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TRANSPORTATION RESEARCH BOARD

Evaluating and Rating Unsurfaced Roads

August 25, 2021

1:00- 2:30 PM Eastern

@NASEMTRB
#TRBwebinar

PDH Certification Information:

- 1.5 Professional Development Hours (PDH) – see follow-up email for instructions
- You must attend the entire webinar to be eligible to receive PDH credits
- Questions? Contact Beth Ewoldsen at Bewoldsen@nas.edu

#TRBwebinar

The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Providers Program. Credit earned on completion of this program will be reported to RCEP. A certificate of completion will be issued to participants that have registered and attended the entire session. As such, it does not include content that may be deemed or construed to be an approval or endorsement by RCEP.

RCEP

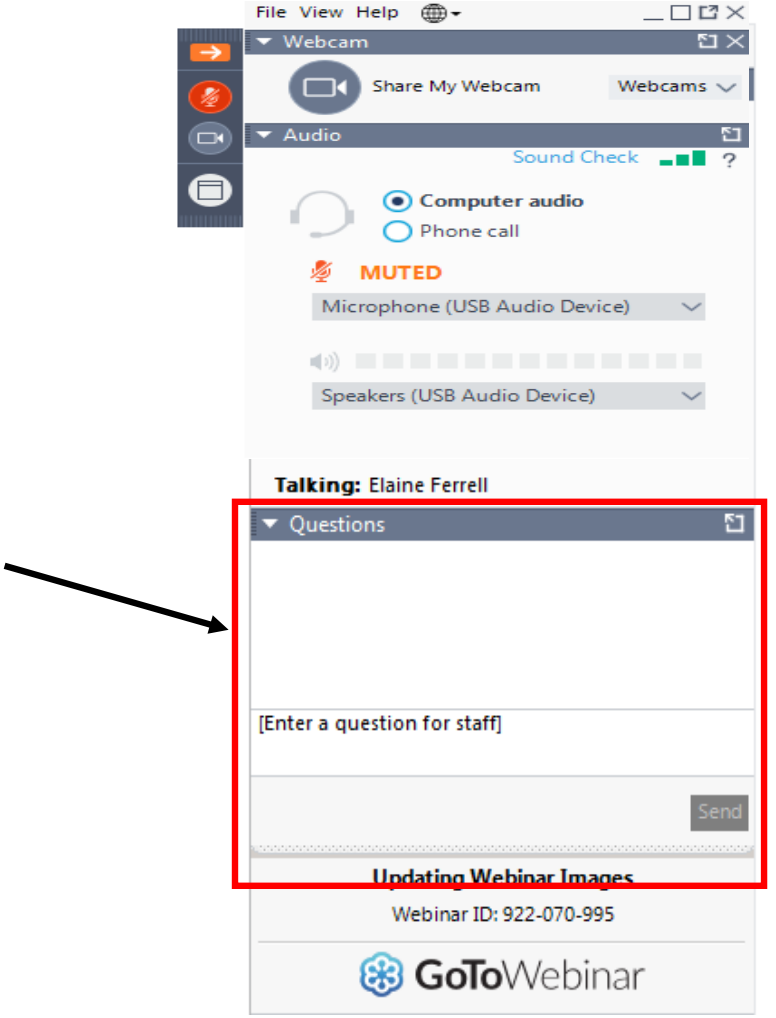
REGISTERED CONTINUING EDUCATION PROGRAM

Learning Objectives

- Establish a basic framework for an evaluation and rating system for unsurfaced road network

Questions and Answers

- Please type your questions into your webinar control panel
- We will read your questions out loud, and answer as many as time allows



#TRBwebinar

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Chair, TRB's Standing Technical Committee on Aggregates

Evaluating and Rating Unsurfaced Roads

Webinar arranged by
TRB Committee AKM80 "Aggregates"

August 25th 2021

Andrew Dawson

The University of Nottingham

- Who am I?
  - Until last month Associate Prof., Univ. Nottingham, UK
    - 37+ years
  - Now ‘retired’ due to Covid-19 economic squeeze
  - Chair, TRB’s Aggregates Committee
- Expertise
  - Pavement and geotechnical engineer
  - Specializing in unbound road layers & drains / LVRs

This Webinar

Our Speakers aim to give coverage of:

- Unsurfaced road conditions/terminology
- Condition evaluation & rating using
  - Univ. Wisconsin PASER
  - US Army Corps of Engineers URCI
- Use of these methods
- Question & Answers

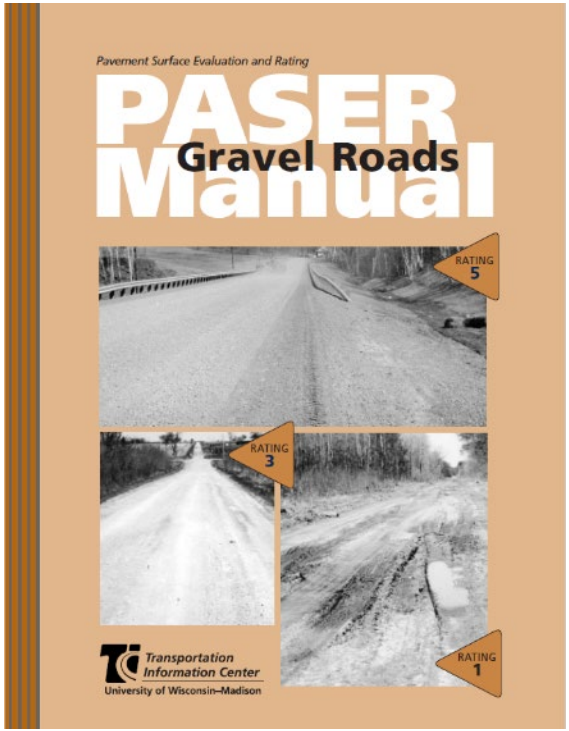
TRB Webinar:

Evaluating and Rating Unsurfaced Roads

#1 Unsurfaced road conditions & the Gravel Roads PASER rating method

Chris Senseney

University of Colorado



Chris Senseney

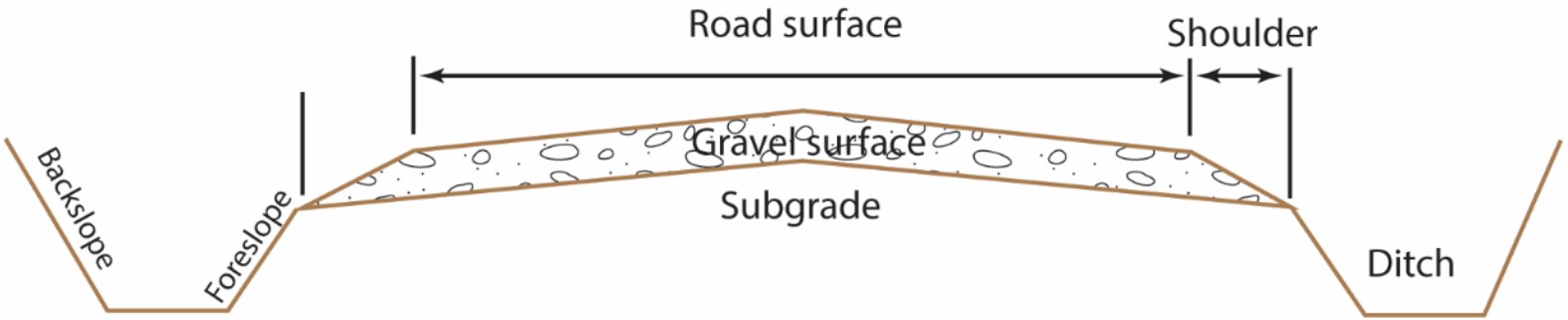
University of Colorado

- Senior Instructor/Professor of Practice in Civil, Environmental & Architectural Engineering
- Former pavement engineer at Kiewit Infrastructure Engineers
- Former U.S. Air Force Civil Engineering officer
- Member of TRB AKG20 – Standing Committee for Soil and Rock Properties Characterization

