MnROAD Research Facility & NRRA

2017 WAPA Annual Meeting

Presented by Barry Paye, P.E. (WisDOT)

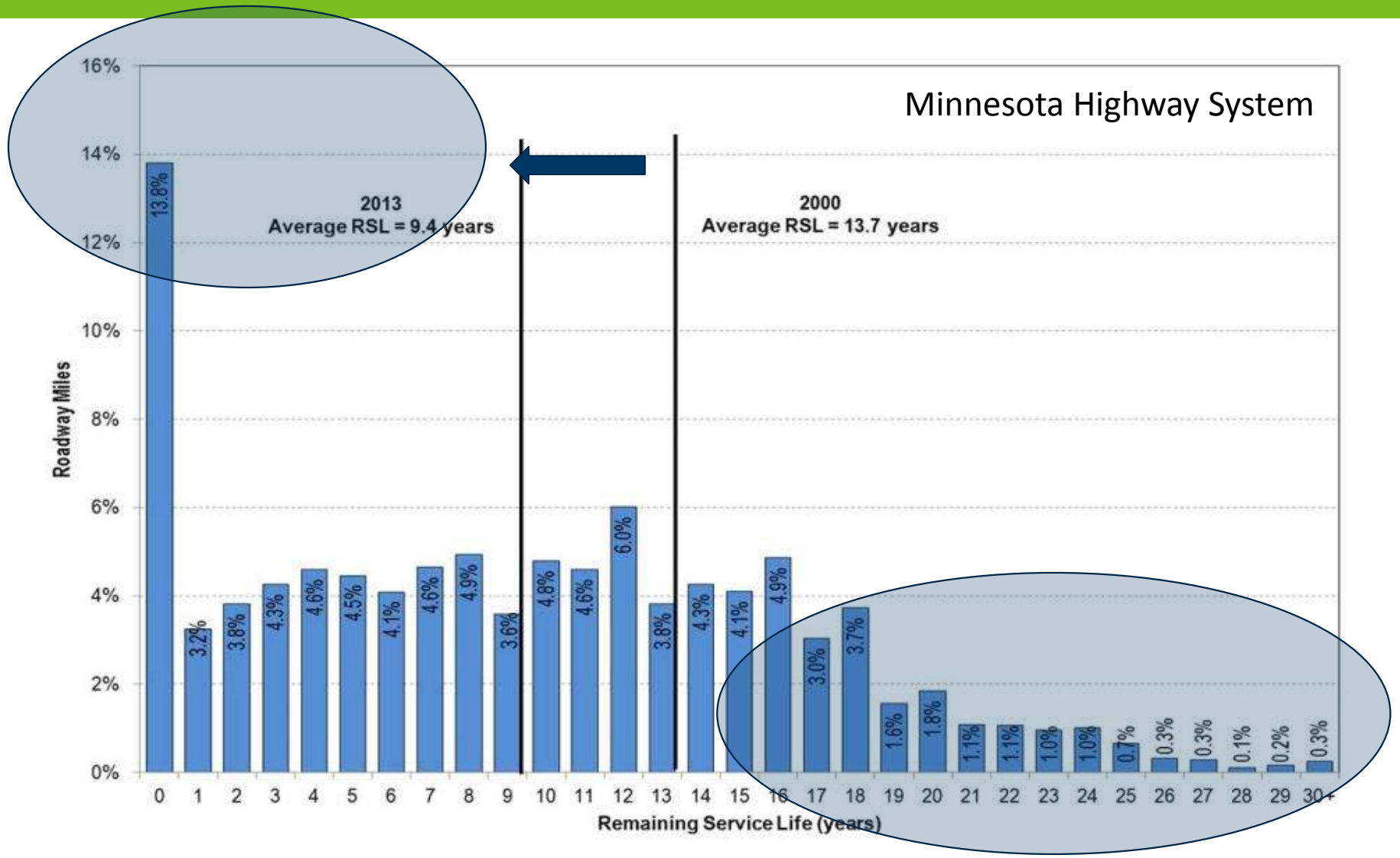
Written by Benjamin Worel, P.E.

