CHAPTER 16: NOISE AND VIBRATION

Introduction

16.1 This chapter assesses the noise and vibration impacts that could arise as a result of the proposed development. Consideration is given to potential noise and vibration impacts during both the construction and operational phases of the development. Consideration is given to the suitability of the prevailing noise environment for the proposed development, and the impacts that the scheme could have on existing local noise and vibration sensitive receptors.

16.2 In particular, this chapter considers:

- the suitability of the prevailing local noise environment for noise-sensitive aspects of the proposed development i.e. proposed residential development, holiday accommodation, and potential prior use of holiday accommodation as nuclear construction workers accommodation.
- the potential construction noise and vibration impacts that could arise on existing nearby receptors;
- the potential noise impacts that could arise at local receptors as a result of development generated road traffic movements;
- the potential impact that could arise at existing and proposed noise sensitive receptors as a result noise from any fixed plant associated with the proposed development.

16.3 The chapter describes the methods used in the assessment of potential impacts, the baseline conditions currently existing at the site and surrounding area, the potential impacts of the development arising from construction and operation, the mitigation measures required to prevent, reduce, or offset the impacts and, as well as the resulting residual impacts. This chapter has been written by WSP Acoustics.

16.4 This chapter is necessarily technical in nature so to assist the reader a glossary of noise and vibration is provided in **Appendix 16.1**.

Planning Policy Context

National Planning Policy

Technical Advice Note (Wales) 11: Noise

16.5 Technical Advice Note (TAN) 11, published in October 1997, sets out the Government's policies on noise related planning issues. It gives guidance to local authorities in Wales on the use of their planning powers to minimise the adverse impact of noise. Specifically, it:

- outlines the considerations to be taken into account when determining planning applications for both noise-sensitive developments and for those activities which will generate noise;
- sets out Noise Exposure Categories (NECs) for residential development, encourages their use and recommends appropriate levels for exposure to different sources of noise; and
- advises on the use of planning conditions to minimise the impact of noise.

16.6 For proposed residential development sites, such as the Kingsland site, where the noise environment is dominated by transportation noise or subject to 'mixed sources', TAN 11 requires application of the Noise Exposures Categories which are also defined within this document.

16.7 The four Noise Exposure Category (NEC) bands set out in TAN 11 are designed to assist local planning authorities in evaluating applications for residential development in noisy areas. Table 16.1 summarises the planning guidance for each NEC band. Table 16.2 sets out the 'open site' noise levels relating to each NEC band for road traffic and mixed sources noise.

Table 16.1: Planning Advice for each Noise Exposure Category

NEC	Planning Advice
A	Noise need not be considered as a determining factor in granting planning permission, although noise at the high end of the category should not be regarded as a desirable level.
B	Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection.
C	Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	Planning permission should normally be refused.

Table 16.2: Noise Levels Corresponding to the NECs for New Dwellings $L_{Aeq,T}$ dB

NEC	Road Traffic and Mixed Sources Noise	
	Day 07:00-23:00	Night 23:00-07:00
A	<55	<45
B	55-63	45-57
C	63-72	57-66
D	>72	>66

16.8 In addition to the above, TAN 11 also states that during the night, (2300-0700 hours):

> "*Sites where individual noise events regularly exceed 82 dB LAmax (slow) several times in any hour should be treated as being in NEC C, regardless of the LAeq (8 hour) (except where the LAeq (8 hour) already puts the site into NEC D).*"

16.9 TAN 11 allows a degree of local authority discretion in the application of the above criteria, up to 3 dB(A) either way. However, for this report the stated values have been taken as the assessment criteria.

16.10 Where industrial noise is identified to be dominant, it is appropriate to follow the guidance contained within Annex B of TAN 11, in the section entitled *Noise from Industrial and Commercial Developments*. This section is primarily associated with the impact of 'new' industrial development and states that BS 4142 should be used to determine the likelihood of complaints when assessing "*the noise from the **new** development*", and stating that this standard can be used when "*stipulating the level of noise that **can be permitted***" i.e. from the new development.

16.11 Furthermore, this paragraph goes on to state that "*In addition, general guidance on acceptable noise levels within buildings can be found in BS 8233*". The guidance found within this document is therefore that which should be applied

when 'existing' industrial/commercial noise is dominant and has the potential to impact upon 'proposed' residential development.

16.12 The NECs are explicitly stated to be for use in the assessment of sites proposed for residential development only. In the section entitled 'other noise-sensitive development' (i.e. other than permanent residential accommodation, such as leisure holiday accommodation, as proposed at the Cae Glas and Penrhos sites), the following is stated:

> "*Although developments such as offices, hospitals and schools will contain buildings and activities that are noise-sensitive, such developments are likely to occupy sizeable sites and contain a proportion of buildings and activities which are less noise-sensitive. The NEC principle cannot therefore be applied sensibly to such developments and it will be more appropriate to refer to specific guidance on internal noise standards in respect of each activity. General information can be found in BS 8233: 1987"*

16.13 Accordingly, for sites such as Cae Glas, and Penrhos, which are sizable, and for which a leisure-led development is proposed, it is appropriate to consider the suitability of the prevailing noise environment with respect to relevant noise assessment criteria adopted from BS8233:1999 (which superseded the 1987 version).

16.14 For proposed aspects of the development which have the potential to generate industrial / commercial noise, such as that which could be generated by fixed plant items, it is appropriate that noise level criteria are determined in accordance with the requirements of BS4142:1997.

16.15 Summaries of both BS 8233 and BS 4142 can be found in the legislation and guidance sections below.

Local Planning Policy

16.16 The Isle of Anglesey County Council (IOACC) has confirmed that the Local Planning Policy comprises the three key documents detailed below, along with a range of Supplementary Planning Guidance's.

Development Plan

16.17 The Development Plan comprises the adopted *Gwynedd Replacement Structure Plan* (1993) and the adopted *Isle of Anglesey Local Plan* (1996).

16.18 The *Gwynedd Replacement Structure Plan* is stated to provide strategic guidance for development on Anglesey for the period 1991 to 2006 and presents a series of Policies. The following policy is that which is specific to noise and vibration:

> *PolicyD20: There will be a presumption against development which will…*[a number of points including]*…introduce major noise or vibration nuisance levels*

16.19 The *IOACC Local Plan* is stated to interpret policies in the *Gwynedd Structure Plan* (1993) in more detail and also includes a Proposals Map. In Section 3, entitled '*Jobs'*, consideration is given to '*Bad Neighbour Uses*' and specific reference is made to noise. However bad neighbour uses are referenced as, for example, "*builder's yards, waste processing, and open storage*" and therefore to not apply to this development.

16.20 Although not directly related to the Penrhos proposals, noise is also referenced under the section entitled *Hot Food Take-Aways, to which Policy 21 applies. This policy is detailed below:*

> *Policy 21. The Council will allow proposals for hot food takeaway where it is satisfied that the development would not cause unacceptable harm to the character and amenities of the area. In assessing proposals for hot food takeaways, the Council will have particular regard to....*[a number of points including]*….The likely levels of noise, disturbance, smell and litter which will be generated.*

Stopped Unitary Development Plan (UDP) (December 2005)

16.21 Although this document is not adopted, IOACC has advised that due to the advanced stage reached in its preparation, it is afforded weight as a material consideration in dealing with current planning applications.

16.22 The stopped UDP comprises two parts, the first of which sets out the authorities strategic and general polices, and a second part containing more detailed policies and proposals, including Proposals Maps.

16.23 Chapter 12 of the Stopped UDP is pertinent to transport and references noise stating that:

> "*At the technical level, proposals will be expected to take into account Local Agenda 21 principles. As such, proposals will be expected to promote the use of secondary or recycled aggregate material in construction where this is technically feasible. Provision should also be made for the beneficial reuse of waste materials such as road planings. Considerations should also be given during design to wider impacts on, for example, safety, noise, air quality and other forms of pollution."*

16.24 Chapter 17 of the stopped UDP which is pertinent to infrastructure and implementation issues, includes a section specific to noise. This section is duplicated below:

> "*NOISE*
>
> *Planning guidance requires the Council to minimise the adverse impacts of noise and this can clearly be in the best interest of the local community. Ynys Môn has a number of operations, including an RAF base where noise is an important planning matter.*
>
> *In terms of British Standards, the current standards applicable to the control of noise from fixed industrial sources is BS4142, whilst BS5228 is applicable to controlling noise from construction and open sites. Noise is a constraint on residential development in some areas adjoining Valley and Mona Airfields as indicated on the proposals map. The 1992 Town and Country Planning Aerodomes and Aeronautical Technical Site Direction identifies zones of consultation in respect to new development that need to be taken into consideration. TAN (Wales) 11 on Noise provides appropriate guidance on the acceptability of development in such areas.*
>
> *Infrastructure Policy SG7 – Noise: SG7. Development will not be permitted;*

i) within the Noise Constraint Area defined on the Proposal Maps where the development would be subject to an unacceptable exposure to noise; and/or
ii) when the level of noise generated by the development does not satisfy the relevant current standards, and would be detrimental to the amenity of adjacent users.

Reasoned Justification

The Council will have regard to defined Noise Exposure Categories when making decisions on residential applications. It should be noted that the information shown on the proposals map is mapped at 1:50,000 scale and is indicative on the inset proposal maps and may be subject to amendment by the Ministry of Defence. The general perception is that noise is an increasing form of pollution in the human environment. The Unitary Development Plan should seek to address this by minimising the potential problems through the development and adoption of relevant policies to ensure the separation of potentially noisy development and noise-sensitive development. Noise-sensitive development will include housing and schools and may also include development that requires a high-quality environment such as some business and high-technology users.

Where difficulties are experienced in separating noise-sensitive from noise-generating developments, proposals should contain mitigating measures to minimise any detrimental impact. To this end, suitable planning conditions and obligations will be utilised by the Council to ensure that such mitigation is carried out where practicable. In the event that mitigation measures are considered unable to overcome potentially unacceptable noise problems, planning permission will not normally be granted.

Other statutory controls exist to deal with specific noise nuisance. The Building Regulations specify and impose standards for sound insulation in dwellings and, at times, the Council as Local Planning Authority may ask for enhanced sound insulation measures. This would be appropriate, for example, in the conversion of buildings to flats and multiple occupation."

16.25 The noise constraint area detailed within the Proposals Maps is duplicated in **Figure 16.1**.

16.26 Other references to noise and/or vibration are made within the stopped UDP regarding commercial use of RAF Valley Airport, mineral extraction sites and waste management facilities, but these are of little relevance to the proposed development.

Interim Planning Policy Large Sites (2011)

16.27 This document does not make specific reference to noise or vibration.

Supplementary Planning Guidance

16.28 The supplementary planning guidance on Holiday Accommodation confirms that consideration should be given to noise (amongst a series of other factors) in the development proposals for holiday accommodation.

Legislation and Guidance

BS 8233: 1999: Sound Insulation and Noise Reduction for Buildings - Code of Practice

16.29 The scope of this Standard is the provision of recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new buildings, or refurbished buildings undergoing a change of use, rather than to assess the effect of changes in the external noise climate.

16.30 The standard suggests suitable internal noise levels within different types of buildings, including residential dwellings. It suggests that an internal noise level of 30 dB $L_{Aeq,T}$ within bedrooms is a '*good*' standard, whilst 35 dB $L_{Aeq,T}$ is a '*reasonable*' standard. For living areas in the daytime, the standard recommends 30 dB $L_{Aeq,T}$ as a '*good*' standard and 40 dB $L_{Aeq,T}$ as being a '*reasonable*' standard. BS8233 also states that individual noise events should not normally exceed 45 dB L_{AFmax} in bedrooms at night.

16.31 With regards to external noise levels, BS8233 states:

> "*it is desirable that the steady state noise level does not exceed 50 dB $L_{Aeq,T}$ and 55 dB $L_{Aeq,T}$ should be regarded as the upper limit.*"

World Health Organisation: Guidelines for Community Noise

16.32 As with the '*good*' and '*reasonable*' criteria in BS8233, the L_{AFmax} criterion is largely concordant with the World Health Organisation (WHO) guidance: 1999: Guidelines for Community Noise, which states:

> "*For good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{AFmax} more than 10-15 times per night*"

BS 4142: 1997: Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas.

16.33 BS 4142 sets out a method to assess whether noise from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises are likely to give rise to complaints from noise-sensitive receptors in the vicinity.

16.34 The procedure contained in BS 4142 for assessing the likelihood of complaint is to compare the measured or predicted noise level from the source in question, known as the $L_{Aeq,T}$ specific noise level, immediately outside the dwelling, with the $L_{A90,T}$ background noise level that exists in the absence of the source in question.

16.35 Where the noise contains a "*distinguishable discrete continuous note (whine, hiss, screech, hum etc.)*" or if there are "*distinct impulses in the noise (bangs, clicks, clatters or thumps)*", or if the noise is "*irregular enough to attract attention*" then a correction of +5 dB is added to the specific noise level to obtain the $L_{Ar,T}$ rating level.

16.36 The likelihood of the noise giving rise to complaints is assessed by subtracting the background noise level from the rating noise level. BS 4142 states:

"*A difference of around 10 dB or higher indicates that complaints are likely. A difference of around 5 dB is of marginal significance. A difference of –10 dB is a positive indication that complaints are unlikely.*"

16.37 This document states that it is not suitable for use where the background noise level and rating noise level are "*very low*". This is because the likelihood of complaint under such circumstances is lessened due to the level itself being low. The standard goes on to state that for the purpose of this BS, rating levels below 35 dB $L_{Ar,t}$ and background noise levels below 30 dB(A) $L_{A90,T}$ are considered to be "*very low*".

Guidelines for Environmental Noise Impact Assessment

16.38 Whilst this document, produced by the Institute of Acoustics / Institute of Environmental Management and Assessment working party, is still draft at this stage, the guidance it contains is of assistance in establishing environmental noise impacts. The Working Party provides an example of how changes in noise level can be categorised by significance. Table 16.3 below contains this example along with an indication of the likely subjective response relating to such changes.

Table 16.3: Impact Scale for Comparison of Future Noise Against Existing Noise

Change in Noise Level dB(A)	Subjective Response	Significance
0	No change	No impact
0.1-2.9	Barely perceptible	Slight impact
3.0-4.9	Noticeable	Moderate impact
5.0-9.9	Up to a doubling or halving in loudness	Substantial impact
10.0 or more	More than a doubling or halving in loudness	Severe impact

16.39 The draft guidelines state that the significance ranges provided within the above table are an example of how basic noise changes may be categorised and that in any assessment the noise level threshold and significance statement should be determined by the assessor, based upon the specific evidence and likely subjective response to the noise.

16.40 The criteria above reflect key benchmarks that relate to human perception of sound. A change of 3 dB is generally considered to be the smallest change in noise that is perceptible and a 10 dB change in noise represents a doubling or halving of the noise level. The difference between the minimum perceptible change and the doubling or halving of the noise level is split to provide greater definition to the rating of noise level changes.

The Design Manual for Roads and Bridges (DMRB): Volume 11: Environmental Assessment

16.41 Section 3 Part 7 is that which is pertinent to noise and vibration. This document was published by the Department of Transport in 1993 with subsequent amendments, the latest of which is dated November 2011. This document sets out procedures for undertaking the environmental assessment of new road schemes, including the assessment of noise impacts from road traffic. In particular, Section 3 Part 7 describes a method for assessing the severity of a noise impact in terms of the number of people who will be bothered from any noise increase due to a new road scheme. In undertaking a DMRB assessment, the calculation of traffic noise levels uses the methodology contained within the *Calculation of Road Traffic Noise* (CRTN) document as described below.

16.42 Although the DMRB strictly applies to new road schemes, the principles of the approach contained within the document can also be applied to the assessment of noise from road traffic in general. The proposed development has the potential to affect road traffic noise levels along existing roads, hence the need for this assessment.

16.43 The DMRB assessment suggests that the magnitude of noise changes from a project should be classified into levels of impact. The November 2011 amendment to Section 3 Part 7 gives detailed consideration to how impact magnitude will be affected by a noise level change over the short term (e.g. as a result of a sudden opening of a scheme), or over the long term (e.g. gradually over time, such as that associated with natural traffic growth, or the gradual occupation of a proposed development over a number of years).

16.44 The two example classification scales are duplicated in Tables 16.4 (short term) and Table 16.5 (long term) below.

Table 16.4: Classification of Magnitude of Noise Impacts in the Short Term

Noise Change, $L_{A10, 18hour}$ dB	**Magnitude of Impact**
0	No Change
0.1 to 0.9	Negligible
1.0 to 2.9	Minor
3.0 to 4.9	Moderate
5.0+	Major

Table 16.5: Classification of Magnitude of Noise Impacts in the Long Term

Noise Change, $L_{A10, 18hour}$ dB	**Magnitude of Impact**
0	No Change
0.1 to 2.9	Negligible
3.0 to 4.9	Minor
5.0 to 9.9	Moderate
10.0+	Major

16.45 The above scales apply to the impact magnitude, not the impact significance. The impact significance will depend upon both the impact magnitude and the sensitivity of the receiving environment.

Calculation of Road Traffic Noise (CRTN)

16.46 Published by the Department of Transport and the Welsh Office in 1988, this document sets out standard procedures for calculating noise levels from road traffic. The calculation methods use a number of input variables, including traffic flow volume, average vehicle speed, percentage of heavy goods vehicles, type of road surface, site geometry and the presence of noise barriers or acoustically absorbent ground. CRTN predicts the $L_{A10,18hour}$ or $L_{A10,1hour}$ noise level for any receptor point at a given distance from the road.

