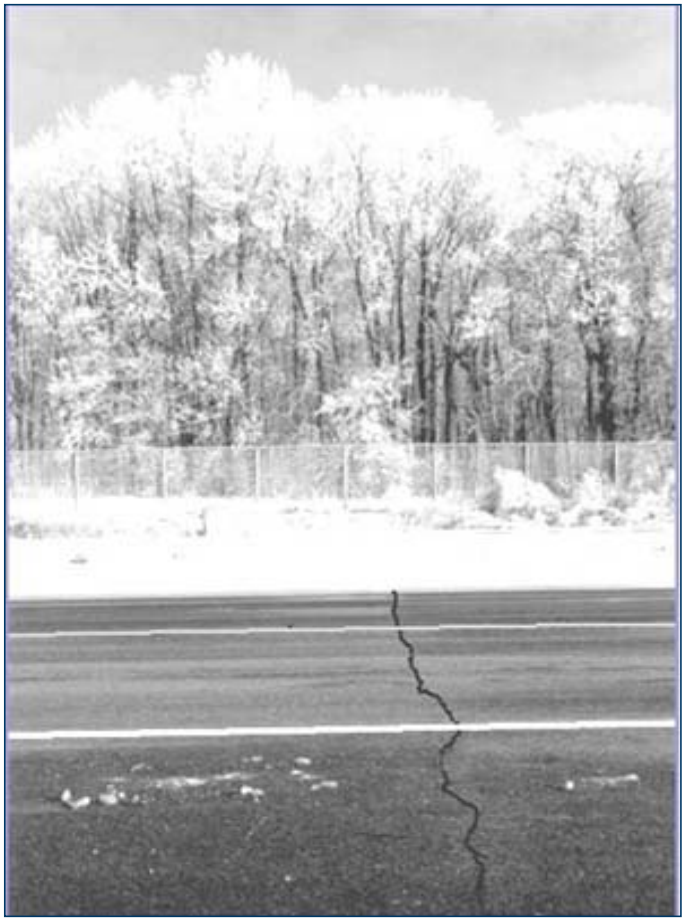

DEPARTMENT OF TRANSPORTATION
MoDOT
MDOT
Michigan Department of Transportation
Illinois Department of Transportation
WISCONSIN DEPARTMENT OF TRANSPORTATION
Caltrans
LRRB
Minnesota State University
University of New Hampshire
NDSU
UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
National Concrete Pavement Technology Center
Michigan Technological University
AGGREGATE & READY MIX ASSOCIATION OF MINNESOTA
NRRA
National Road Research Alliance
National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY
UMD
University of Minnesota Duluth
Driven to Discover
PITT
SWANSON ENGINEERING
HELIX
APA
Strategic Implementation Through
Cooperative Pavement Research
BRAUN INTERTEC
MIDSTATE
GSE
ENVIRONMENTAL
AMPP
CONCRETE PAVING ASSOCIATION OF MINNESOTA
Cargill
UCPRC
Center for Transportation Infrastructure Systems
CTIS
ARRA
ingios
FLINT HILLS resources
MATHY
DIAMOND SURFACE INC.
IGGA
International Grooving & Grinding Association
Minnesota Asphalt Pavement Association
INFRASENSE
ROADSCANNERS
ASTEC
CEI ENTERPRISES
COLLABORATIVE AGGREGATES LLC
3M
WSB
AMERICAN ENGINEERING TESTING, INC.
paviasystems
BASF
We create chemistry
All States Materials Group®

National Road Research Winter Meeting
January 11, 2018

NRRA
National Road Research Alliance

Todays Outline



NRRA Pooled Fund

Construction

Short and Long Term Research

Discussion Items


NRRA
National Road Research Alliance
Strategic Implementation Through
Cooperative Pavement Research
Develop Collaborate Research Implement Sustain.

NRRA
National Road Research Alliance

What is NRRA?

- Pooled fund
- 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

Technical Teams/Budget

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

Develop → Collaborate → Research → Implement → Sustain.

National Road Research Alliance

Pooled Fund Details

- Start = 2/22/2016
- End = 2/22/2021

(Extension approved by EC to 5 years)

(Allows for long term research to be done – note the research can go beyond the pooled fund as long as the money is encumbered before the pooled fund ends)

National Road Research Alliance

Pooled Fund Details

Study	FY2016 (1)	FY2017 (2)	FY2018 (3)	FY2019 (4)	FY2020 (5)	2021 (6)	2022 (7)	2023 (8)
Phase-1	$150	$150	$150	$?	$?			
Phase-2						$?	$?	$?

- Agencies $150,000/year (3 years)
- Associates $2,000/year

(EC will discuss funding for years 4 and 5 at the summer (May) meeting. At that time more of the current budget would be accounted for)

(EC also discussed Phase-II and the future. Right now no decision is needed on Phase-II and this can wait till year 4)

(Note pooled fund max is 5 years but obligated money can go over)

