Strengthening Base instead of Paving:

Regional Local Road Conference

Rapid City, South Dakota

October 21 & 22, 2009

OVERVIEW

- ROAD TYPES
  - BASE STRENGTHENING APPLIES TO ALL
- KEY CONSIDERATIONS for SUCCESS
  - PAVEMENT ASSESSMENT
- REHAB SELECTION
  - ASSURE PERFORMANCE
- QUESTIONS/COMMENTS

ROAD TYPES

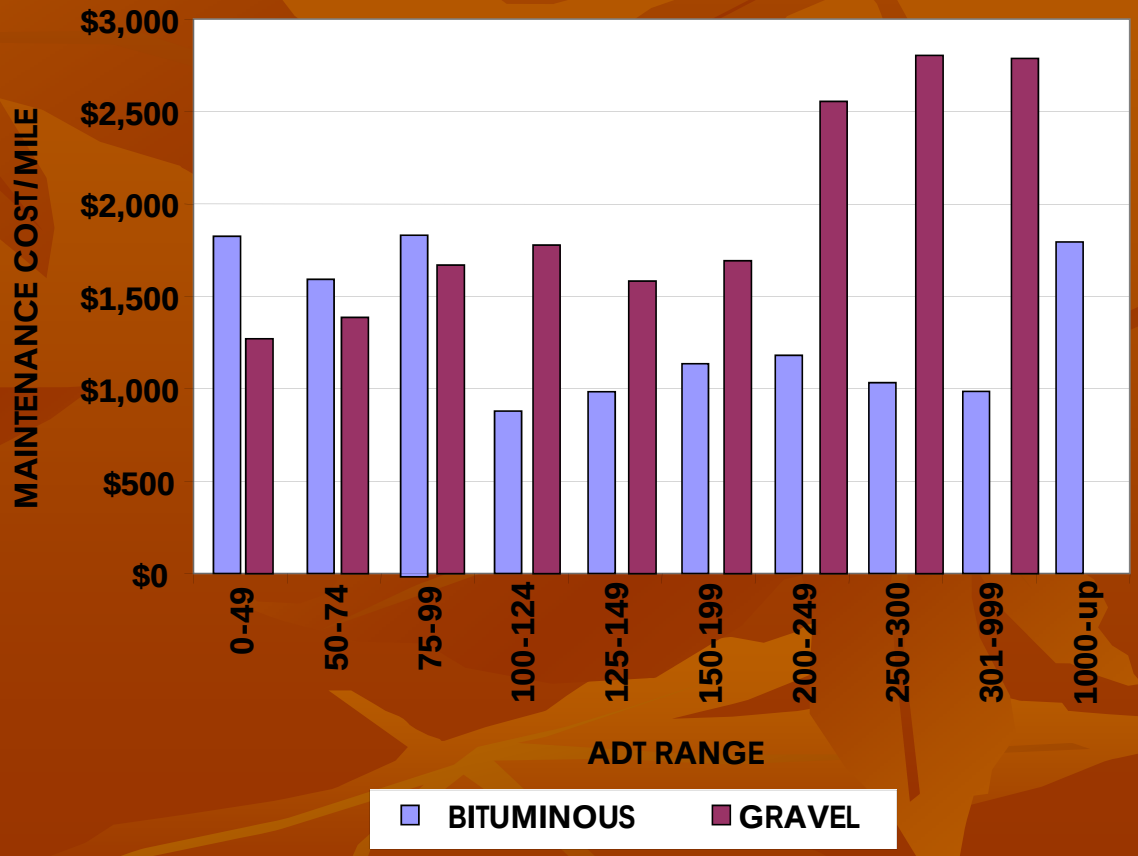
- GRAVEL
  - What are my current costs?
  - What are my future needs?
- RURAL HMA
  - Staged construction/perpetual pavents
- URBAN HMA
  - Adding strength to existing design
- INTERSTATE HMA – Mn/Road

GRAVEL (Unpaved)

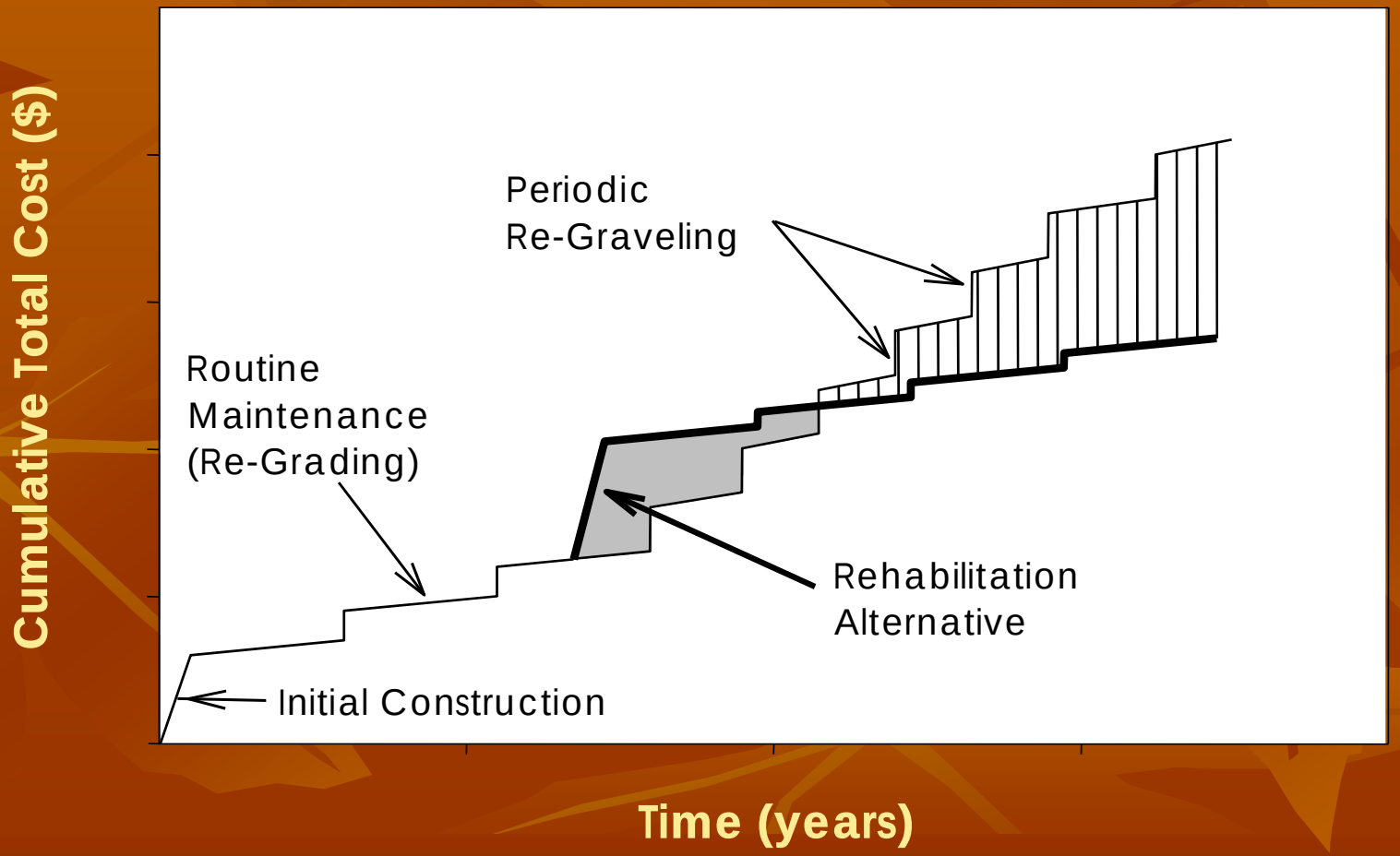
Lincoln Highway between Ames and Nevada, 1918.
(Courtesy: Iowa State Highway Commission)

Traffic's effect on maintenance costs/mile

- Roads grouped by traffic volumes and surface type
- An increase in traffic should lead to an increase in maintenance costs, particularly for gravel roads
  - More gravel needed
  - More blading and smoothing of road surface needed



