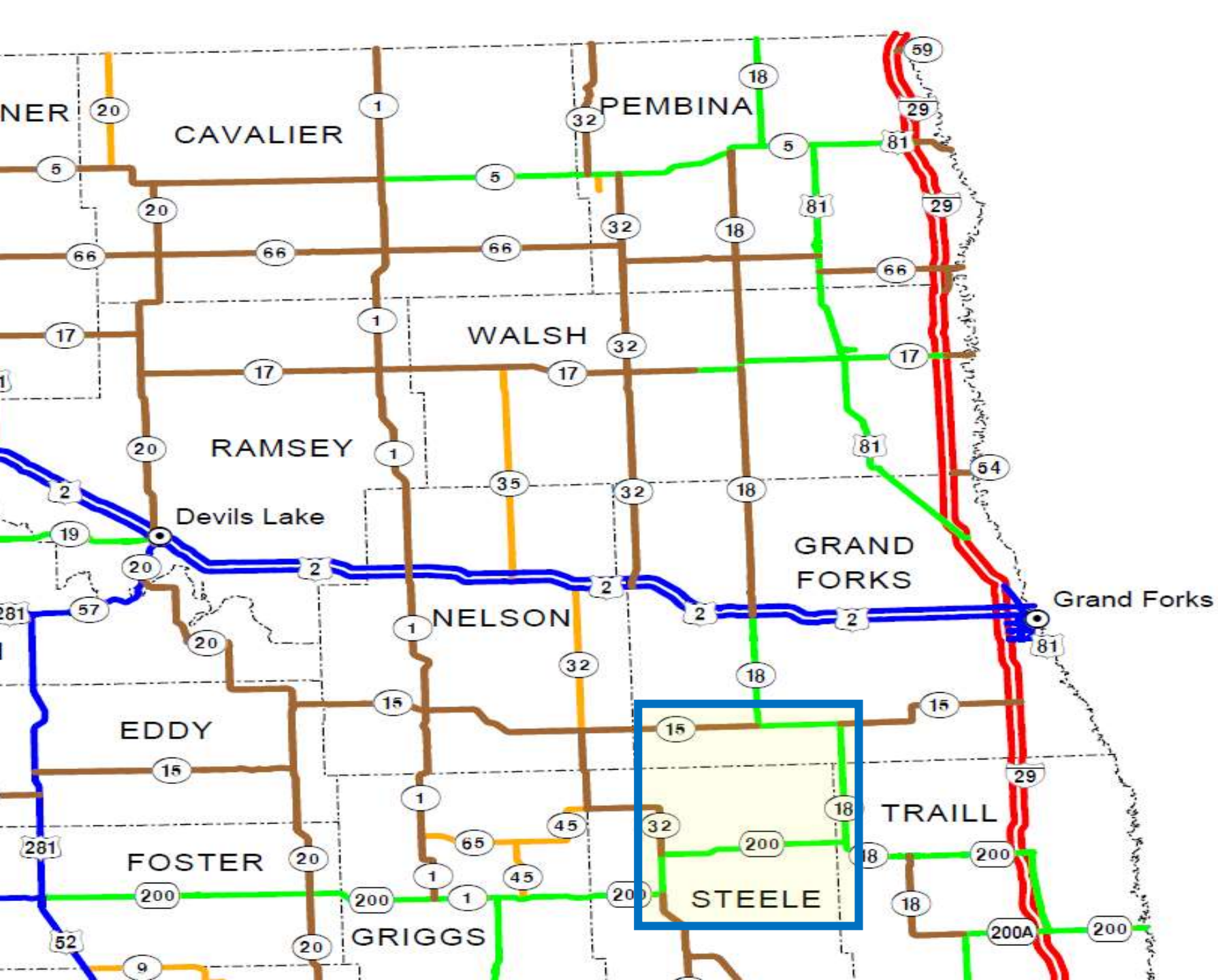
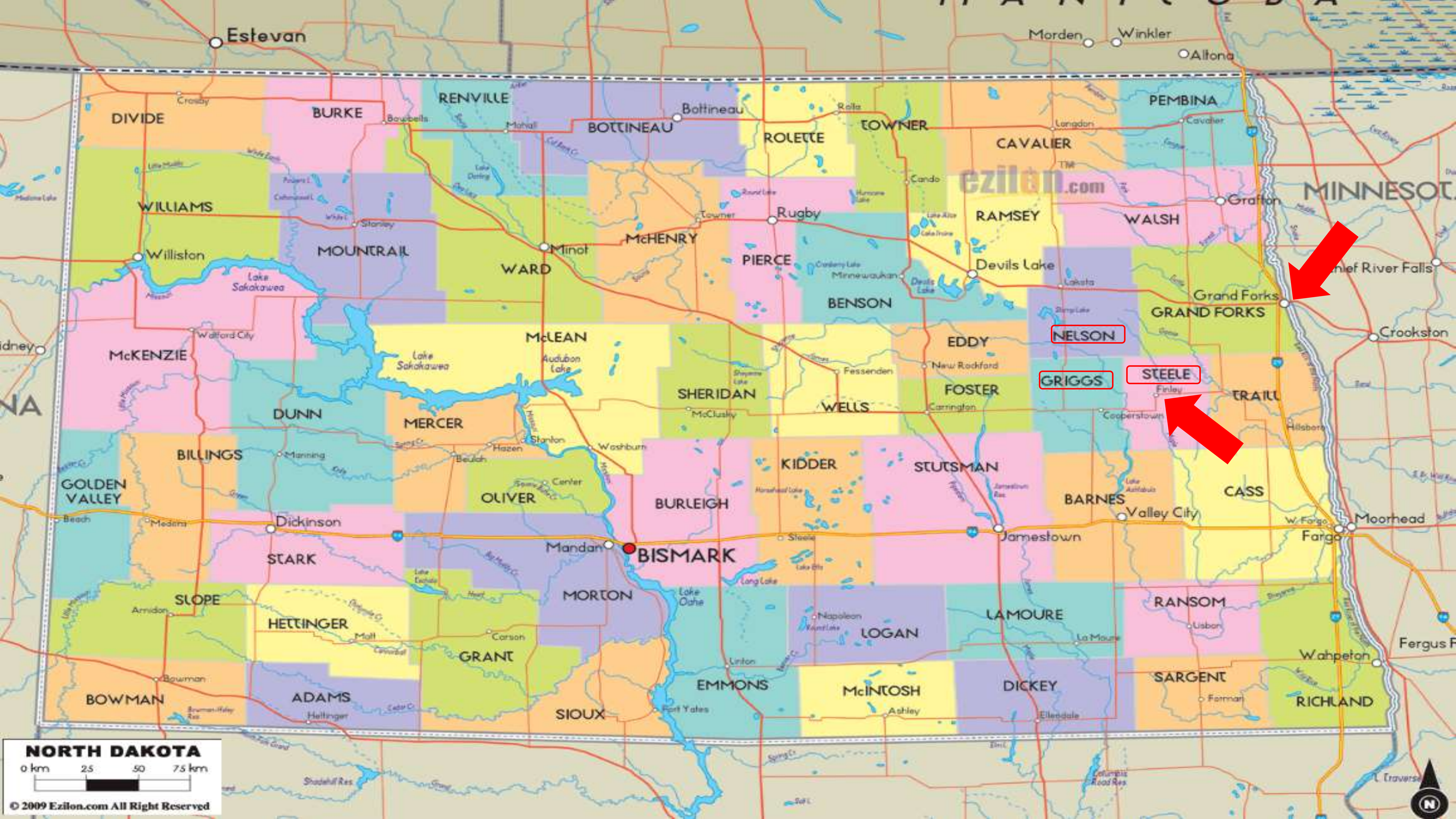
HWY 32 Pavement Test Sections



Highway Classification System

- Interstate
- Interregional
- State Corridor
- District Corridor
- District Collector


Estevan
Morden
Winkler
Altona
DIVIDE
BURKE
RENVILLE
BOTTINEAU
Bottineau
ROLETTE
TOWNER
CAVALIER
PEMBINA
Crosby
Bowbells
Mohall
Rolla
Langdon
Cavalier
Cando
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MINNESOTA
WILLIAMS
Stanley
MOUNTRAIL
Minot
WARD
McHENRY
Towner
Rugby
PIERCE
RAMSEY
WALSH
Grafton
Williston
Lake Sakakawea
Devils Lake
BENSON
Minnewaukan
Lakota
Grand Forks
GRAND FORKS
Thief River Falls
Watford City
McKENZIE
McLEAN
Audubon Lake
EDDY
NELSON
New Rockford
Crookston
Fessenden
SHERIDAN
McClusky
WELLS
FOSTER
Carrington
GRIGGS
STEELE
Finley
TRAILL
Cooperstown
DUNN
MERCER
Stanton
Washburn
Hazen
Beulah
Manning
BILLINGS
KIDDER
STUTSMAN
BARNES
Valley City
CASS
GOLDEN VALLEY
OLIVER
Center
BURLEIGH
Beach
Medora
Dickinson
STARK
Mandan
BISMARK
Steele
Jamestown
W. Fargo
Fargo
Moorhead
SLOPE
Amidon
HETTINGER
Mott
MORTON
Lake Oahe
Napoleon
LOGAN
LAMOURE
La Moure
RANSOM
Lisbon
Fergus F
Carson
GRANT
Linton
EMMONS
McINTOSH
Ashley
DICKEY
Ellendale
SARGENT
Forman
Wahpeton
RICHLAND
Bowman
BOWMAN
ADAMS
Hettinger
SIOUX
Fort Yates
NORTH DAKOTA
0 km 25 50 75 km
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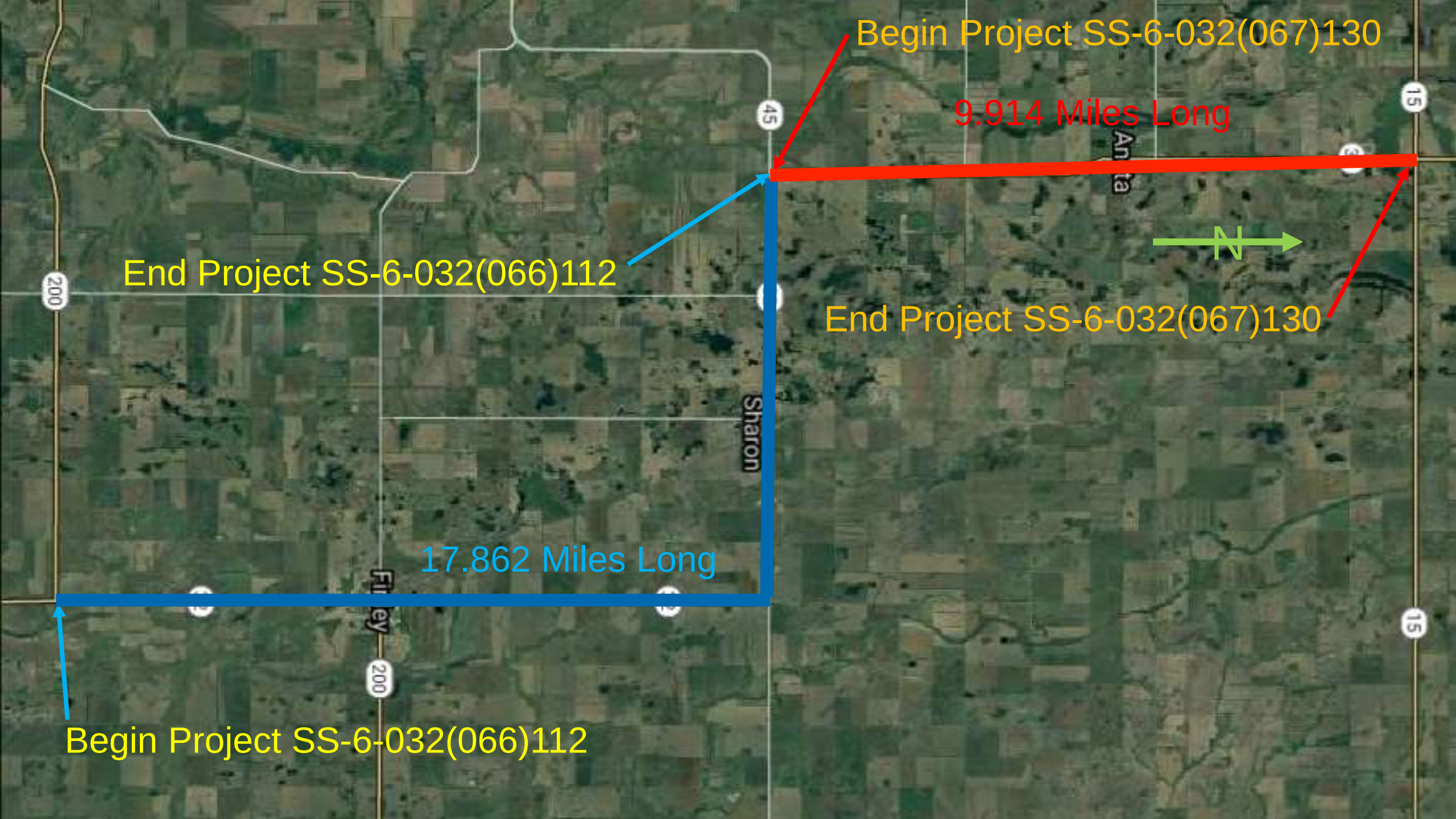

Begin Project SS-6-032(067)130
9.914 Miles Long
End Project SS-6-032(066)112
End Project SS-6-032(067)130
17.862 Miles Long
Begin Project SS-6-032(066)112
45
200
15
Sharon

SS-6-032(066)112 (PCN-22974) & SS-6-032(067)130 (PCN-22975)

27.766 Miles

MILLING, HMA, ADA CURB RAMPS

Owner:

ND/DOT Grand Forks District

Consultant:

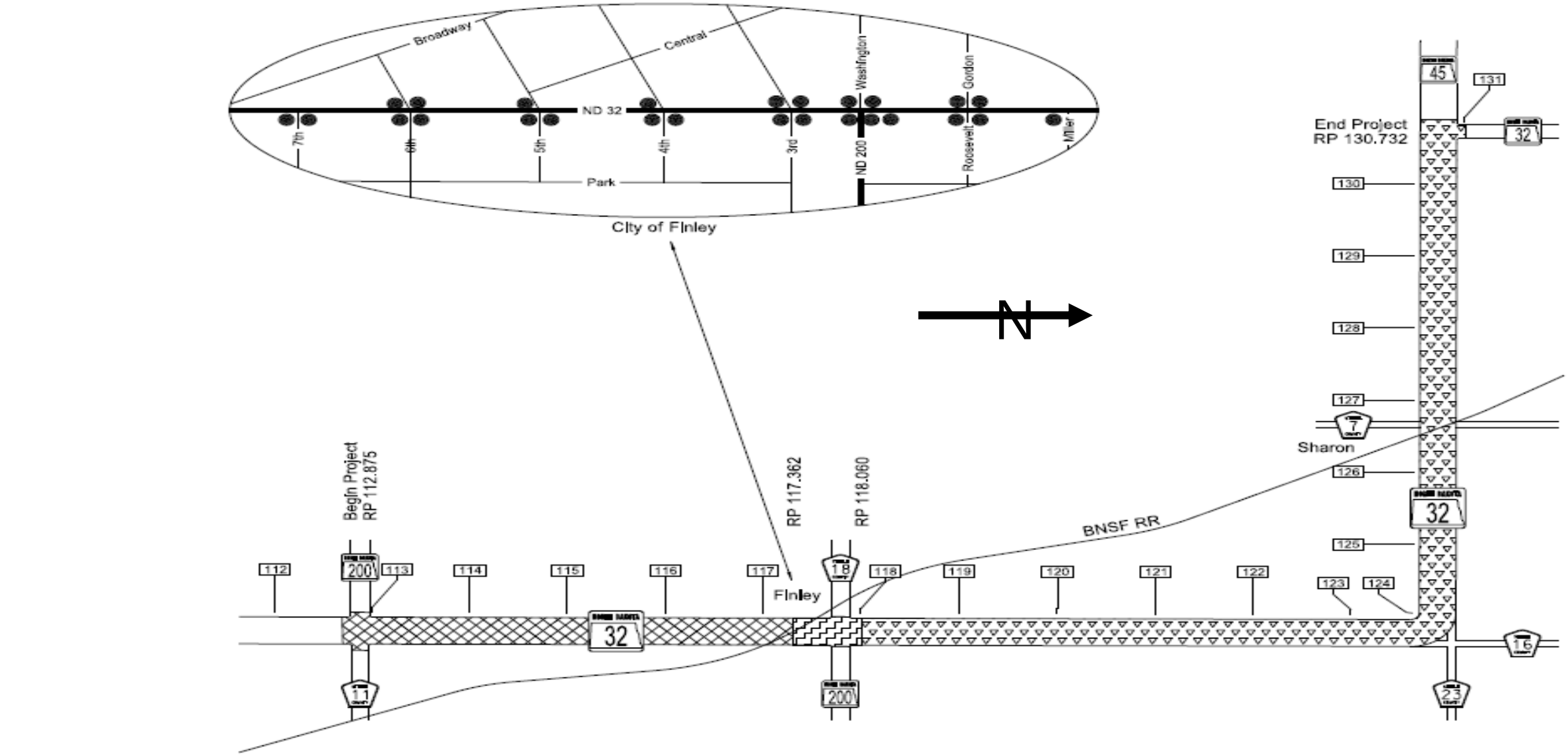
Interstate Engineering Inc.

