

Intelligent Compaction for HMA



Pavement Conference

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Intelligent Compaction (Video)

Mn/DOT Priorities

- Uniform Compaction - All rollers in a train having a display showing # of passes (GPS)



- Uniform Temperature - Surface Temperature behind Screed (Pave-IR)



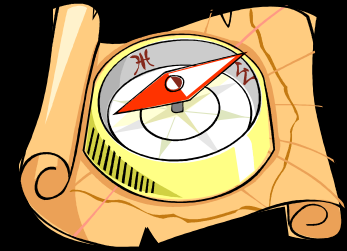
1989 – “Effect of Compaction on Asphalt Concrete Performance”



Each 1% increase in air voids
(over the base air void of 7
percent) tends to produce
about a 10 percent loss in
pavement life (or about 1 year
less life)



How Did We Get Here?



- *Washington DOT did a study in 1998 to 2001 on Temperature and Density Differentials*



- Increasing temp. differential correspond to increasing air voids which affect pavement performance

- *Mn/DOT Study in 2001*



- Profiles with $> 25^{\circ}\text{F}$ difference had a 50/50 split on passing and failing densities
 - Profiles with $< 25^{\circ}\text{F}$ difference had 93% passing the density requirement



Texas Implementation



- *TXDOT has a Lay-Down Operations Spec.*
 - Take a thermal profile in every subplot
(IR Thermometer, Thermal Camera, or Pave-IR)
 - If the subplot has moderate segregation (25-50°F), contractor directed to take corrective actions
 - If subplot has severe segregation (> 50°F), Engineer may suspend operations, no bonus \$ available (if not using Pave-IR)
 - Basically TXDOT is trying to minimize thermal segregation.



Two Projects in 2010

Anderson Brothers – TH 169
Ulland Brothers – TH 13



MOBA Pave-IR



12 sensors spaced 1 foot apart,
reading interval = every 6 inches



Pave-IR Purpose



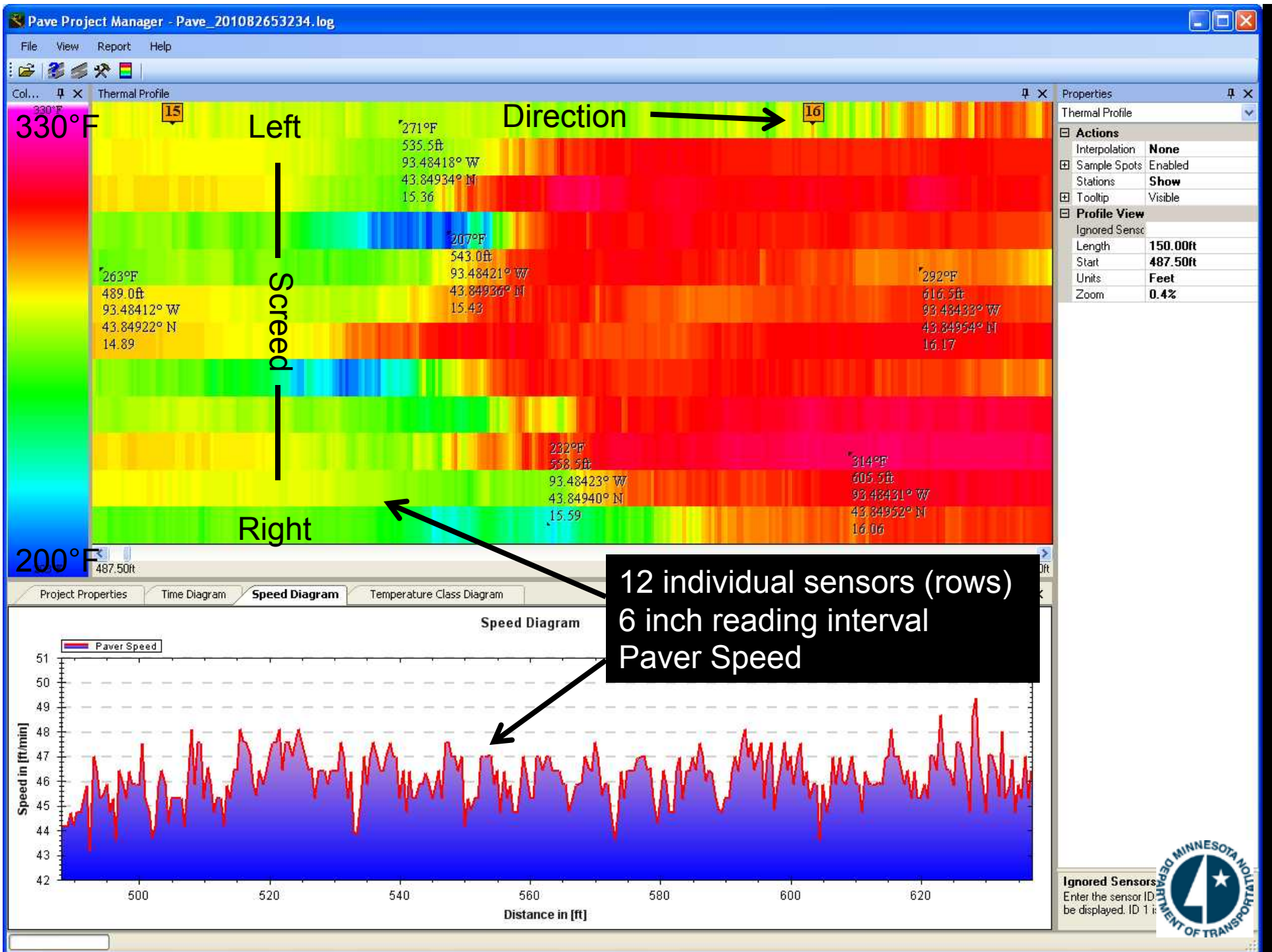
- Promote more uniform, higher quality pavements
- WADOT, NCAT, And TTI found thermal uniformity useful for detecting segregation.
- A segregated mat increases the contractor's chances of QC/QA core being in a poor/low density area.
- A segregated mat increases agency's risk of early distress

