Virginia Center *for* Transportation
INNOVATION & RESEARCH

We bring innovation to transportation.

VDOT Experiences with Cold Recycling

- I-81 In-Place Pavement Recycling Project Update

Northeast Pavement Preservation Partnership

April 30, 2013

Brian Diefenderfer, Ph.D., P.E.

In-Place Pavement Recycling

- **Reuses existing materials**
  - **Incorporates a stabilizing additive**
    - Foamed asphalt, asphalt emulsion, hydraulic cement, lime

- **Hot in-place recycling (HIR)**
- **Cold recycling**
  - **Cold in-place recycling (CIR)**
  - **Cold central/mobile plant (CCPR)**
- **Full-depth reclamation (FDR)**

increasing depth and level of deterioration

Why We Should Recycle our Pavements

- **Economic**
  - **Nevada DOT saved $600 million over 20 years**
  - **Other studies show 30-50 percent cost savings**
- **Environment**
  - **MTO (Ontario) estimated CIR process emits 50 percent less greenhouse gases**
- **Construction**
  - **Fix deterioration causes rather than symptoms**
- **FHWA recycled materials policy***

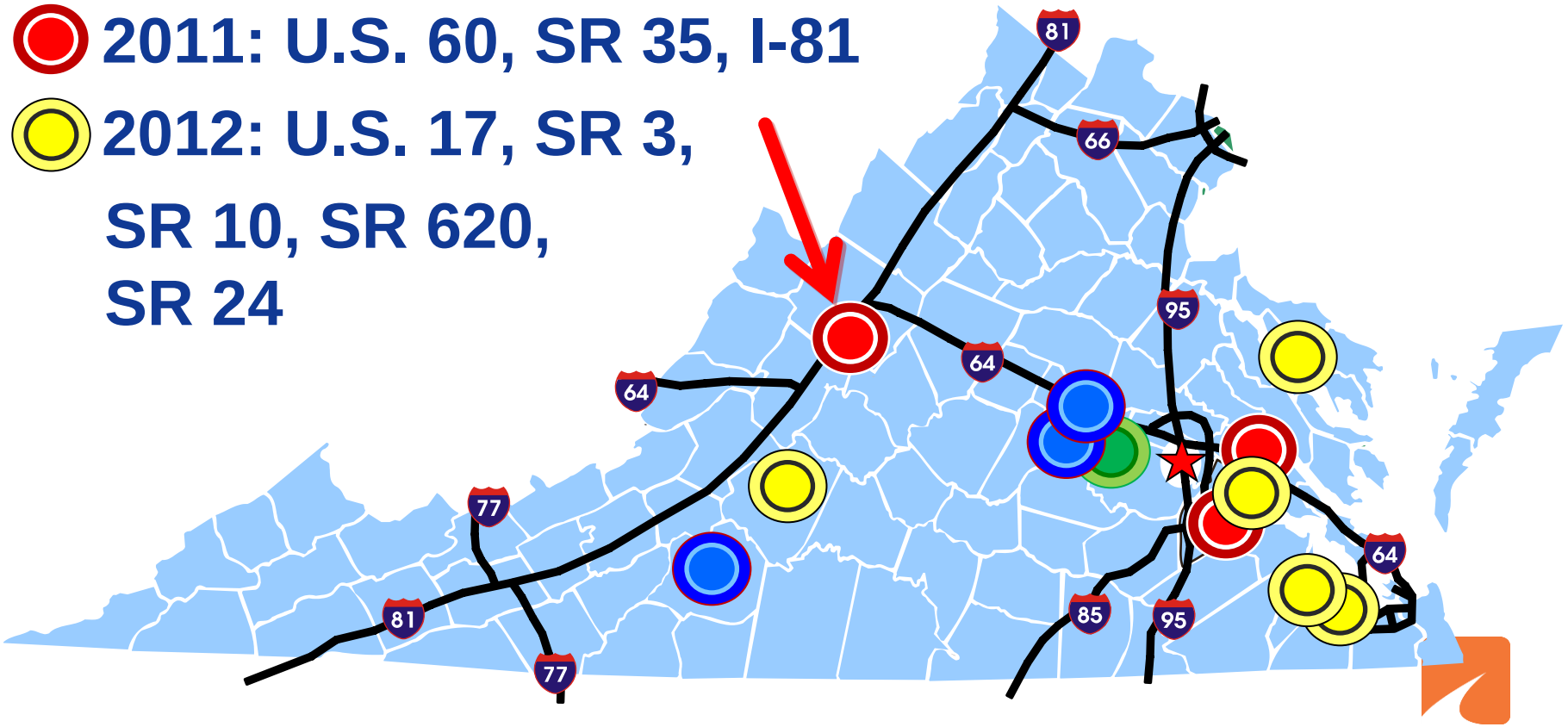
*http://www.fhwa.dot.gov/legsregs/directives/policy/recmatpolicy.htm

