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AECOM

Hertfordshire Constabulary

Headquarters Redevelopment

Construction Noise Assessment

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Construction Noise Assessment

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1. Introduction

AECOM have been appointed to carry out a noise impact assessment for the proposed demolition and construction works associated with the Hertfordshire Constabulary Headquarters redevelopment located in Welwyn Garden City.

This report provides details of the construction noise assessment and outlines recommendations for mitigation measures in order to provide a method for controlling and managing the noise to sensitive spaces within the site boundary during the construction and demolition works.

A glossary of acoustic terminology used in this report is presented in Appendix A.

2. Noise Sensitive Spaces

This report considers the potential noise impact on the noise sensitive receptors (NSRs) within the site boundary. NSRs identified within the site by the client are:

- OSB Level 1 24-hour Call Centre
- OSB Ground Floor Conference Rooms, Training Rooms and Incident Rooms
- Peter Sharp Forensics Labs/Offices
- CMD Offices

The location of the receivers relative to the proposed construction works are shown on the site plan in the following figure.

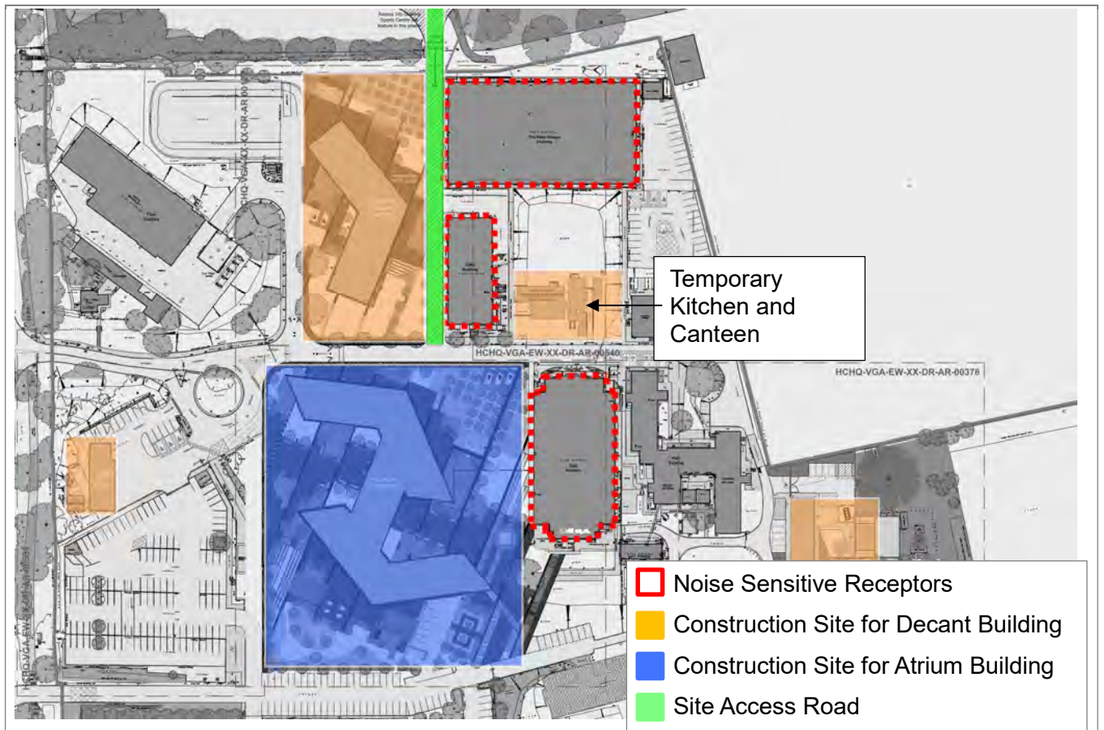

Figure 2.1 Noise Sensitive Spaces and Construction Locations

3. Description of Works

At this stage in design of the development, the proposed construction methods have not been determined. As such a worst-case assessment based on a range of typical construction methods has been undertaken. A description of the activities and potential noise levels that have been used in the assessment are presented in the table below.

