SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM




Advanced Methods to Identify Asphalt Pavement Delamination--R06D New Mexico Department of Transportation

IE/SASW

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U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

Introduction *IE/SASW*

Objective

Assess the pavement structural condition using Sonic Surface Scanner (SSS) to perform Impact Echo (IE) and Spectral Analysis of Surface Waves (SASW)

- Identify possible
  - Stripping
  - Debonding
  - Delamination
  - Degraded zones
- Explore the effects of asphalt pavement temperature on the IE and SASW test methods and to assess the repeatability of the test methods

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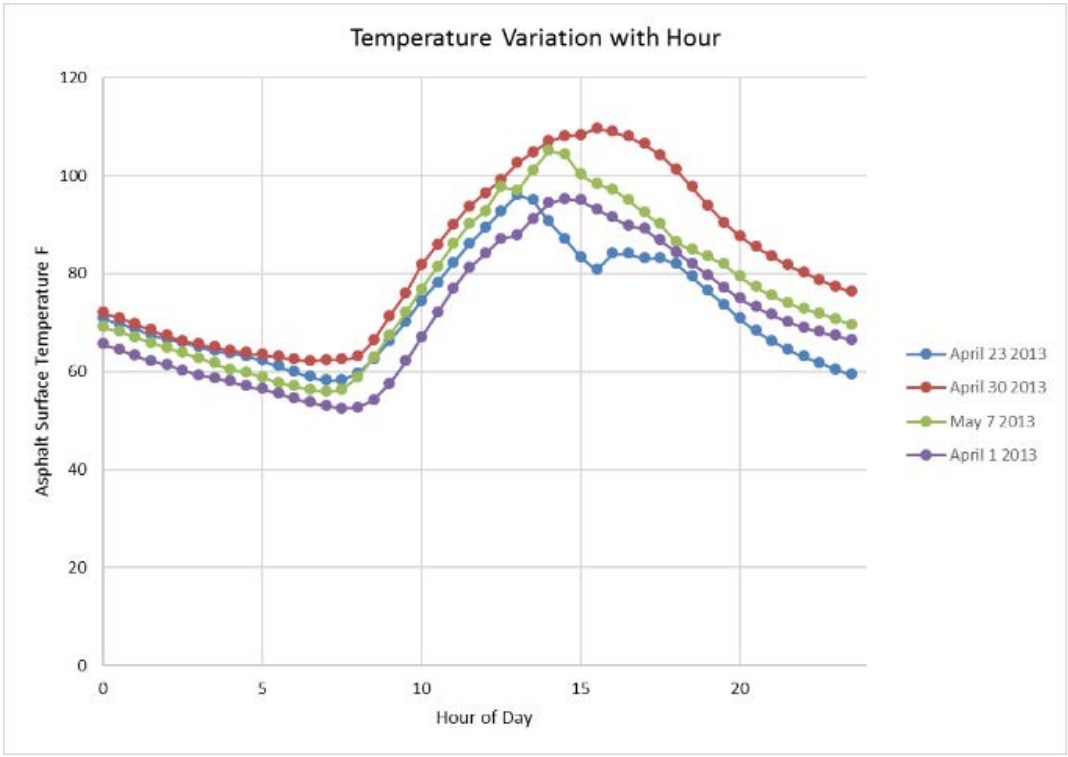
Introduction *IE/SASW*

New Mexico Concerns

- Temperature sensitivity
- Surface Treatment (OGFC)
- Delamination Detection



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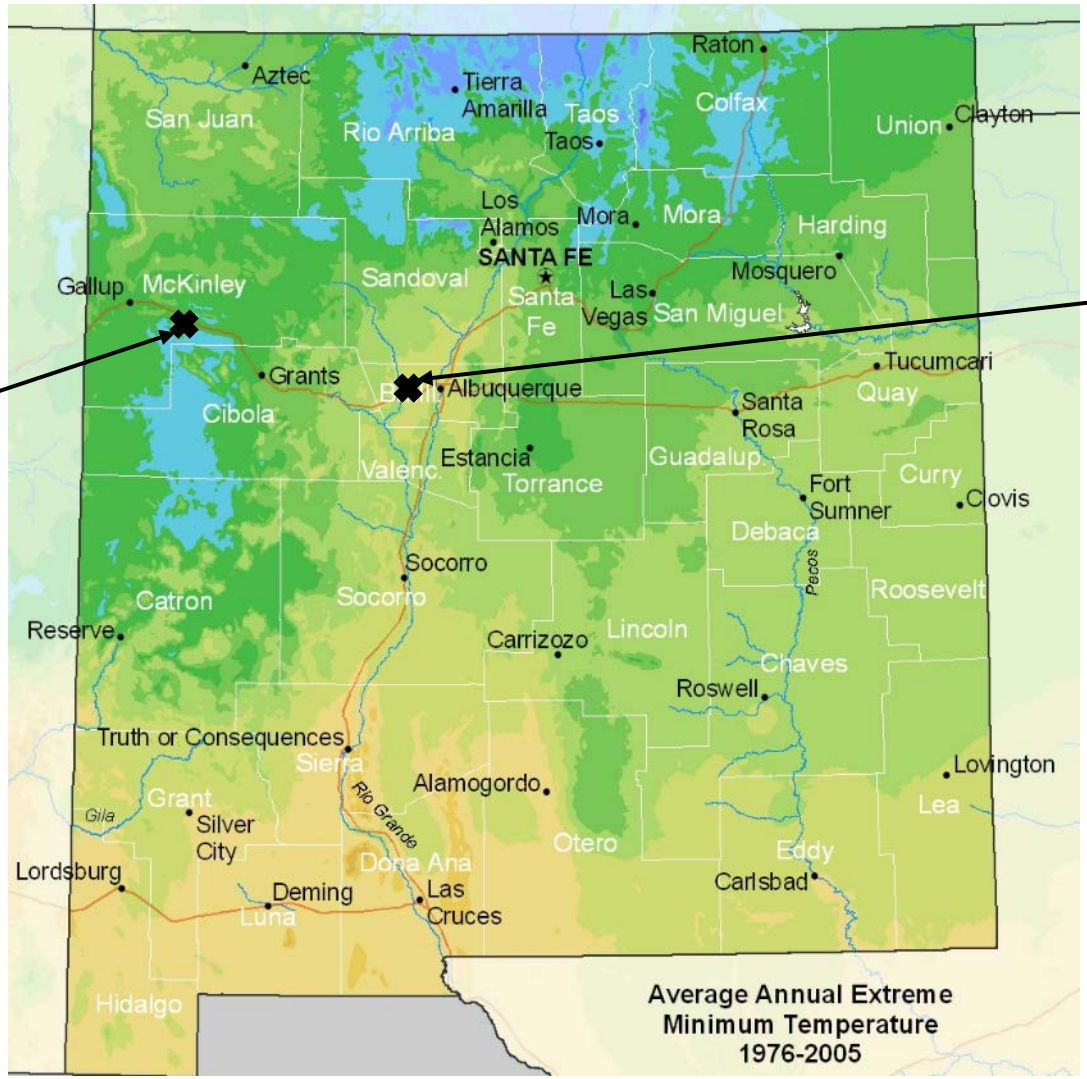
Site Locations

