pennsylvania State Conservation Commission's Dirt, Gravel, and Low Volume Roads Maintenance Program (DGLVRMP). DSA is an aggregate mixture of crushed stone designed specifically as a surface-wearing course for unpaved roads. DSA provides a durable road surface with longer maintenance cycles than conventional road surface aggregates.

II. **Use -** For the purposes of funding under the Dirt, Gravel, and Low Volume Roads Maintenance Program (DGLVRMP), DSA must be used in areas where it will have an environmental benefit (reduced erosion, reduced runoff). DSA shall only be placed after drainage and subgrade issues have been addressed by utilizing practices that promote Environmentally Sensitive Maintenance DSA was originally designed to reduce erosion and runoff on road segments close to streams where drainage improvements were limited. DSA is not required on every project.

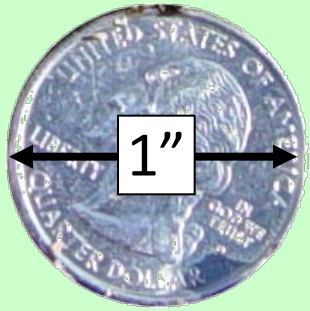
III. **Material -** Material to be used on the project shall be tested prior to delivery by an independent lab that has no affiliation with the source quarry. Samples shall be obtained by Conservation District

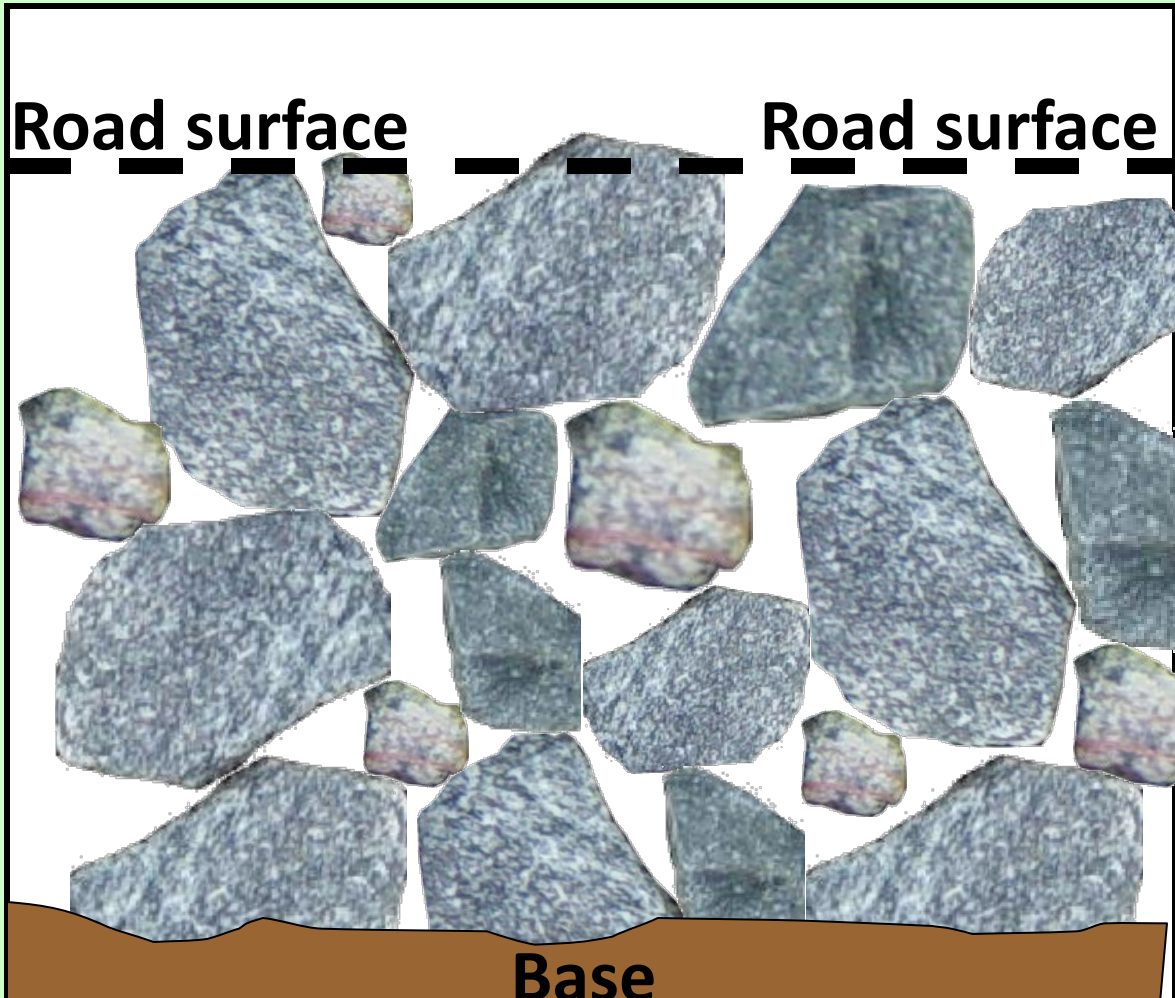
Details of DSA specification

- **Size or Gradation**
- **Moisture**
- **Plasticity Index, Resistance to Abrasion, Soundness, pH**

What is good aggregate?

