SMAR-RU0473

Forensic Testing of Stone Matrix Asphalt Rubber Material

FINAL REPORT
March 2010

Submitted by
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NJDOT Project Manager
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In cooperation with

State of New Jersey
Department of Transportation
And
U.S. Department of Transportation
Federal Highway Administration

Disclaimer Statement

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1200 New Jersey Avenue, SE
Washington, DC 20590-0001

16. Abstract

The project will encompass forensic testing on extracted cores of the stone matrix asphalt rubber (SMAR) material placed on I295. Cores were provided to the Rutgers Asphalt/Pavement Laboratory (RAPL) via Advanced Infrastructure and Design (AID) Performance testing on cores will determine the following volumetric and mechanical properties, bulk specific gravity and air voids, permeability, fatigue cracking, rutting resistance and moisture sensitivity.

17. Key Words	18. Distribution Statement
Asphalt, pavement stone matrix asphalt rubber (SMAR), material characterization	

19. Security Classif (of this report)	20. Security Classif. (of this page)	21. No of Pages	22. Price
Unclassified	Unclassified	27	

Form DOT F 1700.7 (8-69)

Introduction

Enclosed for your review are the preliminary results for the forensic testing conducted on extracted cores of the stone matrix asphalt rubber (SMAR) material placed on I295. Cores were provided to the Rutgers Asphalt/Pavement Laboratory (RAPL) via Advanced Infrastructure and Design (AID) on December 4th, 2009. The cores were provided to RAPL in plastic concrete cylinders to eliminate, as best as possible, any damage that could be caused during transport. Locations of the re-cored areas are found in the Appendix of this report.

Immediately upon receipt of the cores, RAPL took photos and measured the thickness of the SMAR lift. For brevity, photos of the cores are not provided in this report. However, they will be provided to NJDOT upon request. The thickness' of the cores collected are shown in Table 1. The average thickness of the SMAR lift was 1.79 inches with a standard deviation of 0.2 inches.

After the layer thickness was measured, performance testing was conducted on various samples to determine the following volumetric and mechanical properties:

- o Bulk Specific Gravity and Air Voids;
- o Permeability (Falling Head Permeability Testing);
- o Fatigue Cracking (Overlay Tester);
- o Rutting Resistance (Asphalt Pavement Analyzer); and
- o Moisture Sensitivity (Tensile Strength Ratio).

Table 1 – Thickness of SMAR from I295

Core ID	Height Measurements					
	1	2	3	4	Average (mm)	(inches)
T1	51.06	50.22	48.91	44.03	48.555	1.91
T2	41.46	40.88	42.62	37.88	40.71	1.60
T3	44.08	44.55	42.52	46.01	44.29	1.74
T4	50.57	48.03	52.98	50.42	50.5	1.99
T5	50.23	48.61	50.36	50.55	49.9375	1.97
T6	40.13	38.13	47.36	40.11	41.4325	1.63
T7	47.35	44.21	48.79	45.04	46.3475	1.82
T8	41	40.94	45.77	44.73	43.11	1.70
T9	38.34	38.49	42.05	38.8	39.42	1.55
T10	49.34	58.53	53.77	55.97	54.4025	2.14
T11	47.32	47.83	46.02	52.22	48.3475	1.90
T12	42.79	41.89	42.08	43.89	42.6625	1.68
T13	49.16	42.24	47.4	46.29	46.2725	1.82
T14	42.49	46.33	45.67	49.75	46.06	1.81
T15	44.98	44.05	45.29	43.78	44.525	1.75
T16	48.9	49.16	45.81	48.35	48.055	1.89
T17	47.86	46.68	53.21	51.66	49.8525	1.96
T18	52.29	52.05	52.65	53.04	52.5075	2.07
T19	46.34	42.79	47.64	46.23	45.75	1.80
T20	43.4	42.36	42.47	43.63	42.965	1.69
T21	56.64	56.81	53.43	54.14	55.255	2.18
T22	49.27	48.53	46.83	49.91	48.635	1.91
T23	46.54	45.88	49.45	47.4	47.3175	1.86
T24	43.99	40.98	39.65	44.61	42.3075	1.67
T25	45.74	44.5	48.43	44.1	45.6925	1.80
T26	42.11	38.98	43.41	40.33	41.2075	1.62
T27	51.88	51.81	52.39	53.25	52.3325	2.06
T28	43.35	42.9	46.1	43.99	44.085	1.74
T29	50.77	49.91	48.45	46.34	48.8675	1.92
T30	55.9	58.04	56.05	58.42	57.1025	2.25
T31	44.86	47.32	42.66	41.54	44.095	1.74
T32	38.84	36.63	37.98	40.09	38.385	1.51
T33	49.05	47.44	46.12	42.06	46.1675	1.82
T34	43.97	47.54	48.23	49.19	47.2325	1.86
T35	49.51	46.42	51.4	49.23	49.14	1.93
T36	45.61	42.09	46.7	46.67	45.2675	1.78
T37	46.57	45.14	48.35	46.3	46.59	1.83
T38	50.47	49.12	52.83	46.29	49.6775	1.96
T39	48.47	49.51	51.08	49.35	49.6025	1.95
T40	54.96	56.07	54.35	56.71	55.5225	2.19
T41	46.01	43.72	40.53	44.71	43.7425	1.72
T42	49.31	49.11	51.66	53.01	50.7725	2.00
T43	41.46	40.06	38.43	39.81	39.94	1.57
T44	44.12	40.96	41.85	39.05	41.495	1.63
T45	44.37	46.81	46.59	45.91	45.92	1.81
T46	38.5	36.78	35.39	35.87	36.635	1.44
T47	35.69	35.47	35.77	37.82	36.1875	1.42
T48	40.02	41.98	38.06	41.77	40.4575	1.59
T49	44.2	45.04	49.7	46.98	46.48	1.83
T50	41	42.67	42.01	42.78	42.115	1.66
T51	47.94	47.77	44.25	45.02	46.245	1.82
T52	35.6	35.86	35.61	33.52	35.1475	1.38
T53	43.03	42.25	41.32	43.38	42.495	1.67
T54	32.7	35.68	33.98	32.34	33.675	1.33
T55	39.66	39.35	41.54	41.79	40.585	1.60

Average	**1.79**
Std Dev	**0.20**

Bulk Specific Gravity Testing (AASHTO T166 and T331)

The bulk specific gravity of the SMAR field cores were measured using two different test procedures; 1) AASHTO T166, *Bulk Specific Gravity of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens*, and 2) AASHTO T331, *Bulk Specific Gravity and Density of Compacted Hot Mix Asphalt (HMA) Using Automatic Vacuum Sealing Method*. AASHTO T331 was included as this test procedure often results in a more realistic bulk specific gravity determination in porous compacted specimens.