Prime Contractor:

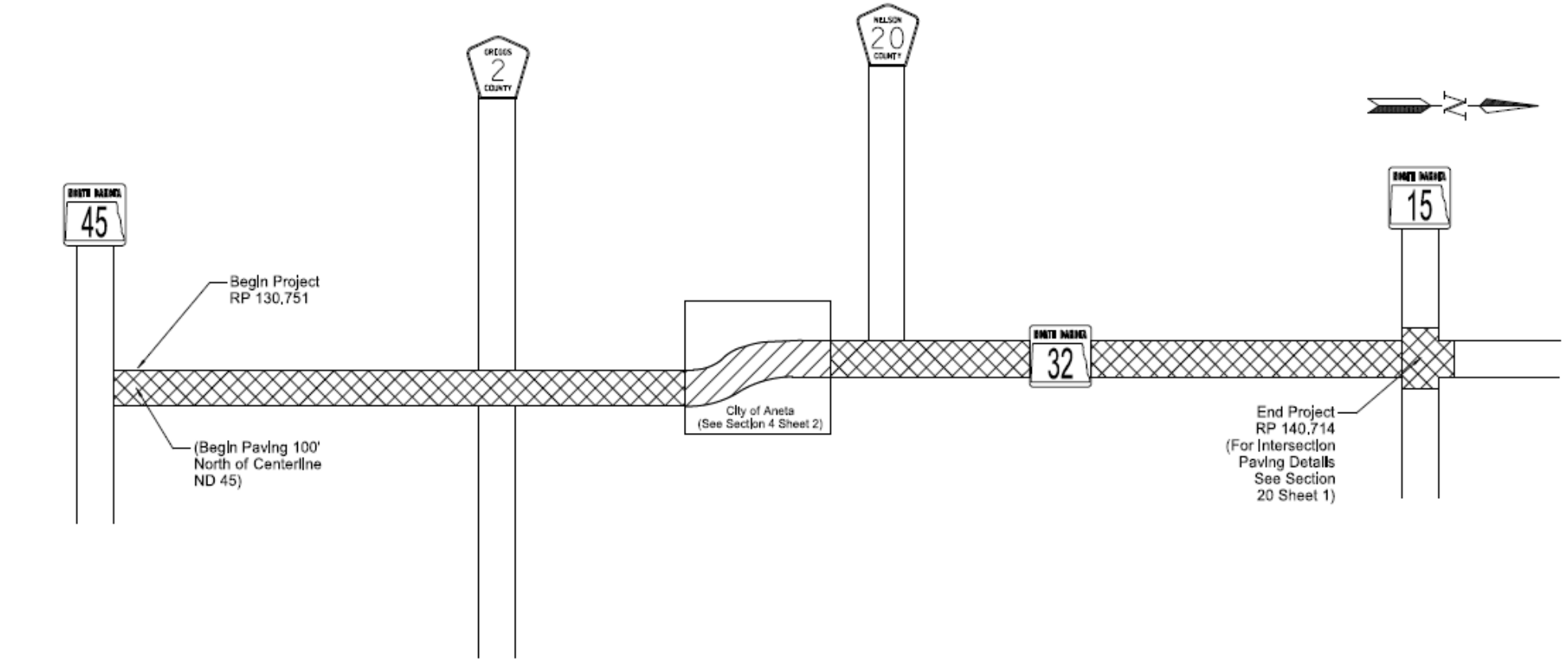
Knife River Materials - Bemidji

Project Scope

- 27.766 Miles Total (17.852 Finley & 9.914 Aneta)
- 1-1/2” & 2” Milling
- 2” HMA (RAP FAA-43)
- Subgrade Repair
- HMA Patching
- ADA Improvements
- Utility Adjustments
- Relaying Milled Material on Shoulders
- Striping/Rumble Strips



Finley
Project SS-6-032(066)112



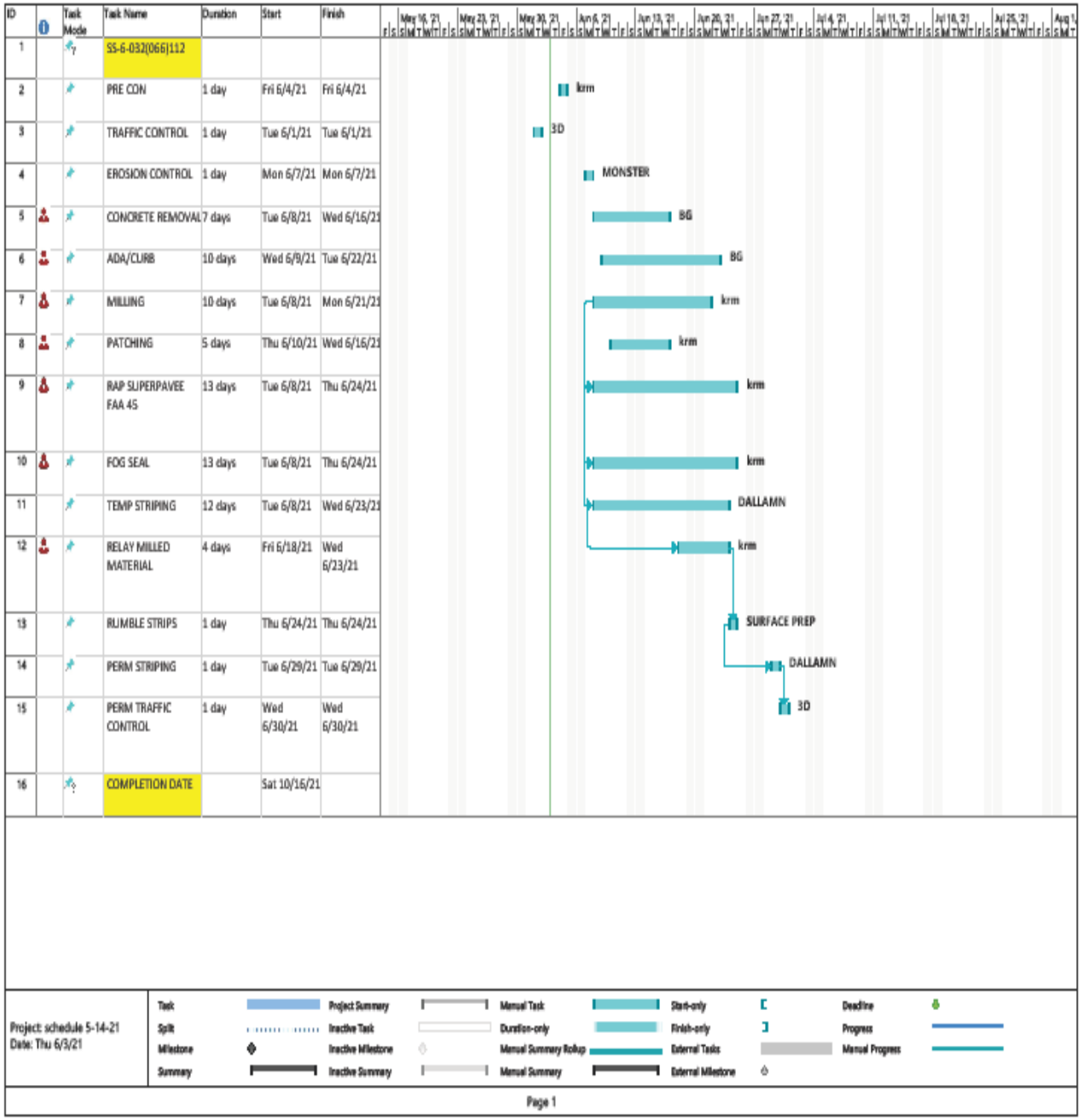
2" Mill and HMA (Aneta)

1" Mill and HMA

Aneta
Project: SS-6-032(067)130

Pre-Construction

- Project Bid on May 14, 2021
- Preconstruction Meeting on June 4, 2021
- Very important to invite everyone due to all the SP'S.
- Communication, communication, communication!



Pre-Construction

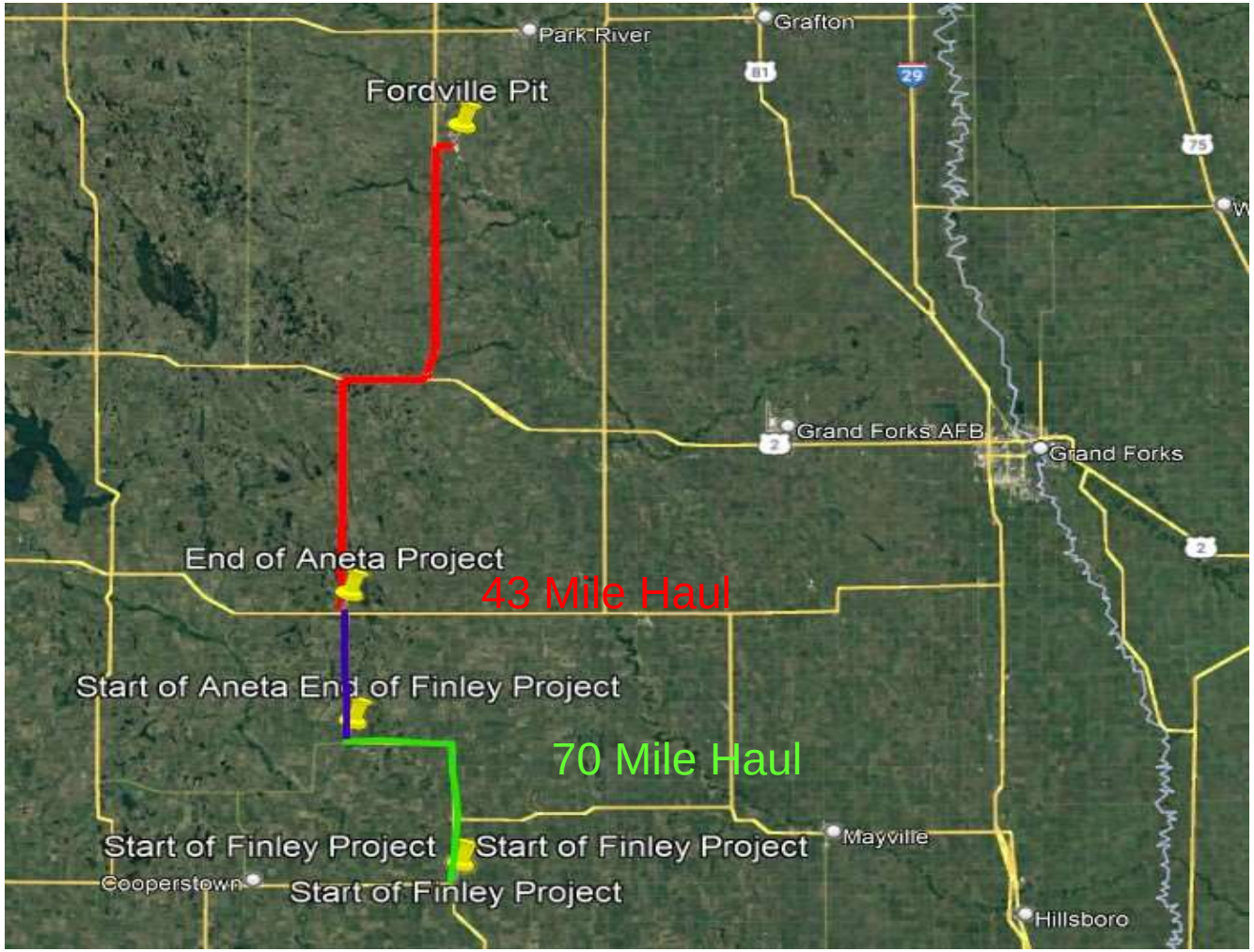
- Coordination immediately following as Prime already had the subcontractor set construction signs up before pre-construction meeting was scheduled.
- Surveyors immediately began setting control for IC/PMTP work & creating alignment.
- Finley & Aneta municipal staff were invited to be involved with meetings to avoid any interference with their city celebrations.

Avoid the “hurry up and wait”

Communication & looking ahead with Engineering staff, Materials & Research and Contractors was vital to coordinate all the pieces to work together to avoid any delays.

Fordville Pit

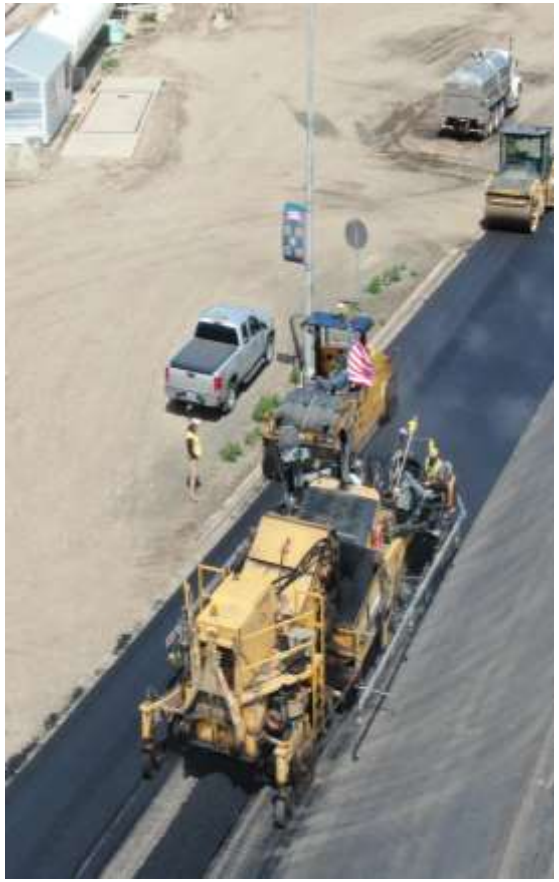
- 43 Mile haul to the north end
- 70 Mile haul to the south end
- 27 Mile diff. from end to end of project
- 40-45 trucks hauling average



Milling

- Milled from June 8, 2021 to June 18, 2021(Finley)
- Milled from June 21, 2021 to June 23, 2021(Aneta)
- Aprox. 15,000 CY of milling went to the Finley truck station first and then the rest was back hauled to the Fordville Plant.

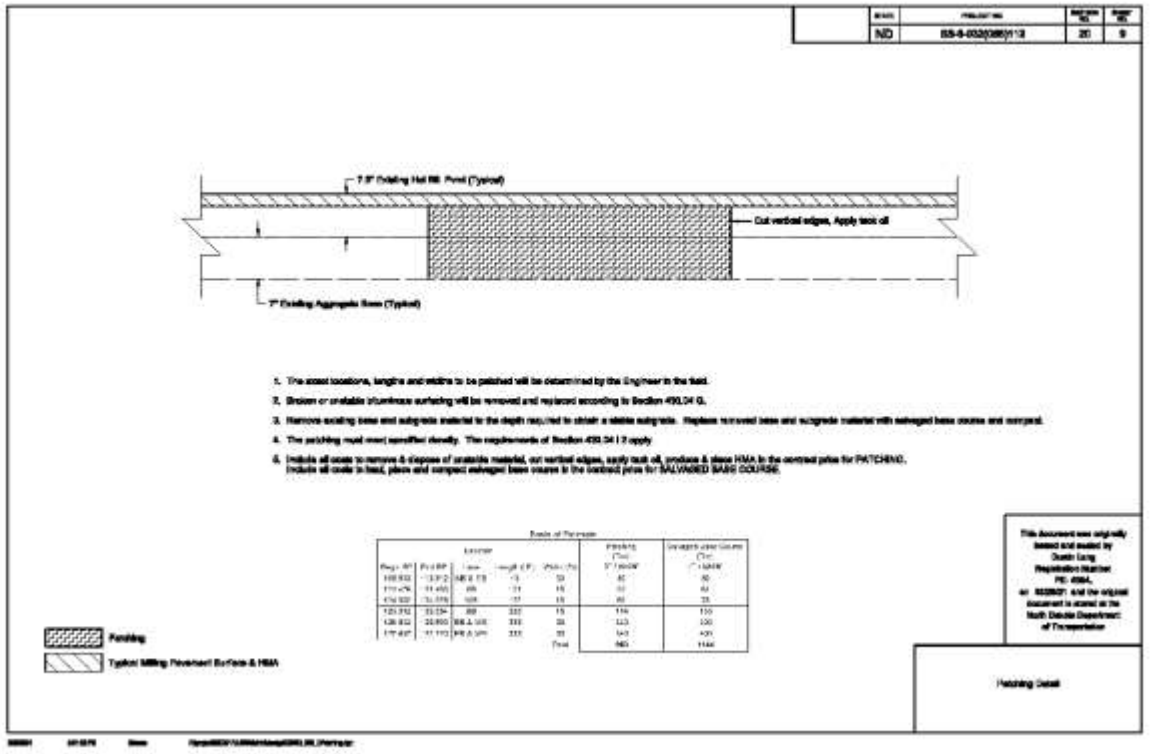
Paving



- Paved from June 11, 2021 to June 23, 2021 (Finley)
- Paved from June 24, 2021 to June 30, 2021 (Aneta)
- Pave away from the pit generally

Patching

- Average depth of 10” after 2” mill
- Subgrade repair on some
- Roll test, probing & visual inspection, light weight deflectometer was done for subgrade testing
- 6 locations in Finley
- 9 locations in Aneta



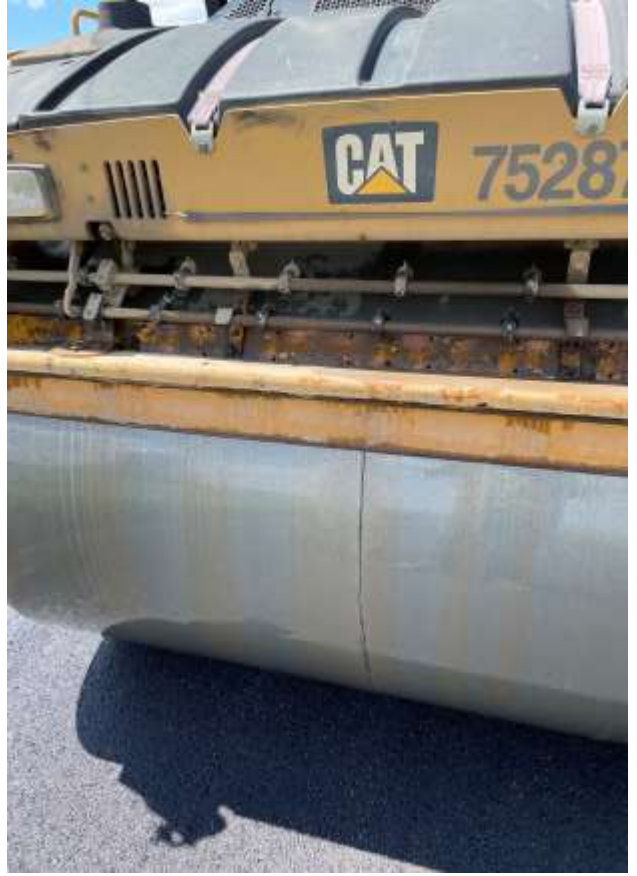
Patching

- 3 lifts of 3” plus the mainline 2” Overlay
- Took more time due to additional lifts and cooling
- Mill could only go down so deep so had to build 25’ ramps




Problems Encountered

- New patch’s needing additional repair work
- One job paid oil in patches the other job didn’t pay for oil in patches
- Out of tolerance workmanship and safety concerns for the public
- Steep shoulders that required additional work to achieve a 4:1 due to slough breaking off
- Finding a concrete plant close enough & utility repairs



Problems Encountered

- 343+ Tons wasted & patch/subgrade repair in rain event
- Equipment breakdowns
- Patch’s being deeper than anticipated; took extra lifts and time to complete
- Couldn’t have a vertical edge cut with patches, had to have a taper/ramp due to the depth
- Finley & Aneta Days working with Contractor Schedule

Construction Research & Innovations Used

- 2 Binders W/Test Sections(PG 58S-28 & PG 58H-34)
- Intelligent Compaction(IC)
- Paver Mounted Thermal Profiler (PMTP)
- Rolling Density Meter(RDM)
- Flexible Pvmt Surface Tolerance(IRI AKA “Ride”)
- Density Cores on Patch’s, Longitudinal & Mainline
- Lightweight Deflectometer

History & Background of Asphalt Binder Test Sections

Performance Grade Asphalt Binders

PG58S-28 - Unmodified

PG58H-34 – Polymer Modified

Highway 32
Major Distress Trigger

Thermal/Reflective Transverse Cracking
& the
Consequential Impact on Ride Quality

Year	IRI
2011	64
2012	60
2013	78
2014	72
2015	97
2016	81
2017	115
2018	95
2019	119
2020	102

Chronological History of Highway32 (Test Section Segment)

