



Barons Park Farm, Desford Lane
15/01221/HYB

Noise Impact Assessment

18th May 2021
Final Issue



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Executive Summary and Conclusions

This document, a Noise Impact Assessment (NIA), has been written to assess the proposals for residential development at Land at Barons Park Farm, Desford Lane, Kirby Muxloe in terms of the noise and vibration impact that the residual environment would have on future occupants of the proposed development.

In summary, PJA believes that the noise impact on future occupants at the proposed development can be controlled to an acceptable level – without unreasonably impacting on residential amenity.

Internal ambient noise level (IANL) targets can be met with closed windows glazing with a moderate-to-high level of acoustic performance on the elevations closest to the railway and Desford Road, with low/standard performance glazing on other facades. Glazing and trickle ventilators should meet the sound reduction indices outlined in **Table 4.1/Figure 4.1** of **Section 4.5**. This also does not mean windows are not openable – most people will wish to open windows despite slightly elevated noise levels internally, and external noise levels are not excessively high to mean that that opening the windows would be unacceptable.

As per **Section 4.4**, external amenity noise levels are within or below the recommended 50 – 55 dB $L_{Aeq,16hr}$ upper range (as recommended by WHO guidelines, BS 8233:2014, and the ProPG) for the external amenity spaces to be enjoyed as intended.

Regarding vibration, PJA anticipates that the **risk of vibration impact is negligible**, as summarised in **Section 5.0**.

Therefore, PJA, as suitably qualified acoustic consultants, recommends that noise and vibration should not pose a constraint to achieving planning permission for the proposed development, providing the recommendations herein are followed.

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1.0 Introduction

ParkerJones Acoustics Limited (PJA) has been instructed to undertake a Noise and Vibration Assessment for residential development at Land at Barons Park Farm, Desford Lane, Kirby Muxloe.

1.1 Scope of Report

This report has been written to assess the site in terms of the noise and vibration impact that the residual environment would have on the future occupants of the proposed development.

The objective is to ensure that the noise/vibration impact is being considered and controlled sufficiently. Therefore, where considered necessary, mitigation measures have been suggested to ensure that identified impacts are minimised.

Whilst every attempt has been made to ensure that this report communicates effectively to a reader who might not have much knowledge of acoustics, some parts are necessarily technical. A glossary of acoustic terminology and concepts is provided in **Appendix A**.

1.2 Assessment Criteria

This report takes into consideration national planning policies including the National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and the Planning Practice Guidance on Noise (PPG-N) (summarised in **Appendix B**), which outline the purpose and long-term vision of planning policy with respect to noise. The assessment is aimed at limiting the impacts to no greater than the Lowest Observed Adverse Effect Level (the level above which *adverse* effects on health and quality of life can be detected).

More specifically, the assessment has been undertaken with reference to:

- the Professional Practice Guidance on Planning and Noise (ProPG) (2017), which provides guidelines regarding suitable internal ambient noise levels for residential properties;
- BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings*, which “provides guidance on the control of noise in and around buildings” and recommends appropriate criteria and internal noise limits for different situations, including residential developments;
- The World Health Organisation (WHO) ‘*Guidelines for Community Noise*’ (1999) and ‘*Night Noise Guidelines for Europe*’ (2009) documents, which suggest suitable internal noise levels in dwellings, and external noise levels in external amenity areas which would constitute a “moderate” or “serious” annoyance; and
- BS 6472-1:2008 ‘*Guide to evaluation of human exposure to vibration in buildings – vibration sources other than blasting*’ which gives guidance on levels of perceptible vibration at which adverse comments may begin to arise and states acceptable vibration levels for various building types including residential dwellings.

2.0 Site and Development Description

The site of the proposed development is at Land at Barons Park Farm, Desford Lane, Kirby Muxloe. As shown in **Figure 2.1**, the site comprises the existing Barons Park Farm buildings, sitting to the south of Desford Lane and between a care home/agricultural use land to the west, and residential development to the east and south. A freight only railway line runs close to the south boundary.

The approved proposals are for the creation of up to 17 additional dwellings to the existing three on-site. The development comprises the retention of the existing farmhouse, conversion of traditional agricultural barns to three dwellings, and the construction of new houses – as per the site plan in **Figure 2.2**.

