1MC04 Main Works - Contract Lot S2

Noise Impact Assessment – Northolt Storage & Treatment Area – Material Treatment

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Revision	Author	Checked by	Approved by		Date approved	Reason for revision
C01	Patrick Schafstein	Matthew Weston				
						
C02	Patrick Schafstein	Matthew Weston				Report updated in response to Client Comments
						
C03	Patrick Schafstein	Matthew Weston		Sophie Hart	28/01/2022	Report updated incorporating additional mitigation
						

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1 Introduction

1.1.1 The intent of this report is to investigate and assess the sound impact of the proposed waste management facilities associated with the westernmost section of the Skanska Costain Strabag Joint Venture (SCSjv) High Speed 2 (HS2) works. The waste management facilities commonly known as the Northolt Storage & Treatment Area (S&T).

1.1.2 The Northolt Storage & Treatment Area (S&T) is bounded by Harvil Road to the west, train tracks to the north, and agricultural land immediately to the south and east. The residential property, Shorthill Cottage, occupies a segment within the western portion of site. There are few residential properties located immediately surrounding the site off Harvil Road and Breakspear Road. A more densely populated area of West Ruislip is located east of Breakspear Road.

1.1.3 In brief, excavated material will be transported to the S&T area by conveyors. Material will undergo onsite treatment with lime, through the lime mixing plant, and deposited in muck bins. The material will then be transported to stockpiles using heavy machinery such as dump trucks, the material will be spread out in layers using excavators and compacted by repeated movement of earthmoving machinery.

1.1.4 The receptors Shorthill Cottage, Brackenbury House, Brackenbury Barn, Oak Farm, The Bungalow, Harvil Farm, 160 Hoylake Crescent, 178 Hoylake Crescent and 77 The Greenway are identified as potentially affected by sound due to their relative proximity to the S&T area boundaries. As such these receptors are considered representative locations for the basis of the sound impact assessment. Figure 1 below illustrates the receptors location in relation to the S&T Area.

1.1.5 This sound assessment will form part of the requested waste permitting documentation.

1.1.6 An initial assessment was undertaken and indicated significant adverse impacts several receptor groups. Further discussion was held with the construction team to identify additional extraordinary mitigation which could be practicably implemented. The assessments of both pre and post extraordinary mitigation scenarios are presented it this report.

1.1.7 The report has been produced by Patrick Schafstein (AMIOA) who also undertook attended environmental monitoring at Harvil Road. Patrick has over three years' experience in acoustic consultancy. Sound modelling was undertaken by Robin Bolt (AMIOA). The modelling and calculations have been checked by Sam Geering (MIOA). Matthew Weston (MIOA) managed and directed the assessment. Matthew has over 16 years' experience of work in the field of environmental sound

assessment including a significant number of projects where assessment in accordance with the principles of BS 4142 was required.

Figure 1: Area surrounding S&T Area – Representative Receptors and Conveyor Line

2 Methodology

2.1.1 An investigation and assessment of noise impact has been undertaken using guidance outlined in British Standard (BS) 4142:2014 Methods for rating and assessing industrial and commercial sound. This assessment has been undertaken in line with Environment Agency Guidance.

2.1.2 In principle, when determining noise impact in line with BS 4142:2014, the assessment must include the following:

- *Background noise survey at relevant local receptors.*
- *Specific noise levels at these receptors due to site operations (usually by calculation).*
- *Assessment of the impact of characteristic features of the site noise (e.g. tonality, irregularity, impulsiveness).*
- *Comparison of the rating noise level (specific noise level + any feature correction applied) in relation to the background noise level to assess the noise impact. and*
- *General consideration of all of the above in context of the situation in addition to uncertainty to conclude on the overall acceptability of the noise impact.*

2.1.3 When assessing the likelihood of complaints determining the differences between the rating level and the background $L_{A90,T}$ noise level is paramount. The Standard states that:

- *Typically, the greater this difference, the greater the magnitude of the impact.*
- *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context. (EA definition of 'Unacceptable level of audible or detectable noise').*
- *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on context. (EA definition of Audible or detectable noise') and*
- *The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact depending on the context. (EA definition of 'No noise, or barely audible or detectable noise').*

2.1.4 The rating level ($L_{Ar,Tr}$) is defined in BS 4142: 2014 and is used to rate the industrial source (known as the specific noise source) outside residential dwellings. This

level is obtained by adding suitable correction values (outlined in table 1) to the specific sound level.

2.1.5 Reference time intervals, Tr, of 1 hour and 15 minutes are specified for the determination of rating levels during the day and night, respectively, as stated in BS 4142:2014:

"The shorter reference time interval at night means that short duration sounds with an on time of less than 1 h can lead to a greater specific sound level when determined over the reference time interval during the night than when determined during the day."

Table 1: BS 4142 feature correction

Section 9.2 Subjective Method	Perceptibility to noise sensitive façades	Correction
Tonality Ranging from not tonal to prominently tonal	Not tonal	+0
	Just perceptible	+2
	Clearly perceptible	+4
	Highly perceptible	+6
Impulsivity Considering both the rapidity and any overall change in sound levels	Not impulsive	+0
	Just impulsive	+3
	Clearly impulsive	+6
	Highly impulsive	+9
Readily Distinctive Characteristic is neither tonal nor impulsive	Is not present	+0
	Is present	+3
Intermittency Identifiable "on/off" conditions	Is not present	+0
	Is present	+3

3 Noise Monitoring

3.1.1 Semi-permanent unattended noise monitoring systems were installed at monitoring positions MP01 and MP02, identified in Figure 1, from 6th February 2021 and data was obtained for this assessment up to 21st February 2021. Site logs were analysed to identify periods of non-site activity and this data was processed to provide indicative background noise levels for the sensitive receptors identified in the assessment.

3.1.2 In advance of significant construction works being undertaken in the area, semi-permanent noise monitors were installed at monitoring positions N056 and N057. Noise data obtained from 1st November to 18th December 2020 from these two monitoring positions has been analysed to determine representative background noise levels at nearby sensitive receptor groups. The locations of N056 and N057 are shown on Figure.

3.1.3 For the purposes of this assessment the following sensitive receptors, followed by the ES ID where applicable, have been identified:

- R1 – Shorthill Cottage - 408811;
- R2 – 2 Harvil Farm - 406098;
- R3 – Brackenbury House – N/A;
- R4 – Brackenbury Barn - 419116;
- R5 – The Bungalow – N/A;
- R6 – 160 Hoylake Crescent - 419214;
- R7 – 178 Hoylake Crescent - 419186;
- R8 – 77 The Greenway - 700377; and
- R9 – Oak Farm – N/A.

3.1.4 The MP01 monitoring location was considered to represent the ambient and background noise levels for receptors Shorthill Cottage; Brackenbury House and Brackenbury Barn.

3.1.5 The MP02 monitoring location was considered to represent the ambient and background noise levels for the receptors Harvil Farm and The Bungalow due to its proximity to the neighbouring road network.

3.1.6 The N056 location was considered to represent the ambient and background noise levels for the receptors Oak Farm; 160 and 178 Hoylake Crescent and 77 The Greenway due to their proximity to residential roads and the undeveloped area to the North.

3.1.7 Supplementary attended noise measurements on the 22nd and 23rd March 2021 were obtained on Harvil Road and Breakspear Road for validation of the use of unattended data at satellite receptor locations (MP02), the locations are shown on Figure 4 below.

3.1.8 The grid references for the noise monitoring data used for this assessment are as follows:

- Monitoring Position 1 (MP01) – Latitude 51.573324; Longitude -0.46691052;
- Monitoring Position 2 (MP02) – Latitude 51.574401; Longitude -0.46880803;
- Monitoring Position N056 – Latitude 51.57172; Longitude -0.44515; and
- Monitoring Position N056 – Latitude 51.57065; Longitude 0.44175.

3.1.9 Figure 2 and 3 below shows the monitoring systems as set-up in situ.

Figure 2: Noise monitoring systems setup, MP01 and MP02 respectively.

Figure 3: Noise monitoring systems setup, N056 and N057 respectively.

Figure 4: Location of supplementary attended monitoring.

3.2 Weather Conditions

3.2.1 The weather conditions during the unattended noise measurements between 1st November and 18th December 2020 and from 6th February 2021 to 21st February 2021 are summarised in Table 3 in Appendix B.

3.2.2 Weather data was obtained from an additional noise monitor, N048, fitted with a weather station within West Ruislip Portal Compound.

3.2.3 During the attended noise survey on the 22nd March 2021 the temperature was measured to be 14°C with a relative humidity of 50%. Wind speeds were measured to be around 1 ms^{-1} and there was no precipitation throughout the attended survey.

3.2.4 During the attended noise survey on the 23rd March 2021 the temperature was measured to be 13°C with a relative humidity of 50%. Wind speeds were measured to be around 0.8 ms^{-1} and there was no precipitation throughout the attended survey.

3.3 Background sound levels

3.3.1 The $L_{A90,T}$ levels presented in this document were measured during the Covid-19 pandemic, during a government lockdown. It is considered that this may have led to unusually low weekday and weekend $L_{90,T}$ daytime and night-time levels, as road traffic is likely to have reduced due to restrictions in place at the time.

3.3.2 Unattended weather data from monitoring location N048 has been analysed to identify where periods of elevated wind or higher levels of precipitation occurred. Corresponding measured noise levels during the adverse weather periods were reviewed and excluded from the assessment if judged to have been adversely influenced.

3.3.3 The MP01 and MP02 background sound levels used in this assessment have been obtained from the semi-permanent unattended noise monitoring systems identified, the following periods were identified where there was no site activity and data is considered to be representative of background noise levels in the absence of construction noise:

- weekend of the 6th February;
- 9th February;
- weekend of the 13th February; and
- weekend of the 20th February.

3.3.4 The N056 and N057 background sound levels used in the assessment have been obtained from the semi-permanent unattended noise monitoring systems, the following periods were identified where there was no significant site activity and data considered to be representative of background noise levels in the absence of construction noise:

- from 1st Nov 2020 to 19th Dec 2020.

3.3.5 Additional attended noise measurements were obtained between 16:03 and 16:18 hrs on Breakspear Road on 22nd March and between 15:10 and 15:25 hrs on 23rd March to provide additional noise reference data for the sensitive receptors located off Breakspear Road. The measurement location is marked as ST1 on Figure 4. During the attended noise measurements construction noise from the Harvil Road site was not audible.

3.3.6 Further attended noise measurements were obtained c. 15 m south of 2 Harvil Farm between 15:03 and 17:08 hrs on 22nd March and between 15:35 and 15:50 hrs on 23rd March. The measurement location is marked as ST2 on Figure 5. During the attended noise measurements construction noise from the Harvil Road site was not audible.

3.3.7 The proposed S&T area will be operational during daytime and night-time hours, weekdays Monday to Friday, Saturday, and Sunday.

3.3.8 Analysis of the most frequently occurring daytime background sound levels, has been undertaken using the data sets obtained in the absence of significant construction at MP01, MP02, N056 and N057. The most commonly occurring daytime level for MP01 and MP02 monitoring locations was 48 dB $L_{A90,16hr}$ while for night-time the MP01 level was 45 dB $L_{A90,8hr,}$ excluding outlying data, and the MP02 level was 47 dB $L_{A90,8hr}$.

3.3.9 The most commonly occurring daytime level for N056 was 47 dB $L_{A90,16hr}$ while for night-time the level was 38 dB $L_{A90,8hr}$. The most commonly occurring daytime level for N057 was 46 dB $L_{A90,16hr}$ while for night-time the level was 38 dB $L_{A90,8hr}$. N056 has been selected to represent R6 – R9 receptors as this lies in closer proximity and has lower values to represent a worse case assessment.

3.3.10 Statistical analysis showing the frequency of background level occurrences in the absence of significant construction is presented graphically in Figures A1 to A6 of Appendix A.

Table 2: Breakdown of $L_{A90,T}$ Results from MP01

Monitoring Period		MP01 – Measured Sound Pressure Level
Hours	Period	$L_{A90,T}$
07:00 - 23:00 hrs	Daytime	48
07:00 - 19:00 hrs	Daytime*	48
19:00 - 23:00 hrs	Evening*	48
23:00 - 07:00 hrs	Night-time	45

Note: *Added for post mitigation assessment.

Table 3: Breakdown of $L_{A90,T}$ Results from MP02

Monitoring Period		MP02 – Measured Sound Pressure Level
Hours	Period	$L_{A90,T}$
07:00 - 23:00 hrs	Daytime	48
07:00 - 19:00 hrs	Daytime*	48
19:00 - 23:00 hrs	Evening*	49
23:00 - 07:00 hrs	Night-time	47

Note: *Added for post mitigation assessment.

Table 4: Breakdown of $L_{A90,T}$ Results from N056

Monitoring Period		N056 – Measured Sound Pressure Level
Hours	Period	$L_{A90,T}$
07:00 - 23:00 hrs	Daytime	47
07:00 - 19:00 hrs	Daytime*	47
19:00 - 23:00 hrs	Evening*	44
23:00 - 07:00 hrs	Night-time	38

Note: *Added for post mitigation assessment.

Table 5: Breakdown of $L_{A90,T}$ Results from N057

Monitoring Period		N057 – Measured Sound Pressure Level
Hours	Period	$L_{A90,T}$
07:00 - 23:00 hrs	Daytime	46
07:00 - 19:00 hrs	Daytime*	46
19:00 - 23:00 hrs	Evening*	46
23:00 - 07:00 hrs	Night-time	38

Note: *Added for post mitigation assessment.

3.4 MP01 Unattended Survey Results

3.4.1 Daytime $L_{Aeq,16hr}$ and night-time $L_{Aeq,8hr}$ ambient sound levels at MP01 are presented in Table 6 overleaf. These ambient sound levels have been calculated using logarithmic averaging of 1-minute measurements, whilst mean $L_{Amax,F}$ and $L_{A90,T}$ sound levels have been calculated using arithmetic averaging of 1-minute measurements. The range of measured 1-minute levels from which each logarithmic or mean value has been calculated is shown in parenthesis.

