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ST JULIE'S CATHOLIC HIGH SCHOOL, WOOLTON, LIVERPOOL

Noise Impact Assessment

16/12/2014

Quality Management

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St Julie's Catholic High School, Woolton, Liverpool

Noise Impact Assessment

16/12/2014

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Table of Contents

1	Introduction.....	5
1.1	Overview.....	5
1.2	Site and the Surroundings	5
1.3	Development Proposals.....	7
2	Assessment Criteria.....	8
2.1	Construction Phase Criteria	8
2.2	Consultation.....	10
3	Environmental Noise Monitoring.....	11
3.1	Background Noise Survey	11
3.2	Noise Measurement Equipment.....	11
4	Assessment.....	13
4.1	Construction Noise Assessment	13
4.2	Operational Phase Plant Noise Limits.....	16
5	Mitigation	17
5.1	Construction Phase.....	17
5.2	Operational Phase	18
6	Conclusion.....	18

1 Introduction

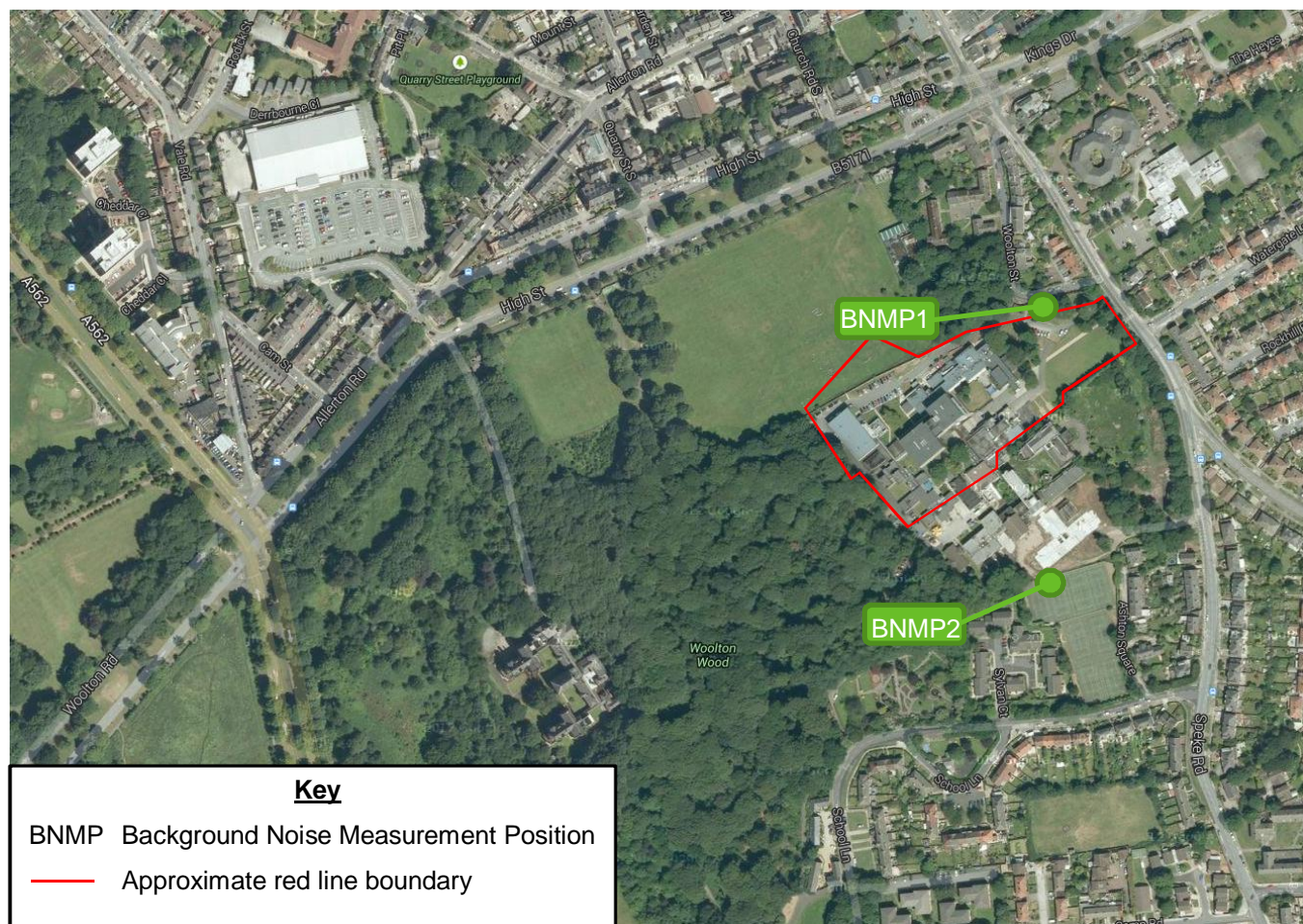
1.1 Overview

- 1.1.1 WSP has been commissioned by Kier Northern to undertake a noise impact assessment for the proposed St Julies Catholic High School, Woolton, Liverpool. This report provides the results of the environmental noise survey conducted on site between Tuesday 29th and Wednesday 30th October 2014. The results of the environmental noise survey undertaken have been used to specify noise level limits for any proposed building services equipment associated with the development.
- 1.1.2 In addition, a construction phase noise assessment has been undertaken to determine likely impacts from construction activities.
- 1.1.3 This report is necessarily technical in nature and so, to assist the reader, a glossary of terms is provided in **Appendix A**.

1.2 Site and the Surroundings

- 1.2.1 The site of the proposed school is located on Speke Road in Woolton, Liverpool. Currently at the site are the existing St Julie's High School buildings which are proposed to be demolished as part of the development proposals.
- 1.2.2 To the North, the site is bounded High Street and Speke Road to the East. To the West the site is bound by Woolton Woods and Woolton Manor. Further afield to the West, approximately 400 m away, is Menlove Avenue. To the south of the site is School Lane.
- 1.2.3 The nearest residential properties to the site are located on Woolton Street, off Speke Road to the north of the site. The nearest residential premises to the south of the site are located on Sylvan Court off School lane.
- 1.2.4 Aerial photography of the site and the surroundings is provided in **Figure 1**.

Figure 1 – Aerial Photograph of the Existing Site and the Surroundings