Figure 2.1 – Site location



Figure 2.2 – Site plan



3.0 Conditions and Guidelines

3.1 Planning Conditions

This report has been written with reference to the planning approval for the development issued on the 21st of October 2019 (ref 15/01221/HYB), which includes a condition in respect of the outline application:

"O5. Prior to commencement of development a scheme for protecting the occupiers of the proposed dwellings from noise and vibration from the adjacent railway has been submitted to and approved by the Local Planning Authority. All works which form part of the scheme shall be completed prior to occupation of any dwelling hereby permitted."

Reason: To ensure the amenity of future occupiers to accord with Policy DM10 of the Site Allocations and Development Management Policies DPD."

3.2 World Health Organisation (WHO) Environmental Noise Guidelines

The WHO document *Guidelines for Community Noise 1999* has recently been superseded by the *Environmental Noise Guidelines for the European Region*. However, the updated guidance states that 'all WHO guidelines for community noise (CNG) indoor guideline values and any values not covered by the current guidelines (such as industrial noise and shopping areas) should remain valid'.

The 1999 document gives the following description of community noise:

*"Community noise (also called environmental noise, residential noise or domestic noise) is defined as noise emitted from all sources except noise at the industrial workplace. Main sources of community noise include **road, rail and air traffic**, industries, construction and public work, and the neighbourhood. Typical neighbourhood noise comes from premises and installations related to the catering trade (restaurant, cafeterias, discotheques, etc.); from live or recorded music; sport events including motor sports; playgrounds; car parks; and domestic animals such as barking dogs."*

3.2.1 Internal Ambient Noise Levels

For steady continuous noise, the GCN recommends an indoor guideline value for bedrooms of 30 dB $L_{Aeq,8hr}$ and 45 dB L_{AFmax} for a single sound event to prevent sleep disturbance.

3.2.2 Outdoor Amenity Noise Levels

Regarding external noise, the GCN states:

- To protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55 dB L_{Aeq} for a steady, continuous noise.
- To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB L_{Aeq}

3.3 BS 8233:2014

BS 8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings' suggests appropriate criteria and limits for different situations. It is primarily intended to guide the design of new buildings, or refurbished buildings undergoing a change of use.

This includes internal and external noise criteria for residential developments. The limits with BS 8233:2014 are similar to those in the WHO's 'Guidelines for Community Noise' (1999) and 'Night Noise Guidelines for Europe' (2009) documents.

3.3.1 Internal Ambient Noise Levels

Table 4 of BS 8233:2014 provides 'desirable' internal ambient noise level (IANL) limits for dwellings from "steady external noise sources". BS 8233:2014 also notes that "where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved." These targets are summarised in **Table 3.1** below.

Table 3.1 – BS 8233:2014 internal ambient noise level (IANL) upper limits

Activity	Location	Daytime (07:00 – 23:00)		Night-time (23:00 – 07:00)	
		Desirable conditions	Reasonable conditions	Desirable conditions	Reasonable conditions
Resting	Living Room	35 dB L _{Aeq,16hr}	40 dB L _{Aeq,16hr}	-	-
Dining	Dining Room/Area	40 dB L _{Aeq,16hr}	45 dB L _{Aeq,16hr}	-	-
Sleeping (daytime resting)	Bedroom	35 dB L _{Aeq,16hr}	40 dB L _{Aeq,16hr}	30 dB L _{Aeq,8hr}	35 dB L _{Aeq,8hr}

In Annex G.1 of BS 8233:2014 it suggests that "if partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB".

Whilst it is desirable to achieve the recommended IANLs with windows open, this is not stipulated as a mandatory requirement within the guidance of BS 8233:2014 which states "if relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level. If applicable, any room should have adequate ventilation (e.g. trickle ventilators should be open) during assessment."

Therefore, a noise limit directly outside of the nearest residential windows could be set based upon the values above plus 15 dB, as per below:

- Desirable internal conditions – Façade noise levels <50 dB L_{Aeq,16hr}
- Reasonable internal conditions – Façade noise levels <55 dB L_{Aeq,16hr}

3.3.2 Outdoor Amenity Noise Levels

BS 8233:2014 indicates that in external areas used for amenity space, it is desirable that external noise levels do not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments.

Although in many areas, i.e. next to a strategic transport network, a compromise between elevated noise levels and the convenience of living in these locations may be acceptable. In such a case, the development should be designed to 'achieve the lowest practicable levels' in these external amenity spaces but should not be prohibited.