BS 5228: Noise and Vibration Control on Construction and Open Sites - Part 1: Noise: 2009

16.47 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.

16.48 The noise prediction method can be used to establish likely noise levels in terms of the $L_{Aeq,T}$ over the core working day.

16.49 This Standard also includes a database of information, comprising previously measured noise levels for a variety of different construction plant undertaking various common activities.

16.50 Example criteria are presented for the assessment of the significance of noise effects. Such criteria may be concerned with fixed noise limits and/or 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. The presented limits are:

- 70 dB(A) in rural, suburban and urban areas away from main road traffic and industrial noise; and
- 75 dB(A) in urban areas near main roads and heavy industrial areas.

16.51 For the purpose of this assessment, which is located in a primarily rural area, an assessment criterion of 70 dB(A) has been adopted for construction noise.

BS 5228: Noise and Vibration Control on Construction and Open Sites - Part 2: Vibration: 2009

16.52 This standard provides recommendations for basic methods of vibration control relating to construction and open sites. The legislative background to vibration control is described and guidance is provided concerning methods of measuring vibration and assessing its effects on the environment.

16.53 Guidance criteria are suggested for the assessment of the significance of vibration effects, such criteria are provided in terms of Peak Particle Velocities (PPV) and are concerned with both human and structural responses to vibration. Those applicable to human perception and disturbance are presented within Table 16.6 below.

Table 16.6: Guidance on Effects of Vibration Levels Based on Human Perception

Vibration Level (PPV)	Effect
0.14 mm s^{-1}	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm s^{-1}	Vibration might be just perceptible in residential environments.
1.0 mm s^{-1}	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mm s^{-1}	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

16.54 The standard goes on to present guidance criteria applicable to the vibration response limits of buildings, again in terms of the component PPV. These are presented within Table 16.7 below.

Table 16.7: Transient Vibration Guide Values for Cosmetic Damage

Type of building	Peak Component Particle Velocity in Frequency Range of Predominant pulse	
	4 Hz to 15 Hz	4 Hz to 15 Hz
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	50 mm/s at 4Hz and above
Unreinforced or light framed structures Residential or light commercial buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
NOTE 1: Values referred to are at the base of the building. NOTE 2: At frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.		

16.55 It should be noted that the values presented within Table 16.7 are applicable to cosmetic damage only. It is stated within BS 5228-2 that minor damage is possible at vibration magnitudes which are greater than twice those given in the table. It can be seen that the guide values for building damage are an order of magnitude higher than for human disturbance.

Approach

Assessment Methodology

16.56 At the outset of the project, the Environmental Health Department of the IOACC was consulted to discuss the scope of the assessment, the assessment methodology, and the extent and approach to the baseline noise survey.

16.57 The results of this consultation were used to inform the adopted assessment methodology, which is detailed below.

- The properties and locations that could potentially be affected by noise during the construction and operational phases of the development have been identified by means of a desk review, supported with the results of a site walkover;
- A series of detailed baseline noise surveys have been undertaken. These surveys have been undertaken to determine the prevailing background noise levels at a sample number
- of locations considered representative of both existing noise-sensitive receptors and those proposed as part of the development. In addition, daytime and night-time noise measurements have been undertaken of key local sources (including local road traffic routes, existing local industrial / commercial and fixed plant sources, and noise from a match day event at the Holyhead Hotspur sports stadium;
- Drawing on the results of the detailed baseline noise surveys, a detailed noise model has been prepared for the development sites. This noise model has been used to determine the noise environment across the development sites during both daytime and night-time periods;
- The noise model has been used to determine the TAN 11 NECs across the proposed residential development site at Kingsland;
- The noise model has also been used to determine the degree of sound attenuation that will be required to ensure compliance with appropriate internal and external noise level criteria adopted from BS8233:1999. This

assessment has been undertaken for both the proposed residential accommodation at Kingsland, and the proposed holiday accommodation at the Cae Glas and Penrhos sites;

- Predictions have been undertaken in accordance with the methodology presented in BS 5228, to establish construction noise levels that would typically be generated at a representative sample of local sensitive receptors. Predicted construction noise levels have been compared with applicable assessment criteria adopted from BS 5228-1:2009;
- An assessment of groundborne vibration associated with typical on-site site preparation/construction activities has been undertaken drawing upon the guidance presented within BS 5228-2:2009. Predictions have been conducted in order to determine a series of setback distances at which different impact magnitudes would arise for a sample of typical construction activities. Such predictions have been performed based upon empirical prediction methods detailed in the Transport Research Laboratory's TRL report 429 entitled *Groundborne vibration caused by mechanical construction works*, the TRRL Report 246 entitled *Traffic induces vibrations in buildings,* and BS 5228-2:2009;
- Construction vibration impacts at a representative sample of local receptors have been determined by comparing receptor setback distances from anticipated works areas, against the derived setback distances at which different degrees of impact magnitude may arise (see bullet point above);
- Consideration has been given to the best practicable means for the control of noise and vibration from construction operations;
- The changes in road traffic noise levels along the local road network have been predicted in accordance with the *Calculation of road traffic noise* memorandum;
- The impacts of such noise level changes have been assessed according to the principles of the *Design manual for roads and bridges;*
- Drawing upon the results of the baseline noise survey, a series of noise level limits have been determined for noise from any proposed fixed plant which may be incorporated into the development. It has been demonstrated how such limits could be incorporated into a conditional planning approval to ensure a commensurate level of protection against noise for both proposed and existing local noise-sensitive receptors;
- Where determined necessary, consideration has been given to available mitigation measures; and
- Residual impacts have been determined and assessed in accordance with the significance matrix detailed below.

Significance Criteria

16.58 The significance of noise and vibration impacts has been determined by consideration to both the sensitivity of the receiving receptor and the impact magnitude. To reflect the different guidance applicable to different impact areas (e.g. BS 5228-1:2009 for construction noise and the DMRB for development generated road traffic noise), impact magnitude has been determined based on a dedicated scale for each assessed impact area.

Receptor Sensitivity

16.59 Table 16.8 below presents the criteria used to determine the sensitivity of receptors.

Table 16.8: Criteria Used to Define the Sensitivity of Receptors

Sensitivity	Example Receptors
High	Permanent residential dwellings Auditoria/studios Schools in the daytime Hospitals/residential care homes
Medium	Holiday and temporary accommodation Conference facilities
Low	Offices Restaurants
Slight	Factories Commercial installations Storage centres Industrial sites

Impact Magnitude – Existing Noise Environment on Proposed Noise-Sensitive Development

16.60 Impact magnitude has been determined with respect to the guidance contained with BS 8233, as referenced for use within TAN 11. Where it is identified that the development can be designed such that applicable assessment criteria obtained from BS 8233 can be achieved, the impact magnitude is categorised as being Slight. Where such criteria cannot be achieved, the impact magnitude is categorised as Low, Medium or High depending upon the degree of exceedance.

Impact Magnitude – Construction Noise

16.61 A façade noise level criterion of 70 dB $L_{Aeq,T}$ has been adopted for this assessment, based on the guidance contained within BS 5228 which specifies this limit as applicable to rural areas. Accordingly, predicted construction noise levels above this criterion are categorised as Medium or High, whilst levels below this criteria are specified as being Low or Slight. BS 5228 also presents a 5 dB higher criteria (75 dB $L_{Aeq,T}$) for urban areas. Accordingly, impact magnitudes have been determined adopting 5 dB noise level bands. The adopted impact magnitude scale for construction noise is presented in Table 16.9 below.

Table 16.9: Impact Magnitude Scale for Construction Noise

Construction Noise Level ($L_{Aeq,T}$) Façade	Impact Magnitude
≥75.1	High
70.1 to 75.0	Medium
65.1 to 70	Low
≤65.0	Slight

Impact Magnitude – Construction Vibration

16.62 For construction vibration, the impact magnitude has been determined according to the resulting vibration levels in absolute terms. The impact magnitude criteria for construction vibration is presented in Table 16.10 below, based on the guidance contained within BS5228 for human perception.

Table 16.10: Impact Magnitude Scale for Construction Vibration - Human Perception - Absolute Levels

Vibration Level	Effect	Impact Magnitude
<0.3 mm s^{-1}	Unlikely to be perceptible in residential environments	Slight
0.3>1.0 mm s^{-1}	Onset of perceptibility in residential environments.	Low
1.0>10.0 mm s^{-1}	Onset of complaints in residential environments	Medium
>10.0 mm s^{-1}	Vibration is likely to be intolerable for any more than a very brief exposure to this level.	High

Impact Magnitude - Development Generated Road Traffic Noise

16.63 In the case of this development, changes in road traffic noise levels due to development traffic would be gradual over many years, in line with the proposed phased opening of the development. Accordingly, impact magnitude has been determined drawing on the long-term impact guidance contained within the *Design Manual for Roads and Bridges*. Table 16.11 below presents the criteria used to determine the impact magnitude for road traffic noise level changes.

Table 16.11 Impact Magnitude Scale for Road Traffic Noise Level Changes

Noise Level Change, (dB(A))	Impact Magnitude
0	None
0.1-2.9	Slight
3-4.9	Low
5-9.9	Medium
10+	High

Impact Magnitude – Proposed Fixed Plant

16.64 For noise from any proposed fixed plant, the associated impact magnitude has been determined based on the guidance contained within BS 4142:1997, i.e. by consideration of the difference between the rating noise level from the source and the prevailing background noise levels. Table 16.12 presents the adopted impact magnitude scale.

Table 16.12: Impact Magnitude Scale for Proposed Fixed Plant

Difference Between Rating Level ($L_{A,r}$) and Background Noise Level (L_{A90})	Effect	Impact Magnitude
≥ +10	Positive indication that complaints are likely	High
+5 to +10	Marginal Significance	Medium
-10 to +5	Positive indication that complaints are unlikely	Low
≤ -10		Slight
Where the rating level is below 35 dB ($L_{A,r}$) the impact magnitude is classified as Slight regardless of the relationship to the background noise level. + indicates rating level above background noise level - indicates rating level below background noise level		

Impact Significance Matrix

16.65 The impact significance has been determined by assessment of the determined impact magnitude and the sensitivity of receptor, in accordance with the Impact Matrix presented in Table 16.13 below.

Table 16.13: Matrix for Determining the Impact Significance (Impact Magnitude Versus Sensitivity of Receptor)

Impact Magnitude	Sensitivity of Receptor			
	High	**Medium**	**Low**	**Slight**
High	Major	Moderate	Minor	Negligible
Medium	Moderate	Minor	Negligible	None
Low	Minor	Negligible	None	None
Slight	Negligible	None	None	None
None	None	None	None	None

Assumptions / Limitations

16.66 The precise construction methodologies and required plant numbers etc. would be confirmed following further studies, and would be dependent upon the successful construction contractor. It is not uncommon for such details to be unconfirmed for an outline application such as this. Accordingly, the completed construction noise and vibration assessments have been undertaken based on assumed construction operations, drawing upon the content of Chapter 6. Notwithstanding this, the use of a Construction Environmental Management Plan (CEMP) is proposed in Chapter 6, and this could include a requirement to revise the noise and vibration predictions to reflect the finalised construction method statement etc.

16.67 The assessment of potential noise impact from development generated road traffic has been undertaken drawing upon the results of the completed transportation assessment, and more specifically, the scheme traffic data. Typically, a noise assessment will include consideration to a +15 design year. In the case of this development, the opening of the scheme would be phases, with 100% completion of all development aspects by 2022, meaning a +15 design year of 2037. However, it has been agreed that the Transportation Assessment adopt NTM modified TEMPRO growth factors, which are only available up to 2035. Accordingly, the design year for the noise assessment has been taken at +13 year after completion, i.e. 2035.

16.68 The scheme traffic data also include data for the year 2017, which is based on 100% completion of the Penrhos development, and full occupation of the Cae Glas development by nuclear construction workers. This is now proposed for 2018, with circa 80% of Penrhos development completed in 2017. Nonetheless, the scheme traffic data have remained unchanged, as assuming 100% completion of the Penrhos development represents a worst case.

Baseline Conditions

Noise Sensitive Receptors

16.69 Local noise and vibration sensitive receptors in the vicinity of the site have been identified by means of a desk based review of available mapping for the site, supplemented by observations made during the baseline noise surveys. Noise and vibration sensitive receptors in the vicinity of the sites were identified to include:

Kingsland site

- Dwellings on Mill Road to the north, including Bryniau-Geirwon towards its western end;
- Dwellings on Kingsland Road to the north-east, including numbers 1&2, Cweryd Cottages, Killowen Cottages, 1&2 Cweryrd Villas and Tyddyn-Pioden;
- Dwellings to the south including The Cottage, and those on Lon Garreg Fawr, as well as a golf club house; and
- Dwellings to the south-west including Overdale, Bryn loan and Tref Lago.

Cae Glas site

- Dwellings on Penrhyn Geirol, Delfryn Bach, Hunters Chase, Kingsland Road, Snowdon View Road, Lon St Ffraid, Trearddur Road and Trearddur Mews to the west;
- Dwellings off Lon Towyn Capel and Bro Iarddur, including Stretton, Pen Craig, Trelawny and New Lodge, to the south-west;
- Dwellings within the central portion of the site, including, Cae-glas, Canoldir and Felin-heli, as well as a caravan park; and
- Tyddynuchaf, a residential dwelling to the north-west.

Penhros site

- Dwellings within the north-western portion of the site including 1&2 Brynglas, Charay, Penrhos Lodge and Valhalla;
- Y Bwythyn, a residential dwelling beyond the north-western site boundary;
- Dwellings within the central portion of the site including Penrhos, The Tower, Homewood, and Gardener's Cottage;
- Beddrnanarch, a dwelling within the eastern boundary of the site; and
- The Toll House beyond the southern site boundary.

16.70 The above receptors are identified on **Figures 16.2a,b&c**.

16.71 The Bathing House is located adjacent to the eastern site boundary, but this would be converted into a restaurant as part of the proposed development. Accordingly this again is not considered noise-sensitive for the purpose of this assessment.

Baseline Noise Surveys

16.72 A series of detailed baseline noise surveys have been undertaken on, and in the vicinity of the site. These surveys were carried out in order to establish the prevailing noise climate arising from local noise sources during both daytime and night-time periods, and to determine the prevailing background noise levels at a sample of locations representative of existing and proposed noise-sensitive receptors.

16.73 The following key nose sources were identified in the vicinity of the site:

- Road traffic noise from the A5, immediately west of the Penrhos site;
- Road traffic noise from the A55, immediately east of the Cae Glas site;
- Road Traffic noise from Kingsland Road immediately to the east of the Kingsland site;
- Noise from operations at the Aluminium Powder Company (Alpoco) works which is positioned between the A5 and A55, south of the former Anglesey Aluminium facility (N.B. the Anglesey Aluminium facility is no longer in operation);
- Noise from fixed plant items at the Holyhead Leisure Centre to the north of the Kingsland site; and

- Noise from match-day events at the Holyhead Hotspur sports stadium to the north of the Kingsland site and west of the Holyhead Leisure centre.

16.74 In addition to the above sources, noise is also generated from rail pass-bys on a railway line immediately east of the A55. However, rail movements on this line are not intensive with the line only serving Holyhead. In addition, the location of this line is such that it is between the A55 and the A5, with road traffic noise being of greater significance. Furthermore, at its closest point to the Penrhos site, the railway line is fully screened by a significant stone wall structure located between the railway line and the A55.

16.75 Other local noise sources included occasional aircraft fly-overs and natural sources such as the sea on the shoreline, vegetation moving in the breeze and bird song etc.

16.76 Three baseline noise surveys have been undertaken, being completed between the following dates / times:

- Survey 1 - 13:00 hours on Monday the 15th August 2011 until 19:00 hours on Thursday the 18th August 2011;
- Survey 2 - 13:30 hours on Bank Holiday Monday the 29th August 2012 until 16:40 the same day; and
- Survey 3 – 17:00 hours on Tuesday the 11th September 2012 until 19:00 hours on the Thursday the 13th September 2012.

16.77 Over the course of Survey 1, a series of approximate 24 hour continuous noise measurements were undertaken at a sample of locations on, and in the vicinity of the development sites. Measurements were undertaken to establish the daytime and night-time levels generated by key local sources, and the background levels at a sample of locations representative of existing and proposed noise-sensitive development.

16.78 Survey 2 was used to establish the noise levels generated at the northern boundary of the Kingsland site during a match day event at the Holyhead Hotspur sports stadium.

16.79 Following completion of Surveys 1 and 2, modifications were made to operations at the Alpoco works facilities, which in-turn gave rise to a change in the noise emission levels from this facility. It was identified by IOACC that the site was in breach the noise condition stated on the site's Environment Permit. This facility was subsequently served with a noise abatement notice. Remedial action was taken by the Alpoco works in response to the abatement notice, seeking to address a tonal noise issue. This included the fitting of a temporary silencer.

16.80 To ensure that this assessment reflects the prevailing noise environment at the time of submission, Survey 3 was undertaken, which included a repeat of five 24 hour noise measurements in closest proximity to the Alpoco works. A series of short term night-time spot measurements were also undertaken to establish the levels generated by the Alpoco works at the critical Environmental Permit location, as well as locations representative of the closest holiday accommodation to the Alpoco works on both the Cae Glas and Penrhos development sites.