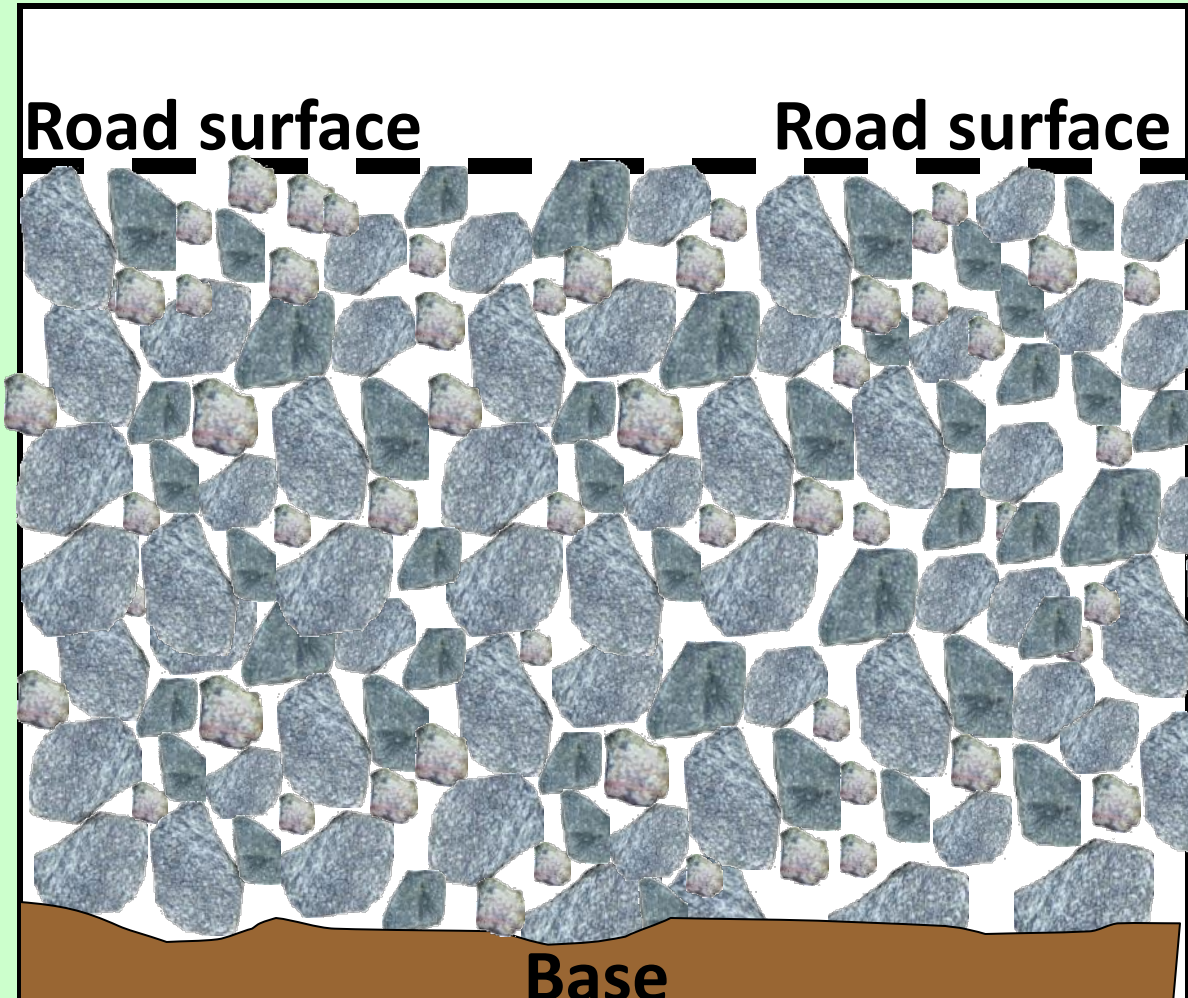
A mixture of only large stones will fail!!





What is good aggregate?

A mixture of only small stones will fail!!

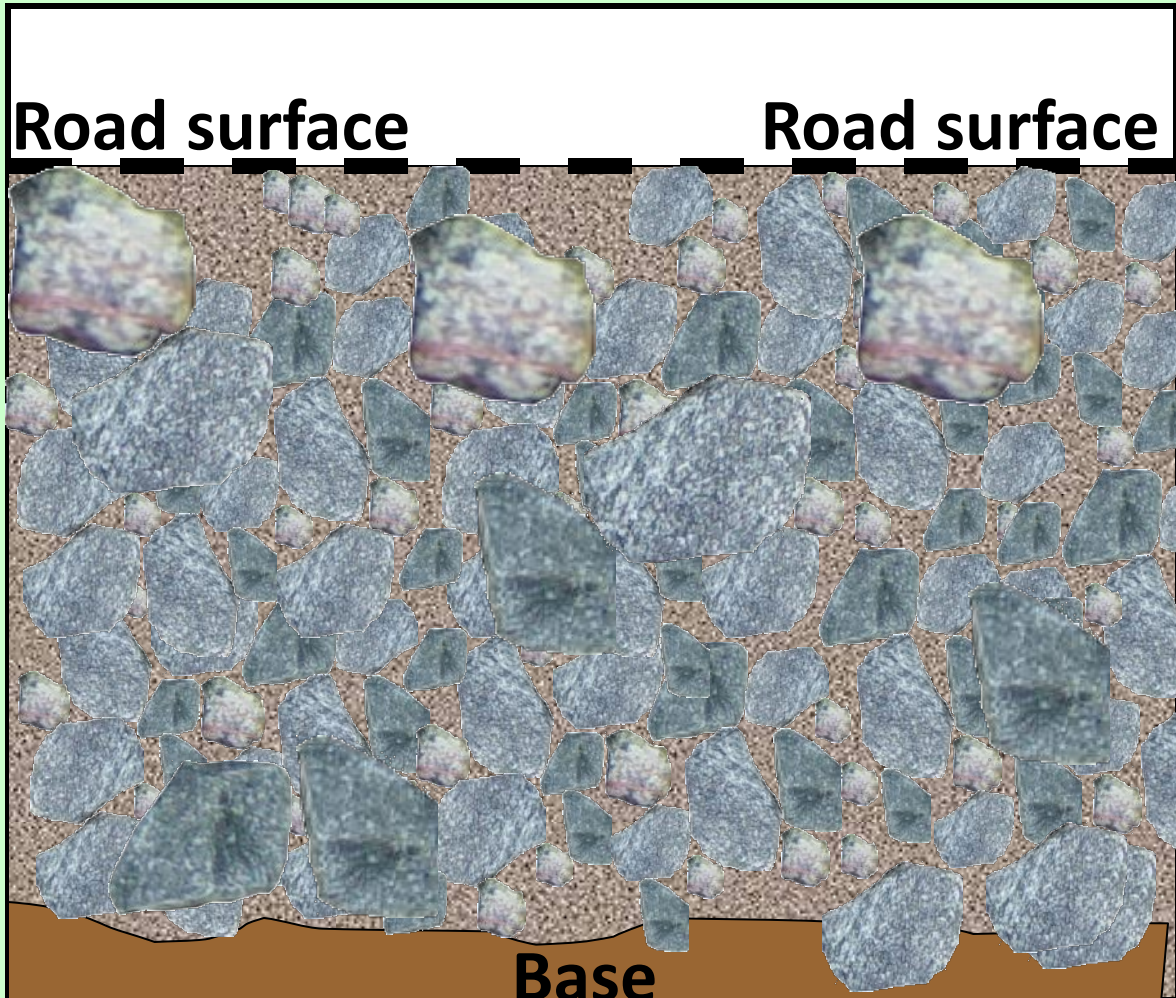


What is good aggregate?

So what will work?

A good mix of stone sizes…..

INCLUDING FINES!



