VTRC
Virginia Transportation Research Council

VDOT

Pavement Recycling in the US: Recent Findings and Future Solutions

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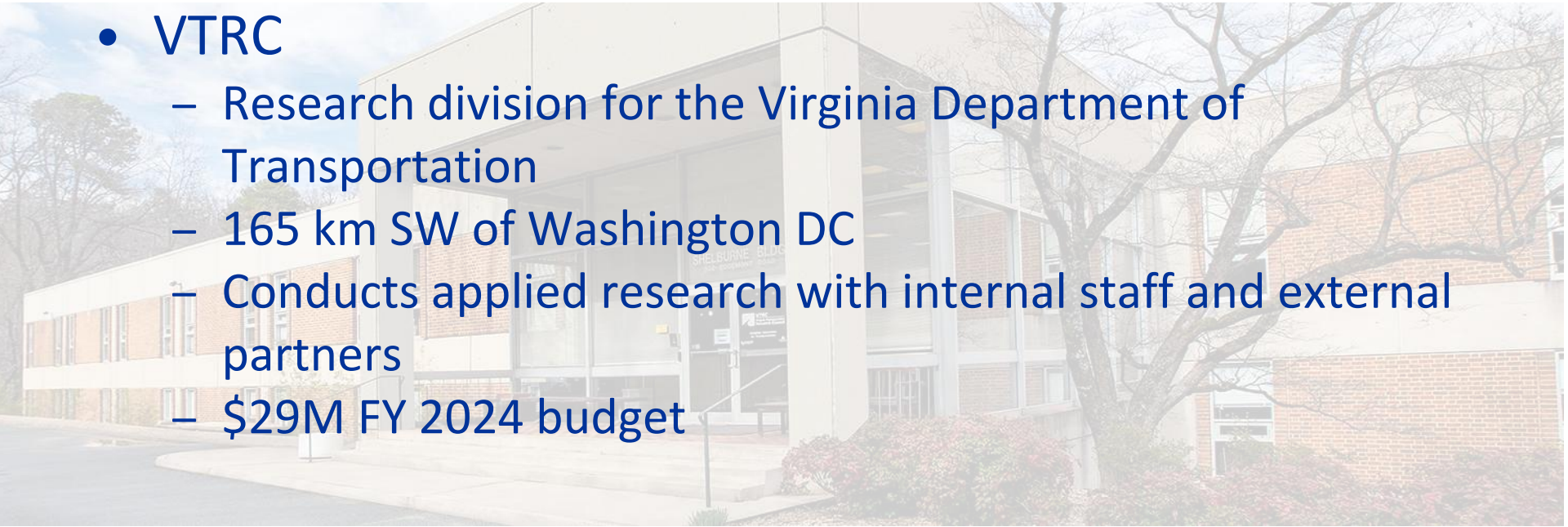
Background



