VERMONT

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Agency of Transportation

Date: October 9, 2023

To: Matthew Bogaczyk, P.E., Pavement Design Unit Project Manager

From: Aaron Schwartz, P.E., Bituminous & Unbound Materials Engineer via Dr. Ian Anderson, Bituminous Concrete Materials Manager

Subject: Montpelier – Waterbury IM 089-2(56) Asphalt Core Analysis

We have completed our investigation of the asphalt cores taken for the recently programmed Montpelier – Waterbury IM 089-2(56) project. The project is exclusively within the southbound (SB) barrel of Interstate 89 through the towns of Waterbury, Middlesex, and Montpelier, starting at MM 63.0 and ending at MM 52.5. The asphalt cores were taken concurrently with the field exploration conducted by consultant firm GEODesign, with the investigation having occurred from August 14th through September 7th, 2023. The findings from the field exploration, as well as a Ground Penetrating Radar (GPR) survey conducted by Infrasense, are described in separate reports. Forty asphalt cores were taken along the total length of the project, with four cores being taken at each 1-mile interval. This included the left shoulder, left lane, right lane, and right shoulder, to provide a cross section of the pavement structure.

Pavement cores ranged from 3 to 7 inches in thickness in the shoulders, with an average of 5 inches. Travel lane pavement ranged from 5.5 to 11 inches, with an average of 8.3 inches. Surface distresses include medium-to-high rutting and raveling that are prevalent throughout the entire project length, as well as various instances of top-down fatigue cracking in the wheel paths and transverse cracking across the entire paved width. The prevailing subsurface distress observed in the asphalt cores was moisture damage, resulting in debonding at the existing interface between two asphalt layers. While most of the distresses observed in the driving lanes were confined to the first 5 inches of the comprehensive asphalt pavement layer, there were deeper subsurface distresses observed at 4 different MM locations. MMs 52.85 and 60.0 exhibited evidence of full depth asphalt layer failure primarily due to moisture damage, with possible drainage issues being observed at MM 52.85 due to subbase material being mixed in with the asphalt layer starting at an approximate depth of 3.0 inches. MMs 54.0 and 61.0 exhibited evidence of bottom-up fatigue cracking beginning at approximate depths of 5.5 inches and 7.0 inches, respectively.

The project as initially programmed by the Asset Management Bureau (AMB) presumes that a 4-

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inch Structural Overlay is sufficient to meet the Agency's pavement performance measures. After analysis of the asphalt cores and noting surface distresses out in the field, we **partially concur** in that the minimum treatment thickness should be 4 inches. At the aforementioned MM's noted where deeper distresses were observed, it is evident that additional investigations should be conducted to determine the extent of these failures and the root cause of these issues. A 4-inch Structural Overlay may not adequately resolve these potential issues, and among the risks associated with maintaining this treatment thickness at these locations include cracks propagating upward onto the wearing surface and/or deeper ruts forming in the wheel paths due to undetermined distresses beneath the asphalt layer. It is advised that Falling Weight Deflectometer (FWD) testing may help determine the capacity of the full pavement structure at these locations and determine whether a deeper treatment is necessary. The findings presented in this memo should not be presumed to have precedence over memos prepared by GEODesign and Infrasense regarding their investigations.

Please contact me via email if you have any questions or would like to discuss this report. A visualization of each asphalt core's condition throughout the project length, typed notes describing the surface distresses observed at each asphalt core location, and photos of both the surface distresses and asphalt cores at each location are attached herein as Appendices.