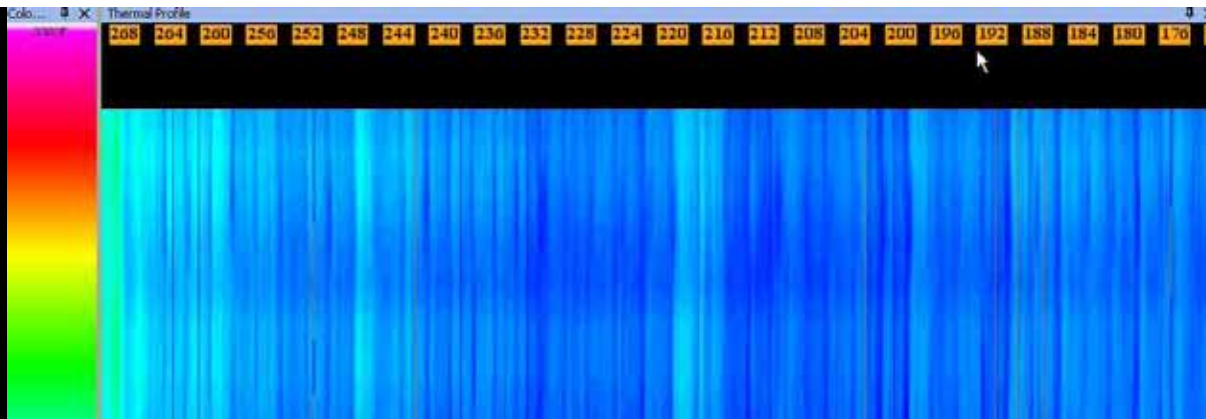


What will this technology do for you?

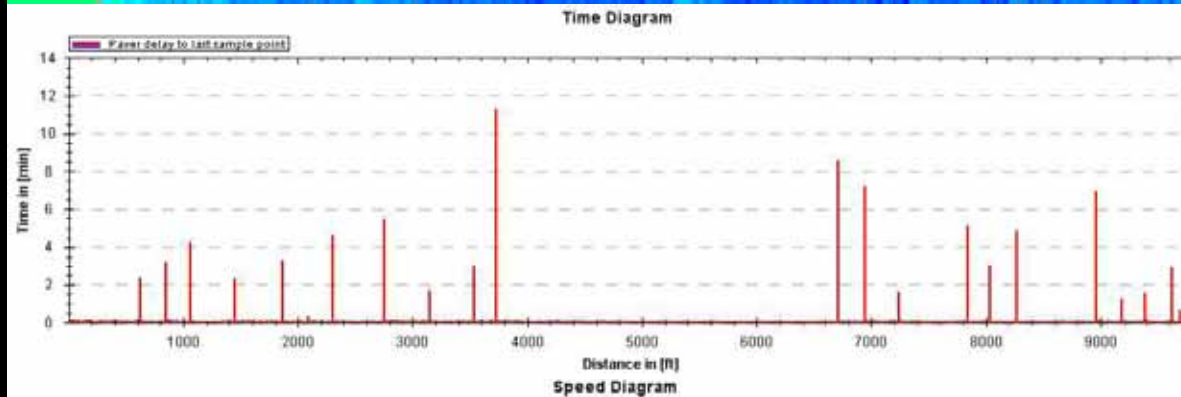
- Identify in real time if you have temperature segregation related issues due to:
 - End of truck
 - Streaks – paver/plant adjustments
 - Random – small clumps
 - Production temperature



