Rural Road Safety

December 8th, 2025
2025 NDTOA Annual Convention

Bryon Fuchs, PE
NDLTAP Director

NDSU

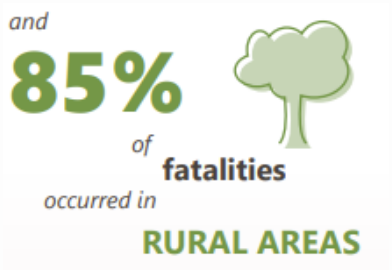
Background

In North Dakota:

- 107,000 miles of public roads and trails state-wide
- Approximately 90% of mileage is locally owned (county, town, township or municipal)

What's going on in ND?

- Between 2017 and 2021 (from 2024 SHSP)
  - 40% of fatalities are occurring on local roads
  - 48% of serious injuries are occurring on local roads
  - 85% of fatalities are occurring in rural areas across the state
  - Increase in fatalities on local roads



How can you help with keeping road users safe?

- Signing
- Clear Zone
- Roadway Surfacing

Road Agency Duty

- Provide safe roads
- Warn of existing known hazards

Why do we Need Signs or other Traffic Control Devices?

- Safety
- Promote movement of traffic
- Provide direction & guidance

Why do we have Standards and Regulations?

- To meet driver expectation
- Provide uniformity and consistency across jurisdictions
  - Simplifies the task of the road user – avoids confusion and aids in the recognition and understanding

Hazards

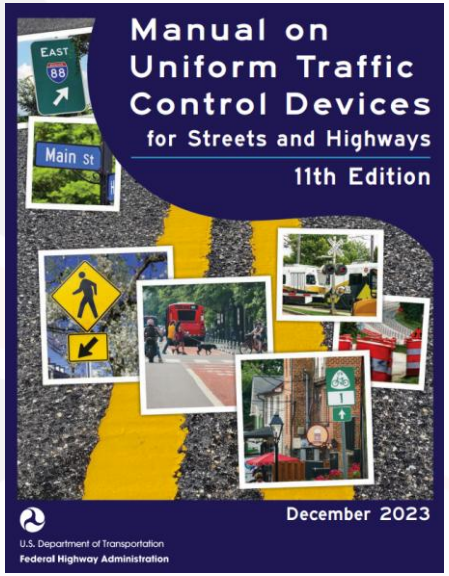
Other Hazards

Other Hazards

Message?

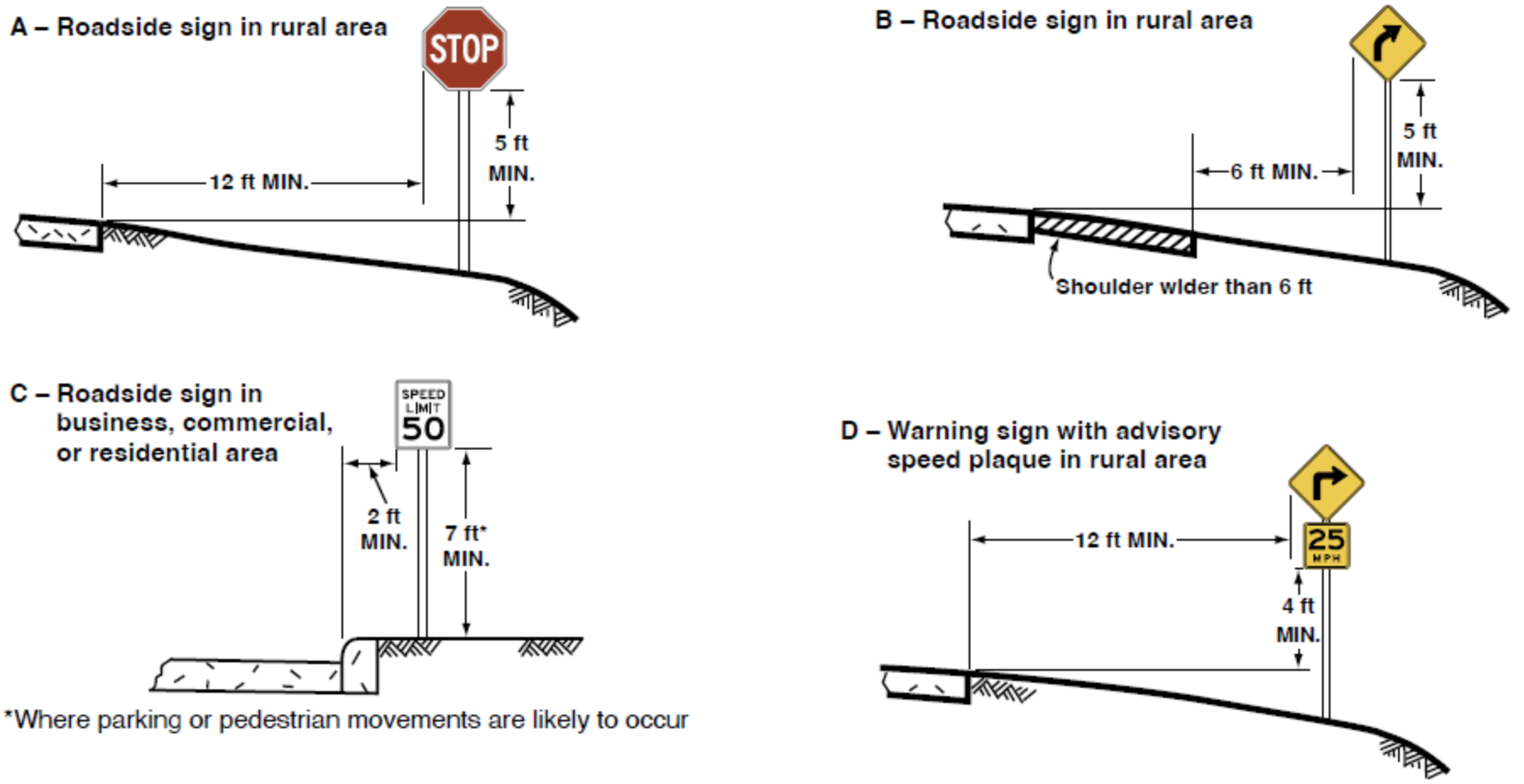
Where are the rules I need to follow?

- 2023 Manual on Uniform Traffic Control Devices (MUTCD)
  - 11th Edition published on December 19th, 2023
  - Effective on January 18, 2024
  - States need to adopt within 2-years
    - In whole, or
    - have a State MUTCD, or
    - Supplement that is in substantial conformance with the National MUTCD as their legal State standard for traffic control devices
- NDDOT Adopted July 2024
- Owner Requirements
  - Township, County, City, Tribal, State, or perhaps another agency



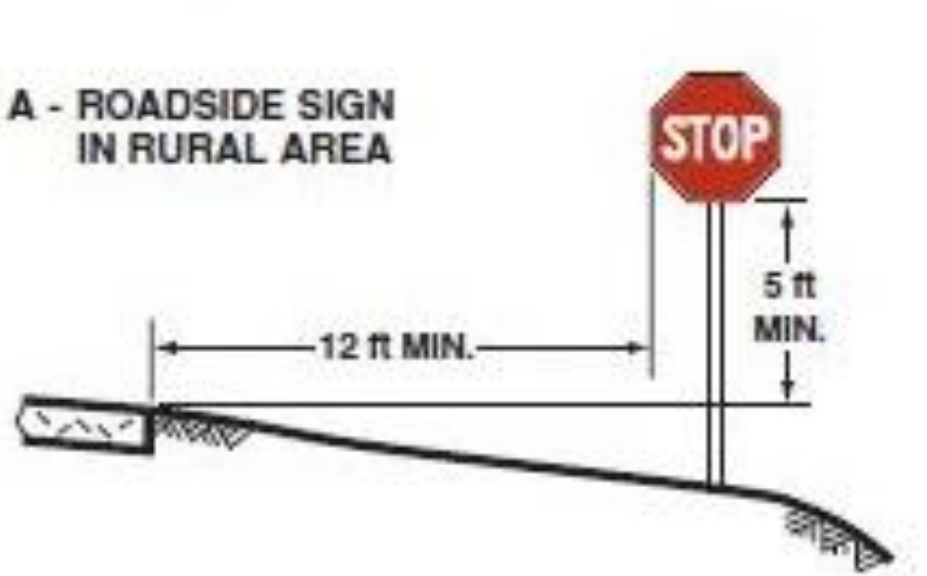
Placement of your signs

Figure 2A-2. Examples of Heights and Lateral Locations of Sign Installations

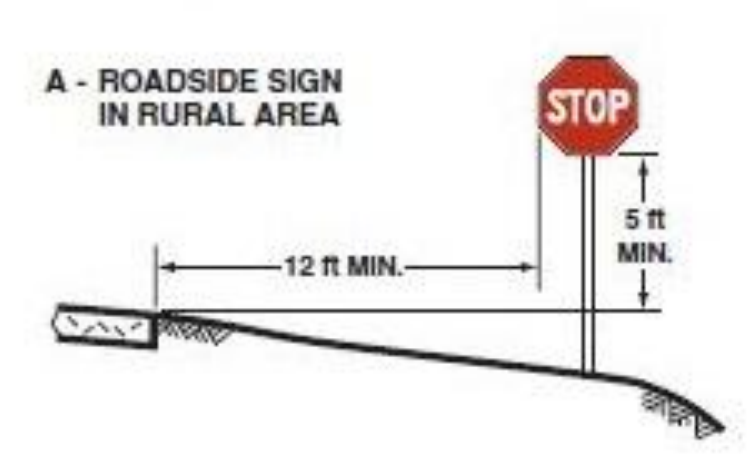


*Where parking or pedestrian movements are likely to occur

Proper Height and Offset

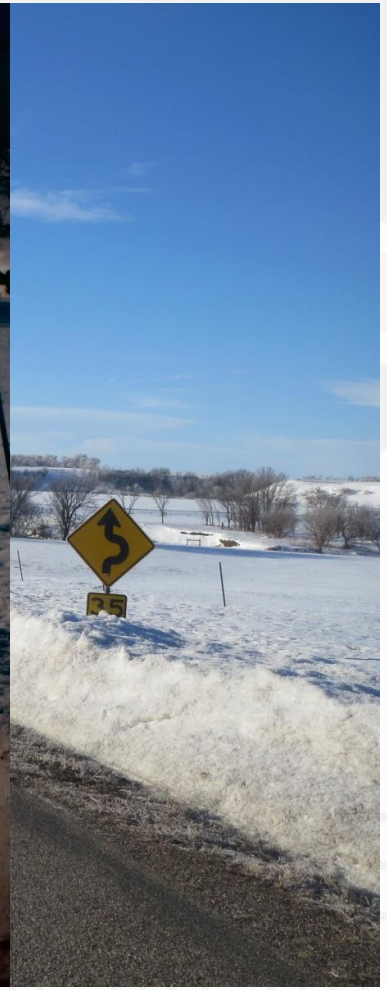


Proper Height and Offset



Proper Height and Offset

Proper Height and Offset



Advanced Placement of Warning Signs

Figure 2C-2. Examples of Warning Signs for Changes in Horizontal Alignment (Sheet 1 of 2)

