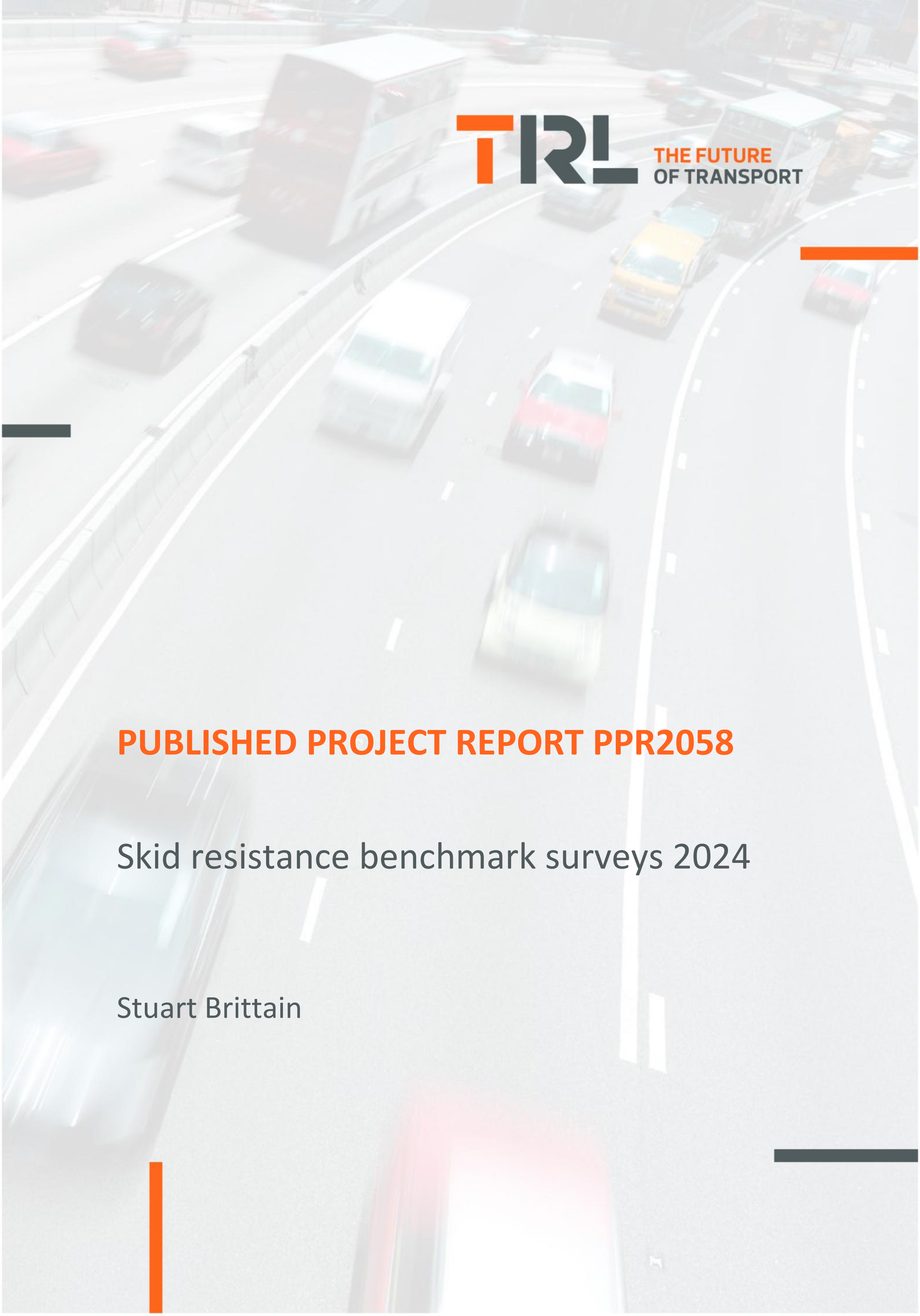

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Skid resistance benchmark surveys 2024

Stuart Brittain

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Disclaimer

Executive summary

As part of its process for managing skid resistance on the Strategic Road network (SRN), National Highways undertakes single annual skid resistance surveys (SASS). These surveys are carried out over the course of the summer and are split over three survey periods (early, middle and late). It is known that skid resistance varies during the year and between years and the survey data is corrected by the application of correction factors called the "Local Equilibrium Correction Factors" (LECF). To monitor the ongoing trends in skid resistance levels, National Highways established a series of benchmark sites. These sites are surveyed in all three of the survey periods during the survey season. The data collected is then examined for within year and between year trends in the skid resistance levels. This report discusses the analysis of the benchmark sites survey data collected in 2024, and compares the results of the analysis to those from earlier years.

Initially, in 2002, 39 sites were selected as benchmark sites, with two additional sites added in 2008 and a further two in 2009. The initial 39 sites contain mainly asphalt surfaces and the additional four contain mainly concrete surfaces.

No sites were removed from the long-term reference benchmark site list (sites which have a full survey history and have had no treatment since 2002) during the 2024 analysis. Currently 9 of the original 39 sites are suitable for use in the investigation of trends since 2002. An approach proposed in the analysis of the 2011 data and amended in 2020 to increase the amount of data used, resulted in 347 individual 100m lengths being suitable for use in the investigation of skid resistance trends over the last 10 years.

Comparison of the mean summer skid coefficient (MSSC) values from the asphalt benchmark sites suggests that 2024 was a "slightly high skid resistance" year in comparison to the average of the previous three years and a "low skid resistance" year when considering all of the years in the analysis. The analysis also found that the minimum value appears to occur on the boundary of the middle and late periods for the benchmark sites in 2024 (i.e. slightly later than expected).

For the 2024 data, the between period standard deviation for the concrete sites was above the 3 SR threshold suggesting some form of within year seasonal variation. However, it has been noted that the seasonal variation is often different from the trend seen for the asphalt sites. Therefore, the practice of not applying the LECF calculated (primarily based on asphalt lengths) to the concrete lengths on the Strategic Road Network (SRN) should continue. However, further work should be undertaken to identify if concrete specific LECF values can be calculated and if they would provide a benefit.

Analysis of the results since 2010 identified that there appears to be a flat trend between 2010 and 2019 for all sites. There then appears to be a clear downward trend for the concrete sites since 2019. However, it is less clear if this is also the case for asphalt sites. It is possible that recent low values in 2022 and 2023 are outliers and there will be a regression to the mean effect (i.e. values return to similar values as before). However, it is also possible that this is indicative of a trend in skid resistance possibly due to longer term climatic changes. This should therefore be continued to be monitored to determine if this trend continues, returns to previous levels or if it stabilises at a new mean level.

An investigation into different geographic groupings of the benchmark sites was undertaken and this did not find any consistent geographic effects on the results.

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1 Introduction

1.1 Background

As part of its process for managing skid resistance on the Strategic Road network (SRN), National Highways undertakes single annual skid resistance surveys (SASS). These surveys are carried out over the course of the summer and are split over three survey periods (early, middle and late). It is known that skid resistance varies during the year and between years and the survey data is corrected by the application of correction factors called the "Local Equilibrium Correction Factors" (LECF). Further details on the surveys and how LECFs are calculated can be found in the skidding resistance part of the DMRB (DMRB CS 228)

In order to investigate long term trends in skid resistance values, National Highways established a series of benchmark sites. These benchmark sites have three surveys in each survey season (one in each survey period) in addition to the routine annual skid resistance survey. These additional surveys allow for the investigation of trends in skid resistance within and between years.

The first of the benchmark site surveys occurred in 2002 and they have been carried out in each year since. Initially there were 39 benchmark sites selected using the following criteria:

1. The site should be well defined (i.e. easily locatable)
2. Safe to test at 50km/h
3. Traffic delays or parked vehicles unlikely
4. Straight and level
5. Typical road surfacings (excluding concrete)
6. Surfacing in good condition

As part of the investigation into the seasonal correction values generated for the network (Donbavand & Brittain, 2007), it was found that concrete did not appear to behave in the same way as asphalt surfaces with regards to seasonal variation. National Highways therefore decided that some concrete sites should be added to the benchmark site investigations. Two sites were added in 2008 (labelled 40 and 41) and a further two were added in 2009 (labelled 42 and 43).

The expected distribution of skid resistance (shown diagrammatically in Figure 1.1) means that skid resistance should be at similar levels in the early and late period surveys with the middle period producing slightly lower results. However, during the analysis of the 2005 benchmark site data it was found that the late surveys did not appear to return to levels similar to the early surveys. It was decided that an additional very late survey (i.e. after the late period survey) would be conducted in 2006 to see if the skid resistance values returned to the levels seen in the early period. This additional survey was also conducted in 2007, 2008 and 2009. A review of the data from the additional very late surveys suggested that the skid resistance was returning to levels seen in the early period during the very late period. Based on these findings, National Highways decided that the survey season should be modified so that the late surveys would produce similar results to the early surveys. The modified survey periods were first used for the 2010 surveys and the survey periods are shown in Table 1.1. Analyses undertaken since 2010 have shown that the revised dates for the survey periods continue to remain suitable.

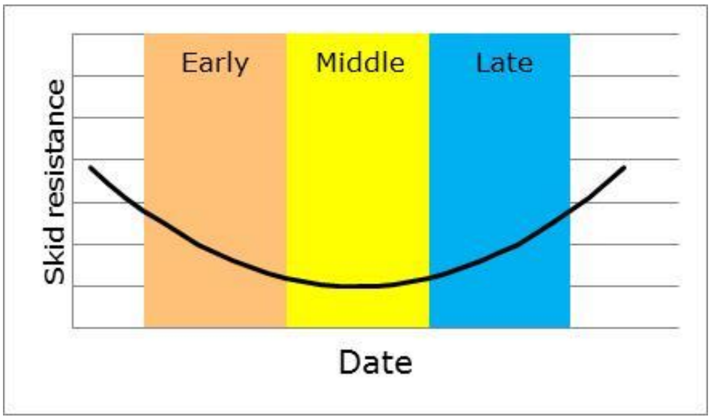

Figure 1.1: Expected seasonal variation of skid resistance over the summer

Table 1.1: Dates for the skid resistance survey periods

	Prior to 2010	2010 onwards
Early start	1st May	1st May
Early end	20th June	27th June
Middle start	21st June	28th June
Middle end	10th August	24th August
Late start	11th August	25th August
Late end	30th September	20th October
Very Late[1] start	1st October	n/a
Very late end	31st October	n/a

1.2 Directory of benchmark sites

The location and condition of each benchmark site is detailed within the directory of benchmark sites. The directory is a spreadsheet which contains schematics and summaries of the operators' notes to illustrate the surface changes and condition of each site. This directory is updated after each survey period to reflect the changes observed. The location information from the directory is reproduced in Table A.1 of Appendix A.

[1] The Very Late period was included in the surveys conducted in 2006 to 2009

2 Analysis process

2.1 Development of 10 year rolling analysis

During the analysis of the 2011 skid resistance benchmark sites data (Brittain, 2012) it was proposed that the analysis process should be amended. Prior to the amendment, the process involved examining the data from all of the sites which had not had any treatment or other anomaly since the start of the benchmark site programme in 2002. Using this approach meant that, for the report on the 2011 data, only 21 of the 39 sites could be used in the main analysis.

To increase the amount of data included in the main analysis, a new approach was formulated which would only exclude the lengths maintained, rather than removing the whole site. In addition, a new cut-off date for identifying sites with anomalies or resurfaced lengths would be set at 2010 rather than 2002. This new date was selected in part due to availability of the data in a format suitable for this analysis, and partly due to the change in the survey periods which occurred in 2010.

In the analysis of the 2019 skid resistance benchmark sites data (Brittain, 2020) it was proposed that this analysis should be further refined to use a rolling 10 year analysis, i.e. for the analysis of the 2024 surveys, data from 2015 to 2024 would be used. The results from this analysis, incorporating the data from the 2024 surveys, are given in Section 4.

2.2 Combining 10 year rolling analyses

Over time, the 10 year rolling analysis approach will result in overlapping sets of 10 year analyses. Therefore, to provide an indication of trends going back to 2010 a method of providing values normalised to the current analysis from years before the current 10 year window was developed prior to the 2022 analysis.

The first step of this process is to determine the normalisation factor. This is calculated by dividing the average SR value for the earliest survey year in the current analysis by the average of the values obtained in previous analyses (which themselves are the average values of the included lengths) for the same survey year. This normalisation factor is then multiplied by the average SR values obtained for the earlier survey analyses (either directly measured or the normalised values) to generate the normalised value. This process is then repeated to produce normalised values back to 2010. An example illustrating this process is given in Figure 2.1.

	Average SR for 2013 analysis year	Average SR for 2014 analysis year	Average SR for 2015 analysis year	Average SR for 2016 analysis year	Average SR for 2017 analysis year	Average SR for 2018 analysis year	Average SR for 2019 analysis year	Average SR for 2020 analysis year	Average SR for 2021 analysis year
2010 survey year	I	II	III	IV	V	VI	VII	a	b
2011 survey year	VIII	IX	X	XI	XII	XIII	XIV	XV	c
2012 survey year	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV
2013 survey year	…	…	…	…	…	…	…	…	…
2014 survey year	-	…	…	…	…	…	…	…	…
2015 survey year	-	-	…	…	…	…	…	…	…

Where:

$$a = \frac{XV}{Average(VIII\ to\ XIV)} \times Average(I\ to\ VII)$$

$$b = \frac{XXIV}{Average(XVI\ to\ XXIII)} \times Average(I\ to\ a)$$

$$c = \frac{XXIV}{Average(XVI\ to\ XXIII)} \times Average(VIII\ to\ XV)$$

Figure 2.1: Overview of process for calculating normalised values for examination of trends since 2010

2.3 Examination of trends going back to 2002

So that it is still possible to examine trends going back to 2002, an analysis based on the original approach was also undertaken and is reported in Appendix B.

Consideration was given to merging this data into the combined analysis discussed in Section 2.2. However, the change in survey periods prior to the 2010 surveys and the different approaches to the datasets meant that this did not appear to be a suitable approach.

Over time the original approach for processing the benchmark sites is becoming less robust due to the reduction in the number of sites that are suitable for inclusion in the analysis. Therefore, the appropriateness of this analysis will be reviewed annually, and will be removed when it is no longer deemed sufficiently robust. The review of the 2024 data found that it is still suitable to report the trends going back to 2002. However, it is expected that this analysis will be dropped in the next few years.

3 Survey issues

3.1 Alignment of data

Prior to 2021, the survey contractor provided data with markers entered using push button entry. When using these markers to align the data, it was found that the resulting alignments were, in general, good. It is, however, sometimes necessary to shift the locations of the markers by up to 50m (based on a visual analysis of the patterns in the data).

For the review of the 2021 surveys the data was manually aligned (using the graph shapes and OSGR data). This work identified that it would be better to use fitting tools to automatically identify the marker position using the OSGR data. This should ensure a good starting point for the alignment process. This was introduced for the 2022 surveys and the fitting was carried out using the software provided by National Highways (Machine Survey Pre-processor or MSP) to survey contractors to fit data for the SASS of the network. After fitting, the data was reviewed manually to identify if any small changes to the alignment would be necessary.

To run the fitting process, route files are required which contain OSGR coordinates of specified points in the survey. These were created prior to the 2022 analysis using the National Highways network section definition. The use of National highways network sections will make it easier to extract the matching construction records (and other useful data) from National Highways pavement management system. It is known that the network definition can change over time so these files will need to be reviewed annually and updated as appropriate. In addition, some of the sites might start and finish partway through sections; as such, a record will be kept of these offsets and applied to the fitted data before manually checking the alignment. A review of the files prior to the processing of the 2024 found that only minor updates were required due to small changes (<1m) in the reported position of some of the start and end points.

3.2 Issues and observations from surveys

Each 100m length of each site for each survey year is marked with one of three options. These are:

- Valid – No issues with the current year's data and no maintenance between the previous year and the current year.
- Invalid – Issues with the consistency of the current year's data. For example, if the length was resurfaced during the survey year or there was an issue with the survey (e.g. closed for roadworks). This data is not used in any analysis.
- Changed – Length has been resurfaced between the current and previous year's survey. Previous data for this length will be excluded from future analyses (i.e. assuming no further issues this length will be re-included in the analyses in 10 years time).