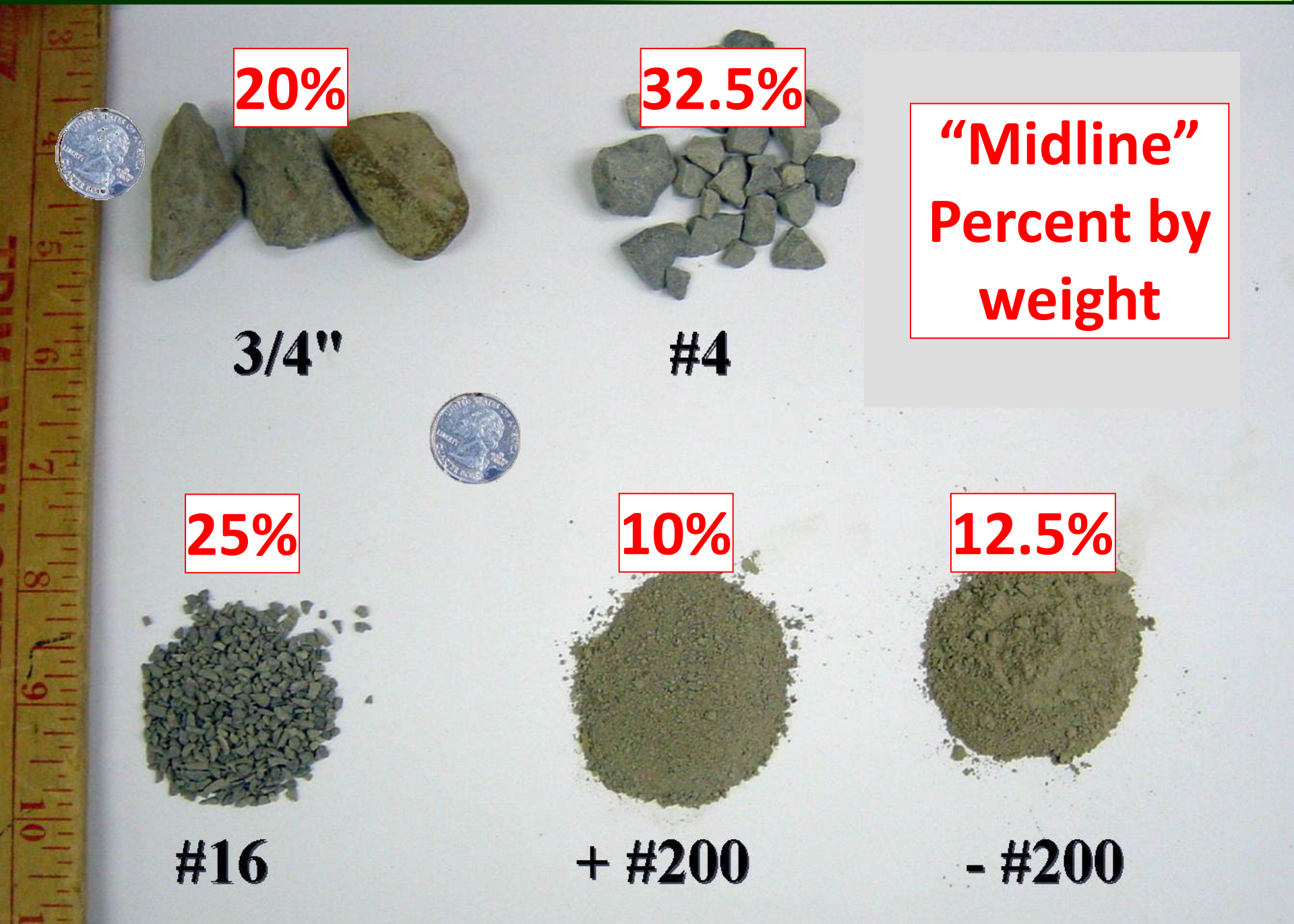
Gradation: What does this really mean?

The DSA spec:

% passing by weight

Passing Sieve	Lower %	Higher %
1½ inch	100	-
3/4 inch	65	97
#4 (1/4 ")	30	65
#16 (1/16 ")	15	32
#200(1/200 ")	11	15*

*** Up to 17 % fines if PI ≤2**



"Midline" Percent by weight

Rock "FINES" are the glue that holds DSA together!

Crushed rock fines from other sources that meet DSA standards can be added.

Details of DSA specification

- Size or Gradation
- Moisture
- Plasticity Index, Resistance to Abrasion, Soundness, pH

DSA Moisture:

"Aggregate MUST be delivered at optimum moisture*"

WHY?

- **Reduces segregation during transport and placement**
- **Allows for maximum compaction!!**

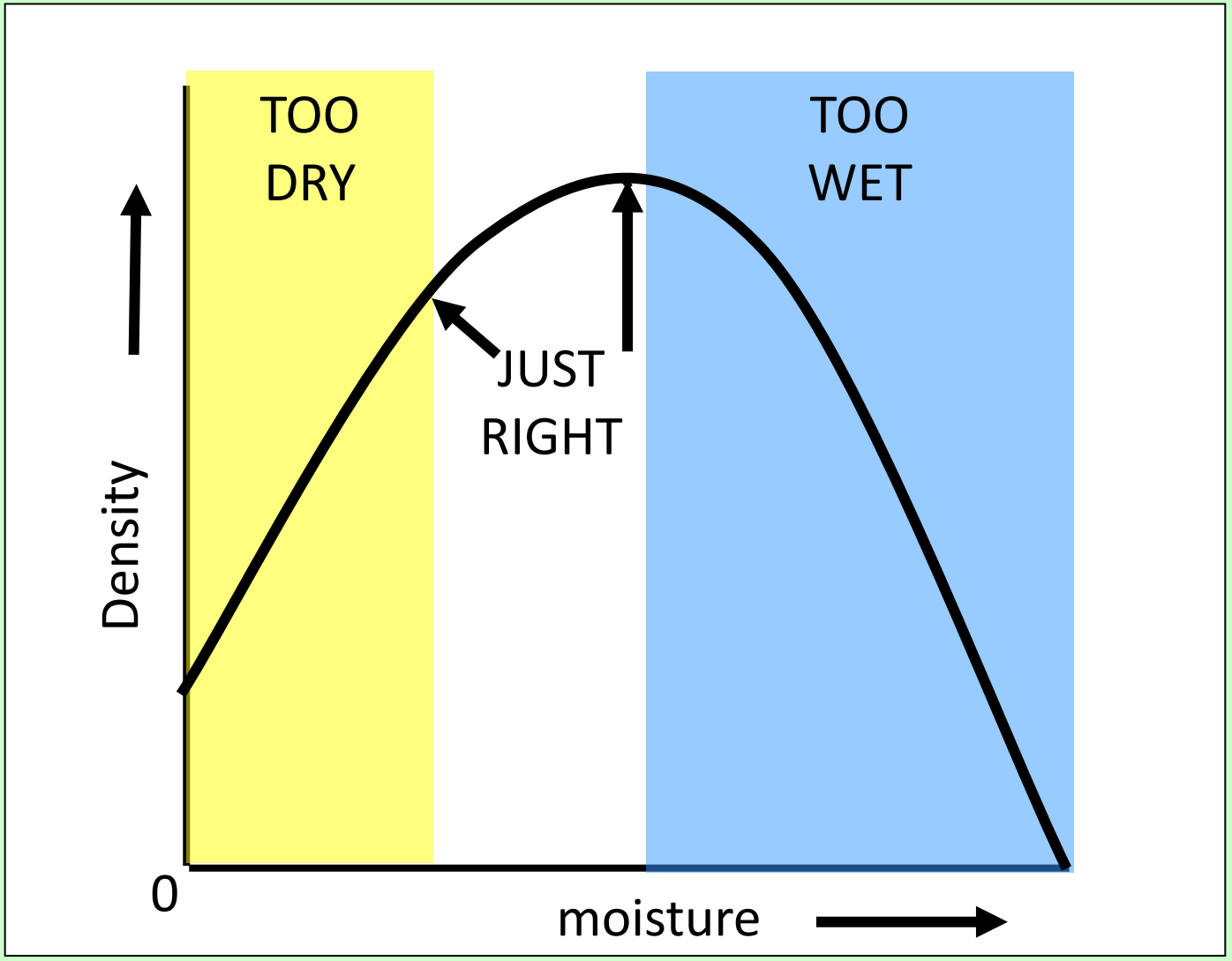
*DSA must be delivered and placed at optimum moisture or up to 2% below optimum. If OM = 7%, DSA must be placed at 5-7%

DSA Moisture:

"Aggregate MUST be delivered at optimum moisture"

Optimum Moisture: The moisture at which an aggregate will achieve maximum compaction.

