

Meeting Minutes: NRRRA Intelligent Construction Technologies (ICT) Team

(Agency & Associate Member Meeting)

Date: August 5, 2021
 Minutes prepared by: Rebecca Embacher
 Location: Microsoft Teams
 NRRRA Team Webpage: <http://www.dot.state.mn.us/mnroad/nrra/structure-teams/intelligent-construction/index.html>

Attendance

Agency Members

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☐	North Dakota	David Bruins	
☐	North Dakota	Nathan Haaland	

Other Attendees: Joseph Podolsky (MnDOT), Jim Schneider (MnDOT)

Decisions Made

- Finalizing MnROAD Reconstruction Construction / Testing Matrix

Action items

- Continue working on contract paperwork for projects approved for funding.
- Continue finalizing MnROAD Reconstruction Construction / Testing Matrix.

Agenda

- Fall Workshop Update
- 2022 MnROAD Construction Timeline
- Working meeting discussing which ICTs to use during construction of the various Test Cells

Next Meeting

Date: September 2, 2021

Time: 10:30-11:30AM Central Time

Location: Microsoft Teams

Agenda items: Complete Brainstorming of ICTs to use during MnROAD Reconstruction

Meeting Notes

Fall Workshop Update (Worel)

See attached slides 2-3.

Reminder requesting 3 agency members to share examples of work implementing results from NRRA projects.

Please complete the online survey if you have not already done so. This survey lists the projects currently funded. The intent is to reduce this list down to allow for one project to be presented at the workshop from each NRRA team. Presentations for other projects, not being presented at the fall workshop, can still occur during the monthly research pays off seminars if interested.

The executive committee is discussing the possibility of creating a PowerPoint slide deck containing a summary of all of the research projects that are currently being funded by NRRA. 1-2 slides describing the objective of the study, general study, and who is participating in this study would be created for each project.

ICT During MnROAD Construction (All – Working Group Discussion)

Please note that ICT ideas, and discussion elements, were written “live” on slides during the meeting. See attached slides 4-23.

Intelligent Construction Technology Team

Meeting | 08/05/21

Microsoft Teams

Fall Workshop: September 13-15

- In-Person
 - Social Distancing
- Travel Costs
 - NRRRA Pay: 2 members per agency
 - Members only participating in ICT/Veta – NRRRA cover 1 member
 - More state members can attend
 - Add'l \$\$ may be available
- NRRRA Implementation Examples
 - 3 Agency members to share

2022 MnROAD Construction Timeline

See spreadsheet

HMA Reflective Cracking Study

- tied to NCAT additive and Missouri test sections
- Existing Test Sections: 16-23 (4,487 feet)
- Construction:
 - Remove 5" HMA – Replace with 6" HMA mix on 12" class-6 granular base
 - 10 test sections (400 feet with 25' before and after for coring ~450 feet total of each mix)
- Action Needed:
 - Flexible Team determine what 10 HMA mixes are needed?
 - GeoTechnical Review (at a later time) base materials (we need a consistent base for study)
 - ICT Team – what technology could be utilized in this ~4,500 ft of granular base or HMA paving?

Reconstruction of Cells 16-23

4,500 feet

2016 HMA Performance Testing Test Sections (tied to NCAT)

Replace:
with 6" HMA
3, 2" Lifts

Remains:
12" Class 6

	23	22	21	20	19	18	17	16
	5" HMA PG 64E-34	5" HMA PG58H-34	5" HMA PG 58H-34	5" HMA PG 52S-34	5" HMA PG 64S-22	5" HMA PG 64S-22	5" HMA PG 64S-22	5" HMA PG 64S-22
	Low LTC Potential 15% RAP HiMA 12" Class 6	High LTC Potential 20% RAP LMS PG Binder + anti-strip 12" Class 6	Med LTC Potential 20% RAP Typical Mix 12" Class 6	Med/High LTC Potential 30% RAP 12" Class 6	Med LTC Potential 20% RAP 3% Air Voids 12" Class 6	Med LTC Potential 20% RAP 12" Class 6	High LTC Potential 10% RAP 5% RAS 12" Class 6	High LTC Potential 20% RAP 5% RAS 12" Class 6
	12" Class 3	12" Class 3	12" Class 3	12" Class 3	12" Class 3	12" Class 3	12" Class 3	12" Class 3
	7" Select Gran	7" Select Gran	7" Select Gran	7" Select Gran	7" Select Gran	7" Select Gran	7" Select Gran	7" Select Gran
	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay
Opened Length (ft)	Sept 16 500	Sept 16 500	Sept 16 500	Sept 16 500	Sept 16 500	Sept 16 500	Sept 16 500	Sept 16 500
Gap (ft)		80	80	90	50	70	70	47