Gravel road conditions/terminology

Crown: fall or slope from center to edge of road

- Normally a gravel road has 4” – 6” of crown form center to edge
- Paved roads constructed with careful consideration of cross-section (not necessarily the case with gravel roads)
- Crowns should be “Straight-A” shaped, not parabolic (rounded)



Gravel road conditions/terminology

Drainage: roadside ditches and culverts must handle surface water flow

- Roadway crown is the first line of defense for good drainage
- Roadside ditches must be functional and unobstructed to maintain design life of road
- Bridges and culverts are needed to carry surface flow under road

Lack of ditch drainage impacts performance of this road

Limited space, but agency has maintained small, functional ditch

Gravel road conditions/terminology

Gravel layer: Traffic loads require an adequate layer of gravel to carry and distribute the loads to the subsoils.

- Thickness dependent on vehicle loads and soil strength (normally 6-10”)
- Proper gradation contains mixture of large aggregate (1/2” – 1”), sand size aggregate, and fines (8-15%)

High quality gravel

Poor quality gravel

Gravel road conditions/terminology

Surface deformation: .

- **Washboarding –** corrugation across the road, perpendicular to traffic
- **Potholes –** depressions caused when gravel worn away or soft spots in underlying soils
- **Ruts –** traffic caused depressions in the wheel path

Washboarding is caused by traffic, but can be worsened by poor grading

What is the root cause of these potholes?

Gravel road conditions/terminology

Surface defects: .

- **Dust –** often caused by traffic on overly dry gravel roads
- **Loose aggregate –** caused by a loss of fines through dust action or erosion (from an improper gravel mixture)

Dust becomes worse over time as particles are pulverized

Loose aggregate from a poorly graded gravel mixture

PASER rating method

Surface rating	Visible distress	General condition/treatment measures
5 Excellent	No distress. Dust controlled. Excellent surface condition and ride.	New construction or total reconstruction. Excellent drainage. Little or no maintenance needed.
4 Good	Dust under dry conditions. Moderate loose aggregate. Slight washboarding.	Recently regraded. Good crown and drainage throughout. Adequate gravel for traffic. Routine grading and dust control may be needed.
3 Fair	Good crown (3”-6”). Adequate ditches on more than 50% of roadway. Gravel layer mostly adequate. Some culvert cleaning needed. Moderate washboarding (1”-2” deep) over 10%-25% of area. Moderate dust. None or slight rutting (< 1” deep). An occasional small pothole (< 2” deep). Some loose aggregate (2” deep).	Shows traffic effects. Regrading (reworking) necessary to maintain. Needs some ditch improvement and culvert maintenance. Some areas may need additional gravel.
2 Poor	Little or no roadway crown (< 3”). Adequate ditches on less than 50% of roadway. Portions of the ditches may be filled and/or show erosion. Culverts partially full of debris. Moderate to severe washboarding (> 3” deep) over 25% of area. Moderate rutting (1”-3”) over 10%-25% of area. Moderate potholes (2”-4”) over 10%-25% of area. Severe loose aggregate (> 4” thick).	Travel at slow speeds (less than 25 mph) is required. Needs additional new aggregate. Major ditch construction and culvert maintenance also required.
1 Failed	No roadway crown or road is bowl shaped with extensive ponding. Little if any ditching. Filled or damaged culverts. Severe rutting (> 3” deep), over 25% of area. Severe potholes (> 4” deep), over 25% of area. Many areas (> 25%) with little or no aggregate.	Travel is difficult and road may be closed at times. Needs complete rebuilding and/or new culverts.

Example PASER unsurfaced road ratings

Rating
3

Some culvert cleaning needed.

Adequate ditches on more than 50% of roadway.

Example PASER unsurfaced road ratings

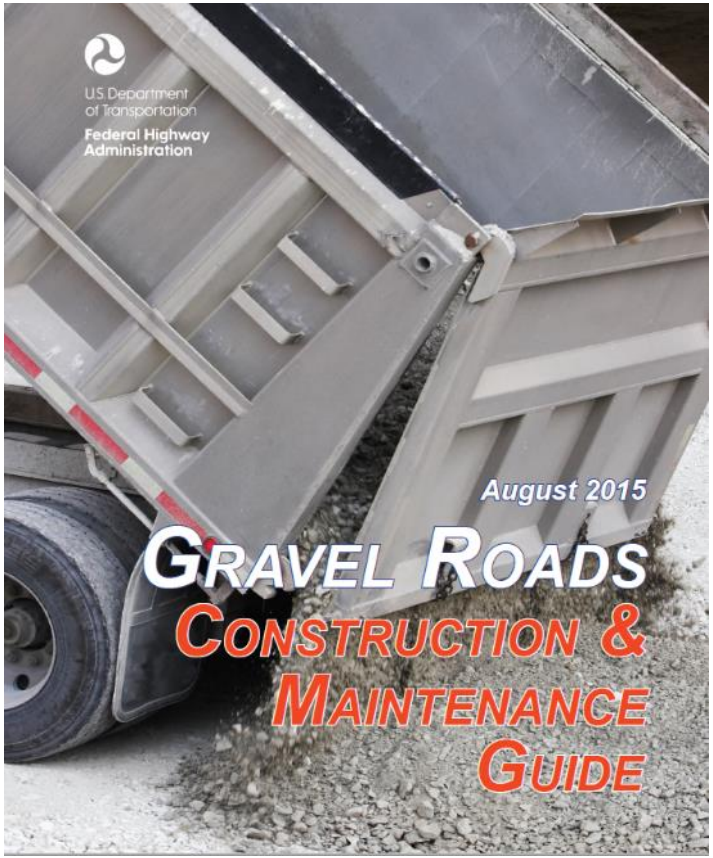
Rating
2

Little to no crown. No ditches at edge of roadway. Potholes (2”-4”) over 10-25% of area.

Adequate ditches on less than 50% of roadway. Moderate rutting over 10-25% of area.