PTH IN)	COMPONENTS	OIL/CON CLS TYPE	AGG	YEAR
	GRADE			1960
	RESHAPED			1987
7.0	AGGREGATE BASE			1987
2.0	RECYCLED BIT BASE			1987
3.5	RECYCLED HOT BIT PAVT	200-300		1987
	CONTRACT SAND SEAL	HFMS-2		1988
	INT CONT PATCH-1.5"	120-150		1993
	CONTRACT CHIP SEAL	HFMS-2	42	1998
	INT CONT PATCH-1.5"	PG 58-28	27	2003
2.0	HBP-SUPERPAVE-FAA 45	PG 58-28		2007
	FEDERAL AID CHIP SEAL	HFMS-2	43	2010

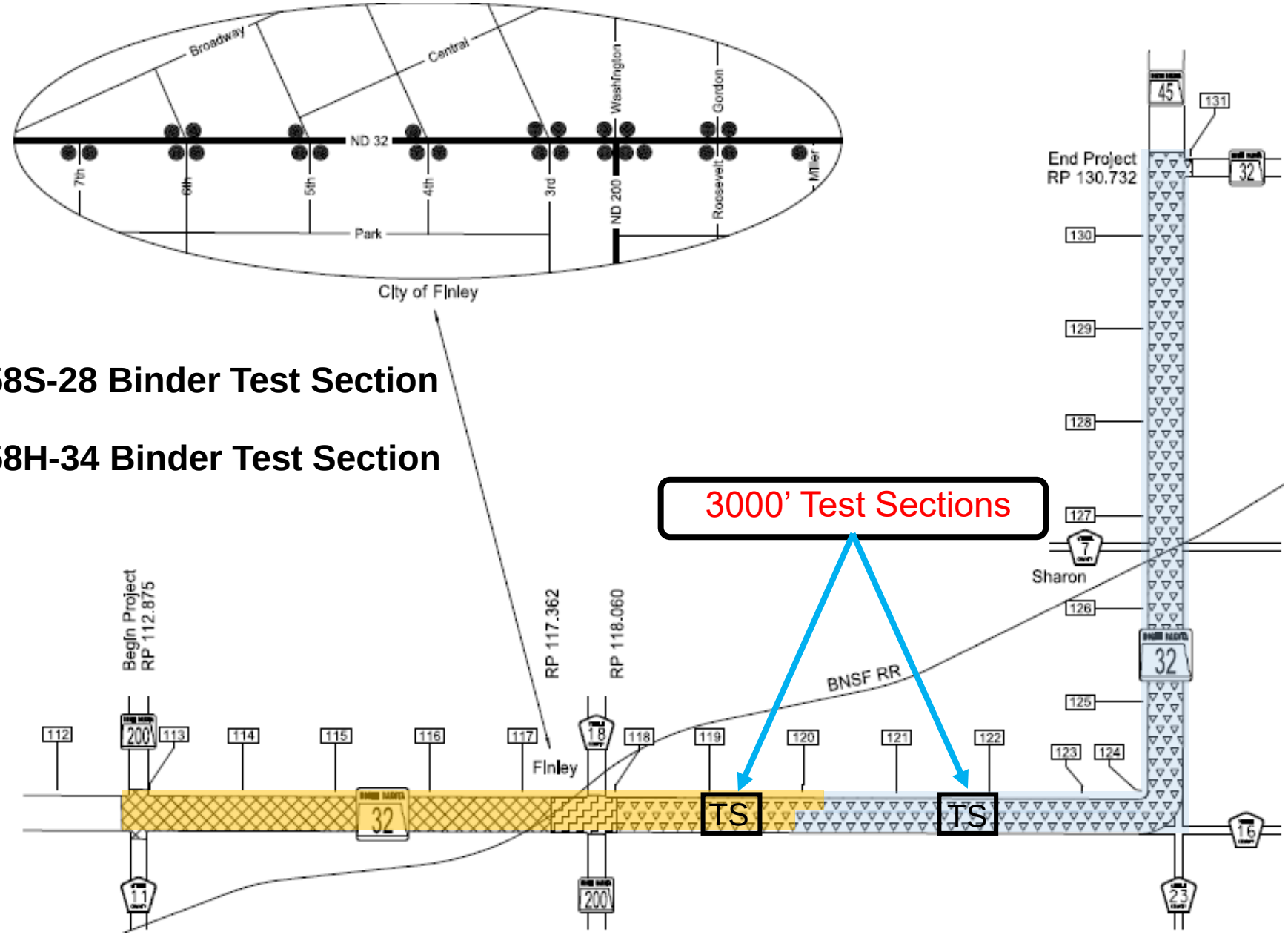
Year	IRI
2011	64
2012	60
2013	78
2014	72
2015	97
2016	81
2017	115
2018	95
2019	119
2020	102

Why Two Types of Performance Grade Asphalt Binders???

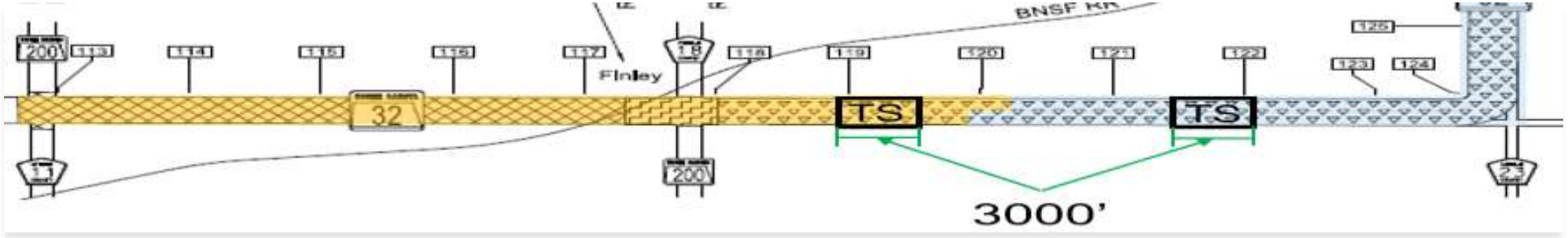
To Determine if HMA containing a Polymer Modified Asphalt Binder will be more resistant to:

Thermal and Reflective Cracking when compared to a Standard Unmodified Asphalt Binder

Project SS-6-032(066)112



Binder Test Sections (Constants)



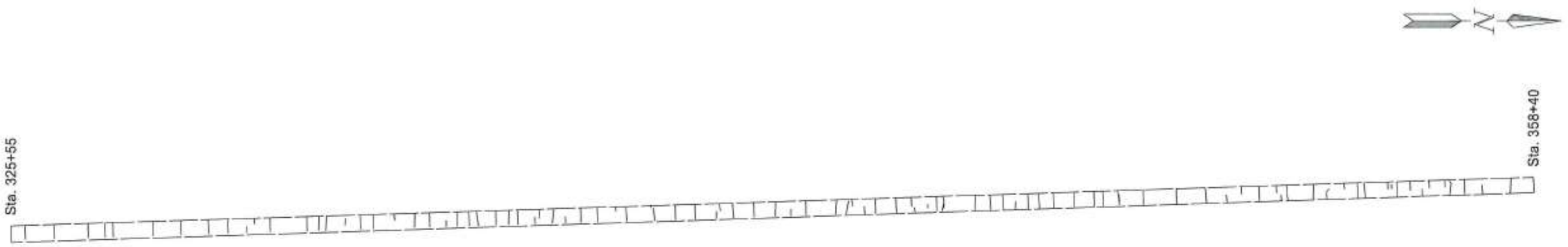
Similar:

- Traffic Loading
- Age of Existing Pavement
- Climate & Environment
- Subgrade/Substrate Support Values
- Construction Approach
- Asphalt Contractor
- Existing Type, Severity, and Number of Distresses
- Asphalt Mix Design: (75 gyration, 12.5 mm, fine dense graded Superpave mixture with 15% RAP)
- Material Pit Location

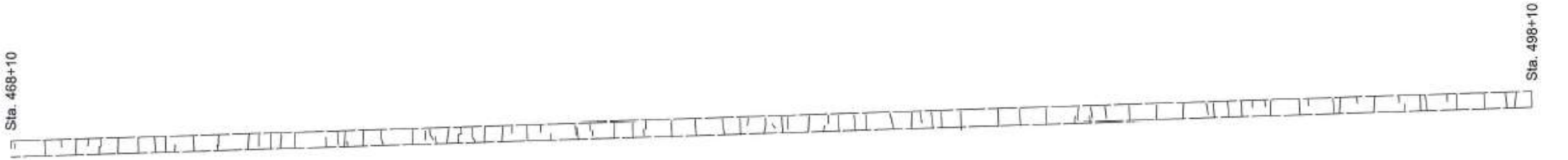

Hwy 32 Asphalt
Binder Test Sections
PG58S-28 Test Section
PG58H-34 Test Section
Finley

NDDOT (Grand Forks District) Surveyed and Recorded Existing Transverse Cracking in both Test Sections prior to Project Milling

Predetermined Crack Pattern



PG58H-34 Binder Test Section

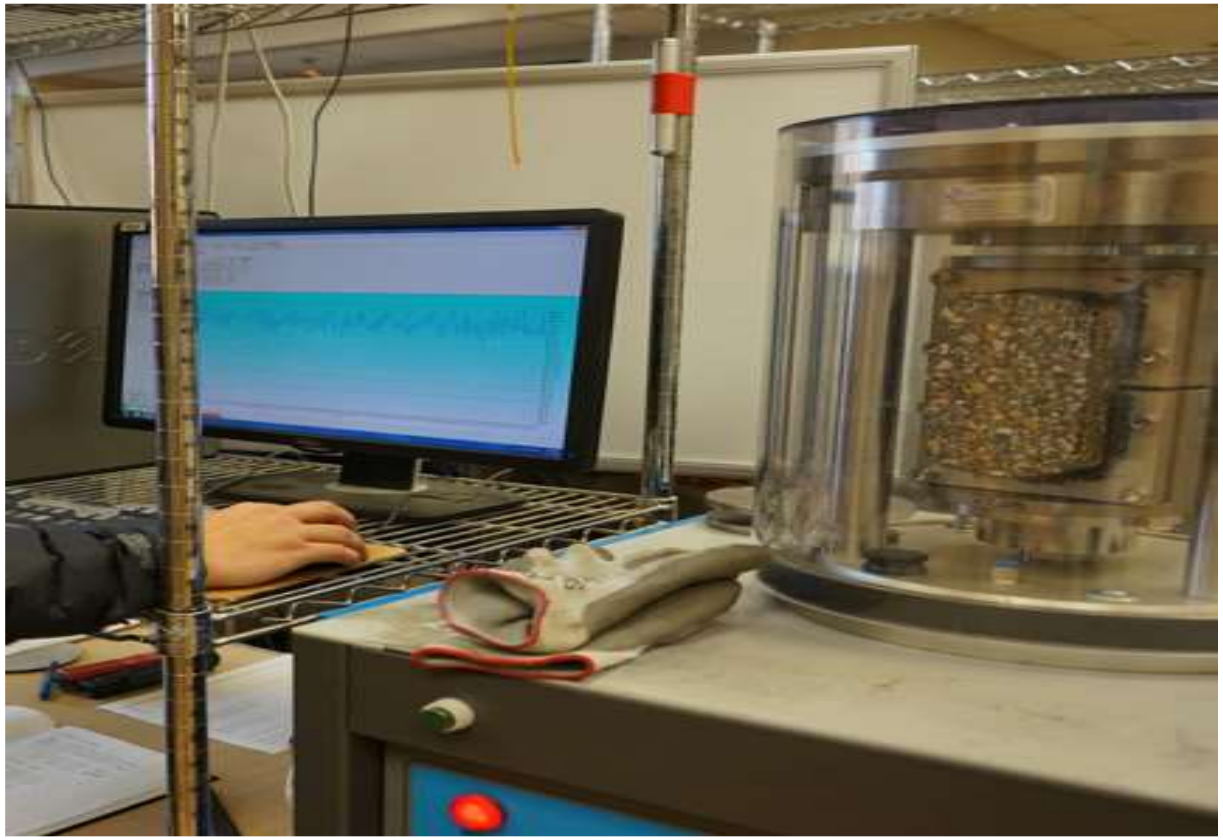


PG58S-28 Binder Test Section

Asphalt Mix/Binder Sampling and Performance Testing

Purpose of Mixture and Binder Performance Testing

- To Determine if Performance Testing Predicts Actual Field Performance
- What Performance Cracking Test Best Predicts Actual Field performance



Performance Testing Protocol
NDDOT (Materials and Research)

Types of Performance Tests

- Ideal CT (Indirect Tension)
- Ideal RT
- Hamburg Wheel Test

Performance Testing Continued

NDDOT has also contracted with University of North Dakota to Analyze the Two Mixes using the Asphalt Performance Mixture Tester (AMPT)

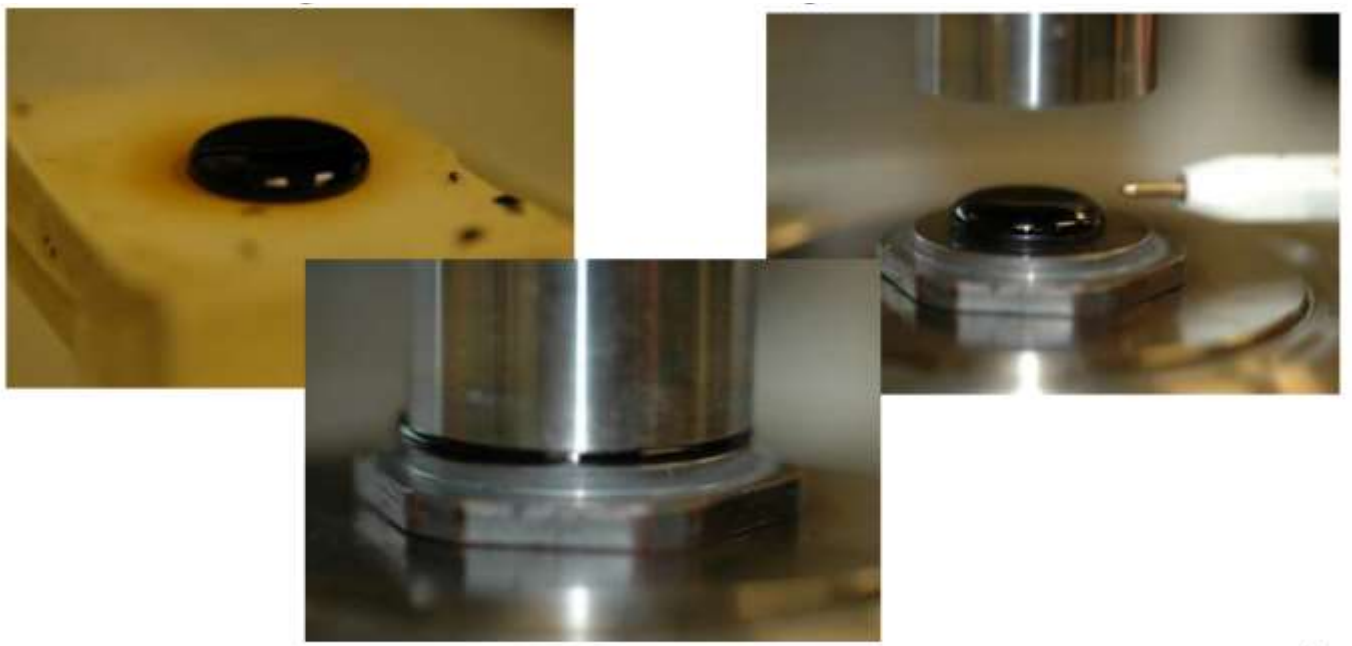
- Dynamic Modulus Test
- Cyclic Fatigue Test
- Stress Sweep Rutting Test

Additional Performance testing

FHWA Mobile Asphalt Technology Center (MATC)

Leslie Myers and the Mobile Asphalt Technology Center (MATC) team are Evaluating the Cracking Performance of each Material using the Texas Overlay Test.

Multi Stress Creep and Recovery



Training, so necessary.

Does the PG58H-34 Binder used on the Project Polymer Modified?

Why is NDDOT Exploring Intelligent Construction Technologies on Highway 32 and other State Roadways?

Importance of Technology

- Research
- Knowledge Of how Pavement was Constructed
- Potential Forensic Tool
- Geospatial Data

Goals

- Aid Contractors to Increase QC Efforts (Real Time)
- Increase uniformity and Density
- Establish Long-Term Plan
- Reduce or Eliminate Acceptance Coring

Paving Construction Can Cause of Pavement Failures

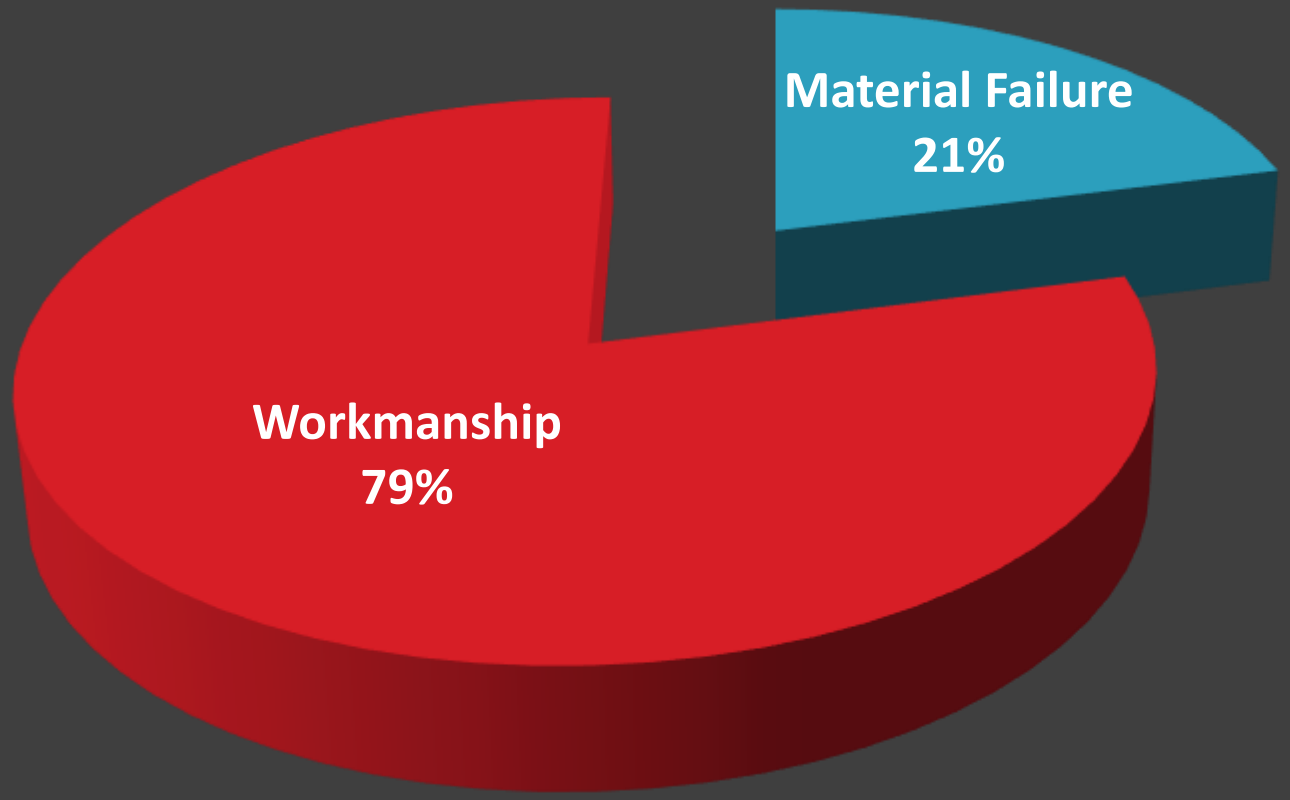


Figure Courtesy of Mark Woolaver, VAOT


“Coring provides limited information that is not readily available during paving”

COMPACTION!