Table 3.1 Noise Levels at the Façade as a result of Construction Noise

Description of Works	Potential Noise Level at Facades of NSRs
Demolition Works – Breaking of concrete slabs, etc.	85-95 dB L_{Aeq}
Piling Works	75-90 dB L_{Aeq}
HGV Movements – maximum noise level during passby	75-85 dB L_{Amax}

The above examples have been taken from BS5228-1:2009+A1:2014 *'Code of practice for noise and vibration control on construction and open sites. Part 1: Noise'* historic data and previous project experience of working on construction sites. However, the actual noise levels incident on the façade may vary depending on the duration of works, proposed construction methods, plant/equipment usage and locations of works within the site.

Piling works noise levels will vary depending on the technique. Hydraulic pile press-in techniques can be substantially quieter that continuous flight auger techniques, with impact or driven piling typically being the noisiest option. However actual piling methodologies are also dependent on physical constraints such as the pile depth requirements as well as ground conditions.

4. Noise Levels within Buildings

4.1 Noise Measurements in Existing Spaces

Noise measurements were taken in a number of sensitive spaces that were identified by the Client and that are planned to remain occupied throughout the construction period of the proposed development. The spaces identified were:

- 24-hour Call Centre – Level 1 OSB Building
- Conference Room – Ground Floor OSB Building
- Forensic Lab – West side of Peter Sharp Building

The following Table provides an overview of the measurement results in each of the spaces.

Table 4.1 Internal Ambient Noise Measurement Results

Location	Occupied	L_{Aeq} (dB)	L_{Amax} (dB)	L_{A90} (dB)
OSB 24-hour Call Centre	✓	53	63	49
OSB Gold Conference Room	×	37	45	36
Peter Sharp Forensic Labs/Offices	✓	49	57	44

4.2 Noise Intrusion Criteria

4.2.1 BS 8233:2014

While there are no national or local limiting criteria for demolition works noise inside an occupied building, BS 8233 provides recommendations for internal ambient noise levels dependent on their usage.

The primary use of nearby buildings which are considered sensitive to noise comprise of offices, meeting rooms and call centres. BS 8233 advises the following unoccupied internal ambient noise level design ranges. These values consider the contribution of both noise ingress and internal building services.

Table 4.2 BS 8233 Internal Noise Level Design Ranges

Space	Design Range (dB $L_{Aeq,T}$)
Staff/Meeting Room, Training Room	35-45
Open Plan Office	40-50

4.2.2 British Council for Offices (BCO)

In addition to the guidance provided by BS 8233, BCO *Guide to Specification* 2019 provides the following guidance relating to external noise intrusion:

> *"To avoid speech interference, regular individual noise events – e.g. scheduled aircraft or passing trains –should not normally be more than 55 dB $L_{A01,1hour}$ in open plan/ speculative offices or 50 dB $L_{A01,1hour}$ in cellular offices/meeting rooms."*

While the above BS 8233 and BCO criteria is generally intended to be applied in the presence of permanent noise sources (rather than demolition or construction works which are temporary in nature), these design ranges levels have been considered as part of the assessment in order to identify the extent of potential mitigation measures in order to allow use of the existing buildings to be maintained during the construction/demolition works programme.

4.2.3 Previous AECOM Experience

AECOM has previously conducted trials in office environments and asked the users for their opinion on what level of noise is unacceptable for transient demolition/construction events such as these. The conclusion of that exercise was that for regular short burst of noise, a level of 55 dB $L_{Aeq,T}$ was intrusive but tolerable.

It is recommended that an upper level of 65 dB $L_{Aeq,T}$ is set as a threshold, this is level at which speech and communication starts to be impacted. As can be seen from Table 4.1, this target is only marginally greater than the maximum noise levels, L_{Amax}, as a result of occupants within the existing space, therefore it is anticipated that level will be acceptable. This will allow a realistic limit for construction works to take place.

Whether or not demolition works causes internal noise levels resulting in disturbance to NSRs will depend not only the magnitude of noise itself but also how regularly the events occur. Noise levels will be there highest when activities take place in proximity to an NSR, however noise levels will reduce when works take place at greater distances.

It is likely that many people will find the noise intrusive simply as a result of its subjective character and unpredictability rather than just its level. This intrusiveness is most likely to be noticeable in the quieter areas of the buildings such as single occupancy offices and conference rooms overlooking the construction site. The disturbance caused by the noise is likely to also be a function of the regularity with which it occurs.

Where heavy duty impulsive tools are used extensively, there may be noise disturbance caused to spaces that directly overlook the proposed construction site, in particular in rooms that are within 10 m of works.

