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Sub-Task 1.1: The Next Generation of Asphalt Surfacings - Road Trials (Phase II)

Task 1-444 Collaborative Research Project

Highways England, Eurobitume UK and Mineral Products Association (MPA)

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Executive Summary

The overall objective of this project is focused on ensuring that asphalt surfacings continue to deliver value for money and to maximise the benefits from innovation on the Strategic Road Network. This project is a collaborative output between AECOM, Highways England (HE), Eurobitume UK and Mineral Products Association (MPA).

The project includes several sub tasks carried out under the Collaborative Research Project. The sub-task reported herein is the follow up work on the next generation of asphalt materials, specifically Premium Asphalt Surfacing System (PASS) and Low Noise Hot Rolled Asphalt (HRA) surface course. These were successfully completed by the Work Package Delivery Team during the previous collaborative research works (2015/2016 and 2016/2017). The project reports are detailed in Ojum, Widyatmoko and Edwards (2017) and Ojum, Tuck and Widyatmoko (2017). These can be found on AECOM's publications website: https://www.aecom.com/uk/pavement-design-publications/

This project is tasked with the continuous development, monitoring and assessment of PASS and the Low Noise HRA surface course materials. Initial laboratory tests and assessments for the Low Noise Clause 943 HRA using 10 mm and 8/14 mm Pre-Coated Chippings (PCC) resulted in texture depths <1.6 mm. In-situ texture depth post installation was estimated to be less than the specified 1.5 mm. It was agreed that work would focus only on further development of PASS for this project.

This project successfully installed PASS on the A458 Welshpool Road Shrewsbury/Ford Village (Westbound). The project made use of different sources of aggregates and bitumen in comparison to the materials used in the Alrewas Quarry Access Trial and the A46 PASS Trial. The PASS was successfully installed on this site using the same techniques and equipment for typical Clause 942 thin surface course materials.

Monitoring and testing show that the PASS had a mean texture depth of 1.4 mm. The average air void content of the PASS mixtures was measured to be 6%. The rutting resistance of PASS mixtures showed that PASS had mean Proportional Rut Depth (PRD) of 11.1%. The water sensitivity tests showed that PASS mixtures have good resistance to moisture damage with Indirect Tensile Strength Ratios (ITSR) > 80%.

The findings from this phase of the project show positive results for PASS. It is recommended that PASS should be further developed, monitored and assessed considering the mechanical and performance properties of trial sites at Alrewas Quarry Access Road, A46 Hykeham to Carholme (Southbound) and the A458 Welshpool Road Shrewsbury/Ford Village (Westbound). It is recommended that the findings from these trials should lead to the development of guidance documents and specifications for the design, testing and use of the next generation of asphalt mixtures.

1. Introduction

Following the completion of the previous collaborative research projects on the next generation of asphalt surfacing (Highways England Framework - Task 409 and Task 1-111), Arup AECOM consortium was commissioned by Highways England, Eurobitume UK and Mineral Products Association (MPA) to carry out further development, assessment and a trial on the next generation asphalt materials under a new project: Task 1-444 Collaborative Research 2017/2018 Road Trials (Phase II) and QA Measurement Methods.

This report focuses on Sub-Task 1.1 of the project. The scope and outputs are detailed in Table 1.

Table 1: Project Scope for Sub-Task 1.1

Sub-Task 1.1		Output	Deliverable
1	Continuous monitoring, Visual Condition Survey (VCS) and surface macrotexture depth measurements of the installed materials on Alrewas Quarry Access Road - (PASS and Low Noise HRA surface).	Technical Report	Appendix A Appendix B
2	Continuous monitoring, VCS and surface macrotexture depth measurements of PASS on the A46.	Technical Report	Appendix A Appendix B Appendix C
3	Further development and assessment of PASS considering the findings and lessons from the A46 network trial undertaken in August 2017.	Project Report	Project Report
4	Assessment of suitability of Low Noise HRA for use on the Strategic Road Network (SRN)	Project Report	Project Report

Appendix A summarises the mix design for the Premium Asphalt Surfacing System (PASS) and Low Noise HRA. Continuous monitoring of the next generation asphalt materials was completed by conducting Visual Condition Surveys (VCS) and surface macrotexture depth measurements of the installed materials on Alrewas Quarry Access Road (PASS and the Low Noise HRA surface) and the A46 (PASS).

Findings from the visual observations on the Alrewas Quarry Access Road indicated that there was no chipping loss, cracking or fretting of the HRA and PASS materials. There was no evidence of rutting or permanent deformation of the installed materials. The findings are detailed in Appendix B.

The visual condition survey of the PASS on the A46 was carried out using a vehicle-mounted high definition (HD) camera incorporated with a laser mounted system. Appendix C presents the findings in a technical note.

2. Further Development and Assessment of PASS

2.1 Key Findings and Recommendations from the A46 Hykeham to Carholme (Southbound) Trial

The background and key findings following the installation of the PASS on the A46 Hykeham to Carholme (Southbound) on 10th August 2017 are summarised below:

- The PASS material was successfully installed with observations and feedback from the site team noting that the PASS material was relatively easy to lay and compact.
- The PASS mixtures had measured mean macrotexture values ranging between 1.2 mm and 1.3 mm with visual inspection showing a 'dense' asphalt material in accordance with BS EN 13036-1.
- Skid resistance values exceeding 70 were obtained using the skid pendulum test value (PTV) determined in accordance with BS EN 13036-4.
- The resistance to permanent deformation test of the PASS mixtures showed rut depths of less than 5 mm after 10,000 cycles at 60°C determined in accordance with BS EN 12697-22 Procedure B (small scale wheel tracker). The visual inspection of the PASS mixtures following the wheel track testing showed that there was little or no rutting on the surface of the mixtures.
- The water sensitivity of the PASS mixtures was considered acceptable with Indirect Tensile Strength Ratios (ITSR) of 72% in accordance with BS EN 12697-12.
- The Statistical Pass-By (SPB) method was used in assessing the noise properties of the PASS mixtures following the road trial to obtain the Road Surface Influence (RSI). The obtained value for the PASS from this survey was obtained as -5.7 dB(A) which is equivalent to a noise level Class 3 - very quiet surfacing material in accordance with Series 900 Table 9/17.
- The visual condition survey of the PASS on the A46 was carried out using a vehicle-mounted high definition (HD) camera, travelling at traffic speed, on 14th February 2018 (about 6 months after construction). The visual observations indicated that there were no observed defects on the sections installed with PASS. There was no evidence of rutting or permanent deformation of the installed materials. The "estimated" surface macrotexture depth measurement using the laser mounted device provided an indication and estimate of the pavement surface macrotexture. The values were obtained as 1.3 mm and 1.4 mm. Appendix C presents the findings in a technical note.
- This project has successfully arranged the installation of PASS trial sections on the strategic road network. This demonstrates that the PASS can be installed using current practices to achieve the trial requirements. Most importantly, the PASS mixtures have shown acceptable noise characteristics following the SPB tests conducted.
- A key recommendation from this project proposes further development, optimisation and assessment of PASS making use of alternative aggregate materials, binder and a different

installation contractor. This would provide increased confidence in the design and installation of PASS.

2.2 A458 Welshpool Road Shrewsbury/Ford Village PASS Trial

This section presents details of a further PASS road trial on a section of the Strategic Road Network. Previous trials have demonstrated that PASS can be installed using current installation equipment and best practices to achieve the specified trial requirements. However, previous trials were limited to the use of a single source of aggregate and binder materials, produced by a single supplier and installed on one section of the strategic road network. This network trial of PASS used a different aggregate source, binder supplied by a different supplier and laid by a different installation contractor. The site was located on the A458 Welshpool Road Shrewsbury/Ford Village (Westbound).

The trial was completed between 30th October (Night Time Works) and 31st October 2018. A section of the A458 Welshpool Road Shrewsbury/Ford Village (Westbound) is shown in Figure 1. The road is a single carriageway with a speed limit of 40 mph. The trial section is relatively flat in topography and straight in geometry. The road trial location including chainage are detailed in Appendix D of this report.

Figure 1. A458 Welshpool Road Shrewsbury

The laying schedule for the PASS mixtures as provided by the contractor is summarised in Table 2.

Table 2: PASS Road Trial 2018 Laying Schedule

Chainage From	Chainage To	Lane	Direction	Length (m)	Depth (mm)	Date
1310	1124	1	Westbound	186	50	30/10/18

2.3 Mix Design for the A458 Welshpool Road Shrewsbury/Ford Village

- The mix design for the PASS trial for the A458 Welshpool Road Shrewsbury/Ford Village PASS Trials is detailed in Table 3.

Table 3: Mix Design for PASS Trial on A458 Welshpool Road Shrewsbury/Ford Village

Sieve Size (mm)	% Passing		
	Lower Limit	Upper Limit	Target Design
14	98	100	100
10	85	98	94
6.3	40	54	46
4	31	45	39
2	20	32	29
0.25	5	13	12
0.063	4.2	8.2	6.5
Binder Content (%)	4.9	5.9	5.4

- The coarse aggregate materials were obtained from Gilfach quarry. The Polished Stone Value (PSV) of the coarse aggregate is reported as 68. The fine aggregate material was obtained from Haughmond Quarry.
- Elastomeric polymer modified binder (PMB) was used. The binder was classified as 25/55-55. The target binder content was 5.4%.
- The target mix design in-situ air void content is 2% - 6%.
- The target in-situ macrotexture is 1.0 mm – 1.5 mm. It was agreed that if the macrotexture values were < 0.7 mm, Highways England would arrange for the replacement of the trial section.
- The installation contractor supplied loose asphalt mixtures for the PASS. These samples were used to determine mix binder content and grading in accordance with BS EN 12697-1 and 2.

2.4 Test Layout and Installation of PASS

- The laying contractor carried out standard control testing for the installation works in accordance with BS 594987:2015+A1:2017. This included the application of bond coats on the substrate prior to laying the PASS and measurement of surface texture after PASS has been laid prior to trafficking. Production records and temperatures (mix and installation) were provided for the works by the contractor. These records are presented in Appendix E.
- The same equipment and procedure used in the installation of typical Clause 942 thin surface course materials were utilised for the PASS trial.

- The network trial installed PASS targeting 50 mm and 35 mm nominal thicknesses over 2 x 100 m lane length sections (Figure 2). However, cores taken from the section with 35 mm nominal thickness showed an average thickness of 47 mm (Figure 2). The cores are presented in Appendix F. Considering this factor, the difference in nominal thickness between the two sections will not be taken into consideration.

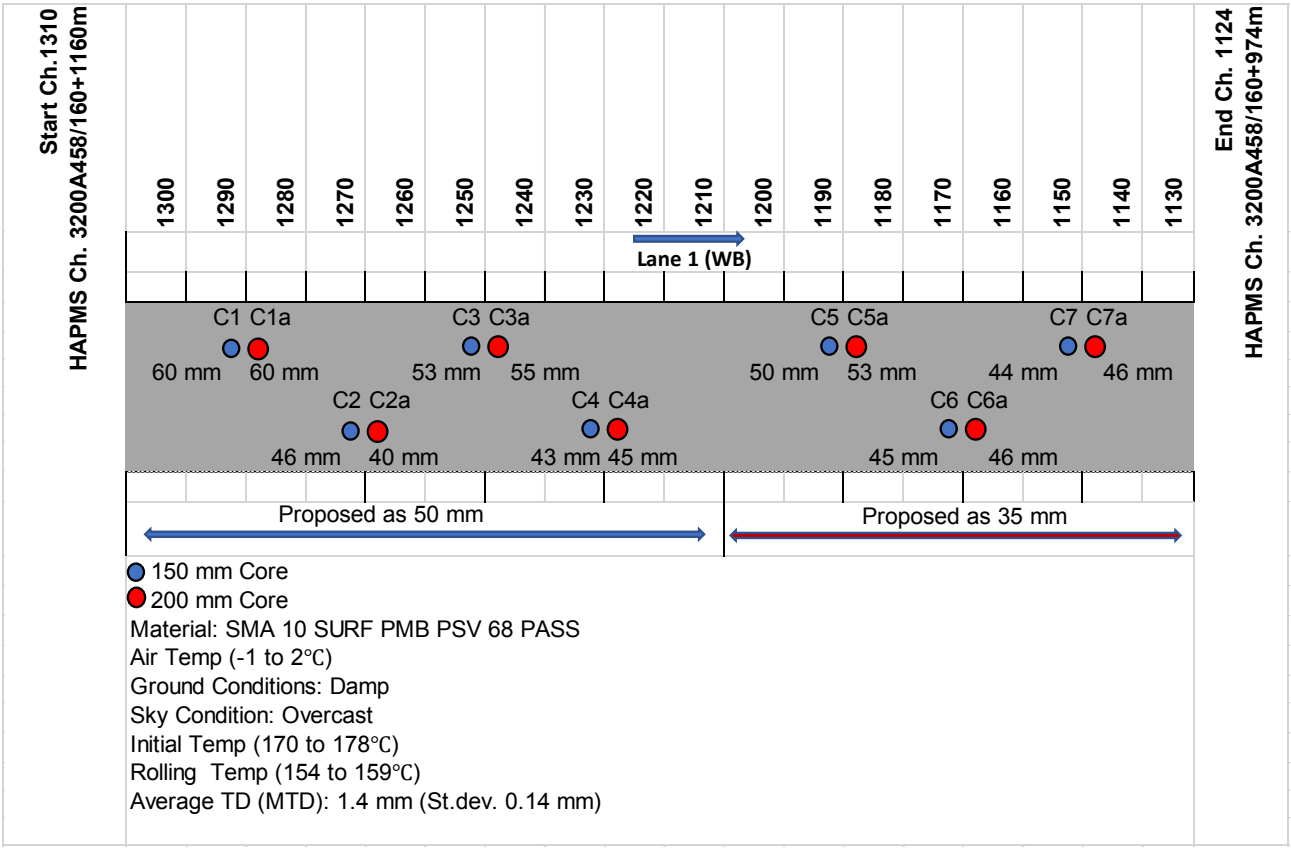


Figure 2: Test Layout for PASS Road Trial Mixtures

- Observations and feedback during the trial showed that the PASS material was relatively easy to lay and compact (see Figure 3).
- The production test records obtained from the site showed that the surface macrotexture is comparable to that expected for Thin Surface Course Systems (1.0 to 1.5 mm).
- Following the laying and installation of PASS on the A458, cores were obtained from the site as detailed in Figure 2. The obtained cores were used for further tests to ascertain the mechanical and performance properties of the PASS mixtures. The PASS trial report following the installation on the A458 Welshpool Road Shrewsbury/Ford Village (Westbound) and the laboratory test results are enclosed in Appendix G.

Figure 3: Installation of PASS on A458 Welshpool Road Shrewsbury/Ford Village (Westbound)

2.5 A458 PASS Trial Test Report

The test summary for the PASS mixtures following the installation on A458 Welshpool Road Shrewsbury/Ford Village is presented in Table 4.

Table 4: Test Summary for PASS Trial on A458 Welshpool Road Shrewsbury/Ford Village

Mix	Sample	Tests to be Conducted
PASS	2 bags of loose material from the asphalt plant. 2 bags of loose material during laying of the PASS.	Compositional Analysis in accordance with BS EN 12697-1 and BS EN 12697-2.
		Maximum density in accordance with BS EN 12697-5.
	7 x 150 mm diameter cores.	Bulk densities in accordance with BS EN 12697-6 using density methods B and C.
		Water Sensitivity Tests in accordance with BS EN 12697-12.
		Indirect Tensile Stiffness modulus (ITSM) @ 20 °C in accordance with BS EN 12697-26.
	7 x 200 mm diameter cores.	WTT in accordance with BS EN 12697-22 using the small device to 10,000 cycles Procedure B.
		Bulk densities in accordance with BS EN 12697-6 using density methods B and C.

The key findings following the testing and evaluation of samples obtained from the PASS trial are discussed below.

2.5.1 Visual Assessment of the PASS Samples

The core logs are presented in Appendix F. The PASS samples (Layer 1) appeared to be dense with a high coarse aggregate content showing good interlocking properties. A typical cross section of the PASS material is shown below in Figure 4.

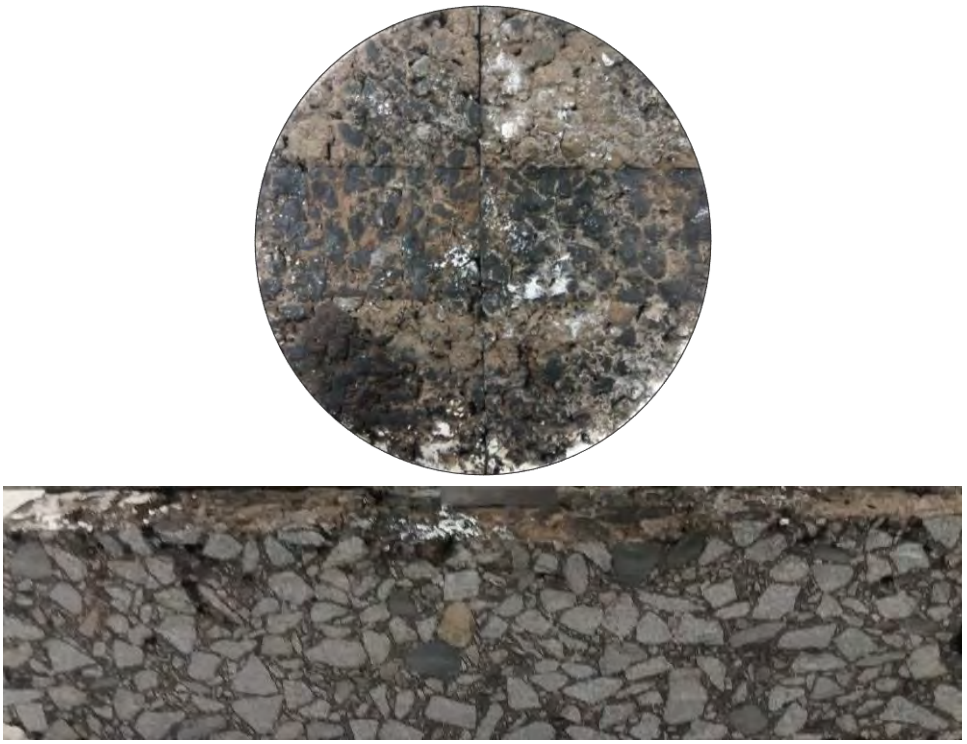


Figure 4. Typical Top View and Cross-Section of the PASS

2.5.2 Compositional Analysis

Compositional analysis was conducted on loose bulk samples obtained from the road trial (Asphalt Plant and Paver). The tests were carried out in accordance with BS EN 12697-1 and 2. Figure 5 and Table 5 show the aggregate gradations taken from different loose bulk samples during the installation of the road trial on the A458 Welshpool Road Shrewsbury/Ford Village (Westbound) termed as Sample 1, Sample 2 and Sample 3.

The compositional analysis results of the three samples meet the target designs for PASS.

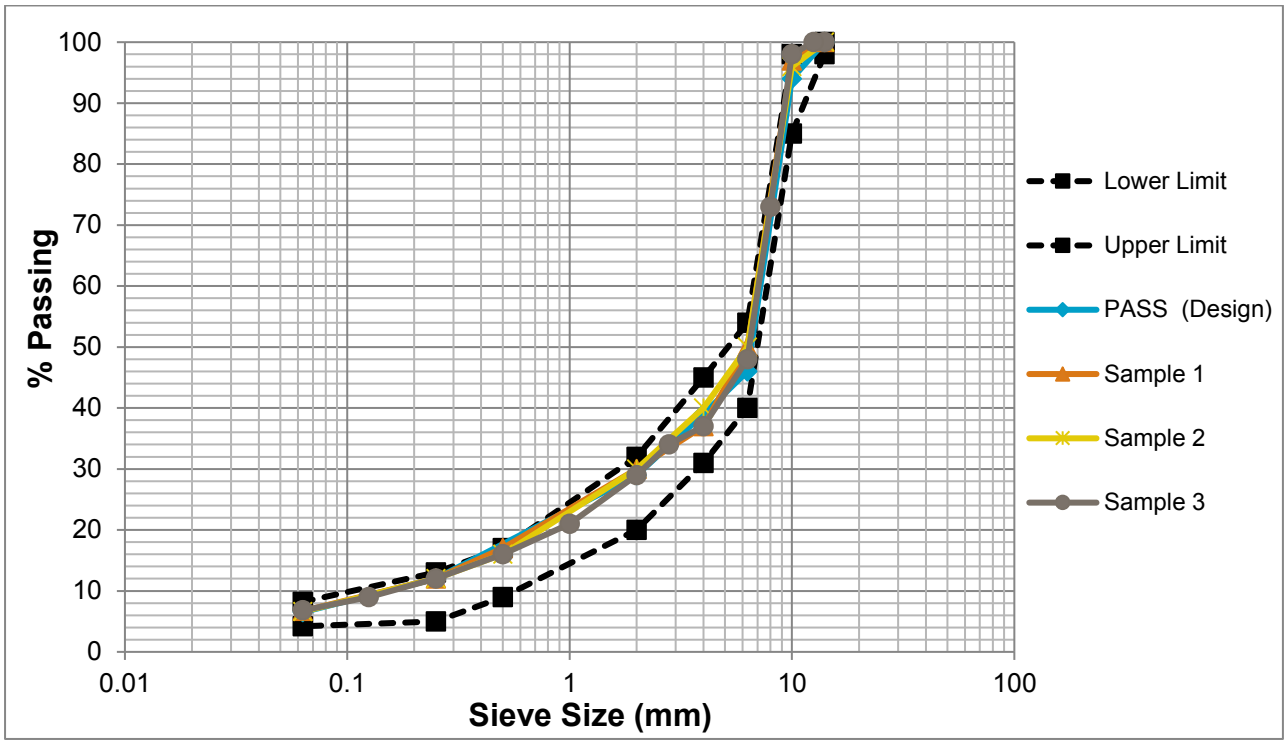


Figure 5. Aggregate Gradations for PASS on the A458 Welshpool Road Shrewsbury/Ford Village (Westbound)

Table 5: Aggregate Gradations for the A458 Welshpool Road Shrewsbury/Ford Village (Westbound)

Sieve Size (mm)	Percentage Passing Sample 1	Percentage Passing Sample 2	Percentage Passing Sample 3	Mean value Passing	Specification Limits
14.0	100	100	100	100	98 - 100
10.0	97	96	98	97	85 - 98
6.3	50	50	48	49	40 - 54
4.0	37	40	37	39	31 - 45
2.0	30	30	29	30	20 - 32
0.50	17	16	16	16	9 - 17
0.25	12	12	12	12	5 - 13
0.063	6.7	6.6	6.8	7	4.2 - 8.2
Binder Content (%)	5.6	5.7	5.6	5.6	4.9 - 5.9

2.5.3 Mixture Volumetrics and Functional Properties

The maximum density, bulk density and air voids were measured in accordance with BS EN 12697-5 - Procedure A, BS EN 12697-6 Procedure B and BS EN 12697-8 respectively. The air void contents of the PASS mixture are detailed below in Figure 6. The results of air voids shown in Figure 6 represents the values of 14 samples. The error ranges represent the minimum and maximum values. The standard deviation is shown as a ± after the mean value in the chart. The mean in-situ air voids of PASS mixture were obtained as 6.3% with values ranging from 4.5% to 10.3%. The air void results from the A458 are lower than those obtained from the previous trial conducted on A46 Hykeham, being 10.6% (with values ranging from 7.5% to 12.7%) and 9.8% (with values ranging from 7.4% to 12.3% for the two PASS mixtures), respectively.