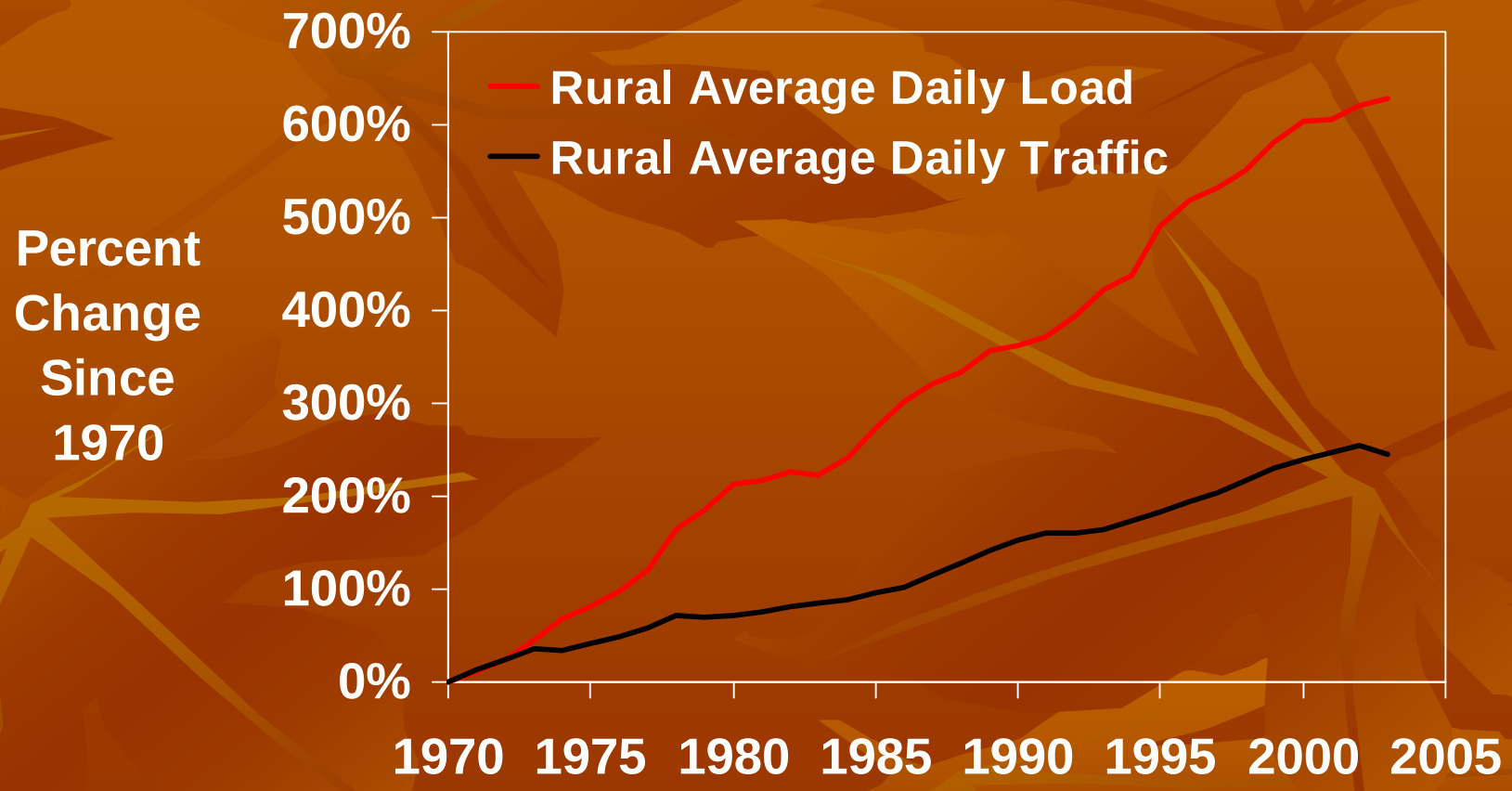
Cumulative maintenance costs/mile over time for a gravel road



RURAL HMA (Limited Design)

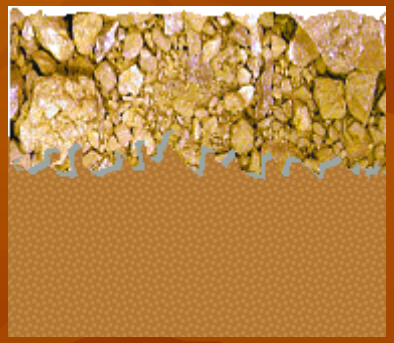
- Limited Pavement and Mix Design
  - Pavement designs assume stronger base
  - Mix designs were economized
  - Performance suffers as expectations rise >
- Staged Construction options
  - Rehab economics
- Perpetual Pavement Design Goal
  - Current research providing more tools