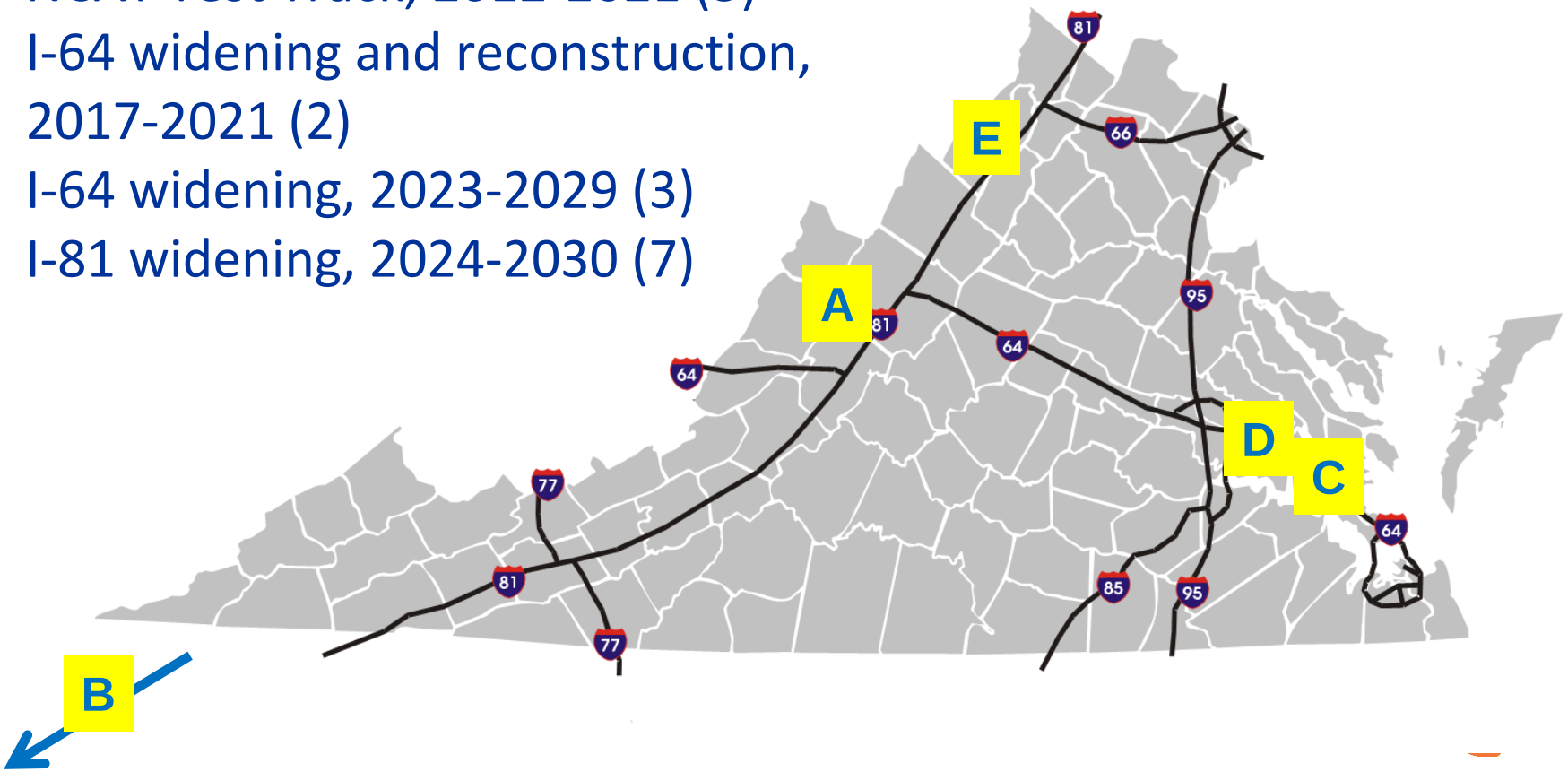
- VTRC
  - Research division for the Virginia Department of Transportation
  - 165 km SW of Washington DC
  - Conducts applied research with internal staff and external partners
  - $29M FY 2024 budget

Overview

- Virginia perspective

- Higher volume applications
- Lower volume / high production applications
- Future work
- Summary

A. I-81 reconstruction, 2011 (1)
B. NCAT Test Track, 2012-2021 (3)
C. I-64 widening and reconstruction, 2017-2021 (2)
D. I-64 widening, 2023-2029 (3)
E. I-81 widening, 2024-2030 (7)