10 Test Sections @ 450 feet

Cells 16-23 ICT

Material	Technology
Pre-Milling	3D GPR (thickness), FWD, TSD (traffic speed deflectometer / NCHRP project – completed in September 2021 on all test sections; data also available from 2019, 2020) Smoothness (already being collected as part of standard matrix) Scan road and create 3D existing and milled surface models Is milling texture being looked at and affect on bonding (e.g., drum speed)?
Milling	AMG (Variable Depth) Milling ($\geq 1,000$ feet) – tie Phase I milling study (is need for AMG to support this study?) – Include as Contract Item review thickness to determine if variable depth milling is needed (if uniform thickness – conventional milling can be used, unless Phase I milling study is desiring access the measurements collected by AMG system).
12" Granular Base	IC Pre-Mapping (Phase I project – level 3 ICMV depending upon timing) – include as contract item LWD, DCP (assuming refusal) – collecting by OMRR Research? Scanning of Moisture – tie to Phase I project Corrective Action Needed?... GPR – for correlation with continuous moisture

Material	Technology
6" Hot Mix Asphalt	Variable Depth Paving – Contract (concern: No paving contractors in MN set up with this technology – pave to depth with AMG milling) Asphalt Real-Time Smoothness (ARTS) (Phase I project – if available) – Add via Change Order if technology ready IC – contract item (special provision) PMTP – contract item (special provision) MDMS – contract item (special provision) Smoothness – contract item FWD – collected by OMRR research DPS – collected by OMRR research (collaboration on cores w/ Flex Team) must collect 3 linear passes of k-measurements (adjacent CL, middle of lane, adjacent to shoulder; data lot labeling must be used and follow other ICT requirements) Seismic – collected by Geotech if system available (phase I project) Road Doctor (include GPR – layer thickness) – collected by OMRR research TSD (Pay for service is available) NRRA Project - Continuous Moisture Meter ? (has not currently been used on asphalt) GPR – correlation with continuous moisture

All spot tests (LWD, Density, etc.) – collect RTK GPS coordinates and/or station and offset

Laser Scanning if AMG milling is completed

As-Builts recorded during AMG milling & paving and done

3 Concrete Studies

12	72	73	71	70	96	162	160	9	8	7	806	706	606	506	805
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Study - Use of Carbon Dioxide for Sustainable and Resilient Concrete Pavements

Study - Reduced Cement in Concrete

Alternative Cementitious Materials – Geopolymer Concrete

- (three studies – Rigid team determines the number of cells for each)
- Existing Test Sections:
 - First Grouping - 506, 606, 706, 806, 7, 8, 9 (2,074 feet)
 - gap
 - Second Grouping - 96, 70 (648 feet), 71, 73, 72 (945 feet), 12 (499 feet)
- Construction:
 - Remove existing concrete and base materials varying depths
 - Pave 7.5" PCC with common drainable granular base – 15' panels - input from Geotech team
 - First Grouping - 8 test sections (~250 feet each with no transitions)
 - Second Group – 8 test sections (~250 feet each with no transitions)
- Action Needed:
 - Rigid Team determine the number and concrete mixes for each study from the above utilizing the 16 test section locations.
 - Rigid Team discuss the need for a consistent base support (can the geotechnical have variations built into the test sections and not effect the surface material studies)?
 - GeoTechnical Review (at a later time) base material
 - ICT Team – what technology could be utilized in this granular base or PCC paving?
 - Assume a common control mix could be shared as one test section leaving 15 test sections.
 - Note that cells 71,73,72 do not have to be reconstructed due to pavement condition. Could be withheld from the contract if costs come in high.