Interstate Expectations

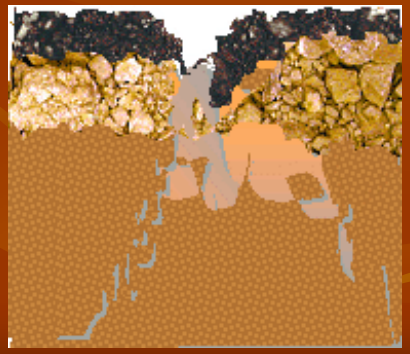


Staged Construction options

Granular pavement needing upgrading

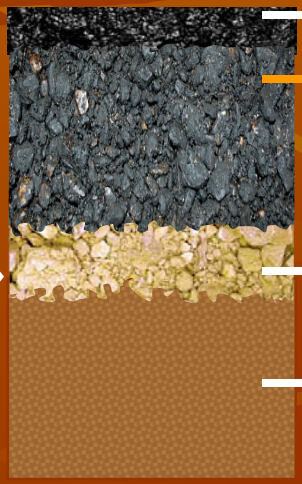


Bituminous pavement needing repair



GBS

FDR



Overlay

6-10 inch stabilized material

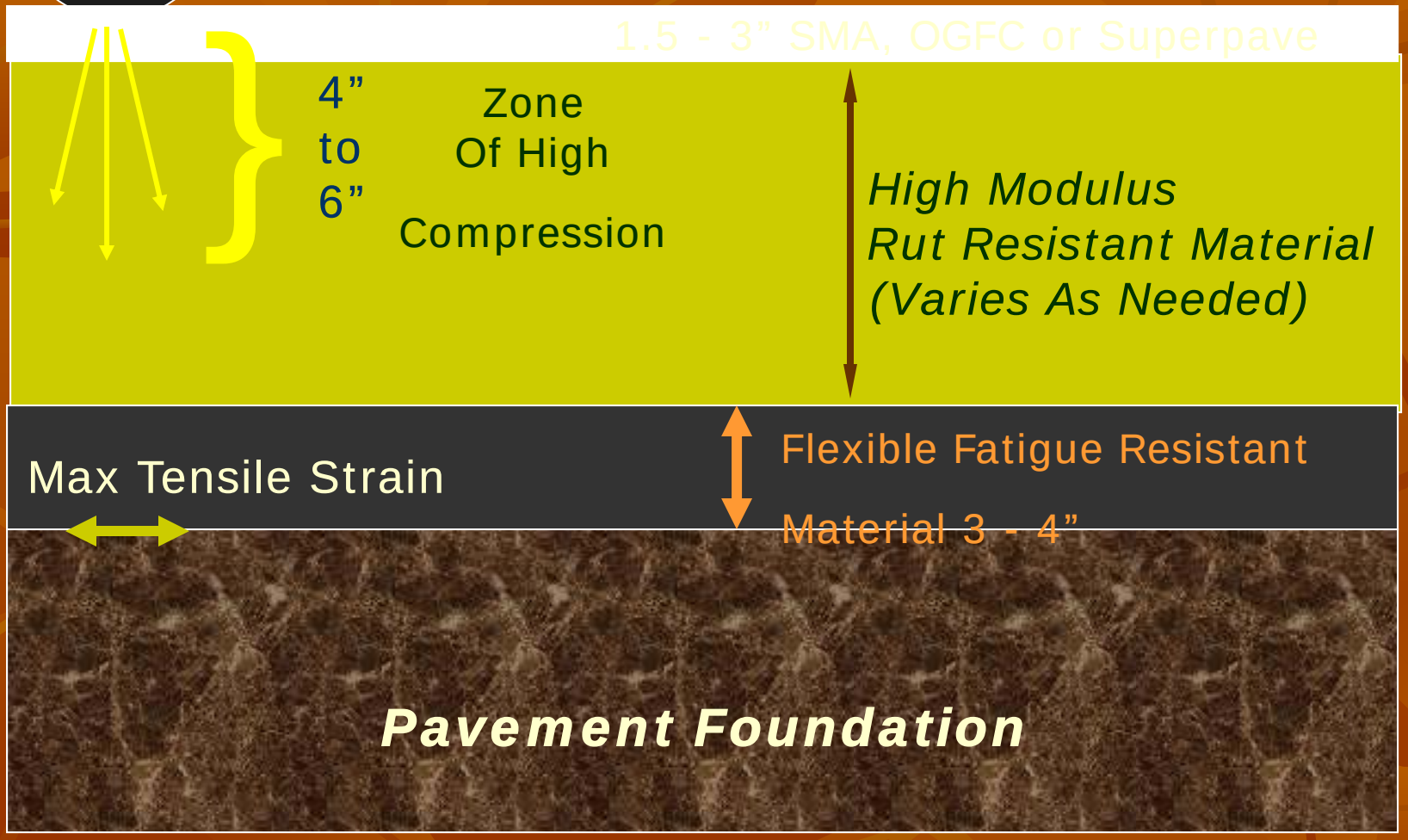
Granular base

Soil

Perpetual Pavement Design Goal

- Proper roadway/pavement assessment
- Selection of best rehab option
- Selection of process and materials
- Best Practices Construction (manage risk)
- Lowest Life Cycle Cost (LLC)
- Optimized Performance (safety,ride,durability)