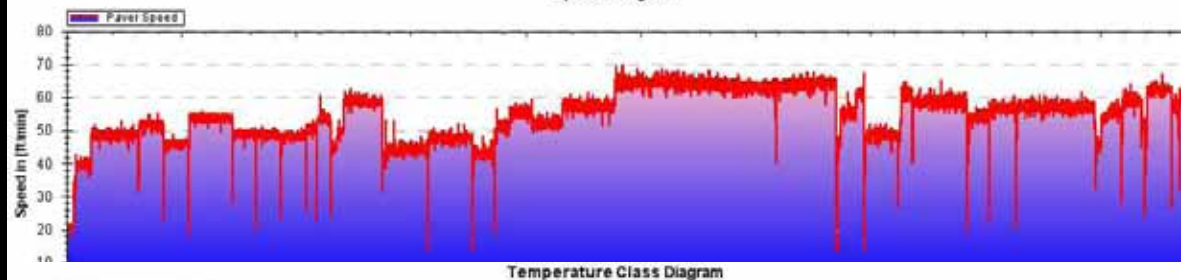




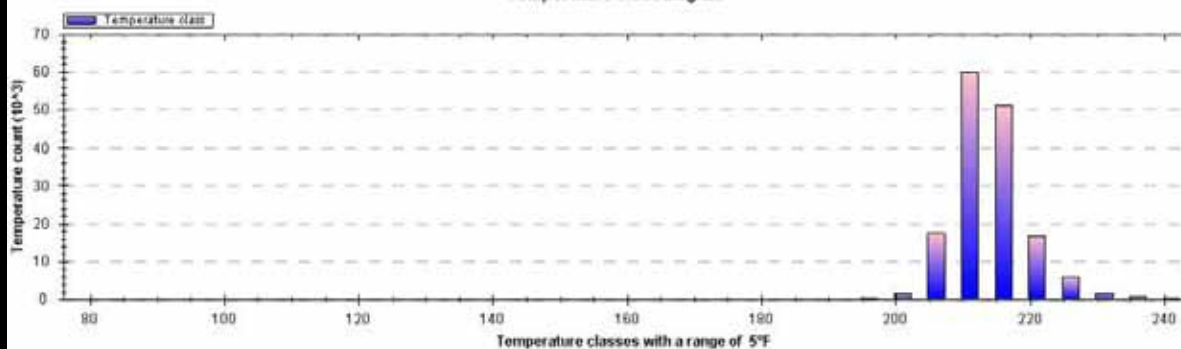
Duration
4 hr 30 min



Paver Stops Total
1 hr 25 min



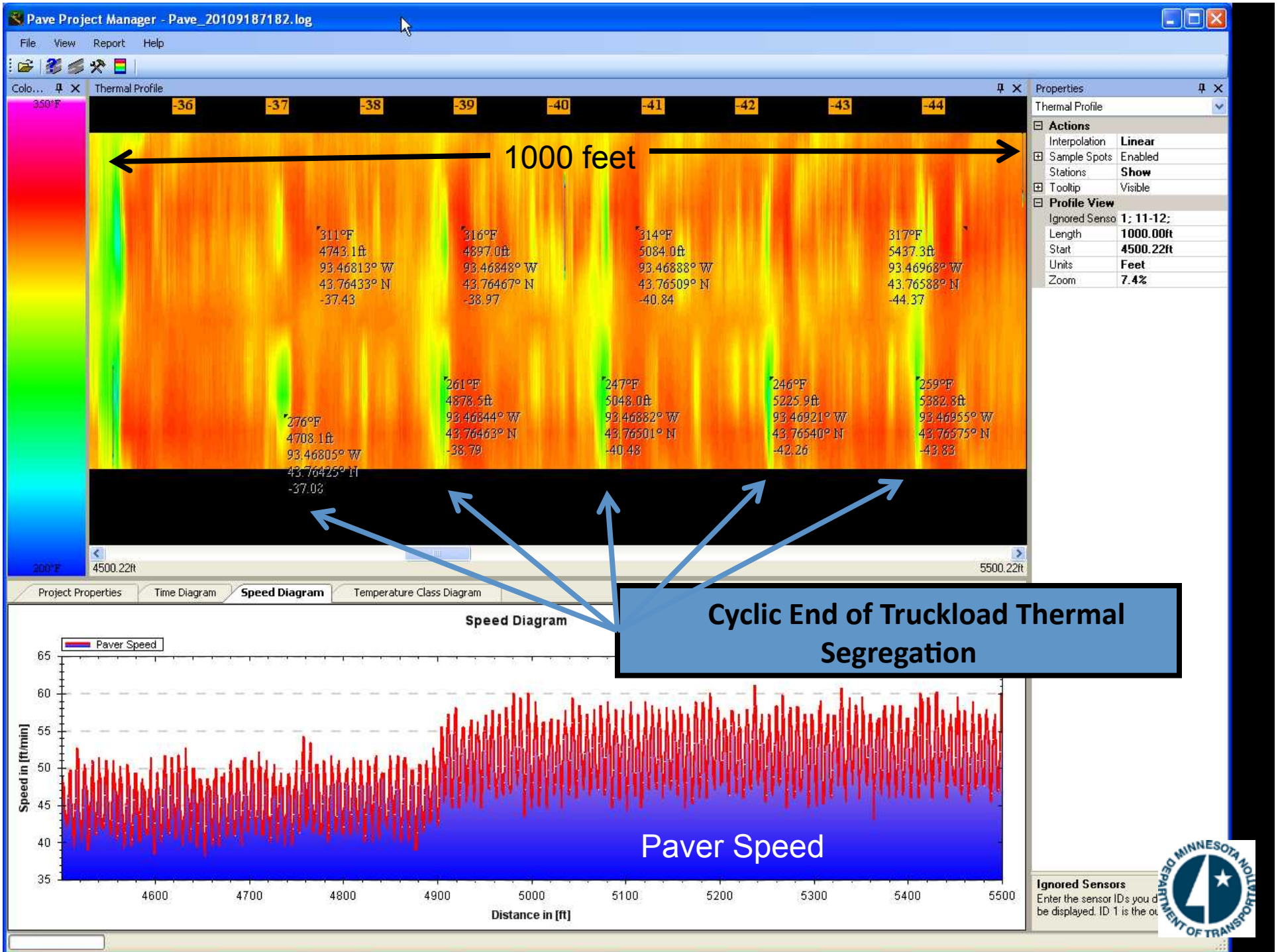