The test results for the bulk specific gravity indicated the following:

- AASHTO T166
  - Average Bulk Specific Gravity = 2.203 g/cm^3
  - Standard Deviation = 0.028 g/cm^3
- AASHTO T331
  - Average Bulk Specific Gravity = 2.163 g/cm^3
  - Standard Deviation = 0.043 g/cm^3

It should be noted that this is based on 48 core samples tested. Although 55 cores were extracted, some cores were left attached to the intermediate course to test for rutting in the Asphalt Pavement Analyzer (APA). As expected with higher air void specimens, AASHTO T331 resulted in lower bulk specific values than AASHTO T166. Comparison of the two test procedures are shown in Figure 1.

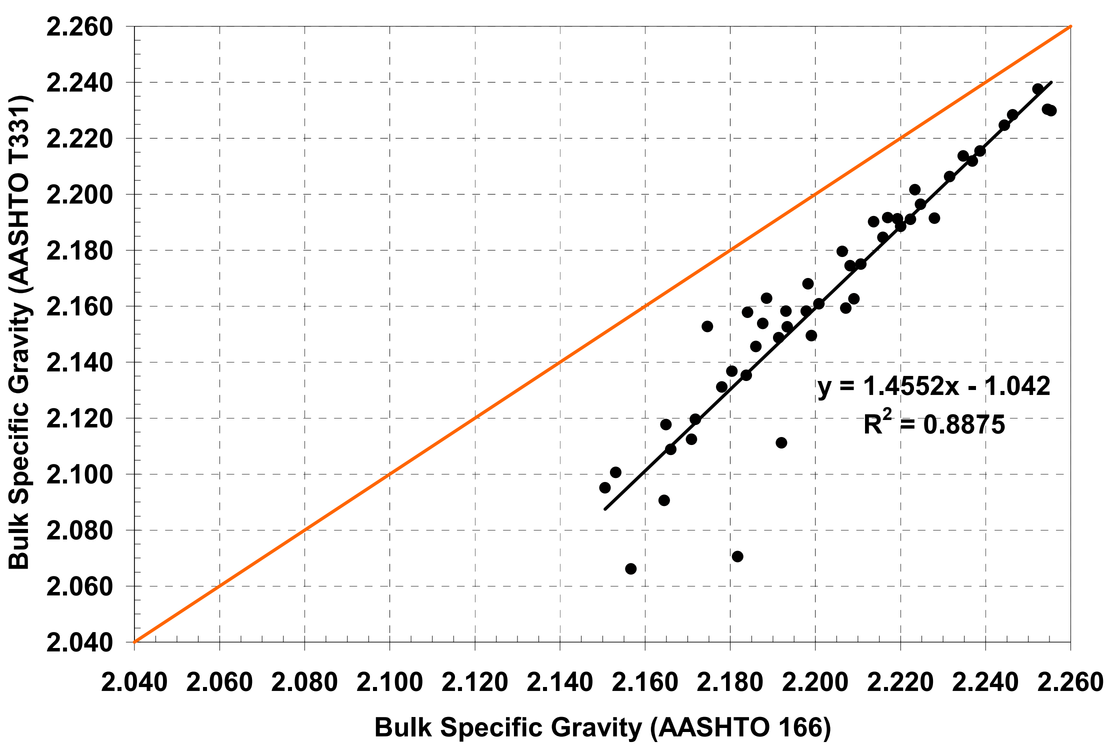

Figure 1 – Bulk Specific Gravity Measurements Using AASHTO T166 and T331

Similar analysis, with respect to Figure 1, was also conducted plotting the calculated air voids of the cores. The test results are shown in Figure 2. Figure 2 clearly shows the difference in calculated air voids when using either the CoreLok system (AASHTO T331) or the traditional saturated surface dry method (AASHTO T166). On average, AASHTO T166 results in a compacted air void level 17% lower (i.e. – higher density) than when using the CoreLok procedure. This is consistent with other studies that have indicated that the CoreLok procedure will result in more realistic densities when the compacted air voids in the specimens are above 6 to 7%. This is mainly due to water running out of the specimen during the saturated surface dry procedure (AASHTO T166) when surface drying the test specimen.

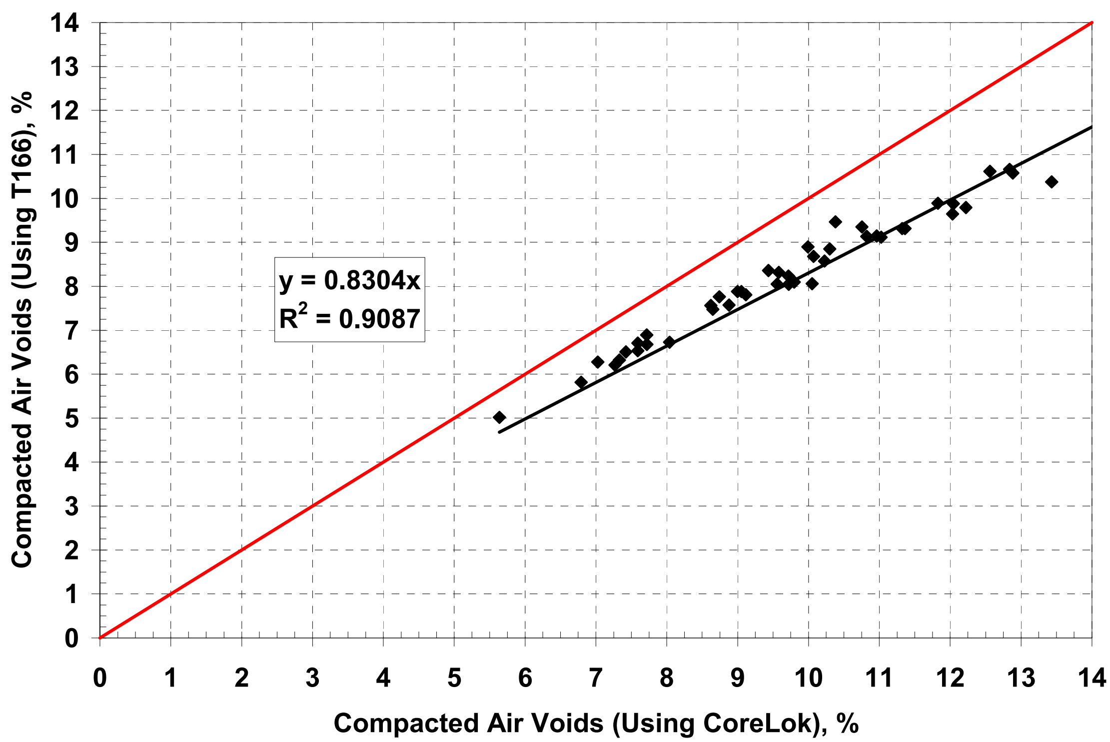

Figure 2 – Comparison of Calculated Air Voids Between Saturated Surface Dry (AASHTO T166) and CoreLok (AASHTO T331) Test Procedures

The density specification of the NJDOT SMAR for the I295 project was 2 to 7% compacted, in-place air voids. For acceptance, the two procedures would produce very different results. If the NJDOT were to utilize AASHTO T166, which is the current test procedure, only 10 out of the 48 cores (20.8%) would have passed the NJDOT density specification. Meanwhile, if the NJDOT were to utilize AASHTO T331, which is currently not the test procedure used by the NJDOT, only 2 out of the 48 cores (4.2%) would have passed the NJDOT density specification.