16.81 During Survey 1, fixed plant noise was identified to be emitted from the side/rear the Holyhead Leisure centre. Following discussions with the leisure centre manager, it was identified that key plant at this facility was to be replaced. According, measurements of fixed plant noise emissions from this facility were

undertaken during Survey 3, which was completed following commissioning of the replacement plant.

16.82 The measurement locations adopted during the baseline noise surveys are detailed below:

- Measurement Location 1 (Survey 1): Located on the eastern side of the Kingsland site, 9m from the nearside kerb edge of Kingsland Road, and with clear line of sight to this source. This location was subject to a continuous noise measurement of approximately 24 hours in duration and was used to establish the road traffic noise levels generated from Kingsland Road;
- Measurement Location 2 (Surveys 1 and 3): Located on the eastern side of the Cae Glas site, 170m from the nearside kerb edge of the A55 (although the A55 is in-part in cutting and therefore partially obstructed from this measurement location). This location was subject to two continuous measurements each of approximately 24 hours in duration, used to establish the road traffic noise levels generated from the A55 at the location of proposed holiday lodge accommodation;
- Measurement Location 3 (Surveys 1 and 3): Located on the eastern side of the Cae Glas site, 14m from the nearside kerb edge of the A55, with clear line of sight to this source. This location was subject to two continuous noise measurements each of approximately 24 hours in duration and was used to establish the road traffic noise levels generated from the A55;
- Measurement Location 4 (Surveys 1 and 3): Located just beyond the southern boundary of the Penrhos site, 31m from the nearside kerb edge of the A5, with clear line of sight to this source. This location was subject to two continuous noise measurements each of approximately 24 hours in duration and was used to establish the road traffic noise levels generated from the A5. This measurement location was also used to establish the prevailing background noise level at the Toll House (a residential dwelling) which was to the immediate east;
- Measurement Location 5 (Surveys 1 and 3): Located on the western side of the Penrhos site, immediately opposite the site entrance to the Alpoco works, and 5m from the nearside kerb edge of the A5, with clear line of sight to this source. This location was subject to two a continuous noise measurements each of approximately 24 hours in duration and was used to establish the road traffic noise levels generated from the A5, and the noise level generated by operations from the Alpoco works;
- Measurement Location 6 (Survey 1): Located on the south-western edge of the Kingsland site, and used to establish the prevailing background noise levels representative of nearby receptors including Overdale, Bryn loan and Tref Lago (residential dwellings). This location was subject to a continuous noise measurement of approximately 24 hours in duration;
- Measurement Location 7 (Survey 1): Located west of the centre of the Cae Gals site, and used to establish the prevailing background noise levels representative of nearby receptors including dwellings at Trearddur Mews. This location was subject to a continuous noise measurement of approximately 24 hours in duration;
- Measurement Location 8 (Survey 1): Located in the western portion of the Cae Gals site, and used to establish the prevailing background noise levels representative of nearby receptors including Tyddynuchaf (residential dwelling). This location was subject to a continuous noise measurement of approximately 24 hours in duration;
- Measurement Location 9 (Surveys 1&3): Located in the western portion of the enrhos site, and used to establish the prevailing background noise levels representative of nearby receptors including Penrhos Farm, Gardener's Cottage and Homewood (residential dwellings), and the noise levels generated

from the A55 at the location of proposed estate cottages. This location was subject to two continuous noise measurements, one of approximately 8 hours in duration (Survey 1) and one of approximately 24 hours in duration (Survey 3);

- Measurement Location 10 (Survey 1): Located in the eastern portion of the Penrhos site, and used to establish the prevailing background noise levels representative of nearby receptors including the Bathing House (residential dwelling), and the noise levels generated at the proposed holiday lodge accommodation. This location was subject to a continuous noise measurement of approximately 24 hours in duration;
- Measurement Location 11 (Survey 2): Located within the northern boundary of the Kingsland Site, adjacent to the Holyhead Hotspur sports stadium. This measurement location was used to establish the noise levels generated at the site boundary over the course of a football match event. This location was subject to a continuous noise measurement of approximately 3 hours in duration, encompassing the period before, during and after a Bank Holiday weekend first team league football match event;
- Measurement Location 12 (Survey 3): Located on the northern site boundary of the Kingsland Site, at the closest point to the Holyhead Leisure Centre plant room. This location was used to undertake a series of short term attended daytime and night-time noise measurements, to establish the levels generated by fixed plant at the Holyhead Leisure Centre;
- Measurement Location 13 (Survey 3): On a footpath within the Penrhos site. The location at which the critical noise limit condition, as detailed within the Alpoco works Environmental Permit, is stipulated to apply. This location was subject to a fully attended 10 minute night-time measurement;
- Measurement Location 14 (Survey 3): At the location of the closest proposed holiday lodge accommodation, within the Penrhos Site, to the Alpoco Works. This location was subject to a fully attended 10 night-time minute measurement; and
- Measurement Location 15 (Survey 3): At the location of the closest proposed holiday lodge accommodation, within the Cae Glas site, to the Alpoco Works. This location was subject to a fully attended 10 night-time minute measurement.

16.83 The adopted measurement locations are depicted in **Figure 16.3**.

16.84 Measurements at Location 12 were undertaken in consultation with representatives at the Holyhead Leisure Centre to ensure that all key plant items were operating under typical duties during the measurements.

16.85 All measurement locations were subject to free-field conditions, with the microphones mounted between 1.2 and 1.5m above local ground.

16.86 Over the course of Surveys 1 and 2, meteorological conditions remained suitable for environmental noise measurement. Wind conditions ranged from still to a light breeze and there was no precipitation. Similar conditions were experienced for Survey 3, but with wind speeds rising to moderate for limited periods and some rain showers on the first night.

16.87 The environmental noise survey was undertaken using the Type 1 specification noise measurement equipment detailed in Table 16.14 below.

Table 16.14: Noise Measurement Equipment

Equipment Description	Manufacturer & Type No.	Serial No.
Sound Level Meter	01dB-Stell Solo Master	11750
Pre-amplifier	01dB-Stell PRE 21 S	12309
Microphone	Microtech Gefell GmbH MCE212	61802
Sound Level Meter	01dB-METRAVIB Solo Master	60845
Pre-amplifier	01dB-Stell PRE 21 S	13399
Microphone	Microtech Gefell GmbH MCE212	85088
Sound Level Meter	01dB-Stell SIP 95	10566
Pre-amplifier	01dB-Stell PRE 12 N	990762
Microphone	Microtech Gefell GmbH MK250	103416
Sound Level Meter	01dB-METRAVIB Solo Master	60532
Pre-amplifier	01dB-Stell PRE 21 S	13150
Microphone	Microtech Gefell GmbH MCE212	65593
Sound Level Meter	01dB-Stell Solo Master	11810
Pre-amplifier	01dB-Stell PRE 21 S	12495
Microphone	Microtech Gefell GmbH MCE212	67311
Sound Level Meter	01dB-Stell Solo Master	65242
Pre-amplifier	01dB-Stell PRE 21 S	15710
Microphone	Microtech Gefell GmbH MCE212	103463
Hand Held Calibrator	01dB-STELL Cal 21	35293346
Hand Held Calibrator	Brüel & Kjær 4231	2685554
Hand Held Calibrator	01dB-Stell Cal 21	51031216
Hand Held Calibrator	01dB-Stell Cal 21	01120240
Hand Held Calibrator	01dB-METRAVIB Cal 21	50441999
Hand Held Calibrator	01dB-METRAVIB Cal 21	35242306

16.88 Each of the noise meters had been calibrated to traceable standards within the previous 24 months. The hand held calibrators had been calibrated to traceable standards within the previous 12 months.

16.89 The microphone for each measurement location was fitted with a windshield and all sound level meters were calibrated prior to and upon completion of measurements. No significant calibration drifts were found to have occurred.

16.90 A summary of the key noise measurement results are presented in Table 16.15 to 16.19 below.

16.91 Table 16.15 presents a summary of the measured road traffic noise levels for Kingsland Road, the A55 and the A5. Where measurements were undertaken during Surveys 1 and 3, both sets of results have been presented. The highest measured levels for each location have been presented in bold type and have been adopted in the subsequent assessment to represent a worst case.

16.92 Table 16.16 presents a summary of the measured noise levels associated with operations at the Alpoco works, as measured on the Penrhos and Cae Glas sites.

16.93 Table 16.17 presents a summary of the measured noise levels obtained over the course of a first team football match event at the Holyhead Hotspur sports stadium.

16.94 Table 16.18 presents a summary of the measured noise levels associated with operational fixed plant items at the Holyhead Leisure Centre.

16.95 Table 16.19 presents a summary of the measured background noise levels at locations representative of existing and proposed noise-sensitive receptors. Where measurements were undertaken during both Surveys 1 and 3, both sets of results have been presented. The lowest measured background levels for each location have been presented in bold type and have been adopted in the subsequent assessment to represent a worst case.

Table 16.15: Summary of Measured Road Traffic Noise Levels (Surveys 1 and 3) – Free-field, dB(A)

Meas. Location	Survey	Road Traffic Source	Day/Night	Period	Measured Sound Pressure Level dB(A)		
					$L_{Aeq,T}$	L_{ASmax}	L_{AFmax}
1	1	Kingsland Road – 9m	Daytime	15 hours[1]	**58.9**	-	-
			Night-time	8 hours	**47.0**	**72.9**	**74.5**
2	1	A55 – 141m	Daytime	16 hours	57.8	-	-
			Night-time	8 hours	**49.8**	**69**	**70.2**
	2		Daytime	16 hours	**57.9**	-	-
			Night-time	8 hours	46.2	61.7	68.1
3	1	A55 – 14m	Daytime	16 hours	66.1	-	-
			Night-time	8 hours	62.0	78.1[3]	78.1[4]
	2		Daytime	16 hours	**70.3**	-	-
			Night-time	8 hours	**66.7**	**83.7[3]**	**84.7[4]**
4	1	A5 – 31m	Daytime	16 hours	63.2	-	-
			Night-time	8 hours	**57.9**	73.5	**76.1**
	2		Daytime	16 hours	**65.9**	-	-
			Night-time	8 hours	57.6	**75.1**	76
5	1	A5[2] – 5m	Daytime	16 hours	**72.5**	-	-
			Night-time	8 hours	**62.5[2]**	**85.7[3]**	**87.2[4]**
	2		Daytime	16 hours	70.9	-	-
			Night-time	8 hours	59.6[2]	82.6[3]	81.4[4]

[1] Considered representative of full 16 hour period.
[2] Corrected to eliminate contribution from Alpoco Works.
[3] 3rd highest L_{ASmax} in any 1 hour night-time period, in accordance with TAN 11.
[4] 10th highest L_{AFmax} used during whole night-time measurement period, in accordance with WHO guidance.

Table 16.16: Summary of Measured Noise Levels from Alpoco Works (September 2012 – Survey 3), Free-field dB(A)

Measurement Location	Measurement Time[1]	Period	Measured Sound Pressure Level[2]
			$L_{Aeq,T}$
5	Night-time	23:00 to 07:00	60.5
13	Late Evening	22:44 to 22:55	57.9
14	Night-time	23:12 to 23:22	51.0
15	Night-time	23:43 to 23:54	48.8

[1] Relates to time of measurement, N.B. levels generated are continuous 24hours/day.
[2] N.B contributions from other sources (e.g. local car pass-bys) have been omitted in the determination of measured levels.

Table 16.17: Summary of Measured Noise Levels from Match Event at Holyhead Hotspur Ground (Survey 2), Free-field, dB(A)

Measurement Location	Measurement Time	Description	Measurement Period (hh:mm:ss)	Measured Sound Pressure Level $L_{Aeq,T}$
11	Bank Holiday Afternoon	Full Match event from 15 minutes before Kick-off, until 15 minutes after final whistle	02:15:00	50.1

Table 16.18: Summary of Measured Noise Levels from Holyhead Leisure Centre Fixed Plant (Survey 3)

Measurement Location	Measurement Time	Period	Measured Sound Pressure Level[1] $L_{Aeq,T}$
12	Evening	20:59 to 21:29	37.4
	Night-time	00:05 to 00:10	41.2
	Morning	07:30 to 08:00	40.2
	Afternoon	16:26 to 16:36	41.0

[1] N.B contribution from other sources (e.g. local car pass-bys) have been omitted in the determination of the measured levels.

Table 16.19: Summary of Measured Background Noise Levels at Existing and Proposed Noise-Sensitive receptors (Surveys 1 and 2), Free-field dB(A)

Measurement Location	Survey	Daytime/ Night-time	Period	Measured Background Level $L_{A90,T}$
2	1	Daytime	16 hours	45.5
		Night-time	8 hours	46.5
	2	Daytime	16 hours	**44.1**
		Night-time	8 hours	**39.0**
4	1	Daytime	16 hours	**54.1**
		Night-time	8 hours	**44.4**
	2	Daytime	16 hours	54.9
		Night-time	8 hours	52.2
6	1	Daytime	15 hours[1]	**27.6**
		Night-time	8 hours	**26.8**
7	1	Daytime	16 hours	**33.3**
		Night-time	8 hours	**35.3**
8	1	Daytime	13 hours[1]	**33.6**
		Night-time	8 hours	**31.6**
9	1	Daytime	8 hours[1]	**40.7**
		Night-time	20 mins[2]	**32.5**
	2	Daytime	16 hours	49.9
		Night-time	8 hours	39.4
10	1	Daytime	16 hours	41.1
		Night-time	8 hours	40.9

[1] Considered representative of full daytime 16 hour period.
[2] Considered indicative of full night-time 8 hour period

Potential Impacts

Demolition and Construction

Construction Noise

16.96 It is inevitable with any major redevelopment that there will be some disturbance caused to those nearby during site clearance, earthworks and construction works. However, disruption due to such activities is generally localised and is temporary in nature.

16.97 Although there are techniques available to predict the likely effect of noise from site clearance, earthworks and construction works, such as those contained within BS 5228-1:2009, they are necessarily based on detailed information of the type and number of plant being used, their location and the length of time they are in operation. For an outline application such as this, it is common for such details to not yet be confirmed, and to be dependent upon the successful construction contractor, appointed at the subsequent tendering process.

16.98 Notwithstanding this, as detailed within Chapter 6, use of a Construction Environmental Management Plan (CEMP) is proposed. A requirement of the CEMP could be that a further construction noise assessment is undertaken once more details are known regarding the precise construction process.

16.99 Accordingly, for the purpose of this chapter, it has been necessary to make assumptions with respect to the likely site clearance, earthwork and construction activities to be carried out, in order to inform a series of construction noise level predictions. Assumptions have been informed by the content of Chapter 6.

16.100 The completed predictions have been undertaken in accordance with the methodology contained within BS 5228-1:2009, and are in terms of the $L_{Aeq,T}$ over the core working day, which is anticipated to be 0800 to 1800 hours Monday to Friday and 0900 to 1800 on Saturdays, with no working on Sundays or Bank Holidays. Unless prior agreement has been sought and agreed with IOACC it is expected that no construction activities will take place outside these periods. The predictions are worst case in that it is assumed that any mitigation measures (such as those identified later in this chapter) have not been implemented.

16.101 Based on the physical separation of Penrhos, Cae Glas and Kingsland sites, the construction phasing (See Chapter 6), as well as the presence of the A5 and A55 between the Penrhos and Cae Glas sites, it is considered that there is little potential for cumulative noise impacts from concurrent construction works on the different sites. Accordingly, separate construction noise level predictions have been undertaken for each site.

16.102 Drawing upon Chapter 6, few earthworks or demolition works are anticipated, whilst proposed lodges will be prefabricated, being delivered by means of 2 HGV's per lodge. Accordingly, proposed works for each site have been split down into the following 3 phases:

- Phase 1: Access works, road works, utilities and connections;
- Phase 2: Substructure / foundation works; and
- Phase 3: Superstructure works.

16.103 Other works such as those associated with creation of the nature reserve, delivery of the enhanced planting plans, and refurbishment works at Cae Glas development (post nuclear construction workers occupation) are anticipated to have less potential for noise generation than the key phases above.

16.104 Table 16.20 sets out the typical plant type, number and assumed utilisation (percentage 'on-time') used in the prediction of noise levels during each of the three phases above. In accordance with Chapter 6, it is assumed that for each Lodge, a mini auger piled foundation would be created. For the proposed dwellings at Kingsland it is anticipated that standard strip or raft foundations would be used, although a potential for auger piled foundations has been identified. Accordingly, use of a continuous flight auger (CFA) piling rig has been assumed.