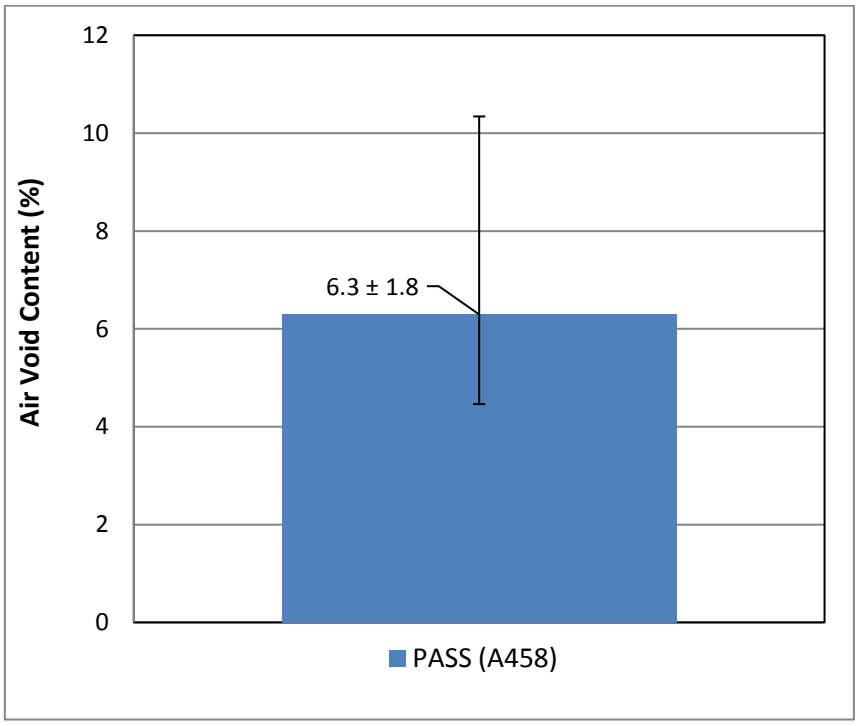


Figure 6. Air Void Content of PASS Mixtures

The pavement surface macrotexture in accordance with BS EN 13036-1 was obtained on site following installation of the PASS asphalt materials. The results are shown in Figure 7. The results are a mean value of ten macrotexture measurements on site. The macrotexture test results conducted on-site had a mean macrotexture value of 1.4 mm. The macrotexture values obtained from the road trial for the PASS mixtures met the target in-situ macrotexture levels of not less than 1.0 mm set for the project. This macrotexture (1.4 mm) was higher than the mean macrotexture (1.2 mm and 1.3 mm) of two PASS mixtures conducted on A46 Hykeham.

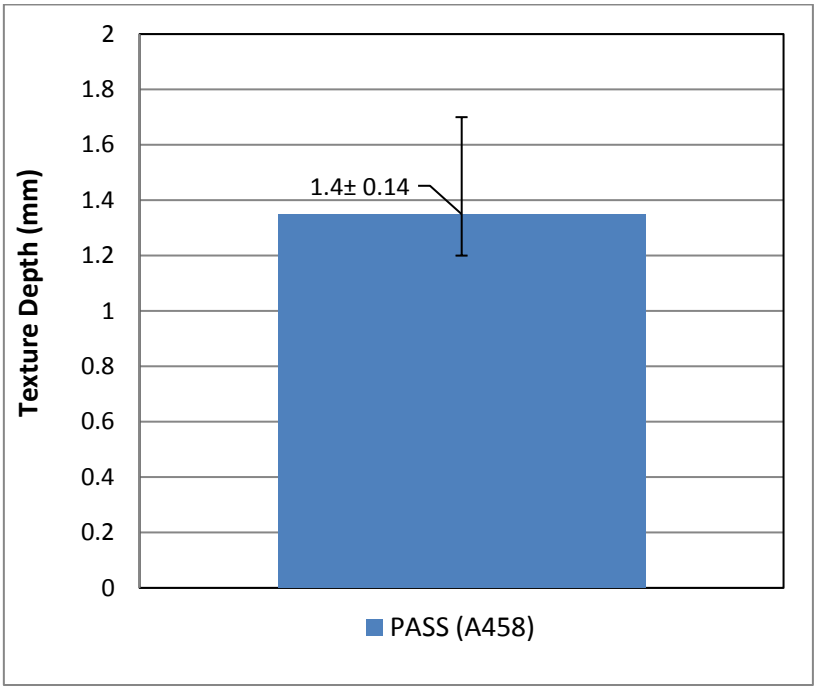


Figure 7. In-Situ Pavement Surface Macrotexture

2.5.4 Wheel Track Test

Resistance to deformation was measured by using the Wheel Tracking Tests (WTT) in accordance with EN 12697-22 using the small device to 10,000 cycles Procedure B at 60 ℃. Table 6 presents the WTT results representing 4 samples. Table D2 of PD 6691 states that the deformation resistance for Class 2, should have wheel tracking slope in the air less than 1 mm/1000 cycles. As seen in Table 6, the PASS asphalt mixtures performance complies with Class 2 requirements (very heavily stressed sites requiring very high rut resistance) as detailed in PD 6691 Table D.2. In comparison to previous PASS trail of A46 Hykeham, the present wheel track results, WTS, PRD and MRD (0.24, 11.1 and 5.1) are higher. Previous WTT results showed mean values of WTS, PRD and MRD of (0.065, 4.67 and 2.10) and (0.057, 4.67 and 2.10) for two PASS mixtures, respectively.

Table 6: Wheel Tracking Test Results for A458 Welshpool Road Shrewsbury/Ford Village (Westbound)

Sample	Wheel Tracking Slope (WTS) in Air (mm/10³ cycles)	Proportional Rut Depth (PRD) at 10,000 cycles (%)	Mean Rut Depth (MRD) at 10,000 cycles (mm)
3A	0.36	15.8	7.4
4A	0.31	13.6	5.6
5A	0.17	8.1	4.1
6A	0.11	6.9	3.1
Mean	**0.24**	**11.1**	**5.1**

2.5.5 Indirect Tensile Stiffness Modulus

The results of ITSM tests at 20°C in accordance with BS EN 12697-26:2004 (Annex C) are presented in Table 7. The ITSM values of the PASS samples ranged from 1060 MPa to 1720 MPa with an average of 1343 MPa. These values are not unusual for polymer modified asphalt surface courses containing elastomeric binder.

Table 7: ITSM Results of PASS Mixtures

Sample	ITSM at 20°C (MPa)
1	1630
2	1060
3	1130
4	1280
5	1290
6	1720
7	1290
Mean	**1343**

2.5.6 Resistance to Moisture Damage

Resistance to moisture damage was obtained by ascertaining the water sensitivity of the PASS mixtures in accordance with BS EN 12697-12 and BS EN 12697-23. The Indirect Tensile Strength Ratio (ITSR) ratio was 135% (two batches were tested; Batch 1 was 132% and Batch 2 was 137%). This value was higher than 100% indicating that the material is not sensitive to moisture induced damage but more sensitive to hardening during the conditioning regime. This value is also higher than the ITSR results of previous trial (A46 Hykeham), previous trail showed ITSR of 77% and 67% for two PASS mixtures, respectively.

2.5.7 Key Findings and Summary

- The PASS material was relatively easy to lay and compact using the same equipment and procedure for the installation of Clause 942 thin surface course materials.
- The compositional analysis results show the aggregate gradation and binder content were within the mix design and production control limits set for PASS to comply with a BS EN 13108-5 material.
- The on-site surface macrotexture of A458 trial was 1.4 mm (mean of 10 measurements) which is higher than the target value of 1.0 mm set for the project. This macrotexture (1.4 mm) was higher than the mean macrotexture (1.2 mm and 1.3 mm) of two PASS mixtures conducted on A46 Hykeham.
- The mean in-situ air voids of A458 PASS mixture were obtained as 6.3% which was slightly higher than the maximum target air void of 6% set for the project but lower than those achieved on the A46 Hykeham road trial. Reviewing the macrotexture and air void test results, it is expected that the target air void content is achievable for the PASS mixtures. It should be mentioned that the air temperature during the installation was -1°C to 2°C (BS594987 allows laying to be carried out until -3 ℃ in calm and dry conditions).
- The mean wheel track results, WTS, PRD and MRD (0.24, 11.1 and 5.1) of A458 trial are higher in comparison to previous PASS trail of A46 Hykeham. Previous WTT results showed mean values of WTS, PRD and MRD of (0.065, 4.67 and 2.10) and (0.057, 4.67 and 2.10) for two PASS mixtures, respectively. However, all meet the Class 2 requirements (very heavily stressed sites requiring very high rut resistance) as detailed in PD 6691.
- The average ITSM at 20°C of A458 PASS mixtures was 1343 MPa. This value is not unusual for polymer modified asphalt surface courses containing elastomeric binder.
- Finally, the conditioned indirect tensile strength (ITS) values of PASS mixtures were higher than the unconditioned values indicating that PASS mixtures have a good moisture damage resistance. The ITSR of A458 being higher than 100% indicates that the material is not sensitive to moisture induced damage.

3. Assessment of Suitability of Low Noise HRA for Use on Strategic Road Network

3.1 Laboratory Assessment of Low Noise HRA

Prior to carrying out a trial of Low Noise HRA on the SRN, a suite of laboratory assessment was carried out by a member company of the collaborative research project team. The aggregate material used was Gritstone from Gilfach Quarry. The PSV of the aggregate material was 68. The binder used had a classification of 25/55-55 PMB.

10 mm and 8/14 mm Pre-Coated Chippings (PCC) were used. The PCC had a binder content of 1.7% for the 10 mm PCC while the 8/14 mm PCC had a binder content of 1.8%. All pre-coats were applied to the slabs to give shoulder to shoulder spread and the effective rate of spread was calculated. The HRA material was produced in accordance with MCHW Clause 943 and PD 6691. The laboratory prepared slabs were produced to a thickness of 50 mm.

3.2 Results

3.2.1 PCC Using 10 mm Single Size

Figure 8: Low Noise HRA - 10 mm PCC

Figure 8 shows the laboratory produced Clause 943 HRA using 10 mm single size PCC. The rate of spread for the 10 mm PCC was measured as 5.2 kg/m^2 and the texture depth value in accordance with BS EN 13036-1 was measured to be 1.5 mm.

3.2.2 PCC Using 8/14 mm

Figure 9 shows the laboratory produced Clause 943 HRA using 8/14 mm PCC. The rate of spread for the 8/14 mm PCC was measured as 7.1 kg/m^2 and the texture depth value in accordance with BS EN 13036-1 was measured to be 1.6 mm.

Figure 9: Low Noise HRA – 8/14 mm PCC

3.3 Key Findings and Summary

The texture depths for the laboratory produced Clause 943 HRA materials all exceeded the minimum requirement of 1.5 mm as per MCHW Clause 921 (Surface Macrotexture of Bituminous Surface Courses).

The rate of spread was reviewed against current experience (14/20 mm) and previous trials. It was evaluated that a typical rate of spread for 14/20 mm is 10 – 11 kg/m^2 which gives a typical texture of 1.6 mm. The rate of spread used in the Alrewas Quarry Access Road Trial was 5.5 – 6.0 k/g/m^2 which resulted in a texture of 0.8 mm. Based on these, it was estimated that the 10 mm and 8/14 pre-coats would provide a texture depth value in the region of 1.0 – 1.2 mm in site conditions which would not meet the MCHW Clause 921 requirement of 1.5 mm for Clause 943 HRA materials. In addition to this, there is currently no room to relax and/or lower the texture depth requirement for Clause 943 HRA materials. Therefore, it was agreed not to proceed with trialling these HRA materials on the road network and that this project would focus on further development and assessment of PASS.

4. Conclusions and Recommendations

4.1 Conclusions

Based on the in-situ and laboratory assessments, the following conclusions are drawn:

1. This project has successfully installed PASS on the A458 Welshpool Road Shrewsbury/Ford Village (Westbound) using the same installation techniques and equipment for typical Clause 942 thin surface course materials. The project made use of aggregates and binder from different sources in comparison to materials used for the Alrewas Quarry Access Trial and the A46 PASS Trial.
2. The PASS material has met the target performance being set for the surface characteristics. The on-site surface macrotexture (1.2 to 1.4mm) was consistently higher than the target value of 1.0 mm set for the project.
3. The average air void contents of the PASS mixture was slightly higher than the target limit, i.e. 6.3% compared to 6.0%. More work is required to be confident that an in-situ air voids content of less than 6% is consistently achieved.
4. The rutting resistance of the PASS mixture showed that it complies with the Class 2 of PD6691 which is specified for the very heavily stressed sites requiring very high rut resistance.
5. The ratio of conditioned indirect tensile strength (ITS) values to dry values of the PASS mixture indicated that this PASS mixture has a good moisture damage resistance.

4.2 Recommendations

- The network trials of both the A458 Welshpool Road Shrewsbury/Ford Village (Westbound) and A46 Hykeham to Carholme (Southbound) Trial should be monitored for their visual condition, mechanical and performance properties including noise assessments, at regular intervals.
- It is recommended that further comparison development and assessment of the PASS asphalt mixtures are continued leading to the development of guidance documents and specifications for the design, testing and use of these next generation asphalt mixtures. More specifically, an alternative approach is needed to manage the requirements for in-situ density particularly to account for the influence of macrotexture and air void contents. This is a very important element considering the PASS is designed to have a low voided dense body with improved surface characteristics.
- To gain a better understanding of the long-term performance of the PASS asphalt mixtures, accelerated loading of the mixtures could be performed. This assessment would be able to estimate the serviceable life of the PASS materials relative to control samples or in comparison to other asphalt mixture types.
- Finally, it is recommended that the project reports are disseminated to a wider audience and to industry to promote research and innovation.

References

Ojum, C., Widyatmoko, I. and Edwards, P. (2017). Task 409: Collaborative Research into the Next Generation of Asphalt Surfacings. [online] AECOM. Available at: https://www.aecom.com/uk/wp-content/uploads/2017/09/report_highways-england_task-409_subtask-1.pdf [Accessed 14 Jan. 2019].

Ojum, C., Tuck, J. and Widyatmoko, I. (2017). Task 1-111 Sub-Task 1: Project Report on Premium Asphalt Surfacing System (PASS) Road Trial. [online] AECOM. Available at: https://www.aecom.com/uk/wp-content/uploads/2018/03/report_highways-england_task-1-111_subtask-1.pdf [Accessed 14 Jan. 2019].

The Manual of Contract Documents for Highway Works, Volume 1 Specification for Highways Works, Series 900, Clause 942.

The Manual of Contract Documents for Highway Works, Volume 1 Specification for Highways Works, Series 900, Clause 943.

BS EN 12697-1: 2012: Bituminous mixtures. Test methods for hot mix asphalt. Soluble binder content.

BS EN 12697-2: 2015: Bituminous mixtures. Test methods. Determination of particle size distribution.

BS EN 12697-5: 2018: Bituminous mixtures. Test methods. Determination of the maximum density.

BS EN 12697-6: 2012: Bituminous mixtures. Test methods for hot mix asphalt. Determination of bulk density of bituminous specimens.

BS EN 12697-8: 2018: Bituminous mixtures. Test methods. Determination of void characteristics of bituminous specimens.

BS EN 12697-12: 2018: Bituminous mixtures. Test methods. Determination of the water sensitivity of bituminous specimens.

BS EN 12697-22: 2003: Bituminous mixtures. Test methods for hot mix asphalt. Wheel tracking.

BS EN 12697-23 Bituminous mixtures. Test methods. Determination of the indirect tensile strength of bituminous specimens.

BS EN 12697-26: 2018: Bituminous mixtures. Test methods. Stiffness

BS EN 13036-1: 2010: Road and airfield surface characteristics. Test methods. Measurement of pavement surface macrotexture depth using a volumetric patch technique.

BS EN 13036-4: 2011 Road and airfield surface characteristics. Test methods. Method for measurement of slip/skid resistance of a surface: The pendulum test.

BS 594987: 2015+A1:2017: Asphalt for roads and other paved areas. Specification for transport, laying, compaction and product type testing protocols.

BSI. PD 6691: 2016: Guidance on the use of BS EN 13108, Bituminous mixtures. Material specifications.

Appendix A - Technical Note 1: Mix Designs for PASS and Low Noise HRA

Project:	**Task 1-444: Collaborative Research into the Next Generation of Asphalt Surfacings**	Job No/Ref: **60559099**	
Subject:	**Mix Design for PASS and Low Noise HRA**		
Prepared by:	**Chibuzor Ojum**	Date:	**17th January 2018**
Checked by:	**Iswandaru Widyatmoko**	Date:	**17th January 2018**
Approved by:	**Iswandaru Widyatmoko**	Date:	**17th January 2018**

1 Introduction

This technical note presents the mix design details and associated information for the bespoke Premium Asphalt Surfacing System (PASS) and the polymer modified Hot Rolled Asphalt (HRA).

Premium Asphalt Surfacing Systems (PASS)

The mix design and aggregate gradation for the PASS are detailed below in Table 1. This represents target limits following the successful trial on the A46 Hykeham to Carholme in August 2017. The aggregate gradations and target binder content are representative of PASS 1 (representing the same target grading as the pre-trial conducted by Tarmac at Withybrook) and PASS 2 (redesigned PASS to be more open for increased macrotexture values).

Table 1: Mix Design Properties for PASS

PASS Road Trial 2017 Design		
Sieve Size (mm)	**% Passing**	
	PASS 1	**PASS 2**
14	100	100
10	94	91.7
6.3	46	43
4	39	36
2	29	27
0.25	12	11
0.063	6.5	6.5
Binder Content (%)	5.4	

The aggregate materials (crushed rock basalt) were sourced from Mancetter Quarry (PSV 65). The binder type for the PASS mixtures was PMB 45/80-60 supplied by Total with mixing and compaction temperatures of 175°C and 155°C respectively. The target binder content was 5.4%. The target mix design air void content was between 2% and 6% with maximum density values of 2500 kg/m^3. The target in-situ macrotexture was 1.0 – 1.4 mm.

The HRA used in the project conformed to SHW Clause 943 (Performance Related Design Mixture) designated as HRA 35/14 F surf 40/100-65 Wheel Track Class 2. The design gradation is detailed in Table 2.

Table 2: Aggregate Gradation for the Polymer Modified HRA

Sieve Size (mm)	Envelope (% Passing)	Target (% Passing)
20	100	100
14	95-100	99.2
10	62-81	72.3
2	56-66	62.9
0.500	44-63	56.4
0.250	16-46	27
0.063	6-10	7.4

The coarse aggregate fractions (crushed rock basalt) were sourced from Mancetter Quarry (PSV 65) while the sand fraction (0/2 mm) was obtained from Bestwood Quarry. Table 3 presents mix properties of the polymer modified HRA. The binder used was a PMB 40/100-65 (Nypol 75) sourced from Nynas with a target binder content of 7.7% as detailed in Table 3. The manufacturer's recommended mixing temperature ranges from 165°C to 190°C and the compaction temperature ranges from 120°C to 160°C.

Table 3: Mix Properties of the Polymer Modified HRA

Mix Properties	Target	Specification
Binder Type (PMB) supplied by Nynas	40/100-65 (Nypol 75)	
Binder Content (%)	7.7	7.1-8.3%
Bulk density (kg/m³) – BS EN 12697-6 Procedure B	2214	
Maximum density (kg/m³) – BS EN 12697-5	2339	
Air Voids (%) – BS EN 12697-8	4	2-6
Mean Texture Depth (mm) – BS EN 13036-1	1.4	

6/10 mm pre-coated chippings (PCC) with Flakiness Index (FI) of FI_{13} were used for the initial trial and development of the polymer modified HRA. The chippings were pre-coated using 40/60 paving grade bitumen in accordance with SHW Clause 915. The desirable binder properties considered for pre-coating the chippings are detailed below:

- The binder must reduce the risk of clogging during chipping application.
- The binder should promote adhesion of chipping after being embedded to the HRA.
- The binder must not compromise the micro-texture properties of the chipping.

The PCC was produced at 1.5% and 1.8% binder contents. In preparing the PCC, complete coating of the chippings was achieved. In addition to this, binder run-off was prevented. The achieved spread rate using the 6/10 mm chippings on the Alrewas trial was: 3 kg/m^2, 5.5 kg/m^2 and 6 kg/m^2.

It should be noted that this current work will make use of 10/14 mm PCC "ideally" at increased spread rates up to 10 - 16 kg/m^2 preventing double chipping during application.

Tests to Evaluate Performance During Mix Design Process

As part of the mix design process at AECOM, the following tests were carried out following the production of trial mixtures for the PASS and polymer modified HRA to ascertain performance as detailed in Table 4.

Table 4: Proposed Tests

▪ Workability Assessment of the Asphalt Mixtures (In-House AECOM Protocol)
▪ Compositional Analysis in accordance with BS EN 12697-1 and 2.
▪ Maximum density in accordance with BS EN 12697-5.
▪ Bulk densities in accordance with BS EN 12697-6
▪ Water Sensitivity Tests in accordance with BS EN 12697-12.
▪ WTT in accordance with BS EN 12697-22 using the small device to 10,000 cycles
▪ Surface Macrotexture in accordance with BS EN 13036-1
▪ Skid Resistance using the Pendulum Test in accordance with BS EN 13036-4

Appendix B - Technical Note 2: Alrewas Quarry Access Road Trial Visual Condition Survey of PASS and Low Noise Hot Rolled Asphalt

Technical Note

Project:	**Task 1-444: Collaborative Research into the Next Generation of Asphalt Surfacings**	Job No/Ref: **60559099**	
Subject:	**Alrewas Quarry Access Road Trial Visual Condition Survey of PASS and Low Noise Hot Rolled Asphalt**		
Prepared by:	**Chibuzor Ojum**	Date:	**28th February 2018**
Checked by:	**Paul Edwards**	Date:	**7th March 2018**
Approved by:	**Iswandaru Widyatmoko**	Date:	**9th March 2018**

1 Introduction

The objective of the Alrewas Quarry Access Road Trial installed on 27th June 2016 was to validate the optimised laboratory mix designs and demonstrate constructability of the Premium Asphalt Surfacing Systems (PASS) and the low noise polymer modified Hot Rolled Asphalt (HRA).

This technical note presents the findings following a site inspection, visual condition survey and surface macrotexture depth measurements after this installation at the Alrewas Quarry Access Road to ascertain if there any pavement defects including cracking, fretting, loss of chippings and rutting on the installed asphalt surfacings. This site inspection and visual condition survey were carried out on 6th February 2018.

The installation layout and core location plan for the PASS and the low noise polymer modified HRA are shown below in Figure 1.

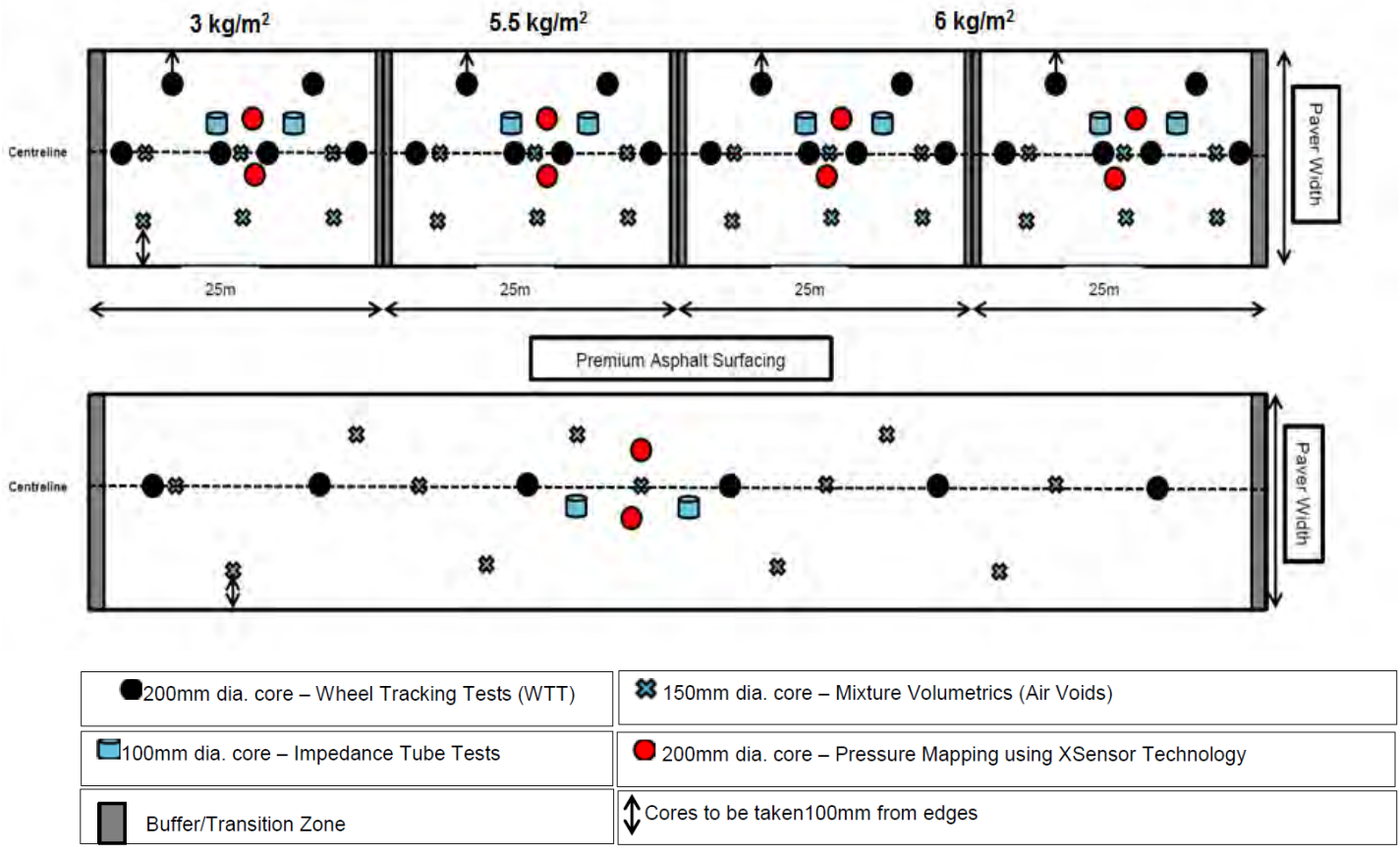


Figure 1: Test Layout for Alrewas Quarry Access Road

2 Update on Site Conditions

Appendix A presents the visual condition survey following the site visit 6th February 2018. The visual observations indicated that there was no chipping loss, cracking or fretting of the HRA and PASS materials. There was no evidence of rutting or permanent deformation of the installed materials.