Falling Head Permeability

The permeability of the SMAR cores was measured using the Falling Head Permeability device shown in Figure 3. The permeability properties were especially important as neither the SMAR nor the stretch of I295 where the SMAR was placed were designed to allow water intrusion.

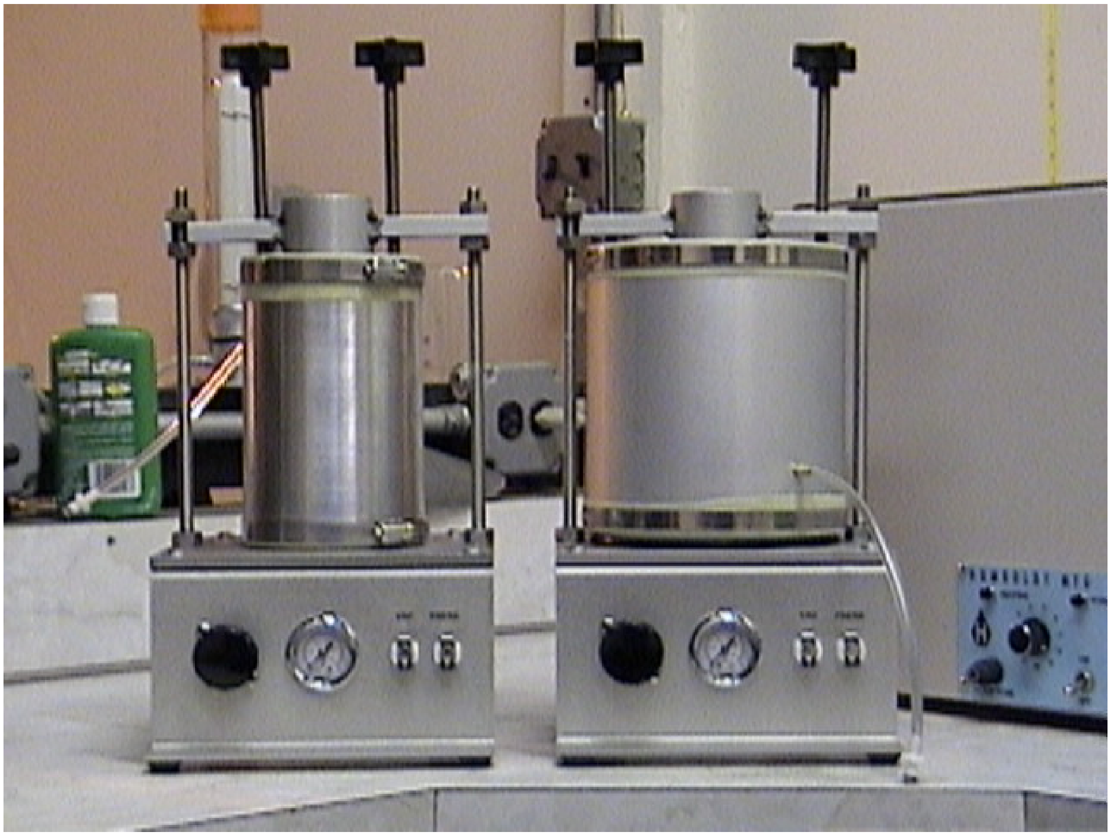

Figure 3 – Falling Head Permeability (4 and 6 Inch Diameter) for Asphalt Samples

The permeability test results showed that the average permeability of the 50 cores tested for permeability was 2.788 ft/day (9.84 E-4 cm/sec) with a standard deviation of 2.996 ft/day (1.06 E-3 cm/sec). Figure 4 also shows the permeability results of the SMAR cores. When incorporating the permeability criteria currently implemented by the Virginia Department of Transportation (VDOT), 15 of the 50 cores (30%) would have failed the VDOT permeability criteria, indicating the material is too porous.

The permeability of the SMAR cores were also plotted against the bulk specific gravity measured by AASHTO T331 (Figure 5). The permeability results clearly show a strong relationship between the bulk specific gravity measured using AASHTO 331 (CoreLok device).