DEPARTMENT OF TRANSPORTATION

WISCONSIN DEPARTMENT OF TRANSPORTATION

NRRA National Road Research Alliance

States Needs



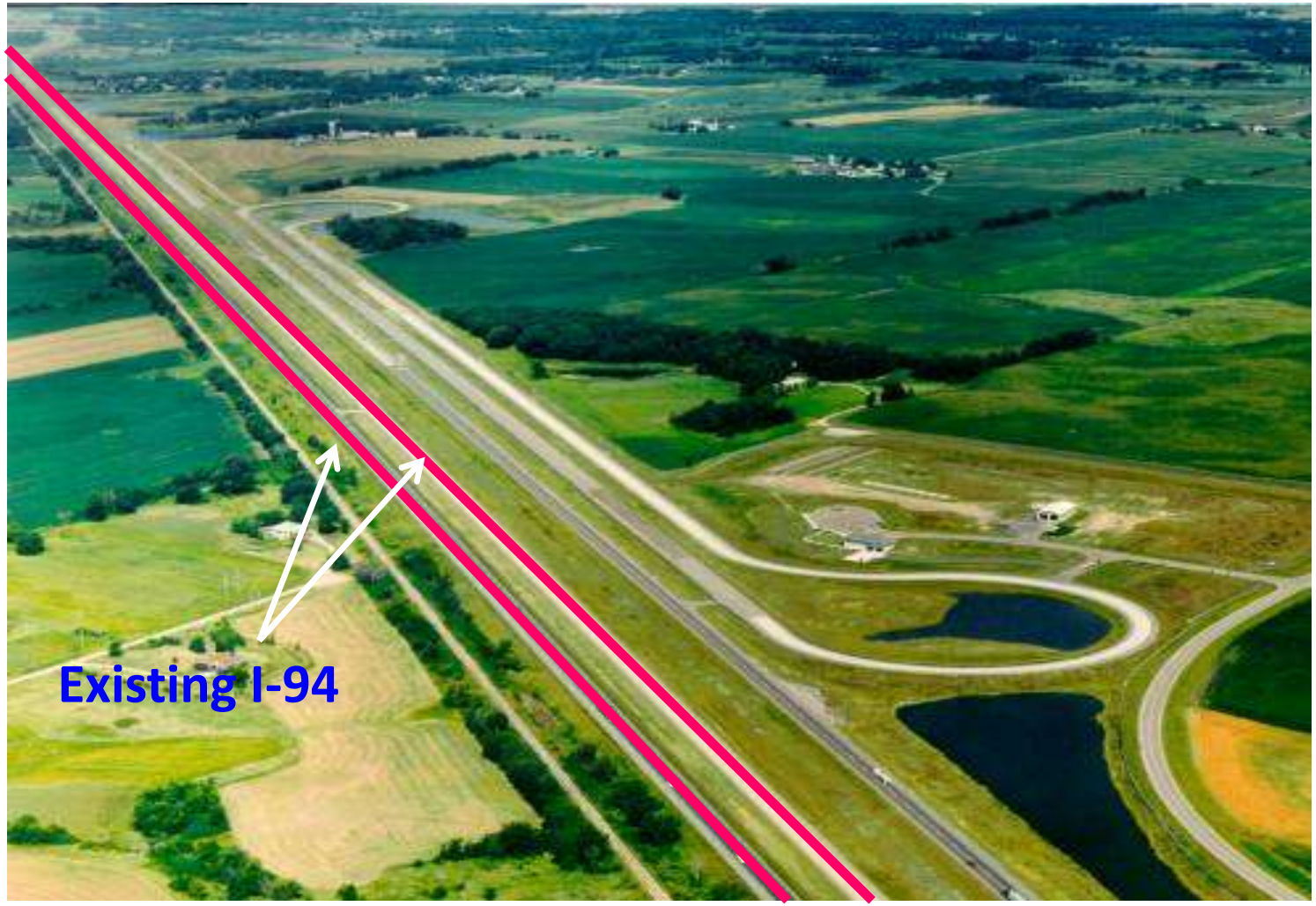
MnROAD Background

- **MnROAD Owned and Operated by Minnesota DOT**
- **23-Years of Long Term Customer Service**

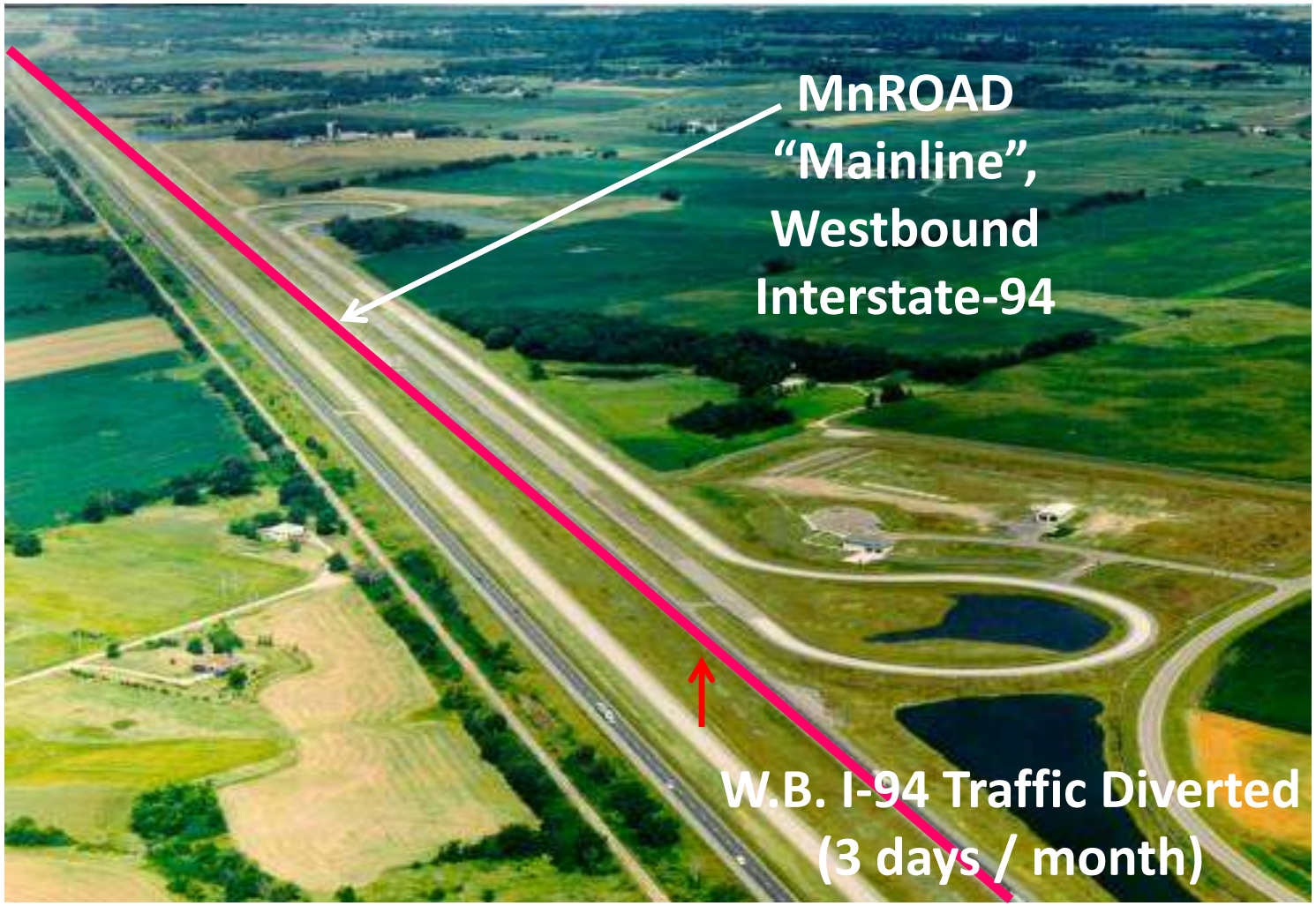
- **HMA and PCC Pavements**
- **New and Rehabilitation**

- **Major Experiments**
  - Phase I (1994-2006)
  - Phase II (2007-2016)
  - Phase III (2017-??)