Table 16.20: Assumed Construction Plant Details

Site	Phase	Plant Type	Sound Power Level (L_{WA} (dB))	Assumed %age On Time	Assumed No. of plant
Penrhos and Cae Glas	Phase 1: Access, road works, utilities and connections	Asphalt paver and tipper lorry	106	60	1
		Bulldozer	110	50	2
		Tracked excavator	111	50	2
		Dumper truck	100	40	2
		Lorry pulling up	98	10	6
		Lorry unloading	112	10	6
	Phase 2: Substructure works	Mini auger piling rig	104	50	2
		Tracked excavator	111	50	1
		Dumper truck	100	40	2
		Compressor	100	60	2
		Lorry pulling up	98	10	10
		Lorry unloading	112	10	10
	Phase 3: Superstructure works	Hammering	107	20	4
		Dumper truck	100	40	2
		Compressor	100	60	2
		Lorry pulling up	98	10	6
		Lorry unloading	112	10	6
Kingsland	Phase 1: Access, road works, utilities and connections	Asphalt spreader and support plant	106	60	1
		Bulldozer	110	50	1
		Tracked excavator	111	50	1
		Dumper truck	100	40	2
		Lorry pulling up	98	10	2
		Lorry unloading	112	10	2
	Phase 2: Substructure works	Crane mounted auger	107	50	1
		Concrete pump	105	50	1
		Tracked excavator	111	50	2
		Dumper truck	100	40	2
		Compressor	100	60	2
		Lorry pulling up	98	10	4
		Lorry unloading	112	10	4
	Phase 3: Superstructure works	Hammering	107	20	2
		Dump truck	100	40	1
		Compressor	100	60	2
		Lorry pulling up	98	10	4
		Lorry unloading	112	10	4

16.105 Calculations have been undertaken for a representative sample of noise-sensitive receptors in the vicinity of each development site. The receptors adopted in the assessment are detailed below, and are also presented within **Figure 16.4**:

- Location A – Charay, a residential dwelling inside the north-eastern Site boundary (Penrhos site);
- Location B – Homewood, a residential dwelling inside the western site boundary (Penrhos site);
- Location C – Gardener's Cottage, a residential dwelling inside the western site boundary (Penrhos site);
- Location D – Beddmanarch, a residential dwelling inside the eastern site boundary (Penrhos site);
- Location E – Toll House, a residential dwelling inside the south-eastern site boundary (Penrhos site);
- Location F – Tyddunuchaf, a residential dwelling immediately beyond the western site boundary (Cae Glas site);
- Location G – Cae Glas, a residential dwelling inside the south-western site boundary (Cae Glas site);
- Location H – Felin-heli, a residential dwelling inside the south-eastern site boundary (Cae Glas site);
- Location I – No.'s 1&2 Cweryrd Villas, residential dwellings beyond the north-eastern site boundary (Kingsland site);
- Location J – Cymyran, a residential dwelling on Mill Road beyond the northern site boundary (Kingsland site);
- Location K – Bryniau-Geirwon, a residential dwelling beyond the north-western site boundary (Kingsland site); and
- Location L – Overdale, a residential dwelling beyond the south-western site boundary (Kingsland site).

16.106 Predictions have been carried out to determine the potential noise levels resulting from each of the above work phases. For the purpose of this assessment it is assumed that the intervening ground between the construction activities and the receptors will be acoustically hard, which represents a worst case given the rural nature of the local area.

16.107 The worst case and the average case are considered. The worst case considers the construction works at the closest point of the relevant site area to the receptor under consideration. The average case considers the construction works at the approximate mid-point of the site. Where limited parts of the relevant site areas are located at the worst case distances, it is considered unlikely that all plant would be located and operated simultaneously at that close to the receptor. Therefore, in this circumstance, consideration is given to the noisiest plant item operating alone.

16.108 Tables 16.21 and 16.22 set out the range of predicted unmitigated construction noise levels for each phase of the works. Predicted noise levels above the adopted 70 dB $L_{Aeq,T}$ criterion are presented in bold type.

Table 16.21: Predicted Unmitigated Construction Noise Levels (Cae Glas and Penrhos Sites) – Façade $L_{Aeq,T}$ (dB)

Receptor	Activity		
	Phase 1	**Phase 2**	**Phase 3**
A	55-**72**	54-**77**	51-**71**
B	66-**75**	64-**75**	62-69
C	62-69	60-69	58-63
D	56-65	55-63	53-61
E	51-69	50-55	47-53
F	54-66	53-59	51-56
G	60-68	58-64	56-62
H	58-69	57-60	54-58

Table 16.22: Predicted Unmitigated Construction Noise Levels (Kingsland Site) – Façade $L_{Aeq,T}$ (dB)

Receptor	Activity		
	Phase 1	**Phase 2**	**Phase 3**
I	53-70	55-**72**	51-68
J	56-62	57-64	53-60
K	52-57	53-58	49-54
L	56-70	57-71	53-67

16.109 Inspection of the above tables reveals that even without mitigation the adopted assessment criterion is anticipated to be achieved for the vast majority of works. No exceedances of the adopted criteria are predicted to arise for the considered 'average' case, which better reflect the majority of the construction period (although it should be noted that lower levels will be generated for some period, e.g. where works are undertaken at even greater distances).

16.110 Exceedances are only anticipated to occur for works undertaken in close proximity to existing receptors (i.e. the worst case levels). However, the duration of such works would be very short in comparison to the overall construction programme.

16.111 Drawing upon the content of the two tables above, and Tables 16.8 and 16.9, the sensitivity of receptor is High, and the magnitude of impact without mitigation is Slight to Low for the vast majority of the time, occasionally rising to Medium to High. In accordance with Table 16.13, this corresponds to impacts of Negligible to Minor significance for the majority of the time, occasionally rising to Moderate to Major for short durations.

16.112 Identified impacts would be short to medium term, temporary and local in nature.

16.113 Consideration has been given to noise mitigation measures in the corresponding section below.

Construction Vibration

16.114 Groundborne vibration calculations have been performed for typical site preparation, earthworks and construction activities, based on the empirical prediction procedures presented within BS 5228-2:2009, TRL RR 246 (applicable to HGV induced vibration), and TRL Report 429 (applicable to vibratory rollers).

16.115 It should be noted that there may be a variety of different potential vibration generating activities employed during the construction phase of the assessment

scheme other than those presented below. The predicted levels given within Table 16.23 have been provided for indicative purposes such that the possibility of groundborne vibration effects arising and their likely impact magnitude can be considered. It is assumed that any necessary piling works would be undertaken using an augured rather than driven method (in line with Chapter 6).

Table 16.23: Predicted Groundborne Vibration Levels Applicable to Typical Vibration Generative Construction Work Activities

Operation	Confidence limit	Distance (m)	PPV (mm/s)
Vibratory Rollers – start & end	95	60	0.3
	95	23	1.0
Vibratory Rollers – steady state[1]	95	3.3	10
Rotary Bored Piling - Augering	N/A	20	≤0.3
	N/A	6	≤1.0
	N/A	0.6	≤10
Rotary Bored Piling – Auger hitting base	N/A	45	≤0.3
	N/A	14	≤1.0
	N/A	1.4	≤10
Rotary Bored Piling – Driving casing	N/A	75	≤0.3
	N/A	23	≤1.0
	N/A	2.3	≤10
HGV's[2]	N/A	50	≤0.3[3]
	N/A	17	≤1.0[3]
	N/A	2.5	≤10[3]

[1] Assumes 2 rollers, 0.4mm amplitude, drum width of 1.3m, e.g. heavy duty ride on roller
[2] Assumes max height / depth of surface defect of 50 mm, max speed of 30 km/h, and that surface defect occurs at both wheels.
[3] Where alluvium soils are present, higher vibration levels can be expected.

16.116 Drawing upon Table 16.23 above, the potential impact magnitudes for different working operations have been determined for the same sample of receptors considered within the construction noise assessment.

16.117 Tables 16.24 and 16.25 presented the impact magnitudes which are identified to arise at each considered receptor, based on the content of Tables 16.23 and 16.10.

Table 16.24: Predicted Impact Magnitude for Range of Activities at Closest Receptors - Groundborne Vibration – Cae Glas and Penrhos

Activity	Magnitude of Significance							
	A	B	C	D	E	F	G	H
Vibratory rollers	Medium	Low	Low	Slight	Low	Slight	Low	Low
Rotary bored piling – Auger hitting base	Low	Low	Slight	Slight	Slight	Slight	Slight	Slight
Rotary bored piling – driving casing	Medium	Low	Low	Slight	Slight	Slight	Low	Slight
HGV's	Low	Low	Slight	Slight	Slight	Slight	Slight	Slight

Table 16.25: Predicted Impact Magnitude for Range of Activities at Closest Receptors - Groundborne Vibration – Kingsland

Activity	Magnitude of Significance			
	I	J	K	L
Vibratory rollers	Slight	Slight	Slight	Slight
Rotary bored piling – Auger hitting base	Slight	Slight	Slight	Slight
Rotary bored piling – driving casing	Low	Slight	Slight	Slight
HGV's	Slight	Slight	Slight	Slight

16.118 Considering the tables above, and Table 16.8, the sensitivity of receptors is High and the magnitude of impact, without mitigation, is Slight to Low for the majority of the time, occasionally rising to Moderate for short term localised works. In accordance with Table 16.13, this corresponds to impacts of Negligible to Minor significance, occasionally rising to Moderate.

16.119 Such impacts would be short to medium term, temporary and local in nature.

16.120 Impacts of Moderate significance are only anticipated to arise when using equipment with similar potential for vibration generation to vibratory rollers or when driving in pile casings. Such impacts are only anticipated to arise for works undertaken in close proximity to existing receptors. Notwithstanding this, consideration to appropriate vibration mitigation measures is presented in the corresponding section below.

Completed Development

Existing Noise Environment – Impact on Proposed Noise Sensitive Development

Detailed Noise Model

16.121 To allow due consideration to the change in the noise environment across the development sites (e.g. due to varying distance from the local source, and localised/topographic screening etc), a detailed noise model has been prepared for the sites and surrounding area.

16.122 The noise model was generated using the PC based CadnaA® noise modelling package. The noise model was set such that all road traffic noise level predictions were undertaken in accordance with the calculation procedures presented within the Department of Transports Calculation of road traffic noise memorandum (CRTN) 1988, whilst industrial noise predictions were undertaken in accordance with ISO9613-2:1996: *Acoustics -Attenuation of sound during propagation outdoors - Part 2: General method of calculation*

16.123 The following approach was adopted when developing of the noise model:

- NextMap® digital terrain model (DTM) 5m postings (topographic data) for the sites and surrounding area were incorporated into the noise model;
- The local ground cover was set to be acoustically absorbent (soft ground, G=1) with the exception of road traffic surfaces which were set to be acoustically reflective (hard ground, G=0);

- A series Ordnance Survey (OS) mapping and aerial photography was calibrated into the noise model based on six figure OS grid reference data;
- Local road traffic routes (Kingsland Road, the A55 and the A5) were incorporated into the noise model with kerb lines located to follow the aerial photography;
- Noise emission levels for each road traffic route were set such that the noise model predicted the worst case measured road traffic noise levels at adopted Measurement Locations 3 (the A55), 4 & 5 (the A5) and 1 (Kingsland Road) during both daytime and night-time periods;
- Two point sources were incorporated in the model, one at the site of each of the main cyclones located within the Alpoco works facility. These point sources were elevated to height of 15m. Octave band source levels were set for each point source such that the industrial noise levels measured at Locations 5, 13, 14 and 15 were predicted by the noise model.

16.124 The noise model included for the effect of the A55 cutting (where present) but did not initially include for the effect of earth bunding / acoustic fencing proposed to screen the Cae Glas development from the A55, or the acoustic fencing proposed to screen the Penrhos development from the A5. Accordingly the completed model initially represented the baseline scenario.

16.125 Consideration has subsequently been given to the benefit that proposed bunding and acoustic screening would afford, within the mitigation section below.

Residential Development at Kingsland

16.126 The noise environment at the Kingsland site is largely dominated by local and distant road traffic noise from the surrounding network, including Kingsland Road. Other sources include localised noise from fixed plant at the Holyhead Leisure centre, and noise from occasional football matches at the Holyhead Hotspur sports stadium.

16.127 Accordingly, in accordance with TAN 11, the noise model has been used to determine the Noise Exposure Categories across this residential development site, whilst separate assessments have been undertaken for noise from match-day events at the Holyhead Hotspur sports stadium and fixed plant at the Holyhead Leisure Centre.

16.128 The Noise Exposure Categories arising from the daytime and night-time $L_{Aeq,T}$ noise levels are presented in **Figures 16.5a&b**.

16.129 It can be seen from Table 16.15, that at Measurement Location 1, a night-time L_{ASmax} noise level of 72.9 dB was measured at 9m from Kingsland Road. This is below the 82 dB(A) threshold stipulated within TAN 11, above which a reclassification may be necessary. Accordingly the L_{ASmax} noise levels do not have any effect on the NECs presented within Figures **16.5a&b**.

16.130 It can be seen from **Figures 16.5a&b**, that the vast majority of the site is classified as NEC A, with a narrow strip of land adjacent to Kingsland Road being classified as NEC B (up to 18m from the nearside kerb edge during the daytime and 15m from the nearside kerb during the night-time).

16.131 The guidance to the local planning authority in TAN11 for all areas of the Site identified as falling within NEC A would be:

"*Noise need not be a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as a desirable level.*"

16.132 For areas falling within NEC B, the guidance is:

"*Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.*"

16.133 Given that a small area of this development site is classified as NEC B, in accordance with TAN11, mitigation measures are required to provide a commensurate level of protection against noise for future occupants.

16.134 Consideration to appropriate mitigation measures are presented in the corresponding section below.

16.135 The Noise Exposure Categories presented in TAN 11 are only applicable to proposed residential accommodation subject to transport or mixed sources noise. Accordingly, a separate assessment has been undertaken for noise associated with fixed plant at the Holyhead Leisure Centre and sporting events at the Holyhead Hotspur sports stadium. In accordance with TAN 11, this assessment has been based on determining the sound reduction that will be required to ensure achieving applicable internal and external noise criteria adopted from BS 8233:1999.

16.136 Table 16.26 below presents the site boundary noise levels measured during a football league match event (taken from Table 16.17), and during operation of the leisure centre fixed plant (taken from Table 16.18). The highest measured fixed plant noise levels have been adopted from Table 16.18. The presented levels are compared with the assessment criteria adopted from BS8233. The required sound attenuation to achieve the adopted criteria are also presented.

Table 16.26: Required Sound Insulation Performance for Dwellings on Site Boundary with Holyhead Hotspur Sports Stadium and Holyhead Leisure Centre, dB

Location	Period	Internal / External	Target Level from BS8233	Measured Site Boundary Level	Required Sound Insulation Performance (dB)
Measurement Location 11 (Football Match Event)	Daytime	External habitable space (e.g. garden)	50-55 dB $L_{Aeq,T}$	50.1	0.1 - achieved
		Internal Living Room	30-40 dB $L_{Aeq,T}$	50.1	20.1 – 10.1
Measurement Location 12 (Leisure Centre fixed plant)	Daytime	External habitable space (e.g. garden)	50-55 dB $L_{Aeq,T}$	41.2	achieved
		Internal Living Room	30-40 dB $L_{Aeq,T}$	41.2	11.2 – 1.2
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	41.2	11.2 – 6.2

16.137 The above table presents the sound attenuation performances that will be required to ensure a commensurate level of protection against noise for the occupants of proposed dwellings on the boundary with the Holyhead Hotspur

sports stadium and the Holyhead Leisure Centre. In accordance with these requirements, consideration has been given to appropriate noise mitigation measures in the corresponding mitigation section below.

16.138 Appropriate mitigation measures will be built into the development design and will form part of the scheme proposals. It is therefore not appropriate to rank the significance of the noise impacts without consideration to the available noise mitigation measures which would form part of the scheme design.

Proposed Holiday Accommodation at Cae Glas and Penrhos

16.139 In accordance with TAN 11, an assessment of the suitability of the prevailing noise environment for the proposed holiday accommodation at the Cae Glas and Penrhos sites, has been undertaken drawing upon the guidance contained within BS8233. TAN 11 states that this this approach is appropriate for 'other noise sensitive development' (e.g. holiday accommodation), making specific reference to developments on '*sizable sites*' as is the case here.

16.140 A representative sample of proposed receptors (holiday lodges etc.) have been selected across the proposed Cae Glas and Penrhos developments, including the closest proposed holiday accommodation to key local noise sources. The noise model has been used to determine the daytime and night-time ambient ($L_{Aeq,T}$) noise levels for each sample receptor during both daytime and night-time periods. Daytime noise levels have been determined at ground floor height (1.5m) whilst night-time noise level have been determined at first floor height (4m). For the night-time period, L_{AFmax} noise levels have also been determined for each receptor by applying a standard acoustic distance correction of a 6 dB loss per doubling of distance from a point source to measurement data adopted from Table 16.15.

16.141 The adopted sample receptors are shown in **Figures 16.6a&b.** These figures also present daytime (**Figure 16.6a**) and night-time (**Figure 16.6b**) noise maps generated from the scheme noise models. The determined noise levels for each receptor are presented in Table 16.27 below. Also presented in Table 16.27 are applicable assessment criteria for the occupation of internal and external living spaces, adopted from BS8233.