VDOT Recycling Program

- 12 projects to date, approx. 75 lane miles
- Specifications and usage guidelines
  - Recently completed and Fed approved
  - Iterative process
- Research
  - Field and lab tests to assess performance
  - Documenting agency experiences

VDOT Recycling Projects

- 2008: SR 6, 13, 40
- 2010: U.S. 60
- 2011: U.S. 60, SR 35, I-81
- 2012: U.S. 17, SR 3, SR 10, SR 620, SR 24

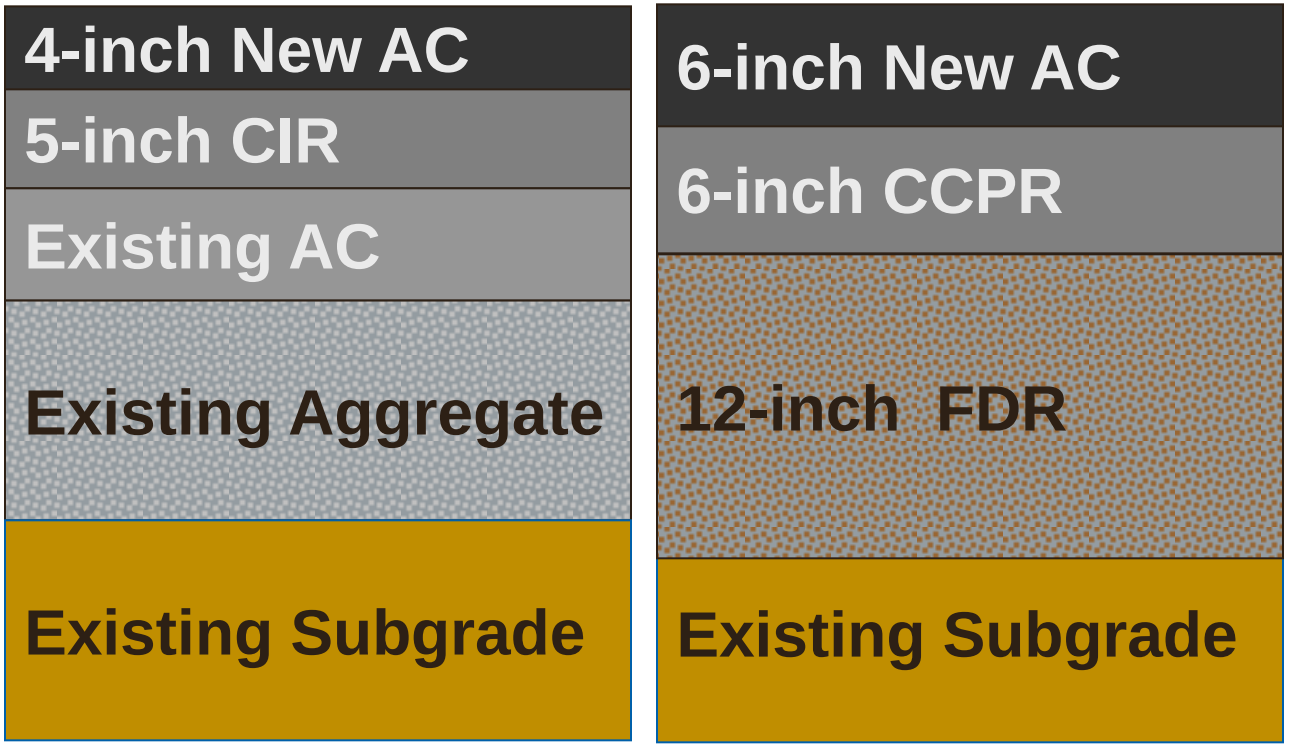


I-81 In-Place Pavement Recycling Project

- AADT = 23,000 (28 percent trucks)
- 7.2 lane miles
- $7.6 million
  - $10.1 M
- April-Sept ’11
- 20 days