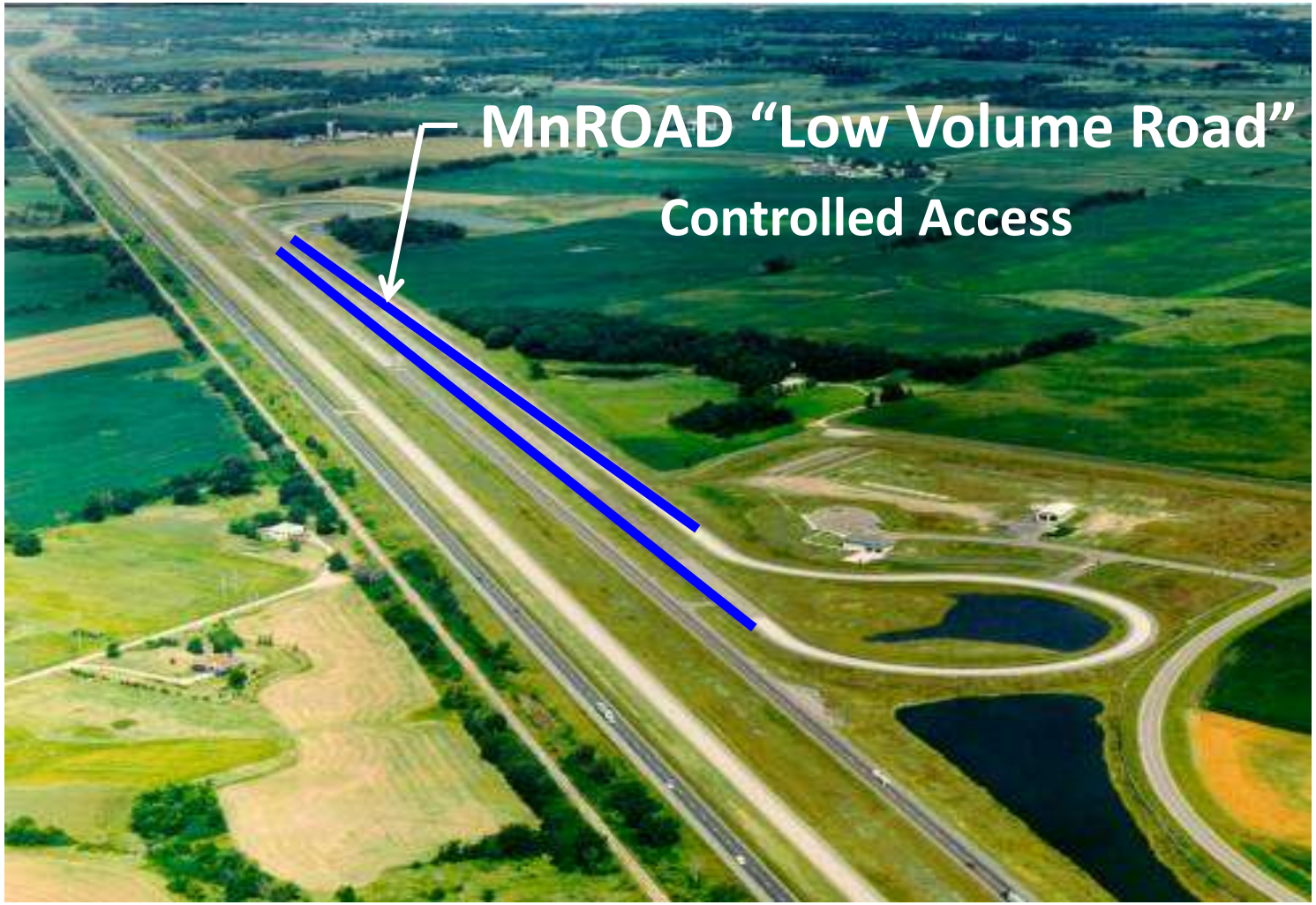
MnROAD Initial Layout



MnROAD Mainline (Started 1994)



MnROAD Low Volume Road (Started 1994)



MnROAD I-94 Westbound (Started 2010)

MnROAD Traffic Loading

Low Volume Road

5-axle Tractor-Trailer Truck
80,000 Inside Lane = 5 days/week
Outside Lane Environmental

Rigid ~ 25,500 ESALs/yr
Flexible ~ 16,000 ESALs/yr

Interstate Mainline

I-94 WB Public Traffic
29,700 AADT -- 13% HCAADT (2013)

Rigid ~ 1.2 Million ESALs/yr
Flexible ~ 0.8 Million ESALs/yr

MnROAD Test Sections / Studies

MnROAD Overall Studies

- **35 unique ongoing studies**
- **141 unique test sections**

Low Volume Road

- Local Road Research Board
- (Minnesota City and Counties)
- 19 Studies / 49 test sections

Interstate 94 Westbound

- **Mainline (3.5 miles)**
  - 12 ongoing studies / 44 test sections
- **Old Westbound (3.5 miles)**
  - 4 ongoing studies / 48 test sections

Additional Offsite Test Sections

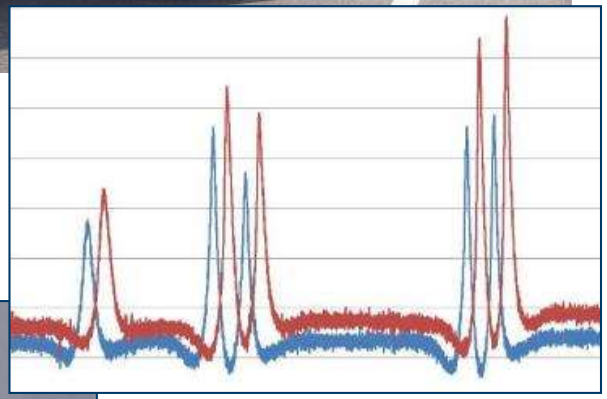
- **Partnership - National Center Asphalt Technology (NCAT)**
- **50 Test Sections south of Milaca – US-169 and CSAH-8**

MnROAD Operations

- **Research Development / Partnerships**
- **Coordination of Construction**

- **Traffic Loadings**
- **Performance Monitoring**
  - Cracking / Rutting / Ride / FWD, …..
- **Sensors**
  - Static (Environmental)
  - Dynamic (Traffic Loading)
- **MnROAD Database**

- **Technology Transfer**



MnROAD Benefits

Phase-1

9:1 B/C Ratio

Seasonal Load Restrictions; Low Temp Cracking

Phase-2

5:1 B/C Ratio

Surface Characteristics (HMA/PCC), Pervious Pavements, **Implements Husbandry, Stabilized Full Depth Reclaimation**, Lightly Surface Roadways, Chip Seal Video, Whitetopping, Thin PCC, Optimal Timing of Preventive Maintenance, **Low Temperature Cracking II**, **Quiet Rumble Strips, Drainable/Stabile Bases**