Table 16.27: Required Sound Insulation Performance for Sample Holiday Accommodation on Cae Glas and Penrhos sites, dB

Receptor	Period	Internal / External	Target Level from BS8233	Level	Required Sound Insulation Performance (dB)
Receptor 1 (Penrhos) closest lodge to A5 (north)	Daytime	External habitable space (e.g. terrace)	55 dB $L_{Aeq,T}$	55.4	0.4
		Internal Living Room	30-40 dB $L_{Aeq,T}$		25.4 – 15.4
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	48.9	18.9 – 13.9
			45 dB L_{AFmax}	66.3	21.3
Receptor 2 (Penrhos) centre	Daytime	External habitable space (e.g. terrace)	55 dB $L_{Aeq,T}$	46.4	achieved

Receptor	Period	Internal / External	Target Level from BS8233	Level	Required Sound Insulation Performance (dB)
of headland lodges		Internal Living Room	30-40 dB $L_{Aeq,T}$		16.4 – 6.4
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	43.5	13.5 – 8.5
			45 dB L_{AFmax}	53.5	8.5
Receptor 3 (Penrhos) closest estate cottage to A5 and Alpoco works	Daytime	External habitable space (e.g. terrace)	55 dB $L_{Aeq,T}$	58.3	3.3
		Internal Living Room	30-40 dB $L_{Aeq,T}$		28.3 – 18.3
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	53.8	23.8 - 18.8
			45 dB L_{AFmax}	69.2	24.2
Receptor 4 (Penrhos) centre of quillet lodges	Daytime	External habitable space (e.g. terrace)	55 dB $L_{Aeq,T}$	50.3	achieved
		Internal Living Room	30-40 dB $L_{Aeq,T}$		20.3 – 10.3
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	49.3	19.3 - 14.3
			45 dB L_{AFmax}	55.4	10.4
Receptor 5 (Penrhos) closest lodge to A5 and Alpoco works	Daytime	External habitable space (e.g. terrace)	55 dB $L_{Aeq,T}$	54.9	achieved
		Internal Living Room	30-40 dB $L_{Aeq,T}$		24.9 – 14.9
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	53.8	23.8 – 18.8
			45 dB L_{AFmax}	61.9	16.9
Receptor 6 (Cae Glas) closest lodge to A55 and Alpoco work	Daytime	External habitable space (e.g. terrace)	55 dB $L_{Aeq,T}$	60.5	5.5
		Internal Living Room	30-40 dB $L_{Aeq,T}$		30.5 – 20.5
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	59.2	29.2 – 24.2
			45 dB L_{AFmax}	76.8	31.8
Receptor 7 (Cae Glas) centre of lodges	Daytime	External habitable space (e.g. terrace)	55 dB $L_{Aeq,T}$	51.2	achieved
		Internal Living Room	30-40 dB $L_{Aeq,T}$		21.2 – 11.2
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	48.8	18.8 – 13.8
			45 dB L_{AFmax}	76.2	31.2

Receptor	Period	Internal / External	Target Level from BS8233	Level	Required Sound Insulation Performance (dB)
Receptor 8 (Cae Glas) lodge adjacent to A55,midpoint along northern site boundary	Daytime	External habitable space (e.g. terrace)	55 dB $L_{Aeq,T}$	61.1	5.1
		Internal Living Room	30-40 dB $L_{Aeq,T}$		31.1 – 21.1
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	59.4	29.4 – 24.4
			45 dB L_{AFmax}	75.0	30.0
Receptor 9 (Cae Glas) Lodge adjacent to A55, north western corner	Daytime	External habitable space (e.g. terrace)	55 dB $L_{Aeq,T}$	61.8	6.8
		Internal Living Room	30-40 dB $L_{Aeq,T}$		31.8 – 21.8
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	59.8	29.8 – 24.8
			45 dB L_{AFmax}	76.6	31.6

16.142 The above table presents the sound attenuation performances that will be required to ensure a commensurate level of protection against noise for occupants of a representative sample of the proposed holiday accommodation.

16.143 In accordance with these requirements, consideration has been given to appropriate noise mitigation measures in the corresponding mitigation section below.

16.144 Appropriate mitigation measures will be built into the development design and will form part of the scheme proposals. It is therefore not appropriate to rank the significance of the noise impacts without consideration to the available noise mitigation measures which would form part of the scheme design.

Development Generated Road Traffic Noise Level Changes

16.145 The proposed development will give rise to changes in local road traffic flows. Accordingly consideration has been given to whether associated road traffic noise level changes would give rise to significant impacts at existing local noise-sensitive receptors.

16.146 The proposed phased completion of the development is as follows:

- 2014 - Kingsland and Penrhos (Phase 1) - Hub, woodland lodges and estate cottages) construction commence
- 2015 – Cae Glas construction commences
- 2016 - Penrhos Phase 1 commences operation
- 2016 - Penrhos Phase 2 (Headland) construction commences
- 2016 – Cae Glas accommodation available for construction workforce
- 2018 - Penrhos construction completed and open at 100% capacity
- 2021-22 - Cae Glas refurbishment
- 2022 - Kingsland construction completed

16.147 The results of the Transport Assessment (TA) (prepared by Curtins Consulting and presented at Appendix 14.1), and more specifically the road traffic flow

data, have been used as the basis for noise level calculations. Calculations have been undertaken for the local road network before development generated road traffic is dispersed across the wider road network system.

16.148 As noted in paragraph 16.68, the scheme traffic data assume 100% completion of the Penrhos development in 2017.

16.149 Considering the phasing detailed above, it can be seen that associated changes in local road traffic flows would be gradual over of a number of years. Accordingly, road traffic noise level calculations have been undertaken for a series of different 'with' versus 'without development scenarios.

16.150 Initially, a review of routes considered within the TA was undertaken, and any routes which are not adjacent to existing residential dwellings / high sensitivity receptors have been discounted from the assessment, on the basis that no significant impacts would arise along these routes.

16.151 For the remaining routes, road traffic noise calculations have been carried out in accordance with CRTN, being undertaken for a notional receptor location 10m from the edge of the carriageway of each road considered, and 1.5m above ground level. A notional receptor has been used because the change in traffic noise level adjacent to any given road will be the same at all distances where noise from that route is dominant. Traffic noise calculations have been undertaken to establish the change in the daytime $L_{A10,18hour}$ noise level.

16.152 The CRTN prediction methodology applies a 'low flow' correction for 18 hour flows of between 1000, and 4000 movements. Below 1000 movements, the CRTN prediction method should not strictly be applied, as it will over-predict the resulting noise levels. In absence of any other applicable road traffic noise prediction method, for routes with flows between 100 and 999 movements, a CRTN calculation has been undertaken assuming 1000 movements, with a manual correction applied based on the standard acoustic principle of a 3dB loss per halving of flow. For example, if a route is subject to a flow of 500, the level associated with a flow of 1000 has been calculated in accordance with CRTN, with a correction of -3dB subsequently applied.

16.153 Routes with flows below 100 have been discounted from the assessment on the basis that the associated absolute noise levels will be of such a low level that no significant impacts will arise.

16.154 Table 16.28 below considers the noise level changes that would arise between the baseline year (2012 without development) and 2017 with development (Penrhos at 100% capacity and Cae Glas nuclear construction workers accommodation occupied).

16.155 Table 16.29 below considers the noise level changes that would arise between the baseline year (2012 without development) and 2022 with development (all phases completed).

16.156 Table 16.30 below considers the noise level changes that would arise between the baseline year (2012 without development) and 2035 with development (all phases completed +13 years).

Table 16.28: Predicted Changes in Road Traffic Noise Levels Resulting from Operation of the Redevelopment (2012 versus 2017), Free-field, dB(A)

Road section	Predicted Noise Level $L_{A10,18hour}$			Change in Noise Levels (C-B) - (C-A)
	2012 Baseline (A)	2017 Without scheme (B)	2017 With scheme (C)	
A5154 north of Kingsland Road	58.1	58.1	58.4	0.3 - 0.3
A55 south of A5154	60.9	61.0	61.1	0.1 - 0.2
Kingsland Road south of A5154	56.1	56.1	56.6	0.5 - 0.5
Kingsland Road north of A5154	53.3	53.3	53.6	0.3 - 0.3
Kingsland Road north of A5153	53.1	53.1	54.3	1.2 - 1.2
A5153 east of Kingsland Road	51.3	51.3	54.4	3.1 - 3.1
Kingsland Road south of A5153	53.5	53.5	54.9	1.4 - 1.4
A55 J2 N/B On-slip	53.6	53.6	54.8	1.2 - 1.2
A55 J2 S/B Off-slip	55.2	55.2	55.8	0.6 - 0.6
A5153 Bridge over A55 @ J2	58.0	58.1	61.5	3.4 - 3.5
A5 London Road north of A5153	56.5	56.5	56.8	3.4 - 3.5
A5 London Road south of A5153	55.7	55.8	56.7	0.3 - 0.3
A5 London Road north of Beach Road	60.4	60.4	62.0	0.9 - 1.0
A5 London Road south of Beach Road	60.3	60.4	62.0	1.6 - 1.6
A5 Holyhead Road north of A5025	55.9	56.0	57.1	1.6 - 1.7
A5025 east of A5	55.3	55.4	55.8	1.1 - 1.2
A5 Holyhead Road south of A5025	56.6	56.6	57.1	0.4 - 0.5
B4545 Station Road	54.6	54.7	55.0	0.5 - 0.5
A5 Holyhead Road north of A55 J3	61.2	61.2	61.9	0.4 - 0.3
J5 E/B On-slip	56.4	56.4	57.3	0.7 - 0.7
W/B Off-slip	57.1	57.2	57.7	0.9 - 0.9
A5 Holyhead Road south of A55 J3	51.9	51.9	52.2	0.5 - 0.6
A5 Holyhead Road Bridge over A55 @ J3	62.3	62.3	63.1	0.3 - 0.3
A5 London Road north of Penrhos Access 1	60.4	60.4	61.9	0.8 - 0.8
A5 London Road north of Penrhos Access 2	60.9	60.9	61.3	1.5 - 1.5
Kingsland Road south of Kingsland Access	53.5	53.5	54.6	0.4 - 0.4

Table 16.29: Predicted Changes in Road Traffic Noise Levels Resulting from Operation of the Redevelopment (2012 versus 2022), Free-field, dB(A)

Road section	Predicted Noise Level $L_{A10,18hour}$			Change in Noise Levels (C-B) - (C-A)
	2012 Baseline (A)	2022 Without scheme (B)	2022 With scheme (C)	
A5154 north of Kingsland Road	58.1	58.3	58.6	0.5 - 0.3
A55 south of A5154	60.9	61.1	61.3	0.4 - 0.2
Kingsland Road south of A5154	56.1	56.3	56.8	0.7 - 0.5
Kingsland Road north of A5154	53.3	53.5	53.9	0.6 - 0.4
Kingsland Road north of A5153	53.1	53.3	54.6	1.5 - 1.3
A5153 east of Kingsland Road	51.3	51.5	54.9	3.6 - 3.4
Kingsland Road south of A5153	53.5	53.7	55.5	2.0 - 1.7
A55 J2 N/B On-slip	53.6	53.8	55.0	1.4 - 1.2
A55 J2 S/B Off-slip	55.2	55.4	56.0	0.8 - 0.6
A5153 Bridge over A55 @ J2	58.0	58.2	61.8	3.8 - 3.6
A5 London Road north of A5153	56.5	56.7	57.1	0.6 - 0.4
A5 London Road south of A5153	55.7	56.0	56.9	1.2 - 0.9
A5 London Road north of Beach Road	60.4	60.6	62.2	1.8 - 1.6
A5 London Road south of Beach Road	60.3	60.5	62.1	1.8 - 1.6
A5 Holyhead Road north of A5025	55.9	56.2	57.2	1.3 - 1.0
A5025 east of A5	55.3	55.6	56.0	0.7 - 0.4
A5 Holyhead Road south of A5025	56.6	56.8	57.3	0.7 - 0.5
B4545 Station Road	54.6	54.9	55.1	0.5 - 0.2
A5 Holyhead Road north of A55 J3	61.2	61.4	62.1	0.9 - 0.7
J5 E/B On-slip	56.4	56.6	57.5	1.1 - 0.9
W/B Off-slip	57.1	57.3	57.9	0.8 - 0.6
A5 Holyhead Road south of A55 J3	51.9	52.1	52.4	0.5 - 0.3
A5 Holyhead Road Bridge over A55 @ J3	62.3	62.5	63.3	1.0 - 0.8
A5 London Road north of Penrhos Access 1	60.4	60.6	62.0	1.6 - 1.4
A5 London Road north of Penrhos Access 2	60.9	61.1	62.4	1.5 - 1.3
Kingsland Road south of Kingsland Access	53.5	53.7	54.8	1.3 - 1.1

Table 16.30: Predicted Changes in Road Traffic Noise Levels Resulting from Operation of the Redevelopment (2012 versus 2037), Free-field, dB(A)

Road section	Predicted Noise Level $L_{A10,18hour}$			Change in Noise Levels (C-B) - (C-A)
	2012 Baseline (A)	2035 Without scheme (B)	2035 With scheme (C)	
A5154 north of Kingsland Road	58.1	58.8	59.1	0.3- 1.0
A55 south of A5154	60.9	61.6	61.8	0.2 - 0.9
Kingsland Road south of A5154	56.1	56.8	57.2	0.6 - 1.1
Kingsland Road north of A5154	53.3	54.0	54.3	0.3 - 1.0
Kingsland Road north of A5153	53.1	53.8	55.0	1.2 - 1.9
A5153 east of Kingsland Road	51.3	52.0	55.1	3.1 - 3.8
Kingsland Road south of A5153	53.5	54.2	55.9	1.7 - 2.4
A55 J2 N/B On-slip	53.6	54.3	55.3	1.0 - 1.7
A55 J2 S/B Off-slip	55.2	55.9	56.4	0.5 - 1.2
A5153 Bridge over A55 @ J2	58.0	58.7	62.0	3.3 - 4.0
A5 London Road north of A5153	56.5	57.2	57.5	0.3 - 1.0
A5 London Road south of A5153	55.7	56.4	57.3	0.9 - 1.6
A5 London Road north of Beach Road	60.4	61.1	62.5	1.4 - 2.1
A5 London Road south of Beach Road	60.3	61.0	62.5	1.5 - 2.2
A5 Holyhead Road north of A5025	55.9	56.6	57.6	1.0 - 1.7
A5025 east of A5	55.3	56.0	56.4	0.4 - 1.1
A5 Holyhead Road south of A5025	56.6	57.3	57.7	0.4 - 1.1
B4545 Station Road	54.6	55.3	55.6	0.3 - 1.0
A5 Holyhead Road north of A55 J3	61.2	61.9	62.5	0.6 - 1.3
J5 E/B On-slip	56.4	57.1	57.9	0.8 - 1.5
W/B Off-slip	57.1	57.8	58.3	0.5 - 1.2
A5 Holyhead Road south of A55 J3	51.9	52.6	52.8	0.2 -0.9
A5 Holyhead Road Bridge over A55 @ J3	62.3	63.0	63.7	0.7 - 1.4
A5 London Road north of Penrhos Access 1	60.4	61.1	62.4	1.3 - 2.0
A5 London Road north of Penrhos Access 2	60.9	61.6	62.7	1.1 - 1.8
Kingsland Road south of Kingsland Access	53.5	54.2	55.2	1.0 - 1.7

16.157 It can be seen from the tables above, that for all years and scenarios considered, the majority of routes are subject to noise level increases of less than 3dB, even when including for the effect of natural traffic growth. Only two routes are predicted to be subject to noise level increases of between 3 and 5 dB (A5153 east of Kingsland Road and A5153 Bridge over A55 @ J2).

16.158 Drawing on the content of Tables 16.8 and 16.11, the sensitivity of receptors is High and the magnitude of impact ranges from Slight to Low. In accordance with Table 16.13 this corresponds to impacts of Negligible to Minor significance.

16.159 Identified impacts would be long term, permanent and local in nature.

Noise from Proposed Fixed Plant

16.160 The proposed development includes various elements which may incorporate fixed plant items and have an associated potential to generate noise. At this stage of the development, details of the proposed type, number and precise location of any such plant are not available. In the absence of such detailed information, it is appropriate to specify suitable noise control limits to which any such plant should conform. These limits could then be incorporated into a conditional planning approval to ensure a commensurate level of protection against fixed plant noise for existing and proposed noise-sensitive receptors.

16.161 BS 4142 states that a rating noise level of +5 dB above background is of marginal significance when assessing the likelihood of complaints from fixed plant noise. Accordingly, for the purpose of this assessment, plant rating noise level limits have been calculated at a level equal to the prevailing background noise levels (e.g. 5 dB better than 'marginal significance'). The derived noise level limits apply to the cumulative effect of noise from proposed fixed plant items when determined at existing and proposed noise-sensitive receptors.

16.162 BS 4142 advises that the measurement time interval for background noise measurements should be '*sufficient to obtain a representative value of the background level*'. In this case the background noise level determined over the full daytime /night-time periods has been adopted.

16.163 In addition to the above, the BS 4142 assessment method is caveated, stating in the introduction that where existing background noise levels are '*very low*' the BS 4142 assessment method is not suitable for use, going on to state that:

> "*For the purposes of this standard, background noise levels below 30 dB and rating levels below about 35 dB are considered to be very low*"

16.164 Consequently, it is considered appropriate that, where the rating level limit based on measured background $L_{A90,T}$ noise level would otherwise be below 35 dB $L_{Ar,t}$, a plant rating level limit of 35 dB $L_{Ar,T}$ should be adopted.

16.165 On the basis of the above, a series of noise level limits have been determined drawing upon the measured background noise levels taken from Table 16.19. Following this approach, the combined noise level from all plant should be designed to meet the noise limits presented in Table 16.31.

Table 16.31: Proposed Noise Limits for Future Plant Noise

Receptors with a Similar Noise Environment to Measurement Location…	Time Period	Measured Background $L_{A90.T}$ Noise Level	Plant Rating Noise Level Limits $L_{Ar.T}$
2	Daytime	44	44
	Night-time	39	39
4	Daytime	54	54
	Night-time	44	44
6	Daytime	28	35
	Night-time	27	35
7	Daytime	33	35
	Night-time	35	35
8	Daytime	34	35
	Night-time	32	35
9	Daytime	41	41
	Night-time	33	35
10	Daytime	41	41
	Night-time	41	41

16.166 The above plant rating level limits apply at 3.5m from the façade of any residential property (Free-Field) or within proposed external living areas.

16.167 In accordance with BS4142, the assessment of plant noise emissions should include +5 dB rating correction for tonal, irregular or intermittent plant where applicable, before comparison with the above limits.