I-81 After Construction

Original structure = 12 inches asphalt concrete over 10-12 inches aggregate base



Left Lane

Right Lane

I-81 Construction Sequence

- **Right lane, 5 day closure window**
  - **Milling, FDR, CCPR, 4” AC overlay on 1800-2500 foot segment per window**
  - **Next segment was worked the following closure window**
  - **Work completed in 4 closure windows**
- **Left lane, 3 day closure window**
  - **Milling, CIR, 2” AC overlay for 3.6 miles completed within one closure window**

Lane Closure

Full-Depth Reclamation

Cold Central-Plant Recycling

2% foamed asphalt
1% cement

Courtesy of Wirtgen

CCPR Paving

Cold In-Place Recycling

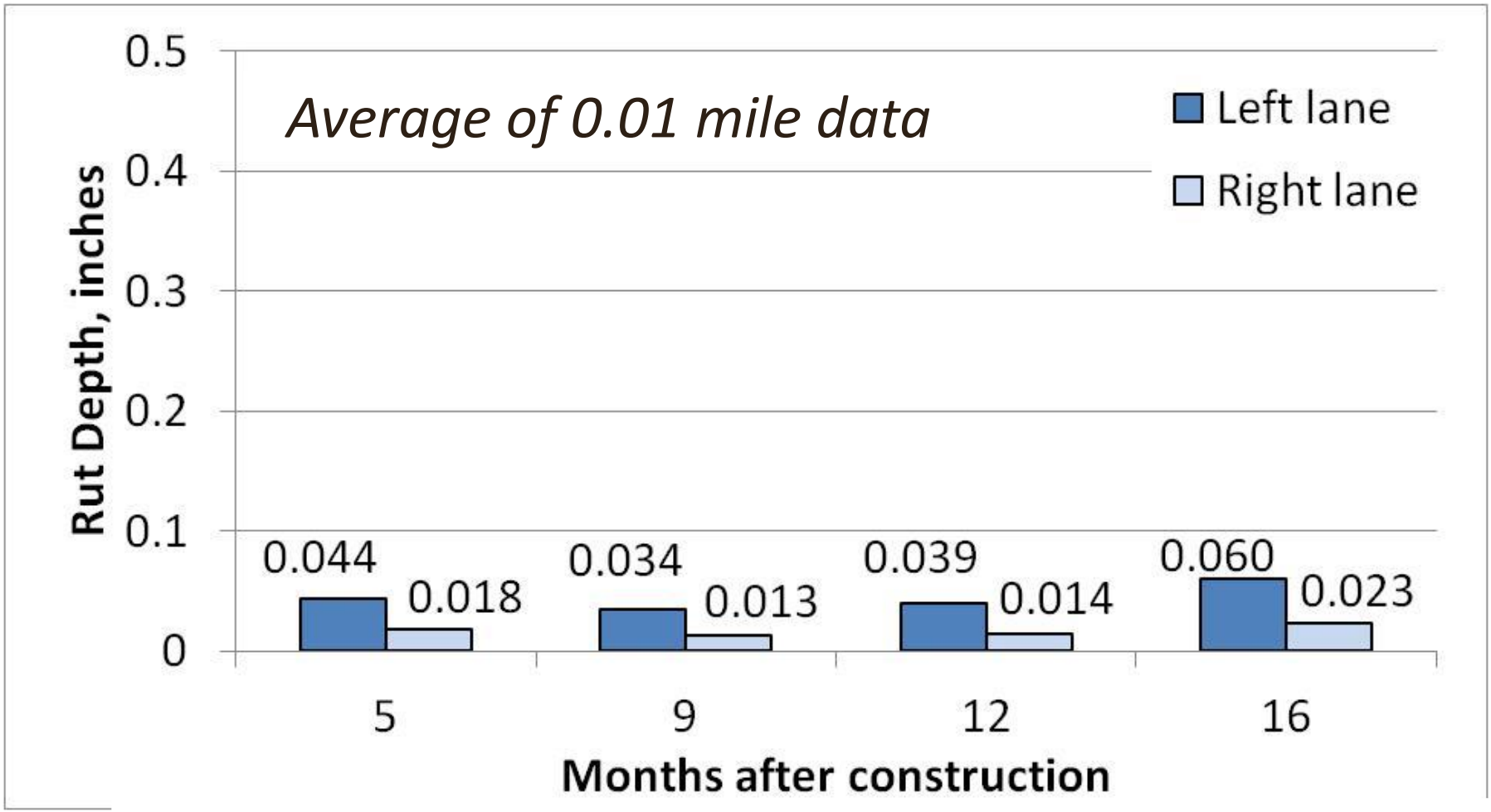
I-81 Project Assessment

- **Lab testing (cores)**
  - **Dynamic modulus**
    - Stiffness input to MEPDG (Pavement-ME)
  - **Repeated load permanent deformation**
    - Rutting susceptibility