MnROAD NCAT Partnership
National Research Initiatives

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

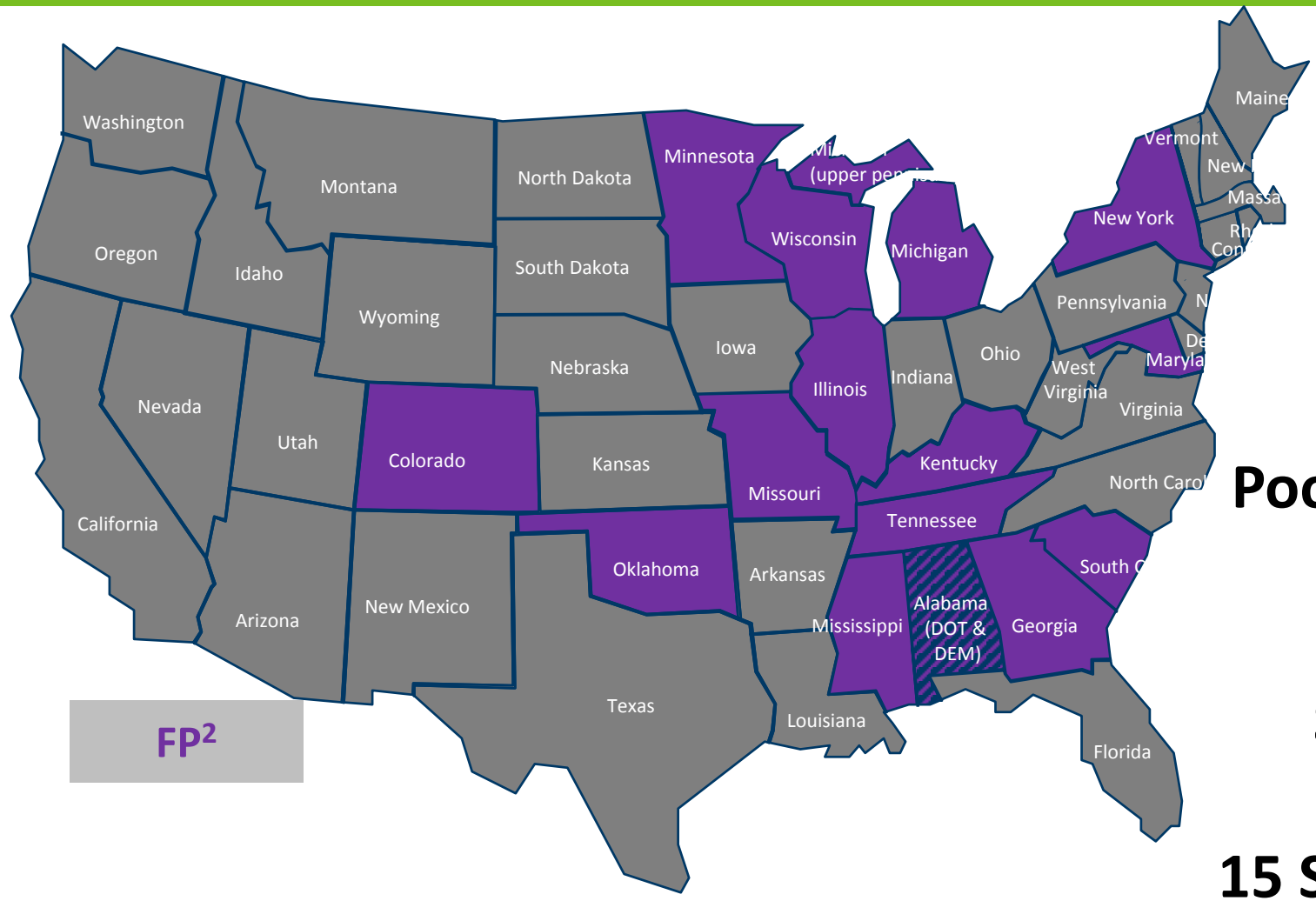
DEPARTMENT OF TRANSPORTATION

MnROAD
Safer, Smarter, Sustainable Pavements Through Innovative Research

National Pavement Preservation Study

Development of a National Cracking Test

2015 Pavement Preservation Research Sponsors



Pooled Fund Study
3-Year
(2015-2018)
$120K / Year

15 States + Industry

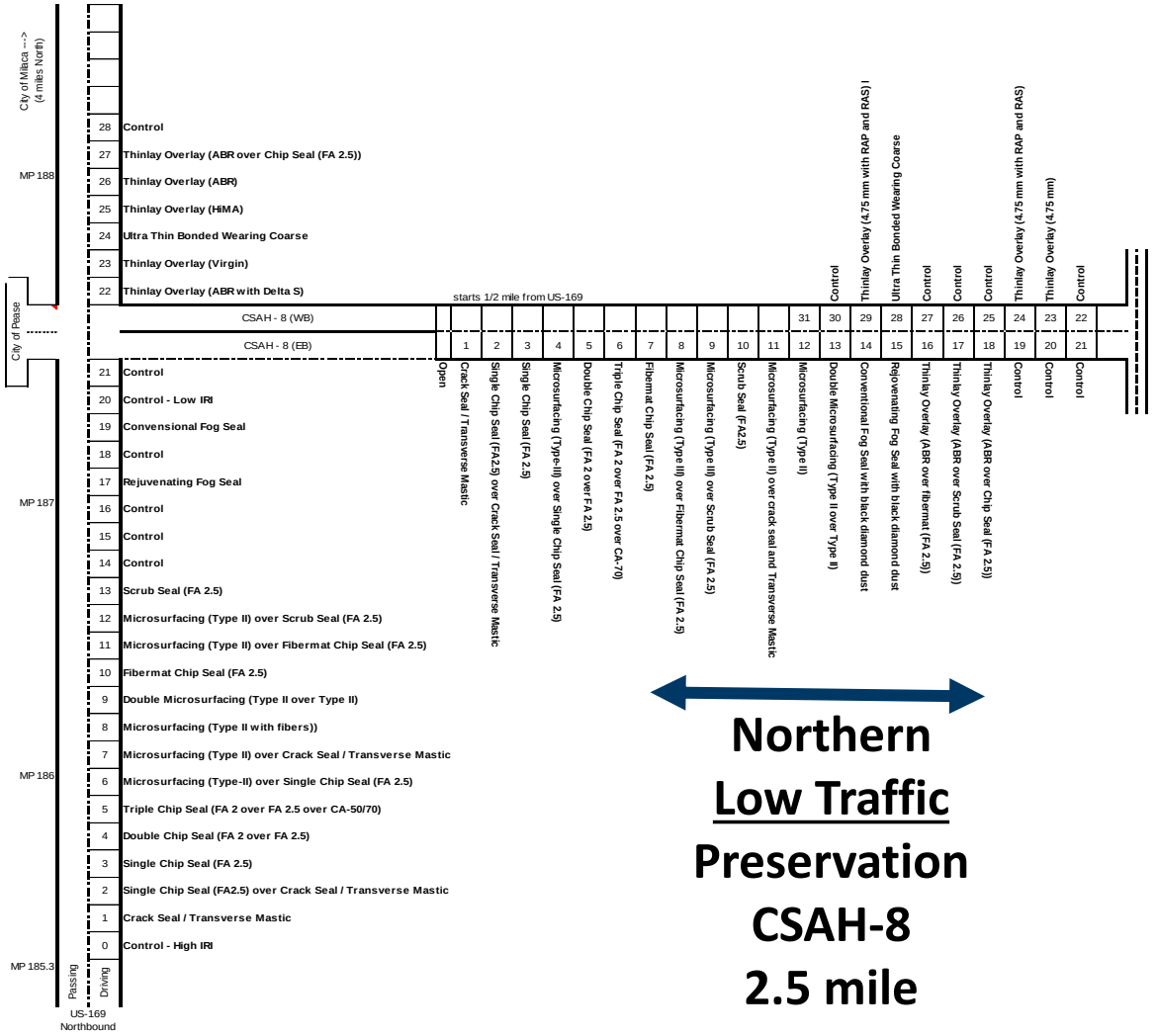
MnROAD NCAT Preservation

- **Partnership**
  - MnROAD (North) / NCAT (South)
    - Offsite Low and High Volume Road Installations
  - FP^2 / National Center for Pavement Preservation
  - Government / Academia / Industry involvement
- **Goals**
  - National Study (Climatic zones)
  - Provide consistently collected data / analysis
  - Quantify the life extending benefits

Northern Layout of US-169/CSAH-8