2 Assessment Criteria

2.1 Construction Phase Criteria

Liverpool City Council – Construction hours of work: Guidance note for contractors and developers

- 2.1.1 This guidance note is currently available from the Liverpool City Council website¹ and has been prepared to assist contractors and developers in understanding the restrictions which may apply to construction work to protect residents and businesses from high noise levels.
- 2.1.2 The document states that “Contractors should ensure that the best practicable means are employed to minimise noise” and references British Standard 5228:Part 1:1997 *Noise and vibration control on construction and open sites* as the approved code of practice for basic information and procedures for noise and vibration control. This British Standard was updated in 2014 (see below).
- 2.1.3 The document also sets out noise limits which should not be exceeded outside noise sensitive premises (i.e. façade levels). The limits are as follows:

Table 1 – Construction Noise limits from Liverpool City Council document

Environment	Critical health effect	Sound Level ($L_{Aeq,T}$ dB)	Time (T)
Dwellings/offices	Speech intelligibility	75	07:00-19:00
Schools	Speech intelligibility	65	During class
Dwellings	Speech intelligibility	65	19:00-23:00
Dwellings	Sleep disturbance	45	23:00-07:00

- 2.1.4 It is stated that the levels are adapted from the Department of the Environment Advisory Leaflet AL72 and the World Health Organisation’s Guidelines for Community Noise.

British Standard 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*

- 2.1.5 This Standard sets out techniques to predict and assess the likely noise effects from construction works, based on detailed information on the type and number of plant being used, their location, and the length of time they are in operation.
- 2.1.6 The noise prediction method is used to establish likely levels in terms of the $L_{Aeq,T}$ over the core working day.
- 2.1.7 This Standard also documents a database of information, comprising previously measured sound pressure levels at given distances for a variety of different construction plant undertaking various common activities.
- 2.1.8 Example criteria are presented for the assessment of the significance of noise effects. Such criteria are concerned with fixed noise limits and ambient noise level changes. With respect to fixed noise limits BS 5228 discusses those included within Advisory Leaflet 72: 1976: Noise Control on Building Sites. These limits are presented according to the nature of the surrounding environment, for a 12-hour working day.