APA Perpetual Pav't

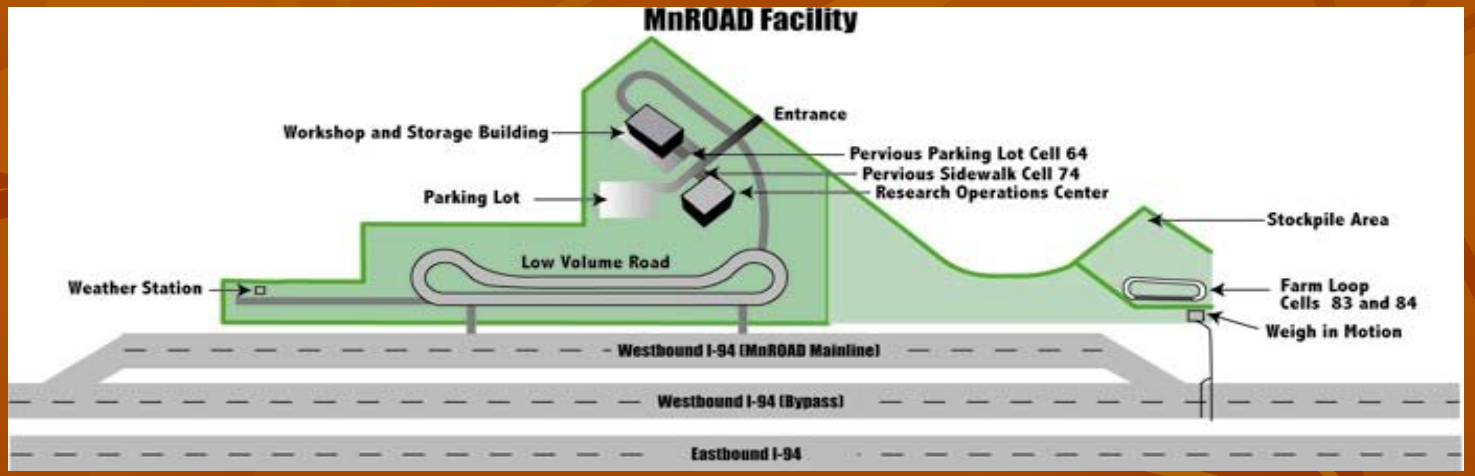


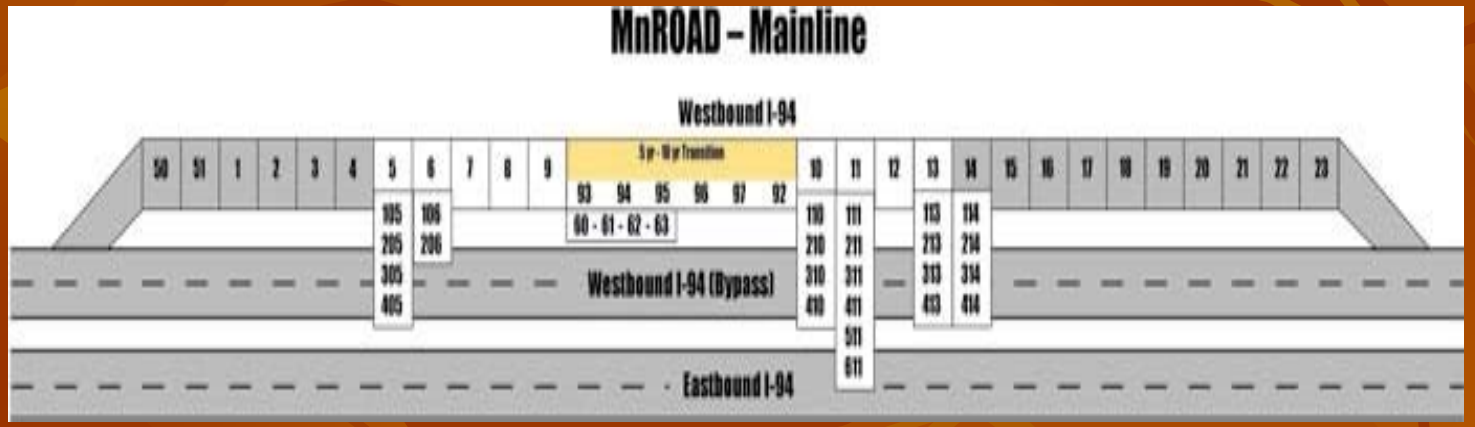
URBAN HMA

INTERSTATE HMA
Mn/Road – I 94

- Cell 2
  - 50% RAP
- Cell 3
  - 75% RAP
- Cell 4
  - 100% RAP

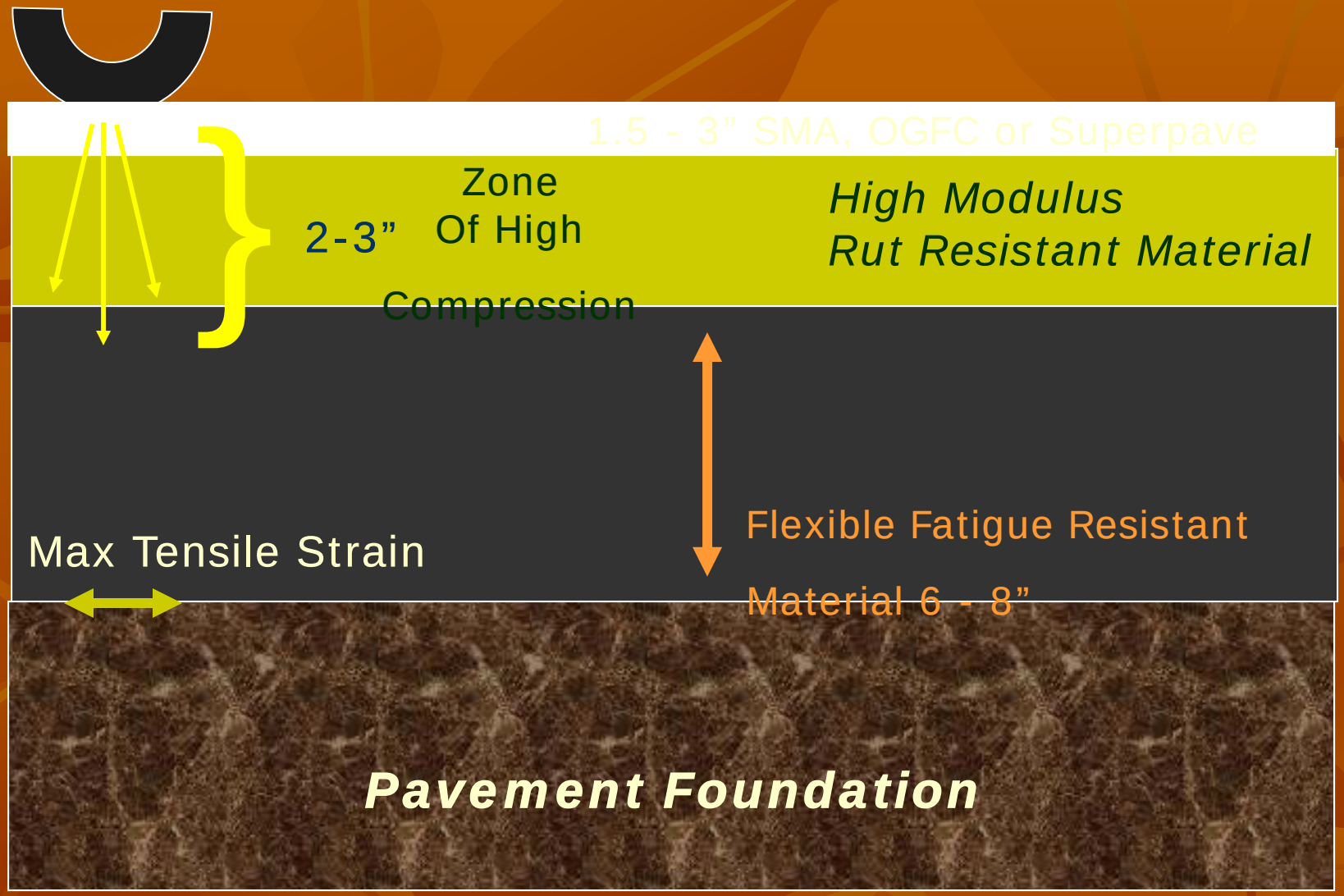
Mn/Road – I 94


MnROAD Facility
Workshop and Storage Building
Entrance
Pervious Parking Lot Cell 64
Pervious Sidewalk Cell 74
Research Operations Center
Parking Lot
Stockpile Area
Low Volume Road
Weather Station
Farm Loop
Cells 83 and 84
Weigh in Motion
Westbound I-94 (MnROAD Mainline)
Westbound I-94 (Bypass)
Eastbound I-94


MnROAD – Mainline
Westbound I-94
50 51 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
93 94 95 96 97 92
60 - 61 - 62 - 63
105 205 305 405
106 206
110 210 310 410
111 211 311 411 511 611
113 213 313 413
114 214 314 414
Westbound I-94 (Bypass)
Eastbound I-94

Base Stabilization Cells 2,3,4

CELL 2	50% RAP	6 inch Stab.	4% EE
CELL 3	75% RAP	6 inch Stab.	3% EE
CELL 4	100% RAP	8 inch Stab.	.075% EE
SHLD	50% RAP	4 inch Stab.	4.5% EE


1.5 - 3" SMA, OGFC or Superpave
Zone
2-3"
Of High
Compression
High Modulus
Rut Resistant Material
Max Tensile Strain
Flexible Fatigue Resistant
Material 6 - 8"
Pavement Foundation

KEY CONSIDERATIONS

- What are short and long term plans for road?
- What Roadway History information is available?
- Do I know the root cause of pavement issues?
- What options fit my desired result?
- What additional information do I need to evaluate my options?
- Where can I go for help?

Where can I go for help?

Asphalt Recycling and Reclaiming Association
ARRA – www.arra.org

Pavement Interactive Website - www.pavementinteractive.org

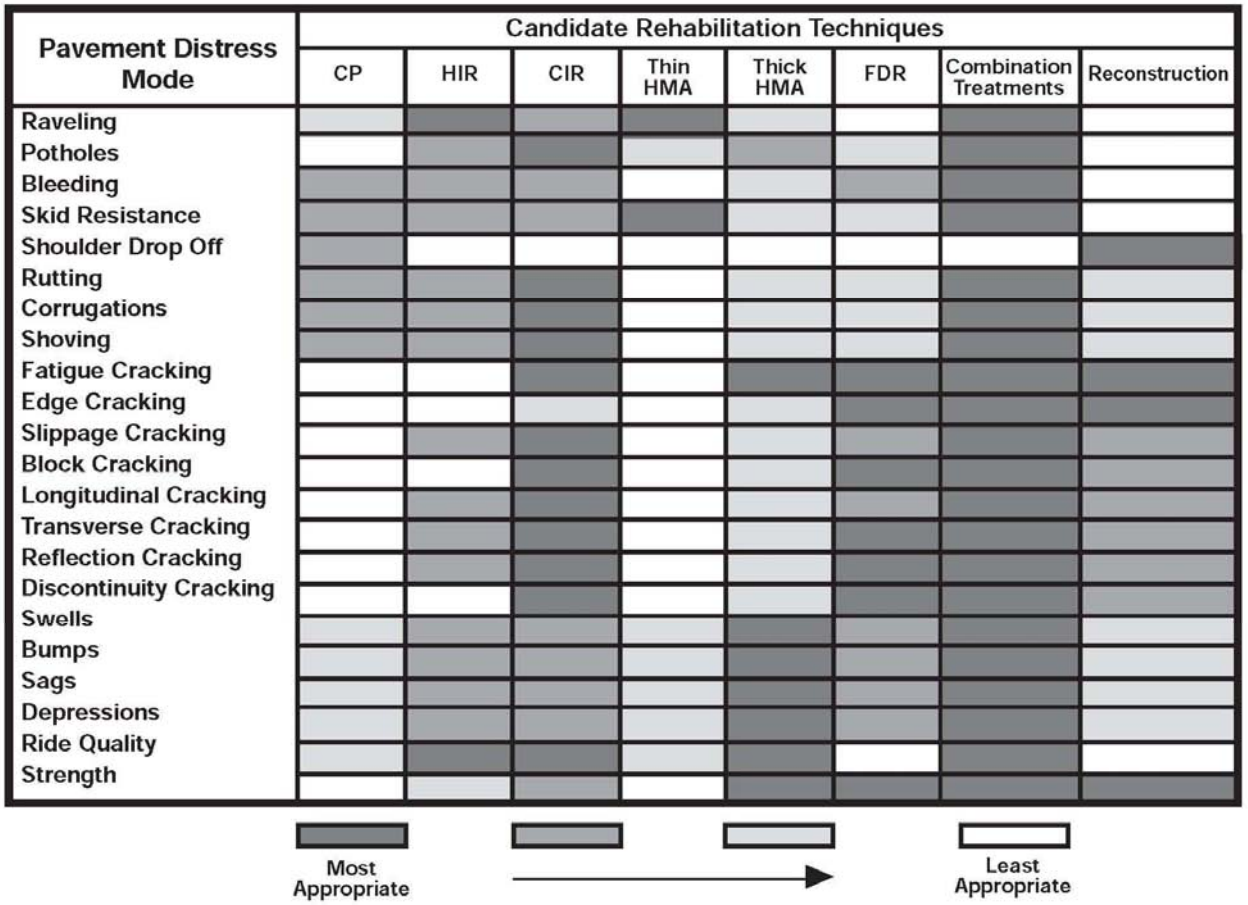
National Asphalt Pavement Association
NAPA – www.hotmix.org

National Center for Pavement Preservation
NCPP - www.pavementpreservation.org

Transportation Engineering and Road Research Alliance
TERRA – www.terraroadalliance.org

Federal Highway Administration
FHWA – www.fhwa.dot.gov/pavement

Rehabilitation Selection BARM



Pavement Assessment

Keys to Success

Determine the Root Cause

- Springtime (preferred) structural evaluation by agency or consulting engineer
  - Structure; layer evaluations
  - Drainage
  - Distresses
  - Road needs