3.4 The Professional Practice Guidance on Planning and Noise (ProPG)

The ProPG, published in 2017, extends on the guidance and numerical targets within BS 8233:2014 and WHO guidelines, new and extended recommendations where these standards are considered to fall short. Therefore, it is considered to be the most relevant and up to date design standard for assessing the noise impact on new residential developments.

3.4.1 Internal Ambient Noise Levels

The ProPG provides internal ambient noise level targets based upon BS 8233:2014 and WHO guidelines, as shown in the table below. The targets are essentially the same as BS 8233:2014 guidelines but with the addition of an $L_{Amax,F}$ target overnight based on WHO guidelines.

The ProPG indicates that the guidance can be relaxed by up to 5 dB (as does BS 8233:2014) where development is considered necessary or desirable, despite high external noise levels.

Table 3.2 – The ProPG internal ambient noise level (IANL) upper limits

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ 45 dB $L_{Amax,F}$ ¹
¹ a threshold by which 'good acoustic design' is achieved by not exceeding this threshold more than 10 times a night			

Whilst it is desirable to achieve the recommended IANLs with windows open, an assessment can be made with closed windows and open ventilators (i.e. trickle vents) which provide "*whole dwelling ventilation*" (as defined by Building Regulations Approved Document F).

Closed windows do not mean sealed shut/un-openable windows, as occupants would favour the ability to open the windows (especially during the hotter months of the year) even if the resultant internal acoustic conditions aren't as satisfactory.

3.4.2 Outdoor Amenity Noise Levels

The ProPG also provides guidance for outdoor amenity noise levels based upon WHO and BS 8233:2014 guidelines. This applies to gardens, balconies, roof terraces, and patio areas.

If outdoor amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended. Noise levels should ideally not be above the range **50 – 55** **dB L_{Aeq,16hr}**.

It does, however, accept that this can't be achieved in all situations, in which the development should be designed to achieve the lowest practicable noise levels in these outdoor amenity spaces. The impact can partially be offset by the residents having access to a:

- relatively quiet alternative outdoor amenity space as part of the property, group of residential properties, or a public space in the nearby area; and/or
- a relatively quiet facade (containing openable windows to habitable rooms) or a relatively quiet externally ventilated space (i.e. an enclosed balcony) as part of their dwelling.

3.5 BS 6472:1992

BS 6472-1:2008 'Guide to evaluation of human exposure to vibration in buildings – vibration sources other than blasting' which gives guidance on levels of perceptible vibration at which adverse comments may begin to arise and states acceptable vibration levels for various building types including residential dwellings.

Table 1 in BS 6472 gives Vibration Dose Values (VDVs) above which various degrees of adverse comment may be expected in residential buildings, as shown in the table below.

Table 3.3 – Vibration dose value ranges which might result in probabilities of adverse comment within residential buildings

Place and time	Low probability of adverse comment $\text{m/s}^{1.75}$	Adverse comment possible $\text{m/s}^{1.75}$	Adverse comment probable $\text{m/s}^{1.75}$
Residential Buildings, 16 hr day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential Buildings, 8 hr night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

4.0 Noise Assessment

4.1 Methodology

The assessment details the impact the existing noise environment would have on the proposed development, including the implications this has on the ventilation strategy and the construction types required within the façade to reduce external noise ingress to an acceptable level for the future occupants.

The following summarises the main steps of action in the assessment method:

- Firstly, the existing ambient noise environment at the site is assessed.
- A 3D noise map model is then used to predict noise levels at the site and surrounding area, with the proposed development then added into the model to predict external noise levels incident on the building's facade once it is in place.
- Noise ingress into living spaces is then assessed against the IANL limits of BS 8233:2104, to determine the sound reduction requirements of the building envelope and determine whether background ventilation can be provided by open windows, trickle ventilators, or mechanical ventilation (to meet IANL limits).

4.2 Environmental Noise Climate

A comprehensive 3D noise map model has been produced for the site and the wider surrounding area. The model parameters have been configured to predict noise levels based on several sources of information:

- Noise mapping data for major transport routes available online from the Department for Environmental Food & Rural Affairs (DEFRA), as part of a *Strategic Noise Mapping* exercise – see **Appendix D**.
- Traffic count data available from the Department for Transport (DFT) ¹. Traffic data can be input into the model which is able to conduct calculations in accordance with the *Calculation of Road Traffic Noise* (CRTN) methodology.
- Data measured at other sites/as part of assessments for other projects which are close to railway lines.