A – Curve

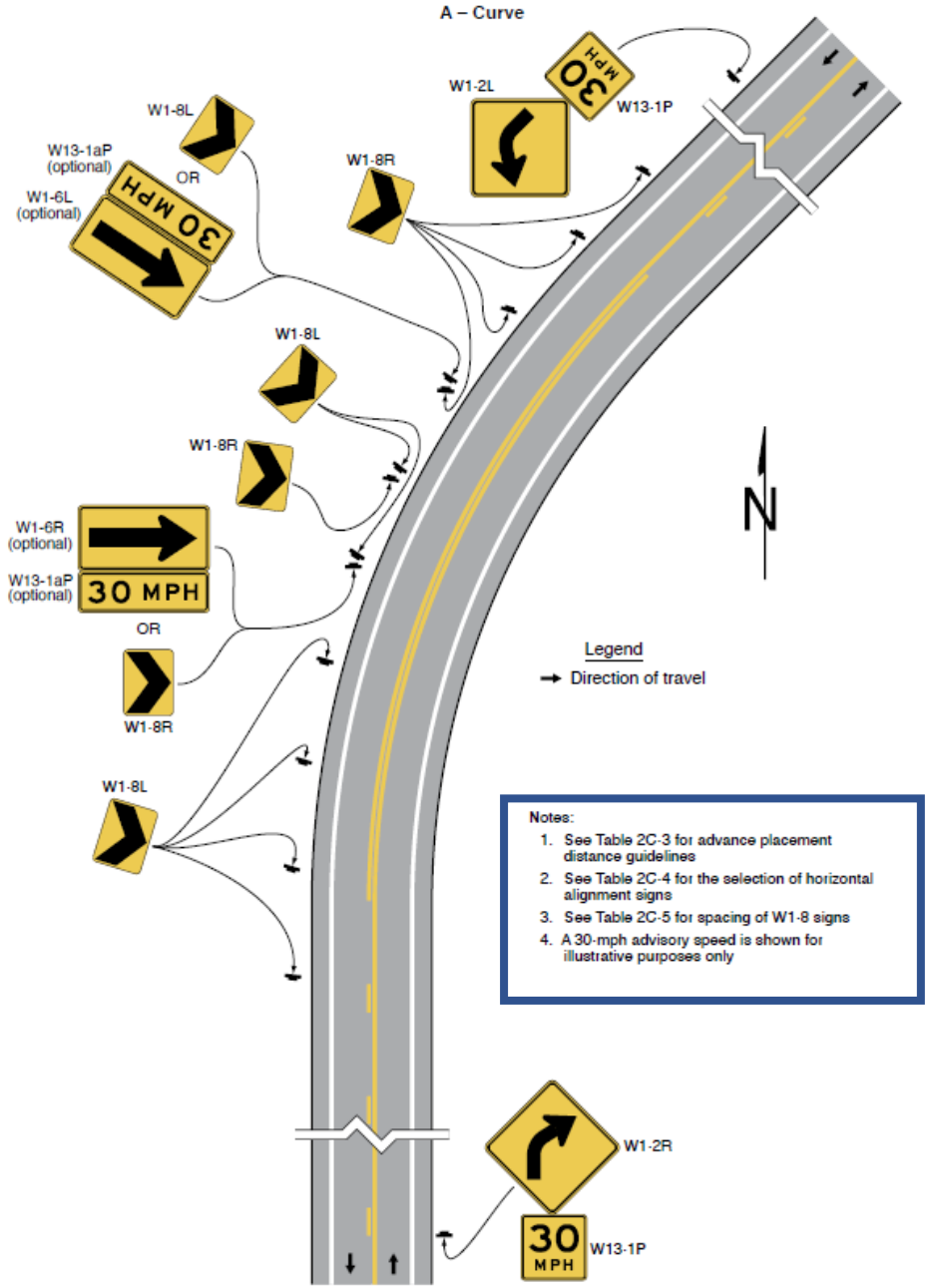
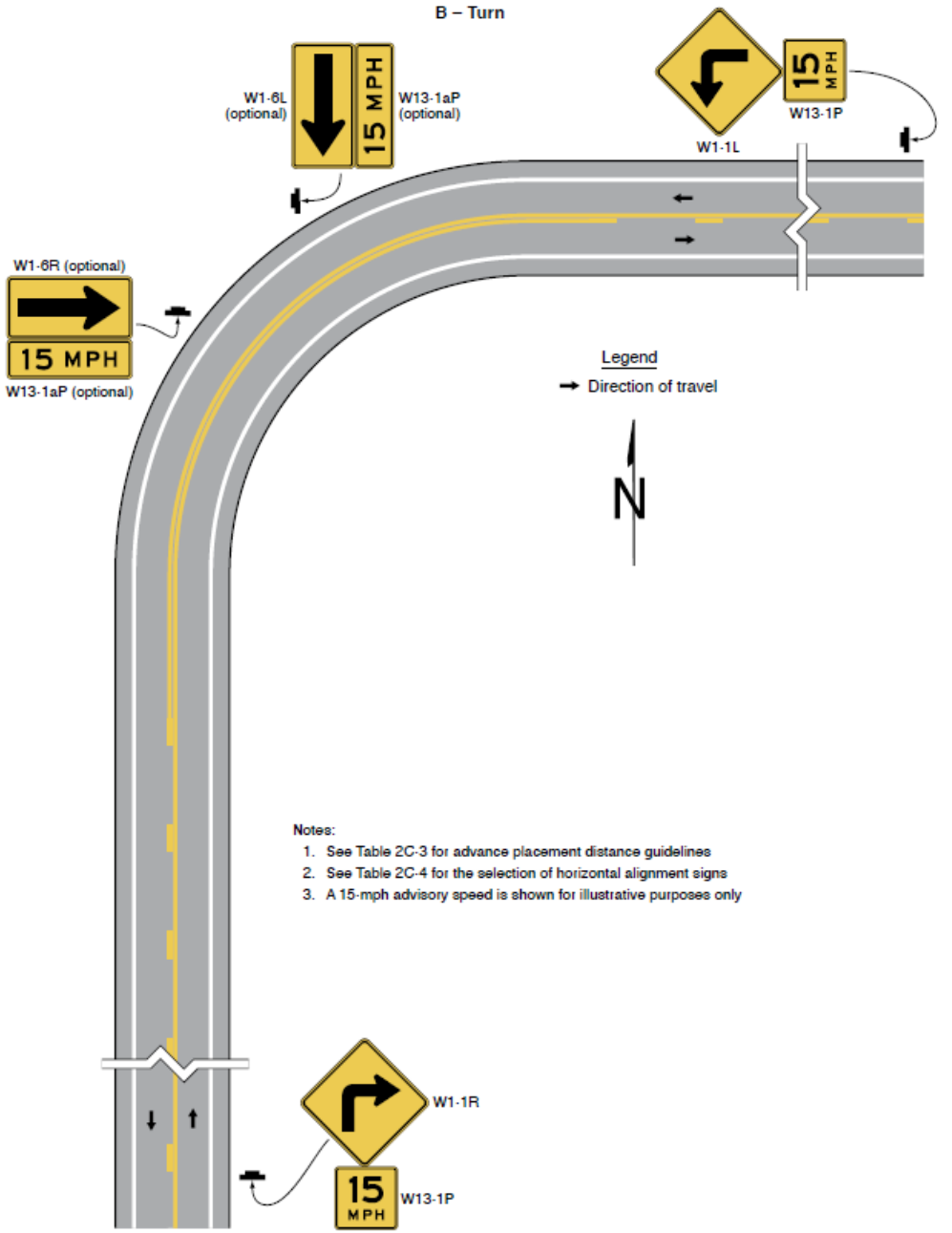


Figure 2C-2. Examples of Warning Signs for Changes in Horizontal Alignment (Sheet 2 of 2)

B – Turn



2009 MUTCD

TABLE 1. Guidelines for Advance Placement of Warning Signs*

Posted or 85th-Percentile Speed	Advance Placement Distance[1]								
	Condition A: Speed reduction and lane changing in heavy traffic	Condition B: Deceleration to the listed advisory speed (mph) for the condition							
		0[3]	10[4]	20[4]	30[4]	40[4]	50[4]	60[4]	70[4]
20 mph	225 ft	100 ft[6]	N/A[5]	—	—	—	—	—	—
25 mph	325 ft	100 ft[6]	N/A[5]	N/A[5]	—	—	—	—	—
30 mph	460 ft	100 ft[6]	N/A[5]	N/					
35 mph	565 ft	100 ft[6]	N/A[5]	N/					
40 mph	670 ft	125 ft	100 ft[6]	100					
45 mph	775 ft	175 ft	125 ft	100					
50 mph	885 ft	250 ft	200 ft	17					
55 mph	990 ft	325 ft	275 ft	22					
60 mph	1,100 ft	400 ft	350 ft	32					
65 mph	1,200 ft	475 ft	450 ft	40					
70 mph	1,250 ft	550 ft	525 ft	50					
75 mph	1,350 ft	650 ft	625 ft	60					

Note the spacing has increased and also additional speeds in2023 MUTCD

Table 2C-3. Guidelines for Advance Placement of Warning Signs

Posted or 85th-Percentile Speed	Advance Placement Distance[1]									
	Condition A: Speed reduction and lane changing in heavy traffic[2]	Condition B: Deceleration to the listed advisory speed (mph) for the condition								
		0[3]	10[4]	20[4]	30[4]	40[4]	50[4]	60[4]	70[4]	80[4]
20 mph	225 ft	115 ft	N/A[5]	—	—	—	—	—	—	—
25 mph	325 ft	155 ft	N/A[5]	N/A[5]	—	—	—	—	—	—
30 mph	460 ft	200 ft	N/A[5]	N/A[5]	—	—	—	—	—	—
35 mph	565 ft	250 ft	N/A[5]	N/A[5]	N/A[5]	—	—	—	—	—
40 mph	670 ft	305 ft	00 ft[6]	100 ft[6]	N/A[5]	—	—	—	—	—
45 mph	775 ft	360 ft	25 ft	100 ft[6]	100 ft[6]	N/A[5]	—	—	—	—
50 mph	885 ft	425 ft	200 ft	175 ft	125 ft	100 ft[6]	—	—	—	—
55 mph	990 ft	495 ft	275 ft	225 ft	200 ft	125 ft	N/A5	—	—	—
60 mph	1,100 ft	570 ft	350 ft	325 ft	275 ft	200 ft	100 ft[6]	—	—	—
65 mph	1,200 ft	645 ft	450 ft	400 ft	350 ft	275 ft	200 ft	100 ft[6]	—	—
70 mph	1,250 ft	730 ft	525 ft	500 ft	450 ft	375 ft	275 ft	150 ft	—	—
75 mph	1,350 ft	820 ft	625 ft	600 ft	550 ft	475 ft	375 ft	250 ft	100 ft[6]	—
80 mph	1,475 ft	910 ft	725 ft	700 ft	625 ft	550 ft	450 ft	350 ft	200 ft	—
85 mph	1,600 ft	1,010 ft	825 ft	800 ft	750 ft	675 ft	575 ft	450 ft	300 ft	150 ft

Do you have a sign Policy?