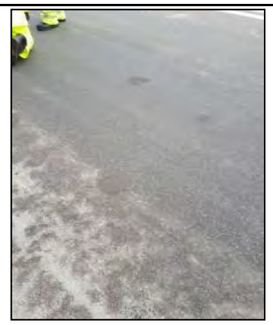
The surface macrotexture depth measurement in accordance with BS EN 13036-1 is presented in Table 1 below.

Table 1: Surface Macrotexture Depth

Surface Macrotexture Depth (mm) – BS EN 13036-1		
Material	**June 2016**	**February 2018**
HRA 1 - 3 kg/m²	0.6	0.7
HRA 2 – 5.5 kg/m²	0.8	0.9
HRA 3 - 6 kg/m²	0.8	0.8
PASS	0.8	0.8

Appendix A

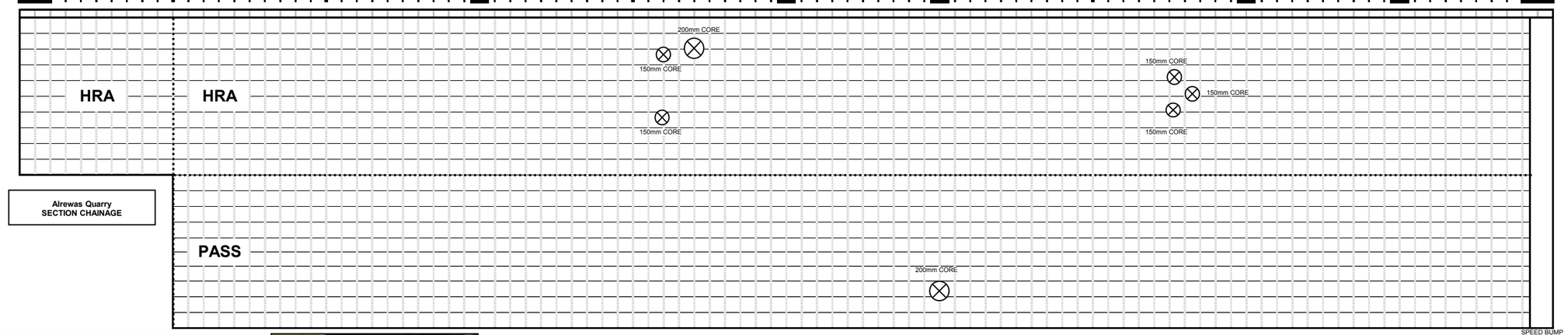
View of section start showing HRA material

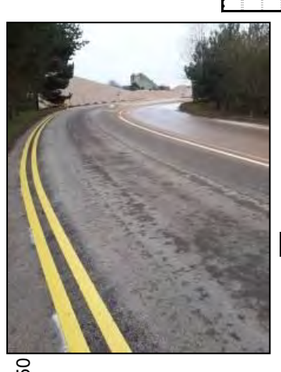


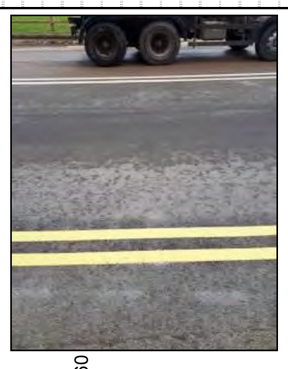
Speed Bump at Ch. 0m

Speed Bump at Ch. 50m

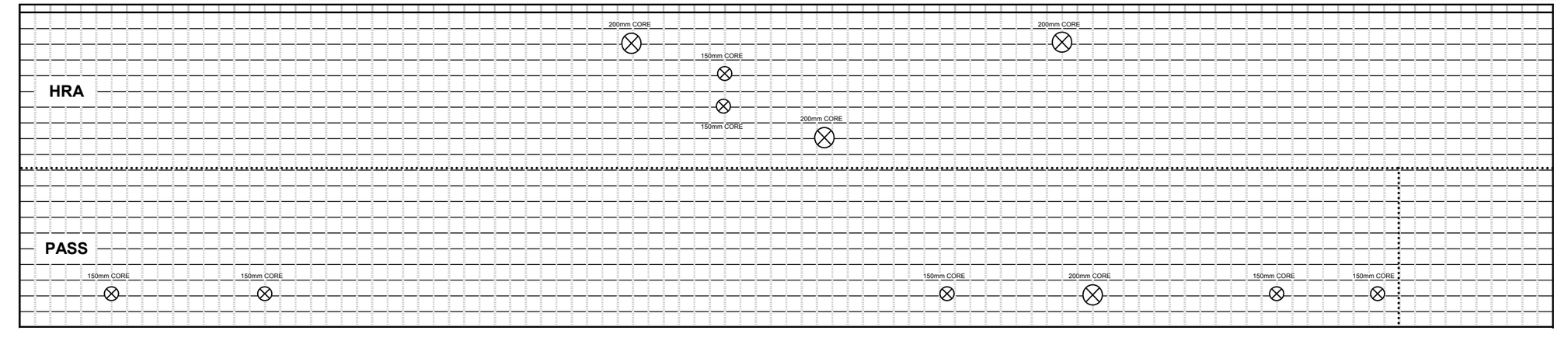
START LAYBY







Veiw of section end showing HRA material (near) and PAS (far)



Annotation	Description
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	Fatting (Major)
	Fatting (Minor)
	Fretting (Major)
	Fretting (Minor)
	Settlement (Major)
	Settlement (Minor)
	Crazing (Major)
	Crazing (Minor)
⊗	Existing Coring Location
C1 ⊗	Proposed Coring Location (Number)
	Open Joint (F=fine, M=Medium, W=Wide)
	Construction Joint
	Pothole
	Gulley
	Manhole
	Edge Cracking
	Longitudinal Crack (W-wide, M-medium, F-fine)
	Transverse Crack (W-wide, M-medium, F-fine)
	Rut (Minor)
	Rut (Major)
	Induction Loops
4	Photograph Locations
	Speed Bump

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Project: **60559099**

Title: **Task 1-444 Alrewas Quarry**

Surveyed By:	Drawn By:
JD	OM
Revision:	Chcked By:
1	JD

Drawing No.: VCS_1

AECOM

1

3

5

6

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12

Annotation	Description
	Patch (✓ Ok, X Failed)
	Fatting (Major)
	Fatting (Minor)
	Fretting (Major)
	Fretting (Minor)
	Settlement (Major)
	Settlement (Minor)
	Crazing (Major)
	Crazing (Minor)
⊗	Existing Coring Location
C1 ⊗	Proposed Coring Location (Number)
	Open Joint (F=fine, M=Medium, W=Wide)
	Construction Joint
	Pothole
G	Gulley
	Manhole
	Edge Cracking
	Longitudinal Crack (W-wide, M-medium, F-fine)
	Transverse Crack (W-wide, M-medium, F-fine)
	Rut (Minor)
	Rut (Major)
	Induction Loops
4	Photograph Locations
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Appendix C - Technical Note 3: A46 Road Trial Visual Condition Survey of the Premium Asphalt Surfacing System (PASS)

Technical Note

Project:	**Task 1-444: Collaborative Research into the Next Generation of Asphalt Surfacings**	Job No/Ref: **60559099**	
Subject:	**A46 Road Trial Visual Condition Survey of the Premium Asphalt Surfacing System (PASS)**		
Prepared by:	**Chibuzor Ojum**	Date:	**28th February 2018**
Checked by:	**Paul Edwards**	Date:	**7th March 2018**
Approved by:	**Iswandaru Widyatmoko**	Date:	**9th March 2018**

1 Introduction

AECOM as part of the collaborative research project led the project delivery team that completed the successful network trial and installation of the PASS on the A46 Hykeham to Carholme (Southbound) which is part of the Area 7 scheme. The trial was conducted on 9th/10th August 2017 (night time installation).

This technical note details the findings following a site inspection and visual condition survey using video imaging techniques on the A46 Hykeham to Carholme (Southbound) – Chainage 1675 to 1817.

2 Background

The background and key findings following the installation of the PASS on the A46 Hykeham to Carholme (Southbound) are summarised below:

- The PASS material was successfully installed with observations and feedback from the site team noting that the PASS material was relatively easy to lay and compact.
- The PASS mixtures had mean macrotexture values ranging between 1.2 mm and 1.3 mm with visual inspection showing a 'dense' asphalt material.
- Skid resistance values exceeding 70 were obtained using the skid pendulum test value (PTV) determined in accordance with EN 13036-4.
- The resistance to permanent deformation test of the PASS mixtures showed rut depths of less than 5 mm after 10,000 cycles at 60°C determined in accordance with BS EN 12697-22 (small scale wheel tracker).
- The visual inspection of the PASS mixtures following the wheel track testing showed that there was little or no rutting on the surface of the mixtures.
- The moisture susceptibility of the PASS mixtures was considered good with Indirect Tensile Strength Ratios (ITSR) of 72% in accordance with BS EN 12697-12.
- The Statistical Pass-By (SPB) method was used in assessing the noise properties of the PASS mixtures following the road trial to obtain the Road Surface Influence (RSI). The obtained value for the PASS from this survey was obtained as -5.7 dB(A) which is a quieter surface than a standard Hot Rolled Asphalt (HRA).

- This project has successfully arranged the installation of PASS trial sections on the strategic road network.
- This demonstrates that the PASS can be installed using current practices to achieve the project requirements. Most importantly, the PASS mixtures have shown acceptable noise characteristics following the SPB tests conducted.

3 Visual Condition Surveys

The site location plan is shown below in Figure 1. The system used comprised of a vehicle-mounted downward facing high definition (HD) camera incorporated with a laser mounted system that produces a beam approximately 200 mm wide with capabilities to “estimate” surface texture properties. The system has an encoder, GPS and computer software program that works together to measure distance, location and provides “estimated” values of the mean texture depth. The visual condition survey was carried out on 14th February 2018.

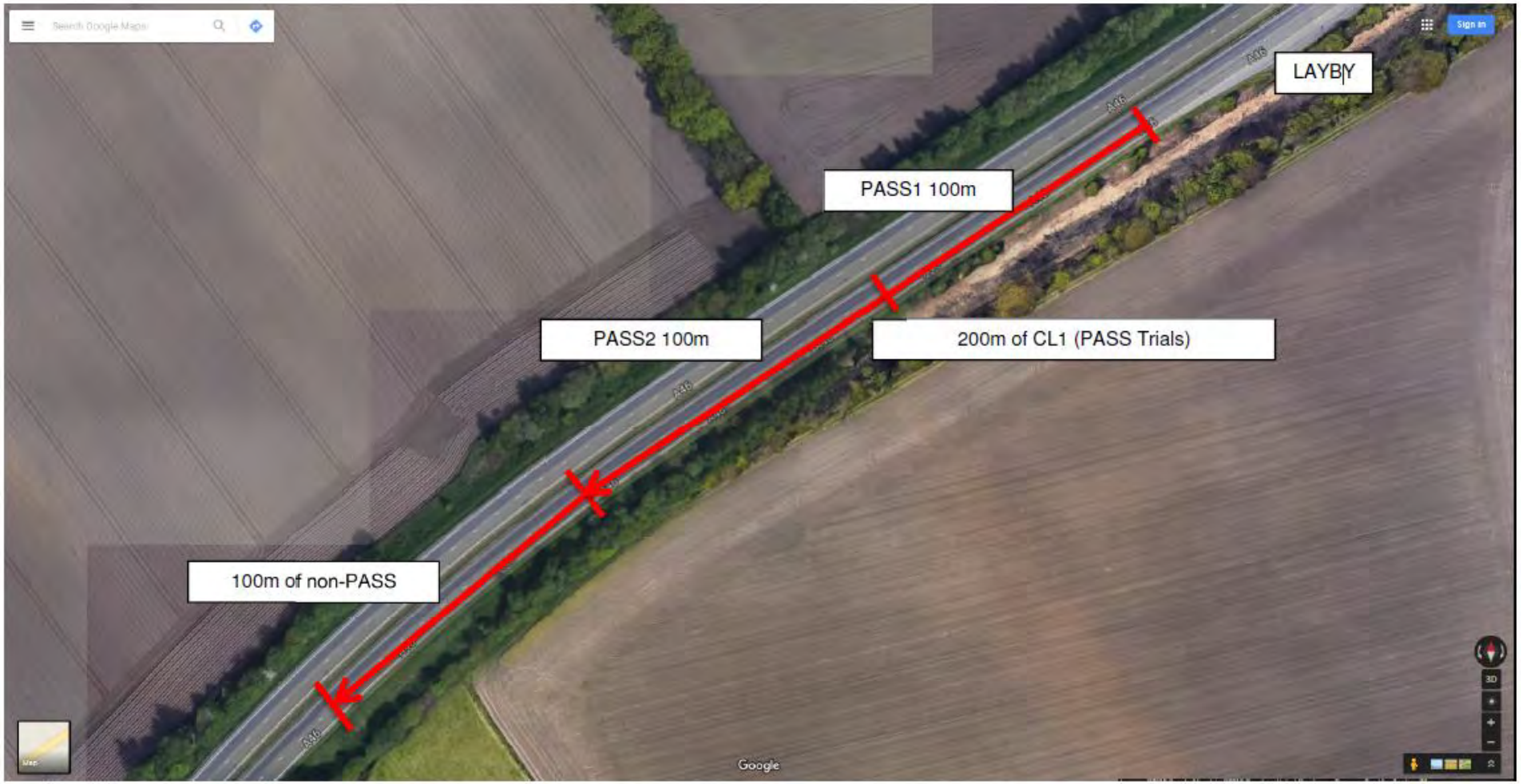


Figure 1: A46 Hykeham to Carholme (Southbound) Site Location

Appendix A presents the visual condition survey following the site visit. The visual observations indicated that there were no observed defects on the sections installed with PASS. There was no evidence of rutting or permanent deformation of the installed materials.

The measured mean surface macrotexture depth measurements following installation of PASS 1 and PASS 2 sections in August 2017 were obtained as 1.2 mm and 1.3 mm respectively (Table 1). The “estimated” surface macrotexture depth measurement using the laser mounted device provides an indication and estimate of the pavement surface macrotexture. The values were obtained as 1.3 mm and 1.4 mm for PASS 1 and 2 sections (Table 1).

Please note that the estimated surface macrotexture depth measurements using laser technique was done for research purposes and does not act as a replacement for measuring surface macrotexture depth using the volumetric patch technique determined in accordance with BS EN 13036-1.

Table 1: Pavement Surface Macrotexture Depth Measurements

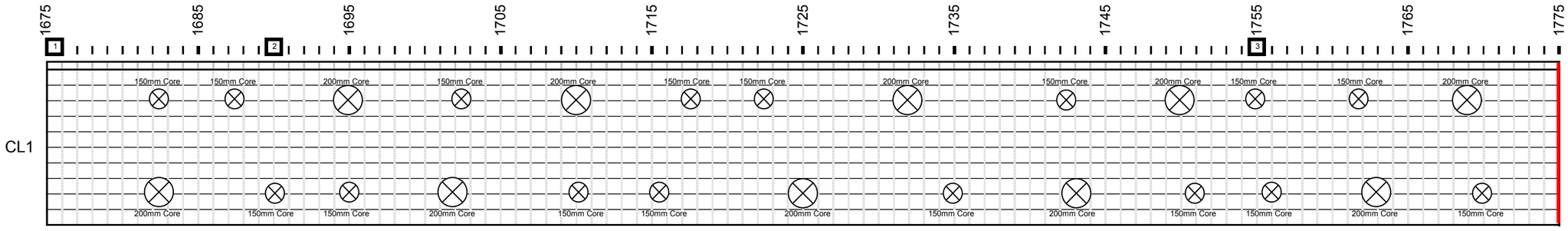
Material	August 2017 (BS EN 13036-1)	February 2018 (Laser Technique)
PASS 1	1.2	1.3
PASS 2	1.3	1.4

Appendix A

Photo 1 - Start of PASS 1 Material in CL1 Ch. 1675m.

Photo 2 - PASS 1 Material Ch. 1690m.

A46 Hykeham - Carholme
SECTION CHAINAGE



PASS 1

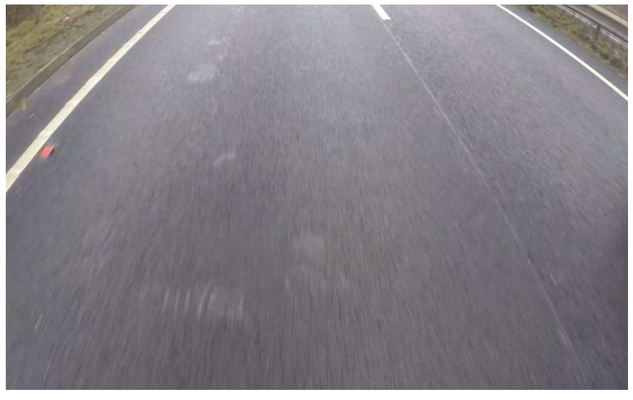


Photo 3 - PASS 1 Material Ch. 1755m.

Annotation	Description
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	Fatting (Minor)
	Fretting (Major)
	Fretting (Minor)
	Settlement (Major)
	Settlement (Minor)
	Crazing (Major)
	Crazing (Minor)
⊗	Existing Coring Location
C1 ⊗	Proposed Coring Location (Number)
	Open Joint (F=fine, M=Medium, W=Wide)
	Construction Joint
	Pothole
	Gulley
	Manhole
	Edge Cracking
	Longitudinal Crack (W-wide, M-medium, F-fine)
	Transverse Crack (W-wide, M-medium, F-fine)
	Rut (Minor)
	Rut (Major)
	Induction Loops
4	Photograph Locations

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Project: **60559099**

Title: **Task 1-444 A46 Hykeham - Carholme**

Visual Condition Survey

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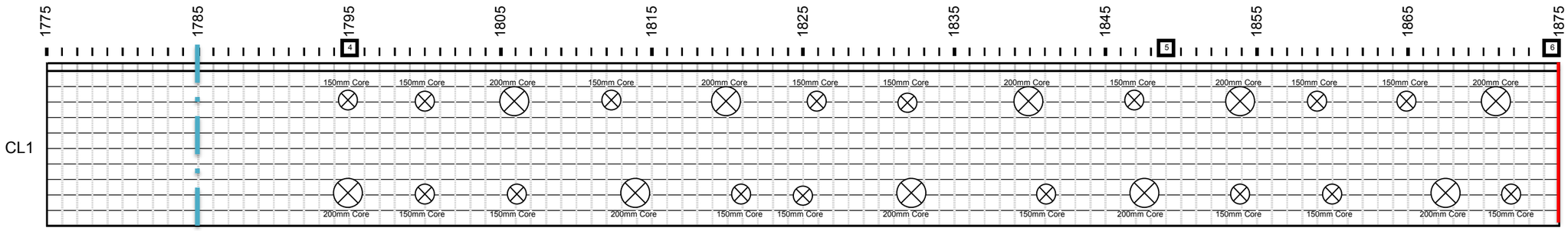
JD	CO

Drawing No.: VCS Pager 1 of 6

Photo 4 - PASS 2 Material CH.1795

Photo 5 - PASS 2 Material Ch. 1849m.

A46 Hykeham - Carholme
SECTION CHAINAGE



Anglian Water

PASS 2

Photo 6 - End of PASS 2 Material Ch. 1875m.

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	Fretting (Major)
	Fretting (Minor)
	Settlement (Major)
	Settlement (Minor)
	Crazing (Major)
	Crazing (Minor)
⊗	Existing Coring Location
C1 ⊗	Proposed Coring Location (Number)
	Open Joint (F=fine, M=Medium, W=Wide)
	Construction Joint
	Pothole
G	Gulley
	Manhole
	Edge Cracking
	Longitudinal Crack (W-wide, M-medium, F-fine)
	Transverse Crack (W-wide, M-medium, F-fine)
	Rut (Minor)
	Rut (Major)
	Induction Loops
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JD	**CO**

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VCS Pager 2 of 6

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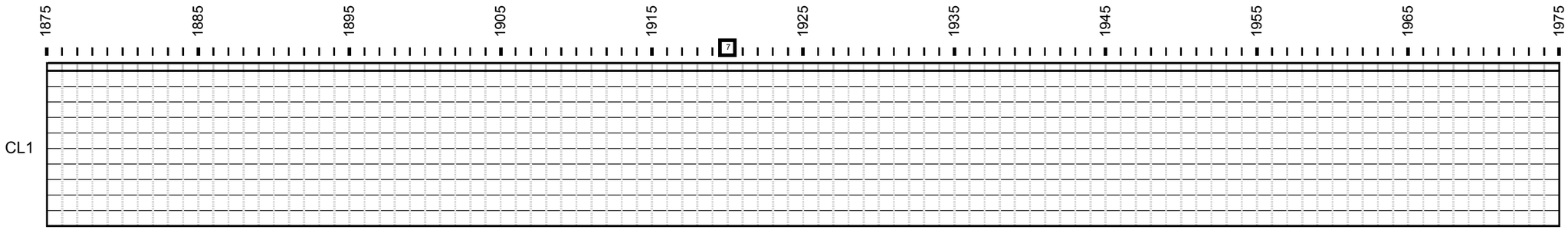
Photo 7 - Control

A46 Hykeham - Carholme
SECTION CHAINAGE



Control

Annotation	Description
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	Crazing (Major)
	Crazing (Minor)
⊗	Existing Coring Location
C1 ⊗	Proposed Coring Location (Number)
	Open Joint (F=fine, M=Medium, W=Wide)
	Construction Joint
	Pothole
	Gulley
	Manhole
	Edge Cracking
	Longitudinal Crack (W-wide, M-medium, F-fine)
	Transverse Crack (W-wide, M-medium, F-fine)
	Rut (Minor)
	Rut (Major)
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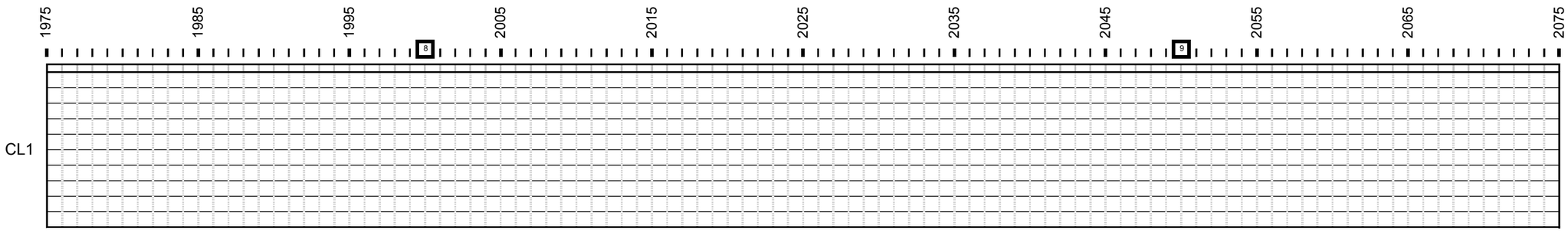
JD	**CO**

Drawing No.:
VCS Pager 3 of 6

Photo 8 - Control

Photo 9 - Control

A46 Hykeham - Carholme
SECTION CHAINAGE



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	Settlement (Minor)
	Crazing (Major)
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C1 ⊗	Proposed Coring Location (Number)
	Open Joint (F=fine, M=Medium, W=Wide)
	Construction Joint
	Pothole
G	Gulley
	Manhole
	Edge Cracking
	Longitudinal Crack (W-wide, M-medium, F-fine)
	Transverse Crack (W-wide, M-medium, F-fine)
	Rut (Minor)
	Rut (Major)
	Induction Loops
4	Photograph Locations