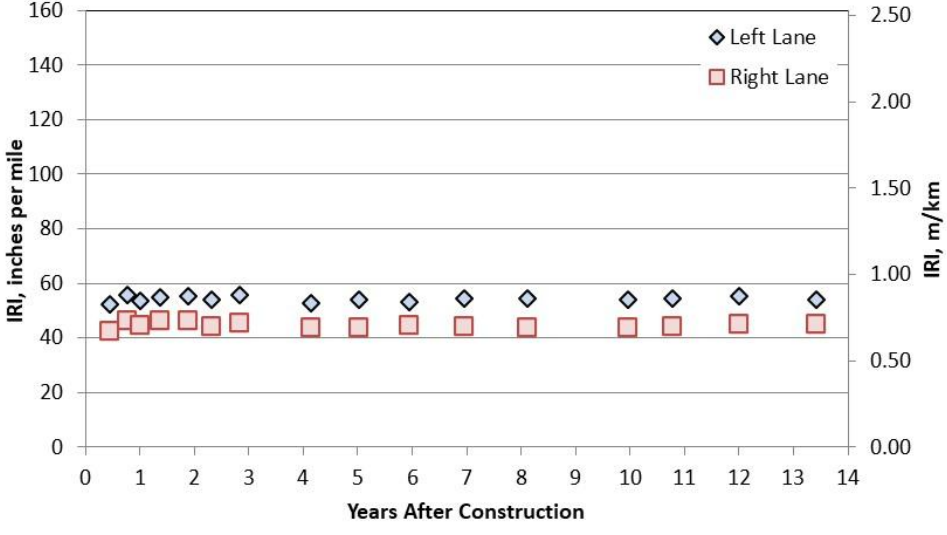


I-81 Reconstruction

- 2011
  - 6.0 km x 2 lanes
  - FDR+CCPR right lane
  - CIR left lane
- Traffic
  - 25,000 AADT
  - 32% trucks
    - 8,000 per day
    - 3 million ESALs per year