Dynamic Cone Penetrometer (DCP)

Pavement and Material Assessment
Keys to Success

- Strength testing options to identify weak areas and determine subgrade strength/modulus:
  - Falling Weight Deflectometer (FWD)
  - California Bearing Ratio (CBR) or R-Value
  - Dynamic Cone Penetrometer (DCP)
  - Proof rolling (granular surfaces only)

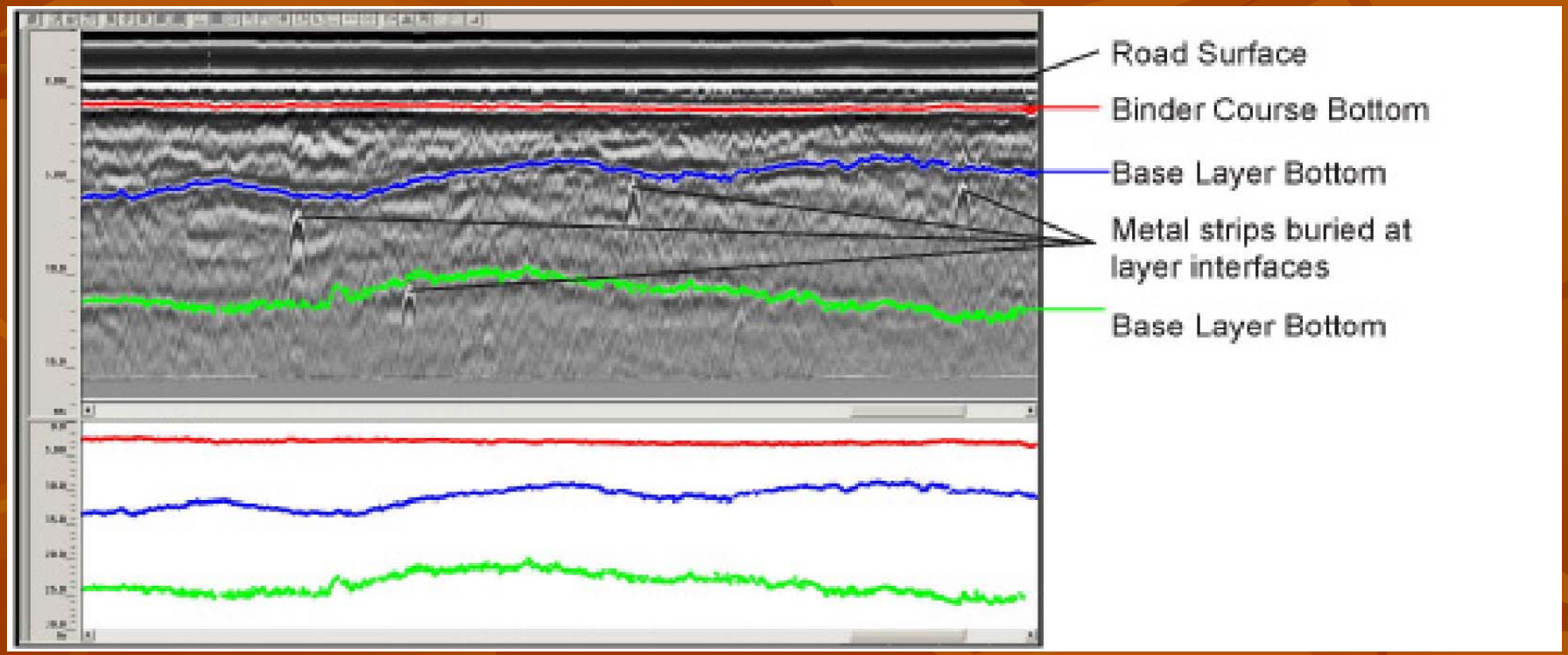
Pavement Assessment
Pavement Condition/Distress Survey

Pavement Condition Data
can be collected either **Manually**
or with **Automated** equipment.

Pavement Assessment
Pavement Strength Evaluation

- Ground Penetrating Radar (GPR) Data
  - Provides a “picture” of pavement structure
  - Used for FWD Analysis

Pavement Assessment
Pavement Strength Evaluation



Pavement Assessment
Surface, Base and Subgrade Analysis

- Coring
  - Determination of pavement thickness, layering, condition of each layer, bonding between layers, presence of materials related to distress and strength
- Soil Borings/GPR
  - Thickness, type or classification, moisture content, contamination, strength determination

Pavement and Materials Assessment Approximate Costs

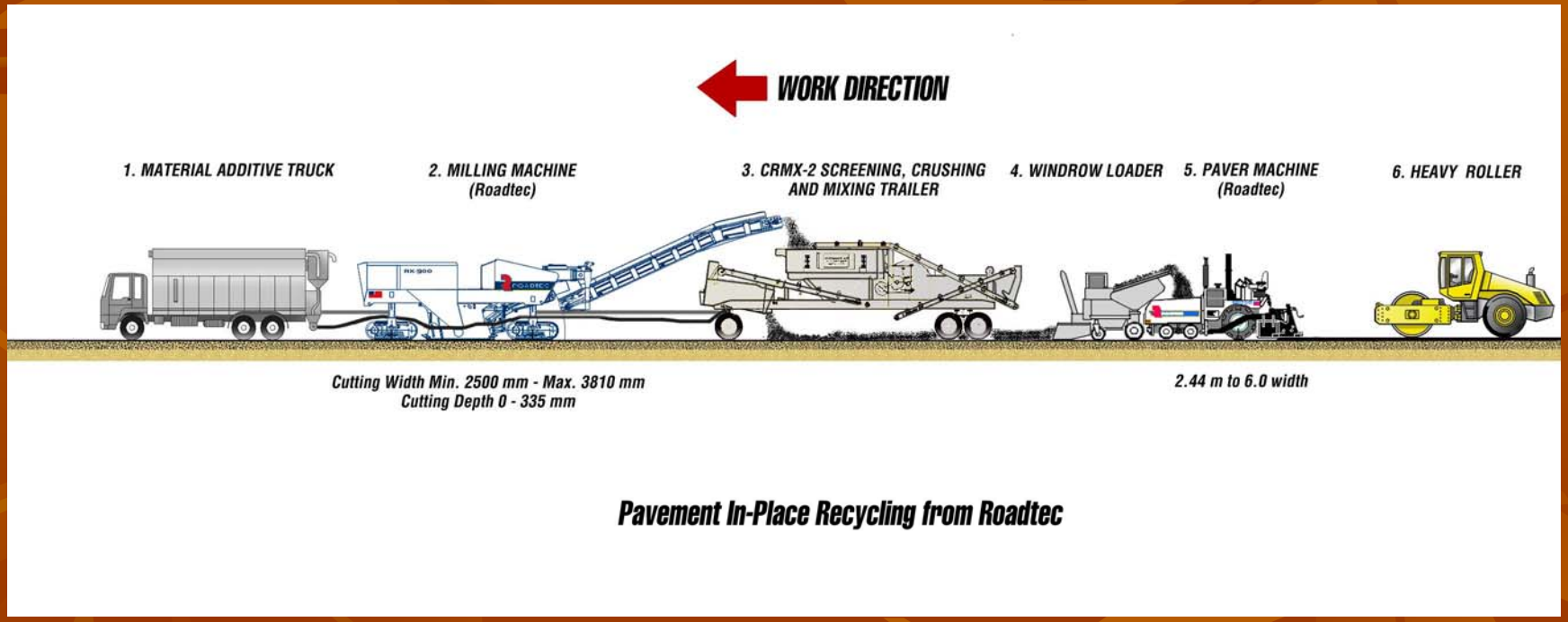
- Coring - $1,000 to $1,500 (per project < 2 miles)
- Soil / pavement borings ~$1,000 (per mile)
- FWD w/ analysis - $2,000 to $5,000 (per project < 2 miles)
- Sampling & subgrade testing - $2,500 (per project < 2 miles)
- DCP - equipment costs $1,500 (per project < 2 miles)

Costs will vary depending on many factors, especially mobilization and traffic control