Table 6: Summary of unattended sound monitoring result at MP01

Day of Meas.	Date	Measured Sound Levels, dB re. 2 x 10^{-5} Pa.					
		Daytime (07:00 hrs - 23:00 hrs)			Night-time (23:00 hrs - 07:00 hrs)		
		$L_{Amax,F}$	$L_{Aeq,16hr}$	$L_{A90,16hr}$	$L_{Amax,F}$	$L_{Aeq,8hr}$	$L_{A90,8hr}$
Sat	06-Feb-21	64 (45-83)	63 (44-76)	50 (43-73)	55 (47-81)	50 (44-62)	46 (43-50)
Sun	07-Feb-21	61 (46-83)	57 (44-69)	51 (44-63)	57 (46-83)	52 (45-66)	47 (44-56)
Tue	09-Feb-21	65 (46-84)	61 (44-72)	52 (44-70)	57 (42-75)	52 (40-60)	44 (39-52)
Sat	13-Feb-21	60 (47-84)	53 (45-66)	48 (44-58)	51 (46-71)	48 (44-58)	46 (42-50)
Sun	14-Feb-21	60 (48-86)	56 (45-67)	51 (44-60)	60 (58-72)	59 (57-62)	58 (57-60)
Sat	20-Feb-21	64 (49-98)	58 (47-73)	52 (46-60)	56 (47-77)	50 (45-62)	46 (43-51)
Sun	21-Feb-21	62 (48-96)	55 (45-71)	48 (41-54)	57 (49-78)	53 (47-65)	49 (46-58)
Overall Mean Values		**62 (60-65)**	**58 (53-63)**	**50 (48-52)**	**56 (51-60)**	**52 (48-59)**	**48 (44-58)**

3.4.2 The results of the unattended sound survey at MP01 show that during the daytime periods, ambient sound levels ranged between 53 and 63 dB $L_{Aeq,16hr}$ with an overall mean level of 58 dB $L_{Aeq,16hr}$ obtained over the 7-day monitoring period.

3.4.3 Mean daily background sound levels measured at MP01 during the daytime periods ranged between 48 and 52 dB $L_{A90,16hr}$. The overall mean 16-hour daytime background sound level measured over the 7-day monitoring period was 50 dB $L_{A90,16hr}$.

3.4.4 The results of the unattended sound survey at MP01 show that during the night-time periods, ambient sound levels ranged between 48 and 59 dB $L_{Aeq,8hr}$ with an overall mean level of 52 dB $L_{Aeq,8hr}$ obtained over the 7-day monitoring period.

3.4.5 Mean daily background sound levels measured at MP01 during the night-time periods ranged between 44 and 58 dB $L_{A90,8hr}$. The overall mean 8-hour night-time background sound level measured over the 7-day monitoring period was 48 dB $L_{A90,8hr}$.

3.5 MP02 Unattended Survey Results

3.5.1 Daytime $L_{Aeq,16hr}$ ambient sound levels at MP02 are presented in Table 7 overleaf. These ambient sound levels have been calculated using logarithmic averaging of 1-minute measurements, whilst mean $L_{Amax,F}$ and $L_{A90,T}$ sound levels have been calculated using arithmetic averaging of 1-minute measurements. The range of measured 1-minute levels from which each logarithmic or mean value has been calculated is shown in parenthesis.

Table 7: Summary of unattended sound monitoring result at MP02

Day of Meas.	Date	Measured Sound Levels, dB re. 2 x 10^{-5} Pa.					
		Daytime (07:00 hrs - 23:00 hrs)			Night-time (23:00 hrs - 07:00 hrs)		
		$L_{Amax,F}$	$L_{Aeq,16hr}$	$L_{A90,16hr}$	$L_{Amax,F}$	$L_{Aeq,8hr}$	$L_{A90,8hr}$
Sat	06-Feb-21	72 (42-98)	62 (40-82)	47 (39-67)	63 (42-91)	55 (40-68)	44 (39-53)
Sun	07-Feb-21	71 (44-92)	61 (41-75)	48 (38-59)	65 (43-93)	58 (41-73)	46 (39-62)
Tue	09-Feb-21	71 (44-91)	64 (41-76)	53 (39-75)	60 (42-92)	59 (39-76)	42 (37-65)
Sat	13-Feb-21	61 (47-96)	57 (45-76)	48 (44-67)	55 (49-80)	50 (45-61)	47 (44-51)
Sun	14-Feb-21	59 (48-89)	55 (46-71)	49 (45-63)	57 (50-89)	57 (46-76)	49 (44-64)
Sat	20-Feb-21	69 (48-90)	60 (46-73)	51 (44-68)	56 (44-82)	51 (41-62)	44 (40-50)
Sun	21-Feb-21	68 (48-91)	59 (44-73)	48 (41-67)	59 (46-87)	58 (43-76)	47 (42-63)
Overall Mean Values		**67 (59-72)**	**60 (55-64)**	**49 (47-53)**	**59 (55-65)**	**55 (50-59)**	**46 (42-49)**

3.5.2 The results of the unattended sound survey at MP02 show that during the daytime periods, ambient sound levels ranged between 55 and 64 dB $L_{Aeq,16hr}$ with an overall mean level of 60 dB $L_{Aeq,16hr}$ obtained over the 7-day monitoring period.

3.5.3 Mean daily background sound levels measured at MP02 during the daytime periods ranged between 47 and 53 dB $L_{A90,16hr}$. The overall mean 16-hour daytime background sound level measured over the 7-day monitoring period was 49 dB $L_{A90,16hr}$.

3.5.4 The results of the unattended sound survey at MP02 show that during the night-time periods, ambient sound levels ranged between 50 and 59 dB $L_{Aeq,8hr}$ with an overall mean level of 55 dB $L_{Aeq,8hr}$ obtained over the 7-day monitoring period.

3.5.5 Mean daily background sound levels measured at MP02 during the night-time periods ranged between 42 and 49 dB $L_{A90,8hr}$. The overall mean 8-hour night-time background sound level measured over the 7-day monitoring period was 46 dB $L_{A90,8hr}$.

3.6 Supplementary Attended Survey Results

3.6.1 A summary of the attended survey results obtained at ST1 and ST2 are presented overleaf in Table 8 and Table 9 respectively.

Table 8: Summary of Attended sound monitoring result at ST1

Meas. Date	Start Time	Duration	Measured Sound Levels, dB re. 2 x 10^{-5} Pa		
			$L_{Amax,F}$	$L_{Aeq,T}$	$L_{A90,T}$
22/03/2021	16:03	15	92.3	68.8	51.0
23/03/2021	15:10	15	85.2	67.7	54.7
Overall Mean Values			**92.3**	**68.3**	**52.9**

3.6.2 Attended noise measurements presented in Table 8 above indicate that background noise levels in the vicinity of the Breakspear Road receptors were between 51 dB and 55 dB $L_{A90,T}$ during the short-term measurement periods with a mean level of 53 dB. This is 5 dB higher than the level adopted for assessment purposes and indicates a worse case assessment has been undertaken.

Table 9: Summary of Attended sound monitoring result at ST2

Measurement Date	Start Time	Duration	Measured Sound Levels, dB re. 2 x 10^{-5} Pa		
			$L_{Amax,F}$	$L_{Aeq,T}$	$L_{A90,T}$
22/03/2021	15:33	15	85.1	70.7	50.7
22/03/2021	16:53	15	84.7	72.4	52.2
23/03/2021	15:35	15	84.7	68.6	50.7
Overall Mean Values			**85.1**	**70.8**	**51.2**

3.6.3 Attended noise measurements presented in Table 9 above indicate that background noise levels in the vicinity of the 2 Harvil Farm receptor were between 51 dB and 52 dB $L_{A90,T}$ during the short-term measurement periods with a mean level of 51 dB. This is 3 dB higher than the level adopted for assessment purposes and indicates a worse case assessment has been undertaken.

3.7 N056 Unattended Survey Results

3.7.1 A summary of the daytime $L_{Aeq,16hr}$ and night-time $L_{Aeq,8hr}$ ambient sound levels at N056 are presented in Table 10 overleaf with the full daily results presented in Appendix B. These ambient sound levels have been calculated using logarithmic averaging of 15-minute measurements, whilst mean $L_{Amax,F}$ and $L_{A90,T}$ sound levels have been calculated using arithmetic averaging of 15-minute measurements. The range of measured 15-minute levels from which each logarithmic or mean value has been calculated is shown in parenthesis.

Table 10: Summary of unattended sound monitoring result at N056

Day of Meas.	Date	Measured Sound Levels, dB re. 2 x 10^{-5} Pa.					
		Daytime (07:00 hrs - 23:00 hrs)			Night-time (23:00 hrs - 07:00 hrs)		
		$L_{Amax,F}$	$L_{Aeq,16hr}$	$L_{A90,16hr}$	$L_{Amax,F}$	$L_{Aeq,8hr}$	$L_{A90,8hr}$
Overall Mean Values		**83 (77-85)**	**61 (59-64)**	**44 (33-48)**	**61 (47-82)**	**54 (45-58)**	**38 (28-46)**

Note: 1 – Data not available due to unfavourable weather.

3.7.2 The results of the unattended sound survey at N056 show that during the daytime periods, ambient sound levels ranged between 59 and 64 dB $L_{Aeq,16hr}$ with an overall mean level of 61 dB $L_{Aeq,16hr}$ obtained over the 48-day monitoring period.

3.7.3 Mean daily background sound levels measured at N056 during the daytime periods ranged between 33 and 48 dB $L_{A90,16hr}$. The overall mean 16-hour daytime background sound level measured over the 48-day monitoring period was 44 dB $L_{A90,16hr}$.

3.7.4 The results of the unattended sound survey at N056 show that during the night-time periods, ambient sound levels ranged between 45 and 58 dB $L_{Aeq,8hr}$ with an overall mean level of 54 dB $L_{Aeq,8hr}$ obtained over the 48-day monitoring period.

3.7.5 Mean daily background sound levels measured at N056 during the night-time periods ranged between 28 and 46 dB $L_{A90,8hr}$. The overall mean 8-hour night-time background sound level measured over the 48-day monitoring period was 38 dB $L_{A90,8hr}$.

3.8 N057 Unattended Survey Results

3.8.1 A summary of the daytime $L_{Aeq,16hr}$ and night-time $L_{A90,8hr}$ ambient sound levels at N057 are presented in Table 11 overleaf, with the full daily results presented in Appendix B. These ambient sound levels have been calculated using logarithmic averaging of 15-minute measurements, whilst mean $L_{Amax,F}$ and $L_{A90,T}$ sound levels have been calculated using arithmetic averaging of 15-minute measurements. The range of measured 15-minute levels from which each logarithmic or mean value has been calculated is shown in parenthesis.

3.8.2 The results of the unattended sound survey at N057 show that during the daytime periods, ambient sound levels ranged between 54 and 60 dB $L_{Aeq,16hr}$ with an overall mean level of 57 dB $L_{Aeq,16hr}$ obtained over the 48-day monitoring period.

3.8.3 Mean daily background sound levels measured at N056 during the daytime periods ranged between 33 and 49 dB $L_{A90,16hr}$. The overall mean 16-hour daytime

background sound level measured over the 48-day monitoring period was 44 dB $L_{A90,16hr}$.

3.8.4 The results of the unattended sound survey at N057 show that during the night-time periods, ambient sound levels ranged between 37 and 53 dB $L_{Aeq,8hr}$ with an overall mean level of 50 dB $L_{Aeq,8hr}$ obtained over the 48-day monitoring period.

3.8.5 Mean daily background sound levels measured at N057 during the night-time periods ranged between 30 and 45 dB $L_{A90,8hr}$. The overall mean 8-hour night-time background sound level measured over the 48-day monitoring period was 39 dB $L_{A90,8hr}$.

Table 11: Summary of unattended sound monitoring result at N057

Day of Meas.	Date	Measured Sound Levels, dB re. 2 x 10^{-5} Pa.					
		Daytime (07:00 hrs - 23:00 hrs)			Night-time (23:00 hrs - 07:00 hrs)		
		$L_{Amax,F}$	$L_{Aeq,16hr}$	$L_{A90,16hr}$	$L_{Amax,F}$	$L_{Aeq,8hr}$	$L_{A90,8hr}$
Overall Mean Values		**77 (71-80)**	**57 (54-60)**	**44 (33-49)**	**58 (48-75)**	**50 (37-53)**	**39 (30-45)**

4 Storage & Treatment Area Plant

4.1.1 The plant sound levels outlined in Tables 12 to 15 below are understood to be representative of the plant to be used on site.

4.1.2 The plant listed below has been processed and using a sound modelling software, the receptor associated Sound Power Level has been determined.

Table 12: Plant and Equipment Assumptions – Conveyor / Muck Storage Bins

Plant	No.	Daytime % on-time	Night-time % on-time	Overall Sound Power Level [dB(A)]	Reference
30-35t ADT dumpers	8	95	5	106	BS 5228-1:2009+A1:2014 Table C.4:2
25t Excavator	2	95	95	105	BS 5228-1:2009+A1:2014 Table C.2:19
30-40t Excavators	2	10	95	107	BS 5228-1:2009+A1:2014 Table C.2:14
Tractors	2	30	20	108	BS 5228-1:2009+A1:2014 Table C.4:74
Loading shovel	3	95	95	113	BS 5228-1:2009+A1:2014 Table C.10:16
4x4 Vehicles	2	20	20	102	Measured
4x4 Diesel tankers	1	15	15	110	BS 5228-1:2009 Table C.11:4-20
Generator	1	0	40	102	BS 5228-1:2009+A1:2014 Table C.4:84
Conveyor In	1	100	100	98	Measured
Conveyor Out	1	100	10	98	Measured
Wheel Wash	1	12	33	91	BS 5228-1:2009+A1:2014 Table C.3:13

Table 13: Plant and Equipment Assumptions – Lime Station Operation

Plant	No.	Daytime % on-time	Night-time % on-time	Overall Sound Power Level [dB(A)]	Reference
Delivery Lorries	4	60	-	110	BS 5228-1:2009 Table C.11:4-20
Compressor	4	60	-	106	BS 5228-1:2009 Table D.7:10
Pugmill / Mixer	3	100	100	104	BS 5228-1:2009+A1:2014 Table C.4:22
Hopper (Discharge Point)	3	100	100	103	BS 5228-1:2009+A1:2014 Table C.6:32

Table 14: Plant and Equipment Assumptions – Stockpile Plant

Plant	No.	Daytime % on-time	Night-time % on-time	Overall Sound Power Level [dB(A)]	Reference
Loading Shovel	3	100	100	113	BS 5228-1:2009+A1:2014 Table C.10:16
40 T Excavator	1	100	100	107	BS 5228-1:2009+A1:2014 Table C.2:14
30-35 T ADT Dumpers	5	100	100	106	BS 5228-1:2009+A1:2014 Table C.4:2

Table 15: Plant and Equipment Assumptions – Attenuation Pond

Plant	No.	Daytime % on-time	Night-time % on-time	Overall Sound Power Level [dB(A)]	Reference
Tractor w/ Water Bowser	1	50	-	109	BS 5228-1:2009+A1:2014 Table C.6:37
40 T Excavator	3	80	100	107	BS 5228-1:2009+A1:2014 Table C.2:14
Bulldozers	2	80	100	107	BS 5228-1:2009+A1:2014 Table C.2:11
30-35 T ADT Dumpers	5	80	100	106	BS 5228-1:2009+A1:2014 Table C.4:2
Dust Suppression Cannon	10	80	80	106	BS 5228-1:2009+A1:2014 Table C.4:91
Generator & Pump	2	100	100	90	BS 5228-1:2009+A1:2014 Table C.8:23

5 Sound Impact Assessment – Calculated Levels

5.1 Background Noise level

5.1.1 Receptors R1, R3 and R4 background noise levels, L_{A90}, relate to monitoring position MP01. Receptors R2 and R5 relate to monitoring position MP02. Receptors R6, R7, R8 and R9 relate to monitoring position N056. As such, background noise levels adopted for pre and post mitigations assessments are presented in Table 16 below.