Signing Policy

- Purpose and goal
- Applicable signs this applies to
- Resource materials
- Sign inventory
- Removal of signs
- Approved sign evaluation methods
- Sign replacement
- Modification or deviation from policy

Help with Downed Signs

A best practices statement would be:

"The _____ County Highway Department/the City of _____ Public Works Department will repair/replace signs after receipt of notice that a sign has been damaged based on the following schedule:

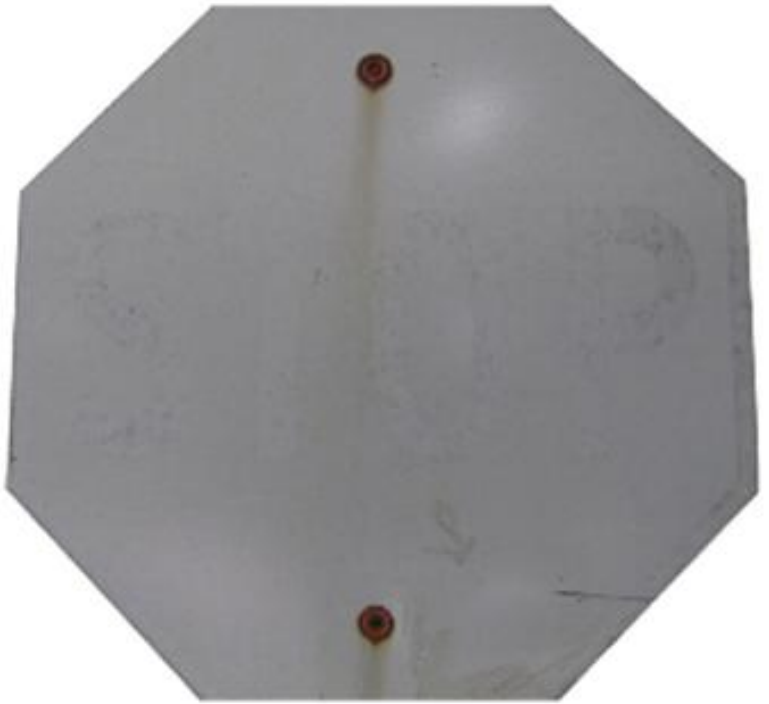
- High Priority Signs (STOP signs) – within one business day
- Intermediate Priority Signs (Reg., Warning and Guide Signs required by the MN MUTCD) – within 2 scheduled business days
- Lower Priority Signs (All other Regulatory, Warning & Guide signs) – within 3 scheduled business days"

Retro-Reflectivity

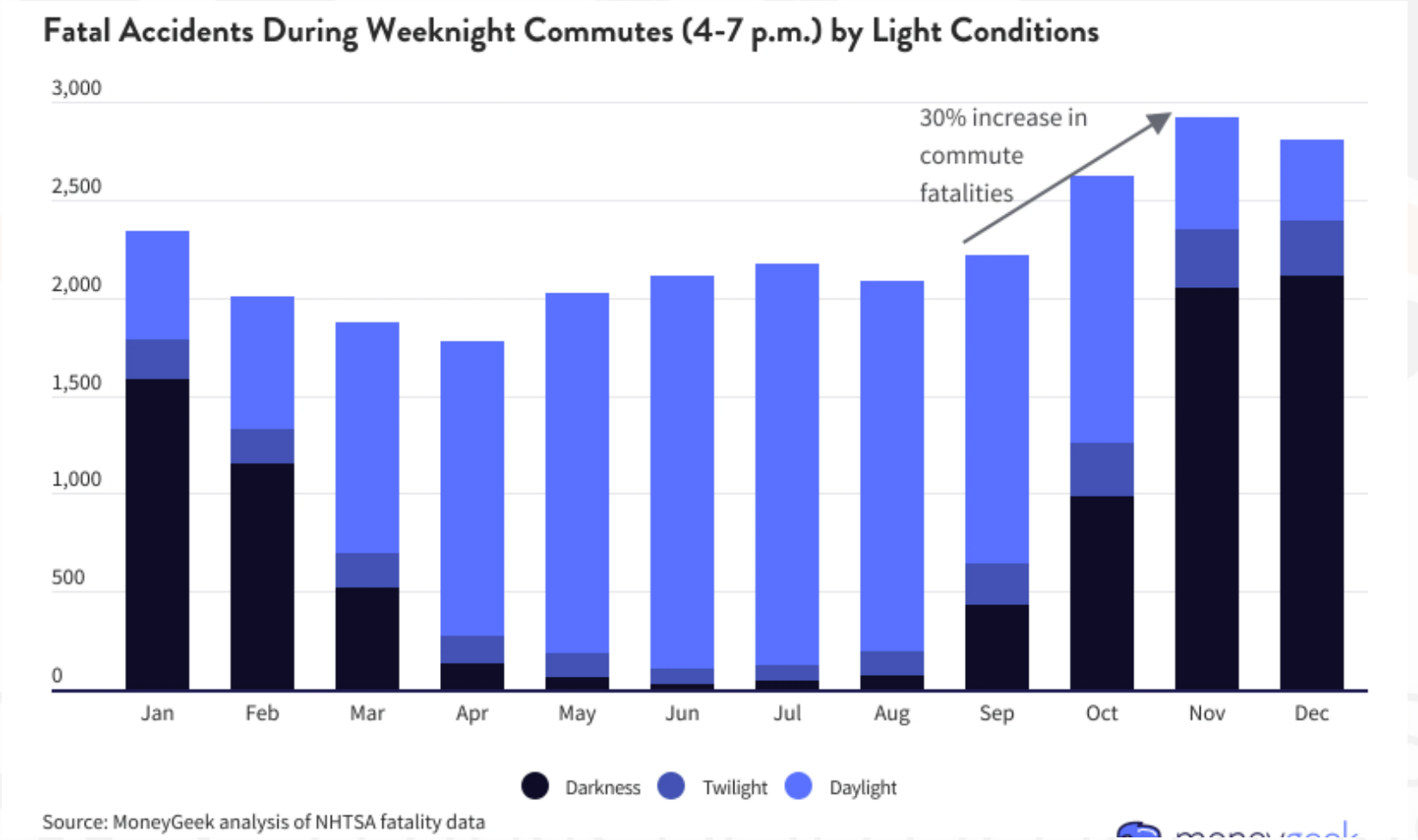
Sign Management & Reflectivity

From This

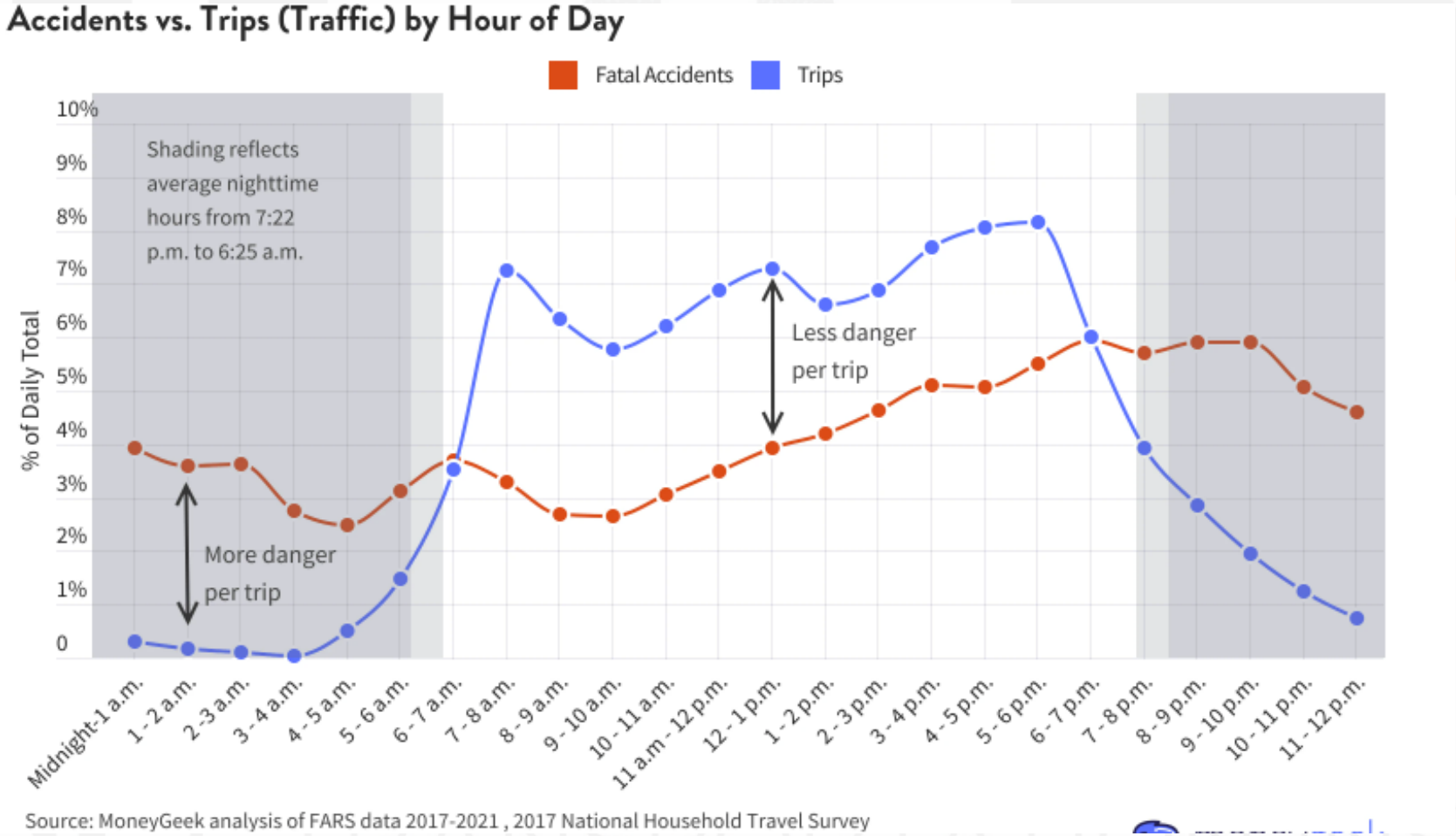
To This



Fatalities


Fatal Accidents During Weeknight Commutes (4-7 p.m.) by Light Conditions
3,000
2,500
2,000
1,500
1,000
500
0
30% increase in commute fatalities
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Darkness
Twilight
Daylight
Source: MoneyGeek analysis of NHTSA fatality data

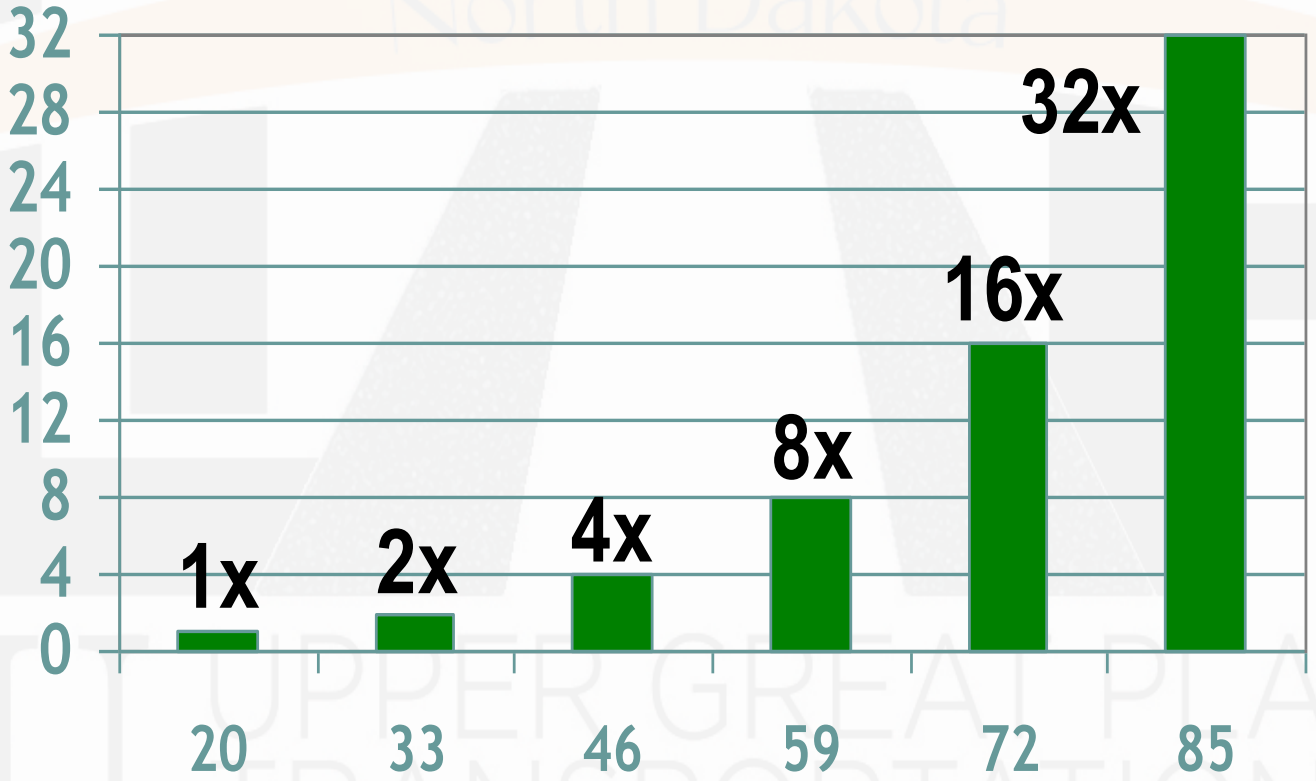
Accidents (Crashes)