National Road Research Alliance

Pooled Fund Details

NRRA Spending Budget - NRRA December Meeting						Current Funding				
NRRA Focus	Effort Type	Item (Letter.#)	General Outcome / Deliverable	Funding Total	Approved Date	SPR	Partnerships	FHWA Grant	MnDOT STIP	MnDOT
5% (M) Marketing	MnDOT Labor	M1.1	(Website, Monthly Newsletter, Written Documents/Marketing work)	125,000	Jan 17	125,000	-	-	-	-
	MnDOT PO	M1.2	Promotional Items / Printing Costs	5,000	Jan 17	-	5,000	-	-	-
30% Tech Transfer (T)	MNDOT PO	T1.1	Agency travel / meals / meeting room costs	115,000	Jan 17	115,000	-	-	-	-
	TBD	T1.2	Communication (Written, Newsletter, video, Website)	40,000	Jan 17	40,000	-	-	-	-
	SRF	T1.3.1	Tech transfer write-ups (Consultant) - Topics Below	160,000	Jan 17	100,000	-	-	-	-
	Remaining		Remaining Tech Transfer		Jan 17	60,000	-	-	-	-
	MnDOT	T1.3.2	Tech transfer write-ups (MnDOT Labor) - Topics Below	80,000	May 17	80,000	-	-	-	-
	Labor to do these State of Practice topics are listed in T1.3.1 (consultant) and T1.3.2 (MnDOT)	T1.3.3	Tack Coats							
		T1.3.4	Longitudinal Joint Construction Performance							
		T1.3.5	Design and Performance of Concrete Unbonded Overlays							
		T1.3.6	Repair of Joint Associated Distress Pavements							
		T1.3.7	Larger Subbase Materials							
		T1.3.8	Subgrade Design for New and Reconstructed							
		T1.3.9	Surface Characteristics of Diamond Ground PCC Surfaces							
		T1.3.10	Pavement preservation approaches for lightly surfaced roadways							
		T1.3.11	Partial Depth Repairs of Concrete							
	TBD	T1.4	Equipment	25,000	Jan 17	-	25,000	-	-	-
65% Research (R)	MnDOT PO	R1.1	Sensor Purchase	159,130	Mar 17	159,130	-	-	-	-
	MnDOT PO	R1.2	Sample Buckets	4,000	May 17	-	4,000	-	-	81,149
	MnDOT	R1.3	Inspection (MnDOT)	81,149	Mar 17	50,400	-	-	-	30,749
	MnDOT	R1.4	MnROAD Staff - Construction, Sensors and Performance Monitoring	320,258	Mar 17	279,318	-	-	-	40,940
			ACTION? Estimated at 110K/year		Dec 17?	-	-	-	-	-
	AET Consultant	R1.5	PCC Sampling/Testing	80,000	May 17	20,000	5,000	-	-	-
		R1.5	Additional Funding Approved		July 17	55,000	-	-	-	-
	TBD	R1.6	HMA Performance Testing	75,000	May 17	75,000	-	-	-	-
	Diamond Surfacing	R1.7	Partial Depth Repairs Construction (not in construction contract)	80,000	May 17	40,000	-	-	-	-
		R1.7	Additional Funding Approved	-	July 17	40,000	-	-	-	-
	Not Done	R1.8	Compacted Concrete Pavement Construction (not in construction contract)	50,000	May 17	50,000	-	-	-	-
			ACTION?		Dec 17?	-	-	-	-	-
	Not Done	R1.9	Diamond Grinding Construction (not in construction contract)	80,000	May 17	80,000	-	-	-	-
			ACTION?		Dec 17?	-	-	-	-	-
	UNH	R1.10	HMA Overlay and Rehab of Concrete and Methods of Enhancing Compaction	1,235,000	May 17	150,000	-	-	-	-
	AET Consultant	R1.11	Cold Central Plant Recycling	-	May 17	100,000	-	-	-	-
	UMD	R1.12	Fiber Reinforced Concrete Pavements	-	May 17	150,000	-	-	-	-
	Not Done	R1.13	Long Term Effects of Diamond Grinding	-	May 17	75,000	-	-	-	-
			ACTION?		Dec 17?	-	-	-	-	-
	UofPitt	R1.14	Concrete Early Opening Strength to Traffic	-	May 17	150,000	-	-	-	-
	Iowa State	R1.15	Optimizing the Concrete Mix Components for Contractors	-	May 17	150,000	-	-	-	-
	Not Done	R1.16	Compacted Concrete Pavements for Local Streets	-	May 17	80,000	-	-	-	-
			ACTION?		Dec 17?	-	-	-	-	-
	Iowa State	R1.17	Recycled Aggregates in Aggregate Base and Larger Subbase Materials	-	May 17	225,000	-	-	-	-
	SRF	R1.18	Maintaining Poor Pavements	-	May 17	80,000	-	-	-	-
	Braun Intertec	R1.19	Partial Depth Repair	-	May 17	75,000	-	-	-	-
FHWA Grant (G)	Engineering	G1.1	Data - Website Interface	25,000	May 17	-	5,000	20,000	-	-
		G2.1		(25,000)	July 17	-	(5,000)	(20,000)	-	-
		G3.1		25,000	Nov 17	-	-	-	-	25,000
Construction MnDOT	C.S. McCrossan	M1.2	MnDOT Funding of ~86 - 500' equivalent test cells	3,132,681	May 17	-	-	-	3,132,681	-
	Uretk	0	Uretk Funding	20,000	July 17	-	20,000	-	-	-
						2,508,848	59,000	-		

Overall Funding ~ $2,760,000

- $2,450,000 SPR
- $150,000 WI – non-SPR
- $160,000 (40) Associates
- $3.1 million Construction (MnDOT)

Develop → Collaborate → Research → Implement → Sustain.

National Road Research Alliance

Short Term Research Technical Advisory Panels

SRF Consulting under contract - Ben Worel (MN is the TL)

NRRA Team	Title	TAP Members (Updated Sept 18th)			
Flex	Tack Coats	Randy West(NCAT) Eshan Dave (UNH)	Zhanping You (MTU) Ed Johnson (MN)	Jill Thomas (MAPA) Jim Trepanier (IL)	Dan Wegman (Braun)
Flex	Longitudinal Joint Construction Performance	Randy West (NCAT) Eshan Dave (UNH) Jim Trepanier (IL)	Ed Johnson (MN) Tim Clyne (MN)	Jill Thomas (MAPA) John Garrity (MN)	Zhanping You (MTU) Curt Turgeon (MN)
Rigid	Design and Performance of Concrete Unbonded Overlays	Jim Wilde (MSU) Matt Zeller (CPAM)	Zhanping You (MTU) Tom Burnham (MN)	Charles Wienrank (IL) Tim Andersen (MN)	Maria Masten (MN)
Rigid	Repair of Joint Associated Distress Pavements	Mark Gawedzinski (IL) Matt Zeller (CPAM)	John Roberts (IGGA) Gordy Bruhn (MN)	Tom Burnham (MN) Ed Johnson (MN)	Maria Masten (MN)
Geo	Larger Subbase Materials	Sheila Beshears (IL) Dan Wegman (Braun)	Terry Beaudry (MN) James Bittmann (MN)	Ed Johnson (MN) Tim Andersen (MN)	
Geo	Subgrade Design for New and Reconstructed	Sheila Beshears (IL) Dan Wegman (Braun)	Terry Beaudry (MN) Ed Johnson (MN)	Chris Dulian (MN) Tim Andersen (MN)	
PM	Surface Characteristics of Diamond Ground PCC Surfaces	Robert Green (MI) John Roberts (IGGA)	Matt Zeller (CPAM) Zhanping You (MTU)	Jim Wilde (MSU) Maria Masten (MN)	
PM	Pavement preservation approaches for lightly surfaced roadways	Mark Gawedzinski (IL) Kevin Kliethermes (FHWA)	Dan Wegman (Braun) Zhanping You (MTU)	Eshan Dave (UNH) Jim Wilde (MSU)	Ed Johnson (MN) Jerry Geib (MN)