Table 16: Background levels adopted per receptor.

Monitor	Receptor	Daytime		Evening	Night-time
		07:00 - 23:00 hrs $L_{A90,16hr}$	07:00 - 19:00 hrs $L_{A90,12hr}$ *	19:00 - 23:00 hrs $L_{A90,4hr}$ *	23:00 - 07:00 hrs $L_{A90,8hr}$
MP01	R1, R3, R4	48	48	48	45
MP02	R2, R5	48	48	49	47
N056	R6 to R9	47	47	44	38

Note: *Added for post mitigation assessment.

5.2 Sound Level Calculations of Plant at Nearest Receptors

5.2.1 The sound power levels presented in Tables 12 to 15 have been used to calculate the receptor sound pressure levels associated with the Storage & Treatment area operation.

5.2.2 The sound modelling has been undertaken using the SoundPLAN (version 8.2) sound modelling software. SoundPLAN is a propriety software package which allows the calculation of sound levels using acoustical ray-tracing techniques through implementing the prediction procedure detailed in ISO 9613-2: 1996.

5.2.3 Areas of hard and soft ground have been estimated from Google aerial mapping images and proposed site layouts.

5.2.4 All sources have been modelled as omnidirectional point sources except for the conveyor and any plant utilising haul roads which have been modelled as line sources.

5.2.5 All plant within the assessment has been calculated at height of 1.5 metre relative to the local ground height, with the following plant exceptions:

- Conveyor belt – modelled at above local ground from 2.5 m to 9.0 m; and
- Plant operating atop the stockpile – modelled at 5.0m above local ground.

5.2.6 A 2.4 metre noise barrier has been positioned between the stockpile and Shorthill cottage the closest and potentially worse affected noise sensitive receptor.

5.2.7 Calculations have been carried out based upon machinery operating for a reasonable worse case daytime hour and 15-minute night-time period. Calculations include all the construction activities identified for the operation of the Storage & Treatment Area.

5.2.8 Sound pressure levels have been calculated as $L_{Aeq,T}$ levels at 1 metre from the facades of noise sensitive receptors. The modelled specific sound levels are for construction noise only (i.e., they exclude any ambient noise). Resulting levels are presented in Tables 17 and 18 below for day (07:00 – 23:00 hrs) and night (23:00 – 07:00 hrs) respectively.

Table 17: Specific Noise Level dB at Receptors (07:00-23:00 hrs) Daytime

Receptor ID / ES ID	Highest Calculated Sound Pressure Level dB L_{Aeq} – Full operation of S&T Areas.
R1 - Shorthill Cottage / 408811	61.7
R2 - Harvil Farm / 406098	59.4
R3 - Brackenbury House / N/A	56.4
R4 - Brackenbury Barn / 419116	55.4
R5 - The Bungalow / N/A	52.9
R6 - 160 Hoylake Crescent / 419214	48.6
R7 - 178 Hoylake Crescent / 419186	49.1
R8 - 77 The Greenway / 700377	44.8
R9 - Oak Farm / N/A	43.5

Table 18: Specific Noise Level dB at Receptors (23:00-07:00 hrs) Night-time

Receptor ID	Highest Calculated Sound Pressure Level dB L_{Aeq} – Full operation of S&T Areas.
R1 - Shorthill Cottage / 408811	63.8
R2 - Harvil Farm / 406098	60.0
R3 - Brackenbury House / N/A	57.0
R4 - Brackenbury Barn / 419116	55.8
R5 - The Bungalow / N/A	55.5
R6 - 160 Hoylake Crescent / 419214	49.6
R7 - 178 Hoylake Crescent / 419186	49.6
R8 - 77 The Greenway / 700377	46.4
R9 - Oak Farm / N/A	45.8

5.2.9 Review of the calculated specific levels presented in Tables 17 and 18 above shows that calculated night-time levels are up to 2.6 dB higher than daytime levels, this is due to alternative plant operating and/or higher percentage operating times.

5.3 Acoustic Character

5.3.1 Acoustic character corrections have been applied in this assessment, as proposed items of plant such as generators may have a slight perceivable tonality, or other characteristic requiring a feature correction. Where appropriate an acoustic feature correction has been applied to the specific noise levels in Tables 19 and 20 overleaf.

5.3.2 Character corrections have been applied to different receptors groups as acoustic characteristics are not expected to be the same for each receptor. It is anticipated that tonal plant noise may be just perceptible at receptors in close proximity to site works, a +3dB correction is proposed for other sound characteristics that are neither tonal or impulsive but could be perceptible.

5.3.3 Receptor R1 has been applied a +7dB correction (+4dB for tonality; +3dB for other characteristics) due to its proximity to the site main noise sources and the specific sound levels being greater than the pre-existing ambient levels, and therefore, having the potential for characteristics to be more noticeable.

5.3.4 Receptors R2 to R7 and R9 have been applied a +5dB correction (+2dB for tonality; +3dB for other characteristics), as the pre-existing ambient levels are c.1. dB higher than the specific sound levels, therefore, site sources are expected to be less perceptible at the receptor.

5.3.5 Receptor R8 has been applied a +2dB correction for tonality due to the conveyor system producing the highest sound at the receptor, but slightly perceptible as it is c.20 dB lower than the ambient sound levels.

5.3.6 Reversing alarms are to comprise broadband ‘white noise’ whenever possible, and not have tonal characteristics such as standard reversing alarms.

5.3.7 It has been deemed that no other characteristic correction needs to be applied.

5.4 Assessment

5.4.1 The BS 4142 assessments are presented overleaf in Tables 19 and 20 with predicted sound levels, for the affected receptors, and are compared to existing background sound levels and the resulting final noise rating levels for this assessment.

Table 19: BS 4142 Assessment Summary Calculations – Daytime 07:00-23:00 hrs

Receptor	Representative $L_{A90, T}$	BS4142 Specific Sound Level $L_{ar,T}$ dB	Character Correction dB	BS4142 Rating Level $L_{ar,T}$ dB	BS4142 Assessment Level dB
R1 - Shorthill Cottage / 408811	48	62	7	69	21
R2 - Harvil Farm / 406098	48	59	5	64	16
R3 - Brackenbury House / 1868	48	56	5	61	13
R4 - Brackenbury Barn / 419116	48	55	5	60	12
R5 - The Bungalow / 1021	48	53	5	58	10
R6 - 160 Hoylake Crescent / 419214	47	49	5	54	7
R7 - 178 Hoylake Crescent / 419186	47	49	5	54	7
R8 - 77 The Greenway / 700377	47	45	2	47	0
R9 - Oak Farm / 1935	47	44	5	49	2

Table 20: BS 4142 Assessment Summary Calculations – Night-time 23:00-07:00 hrs

Receptor	Representative $L_{A90, T}$	BS4142 Specific Sound Level $L_{ar,T}$ dB	Character Correction dB	BS4142 Rating Level $L_{ar,T}$ dB	BS4142 Assessment Level dB
R1 - Shorthill Cottage / 408811	45	64	7	71	26
R2 - Harvil Farm / 406098	47	60	5	65	18
R3 - Brackenbury House / 1868	45	57	5	62	17
R4 - Brackenbury Barn / 419116	45	56	5	61	16
R5 - The Bungalow / 1021	47	56	5	61	14
R6 - 160 Hoylake Crescent / 419214	38	50	5	55	17
R7 - 178 Hoylake Crescent / 419186	38	50	5	55	17
R8 - 77 The Greenway / 700377	38	46	2	48	10
R9 - Oak Farm / 1935	38	46	5	51	13

5.5 Uncertainty

5.5.1 Uncertainty should be considered at each step of the design process and in each step of the source/receiver chain, including:

- Propagation of sound from the sources to the receptors.
- Determination of the background sound level.
- Measurement and commissioning of the system.

5.5.2 The rounding of integer values, as required by BS 4142, has been used in the derivation of the background sound levels and calculations, to avoid an impression of false precision to decimal places.

5.5.3 A qualitative estimate has been made of the uncertainty of the measured sound levels based on several site-specific factors, as outlined in BS4142:2014. Some potential measurement uncertainties that have been considered are listed below:

- Selected monitoring location - The monitoring location have been selected as free field away from reflecting surfaces. The monitoring locations were located at locations considered to be representative of the property facades that will face the future HS2 works and thus representative of the background sound at the most exposed façade.
- The monitoring location MP01 was positioned at a location considered to be representative of Shorthill Cottage that will face the future HS2 works and thus representative of the background sound at the most exposed façade. Brackenbury House and Brackenbury Barn are located c. 700 m to the east of the monitor but both properties of similar distance to adjacent road and rail networks. The monitoring location MP02 was considered representative to 2 Harvil Farm and The Bungalow due to the close proximity with adjacent roads and similar distance to the future S&T site. The monitoring location N056 was positioned at a location representative of 77 The Greenway, Oak Farm, and both 160 and 178 Hoylake Crescent, this is considered representative due to the similar noise environment with residential roads, rural areas and proximity to HS2 works.
- A limited data set was available for unattended monitors MP01 and MP02 where site logs indicated inactivity, as such the background levels adopted may not be as robust as extended period data sets.
- There is c. 7 weeks data for the unattended monitor N056 and N057 in the absence of significant site activity. This data set length is considered robust for the derivation of noise sensitive receptor background sound levels.
- Comparison between measured data MP01 and MP02 and extended period data

obtained at N056 and N057 indicates that daytime levels vary by just 1dB, however, night-time levels vary by up to 9dB across the full locations.

- Calibration drift - Each of the unattended monitors has been calibrated on a regular basis using Class 1 field calibrators with no significant drift noted.
- For unattended monitor references MP01 and MP02, it was necessary to exclude periods of site activity to reduce noise from the adjacent site influencing the background data used. As such the periods removed were more biased towards weekdays leaving the potentially quieter weekend periods. This too may have led to lower background noise levels being adopted for the assessment.
- Equipment measurement range - The noise floor of the Class 1 sound level meter used on this project is specified to be 17 dB(A) or less. At the monitoring location, the specified noise floor of the equipment is sufficiently below the measured noise levels and is unlikely to have affected the measured background sound levels.
- Weather affected data – Weather conditions throughout the monitoring period have been deemed suitable, and are considered to have not changed the $L_{A90,T}$ levels used in this assessment.
- Covid-19 related changes – It was noted that the $L_{A90,T}$ levels during the unattended survey periods, may have been lower than the normal expected level, due to inactivity and movements of local businesses and residential movements during the government-imposed lockdown. This potentially leads to a lower-than-expected $L_{A90,T}$ for the area, and therefore, represents an increased level dB difference, between the $L_{A90,T}$ and predicted construction sound levels, calculated in this assessment. It is not possible to provide a robust estimate of how much the background noise levels could potentially have been reduced by reduced environmental activity.

5.6 Context

5.6.1 When considering the significance of an impact, BS 4142 advises that the context of the impact should be taken into account. The context of the impact should consider factors such as: the absolute level of sound; the character and level of the residual sound compared to the character and level of the specific sound; the sensitivity of the receptor; and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

5.6.2 The proposed operations are not permanent and are proposed to be in operation until April 2024. It would therefore be usual for the HS2 construction project noise

levels to be assessed against criteria presented in BS 5228 part 1. For context purposes a BS 5228 construction noise assessment is presented in Section 5.7 for reference.

5.6.3 Background noise levels were obtained during a period of national lockdown and may therefore be lower than periods of normal national activity. The assessment levels presented within this report may therefore overestimate the potential impacts.

5.6.4 The assumed plant operating times are high and represent a worse case assessment. Several Items of plant are assumed to have 100% operation and so actual usage levels may be less and result in lower receptor noise levels.

5.6.5 The mean ambient noise level at MP01, which represents R1, R3 and R4, in the absence of site activity is 58 dB $L_{Aeq,16hour}$ for daytime, as presented in Table 6. In comparison, the calculated construction level at the closest receptor (R1) is 62 dB $L_{Aeq,16hour}$ which is c. 4 dB above pre-existing ambient noise levels, however, at the other MP01 receptors (R3 & R4) the calculated level is up to 56 dB $L_{Aeq,16hour}$ and so are 2 dB or more lower than pre-existing ambient noise levels. It is noted therefore that construction noise impacts at R3 and R4 are likely to be mitigated by higher pre-existing ambient noise levels.

5.6.6 The mean ambient noise level at MP02, which represents R2 and R5, in the absence of site activity is 60 dB $L_{Aeq,16hour}$ for daytime, as presented in Table 7. In comparison the calculated construction levels at the receptors R2 and R5 are 59 dB $L_{Aeq,16hour}$ and 53 dB $L_{Aeq,16hour}$ which are 1 and 7 dB lower than the pre-existing ambient noise levels. Potential noise impacts are therefore likely to be mitigated by the higher pre-existing ambient noise levels.