16.168 Drawing upon Tables 16.8 and 16.12, the sensitivity of receptors is High, and compliance with the derived noise level limits would ensure that the impact magnitude would be Low. In accordance with Table 16.13, this corresponds to impacts of Minor Significance.

16.169 Identified impacts would be long term, permanent and local in nature.

Mitigation Measures

Construction Noise

16.170 There are several safeguards which exist to minimise the effects of construction noise, these include:

- The various EC Directives and UK Statutory Instruments that limit noise emissions of a variety of construction plant;
- Guidance set out in BS 5228: Part 1: 2009, which covers noise control on construction sites; and
- The powers that exist for local authorities under Sections 60 and 61 of the *Control of Pollution Act 1974* to control noise from construction sites.

16.171 In addition to the above, the adoption of Best Practicable Means (BPM), as defined in Section 72 of the *Control of Pollution Act 1974* is usually the most effective means of controlling noise from construction sites. Such measures where appropriate may include the following:

- Any compressors brought on to site to be silenced or sound reduced models fitted with acoustic enclosures;
- All pneumatic tools to be fitted with silencers or mufflers;
- Care to be taken when erecting or striking scaffolds to avoid impact noise from banging steel. All operatives undertaking such activities to be instructed on the importance of handling the scaffolds to reduce noise to a minimum;
- Deliveries to be programmed to arrive during daytime hours only. Care to be taken when unloading vehicles to minimise noise. Delivery vehicles to be routed so as to minimise disturbance to local residents. Delivery vehicles to be prohibited from waiting within or in the vicinity of the site with their engines running;
- All plant items to be properly maintained and operated according to manufacturers' recommendations in such a manner as to avoid causing excessive noise;
- All plant to be sited so that the noise impact at nearby noise-sensitive properties is minimised;
- Local hoarding, screens or barriers to be erected as necessary to shield particularly noisy activities; and
- Problems concerning noise from construction works can often be avoided by taking a considerate and neighbourly approach to relations with the local residents. Unless prior agreement has been sought, works should only take place during given periods, e.g. during normal construction hours and not at night.

16.172 The above measures, and the need to comply with the principles of Best practicable means (BPM) could be included within a Construction Environmental Management Plan, which is referenced for use in Chapter 6, and to which the appointed contractor could be required to comply.

16.173 Experience from other sites has shown that by implementing a combination of the above best practice measures, typical noise levels from construction works can be reduced by approximately 5 to 10 dB(A).

Construction Vibration

16.174 As the potential for impacts of moderate significance has been identified for a short durations (e.g. during vibration generative works in close proximity to existing receptors), consideration has been given to available vibration mitigation measures.

16.175 However, it should first be noted that in some cases, the predicted vibration levels adopt a 95% confidence limit. Accordingly, it is likely that lower vibration levels will prevail than those identified. It should also be noted that the completed assessment is based on compliance with criteria specific to human comfort, and that significantly greater vibration levels would be required to give rise to the onset of cosmetic building damage (i.e. hairline plaster cracks).

16.176 Notwithstanding this, the following vibration mitigation measures could be employed:

- Adoption of low vibration working methods, with consideration given to the use of the most suitable plant;
- Where processes could potentially give rise to significant levels of vibration, on-site/receptor vibration monitoring should be undertaken with the results assessed in accordance with the guidance contained within BS7385-2 (for building damage) and BS 6472-1: 2008 (for human comfort). The results of such monitoring would determine the need for any additional mitigation measures such adjustments to the rate / intensity of work / operations, or the adoption of alterative working practices;
- The contractor should establish and maintain effective liaison with the local community throughout the construction period. This will include provision of information concerning the on-going activities and provision of telephone numbers to contact the site for information during operational hours. A person should be identified with appropriate authority to resolve any problems. A log of complaints and actions should be taken to remedy these to be completed; and
- Operations with the potential to give rise to significant vibration levels should not be undertaken during the early morning, late afternoon/evening or during the night-time, when neighbouring properties are most likely to be occupied.

16.177 Where considered necessary, compliance with the above vibration mitigation measures could be ensured through an appropriately worded planning condition, or incorporation into the scheme CEMP.

Completed Development

Existing Noise Environment – Impact on Proposed Noise Sensitive Development

<u>Residential Development at Kingsland</u>

16.178 Given that a narrow portion of land adjacent to Kingsland Road has been identified to fall within NEC B, it is appropriate to consider the noise mitigation measures that will be required ensure a commensurate level of protection against noise for future residents.

16.179 Planning Policy Guidance Note (PPG) 24: *Planning and noise* is the former English equivalent of TAN 11. On the subject of the noise limits that define the boundary between NEC B and NEC C, PPG24 states that:

> "*Because noise should be taken into account when determining planning applications in NEC B, it has been assumed that the minimum amelioration measure available to an occupant at night will be to close bedroom windows*"

16.180 In the first instance, it is therefore appropriate to explore the protection that could be afforded by the sound insulation performance of the external building fabric, i.e. the glazing and ventilation elements.

16.181 Table 16.32 below presents the noise levels that are predicted to arise at the closest proposed residential dwelling to Kingsland Road during both daytime and night-time periods. $L_{Aeq,T}$ noise levels have been determined from the scheme noise model. L_{AFmax} noise levels have been based on the measurement data presented in Table 16.15 for Measurement Location 1, and a standard acoustic distance correction of a 6 dB loss per doubling of distance from a point source (the source location has been taken a 3.5m into Kingsland Road, from the nearside kerb edge, in accordance with CRTN).

16.182 Also presented in this table are the applicable internal noise level criteria adopted from BS8233 and the sound attenuation performances that will be required from the proposed building façade to achieve these criteria.

Table 16.32: Predicted Noise Levels at Closest Proposed Residential Dwelling to Kingsland Road, and Required Building Fabric Sound Attenuation to Achieve BS8233 Criteria, dB

Assessment Location	Period / Noise Index	Noise Level	Internal Target Noise Levels "good" – "reasonable" L_{Aeq}	Required Sound Insulation Performance
Closest Proposed dwelling to Kingsland Road (10.5m from Kerb)	Daytime $L_{Aeq,16hour}$	57.2	30 – 40	27.2 – 17.2
	Night-time $L_{Aeq,8hour}$	47.3	30 – 35	17.3 – 12.3
	Night-time L_{AFmax}	73.5	45	28.5

16.183 It is assumed that the proposed buildings will be of a masonry construction and, as such, the glazing will be the acoustic weak link in the sound reduction performance of the façade. PPG24 sets out generic data relating to the typical noise reduction performance of three glazing types, namely single, thermal double and secondary. The performance values for road traffic noise spectra are set out in the Table 16.33 below.

Table 16.33: Sound Insulation Performances of Different Glazing Types for A Road Traffic Noise Source, As Set Out In PPG24, dB

Noise Source	Difference between dB(A) levels outside and inside		
	Single Glazing	Thermal Double Glazing	Secondary Glazing
Road Traffic Noise	28	33	34

16.184 Comparing the required performances set out in Table 16.32 for the closest proposed dwelling to Kingsland Road, with the typical sound insulation performance values for a road traffic noise source taken from Table 16.33, it can

be seen that use of glazing with a similar acoustic performance to the example of thermal double glazing would ensure achieving the $L_{Aeq,T}$ "*Good*" criteria during the daytime and the night-time as well as achieving the adopted night-time L_{AFmax} criterion.

16.185 It can therefore be seen that there are glazing configurations available that could be employed to ensure that the internal noise criteria specified in BS8233 for residential living rooms and bedrooms can be achieved across the site.

16.186 The above glazing calculations are intended to be for planning purposes only. More detailed calculations may be required for the procurement of the glazing units, once the housing floor plans and elevations etc. have been finalized.

16.187 Furthermore, the above calculations do not make any allowance for the incorporation of permanent ventilation to the dwellings. On ventilation, BS8233 advises that:

> "*The Building Regulations on ventilation recommend that habitable rooms in dwellings have background ventilation. Trickle ventilators can provide this, and sound attenuating types are available. Where sound insulation requirements preclude opening windows for rapid ventilation and cooling, acoustic ventilation units incorporating fans are available for insertion in external walls; these can provide sound reduction comparable with domestic secondary glazing.*"

16.188 Where appropriate, the preferred choice of ventilation is through the use of natural ventilation openings such as trickle vents, air-bricks and passive ventilation devices. Such ventilators can be used to meet the requirements of the Building Regulations Approved Document F for background ventilation. The future occupants would then have the option of keeping windows closed for most of the time and opening windows for rapid ventilation and summer cooling.

16.189 The Building Research Establishment (BRE) has published an Information Paper on the acoustic performance of such passive ventilation systems. IP4/99: 1999: *Ventilators: Ventilation and Acoustic Effectiveness* details a study into the sound reduction performance of fourteen different window mounted trickle ventilators and seven different through-wall passive ventilators. The measured sound reduction performance, after taking into account flanking sound paths (i.e. sound paths that do not travel directly through the vent) and the effective area of the ventilator were as follows:

Table 16.34: Range of Measured Sound Reduction Performances of Passive Ventilators, with Vents Open, dBA

Window Mounted Trickle Vents (open)	**Passive Through-Wall Ventilators (open)**
From 14 to 40 (depending on model)	From 30 to 46 (depending on model)
Figures corrected for effective area of ventilator	

16.190 It can be seen from the above figures that trickle vents or passive through wall ventilators are available that meet the requirements of the Building Regulations Approved Document F for background ventilation and also provide a sound reduction performance that meets or exceeds that required from the glazing elements.

16.191 The orientations of the closest proposed dwellings to Kingsland Road are such that the external living areas / gardens are adjacent to this route. It is therefore appropriate to consider mitigation requirements to ensure achieving the 50 and 55 dB $L_{Aeq,T}$ criteria stipulated within BS8233 as applicable to outdoor living spaces.

16.192 Measurement Location 1 was positioned 9m from the nearside kerb edge of Kingsland Road. This is equivalent to an approximate mid-point for the closest proposed gardens to this route. The measured daytime $L_{Aeq,16hour}$ noise level at this location was 58.9 dB.

16.193 Based on the acoustic barrier performance methodology presented in CRTN, a 5 dB noise attenuation is afforded by a noise barrier that just cuts the line of sight between source and receiver, whilst an attenuation of 10 dB and greater is afforded by a barrier which fully obscures the line of sight between source and receptor. Accordingly, with the use of an appropriately aligned and specified acoustic barrier located along the site boundary with Kingsland Road, the adopted 50 and 55 dB(A) noise level criteria could be achieved.

16.194 With regards to noise from the fixed plant and football match events at the Holy Hotspur sports stadium, from Table 16.26, it can be seen that the highest external to internal noise attenuation requirement to ensure achieving a "*good*" internal noise environment (as defined withniBS8233) is 20.1 dB. Comparing this performance requirement with Table 16.33 above, it can be seen that this could be achieved even with the installation of the example of single glazing. It should however be noted that the installation of thermal double glazing it likely to be require to ensure compliance with the thermal requirements of the Building Regulations thus affording additional noise attenuation above that required for acoustic purposes.

16.195 Measured noise levels have been identified to be below the external living space / garden criteria of 50 and 55dB $L_{Aeq,T}$. Accordingly, no additional mitigation is required for these spaces.

Proposed Holiday Accommodation at Cae Glas and Penrhos

16.196 As part of the development, it is proposed to install an earth bund surmounted with an acoustic fence / wall, along the eastern side of the Cae Glas Site, to screen road traffic and associated noise from the A55. The bund would be circa 4m in height with the fence / wall located along its peak, affording an additional height of circa 1.2m.

16.197 In addition it is proposed to install an acoustic fence within the western boundary of the Penrhos site, to screen the A5.

16.198 These proposed mitigation measures have been incorporated into the scheme noise model, and the resulting noise levels at the adopted sample receptor positions have been recalculated.

16.199 A revised version of Table 16.27 is presented below, including for the effect of these proposed mitigation measures. This table also shows the adopted assessment criteria and the remaining levels of noise attenuation that would be required in order to achieve these criteria.

Table 16.35: Required Sound Insulation Performance for Sample Holiday Accommodation on Cae Glas and Penrhos sites (With Proposed Noise Bund and Barriers), dB

Receptor	Period	Internal / External	Target Level from BS8233	Level	Required Sound Insulation Performance (dB)
Receptor 1 (Penrhos) closest lodge to A5 (north)	Daytime	External habitable space (e.g. terrace)	55 dB $L_{Aeq,T}$	53.9	Achieved
		Internal Living Room	30-40 dB $L_{Aeq,T}$		23.9 – 13.9
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	47.2	17.2 – 12.2
			45 dB L_{AFmax}	64.6	19.6
Receptor 2 (Penrhos) centre of headland lodges	Daytime	External habitable space (e.g. terrace)	55 dB $L_{Aeq,T}$	46.2	achieved
		Internal Living Room	30-40 dB $L_{Aeq,T}$		16.4 – 6.4
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	43.8	–
			45 dB L_{AFmax}	53.8	8.8
Receptor 3 (Penrhos) closest estate cottage to A5 and Alpoco works	Daytime	External habitable space (e.g. terrace)	55 dB $L_{Aeq,T}$	56.2	1.2
		Internal Living Room	30-40 dB $L_{Aeq,T}$		26.2 – 16.2
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	53.0	23.0 - 18.0
			45 dB L_{AFmax}	68.4	23.4
Receptor 4 (Penrhos) centre of quillet lodges	Daytime	External habitable space (e.g. terrace)	55 dB $L_{Aeq,T}$	49.9	achieved
		Internal Living Room	30-40 dB $L_{Aeq,T}$		19.9 – 9.9
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	49.1	19.1 - 14.1
			45 dB L_{AFmax}	55.2	10.2
Receptor 5 (Penrhos) closest lodge to A5 and Alpoco works	Daytime	External habitable space (e.g. terrace)	55 dB $L_{Aeq,T}$	54.2	achieved
		Internal Living Room	30-40 dB $L_{Aeq,T}$		24.2 – 14.2
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	53.6	23.6 – 18.6
			45 dB L_{AFmax}	61.2	16.2
Receptor 6 (Cae Glas) closest	Daytime	External habitable space	55 dB $L_{Aeq,T}$	54.2	achieved

Receptor	Period	Internal / External	Target Level from BS8233	Level	Required Sound Insulation Performance (dB)
lodge to A55 and Alpoco work		(e.g. terrace)			
		Internal Living Room	30-40 dB $L_{Aeq,T}$		24.2 – 14.2
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	54.5	24.5 -14.5
			45 dB L_{AFmax}	72.1	27.1
Receptor 7 (Cae Glas) centre of lodges	Daytime	External habitable space (e.g. terrace)	55 dB $L_{Aeq,T}$	49.2	achieved
		Internal Living Room	30-40 dB $L_{Aeq,T}$		19.2- 9.2
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	46.2	16.2- 11.2
			45 dB L_{AFmax}	74.6	29.6
Receptor 8 (Cae Glas) lodge adjacent to A55,mid point along northern site boundary	Daytime	External habitable space (e.g. terrace)	55 dB $L_{Aeq,T}$	52.9	achieved
		Internal Living Room	30-40 dB $L_{Aeq,T}$		22.9 – 12.9
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	53.7	23.7 – 18.7
			45 dB L_{AFmax}	69.3	24.3
Receptor 9 (Cae Glas) Lodge adjacent to A55, north western corner	Daytime	External habitable space (e.g. terrace)	55 dB $L_{Aeq,T}$	56.9	1.9
		Internal Living Room	30-40 dB $L_{Aeq,T}$		26.9 – 21.9
	Night-time	Internal Bedroom	30-35 dB $L_{Aeq,T}$	56.0	26.0 – 21.0
			45 dB L_{AFmax}	72.8	27.8

16.200 Comparing the required sound insulation performances set out in Table 16.35 with the typical sound insulation performance values for a road traffic noise source taken from Table 16.33, it can be seen that use of glazing with a similar acoustic performance to the example of thermal double glazing would ensure achieving the internal $L_{Aeq,T}$ "*Good*" criteria during both daytime and the night-time periods, as well as achieving the adopted internal night-time L_{AFmax} criterion.

16.201 With regards to the daytime external noise environment, it can be seen that with the proposed acoustic bund and barriers in place, the adopted 55 dB $L_{Aeq,16hour}$ criterion would be achieved at all of the adopted sample receptors except 3 and 9, for which additional attenuations of 1.2 and 1.9 dB will be required respectively. For Lodges the vicinity of Receptor 3, it is anticipated that the additional 1.2 dB could be ensured at the detailed design stage, e.g. by locating

rear gardens such that they are screened from the A5 by the proposed dwelling themselves, or by the incorporation of localised acoustic barriers around such spaces.

16.202 For Lodges the vicinity of Receptor 9, it is anticipated that the additional 1.9 dB could be ensured at the detailed design stage, e.g. by locating rear gardens / patios etc. such that they are screened from the A55, or in the finalisation of the design of the proposed bund barrier combination (e.g. a localised increase in bund height, or adjustment to the location of the apex of the bund/barrier to maximise attenuation performance).

Development Generated Road Traffic Noise Level Changes

16.203 Given that impacts of only Negligible to Minor significance have been identified at worst, consideration to detailed noise mitigation measures is not warranted.

Noise from Proposed Fixed Plant

16.204 A series of appropriate noise level limits have been determined for compliance with by proposed fixed plant items. It is anticipated, that at this stage of the development, the specification and location of any plant is sufficiently flexible to ensure suitably quiet plant can be procured, and/or mitigation options can be investigated (e.g. housings, bolt on silencers, relocation and/or screening).