For the 2024 survey data, five sites (6, 16, 22, 26, and 43) had issues identified from the data, the construction records in National Highways' pavement management system (P-AMS), the video and/or from the operator's notes (recorded in the directory of benchmark sites).

3.2.1 Site 6

The survey notes for this site identified debris in the wheelpath for the first 50m of the site for the middle survey. On examination of the survey data (Figure 3.1) for the site it was found that the shape of the middle survey differed at this point relative to the other surveys. In addition, there was also a spike in the value reported for the first measurement on the late survey. Therefore, the first 50m of this site was marked as invalid for the 2024 survey.

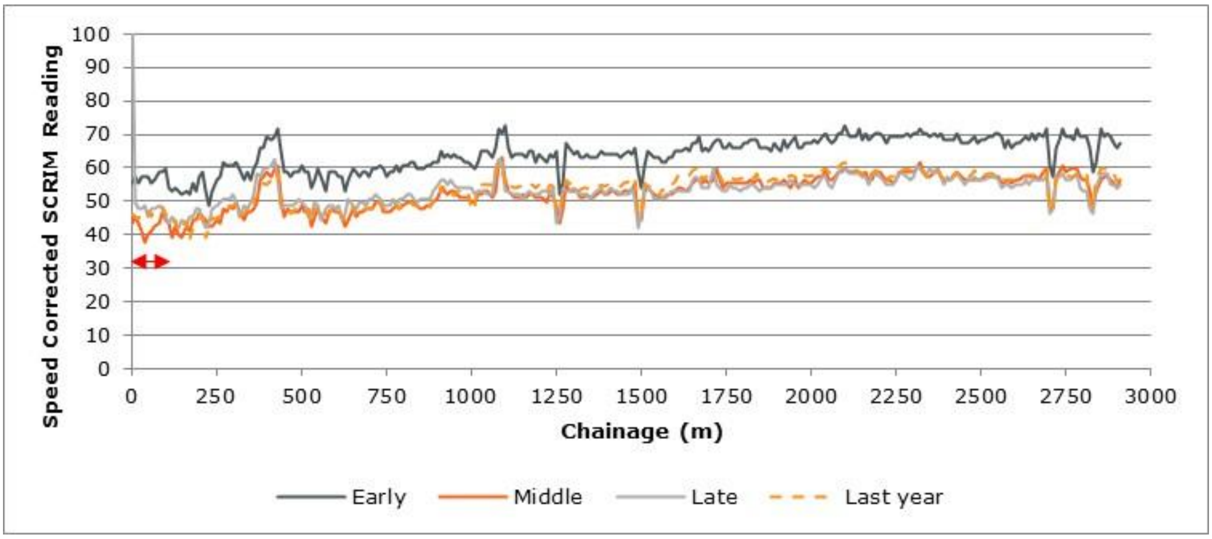

Figure 3.1: Skid resistance values from the 2024 survey for site 6

3.2.2 Site 16

Both the survey notes and the P-AMS construction records identify three short lengths which have been maintained between the early and middle surveys. The lengths can also be seen in the survey data as shown in Figure 3.2. Therefore, these lengths have been marked as invalid for the 2024 survey.

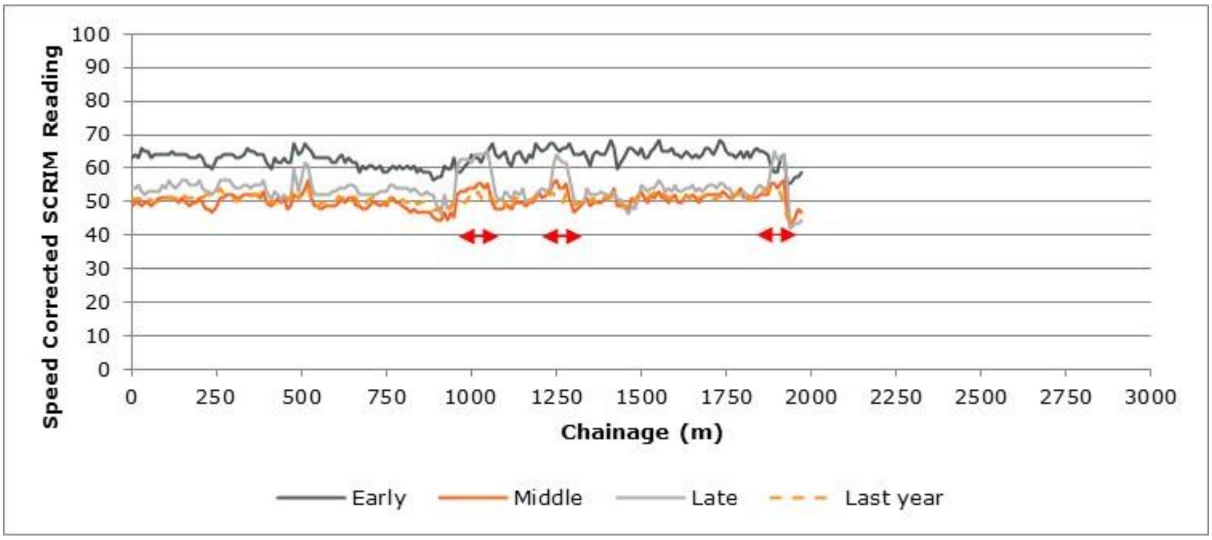

Figure 3.2: Skid resistance values from the 2024 survey for site 16

3.2.3 Site 22

The survey notes for the 2024 surveys of this site identified maintenance was undertaken on several parts of this site prior to the early survey. At the time of writing this report this maintenance was not recorded in P-AMS. It was possible to match up the lengths identified in the survey notes with changes in the levels of skid resistance seen. However, it is noted that for the 2023 surveys of this site there were noticeable differences between the early, middle and late surveys. This meant that this site was labelled as invalid for the 2023 survey. The measurements from the 2024 surveys are shown in Figure 3.3 and for the 2023 surveys in Figure 3.4. As such, site 22 will be excluded from the analysis until 2024 is the first year of the analysis window.

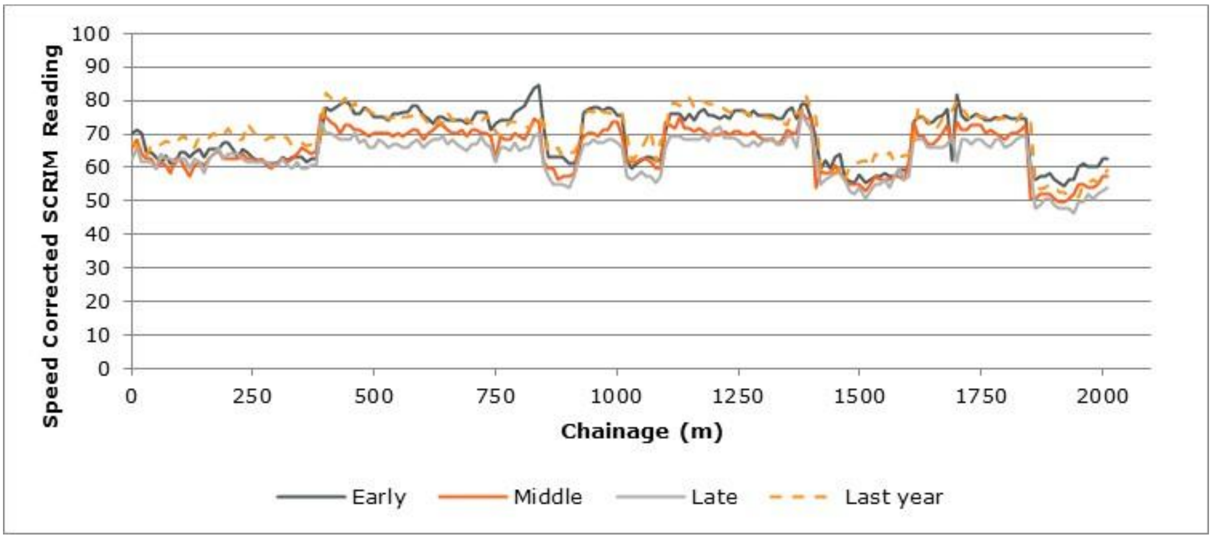

Figure 3.3: Skid resistance values from the 2024 survey for site 22

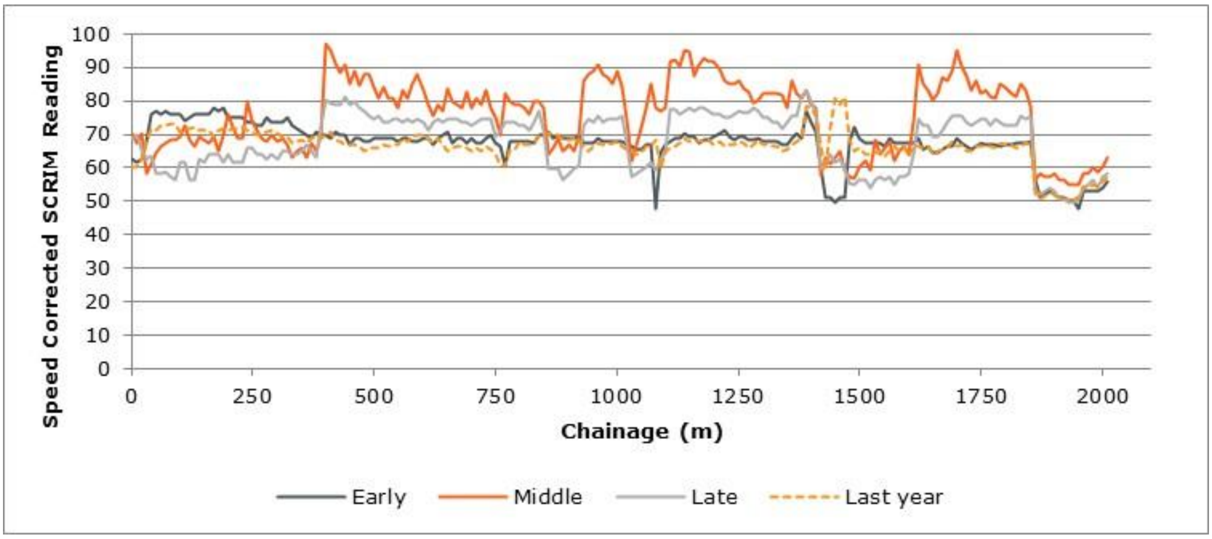

Figure 3.4: Skid resistance values from the 2023 survey for site 22

3.2.4 Site 26

During the middle and late surveys, lane 1 of site 26 was closed for roadworks. Therefore, this site was marked as invalid for the 2024 survey.

3.2.5 Site 43

The survey notes did not identify any maintenance on this site. However, the construction records in P-AMS identify that part of the site was resurfaced prior to the middle survey. This length can be seen in the survey data, as shown in Figure 3.5. Therefore, this length within site 43 was marked as invalid for the 2024 survey.

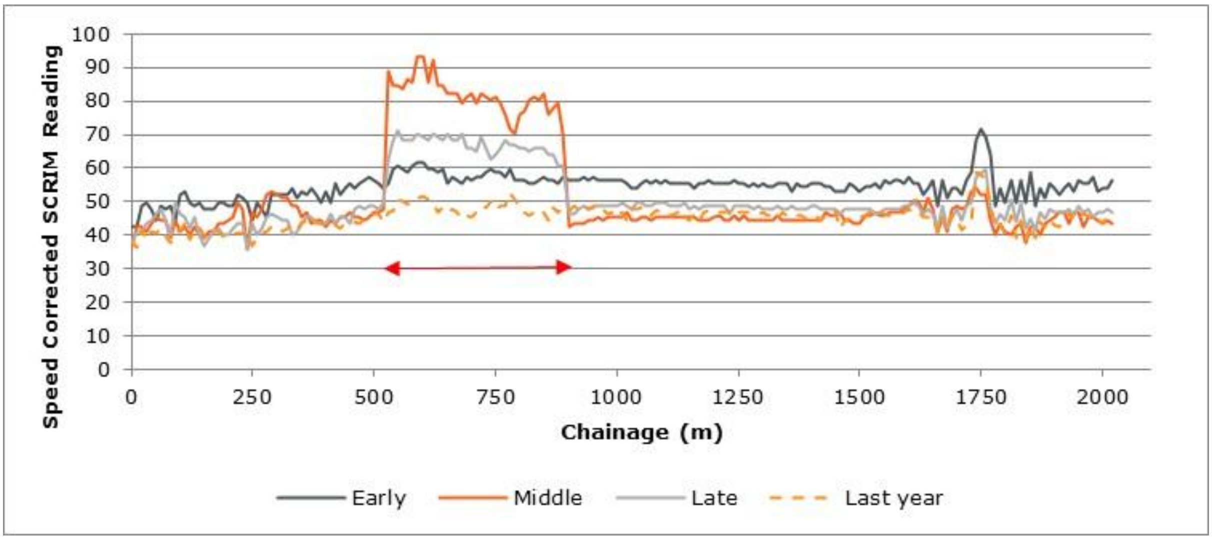

Figure 3.5: Skid resistance values from the 2024 survey for site 43

3.2.6 Summary of issues and observations from surveys

A summary of all the sites which have had any anomalies since the start of the benchmark site programme, which has resulted in them being removed from the long term reference benchmark sites, is shown in Table 3.1. Entries shown in grey italics reflect small anomalies which did not warrant removing the site at those points (but should be removed if any additional issues are found).

If a benchmark site has undergone treatment, is missing surveys or otherwise unsuitable during the analysis period then it can no longer be considered as part of the long term reference set (i.e. used to calculate the average trend in MSSC since 2002). The analysis of the long term reference set is provided in Appendix B.

Table 3.1: Summary of when sites have been removed from the long term reference

Site Numbers	Year	Comments
5	2005	Resurfaced in 2005
4	2007	The late run in 2007 was carried out in lane 2 instead of lane 1
7, 15, 23 and 33	2007	Resurfaced in 2007
10, 16, 20, 22, and 30	2008	These sites were resurfaced in 2008.
2, 21, and 37	2009	Resurfaced in 2009.
24	2009	Site closed during mid period for work on overhead gantry.
28	2010	Road works during early 2010 survey
34	2010	Difference between the early start point and the mid/late start point
11	2011	Unable to align 2011 data
39	2012	Invalid data for part of the testing and resurfaced between 2011 and 2012
26	2014	Was not surveyed
29	2015	First half of the site was resurfaced between the early and middle surveys
3	2016	The whole site has been resurfaced.
6	2017	Site resurfaced between 780 and 2875m between early and middle surveys
17, and 18	2018	Treatment to parts of the sites
38	*2019*	*Short length maintained at end of site (should not be removed from long term analysis at this stage)*
19	2020	No middle survey
8 and 35	2021	Last third of site resurfaced
31	*2022*	*Short length maintained at start of site (should not be removed from long term analysis at this stage)*
32	2022	Anomalies at start and of the site in the Early survey
9	2023	Site was resurfaced between the Early and Middle surveys
13	*2023*	*Short length maintained in the middle of the site (should not be removed from long term analysis at this stage)*
31	*2023*	*Short length maintained near the start of the site (should not be removed from long term analysis at this stage)*
16	2024	Three short lengths maintained
22	2024	Long lengths maintained between 2023 and 2024
26	2024	Surveyed in lane 2 for the mid and late surveys due to roadworks
43	2024	Significant length maintained between 2023 and 2024

No sites were removed from the long term reference benchmark sites this year. Sites 16, 22 and 26 have already been excluded. Site 43 is a concrete site which was added in 2009 and therefore was not included in the reference benchmark sites. There are currently 9 long term reference benchmark sites and these are listed in Table 3.2.

Table 3.2: Reference benchmark sites

Site	Road
1	A30
12	A12
13	A47
14	A1
25	M40
27	A616
31	M6
36	M6
38	A1

An approach proposed in the analysis of the 2011 data (and amended following a review of the 2019 data) to increase the amount of collected data used, enabled skid resistance trends of individual 100m lengths to be analysed from 2013 onwards.