5.6.7 The mean ambient noise level at N056, which represents R6 to R9, in the absence of site activity is 61 dB $L_{Aeq,16hour}$ for daytime, as presented in Table 10. In comparison, the highest calculated construction level at the receptors R6 to R9 is 49 dB $L_{Aeq,16hour}$, and the lowest is 44 dB $L_{Aeq,16hour}$ which are 12 and 17 dB lower than pre-existing ambient noise levels. It is therefore noted that the audibility of site operations and the noise impacts at these receptors will be mitigated by the higher pre-existing ambient noise levels.

5.7 BS 5228 Assessment

5.7.1 The BS 5228 (ABC) example assessment method 1 allows an assessment of the effects from construction noise using a matrix of established noise threshold levels above which a potential significant effect is concluded. ABC threshold levels are to be applied to residential receptors only.

5.7.2 An extract from BS 5288, Table E1 setting out the example ABC threshold values is provided below on Figure 5.

Figure 5: Table E.1 extracted from BS 5228.

Table E.1 **Example threshold of A1 potential significant A1 effect at dwellings**

Assessment category and threshold value period	Threshold value, in decibels (dB) A1 ($L_{Aeq,T}$) A1		
	Category A [A]	Category B [B]	Category C [C]
Night-time (23.00–07.00)	45	50	55
Evenings and weekends [D]	55	60	65
Daytime (07.00–19.00) and Saturdays (07.00–13.00)	65	70	75

A1 *NOTE 1 A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.*

NOTE 2 If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise. A1

NOTE 3 Applied to residential receptors only.

[A] Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

[B] Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

[C] Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

[D] 19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.

5.7.3 The baseline noise levels used in the BS 5228 assessment have been taken from the semi-permanent unattended noise monitoring systems during a period where no construction works were taking place, using background levels obtained from monitors MP01 and MP02 for the period from 12th to 31st March 2021 and using background levels obtained from monitor N056 for the period from 1st November to 18th December 2020. The $L_{Aeq,T}$ levels presented in this document were measured during the Covid-19 pandemic, during a government lockdown. It is considered that this may have led to an unusually low $L_{Aeq,T}$ levels, as road traffic reduced due to restrictions in place at the time.

5.7.4 Sensitive receptor pre-existing ambient noise levels have been calculated for day (07:00 to 19:00 hrs), evening, (19:00 to 23:00 hrs) and night-time (23:00 to 07:00 hrs) periods for BS 5228 assessment purposes.

5.7.5 A summary of the pre-existing ambient noise levels assigned to each receptor is presented in Table 21 overleaf with the BS 5228 assessment category and significant effect level.

Table 21: Receptor BS 5228 Assessment Categories and Significant Effect Levels

Baseline Monitor	Baseline Period	Ambient Level, dB $L_{Aeq,T}$ (no Construction)	Threshold Category / Value, dB $L_{Aeq,T}$
MP01 (R1, R3 & R4)	Day Evening Night	58 52 52	A - 65 A - 55 C - 55
MP02 (R2 & R5)	Day Evening Night	61 56 55	A - 65 B - 60 C - 55
N056 (R6, R7, R8 & R9)	Day Evening Night	61 60 54	A - 65 C - 65 C - 55

5.7.6 A comparison between the predicted receptor day, evening and night construction noise levels with the corresponding significant effect threshold level is presented below in Table 22.

Table 22: Comparison between Calculated Receptor Construction Levels and Significant Effect Levels

Receptor	Assessment Period	Construction Level , dB $L_{Aeq,T}$ (a)	Threshold Level , dB $L_{Aeq,T}$ (b)	Difference (a-b)
R1	Day Evening Night	62 62 64	65 55 55	-3 7 9
R2	Day Evening Night	59 59 60	65 60 55	-6 -1 5
R3	Day Evening Night	56 56 57	65 55 55	-9 1 2
R4	Day Evening Night	55 55 56	65 55 55	-10 0 1
R5	Day Evening Night	53 53 56	65 60 55	-12 -7 1
R6	Day Evening Night	49 49 50	65 65 55	-16 -16 -5
R7	Day Evening Night	49 49 50	65 65 55	-16 -16 -5
R8	Day Evening Night	45 45 46	65 65 55	-20 -20 -9

Receptor	Assessment Period	Construction Level , dB $L_{Aeq,T}$ (a)	Threshold Level , dB $L_{Aeq,T}$ (b)	Difference (a-b)
R9	Day	44	65	-21
	Evening	44	65	-21
	Night	46	55	-9

5.7.7 Summary differences presented in Table 22 above indicate that at R1 construction noise levels are below the daytime significant threshold level by 3 dB but exceed the evening by 7 dB and night threshold levels by up to 9 dB. It is noted at R1 represents a single property.

5.7.8 Calculated construction levels at R2 are predicted to fall below significant effect threshold levels by 6 dB during the daytime and by 1 dB during evening periods, but exceed the night-time threshold level by up to 5 dB. It is noted that Receptor location R2 represents just 2 properties.

5.7.9 Daytime construction noise levels at R3 are predicted to fall below significant effect threshold levels by 9 dB during daytime periods but are calculated to exceed the evening periods by 1 dB and the night threshold levels by 2 dB. It is noted that Receptor location R3 represents 1 property.

5.7.10 Daytime construction noise levels at R4 are predicted to fall below significant effect threshold levels by 10 dB during daytime periods and by 0 dB during evening periods but are calculated to night threshold levels by 1 dB. Receptor Location R4 represents 1 property.

5.7.11 Calculated construction levels at R5 are predicted to fall below significant effect threshold levels by 12 dB during the daytime and by 7 dB during evening periods but exceed the night-time threshold level by up to 1 dB. around 30 properties are represented by Receptor location R5.

5.7.12 At receptor locations R6, R7, R8 and R9 calculated construction levels fall below significant effect threshold levels by 5 dB or more during all day, evening, and night-time periods. It is noted that receptor locations R6 to R9 represent the vast majority of properties potentially affected by noise.

6 Reassessment With Additional Mitigation

6.1 Summary of adopted mitigation

6.1.1 Based on the initial assessment results and the observation of significant adverse impact predicted further discussions were undertaken with the construction team to identify additional extraordinary mitigation which could be adopted to reduce noise impacts. Based on these discussions the following measures were agreed:

- Working Areas - restricted working hours withing the stockpile area;
- Reductions in plant use;
- Removal of Attenuation Pond Works;
- Introduction of 2.4 m high noise barriers;

6.1.2 Further detail on the mitigations is provided in the following sub-sections.

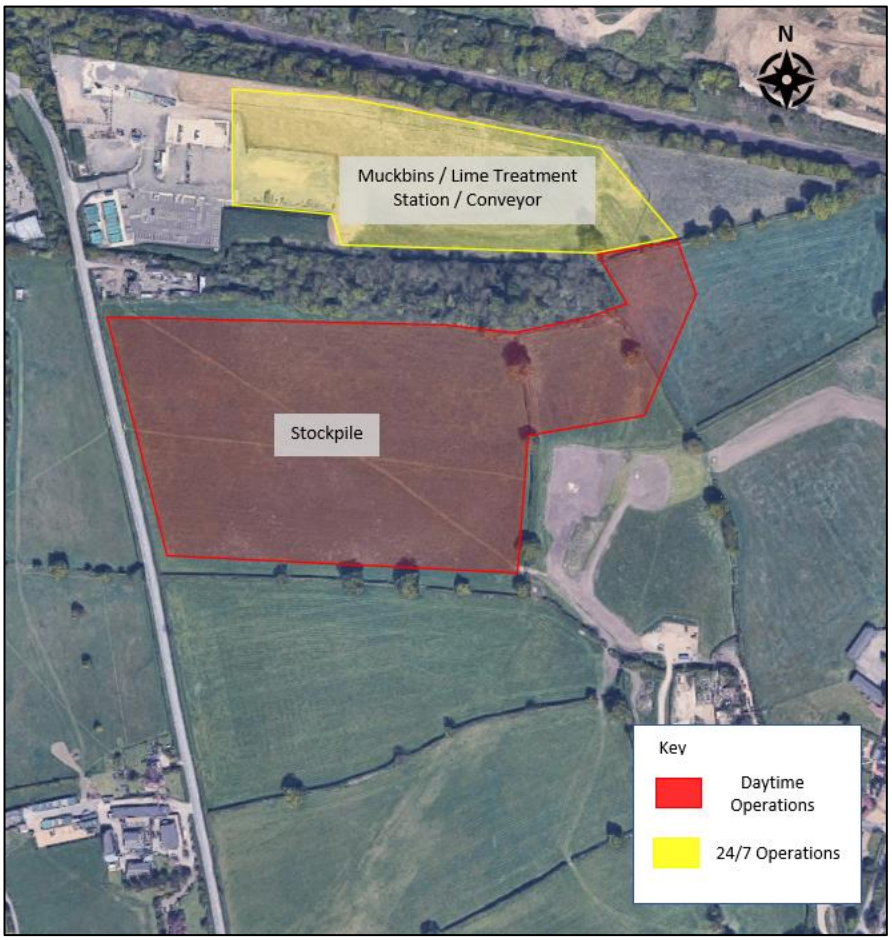
6.2 Working Areas

6.2.1 The initial assessment considered all activities working 24 hours a day, 7 days a week. Subsequently it was agreed that the Storage & Treatment Area (S&T) will operate as two distinct areas with different operating periods as part of the noise mitigation plan.

6.2.2 Noise from activities in the southern stockpile area would be mitigated by restricting activities to daytime (07:00-19:00 hrs) periods only, and the northern area which includes muck bins, conveyors and lime treatment station will be operational on a 24 hours shift, but there will be no material transport to the stockpiles in the southern area.

6.2.3 Figure 6 overleaf indicates the total working area of the Storage & Treatment activities.

Figure 6: Working areas.



6.3 Reduction to Plant Assumptions

6.3.1 The revised plant lists and assumptions is presented overleaf in Tables 23 to 25. It is noted that the restriction of working hours in the stock pile effectively splits the daytime period of 07:00 to 23:00 hours into two periods which are 07:00 – 19:00 hrs and 19:00 – 23:00 hrs. Further assessment therefore follows these revised assessment periods.

6.3.2 The conveyor plant and equipment listed for the conveyor and muck storage bins presented overleaf in Table 23 will operate on a 24-hour basis within the area marked on Figure 6.

6.3.3 The initial assessment included a plant list for the construction of the Attenuation Pond, however, this has been removed from the reassessment as the SCS site team confirmed it won`t be an ongoing activity for the S&T Area.

Table 23: Plant and Equipment Assumptions – Conveyor / Muck Storage Bins

Plant	No.	Daytime % on-time	Evening % on-time	Night-time % on-time	Overall Sound Power Level [dB(A)]	Reference
30-35t ADT dumpers	8	85	20	5	106	BS 5228-1:2009+A1:2014 Table C.4:2
25t Excavator	2	85	20	5	105	BS 5228-1:2009+A1:2014 Table C.2:19
30-40t Excavators	2	10	85	85	107	BS 5228-1:2009+A1:2014 Table C.2:14
Tractors	2	30	20	20	108	BS 5228-1:2009+A1:2014 Table C.4:74
Loading shovel	3	85	85	95	113	BS 5228-1:2009+A1:2014 Table C.10:16
4x4 Vehicles	2	10	10	10	102	Measured
4x4 Diesel tankers	1	5	0	0	110	BS 5228-1:2009 Table C.11:4-20
Generator	1	0	40	40	102	BS 5228-1:2009+A1:2014 Table C.4:84
Conveyor In	1	100	100	100	98	Measured
Conveyor Out	1	100	10	10	98	Measured
Wheel Wash	1	12	0	0	91	BS 5228-1:2009+A1:2014 Table C.3:13

6.3.4 The lime station plant and equipment listed below in Table 24 will operate on a 24-hour basis within the area marked on Figure 7.

Table 24: Plant and Equipment Assumptions – Lime Station Operation

Plant	No.	Daytime % on-time	Evening % on-time	Night-time % on-time	Overall Sound Power Level [dB(A)]	Reference
Delivery Lorries	4	60	20	-	110	BS 5228-1:2009 Table C.11:4-20
Compressor	4	60	60	-	106	BS 5228-1:2009 Table D.7:10
Pugmill / Mixer	3	100	100	100	104	BS 5228-1:2009+A1:2014 Table C.4:22
Hopper (Discharge Point)	3	100	100	100	103	BS 5228-1:2009+A1:2014 Table C.6:32

6.3.5 The stockpile plant and equipment listed below in Table 25 will operate between 07:00 and 19:00 within the Daytime area marked on Figure 7.