Develop → Collaborate → Research → Implement → Sustain.

National Road Research Alliance

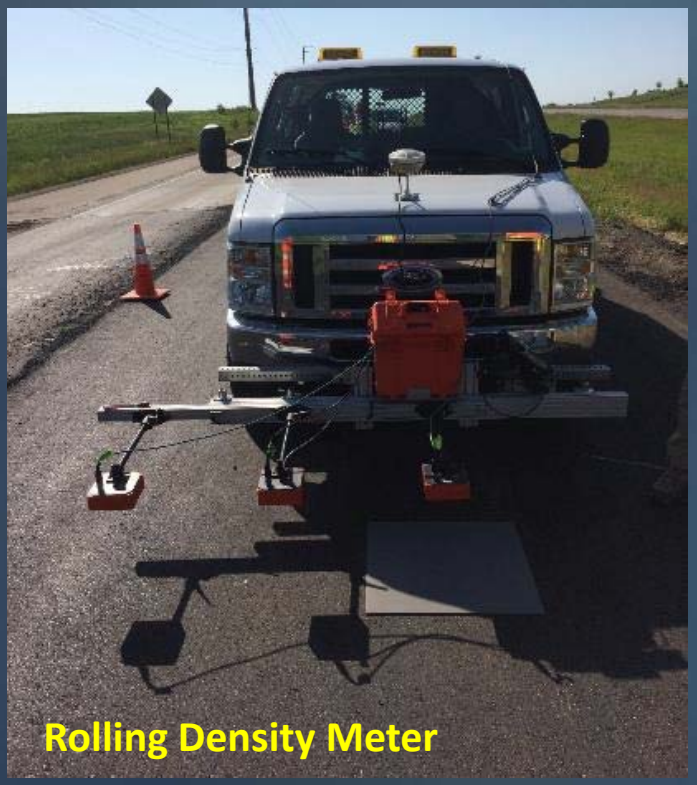
Started Flexible Team - **Effective use of Tack Coats**

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

Started Flexible Team - **Longitudinal Joint Construction Performance**

Longitudinal Joint Adhesive



Rolling Density Meter

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 - Construction Acknowledgments

- NRRA pooled-fund Sponsors and Associates
- MnDOT Golden Valley NW Resident Office
- District 3 – Maintenance, Surveys, Materials
- CS McCrossan
- Midstate Reclamation
- American Engineering Testing, Inc.

Utilize MnROAD for NRRA Long Term Research

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

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

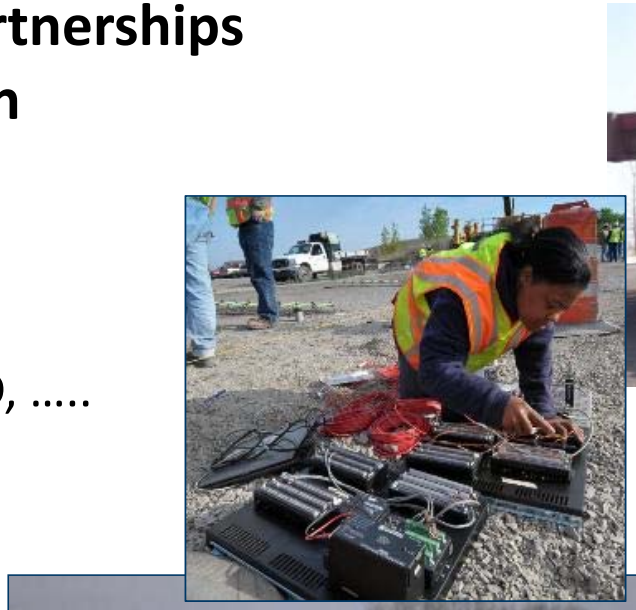
- **Major Experiments**
  - Phase I (1994-2006)
  - Phase II (2007-2016)
  - Phase III (2017-??)