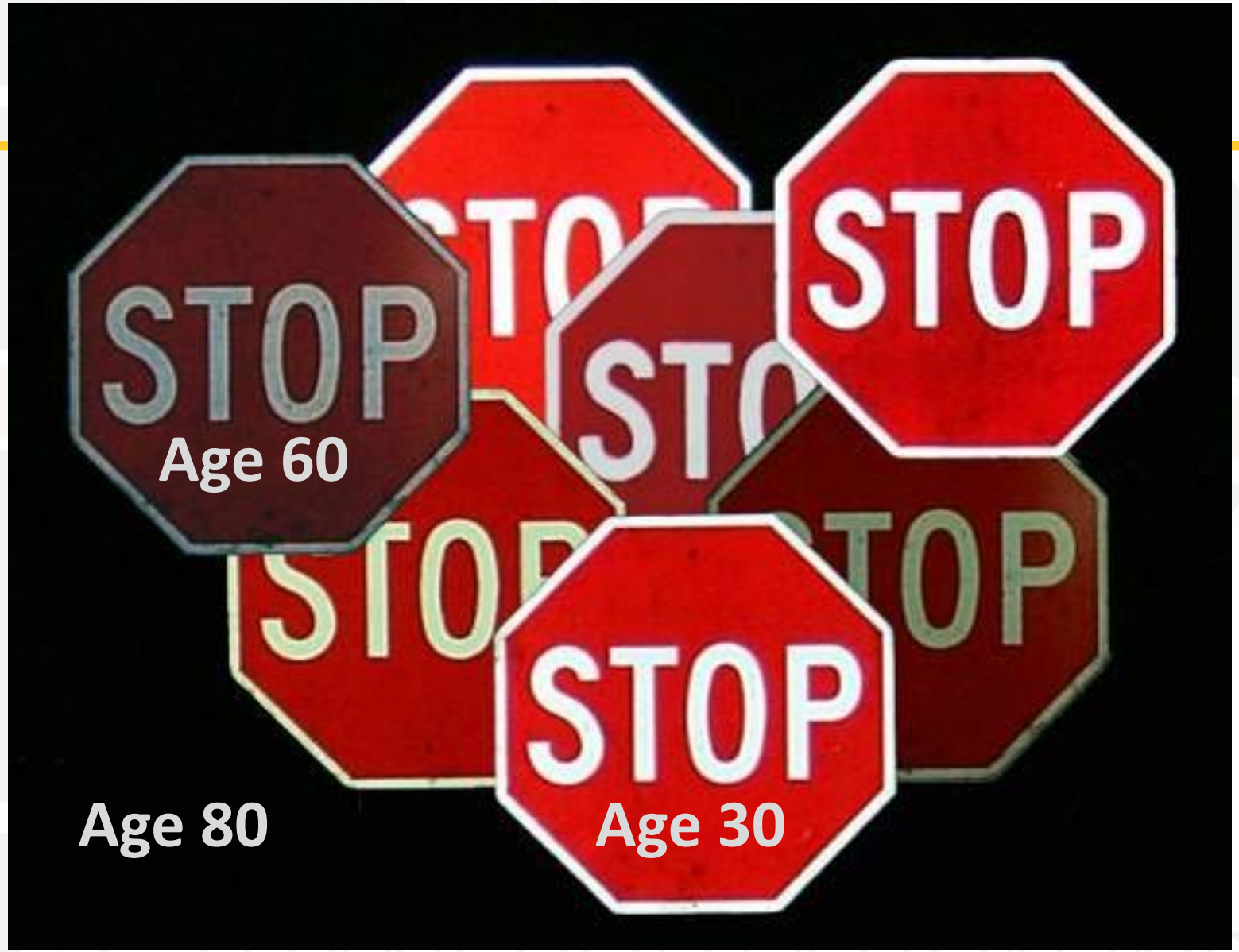


Source: MoneyGeek analysis of FARS data 2017-2021 , 2017 National Household Travel Survey

Older Driver Vision

- Starting at age 20, the amount of light needed to see doubles every 13 years




STOP
Age 60
STOP
STOP
STOP
STOP
Age 80
STOP
Age 30

Reflective Sheeting

- Minimum Maintained Retroreflectivity

Table 2A-5. Minimum Maintained Retroreflectivity Levels[1]

Sign Color	Beaded Sheeting Type (ASTM D4956)			Prismatic Sheeting	Additional Criteria
	I	II	III		
White on Green	W*; G ≥ 7	W*; G ≥ 15	W*; G ≥ 25	W ≥ 250; G ≥ 25	Overhead
	W*; G ≥ 7	W ≥ 120; G ≥ 15			Post-mounted
White on Blue	W*; B ≥ 3	W*; B ≥ 5	W*; B ≥ 12	W ≥ 250; B ≥ 12	Overhead
	W*; B ≥ 3	W ≥ 120; B ≥ 7			Post-mounted
White on Brown	W*; Br ≥ 1	W*; Br ≥ 5	W*; Br ≥ 10	W ≥ 350; Br ≥ 10	Overhead
	W*; Br ≥ 1	W ≥ 150; Br ≥ 5			Post-mounted
Black on Yellow or Black on Orange	Y*; O*	Y ≥ 50; O ≥ 50			[2]
	Y*; O*	Y ≥ 75; O ≥ 75			[3]
White on Red	W ≥ 35; R ≥ 7				[4]
Black on White	W ≥ 50				–