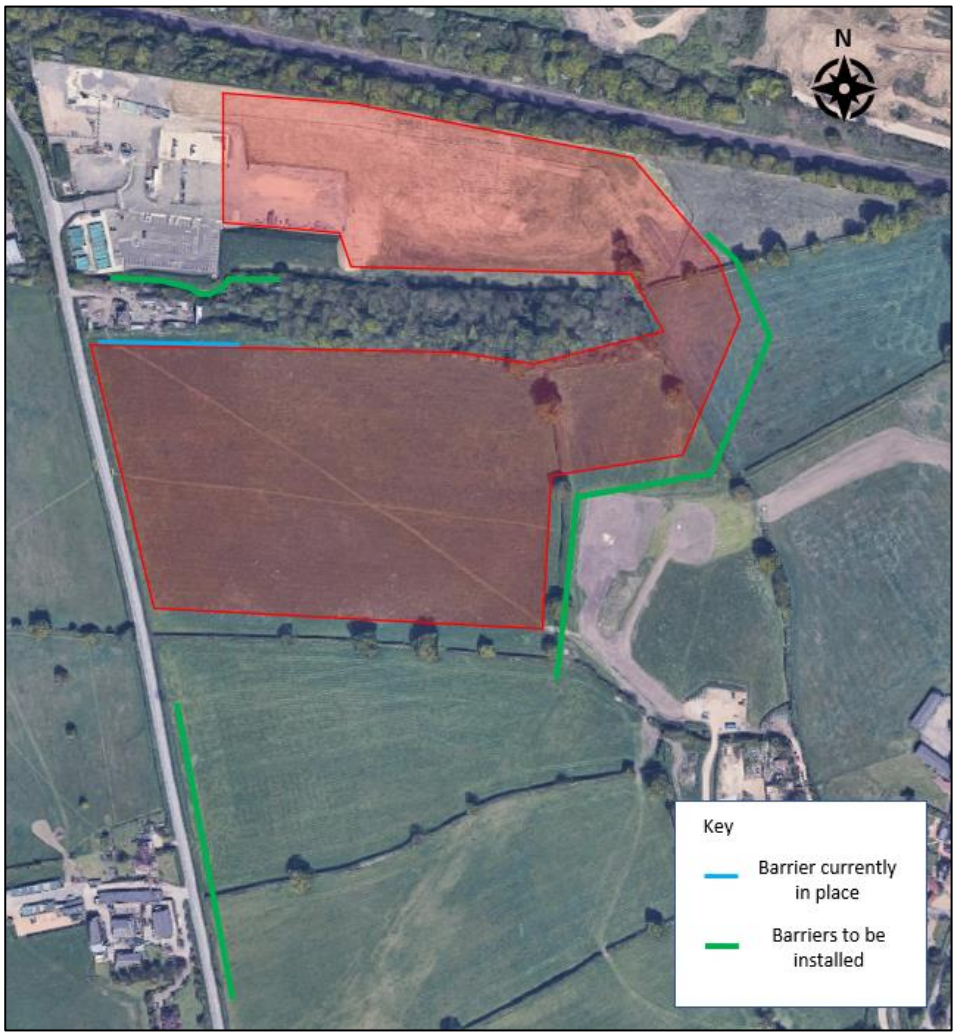
Table 25: Plant and Equipment Assumptions – Stockpile Plant

Plant	No.	Daytime % on-time	Evening % on-time	Night-time % on-time	Overall Sound Power Level [dB(A)]	Reference
Loading Shovel	3	85	-	-	113	BS 5228-1:2009+A1:2014 Table C.10:16
40 T Excavator	1	85	-	-	107	BS 5228-1:2009+A1:2014 Table C.2:14
30-35 T ADT Dumpers	5	85	-	-	106	BS 5228-1:2009+A1:2014 Table C.4:2

6.4 Noise Mitigation Barriers

6.4.1 The mitigated site assessment considers 2.4m barriers installed at strategic locations to provide mitigation to the residential receptors groups detailed in this assessment. The locations of proposed and pre-existing noise barriers are described in Figure 7 overleaf.

Figure 7: Implementation of noise barriers.



6.5 Calculation of Mitigated Noise Levels

6.5.1 Based on the adoption of the mitigation options presented above a recalculation of the mitigated sound levels at the sensitive receptor locations considered is presented below in Tables 26 to 28 overleaf. This included the adoption of 2.4m barriers.

6.5.2 Sound pressure levels have been calculated as $L_{Aeq,T}$ levels at 1 metre from the facades of noise sensitive receptors. The modelled specific sound levels are for construction noise only (i.e., they exclude any ambient noise).

26: Specific Noise Level dB at Receptors (07:00-19:00 hrs) Daytime

Receptor ID / ES ID	Highest Calculated Sound Pressure Level dB L_{Aeq} – Full operation of S&T Areas.
R1 - Shorthill Cottage / 408811	57.7
R2 - Harvil Farm / 406098	55.0
R3 - Brackenbury House / N/A	53.3
R4 - Brackenbury Barn / 419116	53.0
R5 - The Bungalow / N/A	49.7
R6 - 160 Hoylake Crescent / 419214	45.9
R7 - 178 Hoylake Crescent / 419186	46.1
R8 - 77 The Greenway / 700377	41.0
R9 - Oak Farm / N/A	38.7

Table 27: Specific Noise Level dB at Receptors (19:00-23:00 hrs) Evening

Receptor ID	Highest Calculated Sound Pressure Level dB L_{Aeq} – Full operation of S&T Areas.
R1 - Shorthill Cottage / 408811	55.1
R2 - Harvil Farm / 406098	49.4
R3 - Brackenbury House / N/A	49.9
R4 - Brackenbury Barn / 419116	49.6
R5 - The Bungalow / N/A	44.9
R6 - 160 Hoylake Crescent / 419214	42.9
R7 - 178 Hoylake Crescent / 419186	42.6
R8 - 77 The Greenway / 700377	37.1
R9 - Oak Farm / N/A	31.9

Table 28: Specific Noise Level dB at Receptors (23:00-07:00 hrs) Night-time

Receptor ID	Highest Calculated Sound Pressure Level dB L_{Aeq} – Northern S&T Area
R1 - Shorthill Cottage / 408811	57.7
R2 - Harvil Farm / 406098	49.8
R3 - Brackenbury House / N/A	49.8
R4 - Brackenbury Barn / 419116	49.7
R5 - The Bungalow / N/A	46.7
R6 - 160 Hoylake Crescent / 419214	43.7
R7 - 178 Hoylake Crescent / 419186	43.4

R8 - 77 The Greenway / 700377	38.3
R9 - Oak Farm / N/A	32.6

6.6 Mitigated Levels Acoustic Character Corrections

6.6.1 Based on revised calculations and discussion with SCS, characteristic penalties have been reviewed and are presented below.

6.6.2 Character corrections have been applied to different receptors groups as acoustic characteristics are not expected to be the same for each receptor. Potentially an impulsive plant noise may be just perceptible at receptors in close proximity to site works as potentially there might be a low level of audibility when deposited material is collected from material piles. It is not anticipated that impulsivity will be noticeable at distant receptors.

6.6.3 A +3dB correction is proposed for other sound characteristics that are neither tonal, impulsive or intermittent but could be perceptible.

6.6.4 Receptor R1 has been applied a +5dB correction for the daytime and evening periods (+2dB for impulsivity; +3dB for other characteristics), for the night-time period a +5dB correction (+2dB for impulsivity; +3dB for intermittency) due to its proximity to the site main noise sources and the specific sound levels being greater than the pre-existing ambient levels, and therefore, having the potential for characteristics to be more noticeable.

6.6.5 An impulsivity or intermittency correction has not been applied for other receptors at any time periods as the dominating noise sources are noted to be from the loading shovel and it is not anticipated for the loading shovel to have impulsivity or intermittency characteristics perceptible at the more distant receptors.

6.6.6 Receptors R2 to R5 been applied a +3dB correction for other characteristics, as the pre-existing ambient levels are between 2 and 11 dB higher than the specific sound levels, therefore, site sources are expected to be less perceptible at the receptor.

6.6.7 Receptors R6 to R9 have not been applied any characteristic adjustments, as the pre-existing ambient levels are 10 dB or more higher than the specific sound levels. Therefore, site sources are not expected to be perceptible at the receptor. At night-time this is also expected as the highest noise source, that could be potentially noticeable at closer receptors, produces sound levels of up to 26 dB lower than the pre-existing ambient levels at this group of receptors.

6.7 Assessment of Mitigated Sound Levels

6.7.1 The BS 4142 assessments of mitigated sound levels are presented below in Tables 29 to 31. Calculated rating levels, for the potentially impacted receptors, and are compared to existing background sound levels with the resulting differences shown.

Table 29: Daytime 07:00 -19:00 - All Areas

Receptor	Representative $L_{A90,\ T}$	BS4142 Specific Sound Level $L_{ar,T}$ dB	Character Correction dB	BS4142 Rating Level $L_{ar,T}$ dB	BS4142 Assessment Level dB
R1 - Shorthill Cottage / 408811	48	58	5	63	15
R2 - Harvil Farm / 406098	48	55	3	58	10
R3 - Brackenbury House / 1868	48	53	3	56	8
R4 - Brackenbury Barn / 419116	48	53	3	56	8
R5 - The Bungalow / 1021	48	50	3	53	5
R6 - 160 Hoylake Crescent / 419214	47	46	0	46	-1
R7 - 178 Hoylake Crescent / 419186	47	46	0	46	-1
R8 - 77 The Greenway / 700377	47	41	0	41	-6
R9 - Oak Farm / 1935	47	39	0	39	-8

Table 30: Evening 19:00 - 23:00 – Muck bins / Conveyor / Lime treatment station

Receptor	Representative $L_{A90,\ T}$	BS4142 Specific Sound Level $L_{ar,T}$ dB	Character Correction dB	BS4142 Rating Level $L_{ar,T}$ dB	BS4142 Assessment Level dB
R1 - Shorthill Cottage / 408811	48	55	5	60	12
R2 - Harvil Farm / 406098	49	49	3	52	3
R3 - Brackenbury House / 1868	48	50	3	53	5
R4 - Brackenbury Barn / 419116	48	50	3	53	5
R5 - The Bungalow / 1021	49	45	3	48	-1
R6 - 160 Hoylake Crescent / 419214	44	43	0	43	-1
R7 - 178 Hoylake Crescent / 419186	44	43	0	43	-1
R8 - 77 The Greenway / 700377	44	37	0	37	-7

R9 - Oak Farm / 1935	44	32	0	32	-12

Table 31: Night-time 23:00 - 07:00 - Muck bins / Conveyor / Lime treatment station

Receptor	Representative $L_{A90, T}$	BS4142 Specific Sound Level $L_{ar,T}$ dB	Character Correction dB	BS4142 Rating Level $L_{ar,T}$ dB	BS4142 Assessment Level dB
R1 - Shorthill Cottage / 408811	45	58	5	63	18
R2 - Harvil Farm / 406098	47	50	3	53	6
R3 - Brackenbury House / 1868	45	50	3	53	8
R4 - Brackenbury Barn / 419116	45	50	3	53	8
R5 - The Bungalow / 1021	47	47	3	50	3
R6 - 160 Hoylake Crescent / 419214	38	44	0	44	6
R7 - 178 Hoylake Crescent / 419186	38	43	0	43	5
R8 - 77 The Greenway / 700377	38	38	0	38	0
R9 - Oak Farm / 1935	38	33	0	33	-5

6.7.2 Results presented in Tables 29 above shows that for the majority of the daytime the assessment shows an average of 5 dB reduction in the assessment level when compared to the initial daytime (07:00 – 23:00 hrs) assessment without mitigation. The adverse impacts at receptors R6 and R7 are removed and receptor R5's impact is reduced to an adverse impact from a significant adverse impact. Receptors R1 and R2 are still rated with significant adverse impact, however, levels are reduced.

6.7.3 Results presented in Tables 30 above shows that for the evening period (19:00 – 23:00 hrs) the assessment shows no impact at receptors R5 to R9, adverse impacts at R2 to R5 and a significant adverse impact at R1.

6.7.4 Results presented in Tables 31 above shows that for the night-time period (23:00 – 07:00 hrs) assessment levels have reduced by 8 to 13 dB when compared to the initial assessment without mitigation. The adverse significant impact at receptors R8 and R9 are removed, and the significant adverse impacts at receptors R2, R5, R6 and R7 are reduced to adverse impacts. Receptor R1 is still rated with significant adverse impact, however, levels are reduced by 8 dB. Levels at Receptors R3 and R4 are reduced by 9 dB and 8 dB respectively and are still rated with significant adverse impact.

6.8 BS 5228 Reassessment

6.8.1 An updated post mitigation comparison between the predicted receptor day, evening and night construction noise levels with the corresponding significant effect threshold level is presented below in Table 22. The pre-existing ambient noise levels assigned to each receptors remains the same as in Table 21.

Table 32: Comparison between Calculated Receptor Construction Levels and Significant Effect Levels

Receptor	Assessment Period	Construction Level , dB $L_{Aeq,T}$ (a)	Threshold Level , dB $L_{Aeq,T}$ (b)	Difference (a-b)
R1	Day	58	65	-7
	Evening	55	55	0
	Night	58	55	3
R2	Day	55	65	-10
	Evening	49	60	-11
	Night	50	55	-5
R3	Day	53	65	-12
	Evening	50	55	-5
	Night	50	55	-5
R4	Day	53	65	-12
	Evening	50	55	-5
	Night	50	55	-5
R5	Day	50	65	-15
	Evening	45	60	-15
	Night	47	55	-8
R6	Day	46	65	-19
	Evening	43	65	-22
	Night	44	55	-11
R7	Day	46	65	-19
	Evening	43	65	-22
	Night	43	55	-12
R8	Day	41	65	-24
	Evening	37	65	-28
	Night	38	55	-17
R9	Day	39	65	-26
	Evening	32	65	-33
	Night	33	55	-22

6.8.2 Summary differences presented in Table 32 above indicate that with the inclusion of a 2.4m barrier and other adopted mitigation measures the construction noise levels fall below the significant threshold at all properties and time periods except

at receptor R1 where the night threshold is exceeded by 3 dB. It is noted at R1 represents a single property.

7 Conclusions

7.1.1 Construction sound levels associated with the operation of a Storage & Treatment Area have been calculated at 9 no. sensitive receptors (R1 – R9) adjacent to a site off Harvil Road located along the route of the conveyor system. Sound levels have been assessed using the principles of BS 4142:2014+A1:2019 in accordance with Environment Agency guidance.

7.1.2 Sensitive receptor background levels have been obtained by analysing data from 3 no. unattended noise monitors in the absence of logged significant construction activities at nearby construction sites. Supplementary attended noise measurements were also obtained to provide some verification of background levels adopted for assessment.

7.1.3 Initial results considering site operations with standard mitigation indicated differences between rating and background levels such that there would be significant adverse impacts at the receptors considered, depending on the context.

7.1.4 Further discussions were undertaken with the construction team to identify extraordinary mitigation measures which could be adopted. These were identified as the introduction of noise barriers, reductions in working areas between 19:00 and 07:00 hrs and some reduction in plant usage.

7.1.5 Mitigated receptor noise levels were reassessed in accordance with BS 4142. Comparisons between basic mitigation and extraordinary mitigation options indicate that daytime (07:00 – 19:00 hrs) assessment levels would reduce by between 4 and 10 dB. During evening (19:00 – 23:00 hrs) periods differences between receptor rating and background levels would reduce by between 11 and 25 dB, and differences during the night-time period (23:00 – 07:00 hrs) differences would reduce by between 8 and 18 dB.