Avg. Paver Speed
36 ft./min

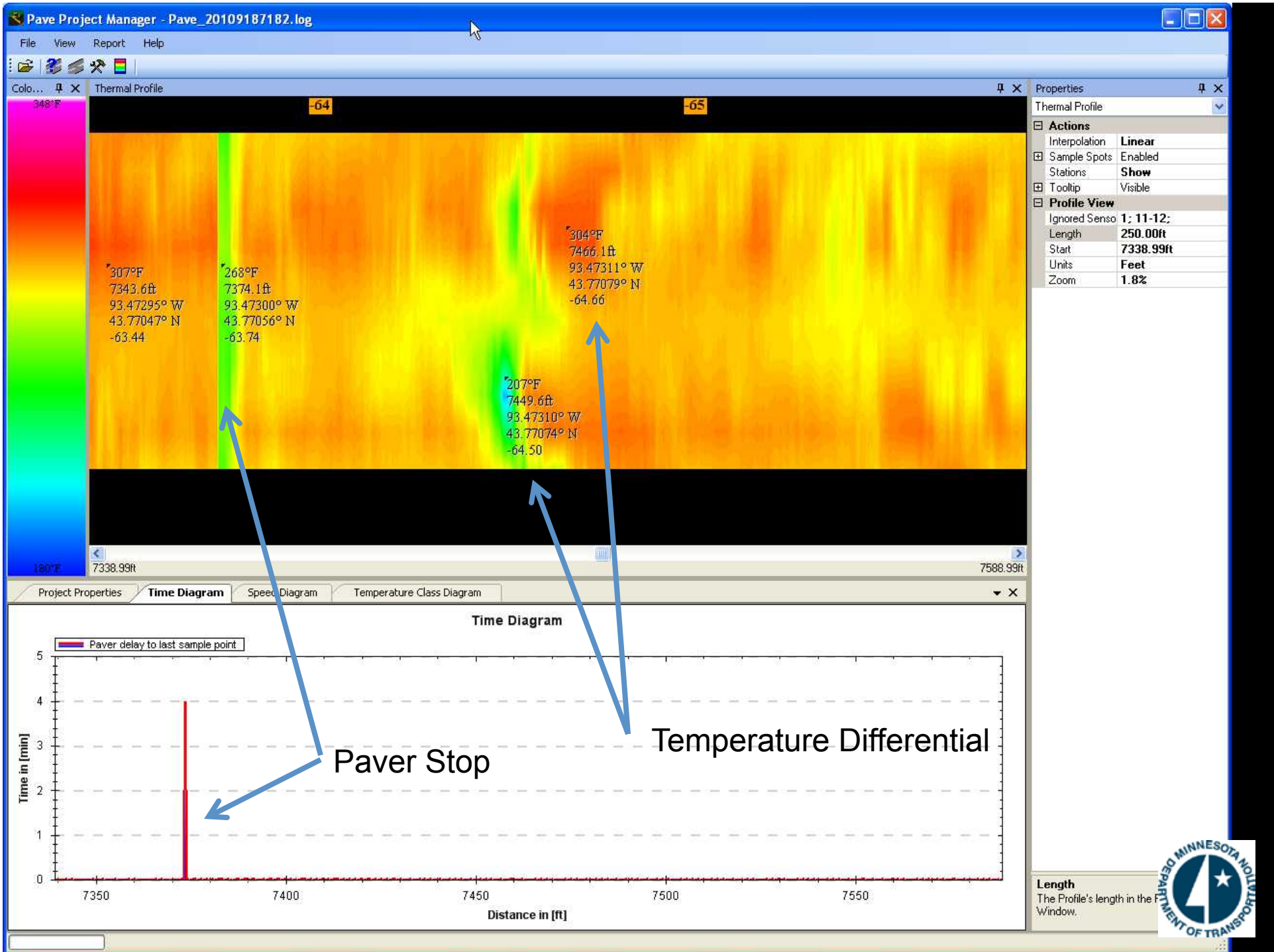


Surface Temp









Material Name:			
Producer:			
Area Engineer:		Project Manager:	