For the 2024 surveys, following the removal of unsuitable lengths, 256 (of 627) individual 100m lengths were available for the investigation of skid resistance trends over 10 years for the asphalt sites and 91 (of 109) 100m lengths for the concrete sites. This is a decrease of 1 for the asphalt sites and 4 for the concrete sites in comparison to last year's analysis. The distribution of these lengths amongst the benchmark sites is shown in Table 4.1.

3.2.7 All lane running

Some parts of the National Highways network have been converted to all lane running (ALR) which is resulting in Lane 1 changing position (to where the hard shoulder was). To date only two sites have been affected by changing to ALR.

The first is site 26 (on the M1). The first survey on this site on the new lane 1 was in 2015. As such this site is currently excluded from the analysis and is expected to be re-included in 2025 (due to the 10 year rolling analysis approach discussed in Section 4.1).

The second is site 23 (on the M6). The first survey on this site on the new lane 1 was in 2022. As such this site is currently excluded from the analysis and is expected to be reincluded in 2032.

4 Results from the 2024 surveys (10 year rolling analysis)

4.1 Average SR and between survey variation

The process implemented to examine data may, in some years, result in some of the sites reducing to very short lengths. These shorter sites should not have as much input into the overall benchmark statistics as longer sites. To allow a sensible weighting of the data, each site is split into 100m lengths, with the average values for each 100m length being averaged together to produce the overall average for the benchmark sites. The results from the 2024 surveys are given in Table 4.1.

Using this process means that the lengths used in the benchmark site analysis change each year, and as such the data provided in previous years' reports will not always be directly comparable to that in the current year's report. This is because some lengths will be excluded in the current analysis which were not previously excluded. In addition, lengths that were excluded as a result of the data collected 11 years ago would be brought back in for this analysis. To provide a comparison to the results of this year's analysis, the data from the preceding 9 years have been reprocessed using the same lengths used for the 2024 analysis; this analysis is presented in Appendix C.

Utilising 100m averages for this analysis also allows for the investigation of between run variation using the criteria from the accreditation trials for sideway-force skid resistance devices (TRL, 2020) as a comparison; i.e. if the road conditions remain the same, the upper limit on the acceptable between run standard deviation is 3 SR. This means that if seasonal variation is occurring then it would be expected that the variation between the early, middle and late runs would be larger than 3 SR. Note, the between run standard deviations have been averaged together using the root mean square approach (the standard approach for calculating averages of standard deviations).

For the 2024 data the between run standard deviation (BRSD) is above the 3 SR threshold for both the asphalt and concrete sites.

Table 4.1: 2024 survey data

Site	Number of 100m lengths	Early Avg. SR	Middle Avg. SR	Late Avg. SR	BRSD	Average
1	22	70.7	59.4	62.4	6.11	64.2
2	0	-	-	-	-	-
3	0	-	-	-	-	-
4	0	-	-	-	-	-
5	0	-	-	-	-	-
6	0	-	-	-	-	-
7	0	-	-	-	-	-
8	0	-	-	-	-	-
9	0	-	-	-	-	-
10	23	63.3	55.0	56.0	4.91	58.1
11	3	72.2	57.1	65.7	7.68	65.0
12	9	60.2	59.1	54.2	3.77	57.8
13	11	55.5	54.0	49.0	3.51	52.8
14	21	61.9	59.5	58.8	2.08	60.1
15	1	43.3	39.4	42.5	2.06	41.7
16	15	63.2	50.1	53.4	6.91	55.6
17	10	42.1	38.0	35.5	3.42	38.5
18	0	-	-	-	-	-
19	0	-	-	-	-	-
20	0	-	-	-	-	-
21	11	61.0	56.0	51.1	5.44	56.1
22	0	-	-	-	-	-
23	0	-	-	-	-	-
24	11	59.8	56.4	51.6	4.12	55.9
25	13	67.3	64.4	60.3	3.65	64.0
26	0	-	-	-	-	-
27	15	63.8	60.2	62.4	1.99	62.2
28	0	-	-	-	-	-
29	0	-	-	-	-	-
30	0	-	-	-	-	-
31	14	65.3	58.2	54.5	5.51	59.4
32	6	48.2	42.1	43.1	3.76	44.5
33	0	-	-	-	-	-
34	0	-	-	-	-	-
35	13	53.2	50.8	48.0	2.65	50.7
36	9	56.5	51.0	46.0	5.61	51.2
37	14	62.7	58.2	57.3	3.25	59.4
38	14	59.1	53.8	54.4	3.04	55.8
39	21	58.9	51.3	52.4	4.16	54.2
40	13	58.2	54.1	54.0	2.80	55.4
41	44	42.6	39.0	37.5	2.83	39.7
42	18	51.7	43.2	44.9	4.61	46.6
43	16	53.8	45.1	46.5	4.94	48.5
Asphalt 0-39	256	60.9	55.1	54.3	4.42	56.8
Concrete 40-43	91	48.6	43.1	42.9	3.67	44.9

A summary of between run standard deviations (BRSD) and the average SR values since 2015 are presented in Table 4.2 for the asphalt lengths and in Table 4.3 for the concrete lengths. The BRSD values are also shown in Figure 4.1, and the average SR values in Figure 4.2 (along with the trend lines for the data).

Table 4.2: Summary of asphalt site data

Year	BRSD	Average SR
2015	5.27	58.2
2016	4.32	59.5
2017	6.31	57.6
2018	5.72	59.8
2019	4.70	59.4
2020	4.47	57.8
2021	6.26	57.8
2022	5.68	52.1
2023	2.86	55.0
2024	4.42	56.8
Average	5.10	57.4

Table 4.3: Summary of concrete site data

Year	BRSD	Average SR
2015	5.15	49.5
2016	2.13	52.4
2017	3.72	48.6
2018	4.00	50.4
2019	3.92	49.3
2020	3.00	45.2
2021	5.50	46.3
2022	3.91	41.5
2023	4.20	42.9
2024	3.67	44.9
Average	4.02	47.1

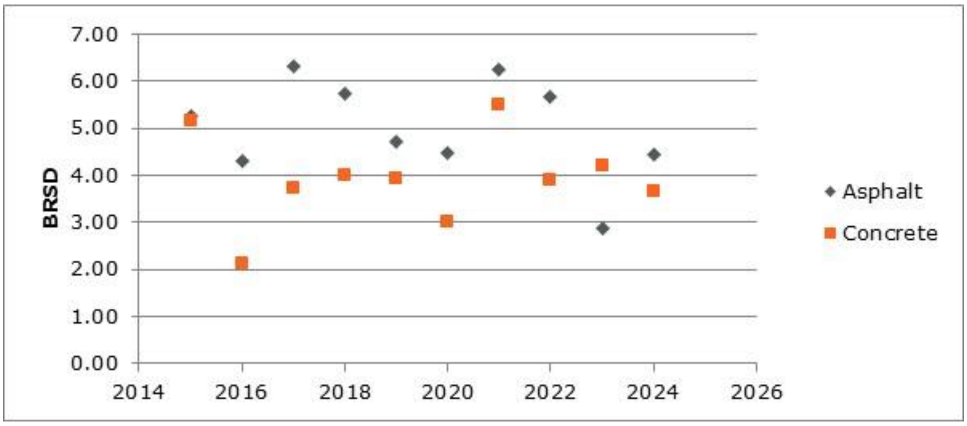

Figure 4.1: Average BRSD of Benchmark sites over 10 year analysis period

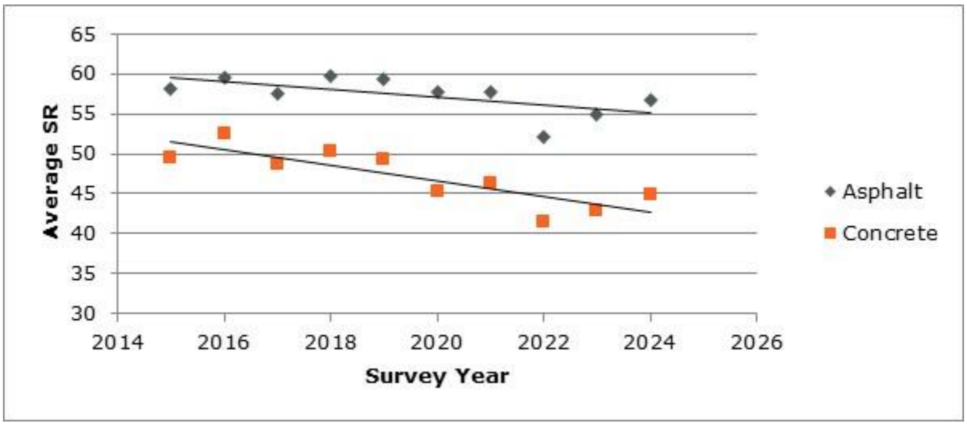

Figure 4.2: Average SR of Benchmark sites over 10 year analysis period

Table 4.2, Table 4.3 and Figure 4.1 show that the between run or between period standard deviation (BRSD) for the asphalt surfaces is highest for the 2017, 2018, 2021 and 2022 survey years, and lowest in 2023. In addition, in the last 10 years, it can be seen that the BRSD is at or below the BRSD criteria from the accreditation trials (3 SR) in one instance for the asphalt surfaces (2023) and two years for the concrete surfaces (2016 and 2020). This suggests that the variation during these years is likely to be mainly or solely caused by normal machine variation.

Table 4.2, Table 4.3 and Figure 4.2 suggest that, with the exception of 2022 and to a lesser extent 2023, the average SR value for the asphalt sites is fairly stable over time. The average SR value for the concrete sites appears to be decreasing over time. However, it is noted that the level seen for 2024 is similar to the value in 2020. The data from the individual concrete sites can be seen in Figure 4.3.

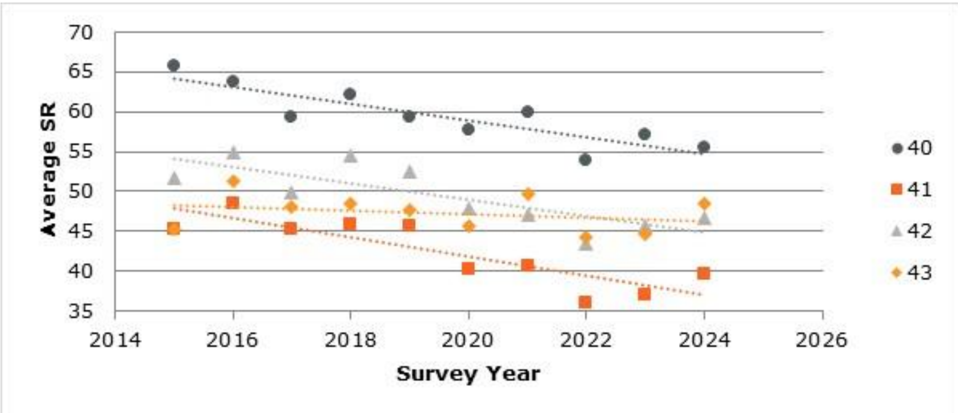

Figure 4.3: Average SR of the concrete Benchmark sites over 10 year analysis period

Figure 4.3 shows that, with the exception of site 43 (which shows a shallow/flat trend) the individual concrete sites all show a similar downward trend in the SR values over the time frame.

4.2 Expected distribution of SC for asphalt sites

In order to visualise the variation of Skid Coefficient (SC) throughout the course of the survey season the ratio of the MSSC value to the measured value (for each period and each 100m length) was calculated. This ratio is approximately equivalent to a Local Equilibrium Correction Factor (LECF) value (although strictly it is not, as it would only correct within year variation and it is being applied to 100m lengths). The average MSSC value for the complete 2024 dataset was then divided by these "LECF" values and combined with the survey dates to produce an estimate for the distribution of SC values.

Using this approach allows the current year's data to be compared to previous years on a like for like basis. In particular, differences in average values between years and also within year trends can be investigated. The lines of best fit for the data for the last five years are shown in Figure 4.4.

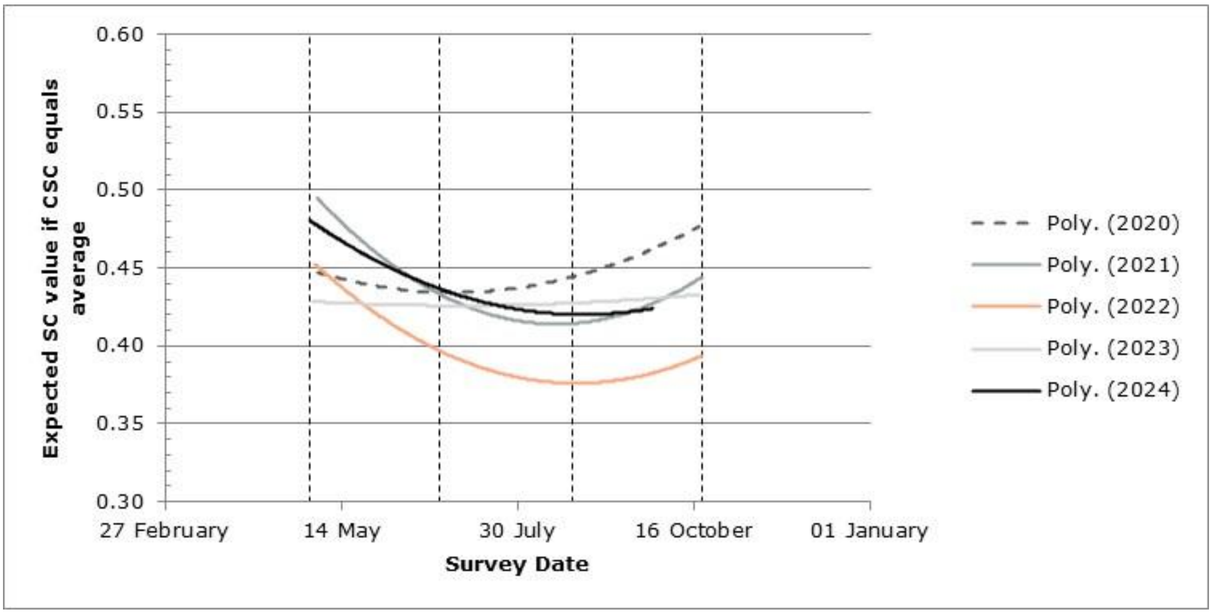

Figure 4.4: Expected SC values (sites 1-39)

It can be seen from Figure 4.4 that the within year seasonal variation, varies from year to year. It can also be seen that for the 2024 data the minimum value appears to lie on the middle to late period survey boundary rather than the midpoint of the middle period. It should be noted that the surveys of the benchmark sites are usually targeted for near the start of the early period, the midpoint of the middle period and towards the end of the late period. For the 2024 survey, the late surveys were completed about midway through the period making it harder to assess the recovery in skid resistance in the late period (this is also why the line ends earlier on the graph).

The analysis of the 2024 LECFs (Brittain, 2025) suggested that the minimum value occurred towards the end of the middle period (i.e. earlier than the benchmark site analysis suggests but still later than expected).

It is noted that this slightly later than expected minimum value has also been seen in recent years. This suggests that it is possible that changes in weather patterns/climate are causing the minimum value to occur later. However, the potential shift is subtle and does not suggest that it is necessary to change the dates of the surveys season. It is recommended that the suitability of the survey periods should continue to be reviewed on an annual basis.

The analysis of the 2024 LECFs also found that the measured skid resistance over the year was slightly above the average of the previous three years. On examination of Table 4.2 it can be seen that this is also true for the asphalt benchmark sites with an average value of 56.8 in 2024 compared to the average of the previous three years (2021, 2022 and 2023) of 55.0.

As noted in the report on the analysis of the 2022 benchmark sites data (Brittain, 2023) the measured SR was noticeably lower in 2022 than any of the other years in the analysis. This low value is likely due to the very warm and dry summer experienced in 2022, and suggests that climate change may result in larger variations in the skid resistance level recorded on the network.

4.3 Expected distribution of SC for concrete sites

The approach used to visualise the distribution of SC values for asphalt sites (see Section 4.2) was also applied to the concrete sites and the results are shown in Figure 4.5.