REHAB SELECTION

- Review pavement history
  - Typical sections
  - Existing distress and root cause of the problem
- Identify Rehab Options
  - CIR
  - FDR
  - Material Considerations
- Select for Success (I have done my homework)

CIR (Train Method)



CIR (w/o Train)

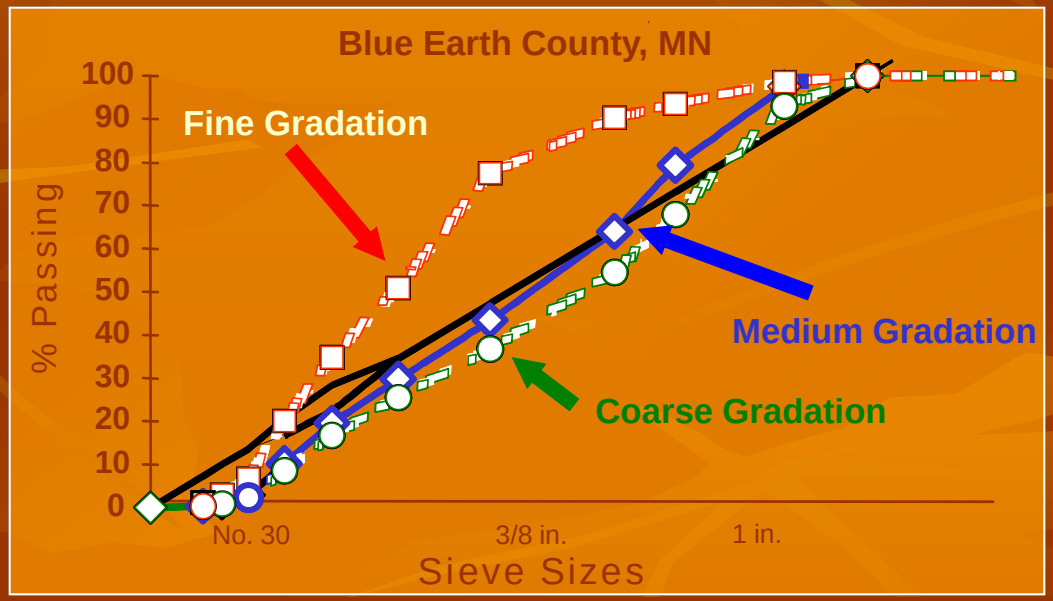
Cold In-place Recycling (CIR)
Fundamentals of CIR

- Conventional
  - No mix design
    - 2% Emulsion
  - QC requirements
    - Two gradations per day
    - 100% passing 1-1/2”
    - 90-100% passing 1”
    - Control strip
- Engineered
- Defined sampling protocol
  - Engineered design
  - Performance-related specs
  - Early strength & long term durability

Cold In-place Recycling (CIR) Mix Design

RAP/Base Analysis

- Foamed Asphalt, Engineered Emulsion and Fly Ash
  - Field cores crushed to 3 gradation bands
  - A design made for at least 2 gradations



Cold In-place Recycling (CIR)
Engineered CIR

Less Raveling – Lab & Field

Conventional CIR
25.7% mass loss

Raveling in the field

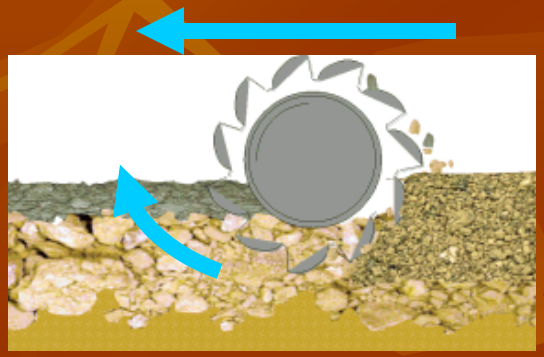
Engineered CIR
1.6% loss

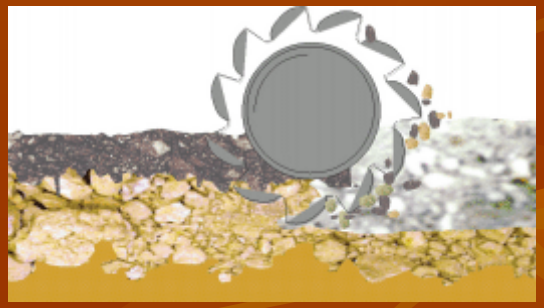
Samples & field photos from
CSAH No. 20,
Blue Earth County, MN

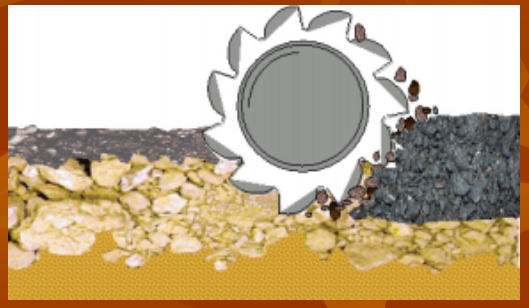
Full Depth Reclamation (FDR)

Full Depth Reclamation (FDR)
Types of FDR

- **Mechanical stabilization** - FDR without addition of binder (Pulverization)
- **Chemical stabilization** - FDR with chemical additive (Calcium or Magnesium Chloride, Lime, Fly Ash, Kiln Dust, Portland Cement, etc.)
- **Bituminous stabilization** - FDR with asphalt emulsion, emulsified recycling agent, or foamed/expanded asphalt additive

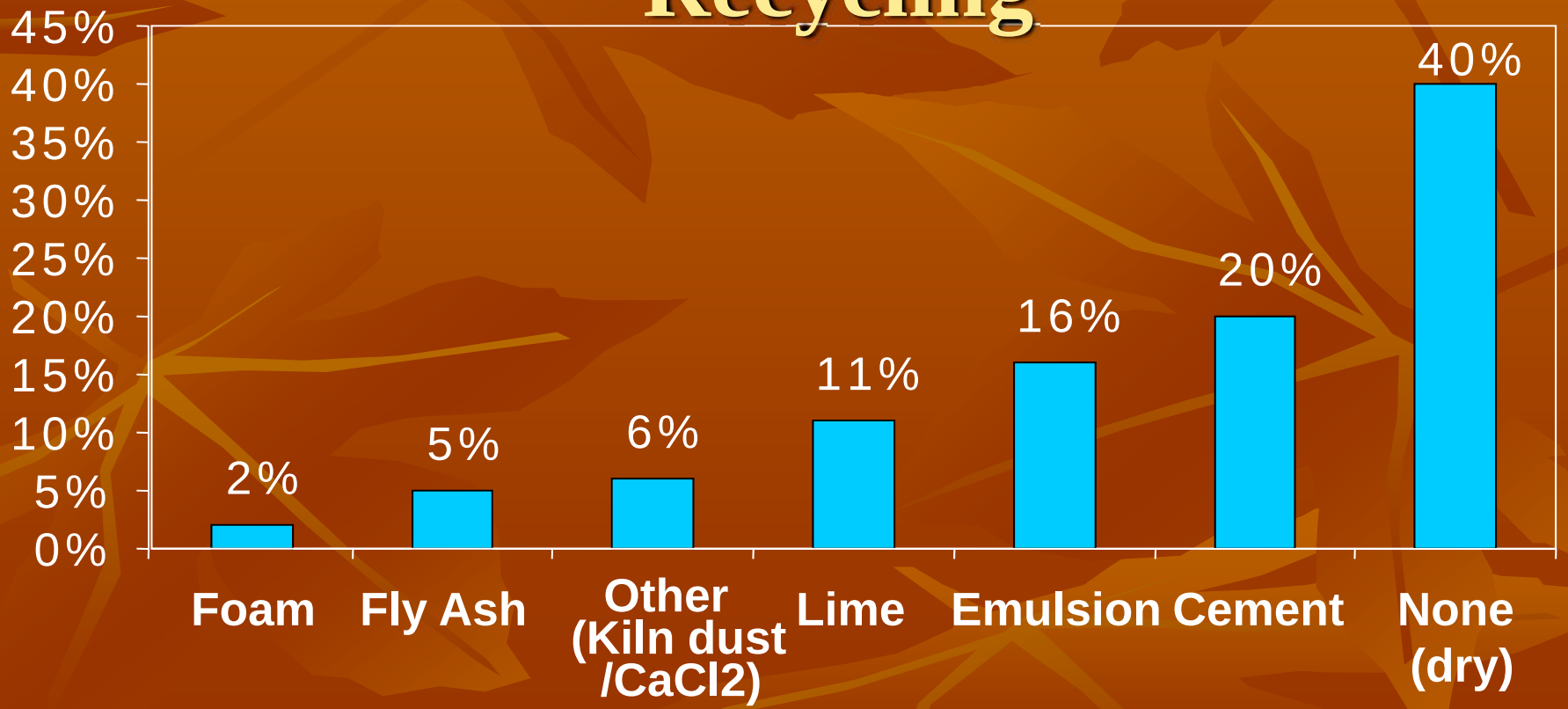






Full Depth Reclamation (FDR)