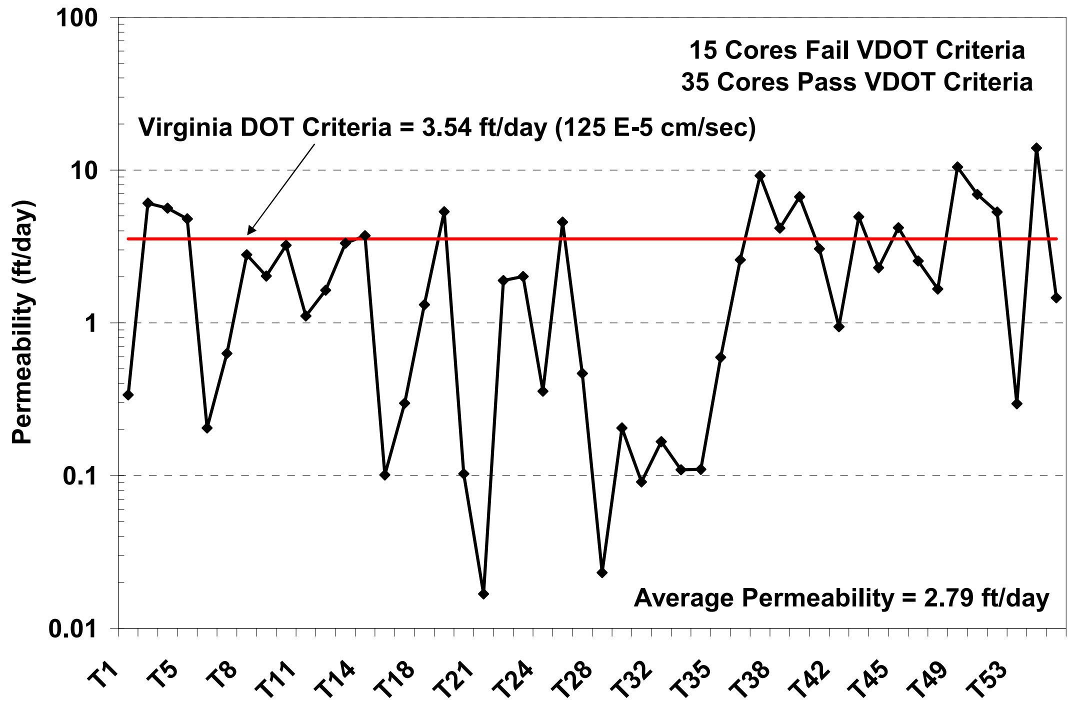

Figure 4 – Permeability of SMAR Cores from I295

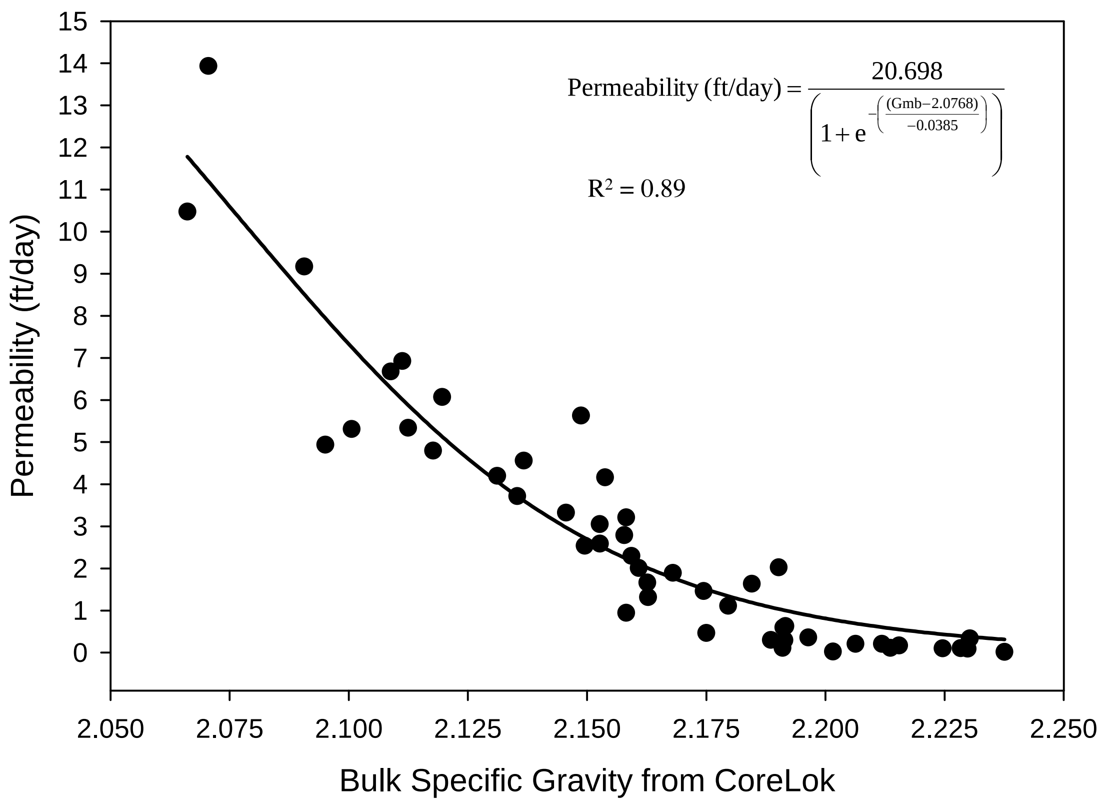

Figure 5 – Relationship Between Permeability and Bulk Specific Gravity

The compacted air voids, as shown earlier in Figure 2, were plotted against the permeability of the cores and is shown in Figure 6. The data in Figure 6 shows that perhaps the 7% air void level specified by the NJDOT is too conservative when considering the permeability characteristics of the compacted samples. At 7% air voids, the AASHTO T166 samples resulted in a permeability value of 0.4 ft/day, with the AASHTO T331 Gmb procedure resulting in a permeability of 0.15 ft/day. The heavy mastic of the SMAR clearly helped to "clog" the interconnected void structure of the SMAR. This interconnected void structure is what results in water transport through the compacted asphalt specimen. It appears from Figure 6 that the NJDOT could relax the compacted air void specification to 8%, which results in a 1 ft/day permeability when using the AASHTO T166 test procedure, and still be conservatively under the VDOT criteria.

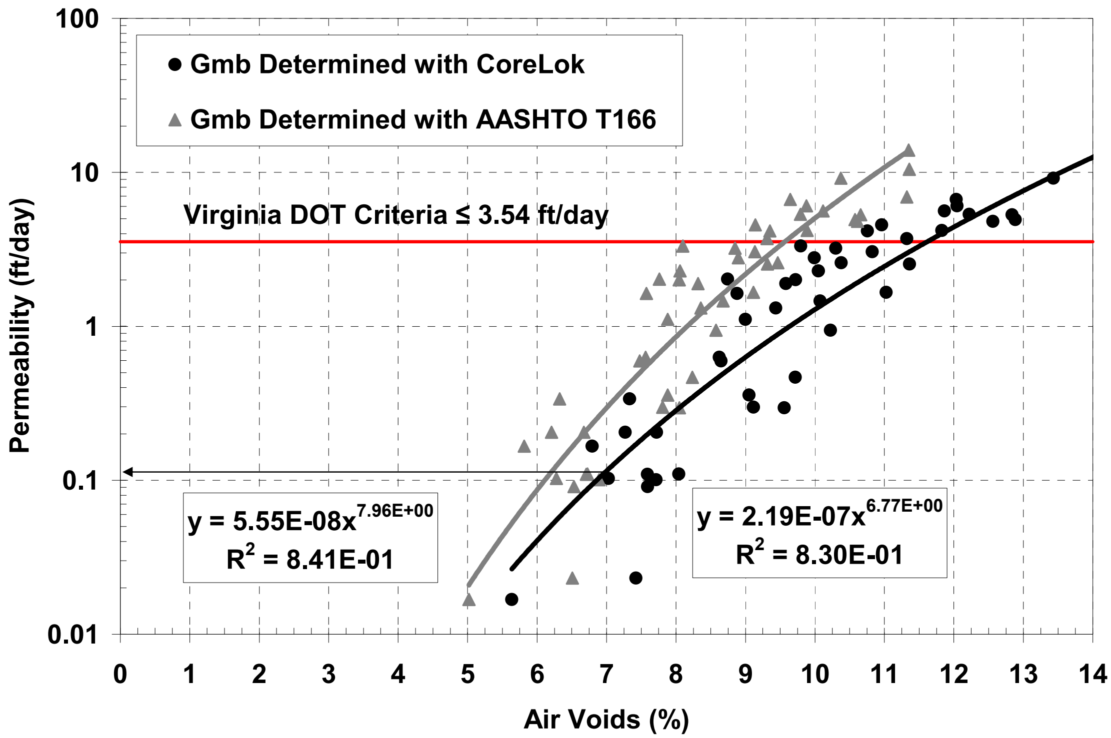

Figure 6 – Compacted Air Voids vs Permeability (Only 48 Samples Represented)