Sincerely,

Aaron Schwartz

Aaron Schwartz, P.E.
Bituminous & Unbound Materials Engineer

Attachments: Appendix A – Visualization of Asphalt Core Conditions
Appendix B – Typed Notes of Surface Distresses
Appendix C – Photographs of Surface Distresses & Asphalt Cores (Driving Lanes Only)

APPENDIX A

VISUALIZATION OF ASPHALT CORE CONDITIONS

Key
Bonding Distress
Moisture Damage
Cracking
No Observed Distress

Figure A.01: Legend of Distresses Observed in Asphalt Cores

		MM/Core Location										
LS	Depth (inches)	52.85	54	55	56	57	58	59.05	60	61	62	63
	0											
	1											
	2											
	3											
	4											
	5											
	6											
	7											
	8											
	9											
	10											

Figure A.02: Visualization of Analyzed Asphalt Cores – Left Shoulder

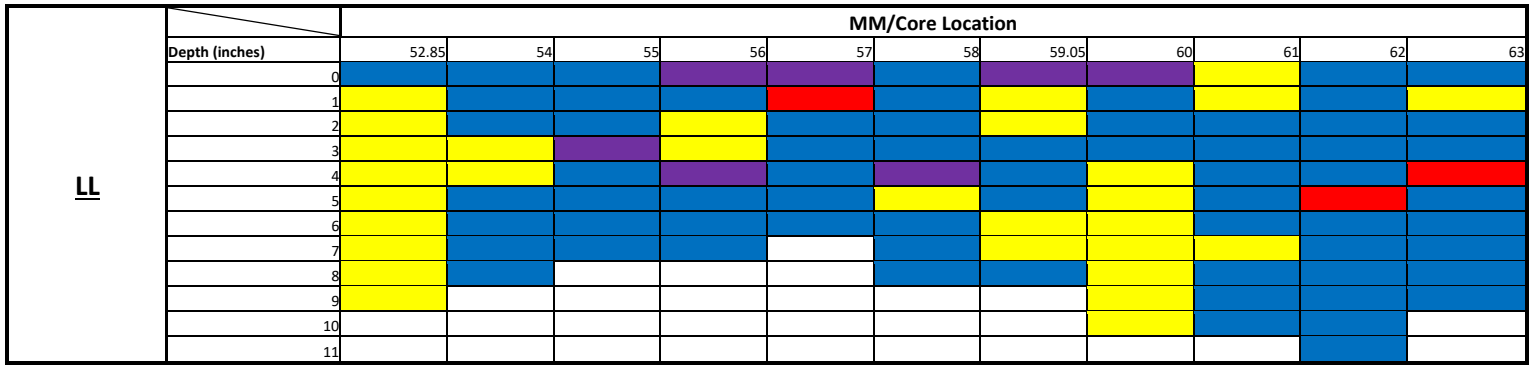


Figure A.03: Visualization of Analyzed Asphalt Cores – Left Lane

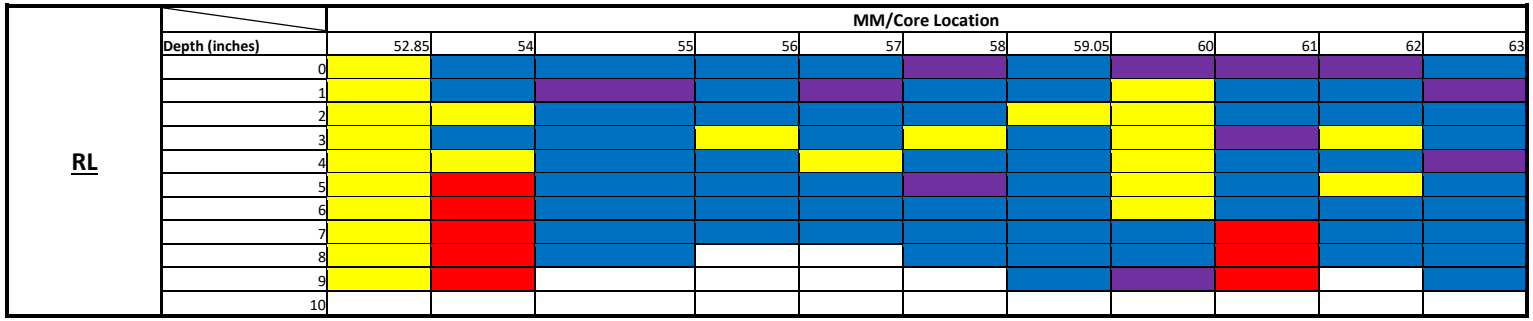


Figure A.04: Visualization of Analyzed Asphalt Cores – Right Lane

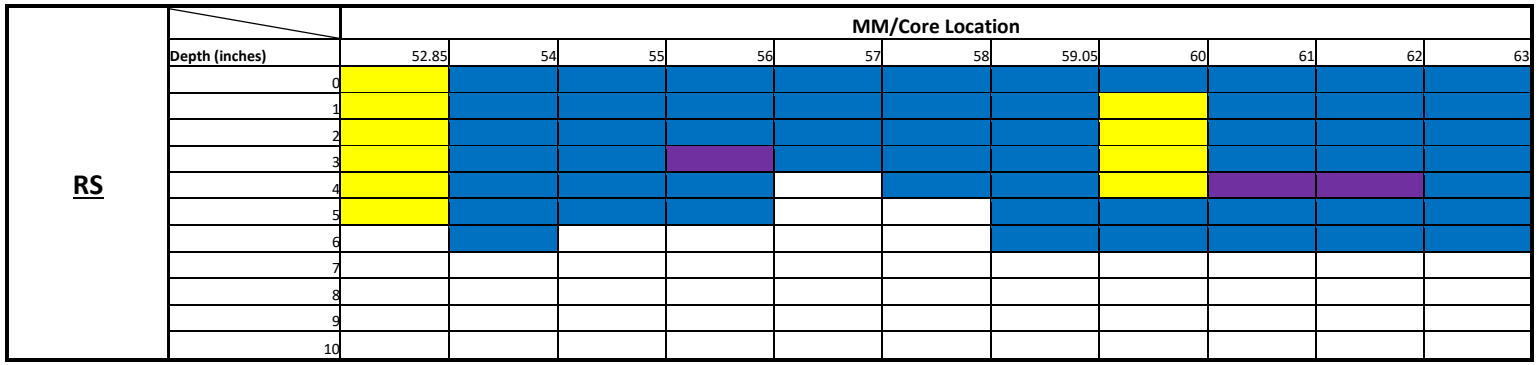


Figure A.05: Visualization of Analyzed Asphalt Cores – Right Shoulder

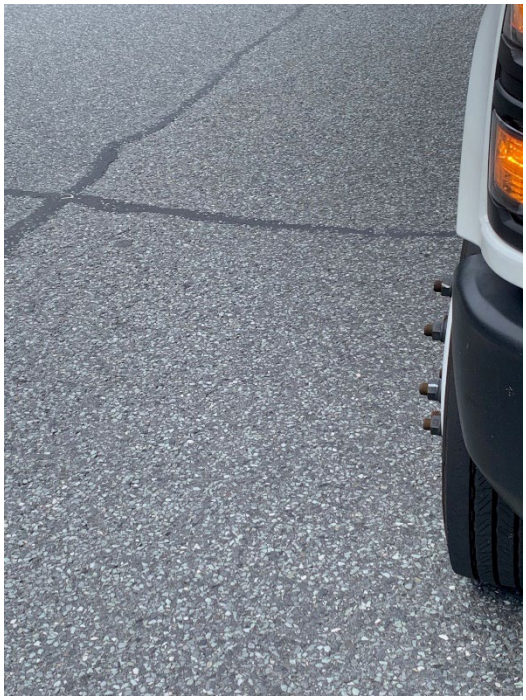
APPENDIX B
TYPED NOTES OF SURFACE DISTRESSES