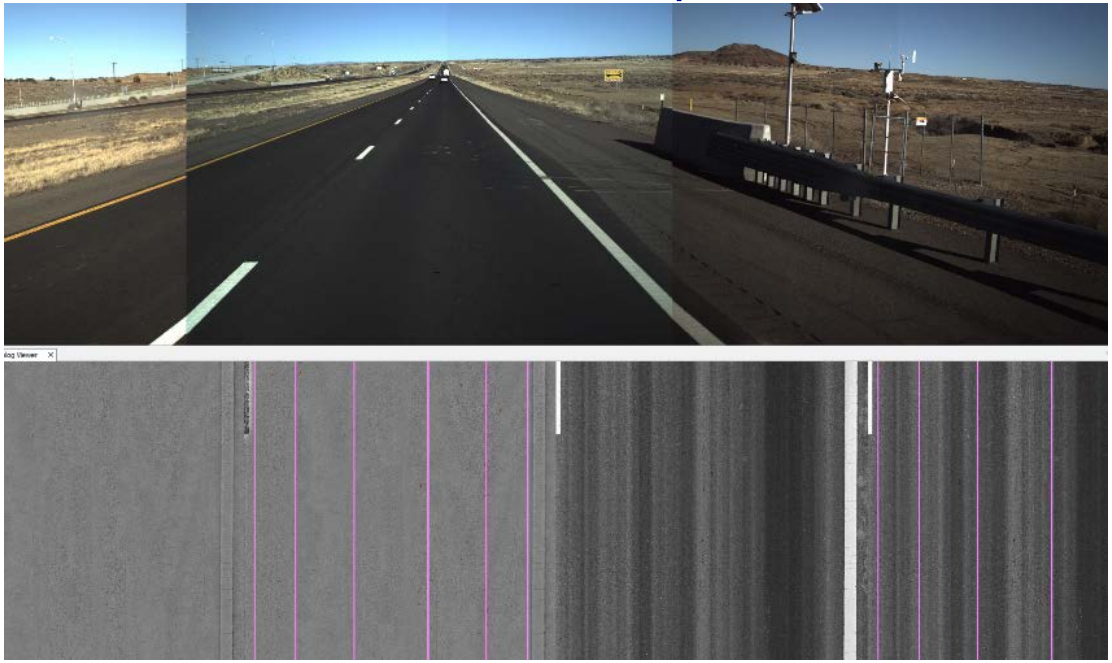
District 6
Site
I-40 Mile
Point 37



District 3
Site
I-40 Mile
Point 141

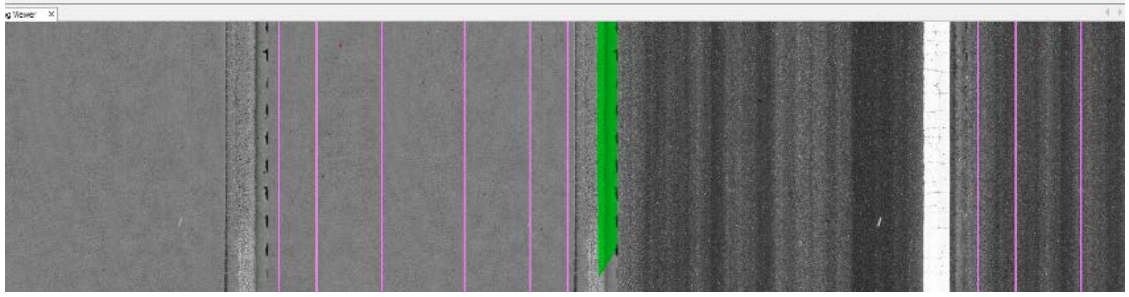
District 3 Site (I-40 MP 141)

- Imbedded with temperature probes
- Daily temperature fluctuation +50 °F
- “Flat” Terrain
- 11 in. of SP-III
- 5/8 in. Open Graded Friction Course (OGFC)
- 500 ft. section tested multiple times