Types of FDR Additives Used in Recycling



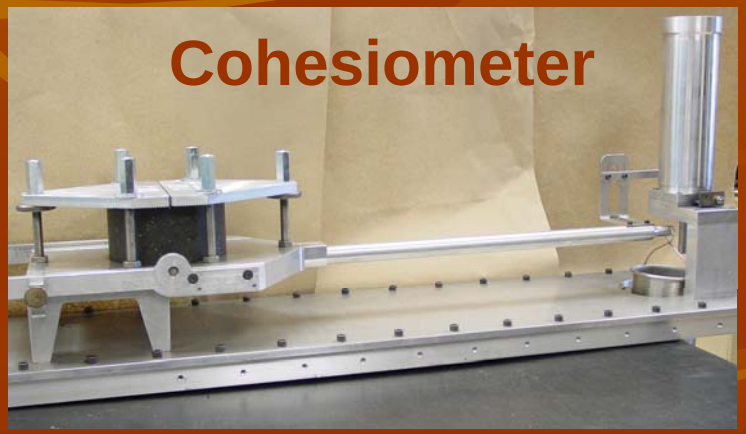
Full Depth Reclamation (FDR)
Keys to Success

- Pavement & material assessment
- Engineered mix design
  - Choose correct additive for the application
- Performance-related specifications
- Construction guidelines & QC specs

Full Depth Reclamation (FDR)
Keys to Success

Engineered Mix Design

Superpave Gyratory Compactor



Cohesiometer

Lab Mixer

Full Depth Reclamation (FDR)
Keys to Success

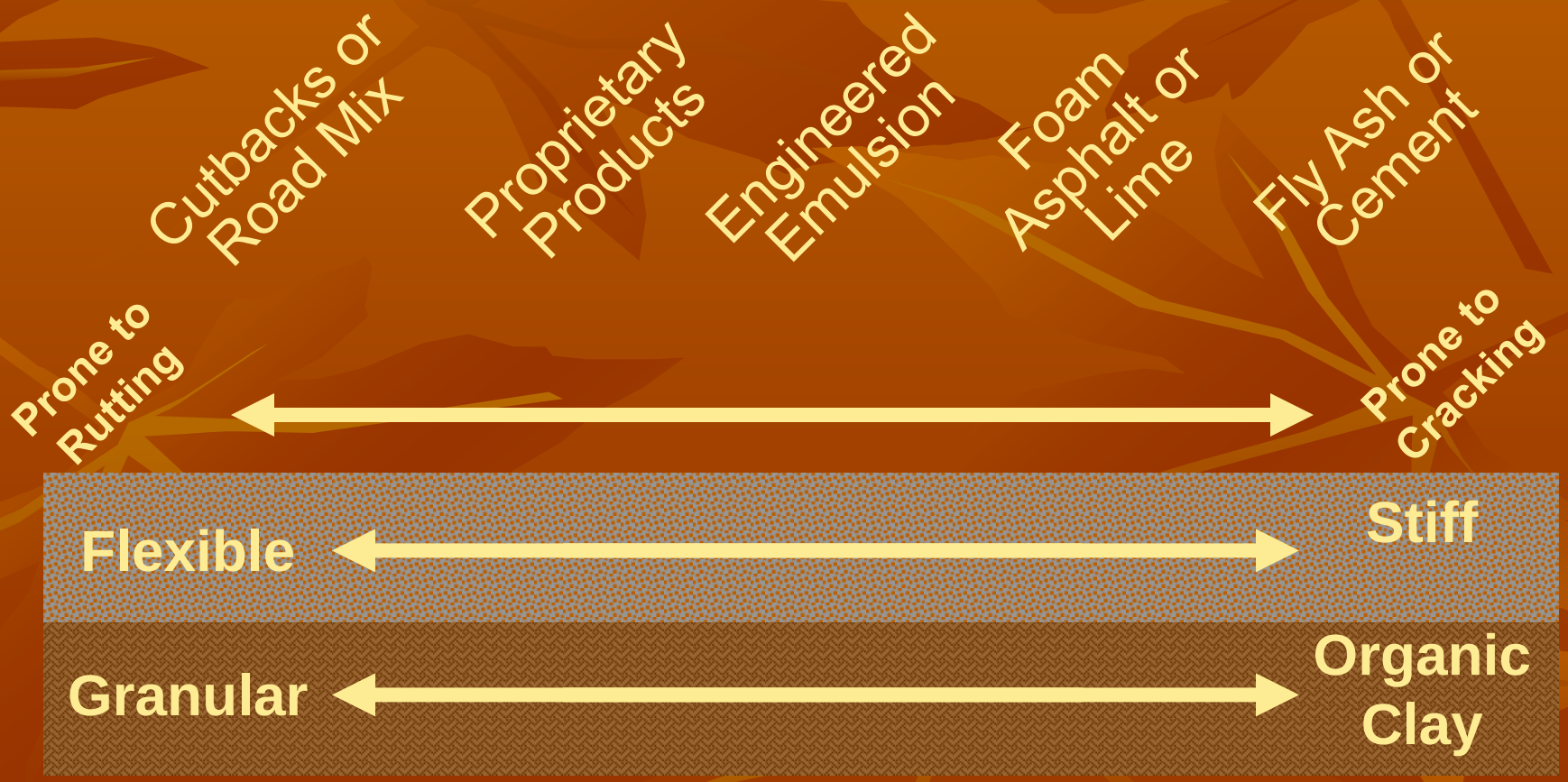
Engineered Mix Design

- Virgin aggregate or RAP may be needed
  - To increase depth of finished structural layer
  - To improve gradation
    - Cleanliness (P200)
    - Material quality
    - Grading

Full Depth Reclamation (FDR)