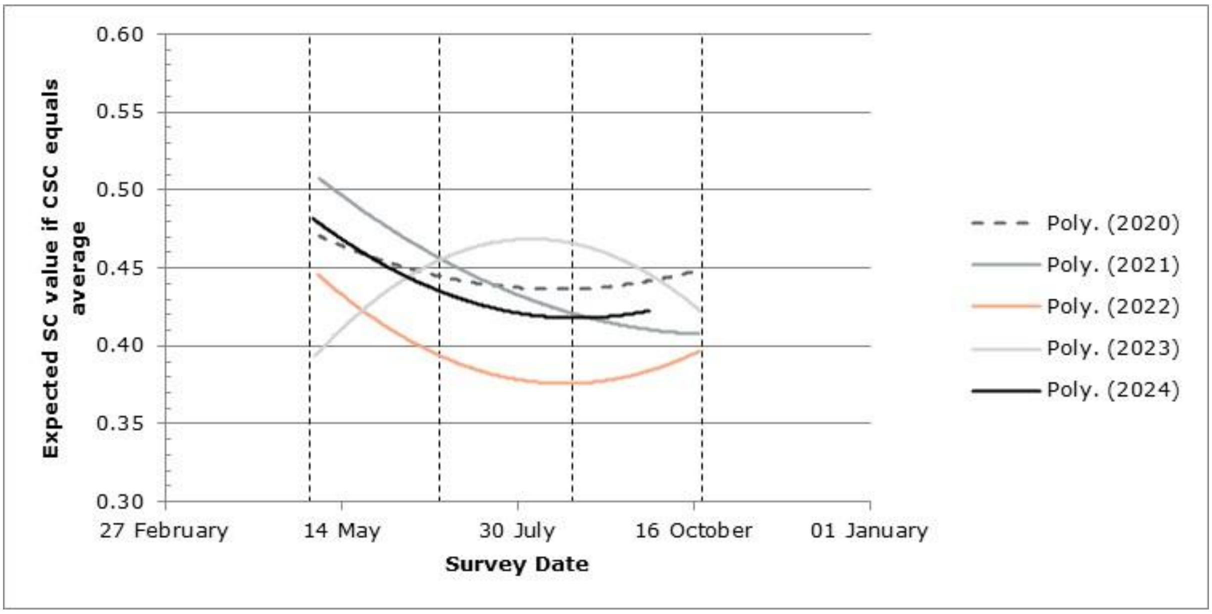

Figure 4.5: Expected SC values (sites 40-43)

The data from the concrete sites for 2024 shows a similar shape as the asphalt sites in 2024. However, it is noted that this is not always the case. However, with the exception of the 2023 surveys each year appears to show the seasonal variation close to the expected shape. The results from the 2023 surveys are further discussed in the 2023 benchmark sites report (Brittain, 2024) . As with previous years this suggests that concrete sites do experience seasonal variation but that this variation may differ from the variation seen for asphalt sites. Therefore, the practice of not applying the LECF calculated (primarily based on asphalt lengths) to the concrete lengths on the Strategic Road Network (SRN) should continue. However, further work should be undertaken to identify if concrete specific LECF values can be calculated and if they would provide a benefit.

4.4 Monitoring lengths available for the analysis

Prior to the 2020 analysis, the procedure used data collected since 2010 and excluded any lengths that had been maintained or had incomplete surveys over the period. This meant that the lengths available to the analysis reduced slightly each year. In the analysis of the 2019 data it was proposed that the procedure would be changed to a rolling 10 year cut-off so that lengths previously excluded could be brought back into the analysis. This rolling cut-off was first applied to the analysis of the 2020 surveys meaning data collected since 2011 was used. The analysis of the 2024 surveys used data collected since 2015. The lengths used in the analysis for each survey year is given in Figure 4.6 for asphalt lengths and in Figure 4.7 for concrete lengths.

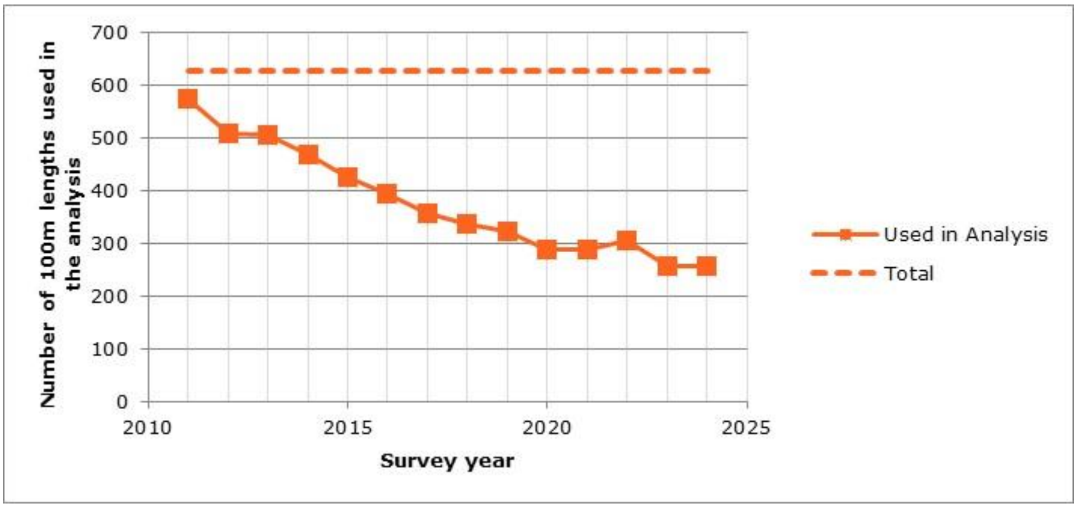

Figure 4.6: Number of 100m asphalt lengths used in the anlaysis

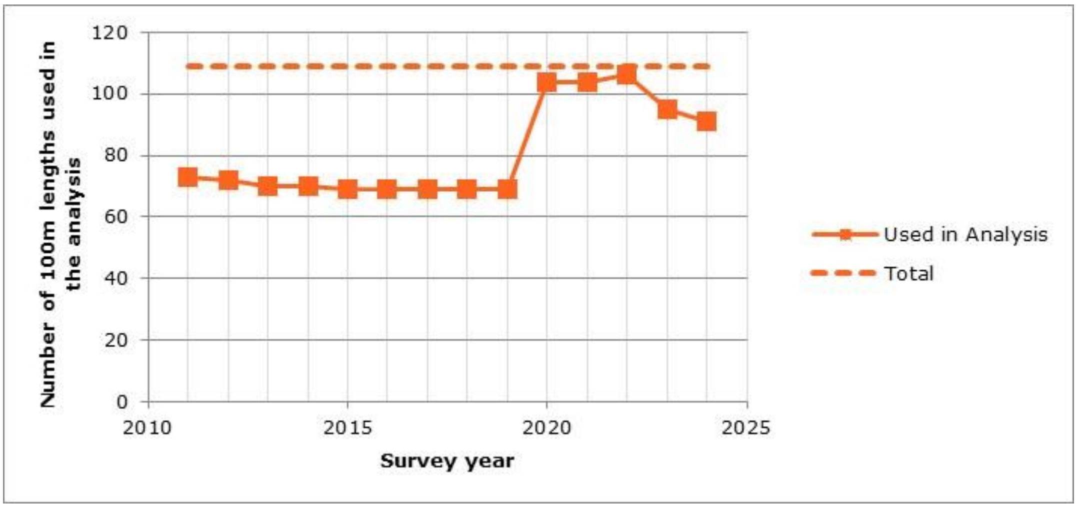

Figure 4.7: Number of 100m concrete lengths used in the anlaysis

The number of lengths (both asphalt and concrete) used in the current analysis has decreased slightly this year. Overall, 41% of the asphalt lengths were used in the current analysis, and 83% of the concrete lengths.

5 Results since 2010

As noted in Section 2.2, a method for combining the current 10 year rolling analysis with previous analyses has been developed in order to provide trends in SR values since 2010. The result of this analysis is presented in Figure 5.1 and Table 5.1.

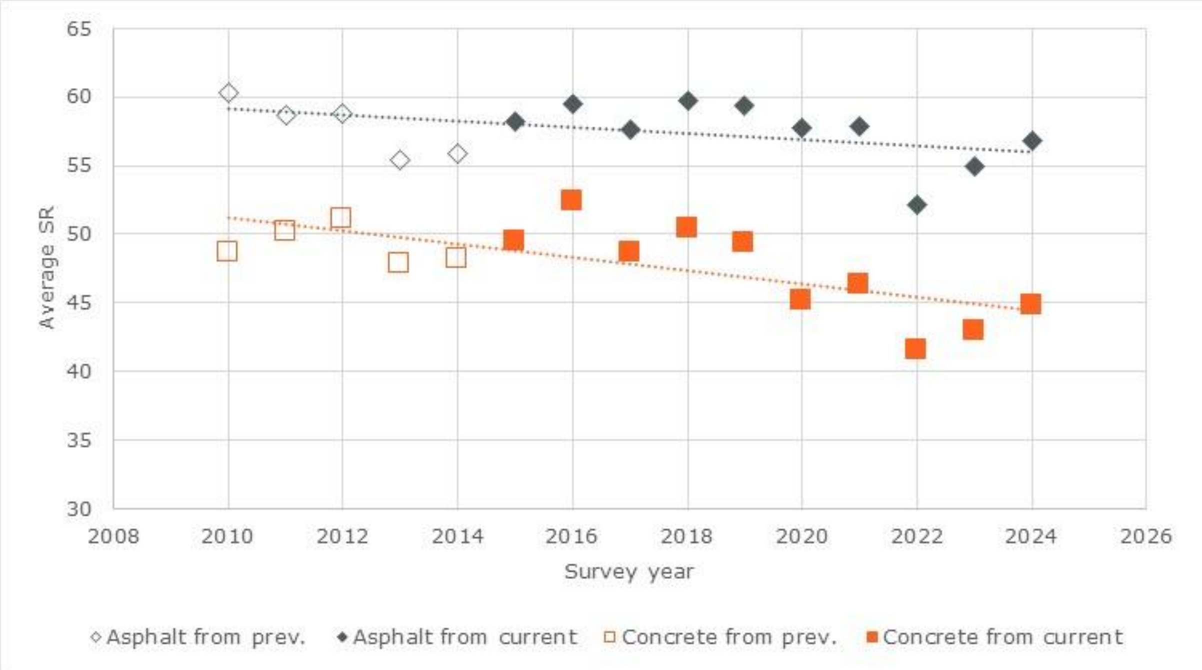

Figure 5.1: Average SR of Benchmark sites since 2010

Table 5.1: Average SR of Benchmark sites since 2010

Year	Asphalt sites	Concrete sites
2010 (estimate)	60.28	48.62
2011 (estimate)	58.73	50.17
2012 (estimate)	58.81	51.09
2013 (estimate)	55.37	47.87
2014 (estimate)	55.82	48.14
2015	58.24	49.50
2016	59.50	52.43
2017	57.62	48.64
2018	59.75	50.40
2019	59.40	49.35
2020	57.78	45.19
2021	57.81	46.29
2022	52.15	41.48
2023	55.00	42.90
2024	56.76	44.85

With the exception of the 2022 (and possibly 2023) data, the data shown in Figure 5.1 and Table 5.1 suggests a relatively flat trend over time for the asphalt lengths.

During the analysis of the 2023 surveys of the benchmark sites (Brittain, 2024) it was noted that the concrete sites appeared to have a flat trend between 2010 and 2019, followed by a downward trend for the 2019 to 2023 data. This trend also appeared to be present to a lesser extent for the asphalt lengths. The SR values for the 2024 surveys (for both asphalt and concrete lengths) are higher than the 2023 surveys. Therefore, this effect (possible downward trend since 2019) has reduced but still appears to be present for the concrete sites. The trend on the asphalt sites is less clear, as the 2024 value is closer to previous values (e.g. 2017). The potential trends can be seen in Figure 5.2 where the graph has been reproduced with the lines of best fit split in two at 2019.

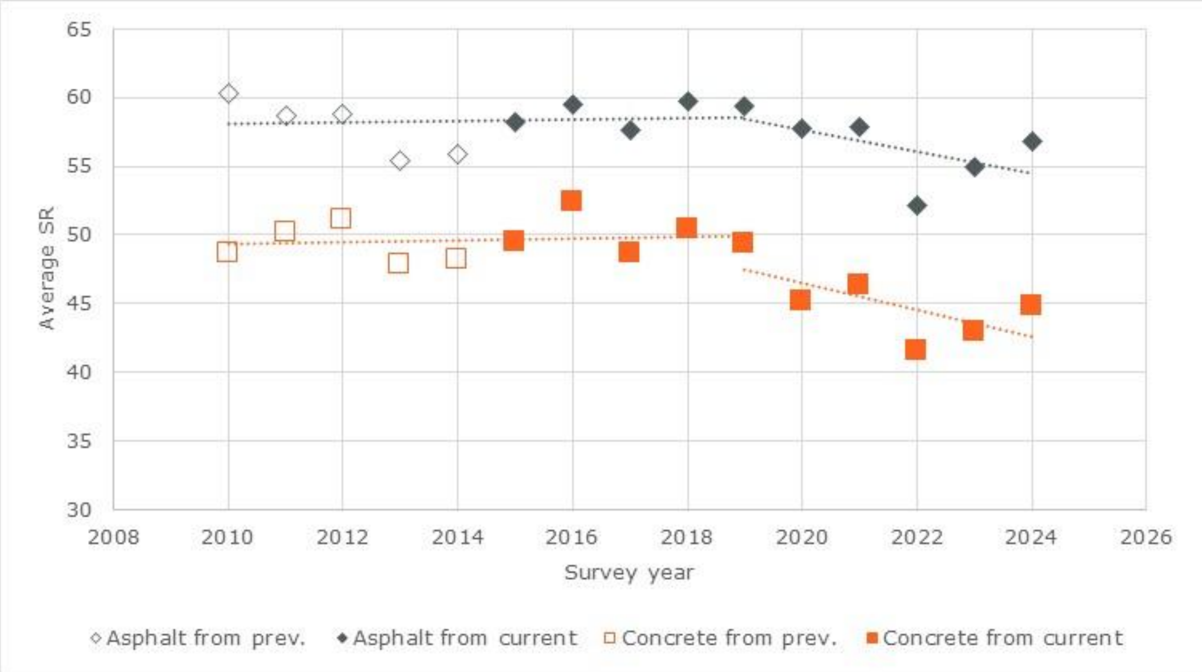

Figure 5.2: Average SR of Benchmark sites since 2010 (with split lines of best fit)

It is possible that the recent low values are outliers and there will be a regression to the mean effect (i.e. values return to similar values as before). However, it is also possible that this is indicative of a trend in skid resistance possibly due to longer term climatic changes. This should, therefore, continue to be monitored to determine if this trend persists or whether SR values return to previous levels or if they stabilise at a new mean level. If this trend continues or stabilises at a new level then this will have implications for the reporting of the pavement condition in National Highways key performance indicator (KPI). However, it is noted that due to implementation of seasonal correction (which normalises the current year's data to the average of the previous three years), any change will have a delayed effect on the KPI. If the values don't return to previous levels then it might be necessary to assess the impact of the reducing trend on National Highways' skid resistance policy. In addition, it might also lead to the need to review the appropriate levels of PSV (polished stone value) given in surface course materials for construction (DMRB CD 236, 2022).

6 Investigation into geographic effects on trends in skid resistance

The benchmark sites are distributed relatively evenly around the National Highways SRN. As such the analysis presented in Sections 4 and 5 provides good information on the overall trend for the SRN. However, it is possible that parts of the SRN may experience different trends in skid resistance over time due to more localised changes in climate or other effects.

To investigate possible locational effects, the benchmark sites were split into groups based on their location on the SRN. In order to maintain reasonably sized datasets for the analysis, it was decided that two grouping analyses would be undertaken. The first would compare the eastern and western sites, and the second would compare northern, central and southern sites. As there are relatively few concrete sites (and they show different patterns to the asphalt sites) these sites have been excluded from this analysis. The list of sites and the groupings assigned are provided in Appendix A. A pictorial representation of the east/west grouping is shown in Figure 6.1 and for the north/central/south grouping in Figure 6.2 (although not included in the analysis the concrete sites are also shown to indicate their locations). The number of 100m lengths available for each grouping in the 2024 analysis is shown in Table 6.1.