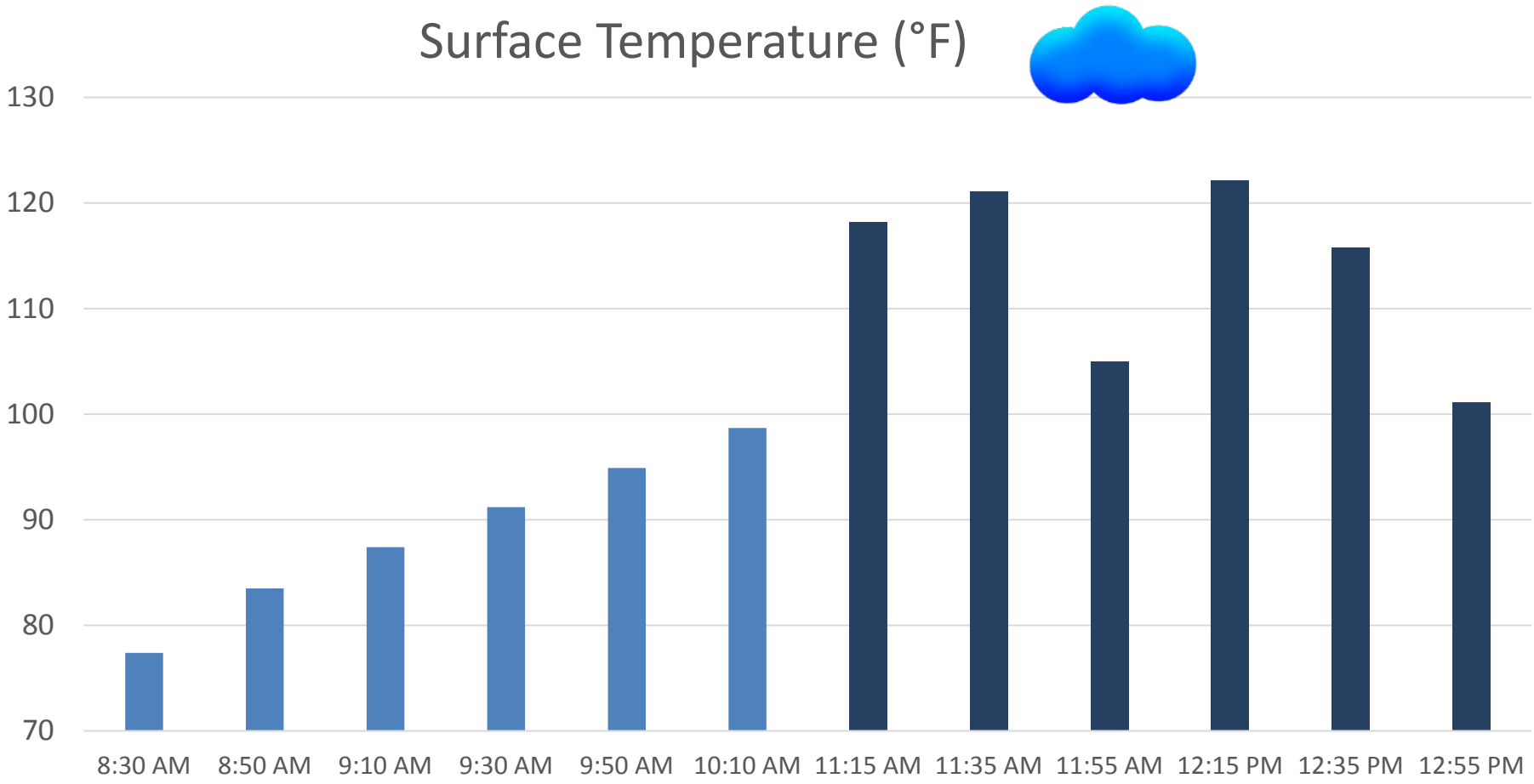


District 6 Sites (I-40 MP 141)

- Two sections 1000ft each tested
- 6 scans each
- Mountainous terrain which receives annual snowfall
- Basalt Mixes Top Mix
- Marshall Mix Bottom Mix
- Open graded friction course



District 6 Test Sites Temperature



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Testing

- IE/SASW
- Portable Seismic Pavement Analyzer (PSPA)
- Coring

NMDOT Experience

- 1000 ft. line ~ 20 min.
- 1000 Segment (6 runs) ~ 2 hrs.
- Still much faster than PSPA!

  PSPA took about 15 min for each point compared to the IE/SASW 1 point second at 6” spacing