4.3 Noise Mapping (Predicted Noise Levels)

A noise model/map for the existing site and proposed development has been constructed using the CadnaA® software package, a commonly used 3-D noise modelling software that implements a wide range of national and international standards, guidelines and calculation algorithms, including those set out in ISO 9613-2:1996.

The intention of noise modelling/mapping for this assessment is to accurately determine the noise levels across the entire site, at each façade and each floor of the building(s) associated with the proposed development, and each external amenity area.

Screenshots from the noise model and further information on the model parameters are provided in **Appendix D**.

1 - <https://roadtraffic.dft.gov.uk/#14/52.6223/-1.2446/basemap-countpoints>

The model has first been set up to reflect the noise climate at the existing site:

- **Figure D.1** – shows 3D views of the model setup of the existing site;
- **Figure D.2** – daytime $L_{Aeq,16hrs}$ of the existing site and wider surrounding area (map height 4m);
- **Figure D.3** – daytime $L_{Aeq,16hrs}$ of the existing site – closer view (map height 1.7m);
- **Figure D.4** – night-time $L_{Aeq,8hrs}$ of the existing site;

The proposed development has then been added to the model:

- **Figure D.5** – shows 3D views of the model setup with the proposed development in place;
- **Figure D.6** – shows the daytime ambient noise level $L_{Aeq,16hr}$ in external amenity areas;
- **Figure D.7** – shows the predicted façade exposure levels outside the windows of the proposed buildings in terms of the daytime $L_{Aeq,16hr}$ – outside of the worst affected floors.
- **Figure D.8** – shows the night-time ambient $L_{Aeq,8hr}$ façade exposure;
- **Figure D.9** – shows the façade exposure in terms of the 10th highest maximum noise level L_{AFmax} at night.

4.4 Outdoor Amenity Noise Levels

WHO Guidelines and the ProPG imply that noise levels in outdoor amenity spaces should ideally not be above the range **50 – 55 dB $L_{Aeq,16hr}$** for the spaces to be enjoyed as intended.

Figure D.6 in **Appendix D** shows the predicted daytime levels in the gardens of the development. It is seen that all plots have garden areas with noise levels in the **50 – 55 dB $L_{Aeq,16hr}$** range on the edge of the site (near to Desford Road and the railway line), with levels of 45 – 50 dB in the centre of the site.

PJA do not believe that any further mitigation would therefore be required and that the external noise levels are at an acceptable level for the enjoyment of the back gardens. The model has accounted for standard garden fencing being installed – though acceptable levels would still be achieved even without such fencing.

4.5 External Noise Ingress

4.5.1 Internal Ambient Noise Limits

The criteria for internal ambient noise levels (IANLs) are based upon guidance from BS 8233:2014 and the ProPG. In summary, the proposed development should seek to control IANLs from external noise sources to no greater than:

- Daytime – 35 dB $L_{Aeq,16hr}$; and
- Night-time – 30 dB $L_{Aeq,8hr}$ and 45 dB L_{AFmax} (no more than 10 times per night).

The criteria apply to bedrooms, the most sensitive room type. The daytime target applies to living rooms (no night-time target is applied to living rooms).

4.5.2 Building Envelope

To assess the required sound reduction performance for the building envelope, façade exposure levels have been defined as shown in **Figure 4.1**. These are based upon the floor-by-floor façade noise levels determined from the noise modelling.

Figure 4.1 – Façade exposure levels



The weakest elements of a façade in terms of sound reduction are the windows/glazing. This is particularly true when windows are open (as an open window will typically provide around 15 dB reduction). In this case, it is seen that IANL targets are unlikely to be met with open windows.

Alternative forms of natural background ventilation (such as trickle vents) can also be a weak point but can be treated to achieve a much higher level of sound reduction than an open window – so that IANL targets *can* be met with natural ventilation in areas where the targets would be exceeded when opening the windows.

Therefore, **Table 4.1** provides the minimum sound reduction indices for glazing and ventilators (the weakest elements acoustically) on each exposure level.

It is not uncommon for external noise levels to mean that internal targets are exceeded with open windows. It should also not be assumed that windows need to be sealed shut, as many occupants will favour the ability to open their windows at will, particularly during the hotter months of the year, and external noise levels are certainly not excessively high to prevent doing so.

What it does mean, is that an alternative form of background ventilation (i.e. trickle vents – or a mechanical ventilation system) should be provided so that IANL targets can be met whilst providing background ventilation to the dwellings with the windows closed (but openable at the occupants' discretion, rather than through necessity).