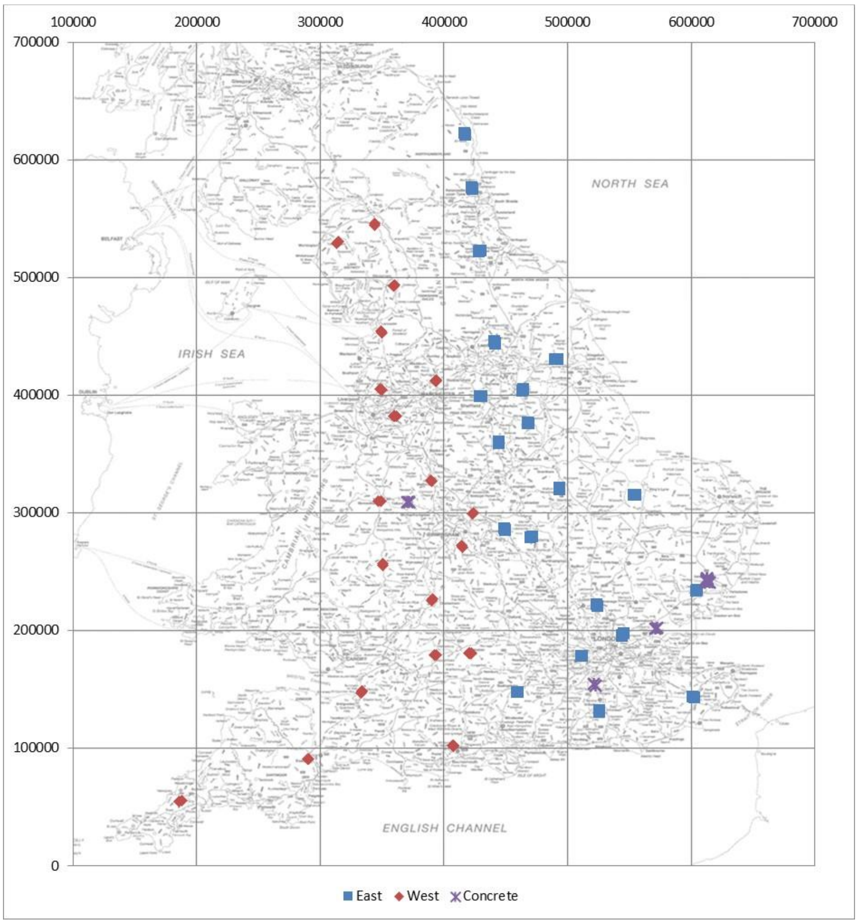

Figure 6.1: Map of east/west grouping of Benchmark sites (contains Ordinance Survey data © Crown copyright and database right 2025)

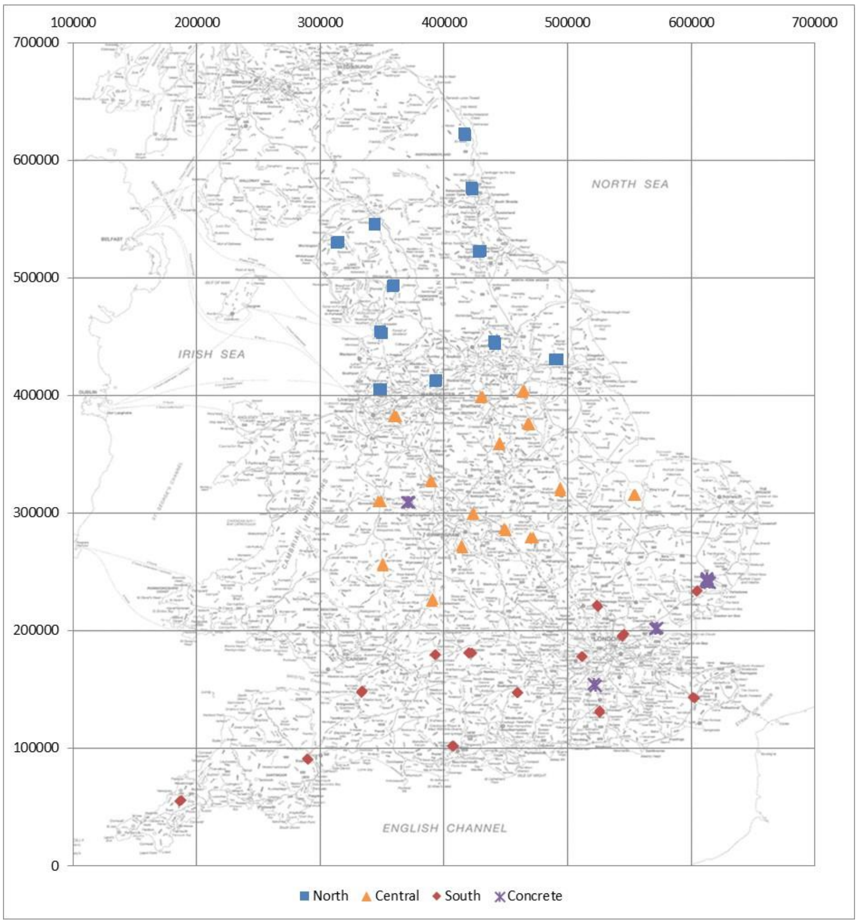

Figure 6.2: Map of north/central/south grouping of Benchmark sites (contains Ordinance Survey data © Crown copyright and database right 2025)

Table 6.1: Number of 100m lengths in each geographic grouping for the analysis

Group	Number of 100m lengths
East	143
West	113
North	91
Central	93
South	72

After splitting the sites into different groups, the average SR values for each grouping and each year were calculated. For this analysis we are interested in how the average SR varies over time for each grouping. Therefore, the difference in the SR value each year relative to the earliest year in the analysis (2015) was calculated for each grouping. This data can be seen in Figure 6.3 and Figure 6.4.

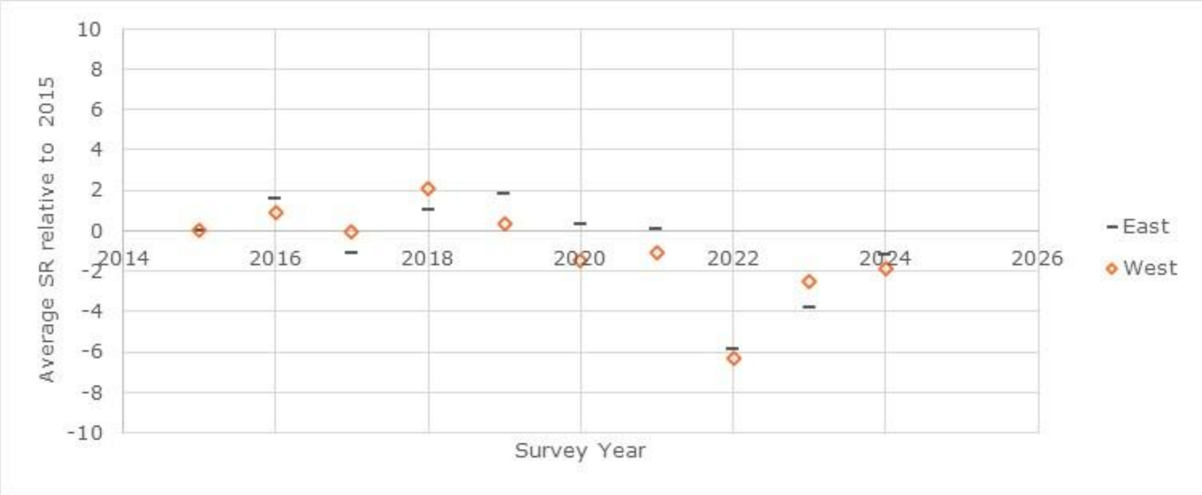

Figure 6.3: Average SR relative to 2015 of (asphalt) Benchmark sites geographically split east/west

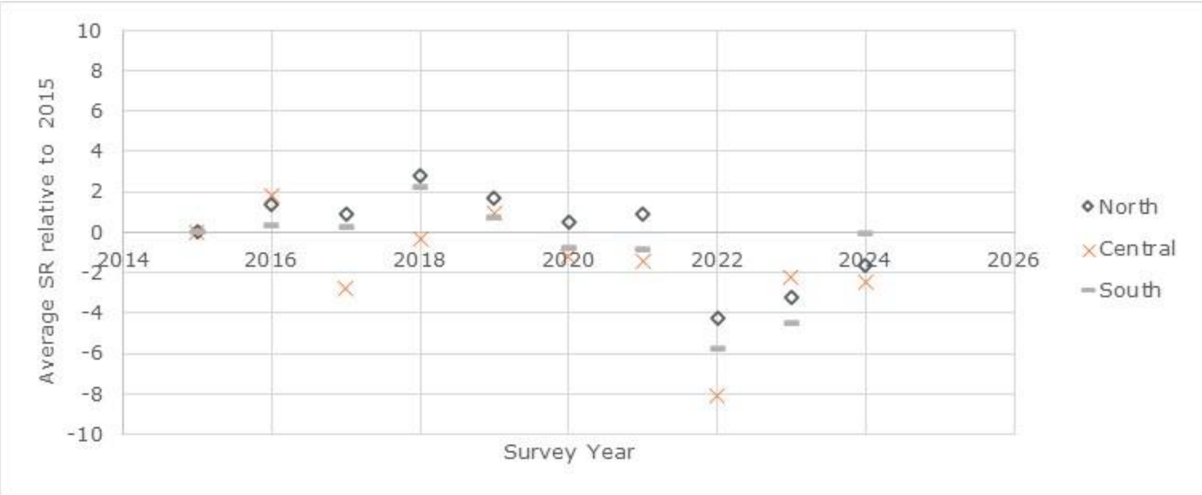

Figure 6.4: Average SR relative to 2015 of (asphalt) Benchmark sites geographically split north/central/south

From Figure 6.3 and Figure 6.4 it can be seen that all five groups follow the same basic shape over time. On examining the east/west groupings it can be seen that typically the east sites show a higher value relative to the 2015 survey than the west sites. However, this is not true in all years and there does not appear to be a trend over time. This suggests that the changes seen are mostly due to noise in the data.

In the latitude split, the variation for the central sites also appears to be noise as it swings from the highest to the lowest between years. There is a tendency for the north values to be higher than the south values. However, the separation between the north and south values does not increase over time (which would be expected from this analysis if there was a difference between them).

Overall, these results do not indicate any particular geographic bias to the data over time.

In addition to potentially varying in average skid resistance each year, it is possible that the within year variation may differ between the locations. To investigate this, the average between run standard deviation (BRSD) values were also calculated for each grouping and year. These numbers provide an indication of how shallow or deep the within year seasonal variation curves are (the higher the number the deeper the curve). As before the BRSD values are calculated by using the root mean square approach. This data can be seen in Figure 6.5 and Figure 6.6.

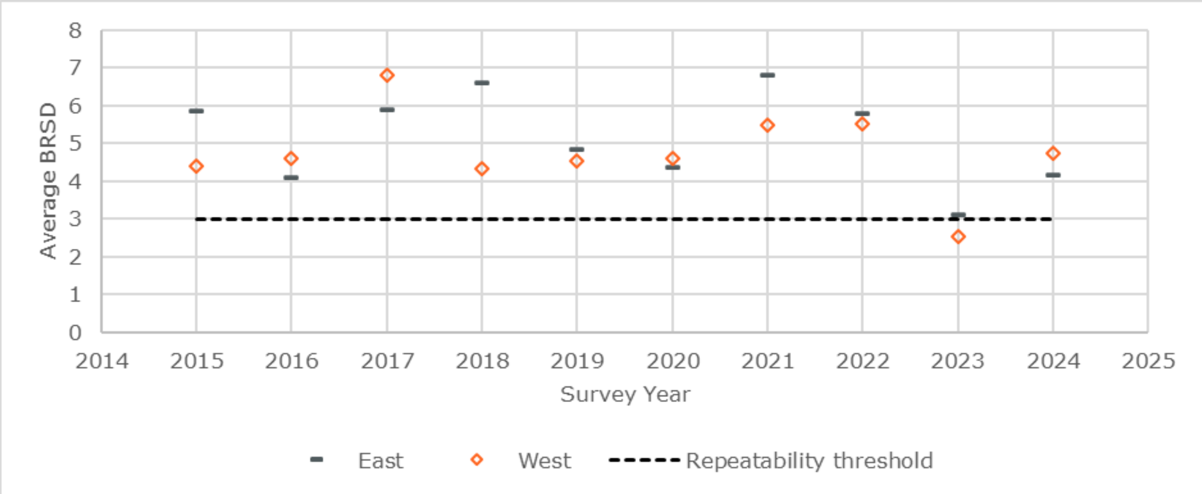

Figure 6.5: Average BRSD of (asphalt) Benchmark sites geographically split east/west

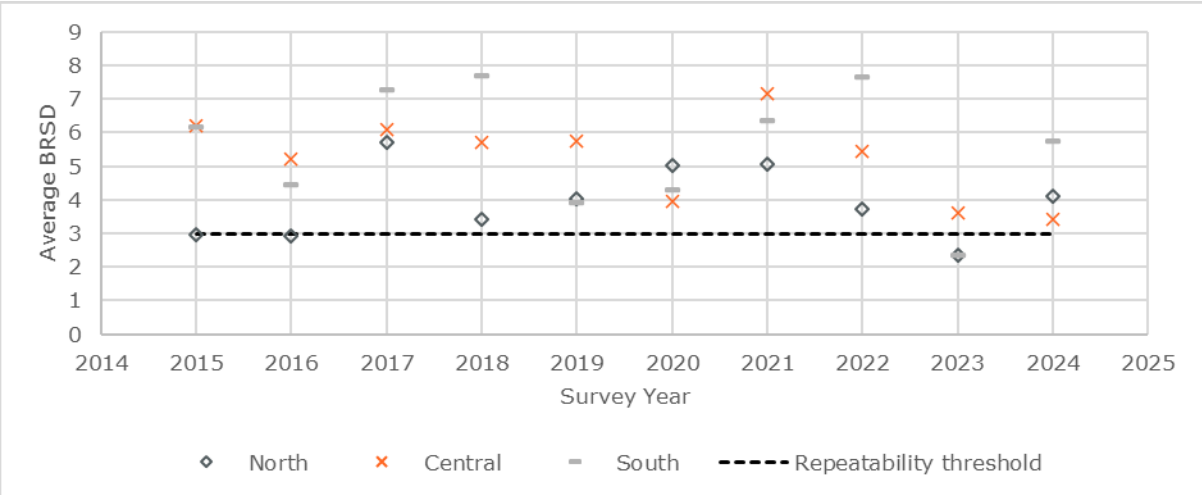

Figure 6.6: Average BRSD of (asphalt) Benchmark sites geographically split north/central/south

From Figure 6.5 and Figure 6.6 it can be seen that the five groupings show similar ranges of BRSD. There does not appear to be any particular trend between the east/west sites. However, the north sites appear to have a tendency to lower BRSD values and the south sites to have higher BRSD values, but this is not always the case. This might be indicative of lower levels of rainfall in the south causing a lower skid resistance value being reached in the middle of the summer. However, the central sites, which you might expect to behave somewhere in between the north and south sites, do not always lie between the two. Therefore, no firm conclusions can be drawn at this stage, and it should continue to be monitored.

7 Conclusions and recommendations

7.1 Data coverage

The current analysis procedure for each year of benchmark site data uses a rolling 10 year cut-off for the analysis. These rolling 10 year analyses are then combined to provide information on the trends since 2010. For the current rolling 10 year analysis 347 individual 100m lengths (256 asphalt lengths and 91 concrete lengths) were found to be suitable for use.

In addition to the current analysis procedure, the original procedure was repeated this year (given in Appendix B). Thie procedure allows for the investigation of trends since 2002. However, it is reliant on sites which have a full survey history and had no treatment since 2002. In the analysis of the 2024 data, no sites were removed from the long-term reference benchmark site list. Currently 9 of the original 39 sites are suitable for the original analysis procedure. Due to the gradual decrease in the number of sites suitable it is likely that the original procedure will be excluded from the analysis in the next few years.