Fatigue Cracking Evaluation

The fatigue resistance of the SMAR was evaluated using the Overlay Tester in accordance with NJDOT Procedure B-10. The TTI Overlay Tester is a relatively new test method developed by the Texas Transportation Institute, TTI (German and Lytton, 1979; Zhou and Scullion, 2005). The test device simulates the expansion and contraction movements that occur in the joint/crack vicinity of PCC pavements. Although this test procedure is essentially a fatigue-type test, it currently represents the best method to truly simulate horizontal joint movements of PCC pavements in the laboratory (Figure 7).

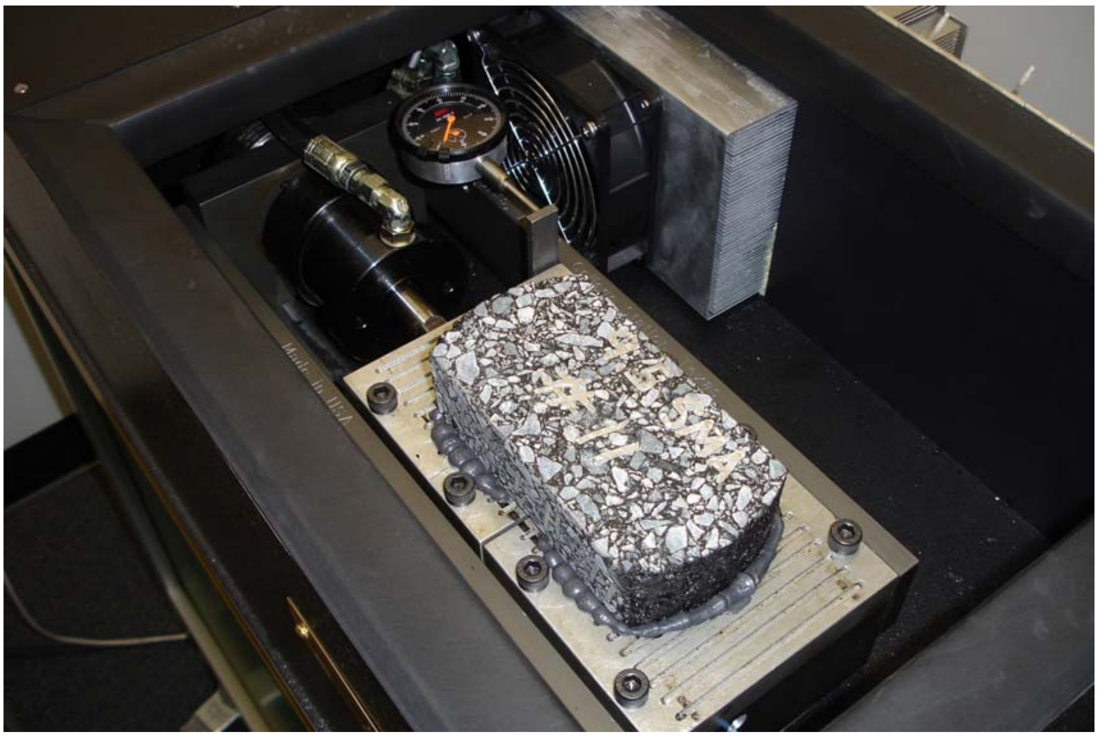

Figure 7 – Picture of the Overlay Tester (Chamber Door Open)

Sample preparation and test parameters used in this study followed that of NJDOT B-10 testing specifications. These include:

- 15°C (59°F) and 25°C (77°F) test temperature;
- Opening width of 0.025 inches;
- Cycle time of 10 seconds (5 seconds loading, 5 seconds unloading); and
- Specimen failure defined as 93% reduction in Initial Load.

Recent work conducted by the TTI has also shown that the test results of the Overlay Tester correlate very well to wheel path cracking, as compared to the measured wheel-path cracking at the FHWA's ALF facility (Zhou et al., 2007). The ALF provided an excellent tool for comparison since the pavement structure used in the comparison (Lanes 2 through 6) had the identical pavement structure, HMA thickness, testing temperature and loading conditions (speed and weight). Therefore, the only difference that could have caused a pavement failure was the mixtures themselves.

The Overlay Tester results are shown in Table 2. As expected, the test results indicated that as the test temperature decreases, so does the SMAR's resistance to fatigue cracking. Additional comparisons were made using a database of different New Jersey surface course mixtures tested within the past 2 years at Rutgers University using the Overlay Tester at 15°C (59°F) (Figure 8). The test results indicate that the SMAR is providing better fatigue resistance than a majority of NJ's surface course mixes, although not as good as the 9.5mm SMA, AR-OGFC, and HPTO mixes previously tested. This is most likely due to the higher air void level and lower binder content with respect to the original mixture design.

Table 2 – Overlay Tester Results for I295 SMAR

SMAR Cores			
Sample ID	**Temp (F)**	**Displacement (inches)**	**Fatigue Life (cycles)**
Core T2	59 F	0.025"	67
Core T20			260
Core T43			126
Average =			**151**
Core T12	77 F	0.025"	545
Core T32			707
Core T44			245
Average =			**499**