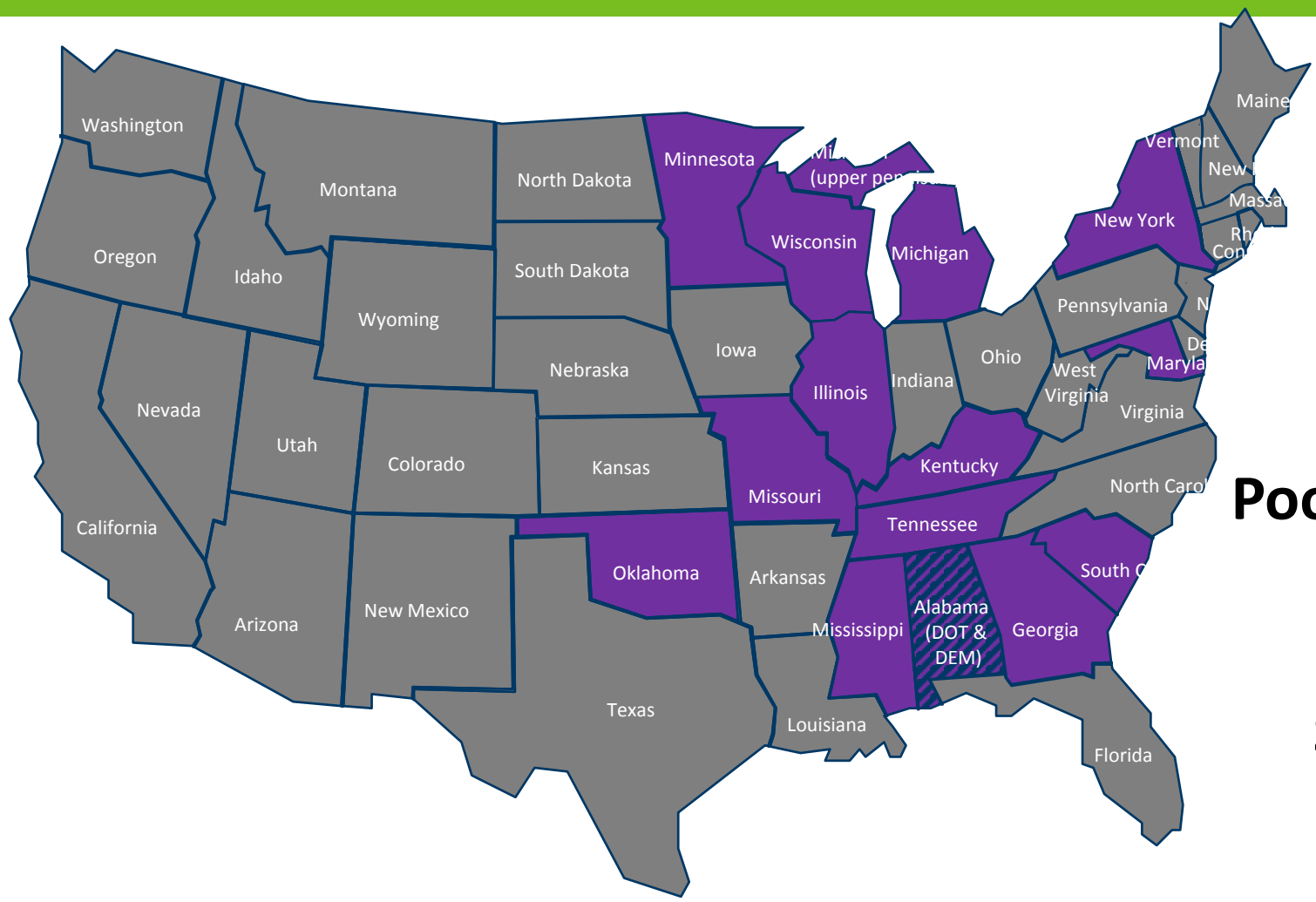
Mille Lac County

Northern
<u>High Traffic</u>
Preservation
on US-169
4 mile



Northern
<u>Low Traffic</u>
Preservation
CSAH-8
2.5 mile

2015 HMA Performance Test Research Sponsors

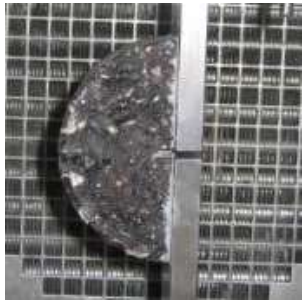


Pooled Fund Study
3-Year
(2015-2018)
$210K / Year

14 States

National HMA Cracking Performance Test

- **Partnerships**
  - Utilize both MnROAD / NCAT Test Tracks
    - Top Down / Reflection / LTC cracking Efforts
    - Range of cracking potential mixes
    - Battery of testing of many different existing tests Nationally
- **Goals**
  - We need tests and criteria that relate to performance.
  - We need tests that are practical for both mix design verification and quality control testing purposes.
  - We need tests that accommodate recycled materials, new and future additives, and combinations.