- Analysis software

  Not easily interpreted

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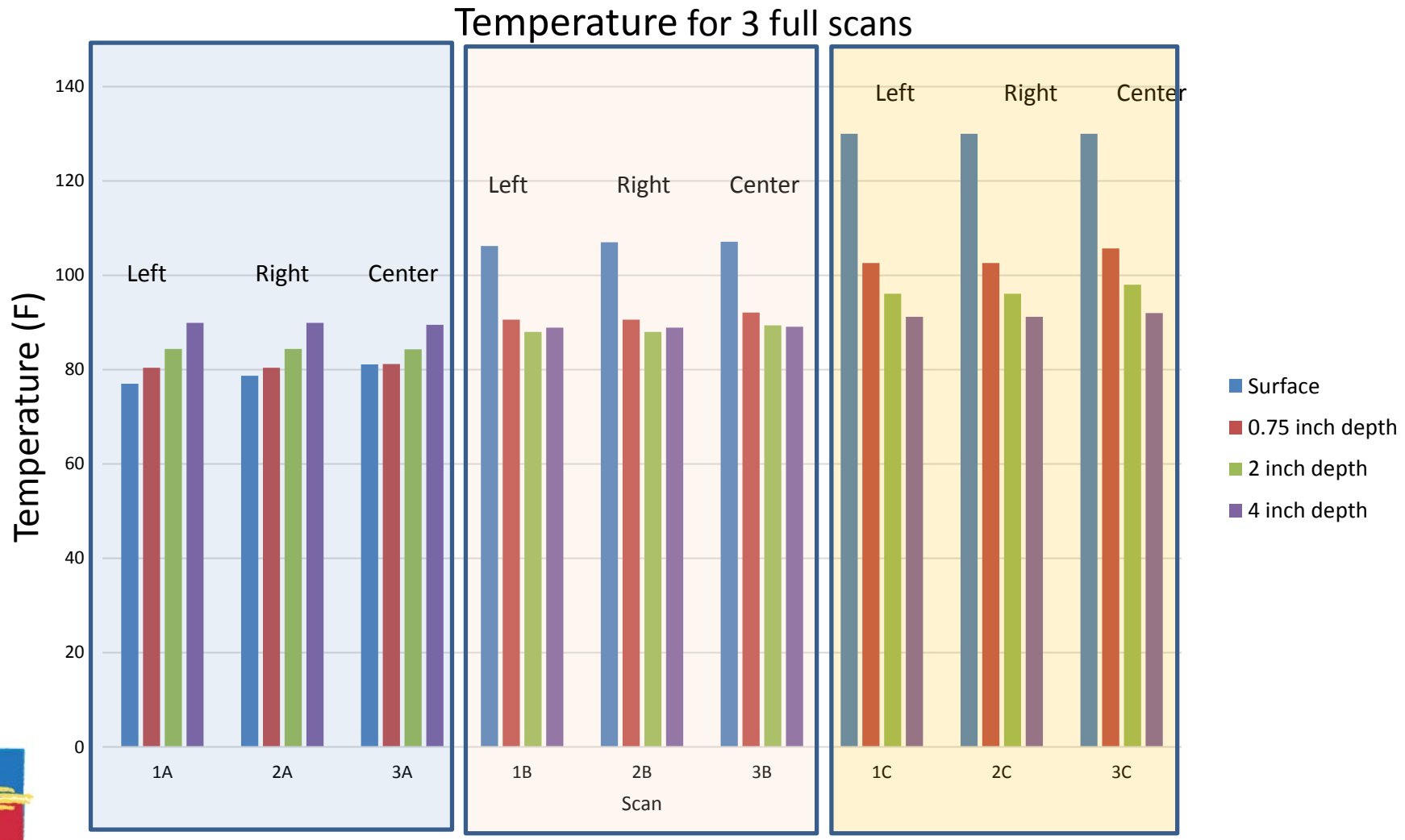