Reconstruction of Cells 12, 70-73 & 96

Remove Existing
Concrete & Base at
varying depths

~ 2,000 feet

7.5" PCC
15' Panels

Common
Drainable Base

4" Class 5Q Drainable Granular Base
5.5" Class 7 Recycled Granular Base
(may or may not use a paver)

SHRP-II Composite Pavements				Wh Reir
72	73	71	70	96
3" PCC 15'Lx12'W 1.25" dowel	3" PCC 15'Lx12'W 1.25" dowel	3" PCC 15'Lx12'W 1.25" dowel	3" 64-34 Saw/Seal	MicroSurface 6" Fiber Reinf. PCC
6" PCC Low Cost	6" PCC Low Cost	6" PCC Recycle	6" PCC Recycle	2011 Traditional Grind
8" Class 7	8" Class 7	8" Class 7	8" Class 7	7" 58-28 93HMA
Clay EAC Surface	Clay Innovative Grind (Driving Ln) Convent. Grind	Clay Innovative Grind (Driving Ln) Convent. Grind	Clay 15'Lx12'W Driving Ln 1.25" dowel	Clay 5'Lx6'W Polyolefin Fibers 25pcy
May 10 469	May 10 210	May 10 267	May 10 480	Oct 97 168

5

8 Test Sections ~ 250 feet (no transitions)

Reconstruction of Cells 7-9, 506, 606, 706, 806

Remove Existing
Concrete & Base at
varying depths

7.5" PCC
15' Panels

Common Drainable Base

4" Class 5Q Drainable Granular Base
5.5" Class 7 Recycled Granular Base
(may or may not use a paver)

~ 2,000 feet						
Original 5-Year PCC			Fiber Reinforced PCC			
9	8	7	806	706	606	506
7.5" PCC 2008 Ultimate Grind	7.5" PCC 2007 Traditional Grind	7.5" PCC 2007 Innovative Grind	5" Fiber Reinf. PCC (High) Astro Turf	5" Fiber Reinf. PCC (Enhanced) Astro Turf	5" Fiber Reinf. PCC (Standard) Astro Turf	5" PCC Control No Fibers Astro Turf
4" PSAB	4" PSAB	4" PSAB	11" Class 5Q	11" Class 5Q	11" Class 5Q	11" Class 5Q
3" CI 4	3" CI 4	3" CI 4				
Clay	Clay	Clay	3" Class 5	3" Class 5	3" Class 5	3" Class 5
15'Lx14'W 15'Lx13'W	15'Lx14'W 15'Lx13'W	20'Lx14'W 20'Lx13'W 1" dowel	Clay	Clay	Clay	Clay
13' PCC Shoulder	13' PCC Shoulder		Fibers 0.75% by Volume	Fibers 30% RSR	Fibers 20% RSR	
Passing Ln 1" dowel	Passing Ln 1" dowel					
Opened Sep 92	Opened Sep 92	Opened Sep 92	2017	2017	2017	2017
Length (ft) 518	Length (ft) 510	Length (ft) 500	131	135	134	146
Gap (ft) 8	Gap (ft) 30	Gap (ft) 35	Gap (ft) 28			

8 Test Sections ~ 250 feet (no transitions)

Material	Technology
4" Class 5Q Drainable Granular Base	IC Pre-Mapping (Phase I project – level 3 ICMV depending upon timing) – include as contract item (mat'l left in place) IC during compaction efforts (ICMV, MDP) – (MDP would require partnership with Caterpillar) LWD, DCP (assuming refusal) – collecting by OMRR Research? Continuous Moisture Testing – tie to Phase I project Automated Plate Load Testing (available construction funding?) Lab Modulus Testing – coordinate with cont. moisture & Level 3/4 testing (OMRR will complete lab testing) Density (who will complete the testing?)
5.5" Class 7 Recycled Granular Base	See 5Q comments Use sand cone if testing for density – not nuke
Concrete Paving (may or may not use a paver)	Concrete Real Time Smoothness (CRTS) – SHRP2 program if paver (special provision would be needed; Iowa will check)
Concrete Removals (5-9")	Wirtgen – Hamm H25iVC roller (vibration crusher) – Tim will send info. (particle size ~ 2 ft down to 4" or less) – out for 5-6 years (will not work in 12" thick rebar enforced concrete; uses force going into mat'l to crush – not affected by underlying mat'l; often used in demolition locations, where vibration not a factor) – (Partnership?) Include vibration monitoring (Geotech) Pre-thickness evaluation with 3D GPR