Average daytime and night-time levels ($L_{Aeq,16hrs}$ and $L_{Aeq,8hrs}$) are relatively low at the site. The reason for the higher minimum ratings Exposure 1 and Exposure 2 are due to night-time maximum noise levels (L_{AFmax}) from train passing's and vehicles passing's on Desford Road.

Across most of Exposure 3 (which covers most of the site) – $L_{Aeq,16hrs}$ and $L_{Aeq,8hrs}$ internal targets should be met with open windows. The requirements on Exposure 3 are likely to be met by any glazing and any trickle ventilator included as standard (which is understood to be compulsory to achieve the ventilation requirements in Approved Document F of the Building Regulations).

A non-exhaustive list of example glazing constructions and ventilator products such as trickle vents and air bricks have been provided in **Appendix E**, which are capable of achieving the required $R_w + C_{tr}$ and $D_{n,e,w} + C_{tr}$ indices.

PJA recommend that glazing which has two panes of glass that are the same thickness are avoided where possible unless the manufacturer has test data that proves its performance can meet the required $R_w + C_{tr}$ – as these can resonate together and are usually worse performing than two panes of different thicknesses, even if the second pane is slightly thinner than the first. This is especially true with triple glazing.

Table 4.1 – Minimum required sound reduction indices for glazing and ventilators

Exposure Category	Minimum sound reduction indices/construction examples	
	Glazing ¹ See Appendix E.1	Ventilators ² see Appendix E.2
Exposure 1	34 dB $R_w + C_{tr}$ Thick double glazing, i.e. - 10mm standard float - 15mm air cavity - 6mm standard float	37 dB $D_{n,e,w} + C_{tr}$ i.e. Duco DucoTop 60 SR – Grando AK+
Exposure 2	31 dB $R_w + C_{tr}$ Standard double glazing, i.e. - 4mm standard float - 10mm air cavity - 10mm standard float	34 dB $D_{n,e,w} + C_{tr}$ i.e. Duco GlasMax
Exposure 3	25 dB $R_w + C_{tr}$ Any double glazing	28 dB $D_{n,e,w} + C_{tr}$ i.e. Duco DucoTop 60 SR – Corto AK+
1. A non-exhaustive list of suitable glazing products is given in Appendix E.1 . Standard double glazing will usually achieve a minimum sound reduction of 26 dB $R_w + C_{tr}$. 2. A non-exhaustive list of suitable ventilator products is given in Appendix E.2 . The acoustic performance should meet these values when the vent is open. They may not be required if the development uses mechanical ventilation. Low-performance trickle vents will usually achieve a minimum sound reduction of 25 dB $D_{n,e,w} + C_{tr}$.		

4.6 Summary

In summary, PJA believes that the noise impact on future occupants at the proposed development can be controlled to an acceptable level and that this aspect of the noise assessment should not pose a constraint to achieving planning permission for the proposed development, providing the recommendations herein are followed.

Internal ambient noise level (IANL) targets can be met with closed windows glazing with a moderate-to-high level of acoustic performance on the elevations closest to the railway and Desford Road, with low/standard performance glazing on other facades. Glazing and trickle ventilators should meet the sound reduction indices outlined in **Table 4.1/Figure 4.1** of **Section 4.5**. This also does not mean windows are not openable – most people will wish to open windows despite slightly elevated noise levels internally, and external noise levels are not excessively high to mean that that opening the windows would be unacceptable.

As per **Section 4.4**, external amenity noise levels are within or below the recommended 50 – 55 dB $L_{Aeq,16hr}$ upper range (as recommended by WHO guidelines, BS 8233:2014, and the ProPG) for the external amenity spaces to be enjoyed as intended.

Therefore, this aspect of the noise assessment should not pose a constraint to achieving planning permission for the proposed development, providing the recommendations herein are followed.

5.0 Vibration Assessment

Sites where a vibration impact may occur would typically be within a few metres (i.e. <10m) of a significant vibration source such as:

- a railway (or an underground tube);
- a major road (i.e. a motorway or multiple lane A-road);
- a large-scale industrial facility;
- a power station or substation;
- continuous long-term construction activities over several years with an extensive amount of piling; or
- a property which shares a party wall or floor with the development and contains vibrating equipment, i.e. a launderette, or a gym (with heavy free weight impacts).

The only applicable source above is the railway, which is around 30m from the nearest building of the proposed site.