2016 MnROAD Construction
HMA Performance Testing Experiment

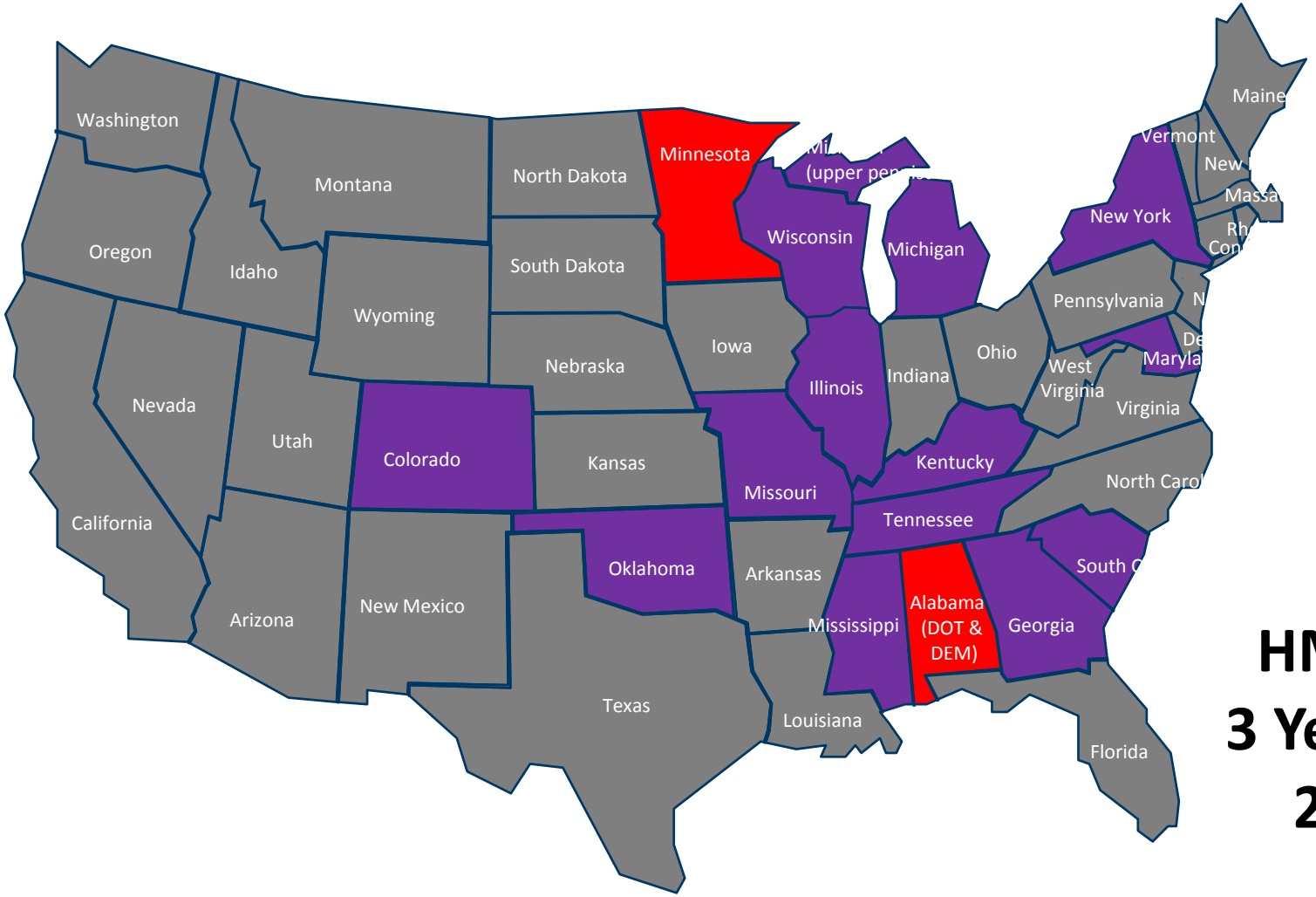
MnROAD Test Sections

LTC Cracking

2016 MnROAD Mix Designs
HMA Performance Test Experiment

MIX DESCRIPTION	RAP	RAS	CELL	BINDER	Aggregate Size	POLY	CRACK POTENTIAL
High Temp Mix	~30	5	16	PG 64S-22	12.5mm	No	High
High Temp Mix	<20	3	17	PG 64S-22	12.5mm	No	High
High Temp Mix	<20	0	18	PG 64S-22	12.5mm	No	Med/High
High Temp Mix + regressed voids (3.0)	<20	0	19	PG 64S-22	12.5mm	No	Med/High
Soft Binder Mix	>30	0	20	PG 52S-34	12.5mm	No	Med
Typical Low-Temp Mix	<20	0	21	PG 58H-34	12.5mm	Yes	Low
Typical Low-Temp Mix + limestone	<20	0	22	PG 58H-34	12.5mm	Yes	Low/Med
HiMA Mix	<15	0	23	PG 64E-34	12.5mm	Yes	Low

Phase-II MnROAD and NCAT Partnership
Proposed Research Efforts



Pavement Preservation
3 Year Pooled Fund Study
2019-2021 (MN Lead)
$50K / Year

HMA Performance Test
3 Year Pooled Fund Study
2019-2021 (AL Lead)
$100K / Year

Strategic Implementation Through Cooperative Pavement Research

Develop → Collaborate → Research → Implement → Sustain.

NRRA
National Road Research Alliance

What is NRRA?

- Pooled fund (Started April 2016 – 5 years)
- Fulfill regional and national road research needs
- Foster innovation with member states, academia and industry
  - Best Utilize
    - Each Members Research Efforts
    - MnROAD Test Track
      - Direct Phase-III of MnROAD Construction
      - $3 million in MnDOT funding
- Develop innovative technologies
- Focus on implementation, technology transfer, and training into research projects from the ground up

Develop → Collaborate → Research → Implement → Sustain.

NRRA
National Road Research Alliance

NRRA Agency Members

Develop → Collaborate → Research → Implement → Sustain.

NRRA
National Road Research Alliance

NRRA Universities

NDSU | UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
NORTH DAKOTA LOCAL TECHNICAL ASSISTANCE PROGRAM

National Concrete Pavement Technology Center
@ Iowa State University

CENTER FOR TRANSPORTATION STUDIES
UNIVERSITY OF MINNESOTA

University of New Hampshire

Michigan Technological University
1885
Michigan Tech Transportation Institute

MINNESOTA STATE UNIVERSITY
MANKATO

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

Center for Transportation Infrastructure Systems
CTIS
@ University of Texas El Paso

UCPRC
UNIVERSITY of CALIFORNIA Davis • Berkeley | PAVEMENT RESEARCH CENTER

AMPP
ASPHALT MATERIALS & PAVEMENTS PROGRAM
@ Iowa State University

PITT | SWANSON ENGINEERING

UMD
UNIVERSITY OF MINNESOTA DULUTH
Driven to Discover

Develop → Collaborate → Research → Implement → Sustain.