1 The minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m² measured at an

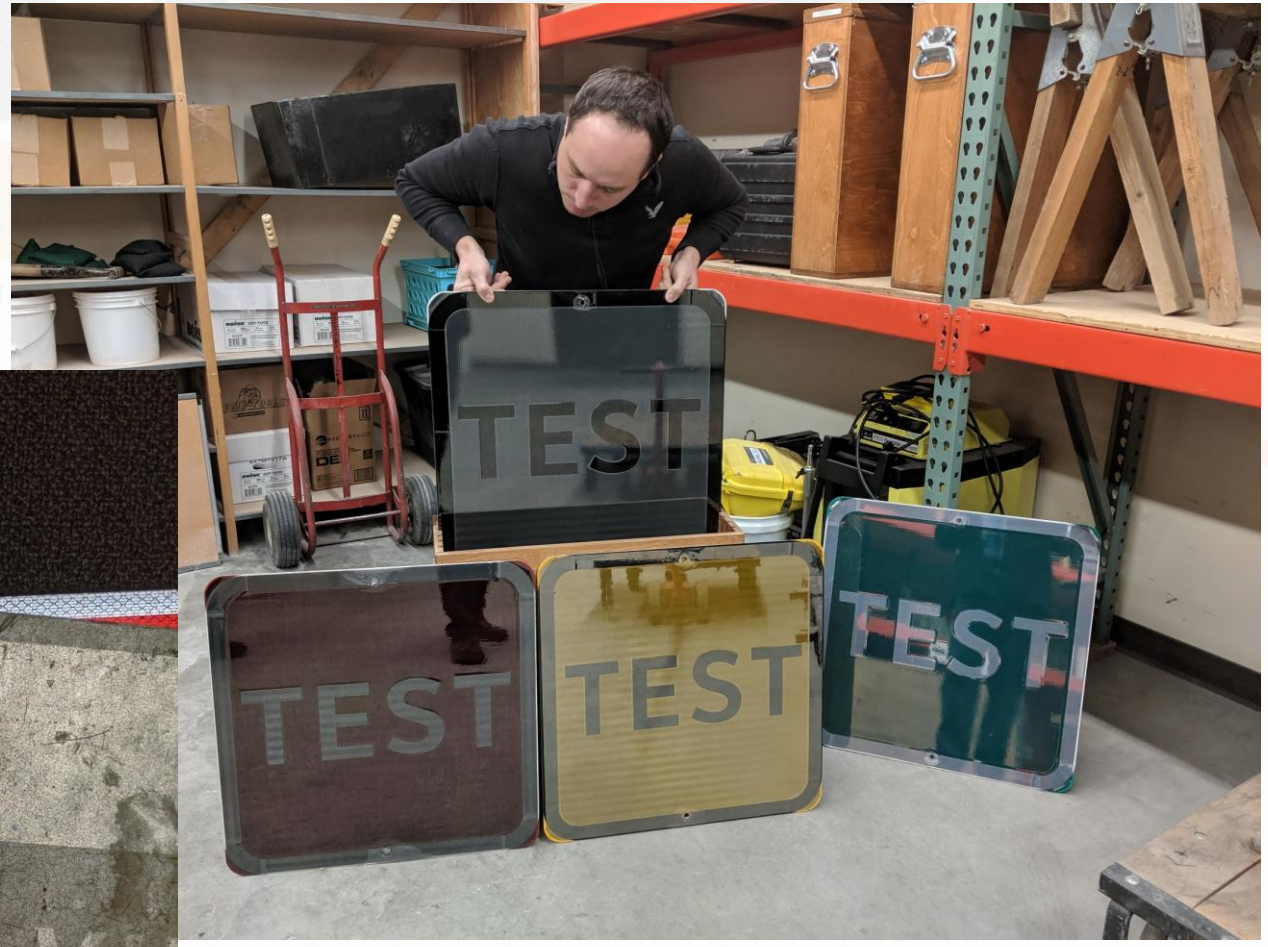
Reflective Sheeting

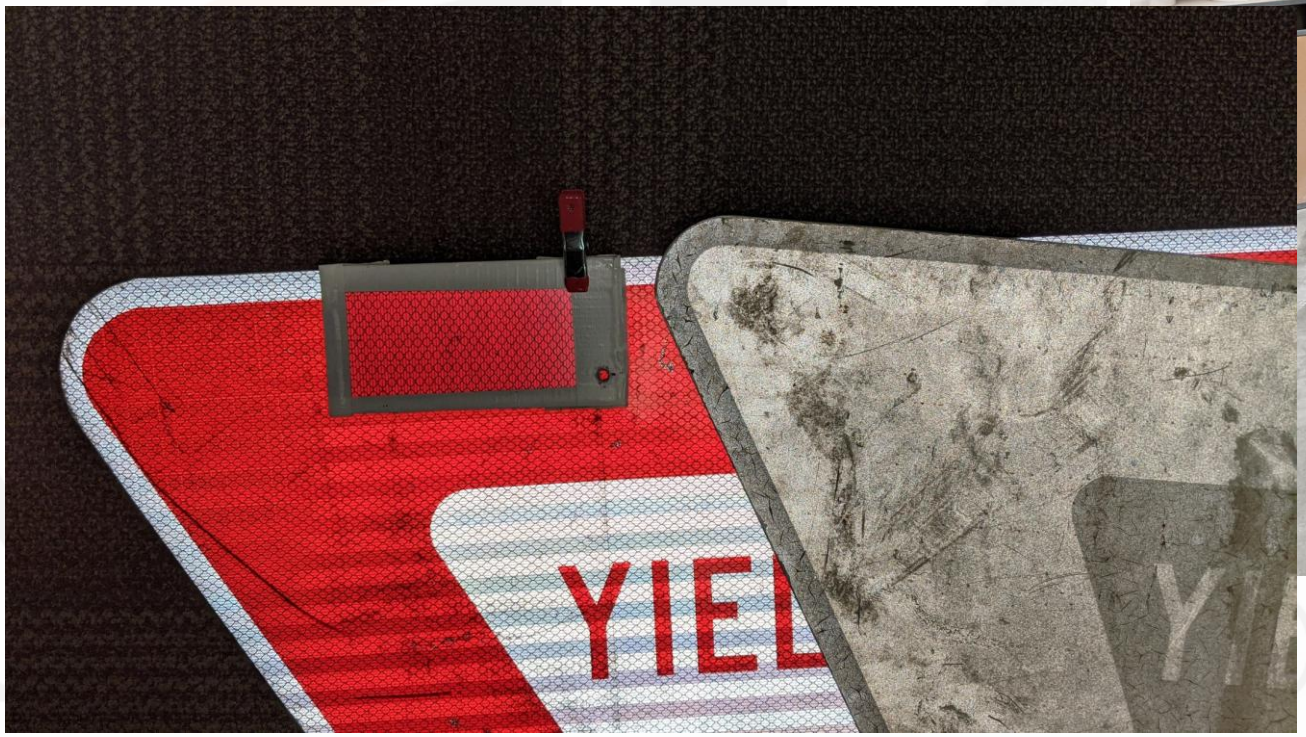
Testing Retro-Reflectivity

- Retroreflectometer
- Inspect at night
  - At least 60-years old

Testing Retro-Reflectivity

- Test Panels
- Comparison Panels



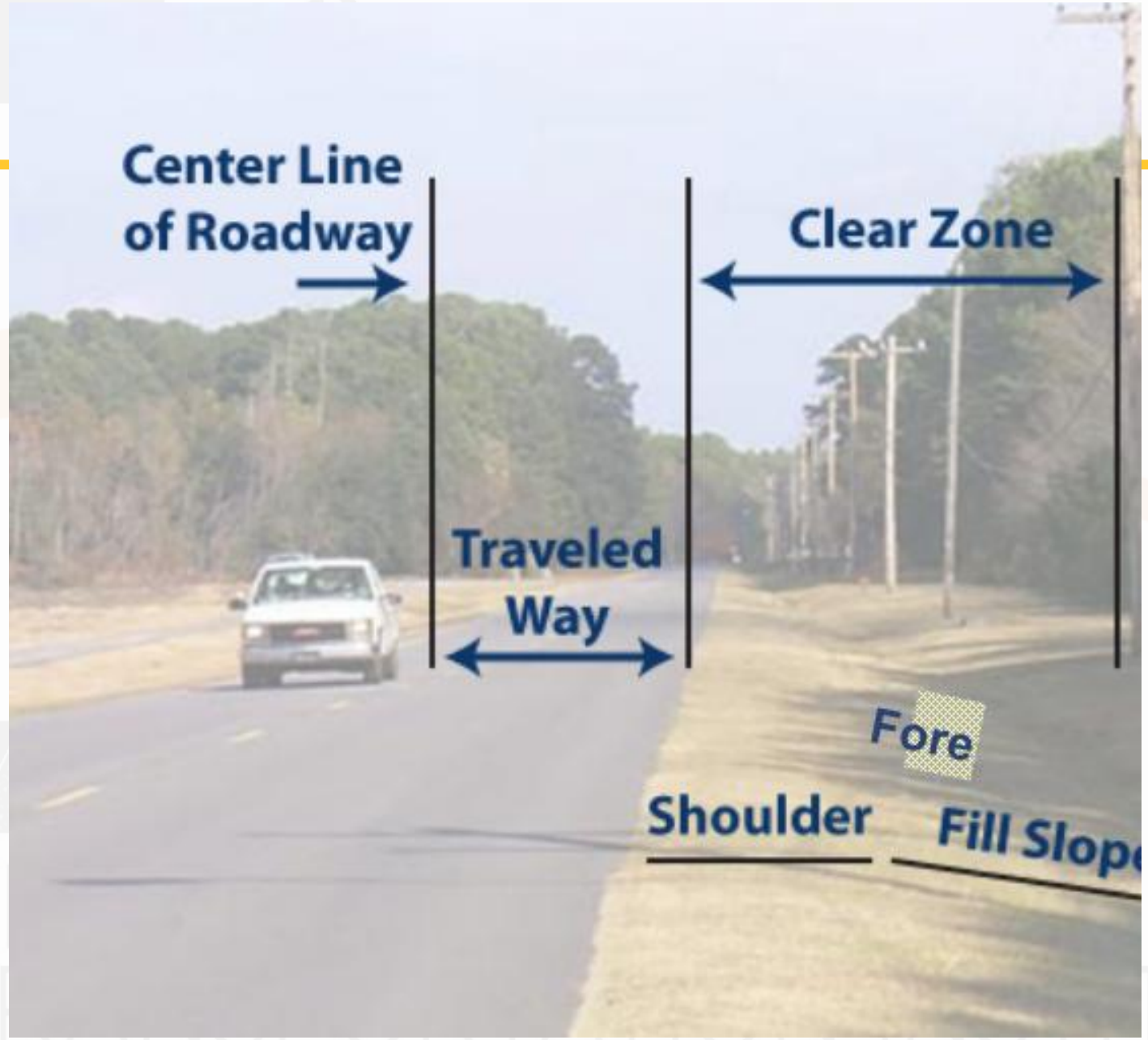



STOP
AHEAD


R
R


YIELD

Clear Zone


Center Line
of Roadway
Clear Zone
Traveled
Way
Fore
Shoulder
Fill Slope

Clear Zone

Table 1 CLEAR ZONE DISTANCE (in Feet from Edge of Driving Lane)[1]

DESIGN SPEED	DESIGN ADT***	FORESLOPE					BACKSLOPE				
		FLAT	1V: 6H	1V: 5H	1V: 4H	1V: 3H	1V: 3H	1V: 4H	1V: 5H	1V: 6H	FLAT
40 mph or less	Under 750	7-10	7-10	7-10	7-10	**	7-10	7-10	7-10	7-10	7-10
	750-1500	10	12	12	14	**	12-14	12-14	12-14	12-14	12-14
	1500-6000	12	14	14	16	**	14-16	14-16	14-16	14-16	14-16
	Over 6000	14	16	16	18	**	16-18	16-18	16-18	16-18	16-18
45-50 mph	Under 750	10	12	12	14	**	8-10	8	10	10	12
	750-1500	14	16	16	20	**	10-12	12	14	14	16
	1500-6000	16	18	20	26	**	12-14	14	16	16	18
	Over 6000	20	22	24	[illegible]	**	14-16	18	20	20	22
55 mph	Under 750	12	14	14	18	*	8-10	10-12	10-12	10-12	10-12
	750-1500	16	18	20	24	**	10-12	14	16	16	18
	1500-6000	20	22	24	30	**	14-16	16	18	20	22
	Over 6000	22	24	26	32*	**	16-18	20	22	22	24
60 mph	Under 750	16	18	20	24	**	10-12	12	14	14	16
	750-1500	20	24	26	32*	**	12-14	16	18	20	22
	1500-6000	26	30	32*	40*	**	14-18	18	22	24	26
	Over 6000	30	32*	36*	44*	**	20-22	24	26	26	28

Clear Zone Considerations

- Curb doesn’t change the clear zone
- Speeds as low as 25-MPH have a clear zone
- Tree size in clear zones should be considered at maturity

Clear Zone

Gravel Roadway

Gravel Roadway

The #1 problem with a gravel road:

It’s not a PAVED road!


MUDDY
WHEN
WET
DUSTY
WHEN
DRY

Gravel Quality

- What can poor quality gravel cost you?
  - $$$$$
    - Additional maintenance
      - Blading
      - Cutting out washboards
    - Additional gravel
      - Fines blow in the wind
      - Larger material to the shoulders and in the ditch
  - Crop production
    - Decreases with dust settling on your plants

Gravel & Dust (fine material) Loss

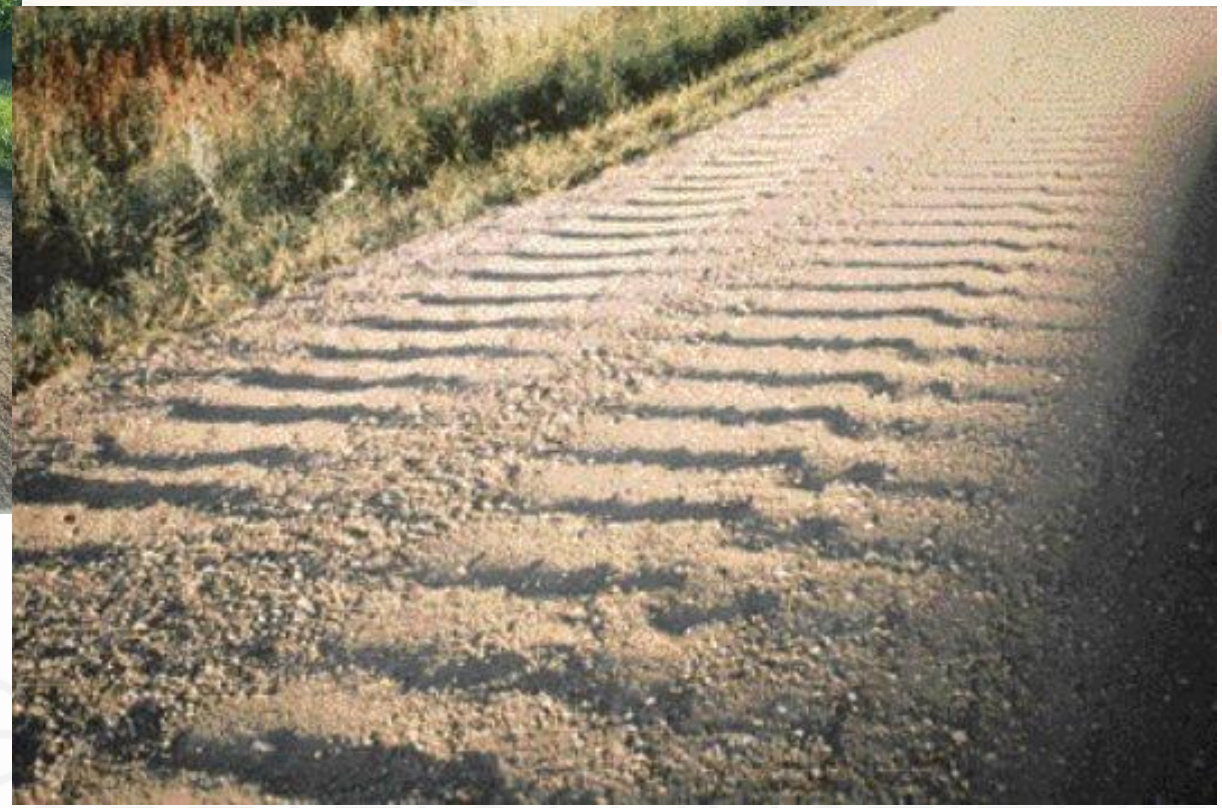
Gravel Quality

- What can poor quality gravel cost you?
  - Safety
    - Health
      - More dust
    - Vehicles Lose of control
      - Float
      - Wash boards
      - Rutting