DSA Moisture: Standard Proctor Analysis



DSA Size Gradation in a nutshell:

Tighter specification with more fine material & moisture allows for better compaction:

DSA: 11-15% crushed rock fines

2A: 0-10% ??? fines

Better compaction leads to a better, harder, longer lasting road.

Details of DSA specification

- Size or Gradation
- Moisture
- Plasticity Index, Resistance to Abrasion, Soundness, pH

Other DSA Specification Requirements:

Plasticity Index (PI):

- PI of 4 or less.
- The PI indicates the range of moisture contents at which a soil is plastic
- Higher PI means aggregate is more prone to rutting & moisture retention.

Other DSA Specification Requirements:

Resistance to Abrasion:

- **LA abrasion loss less than 40%.**
- **Aggregate is placed in steel drum with steel spheres and rotated.**
- **Lower % = less crushing means harder aggregate.**

Other DSA Specification Requirements:

Soundness:

- Allowable loss of 20% or less
- The more sound an aggregate is, the more likely it is to resist degradation due to weathering (freeze/thaw).
- Applies to all aggregates – DSA, 2A, Riprap, etc.

BEFORE

AFTER

Sodium Sulfate Soundness test mimics weathering

Other DSA Specification Requirements:

Proper pH:

- **DSA Spec – pH between 6 and 12.45.**
- **Traditional Aggregates – no specification.**
- **This test is typically only needed once per quarry (source dependent).**

DSA Projects

- **Purchasing DSA**
- Road Preparation
- DSA Placement
- DSA Compaction

Placement Depth

DSA must be placed at an un-compacted depth of 6”- 8”.

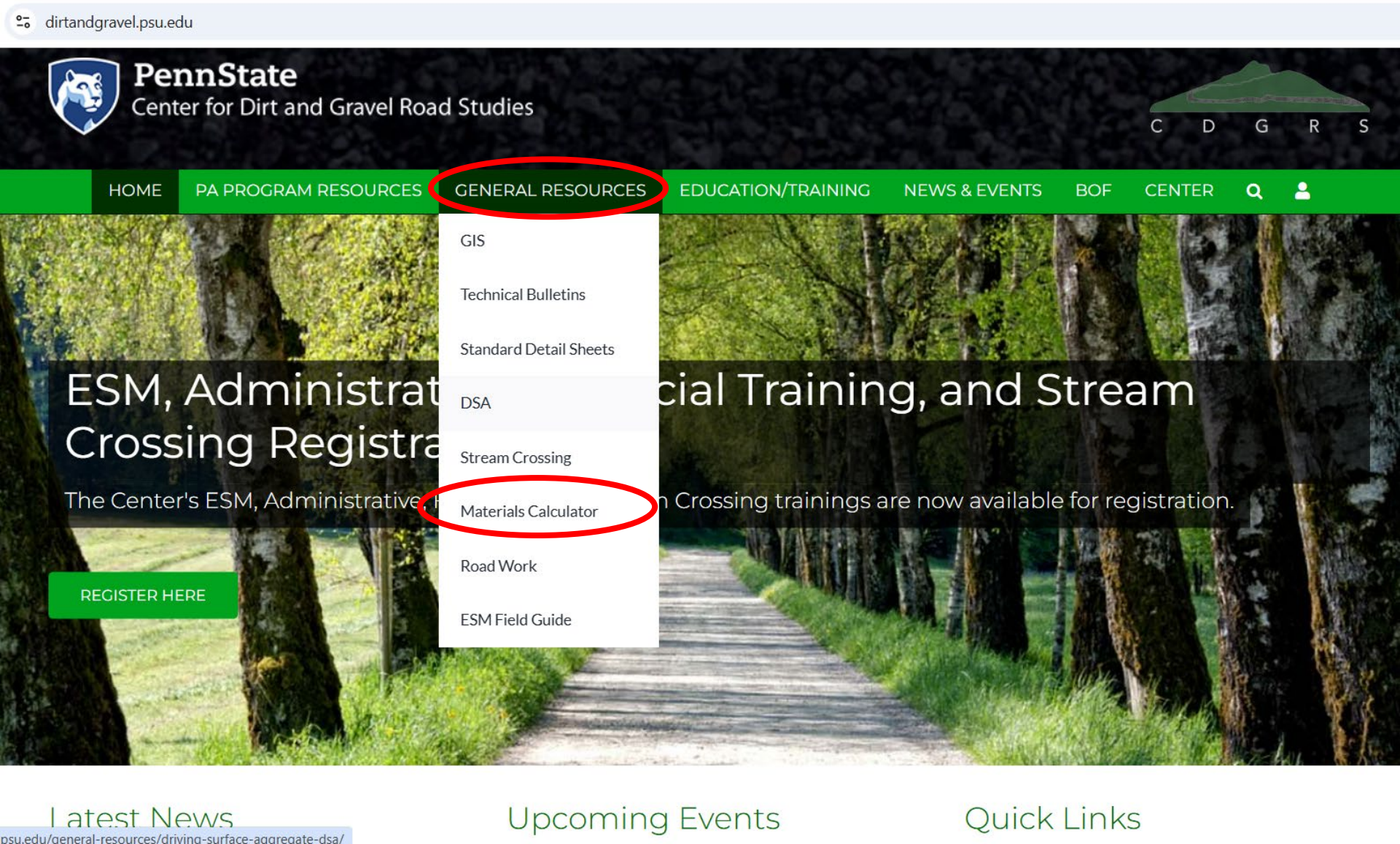
<u>Less than 6”:</u> not enough depth to achieve proper compaction.

<u>Greater than 8”:</u> not able to achieve maximum compaction with a 10-ton roller.