MM/Core Location	Core Thicknesses (inches)				Surface Distresses										
	Left Shoulder (LS)	Left Lane (LL)	Right Lane (RL)	Right Shoulder (RS)	Fatigue Cracking	Block Cracking	Longitudinal Cracking	Transverse Cracking	Patching	Pothole	Shoving	Rutting	Bleeding	Polished Aggregate	Raveling
52.85	5.00	9.00	9.00	5.00	M		H	H	L			M		H	H
54.0	5.00	8.00	8.50	5.75	M		H	M				H		H	H
55.0	4.00	7.50	8.00	4.25	H		H	H				H		H	H
56.0	4.50	7.25	6.25	4.50	H		H	H				H		H	H
57.0	3.00	5.50	6.50	3.00	L		H	M				M		H	H
58.0	4.50	7.50	8.00	4.00	M		M	M				H	M	H	H
59.05	4.50	7.50	9.25	6.00	M		H	M				M		H	H
60.0	7.00	10.00	9.50	6.00	M		H	H				H		H	H
61.0	4.50	9.25	9.50	6.00	H		M	M				H	L	H	H
62.0	6.75	11.00	7.50	6.00	M		M	M				M		M	H
63.0	4.50	9.00	9.50	6.00	M	M	M	M				H	M	H	H

Extent of Distresses
L – Low
M – Medium
H – High

APPENDIX C

PHOTOGRAPHS OF SURFACE DISTRESSES & ASPHALT CORES (DRIVING LANES ONLY)



Surface Distresses at MM 52.85, Left Lane; photograph taken in front of drilling rig.

Surface Distresses at MM 52.85, Right Lane

Asphalt core extracted at MM 52.85, Left Lane

Asphalt core extracted at MM 52.85, Right Lane. The core completely disintegrated when extracted.

Figure C.01: Surface Distresses and Cores from MM 52.85

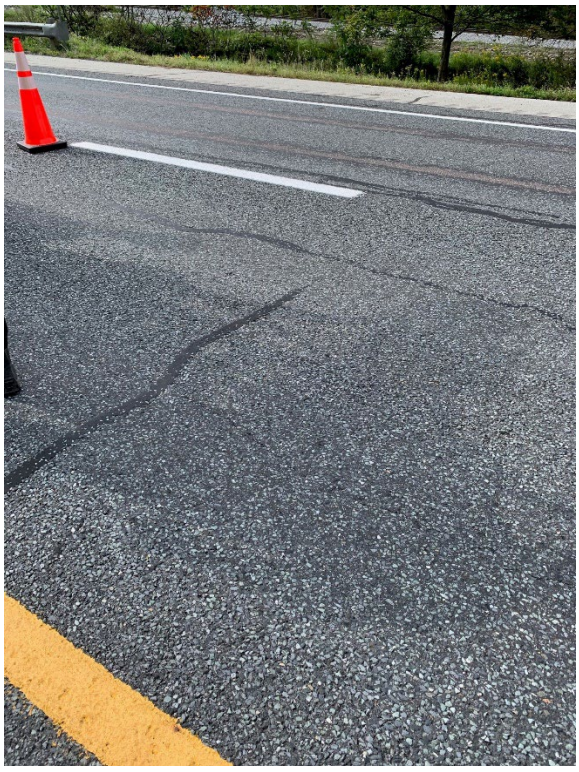
Surface Distresses at MM 54.0, Left Lane

Surface Distresses at MM 54.0, Right Lane

Asphalt core extracted at MM 54.0, Left Lane

Asphalt core extracted at MM 54.0, Right Lane.