- **Field testing**
  - **Rut depth**
  - **Ride quality**
  - **FWD**

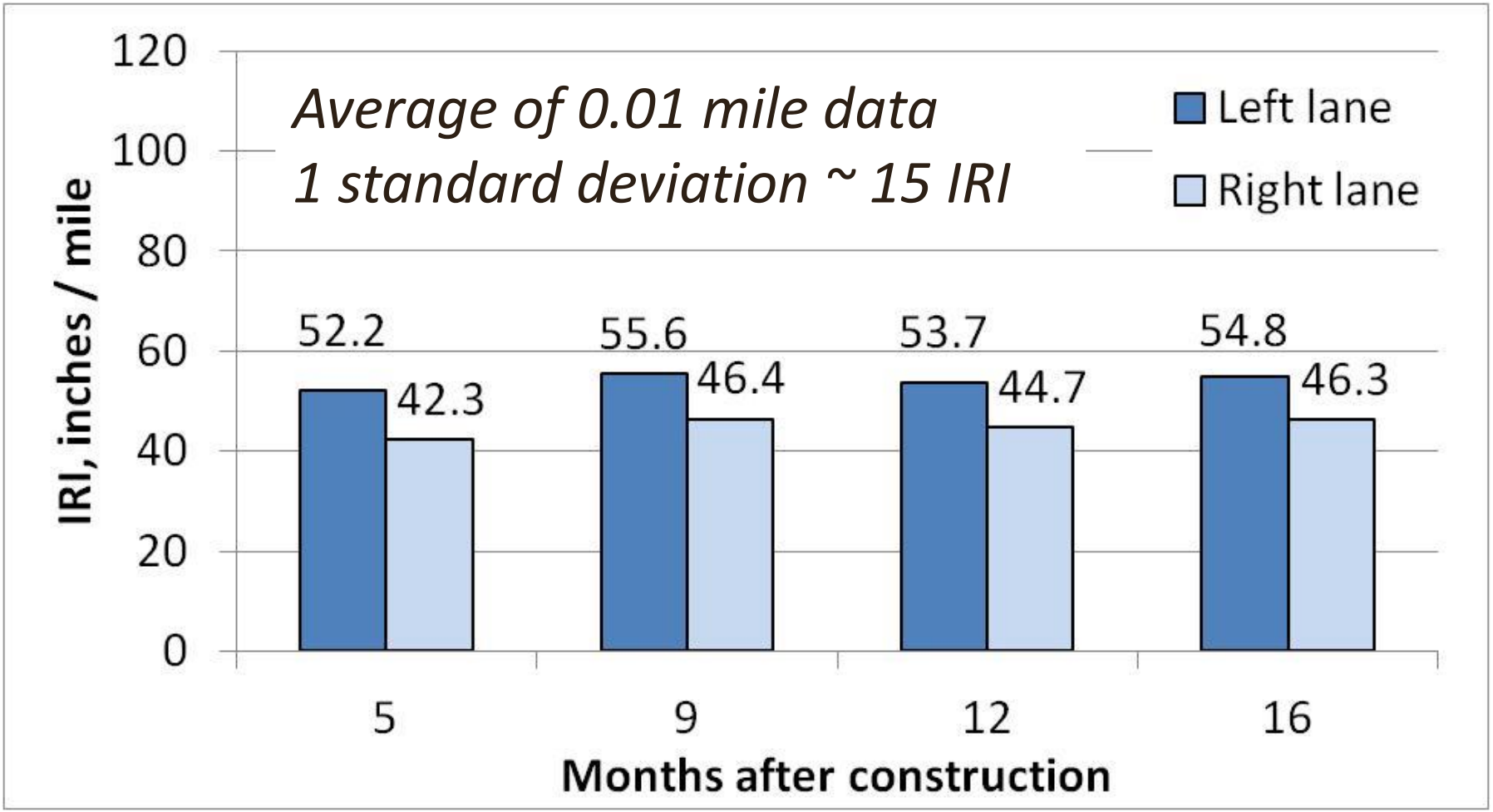
Core Sampling

Rut Depth



Assuming 90% of trucks in the right lane, about 2.8 million ESALs at 16 months