- **6” placements will “stretch” your dollar and allow you to cover more road for the same up-front aggregate cost**
- **8” placements will provide additional material when regrading or reworking the material years into the future**

Materials Calculator on Center Website:

dirtandgravel.psu.edu/general-resources/dglvr-materials-calculator/



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DGLVR Materials Calculator

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- General Resources
- GIS ›
- Technical Bulletins
- Standard Detail Sheets
- DSA
- DGLVR Materials Calculator
- Road Work ›
- ESM Field Guide

DGLVR Materials Calculator

In order to assist Districts in developing and double-checking quantities for grant application workplans, the Center has develop a "DGLVR Materials Calculator". This calculator uses the densities and compaction ratios of common materials available in PA to conveniently determine aggregate, stone, and fill estimates for project needs. By entering the length,

Materials Calculator: dirtandgravel.psu.edu/general-resources/dglvr-materials-calculator/

Length: i.e. 120 feet

Width: i.e. 18.5 feet

Depth: i.e. 6 inches

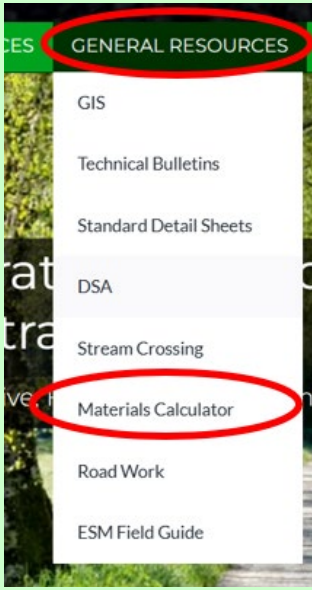
Compaction: (•) Loose ( ) Compacted

Material: Please Select

Tonnage per cubic yard: 0 tons

Price per ton (optional): $

CALCULATE



Materials Calculator: dirtandgravel.psu.edu/general-resources/dglvr-materials-calculator/

Measurements

Length: 2500 feet

Width: 16 feet

Depth: 6 inches

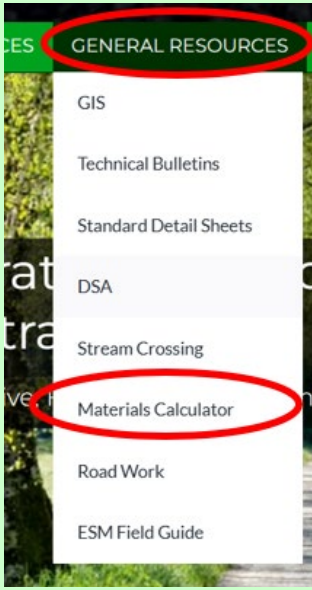
Compaction: (•) Loose ( ) Compacted

Material: Please Select

Tonnage per cubic yard: 0 tons

Price per ton (optional): $

CALCULATE



Let's look at an example: 2,500' DSA placement

Materials Calculator: dirtandgravel.psu.e materials-calculator/

Length:

Width:

Depth:

Compaction:

Material: DSA

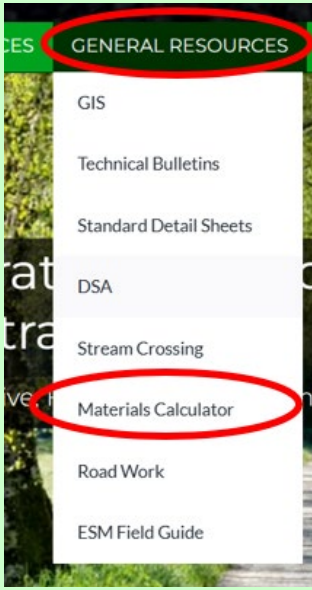
Please Select
DSA
PennDOT 2A
PennDOT 2RC
AASHTO 57 (PennDOT 2B)
AASHTO 1 (PennDOT 4) 1.4
AASHTO 3 (PennDOT 3A)
AASHTO 8 (PennDOT 1B)
R-3 to R-6
Gabion
Shale
Fill Dirt
Topsoil
Asphalt (base, binder and top)
Custom Material

Select Material → Material: Please Select

Tonnage per cubic yard: 0 tons

Price per ton (optional): $

CALCULATE



Let's look at an example: 2,500' DSA placement

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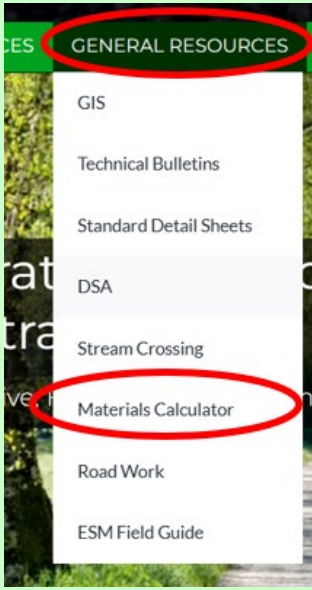


Length: 2500 feet

Width: 16 feet

Depth: 6 inches

Compaction: ◉ Loose ○ Compacted

Material: DSA

Tonnage per cubic yard: 1.65 tons

Density (Automatic based on material selected) →

Price per ton (optional): $ 40

Cost per ton (optional) →

RUN ESTIMATE → CALCULATE

Length: 2500 feet

Width: 16 feet

Depth: 6 inches

Compaction: (•) Loose ( ) Compacted

Material: DSA

Tonnage per cubic yard: 1.65 tons

Price per ton (optional): $ 40

CALCULATE

Results

Estimated cubic yards of material needed (loose):

740.74 yd^3

Estimated tons of material needed (loose/as shipped):

1,222.22

Estimated total material cost:

$48,888.89

DSA Projects

- **Purchasing DSA**
- **Road Preparation**
- DSA Placement
- DSA Compaction

DSA Placement Considerations:

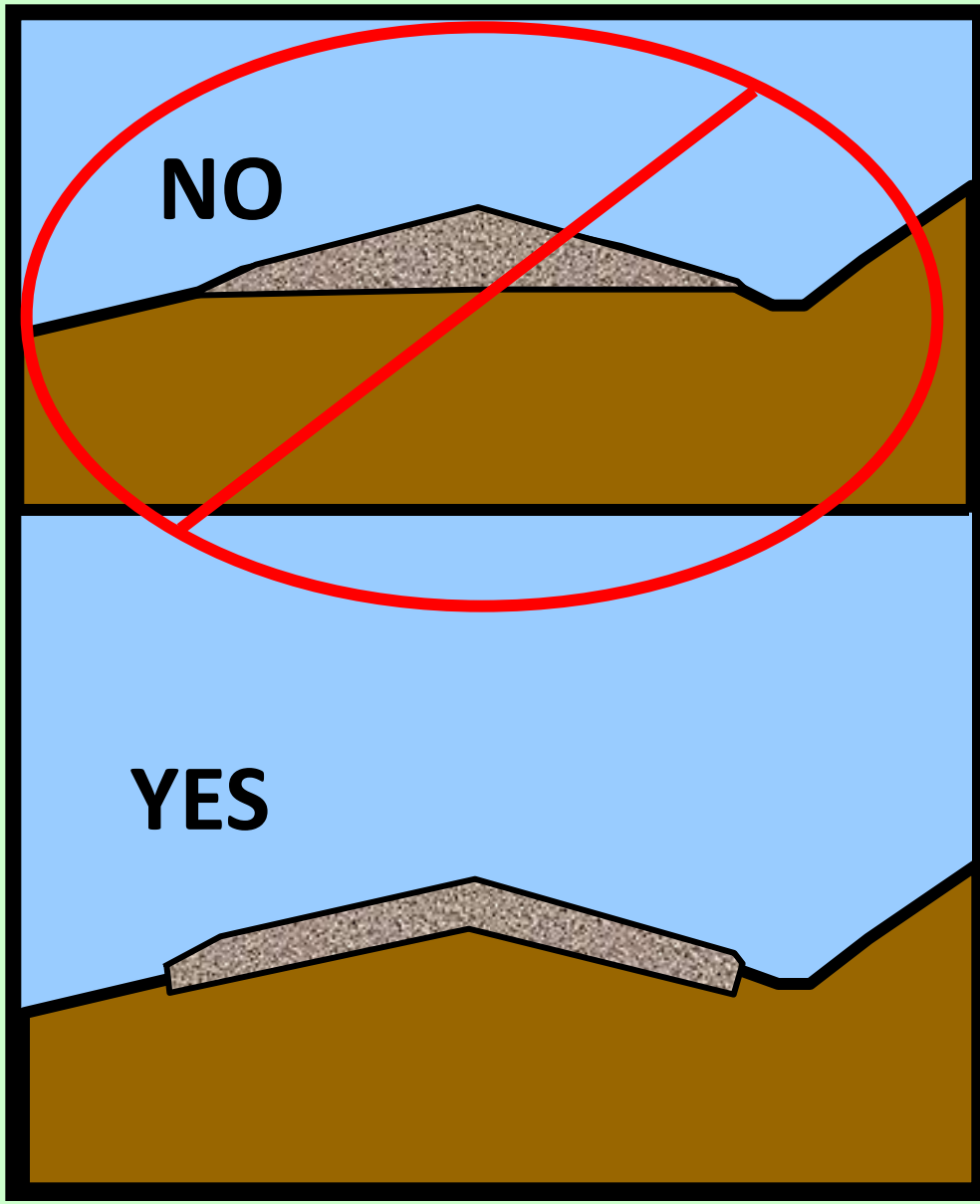
- Close road if feasible to allow DSA to dry.
- Alert residents of inconveniences and the long-term benefits.
- Backup placement dates to plan for rain or freezing temperatures.
  - Placement dates are April 1 to September 30.