Figure C.02: Surface Distresses and Cores from MM 54.0



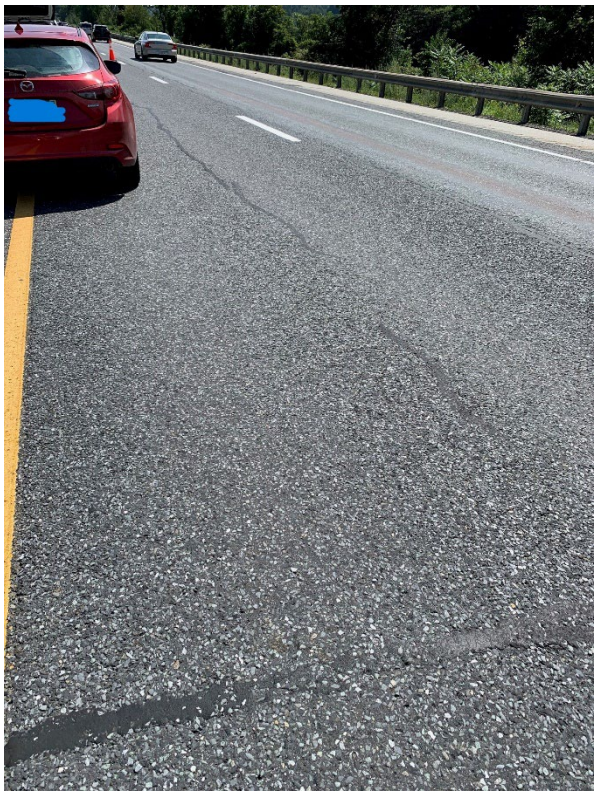
Surface Distresses at MM 55.0, Left Lane

Surface Distresses at MM 55.0, Right Lane

Asphalt core extracted at MM 55.0, Left Lane

Asphalt core extracted at MM 55.0, Right Lane

Figure C.03: Surface Distresses and Cores from MM 55.0



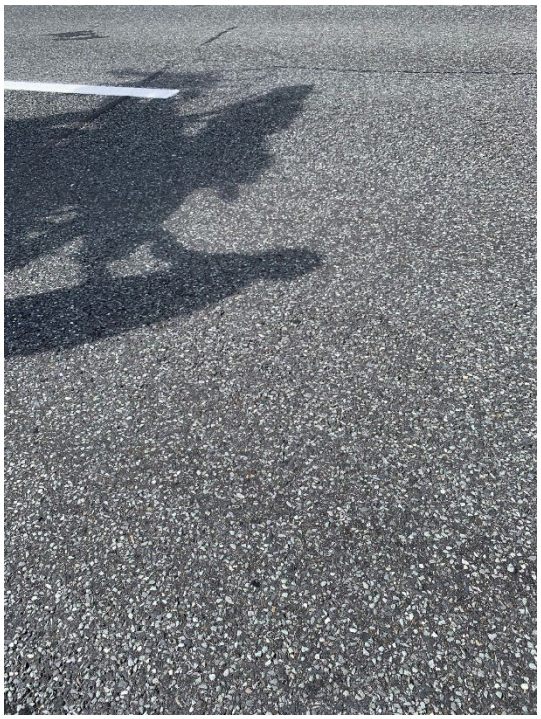
Surface Distresses at MM 56.0, Left Lane

Surface Distresses at MM 56.0, Right Lane.

Asphalt core extracted at MM 56.0, Left Lane.

Asphalt core extracted at MM 56.0, Right Lane.

Figure C.04: Surface Distresses and Cores from MM 56.0



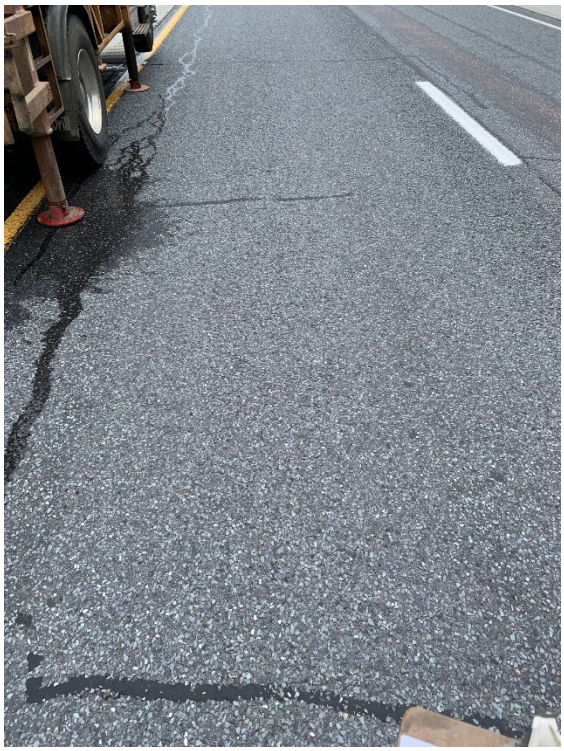
Surface Distresses at MM 57.0, Left Lane