NRRA
National Road Research Alliance

NRRA Associations

IGGA
International Grooving & Grinding Association
Your Pavement Preservation Resource® since 1972

Minnesota Asphalt Pavement Association

APA
ASPHALT PAVEMENT ALLIANCE

AGGREGATE & READY MIX
ASSOCIATION OF MINNESOTA

CONCRETE PAVING ASSOCIATION OF MINNESOTA
CPAM

ARRA

Develop → Collaborate → Research → Implement → Sustain.

NRRA
National Road Research Alliance

NRRA Industry

DIAMOND SURFACE INC.

MIDSTATE RECLAMATION & TRUCKING

INFRASENSE

3M

ingios GEOTECHNICS

ASTEC INDUSTRIES, INC.

CEI ENTERPRISES

ROADSCANNERS

Cargill

HELIX™ A Pensmore™ Company

BASF We create chemistry

AMERICAN ENGINEERING TESTING, INC.

COLLABORATIVE AGGREGATES LLC

BRAUN INTERTEC The Science You Build On.

WSB

CONSTRUCTION CO. MATHY ONALASKA, WIS.

FLINT HILLS resources®

GSE ENVIRONMENTAL™

Develop → Collaborate → Research → Implement → Sustain.

NRRA
National Road Research Alliance

Technical Teams/Budget

- 6 States and 40 Associate Members
- Executive Committee (states)
- 5 Technical Teams (states and associates)
  - Monthly Online Meetings
- Investment in Reserach
  - 65% Research ~$1,825,200
  - 30% Tech Transfer ~$842,400
  - 5% Administration ~$140,400

Road Research

NRRA Flexible Team

Flexible Team

The flexible team is comprised of technical experts in the area of new and rehabilitation of asphalt roadways. Activities include prioritization of short and long term research, development of long term research test sections at MnROAD and providing input to the technology transfer team on what should be marketed.

News

MnRoad weekly construction updates

Follow NRRA on

- LinkedIn
- Twitter
- YouTube
- Facebook

Current Projects and Resources

Team Research Development

- Voted on Research Topics - *Presented at the EC on July 21st* (WORD)S

Tech Transfer Write-ups

1. Longitudinal Joint Construction Performance (NRRA Original Statement) - *March 2017* (WORD)
   - State of Practice "Longitudinal Joint Construction" - draft *March 2017* (WORD)
     - California Longitudinal Joint Treatment Spec (PDF)
     - Illinois Longitudinal Joint Treatment Spec (PDF)

Get Involved

- NRRA Home
- Our Partners
- Membership
- Structure and Teams
- 2017 Construction
- Schedule
- Pavement Conference

Members

- Member List
- Email the team

General Questions

Barry Paye - Chair
Wisconsin DOT
barry.paye@dot.wi.gov

Agency Members

Imad Basheer - Caltrans
Paul Denkler - MoDOT
Shongtao Dai - MnDOT
James Foldesi - St. Louis Co. MN
Kee Foo - Caltrans
John Garrity - MnDOT
Steve Hefel - WisDOT
Kevin Kennedy - MDOT
Dan Kopacz - WisDOT
Dan Oesch - MoDOT
Barry Paye (Chair) - WisDOT
Jim Trepanier - IDOT
Charles Wienrank – IDOT

Ben Worel – MnDOT
Tim Clyne - MnDOT
Dave Van Deusen – MnDOT
Gerry Geib – MnDOT

Associate Members

Jay Bianchini – Collaborative Agg.
Gina Buccelato - 3M Transportation
Mike Byrnes - Mathy Const. Co.
Andy Cascione - Flint Hills
Jo Sias Daniel – U of New Hampshire
Kris Hansen - 3M Transportation
Lev Khazanovich - U of Pittsburgh
Mihai Marasteanu - U of Minnesota
Ken Maser - Infrasense
Dave Rettner - AET
Dan Staebell - APA
Brandon Strand - APA
Jill Thomas - MAPA
Randy West - NCAT
Jason Wielinski - ARRA
Zhanping You - Michigan Tech

NRRA
National Road Research Alliance

Short Term Research Investment

Flexible Team

- Effective use of Tack Coats
- Longitudinal Joint Construction Performance

Geotechnical Team

- Larger Subbase Materials
- Subgrade Design for New and Reconstructed

Rigid Team

- Design and Performance of Concrete Unbonded Overlays
- Repair of Joint Associated Distress Pavements

Pavement Preservation Team

- Surface Characteristics of Diamond Ground PCC
- Pavement preservation approaches for lightly surfaced roadways

National Road Research Alliance

Flexible Team - **Effective use of Tack Coats**

The purpose of this tech transfer project is to compile a synthesis of best practices being used by NRRA members in the area of tack coats and to identify any gaps in the research

National Road Research Alliance

Flexible Team - **Longitudinal Joint Construction Performance**

The construction of longitudinal joints in an asphalt pavement is typically the most difficult to achieve high density due to viscosity of pavements at high temperatures.

The goal of this Tech Transfer would be to compile research and specifications from the NRRA states and others into a synthesis for publication.

Long Term Research Investment

Flexible Team

- HMA Overlay of Concrete and Methods of Enhancing Compaction
- Cold Central Plant Recycling

Rigid Team

- Fiber Reinforced Concrete Pavements
- Early Opening Strength to Traffic
- Optimizing Cement Content for PCC Mixes

Geotechnical Team

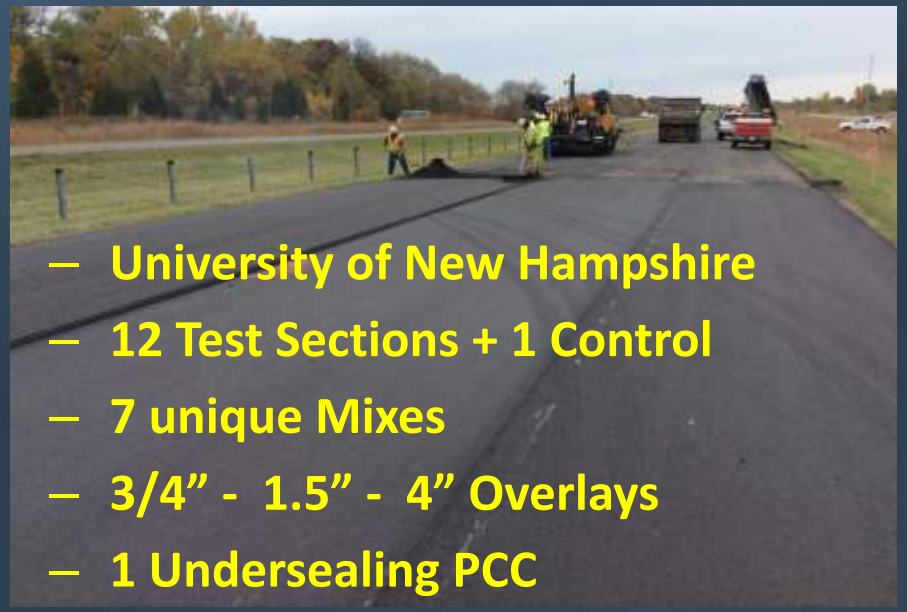
- Recycled Aggregates in Aggregate Base and Larger Subbase Materials