Course/Lift:	1	Temperature Differential Threshold:	25.0
Segment Length (ft):	150	Sensors Ignored:	1, 12



Thermal Profile Results Summary

Number of Profiles	Moderate 25.0°F < differential <= 50.0°F		Severe differential > 50.0°F	
	Number	Percent	Number	Percent
156	15	10	0	0

Summary of Locations Without Thermal Segregation

Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
1	646.00	93.73985 W, 46.44106 N	647.50	93.73963 W, 46.44143 N	268.2	253.6	14.6
2	647.50	93.73963 W, 46.44143 N	649.00	93.73937 W, 46.44181 N	270.9	258.1	12.8
3	649.00	93.73937 W, 46.44181 N	650.50	93.73911 W, 46.44217 N	270.7	251.6	19.1
4	650.50	93.73911 W, 46.44217 N	652.00	93.73888 W, 46.44255 N	278.2	258.4	19.8
5	652.00	93.73888 W, 46.44255 N	653.50	93.73862 W, 46.44291 N	278.4	255.6	22.9
6	653.50	93.73862 W, 46.44291 N	655.00	93.73838 W, 46.44329 N	278.8	261.1	17.6
7	655.00	93.73838 W, 46.44329 N	656.50	93.73814 W, 46.44365 N	279.9	267.3	12.6
8	656.50	93.73814 W, 46.44365 N	658.00	93.73788 W, 46.44402 N	281.7	263.7	18.0
9	658.00	93.73788 W, 46.44402 N	659.50	93.73765 W, 46.44440 N	279.9	264.9	14.9

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18 (18 of 19) 129% Find

Sticky Note Text Edits Show

Location of Paver Stops greater than One Minute

Location (stations)	Duration (h:min:sec)
697.16	0:3:35
703.20	0:4:52
707.66	0:7:36
710.07	0:9:12
717.48	0:4:18
731.04	0:5:13
735.79	0:6:5
744.82	0:8:0
747.03	0:9:2
749.58	0:4:41
753.99	0:7:32
757.81	0:6:26
766.32	0:3:32

MINNESOTA
DEPARTMENT OF TRANSPORTATION

Project Comparison

Mixture Type	Total # of Profiles	Moderate Segregation (%)	Severe Segregation (%)
HMA (TH 169) [300°F]	387	27	1
HMA (TH 13) [320°F]	1303	65	32
WMA (TH 169) [275°F]	145	23	0
WMA (TH 169) [235°F]	446	2	0