Maintenance procedures

- Routine grading/shaping
  - Operating speed, moldboard pitch, moldboard angle
- Ditch re-shaping
- Culvert clearing
- Dust control
  - Water, magnesium chloride
- Adding new gravel



#2 Distresses, deduct values, and scoring system used in URCI

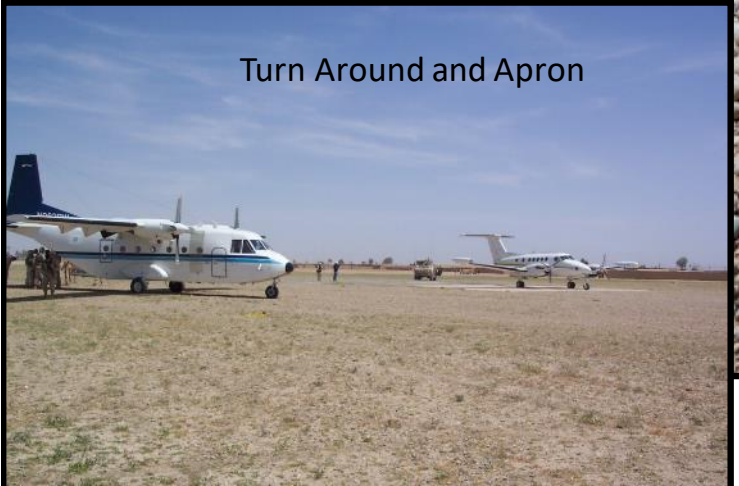
Phil Donovan
Applied Research Associates

Phil Donovan

Applied Research Associates

- Who Am I
  - Retired AF, formerly Dynatest (ARA bought the consulting division of Dynatest)
  - Office in Ventura, California
- Expertise
  - Pavement design, testing, and analysis
  - Pavement management
- Experience with Unsurfaced Roads
  - Runways in Afghanistan
  - Forest Service Roads

Lashkar Ghar Landing Zone

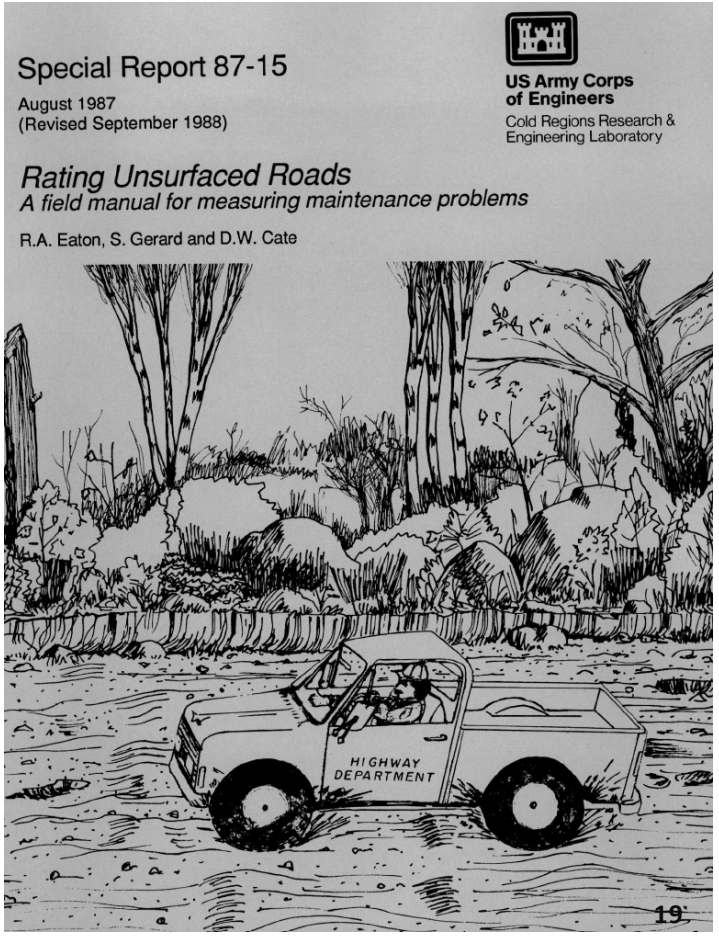


Turn Around and Apron

Maimana

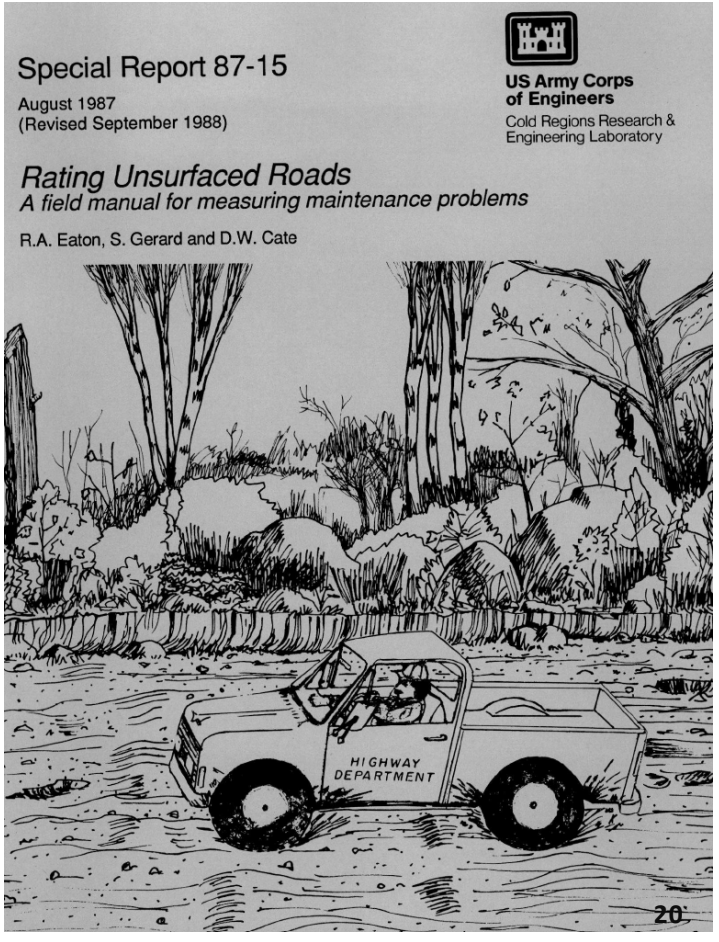
Unsurfaced Road Condition Index (URCI)

- 0-100 scale - A measure of the road's overall condition and corresponds to the PCI in PAVER
- Pavement Sections and Sample units are set up the same way as PCI
  - Branch – major recognizable units (usually entire roads)
  - Section – areas with uniform road conditions (similar construction, traffic, drainage, etc.)
  - Sample Units (100ft long - 2 per mile recommended, capture overall condition of roads)