Float or Loose Rock

Float Test (loose aggregate)

Gravel – Washboards



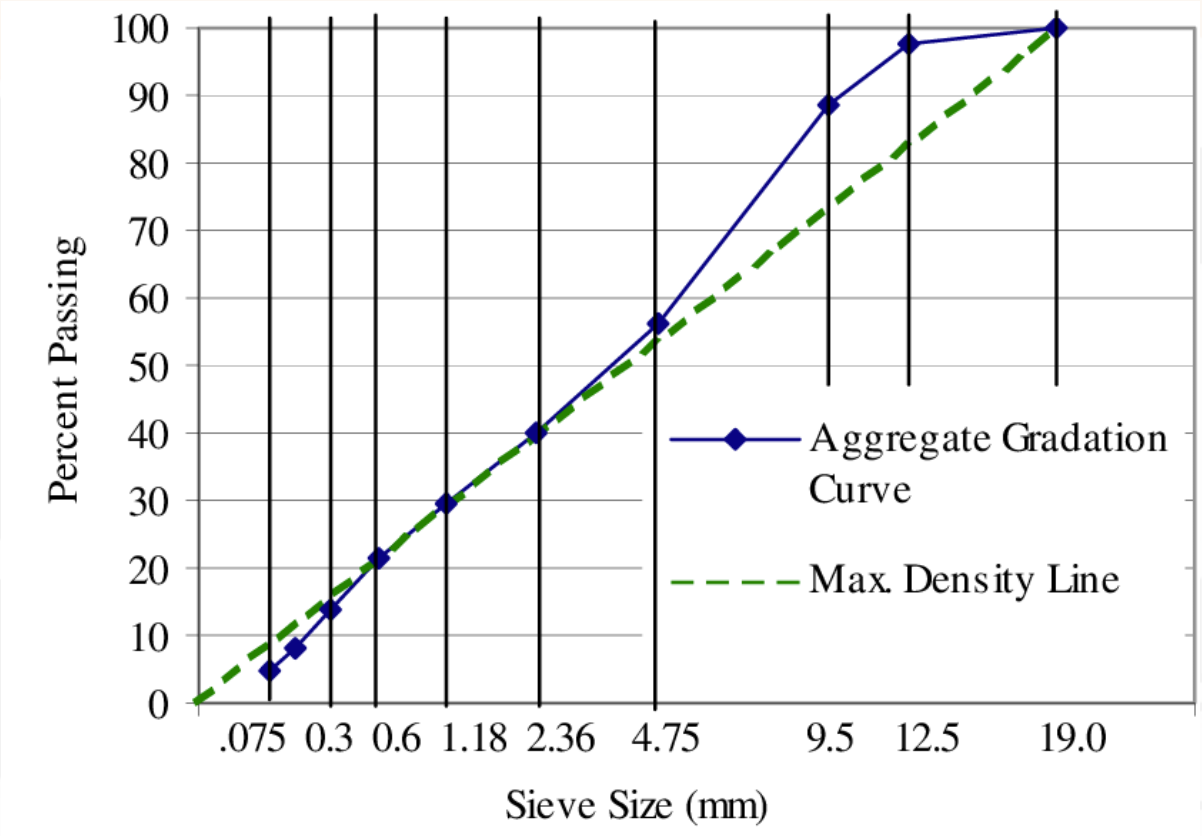
Gravel – Corrugations = Washboards

Gravel Quality

- What can good quality gravel save you?
  - $$$
    - Reduced maintenance cost
      - Less blading
      - Less frequent graveling
  - Lives or your health
    - No more washboards
    - Reduced float
    - Less dust
  - Crop production
    - Increases with less dust

Gravel Quality

- Density/Air Voids
  - Want good density which equals low air voids



Gravel Quality

- Concrete
  - Gradation of aggregates are sized to minimize the voids – rocks are tough
  - So what holds the aggregate together
    - Cement
  - Still has air voids but the cement holds everything together and the hard surface sheds water

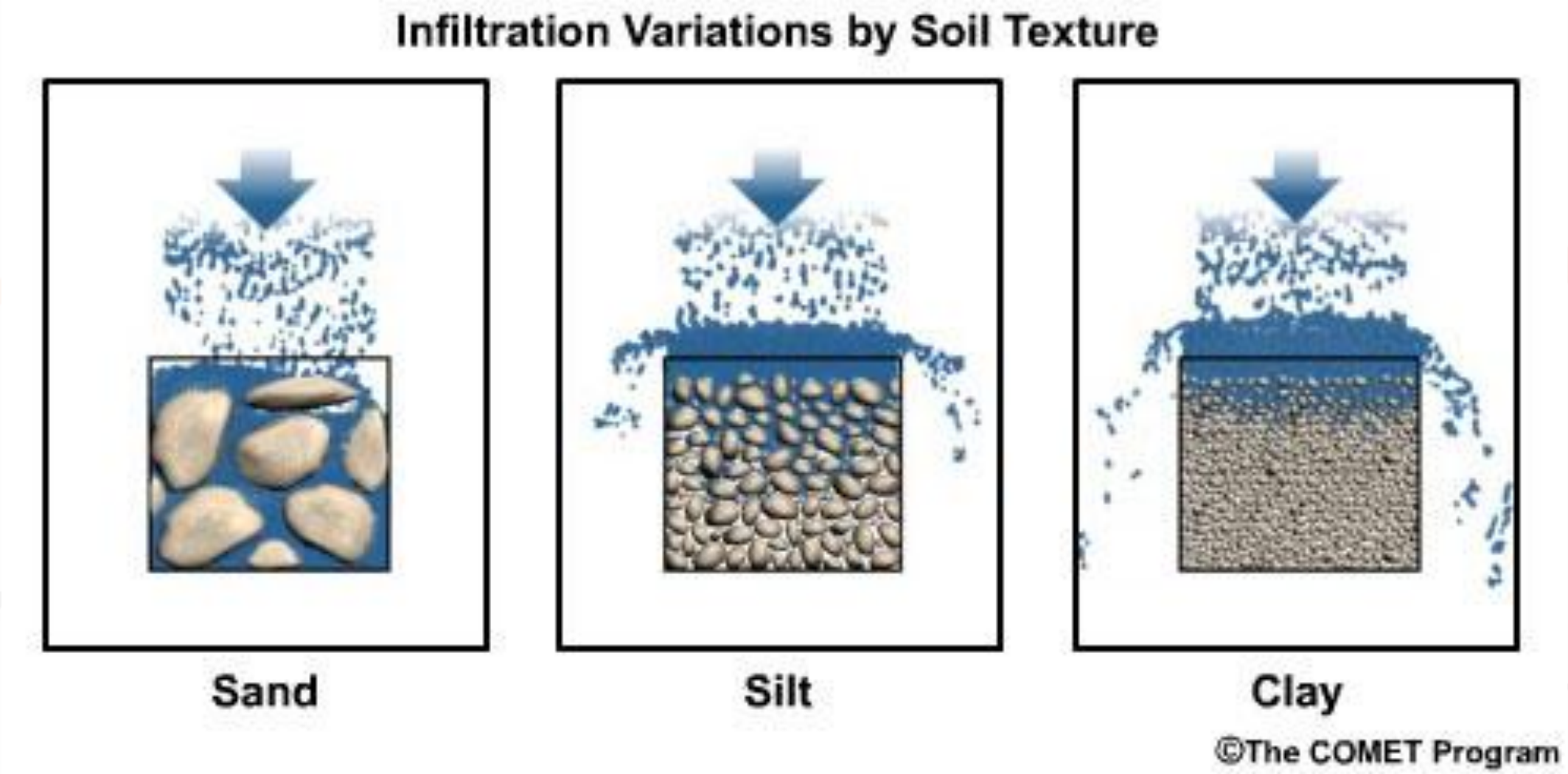
Gravel Quality

- Hot Bituminous Pavement
  - Gradation of aggregates are sized to minimize the voids – rocks are tough
  - So what holds the aggregate together
    - Asphalt Binder
  - Still has air voids but the asphalt binder holds everything together and the hard surface sheds water

Gravel Quality

- Gravel
  - Gradation of aggregates are “not” sized to minimize the voids – we have some large sized, medium sized, and then some finer material
  - So what holds the aggregate together
    - ?????
    - Nothing, unless you have PI (clay) for a binder…
  - Not a hard surfacing so it doesn’t shed water easily or at all
  - With PI, you can get a surface that helps shed the water

Gravel Quality – Gradation and Binder



Plasticity Index

Clay, the glue that hold the rocks and sand together

Clay Content

Too much coarse rock, lacking coarse sands – will ravel badly

Too much coarse sand, too little rock, will washboard badly

Good gravel surfacing (good representation of sizes to fill voids, high enough minus #200 to create road crust, will hold chlorides well