IC Roller & Display

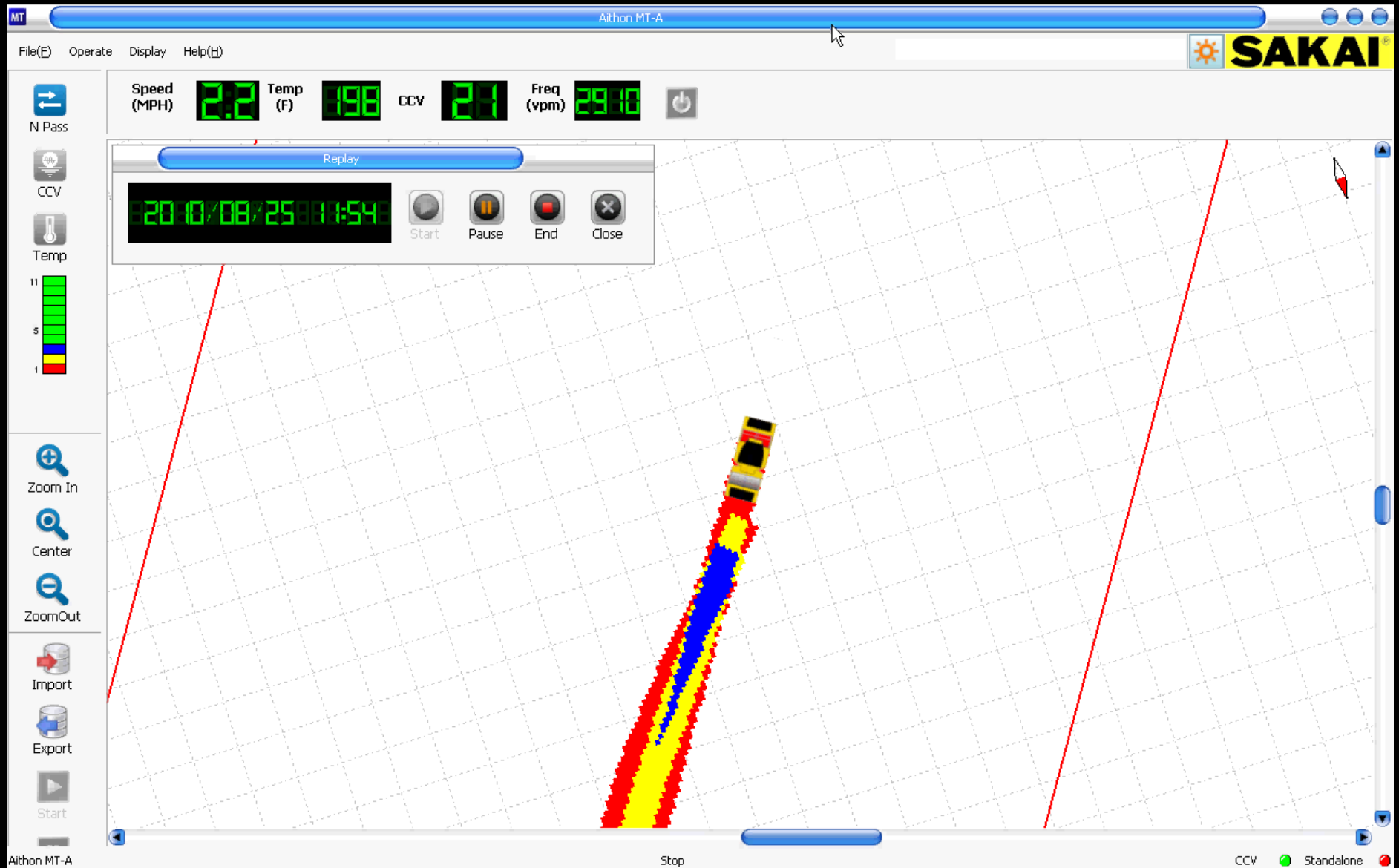


What Data is Collected

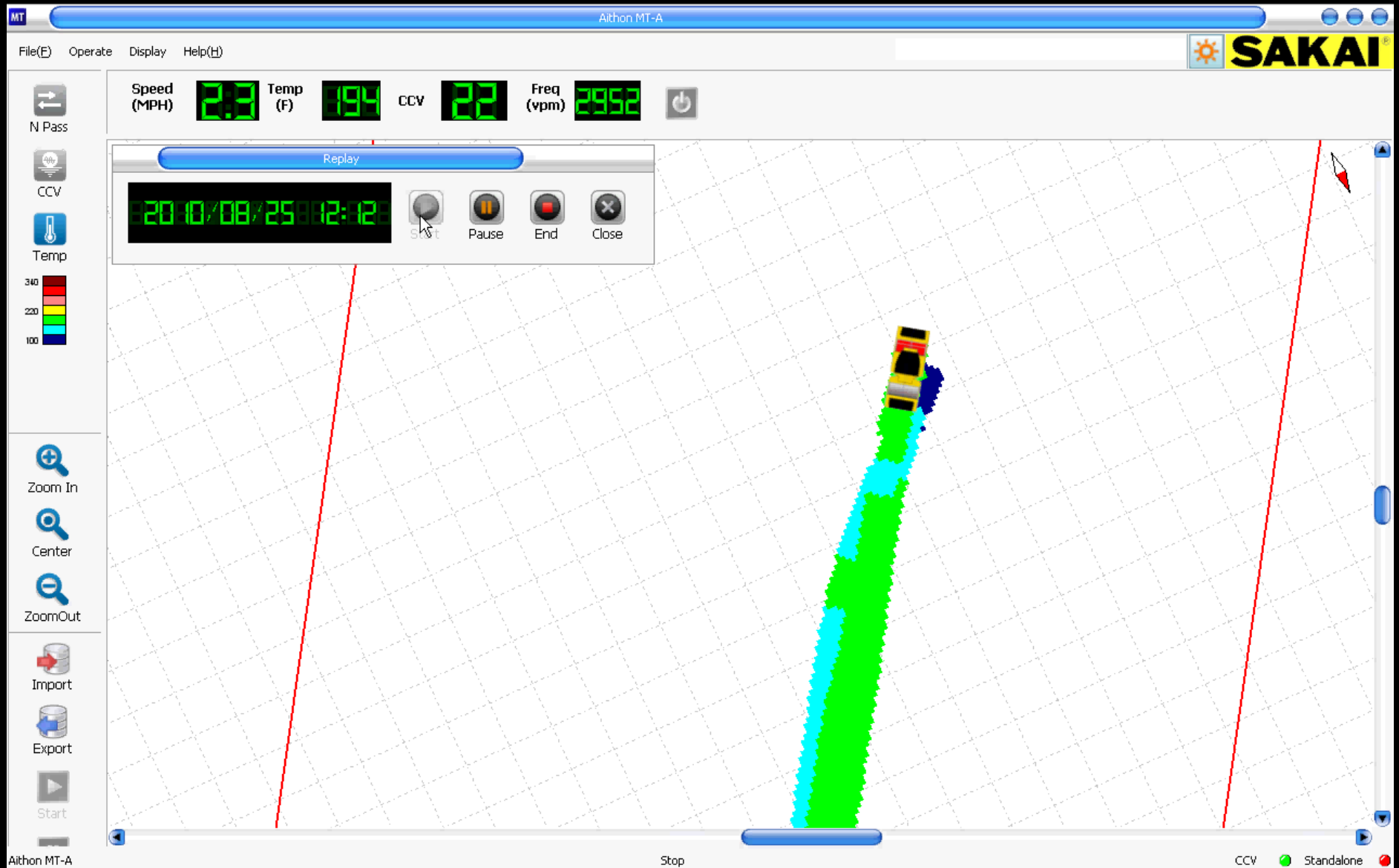
- GPS Coordinates (Location)
- Collects all data, but only displays the following data if drum is vibrating.
- Mat Temperature (in front of lead drum)
- Number of Passes
- Material Stiffness