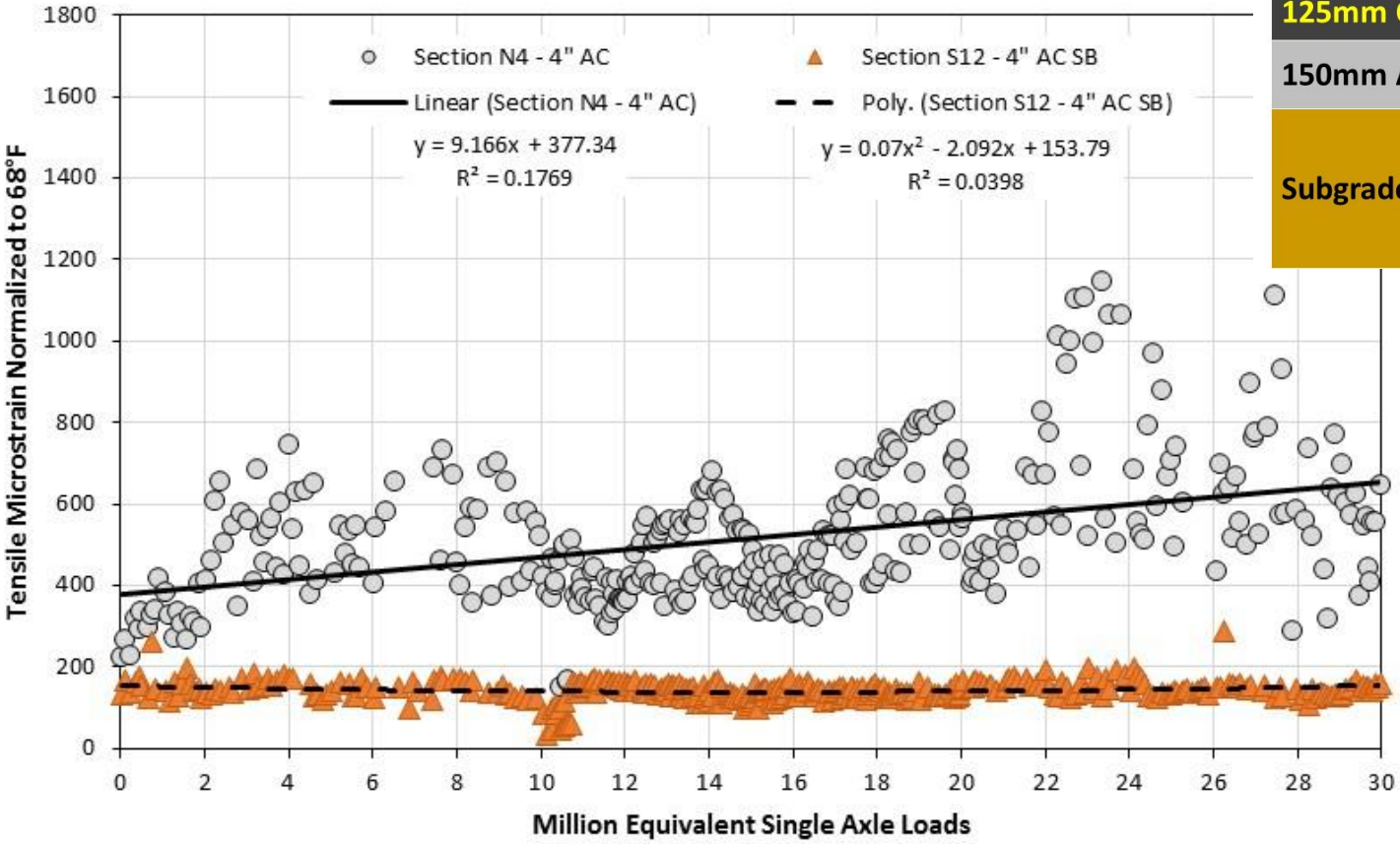
I-81 Reconstruction

- Performance
  - Rut depth < 2mm



VDOT Sponsored Sections at NCAT 2012-2024


N4
S12
100mm AC
125mm CCPR
150mm Agg Base
Subgrade
100mm AC
125mm CCPR
200mm SB
Subgrade
Strain gauges
Strain gauges



N4	S12
100mm AC	100mm AC
125mm CCPR	125mm CCPR
150mm Agg Base	200mm SB
Subgrade	Subgrade

Recycled Structures

- Recycled content
  - Layer 1 = 12.5% RAP
  - Layer 2 = 30% RAP
  - Layer 3 = 97% RAP
  - Layer 4 = 96% existing material
- Entire cross section
  - 76% recycled

