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Reclamation Research at VDOT

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Overview

- Agency methods to begin using FDR
  - Specifications
  - Guidelines
- Research to extend use of FDR
  - Long-term performance monitoring
  - Instrumented pavements
  - Laboratory testing

Pavement Recycling

- A set of cost-effective and environmentally sensitive techniques for pavement rehab
- Benefits
  - 30 to 50 percent cost savings
  - 50 percent less greenhouse gases emitted
  - Fix deterioration causes rather than symptoms
- Used by VDOT
  - Full-depth reclamation, cold in-place recycling, cold central-plant recycling

Full-Depth Reclamation

- Mechanical stabilization
  - Additional aggregate or RAP
- Asphalt stabilization
  - Foamed asphalt
  - Emulsified asphalt
- Chemical stabilization
  - Cement
  - Lime
  - Fly ash (type C or F)
  - Cement / lime kiln dust

VDOT Pavement Recycling History

- Pre-2008
  - Regional focus, no monitoring
- 2008-2011
  - 8 projects, 2-year FDR study
  - I-81 project
  - NCAT test sections constructed
- 2012-today
  - Specs and usage guidelines
  - NCAT test sections continuation

Agency Methods to Begin Using FDR

- Specifications
- Guidelines

Specifications

- Experience requirement
- Quality control plan
  - Corrective action list
- Acceptance requirements
  - Field density
  - Stability / indirect tensile / compressive strength
  - Gradation
  - Depth
  - Stabilizing agent dosage

Specifications

- Mix design
- Recycling equipment
  - Roller weights, etc.
- Test strip construction
- Weather limitations

Guidelines

- Length of project
- Distress rating
- Maintenance history
- Overlay thickness requirements
  - Generally meet SN calculations
  - 2-course overlay on interstate
  - May specify thickness for given traffic levels
- Directives / carrots
  - First consideration for greater than 4 inches?
  - Dedicated pot of funding