Keys to Success

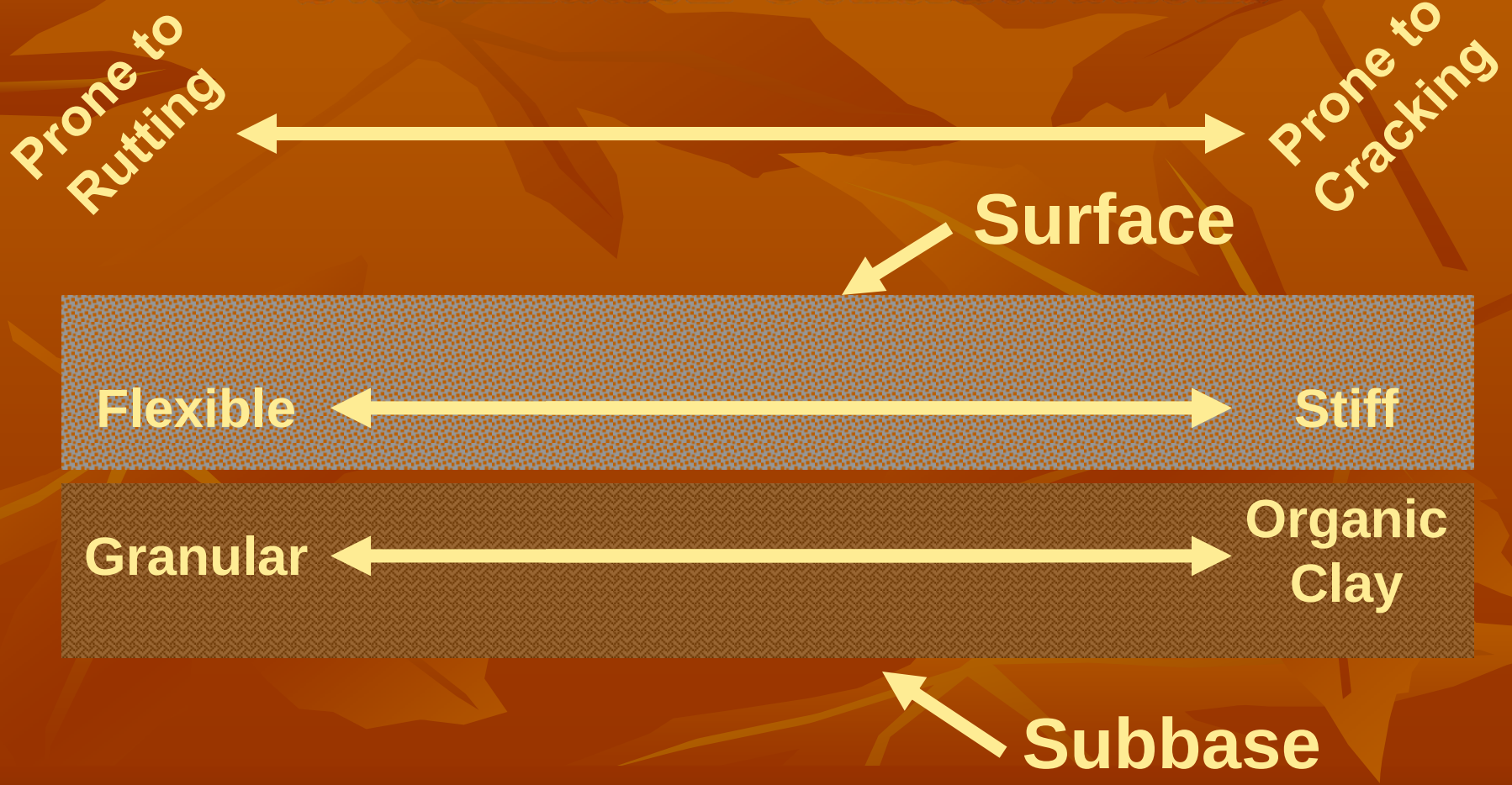
Stabilization Considerations



Full Depth Reclamation (FDR)

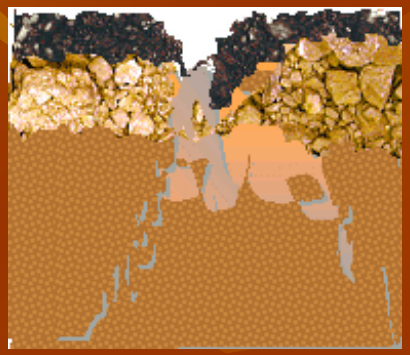
Keys to Success

Stabilization Considerations



Full Depth Reclamation (FDR)
What is FDR?

Bituminous pavement needing repair



FDR Example

- Overlay
- 6-10 inches stabilized material
- Granular base
- Soil

Full Depth Reclamation (FDR)
Keys to Success

Construction and Quality Control

- Corrective actions
  - Sub-cut & replace weak spots
  - Fix drainage
  - Fix thickness deficiency
    - Add rock
  - Widen
    - Cut out soil

Full Depth Reclamation (FDR)
Keys to Success

Construction and Quality Control

- Equipment
  - Reclaimer
  - Padfoot compactor
  - Motor grader
  - Water truck
  - Finishing Rollers

3 C's to evaluate new technology

- Constructability
- Cost
- Credibility

Constructability

- About the same as HMA but you need to manage the weather

Cost

- About the same as HMA but you need to manage the market
  - Managing the market is much easier than the weather

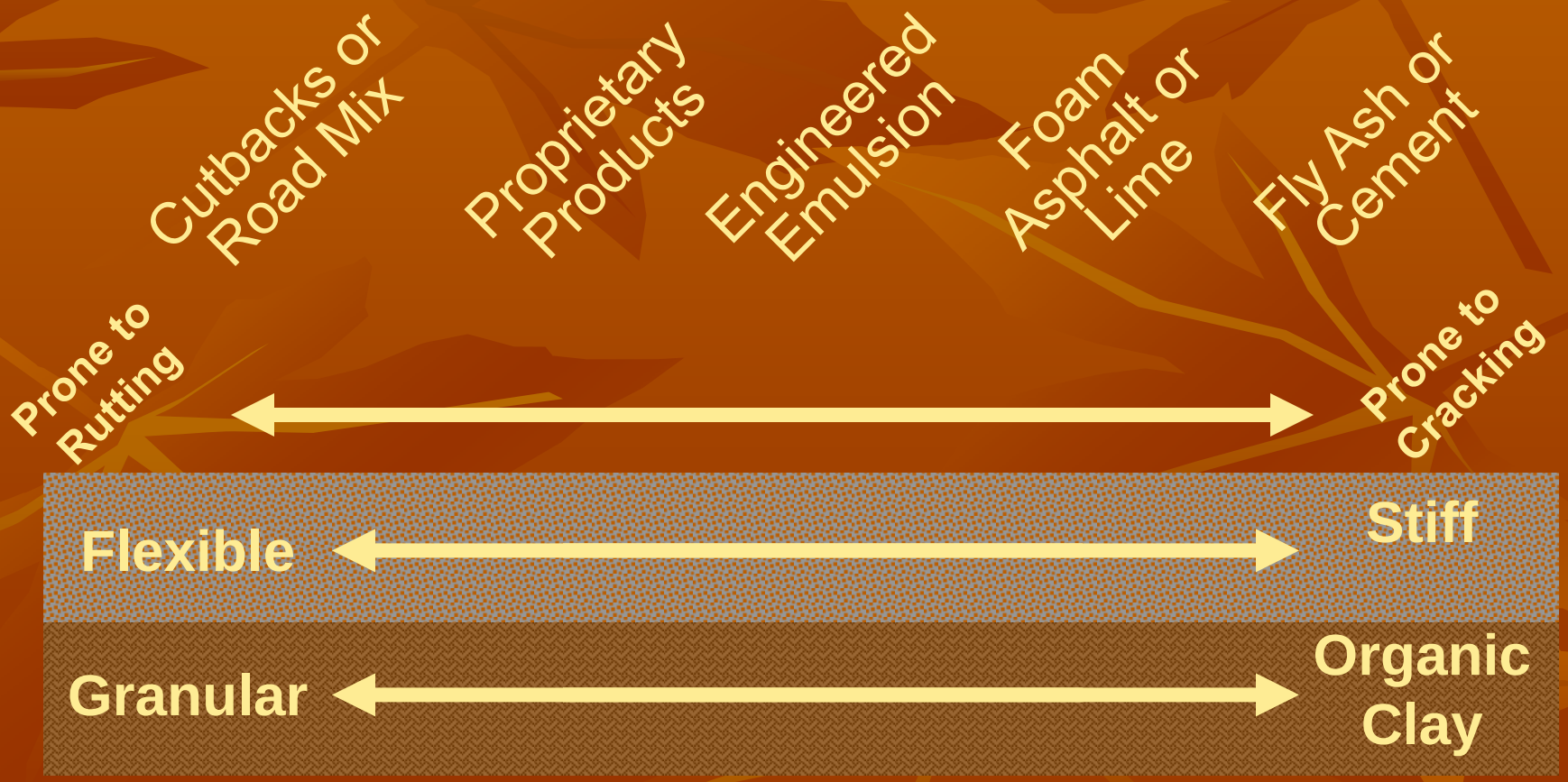
Credibility

- Engineered Emulsion is a product I will always endorse but you need to manage the process.
  - Process is very easy to manage but you need to have credibility which only comes with success

Full Depth Reclamation (FDR)

Keys to Success

Stabilization Considerations



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Thank you.

Questions?