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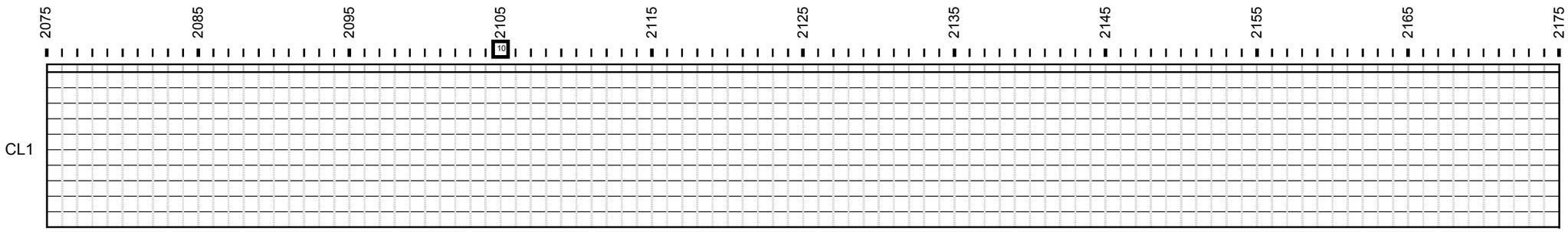
Drawing No.:
VCS Pager 4 of 6

Photo 10 - Control

A46 Hykeham - Carholme
SECTION CHAINAGE



Control

Annotation	Description
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	Fatting (Minor)
	Fretting (Major)
	Fretting (Minor)
	Settlement (Major)
	Settlement (Minor)
	Crazing (Major)
	Crazing (Minor)
⊗	Existing Coring Location
C1 ⊗	Proposed Coring Location (Number)
	Open Joint (F=fine, M=Medium, W=Wide)
	Construction Joint
	Pothole
G	Gulley
	Manhole
	Edge Cracking
	Longitudinal Crack (W-wide, M-medium, F-fine)
	Transverse Crack (W-wide, M-medium, F-fine)
	Rut (Minor)
	Rut (Major)
	Induction Loops
4	Photograph Locations

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Title
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Visual Condition Survey

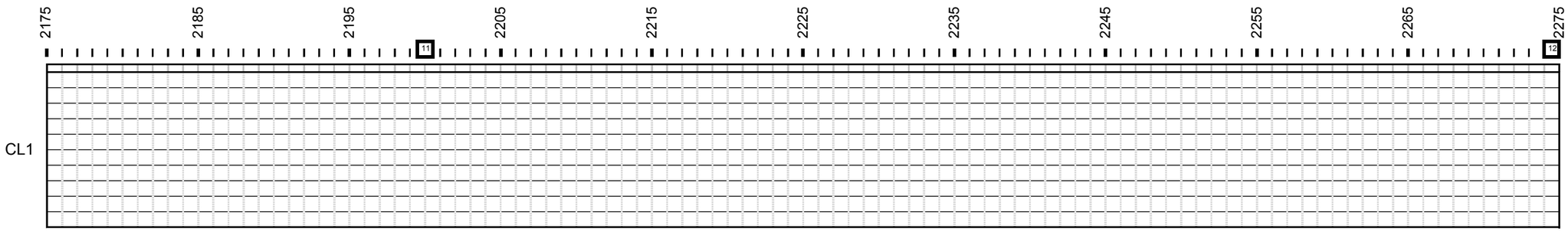
Surveyed By:	Date:
JD/CO	**07/03/0218**
Drawn By:	Chcked By:
JD	**CO**

Drawing No.:
VCS Pager 5 of 6

Photo 11 - Control

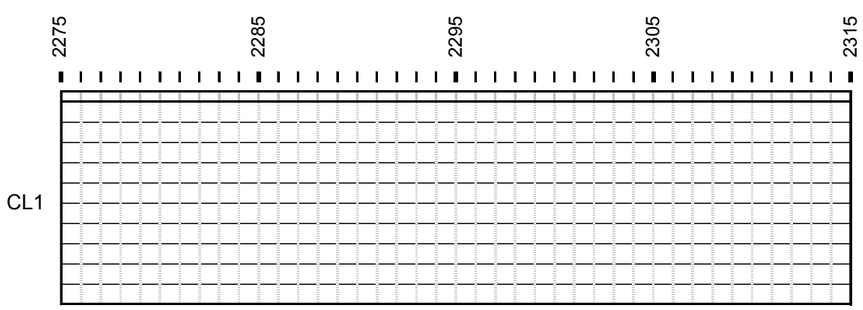
Photo 12 - Control

A46 Hykeham - Carholme
SECTION CHAINAGE



Control

A46 Hykeham - Carholme
SECTION CHAINAGE



Control

Annotation	Description
	Patch (✓ Ok, X Failed)
	Fatting (Major)
	Fatting (Minor)
	Fretting (Major)
	Fretting (Minor)
	Settlement (Major)
	Settlement (Minor)
	Crazing (Major)
	Crazing (Minor)
⊗	Existing Coring Location
C1 ⊗	Proposed Coring Location (Number)
	Open Joint (F=fine, M=Medium, W=Wide)
	Construction Joint
	Pothole
G	Gulley
	Manhole
	Edge Cracking
	Longitudinal Crack (W-wide, M-medium, F-fine)
	Transverse Crack (W-wide, M-medium, F-fine)
	Rut (Minor)
	Rut (Major)
	Induction Loops
4	Photograph Locations

AECOM
12 Regan Way
Chetwynd Business Park
Nottingham, UK
T +44-115-907-7000
aecom.com

Do Not Scale this Sketch

Project
60559099

Title
Task 1-444 A46 Hykeham - Carholme

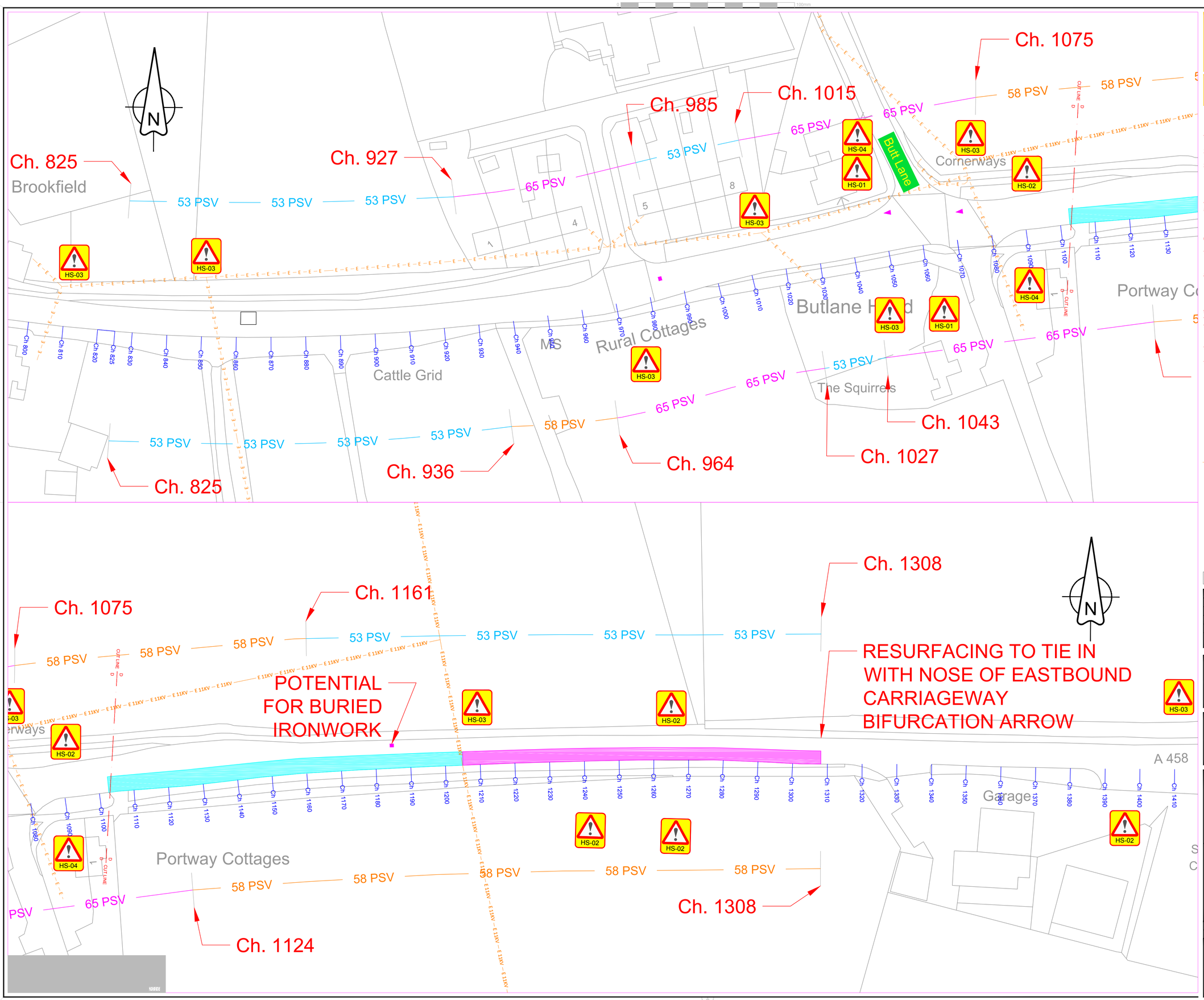
Visual Condition Survey

Surveyed By:	Date:
JD/CO	07/03/0218
Drawn By:	Chcked By:
JD	CO

Drawing No.:
VCS Pager 6 of 6

AECOM

Appendix D – A458 Road Trial Location



RESIDUAL DESIGN HAZARDS

THE FOLLOWING HAS BEEN COLLECTED FROM THE PRE-CONSTRUCTION INFORMATION AND HIGHLIGHTS KNOWN RESIDUAL HAZARDS.

KEY — HS-# = HEALTH AND SAFETY RISK REFERENCE NUMBER; E-# = ENVIRONMENT RISK REFERENCE NUMBER

HS-01 - TRAFFIC - SITE AND ACCESS TRAFFIC
HS-02 - UNDERGROUND SERVICES
HS-03- OVERHEAD SERVICES
HS-04 - TRAFFIC MANAGEMENT

NOTES

1. Site chainage 0m is to be taken from the beginning of eastbound red hatching approaching 40mph speed gate way on eastbound lane.
2. All works to be carried out in accordance with the MCHW Specification of Highways Works.
3. In areas where cast iron road stud casings are present, these are to be removed from the carriageway prior to planing and reinstated following resurfacing as per drawing no. HE600560-KIER-HMK-A458-FORD_VILLAGE_PAVEMENT_PHASE_1-DE-Z-1200_01.
4. Plane out shall be cold milling in accordance with Clause 709.
5. PSV's shown are the minimum values as required by Interim Advice Note 156/16 Rev. 1. The contractor may increase the PSV of the materials to be laid where their use will be cost beneficial to the project.
6. Resurfacing across Butt Lane on the eastbound carriageway is to tie in with the back of the Diagram 1009 give way markings.
7. The 50mm depth resurfacing opposite Butt Lane is to tie in with the edge of the gully nearest to the A458 on the southbound lane of the adjoining road.
8. In areas where it is proposed to inlay a base and/or binder course, the contractor may use a warm-mix asphalt if it is considered necessary to prevent the occurrence of rutting once opened to traffic. A Departure from Standard has been applied for, for use of warm-mix asphalts.
9. 1 no. redundant loop to be removed at approx 862m chainage.
10. All dimensions are in metres unless stated.
11. Indicative location of utilities are shown for information only. For construction purposes and other STAT's refer to Statutory Undertakers plans in Appendix F in the Design Information Pack.
12. Special attention should be paid to the presence of low height overhead cables.
13. Contractors should be aware of the potential presence of BT cables and power cables for illuminated signs when conducting works in the verge.

KEY

- E — E — Electricity cable
- E 11KV — 11kV Electricity cable
- Ironworks in carriageway
- Redundant loop detectors
- 35mm Trial Area
- 50mm Trial Area

REV	DETAILS	CHKD	APPD	DATE

DRAWN : C. Smith	DRAWING STATUS
DESIGN : C. Smith	WORK IN PROGRESS
CHKD : R. Smith	PRELIMINARY DRAWING
APPD : N. Taylor	EXTERNAL ISSUE ✓
DATE : October 2018	AS-BUILT
SUITABILITY : S2	FOR INFORMATION

CLIENT: highways england

AGENT: KIER

SCHEME NAME: A458 Ford Village Surface Trial

DRAWING TITLE: Surfacing Areas

ORIG DRAWING SIZE : A1	DIMENSIONS : AS STATED
COPYRIGHT © KIER	SCALE : 1:500

DRAWING NUMBER — PROJECT | ORIGINATOR | VOLUME — KIER — LOCATION | TYPE | ROLE | NUMBER

SCHEME REFERENCE No.

REVISION C 2

Appendix E – A458 Site Report

Certificate No: K18\7349\301018\a

To: Ashley King

Client: Tarmac West Midlands
Fir Street

Sedgeley, DY3 4AD

Client Ref: J067184015

MAT test Southern Limited
materials testing & consultancy

Suite D, Gloverside
Burymead Road
Hitchin
Herts, SG5 1RT

t: 01462 423 040
e:info@mattestsouth.co.uk
w:www.mattestsouth.co.uk

Dear sirs,

Summary of Paved Surfaces Site Testing
A458 Welshpool Road Shrewsbury

Date Tested : 30.10.18
Tested By : B.Cottrell

Testing / Inspection

	L Base	U Base	Binder	Reg.	Surface	Remarks
Laying records*					Yes	
Material temps					Yes	
Environmental*					Yes	
Insitu Densities						
RSE					No	To be completed next shift
Texture Depth					Yes	
RoS Bond Coat						
3m S. Edge*						
RoS Chips						
RHC*						
Pendulum*						
Cores						
Samples						

Comments

* Not on current UKAS accreditation schedule

Approved For Issue

Date: 31.10.18

M Dicker (Senior Operations Manager)

UKAS TESTING

SITE TEST CERTIFICATE

Certificate No: K18\7349\301018\c

To: Ashley King

Client: Tarmac West Midlands
Fir Street

Sedgeley, DY3 4AD

Client Ref: J067184015

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Suite D, Gloverside
Burymead Road
Hitchin
Herts, SG5 1RT

t: 01462 423 040
e:info@mattestsouth.co.uk
w:www.mattestsouth.co.uk

Dear sirs,

Environmental / Weather Conditions
BS594987 2015 / SHW 945

Date Tested: 30.10.18

Project: A458 Welshpool Road Shrewsbury Tested By: B.Cottrell

Time hh:mm	Air Temp. °C	Ground Conditions	Wind Speed km/hr	Sky Condition
23:00	2	Damp		Overcast
01:00	-1	Damp		Overcast
02:00	1	Damp		Overcast

Comments:

Temperature Ref: e7052023634

Anemometer Ref:

Windspeed / Air temperature taken a 2m height

Approved For Issue

Date: 31.10.18

M Dicker (Senior Operations Manager)

SITE TEST CERTIFICATE

Certificate No: K18\7349\301018\b
To: Ashley King

Client: Tarmac West Midlands
Fir Street

Sedgeley, DY3 4AD

Client Ref: J067184015

MAT test Southern Limited
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Suite D, Gloverside
Burymead Road
Hitchin
Herts, SG5 1RT

t: 01462 423 040
e:info@mattestsouth.co.uk
w:www.mattestsouth.co.uk

Daily Report on Laying Operations

Dear sirs,

Project: A458 Welshpool Road Shrewsbury
Material: SMA 10 SURF PMB PSV 68 PASS
Supplier/Plant (1): Cemex Birmingham
Supplier/Plant (2):
Supplier/Plant (3):

Paver: Volvo
Roller 1: Hw90
Roller 2:
Delivery Temperature Limits: 130 to 200 °C
Min Rolling Temperature: 100 °C

Date Tested: 30.10.18
Tested By: B.Cottrell

Docket Number	Source 1/2/3	Load tonnage	Accum. tonnage	Arrival Time	Unload Time	End Time	Initial Temp	Rolling Temp.	Location Details						Remarks	Sample Number
									Start Ch	End Ch	Road Name	Direction	Lane	Layer		
4250	1	20.10	20.10	22:45	00:00	00:07	173	156	1310	1270	A458	WB	1	Surface		
4335	"	20.02	40.12	22:50	00:08	00:13	176	156	1270	1221	"	"	"	"		
4425	"	19.50	59.62	23:00	00:13	00:21	178	159	1221	1165	"	"	"	"		
4374	"	19.78	79.40	00:00	00:22	00:26	170	154	1165	1124	"	"	"	"		

Temperature Equipment Ref: e7052023634

Rolling Temps tested in accordance with BS EN 12697-13: 2017, CL4.1.3

Discharge temperature in accordance with In house procedure B1 & BS EN 123697-13 : 2017 CL4.2.3.4

Temp Limits in accordance with supplier information and BS 594987:2015 + A1 : 2017; BSEN 13108-1:2006/-4:2006/-5:2006

Delivery limits only applicable if measured within 30 minutes of arrival

cell highlighted = Result not compliant with above standards

Approved For Issue Date: 31.10.18

M Dicker (Senior Operations Manager)

UKAS TESTING 1740

SITE TEST CERTIFICATE

Certificate No: K18\7349\301018\g
To: Ashley King

Client: Tarmac West Midlands
Fir Street

Sedgeley, DY3 4AD

Client Ref: J067184015

MATtest Southern Limited
materials testing & consultancy

Suite D, Gloverside
Burymead Road
Hitchin
Herts, SG5 1RT

t: 01462 423 040
e:info@mattestsouth.co.uk
w:www.mattestsouth.co.uk

Dear sirs,

Initial Surface Texture Depth Measurement
BS EN 13036-1 2010

Project: A458 Welshpool Road Shrewsbury — Date Tested: 30.10.18
Material: SMA 10 SURF PMB PSV 68 PASS — Tested By: B.Cottrell
Supplier: Cemex Birmingham — Date Laid: 30.10.18
Road Speed: <40 mph — Surface Condition: Untrafficked

Direction:	WB	Test no:	1	2	3	4	5	6	7	8	9	10
Lane:	1	R1	149	140	142	150	152	149	150	150	138	130
Start CH:	1300	R2	165	185	170	182	180	179	157	165	162	150
End CH:	1250	R3	150	140	160	161	143	175	148	158	155	130
Average TD(MTD):	**1.4**	R4	144	150	144	152	160	148	151	148	140	142
Road/Remarks:	A458											
Direction:		Test no:	1	2	3	4	5	6	7	8	9	10
Lane:		R1										
Start CH:		R2										
End CH:		R3										
Average TD(MTD):		R4										
Road/Remarks:												
Direction:		Test no:	1	2	3	4	5	6	7	8	9	10
Lane:		R1										
Start CH:		R2										
End CH:		R3										
Average TD(MTD):		R4										
Road/Remarks:												
Direction:		Test no:	1	2	3	4	5	6	7	8	9	10
Lane:		R1										
Start CH:		R2										
End CH:		R3										
Average TD(MTD):		R4										
Road/Remarks:												

Comments:

Extract from Specification of Highway Works. Volume 1, Series 900,Table 9/3: Requirements for Initial Texture Depth2

Road Type	Surfacing Type	Av. per 1 000m		Per set	Round-abouts	Surfacing Type	Av. per 1 000m		Per set
		Min	Max	min			Min	Max	min
≥ 50 mph	Clause 942 TSCS (14mm)	1.3	1.8	1.0	≥ 50 mph	Clause 942 TSCS (10mm)	1.1	1.6	0.9
	Clause 942 TSCS (10mm)	1.1	1.6	0.9		Chipped HRA & all others	1.2	1.7	1.0
	Clause 942 TSCS (6mm)	1.0	1.5	0.9	≤ 40 mph	Clause 942 TSCS (10mm)	1.1	1.6	0.9
	Clause 942 TSCS (cold)	1.5	2.0	1.2		Clause 942 TSCS (6mm)	1.0	1.5	0.9
	Chipped HRA & all others	1.5	2.0	1.2		Chipped HRA & all others	1.0	1.5	0.9
≤ 40 mph	Clause 942 TSCS (≤14mm)	1.0	1.5	0.9					
	Chipped HRA & all others	1.2	1.7	1.0					

cell highlighted = Result not compliant with above table

TD Equipment Ref: td51

Approved For Issue

Date: 31.10.18

M Dicker (Senior Operations Manager)

UKAS TESTING 1740

Appendix F – A458 Core Logs

CORE LOGGING OF PAVEMENT MATERIAL

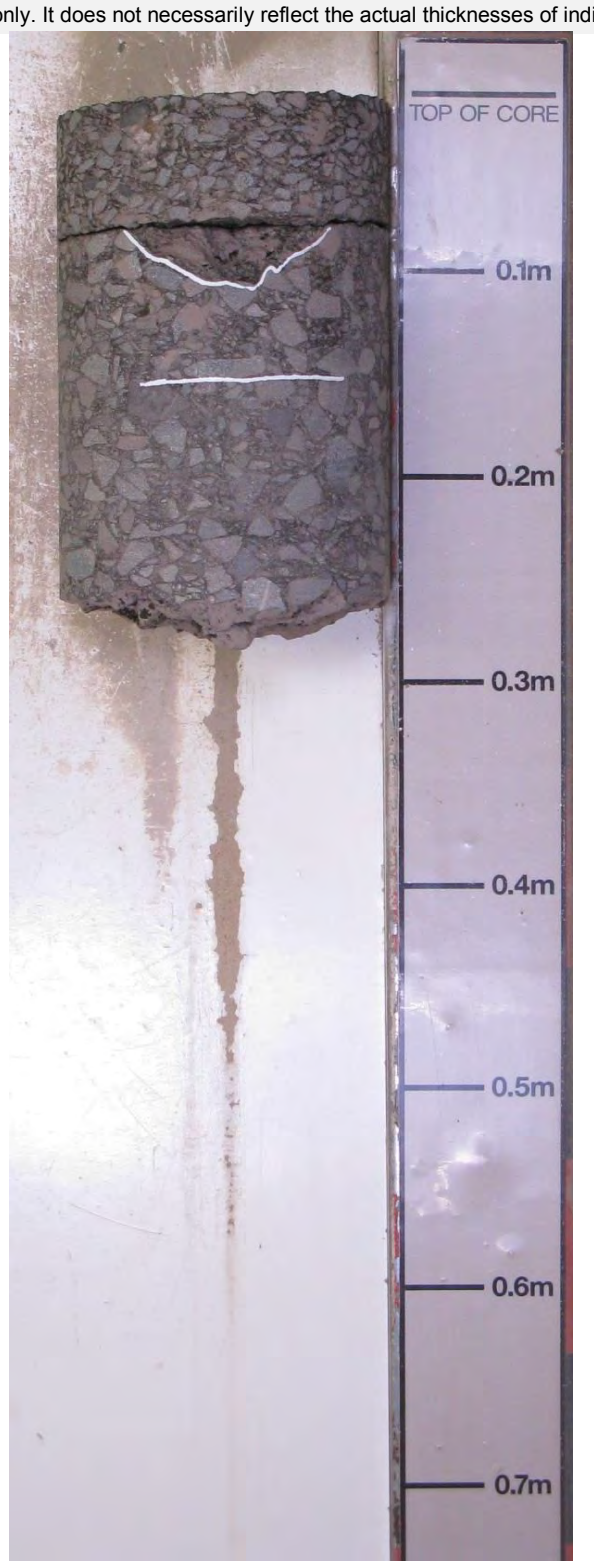
In Accordance with AECOM in House Procedures 0061 - SOP

UKAS TESTING 4410

Job Number :	**60559099-1.2-1.2**	Scheme :	**PASS Trials - A458 Ford Village**
Sample Number :	**T 1384**	Location :	**Westbound, Lane 1 (CR1), Lane Centre, Offset from nearside kerb 1.1m**
Core Number :	**01**		**Survey Ch. 1290m**
Cored / Logged By :	**SP / RBB - SD**		**HAPMS Ch. 3200A458/160+1140m**
Date Cored / Logged :	**31-10-18 / 01-11-18**		**OSGR: SJ 41895, 13222**
Nominal Diameter :	**150mm**		**Notes: N/A**

Layer	Depth (mm)		Thickness (mm)	Material Description [1]	Suitable for NAT/CS Testing (Yes/No)	PAK-Marker [2]	Binder [3]	Aggregate	
	From	To						Size [4]	Type
1	0	60	60	Asphalt Surfacing	Yes	-ve	Bitumen	14	Crushed Rock
				Layers 1 & 2 Not Bonded					
2	60	135	75	Asphalt Concrete (broken @ top)	Yes	-ve	Bitumen	20	Crushed Rock
3	135	265	130	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock

Notes : The scale is for guidance only. It does not necessarily reflect the actual thicknesses of individual layer(s).



