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Pavement Recycling

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Overview

1. Pavement recycling techniques
2. Major projects and design lessons learned
   a) I-81
   b) NCAT
3. Application of design lessons learned
   a) I-64
4. Summary

Pavement Recycling Processes

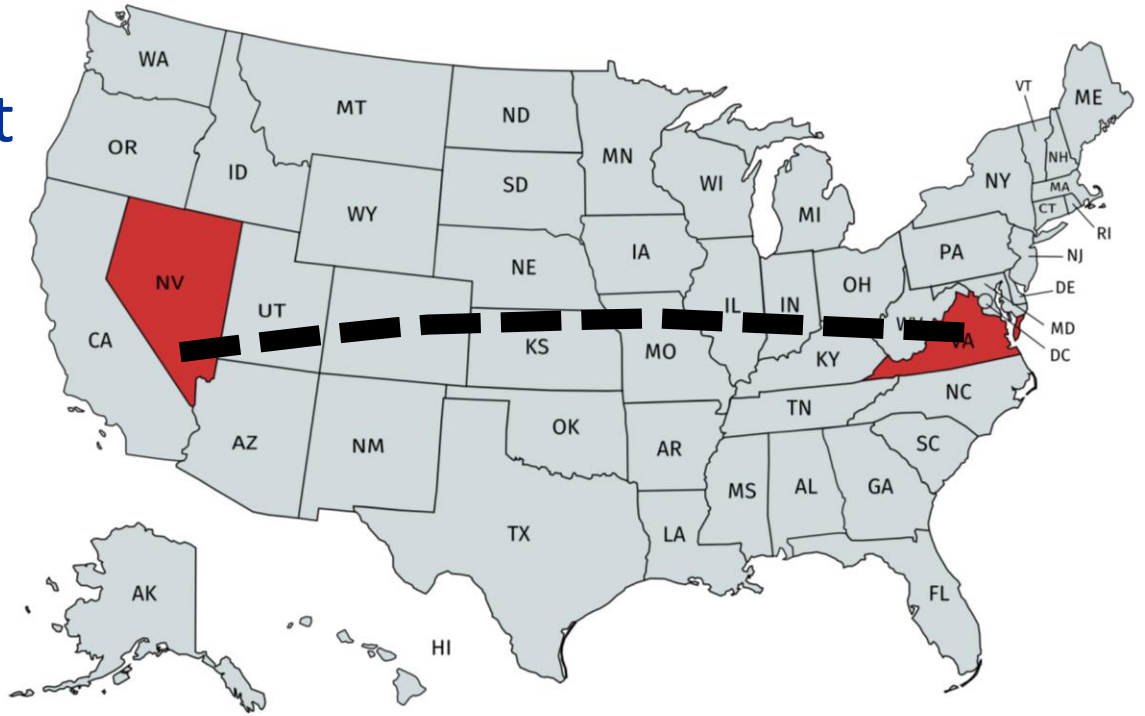
- Full-depth reclamation
  - Pavement foundation
  - Mixed in the road
- Cold in-place recycling
  - Upper portions of the asphalt layers
  - Mixed in the road
- Cold central plant recycling
  - Similar to CIR but at a mobile plant
  - Can be placed in multiple layers

Why Agencies Should Recycle Pavements

- Costs
  - 30-50% reduction
- Greenhouse gases
  - Up to 50% reduction
- Address causes rather than symptoms
- Accumulating RAP