¹ <http://liverpool.gov.uk/media/36881/construction-site-noise-guidance.pdf>

Adopted construction phase criteria

- 2.1.9 Based on the Liverpool City Council guidance and BS 5228, the following criteria can be set for the nearest noise sensitive receptors:

Table 2 – Adopted construction phase noise limits, dB

Noise sensitive receptor	Typical case distance from construction phase activities	Worst case distance from construction phase activities	Time	Adopted Noise Limit ($L_{Aeq,T}$)
St Julie's Catholic High School	20 m south east	5 m south east	During class	65 dB
51 Woolton Street	121 m north east	34 m north east	07:00-19:00	75 dB
Sylvan Court	174 m south east	69 m south east	07:00-19:00	75 dB
Marie Curie Hospice, Speke Road	200 m north east	111 m north east	07:00-19:00	75 dB

British Standard 4142: 2014: Method for Rating and Assessing Industrial and Commercial Sound

- 2.1.10 BS 4142: 2014: *Method for assessing and assessing Industrial and commercial sound* (BS 4142) is intended to be used to assess noise of an industrial nature, which includes sound from fixed installations, which comprise mechanical and electrical plant and equipment.
- 2.1.11 The procedure contained in BS 4142 for assessing the likelihood of complaints is to compare the measured or predicted noise level from the source in question, the 'specific noise level' immediately outside the dwelling, with the background noise level. Where the noise contains attention attracting characteristics such as tonal, impulsive, intermittent elements, it may be appropriate to apply a correction to the specific noise level to obtain the 'rating level'.
- 2.1.12 The likelihood of noise provoking complaints is assessed by subtracting the background noise level from the rating noise level. BS 4142 states:
- 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.*
 - A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.*
 - 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 a 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.*
- 2.1.13 For the daytime, this assessment is carried out over a one-hour period, and over a fifteen minute period at night. The daytime and night-time periods are defined as 07:00 to 23:00 and 23:00 to 07:00 respectively.

2.2 Consultation

- 2.2.1 The proposed construction methodology and criteria set were provided to the Environmental Protection Unit at Liverpool City Council via e-mail on 5 December 2014. Following this, Dr Ian Rushforth, Senior Enforcement Officer responded on 8 December 2014 and confirmed that the approach was acceptable.
- 2.2.2 In addition to this, it was noted that the Council's standard hours for construction works (unless approval is sought in advance for specific works where justification is given why out-of-hours working is essential) are 0800 to 1800 Monday to Friday, 0800 to 1300 on Saturdays.
- 2.2.3 The Council also confirmed that there was no requirement for a construction vibration assessment.

3 Environmental Noise Monitoring

3.1 Background Noise Survey

- 3.1.1 A background noise survey has been conducted by WSP at the proposed development site between approximately 15:00 hrs on Tuesday 29th October until approximately 15:00 on Wednesday 30th October 2014. The purpose of the background noise survey was to determine the background noise levels in the vicinity of nearby noise sensitive premises. The results of the background noise survey will be used to specify appropriate noise level limits for any proposed externally mounted building services equipment associated with the development.
- 3.1.2 Two measurement positions were adopted for the assessment. Sound level monitoring equipment was installed on site and left unattended to continually monitor the noise levels for approximately a 24 hour period. One sound level meter was installed towards the residential premises located to the north on Woolton Street and the other meter was installed to the south towards the residential premises located on Sylvan Court. The location of the background noise measurement positions are shown in **Figure 1** denoted by BNMP1 and BNMP2. **Table 2** provides a summary of the background noise levels measured at these locations.