7.1.6 Assessment using BS 4142 requires that the context of the assessment should be considered in the overall assessment of rating levels. A comparison of the standard mitigation construction levels and pre-existing ambient levels is detailed in section 5.6. The comparison indicates that construction levels exceed the existing ambient levels for only one receptor (R1) during daytime. During night-time periods at all receptor groups pre-existing ambient noise levels are greater than the calculated construction noise and thus mitigate the potential noise impacts.

7.1.7 An additional point of context is that activities being undertaken at the Storage & Treatment Area are part of the HS2 construction project. Typically, construction noise is assessed using BS 5228 part 1. Example criteria presented in BS 5228 has been used to assess the construction noise from the operation of the Storage and Treatment Area. The assessment indicates that the noise from construction

activities would not exceed the threshold during daytime periods for any of the receptors considered. During the evening period the threshold level is exceeded at only two receptor groups. During night-time periods, the threshold levels are exceeded at five receptor groups.

7.1.8 With the adoption of the extraordinary mitigation measures listed calculated construction noise levels exceed the BS 5228 threshold criteria at just 1 receptor group during a night-time period. The receptor group represents just 1 property.

7.1.9 When the assessment levels of the BS 4142 study are considered in the context of both the pre-existing ambient noise levels and the conventional construction noise assessment for these limited time activities, it is considered that the significant adverse impacts calculated would reduce to no more than 1 receptor significant adverse impact representing just 1 property.

7.1.10 It should be noted that the goal of this assessment is to determine the noise impact associated with the proposed works and act as a means of supporting the associated permit application. Eligibility of properties surrounding areas of SCSjv works for noise insulation is constantly reviewed periodically in line with the HS2 technical standard as the works progress in the area, and a number of properties exposed to noise from material transfers and other construction activities (including properties on Hoylake Crescent, the Greenway and Breakspear Road South) are currently being considered for provision of noise insulation in line with the criteria of determination outlined in the technical standard.

8 References

Title	Reference
BS 4142:2014+A1:2019.	Methods for rating and assessing industrial and commercial sound. BSI Standards Publication.
BS 5228-1:2009+A1:2014	Code of practice for noise and vibration control on construction and open sites. Part 1: Noise. BSI Standards Publication.
ISO:9613-2:1996	Acoustics – Attenuation of sound during propagation outdoors. Part 2: General method of calculation