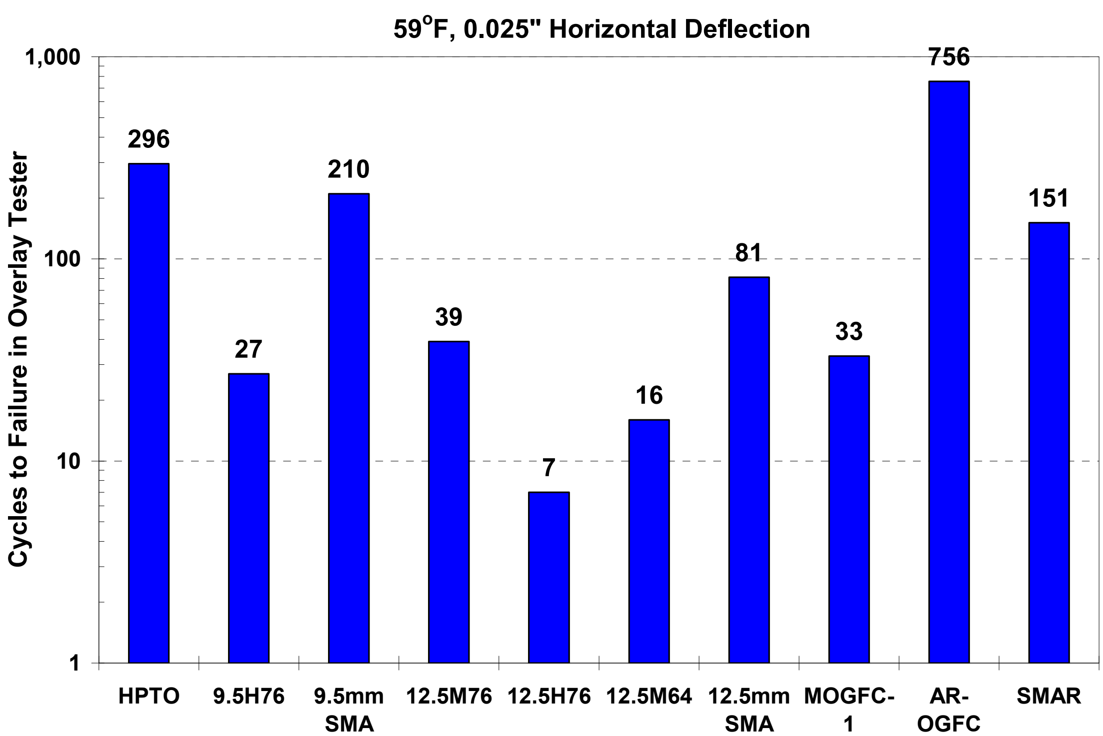

Figure 8 – Database of Overlay Tester Results for New Jersey Surface Course Mixes

Rutting Resistance

The rutting resistance of the SMAR was tested in the Asphalt Pavement Analyzer in accordance to AASHTO TP63. A test temperature of 64°C, hose pressure of 100 psi, and wheel load of 100 lb were used. The test results of the cores are shown in Figure 9 along with the initial mixture design acceptance test results. The APA test results indicate that the SMAR is relatively rut resistant and has similar rutting properties of the original mix design.

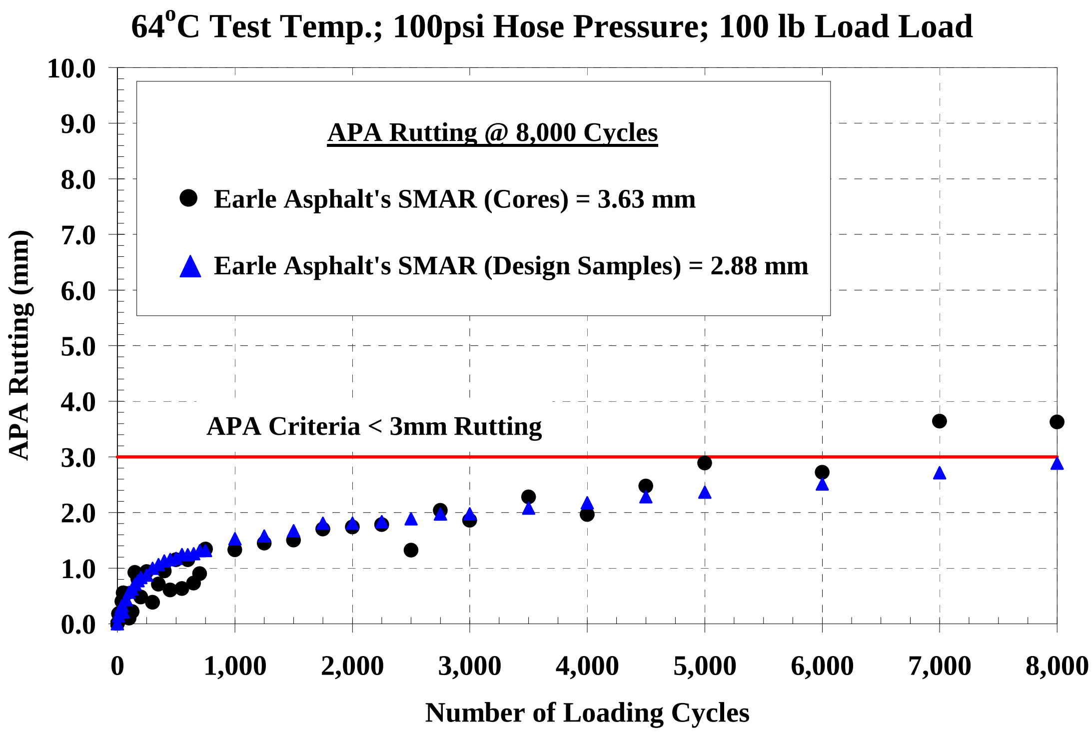

Figure 9 – Asphalt Pavement Analyzer Results for SMAR Samples

Tensile Strength Ratio (Moisture Susceptibility)

The moisture susceptibility of the SMAR was measured using the AASHTO T283 test procedure. Currently, the NJDOT uses an 80% minimum criterion for the tensile strength ratio (TSR). Mixtures falling below the 80% TSR value would technically be classified as having a "stripping potential".

Ten cores were used to determine the moisture susceptibility of the SMAR. Five cores were conditioned, with a freeze-thaw cycle, in accordance to AASHTO T283 and the remaining five cores were unconditioned. The test results are shown in Table 3. Although the compacted air voids of the SMAR cores are higher than air void requirement in AASHTO T283 (6.5 to 7.5%), the average TSR of the SMAR was 75.2%, falling below the 80% requirement set by the NJDOT.

Table 3 – Tensile Strength Ratio (TSR) Results for SMAR

SMAR Cores					
Specimen Type	Average AV (%)		Indirect Tensile Strength		Average TSR (%)
	Dry	Conditioned	Dry	Conditioned	
AASHTO T283 Conditioned	11.31	9.22	148.8	96.8	***75.2%***
	7.01	8.46	124.1	85.4	
	10.22	10.50	101.8	84.2	
	6.80	7.09	125.6	104.7	
	9.95	9.11	116.0	92.5	
	9.06	***8.88***	***123.2***	***92.7***	

General Recommendations

The preliminary test results indicate that the SMAR mechanical properties are generally good with respect to rutting and fatigue cracking resistance. Both the rutting and fatigue cracking properties compare well with "good performing" mixes currently in place in New Jersey. However, the permeability results indicated that the current state of the I295 SMAR is relatively porous with 15 of the 50 tested cores (30%) failing the permeability requirement currently specified by the Virginia Department of Transportation (VDOT). The tensile strength ratio values also indicate that the cores were marginal with respect to the potential for moisture damage. And with the pavement not being designed to allow for lateral drainage of trapped water, it would be prudent to apply some type of "water-proofing" surface over the in-place SMAR to preserve it from moisture and freeze-thaw related damage. A thin-lift application like an Ultra-thin Friction Course would be ideal for this situation.