Table 2 – Summary of the Measured Background Noise Levels

Position	Measurement period, T	Typical L _{A90, 15min} , dB
BNMP1	Daytime (07:00 – 23:00)	46.0
	Night-time (23:00 – 07:00)	39.8
BNMP2	Daytime (07:00 – 23:00)	45.0
	Night-time (23:00 – 07:00)	37.7

3.2 Noise Measurement Equipment

- 3.2.1 The environmental noise survey was carried out using the following Type 1 specification noise measurement equipment.

Table 4 – Noise Measurement Equipment

WSP Equipment reference	Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date
Solo 9	Sound Level Meter	01dB-METRAVIB Solo Master	60532	12 June 2015
	Pre-amplifier	01dB-Stell PRE 21 S	13150	
	Microphone	Microtech Gefell GmbH MCE212	65593	
	Calibrator	01dB-Stell Cal 21	1120240	04 July 2015
Cube 3	Sound Level Meter	01 dB CUBE	10630	09 September 2016
	Pre-amplifier	Acoem PRE 22	10627	
	Microphone	Gras 40CD	162008	

	Calibrator	01 dB-Metravib Cal 21	34344461	02 July 2015
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3.2.2 All instruments had been calibrated to traceable standards within the preceding two years and the calibrators within the preceding 12 months.

4 Assessment

4.1 Construction Noise Assessment

- 4.1.1 Based on experience of similar schemes, the following construction programme has been assumed for the purposes of the noise prediction work.

Construction Phase 1 – Construct New School Buildings

- Enabling Works including establishment of additional fencing and site accommodation, service diversions, R&D asbestos surveys, and new substation / gas meter house and water tank room construction.
- Demolition of sports hall, changing rooms, temporary classrooms, part of existing RE block and 6th form office / stores (soft and hard strip), removal of foundations, excavation. Part removal of existing stone boundary wall. Form temporary site access/ haul road/ routes.
- Excavation of existing lawn area and stoning up / surfacing to form temporary staff car park.
- Substructure construction including excavation and formation of structurally reinforced concrete foundations for shear walls, pad foundations and ground floor slabs.
- Superstructure construction including formation of steel frame, floors, columns and roofs,
- External works including hard and soft landscaping,

Construction Phase 2 – Demolition / External Works

- Possession of existing school.
- establishment of fencing and site accommodation.
- Demolition including soft and hard strip of existing school and removal of foundations.
- External works including soft landscaping, formation of access roads, MUGAs, boundary treatment, play areas and car parking. Includes removal of temporary staff car park and reinstatement of a lawn area.

- 4.1.2 Further to the above, the key activities with respect to noise have been taken to be:

- Demolition.
- Excavation and groundworks.
- Activity within the fill area.
- Foundation and substructure works.
- Superstructure works.
- Infrastructure and landscaping works.

- 4.1.3 For the key activities identified above, the plant and associated sound power levels assumed for the predictions are given in the table below along with a reference to the origin of this source information from Annexes C and D of BS 5228-1:2009+A1:2014.

Table 5 - Construction plant sound power levels and percentage ontime

Plant	Data source	L _{WA} (dB) (each item)	% on-time per day
Demolition			
1 no. 50T long reach excavator	BS 5228 - C.2/14	107	50
3 no. 20T dump trucks	BS 5228 - C.2/30	107	50
1 no. 20T excavator	BS 5228 - C.2/21	99	50
1 no. 20T excavator with breaker	BS 5228 - C.1/9	118	20
1 no. crusher	BS 5228 - C.1/14	110	50
Excavation and groundworks			
1 no. 3T excavator	BS 5228 - C.2/25	97	60
1 no. 13T excavator	BS 5228 - C.2/25	97	60
2 no. 20T excavators	BS 5228 - C.2/21	99	60
1 no. 50T excavator	BS 5228 - C.2/14	107	60
Activity within the fill area			
2 no. D6 Dozers (grading and towing sheepsfoot compactor)	BS 5228 - D.3/74	105	60
1 no. 20T excavator	BS 5228 - C.2/21	99	60
2 no. 30T dump trucks	BS 5228 - C.2/30	107	60
Foundation and substructure works			
1 no. 20T excavator	BS 5228 - C.2/21	99	30
1 no. dumper lorry tipping	BS 5228 - C.2/30	107	30
2 no. concrete mixer truck discharging	BS 5228 - C.4/18	103	20
1 no. concrete pump	BS 5228 - D.6/17	109	20
5 no. poker vibrators	BS 5228 - D.6/20	102	10
Shuttering erection	BS 5228 - D.7/80	107	20
Superstructure works			
2 no. concrete mixer truck discharging	BS 5228 - C.4/19	99	20
1 no. concrete pump	BS 5228 - C.4/32	106	30
2 no. forklift trucks	BS 5228 - D.7/93	104	30
hammering	BS 5228 - D.7/80	107	2
scaffolding erection/dismantling	BS 5288 - D.7/1	108	20
2 no. lorries delivering materials	BS 5228 - C.2/34	108	5
Infrastructure and Landscaping			