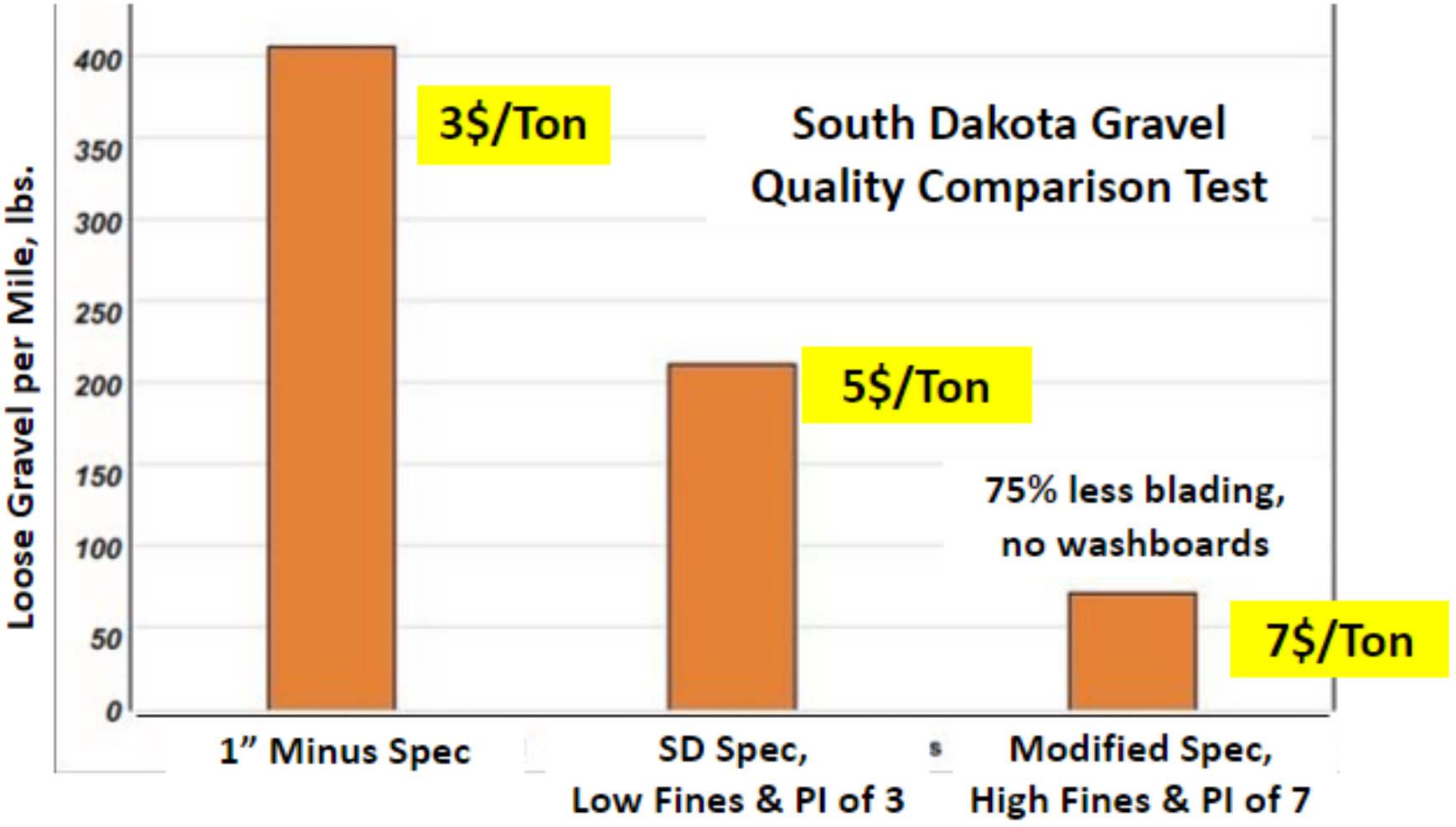
Gravel Surfacing – SSP6

Revised 10-15-2024

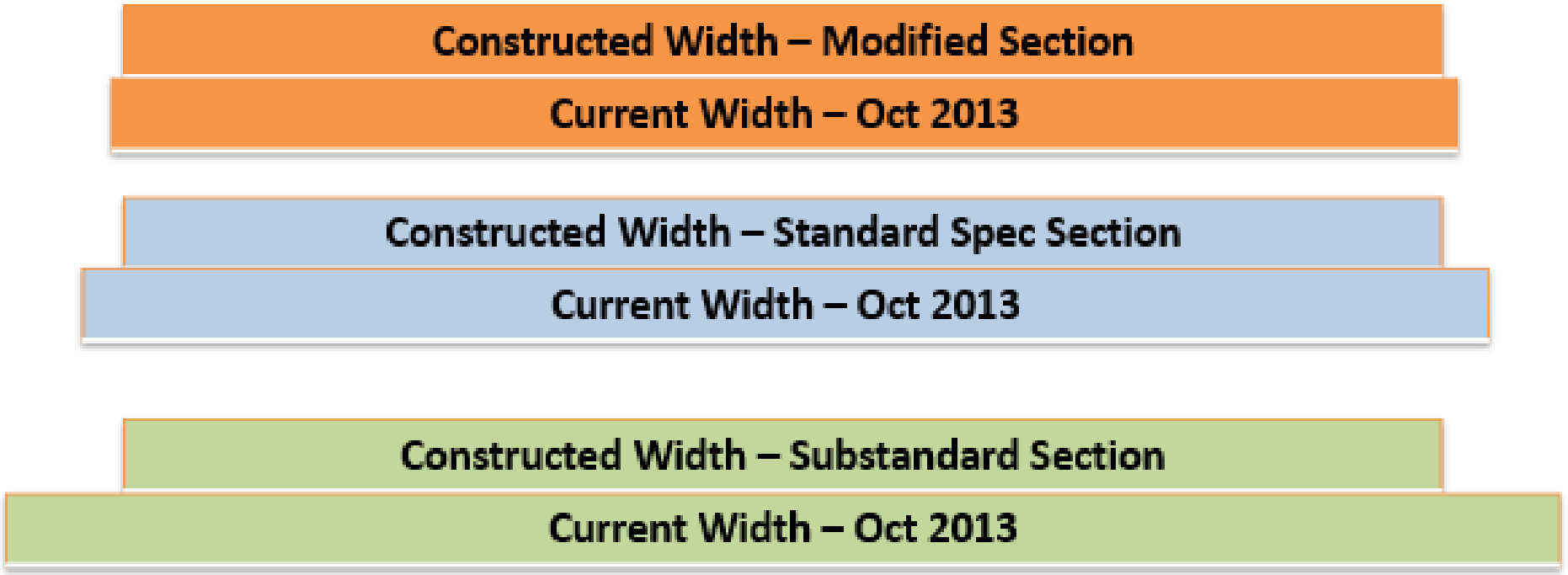
Sieve Size or Testing Method	Aggregate Gravel Surfacing Percent passing or Test Limit
1”	100
¾”	70 – 100
No. 4	38 – 75
No. 8	22 – 62
No. 30	12 – 50
No. 200	7.0 – 18.0
Plasticity Index (PI)	3 - 10
ND T 113, Shale (max %)	12.0%
AASHTO T 96, L.A. Abrasion (max %)	50%
NDDOT 4, Fractured Faces[1]	20%

[1]Minimum weight percentage allowable for the portion of the aggregate retained on a No. 4 sieve having at least 1 fractured face.

Better Gravel = Less blading, Gravel replacement

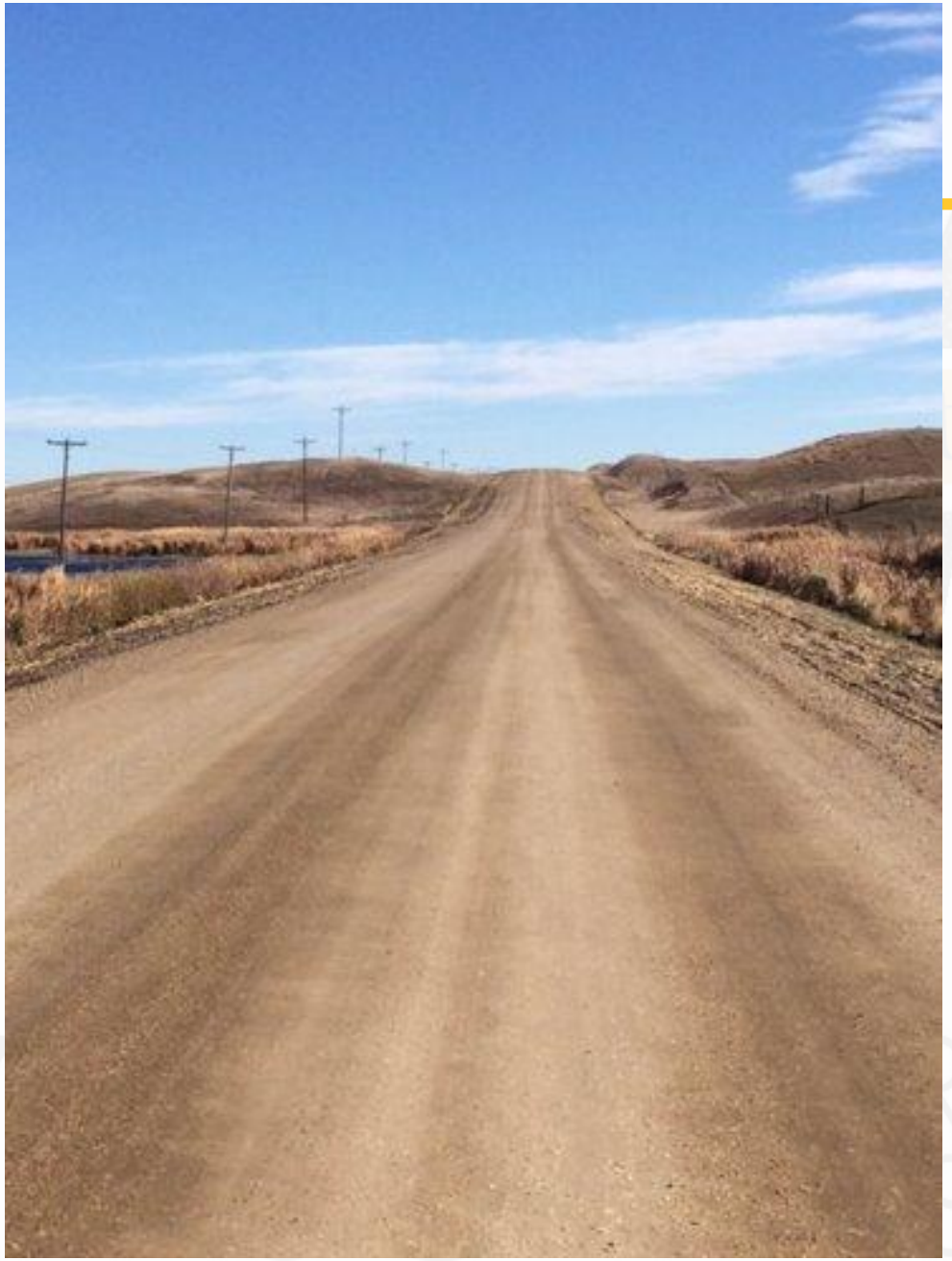


Change in roadway surface width constructed width – 21.5 ft on all sections



Current width ranges from 22 ft on modified section (top bar) to 25.25 ft on substandard section (bottom bar)

Change in Section



Gravel – Materials Assessment

Proper Gravel Section

- How do you get a non-hardened surface to shed water?
  - Proper Slope and have a Crown!!

What is one of the biggest Challenges in Road Maint?

- Maintaining the proper crown!!!!