Prepare the base!

CROWN THE BASE!

Don’t place the aggregate in a hole!

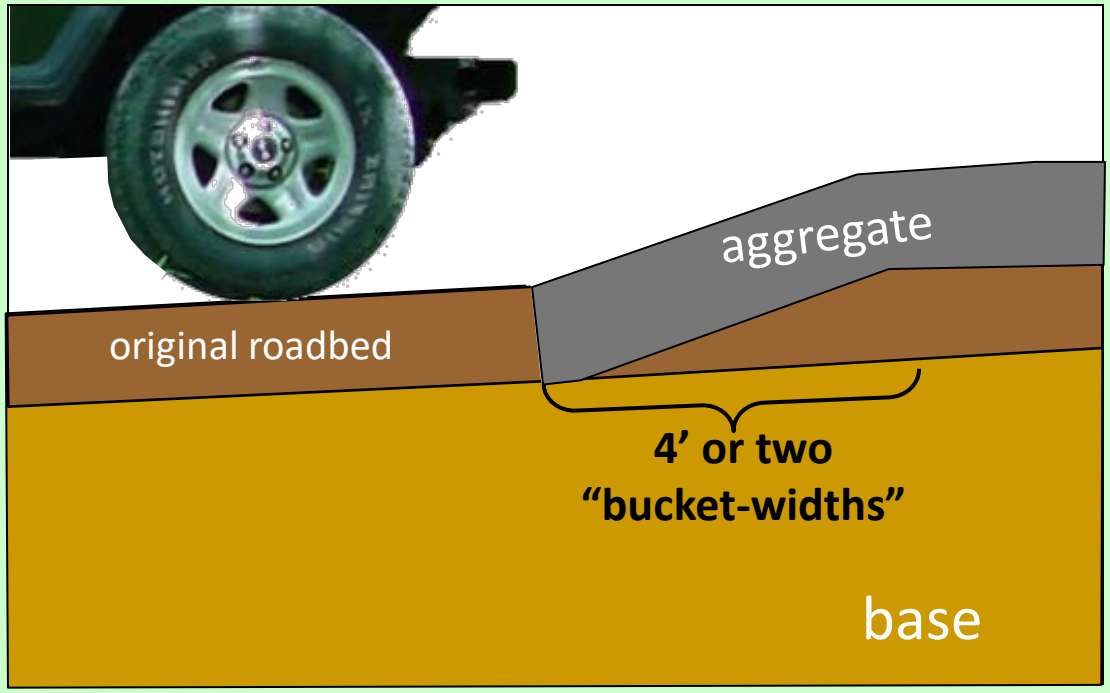
You would not build a flat roof and make the pitch out of shingles



Check the base for proper crown **prior** to aggregate placement.

Paving Notch:

- Cut a notch across the road where aggregate ends.
- Creates a better & longer lasting transition than trailing off aggregate.