Material Description [1]

The material description given (such as hot rolled asphalt or asphalt concrete) is generic only and is based upon a visual assessment of the material. Similarly, use of additional descriptive (such as voided) is based on visual assessment only and the relationship between air voids visually to the naked eye and degree of compaction is complex and materials specific.

PAK-Marker (PAH Spray) [2]

The Tar Spray Test is a rapid, qualitative indicator of the presence of polyaromatic compounds (PACs) typically found in tar. PACs also exist in other road construction materials (e.g. bitumen and cutbacks like kerosene), but at low concentrations. The probability of obtaining a false positive result in the tar spray test with such materials is low, and a positive result in the tar spray test is a strong (but not definitive) indicator of the presence of tar. For quantitative results, this test should be considered in conjunction with the results from other tests (i.e. Total Polynuclear Aromatic Hydrocarbons (PAH) by Gas Chromatography - Flame Ionisation Detection (GC-FID)).

Binder [3]

The binder type is assessed based on visual and aromatic inspection. The PAK-Marker result is also considered.

Aggregate Size [4]

The sizes indicated are given as the best estimate of the nominal size of the material.

CORE LOGGING OF PAVEMENT MATERIAL

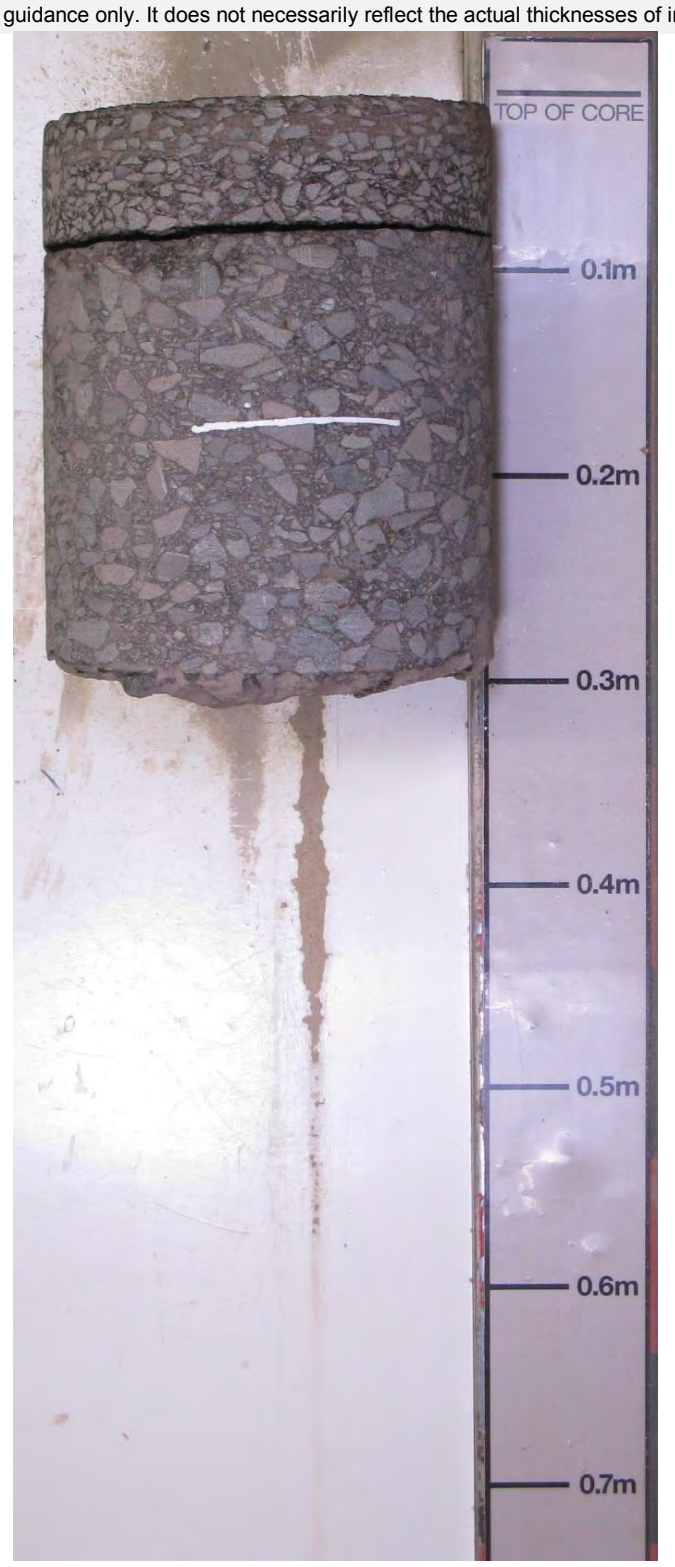
In Accordance with AECOM in House Procedures 0061 - SOP

UKAS TESTING 4410

Job Number :	**60559099-1.2-1.2**	Scheme :	**PASS Trials - A458 Ford Village**
Sample Number :	**T 1384**	Location :	**Westbound, Lane 1 (CR1), Lane Centre, Offset from nearside kerb 1.1m**
Core Number :	**1A**		**Survey Ch. 1290m**
Cored / Logged By :	**SP / RBB - SD**		**HAPMS Ch. 3200A458/160+1140m**
Date Cored / Logged :	**31-10-18 / 01-11-18**		**OSGR: SJ 41895, 13222**
Nominal Diameter :	**200mm**		**Notes: N/A**

Layer	Depth (mm)		Thickness (mm)	Material Description [1]	Suitable for NAT/CS Testing (Yes/No)	PAK-Marker [2]	Binder [3]	Aggregate	
	From	To						Size [4]	Type
1	0	60	60	Asphalt Surfacing	Yes	-ve	Bitumen	14	Crushed Rock
				Layers 1 & 2 Not Bonded					
2	60	148	88	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock
3	148	270	122	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock

Notes : The scale is for guidance only. It does not necessarily reflect the actual thicknesses of individual layer(s).



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Aggregate Size [4]

The sizes indicated are given as the best estimate of the nominal size of the material.

CORE LOGGING OF PAVEMENT MATERIAL

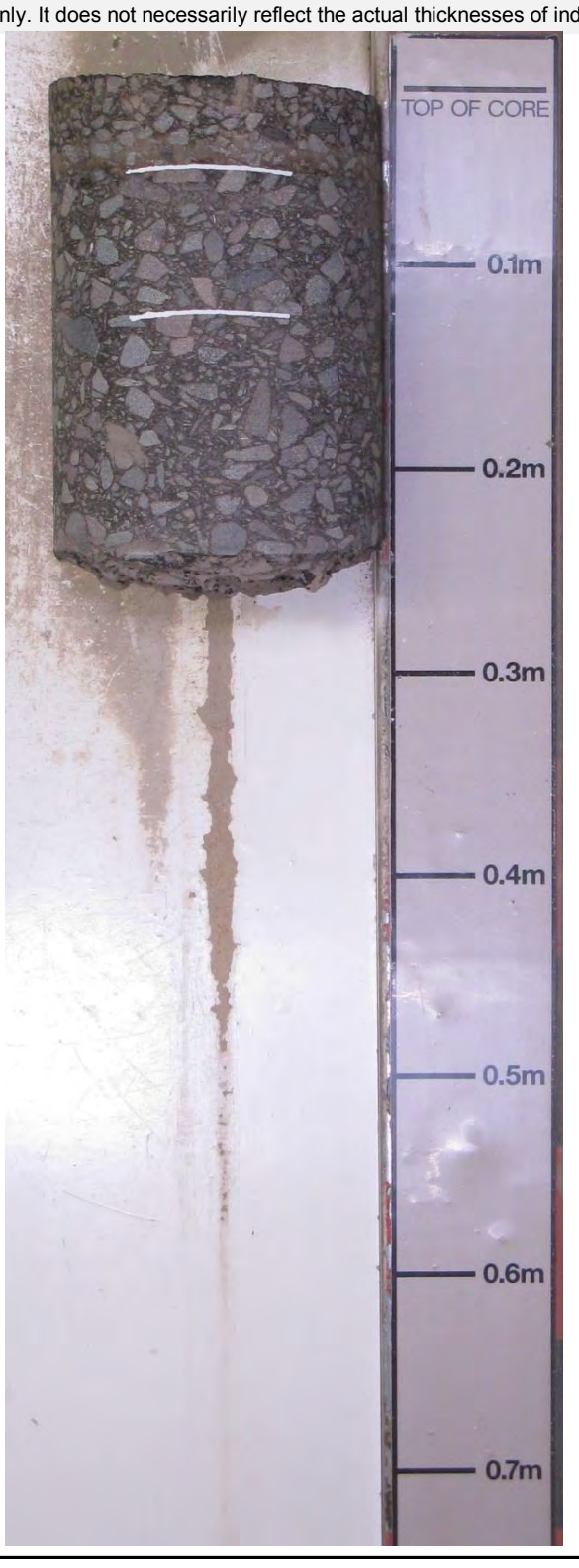
In Accordance with AECOM in House Procedures 0061 - SOP

UKAS TESTING 4410

Job Number :	**60559099-1.2-1.2**	Scheme :	**PASS Trials - A458 Ford Village**
Sample Number :	**T 1384**	Location :	**Westbound, Lane 1 (CR1), Lane Centre, Offset from nearside kerb 1.8m**
Core Number :	**02**		**Survey Ch. 1270m**
Cored / Logged By :	**SP / RBB - SD**		**HAPMS Ch. 3200A458/160+1120m**
Date Cored / Logged :	**31-10-18 / 01-11-18**		**OSGR: SJ 41877, 13221**
Nominal Diameter :	**150mm**		**Notes: N/A**

Layer	Depth (mm)		Thickness (mm)	Material Description [1]	Suitable for NAT/CS Testing (Yes/No)	PAK-Marker [2]	Binder [3]	Aggregate	
	From	To						Size [4]	Type
1	0	46	46	Asphalt Surfacing	Yes	-ve	Bitumen	14	Crushed Rock
2	46	115	69	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock
3	115	230	115	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock

Notes : The scale is for guidance only. It does not necessarily reflect the actual thicknesses of individual layer(s).



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Binder [3]

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Aggregate Size [4]

The sizes indicated are given as the best estimate of the nominal size of the material.

CORE LOGGING OF PAVEMENT MATERIAL

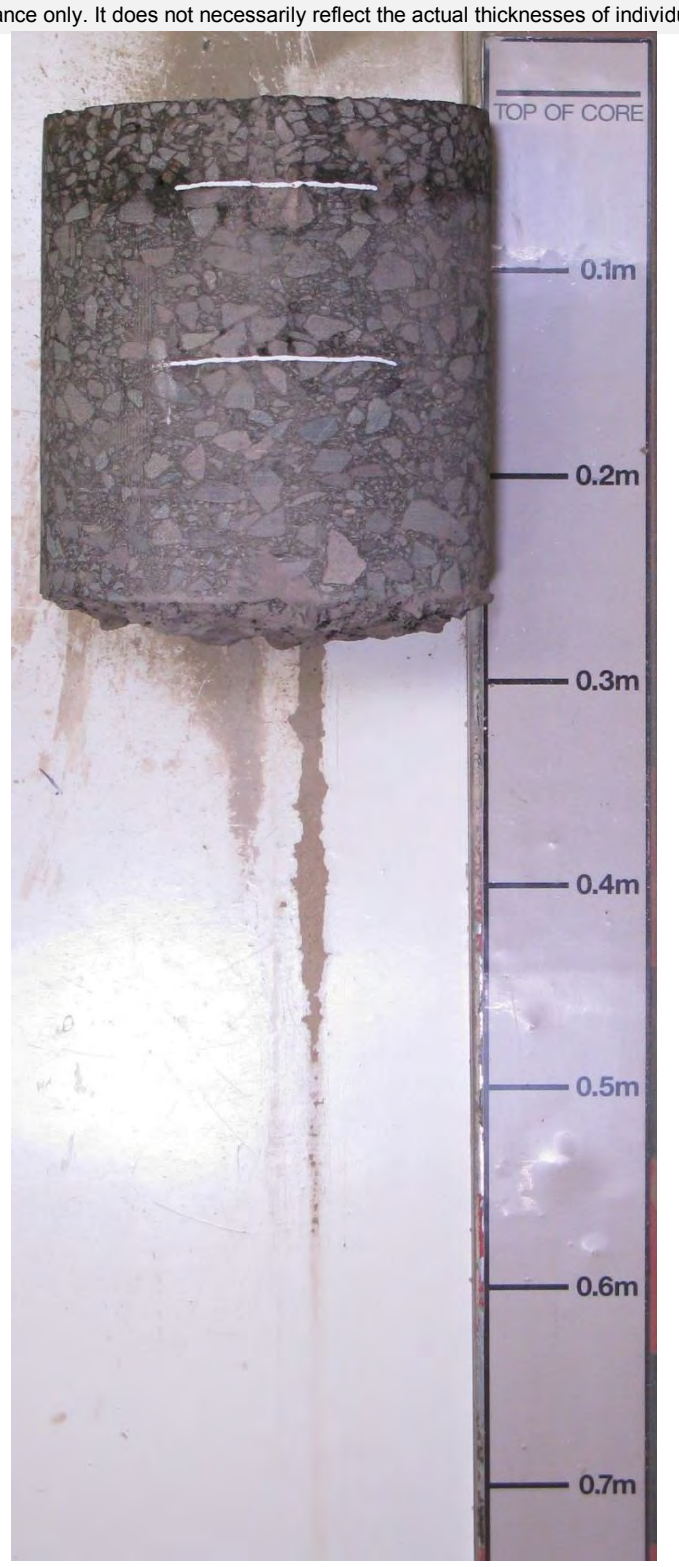
In Accordance with AECOM in House Procedures 0061 - SOP

UKAS TESTING 4410

Job Number :	**60559099-1.2-1.2**	Scheme :	**PASS Trials - A458 Ford Village**
Sample Number :	**T 1384**	Location :	**Westbound, Lane 1 (CR1), Lane Centre, Offset from nearside kerb 1.8m**
Core Number :	**2A**		**Survey Ch. 1270m**
Cored / Logged By :	**SP / RBB - SD**		**HAPMS Ch. 3200A458/160+1120m**
Date Cored / Logged :	**31-10-18 / 01-11-18**		**OSGR: SJ 41877, 13221**
Nominal Diameter :	**200mm**		**Notes: N/A**

Layer	Depth (mm)		Thickness (mm)	Material Description [1]	Suitable for NAT/CS Testing (Yes/No)	PAK-Marker [2]	Binder [3]	Aggregate	
	From	To						Size [4]	Type
1	0	40	40	Asphalt Surfacing	Yes	-ve	Bitumen	14	Crushed Rock
2	40	120	80	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock
3	120	245	125	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock

Notes : The scale is for guidance only. It does not necessarily reflect the actual thicknesses of individual layer(s).



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Binder [3]

The binder type is assessed based on visual and aromatic inspection. The PAK-Marker result is also considered.

Aggregate Size [4]

The sizes indicated are given as the best estimate of the nominal size of the material.

CORE LOGGING OF PAVEMENT MATERIAL

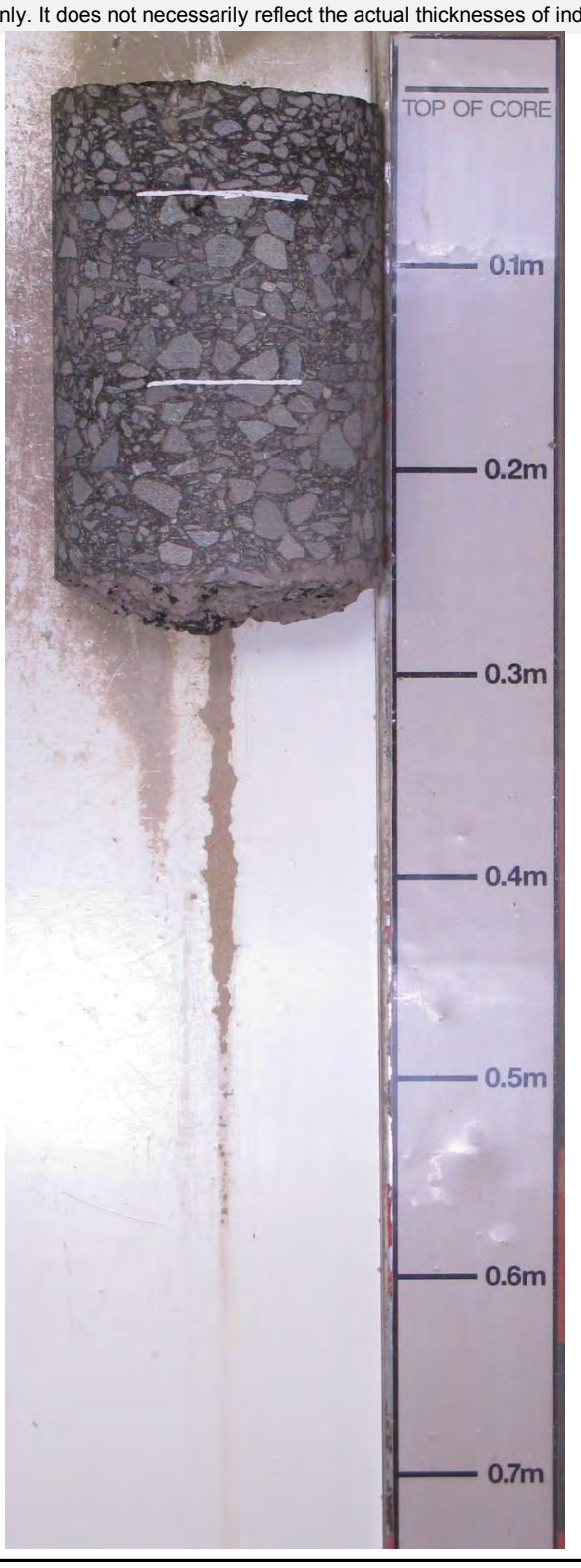
In Accordance with AECOM in House Procedures 0061 - SOP

UKAS TESTING 4410

Job Number :	**60559099-1.2-1.2**	Scheme :	**PASS Trials - A458 Ford Village**
Sample Number :	**T 1384**	Location :	**Westbound, Lane 1 (CR1), Lane Centre, Offset from nearside kerb 1.15m**
Core Number :	**03**		**Survey Ch. 1250m**
Cored / Logged By :	**SP / RBB - SD**		**HAPMS Ch. 3200A458/160+1100m**
Date Cored / Logged :	**31-10-18 / 01-11-18**		**OSGR: SJ 41856, 13219**
Nominal Diameter :	**150mm**		**Notes: N/A**

Layer	Depth (mm)		Thickness (mm)	Material Description [1]	Suitable for NAT/CS Testing (Yes/No)	PAK-Marker [2]	Binder [3]	Aggregate	
	From	To						Size [4]	Type
1	0	53	53	Asphalt Surfacing	Yes	-ve	Bitumen	14	Crushed Rock
2	53	142	89	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock
3	142	250	108	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock

Notes : The scale is for guidance only. It does not necessarily reflect the actual thicknesses of individual layer(s).



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PAK-Marker (PAH Spray) [2]

The Tar Spray Test is a rapid, qualitative indicator of the presence of polyaromatic compounds (PACs) typically found in tar. PACs also exist in other road construction materials (e.g. bitumen and cutbacks like kerosene), but at low concentrations. The probability of obtaining a false positive result in the tar spray test with such materials is low, and a positive result in the tar spray test is a strong (but not definitive) indicator of the presence of tar. For quantitative results, this test should be considered in conjunction with the results from other tests (i.e. Total Polynuclear Aromatic Hydrocarbons (PAH) by Gas Chromatography - Flame Ionisation Detection (GC-FID)).

Binder [3]

The binder type is assessed based on visual and aromatic inspection. The PAK-Marker result is also considered.

Aggregate Size [4]

The sizes indicated are given as the best estimate of the nominal size of the material.

CORE LOGGING OF PAVEMENT MATERIAL

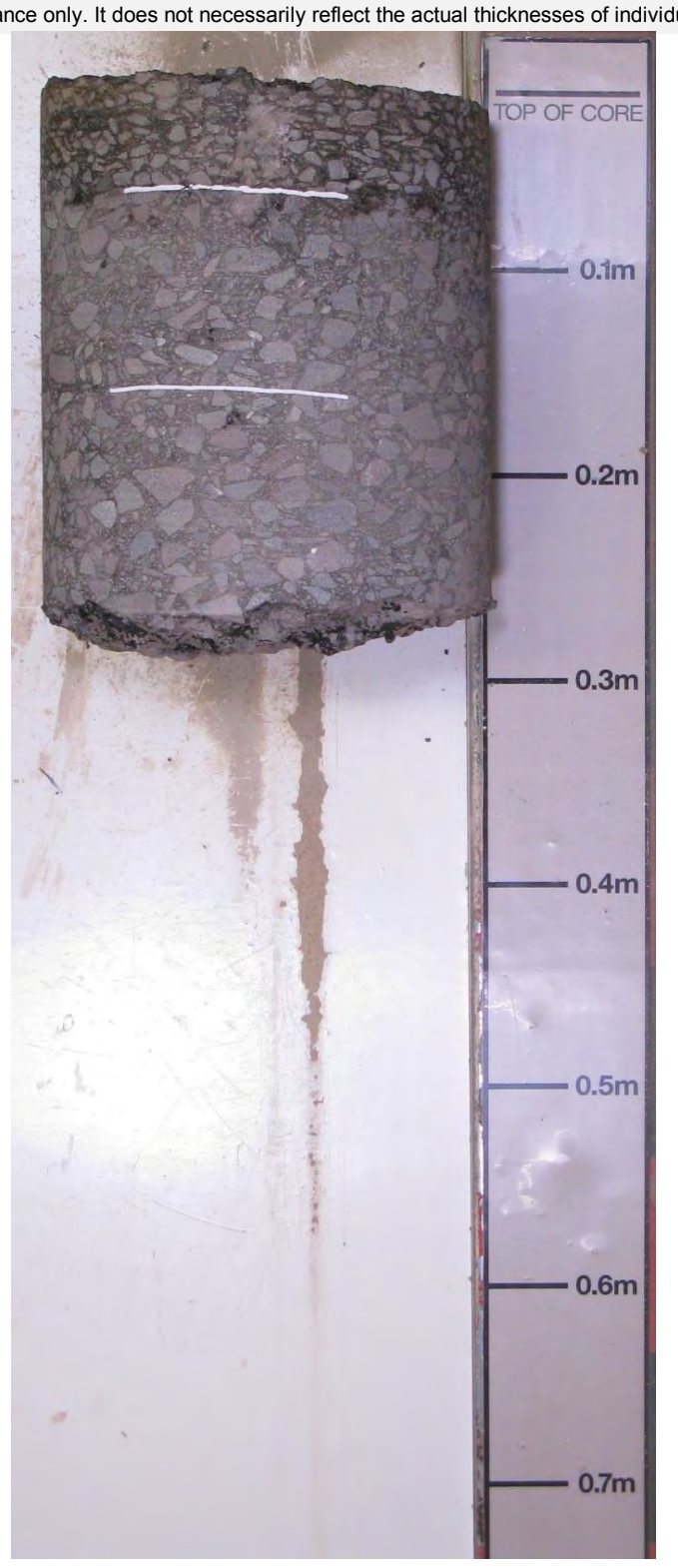
In Accordance with AECOM in House Procedures 0061 - SOP

UKAS TESTING 4410

Job Number :	**60559099-1.2-1.2**	Scheme :	**PASS Trials - A458 Ford Village**
Sample Number :	**T 1384**	Location :	**Westbound, Lane 1 (CR1), Lane Centre, Offset from nearside kerb 1.15m**
Core Number :	**3A**		**Survey Ch. 1250m**
Cored / Logged By :	**SP / RBB - SD**		**HAPMS Ch. 3200A458/160+1100m**
Date Cored / Logged :	**31-10-18 / 01-11-18**		**OSGR: SJ 41856, 13219**
Nominal Diameter :	**200mm**		**Notes: N/A**

Layer	Depth (mm)		Thickness (mm)	Material Description [1]	Suitable for NAT/CS Testing (Yes/No)	PAK-Marker [2]	Binder [3]	Aggregate	
	From	To						Size [4]	Type
1	0	55	55	Asphalt Surfacing	Yes	-ve	Bitumen	14	Crushed Rock
2	55	145	90	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock
3	145	270	125	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock

Notes : The scale is for guidance only. It does not necessarily reflect the actual thicknesses of individual layer(s).