More than 10 million tons of RAP stockpiled in Virginia

Could pave a 12-foot wide lane, 12 inches deep for more than 2,300 miles



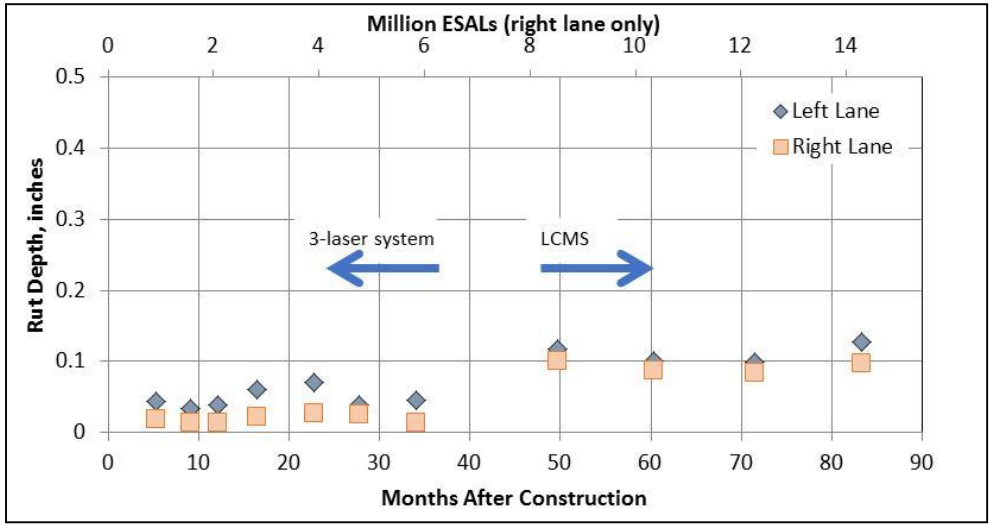
So what hurdles remain?

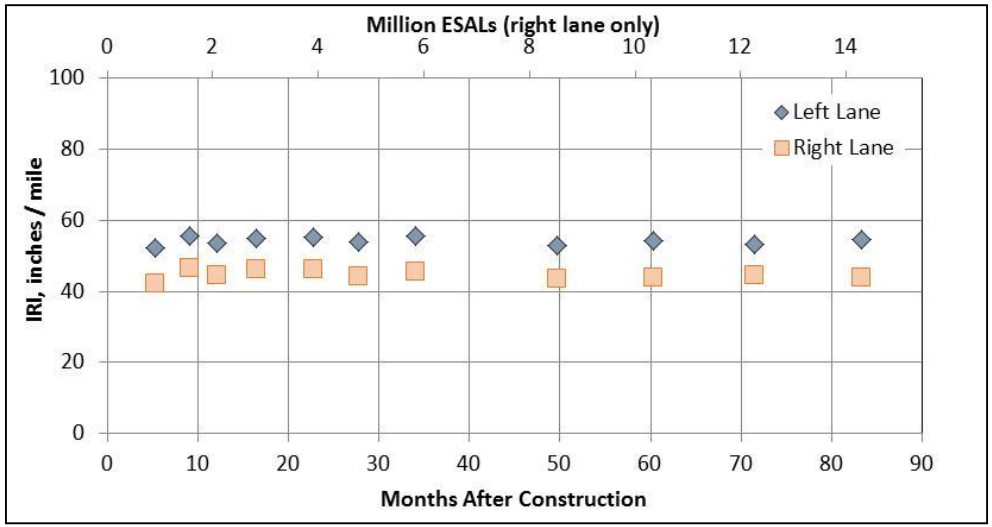
- Limited experience
- Failure mechanisms are not well understood
- Limited number of recycling contractors
- Limited number of projects
- It’s something different