FDR Research

- I-81
- NCAT
- NCHRP 9-51

I-81

- 23,000 AADT
- 28% trucks
- 7.2 lane miles
- Constructed 2011

I-81

4-inch New AC	6-inch New AC
8-inch CCPR	6-inch CCPR
12-inch FDR	
Subgrade	

Right Lane

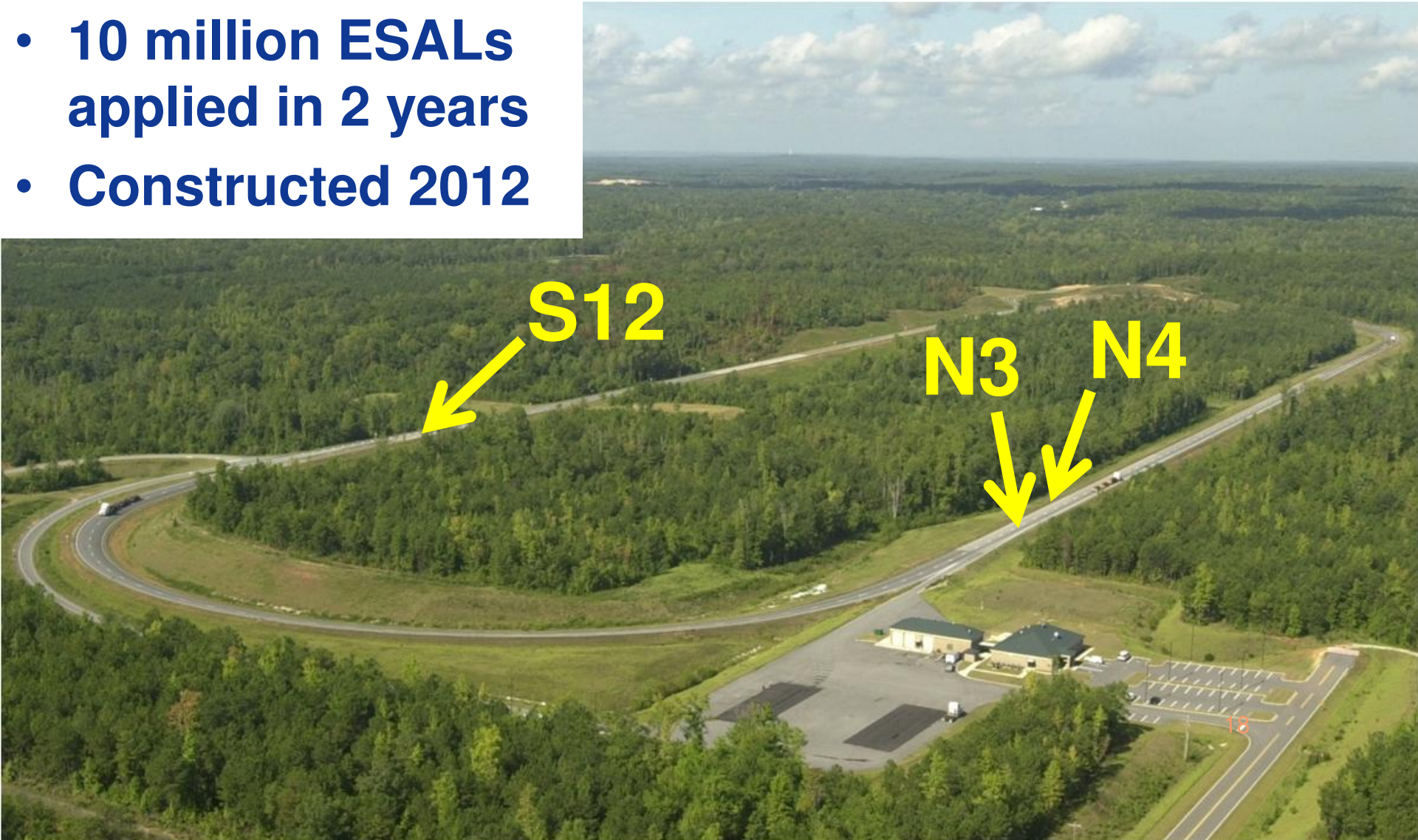

WR 2400
WATER TRUCK
NON
POTABLE
WATER
217
5

What We Learned From I-81

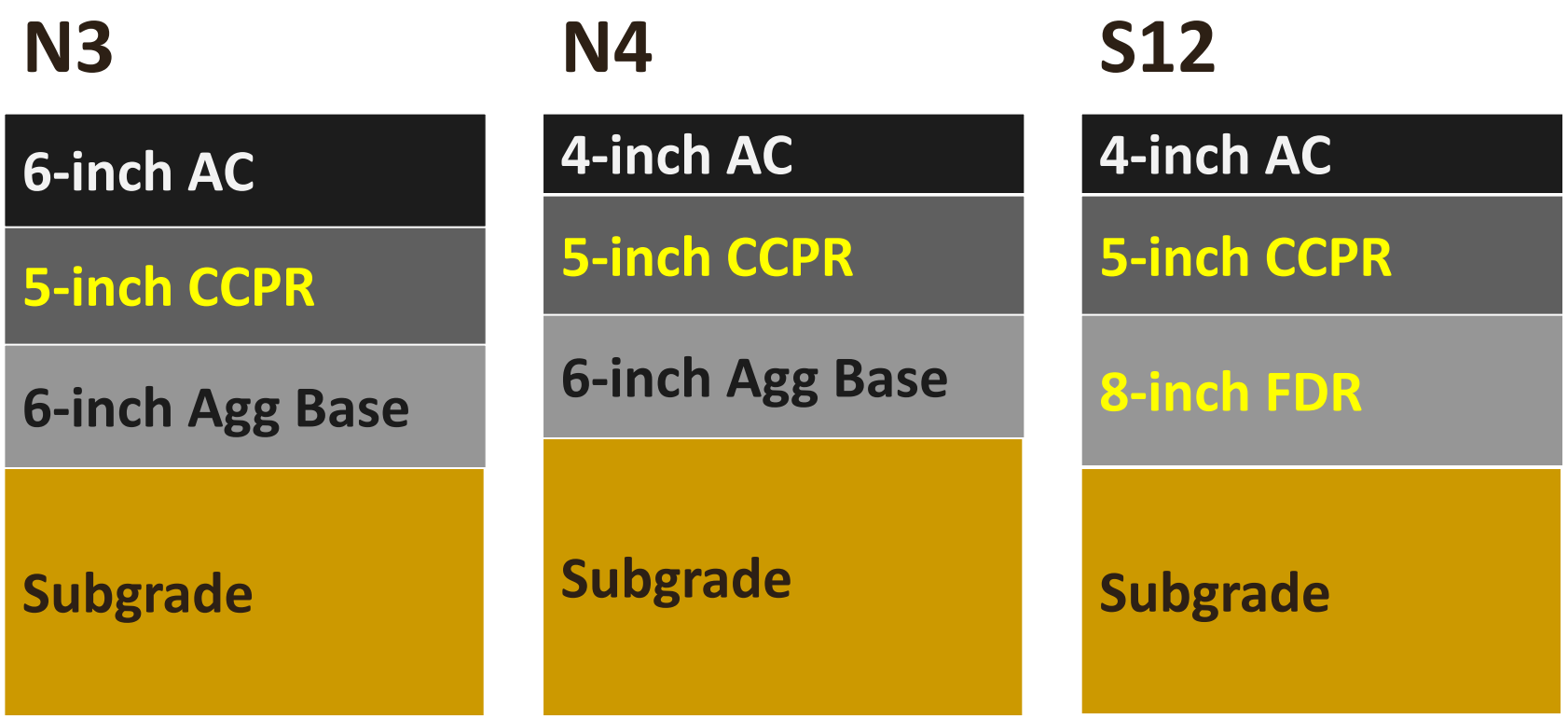
- Recycling performs well on a high volume road
- Service is excellent after 3+ years
  - Nearly 8 million ESALs
  - Rutting less than 0.1 inches
  - Ride quality range = 45-55 inches/mile
- Layer coefficients from this project (lab & field)
  - FDR + CCPR ~ 0.37
  - CCPR range = 0.36 to 0.44
  - CIR range = 0.35 to 0.39