7.2 Results (rolling 10 year analysis)

Investigation into the average SR values for asphalt sites suggests that 2024 was lower than the average SR value for the last 10 years but was not as low as the values seen in 2022 and 2023. This meant that the data for 2024 was slightly above the average of the previous three years. This result was also seen on the concrete sites. It was noted that the low values seen in 2022 were likely due to the very warm and dry summer in that year. The analysis also found that the minimum value in 2024 appears to lie on the middle to late period boundary rather than the midpoint of the middle period. These findings were broadly consistent with the analysis of the 2024 LECFs (Brittain, 2025). The LECF analysis provides an estimate of ongoing trends of the overall seasonal variation of the network, however it is complicated by the fact that it uses data from different areas for each period to perform the analysis. Therefore, the trend seen from the benchmark sites is generally the more reliable of the two when considering the overall trend in skid resistance over time (if the conclusions differ).

For the 2024 data, the between period standard deviation for the concrete sites was above the 3 SR threshold (at 3.67 SR) suggesting some form of within year seasonal variation. In addition, the seasonal variation seen within 2024 for the concrete sites looked broadly similar to the asphalt sites. However, this is not always the case and suggests that while concrete sites do experience seasonal variation, it may differ from that seen on asphalt sites. Therefore, the practice of not applying the LECF calculated (primarily based on asphalt lengths) to the concrete lengths on the Strategic Road Network (SRN) should continue. However, further work should be undertaken to identify if concrete specific LECF values can be calculated and if they would provide a benefit.

7.3 Results since 2010

The data collected for successive rolling 10 year analyses have been combined so that the trends since 2010 can be investigated. This analysis found that initial investigation of the asphalt lengths suggests a relatively stable pattern for skid resistance over time if the very low value in 2022 is excluded. However, it is noted that the 2023 and 2024 data is also towards the lower edge of the range of values previously seen.

Examination of the concrete sites suggests a flat trend between 2010 and 2019 followed by a downward trend from 2019 onwards. If the asphalt lengths are re-examined in light of the observation on the concrete lengths, then there is also a hint of a flat trend between 2010 and 2019 and a possible downward trend from 2019 onwards. However, if the very low value in 2022 is removed then this trend is less clear for the asphalt sites.

It is possible that these recent low values (2022 and 2023) are outliers and there will be a regression to the mean effect (i.e. values return to similar values as before). However, it is also possible that this is indicative of a trend in skid resistance possibly due to longer term climatic changes. This should therefore be continued to be monitored to determine if this trend persists, returns to previous levels or if it stabilises at a new mean level.

If this trend continues or stabilises at a new level then this will have implications for the reporting of the pavement condition in National Highways key performance indicator (KPI). If the values do not return to previous levels then it might be necessary to assess the impact of the reducing trend on National Highways' skid resistance policy. In addition, it might also lead to the need to review the appropriate levels of PSV (polished stone value) given in surface course materials for construction (DMRB CD 236, 2022).

7.4 Geographic effects on trends in skid resistance

An investigation was carried out to see if different geographic groupings of the benchmark sites experience different seasonal variation. This found that there did not appear to be any significant ongoing differences between the different groupings. However, given the likely differences in climate experienced by different parts of the network it is recommended that investigation of geographical effects should be further investigated and built upon in future benchmark sites analyses.

References

Note: this list of references contains both unpublished reports (UPR) and client project reports (CPR) produced for National Highways. Please make a personal application to National Highways if you wish to obtain a copy.

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Appendix A Benchmark site locations

Table A.1: Location details of the benchmark sites

Site No.	Area	Road	Direction	Section(s)	Length (m)	Description	Nodes	East or west group	North, central or south group
1	1	A30	E/B	0800A30/400	2260	Studs under A3076 bridge at Mitchell to studs at 2260m	21435-21460	West	South
2	1	A30	W/B	1100A30/115	1180	End of slip On from A377 to studs at 1180m	492-431	West	South
3	2	M5	S/B	3300M5/210, 3300M5/220	1694	End of slip On at Jct 22 to studs at 1694m	15179-15184-15185	West	South
4	2	M4	E/B	3900M4/162	1226	End of slip On at Jct 17 to studs at 1226m	448-446	West	South
5	3	M3	S/B	1700M3/383, 1700M3/391	1003	Start of slip Off at Jct 7 (A30) to studs at 1003m	75990-75940-75897	East	South
6	3	M4	E/B	0300M4/393, 0300M4/391	2875	End of slip On at Jct 15 to studs at 2875m	35593-35941-35489	West	South
7	3	A31	E/B	1200A31/461, 1200A31/467	1358	Exit from Ameysford Rbt to studs under B3072 bridge	12071-12076-12999	West	South
8	4	M20	E/B	2200M20/290	1634	End of slip On at Jct 9 (A20/A28) for 1634m	5230-1859	East	South
9	4	A23	N/B	3800A23/340	1402	Studs just after bridge over approx. 1050m after B2110 (bridge over at Handcross) to studs under footbridge at 1402m	13078-13216	East	South
10	M25 DBFO	M11	N/B	1500M11/114, 1500M11/116	2473	Start of slip Off at Jct 5 (A1168) to start of concrete	70050-70060-70070	East	South
11	M25 DBFO	M4	W/B	5540M4/244	976	Start of slip Off to Heston Services to end of Slip On	32828-32830	East	South
12	6	A12	N/B	1500A12/294	1053	Studs at Suffolk boundary to start of slip road off to B1029	40560-42270	East	South
13	6	A47	E/B	2600A47/145, 2600A47/147	1348	Studs under bridge at centre of Terrington St John interchange to bridge at 1348m	5027-5733-50343	East	Central
14	7	A1	N/B	2500A1/110	2150	End of slip On from South Witham to Jct Left (to North Witham)	7005-7015	East	Central
15	7	A1	N/B	3000A1/345, 3000A1/347, 3000A1/360	1426	Jct L to Elkesley Village (744m N of B6387) 1426m to Jct Rt	20125-20129	East	Central
16	8	A1(M)	S/B	1900A1M/58	1946	End of slip On at Jct 7 to studs under bridge at 1981m	1530-11489	East	South
17	7	A14	E/B	2800A14/120	1728	Studs under bridge 3742m W of A508 (bridge over) to studs under bridge at 1728m	1820-2022	East	Central
18	2	M5	N/B	1600M5/138	1264	Studs under A4019 bridge at Jct 10 to studs under next bridge	4231-30034	West	Central
19	9	A49	N/B	1800A49/320	1760	Jct R (to Stoke Prior) to River Bridge	43133-43134	West	Central
20	9	A5	W/B	3200A5/293	1641	Exit from A49/A5112 Rbt to studs under bridge at 1641m	50293-50289	West	Central
21	10	M56	W/B	0600M56/419, 0600M56/422	1898	End of slip On at Jct 10 (A49) to studs at 1898m	63410-63501-63601	West	Central
22	7	A5	S/B	2400A5/50	2007	Studs near start of 2 lanes 2.5k S of Jct B577 for 2007m to studs near end of 2 lanes (studs are at start and end of grassed central reserve).	20067-20049	East	Central
23	9	M6	S/B	3400M6/430	995	Studs 2255m before start of slip Off at	23101-	West	Central

Site No.	Area	Road	Direction	Section(s)	Length (m)	Description	Nodes	East or west group	North, central or south group
						Jct 14 to studs at 995m	23001		
24	9	M42	N/B	3700M42/334	1090	Studs 1090m before start of Slip Off to Jct 10 (A5) to start of Slip Off	28687-28685	West	Central
25	9	M40	S/B	3700M40/183	1403	End of slip On at Jct 17 (M42 Jct 3a) to start of slip Off at Jct 16	29504-29503	West	Central
26	7	M1	S/B	1000M1/216	1600	End of slip on at Tibshelf services to studs at “Jct 28 1 mile” sign	10054 (now 9997)-10052	East	Central
27	12	A616	W/B	4405A616/30	1717	Studs L Jct A629 to studs on river bridge at 1717m	61630-61644	East	Central
28	10	M62	E/B	4200M62/450, 4200M62/460	1308	End of slip On at Jct 21 to studs at 1308m	22105-22107	West	North
29	12	M18	S/B	4400M18/108	1681	End of slip On at Jct 4 (A630) to studs at 1681m	4308-321	East	Central
30	12	A63	W/B	2000A63/409	2378	End of slip On at A1034 to studs at bridge over 2378m	2002-30482	East	North
31	13	M6	S/B	2300M6/291	1973	End of slip On at Jct 33 to start of slip Off to Lancaster services	18323-18239	West	North
32	10	M58	W/B	2300 M58/431	1570	End of slip On at Jct 5 to start of slip Off at Jct 4	8618-20005	West	North
33	A1DD DBFO	A1	N/B	2700A1/242, 2700A1/252	1864	End of slip On at Bramham to start of slip Off to A659 (may now be DBFO)	21488-21422-21184	East	North
34	14	A1(M)	N/B	1300A1M/212, 1300A1M/216	1426	End of slip on at Jct 59 (A167) to studs at 1426m	17-18-19	East	North
35	13	A66	E/B	0900A66/142	1860	Studs on bridge over B5292 (1950m E of A5086 Rbt) to studs at 1860m	31347-31507	West	North
36	13	M6	S/B	0900M6/373, 0900M6/379	1121	Start of slip Off at Jct 37 (A684) to end of slip On at Jct 37	14192-14187-14181	West	North
37	13	M6	S/B	0900M6/351	1385	Start of slip Off to Southwaite services to end of slip On from services	14779-14766	West	North
38	14	A1	S/B	2900A1/106	1727	Studs (road under) 2.22km before A19 bridge over to studs at 1727m (25m after Newcastle sign and 45m before start of slip off to A19)	14063-14002	East	North
39	14	A1	N/B	2900A1/380	2200	Jct Rt B6347 (to Christon Bank) to studs at start of dual c/way central reserve	11030-11101	East	North
40	9	M54	E/B	3200M54/784	1434	Asphalt/PQC surface change @ marker post 27/7 to start slip off to J4	54006-40100	Concrete	Concrete
41	6	A14	E/B	3500A14/632 to 3500A14/716	5601	End slip on J54, Sproughton to start slip off J56, Wherstead	90366-90301	Concrete	Concrete
42	6	A12	S/B	1500A12/158	1960	Baddow Park Overbridge to Slip off	40950-40960	Concrete	Concrete
43	M25 DBFO	M25	C/W	3600M25/464	2004	MP55/0 to MP57/0	21543-21541	Concrete	Concrete

Appendix B Benchmark site data processed using the old analysis procedure (asphalt sites only)

B.1 2024 survey results

The average speed corrected skid readings (speed corrected SR) and the range between the highest and lowest average speed corrected SR for the 2024 surveys are shown in Table B.1. These values may differ from those in Table 4.1 in the main analysis as the data in that table will have any lengths with maintenance over the last 10 years removed (whereas Table B.1 includes the whole length of the site). In this table, the mid and late surveys for site 26 are not shown as the site was surveyed in lane 2 due to roadworks. Anomalies in the surveys and changes in the sites are discussed in Section 3.2.

Table B.1: Results of the 2024 surveys

Site	Early speed corrected SR	Middle speed corrected SR	Late speed corrected SR	Average	Range
1	70.67	59.19	62.15	64.00	11.47
2	69.88	62.05	64.46	65.46	7.83
3	65.97	56.90	61.43	61.43	9.07
4	58.39	49.53	48.82	52.25	9.56
5	62.95	57.31	56.75	59.00	6.21
6	64.04	52.44	53.26	56.58	11.60
7	61.29	57.48	57.77	58.85	3.80
8	64.82	55.05	57.56	59.14	9.78
9	67.68	57.15	61.16	62.00	10.53
10	63.22	54.70	55.87	57.93	8.52
11	76.23	60.87	67.75	68.29	15.36
12	60.79	58.97	53.91	57.89	6.88
13	55.75	54.64	49.84	53.41	5.91
14	61.73	59.28	58.58	59.86	3.15
15	52.50	47.65	52.68	50.95	5.03
16	63.07	50.41	54.03	55.83	12.66
17	46.63	42.06	40.18	42.96	6.44
18	63.99	59.79	63.30	62.36	4.20
19	63.44	61.83	57.81	61.03	5.64
20	57.31	61.38	52.02	56.91	9.36
21	61.79	57.63	51.84	57.09	9.95
22	69.39	65.48	63.19	66.02	6.19
23	71.34	68.17	63.71	67.74	7.64
24	59.78	56.40	51.65	55.94	8.13
25	66.91	64.17	59.99	63.69	6.92
26	62.55	-	-	-	-
27	64.01	60.79	62.77	62.52	3.22
28	67.94	61.02	59.01	62.66	8.93
29	55.54	49.89	48.43	51.28	7.11
30	57.66	53.99	57.69	56.45	3.69
31	64.63	58.69	54.66	59.33	9.97
32	46.88	42.59	42.87	44.11	4.29
33	69.32	59.90	64.09	64.44	9.42
34	70.70	62.81	59.18	64.23	11.53
35	56.84	54.41	52.19	54.48	4.65
36	56.39	51.62	46.61	51.54	9.78
37	62.63	58.14	57.27	59.34	5.36
38	58.60	53.37	54.01	55.33	5.22
39	59.29	51.79	52.74	54.61	7.49

B.2 Mean Summer Skid Coefficient

The average of the reference benchmark sites over the course of the benchmark programme (since 2002) is produced in Figure B.1. The reference benchmark sites are the sites with a full survey history and which have not undergone treatment during the course of the programme. These sites are further discussed in Section 3.2.

The very late surveys (conducted in 2006, 2007, 2008 and 2009) are excluded from this calculation and the surveys undertaken under the old survey period dates are shown as empty diamonds. Due to COVID-19, traffic levels on the road network were noticeably lower in 2020. To mark this data as a potential outlier it is highlighted as an orange diamond.

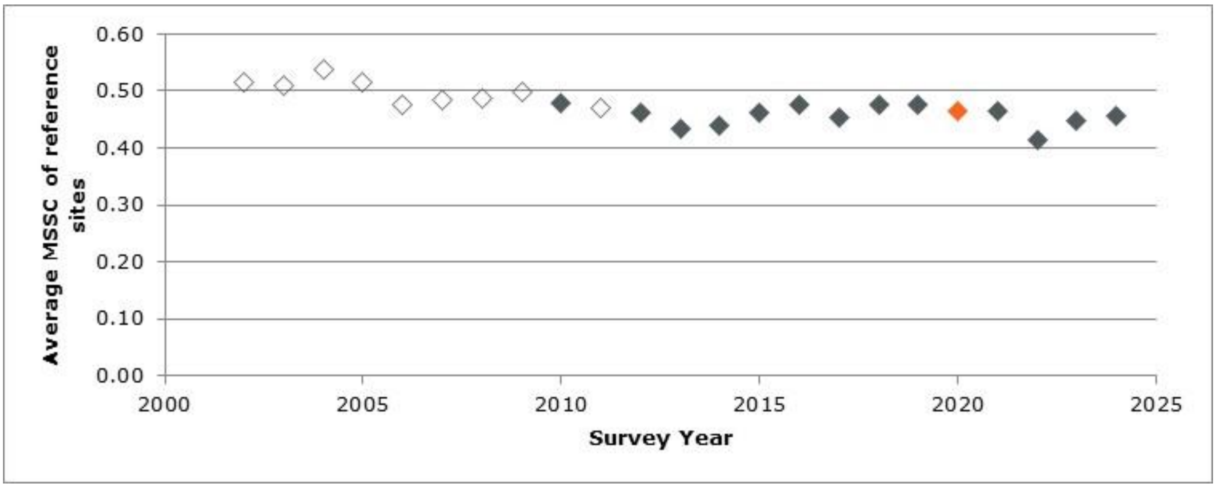

Figure B.1: Average MSSC of reference sites since 2002

The points in Figure B.1 appear to suggest either a gradual downward trend over time, or changing between three different equilibrium states (2002 to 2005, 2006 to 2012 and 2013 onwards). The changes seen could be due to the changes between the survey dates for these surveys. However, if the extended survey dates were the cause, then we would expect the values to be higher for the more recent surveys (as they include late survey where the skid resistance value has been restored). Other options include longer term seasonal changes, e.g. climate change or a reduction in the skid resistance performance of the sites (possibly as a result of a change in traffic levels for the sites compared to those assumed in the design of the surfacings).