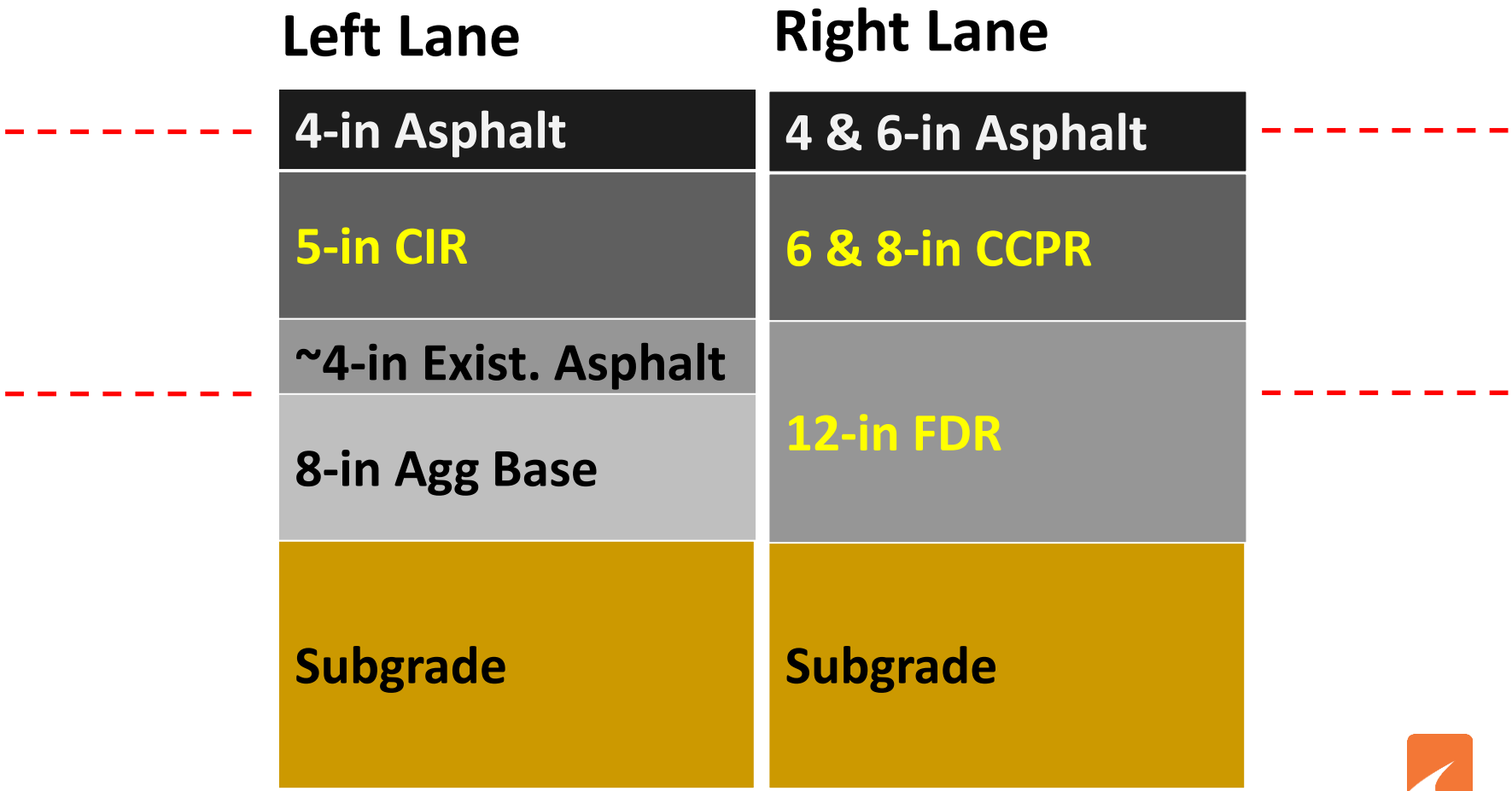
I-81 (2011)

I-81 (2011)

- 2011
- 3.7 miles
- AADT = 24,000
- 29% trucks
- About 14 million ESALs (right lane)






Left Lane
Right Lane
4-in Asphalt
4 & 6-in Asphalt
5-in CIR
6 & 8-in CCPR
~4-in Exist. Asphalt
12-in FDR
8-in Agg Base
Subgrade
Subgrade