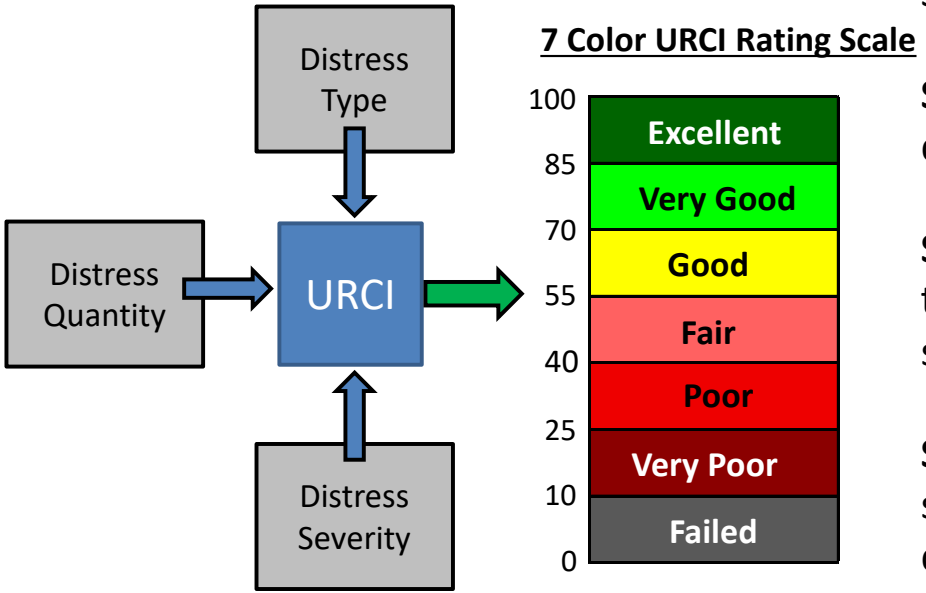


Unsurfaced Road Condition Index (URCI)

- Two Parts to the Inspection
  - Window Survey at 25mph
    - 4 times per year (each season)
    - Simply record drainage and surface problems that need repair
    - Helps estimate maintenance needs and priorities
    - No score, simply notes by section for work
  - URCI every 3 years
    - Same time, same location
    - Roads at their best (i.e. summertime)



Unsurfaced Road Condition Index (URCI)



Step 1: Divide Roads into Branches, Sections, and Sample units

Step 2: Inspect Sample Units and record distress types, quantities, and severities

Step 3: Calculate the distress densities and determine the "Deduct" value for each distress type, density, and severity

Step 4: Compute the Total Deduct Value (TDV) by summing all of the individual deduction values and determine the "q" value (number of individual deduct values > 5)

Step 5: Determine the URCI from the TDV-q correction graph

Unsurfaced Road Condition Index (URCI)

- **Seven distresses:** *(in order of importance to road condition*)*
    1. Improper cross section ***(ft – max of length)***
    2. Inadequate roadside drainage ***(ft – max of 2*length)***
    3. Potholes ***(number)***
    4. Dust ***(low, medium, high)***
    5. Corrugations ***(sq ft)***
    6. Rutting ***(sq ft)***
    7. Loose aggregate ***(ft – no max)***

$$Density = \frac{quantity}{sample\ area} * 100$$

* Order of importance from Special Report 88-5

DISTRESS TYPES

1. Improper Cross Section (linear feet)
2. Inadequate Roadside Drainage (linear feet)
3. Corrugations (square feet)
4. Dust
5. Potholes (number)
6. Ruts (square feet)
7. Loose Aggregate (linear feet)

UNSURFACED ROAD INSPECTION SHEET

Branch _____ Date _____

Section _____ Inspector _____

Sample Unit _____ Area of Sample _____

DISTRESS TYPES

1. Improper Cross Section (linear feet)
2. Inadequate Roadside Drainage (linear feet)
3. Corrugations (square feet)
4. Dust
5. Potholes (number)
6. Ruts (square feet)
7. Loose Aggregate (linear feet)

SKETCH

DISTRESS QUANTITY AND SEVERITY

Type		1	2	3	4	5	6	7
Quantity and Severity	L							
	M							
	H							

URCI CALCULATION

Distress Type	Density	Severity	Deduct Value

Total Deduct Value =

q =

URCI = RATING =

REMARKS:

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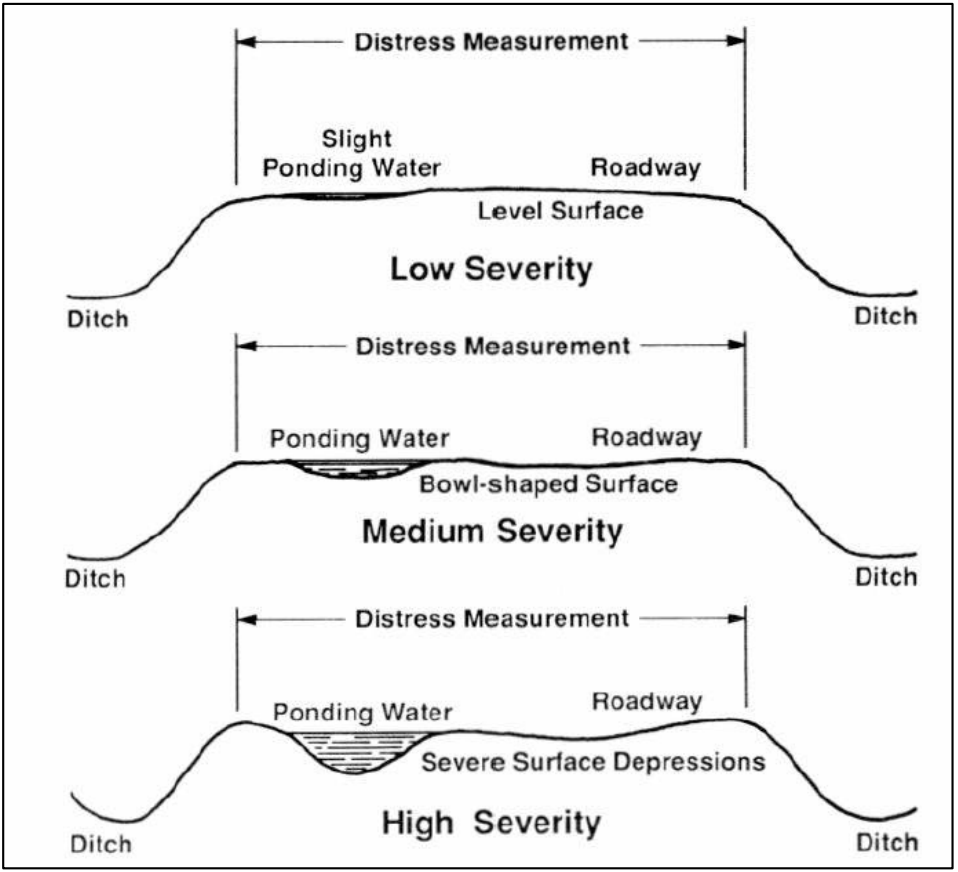
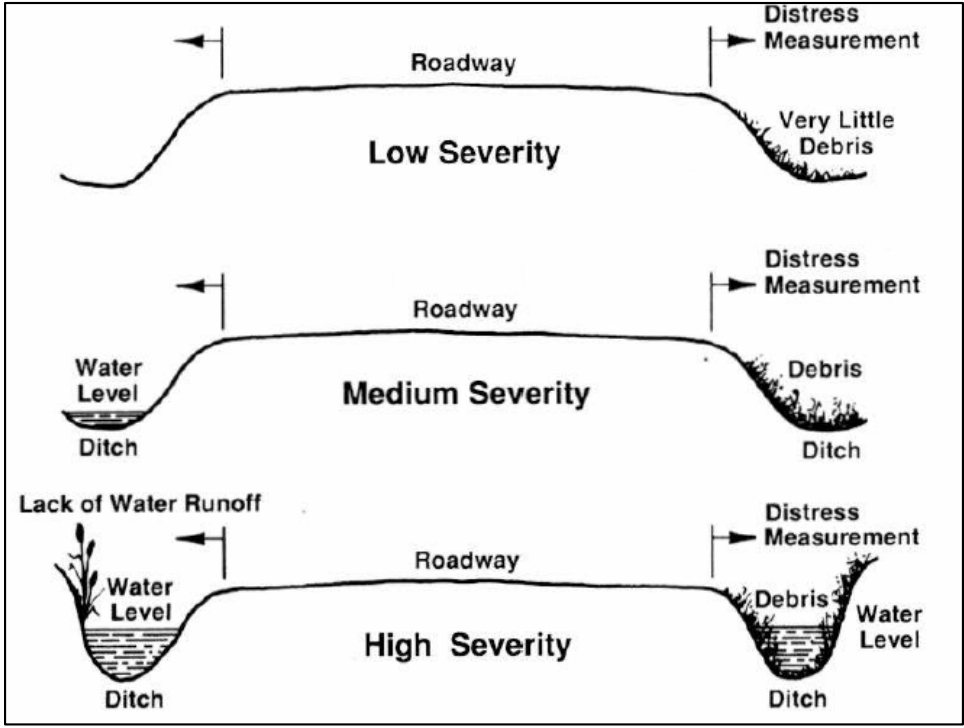
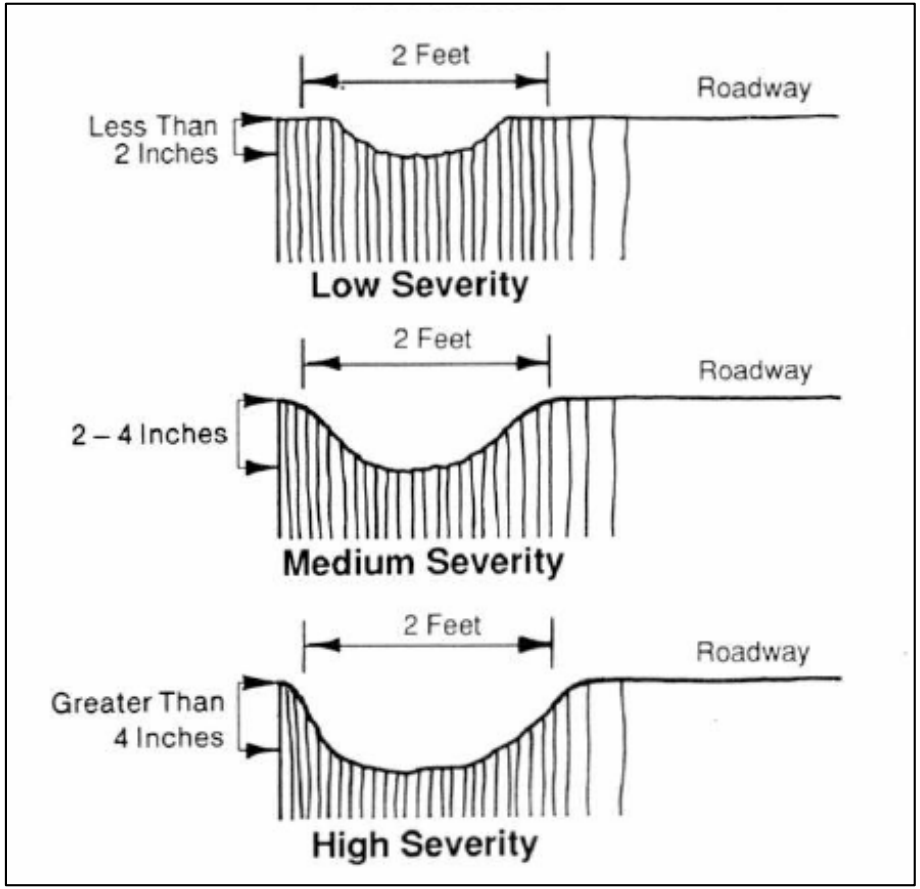
Improper Cross Section