Material	Technology
Existing Clay Subgrade	Will send link to MnDOT standard specs. for subgrade Link is on Geotech team website (state specs and design manuals posted on NRRRA Geotech website). IC: CMV / MDP – if compaction needed

Studies

Thinlays as a PM Treatment

Performance Evaluation of Wicking Geotextiles for Improving Drainage and Stiffness of Road Foundation (ties to 4 and 15 SFDR)

- Existing Test Sections: 2 (575 feet), 3 (575 feet), 4 (575 feet), gap to, 101, 201 (500 feet)
- Construction:
 - Cell 2,3 (minimal repair of SFDR) – split into 4 test sections with minimal PM treatment and thinlay as other treatment. Flex group designs if any milling is done and the mix designs. Example 102 PM treatment, 202 thinlay, 103 thinlay, 203 PM treatment.
 - Cell 4 (extensive repair of SFDR) – Flex and Geotech team design section. How can the wicking geotextile be used to improve system from the past (full depth section with no base was the original roadway before SFDR in 2007)
 - Cell 101, 201 (New reclamation of a 6 inch asphalt with 33 inch granular base) – Flex and Geotech team to design section.
- Action Needed:
 - PM and Flex design surface treatments for cells 2 and 3 good performing SFDR (thinlay and another surface treatment). Note cell 4 and 115-215 also will need surfaces.
 - Flex and Geotech design repairs to cell 4 – highly distressed SFDR
 - Flex and Geotech design a perpetual type of recycled cell to replace 115 and 215.
 - ICT Team – what technology could be utilized in this area?

Cells 2-3 ICT

Material	Technology	Comments
PM Treatments		
Thinlays	AMG Milling	

Possibly
2 Thinlays
2 PM Treatments

Minimal SFDR
Repair

1,150 feet

3	2
1" TBWC	1" TBWC
2"64-34	2"64-34
6" FDR + EE	6" FDR + EE
2" FDR	
2"CI 5	6" FDR
33" Class 3	4" Class 4
Clay	Clay
Oct 08	Oct 08
454	560

4 Test Sections

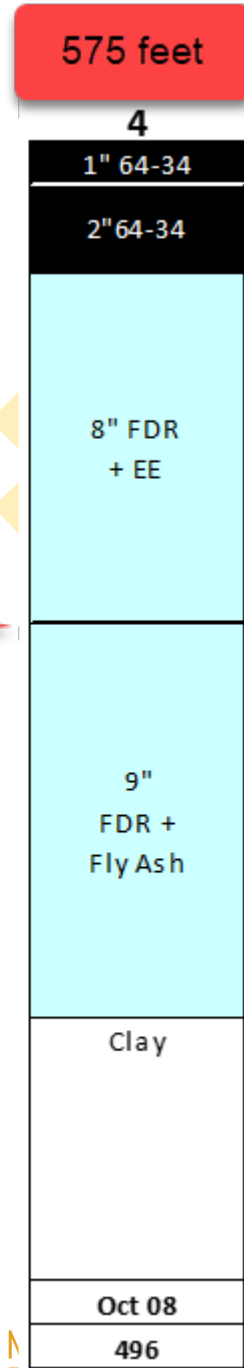
Cell 4 ICT

Surface (?)		
SFDR Repairs	IC	

Extensive SFDR Repair

Flex & Geotech still need to design

Wicking Geotextile to be Used



Cells 101, 201

New SFDR (550 ft)
IC SFDR, HMA
PMTP HMA
DPS HMA
(see other test cells for matrix)

101	201
MicroSurface	0.75" HMA
6" 58-28 75 blow	5.5" 58-28 75 blow
33" Class 4	33" Class 4
Clay Mill 0.375" CQS-1P 0.375" 2 lifts	Clay M-Mill 0.75" 0.75" 4.75mm PG 58V-34
2017	2017
252	248

Reclamation and Recycling Techniques to Achieve Perpetual Pavements Characteristics

- Existing Test Sections: 101, 201 (500 feet)
- Construction:
 - Flexible Team design needed
- Action:
 - Flexible Team – Designs needed for two perpetual pavements
 - How can the wicking geotextile be used to improve system?
 - ICT Team – what technology could be utilized in these test sections?