Ride Quality



FWD

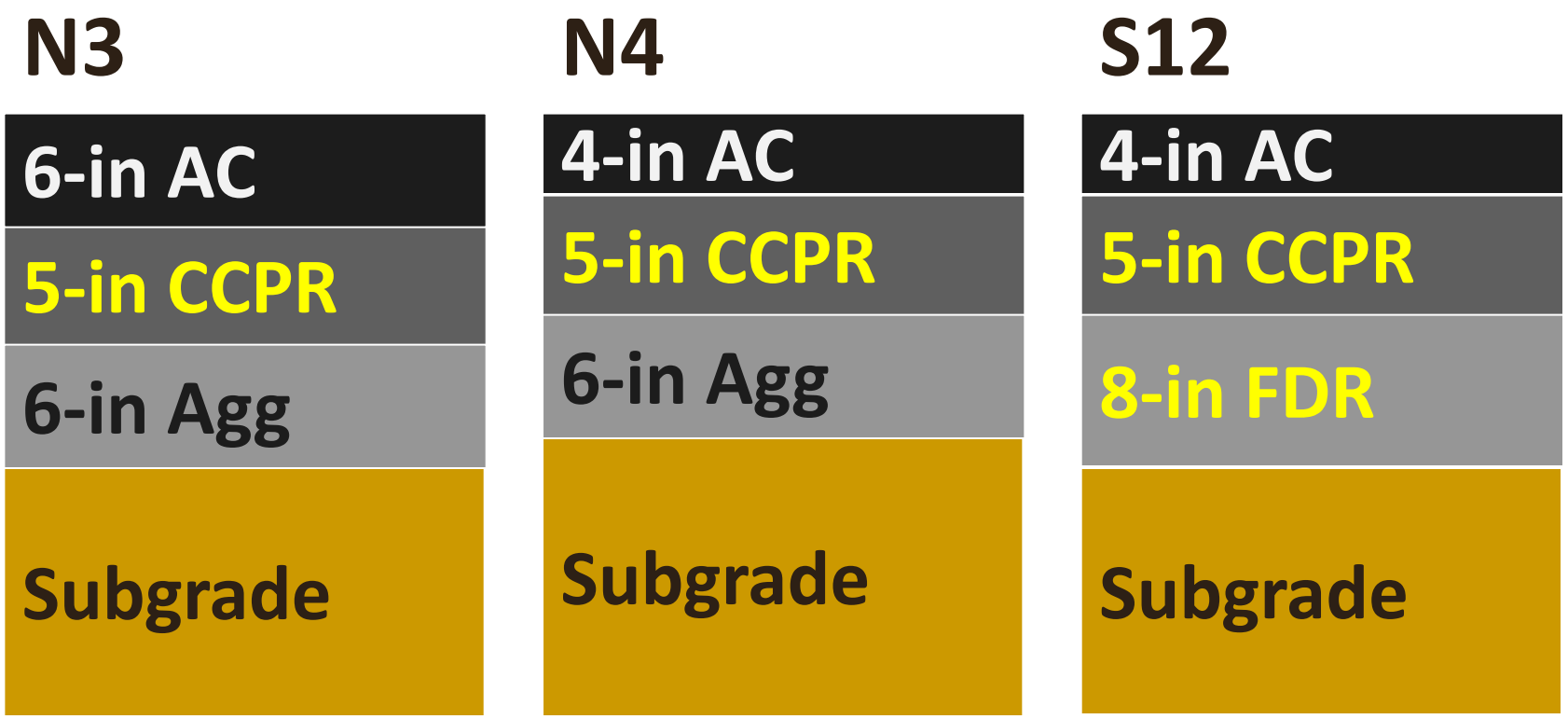

Effective Structural Number
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Left Lane
Right Lane
Dec 2011
Nov 2012