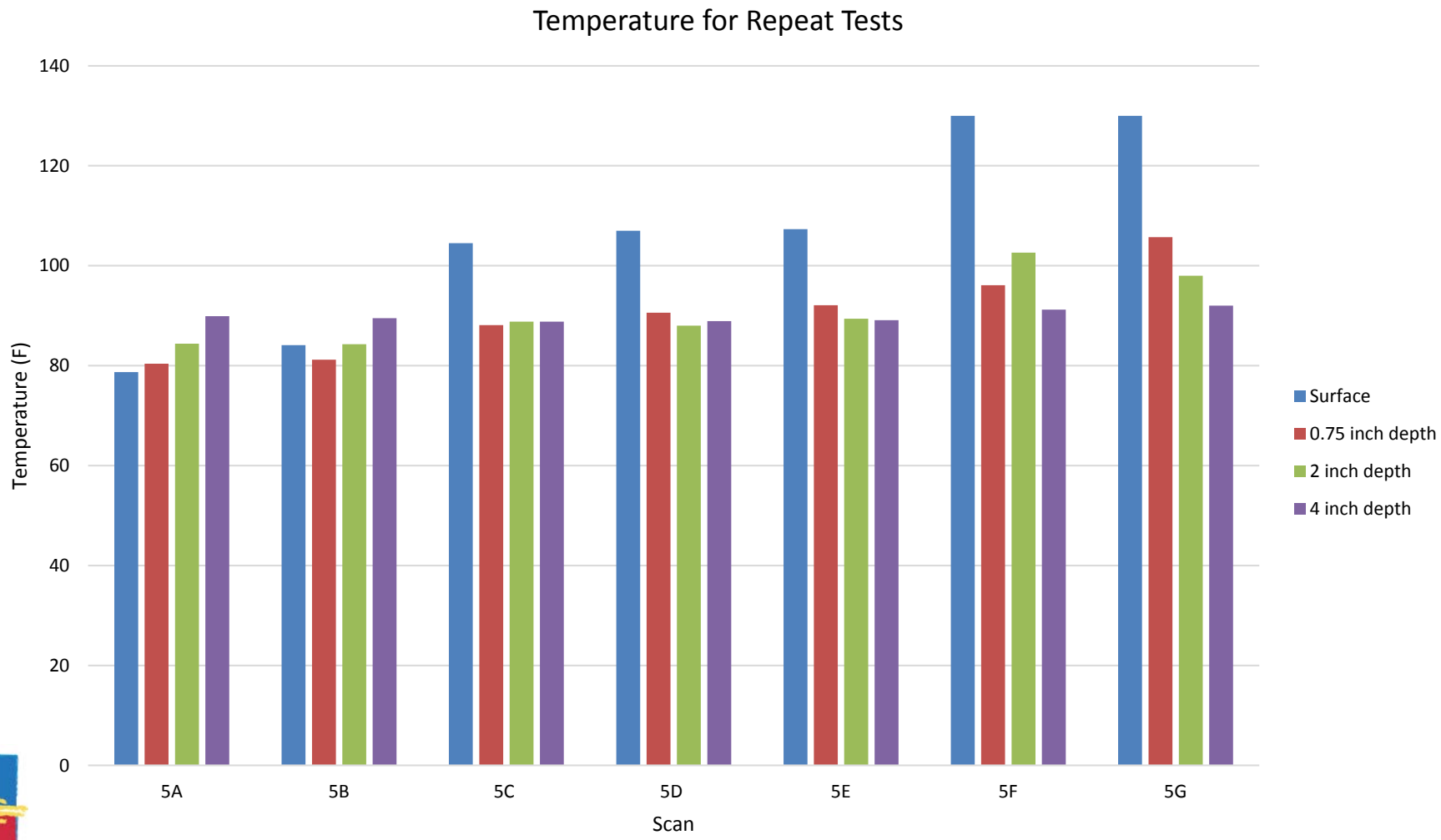
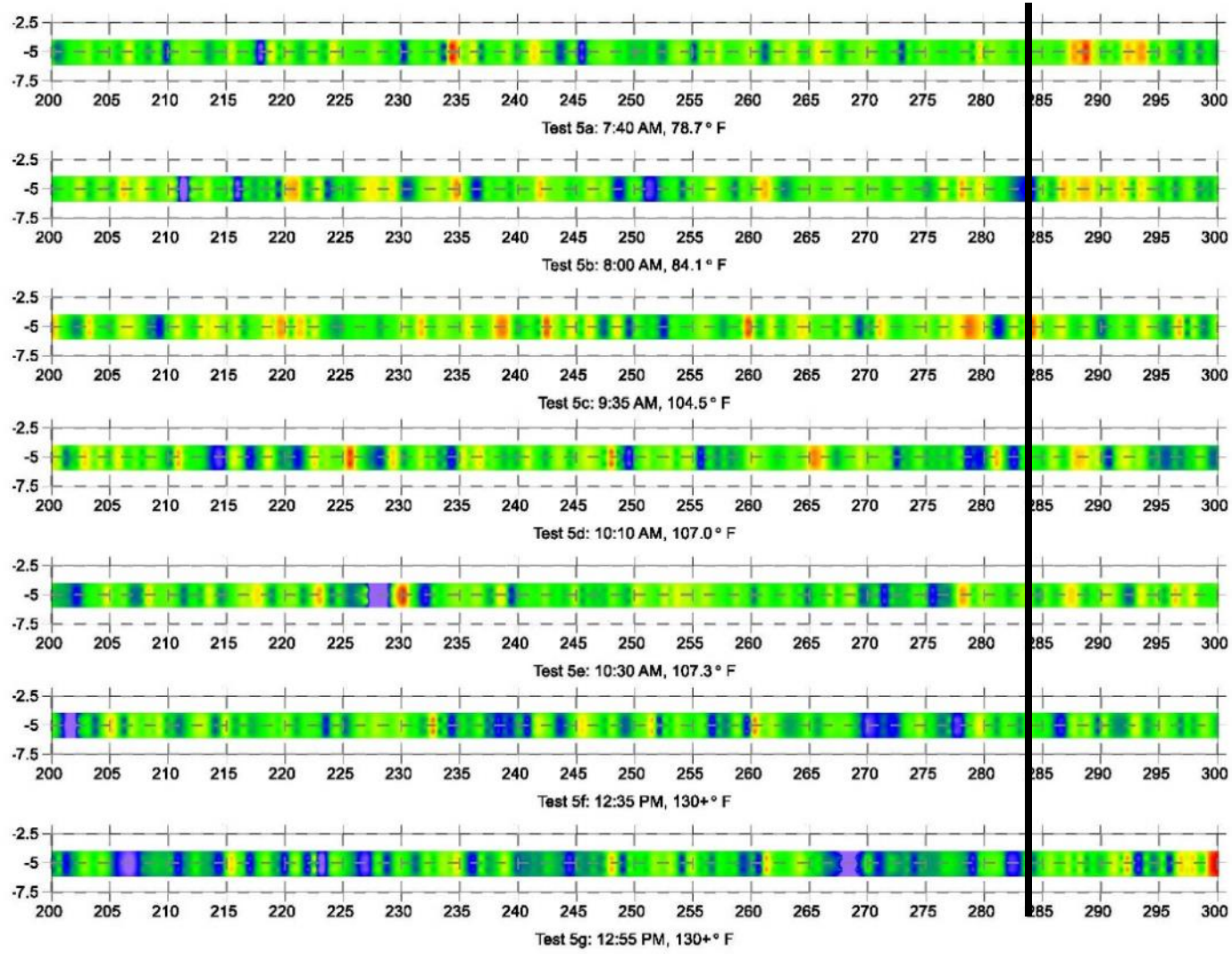
District 3 Full Scans Temperature