16.205 It has been demonstrated how the derived noise level limits could be incorporated into a conditional planning approval to ensure a commensurate level of protection against noise for existing and proposed noise-sensitive receptors.

Residual Impacts

Construction Noise

16.206 The likely effect of the suggested mitigation measures has been considered for the receptors adopted in the above construction noise assessment.

16.207 Tables 16.36 and 16.37 below presents the levels of noise attenuation that will be required, to ensure achieving the adopted 70 dB $L_{Aeq,T}$ criterion, based on the predicted worst case noise levels.

Table 16.36: Required Noise Reduction for Worst Case Construction Noise Levels, Penrhos and Cae Glas dB(A)

Receptor	Phase 1: Access, road works, utilities and connections	Phase 2: Substructure works	Phase 3: Superstructure works
A	2 dB	7 dB	1 dB
B	5 dB	5 dB	No additional Mitigation required
C	No additional Mitigation required	No additional Mitigation required	No additional Mitigation required
D	No additional Mitigation required	No additional Mitigation required	No additional Mitigation required
E	No additional Mitigation required	No additional Mitigation required	No additional Mitigation required
F	No additional Mitigation required	No additional Mitigation required	No additional Mitigation required
G	No additional Mitigation	No additional	No additional Mitigation

	required	Mitigation required	required
H	No additional Mitigation required	No additional Mitigation required	No additional Mitigation required

Table 16.37: Required Noise Reduction for Worst Case Construction Noise Levels, Kingsland dB(A)

Receptor	Phase 1: Access, road works, utilities and connections	Phase 2: Substructure works	Phase 3: Superstructure works
I	No additional Mitigation required	2 dB	No additional Mitigation required
J	No additional Mitigation required	No additional Mitigation required	No additional Mitigation required
K	No additional Mitigation required	No additional Mitigation required	No additional Mitigation required
L	No additional Mitigation required	No additional Mitigation required	No additional Mitigation required

16.208 Considering Tables 16.36 and 16.37 above, it can be seen that the levels of mitigation required to ensure achievement of the adopted assessment criteria, even during worst case operations, fall within those which can be achieved by use of the mitigation measures detailed in the corresponding section above.

16.209 Accordingly, drawing upon the content of the Tables 16.8 and 16.9, the sensitivity of receptor is High, and the magnitude of impact with mitigation is Slight to Low. In accordance with Table 16.13, this corresponds to impacts of **Negligible to Minor** significance.

16.210 Identified impacts would be short to medium term, temporary, and local in nature.

Construction Vibration

16.211 With the above mitigation measures in place, impacts could be controlled to be of Low magnitude at Worst.

16.212 In accordance with Tables 16.8 and 16.10, the sensitivity of receptors would be High, and the magnitude of impacts with mitigation would be Slight to Low. In accordance with Table 16.13, this corresponds to impacts of **Negligible to Minor** significance.

16.213 Such impacts would be short to medium term, temporary and local in nature.

Completed Development

Existing Noise Environment – Impact on Proposed Noise Sensitive Development

Residential Development at Kingsland

16.214 The above assessment has identified that with due consideration to building fabrication and use of localise noise barriers adjacent to Kingsland Road, a commensurate level of protection can be afforded to future occupants of the proposed residential development

16.215 Accordingly, drawing upon Table 16.8 and paragraph 16.60, the sensitivity of receptors is High, and impact magnitude is Slight. In accordance with Table 16.13 this corresponds to an impact of **Negligible** significance.

16.216 Identified impacts would be long term, permanent and local in nature.

Proposed Holiday Accommodation at Cae Glas and Penrhos

16.217 The above assessment has identified that with due consideration to building fabrication, and detailed scheme layout options, a commensurate level of protection can be afforded to future occupants of the proposed residential development

16.218 Accordingly, drawing upon Table 16.8 and paragraph 16.60, the sensitivity of receptors is High, and impact magnitude is Slight. In accordance with Table 16.13 this corresponds to an impact of **Negligible** significance.

16.219 Identified impacts would be long term, permanent and local in nature.

Development Generated Road Traffic Noise Level Changes

16.220 As consideration to mitigation is unwarranted, the identified impacts would remain.

16.221 Drawing on the content of Tables 16.8 and 16.11, the sensitivity of receptors is High and the magnitude of impact ranges from Slight to Low. In accordance with Table 16.13 this corresponds to impacts of **Negligible to Minor** significance.

16.222 Identified impacts would be long term, permanent and local in nature.

Noise from Proposed Fixed Plant/ Commercial Operations

16.223 Drawing upon Tables 16.8 and 16.12, the sensitivity of receptors is High, and compliance with the derived noise level limits would ensure that the impact magnitude would be Low. In accordance with Table 16.13, this corresponds to impacts of **Minor** Significance.

16.224 Identified impacts would be long term, permanent and local in nature.

Conclusions

16.225 The completed noise and vibration assessment has considered the potential noise and vibration impacts that could arise as a result of the proposed development. Consideration has been given to potential impacts during both the construction and operational phases of the development. Consideration is given to the suitability of the prevailing noise environment for the proposed development, and the impacts that the scheme could have on existing local noise and vibration sensitive receptors.

16.226 It has been identified that with the use of appropriate building fabrication measures (e.g. glazing and ventilation products), an appropriate internal noise environmental can be achieved within the proposed residential dwellings across the Kingsland Site. It has also been identified that an appropriate noise environment can be achieved in proposed external living spaces at the Kingsland development, with the use of scheme layout design techniques, or use of localised noise barriers on the site boundary with Kingsland Road. Associated residual impacts have been identified to be of Negligible significance.

16.227 An assessment of the prevailing noise environment across the Cae Glas and Penrhos sites has also identified that with the use of similar building fabrication measures (e.g. glazing and ventilation products), an appropriate internal noise environmental can be achieved within the proposed holiday accommodation (Lodges etc). With use of acoustics bunds / acoustic fences to screen noise from the A5 and A55, and use of careful scheme layout design techniques, an appropriate noise environment can also be achieved within external living spaces associated with this accommodation. Associated residual impacts have been identified to be of Negligible significance.

16.228 With the use of appropriate mitigation measures, such as compliance with the principles of best practicable means for noise mitigation, selection of appropriate working techniques, and possible use of vibration surveys to inform working methods etc., it has been identified that construction noise and vibration impacts can be controlled to be of Minor significance at worst. Necessary mitigation measures could be ensured by specification of appropriate requirements within a Construction Environmental Management Plan (CEMP), which could be conditioned for compliance with.

16.229 Appropriate noise level limits have been determined for the control of noise from any fixed plant associated with the operation of the proposed development. It has been demonstrated how such limits could be conditioned for compliance with, to ensure a commensurate level of protection against noise for existing local residents, and proposed leisure occupants.

16.230 It has been identified that changes in road traffic noise levels associated with the operation of the proposed development would be gradual over time, and corresponds to impact of Negligible to Minor significance at worst.

References

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Noise Constraint Area

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Figure 16.1

Title: Noise Constraint Area, Infrastructure Policy SG7, Stopped Unitary Development Plan – Cae Glas Site

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+ Receptor

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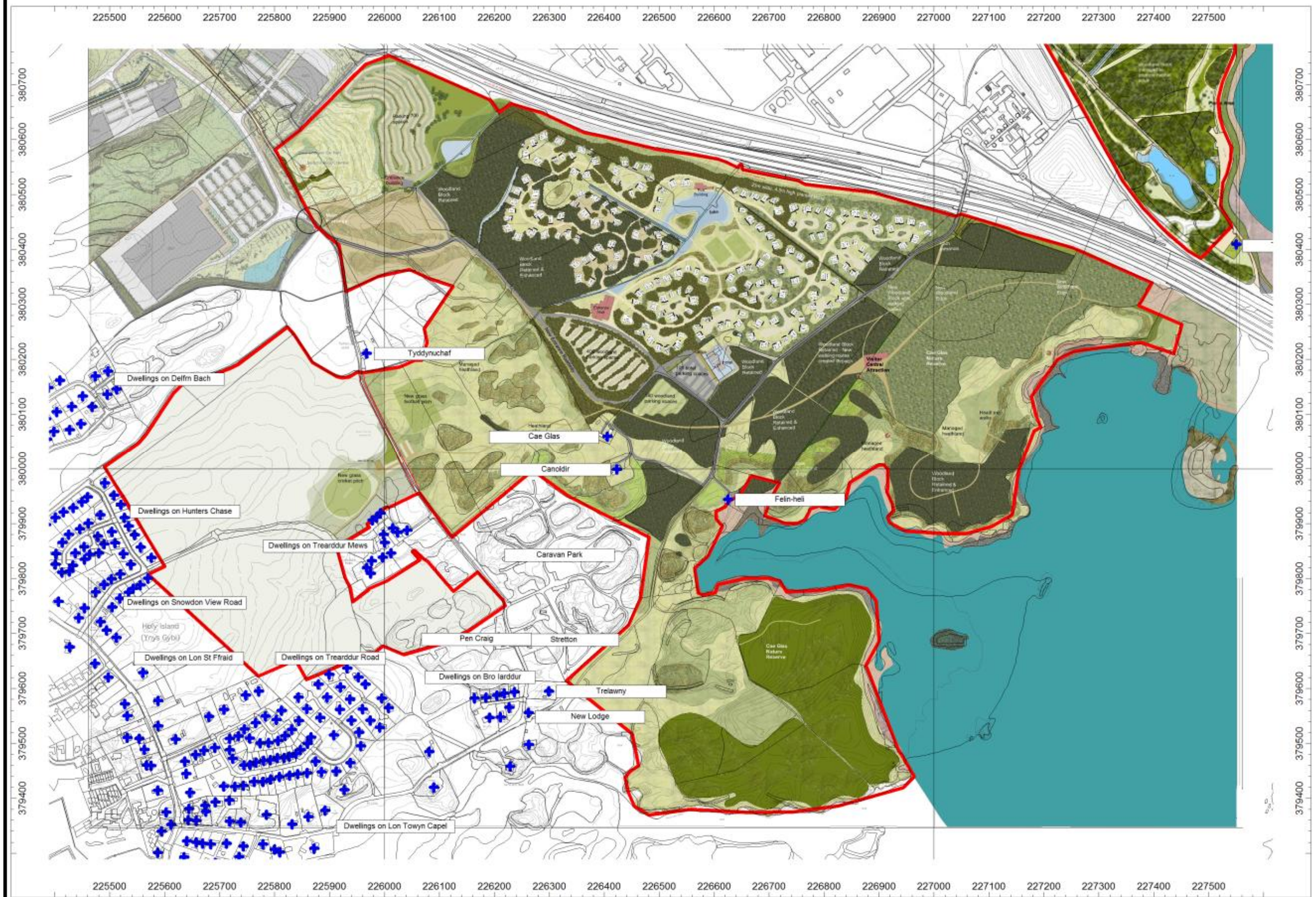
21/09/2012	A		JGP

Figure 16.2a

Title: Noise and Vibration Sensitive Receptors - Kingsland Site

WSP ACOUSTICS



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+ Receptor

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Figure 16.2b

Title: Noise and Vibration Sensitive Receptors - Cae Glas Site

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+ Receptor

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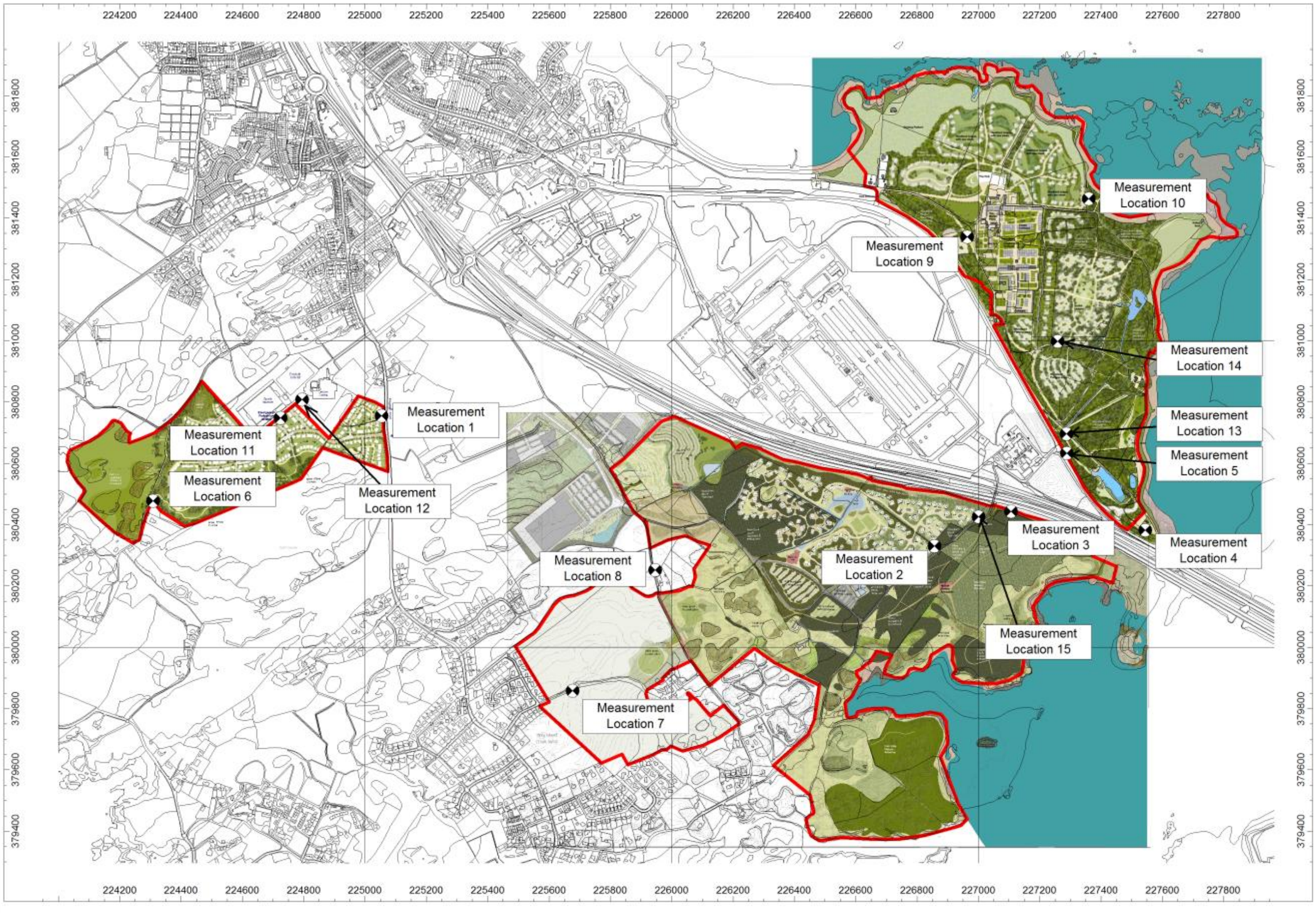
Figure 16.2c

Title: Noise and Vibration Sensitive Receptors - Penrhos Site

WSP ACOUSTICS



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Measurement Location

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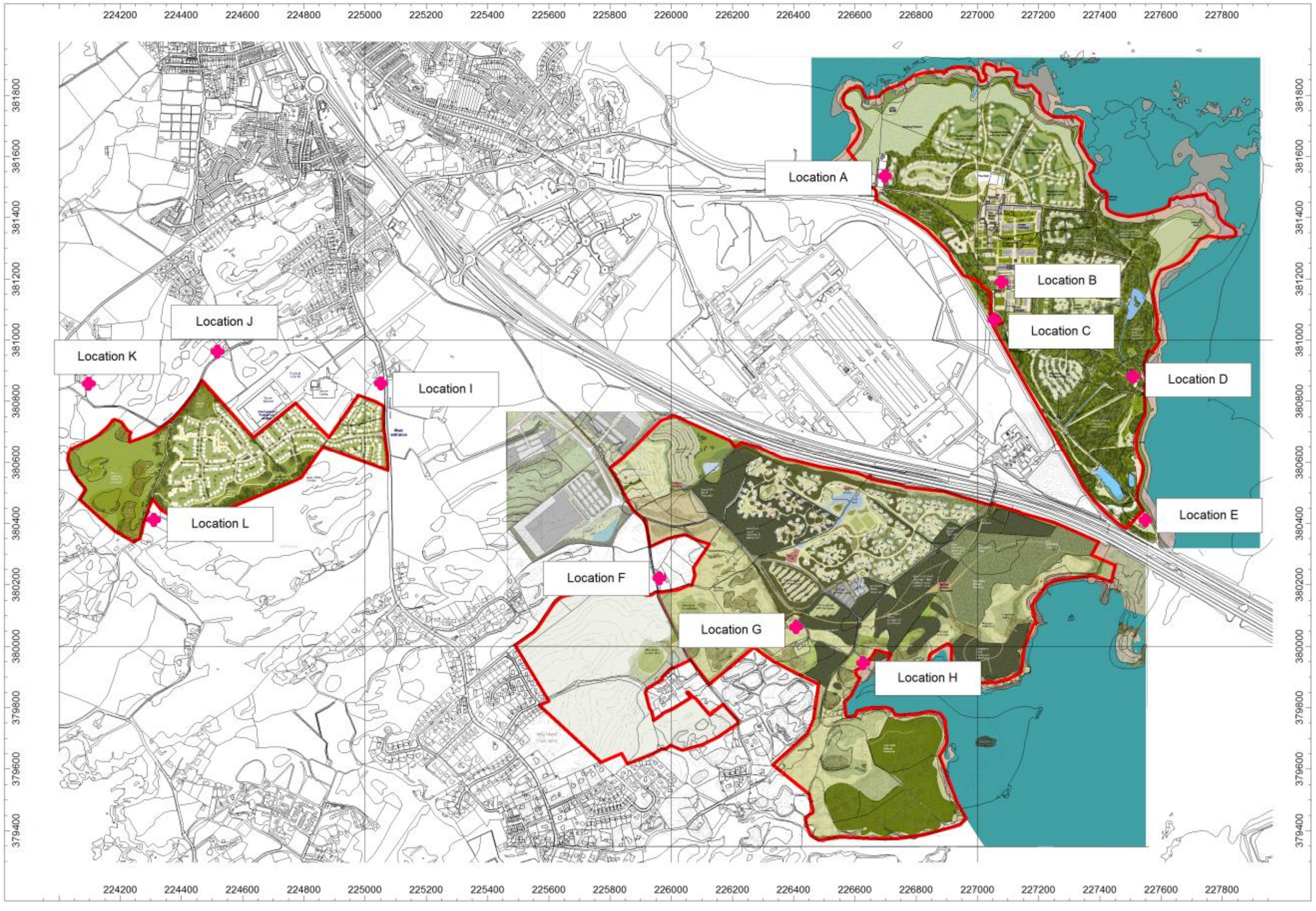
Figure 16.3