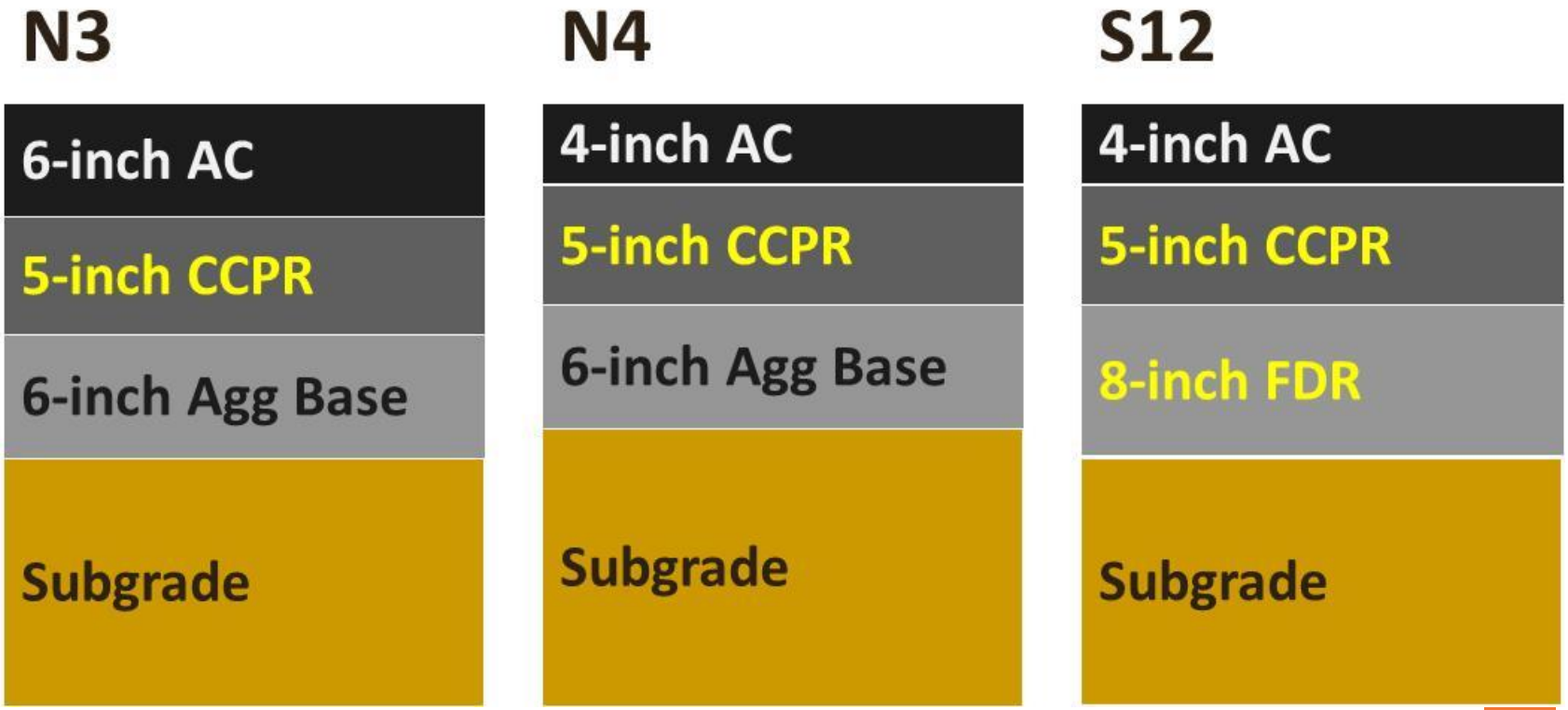
I-81 Design Lessons

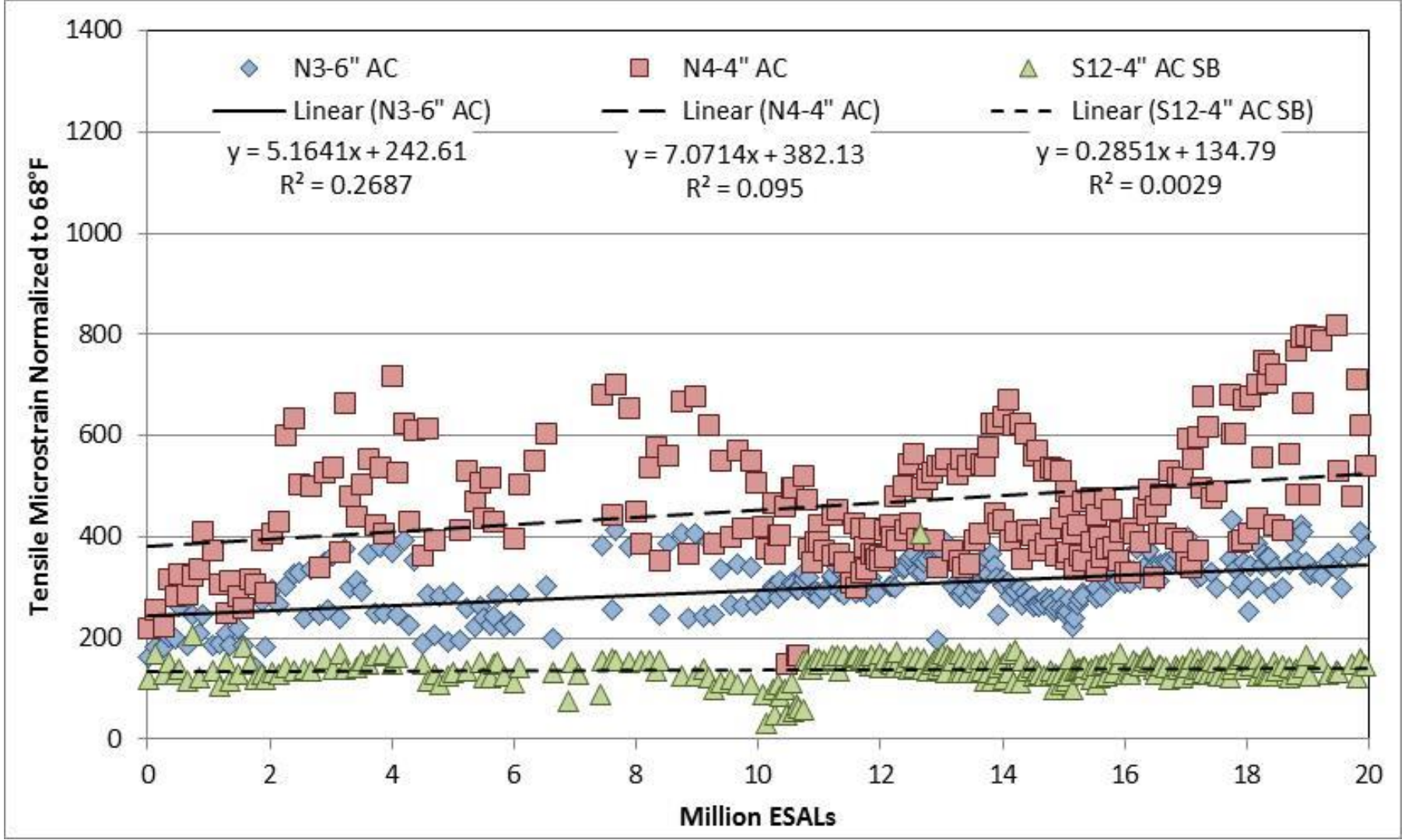
- Lab testing on cored materials
  - Showed CCPR and CIR were statistically the same in terms of stiffness
- FWD testing
  - Showed FDR layer coefficient could be nearly as high as CIR/CCPR

NCAT

- 2012
- 3 test sections
  - CCPR over agg base
  - CCPR over FDR
- 20 million ESALs
- Instrumented pavement sections

NCAT Test Track Sections




N3-6" AC
N4-4" AC
S12-4" AC SB
Linear (N3-6" AC)
Linear (N4-4" AC)
Linear (S12-4" AC SB)
y = 5.1641x + 242.61
R² = 0.2687
y = 7.0714x + 382.13
R² = 0.095
y = 0.2851x + 134.79
R² = 0.0029
Tensile Microstrain Normalized to 68°F
Million ESALs
0
200
400
600
800
1000
1200
1400
0
2
4
6
8
10
12
14
16
18
20