Plant	Data source	L _{WA} (dB) (each item)	% on-time per day
2 no. 20T excavators	BS 5228 - C.2/21	99	50
2 no. concrete mixer truck discharging	BS 5228 - C.4/19	99	5
1 no. concrete pump	BS 5228 - C.4/32	106	30
hammering	BS 5228 - D.7/80	107	2
1 no. petrol hand-held circular saw	BS 5228 - C.4/73	112	2
1 no. asphalt paver and tipper lorry	BS 5228 - C.5/31	105	50
1 no. vibratory roller	BS 5228 - C.5/26	105	50
1 no. pneumatic breaker	BS 5228 - D.8/1	114	2

Note: “% On-Time” is the percentage of the working day over which the plant is assumed to be operating.

- 4.1.4 For the purpose of the predictions, it is assumed that the intervening ground between the construction noise sources and the noise-sensitive properties, for both the ‘worst case’ and ‘average case’ scenarios, will be acoustically hard such that there will be no significant attenuation of sound due to ground absorption.
- 4.1.5 For each activity, “worst case” has been defined as a scenario where all named equipment is operated at the closest point to the noise sensitive receptor in question, whereas the “typical case” is defined as the scenario where all equipment is operated at a point central to the construction site.
- 4.1.6 Based on the distances from source to receiver, and the programme, activities and plant described, the predicted façade construction noise levels are set out in the following table, including where levels are in excess of the 70 dB L_{Aeq,12h} residential criterion or 65 dB L_{Aeq,12h} educational criterion highlighted in bold)

Table 6 - Predicted construction noise levels – L_{Aeq,T} dB

Activity	Predicted Construction Noise Levels, L _{Aeq,T} (dB) (worst case / typical case)			
	Julie’s Catholic High School	51 Woolton Street	Sylvan Court	Marie Curie Hospice, Speke Road
Demolition	95.5 / 83.5	78.8 / 67.8	67.7 / 59.7	58.6 / 53.5
Excavation and ground works	87.6 / 75.6	71.0 / 59.9	64.8 / 51.8	60.7 / 45.6
Activity in fill area	91.1 / 79.1	74.5 / 63.5	68.3 / 55.3	64.2 / 49.1
Foundation and substructure works	88.7 / 76.7	72.1 / 61.1	65.9 / 52.9	61.8 / 46.7
Superstructure works	88.2 / 76.2	71.6 / 60.5	65.4 / 52.4	61.3 / 46.2
Infrastructure and landscaping	90.0 / 78.0	73.3 / 62.3	67.2 / 54.2	63.1 / 48.0

- 4.1.7 It can be seen from the above that, for Sylvan Court and the Marie Curie Hospice, both the typical and the worst case construction noise levels are predicted to be below the 75 dB criterion for all activities associated with the works.

- 4.1.8 For 51 Woolton Street, it can be seen that, for the worst case scenario, the criterion will be met in all but one instance. However, for the typical scenario, the criterion will be met in all cases. It follows that, although there will be a slight, very short term exceedance during some demolition activities, for the vast majority of the site works the criterion will be comfortably met for these receptors.
- 4.1.9 For St. Julie's High School, it can be seen that, even in the typical case, there will be exceedances of between 10.6 and 18.5 dB, whilst for the worst case scenario (where the receptor is only 5 metres away from the noise sources) there will be an exceedance of between 22.6 and 30.5 dB.
- 4.1.10 It is inevitable with any development that there will be some disturbance caused to those nearby during the site clearance, demolition and construction works and the works associated with the proposed development are on a reasonable scale. However, in WSP's experience, and where the residents are provided with sufficient information, and thus given confidence that mitigation measures are in place, complaints are not typically received until construction noise levels exceed 75 dB ($L_{Aeq,12hr}$).
- 4.1.11 Consideration has been given to mitigation measures in Section 5.