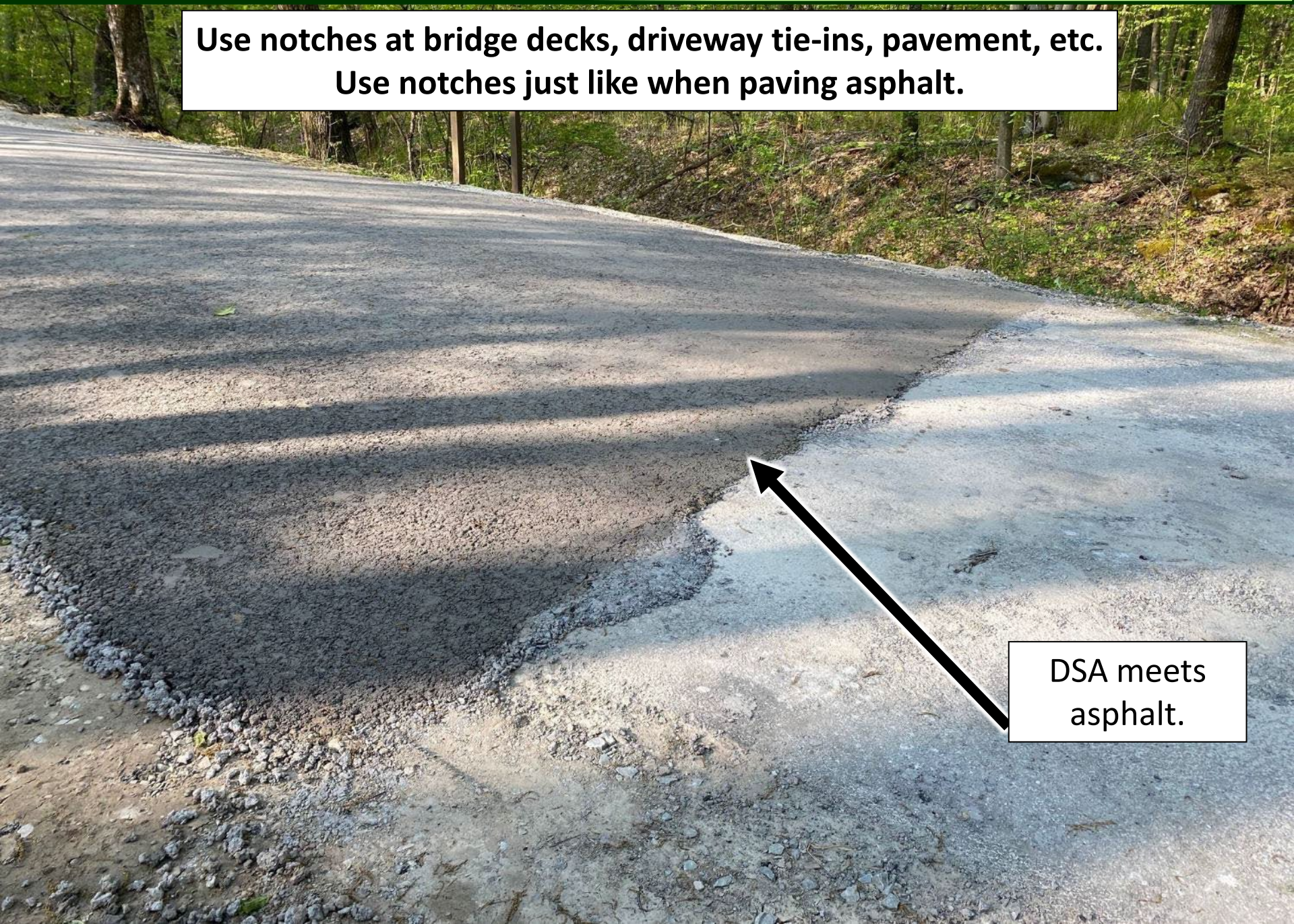


DSA Preparation:

Paving Notches are Required by DSA Specification.

Placement – Paving Notch

Use notches at bridge decks, driveway tie-ins, pavement, etc.
Use notches just like when paving asphalt.



DSA Projects

- **Purchasing DSA**
- Road Preparation
- **DSA Placement**
- DSA Compaction

Placement Scheduling

"If freezing temperatures or precipitation are forecast that may cause the material to freeze, or prevent the material from drying out, placement shall be postponed at the discretion of the road owner, Conservation District, or aggregate supplier." *(SCC DSA Spec Section IV.D)*

Avoid:

- **Late season placements** (exact date depends on weather, location, aspect, shade, traffic control, etc.)
- **During or pre-storm placements**
- **Placement Season: April 1 to September 30**

DSA Placement – Transport

Trucking can be a source of many issues and hazards

Make sure safe routes and turn around locations are available

https://www.carolinatarps.com/item/2026

- **Identify and mark utility lines**
- **Consider removing potential hazards (tree limbs, etc.)**

https://www.courant.com/breaking-news/hc-br-farmington-dump-truck-wires-20190801-jfy7e5rmx5hdpp66opotgo5dwq-story.html

Install stabilized pull-offs if needed

Video

Paver DSA Placement

DSA Projects

- **Purchasing DSA**
- Road Preparation
- DSA Placement
- **DSA Compaction**


DSA is designed for maximum compaction

DSA is designed for maximum compaction

Stop compaction when:

No further compaction is achieved – “non-movement”

Surface rocks start to break apart

DSA Compaction :

- If material sticks to roller drum, allow to dry first.
- Roll up to, but not directly on crown.
- Minimum 10-ton vibratory roller required.

https://www.cat.com/en_US/products/new/equipment/compactors/tandem-vibratory-rollers/1000027026.html

Asphalt roller

https://tuffmanequip.com/product/10-ton-roller

"Dirt" roller

Safety Concerns

DSA Projects

Common Problems with DSA Placement

DSA Moisture: Too wet

Aggregate Problems

It's easier to fix issues before material is placed!!

Inspect loads.

Send trucks back to the quarry when the material is not correct.

Dry material placed instead of sent back...

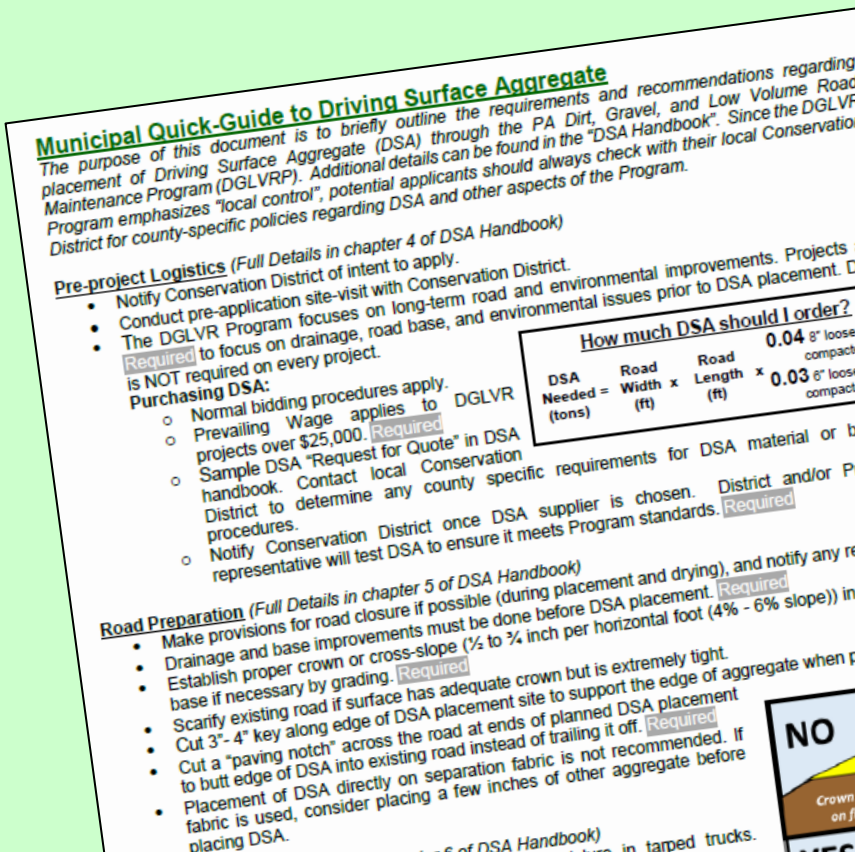
When NOT to use DSA: Before Addressing BASE & Drainage!

DSA RESOURCES:

DSA Handbook: More in-depth DSA information

- includes Request for Quote
- www.dirtandgravelroads.org

Municipal DSA Quick Guide:



Municipal Quick-Guide to Driving Surface Aggregate

The purpose of this document is to briefly outline the requirements and recommendations regarding placement of Driving Surface Aggregate (DSA) through the PA Dirt, Gravel, and Low Volume Road Maintenance Program (DGLVRP). Additional details can be found in the "DSA Handbook". Since the DGLVR Program emphasizes "local control", potential applicants should always check with their local Conservation District for county-specific policies regarding DSA and other aspects of the Program.

Pre-project Logistics *(Full Details in chapter 4 of DSA Handbook)*

- Notify Conservation District of intent to apply.
- Conduct pre-application site-visit with Conservation District.
- The DGLVR Program focuses on long-term road and environmental improvements. Projects Required to focus on drainage, road base, and environmental issues prior to DSA placement. D is NOT required on every project.

Purchasing DSA:

- Normal bidding procedures apply.
- Prevailing Wage applies to DGLVR projects over $25,000. Required
- Sample DSA "Request for Quote" in DSA handbook. Contact local Conservation District to determine any county specific requirements for DSA material or b procedures.
- Notify Conservation District once DSA supplier is chosen. District and/or P representative will test DSA to ensure it meets Program standards. Required

How much DSA should I order?