ICT team needs to wait for more details

Cells 115 & 215 ICT (Perpetual Pavement)

573 feet

8" granular base
12" HMA

Material	Technology
HMA	
FDR	

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"
2017	2017
283	290

Perpetual Pavements in Wet Freeze Climate

- Existing Test Sections: 101, 201 (500 feet)
- Construction:
 - Flexible Team design needed
 - 1 or 2 test sections – match Wisconsin plus?
- Action:
 - Flexible Team – Designs needed for two perpetual pavements
 - Can a 250 foot section work?
 - ICT Team – what technology could be utilized in these test sections?

ICT team needs to wait for more details

Recycled Binder Availability

- Existing Test Sections:

- 160, 162 (447)
- (Break betw
- 114, 214, 3

- Construction

- Remove 18
- 12" granula
- 4 test secti

- Questions:

- Flex team –
- Flex team – do these test sections have to be at MnROAD? Could they be on another roadway because instrumentation is not a priority?
- Geotechnical Group – What base is suggested?

Latest Update: MnROAD sections may not be needed

Latest Update:
MnROAD sections may not be
needed

Cells 160,162,114,214,314,414,514,614,714,814,914 ?

- 12" Granular
- 6" HMA
- 4 test section

Material
Granular Base
HMA

Latest Update:
MnROAD sections may not be
needed

BCOA “Whitetopping” with Fibers

- Existing Test Sections: 114,214,314,414,514,614,714,814,914 (520 feet)
- Construction:
 - Remove existing 6” PCC + mill 1” HMA
 - Construct 5” FRC, 6’x6’ panels BCOA. Use fibers intended to enhance joint LTE (ranked #6)
- Question:
 - Test sections do need work
 - MnDOT would do the needed research at our costs

Cells 114,214,314,414,514,614,714,814,914 (520 feet)?

Material	Technology	Comments
Concrete		

2022 MnROAD Construction Timeline

Project Start:

Thu, 10/7/2021

Display Week:

1

TASK	Responsibility	Key NRRRA	PROGRESS	START	END
Design and Award Contracting					
Layer Design (MnDOT and Teams)	MnROAD/Teams	x	0%	10/7/21	9/1/21
Contracted Design Plans (hired)	MnROAD		0%	9/1/21	11/1/21
Special Provisions Final (MnDOT and Teams)	MnROAD	x	0%	10/1/21	12/1/21
Final Assembly/Review	MnDOT		0%	12/1/21	1/1/22
Construction Advertisement (4 weeks)	MnDOT		0%	1/15/22	2/15/22
Letting (Feb 2022)	MnDOT	x	0%	2/26/22	3/12/22
Contract Award	MnDOT		0%	3/14/22	3/28/22
Material Recommendations					
ETG on PCC Mix Designs (contracted) (need to develop contract)	Consultant		0%	9/1/21	12/31/22
Rigid Mix Designs (input from ETG)	Rigid and ETG	x	0%	9/1/21	3/1/22
Flexible Mix Designs (input from NCAT)	Flex and PM	x	0%	9/1/21	3/1/22
Recycled Designs	Flex and Geo	x	0%	9/1/21	12/31/21
Base Designs	Geo	x	0%	9/1/21	12/1/21
Construction					
CAT Partnership (milling)	CAT/MnROAD		0%	4/15/22	5/1/22
Forensics (Cores, LWD)	MnROAD		0%	8/1/21	6/1/22
Contracted Construction Fixed Days	General		0%	5/1/22	8/1/22
Overall Inspection	D3 / MnROAD		0%	5/1/22	9/1/22
HMA Plant Inspection	NCAT / MnROAD		0%	5/1/22	8/1/22
Concrete Plant Inspection	D3 / MnROAD		0%	5/1/22	8/1/22
Concrete Removals	Contractor		0%	4/15/22	5/1/22
Base and Subgrade Removals	Contractor		0%	5/1/22	5/15/22
Sensor Installations	Contractor		0%	5/15/22	6/12/22
Unbound Base Placement	Contractor		0%	5/15/22	5/29/22

Timeline

Display Week:

1

TASK	Responsibility	Key NRR	PROGRESS	START	END
SFDR Placement (Possible Partnership)	Contractor		0%	5/15/22	5/29/22
HMA Paving	Contractor		0%	5/19/22	6/12/22
PCC Paving	Contractor		0%	5/29/22	6/12/22
NRR Contracting for Research and Construction Efforts					
Construction - ETG on PCC Mix Designs Contract	Direct Select		0%	8/15/21	12/30/22
Construction - Sampling and Testing PCC	Direct Select		0%	8/15/21	12/30/22
NRR Teams Finalize RFP / Direct Select Statements	NRR TAP	x	0%	8/17/21	12/30/22
RFP Posting Period	MnDOT	x	0%	8/17/21	9/17/21
RFP Technical Review and Selection	NRR TAP	x	0%	9/18/21	10/18/21
Contracting - MnROAD Reflective Cracking Challenge	RFP		0%	1/1/22	12/30/22
Contracting - Recycled Binder Availability	RFP		0%	1/1/22	12/30/22
Contracting - Validation of Loose Mix Aging Procedures for Cracking Resistance Evaluation in Balanced Mix Design	RFP		0%	1/1/22	
Contracting - Perpetual Pavements in Wet Freeze Climate	RFP		0%	1/1/22	
Contracting - Reclamation and Recycling Techniques to Achieve Perpetual Pavements Characteristics	RFP		0%	1/1/22	
Contracting - Thinlays as a PM Treatment	Direct Select		0%	11/1/21	
Contracting - Technical Expert Guidance on PCC Mixes and Construction	RFP		0%	1/1/22	
Contracting - Reduced Cement in Concrete	RFP		0%	1/1/22	
Contracting - Use of Carbon Dioxide for Sustainable and Resilient Concrete Pavements	RFP		0%	1/1/22	
Contracting - Alternative Cementitious Materials – Geopolymer Concrete	RFP		0%	1/1/22	
Contracting - Sampling and Testing Contract (construction)	Direct Select		0%	4/1/22	12/31/22
Contracting - EPD Development for 2022 MnROAD Construction	RFP ?		0%	1/1/22	
Contracting - Flooded Pavements Assessment App–Phase 2	Direct Select		0%	10/1/21	

Timeline

Display Week:

1

TASK	Responsibility	Key NRRA	PROGRESS	START	END
Contracting - Performance Evaluation of Wicking Geotextiles for Improving Drainage and Stiffness of Road Foundation	RFP		0%	1/1/22	
Contracting - Convert Desktop Version of Veta to a WebBased Application and Standardized Material Delivery Management System Platform (Phase-1 and 2)	Direct Select		0%	9/1/21	
Sensor Installations					
Sensors Layout for each Study	NRRA Teams	x	0%	10/22/21	9/15/21
Sensor Purchasing	MnROAD		0%	10/3/21	11/3/21
Inventory of Cabinets and Vaults	MnROAD		0%	7/28/21	8/15/21
Match Cabinets to Cells	MnROAD		0%	8/15/21	9/1/21
Disconnect Existing Sensors	MnROAD		0%	9/1/21	9/30/21
Cabinets and Vaults Install	Contractor		0%	10/1/21	5/1/22
Sensor Fabrication (TC Trees ----)	MnROAD		0%	1/1/22	3/1/22
Sensor Calibration	MnROAD		0%	1/1/22	3/1/22
Data Collection Datalogger Programming	MnROAD		0%	1/1/22	3/1/22
Database Loader Development	MnROAD		0%	3/1/22	5/1/22
Conduite to sensors	Contractor		0%	6/1/22	6/8/22
Sensor Field Installations	Contractor		0%	6/1/22	6/8/22

2022 MnROAD Construction Timeline

TASK	Responsibility
Design and Award Contracting	
Layer Design (MnDOT and Teams)	MnROAD
Contracted Design Plans (hired)	MnROAD
Special Provisions Final (MnDOT and Teams)	MnROAD
Final Assembly/Review	MnDOT
Construction Advertisement (4 weeks)	MnDOT
Letting (Feb 2022)	MnDOT
Contract Award	MnDOT
Material Recommendations	
Rigid Mix Designs (input from ETG)	Rigid and ETG
Flexible Mix Designs (input from NCAT)	Flex and PM
Recycled Designs	Flex and Geo
Base Designs	Geo
NRRA Contracting for Research and Construction Efforts	
NRRA Teams Finalize RFP / Direct Select Statements	NRRA TAP
RFP Posting Period	MnDOT
RFP Technical Review and Selection	NRRA TAP
RFPs Contracting	RFP
Direct Select Contracting	Direct Select
Sensor Installations	
Sensors Layout for each Study	NRRA Teams