Title: Noise Measurement Locations - All Sites

WSP ACOUSTICS



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Assessment Location

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Figure 16.4

Title: Construction Noise Assessment Locations - All Sites

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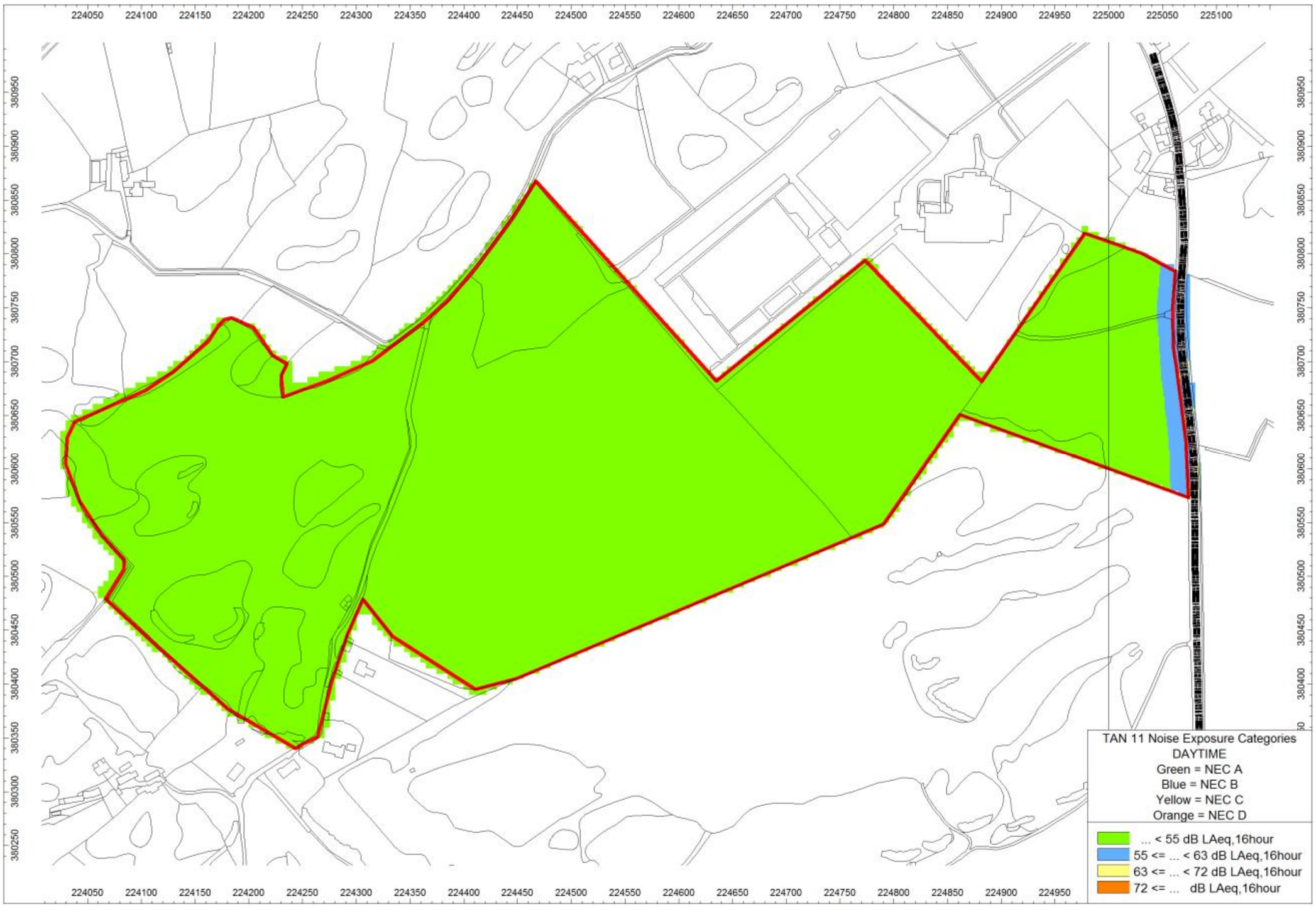

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Figure 16.5a

Title: TAN 11 Noise Exposure Categories – Daytime

Kingsland Site

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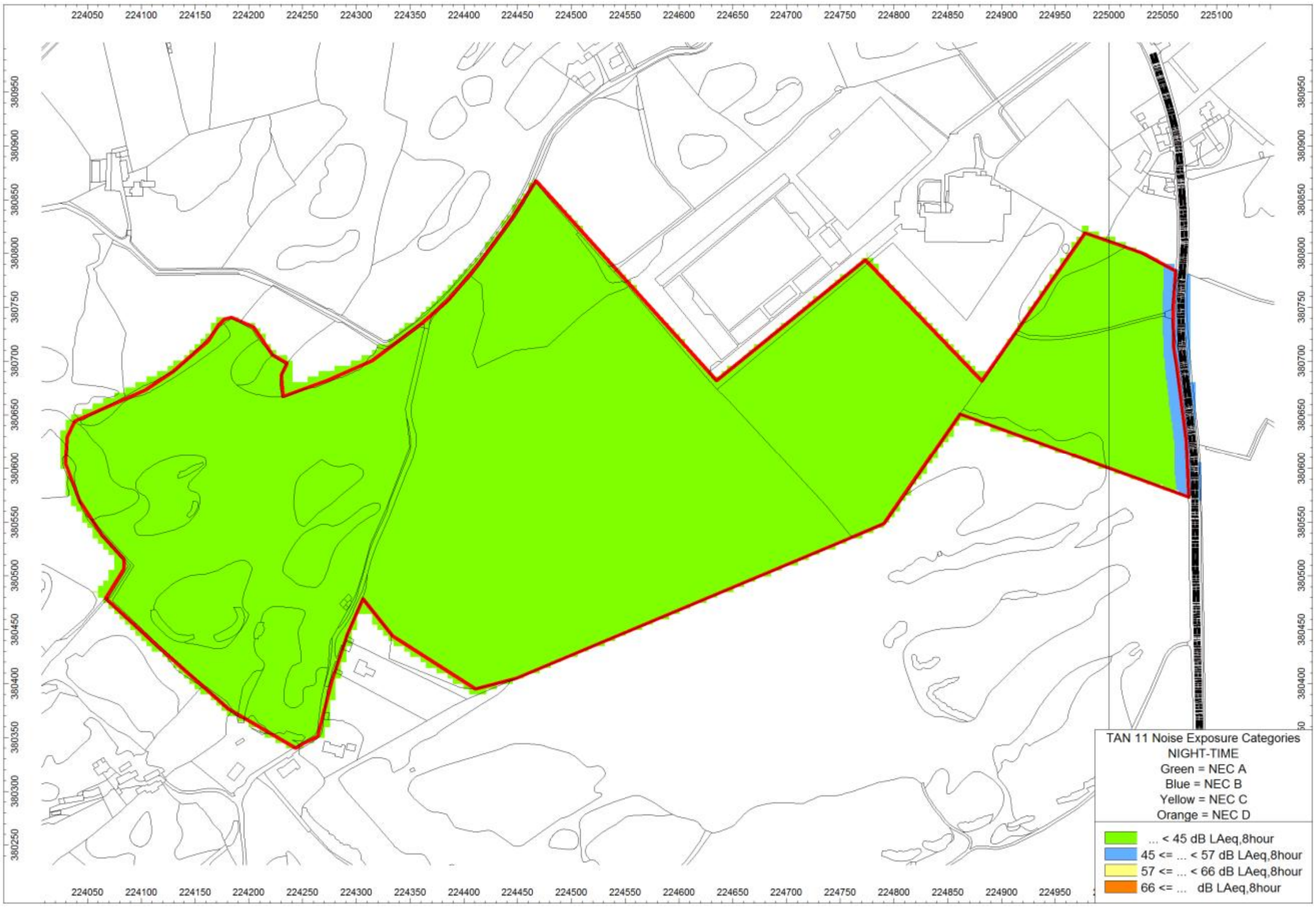

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Figure 16.5b

Title: TAN 11 Noise Exposure Categories – Night-time

Kingsland Site

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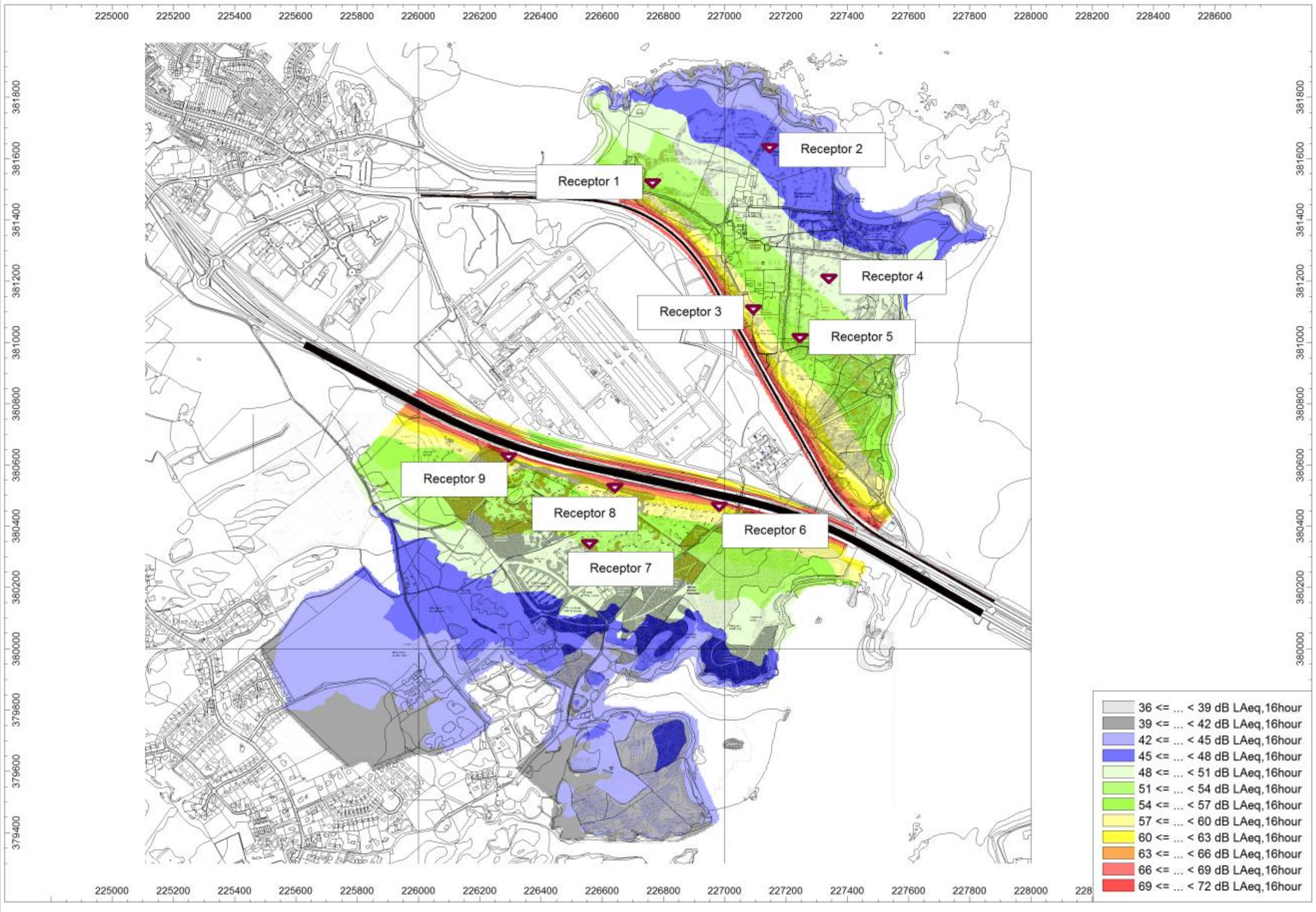

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Sample Proposed Receptor Locations

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Figure 16.6a

Title: Daytime Noise levels and Proposed Sample Receptor Locations – Cae Glas and Penrhos Sites

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Sample Proposed Receptor Locations

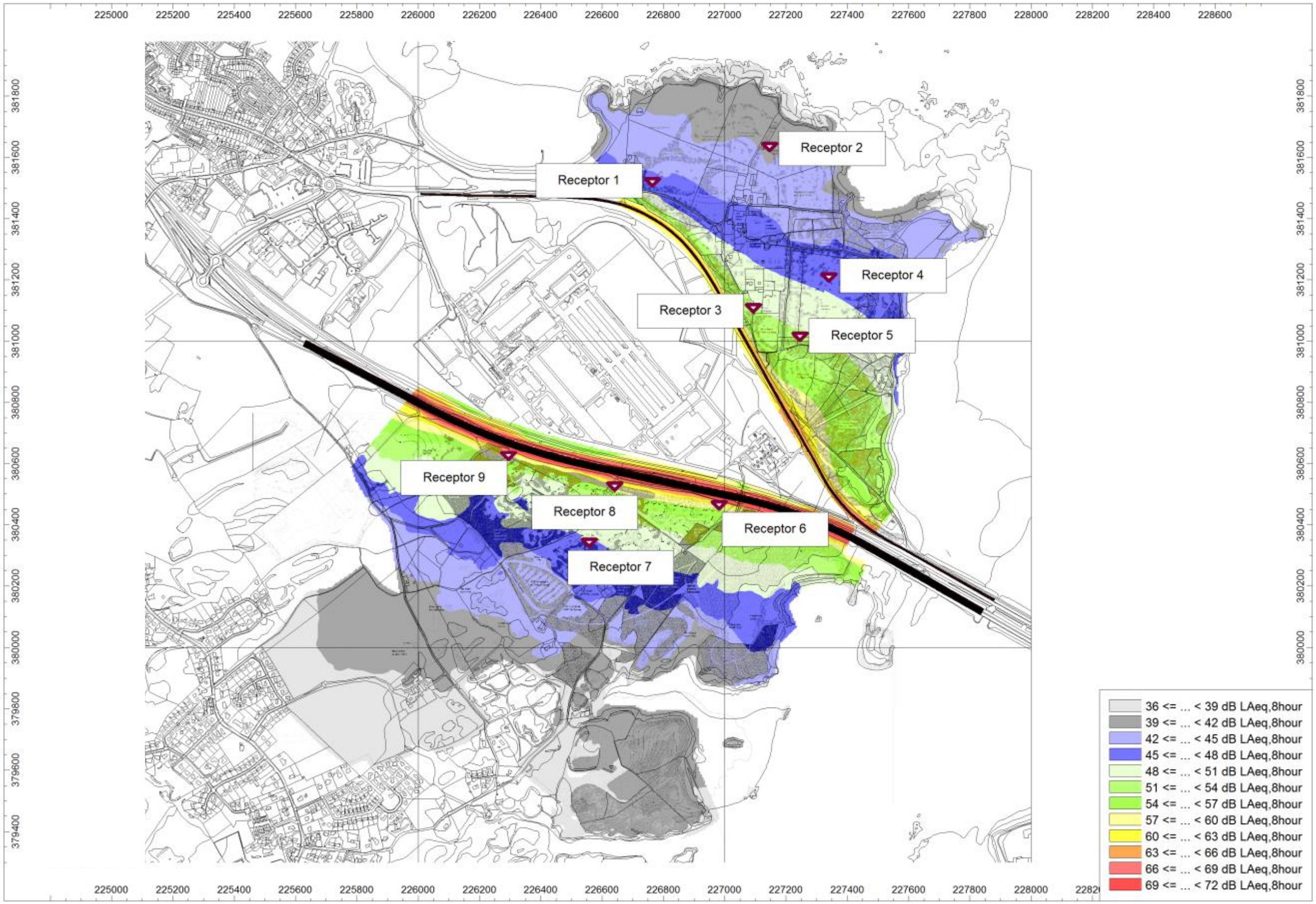

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Figure 16.6b

Title: Night-time Noise levels and Proposed Sample Receptor Locations – Cae Glas and Penrhos Sites

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