4.2 Operational Phase Plant Noise Limits

- 4.2.1 Noise generated by externally mounted building services equipment associated with the development should be controlled such that it does not create an adverse noise level impact on nearby noise sensitive premises.
- 4.2.2 In accordance with the criteria stipulated by the Local Authority, the rating level generated from plant associated with the development should be controlled such that it does not exceed the existing background noise level during the daytime and night-time periods.
- 4.2.3 Based upon the background noise levels measured, and the criteria specified by the Local Authority, **Table 7** provides the maximum permissible rating level limits for noise from fixed plant associated with development, when determined outside existing nearby noise sensitive premises.

Table 7 – Maximum Permissible Cumulative Rating Level Limits at Nearby Noise Sensitive Premises (free field), dB

Noise-Sensitive Premises	Assessment Period	Maximum Permissible Rating Level Limit at the Nearby Noise-Sensitive Premises (free field), $L_{A_{r,Tr}}$ dB
Dwellings on Woolton Street	Daytime (07:00 – 23:00)	46
	Night-time (23:00 – 07:00)	40
Dwellings on Sylvan Court and Ashton Square	Daytime (07:00 – 23:00)	45
	Night-time (23:00 – 07:00)	38

- 4.2.4 In accordance with BS 4142, it is appropriate to consider whether the noise level impact contains an acoustic character i.e. tonal (i.e. whine, hiss, screech, hum, etc.), i or impulsive (i.e. bangs, clicks, clatters, or thumps) or is intermittent in operation. The proposed plant is likely to consist of air handling units and extract fans and therefore unlikely to contain such characteristics. Where such acoustic characteristics are expected, the appropriate correction for attention attracting character should be added to the noise source before comparison to the above noise level limits.

5 Mitigation

5.1 Construction Phase

General

5.1.1 Worst case noise levels have been predicted to exceed adopted criteria at St. Julie's High School and at 51 Woolton Street. Furthermore, the typical case predictions also show that adopted criteria are likely to exceed the criterion at St. Julie's. Therefore consideration has been given to mitigation measures available at this site.

5.1.2 In the first instance, the core working hours will be limited to:

- 08:00 - 18:00 hours weekdays; and
- 08:00 – 13:00 hours Saturdays.

These hours will be strictly adhered to, unless:

- an emergency demands continuation of works on the grounds of safety;
- fitting out works are being carried out within the containment of the building envelope; or
- completion of an operation that would otherwise cause greater interference with the environment/general public if left unfinished.

5.1.3 Best Practicable Means (BPM) of preventing, reducing and minimising noise will be adopted.

5.1.4 Good practice procedures will be followed in order to mitigate noise effects. Measures currently planned include:

- the contractor will comply with the requirements of the Control of Pollution Act 1974, with particular reference to Part III, the Environmental Protection Act 1990, The Control of Noise at Work Regulations 2005 and the Health and Safety at Work etc. Act 1974;
- leaflets giving an overview of works and providing dates and durations of the key activities will be distributed to dwellings within at least 100 m of the site boundary;
- noticeboards will be erected displaying clearly the name of the Principle Contactor and 24 hour contact details;
- all plant and equipment to be used for the works will be properly maintained, silenced where appropriate, and operated to prevent excessive noise and switched off when not in use and where practicable;
- hydraulic demolition and construction will be used in preference to percussive techniques where practical;
- plant will be certified to meet relevant current legislation and selected to be no noisier than similar examples cited in BS 5228:2009+A1:2014;
- all trade contractors will be made familiar with current noise legislation and the guidance in BS 5228:2009+A1:2014 which will form a prerequisite of their appointment;
- Ad-hoc noise monitoring will be undertaken as required;
- loading and unloading of vehicles, dismantling of equipment such as scaffolding or moving equipment or materials around the site will be conducted in such a manner as to minimise noise generation;
- deviation from approved method statements will be permitted only with prior approval from the Principal Contractor and other relevant parties. This will be facilitated by formal review before any deviation is undertaken; and

- any complaints received by the Contractor will be immediately investigated.