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CORE LOGGING OF PAVEMENT MATERIAL

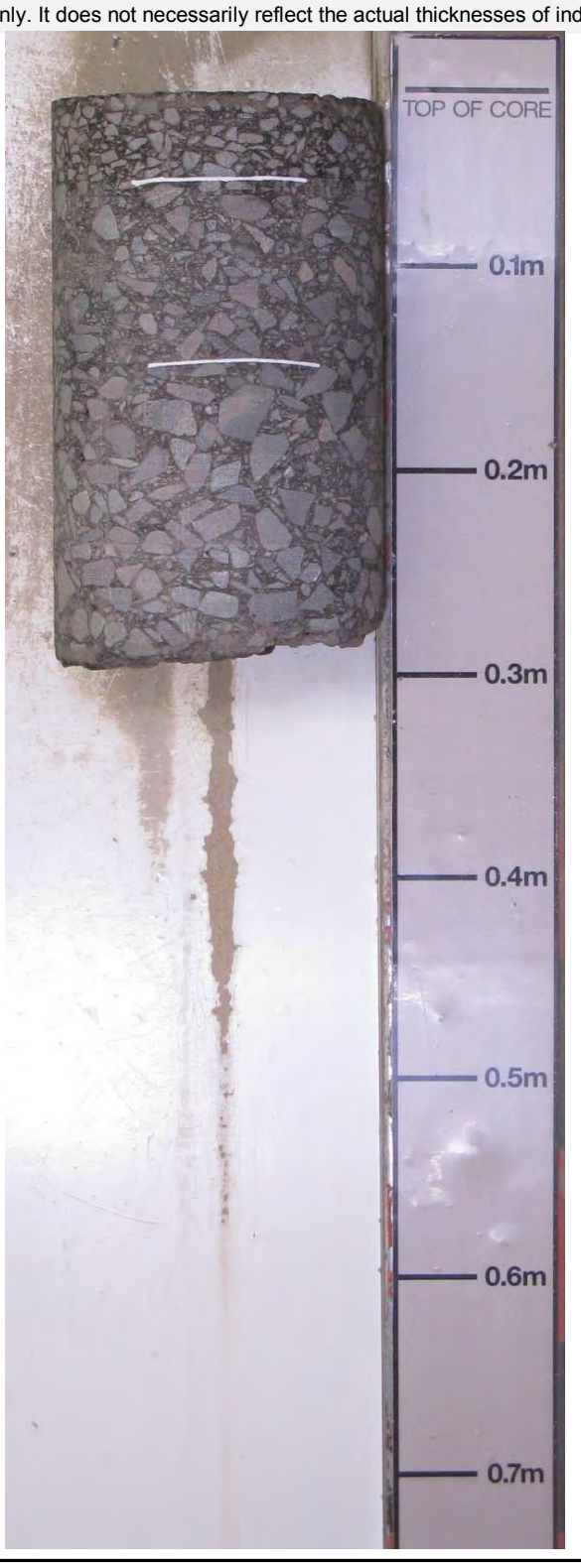
In Accordance with AECOM in House Procedures 0061 - SOP

UKAS TESTING 4410

Job Number :	**60559099-1.2-1.2**	Scheme :	**PASS Trials - A458 Ford Village**
Sample Number :	**T 1384**	Location :	**Westbound, Lane 1 (CR1), Lane Centre, Offset from nearside kerb 1.9m**
Core Number :	**04**		**Survey Ch. 1230m**
Cored / Logged By :	**SP / RBB - SD**		**HAPMS Ch. 3200A458/160+1080m**
Date Cored / Logged :	**31-10-18 / 01-11-18**		**OSGR: SJ 41836, 13221**
Nominal Diameter :	**150mm**		**Notes: N/A**

Layer	Depth (mm)		Thickness (mm)	Material Description [1]	Suitable for NAT/CS Testing (Yes/No)	PAK-Marker [2]	Binder [3]	Aggregate	
	From	To						Size [4]	Type
1	0	43	43	Asphalt Surfacing	Yes	-ve	Bitumen	14	Crushed Rock
2	43	130	87	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock
3	130	270	140	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock

Notes : The scale is for guidance only. It does not necessarily reflect the actual thicknesses of individual layer(s).



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CORE LOGGING OF PAVEMENT MATERIAL

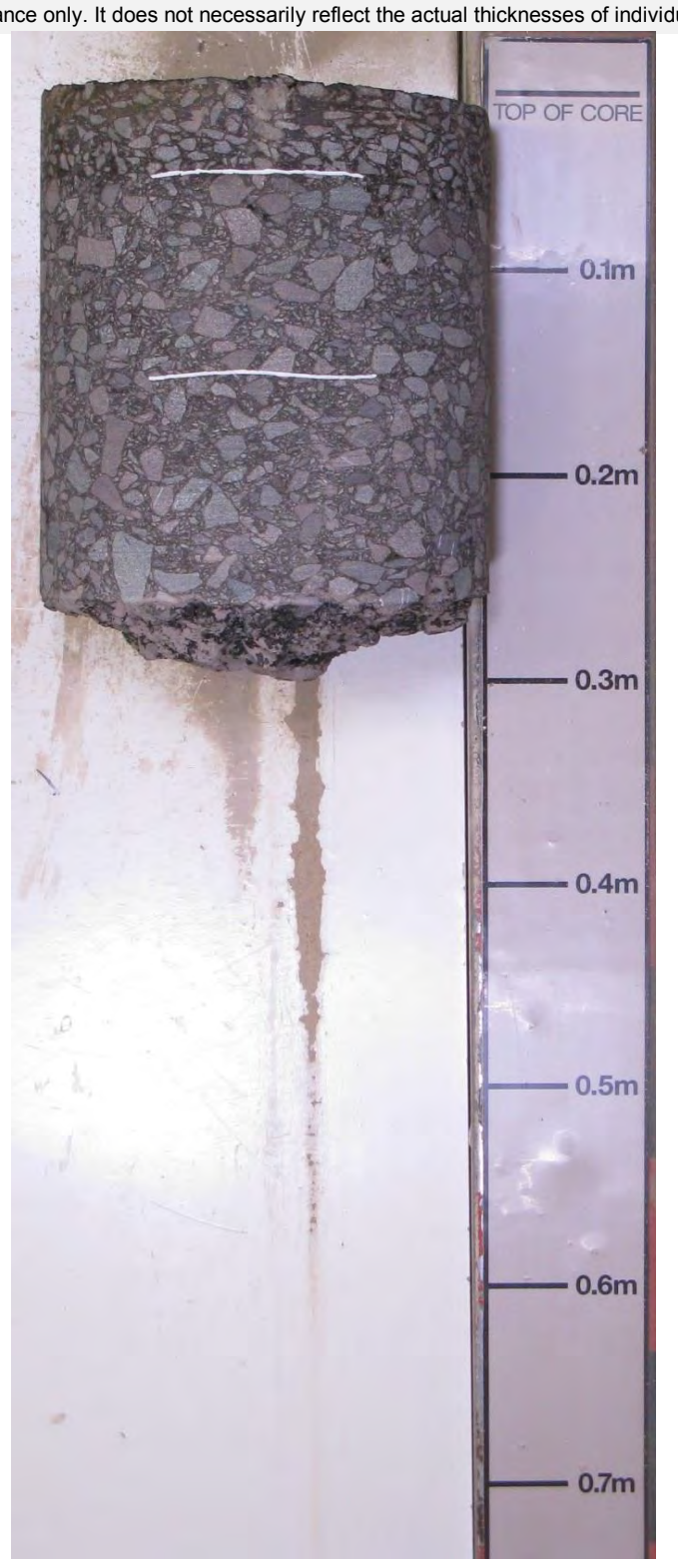
In Accordance with AECOM in House Procedures 0061 - SOP

UKAS TESTING 4410

Job Number :	**60559099-1.2-1.2**	Scheme :	**PASS Trials - A458 Ford Village**
Sample Number :	**T 1384**	Location :	**Westbound, Lane 1 (CR1), Lane Centre, Offset from nearside kerb 1.9m**
Core Number :	**4A**		**Survey Ch. 1230m**
Cored / Logged By :	**SP / RBB - SD**		**HAPMS Ch. 3200A458/160+1080m**
Date Cored / Logged :	**31-10-18 / 01-11-18**		**OSGR: SJ 41836, 13221**
Nominal Diameter :	**200mm**		**Notes: N/A**

Layer	Depth (mm)		Thickness (mm)	Material Description [1]	Suitable for NAT/CS Testing (Yes/No)	PAK-Marker [2]	Binder [3]	Aggregate	
	From	To						Size [4]	Type
1	0	45	45	Asphalt Surfacing	Yes	-ve	Bitumen	14	Crushed Rock
2	45	135	90	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock
3	135	270	135	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock

Notes : The scale is for guidance only. It does not necessarily reflect the actual thicknesses of individual layer(s).



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CORE LOGGING OF PAVEMENT MATERIAL

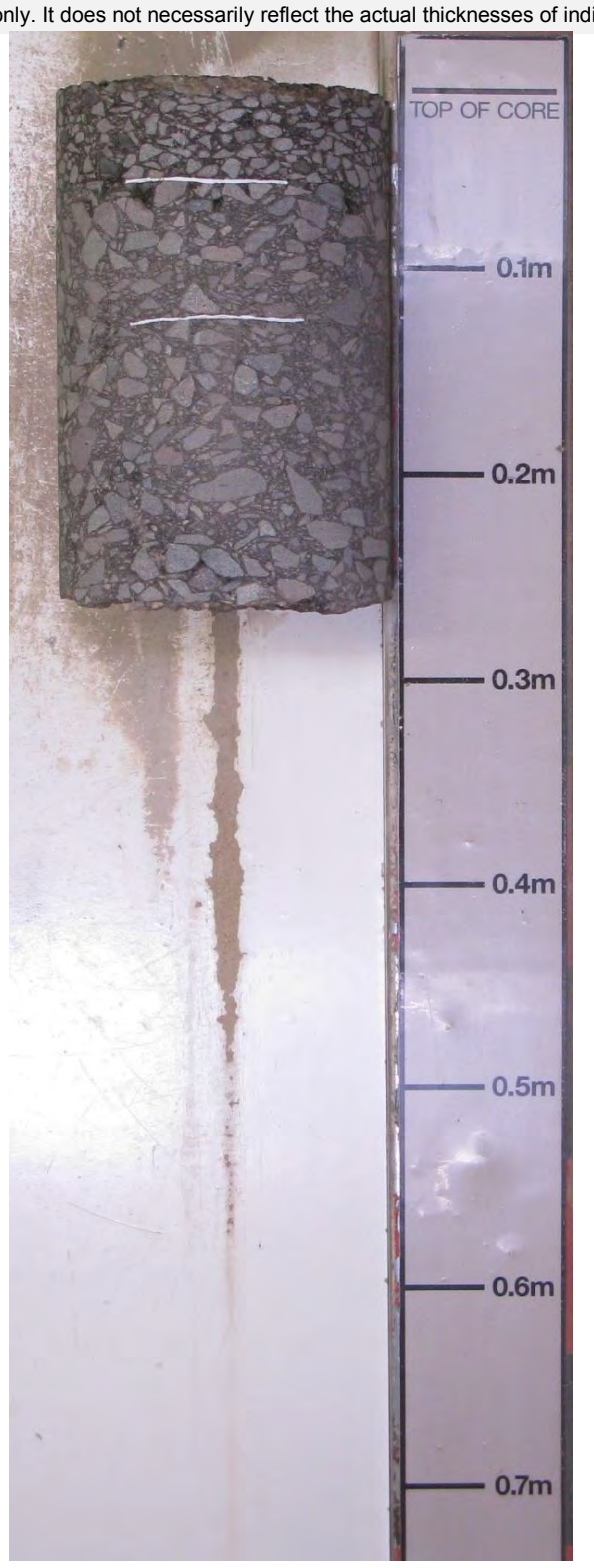
In Accordance with AECOM in House Procedures 0061 - SOP

UKAS TESTING 4410

Job Number :	**60559099-1.2-1.2**	Scheme :	**PASS Trials - A458 Ford Village**
Sample Number :	**T 1384**	Location :	**Westbound, Lane 1 (CR1), Lane Centre, Offset from nearside kerb 1.2m**
Core Number :	**05**		**Survey Ch. 1190m**
Cored / Logged By :	**SP / RBB - SD**		**HAPMS Ch. 3200A458/160+1040m**
Date Cored / Logged :	**31-10-18 / 01-11-18**		**OSGR: SJ 41796, 13220**
Nominal Diameter :	**150mm**		**Notes: N/A**

Layer	Depth (mm)		Thickness (mm)	Material Description [1]	Suitable for NAT/CS Testing (Yes/No)	PAK-Marker [2]	Binder [3]	Aggregate	
	From	To						Size [4]	Type
1	0	50	50	Asphalt Surfacing	Yes	-ve	Bitumen	14	Crushed Rock
2	50	115	65	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock
3	115	250	135	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock

Notes : The scale is for guidance only. It does not necessarily reflect the actual thicknesses of individual layer(s).



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CORE LOGGING OF PAVEMENT MATERIAL

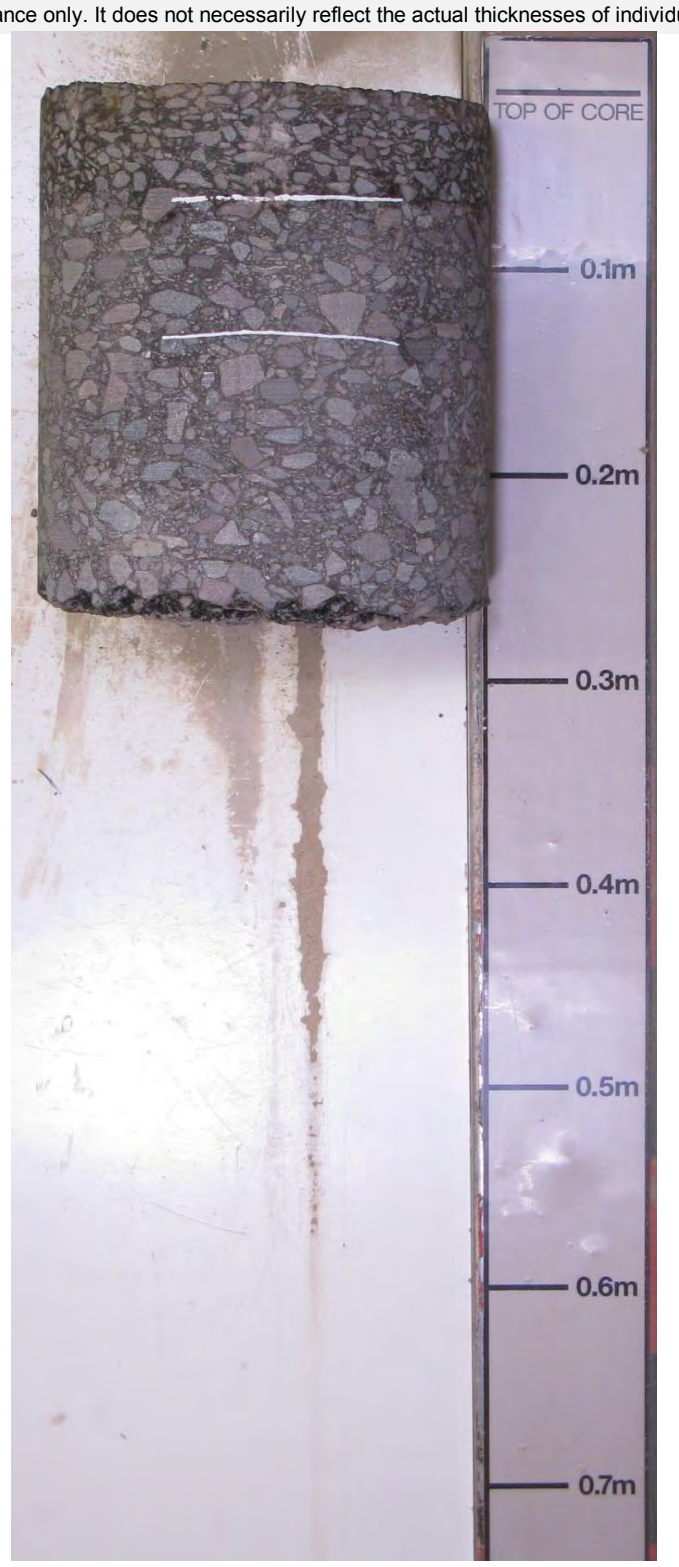
In Accordance with AECOM in House Procedures 0061 - SOP

UKAS TESTING 4410

Job Number :	**60559099-1.2-1.2**	Scheme :	**PASS Trials - A458 Ford Village**
Sample Number :	**T 1384**	Location :	**Westbound, Lane 1 (CR1), Lane Centre, Offset from nearside kerb 1.2m**
Core Number :	**5A**		**Survey Ch. 1190m**
Cored / Logged By :	**SP / RBB - SD**		**HAPMS Ch. 3200A458/160+1040m**
Date Cored / Logged :	**31-10-18 / 01-11-18**		**OSGR: SJ 41796, 13220**
Nominal Diameter :	**200mm**		**Notes: N/A**

Layer	Depth (mm)		Thickness (mm)	Material Description [1]	Suitable for NAT/CS Testing (Yes/No)	PAK-Marker [2]	Binder [3]	Aggregate	
	From	To						Size [4]	Type
1	0	53	53	Asphalt Surfacing	Yes	-ve	Bitumen	14	Crushed Rock
2	53	115	62	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock
3	115	250	135	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock

Notes : The scale is for guidance only. It does not necessarily reflect the actual thicknesses of individual layer(s).



53+

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CORE LOGGING OF PAVEMENT MATERIAL

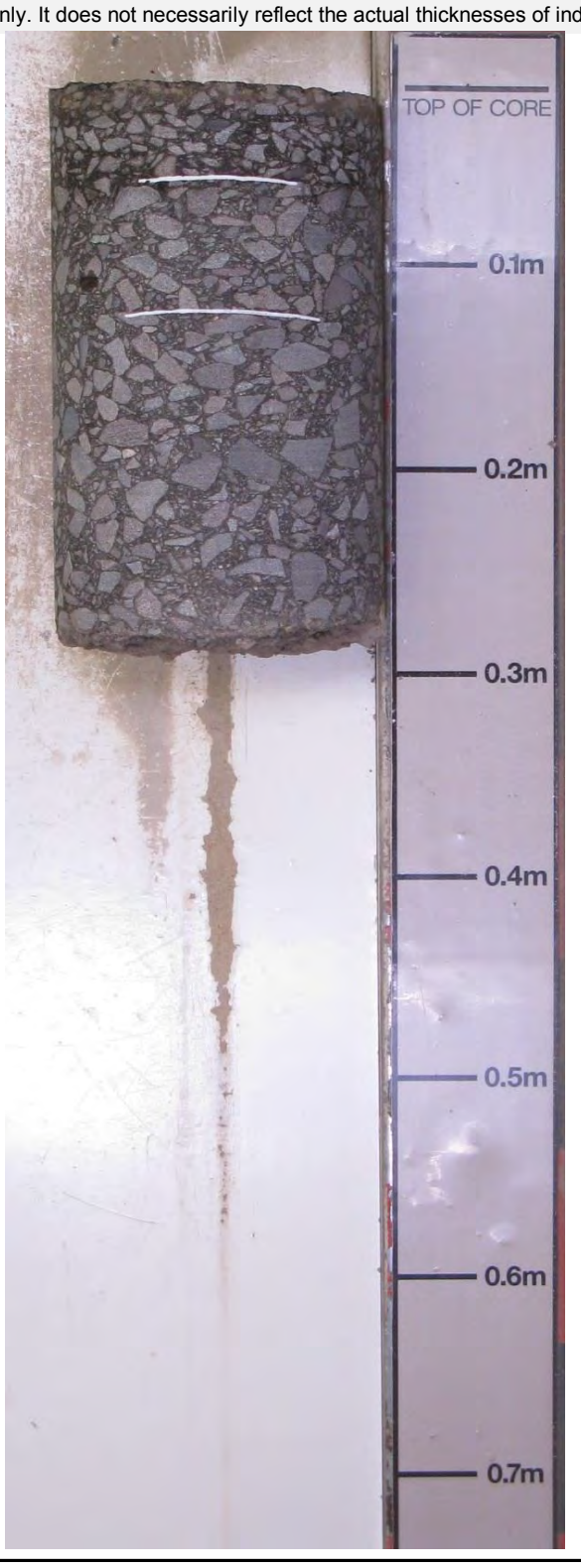
In Accordance with AECOM in House Procedures 0061 - SOP

UKAS TESTING 4410

Job Number :	**60559099-1.2-1.2**	Scheme :	**PASS Trials - A458 Ford Village**
Sample Number :	**T 1384**	Location :	**Westbound, Lane 1 (CR1), Lane Centre, Offset from nearside kerb 1.9m**
Core Number :	**06**		**Survey Ch. 1170m**
Cored / Logged By :	**SP / RBB - SD**		**HAPMS Ch. 3200A458/160+1020m**
Date Cored / Logged :	**31-10-18 / 01-11-18**		**OSGR: SJ 41776, 13218**
Nominal Diameter :	**150mm**		**Notes: N/A**

Layer	Depth (mm)		Thickness (mm)	Material Description [1]	Suitable for NAT/CS Testing (Yes/No)	PAK-Marker [2]	Binder [3]	Aggregate	
	From	To						Size [4]	Type
1	0	45	45	Asphalt Surfacing	Yes	-ve	Bitumen	14	Crushed Rock
2	45	110	65	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock
3	110	270	160	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock

Notes : The scale is for guidance only. It does not necessarily reflect the actual thicknesses of individual layer(s).



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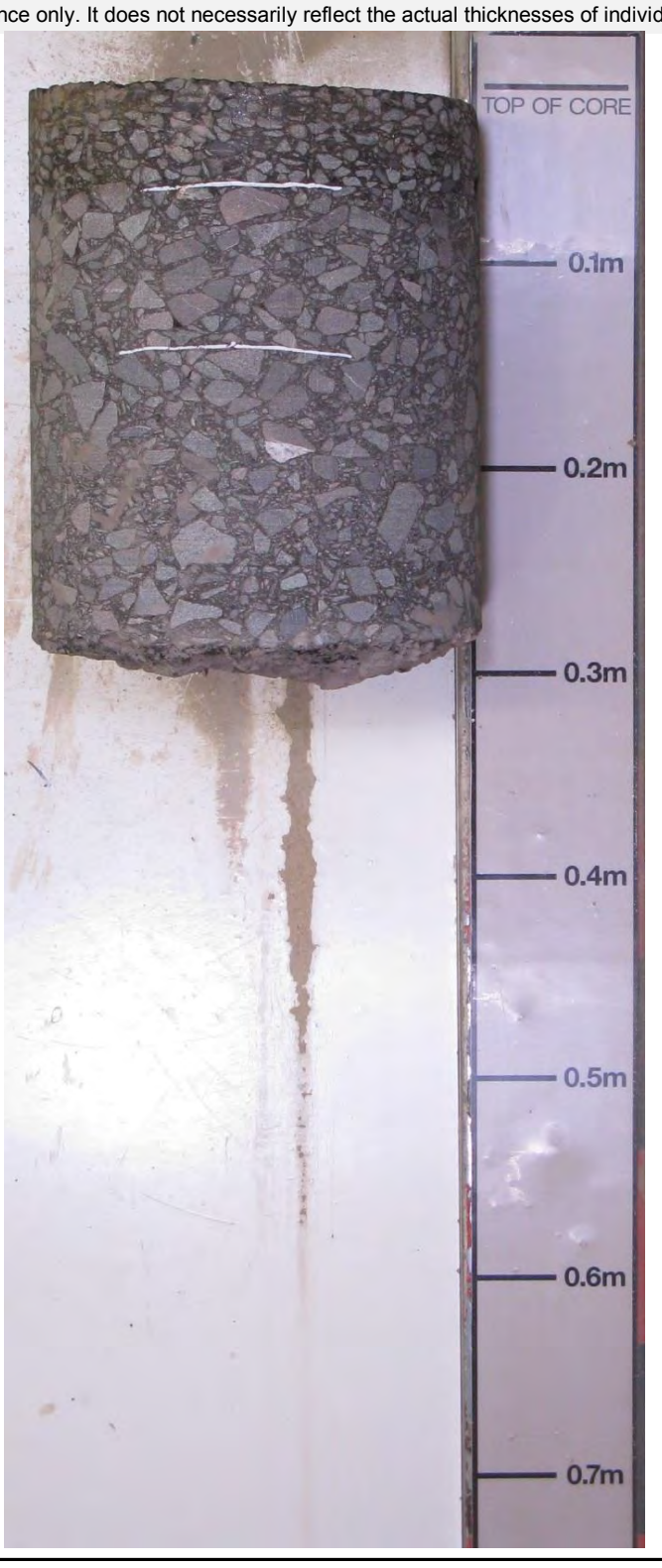
In Accordance with AECOM in House Procedures 0061 - SOP

UKAS TESTING 4410

Job Number :	**60559099-1.2-1.2**	Scheme :	**PASS Trials - A458 Ford Village**
Sample Number :	**T 1384**	Location :	**Westbound, Lane 1 (CR1), Lane Centre, Offset from nearside kerb 1.9m**
Core Number :	**6A**		**Survey Ch. 1170m**
Cored / Logged By :	**SP / RBB - SD**		**HAPMS Ch. 3200A458/160+1020m**
Date Cored / Logged :	**31-10-18 / 01-11-18**		**OSGR: SJ 41776, 13218**
Nominal Diameter :	**200mm**		**Notes: N/A**

Layer	Depth (mm)		Thickness (mm)	Material Description [1]	Suitable for NAT/CS Testing (Yes/No)	PAK-Marker [2]	Binder [3]	Aggregate	
	From	To						Size [4]	Type
1	0	46	46	Asphalt Surfacing	Yes	-ve	Bitumen	14	Crushed Rock
2	46	120	74	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock
3	120	265	145	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock

Notes : The scale is for guidance only. It does not necessarily reflect the actual thicknesses of individual layer(s).