Pavement Preservation Team

- Maintaining Poor Pavements
- Partial Depth Repair

National Road Research Alliance

Flexible Team - HMA Overlay and Rehab of Concrete and Methods of Enhancing Compaction



- University of New Hampshire
- 12 Test Sections + 1 Control
- 7 unique Mixes
- 3/4" - 1.5" - 4" Overlays
- 1 Undersealing PCC

Goal - Designing better asphalt overlay mixes placed on deteriorated concrete. How do different mixtures aid in enhancing compaction and how they may reduce reflective cracking?

DESCRIPTION	CELL	DEPTH (inch)	MIX DESCRIPTION (NMAS, mm)	BINDER	DESIGN VOIDS
Control Section	983	-	-	-	-
HMA over PCC (1 lift)	984	1.50	Superpave (9.5)	58H-28	4.0
	985	1.50	Superpave (12.5)	58H-28	4.0
	986	1.75	Superpave (12.5)	58H-28	4.0
HMA over PCC (2 lifts)	987	1.50	Superpave (9.5)	58H-28	4.0
		2.50	Superpave (19.0)	58H-28	4.0
HMA over PCC (2 lift)	988	1.75	Superpave (12.5)	58H-28	4.0
		2.25	Superpave (19.0)	58H-28	4.0
	989	1.75	Superpave 95/5 (12.5)	58H-28	5.0
		2.25	Superpave (19.0)	58H-28	4.0
	990	1.75	Regressed voids design (12.5)	58H-28	3.0
		2.25	Superpave (19.0)	58H-28	4.0
	991	1.75	Superpave (9.5)	58H-28	4.0
		2.25	Superpave (19.0)	58H-28	4.0
HMA over PCC w/interlayer	992	1.50	Superpave (9.5)	58H-28	4.0
		1.00	Crack inhibiting interlayer (4.75)	58E-34	2.0-3.0
HMA over PCC w/PASSRC	993	1.50	Superpave (9.5)	58H-28	4.0
		1.00	Permeable interlayer mix	64S-22	-
HMA over PCC (1 lift)	994	1.50	Ultra-Thin Bonded Wearing Course with PCC/Soil Stabilization	58V-34	-
	995	0.75	Superpave (9.5)	58H-28	4.0

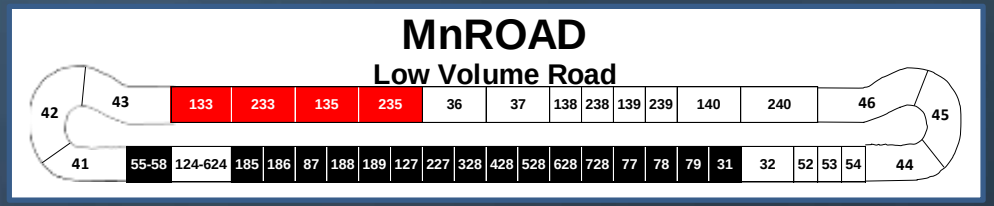
Overlay Cells

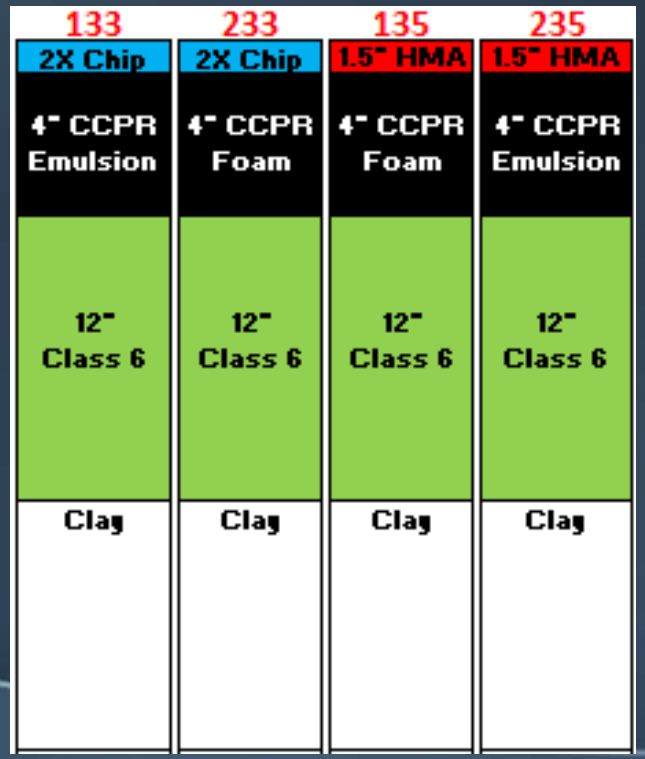
Cell 995 – Tacking Paver

Cells 989/990 – Superpave 5/Regressed

National Road Research Alliance

Flexible Team - **Cold Central Plant Recycling**





Goal - Demonstrating the use of cold central plant mix recycling technology to best utilize RAP stockpiles into new roadway layers.

How can states be green in recycling but not impact long term performance?

Cold Central Plant Recycling

Cell 133 Chip Application

Cell 233 Fog Seal

Develop → Collaborate → Research → Implement → Sustain.

How to Get Involved

- **Research Pays Off Seminar Series**
  - Every 3rd Tuesday
  - 10-11 am
  - Started in June 2015

- **NRRA**
  - Follow NRRA on Linkedin
  - May 23-24, 2018 Conference
  - States Membership – 150K
  - Associates Membership – 2K

- **MnROAD / NCAT Phase-II**
  - March 27-29, 2018 Conference
  - NCAT Opportunities
  - HMA Performance Test – 100K
  - Pavement Preservation – 50K

- **Research Partnerships**
  - Looking for opportunities
  - Offsite pavement studies
  - Sharing of Materials
  - Track / Track / HVS…..

Thank You

Questions?

Benjamin Worel
ben.worel@state.mn.us

Barry Paye
Barry.paye@dot.wi.gov

NRRA Website
www.dot.state.mn.us/mnroad/nrra/