NCAT Design Lessons

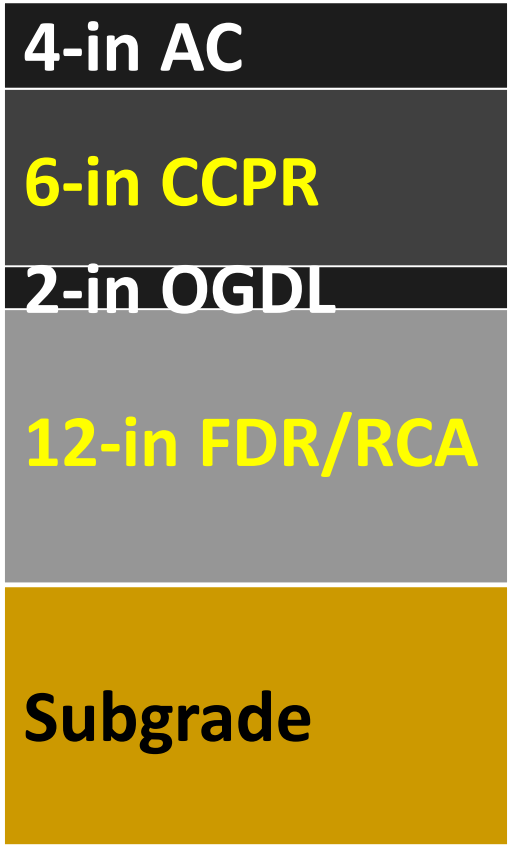
- FWD testing
  - Similar to I-81, showed FDR layer coefficient could be higher than what is often used
- Strain measurements
  - Low strain levels when FDR is included
- 4 inches of asphalt is sufficient cover over CCPR
  - To 20 million ESALs, but likely longer

Section S12

- Recycled content
  - Layer 1 = 12.5%
  - Layer 2 = 30%
  - Layer 3 = 100%
  - Layer 4 = 100%
- Entire cross section
  - 80% recycled

I-64 Lane Widening Recycle Designs

- New lanes
  - Import crushed concrete or RAP, stabilize in FDR process
  - OGDL, CCPR, 4 inches asphalt surface
- Existing lanes
  - FDR existing base materials
  - OGDL, CCPR, 4 inches asphalt surface



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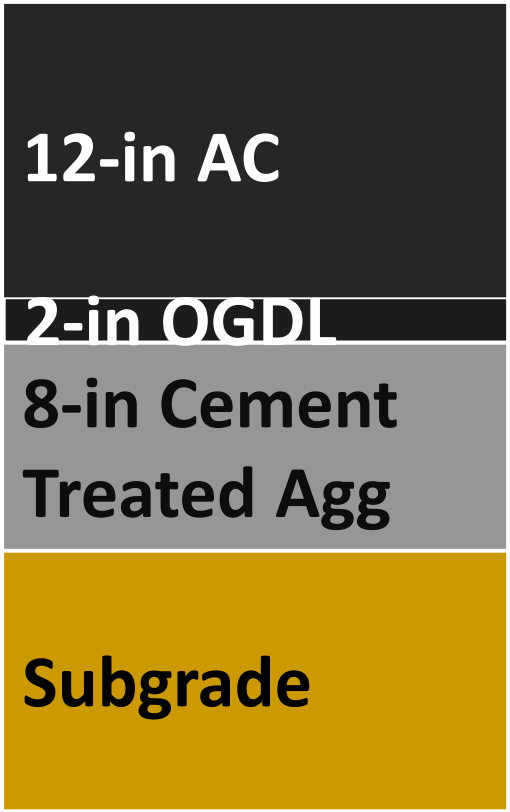

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RAMP
25

Design Lessons Used on I-64

- Excellent performance from recycled system is possible even on a high volume pavement section
- Use of FDR
  - Improved performance for overlying CCPR
- Designed using AASHTO ‘93 process
  - 0.35 for CCPR, 0.25 for FDR
- Potential for significant cost savings

Considering Segments 2 and 3

- Using CCPR and FDR
  - More than a million tons of material will be recycled
  - Compared to a non-recycling design, cost savings will exceed $15 million
- Future work
  - Instrumentation
  - Calculations to quantify greenhouse gas reductions


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Thank you!

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