NCAT Recycled Sections

- 10 million ESALs applied in 2 years
- Constructed 2012

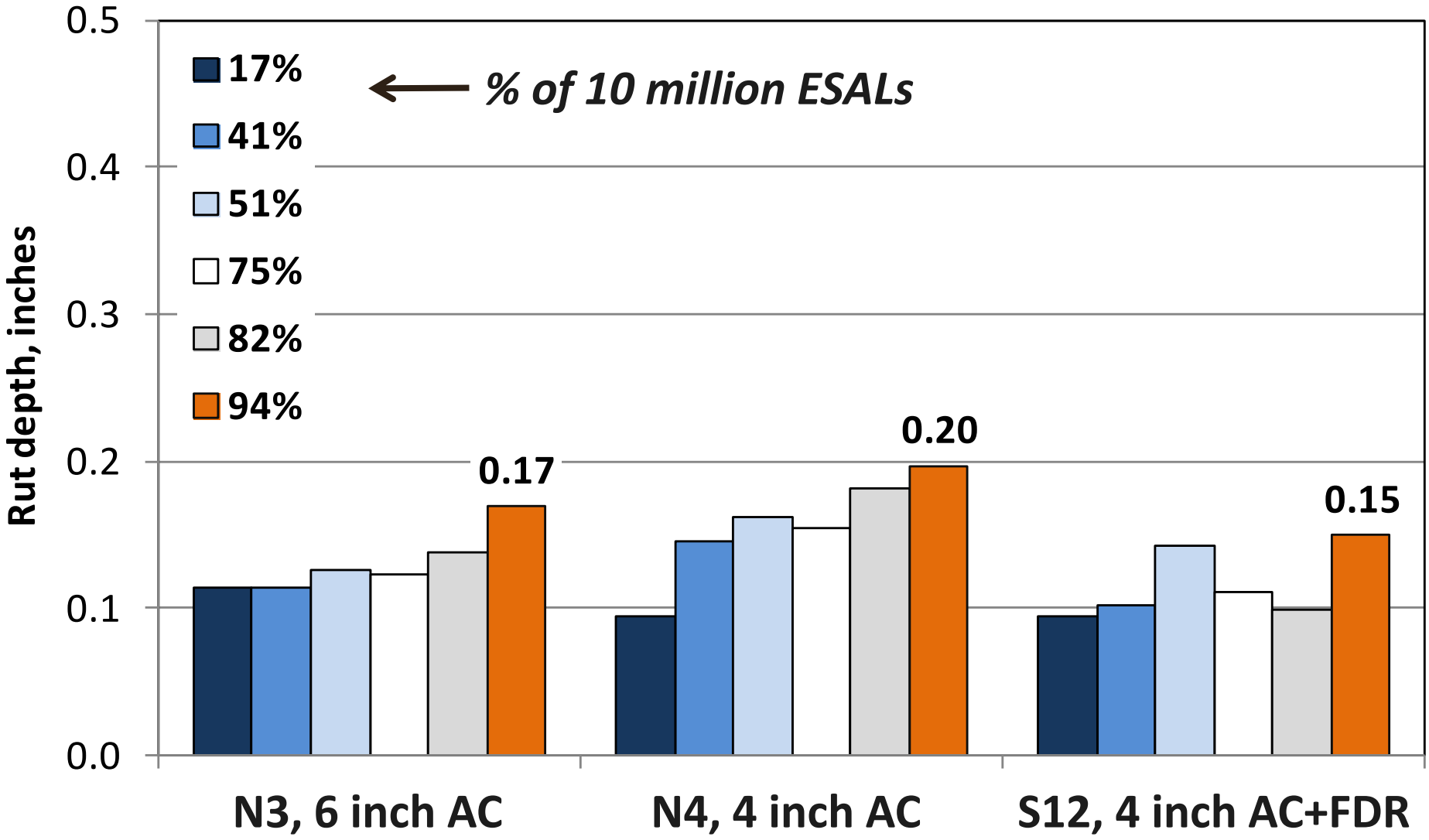


NCAT Recycled Sections

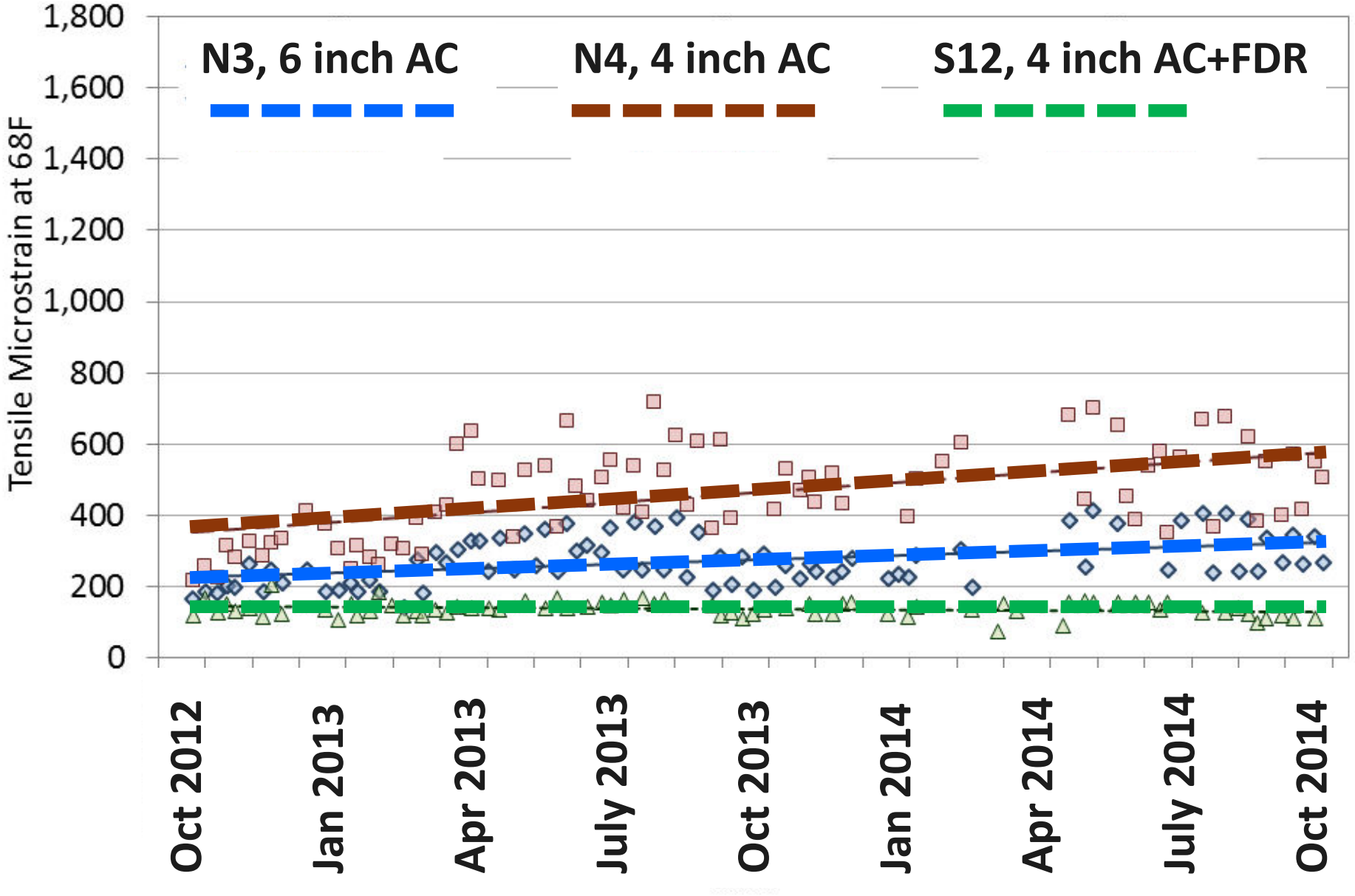



WR 2000
Wirtgen

Rutting


0.5
0.4
0.3
0.2
0.1
0.0
Rut depth, inches
17%
41%
51%
75%
82%
94%
% of 10 million ESALs
0.17
0.20
0.15
N3, 6 inch AC
N4, 4 inch AC
S12, 4 inch AC+FDR

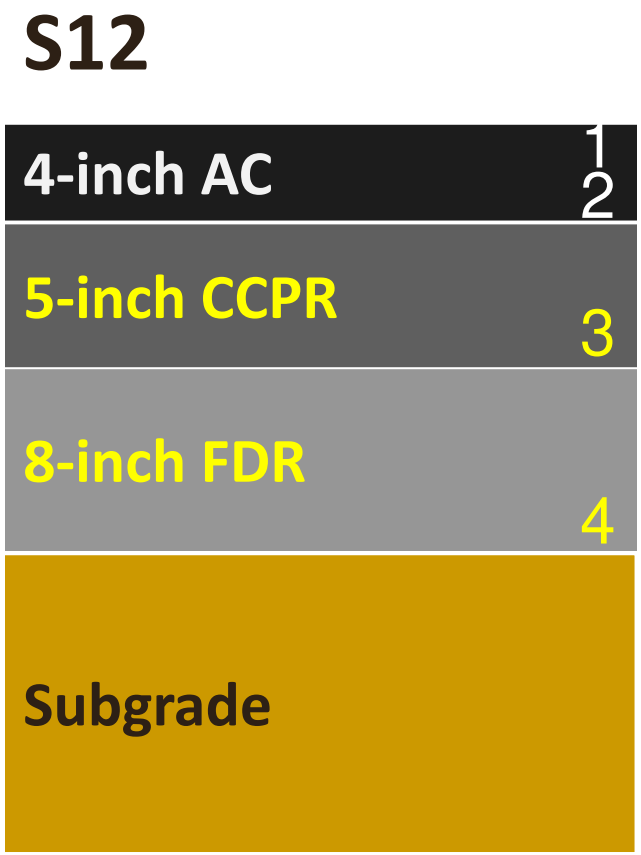
Tensile Strain Beneath CCPR Layer at 68F



What We Learned From NCAT

- Recycling performs well on a high volume road
- No cracking at 10 million ESALs
- Ride quality steady
- Rutting not significant (< 0.25 inch)
- Is FDR section perpetual?
  - Presence of stabilized base reduced strain by 80% for same overlay thickness
  - Does a recycled layer behave the same as an AC material in terms of fatigue?