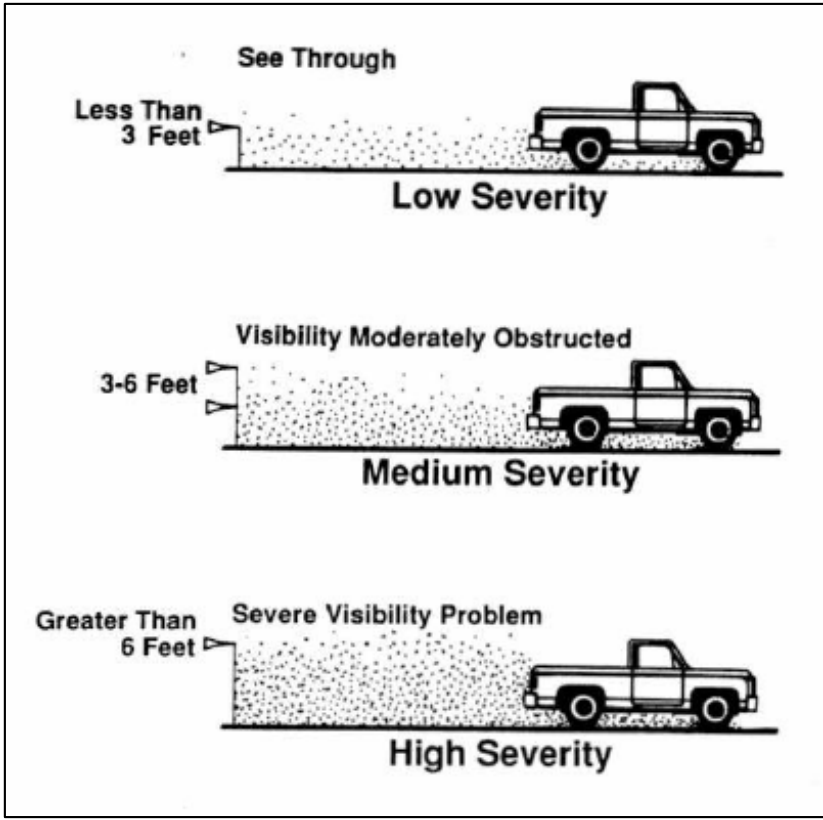
Inadequate Roadside Drainage



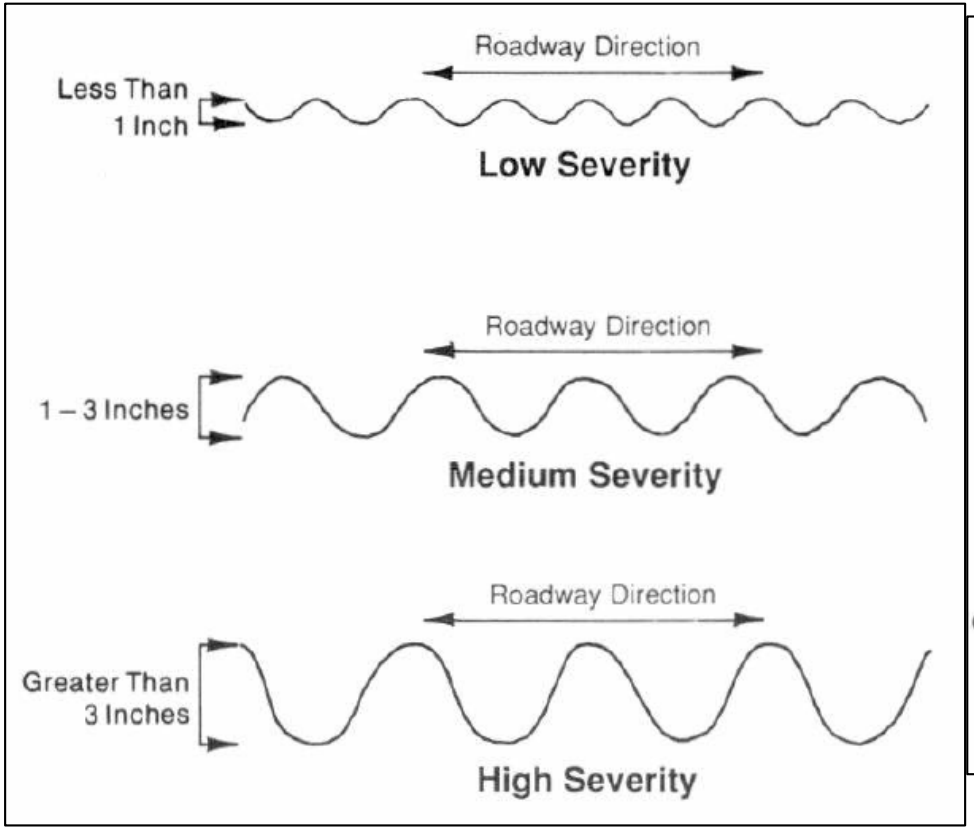
Potholes



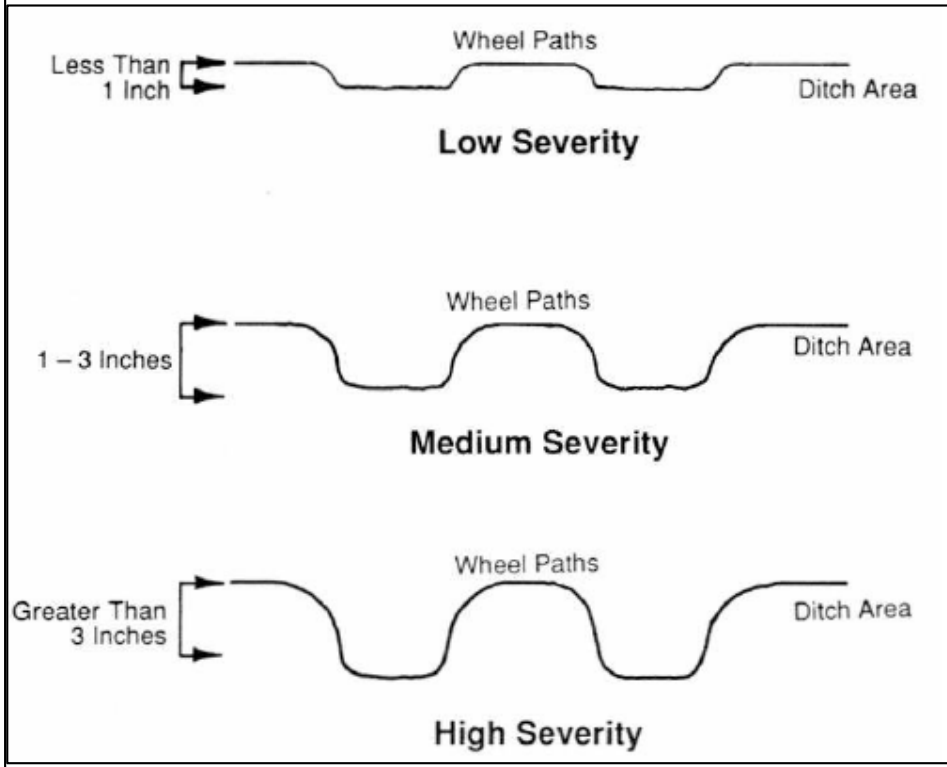
Dust