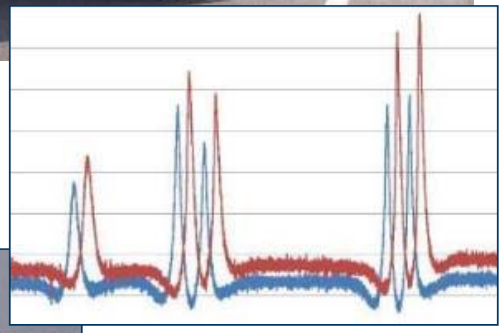
NRRA MnROAD Operations Support

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

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

- **Technology Transfer**





National Road Research Alliance

Long Term Research Technical Advisory Panels

NRRA Team	Title	Contract Status	TAP Members (Updated Sept 18th) (MnDOT TL Underlined) (Review Team Highlighted)		
Flex	HMA Overlay of PCC & Methods in Enhancing Compaction	University of New Hampshire Finalized workplan - Expected Feb 1st	Shongtao Dai (MN) Charles Wienrank (IL) Kevin Kennedy (MI) Barry Paye (WI) Daniel Oesch (MO)	Randy West (NCAT) Zhanping You (MTU) Andy Cascione (Flint Hills) Tom Burnham (MN) Ed Johnson (MN) Chris Dulian (MN)	James Bittmann (MN) Jill Thomas (MAPA) Tim Andersen (MN) Cody Brand (MN) John Garrity (MN) Jerry Geib (MN)
	Cold Central Plant Recycling	American Engineering and Testing Finalized workplan - Expected Feb 1st	Dave Van Deusen Randy West (NCAT) Andy Cascione (Flint Hills)	Curt Turgeon (MN) Ed Johnson (MN) Zhanping You (MTU)	Barry Paye (WI) Terry Beaudry (MN)
Rigid	Fiber Reinforced Concrete Pavements	University of Minnesota Duluth Contracted -1003325(wo56)	Tom Burnham (MN) John Donahue (MO)	Chris Dulian (MN) Maria Masten (MN)	Tim Andersen (MN) Matt Zeller (CPAM)
	Early Opening Strength to Traffic	University of Pittsburgh 1003327 (wo3) - Expected Dec 2018	Bernard Izevbekhai (MN) Matt Zeller (CPAM)	James Krstulovich (IL) Tom Burnham (MN)	Maria Masten (MN) Jim Wilde (MSU)
	Optimizing the PCC Mix Components	Iowa State Expect Dec Contract	Bernard Izevbekhai (MN) Tumer Akakin (ARM)	Brett Trautman (MO) Curt Turgeon (MN)	Maria Masten (MN) Matt Zeller (CPAM)

Develop → Collaborate → Research → Implement → Sustain.

National Road Research Alliance

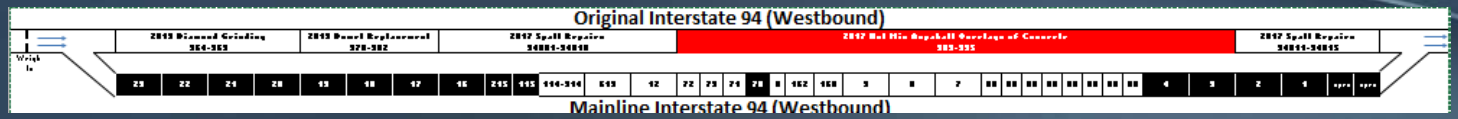
Long Term Research Technical Advisory Panels

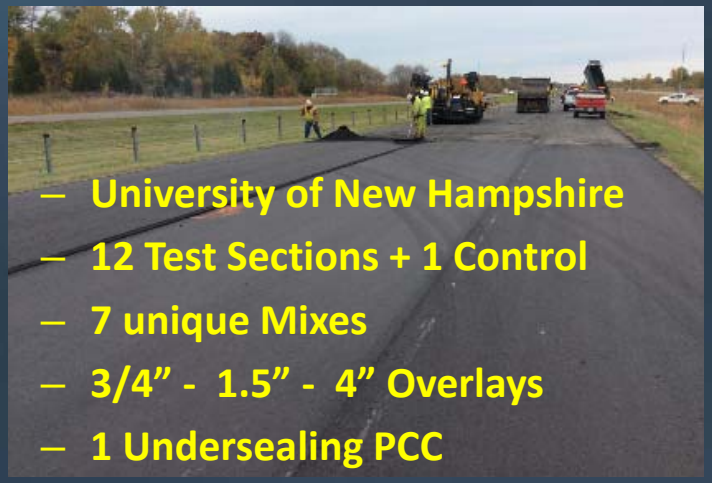
NRRA Team	Title	Contract Status	TAP Members (Updated Sept 18th) (MnDOT TL Underlined) (Review Team Highlighted)		
Geo	**Recycled Aggregates and Larger Subbase Materials**	**Iowa State** 1003320 (wo2) Expect Dec 2018 Contract Start	**John Siekmeier (MN)** Deepak Maskey (CA) Sheila Beshears (IL)	Ed Johnson (MN) James Bittmann (MN) Tim Andersen (MN)	Jeff Horsfall (WI) Richard Endres (MI) Thomas Fennessey (MO)
PM	**Maintaining Poor Pavements**	**SRF Consulting** Contracted 1029360	**Jerry Geib (MN)** Cody Brand (MnDOT D8) Elliot Keyes (MN) Andrew Hanz (Mathy) Robert Green (MI)	Ed Johnson (MN) James Bittmann (MN) Tim Andersen (MN) Mark Gawedzinski (IL)	Timo Saarenketo (RoadScanners) Dan Wegman (Braun) Kevin Kliethermes (FHWA)
	Partial Depth Repair	**Braun Intertec** Finalized workplan - 1029497 Expect Dec 2018 Contract Start	**Jerry Geib (MN)** Mark Gawedzinski (IL) Maria Masten (MN)	Tom Burnham (MN) John Roberts (IGGA) Gordy Bruhn (MN)	Timo Saarenketo (RoadScanners) Eshan Dave (UNH)

Develop → Collaborate → Research → Implement → Sustain.

National Road Research Alliance

Flexible Team - **HMA Overlay of Concrete**





- 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

Develop → Collaborat

HMA Overlays / Reflective Cracking (984-995)

- Objectives
  - Evaluate performance of various material and layer configurations
  - Evaluate performance of mixture design approaches
- Construction
  - HMA over concrete on original in-place I-94 WB
  - Twelve sections
  - Monitor tack coat residual rate and density (nukes, cores, IC)

HMA Overlays / Reflective Cracking (984-995)