Lack of 2% Crown

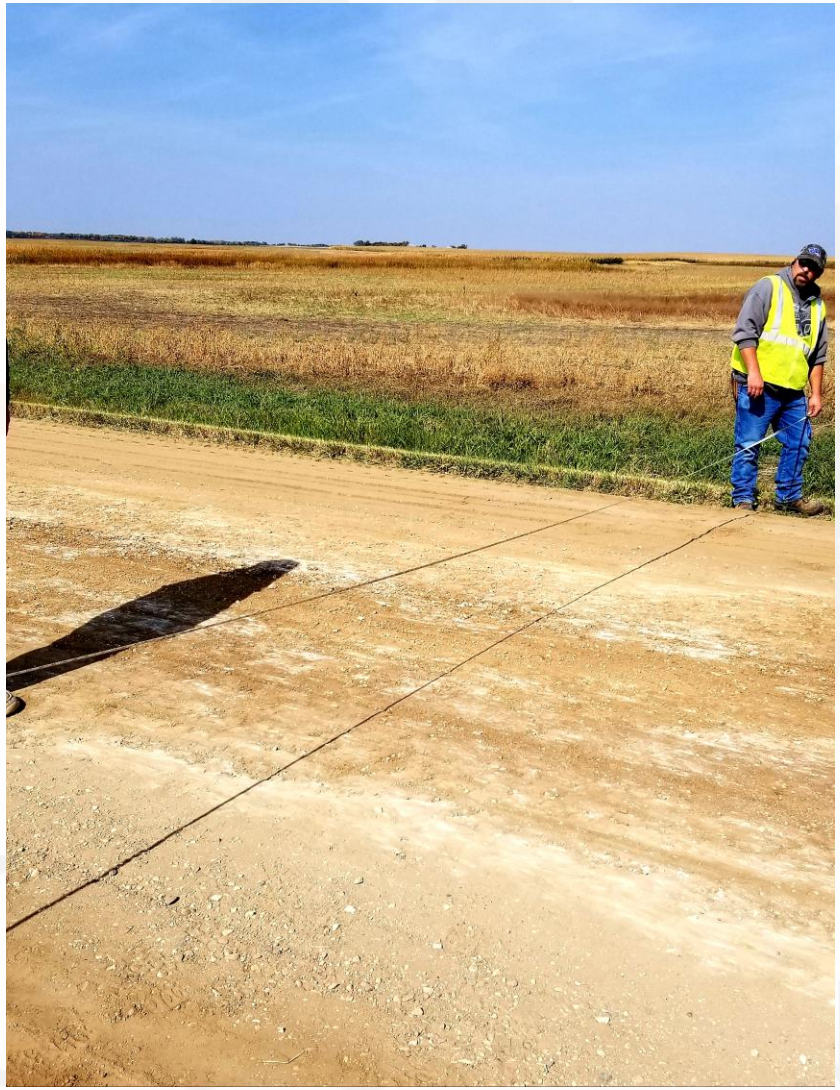
Crown

Good

Excessive

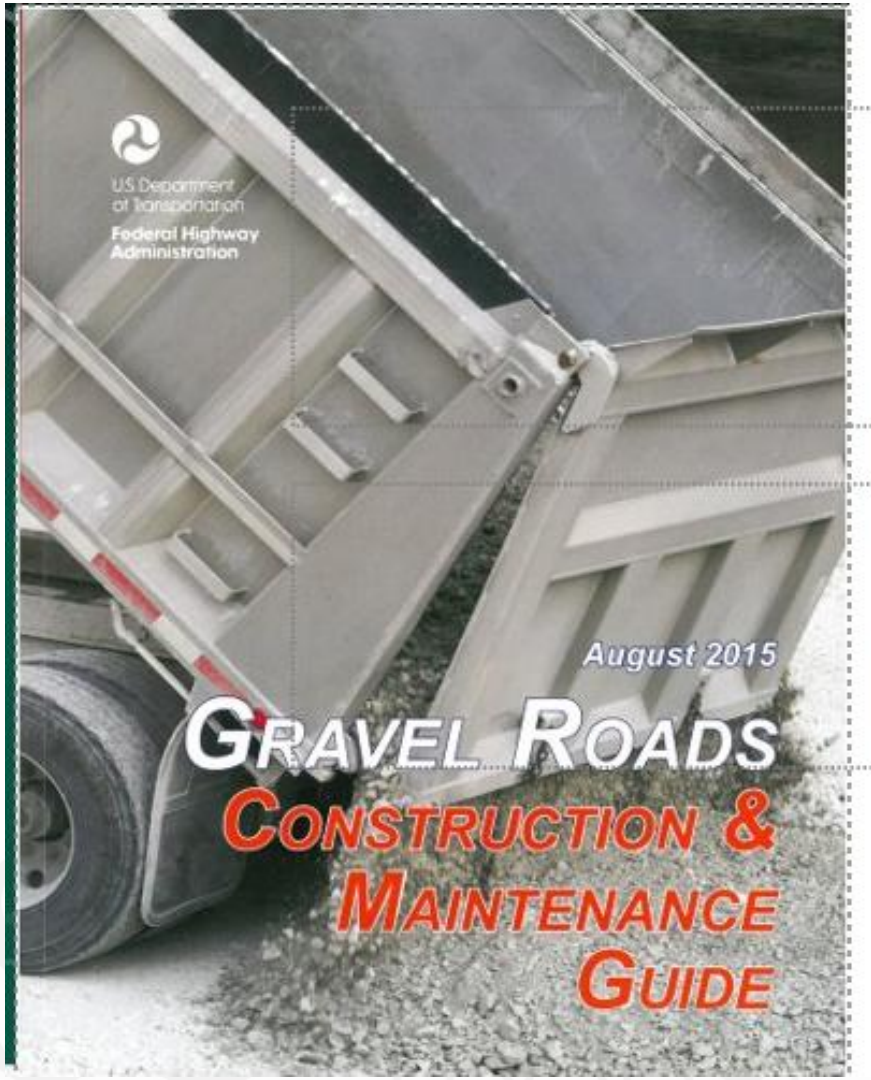
- Crown should be at or near ½ inch per foot [4 %]
  - 4% **Gravel** 2% **Asphalt**
- Example: 24 ft. roadway should have 6 in. of crown
- Crown should be straight like a roof
- Eliminates flat areas in travel way
  - Which allow water to remain on road surface and cause potholes and other problems

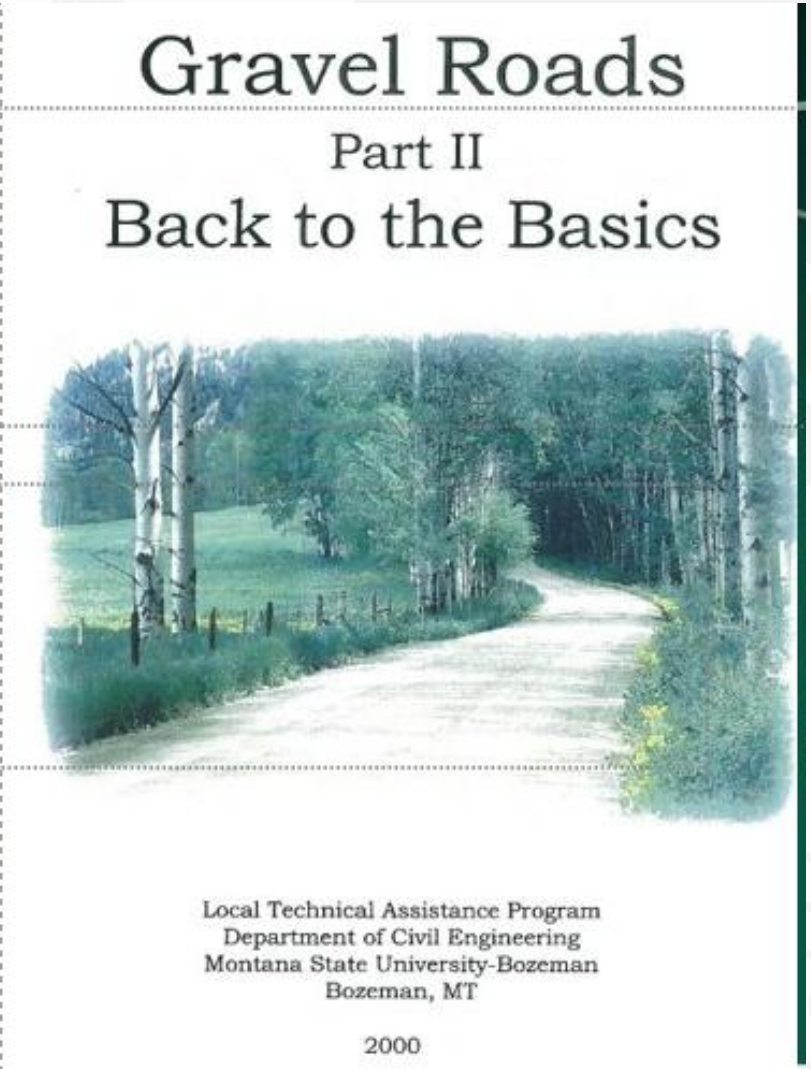
Slope Meter




INSTRUMENTS THAT HELP YOU MAKE THE GRADE
SLOPE METER NO.2
THIS PRECISION INSTRUMENT MOUNTED ON HIGHWAY CONSTRUCTION MACHINERY WILL SHOW THE SETTING OF THE BLADE FOR A DESIRED SLOPE.
MANUFACTURED BY
SLOPE METER, INC.
MINNEAPOLIS, MN 55432
U.S.A.
U.S. PATENT NO. 2,357,817 SEPT. 12, 1944; CANADIAN NO. 437,280 OCT. 8, 1946; BRITISH NO. 581,873 JULY 5, 1944
12 10 8 6 4 2 0 2 4 6 8 10 12

Resources


U.S Department of Transportation
Federal Highway Administration
August 2015
GRAVEL ROADS
CONSTRUCTION &
MAINTENANCE
GUIDE

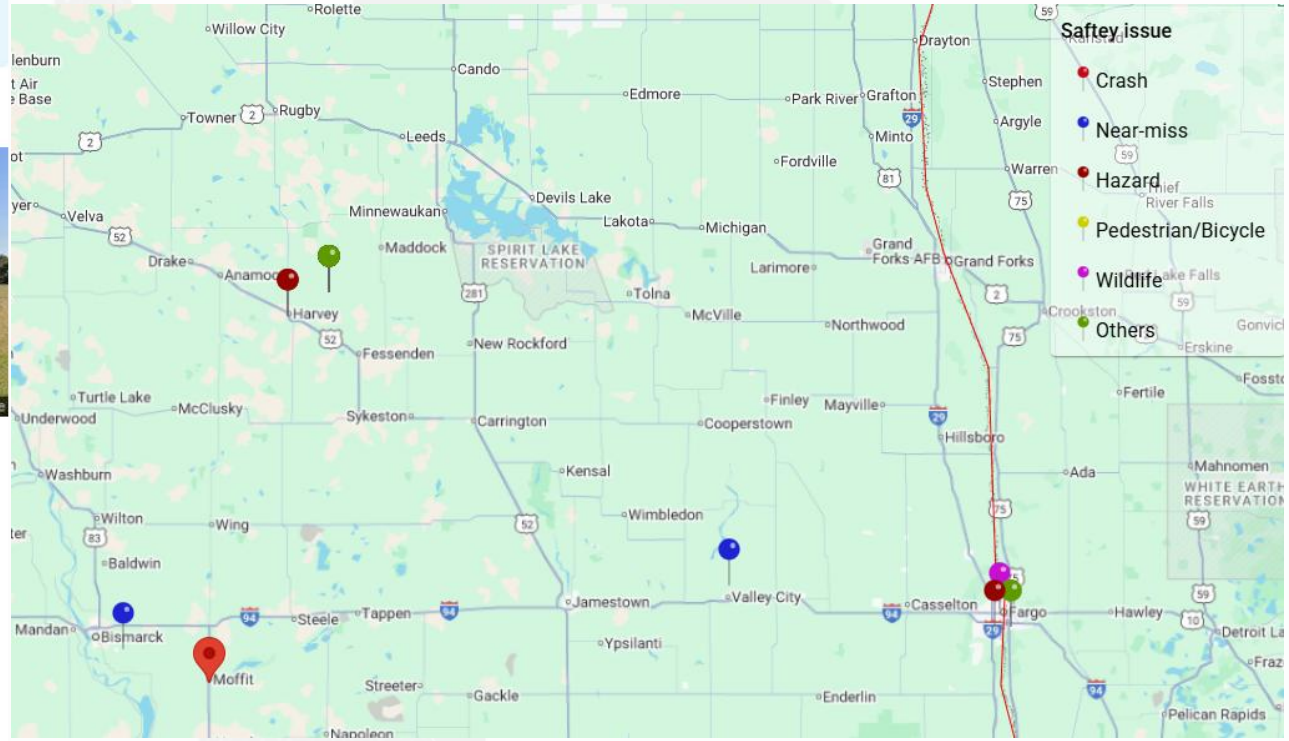

Gravel Roads
Part II
Back to the Basics
Local Technical Assistance Program
Department of Civil Engineering
Montana State University-Bozeman
Bozeman, MT
2000

Unpaved Road Safety Poll

- UGPTI received a grant to look at unpaved road safety
  - Conduct a survey – Survey is located at our Booth
    - Those who hand in a survey will be eligible to win a door from us
  - We also have a link (https://dotsc.ugpti.ndsu.edu:9193/) or you can use this QR code to report a traffic safety issue
    - We can also help at the booth on this one as well
    - It is also located on the paper survey at the booth

Unpaved Road Safety Poll

- Traffic Safety issue



Questions?

Bryon Fuchs, PE
bryon.fuchs@ndsu.edu
701-371-3483

Thank you

NDSU UPPER GREAT PLAINS TRANSPORTATION INSTITUTE