4.2.4 Summary of Assessment Criteria

Based on the criteria presented in sections 4.2.1 to 4.2.3, the following criteria presented in Table 4.3 are proposed for the assessment of construction/demolition effects. An upper threshold of 65 dB $L_{Aeq,T}$ is adopted as this is the level at which there is likely to be significant disruption to speech and communication.

Table 4.3 Summary of Assessment Noise Criteria

Building	Space	Assessment Criteria		
		Demolition/Piling works $L_{Aeq,T}$ (dB)	HGV Passbys L_{Amax} (dB)	Upper Threshold $L_{Aeq,T}$ (dB)
OSB	24-hour Call Centre	40-55	55	65
	Ground Floor Offices	40-55	55	65
	Ground Floor Conference Rooms	35-45	50	65
Peter Sharp	Forensic Labs/Offices	40-55	55	65
CMD	Cellular Offices	35-45	50	65

4.3 Predicted Internal Noise Levels

Based on the noise levels provided in Table 3.1, the existing façade constructions, ventilation methods and geometry, the following noise levels within the acoustically sensitive spaces have been predicted.

As the methods for the demolition and construction works, such as breaking slabs, excavation and piling, have not been determined the noise levels are presented as a range.

In addition to the predicted noise levels, the combined façade performance has been calculated and is presented below, based on the assumed typical sound insulation performance of the façade elements.

Table 4.4 Predicted Internal Noise Levels without Mitigation Measures

Works	Building	Space	Criteria (dB $L_{Aeq,T}$) Lower Range	Criteria (dB $L_{Aeq,T}$) Upper Range	Predicted External Noise Level (dB $L_{Aeq,T}$)	Predicted Façade Performance (dB R_w)	Predicted Internal Noise Levels (dB $L_{Aeq,T}$)	Does this Exceed Criteria Lower Range?	Does this Exceed Criteria Upper Range?	Is there Potential for Disturbance to Room Occupants?
Demolition	OSB	Call Centre	40	55	85	38	47	Yes (+7dB)	No	No
					95		57	Yes (+17dB)	Yes (+2dB)	Yes
		Open Offices	40	55	85	43	42	Yes (+2dB)	No	No
					95		52	Yes (+12dB)	No	No
		Conference Rooms	35	45	85	44	41	Yes (+6dB)	No	No
					95		51	Yes (+16dB)	Yes (+6dB)	Yes
	Peter Sharp	Forensics Labs/Open Offices	40	55	85	39	46	Yes (+6dB)	No	No
					95		56	Yes (+16dB)	Yes (+1dB)	Yes
	CMD	Cellular Offices	35	45	85	30	55	Yes (+20dB)	Yes (+10dB)	Yes
					95		65	Yes (+30dB)	Yes (+20dB)	Yes
Piling	OSB	Call Centre	40	55	75	38	37	No	No	No
					90		52	Yes (+12dB)	No	No
		Open Offices	40	55	75	43	32	No	No	No
					90		47	Yes (+7dB)	No	No
		Conference Rooms	35	45	75	44	31	No	No	No
					90		46	Yes (+11dB)	Yes (+1dB)	Yes
	Peter Sharp	Forensics Labs/Open Offices	40	55	75	39	36	No	No	No
					90		51	Yes (+11dB)	No	No
	CMD	Cellular Offices	35	45	75	30	45	Yes (+10dB)	No	No
					90		60	Yes (+25dB)	Yes (+15dB)	Yes
HGV Movements *	OSB	Call Centre	-	55	75	38	37	-	No	No
					85		47	-	No	No
		Open Offices	-	55	75	43	32	-	No	No
					85		42	-	No	No
		Conference Rooms	-	50	75	44	31	-	No	No
					85		41	-	No	No
	Peter Sharp	Forensics Labs/Open Offices	-	55	75	39	36	-	No	No
					85		46	-	No	No
	CMD	Cellular Offices	-	50	75	30	45	-	No	No
					85		55	-	Yes (+5dB)	Yes

Note: HGV noise levels are assessed as a maximum noise level (L_{Amax}) due to the nature/character of the noise source.*

4.4 Commentary

4.4.1 Comparison with Internal Measurements

Initially the client raised concerns that the noise ingress into the 24-hour call centre may affect the occupants of the space. The occupied noise levels measured in the existing Call Centre show that the noise levels are approximately 53 dB $L_{Aeq,T}$ under normal operation. The predicted noise levels above show that the noise levels within the space as a result of construction works and HGV movements range from 37-52 dB(A), which is below existing noise levels. Where demolition works are taking place, the existing noise level is predicted to be exceeded by up to 4 dB.