I-64 Widening / Reconstruction Project

- Segment 2, 2017-2019
  - 11.4 km, EB & WB
  - 36,000 AADT, 8% trucks
- Segment 3, 2018-2021
  - 13.4 km, EB & WB
  - 37,000 AADT, 5% trucks

I-64 Construction Sequence

1) New left lane and left shoulder
   - Imported FDR
     - RCA or RAP
   - CCPR from existing RAP stockpiles
   - New SMA surface layers

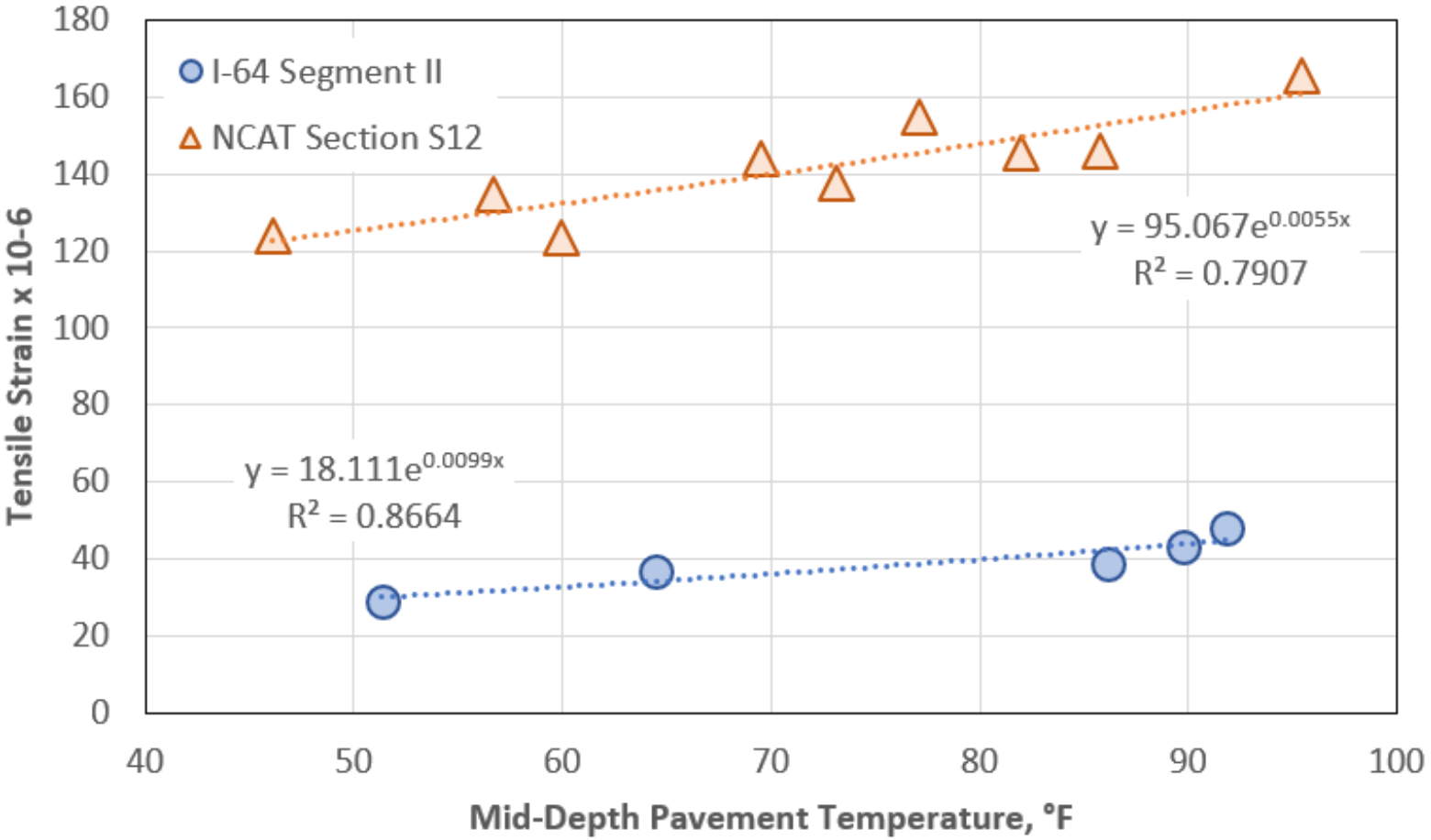
2) Shift traffic and reconstruct existing travel lanes and right shoulder
   - FDR existing foundation
   - CCPR from existing RAP stockpiles
   - New SMA surface layers