NCAT Recycled Content

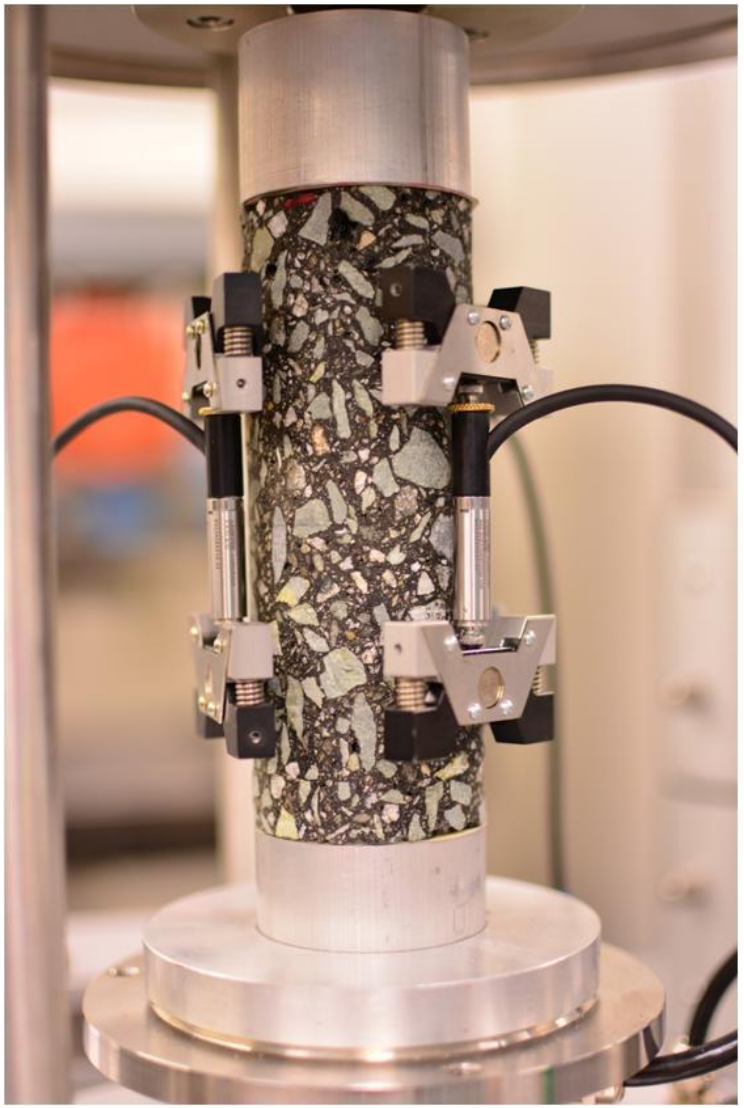


- 17 inches manipulated
  - Layer 1 = 12.5% recycled
  - Layer 2 = 30% recycled
  - Layer 3 = 100% recycled
  - Layer 4 = 100% recycled
- Entire cross section
  - 81% recycled