WHY COMPACTION?

- Minimize Further Consolidation
- Provide Shear Strength & Resists Rutting
- To Improve Thermal Cracking Resistance
- Provide a Smooth, Quiet Driving Surface
- Ensure the Mixture is Impermeable
- Minimize Oxidation of the Asphalt Binder

Intelligent Compaction (IC)

Equipment based technology to assist with quality control of hot mix asphalt paving.

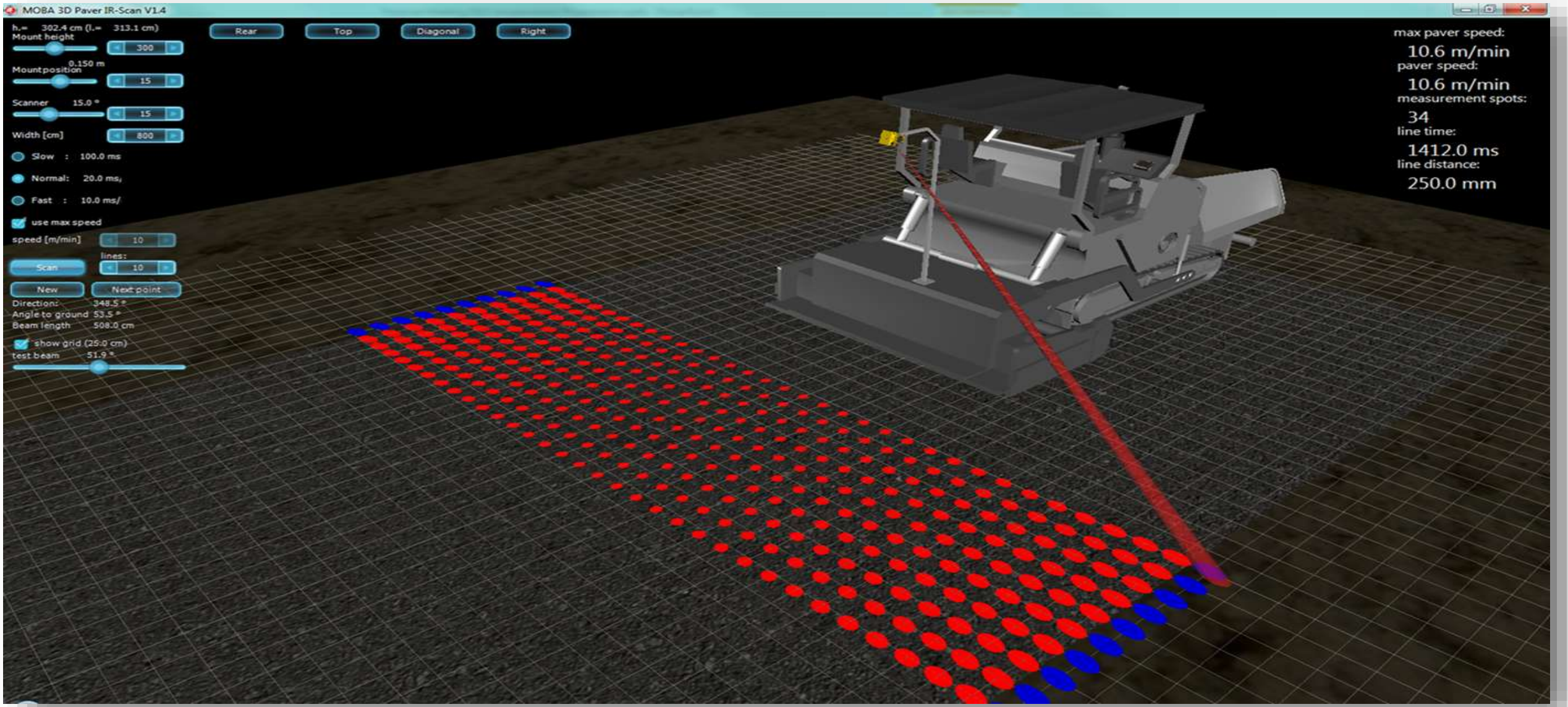
GPS equipped rollers track real-time data of:

- Roller passes
- Surface Temperatures
- Speed
- Frequency
- Amplitude
- Stiffness

Paver Mounted Thermal Profiling (PMTP)

Temperature sensor technology (Infrared) mounted on top of a paver that measures the asphalt surface temperature profiles behind the paver to indicate potential for temperature segregation.

Pavers Equipped with PMTP



Rolling Density Meter

- Ground penetrating radar provides a nondestructive, full coverage, testing alternative for evaluation of compaction quality
- Higher dialectic measurements can be correlated to lower air voids (higher densities)

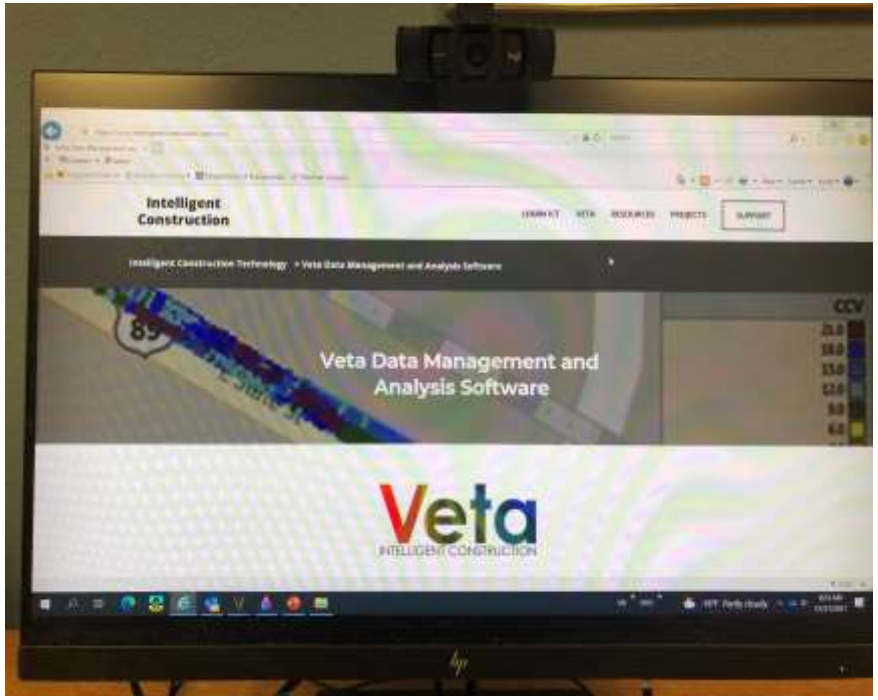
NDDOT (M&R) is currently exploring this technology!!

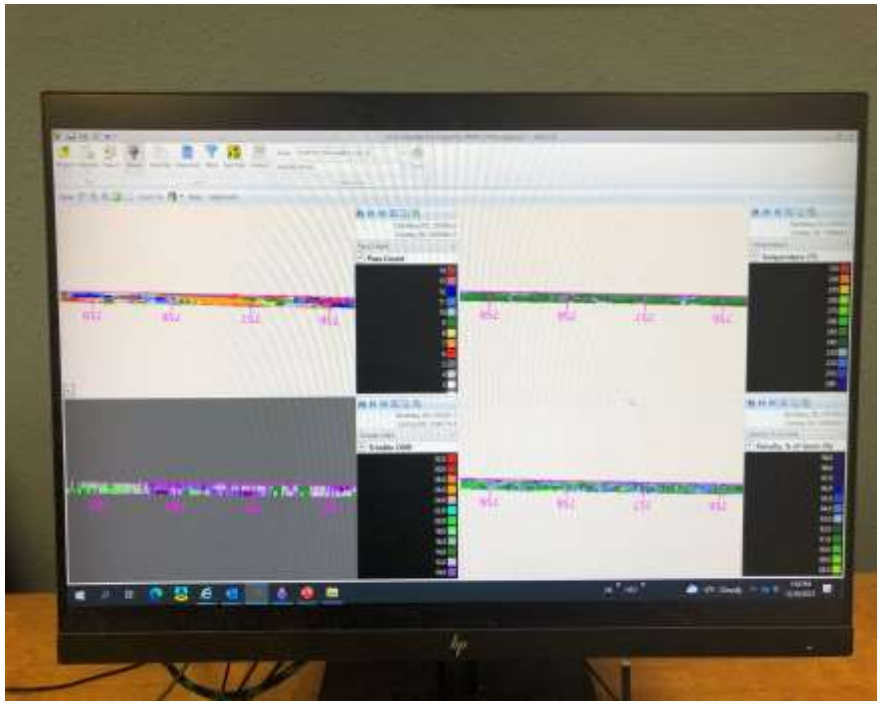
Lightweight Deflectometer (LWD)

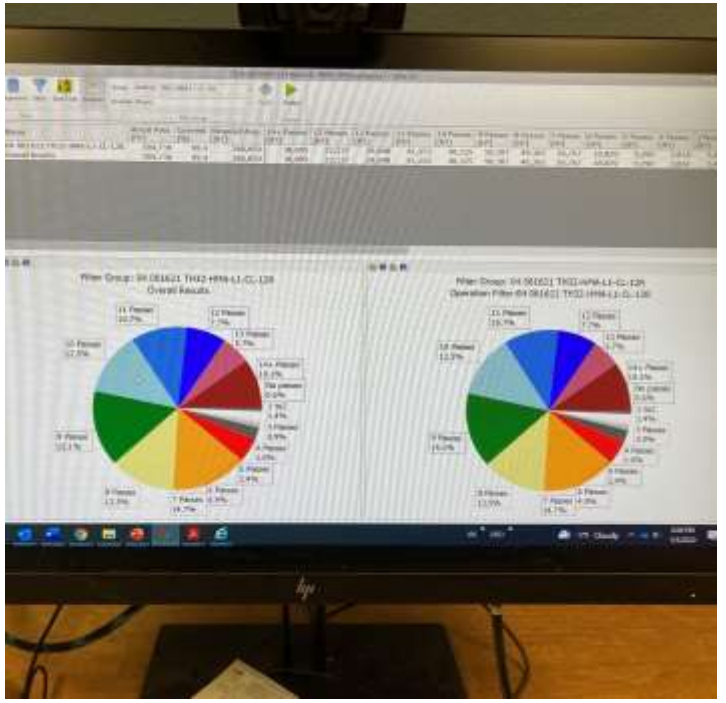
- Used for compaction control and bearing capacity estimation
- Unbound or partially bound layers (sub-grade, sub-base, base)
- Measures the deflection and stiffness (modulus)
- Immediate repeatable results so that on-site decisions can be made straight away

What is VETA?

Standardized Software → Stores Maps Analyzes Reports → Geospatial Data Collected from IC, PMTP, & RDM Technologies



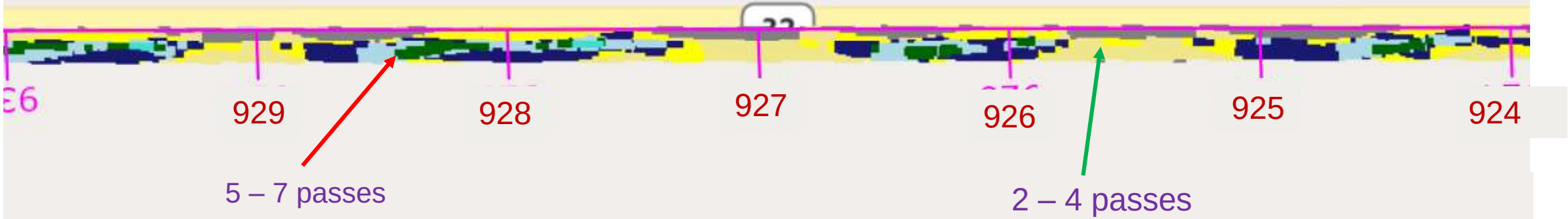




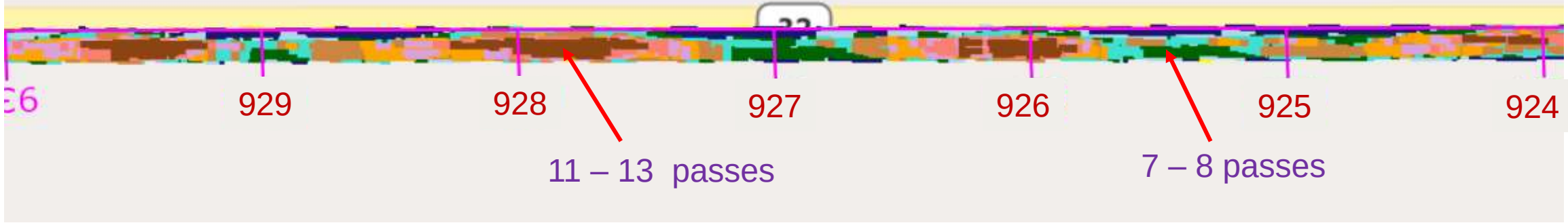
Roller Coverage (IC)

Breakdown

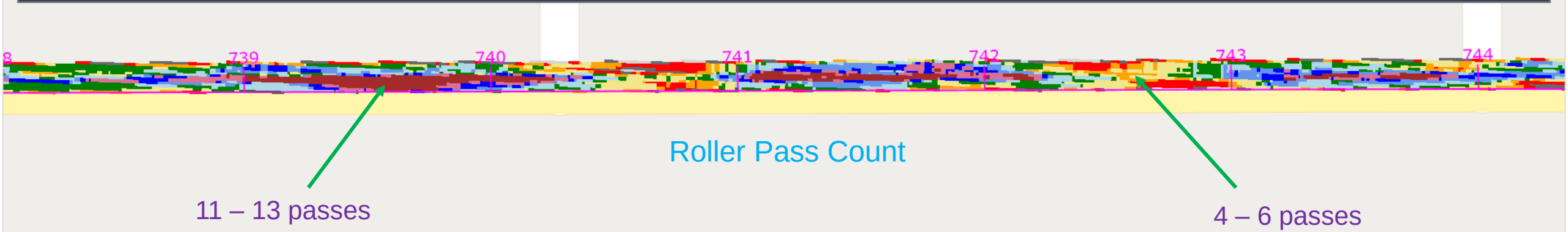
Intermediate



Total Pass Count



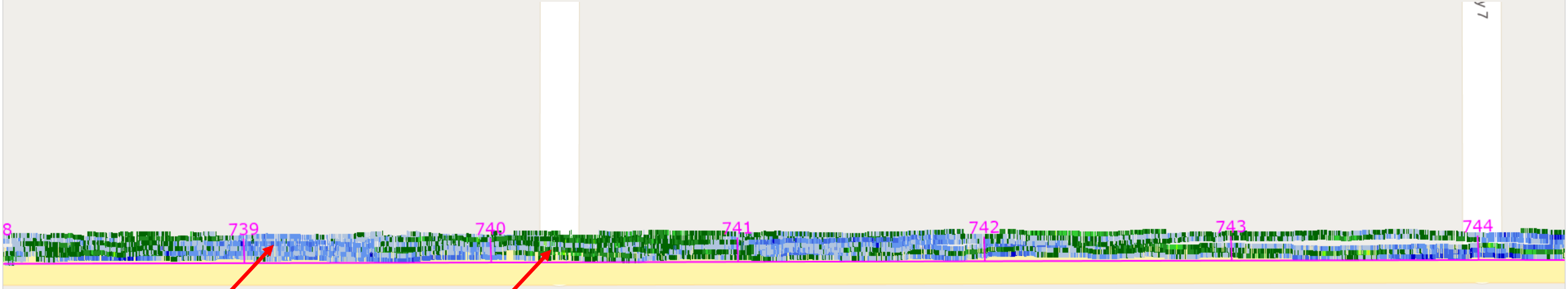
Comparison of Technologies Continued



Roller Pass Count

11 – 13 passes

4 – 6 passes

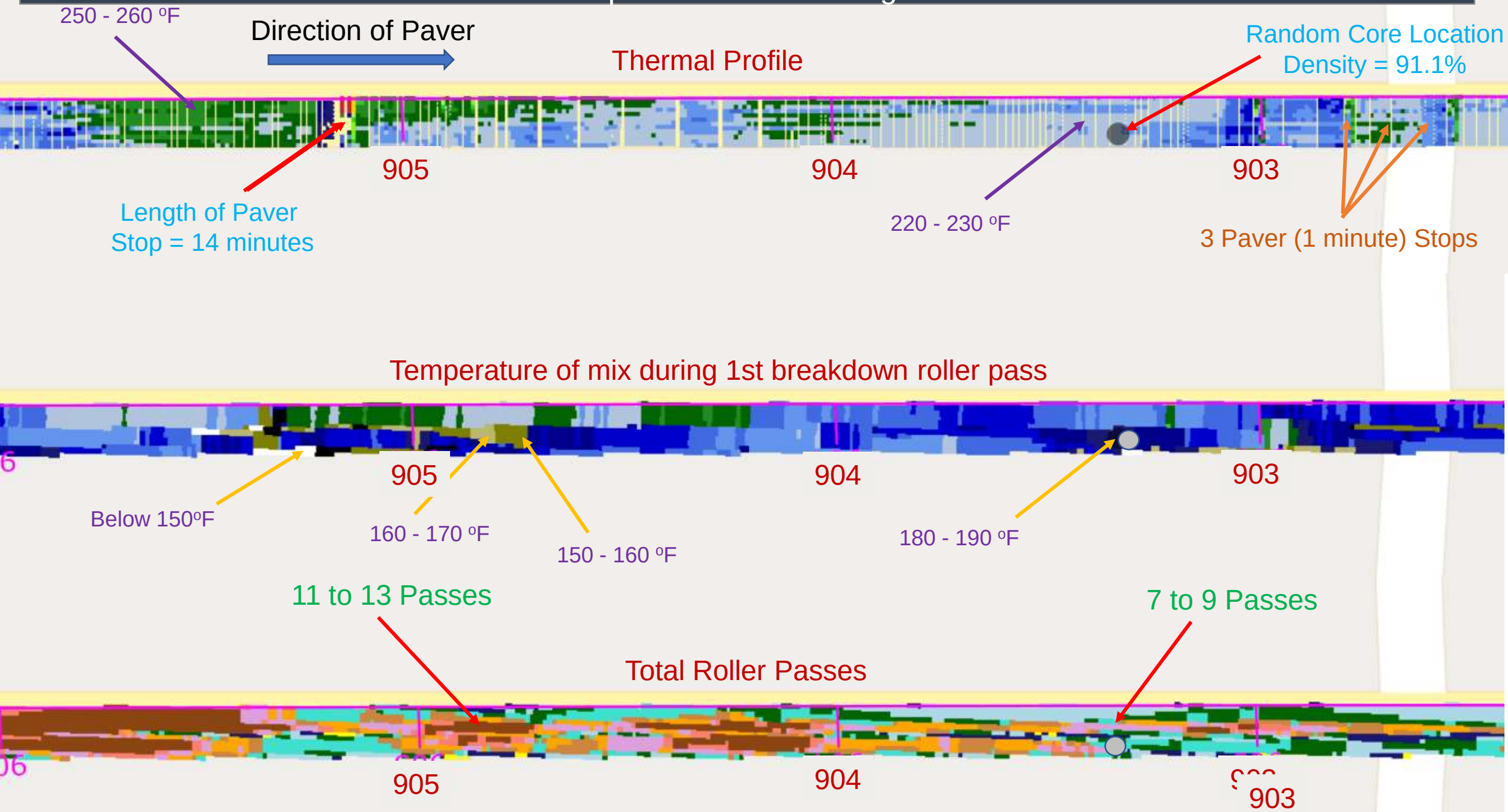


Density % Gmm (DPS)