CCPR

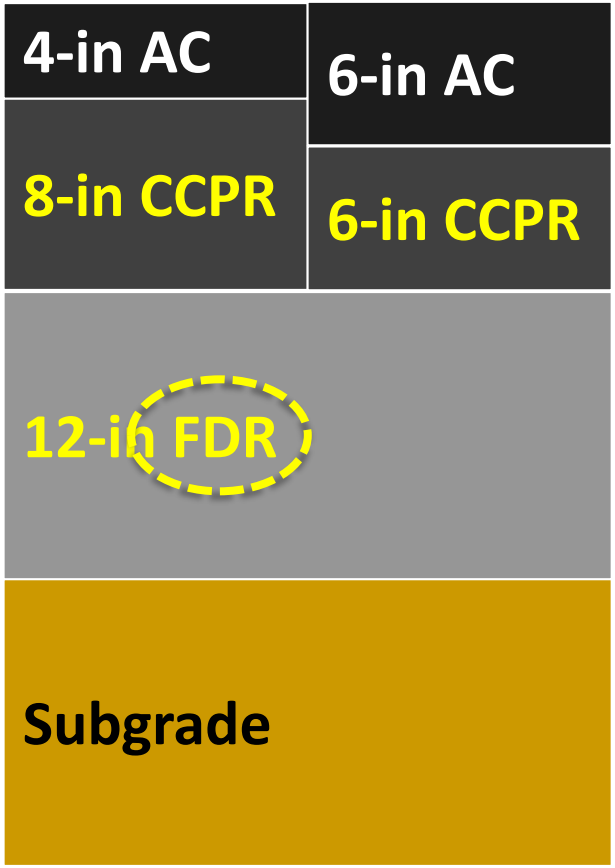
85% RAP, 15% screenings

Mix design =2% foamed asphalt and 1% cement

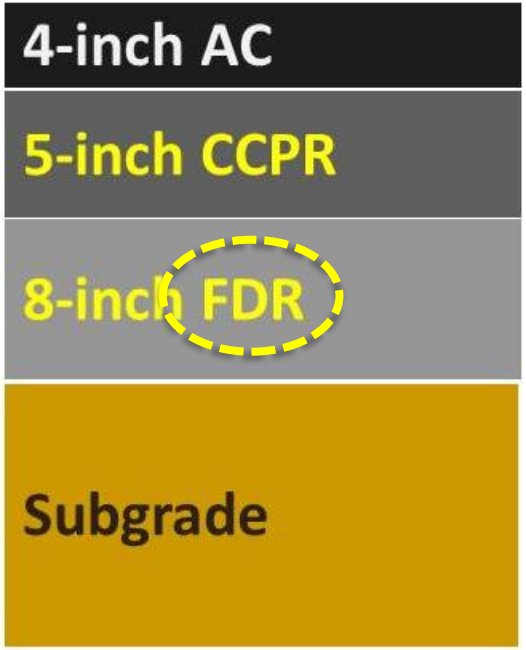
100% passing 12.5mm


I-64 Segment II
NCAT Section S12
y = 95.067e0.0055x
R² = 0.7907
y = 18.111e0.0099x
R² = 0.8664
Tensile Strain x 10-6
Mid-Depth Pavement Temperature, °F
0
20
40
60
80
100
120
140
160
180
40
50
60
70
80
90
100

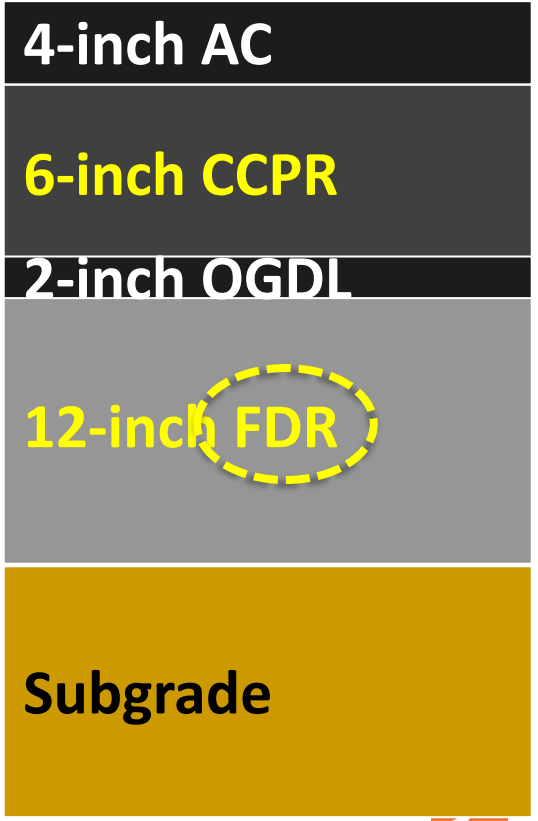
I-81



S12



I-64 Segment II



I-64 Widening / Reconstruction Benefits

- Saved $15 million
- Used more than 360,000 tons of RAP
  - 1 million tons of material recycled
- Reduced total primary energy demand by 25-45%
- Reduced global warming potential ($CO_{2\text{-}eq}$) by 15-40%

Recent Lane Widening

- I-64 (2023-2029)
  - 3 contiguous segments
  - 45 km
  - 29,000-40,000 AADT (directional)
  - 7-10% trucks
- I-81 (2024-2030)
  - 7 separate projects
  - 47 km
  - 24,000-36,000 AADT (directional)
  - 23-27% trucks