MSSC values (excluding the very late surveys) produced for each of the asphalt benchmark sites over the course of the benchmark site programme are provided in Table B.2. The non-reference benchmark sites are also shown but are highlighted in grey and italics in the table. In addition, surveys conducted on the reference benchmark sites using the old survey periods (as discussed in Section 1.1) are highlighted in red. The change in survey periods should result in a slightly higher MSSC value (due to the expected higher value for the late survey) for any years which are using the new survey boundaries relative to the old boundaries.

Table B.2: MSSC values for the asphalt sites (1-39)

Site	Ref	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1	y	0.60	0.57	0.59	0.58	0.55	0.55	0.54	0.57	0.54	0.55	0.52	0.46	0.47	0.51	0.49	0.50	0.52	0.50	0.48	0.48	0.43	0.47	0.50
2	n	0.56	0.54	0.55	0.54	0.54	0.54	0.52	-	0.50	0.51	0.51	0.46	0.47	0.51	0.47	0.49	0.50	0.48	-	0.48	0.45	0.50	0.51
3	n	0.55	0.52	0.53	0.52	0.50	0.47	0.47	0.53	0.48	0.49	0.47	0.44	0.44	0.47	0.46	0.48	0.48	-	0.47	0.47	0.44	0.46	0.48
4	n	0.61	0.60	0.60	0.59	0.58	-	0.56	-	0.53	0.47	0.48	0.44	0.44	0.47	0.45	0.46	0.47	0.47	0.42	0.39	0.38	0.40	0.41
5	n	0.55	0.55	0.58	-	0.53	0.53	0.53	0.49	-	0.51	0.53	0.47	0.50	0.50	0.50	0.51	0.50	0.48	0.45	0.48	-	0.45	0.46
6	n	0.54	0.52	0.52	0.53	0.51	0.51	0.51	0.53	0.52	0.48	0.50	0.47	0.46	0.52	0.51	0.50	0.47	0.49	0.46	0.43	0.42	0.43	0.44
7	n	0.54	0.52	0.51	0.52	0.49	-	0.50	0.52	0.51	0.51	0.51	0.47	0.51	0.49	0.49	0.46	0.49	0.47	0.44	0.45	0.44	0.43	0.46
8	n	0.55	0.53	0.53	0.51	0.50	0.50	0.49	0.51	0.51	0.47	0.49	0.45	0.45	0.45	0.46	0.45	0.50	0.48	0.44	0.47	0.44	0.44	0.46
9	n	0.46	0.44	0.44	0.44	0.39	0.39	0.39	0.41	0.40	0.38	0.40	0.39	0.35	0.37	0.37	0.37	0.38	0.38	0.37	0.36	0.32	0.42	0.48
10	n	0.55	0.54	0.57	0.55	0.54	0.55	-	0.55	0.51	0.50	0.51	0.45	0.44	0.46	0.47	0.47	0.48	0.47	0.45	0.45	0.42	0.42	0.45
11	n	0.55	0.54	0.57	0.56	0.51	0.51	0.51	0.55	0.56	0.53	-	0.49	0.49	0.50	0.52	0.52	0.51	0.53	0.54	0.54	0.49	0.49	0.53
12	y	0.42	0.42	0.59	0.50	0.45	0.44	0.49	0.46	0.45	0.43	0.44	0.41	0.43	0.43	0.46	0.43	0.45	0.46	0.47	0.46	0.42	0.42	0.45
13	y	0.45	0.45	0.47	0.45	0.40	0.41	0.43	0.42	0.41	0.40	0.37	0.35	0.36	0.41	0.40	0.36	0.40	0.42	0.41	0.38	0.33	0.38	0.42
14	Y	0.57	0.55	0.57	0.55	0.53	0.52	0.51	0.53	0.49	0.48	0.48	0.47	0.44	0.50	0.50	0.46	0.48	0.50	0.48	0.47	0.42	0.44	0.47
15	n	0.49	0.48	0.48	0.47	0.45	-	0.43	0.44	0.42	0.42	0.42	0.38	0.39	0.47	0.41	0.41	0.43	0.45	0.42	0.41	0.36	0.39	0.40
16	n	0.54	0.56	0.56	0.51	0.51	0.52	-	0.49	0.49	0.47	0.46	0.41	0.42	0.43	0.43	0.43	0.44	0.43	0.43	0.43	0.40	0.40	0.44
17	n	0.39	0.38	0.39	0.37	0.35	0.36	0.36	0.37	0.34	0.32	0.32	0.32	0.32	0.36	0.33	0.31	0.33	0.34	0.36	0.34	0.31	0.34	0.34
18	n	0.54	0.49	0.48	0.45	0.44	0.44	0.43	0.48	0.45	0.44	0.41	0.41	0.40	0.43	0.43	0.45	0.45	0.45	0.50	0.46	0.45	0.49	0.49
19	n	0.50	0.47	0.47	0.46	0.43	0.44	0.42	0.46	0.45	0.42	0.43	0.39	0.40	0.43	0.43	0.44	0.43	0.42	-	0.47	0.48	0.52	0.48
20	n	0.38	0.35	0.34	0.34	0.31	0.34	-	0.42	0.40	0.39	0.39	0.35	0.39	0.46	0.50	0.46	0.48	0.47	0.45	0.45	0.43	0.48	0.44
21	n	0.44	0.42	0.43	0.42	0.39	0.39	0.39	-	0.44	0.47	0.46	0.44	0.44	0.45	0.48	0.45	0.45	0.47	0.44	0.47	0.40	0.43	0.45
22	n	0.49	0.50	0.48	0.46	0.48	0.46	-	0.52	0.51	0.51	0.54	0.52	0.55	0.56	0.57	0.54	0.58	0.57	0.56	0.59	0.52	0.55	0.51
23	n	0.45	0.44	0.47	0.45	0.41	-	-	0.49	0.45	0.46	0.45	0.44	0.44	0.46	0.47	0.45	0.47	-	-	-	0.50	0.52	0.53
24	n	0.49	0.49	0.51	0.49	0.49	0.49	0.45	-	0.46	0.44	0.44	0.44	0.44	0.46	0.47	0.44	0.46	0.46	0.44	0.43	0.40	0.45	0.44
25	y	0.55	0.53	0.54	0.53	0.51	0.53	0.49	0.54	0.51	0.51	0.51	0.48	0.55	0.53	0.55	0.51	0.52	0.51	0.50	0.49	0.45	0.60	0.50
26	n	0.48	0.45	0.47	0.45	0.43	0.43	0.41	0.44	0.50	0.47	0.48	0.42	-	0.43	0.54	0.50	0.51	0.51	0.49	0.49	0.43	0.46	-
27	y	0.46	0.56	0.52	0.52	0.48	0.50	0.49	0.50	0.48	0.47	0.47	0.45	0.44	0.46	0.53	0.49	0.50	0.51	0.50	0.54	0.45	0.47	0.49
28	n	0.43	0.42	0.39	0.41	0.37	0.35	0.38	0.41	-	0.36	0.37	0.36	-	0.37	0.38	0.37	0.39	0.40	0.38	0.40	0.35	0.50	0.49
29	n	0.49	0.46	0.47	0.47	0.42	0.43	0.43	0.43	0.42	0.41	0.42	0.40	0.39	0.51	0.44	0.43	0.43	0.47	0.42	0.44	0.37	0.42	0.40
30	n	0.50	0.46	0.48	0.46	0.45	0.44	-	-	0.45	0.44	0.43	0.39	0.39	0.41	0.42	0.40	0.43	0.45	0.43	0.43	0.38	0.45	0.44
31	y	0.58	0.55	0.54	0.54	0.48	0.50	0.52	0.51	0.50	0.50	0.49	0.46	0.45	0.48	0.48	0.48	0.50	0.48	0.47	0.48	0.45	0.45	0.46
32	n	0.47	0.44	0.43	0.42	0.38	0.38	0.38	0.42	0.39	0.38	0.38	0.38	0.36	0.38	0.40	0.38	0.38	0.39	0.37	0.37	0.32	0.34	0.34
33	n	0.56	0.52	0.54	0.51	0.50	-	0.48	0.50	0.50	0.50	0.50	0.48	0.49	0.50	0.48	0.56	0.50	0.51	0.50	0.50	0.47	0.47	0.50
34	n	0.44	0.39	0.44	0.41	0.40	0.38	0.38	0.42	-	0.42	0.43	0.41	0.43	0.43	0.46	0.46	-	0.48	0.47	0.50	0.46	0.48	0.50
35	n	0.51	0.49	0.49	0.47	0.43	0.47	0.44	0.45	0.46	0.44	0.43	0.40	0.40	0.42	0.42	0.44	0.45	0.42	0.44	0.44	0.42	0.40	0.42
36	y	0.49	0.47	0.49	0.47	0.43	0.45	0.47	0.47	0.45	0.43	0.44	0.40	0.41	0.42	0.43	0.42	0.45	0.44	0.42	0.43	0.38	0.38	0.40
37	n	0.53	0.50	0.52	0.50	0.48	0.47	0.45	-	0.49	0.48	0.47	0.43	0.46	0.45	0.46	0.47	0.49	0.47	0.46	0.46	0.44	0.43	0.46
38	y	0.52	0.49	0.51	0.48	0.45	0.46	0.46	0.48	0.49	0.47	0.43	0.41	0.42	0.42	0.44	0.41	0.44	0.46	0.46	0.46	0.39	0.43	0.43
39	n	0.44	0.40	0.42	0.40	0.36	0.38	0.36	0.39	0.38	0.36	0.44	0.40	0.44	0.46	0.47	0.46	0.46	0.46	0.45	0.45	0.41	0.43	0.43
Ref sites	-	0.52	0.51	0.54	0.52	0.48	0.48	0.49	0.50	0.48	0.47	0.46	0.43	0.44	0.46	0.47	0.45	0.47	0.48	0.46	0.47	0.41	0.45	0.46

Appendix C Historic data processed using the current defined site lengths

Table C.1: 2015 benchmark surveys using the current defined lengths

Site	Number of 100m lengths	Early avg. SR	Middle avg. SR	Late avg. SR	Between run standard deviation	Average
1	22	68.8	60.3	67.8	5.01	65.6
2	0	-	-	-	-	-
3	0	-	-	-	-	-
4	0	-	-	-	-	-
5	0	-	-	-	-	-
6	0	-	-	-	-	-
7	0	-	-	-	-	-
8	0	-	-	-	-	-
9	0	-	-	-	-	-
10	23	66.4	53.2	56.5	6.92	58.7
11	3	72.7	56.6	59.7	8.92	63.0
12	9	62.5	48.3	53.8	7.19	54.9
13	11	52.7	44.5	58.6	7.09	51.9
14	21	66.9	56.0	70.6	7.70	64.5
15	1	48.4	42.1	54.5	6.23	48.3
16	15	60.6	51.2	52.9	5.12	54.9
17	10	45.2	40.4	51.6	5.85	45.7
18	0	-	-	-	-	-
19	0	-	-	-	-	-
20	0	-	-	-	-	-
21	11	61.8	56.6	54.4	3.94	57.6
22	0	-	-	-	-	-
23	0	-	-	-	-	-
24	11	63.5	55.2	59.6	4.30	59.4
25	13	73.3	59.1	71.5	7.81	68.0
26	0	-	-	-	-	-
27	15	63.7	57.0	57.3	3.83	59.3
28	0	-	-	-	-	-
29	0	-	-	-	-	-
30	0	-	-	-	-	-
31	14	62.0	61.5	61.3	1.19	61.6
32	6	50.2	46.7	48.1	2.48	48.3
33	0	-	-	-	-	-
34	0	-	-	-	-	-
35	13	56.0	49.6	50.4	3.64	52.0
36	9	53.1	51.7	55.4	2.52	53.4
37	14	61.4	54.7	56.7	3.69	57.6
38	14	59.2	52.9	52.2	4.02	54.8
39	21	61.1	57.7	57.4	2.20	58.8
40	13	71.1	57.8	68.3	7.07	65.7
41	44	49.8	41.4	44.9	4.70	45.3
42	18	57.1	48.8	49.1	4.81	51.7
43	16	50.4	41.4	44.1	4.82	45.3
Asphalt 0-39	256	61.9	54.1	58.7	5.27	58.2
Concrete 40-43	91	54.4	45.2	48.9	5.15	49.5

Table C.2: 2016 benchmark surveys using the current defined lengths

Site	Number of 100m lengths	Early avg. SR	Middle avg. SR	Late avg. SR	Between run standard deviation	Average
1	22	59.8	58.8	71.0	7.00	63.2
2	0	-	-	-	-	-
3	0	-	-	-	-	-
4	0	-	-	-	-	-
5	0	-	-	-	-	-
6	0	-	-	-	-	-
7	0	-	-	-	-	-
8	0	-	-	-	-	-
9	0	-	-	-	-	-
10	23	62.2	59.1	59.8	2.07	60.4
11	3	67.7	61.3	66.6	3.67	65.2
12	9	60.7	57.3	58.1	2.63	58.7
13	11	52.0	49.3	53.5	2.55	51.6
14	21	70.2	61.7	59.8	5.66	63.9
15	1	43.5	46.3	48.3	2.38	46.0
16	15	57.1	51.4	55.8	3.24	54.8
17	10	45.1	41.0	41.6	2.38	42.6
18	0	-	-	-	-	-
19	0	-	-	-	-	-
20	0	-	-	-	-	-
21	11	66.2	61.7	57.6	4.47	61.9
22	0	-	-	-	-	-
23	0	-	-	-	-	-
24	11	64.0	56.0	61.1	4.22	60.4
25	13	75.8	65.5	68.7	5.48	70.0
26	0	-	-	-	-	-
27	15	62.0	77.0	66.7	7.88	68.6
28	0	-	-	-	-	-
29	0	-	-	-	-	-
30	0	-	-	-	-	-
31	14	64.0	58.6	63.6	3.11	62.1
32	6	50.8	50.0	51.1	2.27	50.6
33	0	-	-	-	-	-
34	0	-	-	-	-	-
35	13	54.3	50.1	53.4	2.54	52.6
36	9	59.0	52.9	53.8	4.07	55.2
37	14	60.6	56.4	61.3	2.75	59.4
38	14	53.9	56.3	60.5	3.51	56.9
39	21	57.6	60.5	61.9	2.28	60.0
40	13	64.5	62.7	63.8	1.92	63.7
41	44	48.0	48.2	49.4	1.84	48.5
42	18	52.1	57.4	55.1	2.86	54.8
43	16	52.4	49.1	52.4	2.09	51.3
Asphalt 0-39	256	60.5	57.9	60.1	4.32	59.5
Concrete 40-43	91	51.9	52.3	53.1	2.13	52.4

Table C.3: 2017 benchmark surveys using the current defined lengths

Site	Number of 100m lengths	Early avg. SR	Middle avg. SR	Late avg. SR	Between run standard deviation	Average
1	22	71.5	55.5	67.5	8.43	64.8
2	0	-	-	-	-	-
3	0	-	-	-	-	-
4	0	-	-	-	-	-
5	0	-	-	-	-	-
6	0	-	-	-	-	-
7	0	-	-	-	-	-
8	0	-	-	-	-	-
9	0	-	-	-	-	-
10	23	66.5	52.7	60.8	7.51	60.0
11	3	77.4	59.3	64.3	9.53	67.0
12	9	55.9	49.6	58.5	4.77	54.7
13	11	49.4	41.4	49.3	4.64	46.7
14	21	64.8	50.2	60.9	7.66	58.6
15	1	49.8	42.5	48.4	3.90	46.9
16	15	59.7	48.8	55.2	5.55	54.5
17	10	44.8	34.8	40.9	5.11	40.2
18	0	-	-	-	-	-
19	0	-	-	-	-	-
20	0	-	-	-	-	-
21	11	60.5	52.6	61.2	5.02	58.1
22	0	-	-	-	-	-
23	0	-	-	-	-	-
24	11	62.6	49.3	55.6	6.73	55.8
25	13	72.3	57.7	65.0	7.29	65.0
26	0	-	-	-	-	-
27	15	64.5	58.6	65.3	3.85	62.8
28	0	-	-	-	-	-
29	0	-	-	-	-	-
30	0	-	-	-	-	-
31	14	66.7	56.2	62.8	5.39	61.9
32	6	54.5	44.3	48.4	5.22	49.1
33	0	-	-	-	-	-
34	0	-	-	-	-	-
35	13	60.1	47.1	56.1	6.67	54.4
36	9	60.9	47.6	54.5	6.74	54.4
37	14	66.3	53.3	61.8	6.78	60.5
38	14	57.2	48.4	57.2	5.15	54.3
39	21	61.1	53.9	61.3	4.26	58.8
40	13	60.1	55.7	62.4	3.66	59.4
41	44	45.8	42.1	47.7	3.26	45.2
42	18	49.7	46.0	54.0	4.24	49.9
43	16	49.5	43.3	51.2	4.32	48.0
Asphalt 0-39	256	62.5	51.1	59.2	6.31	57.6
Concrete 40-43	91	49.2	45.0	51.6	3.72	48.6