On-Going / Future Work

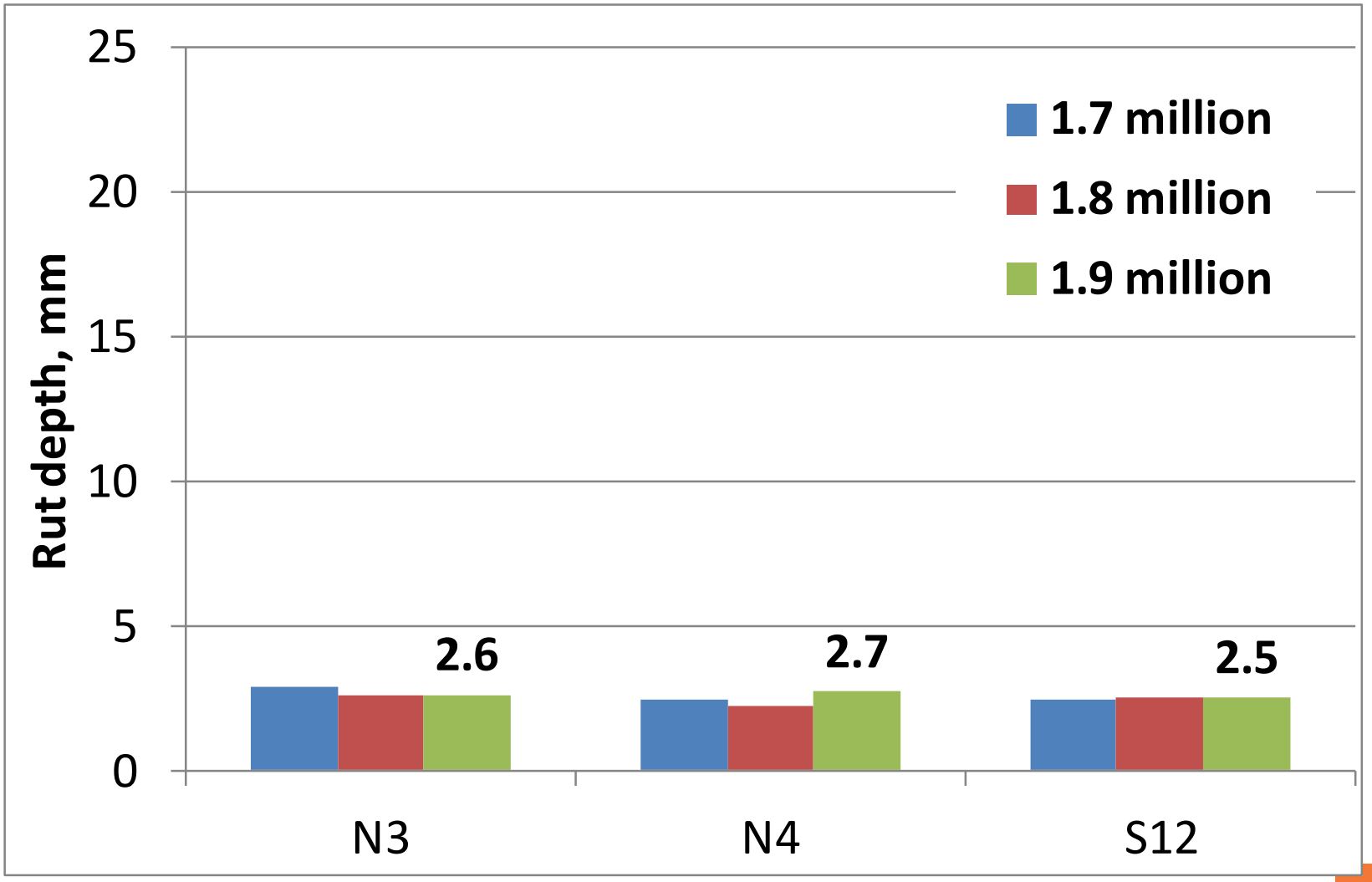
- **Continue assessment of I-81**
  - **Rut depth and structural capacity annually**
  - **Coring**
    - April 2013, condition at nearly 2 years
- **National Center for Asphalt Technology (NCAT) Test Track**
- **NCHRP 9-51**