Noise level measurements were also taken within the Peter Sharp Digital Forensics Lab which showed that the noise levels were typically 49 dB $L_{Aeq,T}$ when occupied, with maximum noise levels of 57 dB L_{Amax}. Existing noise levels may be exceeded by up to 6 dB during piling and demolition activities, however, this will depend on the methods used.

Further measurements were undertaken in the ground floor Conference Room located in the OSB, however as the space was unoccupied at the time this is not considered suitable for direct comparison to existing noise levels. Predicted noise levels of up to 51 dB $L_{Aeq,T}$ from demolition works may occur which exceeds the upper design range for conference rooms by 6 dB. However, it is not considered that these noise levels would result in notable disruption to meetings in the conference room.

In all instances, predicted internal noise levels from demolition, piling and HGV activities within the various NSRs do not exceed the upper threshold of 65 dB $L_{Aeq,T}$. It is not expected that these works will result in significant disruption to speech and communication.

4.4.2 Identified Building Facades for Acoustic Treatments

Based on the results of the predicted noise levels incident on the façade of buildings within the site, the CMD building may benefit from acoustic mitigation measures in order to reduce the noise ingress during the proposed demolition works. This is where the construction noise exceeds the internal noise level project criteria and where adverse effects/disturbance may be experienced by room occupants.

For the OSB and Peter Sharp buildings, it is predicted that construction/demolition works noise ingress exceeds the lower range of the internal noise project criteria, however, as the final construction and demolition methods have not been established it is not possible to determine whether works will exceed the upper limit. Based on AECOM's previous experience of noise levels typically experienced in spaces adjacent to construction sites, levels below 55 dB $L_{Aeq,T}$ are considered tolerable.

Given the nature of the works undertaken in the OSB Conference Rooms and Call Centre, it is recommended that mitigation measures be incorporated to reduce the potential for construction noise to impact the users of the space.

5. Noise Mitigation/Measurements

5.1 Best Practicable Means

'Best Practicable Means' (as per the Control of Pollution Act 1974) will be adopted in order to mitigate against the construction phase noise effects at NSR's.

Mitigation measures will help to further reduce the scale of the impacts on the environment. BS 5228 does not state criteria for acceptable levels of construction noise, therefore the preferred approach is to reduce noise and vibration levels (where possible), but with due regard to practicality. Sometimes, a greater level may be acceptable if the overall construction time and therefore length of disruption is reduced. However, given the uses of the spaces overlooking the site the approach will need to be carefully considered.

As plant selections and site working procedures are yet to be finalised, exact mitigation measures cannot yet be detailed. However, the following mitigation measures have been prepared in order to provide a methodology for controlling noise emissions during works such that noise limits may be adhered to during the construction works programme. BS 5228 is a useful reference document and provides additional advice for mitigation measures.

- Orientate plant away from Noise Sensitive Receptors (NSRs) (where possible)
- Shut down machines used intermittently between periods of activity
- Fit ancillary pneumatic percussive tools with mufflers or silencers of the type recommended by the manufacturers
- Best Practicable Means shall be employed and demonstrated in relation to all noise generating demolition and construction works
- Regular and effective maintenance by trained personnel will be undertaken to keep plant and equipment working to manufacturers' specifications
- Avoid idling where possible
- Utilise super silence generators
- Avoidance of percussive piling or any other percussive works activity where possible. Where this is not possible all practicable means will be employed to reduce noise impacts such as enclosing the works activity
- Acoustic covers to engines will be kept closed during use
- Use of effective exhaust silence systems or acoustic engine covers as appropriate
- Acoustic shrouds to be located around equipment and plant where practicable
- Compressors to have effective acoustic enclosures

5.2 Equipment Screening and Site Hoarding

Use of mitigation measures such as acoustic screening around equipment, where practicable, shall be used in order to control noise emissions at nearby NSRs. For maximum benefit, screens should be close to the source of noise. Careful positioning of noise barriers or screens can bring about significant reductions in noise levels.