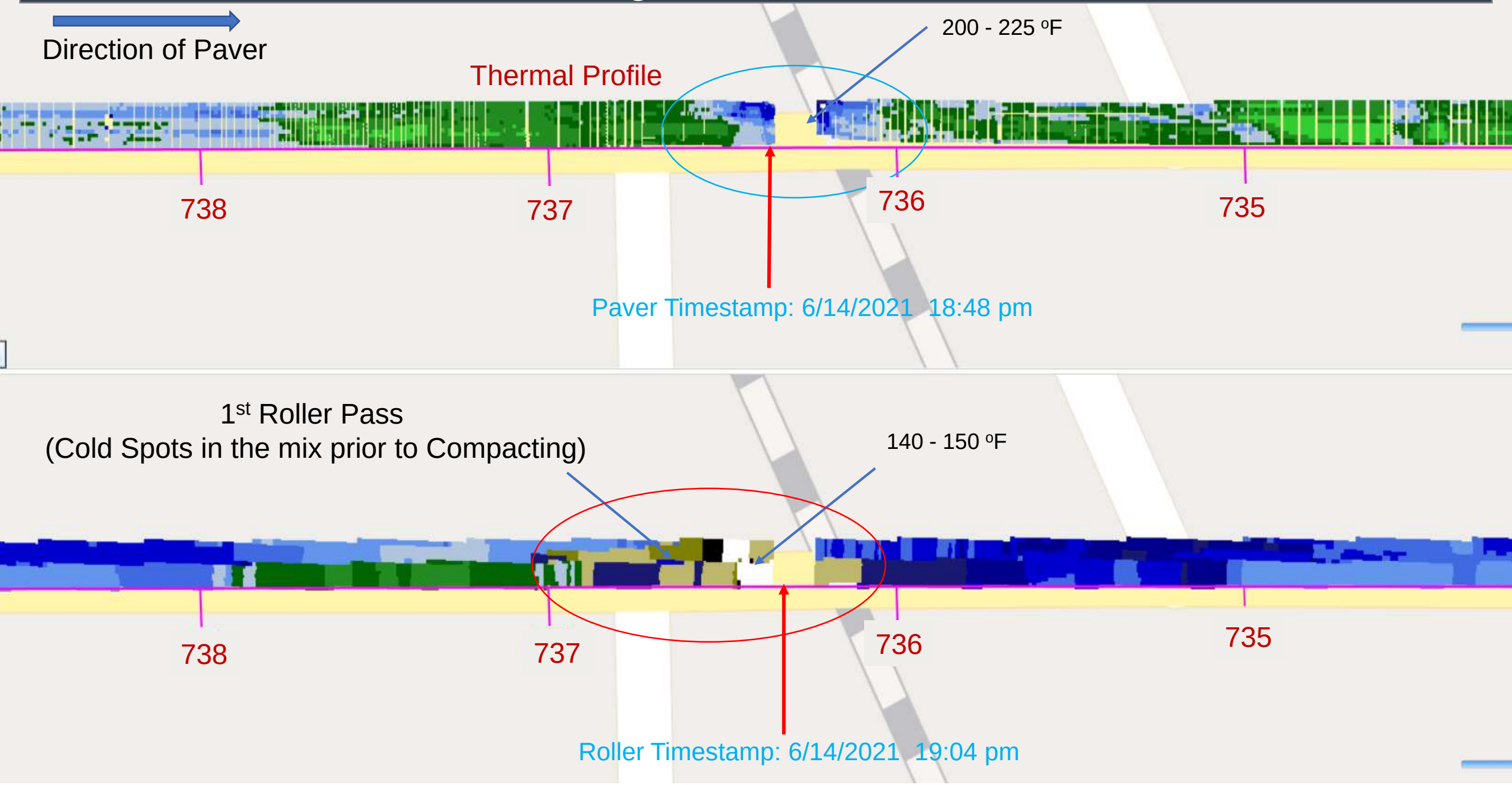
93%-95%

87%-93%

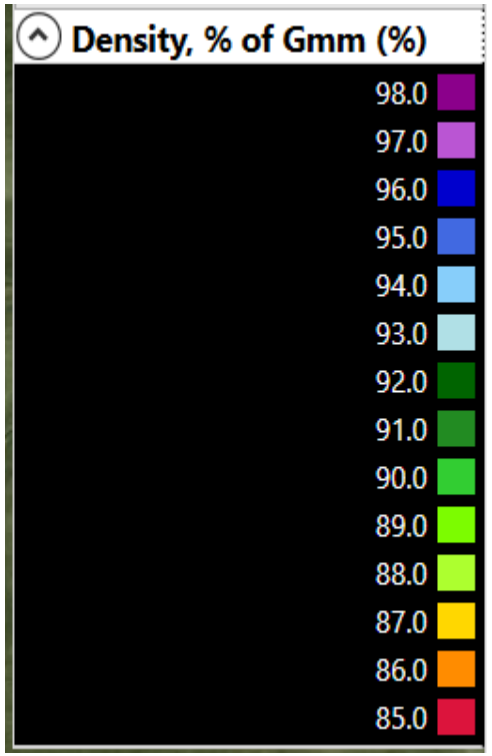
Comparison of Technologies

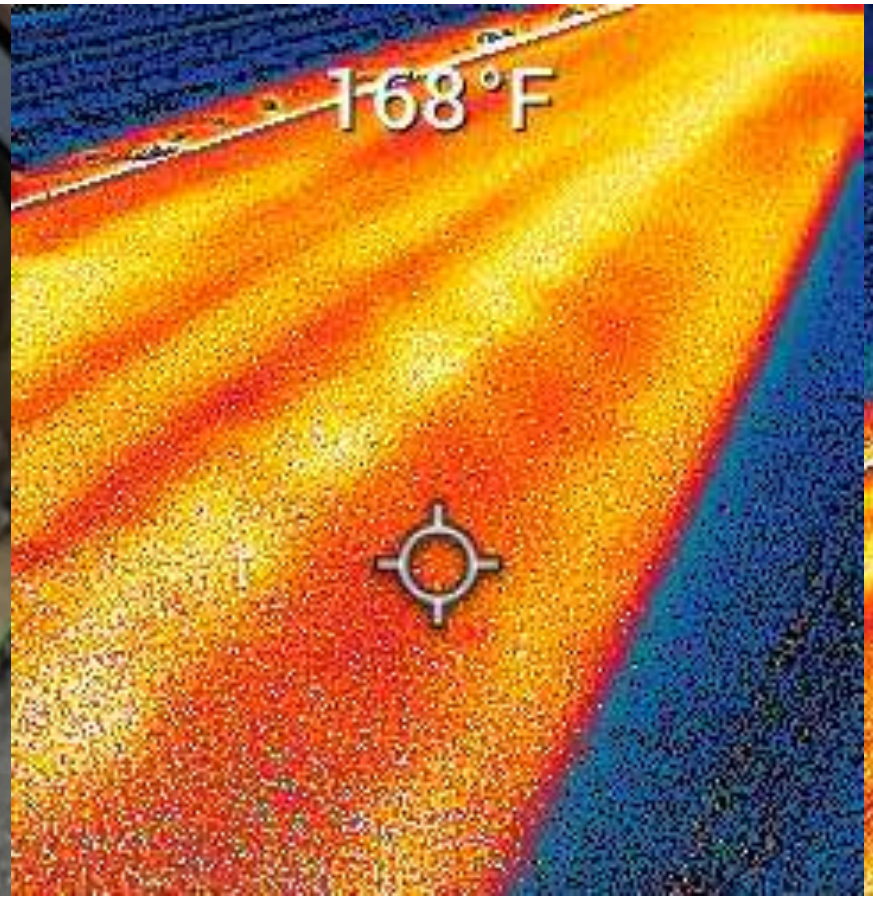


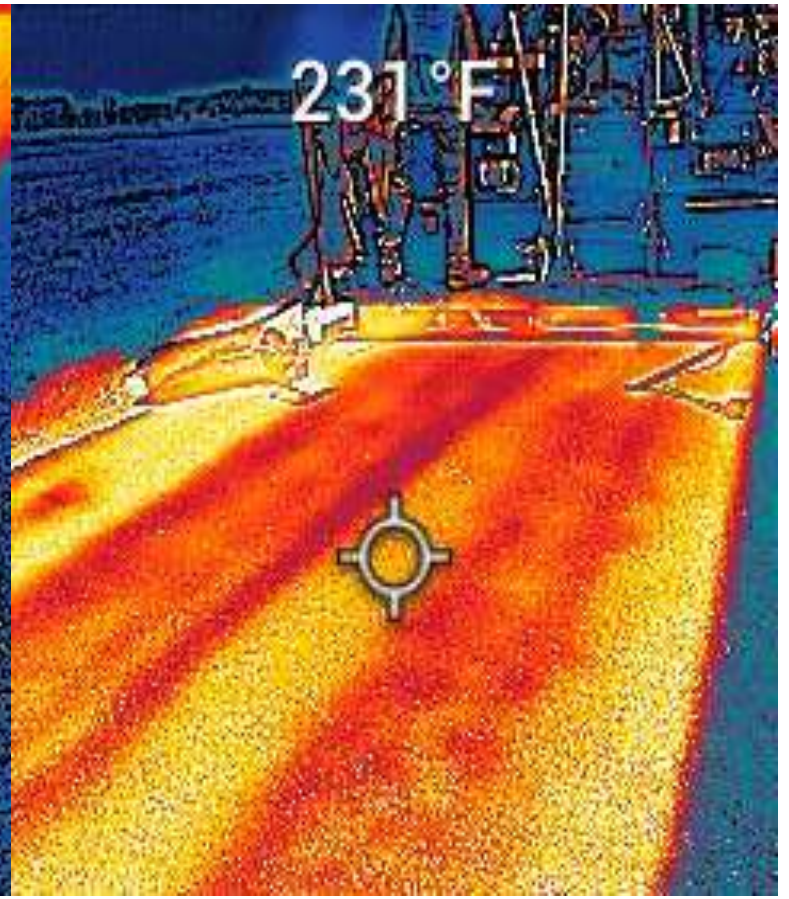
Paving near RR Tracks



Comparison of Density between 3000’ Test Sections



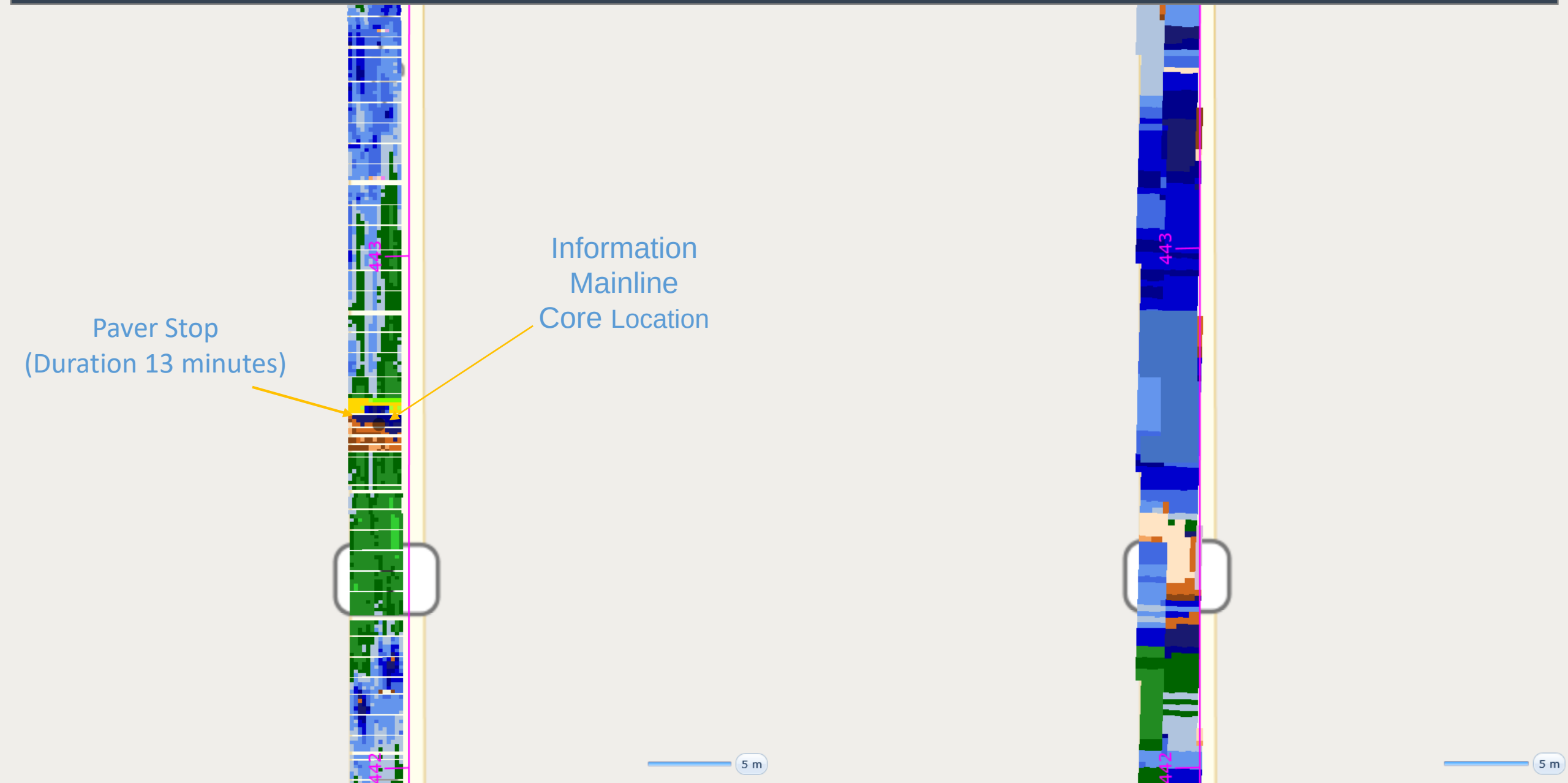




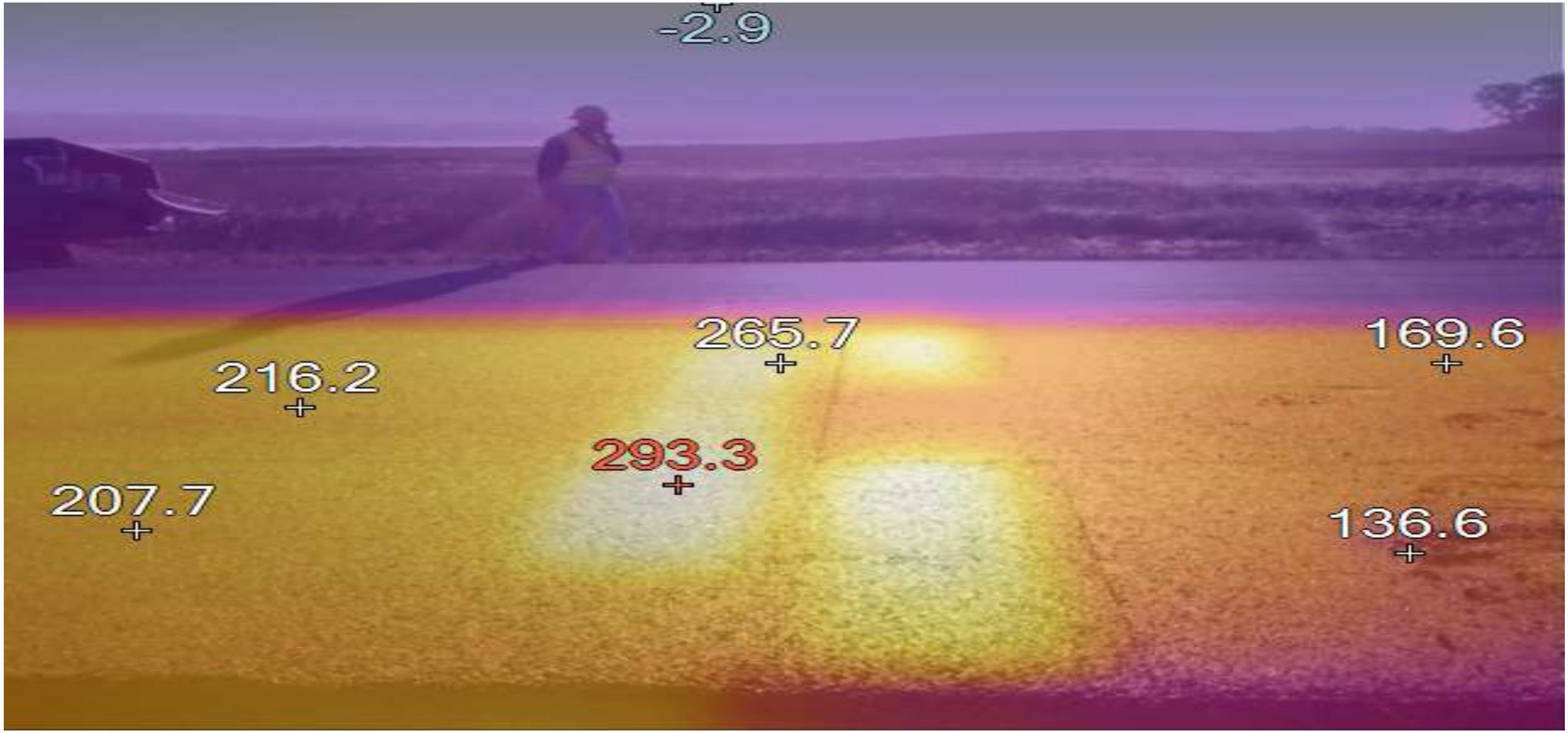
Thermal Imager

Paver Stop Concerns

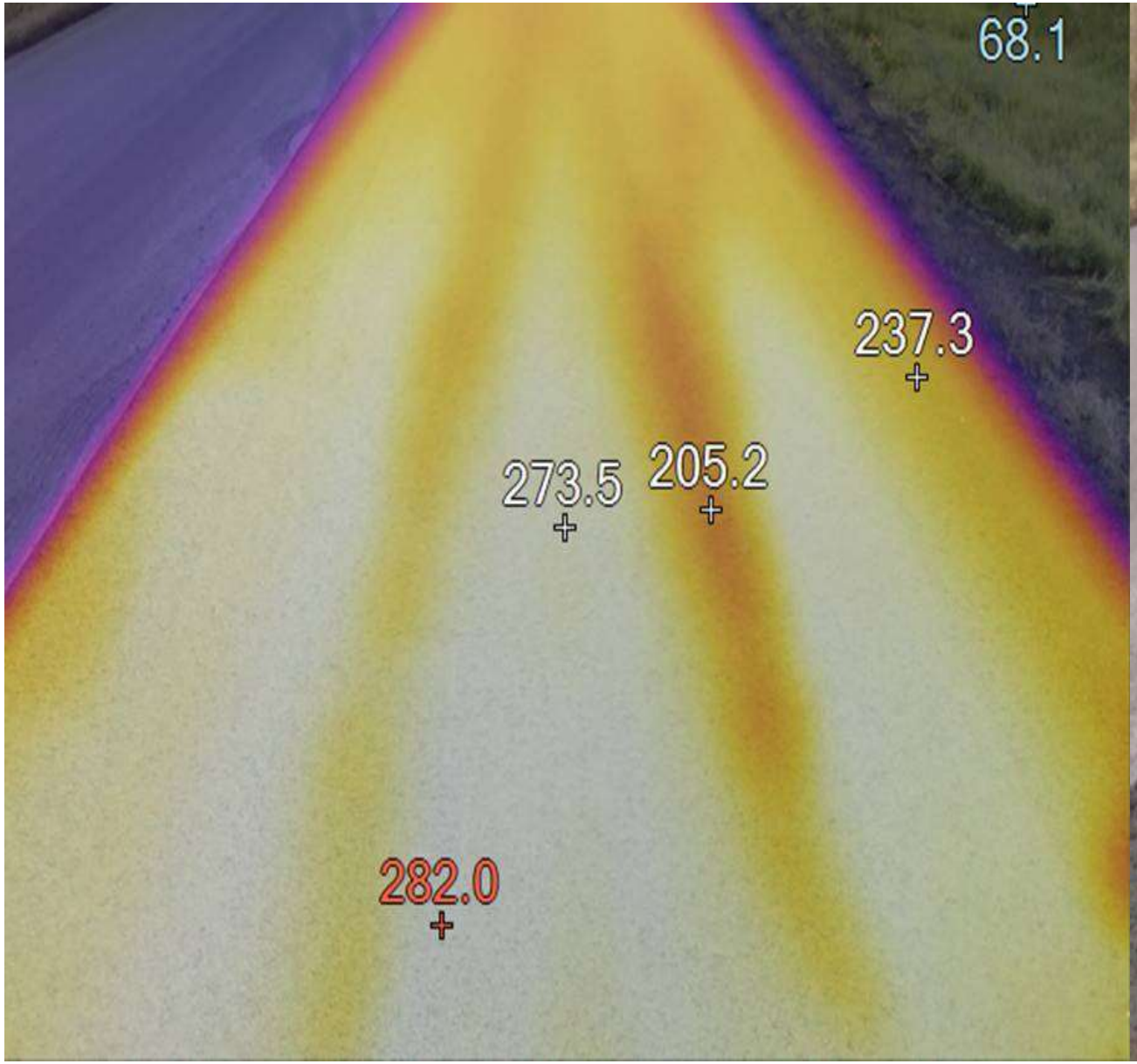
Anatomy of a Paver Stop (Veta Display)



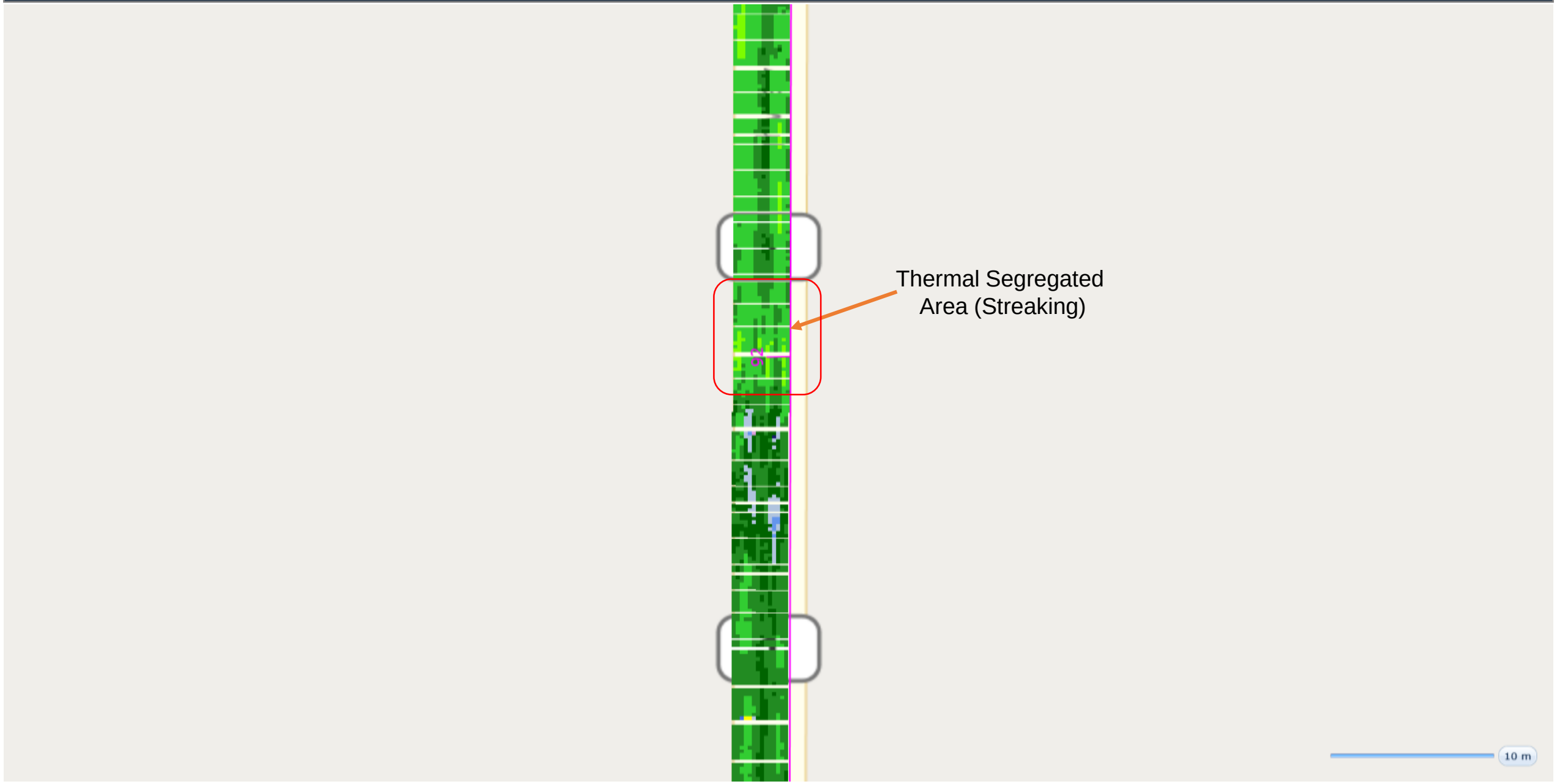
Thermal Image of Paver Stop Area using Fluke Handheld Camera



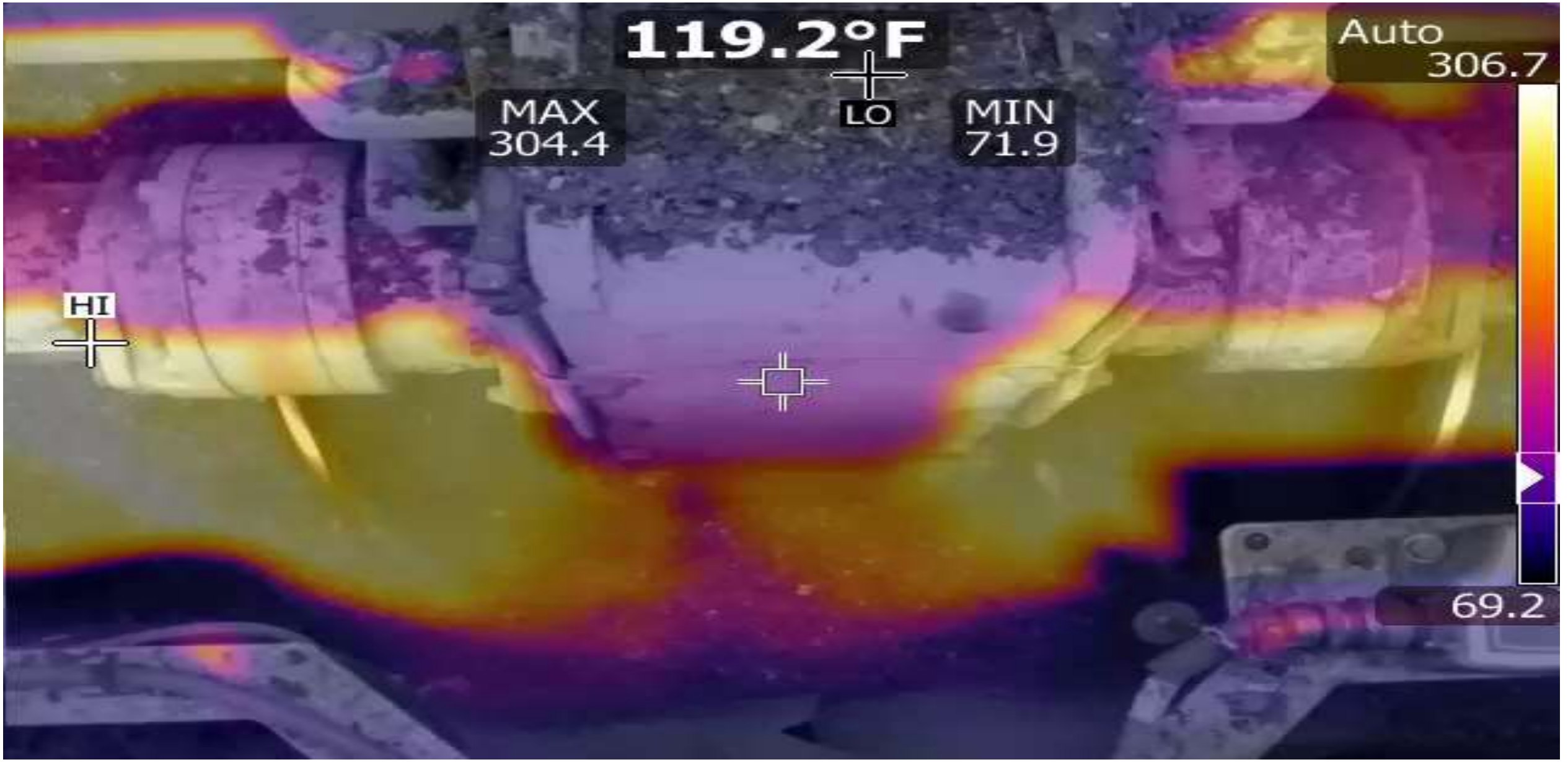
Thermal Image and Regular Photo of Same Location



Thermal Display in Veta Software of the Segregated Area



Thermal Videos Taken with Fluke Camera (Mix Directly below the Center Gear Box)



Thermal Videos Taken with Fluke Camera

Density Summary

Rolling Pattern:
Breakdown Roller: Pneumatic Rubber-Tire Cat
Intermediate Roller: Vibratory Steel Drum Cat
Finish Roller: Vibratory Steel Drum Cat

50,847.77 Mainline Tons Paved
4,126.30 Patching Tons Paved

$109,303.28 Total Incentive Paid for Density
$61,581.28 Mainline & Patching Incentive
$47,722.00 Longitudinal Incentive

93.4% Average Mainline Density (91% required per spec.)
92.0% Average Longitudinal Density (90% required per SSP4)

IRI Results

Finley Project:

- $10,400 Deduct
- 10 Must Grind Lots
- 258 Locations Larger than 3/16”=16’ Straightedge
- 1-1/32” dip -13/16 Bump

Aneta Project:

- $22,750 Incentive
- 4 Must Grind Lots
- 130 Locations Larger than 3/16”=16’ Straightedge
- 16/32” dip -11/16” Bump

Finley

Date Tested:	8/4/2021
Operator:	Nathan
Project Location:	S JCT 200 N to JCT 45 - W Sharon

Project Summary

Profile Length	
17.7	Miles

Range	Inc/CPA
<=34.0	$300.00
34.1 to 39.0	$225.00
39.1 to 44.0	$150.00
44.1 to 48.0	$75.00
48.1 to 56.0	$0.00
56.1 to 62.0	($100.00)
62.1 to 69.0	($200.00)
69.1 to 75.0	($400.00)
>=75.1	Corrective Action

Incentive/Contract Price Adjustment		
Total Cost		Cost/Lane-Mile