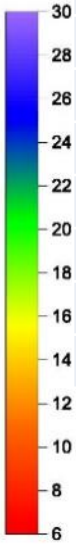


District 3 Repeat Scan Temperature



IE Repeatability Results





Distance from start 283ft	
Depth (in)	Temperature (°F)
20	78.7
26	84.1
10	104.5
18	107
18	107.3
20	130
22	130

No consistency

Figure B4: IE Results, 7/20/2017, Repeatability Study, 5 feet from left shoulder tested seven times (a – g). X = 0 @ start of section, Y = 0 at left shoulder. Distance 100 – 200 feet for all seven tests.

IE Conclusions

- The IE provides no information regarding the pavement structure beyond the first strong resonance echo
- Repeatability was fair to poor even with tests of similar temperatures
- Relatively soft surface makes it difficult to impart the needed range of high frequency vibrations
- As temperature increases at the pavement surface, the velocity of the asphalt pavement decrease

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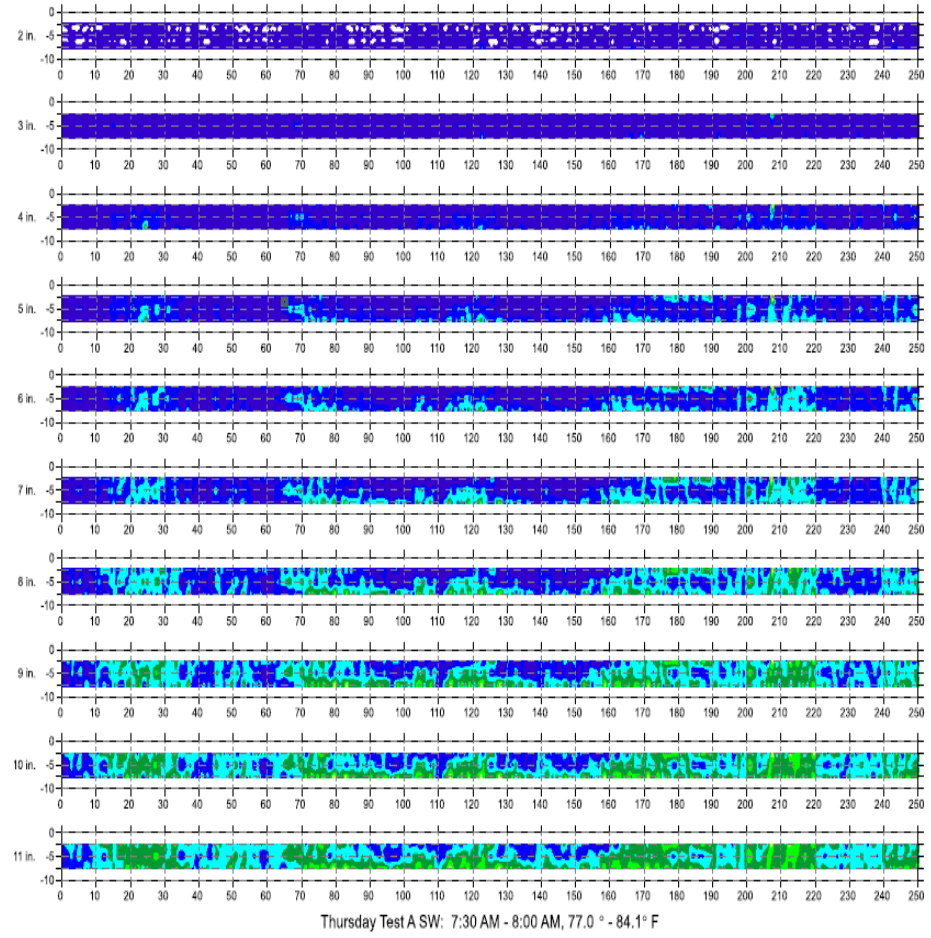
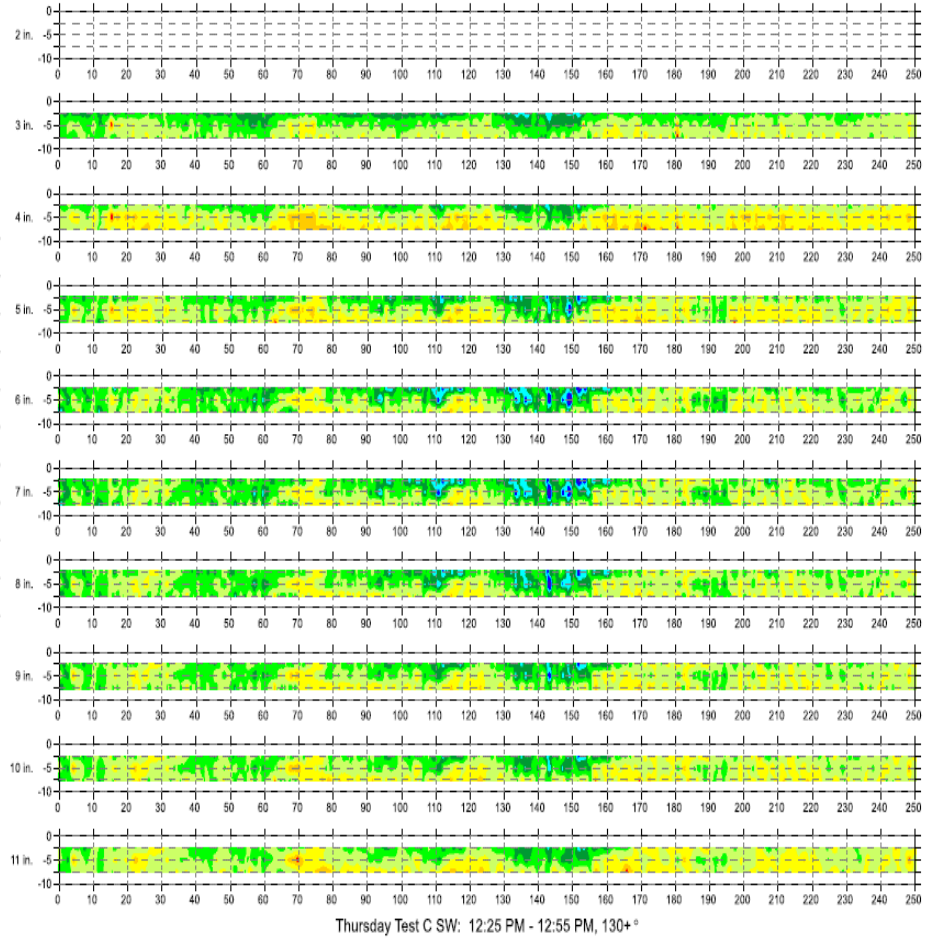
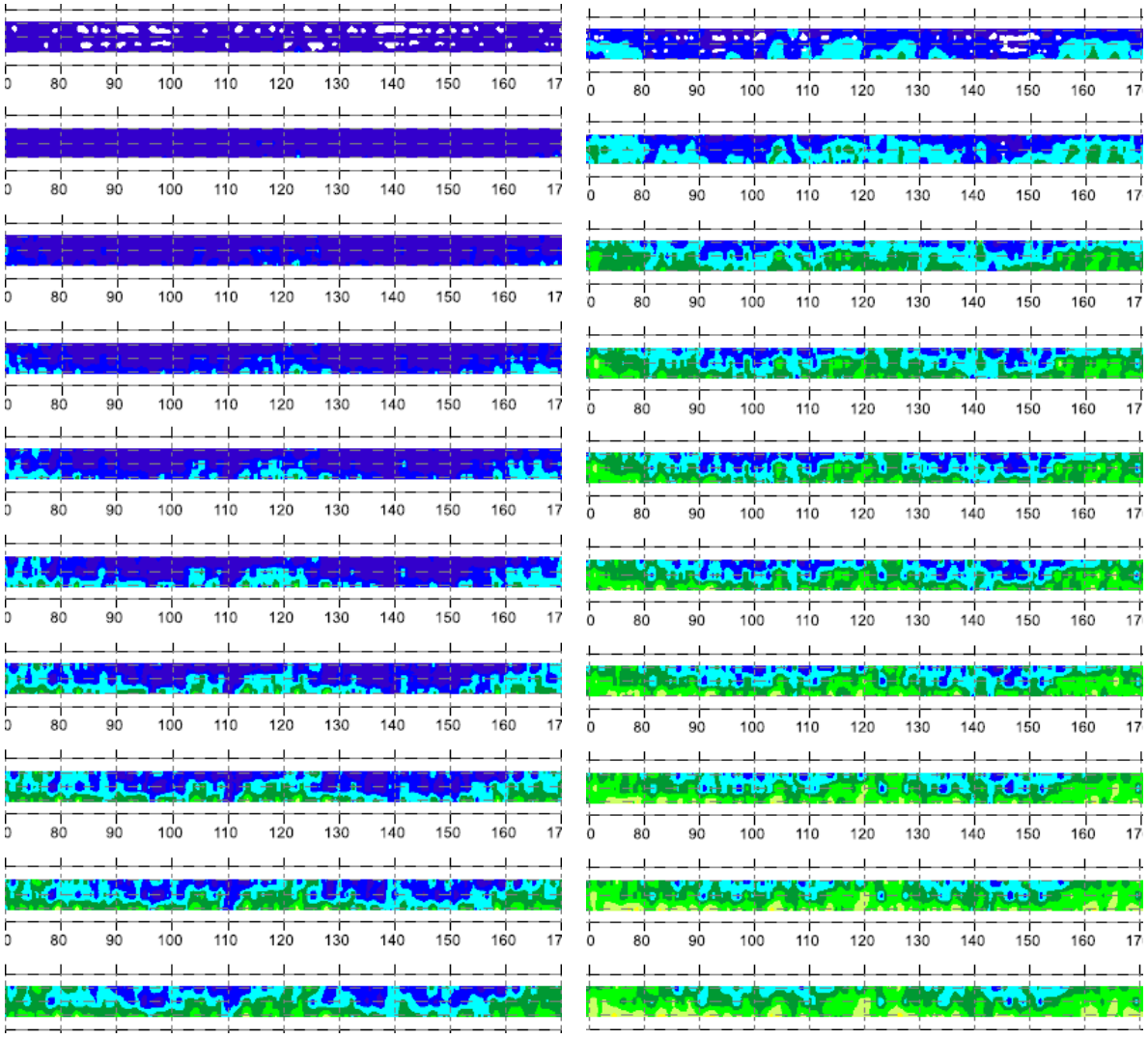
SASW Repeatability Results

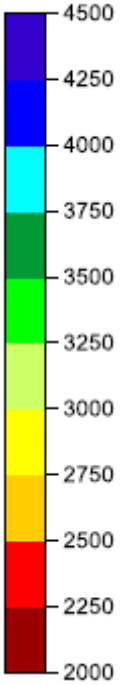




As temperature increases velocity decreases

SASW Repeatability Results





Test A

Test B

SASW Conclusions

- Good repeatability between pairs of scans performed at similar temperatures
- Trends across the scan area considered quite similar and would lead to virtually the same overall pavement assessment
- Small differences in the data sets are likely due to scans not being at the exact location
- At high surface temperatures (130+ F) degradation of data that was 2 inches or less in depth was noticed
- Absolute velocity values changed with temperature