Continuous/close-boarded wooden hoarding around the works areas could provide some reduction in noise levels, this would realistically be limited to where the hoarding is located in close proximity (within a few metres) to either operational plant or an existing building, and would only be effective up to the height of the barrier itself (i.e. ground floor height only).

It may also be beneficial to reduce the continuous background noise (such as drilling rig engines) by providing an acoustic canopy to replace the normal engine covers of the drilling rigs. Note that any replacement canopy should not cause the engine to overheat nor interfere excessively with routine maintenance operations. The rig manufacturer/suppliers should be able to advise on available options.

5.3 Acoustic Blankets on Windows

As a primary measure, it is recommended that acoustic blankets are hung externally onto windows of the CMD building facing construction work areas. However, note that use of acoustic blankets will reduce natural light ingress into spaces.

The use of acoustic blankets on windows approximately provides an additional 20 dB of noise reduction and allows works noise levels to be brought down to an appropriate level, such that speech communication inside spaces is not interfered with.

As the CMD building is naturally ventilated, the practicalities of providing acoustic blankets will need to be considered. Leaving the trickle ventilators exposed to noise is likely to have a significant impact on the sound insulation achieved. As such it may be more appropriate to provide a full height blanket to

spaces slightly away from the façade.

It is noted that noise ingress into the Peter Sharp building slightly exceeds the project criteria, however, as this exceedance is minimal it is recommended that mitigation is not initially provided and reviewed once the works have begun. Acoustic blankets may then be provided if the noise ingress is considered a problem.

5.4 Secondary Glazing

An alternative to acoustic blankets may be provide secondary glazing, however, this approach depends on whether the secondary glazing can practically be installed to the existing buildings. Note that any acoustic protection would be negated with the windows open (e.g. for purge ventilation of temperature control purposes) and would need to consider current ventilation methods. Adequate time allowances in the programme are also required to measure, procure, and install any secondary glazing units.

As part of the site inspection, it was noted that the only practical place where secondary glazing could be included is anticipated to be within the OSB Conference Rooms and Call Centre however it may be possible elsewhere. To meet the project criteria, it is recommended that secondary glazing is provided to the spaces facing the construction site.

It is recommended that the acoustic treatment comprises an interior secondary glazing unit, with the glazing providing a minimum weighted sound reduction index of 20 dB R_w.

These windows could utilise either aluminium or uPVC fixed window frames and be either single or double glazed.

It should be noted that they require sufficient internal sill space and the secondary glazing unit would require a minimum air space of 50mm between the primary and new windows.

Internal secondary glazing units would be fixed onto the interior of existing glazing units and can be installed from inside a room space.

The following figures present examples of internal secondary glazing, including options of vertical and horizontal sliding openable windows.

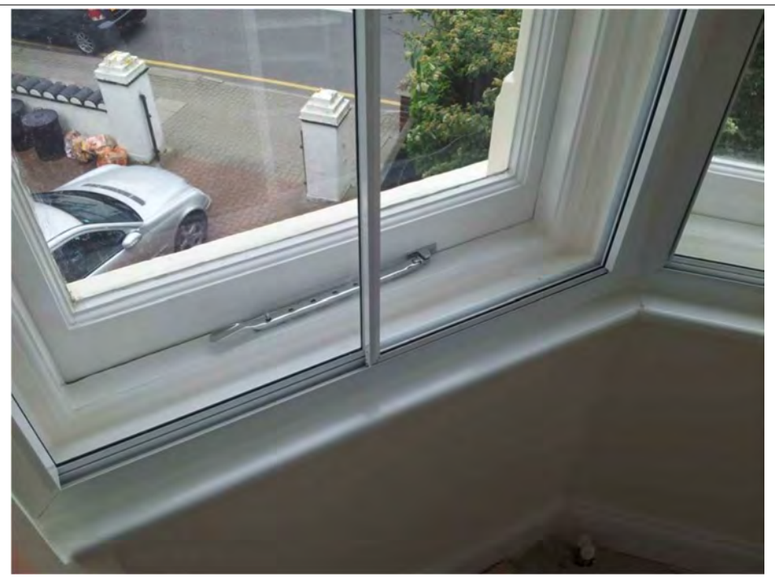

Figure 5.1 Horizontal Sliding Internal Secondary Glazing

Figure 5.2 Vertical Sliding Internal Secondary Glazing

If this solution is not considered appropriate, as an alternative mitigation could be provided using acoustic blankets to cover the existing windows.