Table C.4: 2018 benchmark surveys using the current defined lengths

Site	Number of 100m lengths	Early avg. SR	Middle avg. SR	Late avg. SR	Between run standard deviation	Average
1	22	73.5	61.2	67.5	6.29	67.4
2	0	-	-	-	-	-
3	0	-	-	-	-	-
4	0	-	-	-	-	-
5	0	-	-	-	-	-
6	0	-	-	-	-	-
7	0	-	-	-	-	-
8	0	-	-	-	-	-
9	0	-	-	-	-	-
10	23	67.8	54.4	63.4	6.91	61.9
11	3	72.2	55.7	64.6	8.55	64.2
12	9	67.0	47.6	58.4	9.87	57.7
13	11	57.6	46.6	50.4	5.72	51.5
14	21	69.9	53.5	61.7	8.29	61.7
15	1	52.0	43.4	48.3	4.32	47.9
16	15	65.2	47.4	56.2	9.00	56.3
17	10	47.6	36.3	43.4	5.84	42.4
18	0	-	-	-	-	-
19	0	-	-	-	-	-
20	0	-	-	-	-	-
21	11	61.9	50.2	62.0	6.94	58.0
22	0	-	-	-	-	-
23	0	-	-	-	-	-
24	11	61.1	57.0	59.6	2.20	59.3
25	13	67.8	66.1	68.3	1.37	67.4
26	0	-	-	-	-	-
27	15	68.0	59.7	65.0	4.27	64.2
28	0	-	-	-	-	-
29	0	-	-	-	-	-
30	0	-	-	-	-	-
31	14	64.2	60.2	67.3	3.62	63.9
32	6	51.8	45.6	51.6	3.90	49.7
33	0	-	-	-	-	-
34	0	-	-	-	-	-
35	13	55.8	54.4	58.4	2.21	56.2
36	9	59.3	53.5	60.6	4.11	57.8
37	14	65.2	59.1	63.4	3.35	62.6
38	14	61.6	54.2	58.0	3.90	57.9
39	21	60.8	55.7	60.5	3.06	59.0
40	13	60.4	60.8	65.4	3.12	62.2
41	44	48.3	41.8	47.8	4.26	46.0
42	18	55.5	51.0	56.8	3.28	54.4
43	16	52.2	43.5	49.6	4.57	48.5
Asphalt 0-39	256	64.0	54.5	60.8	5.72	59.8
Concrete 40-43	91	52.1	46.6	52.4	4.00	50.4

Table C.5: 2019 benchmark surveys using the current defined lengths

Site	Number of 100m lengths	Early avg. SR	Middle avg. SR	Late avg. SR	Between run standard deviation	Average
1	22	64.4	60.2	67.9	4.16	64.2
2	0	-	-	-	-	-
3	0	-	-	-	-	-
4	0	-	-	-	-	-
5	0	-	-	-	-	-
6	0	-	-	-	-	-
7	0	-	-	-	-	-
8	0	-	-	-	-	-
9	0	-	-	-	-	-
10	23	60.9	58.4	62.3	2.55	60.5
11	3	62.4	73.2	66.8	5.51	67.4
12	9	65.9	54.4	56.7	6.16	59.0
13	11	58.3	48.4	53.4	5.04	53.3
14	21	72.1	58.8	63.9	6.92	64.9
15	1	54.9	48.3	44.7	5.16	49.3
16	15	57.7	53.5	52.9	2.99	54.7
17	10	49.5	39.1	40.5	5.71	43.1
18	0	-	-	-	-	-
19	0	-	-	-	-	-
20	0	-	-	-	-	-
21	11	66.8	55.8	60.3	5.96	60.9
22	0	-	-	-	-	-
23	0	-	-	-	-	-
24	11	63.5	55.9	56.3	4.67	58.6
25	13	69.6	62.4	64.3	3.80	65.5
26	0	-	-	-	-	-
27	15	72.6	60.3	64.7	6.41	65.9
28	0	-	-	-	-	-
29	0	-	-	-	-	-
30	0	-	-	-	-	-
31	14	67.0	57.1	62.3	5.09	62.2
32	6	52.2	47.8	49.9	2.66	49.9
33	0	-	-	-	-	-
34	0	-	-	-	-	-
35	13	56.9	48.5	53.0	4.40	52.8
36	9	61.1	51.3	55.1	5.33	55.8
37	14	63.4	56.5	59.1	3.76	59.7
38	14	62.6	57.9	56.0	3.91	58.9
39	21	62.4	58.2	57.9	2.67	59.5
40	13	62.5	55.1	60.5	4.06	59.3
41	44	50.1	43.1	43.9	4.21	45.7
42	18	57.1	48.9	51.6	4.40	52.5
43	16	46.5	47.5	49.1	1.81	47.7
Asphalt 0-39	256	63.3	56.0	58.9	4.70	59.4
Concrete 40-43	91	52.6	46.7	48.7	3.92	49.3

Table C.6: 2020 benchmark surveys using the current defined lengths

Site	Number of 100m lengths	Early avg. SR	Middle avg. SR	Late avg. SR	Between run standard deviation	Average
1	22	65.3	59.3	58.6	4.09	61.1
2	0	-	-	-	-	-
3	0	-	-	-	-	-
4	0	-	-	-	-	-
5	0	-	-	-	-	-
6	0	-	-	-	-	-
7	0	-	-	-	-	-
8	0	-	-	-	-	-
9	0	-	-	-	-	-
10	23	61.2	55.9	55.9	3.45	57.7
11	3	65.3	60.1	70.6	5.29	65.3
12	9	64.8	55.5	61.2	4.96	60.5
13	11	49.3	52.3	54.6	2.84	52.1
14	21	58.3	60.5	66.3	4.34	61.7
15	1	41.5	44.9	45.8	2.26	44.1
16	15	56.9	50.2	59.8	5.13	55.6
17	10	42.1	43.3	41.4	2.26	42.3
18	0	-	-	-	-	-
19	0	-	-	-	-	-
20	0	-	-	-	-	-
21	11	52.6	54.3	62.1	5.26	56.3
22	0	-	-	-	-	-
23	0	-	-	-	-	-
24	11	56.7	55.5	58.7	1.94	57.0
25	13	64.5	61.8	66.9	2.77	64.4
26	0	-	-	-	-	-
27	15	60.2	62.0	70.5	5.57	64.3
28	0	-	-	-	-	-
29	0	-	-	-	-	-
30	0	-	-	-	-	-
31	14	54.8	60.9	65.4	5.53	60.4
32	6	42.9	49.0	50.2	4.56	47.4
33	0	-	-	-	-	-
34	0	-	-	-	-	-
35	13	57.3	49.6	55.4	4.20	54.1
36	9	49.8	51.7	58.8	4.93	53.4
37	14	52.8	58.8	65.4	6.39	59.0
38	14	56.2	56.6	63.5	4.69	58.8
39	21	53.9	55.5	62.3	4.54	57.2
40	13	54.4	57.6	61.2	3.51	57.7
41	44	43.0	38.4	39.3	3.39	40.2
42	18	50.4	47.0	46.3	2.74	47.9
43	16	46.5	45.1	45.3	1.14	45.6
Asphalt 0-39	256	56.7	56.0	60.6	4.47	57.8
Concrete 40-43	91	46.7	44.0	44.9	3.00	45.2

Table C.7: 2021 benchmark surveys using the current defined lengths

Site	Number of 100m lengths	Early avg. SR	Middle avg. SR	Late avg. SR	Between run standard deviation	Average
1	22	64.3	57.8	63.1	3.76	61.7
2	0	-	-	-	-	-
3	0	-	-	-	-	-
4	0	-	-	-	-	-
5	0	-	-	-	-	-
6	0	-	-	-	-	-
7	0	-	-	-	-	-
8	0	-	-	-	-	-
9	0	-	-	-	-	-
10	23	64.6	56.1	53.2	6.19	58.0
11	3	72.3	59.7	61.1	6.93	64.4
12	9	68.6	53.6	53.7	8.93	58.6
13	11	57.6	43.6	43.6	8.13	48.3
14	21	71.0	56.1	53.3	9.65	60.1
15	1	52.3	39.7	38.1	7.79	43.4
16	15	63.1	53.7	48.8	7.53	55.2
17	10	39.1	36.8	41.9	2.73	39.3
18	0	-	-	-	-	-
19	0	-	-	-	-	-
20	0	-	-	-	-	-
21	11	67.2	52.3	63.0	7.88	60.9
22	0	-	-	-	-	-
23	0	-	-	-	-	-
24	11	60.1	51.8	53.7	4.46	55.2
25	13	66.4	63.2	61.1	2.77	63.6
26	0	-	-	-	-	-
27	15	76.9	61.0	67.8	8.03	68.6
28	0	-	-	-	-	-
29	0	-	-	-	-	-
30	0	-	-	-	-	-
31	14	66.8	54.3	62.5	6.43	61.2
32	6	52.8	45.4	46.8	4.79	48.3
33	0	-	-	-	-	-
34	0	-	-	-	-	-
35	13	53.4	47.2	54.8	4.14	51.8
36	9	64.5	47.4	54.2	8.88	55.3
37	14	60.1	53.8	63.9	5.54	59.3
38	14	58.6	57.6	61.9	2.68	59.4
39	21	59.6	55.1	59.5	2.75	58.1
40	13	63.7	56.8	59.2	3.86	59.9
41	44	46.4	40.3	35.4	5.79	40.7
42	18	55.0	44.1	42.4	6.88	47.2
43	16	53.5	48.9	46.4	3.79	49.6
Asphalt 0-39	256	62.9	53.8	56.7	6.26	57.8
Concrete 40-43	91	51.8	44.9	42.1	5.50	46.3

Table C.8: 2022 benchmark surveys using the current defined lengths

Site	Number of 100m lengths	Early avg. SR	Middle avg. SR	Late avg. SR	Between run standard deviation	Average
1	22	62.8	55.2	46.2	8.53	54.8
2	0	-	-	-	-	-
3	0	-	-	-	-	-
4	0	-	-	-	-	-
5	0	-	-	-	-	-
6	0	-	-	-	-	-
7	0	-	-	-	-	-
8	0	-	-	-	-	-
9	0	-	-	-	-	-
10	23	61.0	49.4	52.3	6.38	54.2
11	3	60.2	52.3	57.5	4.07	56.7
12	9	63.4	47.4	52.7	8.56	54.5
13	11	47.5	40.4	40.6	4.09	42.9
14	21	60.7	49.0	51.9	6.92	53.9
15	1	41.7	34.5	36.8	3.64	37.7
16	15	60.4	45.1	49.0	8.06	51.5
17	10	38.0	31.9	37.3	3.52	35.7
18	0	-	-	-	-	-
19	0	-	-	-	-	-
20	0	-	-	-	-	-
21	11	55.7	47.9	49.0	4.24	50.8
22	0	-	-	-	-	-
23	0	-	-	-	-	-
24	11	59.2	46.6	49.1	6.79	51.6
25	13	64.8	56.4	53.9	5.71	58.4
26	0	-	-	-	-	-
27	15	62.0	54.2	54.9	4.48	57.0
28	0	-	-	-	-	-
29	0	-	-	-	-	-
30	0	-	-	-	-	-
31	14	60.2	54.0	59.8	3.85	58.0
32	6	43.7	39.4	37.7	3.45	40.3
33	0	-	-	-	-	-
34	0	-	-	-	-	-
35	13	52.5	45.9	50.2	3.37	49.5
36	9	52.5	44.9	49.6	4.02	49.0
37	14	59.2	53.1	56.5	3.20	56.3
38	14	55.1	47.1	50.1	4.35	50.8
39	21	55.6	51.5	48.5	3.72	51.9
40	13	57.7	52.8	51.5	3.47	54.0
41	44	39.2	33.4	35.3	3.43	36.0
42	18	49.2	40.2	41.1	5.09	43.5
43	16	47.9	40.7	43.9	3.96	44.2
Asphalt 0-39	256	57.5	48.8	50.1	5.68	52.1
Concrete 40-43	91	45.4	38.8	40.3	3.91	41.5

Table C.9: 2023 benchmark surveys using the current defined lengths

Site	Number of 100m lengths	Early avg. SR	Middle avg. SR	Late avg. SR	Between run standard deviation	Average
1	22	59.4	60.1	60.5	1.26	60.0
2	0	-	-	-	-	-
3	0	-	-	-	-	-
4	0	-	-	-	-	-
5	0	-	-	-	-	-
6	0	-	-	-	-	-
7	0	-	-	-	-	-
8	0	-	-	-	-	-
9	0	-	-	-	-	-
10	23	56.1	50.4	54.1	3.02	53.5
11	3	59.6	57.9	59.8	1.40	59.1
12	9	54.2	56.1	50.5	2.99	53.6
13	11	44.2	53.1	45.4	4.86	47.6
14	21	56.0	59.6	52.9	3.70	56.1
15	1	45.4	38.4	43.8	3.68	42.6
16	15	52.9	50.1	49.7	2.02	50.9
17	10	37.3	39.9	41.9	2.88	39.7
18	0	-	-	-	-	-
19	0	-	-	-	-	-
20	0	-	-	-	-	-
21	11	53.7	52.1	57.6	2.96	54.5
22	0	-	-	-	-	-
23	0	-	-	-	-	-
24	11	53.5	62.6	57.1	4.73	57.7
25	13	77.9	78.0	75.5	2.64	77.2
26	0	-	-	-	-	-
27	15	62.8	57.3	60.9	2.99	60.3
28	0	-	-	-	-	-
29	0	-	-	-	-	-
30	0	-	-	-	-	-
31	14	57.3	55.3	58.2	1.89	57.0
32	6	43.2	41.5	45.3	2.48	43.4
33	0	-	-	-	-	-
34	0	-	-	-	-	-
35	13	48.0	46.0	50.3	2.30	48.1
36	9	48.2	47.2	50.0	1.97	48.4
37	14	54.7	53.7	57.6	2.13	55.3
38	14	53.1	54.7	58.5	3.02	55.5
39	21	55.3	52.4	56.6	2.32	54.8
40	13	52.6	57.0	61.5	4.56	57.0
41	44	33.0	42.1	35.9	4.78	37.0
42	18	41.8	49.7	45.5	4.12	45.7
43	16	45.0	45.3	43.4	1.33	44.6
Asphalt 0-39	256	54.9	54.6	55.4	2.86	55.0
Concrete 40-43	91	39.7	46.3	42.8	4.20	42.9

Skid resistance benchmark surveys 2024

National Highways manages levels of skid resistance on strategic road network by carrying out single annual skid resistance surveys. These are carried out over the summer and are split over three survey periods. It is known that skid resistance varies during the year and between years. To monitor the ongoing trends in skid resistance National Highways established a series of benchmark sites. These sites are surveyed in all three of the survey periods during the survey season. This report discusses the analysis of the data collected in 2024.lysis of the data collected in 2024.

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TRL
Crowthorne House, Nine Mile Ride,
Wokingham, Berkshire, RG40 3GA,
United Kingdom
T: +44 (0) 1344 773131
F: +44 (0) 1344 770356
E: enquiries@trl.co.uk
W: www.trl.co.uk

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