NB	-$6,875.00	$ (1,964)
SB	-$3,525.00	$ (1,007)
Total		-$10,400.00

Statistical Information		
Statistic	NB 0.1 mile	SB 0.1 mile
Average	55.3	53.7
Standard Deviation	9.4	10.4
Minimum	39.7	34.0
Maximum	101.2	99.9
Median	53.9	52.1

Aneta

Date Tested:	8/4/2021
Operator:	Nathan
Project Location:	JCT ND 45 to JCT ND 15

Project Summary

Profile Length	
9.6	Miles

Range	Inc/CPA
<=34.0	$300.00
34.1 to 39.0	$225.00
39.1 to 44.0	$150.00
44.1 to 48.0	$75.00
48.1 to 56.0	$0.00
56.1 to 62.0	($100.00)
62.1 to 69.0	($200.00)
69.1 to 75.0	($400.00)
>=75.1	Corrective Action

Incentive/Contract Price Adjustment		
Total Cost		Cost/Lane-Mile
NB	$12,700.00	$ 3,629
SB	$10,050.00	$ 2,872
Total		$22,750.00

Statistical Information		
Statistic	NB 0.1 mile	SB 0.1 mile
Average	43.5	45.1
Standard Deviation	11.0	10.8
Minimum	30.7	31.1
Maximum	98.4	82.8
Median	40.8	41.2

Costs:

- **Bid Total=$4,543,376.03** Finley=$2,899,061.04 Aneta=$1,644,342.99
- **Total Cost is $4,840,394.00** Finley=$3,025,269.53 Aneta=$1,815,124.47
- IC Bid Price=$5,000
- Average 2021 IC Bid Price=$16,671.43
- PMTP Bid Price=$5,000
- Average 2021 PMTP Bid Price=$18,750.00
- IRI Deduct=$10,400 (Finley)
- IRI Incentive=$22,750.00 (Aneta)
- Compaction Incentive=$109,303.28; $60,431.95 Finley & $48,871.33 Aneta
- PG58S-28 + FAA 43=$61.25/Ton
- PG58H-34 + FAA43=$65.28/Ton
- $4/Ton more for the better oil(polymer modified)

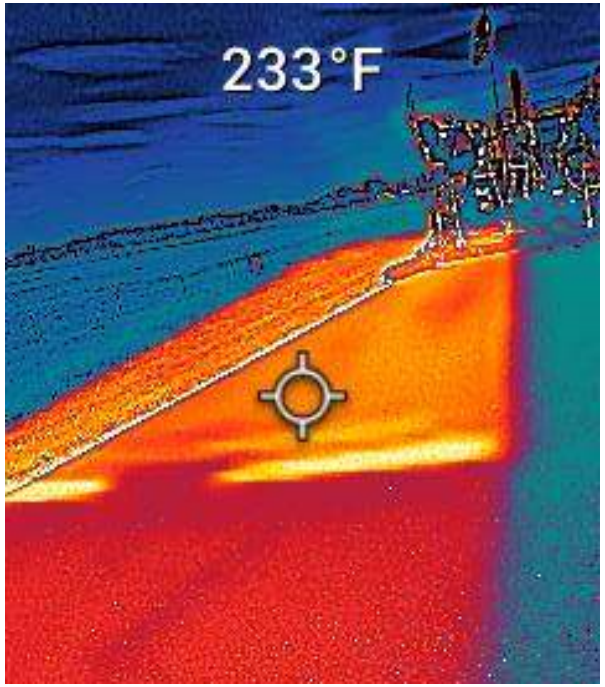
Paver Stops:

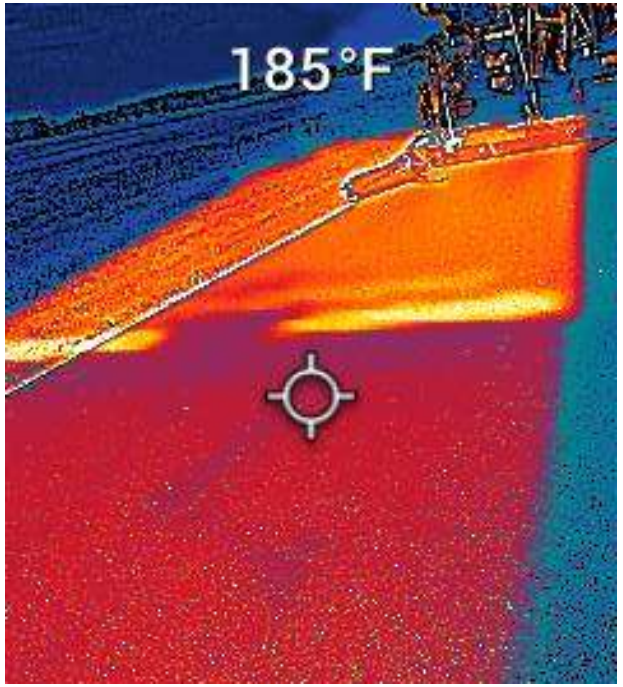
Finley:

Total days paved:	9 days
Total time paver was running(hours):	88.0
Total time of paver stops(hours):	33.5
Total time paver was moving(hours):	54.5
Percentage of time that was productive:	62%
Percentage of paver stops:	38%
Total time of paver stops:	2012 min or 1.4 days

Aneta:

Total days paved:	5 days
Total time paver was running(hours):	42.8
Total time of paver stops(hours):	17.1
Total time paver was moving(hours):	25.7
Percentage of time that was productive:	60%
Percentage of time of paver stops:	40%
Total time of paver stops:	1025 min or 0.7 days