DESCRIPTION	CELL	THICKNESS	MIX DESCRIPTION (NMAS, mm)	BINDER	DES VOIDS
Control Section	983	-	-	-	-
HMA over concrete (1 lift)	984	1.50	Fine mix (9.5)	58H-28	4.0
	985	1.50	Typical mix (12.5)	58H-28	4.0
	986	1.75	Typical mix (12.5)	58H-28	4.0
HMA over concrete (2 lift)	987	2.50	Coarse leveling (19.0)	58H-28	4.0
		1.50	Fine mix (9.5)	58H-28	4.0
HMA over concrete (2 lift)	988	2.25	Coarse leveling (19.0)	58H-28	4.0
		1.75	Typical mix (12.5)	58H-28	4.0
	989	2.25	Coarse leveling (19.0)	58H-28	4.0
		1.75	Superpave 95/5 (12.5)	58H-28	5.0
	990	2.25	Coarse leveling (19.0)	58H-28	4.0
		1.75	Regressed voids design (12.5)	58H-28	3.0
	991	2.25	Coarse leveling (19.0)	58H-28	4.0
		1.75	Fine mix (9.5)	58H-28	4.0
HMA over concrete	992	1.00	Crack inhibiting interlayer (4.75)	58E-34	2.0-3.0
		1.50	Fine mix (9.5)	58H-28	4.0
HMA over concrete	993	1.00	Permeable interlayer mix	-	-
		1.50	Fine mix (9.5)	58H-28	4.0
HMA over concrete (1 lift)	994	1.50	Fine mix (9.5)	58H-28	4.0
	995	0.75	Ultra-Thin Bonded Wearing Course	-	-

HMA Overlays / Reflective Cracking (984-995)

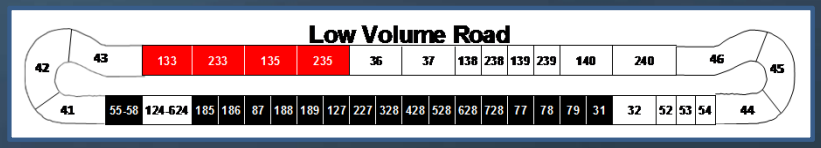
Nuke Calibration Cores, Tack Rate

MIX DES	COUNT	MIN	AVE	MAX
SPWEA440	16	91.4	93.1	94.1
SPWEB430	8	93.6	94.7	95.1
SPWEB440	16	91.2	93.5	95.1
SPWEB450	8	96.2	96.6	97.0

CELL	LIFT1 (0.05 gal/sy)	LIFT2 (0.03 gal/sy)
984	0.05	-
985	0.06	-
986*	0.19	-
987	0.05	0.05
988	0.06	0.06
989	0.05	0.04
990	0.05	0.04
991	0.05	0.04
992	0.04	0.04
993	0.04	-
994	0.04	-
995*	0.26	-

National Road Research Alliance

Flexible Team - **Cold Central Plant Recycling**



133	233	135	235
2X Chip	2X Chip	1.5" HMA	1.5" HMA
4" CCPR Emulsion	4" CCPR Foam	4" CCPR Foam	4" CCPR Emulsion
12" Class 6	12" Class 6	12" Class 6	12" Class 6
Clay	Clay	Clay	Clay

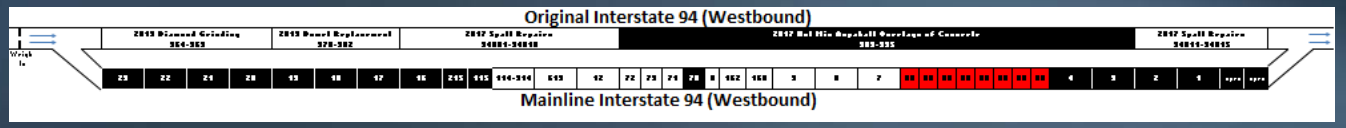
Goal - Demonstrating the use of cold central plant mix recycling technology to best utilize RAP stockpiles into new roadway layers.

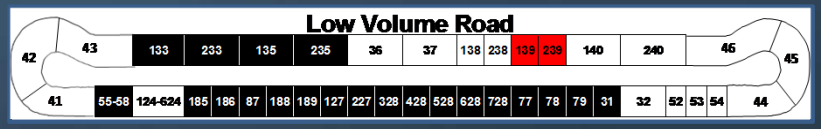
- American Engineering and Testing
- 4 Test Sections
  - Foam vs Emulsion
  - 2X Chip vs 1.5" HMA Overlay

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

Rigid Team – **Fiber Reinforced Concrete**

National Road Research Alliance





- University of Minnesota Duluth
- Mainline - Interstate
- LVR Test Sections – City Streets

139	239
3" Fiber Reinf PCC Turf	4" Fiber Reinf PCC Turf
6" Class 5	6" Class 5
4" Common Borrow	4" Common Borrow
Clay	Clay
6'Lx6'W Sealed Joints 30% RSR	6'Lx6'W Sealed Joints 30% RSR

Goals - What is the long term effects of using fiber reinforcement in concrete pavements?

Are the fibers cost beneficial?

Can engineers design thinner pavements or expect the concrete to hold together better when/if cracks develop?

806	706	606	506	805	705
5" Fiber Reinf. PCC (High) Astro Turf	5" Fiber Reinf. PCC (Enhanced) Astro Turf	6" Fiber Reinf. PCC (Standard) Astro Turf	5" PCC Control No Fibers Astro Turf	5" PCC Fibers Unsealed No Dowels Astro Turf	5" PCC Fibers Unsealed No Dowels Astro Turf
				Geotextile	Geotextile
11" Class 5Q	11" Class 5Q	11" Class 5Q	11" Class 5Q	7.5"PCC 1993 cracked D 12'Lx6'W, 12'Lx8'W P 12'Lx6'W, 12'Lx7'	7.5" PCC 1993 Driving 12'Lx14'W Passing 12'Lx12'W
				3" Class-4	3" Class-4
3" Class 5	3" Class 5	3" Class 5	3" Class 5	27" Class-3	27" Class-3
Clay	Clay	Clay	Clay	Clay	Clay
Fibers 0.75% by Volume	Fibers 30% RSR	Fibers 20% RSR		4" PCC Shoulder Inside lane	4" PCC Shoulder Inside lane

Develop → Collaborate → Research → Implement → Sustain.