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Summary of Test Results

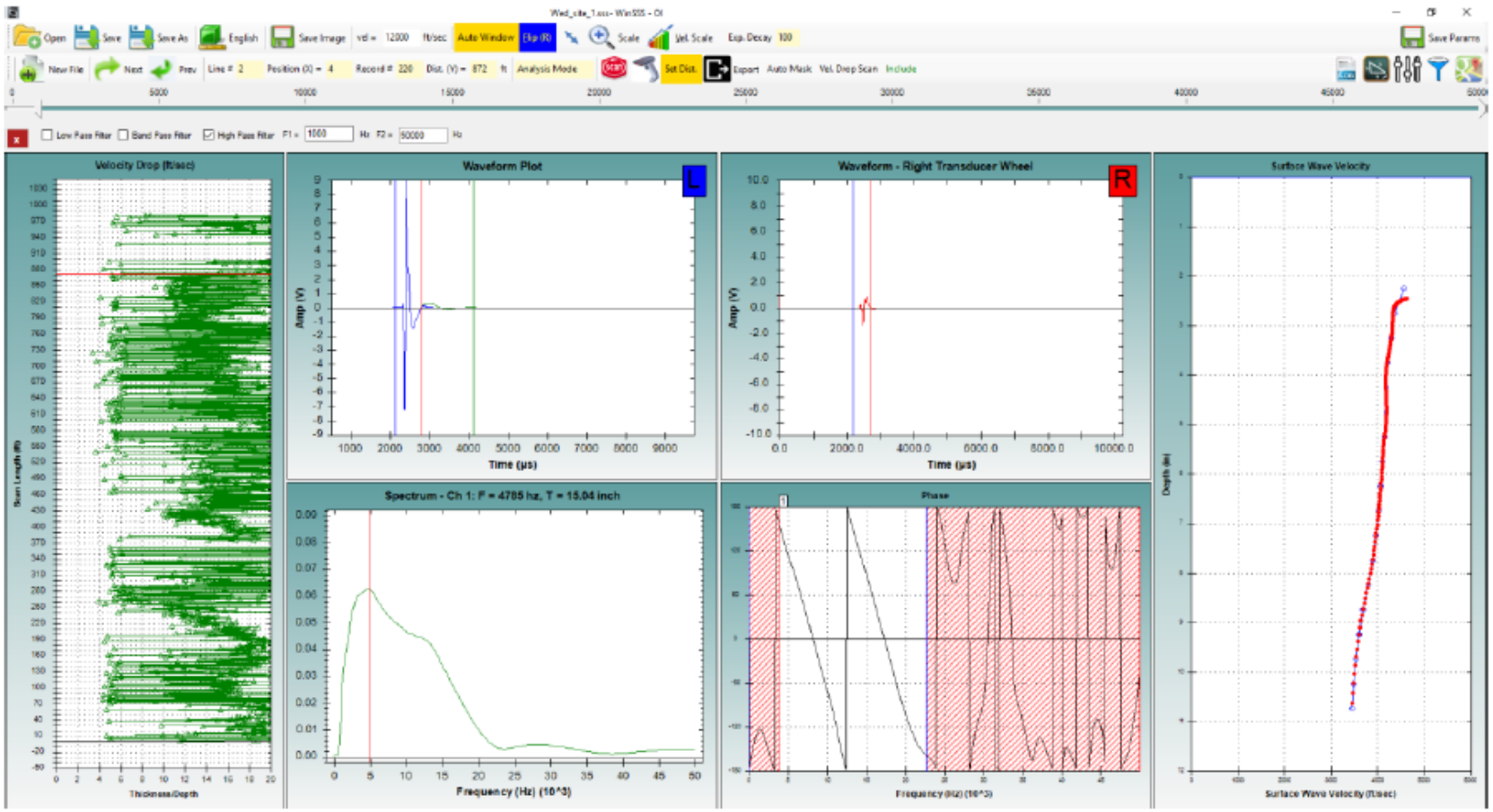


Figure 4: Good SASW conditions from 7/19 Site #1 at X = 872', Y = 3', consistent velocity gradually decrecreasing throughout full tested depth (2 – 11 inches).

Summary of Test Results

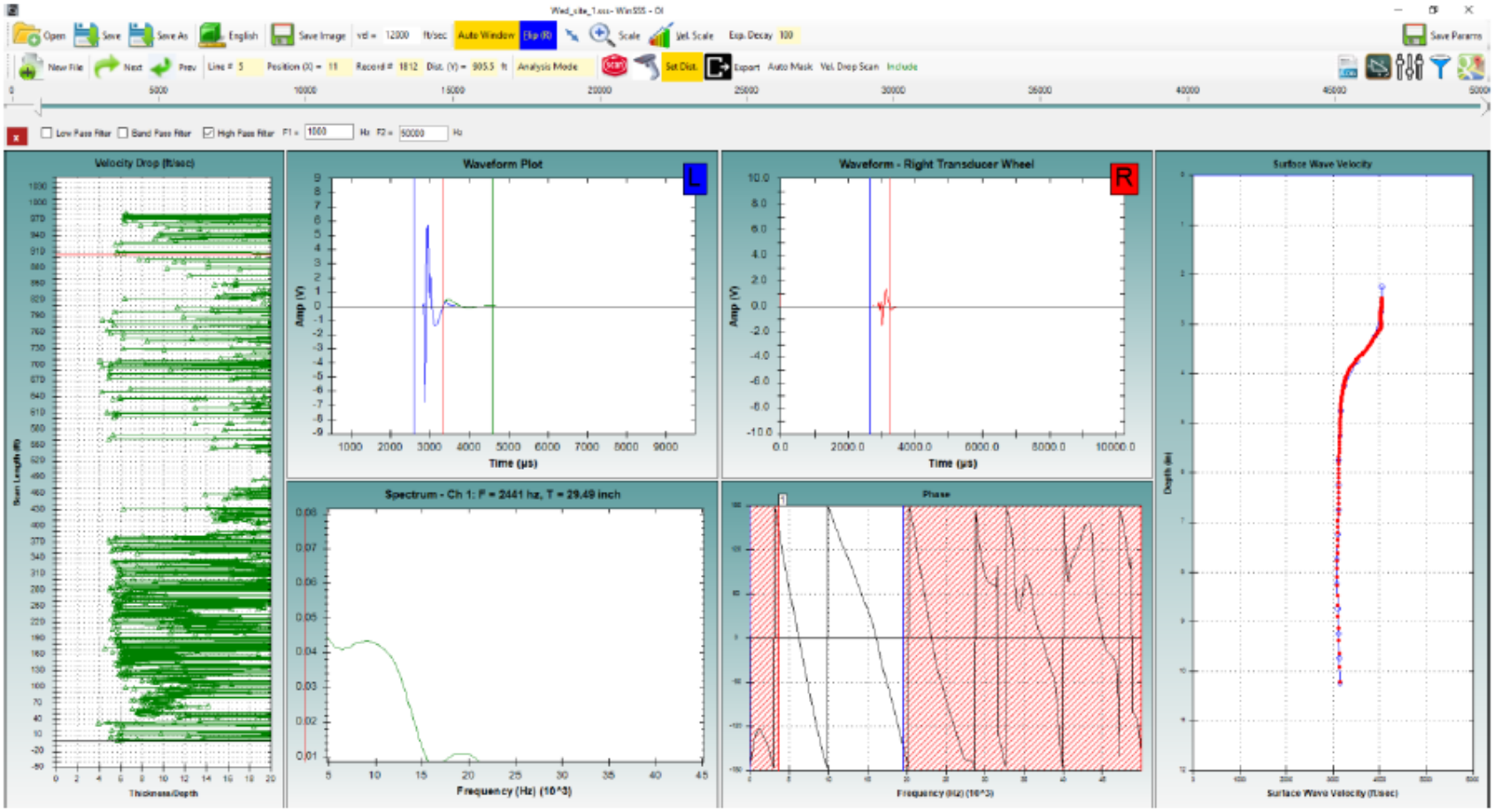
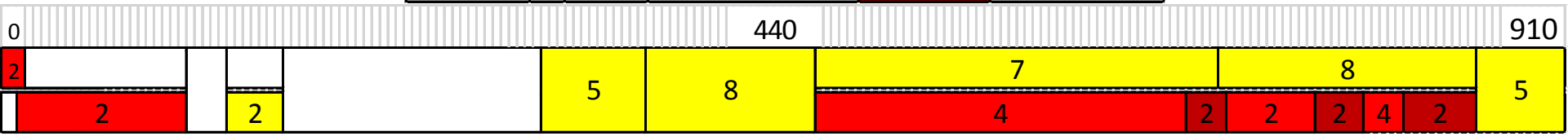