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CORE LOGGING OF PAVEMENT MATERIAL

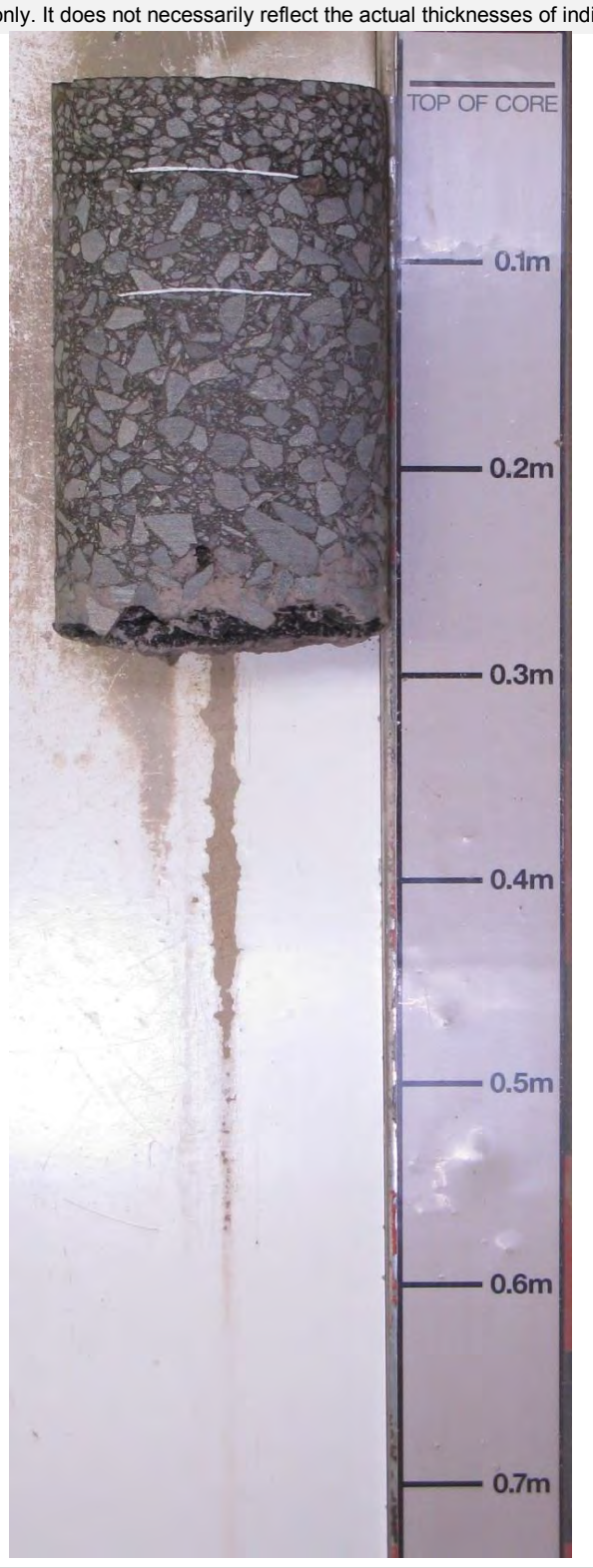
In Accordance with AECOM in House Procedures 0061 - SOP

UKAS TESTING 4410

Job Number :	**60559099-1.2-1.2**	Scheme :	**PASS Trials - A458 Ford Village**
Sample Number :	**T 1384**	Location :	**Westbound, Lane 1 (CR1), Lane Centre, Offset from nearside kerb 1.1m**
Core Number :	**07**		**Survey Ch. 1150m**
Cored / Logged By :	**SP / RBB - SD**		**-1124**
Date Cored / Logged :	**31-10-18 / 01-11-18**		**OSGR: SJ 41756, 13217**
Nominal Diameter :	**150mm**		**Notes: N/A**

Layer	Depth (mm)		Thickness (mm)	Material Description [1]	Suitable for NAT/CS Testing (Yes/No)	PAK-Marker [2]	Binder [3]	Aggregate	
	From	To						Size [4]	Type
1	0	44	44	Asphalt Surfacing	Yes	-ve	Bitumen	14	Crushed Rock
2	44	100	56	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock
3	100	270	170	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock

Notes : The scale is for guidance only. It does not necessarily reflect the actual thicknesses of individual layer(s).



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CORE LOGGING OF PAVEMENT MATERIAL

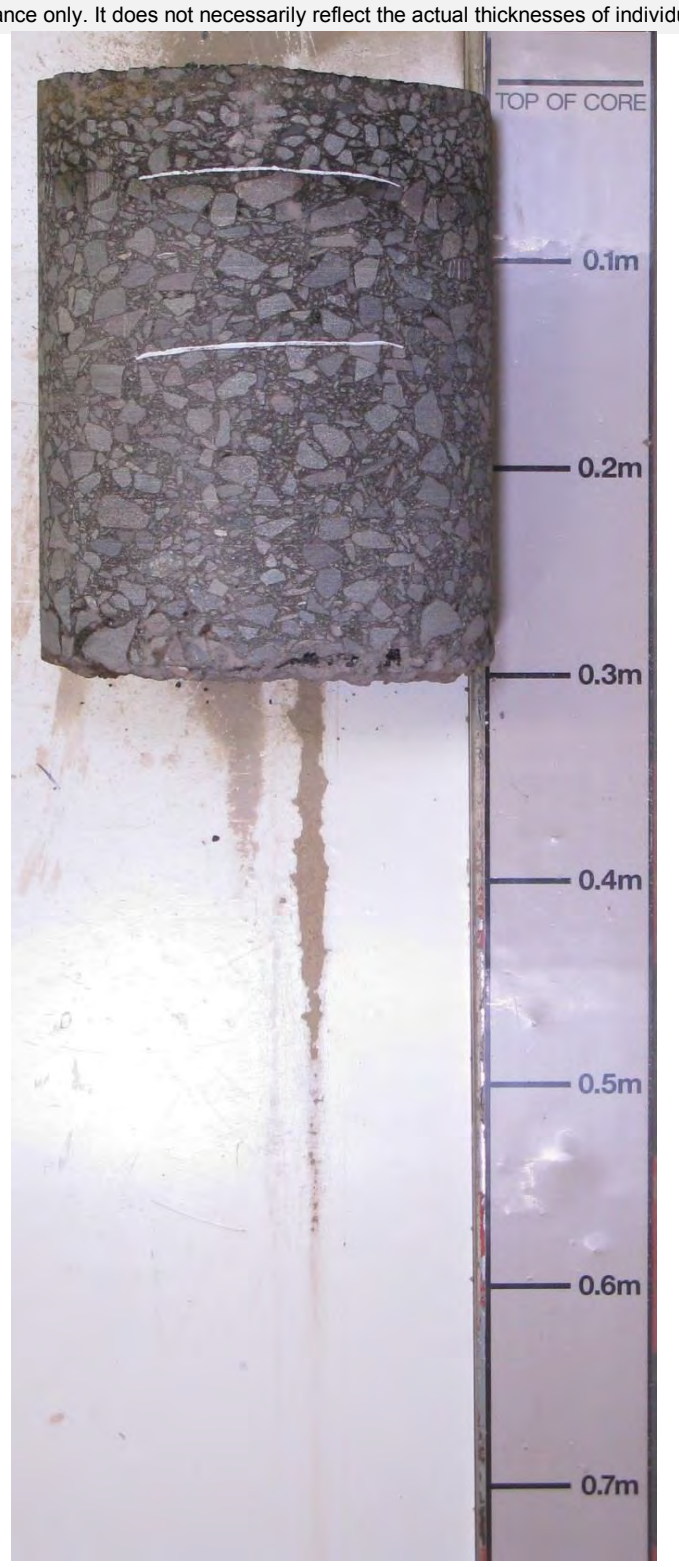
In Accordance with AECOM in House Procedures 0061 - SOP

UKAS TESTING 4410

Job Number :	**60559099-1.2-1.2**	Scheme :	**PASS Trials - A458 Ford Village**
Sample Number :	**T 1384**	Location :	**Westbound, Lane 1 (CR1), Lane Centre, Offset from nearside kerb 1.1m**
Core Number :	**7A**		**Survey Ch. 1150m**
Cored / Logged By :	**SP / RBB - SD**		**HAPMS Ch. 3200A458/160+1000m**
Date Cored / Logged :	**31-10-18 / 01-11-18**		**OSGR: SJ 41756, 13217**
Nominal Diameter :	**200mm**		**Notes: N/A**

Layer	Depth (mm)		Thickness (mm)	Material Description [1]	Suitable for NAT/CS Testing (Yes/No)	PAK-Marker [2]	Binder [3]	Aggregate	
	From	To						Size [4]	Type
1	0	46	46	Asphalt Surfacing	Yes	-ve	Bitumen	14	Crushed Rock
2	46	122	76	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock
3	122	275	153	Asphalt Concrete	Yes	-ve	Bitumen	20	Crushed Rock

Notes : The scale is for guidance only. It does not necessarily reflect the actual thicknesses of individual layer(s).



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Aggregate Size [4]

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Appendix G - A458 Laboratory Test Results

AECOM

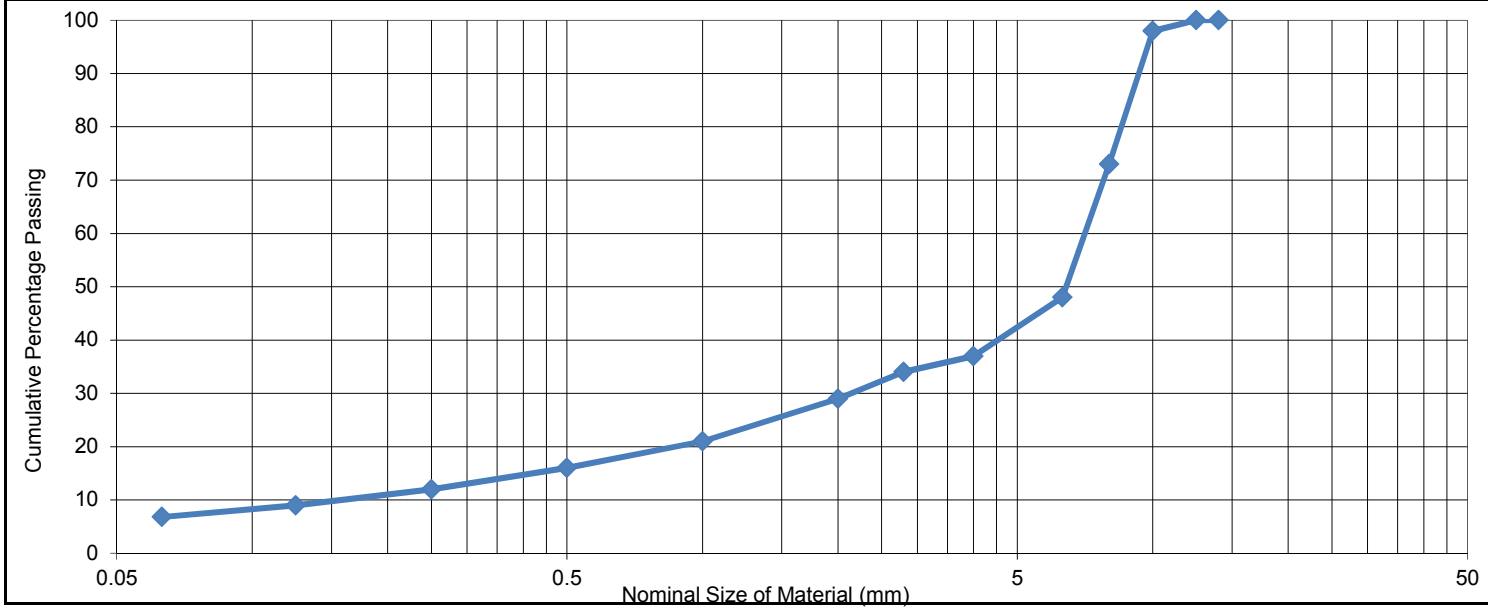
COMPOSITION ANALYSIS

BS EN 12697 -1: 2012 & BS EN 12697-2: 2002

Project Title :	**Task 1-444: Collaborative Research Project (sib-Task 1) PASS Trials - A458 Ford Village**			Tested By :	**Lincs Lab**
Job Number :	**60559099**	Location of Testing :	**Lincs Lab**	Reported By :	**Lincs Lab**
Ticket Number :	**T1384**	Date of Issue :	**07 December 2018**	Checked By :	**NAL**

Sample Reference :

Composition Analysis Plot



Sieve Size (mm)	Percentage Passing	Specification Limits
14.0	100	98 - 100
12.5	100	
10.0	98	85 - 98
8.0	73	
6.3	48	40 - 54
4.0	37	31 - 45
2.8	34	
2.0	29	20 - 32
1.0	21	
0.50	16	9 - 17
0.25	12	5 - 13
0.125	9	
0.063	6.8	4.2 - 8.2
Binder Content (%)	5.6	4.9 - 5.9

Comments and Deviations:

Materials Description :	SMA 10 Surf PMB	Method of Sampling :	n/a	Sampling Location :	n/a
Sample Origin :	Asphalt Plant	Date Sampled :	n/a		
Material Specification :	AC Small Aggregate	Sampled by :	n/a		

Checked by: - NN

Date: - **07 December 2018**

Neil Woodfield
Cemex Uk Materials Ltd
Aston Church Road
Saltley
Birmingham
B8 1QF
0121 327 6582

BITUMINOUS ANALYSIS TEST REPORT

for Product: 10112635/ Sma 10 Surf Pmb Psv 68 Pass_PMB Bitumen

Supplier/ source: ASPHALT PLANT BIRMINGHAM

Material type: EN 13108-1 AC: Small Agg Test method: Binder by difference to BS EN 12697-1:2005

SAMPLE INFORMATION

Sampled/ tested
Tue 30 October 2018/ 01-11-18
at 2110 hrs

Sample number BC0705885

Location	Ford A458	Docket No	-
Vehicle Reg	Cn57Bwu	Weather conditions	COLD 2'
Mixer Man =	Andy, NIGHTS	Aggregate type	HARDSTONE
Binder Pen	PMB	Sampled/Tested By:	D Tomlinson

SAMPLE ANALYSIS

Sieve size	Percent passing	Specification limits	Complies ?
14mm	100	98 - 100	yes
10mm	97	85 - 98	yes
6.3mm	50	40 - 54	yes
4mm	37	31 - 45	yes
2mm	30	20 - 32	yes
500µm	17	9 - 17	yes
250µm	12	5 - 13	yes
63µm	6.7	4.2 - 8.2	yes
Binder content %	5.6	4.9 - 5.9	yes
Temperature °C	184	160 - 190	yes

Parameters are evaluated to the accuracy of spec. limits

REMARKS

Compliance status ok. Category A of A-C includes secondary parameters

1St Sample Nights

Signed _____Technical Department Print date 01 Nov 2018

Neil Woodfield
Cemex Uk Materials Ltd
Aston Church Road
Saltley
Birmingham
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0121 327 6582

BITUMINOUS ANALYSIS TEST REPORT

for Product: 10112635/ Sma 10 Surf Pmb Psv 68 Pass_PMB Bitumen

Supplier/ source: ASPHALT PLANT BIRMINGHAM

Material type: EN 13108-1 AC: Small Agg Test method: Binder by difference to BS EN 12697-1:2005

SAMPLE INFORMATION

Sampled/ tested
Tue 30 October 2018/ 01-11-18
at 2125 hrs

Sample number BC0705886

Location	Ford A458	Docket No	-
Vehicle Reg	rx08hfg	Weather conditions	COLD 2'
Mixer Man =	Andy, NIGHTS	Aggregate type	HARDSTONE
Binder Pen	PMB	Sampled/Tested By:	D Tomlinson

SAMPLE ANALYSIS

Sieve size	Percent passing	Specification limits	Complies ?
14mm	100	98 - 100	yes
10mm	96	85 - 98	yes
6.3mm	50	40 - 54	yes
4mm	40	31 - 45	yes
2mm	30	20 - 32	yes
500µm	16	9 - 17	yes
250µm	12	5 - 13	yes
63µm	6.6	4.2 - 8.2	yes
Binder content %	5.7	4.9 - 5.9	yes
Temperature °C	180	160 - 190	yes

Parameters are evaluated to the accuracy of spec. limits

REMARKS

Compliance status ok. Category A of A-C includes secondary parameters

3rd load Sample nights

Signed _____Technical Department Print date 01 Nov 2018

AECOM

MAXIMUM DENSITY & AIR VOIDS

UKAS TESTING 4410

BS EN 12697-5 : 2009 - Procedure A & BS EN 12697-8 : 2003

Project Title :	**Task 1-444: Collaborative Research Project (sib-Task 1) PASS Trials - A458 Ford Village**		
Job Number :	**60559099**	Reported By : **NAL**	Tested By : **NAL**
Ticket Number :	**T1384-1**	Checked By : **JR**	
Location of Testing :	**AECOM Laboratory, NG9 6RZ**	Date of Issue : **30 November 2018**	

Sample Reference	Date of Test	Bulk Density Method	Bulk Density (kg/m³)	Maximum Density Test Temperature (˚C)		Maximum Density (kg/m³)*	Air Voids (% v/v)
1	26-Nov-18	B	2310	21.0		2463	**6.2**
2	26-Nov-18	B	2208	21.0		2463	**10.3**
3	26-Nov-18	B	2329	21.0		2463	**5.4**
4	26-Nov-18	B	2335	21.0		2463	**5.2**
5	26-Nov-18	B	2337	21.0		2463	**5.1**
6	26-Nov-18	B	2295	21.0		2463	**6.8**
7	26-Nov-18	B	2350	21.0		2463	**4.6**
1A	27-Nov-18	B	2313	20.0		2463	**6.1**
2A	27-Nov-18	B	2225	20.0		2463	**9.7**
3A	27-Nov-18	B	2332	20.0		2463	**5.3**
4A	27-Nov-18	B	2331	20.0		2463	**5.3**
5A	27-Nov-18	B	2323	20.0		2463	**5.7**
6A	27-Nov-18	B	2272	20.0		2463	**7.8**
7A	27-Nov-18	B	2353	20.0		2463	**4.5**

Comments and Deviations:

m_1= mass of pyknometer (g), m_2= m_1 and sample (g), m_3= m_2 and filled with water (g), Vp= volume of pyknometer (m³)

ρw= density of water (mg/m³), ρmv= sample maximum density (mg/m³) * x10⁻³ Mg/m³

$$\rho w = 1.00025205 + \frac{7.59t - 5.32t^2}{10^6} \qquad \rho mv = \frac{(m_2 - m_1)}{10^6 x Vp - (m_3 - m_2)/\rho w}$$

Origin of Specimen : Extracted from Site

Checked by: - Rawlings Date: - **30 November 2018**

WHEEL TRACKING

BS EN 12697-22:2003+A1:2007 - Procedure B in Air

UKAS TESTING 4410

Project Title :	**Task 1-444: Collaborative Research Project (sib-Task 1) PASS Trials - A458 Ford Village**		
Job Number :	**60559099**	Tested By :	**NAL**
Ticket Number :	**T1384**	Reported By :	**NAL**
Location of Testing :	**AECOM Laboratory, NG9 6RZ**	Checked By :	**HEB**
		Date of Issue :	**19 December 2018**

Sample Number	Thickness (mm)	Bulk density (kg/m³)	Test Temperature (°C)	Wheel-Tracking Slope in Air (mm/10^3 cycles)	Proportional Rut Depth at 10000 Cycles (%)	Rut Depth at 10000 Cycles (mm)
3A	47	2332	60	**3.6E-01**	**15.8**	**7.4**
4A	41	2331	60	**3.1E-01**	**13.6**	**5.6**
5A	50	2323	60	**1.7E-01**	**8.1**	**4.1**
6A	44	2272	60	**1.1E-01**	**6.9**	**3.1**
Mean Wheel-Tracking Slope in Air (mm/10^3 cycles)				**2.4E-01**		
Mean Proportion Rut Depth at 10000 Cycles (%)					**11.1**	
Mean Rut Depth at 10000 Cycles (mm)						**5.0**
Mean Wheel-Tracking Slope in Air (mm/10^3 cycles)						
Mean Proportion Rut Depth at 10000 Cycles (%)						
Mean Rut Depth at 10000 Cycles (mm)						
Mean Wheel-Tracking Slope in Air (mm/10^3 cycles)						
Mean Proportion Rut Depth at 10000 Cycles (%)						
Mean Rut Depth at 10000 Cycles (mm)						
Mean Wheel-Tracking Slope in Air (mm/10^3 cycles)						
Mean Proportion Rut Depth at 10000 Cycles (%)						
Mean Rut Depth at 10000 Cycles (mm)						

Checked by: -  Date: - **19 December 2018**

AECOM

WHEEL-TRACKI

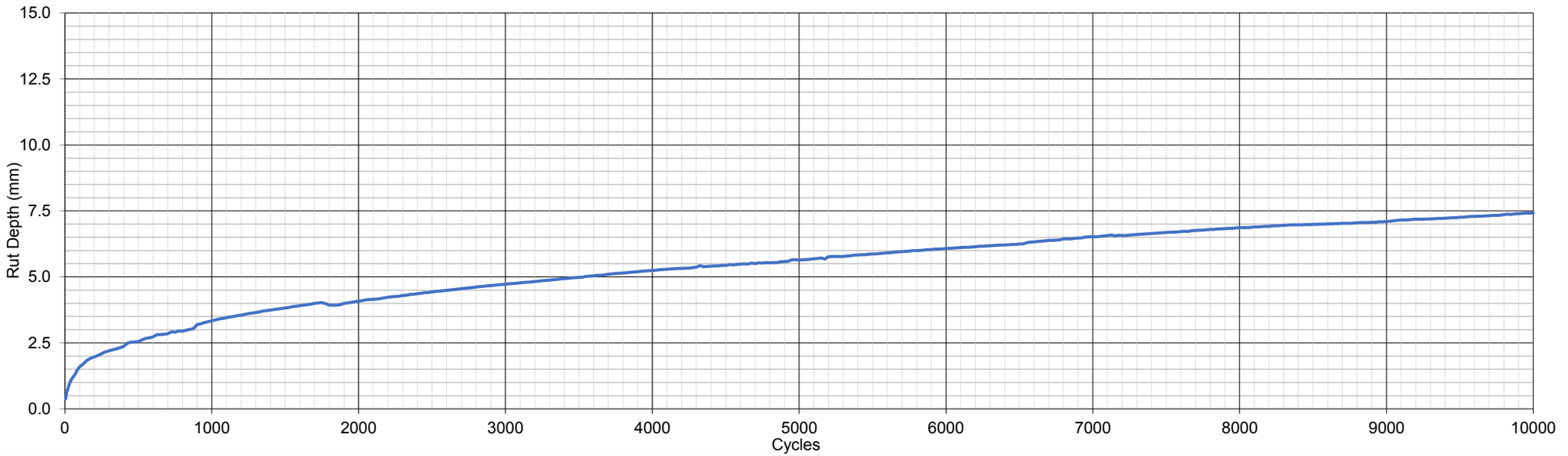
BS EN 12697-22:2003+A1:2007 - Procedure B in