5.1.5 The construction site management must be vigilant at all times in this regard to ensure that BPM are being adopted at all times, and that adjustments to plant, techniques and screening etc. are made where necessary.

51 Woolton Street

5.1.6 For 51 Woolton Street, during the demolition phase, should demolition occur within 55 metres of the closest façade of 51 Woolton Street, the contractor will need to erect and maintain throughout the activities localised acoustic temporary barriers around the activities. The barrier will need to be at least 2 m high and possess a surface density of at least 7 kg/m² and have no holes or gaps.

5.1.7 BS 5228 indicates that a barrier just breaking line-of-sight between source and receiver would afford a reduction of around 5 dB to the resultant noise level, whereas a barrier which completely hides the noise source from the receiver would afford a reduction of around 10 dB. Based on this, it is likely that such acoustic screening would result in noise levels during the demolition activities that meet the criterion adopted at 51 Woolton Street.

St. Julie's High School

5.1.8 With respect to teaching spaces in St. Julie's High School, it is clear that, for the closest elements of the school that have a view onto the demolition and construction works, noise would be particularly intrusive and teaching would not be possible.

5.1.9 However, due to the fact that the site is part of the school, there is the opportunity to implement a classroom management programme which takes certain classrooms out of use for the duration of the works. This would involve timetabling lessons to utilise classrooms at the southernmost point of the site. For the worst case activities (identified as the demolition phase) an unscreened separation distance of 170 metres would be required to achieve 65 dB L_{Aeq,T} outside teaching spaces, which effectively sterilises the whole existing school during the course of the works.

5.1.10 However, the existing school building will provide self-screening. For classrooms with windows facing to the south and east only, it would not be uncommon for a noise reduction up to 20 dB to be realised.

5.1.11 Taking this into consideration for the demolition phase, separation distance of 20 metres would be required to achieve 65 dB L_{Aeq,T} outside teaching spaces, where the glazed element of the teaching space faces away from the works.

5.1.12 Once the exact equipment and plant is known, a noise management section will be included in a Construction Environmental Management Plan (CEMP) in order to ensure that appropriate zoning is planned and implemented with the school for the duration of the works. This may include noise monitoring which would be undertaken to monitor any exceedance of the noise limit at classrooms that have been zoned as "meeting the limit". Such a noise management plan could be included in a suitably worded planning condition, should the Council consider this appropriate.

5.2 Operational Phase

5.2.1 Noise from externally mounted building services equipment will need to be controlled in order to meet the Maximum Permissible Cumulative Rating Level Limits at nearby noise sensitive premises as specified in **Table 7**, taking into consideration any potential attention attracting characteristics associated with the noise impact. Once details of the building services equipment have been confirmed, an appropriate acoustic mitigation strategy in order to be capable of meeting the noise level limits will be developed to by the Acoustic Consultant, WSP. At this stage, it is anticipated that

the mitigation strategy would likely consist of rooftop mounted acoustic attenuators and acoustic rated fan/plant encasement.