Figure 5: Poor SASW conditions from 7/19 Site #1 at X = 905.5', Y = -9', significant velocity drop of ~1,000 ft/sec between 3 and 4.5 inches deep indicating degradation.

Summary of Test Results
District 6

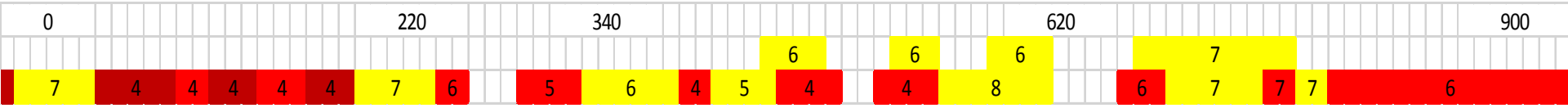
Distance from Start (ft)			Effected Portion	Pavement Condition	Approximate Depth of Degradation (in)
335	-	395	Full Width	Fair	5
400	-	500	Full Width	Fair	8
910	-	965	Full Width	Fair	5
0	-	10	Left Half	Poor	2
500	-	750	Left Half	Fair	7
750	-	910	Left half	Fair	8
10	-	110	Right Half	Poor	2
142	-	170	Right Half	Fair	2
500	-	730	Right Half	Poor	4
730	-	760	Right Half	Severe	2
760	-	810	Right Half	Poor	2
810	-	840	Right Half	Severe	2
840	-	865	Right Half	Poor	4
865	-	910	Right Half	Severe	2



Summary of Test Results
District 6

Distance from Start (ft)			Effected Portion of Lane	Pavement Condition	Approximate Depth of Degradation (in)
460	-	500	Left Half	Fair	6
540	-	570	Left Half	Fair	6
610	-	640	Left Half	Fair	6
700	-	790	Left Half	Fair	7
0	-	5	Right Half	Severe	2
10	-	50	Right Half	Fair	7
50	-	100	Right Half	Severe	4
100	-	115	Right Half	Poor	4
115	-	145	Right Half	Severe	4
145	-	180	Right Half	Poor	4
180	-	210	Right Half	Severe	4
210	-	267	Right Half	Fair	7
267	-	280	Right Half	Poor	6

Distance from Start (ft)			Effected Portion of Lane	Pavement Condition	Approximate Depth of Degradation (in)
320	-	352	Right Half	Poor	5
352	-	410	Right Half	Fair	6
410	-	430	Right Half	Poor	4
430	-	478	Right Half	Fair	5
478	-	510	Right Half	Poor	4
540	-	570	Right Half	Poor	4
570	-	640	Right Half	Fair	8
690	-	710	Right Half	Poor	6
710	-	770	Right Half	Fair	7
770	-	780	Right Half	Poor	7
780	-	815	Right Half	Fair	7
815	-	860	Right Half	Poor	6
860	-	925	Right Half	Poor	3
925	-	980	Right Half	Poor	7



Core Comparison

Core #	IE/SASW condition	Depth to Delamination	Core Condition	Depth to Delamination	Accuracy
3	Good, full depth	NA	Visible strip	6	Incorrect
4	Fair to Poor	4	Debonding	5	Correct, close
5	Good to fair	4.5	Visible strip + horizontal crack	4.5	Correct, exact
6	Good to fair	4	Debonding	5.5	Correct, close
7	Good to fair	4	Debonding	4.75	Correct, close
8	Good, full depth	NA	Visible strip	3	Incorrect

Core Comparison

Core #	IE/SASW condition	Depth to Delamination	Core Condition	Depth to Delamination	Accuracy
4	Fair to Poor	4	Debonding	5	Correct, close

Core Comparison

Core #	IE/SASW condition	Depth to Delamination	Core Condition	Depth to Delamination	Accuracy
3	Good, full depth	NA	Visible strip	6	Incorrect

Core Comparison

Core #	IE/SASW condition	Depth to Delamination	Core Condition	Depth to Delamination	Accuracy
6	Good to fair	4	Debonding	5.5	Correct, close

Core Comparison District 3

Core #	IE/SASW condition	Depth to Delamination	Core Condition	Depth to Delamination	Accuracy
15	Good, full depth	NA	Debonding	8	Incorrect
16	Good, full depth	NA	Visible strip	4	Incorrect

Core Conclusions

- General data trends observed in the data appear repeatable even across a wide range of temperatures
- At shallow depths debonding was detected and matched to the cores.
- Debonding was not picked up at larger depths
- Pavement thicknesses was found to be reasonably close to core data
- OGFC did not seem to have an influence on the IE/SASW results.

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