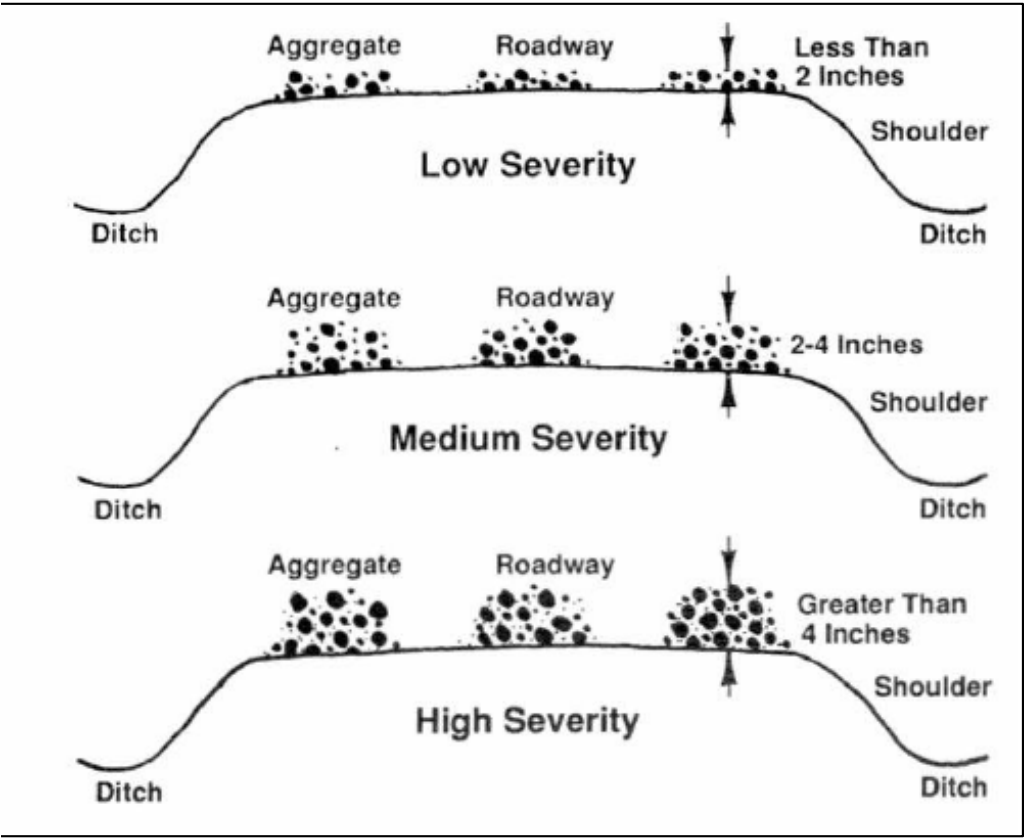
Corrugations



Rutting



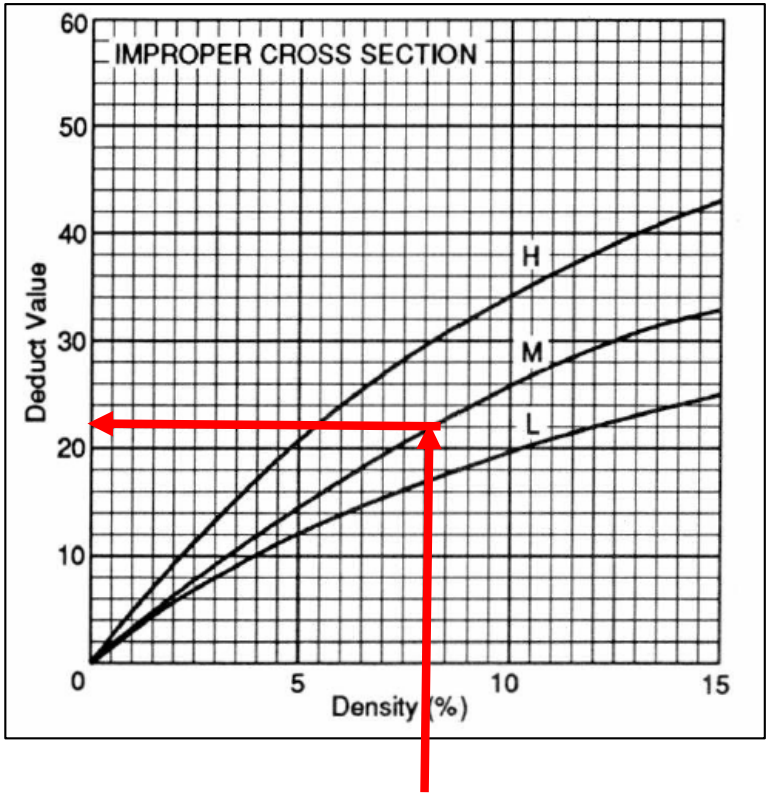
Loose Aggregate



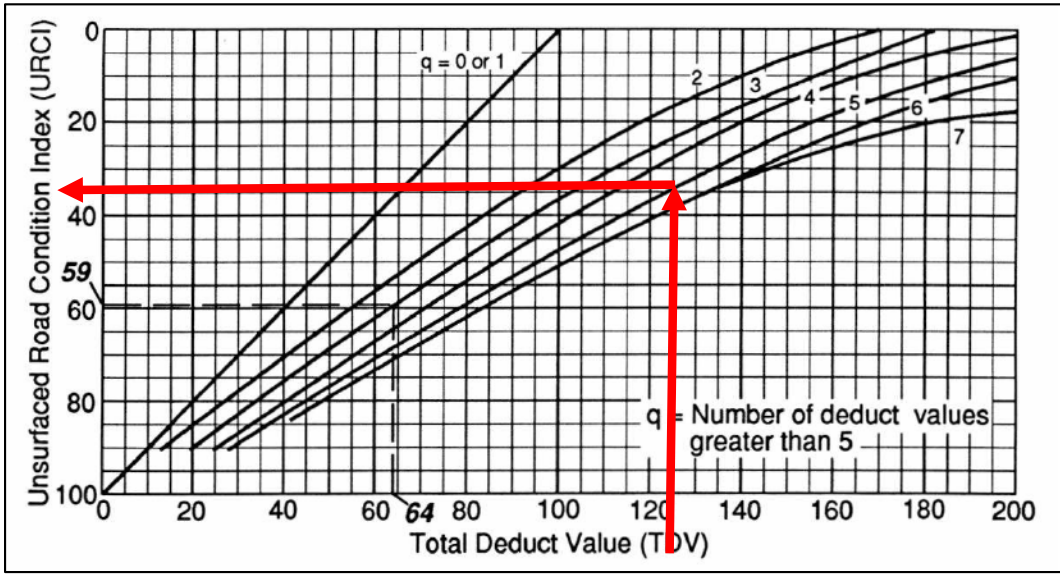
Loose aggregate, low severity.