Appendix A

Figure A1: STATISTICAL ANALYSIS OF BACKGROUND LEVELS AT MP01 – NO CONSTRUCTION

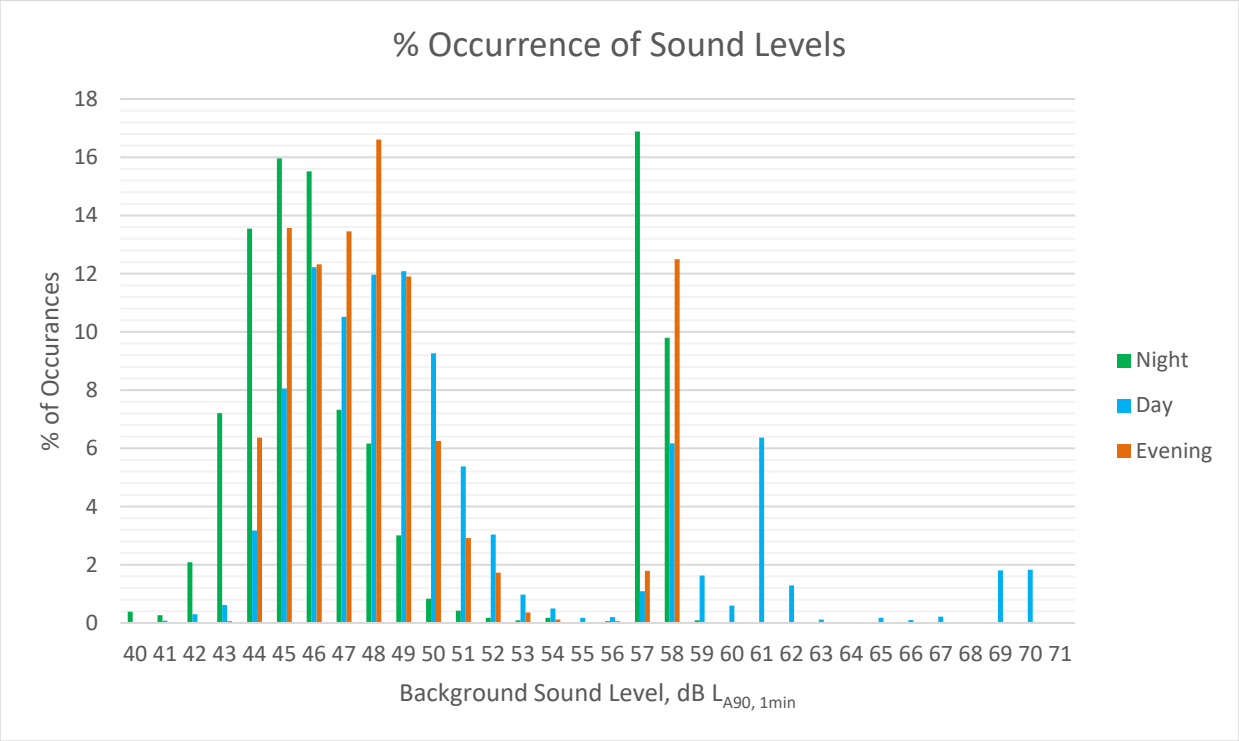


Figure A2: STATISTICAL ANALYSIS OF BACKGROUND LEVELS AT MP02 – NO CONSTRUCTION

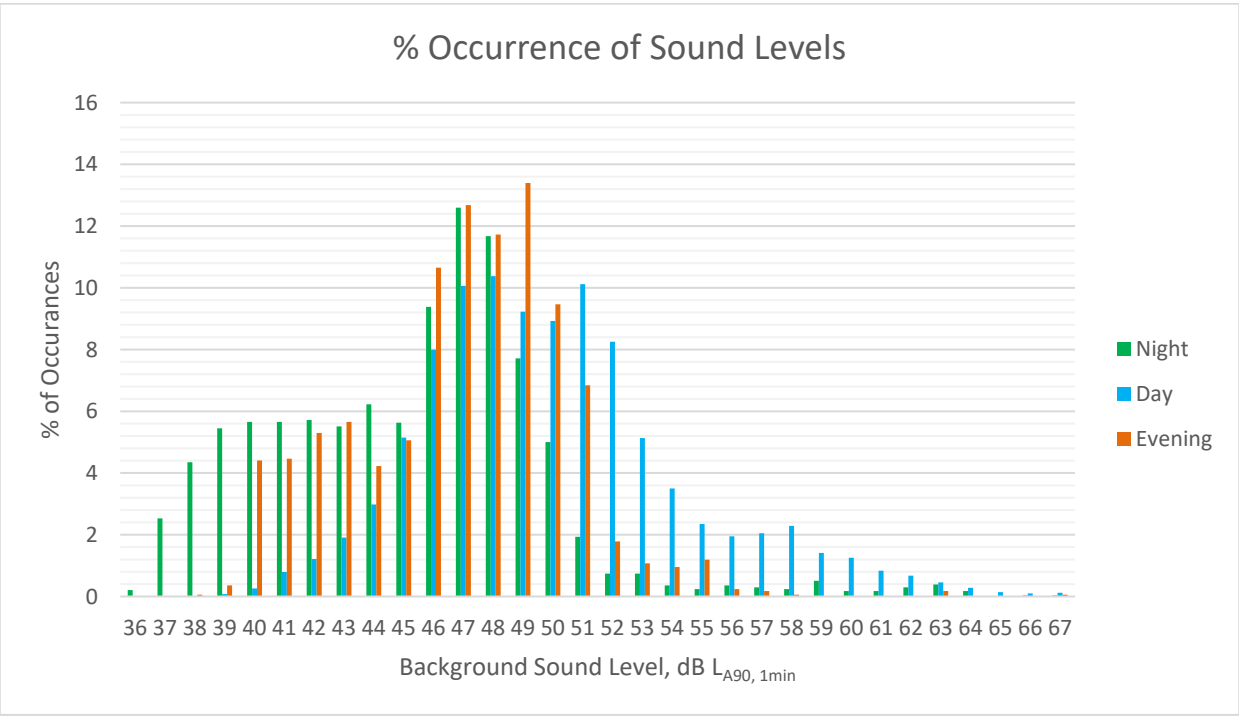


Figure A3: STATISTICAL ANALYSIS OF BACKGROUND LEVELS AT N056 - NO SIGNIFICANT CONSTRUCTION

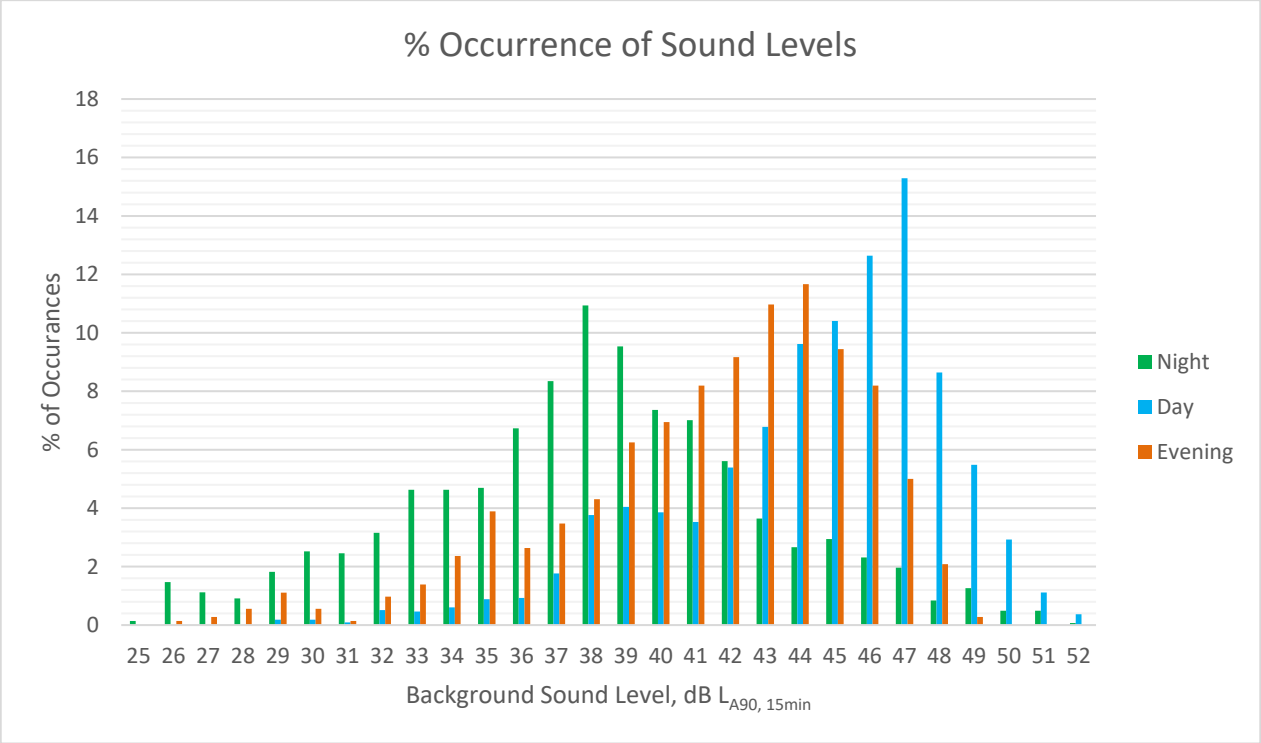


Figure A4: STATISTICAL ANALYSIS OF BACKGROUND LEVELS AT N057 - NO SIGNIFICANT CONSTRUCTION

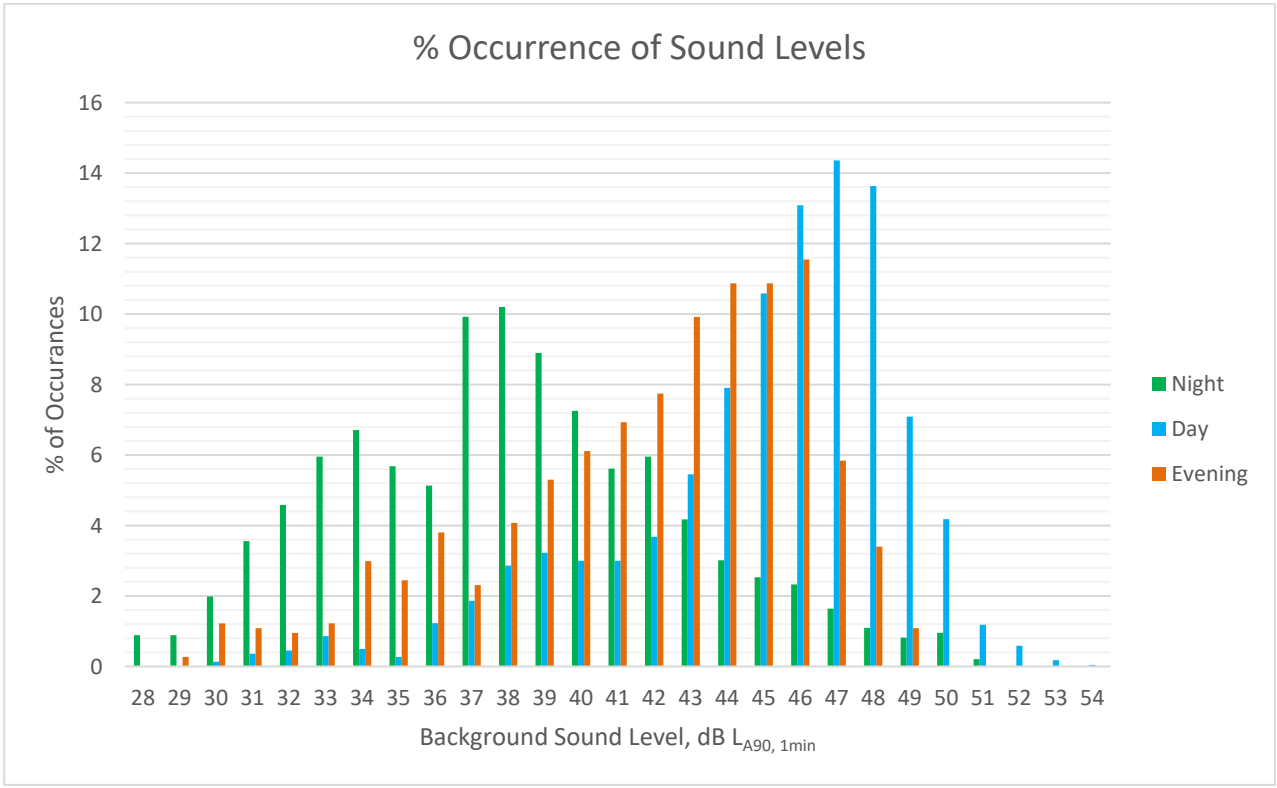


Figure A5: STATISTICAL ANALYSIS OF BACKGROUND LEVELS AT MP01 FOR PERIODS DURING CONSTRUCTION

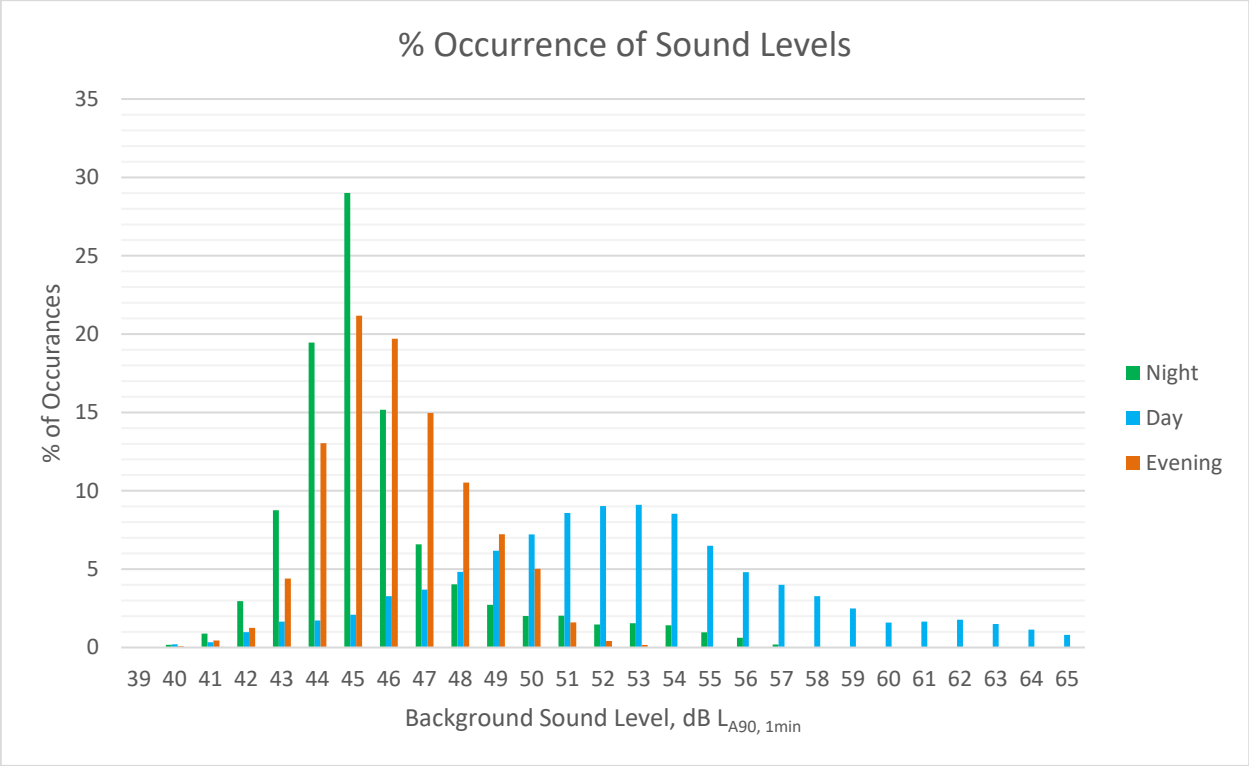
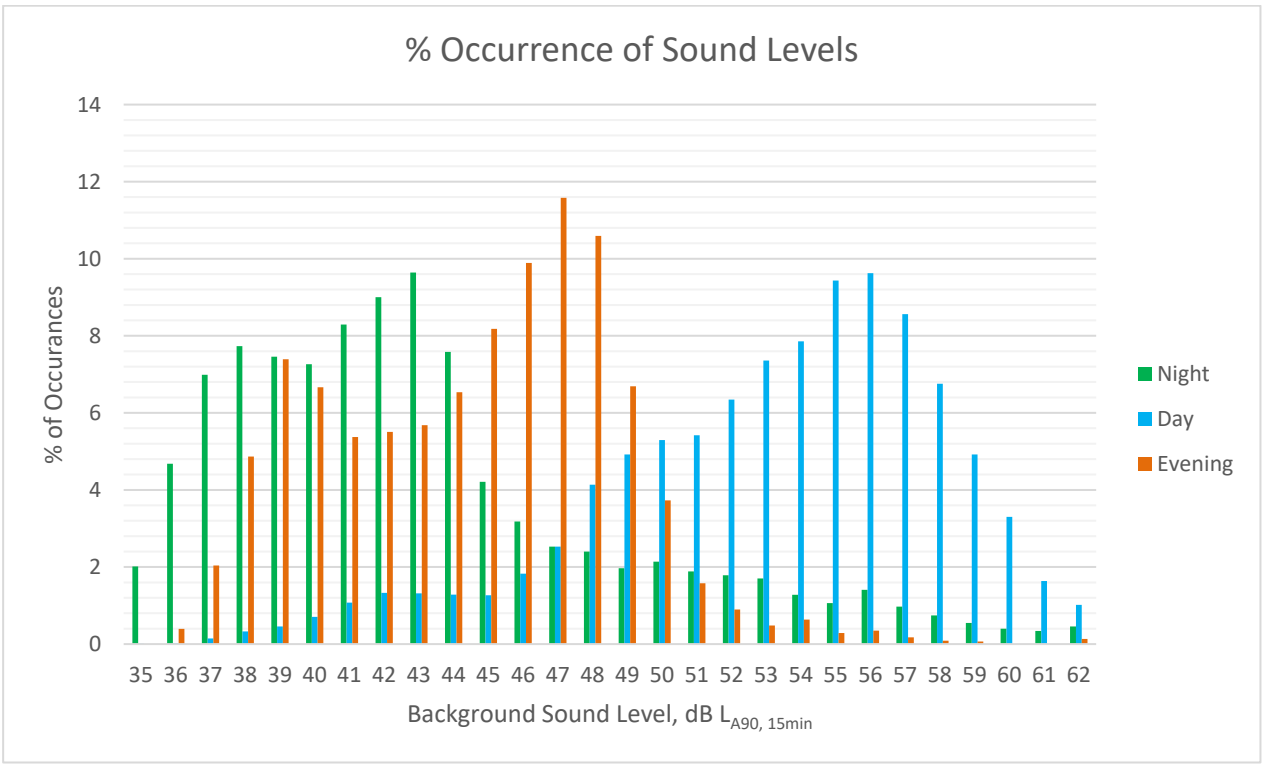


Figure A6: STATISTICAL ANALYSIS OF BACKGROUND LEVELS AT MP02 FOR PERIODS DURING CONSTRUCTION



Appendix B

Table 1: SUMMARY OF UNATTENDED SOUND MONITORING RESULT AT N056

Day of Meas.	Date	Measured Sound Levels, dB re. 2 x 10^{-5} Pa.					
		Daytime (07:00 hrs - 23:00 hrs)			Night-time (23:00 hrs - 07:00 hrs)		
		$L_{Amax,F}$	$L_{Aeq,16hr}$	$L_{A90,16hr}$	$L_{Amax,F}$	$L_{Aeq,8hr}$	$L_{A90,8hr}$
Sat	01-Nov-20	80 (57-89)	59 (48-64)	46 (43-48)	60 (51-84)	51 (45-60)	41 (38-46)
Sun	02-Nov-20	83 (79-89)	61 (59-64)	48 (42-49)	71 (56-87)	56 (50-63)	46 (41-51)
Mon	03-Nov-20	83 (79-87)	60 (55-63)	46 (43-48)	66 (54-88)	56 (46-64)	42 (39-48)
Tue	04-Nov-20	85 (75-89)	62 (52-66)	44 (39-49)	64 (52-88)	56 (45-65)	40 (37-46)
Wed	05-Nov-20	84 (78-88)	62 (54-65)	41 (37-46)	-[1]	-[1]	-[1]
Thu	06-Nov-20	84 (76-91)	62 (55-66)	44 (38-50)	80 (75-87)	57 (49-60)	38 (38-39)
Fri	07-Nov-20	82 (50-90)	59 (40-65)	41 (38-45)	58 (41-83)	52 (37-61)	38 (36-44)
Sat	08-Nov-20	80 (51-89)	59 (41-64)	38 (34-40)	51 (37-84)	49 (33-59)	34 (32-38)
Sun	09-Nov-20	84 (75-91)	62 (54-66)	43 (38-48)	60 (38-85)	55 (34-61)	36 (32-44)
Mon	10-Nov-20	84 (72-91)	62 (50-67)	43 (39-49)	60 (40-87)	54 (35-63)	37 (32-44)
Tues	11-Nov-20	84 (72-90)	62 (49-66)	46 (43-49)	60 (37-88)	55 (33-63)	39 (31-49)
Wed	12-Nov-20	84 (71-91)	62 (52-65)	45 (42-49)	62 (43-86)	54 (38-61)	39 (37-48)
Thu	13-Nov-20	84 (77-90)	62 (53-68)	46 (41-48)	61 (43-88)	55 (39-65)	41 (37-47)
Fri	14-Nov-20	83 (75-93)	61 (53-70)	46 (42-49)	58 (38-89)	54 (35-66)	39 (34-46)
Sat	15-Nov-20	80 (52-88)	60 (44-65)	44 (41-47)	51 (41-82)	48 (35-59)	38 (34-46)
Sun	16-Nov-20	83 (74-89)	61 (51-65)	45 (39-48)	60 (47-81)	52 (38-59)	38 (36-39)
Mon	17-Nov-20	84 (76-90)	62 (51-65)	44 (40-48)	59 (42-86)	54 (38-63)	39 (35-47)
Tue	18-Nov-20	84 (77-91)	62 (54-66)	47 (42-49)	56 (43-88)	53 (38-64)	39 (36-46)
Wed	19-Nov-20	83 (79-85)	61 (54-63)	40 (36-44)	68 (48-88)	58 (39-64)	38 (35-41)
Thu	20-Nov-20	83 (67-92)	62 (46-69)	48 (41-52)	62 (43-86)	55 (37-62)	40 (34-50)
Fri	21-Nov-20	82 (77-88)	59 (52-62)	43 (41-45)	58 (42-86)	54 (39-64)	39 (37-43)
Sat	22-Nov-20	79 (54-90)	59 (42-66)	39 (37-40)	51 (41-79)	49 (34-58)	35 (31-37)
Sun	23-Nov-20	84 (72-90)	62 (50-66)	46 (43-50)	54 (41-87)	55 (34-64)	38 (32-47)
Mon	24-Nov-20	83 (69-90)	61 (48-65)	45 (43-48)	63 (46-87)	55 (40-64)	40 (37-47)
Tue	25-Nov-20	83 (67-101)	64 (44-75)	43 (34-47)	61 (43-85)	55 (39-64)	41 (37-46)
Wed	26-Nov-20	84 (75-90)	61 (50-65)	42 (40-48)	48 (39-80)	45 (31-57)	31 (29-39)
Thu	27-Nov-20	83 (74-88)	61 (53-66)	45 (40-50)	62 (46-85)	53 (37-59)	39 (34-45)
Fri	28-Nov-20	82 (77-89)	59 (51-62)	38 (33-40)	56 (38-88)	53 (33-63)	34 (31-39)
Sat	29-Nov-20	80 (56-89)	59 (41-63)	33 (29-38)	49 (35-81)	45 (30-58)	30 (28-32)
Sun	30-Nov-20	83 (80-87)	61 (57-63)	44 (41-45)	63 (36-84)	54 (28-59)	28 (26-33)
Mon	01-Dec-20	83 (77-90)	61 (54-65)	41 (35-46)	55 (36-81)	53 (33-60)	34 (32-39)
Tue	02-Dec-20	83 (75-89)	61 (54-65)	43 (37-47)	58 (37-84)	54 (31-62)	37 (29-42)
Wed	03-Dec-20	84 (70-90)	62 (55-66)	48 (34-56)	60 (45-87)	54 (40-63)	42 (36-51)
Thu	04-Dec-20	84 (78-89)	61 (53-65)	47 (44-49)	78 (70-84)	57 (48-60)	45 (44-45)
Fri	05-Dec-20	79 (43-89)	59 (39-64)	41 (38-45)	55 (42-84)	51 (38-61)	40 (36-46)
Sat	06-Dec-20	77 (53-89)	59 (39-64)	34 (29-38)	47 (38-79)	45 (31-57)	32 (30-35)
Sun	07-Dec-20	84 (77-90)	62 (54-66)	38 (32-43)	54 (39-83)	51 (29-59)	29 (26-32)
Mon	08-Dec-20	84 (79-89)	62 (57-65)	46 (42-50)	64 (43-86)	57 (34-63)	37 (32-45)
Tue	09-Dec-20	-[1]	-[1]	-[1]	82 (78-86)	58 (52-60)	43 (43-43)
Wed	10-Dec-20	84 (74-89)	62 (53-66)	44 (40-48)	63 (41-89)	56 (37-64)	39 (36-55)
Thu	11-Dec-20	84 (74-89)	62 (52-67)	44 (38-48)	63 (44-89)	56 (40-65)	43 (36-55)
Fri	12-Dec-20	83 (81-88)	59 (57-62)	40 (39-42)	79 (77-83)	57 (50-61)	32 (32-33)
Sat	13-Dec-20	80 (57-89)	59 (48-65)	46 (43-50)	55 (44-84)	50 (40-59)	41 (37-47)
Sun	14-Dec-20	84 (77-88)	62 (54-66)	47 (43-51)	60 (44-89)	55 (39-63)	42 (37-50)
Mon	15-Dec-20	84 (73-89)	62 (53-66)	48 (45-51)	61 (47-88)	54 (42-63)	43 (39-51)
Tues	16-Dec-20	84 (76-90)	62 (52-66)	47 (44-50)	60 (43-89)	56 (39-67)	41 (38-47)
Wed	17-Dec-20	84 (76-94)	62 (53-66)	48 (43-53)	62 (46-87)	56 (40-65)	43 (38-51)

Thu	18-Dec-20	84 (75-89)	62 (53-67)	47 (43-51)	59 (44-87)	56 (40-65)	41 (38-47)
Overall Mean		**83 (77-85)**	**61 (59-64)**	**44 (33-48)**	**61 (47-82)**	**54 (45-58)**	**38 (28-46)**

Note: [1] Data not available for the period.