5.5 Work Scheduling

Sensitive work programming will also be essential as will good communication with the building occupants during the works. It is likely that many people will find the noise intrusive simply as a result of its subjective character and unpredictability rather than just its level. This intrusiveness is most likely to be noticeable in rooms with windows directly fronting onto construction works areas. The annoyance caused by the noise is likely to also be a function of the regularity with which it occurs e.g. occasional drilling will be less likely to cause disturbance than intense periods of activity with regular drilling.

In practice, construction noise levels and resulting impacts are likely to vary during the different construction phases of the project depending upon the location of work sites and proximity of receptors. It is considered that noise impacts are likely to be greatest during the early stages of construction for example demolition and other preparation works and also ground works, when heavier plant is likely to be used. Furthermore, best practicable means of mitigation will further assist in minimising construction noise effects.

The nature of construction work means that a worst-case scenario with the plant working at closest approach may exist for only a matter of days or even hours and there would be regular periods, even during the course of a single day, when the assumed noisy plant would not be in operation during breaks or changes of working routine.

6. Site Management

Good relationships with the occupants of the site and surrounding area and communication of proposed works will be essential to help to minimise the effect of construction work. Occupants will need to be assured that any higher levels of noise will only be for a short period of time and so it will be necessary to publicise and adhere to a stated works schedule.

In order to minimise the likelihood of complaints, on site staff and nearby residents should be kept informed of the works to be carried out. The Principal Contractor, throughout the construction phase, should operate a complaints procedure. This process should ensure that any complaints or queries raised are promptly addressed. Additionally, liaison meetings can provide development updates as well as providing a forum for issues and complaints.

It is recommended that there be a dedicated contact number for staff/residents to phone should they have any immediate queries or complaints. A log must be kept of all complaints, along with the actions taken to resolve these.

7. Training & Awareness

All project personnel, subcontractors and consultants attending site will be required to complete induction training which shall be arranged by the Principal Contractor. This will include a noise and vibration component to reinforce the important management issues and the measures that will be implemented to protect prevent adverse noise impacts. Ongoing toolbox talks will highlight specific environmental requirements associated with activities underway at the time.

Examples of topics that may be covered during project induction and toolbox talks include:

- Normal work hours
- What activities can and can’t take place outside of these working hours
- The process for seeking approval for out of hours works, including consultation
- Location of noise sensitive areas
- The employment of high standards of working, reasonable and feasible noise mitigation measures
- Roles and responsibilities of the Project team related to noise and vibration

8. Monitoring & Review

The Principal Contractor shall carry out representative construction noise monitoring as construction works progress in order to: verify construction noise levels from works; review the effectiveness of mitigation measures; and/or demonstrate compliance with any agreed noise threshold criteria.

All monitoring will be in accordance with the construction monitoring guidelines presented in BS 5228 and monitoring data made available to relevant key stakeholders on request.

Representative monitoring shall be carried out periodically e.g. at the start of new works phases or when works commence in new locations.

Where actual levels are found to exceed project criteria levels, the source of excessive noise level generation will be identified, and any additional feasible and reasonable measures available will be implemented to either reduce emissions or reduce the impacts on receivers.

9. Non-Compliance & Corrective Actions

Where complaints due to construction works noise and vibration are received, the cause/source of excessive noise generation will be identified, the Principal Contractor will review the works in progress, and if it is identified that construction works are resulting in non-compliance then the infringement will be stopped immediately. Any additional reasonable and feasible measures available shall be implemented to either reduce noise emissions or reduce impacts on receivers.

If deficiencies are identified and non-compliances with the environmental requirements/objectives are observed, this will be reported and relevant actions/mitigations will be enforced.

AECOM has provided an example Incident Procedure Flowchart (Figure 9.1) should there be any complaints due to construction works noise and vibration during works.