NCAT Recycled Sections

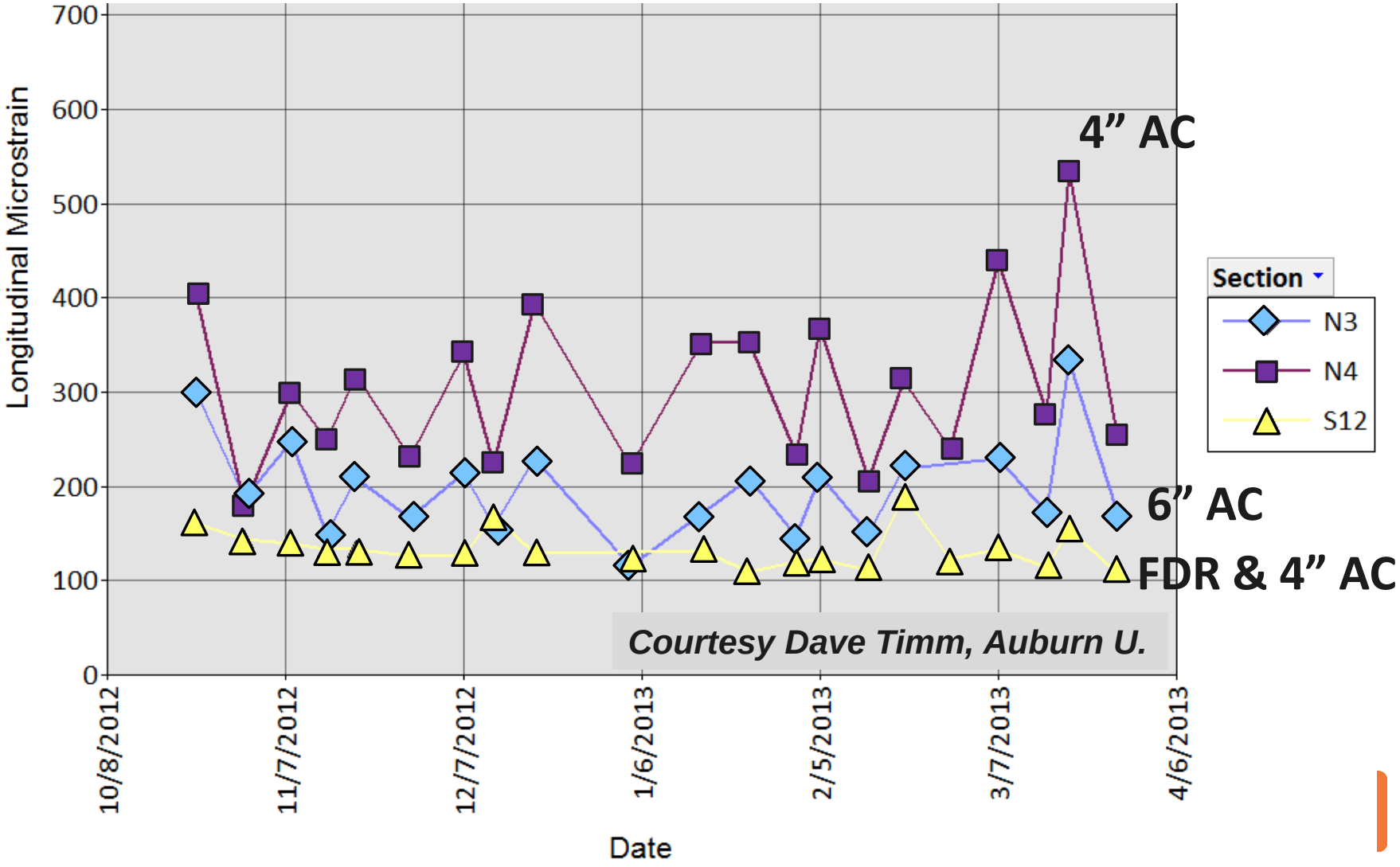
NCAT Recycled Sections



Rutting


25
20
15
10
5
0
Rut depth, mm
1.7 million
1.8 million
1.9 million
2.6
2.7
2.5
N3
N4
S12

Longitudinal Strain, Below CCPR



NCHRP 9-51

- ***Material Properties of CIR and FDR Asphalt Concrete for Pavement Design***

- **Charles Schwartz (PI), Brian Diefenderfer (co-PI), Todd Thomas, Mike Marshall**

- **Looking for projects to include in testing program**
  - **Constructed in 2012 or 2013**
  - **Asphalt emulsion or foamed asphalt**

Summary

- **We should recycle our pavements where appropriate**
  - **Cost**
  - **Environment**
  - **Construction solutions**
- **Research is adding to our knowledge-base**
  - **Documenting and summarizing experiences**
  - **Developing engineering-design input parameters**
  - **Assessing long-term performance**

Virginia Center *for* Transportation
INNOVATION & RESEARCH

We bring innovation to transportation.

Brian Diefenderfer, PhD, PE

brian.diefenderfer@vdot.virginia.gov

434 293-1944