Thin Fiber-reinforced PCC (139 and 239)

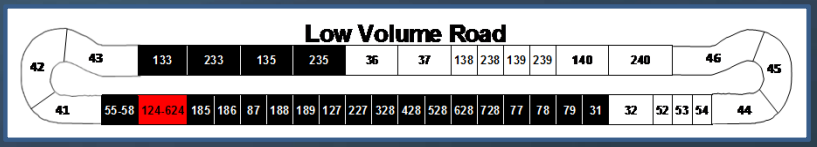
- Objectives (low- and high-volume applications)
  - Evaluate/quantify effects of fiber-reinforced concrete on performance based on panel size, and thickness
- Construction
  - Two LVR sections:
    - Residential street application
    - 3-inch and 4-inch
    - Panel size = 6 ft W x 6 ft L
    - Fiber reinforcement: Min Residual Strength = 30%
  - Research plan called for minimal in-place subgrade improvement

Thin Fiber-reinforced PCC (139 and 239)

Early FRC Performance

National Road Research Alliance

Rigid Team – Early Opening Strength to Traffic



Goals - How early can concrete be loaded when it is curing?

How early can you put traffic on roadways and what is the loss in long-term performance/life of the pavement?

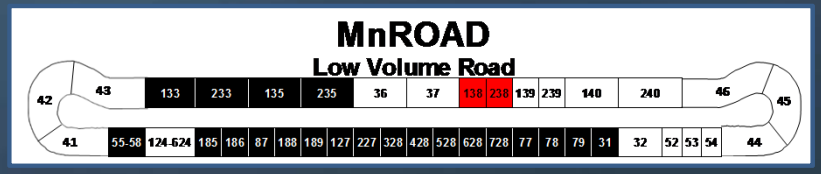
Can it be measured?

Early loading of Cells 624

Early loading of Cells 124-424 (524 no loading)

National Road Research Alliance

Rigid Team – Optimizing Cement Content for PCC Mixes



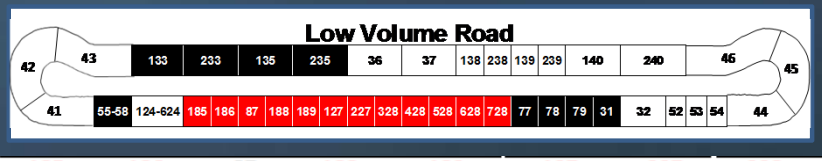
138	238
8" PCC 1" Dowel 15'Lx12'W Astro Turf 500 lbs Cement	8" PCC 1" Dowel 15'Lx12'W Astro Turf 470 lbs Cement
5" Class 5	5" Class 5
Clay	Clay

Goal - How can we optimize the amount of cement without impacting the workability and long-term pavement performance?

Develop → Collaborate → Research → Implement → Sustain.

Geotechnical Team – Recycled Aggregates Bases and Large Subbase Materials

National Road Research Alliance



Goals - What's the best use of recycled unbound aggregate bases in our pavement layers to promote recycling, maintain quality, and achieve long pavement life?

185	186	87	188	189	127	227	328	428	528	628	728
3.5" HMA	3.5" HMA	4" HMA	3.5" HMA	3.5" HMA	3.5" HMA	3.5" HMA	3.5" HMA	3.5" HMA	3.5" HMA	3.5" HMA	3.5" HMA
12" Coarse RCA	12" Fine RCA	4" Mesabi Ballast	12" Recycled Agg Base Class 6	12" Recycled Agg Base Class 6	6" Class 6	6" Class 6	6" Class 6	6" Class 5Q	6" Class 5Q	6" Class 5Q	6" Class 5Q
3.5" Select Granular Borrow	3.5" Select Granular Borrow	11"	3.5" Select Granular Borrow	3.5" Select Granular Borrow	18" Large Subbase 1 lift	18" Large Subbase 2 lifts	9" Large Subbase	Grid 1 9" Large Subbase	Fabric Grid 1 9" Large Subbase	Fabric Grid 2 9" Large Subbase	Grid 2 9" Large Subbase
Sand	Sand	Clay Sand	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay

Goals - How best can we use large stone subbase layers that require less crushing? What are the benefits of this supporting layer over soft soils?

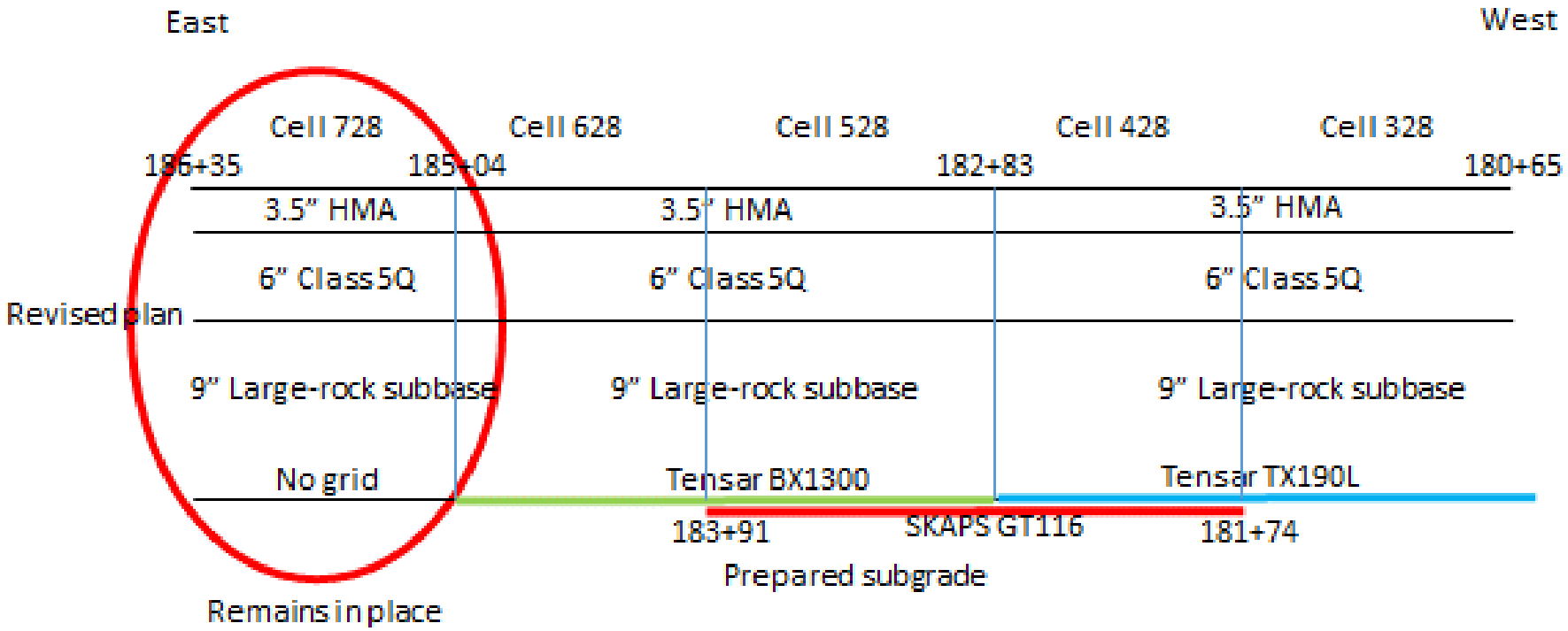
Develop → Collaborate → Research → Implement → Sustain.