Additional recommendations, based on the work conducted in this study, are:

- Based on the measured permeability of the cores, and comparing them to the measured air voids, the NJDOT may want to "relax" the compacted air void specification of the SMAR from 7% air voids to 8% air voids. The test data clearly indicates that even at 8% air voids, the heavy mastic of the SMAR "clogs" the interconnected voids of the compacted asphalt sample, limiting water penetration.
- NJDOT may want to replace the currently specified AASHTO T166 (Saturated Surface Dry procedure) with AASHTO T331 (CoreLok procedure) for determining the bulk specific gravity of gap-graded mixtures (SMAR and SMA). The main reason for the replacement is that AASHTO T331 will provide a better measurement of the bulk specific gravity of the compacted specimen when air voids are above 6 to 7% than AASHTO T166. Based on the testing conducted in this study, the difference of the compacted air voids, when using AASHTO T166 and AASHTO T331 to determine the bulk specific gravity of the compacted specimen, was 15% (i.e. – AASHTO T166 resulted in bulk specific gravity values 15% higher than AASHTO T331).

APPENDIX – CORE LOCATIONS

Advanced Infrastructure Design, Inc.

LETTER OF TRANSMITTAL
Date: December 4, 2009
Job Number: 1437N
Attention: Tom Bennert
Reference: Rt. 295 NB/SB from Rt. 29/195 to Rt. 130

TO: Thomas Bennert
Rutgers University
93 Road 1
Piscataway, NJ 08854

The following documents are being transmitted:

COPIES	DATE	DESCRIPTION
1	12-4-09	Table with Core Locations

☐ For Approval ☒ For Your Use ☐ As Requested ☐ Review & Comment

☐ Return ☐ For Bids Due ☐ Other________________

SIGNED: *Thomas M. Lombardi*
Thomas Lombardi
Project Engineer

One Crossroads Drive • Hamilton, NJ 08691 • (v) 609.838.2216 • (f) 609.586.1301
www.aidpe.com

NEW JERSEY DEPARTMENT OF TRANSPORTATION
PAVEMENT CORE RECORD

PROJECT/ROUTE & SECTION:
Rt. 295 NB/SB from Rt. 29/195 to Rt. 130

DRILLER:
Joe Russo

INSPECTOR: Danny Gomez

COUNTY/TOWNSHIP:
Bordentown Twp, Burlington County & Hamilton Twp, Mercer County

DATE STARTED: 12/01/2009
DATE COMPLETED: 12/03/2009

CORE NUMBER	1	2	3	4	5
ROUTE	295	295	295	295	295
DIRECTION (N, E, S, W)	N	N	N	N	N
MILE POST (MP or Station)	1123+32	1146+01	858+89	814+02	827+14
LANE NO. (Left to Right)	1	1	1	1	1
SHOULDER (Inside or Outside)					
CORE DIAMETER (Inches)	6	6	6	6	6
TOTAL CORE DEPTH (Inches)					
CORE DRILLED TO					
SURFACE TYPE (AC/PC)	AC	AC	AC	AC	AC
AC THICKNESS (Inches)					
PC THICKNESS (Inches)					

* Lane 1 is the left lane in the direction of travel.

The pavement information shown herein was obtained for State design and estimate purposes. It is made available to the authorized users only that they may have access to the same information available to the State. It is presented in good faith, but is not intended as a substitute for investigations, interpretation or judgment of such authorized users.

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PAVEMENT CORE RECORD

PROJECT/ROUTE & SECTION:
Rt. 295 NB/SB from Rt. 29/195 to Rt. 130

DRILLER:
Joe Russo

INSPECTOR: Danny Gomez

COUNTY/TOWNSHIP:
Bordentown Twp, Burlington County & Hamilton Twp, Mercer County

DATE STARTED: 12/01/2009
DATE COMPLETED: 12/03/2009

CORE NUMBER	6	7	8	9	10
ROUTE	295	295	295	295	295
DIRECTION (N, E, S, W)	N	N	N	N	N
MILE POST (MP or Station)	749+14	763+92	778+78	790+04	798+95
LANE NO. (Left to Right)	1	1	1	1	1
SHOULDER (Inside or Outside)					
CORE DIAMETER (Inches)	6	6	6	6	6
TOTAL CORE DEPTH (Inches)					
CORE DRILLED TO					
SURFACE TYPE (AC/PC)	AC	AC	AC	AC	AC
AC THICKNESS (Inches)					
PC THICKNESS (Inches)					

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Bordentown Twp, Burlington County & Hamilton Twp, Mercer County

DATE STARTED: 12/01/2009
DATE COMPLETED: 12/03/2009

CORE NUMBER	11	12	13	14	15
ROUTE	295	295	295	295	295
DIRECTION (N, E, S, W)	S	S	S	S	S
MILE POST (MP or Station)	743+45	751.47	760+06	774+68	790+09
LANE NO. (Left to Right)	1	1	1	1	1
SHOULDER (Inside or Outside)					
CORE DIAMETER (Inches)	6	6	6	6	6
TOTAL CORE DEPTH (Inches)					
CORE DRILLED TO					
SURFACE TYPE (AC/PC)	AC	AC	AC	AC	AC
AC THICKNESS (Inches)					
PC THICKNESS (Inches)					

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COUNTY/TOWNSHIP:
Bordentown Twp, Burlington County & Hamilton Twp, Mercer County

DATE STARTED: 12/01/2009
DATE COMPLETED: 12/03/2009

CORE NUMBER	16	17	18	19	20
ROUTE	295	295	295	295	295
DIRECTION (N, E, S, W)	S	S	S	S	S
MILE POST (MP or Station)	866+70	1133+00	1143+83	1121+91	1130+56
LANE NO. (Left to Right)	1	1	1	1	1
SHOULDER (Inside or Outside)					
CORE DIAMETER (Inches)	6	6	6	6	6
TOTAL CORE DEPTH (Inches)					
CORE DRILLED TO					
SURFACE TYPE (AC/PC)	AC	AC	AC	AC	AC
AC THICKNESS (Inches)					
PC THICKNESS (Inches)					

* Lane 1 is the left lane in the direction of travel.