6 Conclusion

- 6.1.1 WSP has been commissioned by Kier Northern to undertake a noise impact assessment for the proposed St Julies Catholic High School, Woolton, Liverpool. This report provides the results of the environmental noise survey conducted on site between Tuesday 29th and Wednesday 30th October 2014. The results of the environmental noise survey have been used to specify noise level limits for any proposed building services equipment associated with the development.
- 6.1.2 In accordance with the procedures contained in BS 5228:2009+A1: 2014 part 1, and in keeping with the requirements of Liverpool City Council, an assessment has been undertaken to determine the likely noise levels during the key demolition and construction activities associated with the proposed development.
- 6.1.3 The assessment results show that, for all residential noise sensitive receptors, the adopted noise limits will not typically be exceeded. Furthermore, in all but one case, the worst case scenarios would also generate noise levels below the adopted limits at residential receptors.
- 6.1.4 For 51 Woolton Street, worst case noise levels generated through demolition works will lead to a slight exceedance of the criterion. As such, 2 metre high, localised acoustic screening has been recommended for such works where they occur within 55 metres of this property.
- 6.1.5 For the closest existing classroom at St. Julie's Catholic High School, to the proposed works, worst case and typical case noise levels generated by all demolition and construction works are predicted to exceed the adopted educational use limit. Therefore it will not be appropriate to use these classrooms.
- 6.1.6 Once the exact equipment and plant is known, a noise management section will be included in a Construction Environmental Management Plan (CEMP) in order to ensure that appropriate zoning is planned and implemented with the school for the duration of the works, and where appropriate, classrooms face away from the demolition and construction activities located at a minimum distance from the noise sources. This may also include noise monitoring which would be undertaken to monitor any exceedance of the noise limit at classrooms that have been zoned as "meeting the limit". Such a noise management plan could be included in a suitably worded planning condition, should the Council consider this appropriate.
- 6.1.7 BPM must be adopted at all times, which will require a proactive approach by the site management.
- 6.1.8 Operational phase noise level limits have been specified to be achieved by any proposed externally mounted building services equipment associated with the development. The required details of the proposed plant to be installed as part of the development are currently not known and will be developed as the design progresses. An appropriate mitigation strategy will be developed once details of the proposed building services equipment are confirmed, to ensure that the derived limits are achieved.

Appendix 1 – Glossary of acoustic terminology

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq} , L_{A90} etc, according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

An indication of the range of sound levels commonly found in the environment is given in Table 3.

Table 3 – Typical sound levels found in the environment

Sound Level	Location
0 dB(A)	Threshold of hearing
20 to 30 dB(A)	Quiet bedroom at night
30 to 40 dB(A)	Living room during the day
40 to 50 dB(A)	Typical office
50 to 60 dB(A)	Inside a car
60 to 70 dB(A)	Typical high street
70 to 90 dB(A)	Inside factory
100 to 110 dB(A)	Burglar alarm at 1m away
110 to 130 dB(A)	Jet aircraft on take off
140 dB(A)	Threshold of Pain

Table 4 – Terminology relating to noise

Term	Description
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20µPa (20x10 ⁻⁶ Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log ₁₀ (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20 µPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
L _{eq,T}	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
L _{max,T}	A noise level index defined as the maximum noise level during the period T. L _{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L _{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L _{90,T}	A noise level index. The noise level exceeded for 90% of the time over the period T. L90 can be considered to be the "average minimum" noise level and is often used to describe the background noise.
L _{10,T}	A noise level index. The noise level exceeded for 10% of the time over the period T. L10 can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Façade	At a distance of 1m in front of a large sound reflecting object such as a building façade.
Fast/Slow Time Weighting	Averaging times used in sound level meters.
Octave Band	A range of frequencies whose upper limit is twice the frequency of the lower limit.

Appendix 2 – Limitations to This Report

This report has been prepared for the titled project or named part thereof and should not be used in whole or part and relied upon for any other project without the written authorisation of WSP Environmental Limited. WSP Environmental Limited accepts no responsibility or liability for the consequences of this document if it is used for a purpose other than that for which it was commissioned. Persons wishing to use or rely upon this report for other purposes must seek written authority to do so from the owner of this report and/ or WSP Environmental Limited and agree to indemnify WSP Environmental Limited for any and all loss or damage resulting there from. WSP Environmental Limited accepts no responsibility or liability for this document to any other party other than the person by whom it was commissioned.

The findings and opinions expressed are relevant to the dates of the site works and should not be relied upon to represent conditions at substantially later dates. Opinions included therein are based on information gathered during the study and from our experience. If additional information becomes available which may affect our comments, conclusions or recommendations WSP Environmental Limited reserve the right to review the information, reassess any new potential concerns and modify our opinions accordingly.

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