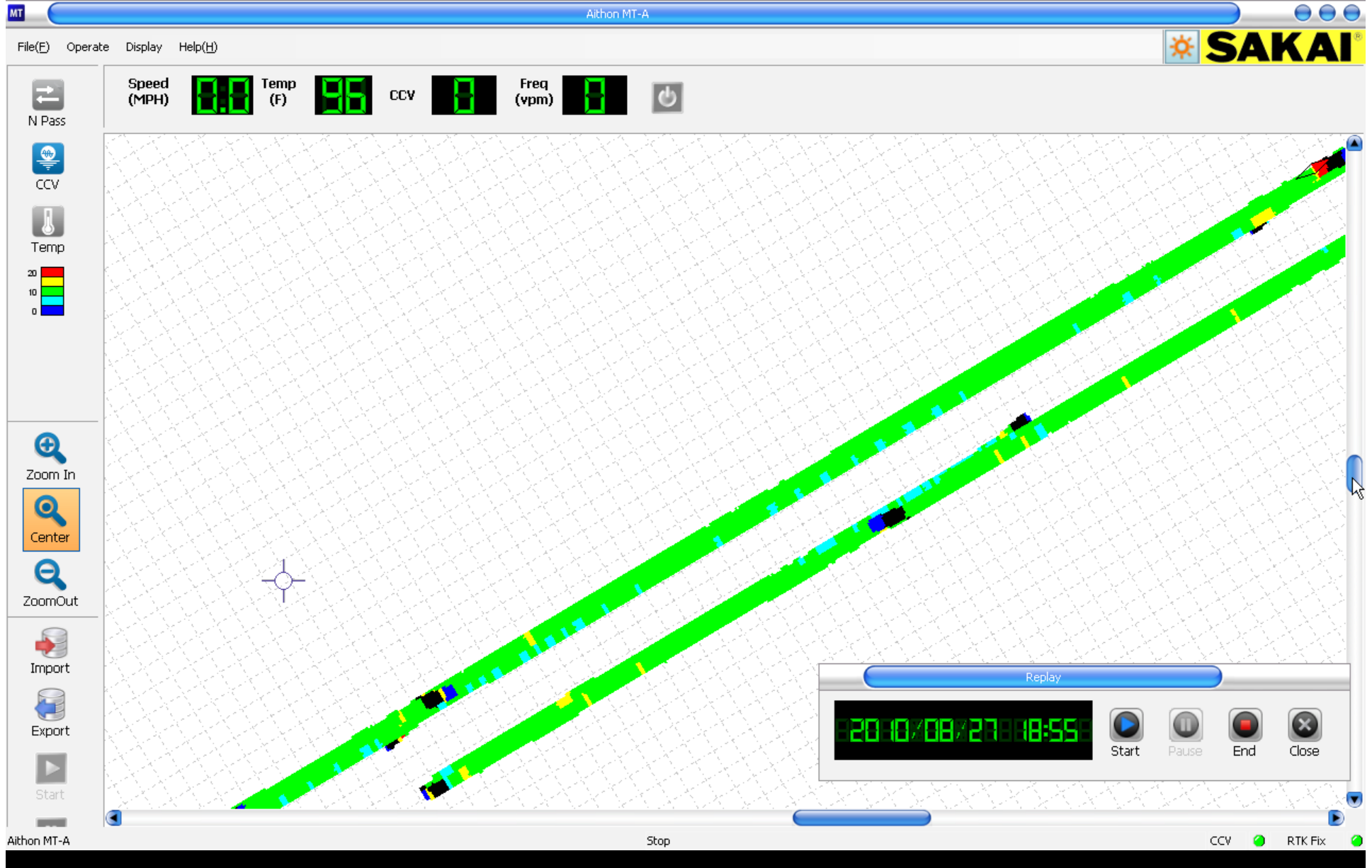
Roller – Number of Passes

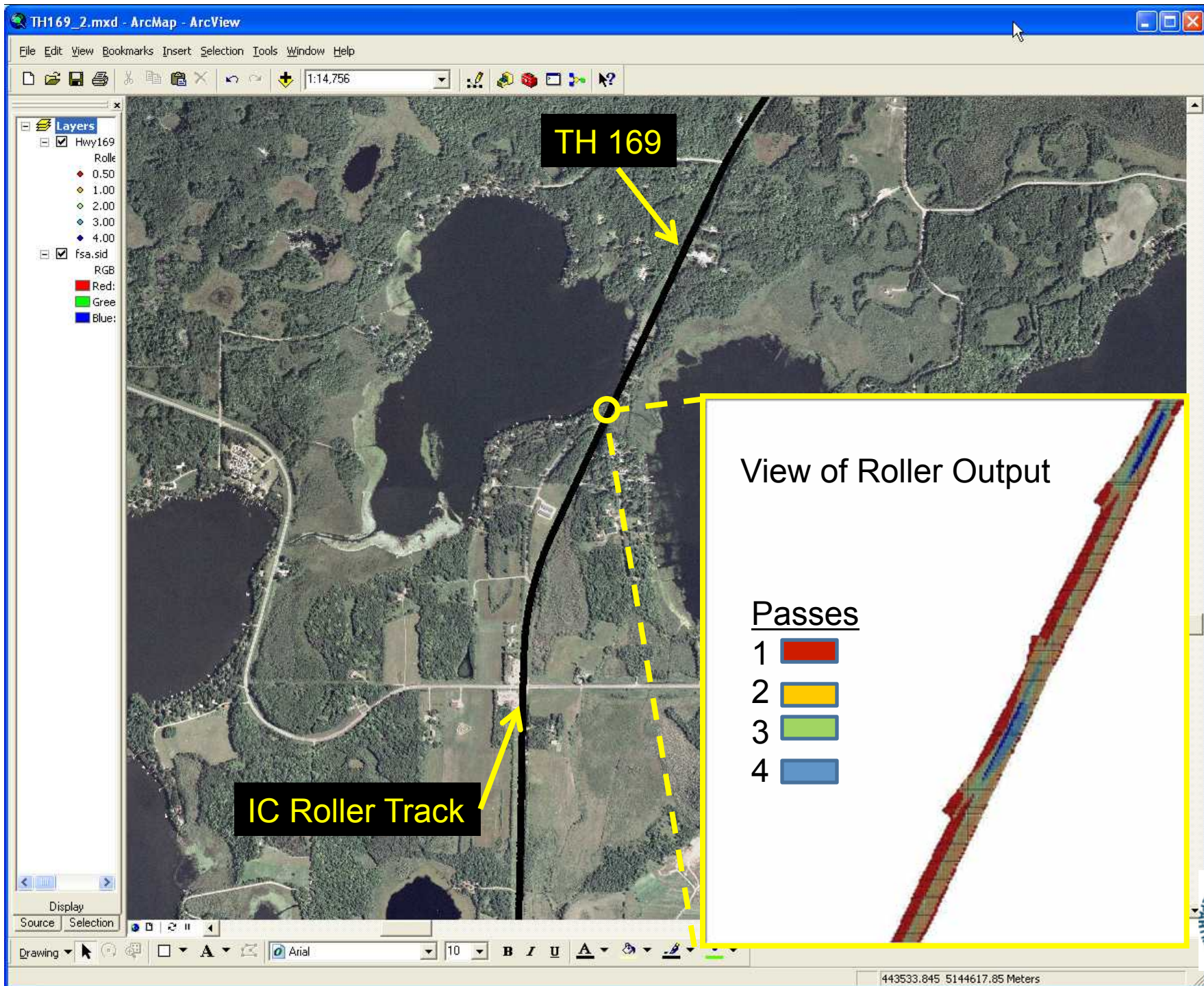


Roller – Temperature



Roller – Compaction Value





What is Gained?



- Values of mapping existing support before construction or overlay
- Significant improvements of rolling patterns, thus, consistent products
- Improvement of roller operators' accountability
- Measurement influence depth varies depending on technology and site conditions

Benefits of Intelligent Compaction



- Improve density – better performance
- Improve efficiency – cost savings
- Increase information – better QC/QA
- Overall benefit – improved pavement performance
- Shortcomings of density acceptance process
 - Limited number of locations
 - After compaction is complete

Next?

- Pave-IR
 - Encourage its use as a construction aid to reduce thermal segregation
- Roller IC
 - Install a retro fit system on an entire roller train



TH 18 (169) Elk River, 1920's



Thank You