Table 2: SUMMARY OF UNATTENDED SOUND MONITORING RESULT AT N057

Day of Meas.	Date	Measured Sound Levels, dB re. 2 x 10^{-5} Pa.					
		Daytime (07:00 hrs - 23:00 hrs)			Night-time (23:00 hrs - 07:00 hrs)		
		$L_{Amax,F}$	$L_{Aeq,16hr}$	$L_{A90,16hr}$	$L_{Amax,F}$	$L_{Aeq,8hr}$	$L_{A90,8hr}$
Sat	01-Nov-20	75 (54-82)	54 (46-59)	46 (43-48)	55 (43-77)	47 (38-55)	40 (36-46)
Sun	02-Nov-20	77 (75-80)	57 (56-60)	47 (41-49)	69 (57-82)	53 (48-59)	45 (40-50)
Mon	03-Nov-20	78 (77-80)	56 (52-59)	44 (42-47)	61 (45-82)	52 (40-61)	41 (37-48)
Tue	04-Nov-20	79 (73-84)	58 (50-62)	42 (38-48)	58 (40-84)	52 (35-61)	37 (33-44)
Wed	05-Nov-20	77 (72-82)	57 (49-61)	41 (36-44)	-	-	-
Thu	06-Nov-20	79 (73-86)	57 (52-62)	44 (39-50)	75 (71-78)	53 (46-55)	39 (38-39)
Fri	07-Nov-20	77 (54-88)	57 (42-69)	41 (37-45)	65 (47-76)	49 (39-55)	37 (36-39)
Sat	08-Nov-20	76 (56-83)	55 (41-59)	38 (34-41)	51 (39-78)	46 (33-56)	34 (31-38)
Sun	09-Nov-20	78 (71-83)	57 (49-61)	43 (38-47)	60 (41-81)	51 (34-57)	37 (32-45)
Mon	10-Nov-20	79 (72-84)	59 (52-65)	44 (40-50)	60 (46-83)	52 (36-62)	37 (34-44)
Tues	11-Nov-20	78 (71-85)	58 (50-61)	47 (44-50)	57 (36-83)	52 (33-59)	40 (32-49)
Wed	12-Nov-20	79 (73-84)	57 (50-61)	46 (43-48)	60 (45-81)	51 (39-60)	39 (36-48)
Thu	13-Nov-20	78 (73-86)	58 (50-62)	47 (43-50)	60 (43-85)	52 (39-62)	41 (37-47)
Fri	14-Nov-20	78 (72-93)	60 (50-71)	47 (43-50)	56 (40-79)	48 (35-57)	39 (34-47)
Sat	15-Nov-20	76 (50-101)	59 (45-73)	45 (42-49)	51 (43-62)	44 (36-50)	38 (34-47)
Sun	16-Nov-20	78 (70-84)	57 (51-62)	46 (40-49)	60 (44-86)	53 (39-61)	38 (37-40)
Mon	17-Nov-20	78 (71-83)	57 (51-61)	45 (40-49)	59 (43-79)	51 (38-58)	40 (37-48)
Tue	18-Nov-20	78 (72-89)	58 (52-61)	48 (43-49)	54 (44-80)	50 (38-59)	40 (36-47)
Wed	19-Nov-20	79 (76-82)	57 (52-60)	41 (35-47)	62 (43-81)	52 (37-58)	35 (34-39)
Thu	20-Nov-20	78 (63-84)	58 (46-62)	49 (42-53)	62 (43-82)	52 (38-60)	41 (36-50)
Fri	21-Nov-20	76 (73-83)	55 (49-59)	44 (42-46)	57 (44-76)	46 (40-53)	40 (37-43)
Sat	22-Nov-20	74 (53-82)	55 (41-60)	39 (37-40)	53 (44-77)	48 (34-56)	35 (32-38)
Sun	23-Nov-20	78 (62-88)	59 (49-64)	48 (44-59)	55 (40-81)	51 (34-59)	39 (32-46)
Mon	24-Nov-20	77 (65-86)	57 (47-61)	46 (44-49)	61 (44-84)	53 (39-63)	41 (37-47)
Tue	25-Nov-20	78 (64-98)	59 (43-71)	44 (34-48)	57 (43-78)	50 (39-58)	41 (37-47)
Wed	26-Nov-20	78 (72-83)	57 (49-60)	43 (40-49)	50 (37-80)	47 (32-58)	32 (30-38)
Thu	27-Nov-20	71 (0-84)	57 (0-62)	42 (0-50)	60 (46-84)	51 (37-59)	39 (34-44)
Fri	28-Nov-20	77 (71-81)	56 (50-66)	38 (33-41)	53 (36-79)	47 (33-56)	34 (31-37)
Sat	29-Nov-20	75 (52-81)	54 (40-57)	33 (30-36)	48 (35-59)	37 (32-41)	31 (31-33)
Sun	30-Nov-20	78 (76-82)	60 (55-66)	45 (42-46)	58 (34-76)	48 (29-53)	30 (28-33)
Mon	01-Dec-20	77 (71-82)	56 (49-59)	42 (35-47)	54 (37-77)	50 (33-57)	34 (32-39)
Tue	02-Dec-20	78 (74-85)	57 (50-61)	43 (37-47)	57 (36-77)	51 (31-58)	36 (30-41)
Wed	03-Dec-20	78 (73-85)	57 (51-61)	47 (34-52)	59 (44-81)	51 (39-58)	43 (36-51)
Thu	04-Dec-20	78 (73-83)	57 (52-61)	47 (45-49)	69 (47-81)	53 (43-57)	44 (41-46)
Fri	05-Dec-20	75 (46-83)	55 (39-63)	43 (38-47)	53 (43-77)	46 (36-55)	39 (35-45)
Sat	06-Dec-20	72 (54-81)	54 (40-59)	35 (33-38)	52 (36-67)	38 (34-44)	34 (33-35)
Sun	07-Dec-20	79 (74-86)	58 (51-62)	40 (33-45)	57 (37-80)	50 (32-59)	31 (30-33)
Mon	08-Dec-20	77 (70-84)	57 (50-61)	46 (41-50)	63 (39-80)	52 (35-57)	37 (33-43)
Tue	09-Dec-20	78 (73-84)	57 (50-61)	45 (42-48)	63 (43-81)	53 (39-60)	41 (36-44)
Wed	10-Dec-20	78 (73-85)	57 (50-61)	45 (41-48)	61 (43-84)	52 (38-60)	41 (35-50)
Thu	11-Dec-20	79 (74-94)	58 (49-66)	44 (38-48)	61 (45-83)	51 (41-59)	40 (34-45)
Fri	12-Dec-20	80 (77-84)	57 (54-60)	41 (40-42)	51 (46-55)	41 (41-42)	39 (39-39)
Sat	13-Dec-20	75 (55-85)	55 (46-59)	47 (44-49)	55 (44-79)	48 (40-57)	41 (38-48)
Sun	14-Dec-20	78 (71-87)	58 (52-61)	48 (44-52)	59 (44-84)	51 (40-58)	43 (38-50)
Mon	15-Dec-20	78 (70-84)	58 (52-62)	49 (46-51)	59 (47-81)	52 (41-61)	44 (39-51)

Tues	16-Dec-20	78 (72-85)	58 (50-61)	48 (44-50)	57 (45-82)	51 (40-60)	41 (38-48)
Wed	17-Dec-20	79 (69-91)	58 (49-64)	49 (44-54)	59 (44-80)	52 (40-59)	43 (38-50)
Thu	18-Dec-20	78 (69-85)	58 (52-62)	48 (43-51)	58 (46-81)	51 (41-58)	42 (39-48)
Overall Mean Values		**83 (77-85)**	**61 (59-64)**	**44 (33-48)**	**61 (47-82)**	**54 (45-58)**	**38 (28-46)**

Table 3: WEATHER RECORD OBTAINED FOR UNATTENDED MONITOR PERIODS

Data type Unit	Wind Speed, m/s		Rain intensity, mm/h		Temperature, °C		Humidity rate, %	
Period start (dd/mm/yyyy)	Mean	Max	Mean	Max	Mean	Max	Mean	Max
01/11/2020	1.6	9.3	0	0.3	14.4	17.4	81	91
02/11/2020	2.1	13.3	0	6.6	13.2	17	71	87
03/11/2020	1.1	11.4	0.2	22.6	7.1	10.4	78	91
04/11/2020	0.5	3.9	0	0	4.3	12.6	83	94
05/11/2020	0.9	3.2	0	0	3.4	10.7	90	94
06/11/2020	0.8	4.7	0	0	5.7	11.8	79	95
07/11/2020	0.5	2.9	0	1.3	9.9	16	82	93
08/11/2020	0.4	2.3	0	1.6	12.1	14.3	89	93
09/11/2020	0.5	3.8	0.1	8	12.8	16.2	90	95
10/11/2020	0.5	3.2	0.1	3.7	11.3	15.9	88	94
11/11/2020	1.3	8	0.1	4.5	11.2	13.1	86	94
12/11/2020	1.2	7.8	0	1.4	10.6	13.4	77	86
13/11/2020	0.9	6.7	0	3.6	10.5	12.6	77	88
14/11/2020	1.3	7.9	0.2	10.5	12.1	13.7	87	93
15/11/2020	1.4	8	0.2	11.3	10.4	13.1	80	92
16/11/2020	1.3	7	0	1.8	10.6	12.9	78	92
17/11/2020	1.2	7.5	0	0	12.8	14.2	81	89
18/11/2020	1.5	10.5	0	4.1	11.6	15.2	77	89
19/11/2020	1.5	8.5	0	2.4	7.5	10.5	75	89
20/11/2020	0.8	5	0	1.7	5.5	10.7	89	94
21/11/2020	1.4	8.5	0	0	11	12.6	75	83
22/11/2020	0.6	4.5	0	0	7.7	11.4	84	94
23/11/2020	0.6	3.8	0	0	5	10.1	88	94
24/11/2020	1	5.8	0	0	10	12.3	81	90
25/11/2020	0.7	5.2	0	3.6	9.1	12.8	87	93
26/11/2020	0.4	2.5	0	0	4.6	9	87	94
27/11/2020	0.5	3	0	0.3	2.4	5.4	91	95
28/11/2020	0.7	3.8	0	0	8.5	10.3	88	92

29/11/2020	0.7	2.8	0	0	7.2	8.8	91	93
30/11/2020	1.3	7.9	0	1.1	6.7	10.3	87	94
01/12/2020	0.9	4.2	0	0	4	8.3	80	91
02/12/2020	0.5	2.8	0	0	4.3	6.4	86	93
03/12/2020	0.8	4.6	0.4	8.2	4.9	6.8	90	93
04/12/2020	1.4	6.6	0.1	2.8	4.1	5.4	81	93
05/12/2020	1.2	6.4	0	0	5.1	8.5	76	86
06/12/2020	0.8	3.9	0	0.5	2.2	5.9	88	93
07/12/2020	0.6	2.5	0	0.7	0.9	2	93	94
08/12/2020	0.5	2.9	0	3.8	0.7	3.7	92	94
09/12/2020	0.8	4.1	0	2.4	5	6.5	85	93
10/12/2020	1.1	5	0	5.1	6.8	7.4	83	93
11/12/2020	0.5	4.6	0.2	8	8.1	10.7	92	94
12/12/2020	1.2	6.6	0	0	6.8	9.4	84	94
13/12/2020	1.1	6.7	0.1	4.1	6.6	11.4	91	94
14/12/2020	1.2	7.7	0.1	8.5	10.2	13.1	84	91
15/12/2020	0.8	6	0	5.4	8.5	11.5	85	93
16/12/2020	1.3	8.3	0.1	11.2	8.7	10.5	84	91
17/12/2020	0.8	5.2	0	0.9	8.4	11.5	85	94
18/12/2020	1.7	8.3	0	0	11.1	11.9	86	91
19/12/2020	1.4	8.2	0.1	37.2	9.8	12	81	91
20/12/2020	1	7	0	7.9	7.6	10.5	81	88
21/12/2020	1.2	7.5	0.1	6.9	10.9	13.6	89	93
22/12/2020	1	7.8	0	0.8	10.6	13.6	87	93
23/12/2020	0.8	9.6	0.1	22.8	10.2	13.1	85	93
24/12/2020	2.2	9.5	0	4	4.4	6.5	76	88
25/12/2020	1.2	4.8	0	0	1.6	4.1	74	84
26/12/2020	1.4	9.7	0	1.1	6.3	10.6	83	90
27/12/2020	1.4	11.8	0.3	9.8	5.6	9.7	80	93
28/12/2020	0.8	4.7	0	0.1	0.8	2.9	90	94
29/12/2020	1.2	5.1	0	0.2	2.4	4.1	84	89
30/12/2020	0.5	4	0	0	0.6	5.1	88	94
31/12/2020	0.8	3.6	0	0	-0.3	1	89	94
06/02/2021	0.9	6.1	0.2	8.8	5.9	9.1	87	93
06/02/2021	2.4	9.3	0	4.8	1.6	3.7	76	90
09/02/2021	1.3	6.3	0	2.8	-0.5	0.4	77	85
13/02/2021	1.9	7.6	0	0	-0.8	1.8	53	66
14/02/2021	1.7	8.6	0	4.9	2.6	4.3	61	85
20/02/2021	1.5	8.6	0	0	12.7	14.3	65	76
21/02/2021	0.7	4.9	0	0.5	11	13.6	78	90