Surface Distresses at MM 57.0, Right Lane

Asphalt core extracted at MM 57.0, Left Lane

Asphalt core extracted at MM 57.0, Right Lane.

Figure C.05: Surface Distresses and Cores from MM 57.0



Surface Distresses at MM 58.0, Left Lane

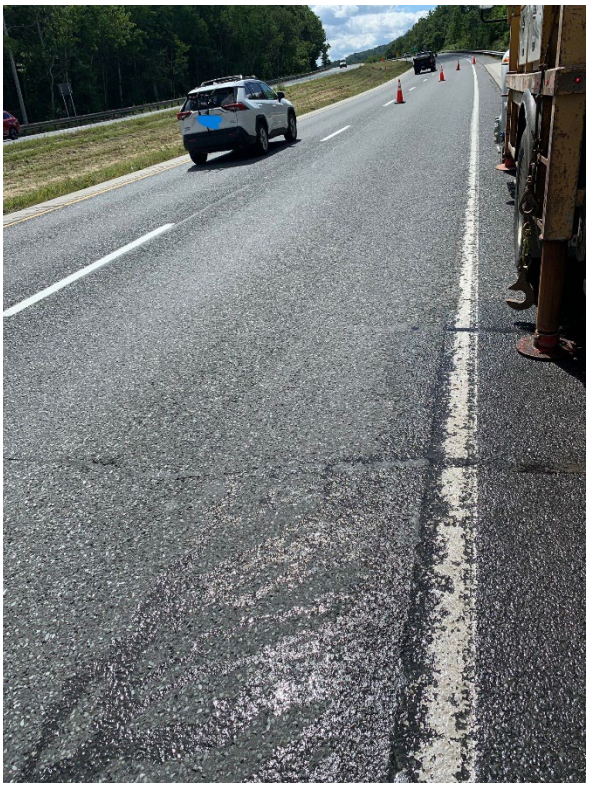
Surface Distresses at MM 58.0, Right Lane

Asphalt core extracted at MM 58.0, Left Lane

Asphalt core extracted at MM 58.0, Right Lane

Figure C.06: Surface Distresses and Cores from MM 58.0

Surface Distresses at MM 59.05, Left Lane



Surface Distresses at MM 59.05, Right Lane

Asphalt core extracted at MM 59.05, Left Lane

Asphalt core extracted at MM 59.05, Right Lane

Figure C.07: Surface Distresses and Cores from MM 59.05

Surface Distresses at MM 60.0, Left Lane

Surface Distresses at MM 60.0, Right Lane

Asphalt core extracted at MM 60.0, Left Lane

Asphalt core extracted at MM 60.0, Right Lane

Figure C.08: Surface Distresses and Cores from MM 60.0

Surface Distresses at MM 61.0, Left Lane

Surface Distresses at MM 61.0, Right Lane

Asphalt core extracted at MM 61.0, Left Lane

Asphalt core extracted at MM 61.0, Right Lane

Figure C.09: Surface Distresses and Cores from MM 61.0

Surface Distresses at MM 62.0, Left Lane

Surface Distresses at MM 62.0, Right Lane

Asphalt core extracted at MM 62.0, Left Lane

Asphalt core extracted at MM 62.0, Right Lane

Figure C.10: Surface Distresses and Cores from MM 62.0

Surface Distresses at MM 63.0

Asphalt core extracted at MM 63.0, Left Lane

Asphalt core extracted at MM 63.0, Right Lane

Figure C.11: Surface Distresses and Cores from MM 63.0