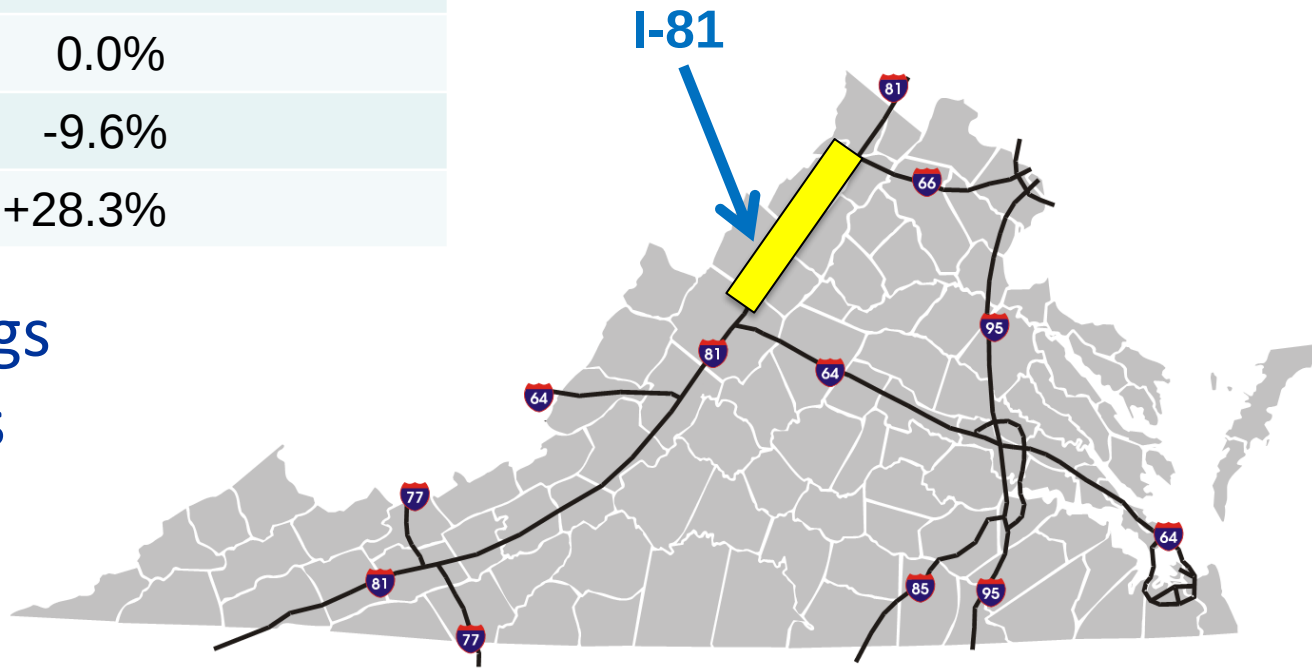
I-64 Imported FDR RCA

I-81 Imported FDR Screenings

Projected Savings I-81 Widening

Design Alternative	Cost Difference, %
Original	+18.9%
FDR	0.0%
FDR+CCPR	-9.6%
CRCP	+28.3%

- Projected savings for all segments > $25M



Paver-Laid FDR

- Used so far on lower volume routes
  - Cold recycler
  - 1.7-2 km per day
  - Easier process to handle bulking
- Potential benefits
  - Single pass per lane
  - Better lateral blending?
  - Productivity?
- Hurdles
  - Equipment width
  - Paver throughput


W 380 CRi
NEW FIELD
WIRTGEN
Conveyor
High density asphalt paver
Cold recycler (down cut)
3.8m max width


VÖGELE

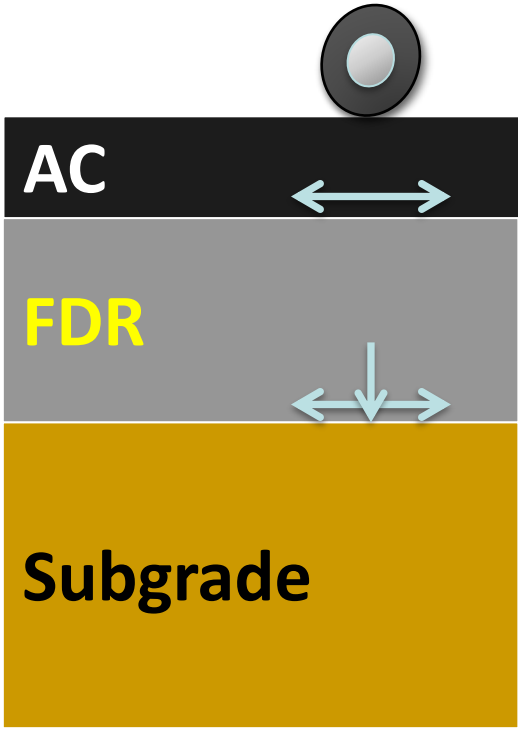

VÖGELE


VÖGELE
SUPER 2000-3i
Rhodes


HAMM
HAMM

Future Work

- Continued long-term performance monitoring
- Re-recycling
- Surfacing thickness design
  - Fatigue performance of FDR
  - Shear properties of CR
- LCA of recycling techniques



Summary

- Recycling successful on higher volume routes
- Optimize surfacing layer thickness
- Continued international cooperation

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Thank you!

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