DSA Needed = (tons) Road Width x (ft) Road Length x (ft) 0.04 8" loose compact 0.03 6" loos compact

Road Preparation *(Full Details in chapter 5 of DSA Handbook)*

- Make provisions for road closure if possible (during placement and drying), and notify any re
- Drainage and base improvements must be done before DSA placement. Required
- Establish proper crown or cross-slope (¼ to ¾ inch per horizontal foot (4% - 6% slope)) in base if necessary by grading. Required
- Scarify existing road if surface has adequate crown but is extremely tight.
- Cut 3"- 4" key along edge of DSA placement site to support the edge of aggregate when p
- Cut a "paving notch" across the road at ends of planned DSA placement to butt edge of DSA into existing road instead of trailing it off. Required
- Placement of DSA directly on separation fabric is not recommended. If fabric is used, consider placing a few inches of other aggregate before placing DSA.

NO

Crown on f

of DSA Handbook)

in tarped trucks.

Available on CDGRS website

https://dirtandgravel.psu.edu

Chip Seal and Asphalt

All ESM Practices must be addressed first!

- Drainage issues
- Base instability issues
- Other necessary and appropriate issues such as bank stability, road entrenchment, vegetation, etc.

The use of petroleum solvent based "cutback asphalts" such as MC-30 and MC-70 are <u>NOT</u> recommended for use!

Chip Seal: Surface treatment where surface is sprayed with emulsified asphalt, covered with aggregate, then rolled.

- Originally designed to prolong the life of pavements.
- Cost effective compared to resurfacing.
- Extends pavement life.
- Restores surface friction.
- Seals cracks and imperfections.
- Not for use on distressed or failing pavement

Asphalt Pavement: Mixture of different sized aggregates, binder and filler.

- Designed to be a *durable, long lasting driving surface*.
- Cost effective compared to concrete (oil price dependent)
- Provides a smooth-running surface
- Can be recycled

When does it make sense to seal a gravel road?

- **High traffic road**
  - >250 vehicles per day determined by a traffic count.
- **Extreme slopes**
  - Projects, or segments of projects, with average 10% grade or greater may be converted to a sealed surface
- **Aprons**
  - Paved aprons at intersections with paved roads.
- **Sensitive environmental areas**
  - When sediment runoff into lakes, wetlands and streams is a concern

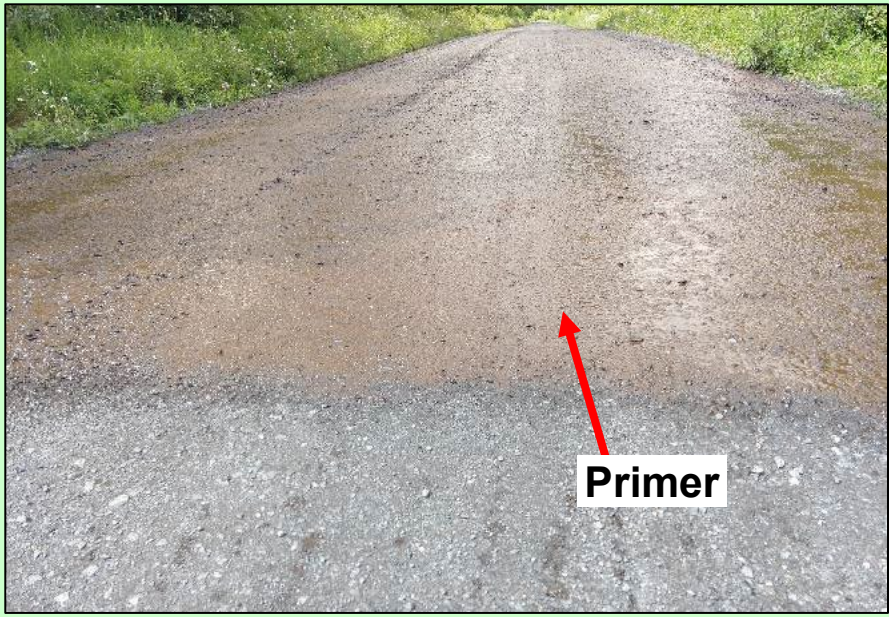
Recommendations for converting a *gravel road* to chip seal:

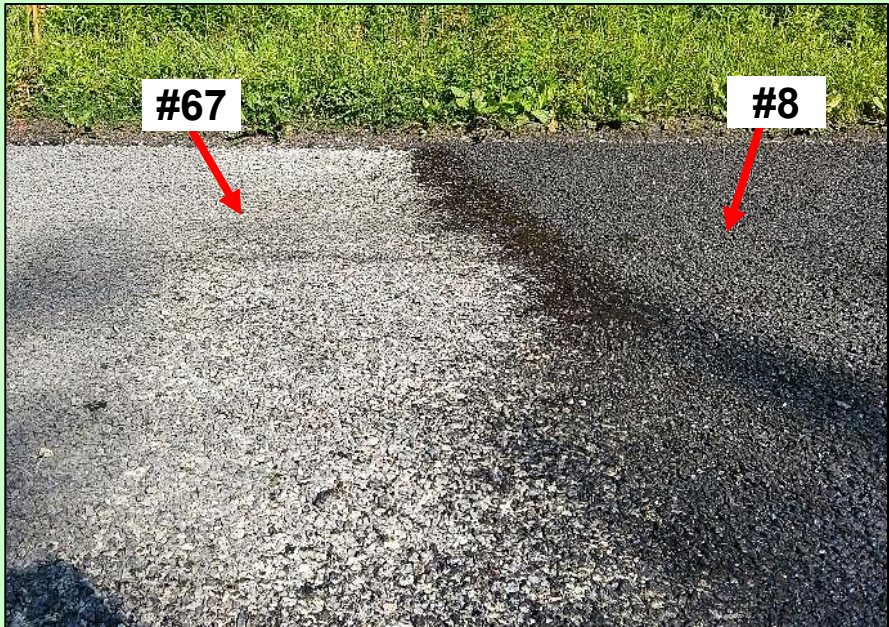
- Address all drainage and road base issues
- Grade road to establish a 2-4% crown.
- Roll and compact prior to placement of chip seal.

Recommendations for converting a *gravel road* to chip seal:

Install Triple Seal Over Existing Road:

- Apply primer coat to existing road surface.
- **Option #1 -** Install base layer of AASHTO #67 aggregate followed by a double coat of AASHTO #8 aggregate.
- **Option #2 -** Install a triple layer of AASHTO #8 aggregate.





Recommendations for converting a gravel road to chip seal:

Install Triple Seal:

- Compact chips with a rubber tire roller.

- Sweep the road surface to remove loose chips after the emulsion cures.

PennState
Center for Dirt and Gravel Road Studies
Pennsylvania SCC
PA State Conservation Commission
DCNR
PA Dept. of Conservation and Natural Resources
Forestry

THANK YOU!

Additional Questions??

www.dirtandgravelroads.org

Drive Safe!