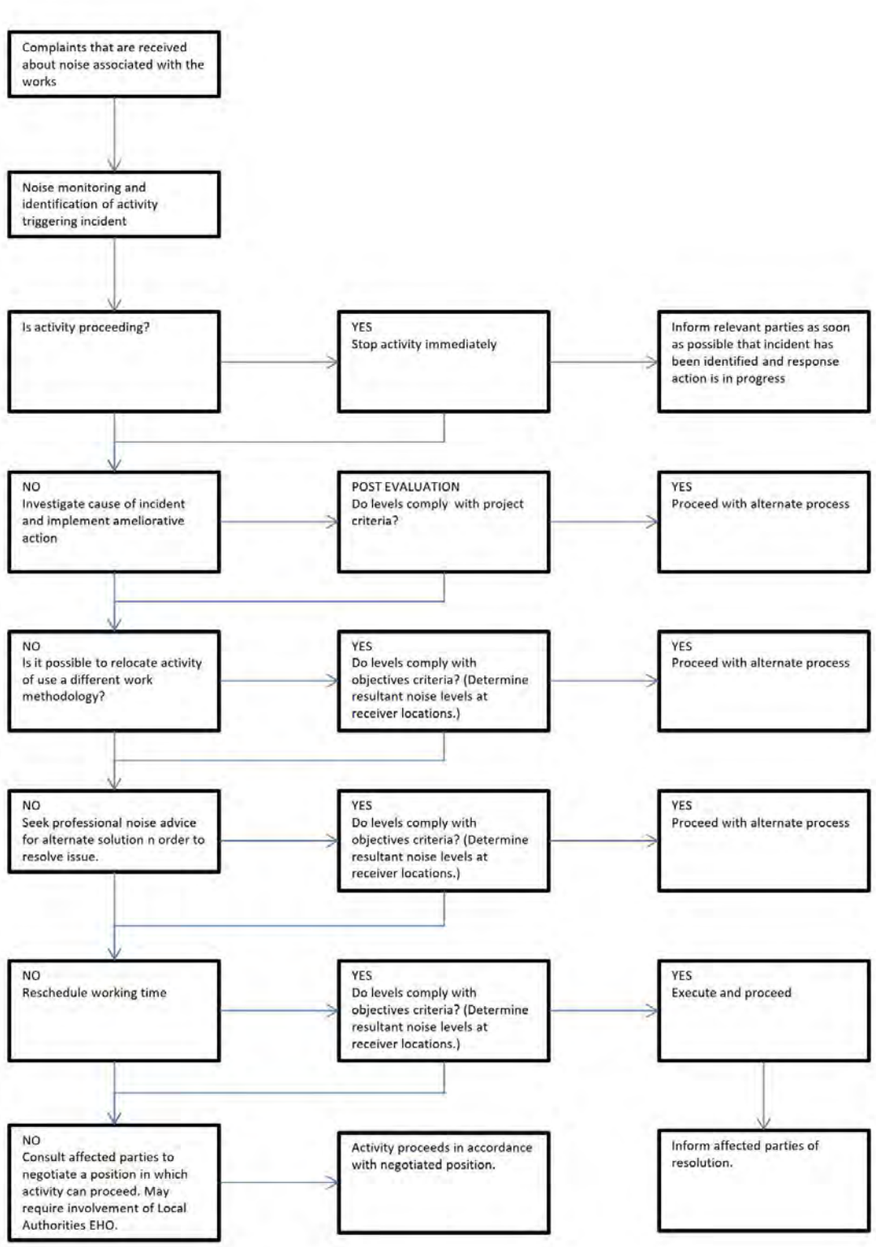

Figure 9.1 Example Incident Procedure Flow Chart

10. Conclusions

AECOM has been appointed by Hertfordshire Constabulary to undertake a noise assessment of the demolition and construction works taking place at Hertfordshire Constabulary Headquarters in Welwyn Garden City.

AECOM has provided outline recommendations for mitigation measures to provide a methodology for controlling and managing noise and vibration emissions during the construction works programme. This report provides a documented methodology which will apply to the proposed works, which includes details of:

- Mitigation
- Site management
- Training and awareness
- Monitoring and review
- Non-compliance and corrective actions

Attended measurements of existing background noise inside a selection of on-site sensitive spaces identified by the client where undertaken to identify the existing noise levels.

It was identified that in spaces within the OSB and CMD building directly facing onto construction works areas with no acoustic mitigation in place, noise levels during demolition/construction works exceeded the project criteria and would likely cause disturbance to users of these spaces. As such the use of secondary glazing and acoustic blankets has been recommended to the OSB building and CMD buildings, respectively.