Large-sized Subbase (X27 and X28)

- Objectives
  - Test soft-soil condition stabilization technique used by Wisconsin, Illinois
  - Two sections: 9-inch and 18-inch
  - Same aggregate base and bituminous pavement section above
  - Create condition with moisture, scarification, and minimum compaction
  - Penetration Index req ➔ 2.5-3.5 inches per blow over top 1-foot
- Construction
  - 9-inch section failed within one week



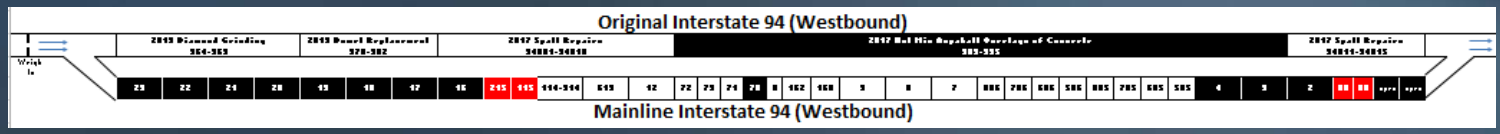
Redesigned sections



Redesigned sections

NRRA
National Road Research Alliance

Preventative Maintenance Team – **Maintaining Poor Roadways**



215	115
1.5" HMA	MicroSurface
2.25" WM 58-34	2.6" WM 58-34
11" 64-22 1993 HMA	11" 64-22 1993 HMA
Clay	Clay
M-Mill .75" Overlay 1.5" (2 0.75" lifts, 4.75 mm PG 58V-34)	M-Mill .375" Micro surface CQS-1P 0.375"

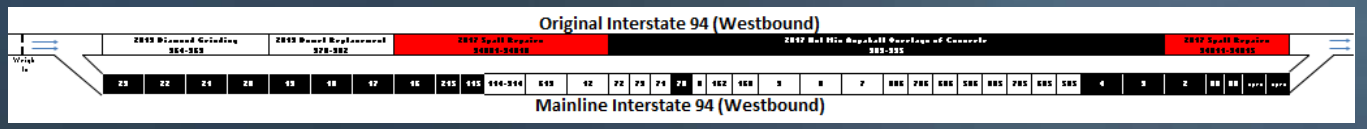
201	101
MicroSurface	0.75" HMA
6" 58-28 75 blow	5.5" 58-28 75 blow
33" Class 4	33" Class 4
Clay	Clay
Mill 0.375" CQS-1P 0.375" 2 lifts	M-Mill 0.75" 0.75" 4.75mm PG 58V-34

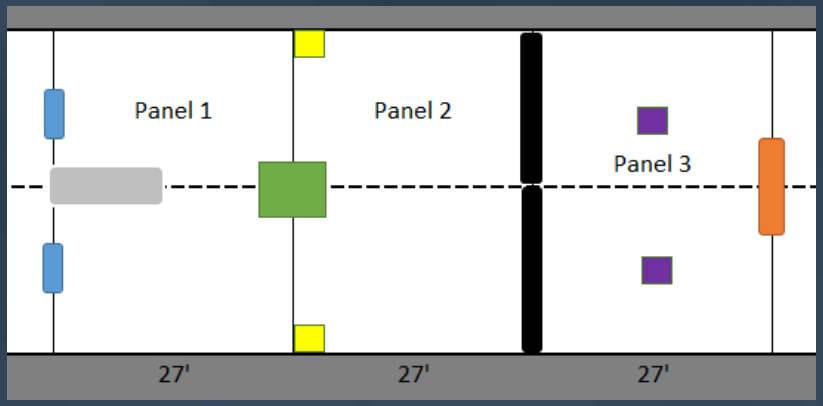
Goal - What are the best practices for maintaining existing asphalt and concrete roadways?

Develop → Collaborate → Research → Implement → Sustain.

National Road Research Alliance

Preventative Maintenance Team – **Maintaining Poor Roadways**

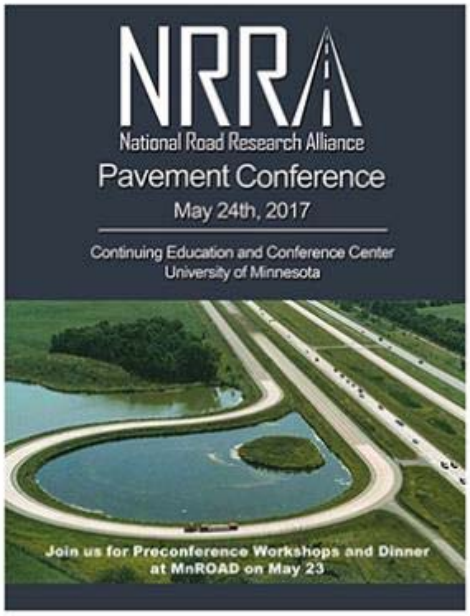




Goal - What are some of the best partial depth repair methods used to fix concrete pavements?