UKAS TESTING 4410

Project Title :	**Task 1-444: Collaborative Research Project (sib-Task 1) PASS Trials - A458 Ford Village**	Tested By :	**NAL**
Job Number :	**60559099**	Location of Testing : **AECOM Laboratory, NG9 6RZ**	Reported By : **NAL**
Ticket Number :	**T1384**	Date of Issue : **43453**	Checked By : **HEB**

Sample reference: **3A**

Rut Depth Plot



Comments and Deviations:

Origin of Sample :	Extracted from Site	Sample Certificate Available :	No	**Rut Depth at 10000 cycles 7.43 mm**
Date Cored :	31 October 2018			
Date of Compaction :	n/a			

Checked by: -	**Signature**	Date: -	**01 January 1900**

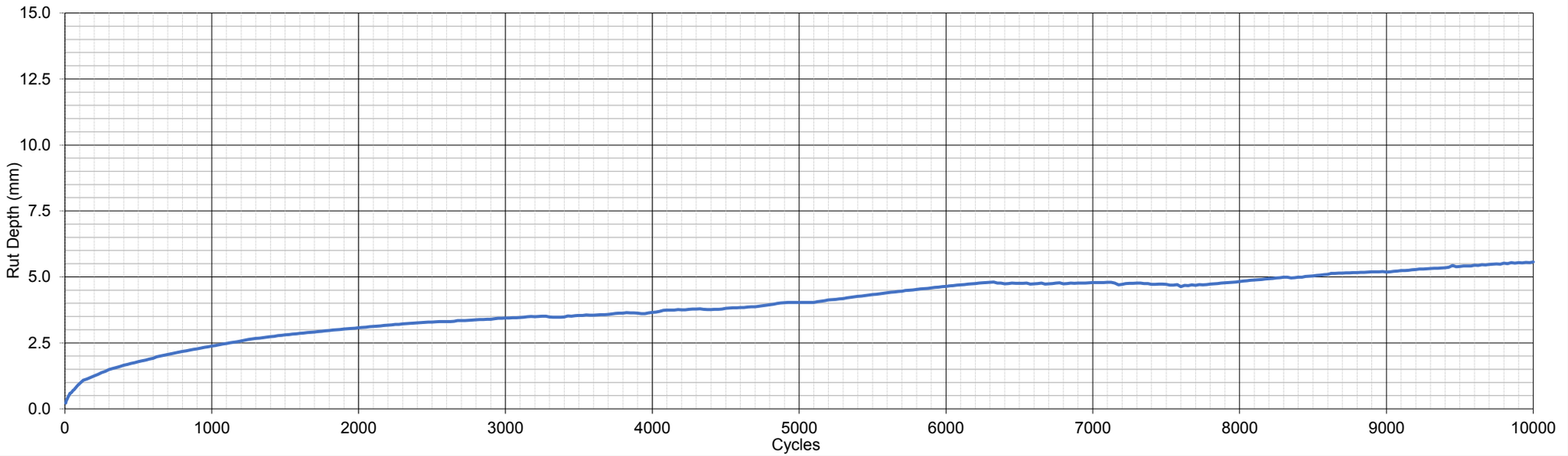
WHEEL-TRACKING

BS EN 12697-22:2003+A1:2007 - Procedure B in Air

Project Title :	**Task 1-444: Collaborative Research Project (sib-Task 1) PASS Trials - A458 Ford Village**	Tested By :	**NAL**
Job Number :	**60559099**	Location of Testing : **AECOM Laboratory, NG9 6RZ**	Reported By : **NAL**
Ticket Number :	**T1384**	Date of Issue : **19 December 2018**	Checked By : **HEB**

Sample reference: **4A**

Rut Depth Plot



Comments and Deviations:

Origin of Sample :	Extracted from Site	Sample Certificate Available :	No	**Rut Depth at 10000 cycles 5.57 mm**
Date Cored :	31 October 2018			
Date of Compaction :	n/a			

Checked by: -  Date: - **19 December 2018**

AECOM

WHEEL-TRA G

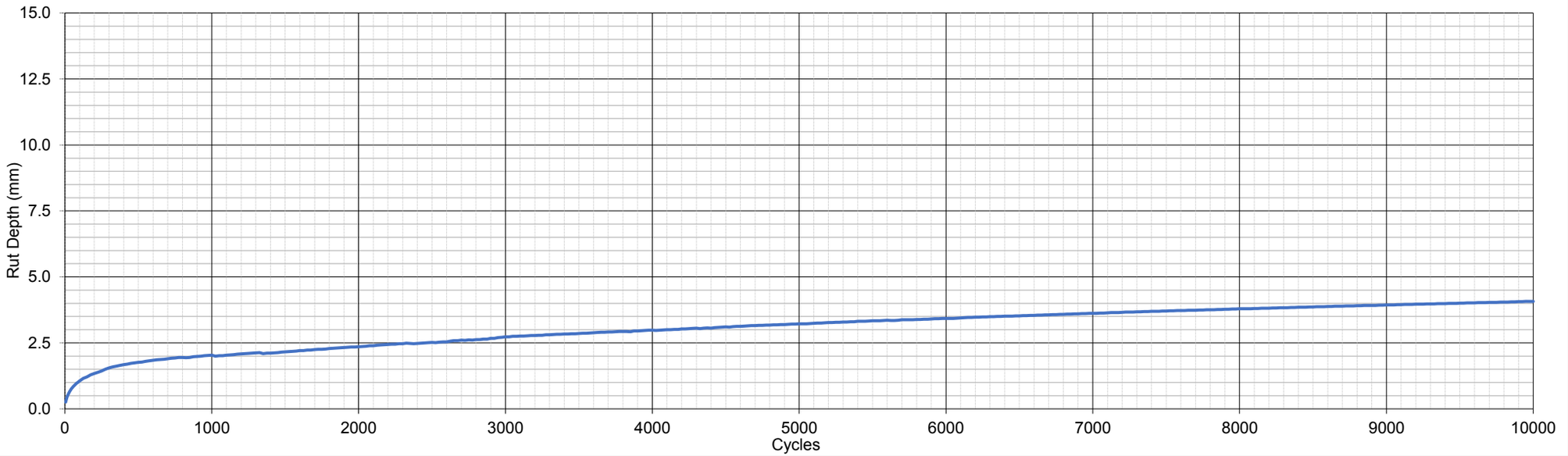
BS EN 12697-22:2003+A1:2007 - Procedu Air

UKAS TESTING 4410

Project Title :	**Task 1-444: Collaborative Research Project (sib-Task 1) PASS Trials - A458 Ford Village**			Reported By :	**NAL**
Job Number :	**60559099**	Location of Testing :	**AECOM Laboratory, NG9 6RZ**	Reported By :	**NAL**
Ticket Number :	**T1384**	Date of Issue :	**43453**	Checked By :	**HEB**

Sample reference: **5A**

Rut Depth Plot



Comments and Deviations:

Origin of Sample :	Extracted from Site	Sample Certificate Available :	No	**Rut Depth at 10000 cycles 4.07 mm**	
Date Cored :	31 October 2018				
Date of Compaction :	n/a				

Checked by: -	**Signature**	Date: -	**01 January 1900**

WHEEL-TRACKING

AECOM

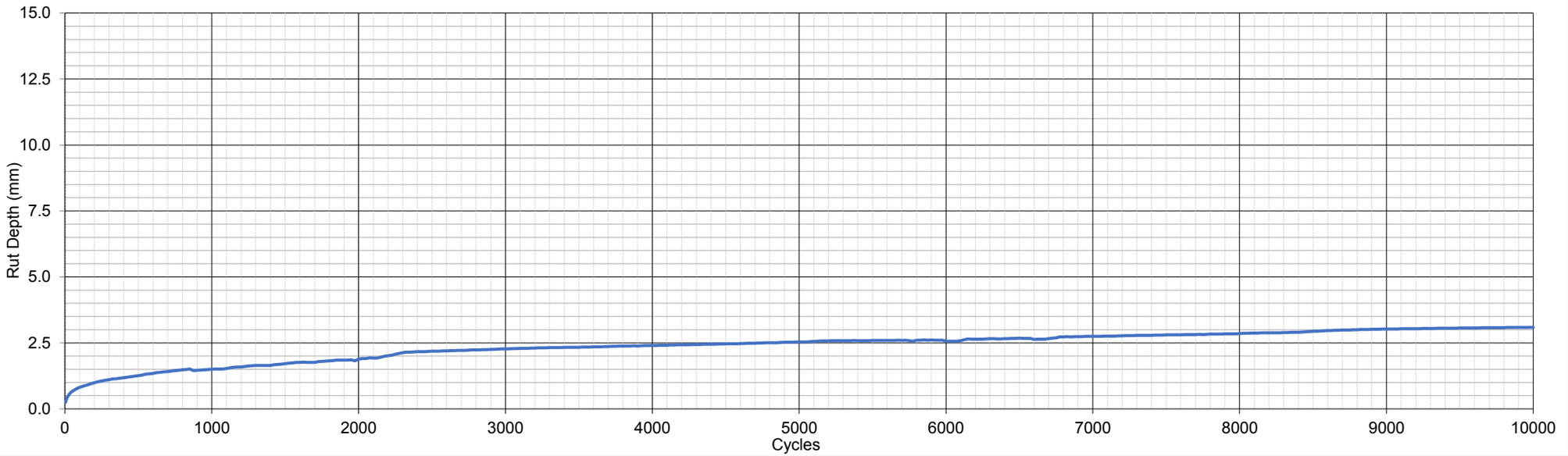
BS EN 12697-22:2003+A1:2007 - Procedu Air

UKAS TESTING 4410

Project Title :	**Task 1-444: Collaborative Research Project (sib-Task 1) PASS Trials - A458 Ford Village**	Tested By :	**NAL**
Job Number :	**60559099**	Location of Testing : **AECOM Laboratory, NG9 6RZ**	Reported By : **NAL**
Ticket Number :	**T1384**	Date of Issue : **19 December 2018**	Checked By : **HEB**

Sample reference: **6A**

Rut Depth Plot



Comments and Deviations:

Origin of Sample :	Extracted from Site	Sample Certificate Available :	No	**Rut Depth at 10000 cycles 3.09 mm**
Date Cored :	31 October 2018			
Date of Compaction :	n/a			

Checked by: -

Date: - **19 December 2018**

AECOM

SUMMARY OF INDIRECT TENSILE STIFFNESS MODULUS (ITSM) DATA

UKAS TESTING 4410

BS EN 12697-26 : 2004 (Annex C)

Project Title :	**Task 1-444: Collaborative Research Project (sib-Task 1) PASS Trials - A458 Ford Village**	Tested By :	**NAL**
Job Number :	**60559099**	Location of Testing : **AECOM Laboratory, NG9 6RZ**	Reported By : **NAL**
Ticket Number :	**T1384-1**	Date of Issue : **30 November 2018**	Checked By : **JR**

Sample Reference	Thickness (mm)	Diameter (mm)	Bulk Density (kg/m³)	Horizontal Deformation at 20°C (microns)	Rise Time at 20°C (m.sec)	**ITSM at 20°C (MPa)**
1	61.9	152.7	2268	7.0	125	**1630**
2	41.6	152.7	2175	7.1	120	**1060**
3	47.6	152.9	2305	7.0	120	**1130**
4	42.0	152.9	2309	7.0	124	**1280**
5	43.8	152.9	2301	6.9	121	**1290**
6	44.8	153.1	2247	6.9	125	**1720**
7	42.2	153.1	2319	7.0	123	**1290**
Test Annulus	70	150	n/a	n/a	n/a	Test Annulus Reference : 1-108 Test Annulus Percentage Difference : 0.7%

Comments and Deviations:

Origin of specimen : Extracted from Site

Density Method Used : Procedure C - Sealed

Checked by: - Rawlings

Date: - **30 November 2018**

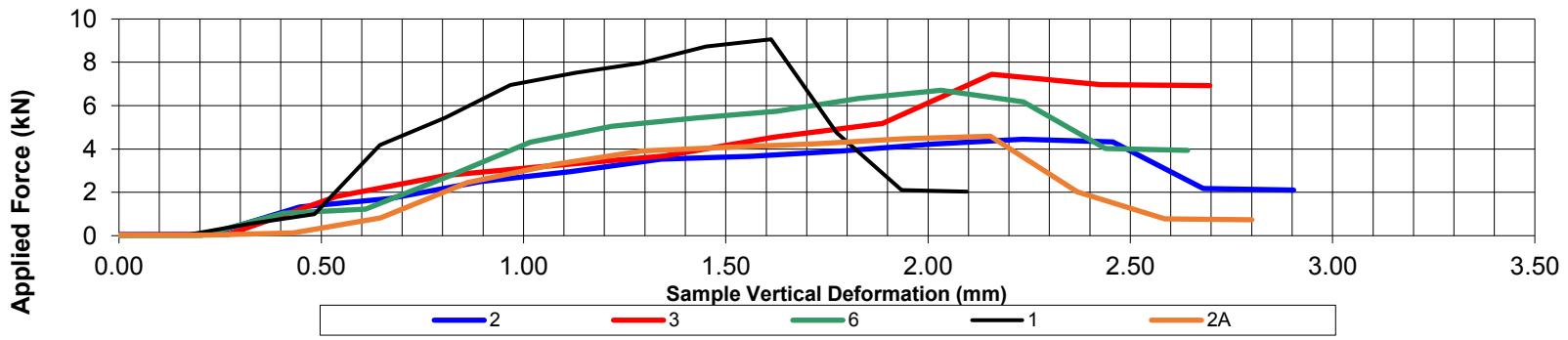
AECOM

INDIRECT TENSILE STRENGTH TEST

BS EN 12697-23:2003

Project Title :	**Task 1-444: Collaborative Research Project (sib-Task 1) PASS Trials - A458 Ford Village**	Tested By :	**NAL**
Job Number :	**60559099**	Location of Testing : **Aecom, Nottingham, NG9 6RZ**	Reported By : **NAL**
Ticket Number :	**T1384**	Date of Issue : **17 December 2018**	Checked By : **JR**

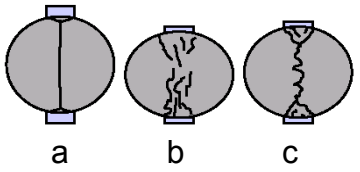
Sample ID	Test Temperature (°C)	Bulk Density (kg/m^3)	Thickness (mm)	Diameter (mm)	Peak Load (kN)	ITST (GPa)	Failure Mode	Broken Aggregate
2	20.0	2208	41.6	152.7	4.9	4.93E-04	c	Yes
3	20.0	2329	47.6	152.9	7.5	6.53E-04	c	Yes
6	20.0	2295	44.8	153.1	7.3	6.73E-04	c	Yes
1	20.0	2310	61.2	98.7	9.1	9.62E-04	a	Yes
2A	20.0	2225	39.2	98.8	4.6	7.56E-04	a	Yes



Calculations: $ITST = \frac{2P}{\pi DH}$

ITST = Indirect Tensile Strength (GPa)
P = Peak Load (kN)
D = Specimen Diameter (mm)
H = Specimen Thickness (mm)

* Failure Types
a:- clear tensile break
b:- deformation
c:- combination



Comments and Deviations:

Comments :- a: - "clear tensile break" - Specimen clearly broken along a diametrical line, except perhaps for small triangular sections close to the loading strips -
b: - "deformation" - Specimen without a clearly visible tensile break line -
c: - "combination" - Specimen with a limited tensile break line and larger deformed areas close to the loading strips -

Checked by: - Rawlings

Date: - **17 December 2018**

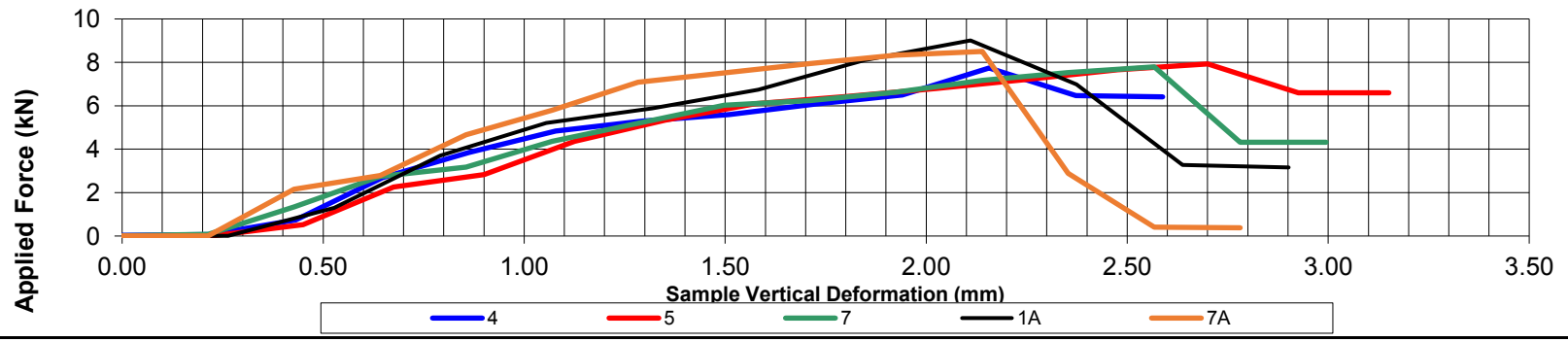
AECOM

INDIRECT TENSILE STRENGTH TEST

BS EN 12697-23:2003

Project Title :	**Task 1-444: Collaborative Research Project (sib-Task 1) PASS Trials - A458 Ford Village**	Tested By :	**NAL**
Job Number :	**60559099**	Location of Testing : **Aecom, Nottingham, NG9 6RZ**	Reported By : **NAL**
Ticket Number :	**T1384**	Date of Issue : **17 December 2018**	Checked By : **JR**

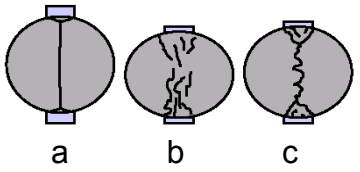
Sample ID	Test Temperature (°C)	Bulk Density (kg/m^3)	Thickness (mm)	Diameter (mm)	Peak Load (kN)	ITST (GPa)	Failure Mode	Broken Aggregate
4	20.0	2338	41.8	153.1	8.0	7.97E-04	c	Yes
5	20.0	2341	44.0	153.0	8.4	7.90E-04	a	Yes
7	20.0	2353	42.0	153.2	8.3	8.19E-04	a	Yes
1A	20.0	2313	60.5	98.7	10.7	1.15E-03	a	Yes
7A	20.0	2353	45.6	98.8	8.5	1.21E-03	a	Yes



Calculations: $ITST = \frac{2P}{\pi DH}$

ITST = Indirect Tensile Strength (GPa)
P = Peak Load (kN)
D = Specimen Diameter (mm)
H = Specimen Thickness (mm)

* Failure Types
a:- clear tensile break
b:- deformation
c:- combination



Comments and Deviations:

Comments :- a: - "clear tensile break" - Specimen clearly broken along a diametrical line, except perhaps for small triangular sections close to the loading strips -
b: - "deformation" - Specimen without a clearly visible tensile break line -
c: - "combination" - Specimen with a limited tensile break line and larger deformed areas close to the loading strips -

Checked by: - JRawlings

Date: - **17 December 2018**

DETERMINATION OF THE WATER SENSITIVITY OF BITUMINOUS SPECIMENS

BS EN 12697-12:2008 - Method A

Project Title :	**Task 1-444: Collaborative Research Project (sib-Task 1) PASS Trials - A458 Ford Village**	Tested By :	**NAL**
Job Number :	**60559099**	Location of Testing : **AECOM, NG9 6RZ**	Reported By : **NAL**
Ticket Number :	**T1384**	Date of Issue : **07 December 2018**	Checked By : **JR**

Number of Test Specimens :	6	Test Temperature :	20 °C
Type of Specimens :	Core Sample, Extracted from Site	Type of mixture :	Asphalt Surfacing

Batch ID	Wet/Dry	Average Diameter (mm)	Average Length (mm)	Average ITS (kPa)	ITSR
1	Dry	152.9	44.7	606.3	132%
1	Wet	153.1	42.6	802.0	
Batch ID	Wet/Dry	Average Diameter	Average Length	Average ITS	ITSR
	Dry				
	Wet				
Batch ID	Wet/Dry	Average Diameter	Average Length	Average ITS	ITSR
	Dry				
	Wet				
Batch ID	Wet/Dry	Average Diameter	Average Length	Average ITS	ITSR
	Dry				
	Wet				

Batch ID	Wet/Dry	Average Diameter	Average Length	Average ITS	ITSR
2	Dry	98.8	50.2	859.0	137%
2	Wet	98.8	53.1	1180.0	
Batch ID	Wet/Dry	Average Diameter	Average Length	Average ITS	ITSR
	Dry				
	Wet				
Batch ID	Wet/Dry	Average Diameter	Average Length	Average ITS	ITSR
	Dry				
	Wet				
Batch ID	Wet/Dry	Average Diameter	Average Length	Average ITS	ITSR
	Dry				
	Wet				

Comments and Deviations:

Calculations:

$$ITSR = 100x \frac{ITS_w}{ITS_d}$$

ITSR - Indirect tensile strength ratio (%)

ITS_w - Average indirect tensile strength of the wet group, in kPa

ITS_d - Average indirect tensile strength of the dry group, in kPa

Bulk Density method B

Checked by: - Rawlings

Date: - **07 December 2018**

DETERMINATION OF THE WATER SENSITIVITY OF BITUMINOUS SPECIMENS

BS EN 12697-12:2008 - Method A

Project Title :	**Task 1-444: Collaborative Research Project (sib-Task 1) PASS Trials - A458 Ford Village**	Tested By :	**NAL**
Job Number :	**60559099**	Location of Testing :	**AECOM, NG9 6RZ**
Ticket Number :	**T1384**	Date of Issue :	**07 December 2018**
		Reported By :	**NAL**
		Checked By :	**JR**

Batch ID	1	Diameter	Length	Bulk Density	ITS	Failure Type(A, B, C)	Crushed Agg (Y/N)
Sample ID	Wet/Dry	(mm)	(mm)	B (kg/m³)	(kPa)		
2	Dry	152.7	41.6	2208	493.0	C	Yes
3	Dry	152.9	47.6	2329	653.0	C	Yes
6	Dry	153.1	44.8	2295	673.0	C	Yes
4	Wet	153.1	41.8	2338	797.0	C	Yes
5	Wet	153.0	44.0	2341	790.0	A	Yes
7	Wet	153.2	42.0	2353	819.0	A	Yes

Batch ID		Diameter	Length	Bulk Density	ITS	Failure Type(A, B, C)	Crushed Agg (Y/N)
Sample ID	Wet/Dry	(mm)	(mm)	B (kg/m³)	(kPa)		

Batch ID		Diameter	Length	Bulk Density	ITS	Failure Type(A, B, C)	Crushed Agg (Y/N)
Sample ID	Wet/Dry	(mm)	(mm)	B (kg/m³)	(kPa)		

Batch ID	2	Diameter	Length	Bulk Density	ITS	Failure Type(A, B, C)	Crushed Agg (Y/N)
Sample ID	Wet/Dry	(mm)	(mm)	B (kg/m³)	(kPa)		
1	Dry	98.7	61.2	2310	962.0	A	Yes
2A	Dry	98.8	39.2	2225	756.0	A	Yes
1A	Wet	98.7	60.5	2313	1150.0	A	Yes
7A	Wet	98.8	45.6	2353	1210.0	A	Yes

Batch ID		Diameter	Length	Bulk Density	ITS	Failure Type(A, B, C)	Crushed Agg (Y/N)
Sample ID	Wet/Dry	(mm)	(mm)	B (kg/m³)	(kPa)		

Batch ID		Diameter	Length	Bulk Density	ITS	Failure Type(A, B, C)	Crushed Agg (Y/N)
Sample ID	Wet/Dry	(mm)	(mm)	B (kg/m³)	(kPa)		

Checked by: - 

Date: - **07 December 2018**