For the Peter Sharp building, it was found that the noise level during demolition may exceed the project criteria, however due to low level of exceedance a practical approach of reviewing the noise ingress as a result of construction noise is recommended. If the noise ingress is found to be a problem, acoustic blankets could then be provided.

Appendix A Glossary of Acoustic Terminology

Sound

This is a description of the physical phenomena of the transmission of energy through gaseous or liquid media via rapid fluctuations in pressure.

Noise

Unwanted sound.

Frequency (Hz)

The number of cycles per second (i.e., the number of vibrations that occur in one second); subjectively this is perceived as pitch.

Frequency Spectrum

The relative frequency contributions that make up a noise.

”A” Weighting (dB(A))

The human ear does not respond uniformly across the audible frequency range. The “A” weighting is commonly used to simulate the frequency response of the ear.

Decibel (dB)

The decibel is a logarithmic ratio of two values of a variable. The range of audible sound pressures is approximately 2 x 10^{-5} Pa to 200 Pa. Using decibel notation presents this range in a more manageable form, 0 dB to 140 dB.

Sound Pressure Level (SPL, L_p)

This is the basic measure of how much sound there is at a given location. It is a measure of the size of the pressure fluctuations in the air that we perceive as sound.

Equal to 20 times the logarithm to the base 10 of the ratio of the root mean squared (RMS) sound pressure to the reference sound pressure. In air the reference sound pressure is 2 x 10^{-5}Pa.

Mathematically: Sound Pressure Level (dB) =20 log10 {p(t) / P0} Where P0 = 2 x 10^{-5} Pa

Sound Power Level (SWL, L_w)

This is the total amount of sound produced by a source. It cannot be measured directly but it can be calculated from Sound Pressure Level measurements in known conditions. It can be used to predict the Sound Pressure Level at any point.

Equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power. In air the reference sound power is 1 x 10^{-12} Pa.

Mathematically: Sound Power Level (dB) = 10 log10 {W / W0} Where W0 = 1 x 10-12 Pa

$L_{eq,T}$

The equivalent continuous sound level. It is the steady sound level which would produce the same energy over a given time period T as a specified time varying sound.

Ambient Noise Level, $L_{Aeq,T}$

The equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time that is usually composed of sound from many sources near and far.

Background Noise Level $L_{A90,T}$

The A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90% of a given time interval, T, measured using the fast time weighting, F, and quoted to the nearest whole number.

Maximum Noise Level, L_{max}

The (A-weighted) maximum instantaneous sound pressure level (L_{Amax}).

Reference Time Interval, Tr

The specified interval over which an equivalent continuous A-weighted sound pressure level is determined.

Specific Noise Level, $L_{Aeq,Tr}$

The equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval.

Weighted Sound Reduction Index R_w

Single number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies.

Percentiles

To describe the time-varying character of environmental noise, statistical noise descriptors were developed:

L_{A10} is the A-weighted sound level equalled or exceeded during only 10% of the measurement time. The L_{A10} provides a good measure of the maximum sound levels caused by intermittent or intrusive noise.

L_{A50} is the A-weighted sound level that is equalled or exceeded 50% of the measurement time period; it represents the median sound level.

L_{A90} is the A-weighted sound level equalled or exceeded 90% of the time. Since this represents 'most' of the time, L_{A90} generally has been adopted as a good measure of the ambient baseline noise of the measurement site. Therefore, the baseline noise is defined as L_{A90} of the overall background noise.

Between the quietest audible sound and the loudest tolerable sound, there is a ten million to one ratio in sound pressure (measured in pascals, Pa). Because of this wide range, a noise level scale based on logarithms is used in noise measurement called the decibel (dB) scale. Audibility of sound covers a range of approximately 0 to 140 dB.

Sound Pressure Level in dB L_A for Common Situations

Typical Noise Level, dB L_A	Example
0	Threshold of hearing
30	Rural area at night, still air
40	Public library Refrigerator humming at 2 m
50	Quiet office, no machinery Boiling kettle at 0.5 m
60	Normal conversation
70	Telephone ringing at 2 m Vacuum cleaner at 3 m
80	General factory noise level
90	Heavy goods vehicle from pavement Powered lawnmower, operator's ear
100	Pneumatic drill at 5 m
120	Discotheque – 1 m in front of loudspeaker
140	Threshold of pain

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