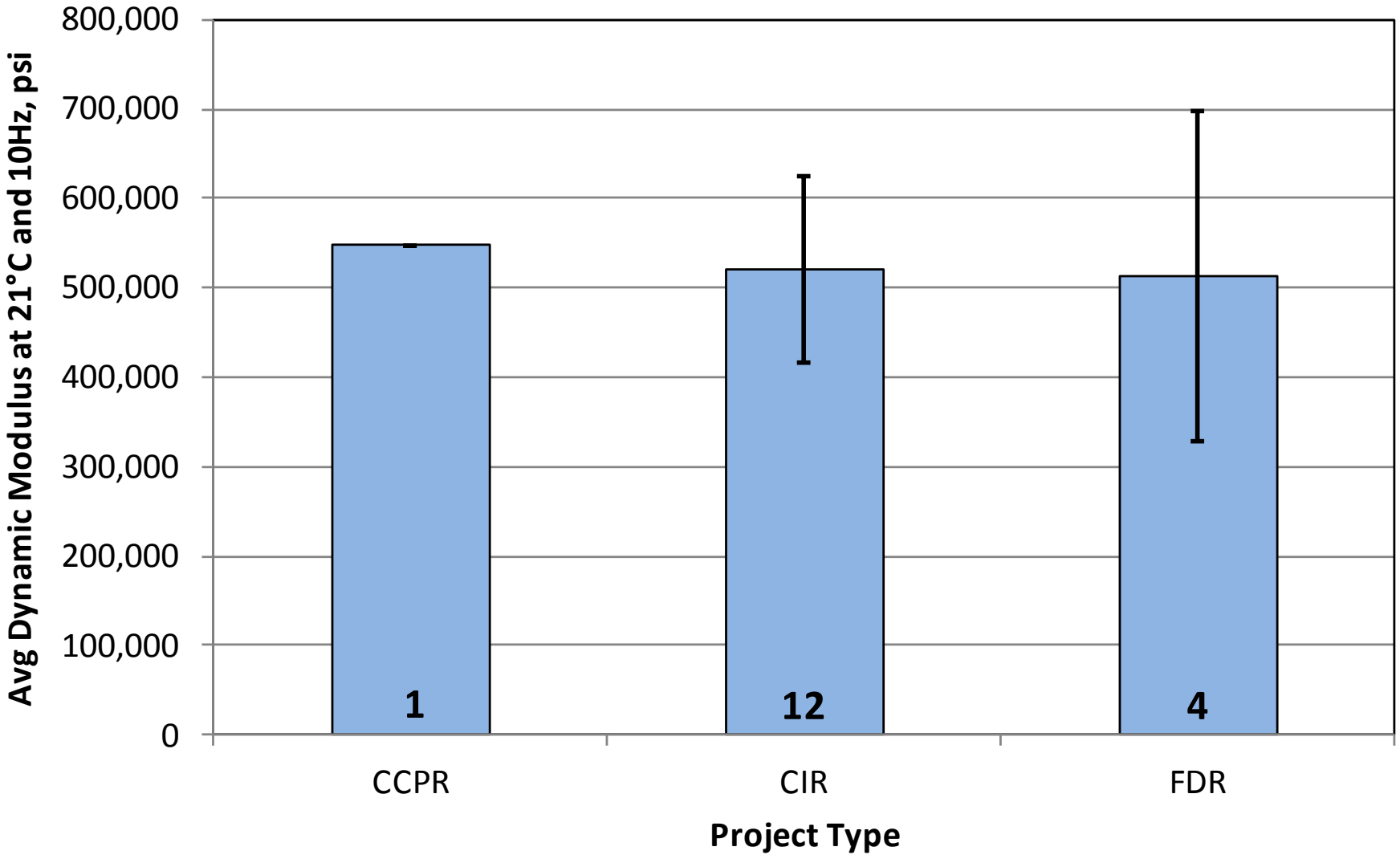
NCHRP 9-51

- ***Material Properties of CIR and FDR for Pavement Design***
- **Partners**
  - **University of MD, VDOT, Colas Solutions, Wirtgen**
- **Project locations (23)**
  - **California, Colorado, Delaware, Edmonton, Georgia, Illinois, Kansas, Maine, New York, Ontario, Utah, Washington, West Virginia**


NEXEL



Example Results



Lessons Learned

- **Recycling performs well on a high volume road**
- **FDR is providing a significant stiffening effect at the NCAT track**
  - **Difference in long-term performance?**
    - If what we know about asphalt pavements is transferable, “yes”
- **The more you know, the more you know you don’t know. You know?**

Future Needs

- **Design**
  - **Representative layer stiffness for AASHTO M-E design (*see 9-51 study*)**
    - Additives, gradation, source materials, etc.
- **Performance**
  - **Deterioration prediction models**
  - **Failure mechanisms**
  - **Performance with thinner overlays / surface treatments**

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Thank you!

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