Deduct Curve and Correction Curve by Hand

Density:8%, deduct 22

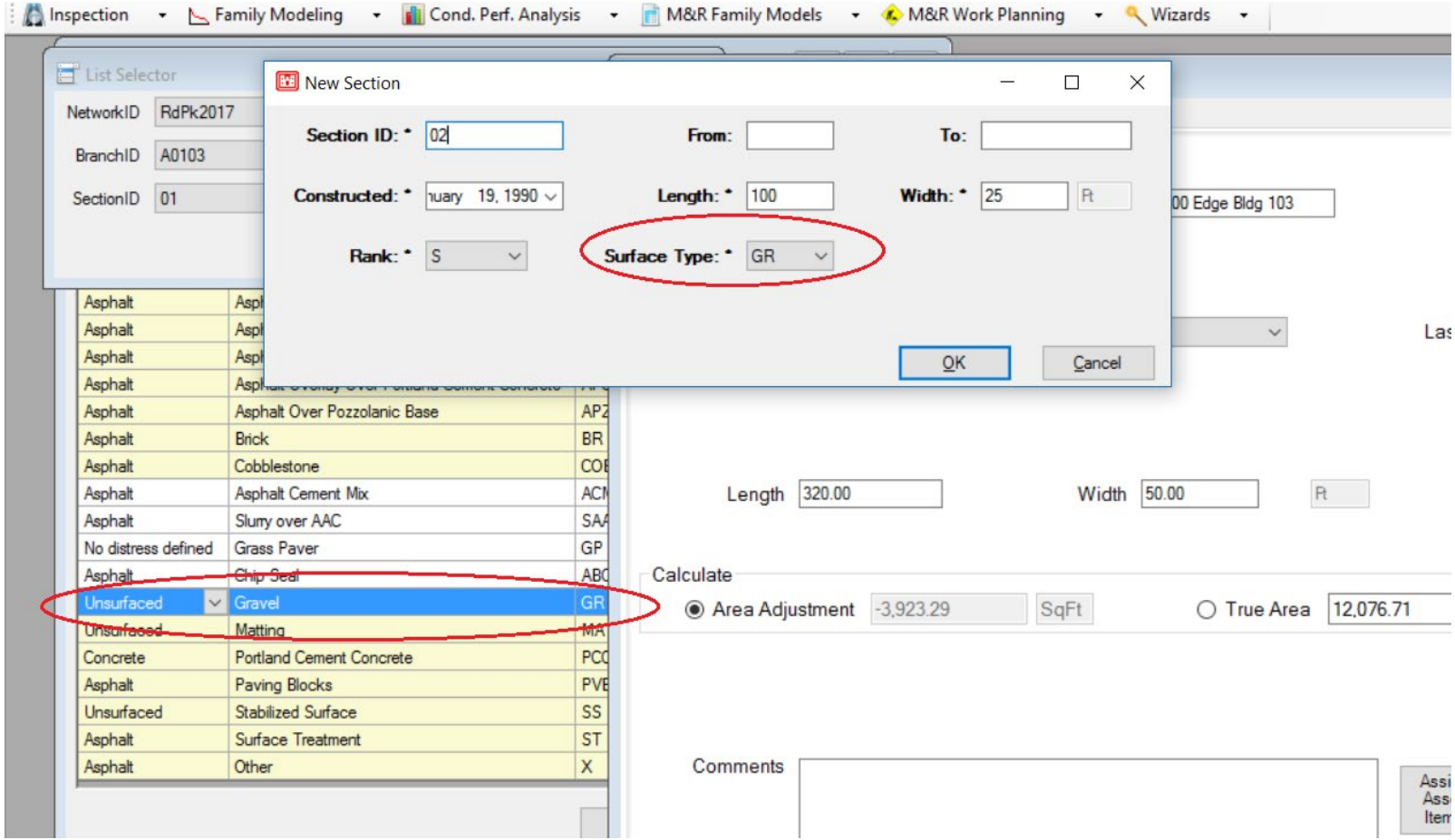


TDV=125, q=5, URCI = 35



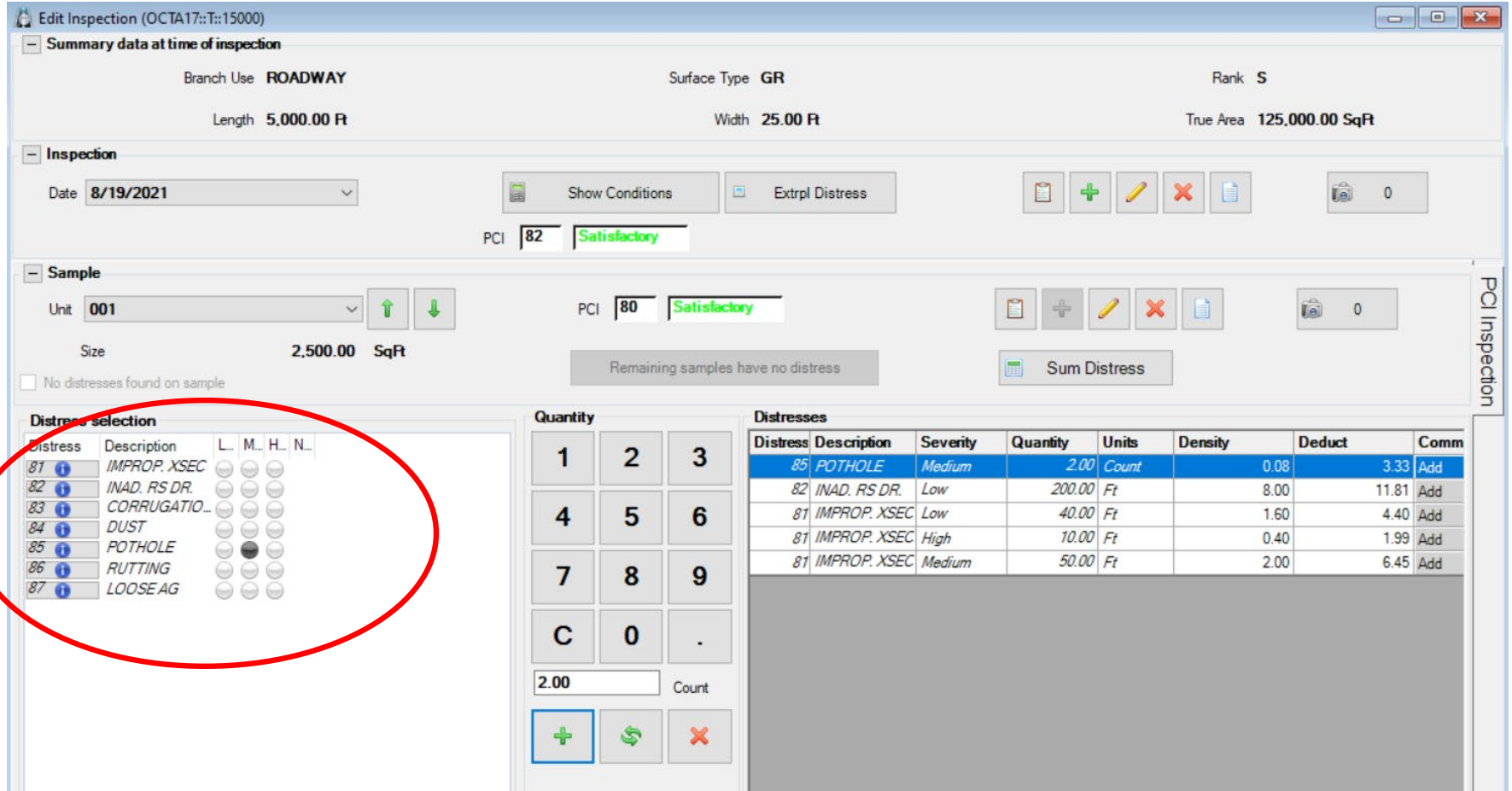
Section identified as an Unsurfaced Road (i.e. gravel)

PAVER



Inspection Page for an Unsurfaced Road (i.e. gravel)

PAVER



URCI (area weighted)

$$Section\ URCI = \frac{(\sum_{i=1}^{n}(sample\ URCI)_i * (sample\ area)_i)}{\sum_{i=1}^{n}(sample\ area)_i}$$

$$Branch\ URCI = \frac{(\sum_{i=1}^{n}(Section\ URCI)_i * (Section\ Area)_i)}{\sum_{i=1}^{n}(Section\ Area)_i}$$

$$Network\ URCI = \frac{(\sum_{i=1}^{n}(Branch\ URCI)_i * (Branch\ Area)_i)}{\sum_{i=1}^{n}(Branch\ Area)_i}$$

Advantages and Disadvantages

- PASER
  - Simple
  - Quick
  - Mostly Windshield Only Survey
  - Single Overall Value (Little consideration for multiple distresses)
  - Limited use to identify maintenance type
  - No PMS software association
- URCI
  - Standardized method
  - Importable into PAVER
  - Identified distresses help plan type of maintenance
  - More complicated and slower
  - PMS software costs

Issues with Unsurfaced Road Evaluations

- Roads change almost on a daily basis
- Unsurfaced roads designed and built to a lower standard than paved surfaces, most times no as-built information is available
- Manual surveys are slow and tedious
- Automated surveys with specialty imaging equipment contend with rough roads (vibrations), dust, and mud

Short Videos from CRREL

- Unsurfaced Road Management using URCI
  - https://www.youtube.com/watch?v=Em1SJMhdt2U

- Inspecting Unsurfaced Roads - URCI
  - https://www.youtube.com/watch?v=b34K3TJ_SPw

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