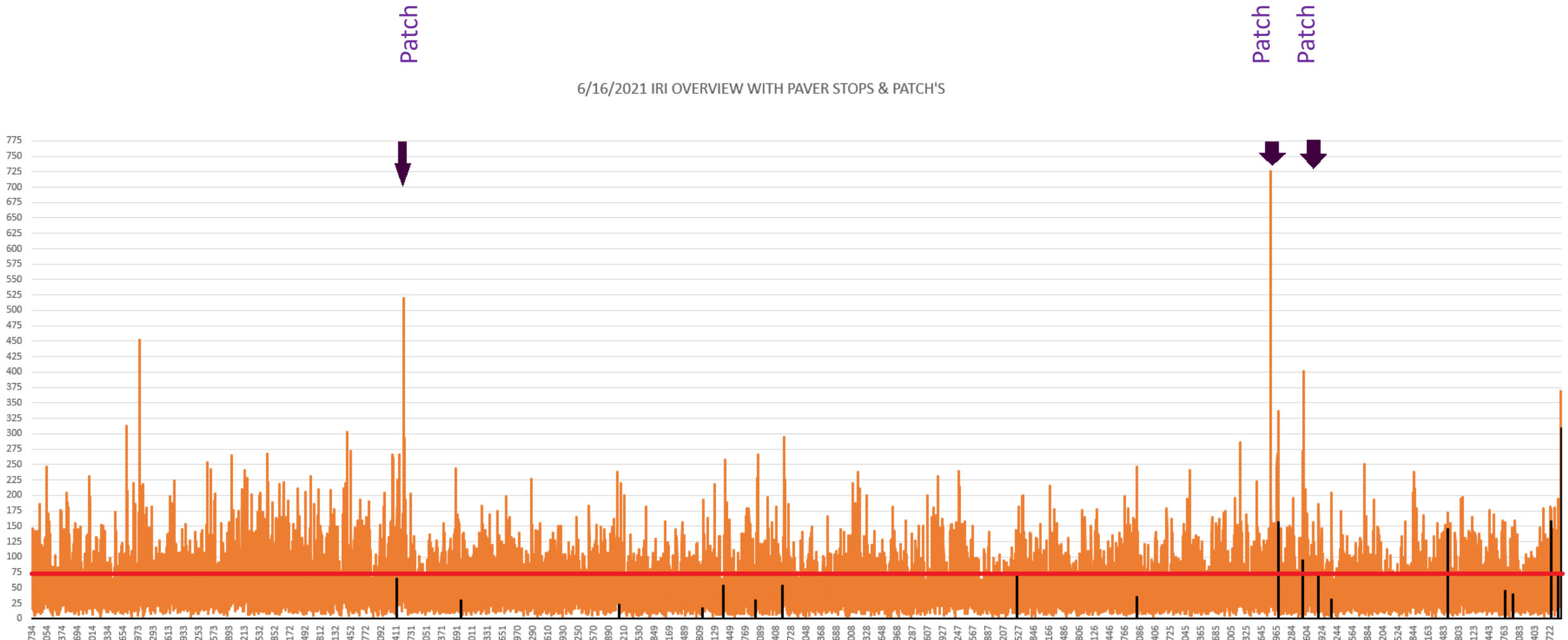




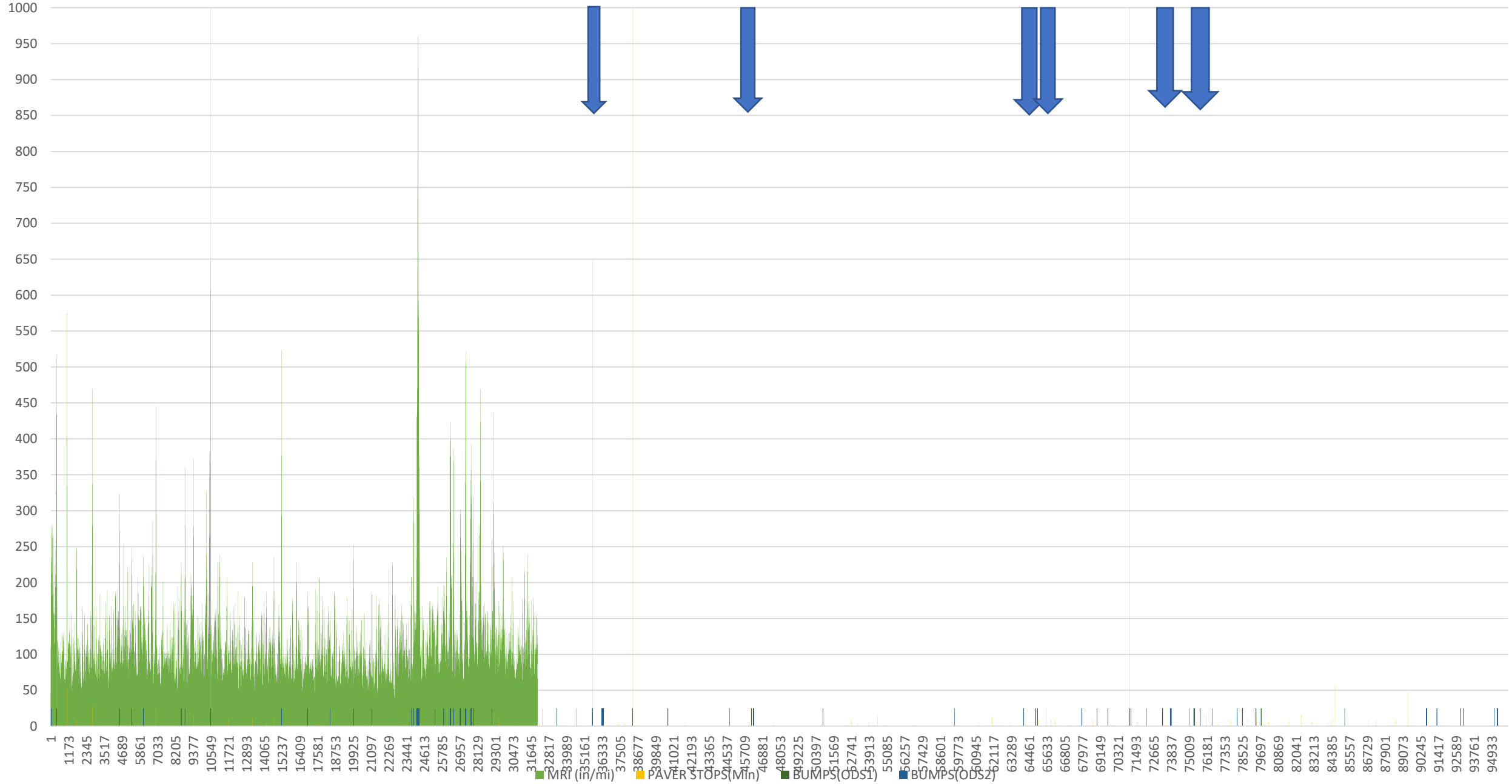
Things that affect IRI/MRI:

- Paver Stops
- Workmanship on Patches
- Joints
- Taking Mix From Mainline to Pave County Road
- Taking Mix From Mainline to Pave Patches
- Strong Winds cooling Temperatures Faster
- “Winging Out” For Field Approaches
- Trucks Stopping to Back Haul Millings
- Segregated mix
- Low compaction temperatures
- Rollers sitting on a hot mat

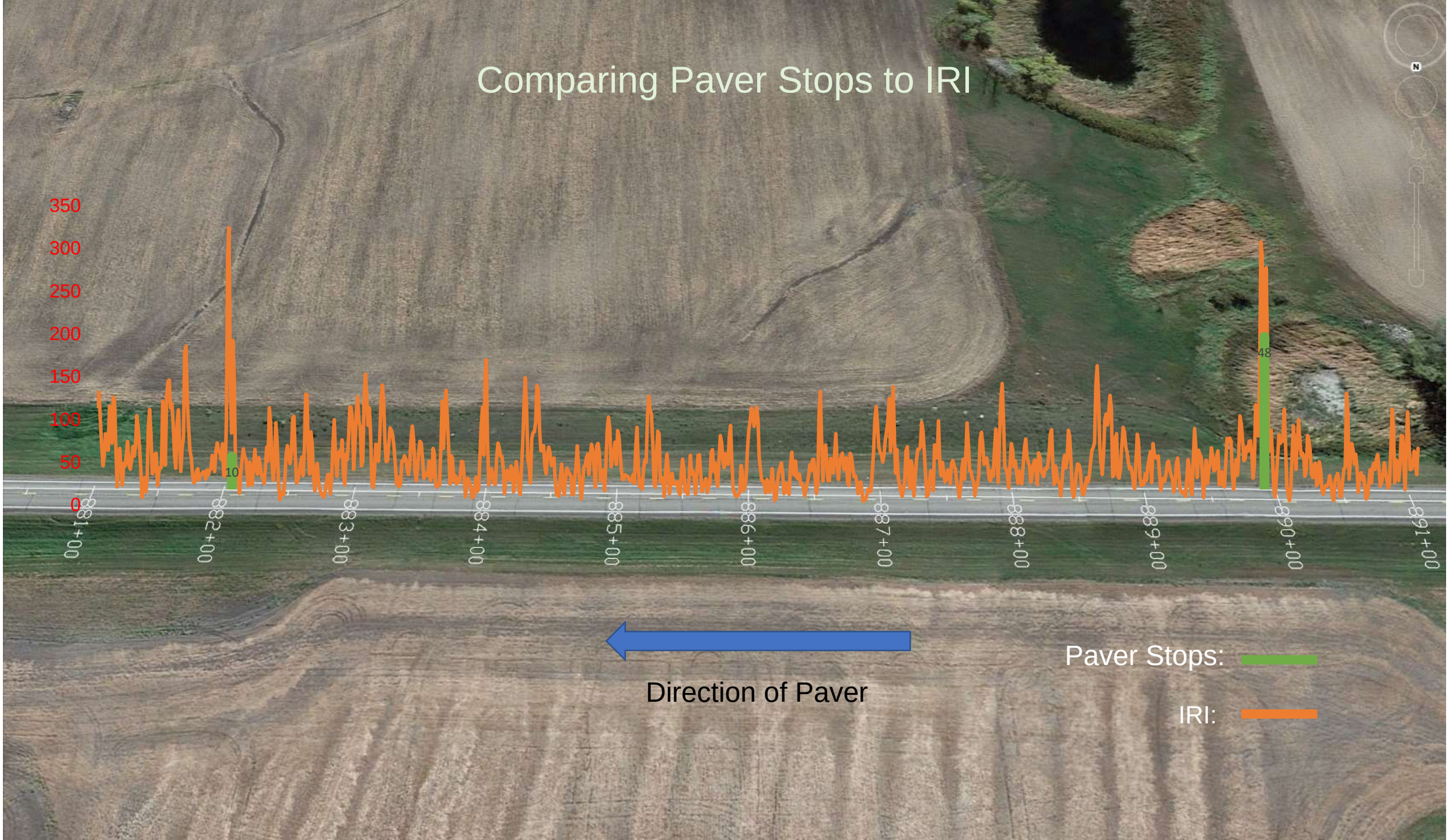
IRI Results With Patches & Paver Stops on 6/16/2021



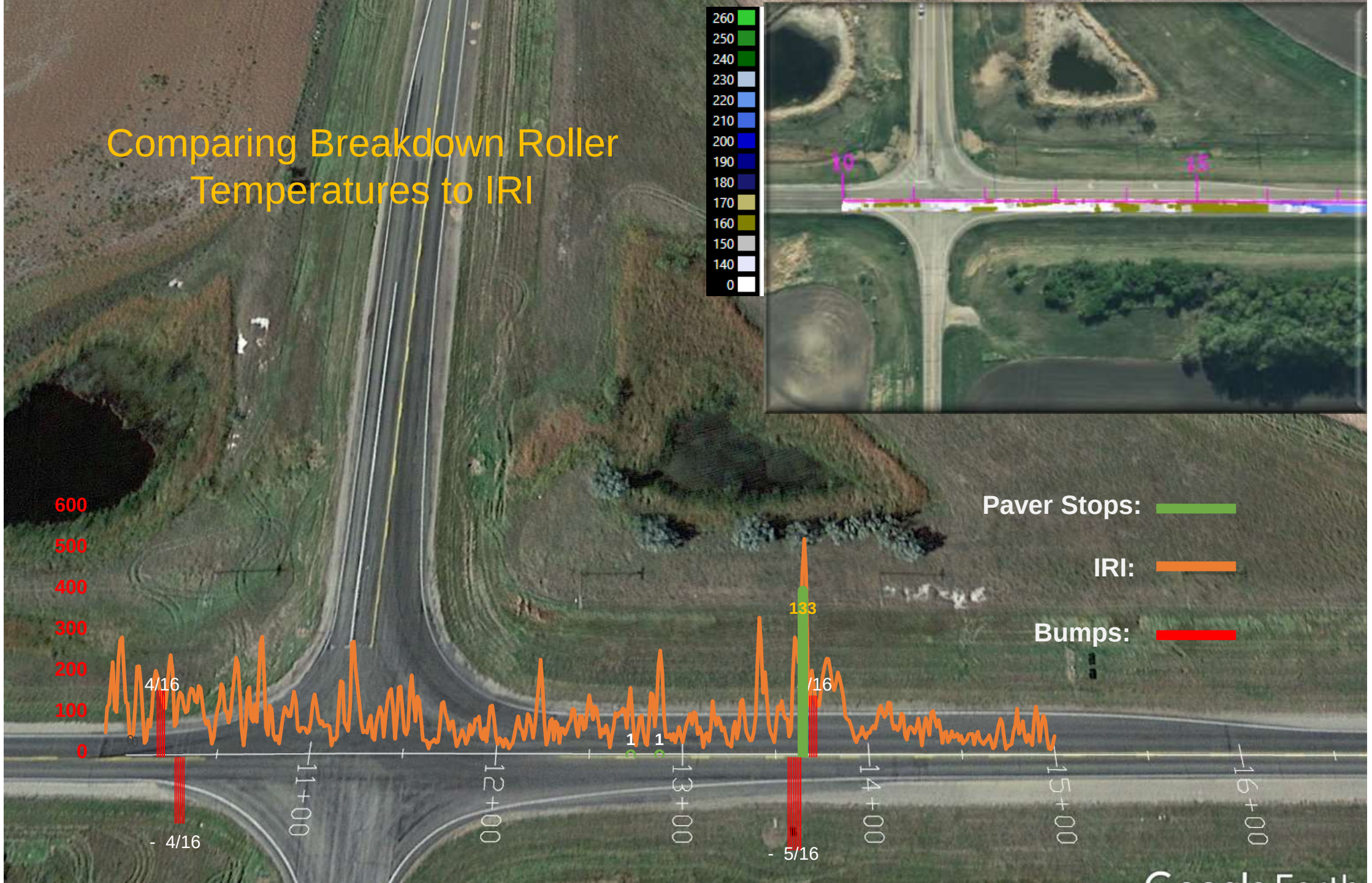
MRI Results With Patches & Paver Stops & Bumps on the NB Lane

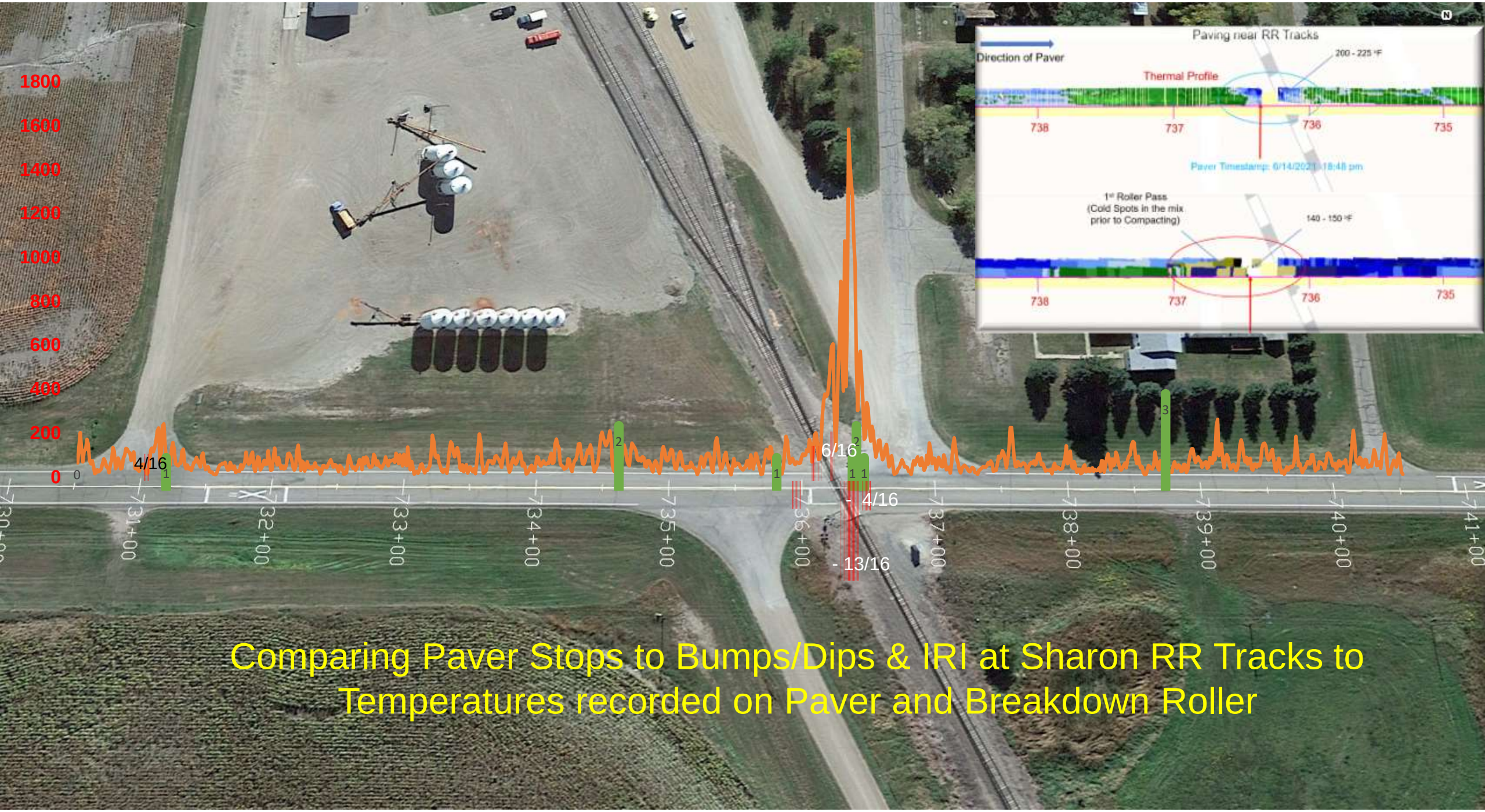


Comparing Paver Stops to IRI



Comparing Breakdown Roller Temperatures to IRI





Comparing Paver Stops to Bumps/Dips & IRI at Sharon RR Tracks to Temperatures recorded on Paver and Breakdown Roller

Comparing Paver Stops to Bumps/Dips & IRI

Int. Roller Stationary
for 4 minutes

HMA
Patch Area

IRI
800
700
600
500
400
300
200
100
0

IRI

638+00
639+00
640+00
641+00
642+00
643+00
644+00
645+00
646+00
647+00
648+00
649+00
650+00
651+00

Minutes

- 4/16
5/16
- 4/16
- 4/16

Paver Stops:
IRI:
Bumps:

Comparing Paver Stops to IRI

Ruby Says!
Reduce your paver stops if you want to Cash-in on Ride Incentives

IRI

450
400
350
300
250
200
150
100
50
0

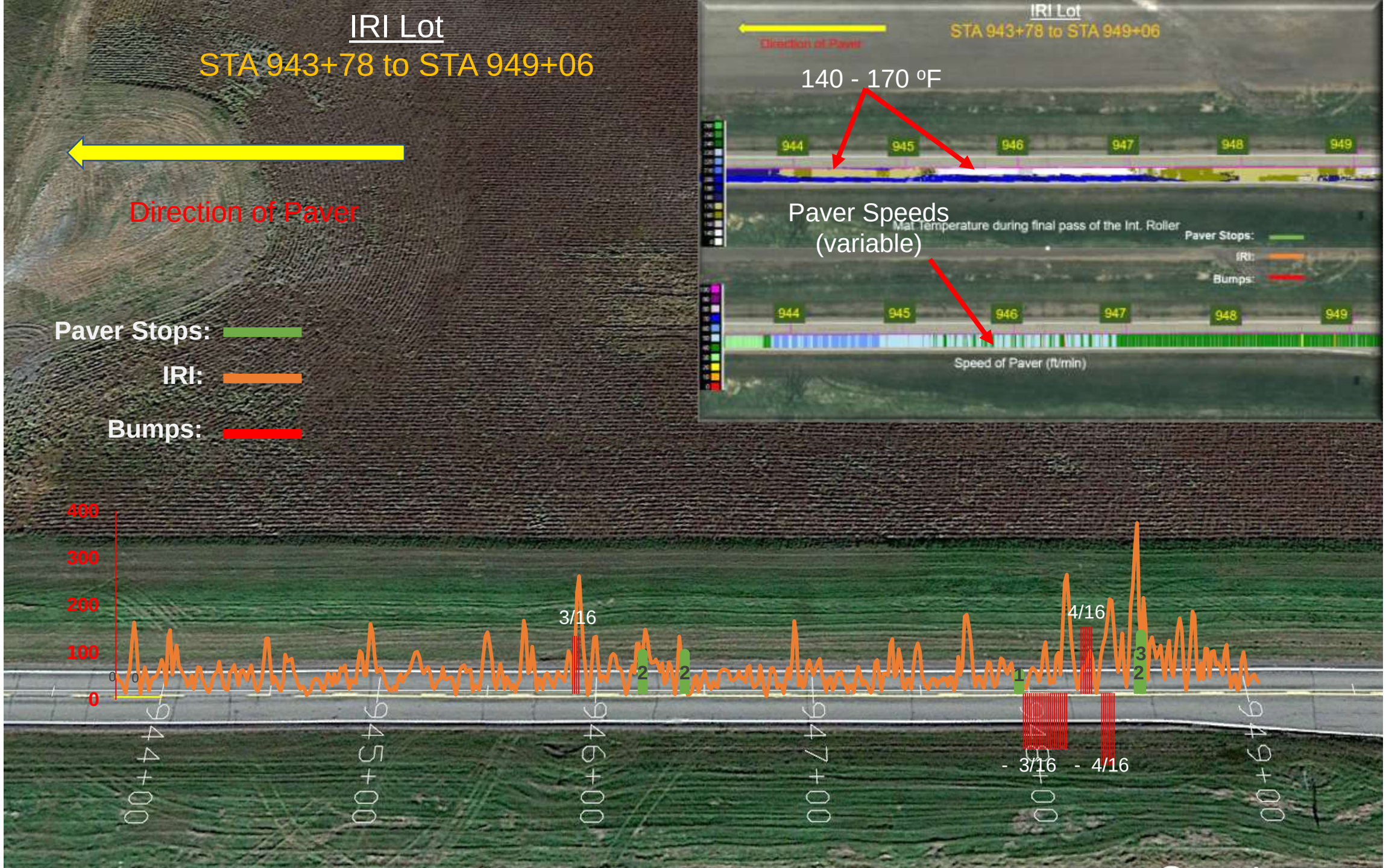
HMA Patch Area

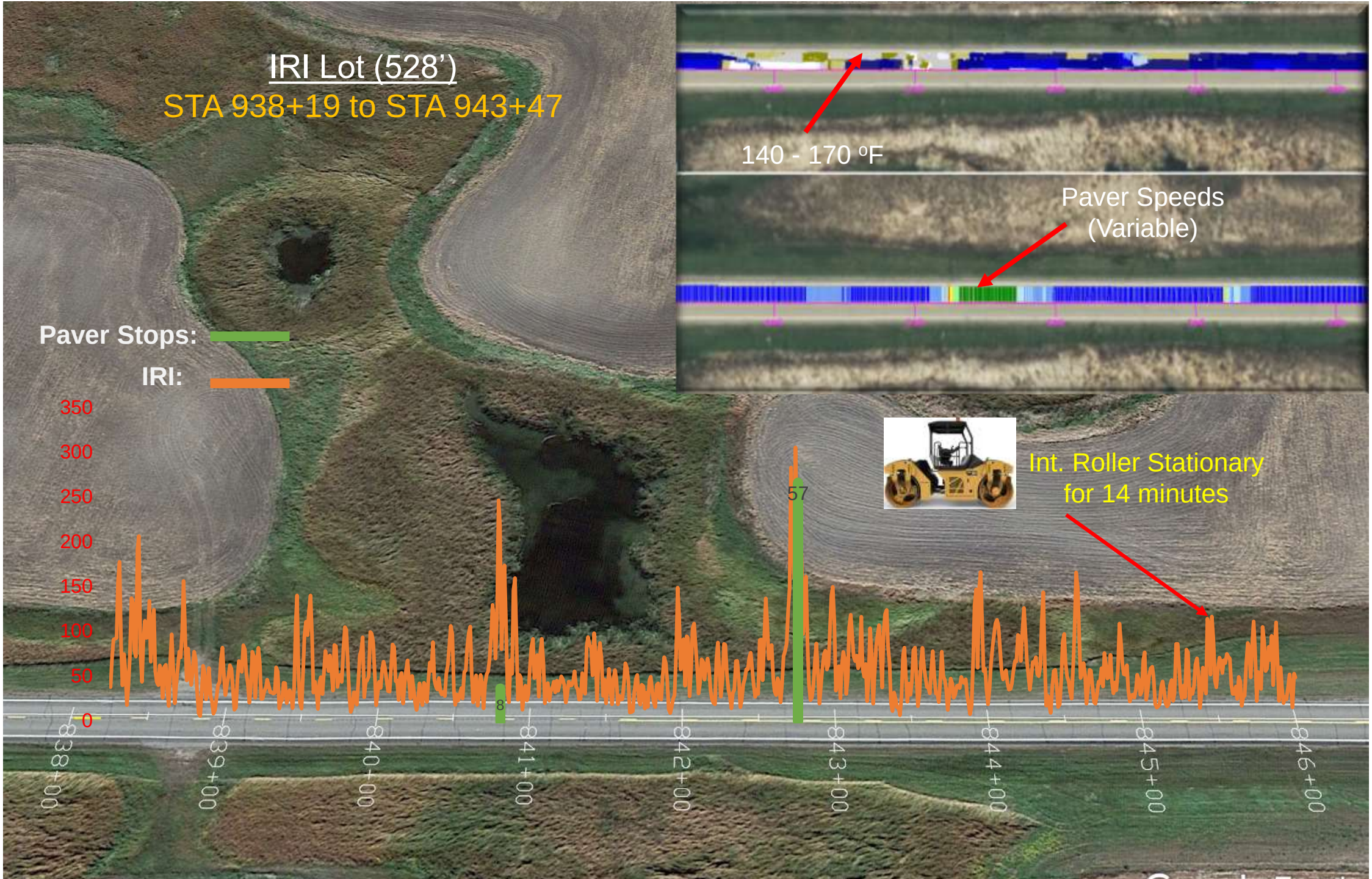
+651+00 +652+00 +653+00 +654+00 +655+00 +656+00 +657+00 +658+00 +659+00 +660+00 +661+00 +662+00 +663+00

Minutes

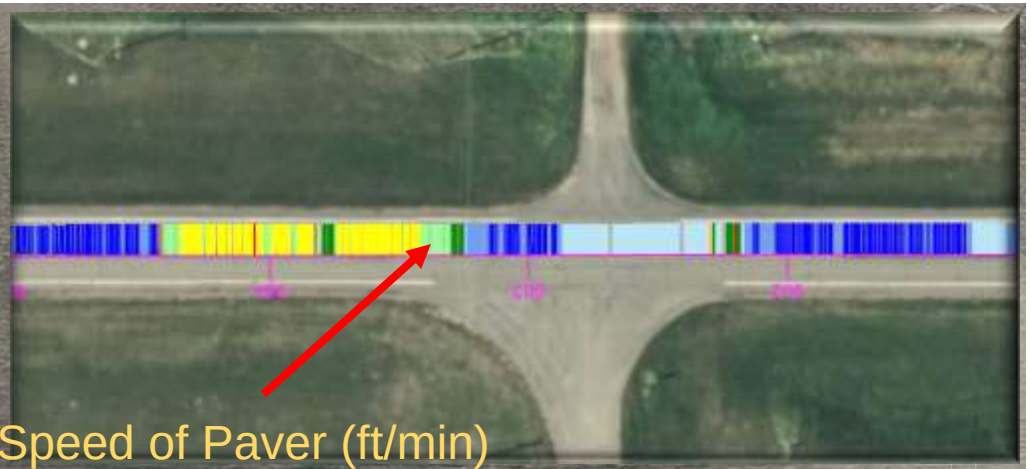
Paver Stops:

IRI:


IRI Lot
STA 943+78 to STA 949+06
Direction of Paver
Paver Stops:
IRI:
Bumps:
140 - 170 ºF
Paver Speeds
(variable)
Mat Temperature during final pass of the Int. Roller
Speed of Paver (ft/min)
944
945
946
947
948
949
400
300
200
100
0
3/16
4/16
- 3/16
- 4/16
6+44+00
6+45+00
6+46+00
6+47+00
6+48+00
6+49+00


IRI Lot (528')
STA 938+19 to STA 943+47
140 - 170 ºF
Paver Speeds
(Variable)
Paver Stops:
IRI:
350
300
250
200
150
100
50
0
8
57
Int. Roller Stationary
for 14 minutes
838+00
839+00
840+00
841+00
842+00
843+00
844+00
845+00
846+00

Breakdown Roller sat approx. 3 minutes in this Location
Surface Temp. of Mat was 220-230 deg.



Speed of Paver (ft/min)

700
600
500
400
300
200
100
0

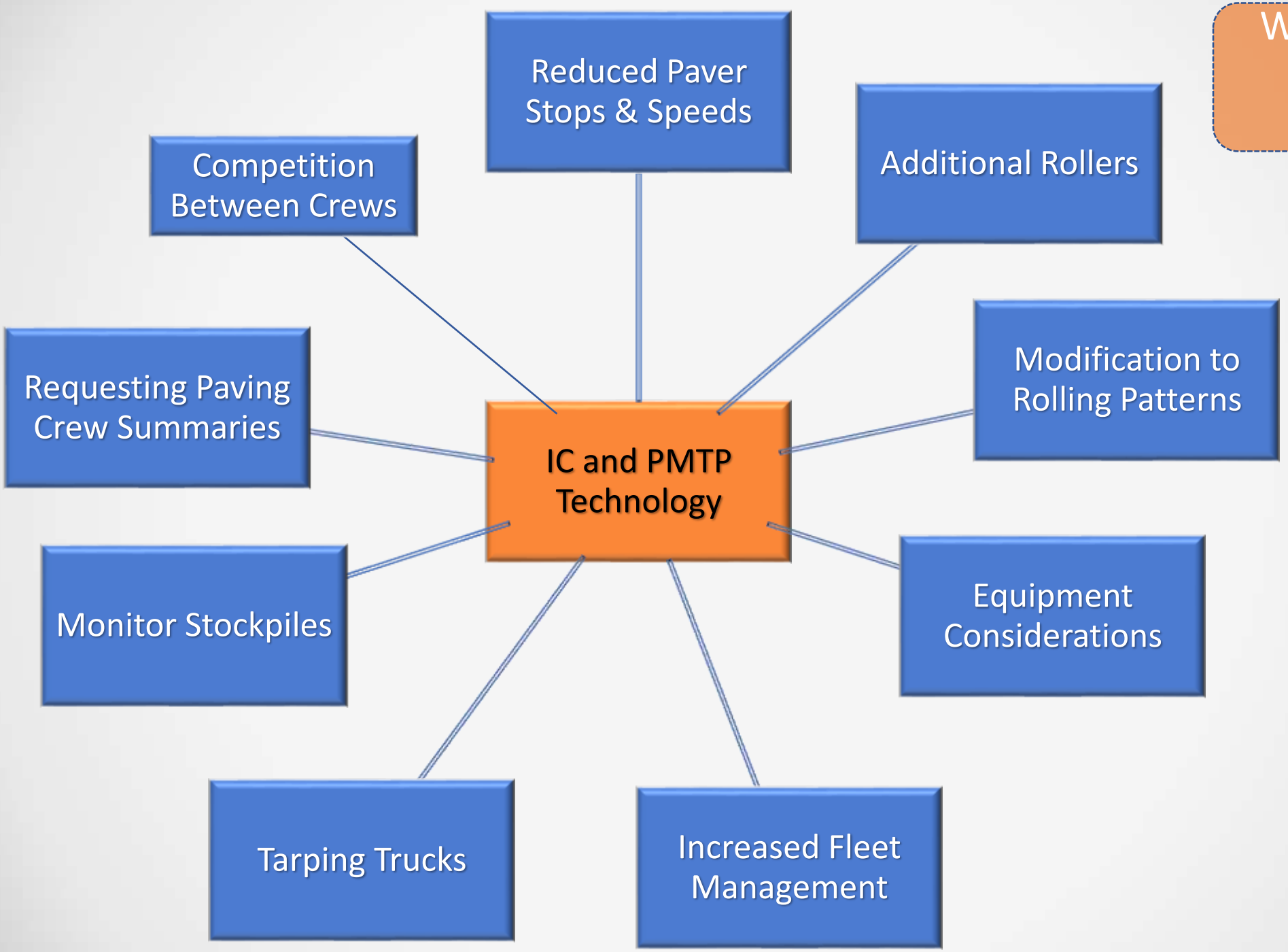
5
10/16
6/16
1
- 4/16
- 7/16 7/16

901+00
902+00
903+00
904+00
905+00
906+00
907+00

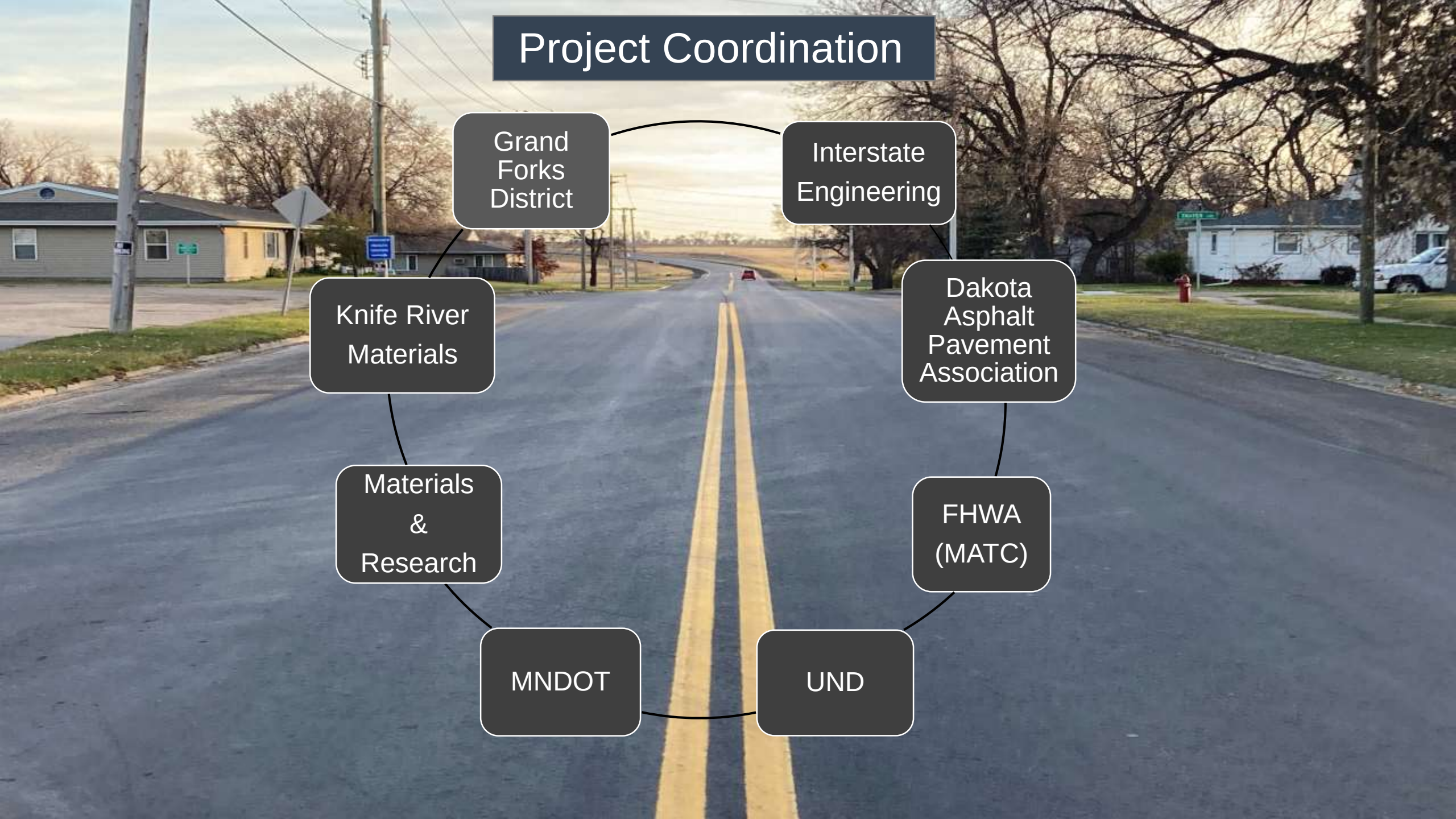
IRI Lot
STA 901+55 to STA 906+83

Paver Stops:
IRI:
Bumps:

What are other contractors doing?



Project Coordination



ONE Team Network Goal


THANK YOU!!!
Jesse Kadrmas
Paul Bervig
Ruby "superfly" Korby
Aaron Perez
Ken Swedeen
Curt Dunn
Amy Biese
Rob Jorgenson
Paul Sharp
Mike May
Dustin Lang
Paul Jeske
Scott Johnson
Tyler Birchem
Austin Snobl
Nick Chicos
Jon Stork
Melissa Korby
Andy Ayash
Chris Fisketjon
Chris Vistad
Aaron Medenwaldt
Surface Preparation Technologies
Glen Newling
Danny Schmidt
Monster Lawn Service
Corey Johnson
3D
Dallman Services
Tyler House
Matt Schadd
Dylan Webb
BG Amundson