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NEW JERSEY DEPARTMENT OF TRANSPORTATION
PAVEMENT CORE RECORD

PROJECT/ROUTE & SECTION:
Rt. 295 NB/SB from Rt. 29/195 to Rt. 130

DRILLER:
Joe Russo

INSPECTOR: Danny Gomez

COUNTY/TOWNSHIP:
Bordentown Twp, Burlington County & Hamilton Twp, Mercer County

DATE STARTED: 12/01/2009
DATE COMPLETED: 12/03/2009

CORE NUMBER	21	22	23	24	25
ROUTE	295	295	295	295	295
DIRECTION (N, E, S, W)	S	S	S	S	S
MILE POST (MP or Station)	1128+61	1144+74	864+95	822+36	831+45
LANE NO. (Left to Right)	2	2	2	2	2
SHOULDER (Inside or Outside)					
CORE DIAMETER (Inches)	6	6	6	6	6
TOTAL CORE DEPTH (Inches)					
CORE DRILLED TO					
SURFACE TYPE (AC/PC)	AC	AC	AC	AC	AC
AC THICKNESS (Inches)					
PC THICKNESS (Inches)					

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PAVEMENT CORE RECORD

PROJECT/ROUTE & SECTION:
Rt. 295 NB/SB from Rt. 29/195 to Rt. 130

DRILLER:
Joe Russo

INSPECTOR: Danny Gomez

COUNTY/TOWNSHIP:
Bordentown Twp, Burlington County & Hamilton Twp, Mercer County

DATE STARTED: 12/01/2009
DATE COMPLETED: 12/03/2009

CORE NUMBER	26	27	28	29	30
ROUTE	295	295	295	295	295
DIRECTION (N, E, S, W)	N	N	N	N	S
MILE POST (MP or Station)	752+57	763+52	775+50	800+90	725+83
LANE NO. (Left to Right)	2	2	2	2	2
SHOULDER (Inside or Outside)					
CORE DIAMETER (Inches)	6	6	6	6	6
TOTAL CORE DEPTH (Inches)					
CORE DRILLED TO					
SURFACE TYPE (AC/PC)	AC	AC	AC	AC	AC
AC THICKNESS (Inches)					
PC THICKNESS (Inches)					

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PAVEMENT CORE RECORD

PROJECT/ROUTE & SECTION:
Rt. 295 NB/SB from Rt. 29/195 to Rt. 130

DRILLER:
Joe Russo

INSPECTOR: Danny Gomez

COUNTY/TOWNSHIP:
Bordentown Twp, Burlington County & Hamilton Twp, Mercer County

DATE STARTED: 12/01/2009
DATE COMPLETED: 12/03/2009

CORE NUMBER	31	32	33	34	35
ROUTE	295	295	295	295	295
DIRECTION (N, E, S, W)	S	S	S	S	S
MILE POST (MP or Station)	752+14	758+46	767+55	787+71	798+43
LANE NO. (Left to Right)	2	2	2	2	2
SHOULDER (Inside or Outside)					
CORE DIAMETER (Inches)	6	6	6	6	6
TOTAL CORE DEPTH (Inches)					
CORE DRILLED TO					
SURFACE TYPE (AC/PC)	AC	AC	AC	AC	AC
AC THICKNESS (Inches)					
PC THICKNESS (Inches)					

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PROJECT/ROUTE & SECTION:
Rt. 295 NB/SB from Rt. 29/195 to Rt. 130

DRILLER:
Joe Russo

INSPECTOR: Danny Gomez

COUNTY/TOWNSHIP:
Bordentown Twp, Burlington County & Hamilton Twp, Mercer County

DATE STARTED: 12/01/2009
DATE COMPLETED: 12/03/2009

CORE NUMBER	36	37	38	39	40
ROUTE	295	295	295	295	295
DIRECTION (N, E, S, W)	N	N	N	N	N
MILE POST (MP or Station)	1139+46	818+68	837+23	774+87	797+45
LANE NO. (Left to Right)	3	3	3	3	3
SHOULDER (Inside or Outside)					
CORE DIAMETER (Inches)	6	6	6	6	6
TOTAL CORE DEPTH (Inches)					
CORE DRILLED TO					
SURFACE TYPE (AC/PC)	AC	AC	AC	AC	AC
AC THICKNESS (Inches)					
PC THICKNESS (Inches)					

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PROJECT/ROUTE & SECTION:
Rt. 295 NB/SB from Rt. 29/195 to Rt. 130

DRILLER:
Joe Russo

INSPECTOR: Danny Gomez

COUNTY/TOWNSHIP:
Bordentown Twp, Burlington County & Hamilton Twp, Mercer County

DATE STARTED: 12/01/2009
DATE COMPLETED: 12/03/2009

CORE NUMBER	41	42	43	44	45
ROUTE	295	295	295	295	295
DIRECTION (N, E, S, W)	N	S	S	S	S
MILE POST (MP or Station)	728+23	743+32	758+26	773+37	792+57
LANE NO. (Left to Right)	3	3	3	3	3
SHOULDER (Inside or Outside)					
CORE DIAMETER (Inches)	6	6	6	6	6
TOTAL CORE DEPTH (Inches)					
CORE DRILLED TO					
SURFACE TYPE (AC/PC)	AC	AC	AC	AC	AC
AC THICKNESS (Inches)					
PC THICKNESS (Inches)					

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Rt. 295 NB/SB from Rt. 29/195 to Rt. 130

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COUNTY/TOWNSHIP:
Bordentown Twp, Burlington County & Hamilton Twp, Mercer County

DATE STARTED: 12/01/2009
DATE COMPLETED: 12/03/2009

CORE NUMBER	46	47	48	49	50
ROUTE	295	295	295	295	295
DIRECTION (N, E, S, W)	S	S	S	S	S
MILE POST (MP or Station)	816+02	822+63	863+99	1121+37	1137+79
LANE NO. (Left to Right)	2	2	2	2	2
SHOULDER (Inside or Outside)					
CORE DIAMETER (Inches)	6	6	6	6	6
TOTAL CORE DEPTH (Inches)					
CORE DRILLED TO					
SURFACE TYPE (AC/PC)	AC	AC	AC	AC	AC
AC THICKNESS (Inches)					
PC THICKNESS (Inches)					

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DRILLER:
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INSPECTOR: Danny Gomez

COUNTY/TOWNSHIP:
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DATE STARTED: 12/01/2009
DATE COMPLETED: 12/03/2009

CORE NUMBER	51	52	53	54	55
ROUTE	295	295	295	295	295
DIRECTION (N, E, S, W)	S	S	S	S	S
MILE POST (MP or Station)	808+33	826+41	865+64	1119+27	1133+40
LANE NO. (Left to Right)	3	3	3	3	3
SHOULDER (Inside or Outside)					
CORE DIAMETER (Inches)	6	6	6	6	6
TOTAL CORE DEPTH (Inches)					
CORE DRILLED TO					
SURFACE TYPE (AC/PC)	AC	AC	AC	AC	AC
AC THICKNESS (Inches)					
PC THICKNESS (Inches)					

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