Technology Transfer Team

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



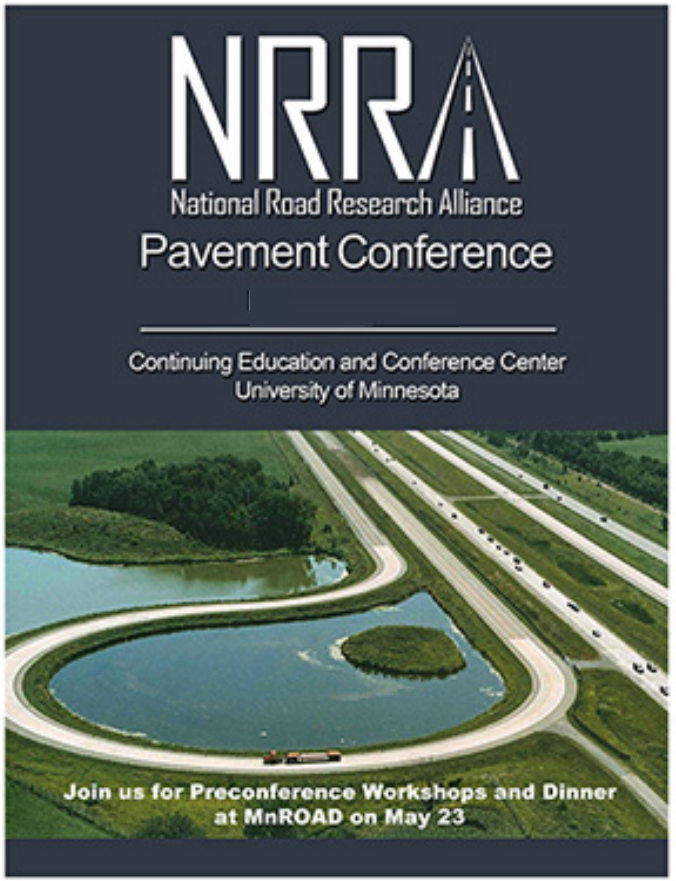
- **NRRA**
  - Follow NRRA on Linkedin
  - May 23-24 2018 Conference

- **Newsletters**
  - Highlight Members
  - Highlight NRRA Projects
  - Highlight Emerging Technology

- **Research Partnerships**
  - Looking for opportunities
  - Offsite pavement studies
  - Sharing of Materials

2018 Planning for Spring Sponsor Meeting

- **Workshop – May 23**
  - Topics
  - Format
- **Pavement Conference – May 24**
  - AM General Sessions
  - PM Concurrent Sessions
    - Topics
    - Process



What else can be done for our associates?

- **Discussion**

Topics from 2018 TRB?

- **Discussion**
- **Ideas**
- **Future NRRA Opportunities?**

SPR Funding / Membership Discussion

- **Membership**
- **Need more states?**
- **Need more funding?**
- **Membership Rate Change?**
  - **150 – Membership Agency**
  - **75K – Supporting Agency**
  - **2K - Associate**

- **Discussion**

(Note Executive Committee will be reviewing year 4-5 funding next summer)

MnROAD NCAT Partnership Relationship

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

DEPARTMENT OF TRANSPORTATION

- **Phase – 1**
  - Ends 2018
  - PG = $120K/yr
  - CG = $210K/yr
  - March Sponsor Meeting
- **Phase - 2**
  - PG – MnDOT Lead
  - $50K/yr
  - CG – Alabama Lead
  - $100K/yr
- **Operations**

National Pavement Preservation Study

Development of a National Cracking Test

Current Studies / Sister Studies?

MnROAD Overall Studies

- **35 unique ongoing studies**
- **141 unique 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

Low Volume Road

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

Additional Offsite Test Sections

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

- **NRRA Members**
- **Other Test Sections**

“non” Pavement Research Opportunities?

Autonomous Bus

- First Group, WSB, EZMILE, 3M

Roadside Vegetation

- University of Minnesota

Traffic/WIM Technology

- Kistler, Intercomp, IRD

3M

- Machine Vision
- Pavement Marking

Discussion?


WISCONSIN DEPARTMENT OF TRANSPORTATION
Caltrans
Illinois Department of Transportation
LRRB
LOCAL ROAD RESEARCH BOARD
DEPARTMENT OF TRANSPORTATION
MDOT
Michigan Department of Transportation
MoDOT


DEPARTMENT OF TRANSPORTATION
MoDOT
MDOT
Michigan Department of Transportation
Illinois Department of Transportation
WISCONSIN DEPARTMENT OF TRANSPORTATION
Caltrans
LRRB
Minnesota State University
University of New Hampshire
NDSU
UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
National Concrete Pavement Technology Center
Michigan Technological University
AGGREGATE & READY MIX ASSOCIATION OF MINNESOTA
NRRA
National Road Research Alliance
National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY
UMD
University of Minnesota Duluth
Driven to Discover
PITT
SWANSON ENGINEERING
HELIX
APA
Strategic Implementation Through
Cooperative Pavement Research
BRAUN INTERTEC
MIDSTATE
GSE
ENVIRONMENTAL
AMPP
CONCRETE PAVING ASSOCIATION OF MINNESOTA
Cargill
UCPRC
Center for Transportation Infrastructure Systems
CTIS
ARRA
ingios
FLINT HILLS resources
MATHY
DIAMOND SURFACE INC.
IGGA
International Grooving & Grinding Association
Minnesota Asphalt Pavement Association
INFRASENSE
ROADSCANNERS
ASTEC
CEI ENTERPRISES
COLLABORATIVE AGGREGATES LLC
3M
WSB
AMERICAN ENGINEERING TESTING, INC.
paviasystems
BASF
We create chemistry
All States Materials Group®