A baseline vibration survey at the site did not appear useful (or necessary) at the time of writing due to the COVID-19 pandemic and, therefore, the decreased levels of railway traffic. In PJA's opinion, a baseline survey should also not be necessary given the distance from the railway to the houses and given the context of the surrounding area in which there are residential properties within much closer proximity to the railway line.

PJA references vibration survey from another site (at Sydney Lawn, Sydney Road, Bathwick, Bath, BA2 6NR) which was a new residential property that sat within 10m of a busy railway in and out of Bath with a high volume of both passenger and freight trains². Vibration measurements were taken at ground level of an existing building, at a distance of less than 10m from the railway. The following estimated Vibration Dose Values (eVDV) were determined:

- Daytime - 0.03 m/s^{-1.75}
- Night-time - 0.025 m/s^{-1.75}

According to BS 6472-1 (see **Table 3.3** in **Section 3.5**), the eVDVs are below the range stated for a "low probability of adverse comment" and hence vibration levels were deemed to be acceptable.

PJA have no reason to believe that vibration levels at the proposed site, a distance of approximately 30m from the railway, would be any higher than those measured above (at a distance of 10m) from a much busier railway line. PJA also note that there is a significant number of developments in the area which are in close proximity to the railway line (many are much closer and the railway runs through a built up area) – including planning applications where vibration has not been raised as an issue.

Therefore, PJA does not anticipate that vibration should pose a constraint on the proposed development and therefore the site is considered suitable in this respect.

2 - The assumption was that there were 2 freight trains, 5 Diesel Multiple units (e.g. Wessex Trains) and 5 Diesel Locomotive-hauled (e.g. Intercity 125 Trains) per hour over the 24-hour period - based on observations made during a 2-hour period on a weekday afternoon where 3 freight trains, 9 DMUs and 8 125 Intercity 125 Trains passed the site. The same value was used for night but is extremely conservative and not representative of actual conditions.

Appendix A – Acoustic Terminology and Concepts

A.1 – Glossary

Table A.1 – Glossary of acoustic terminology

Term	Description
Airborne sound	Airborne sound is sound that is transmitted through the air. Airborne sound can be transmitted through elements, by causing the element to vibrate (imperceptible to the eye), in turn transmitting vibrations into the air on the other side. Most noise in a typical acoustic assessment is 'airborne' sound and is generated by sources such as speech, music and transport.
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio of the root-mean-square pressure of the sound and a reference pressure (2×10^{-5} Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
C_{tr}	A weighting curve applied to level differences to account for low-frequency noise, typically associated with traffic noise. This is often applied as an addition to $D_{nT,w}$ and R_w ratings used to describe levels of sound insulation.
$D_w / D_{nT,w}$	The D_w weighted level difference used to characterize the sound insulation between rooms in a building as they are. Single-number quantity that characterizes airborne sound insulation between rooms, but which is not adjusted to reference conditions. A $D_{nT,w}$ is a D_w which is then 'normalised' to account for the reverberation time of the room (the 'nT'), recognising that the level difference is dependent on how reverberant the receiver room is and that every room will have a slightly different reverberation time, hence the $D_{nT,w}$ is adjusted to reference conditions.
Flanking	Transmission of sound energy through paths adjacent to the building element being considered. For example, when considering a separating wall, as well as transmitting directly through the wall, sound can also travel around the wall by the floor, ceiling, corridor wall, and external wall.
Frequency	Sound is generally assessed over the frequency range of 63 Hz to 4000 Hz (4 kHz), although humans can potentially hear between 20 Hz and 20 kHz. Frequency is often divided into ('first') octave bands for analysis, with the range above considered within 7-octave bands with centre frequencies at 63 Hz, 125 Hz, 250 Hz, 1 kHz, 2 kHz and 4 kHz. 'Third' octave bands split this further into smaller frequency bands.
$L_{Aeq,T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period. This parameter is typically considered as a good representation of the 'average' overall noise level. It is referred to technically as the A-weighted equivalent continuous sound level and is a dB(A) as defined above.
$L_{A90,T}$	The A-weighted noise level that is exceeded for 90% of the measurement period T. This parameter is often considered as the 'average minimum level'.
$L_{AFmax,T}$	The maximum A-weighted noise level during the measurement period T.
R_w	Weighted sound reduction index. A single number rating of the sound insulation performance of a specific building element. R_w is measured in a laboratory. R_w is commonly used by manufacturers to describe the sound insulation performance of building elements such as plasterboard and concrete.
Sound insulation	When sound hits a surface, some of the sound energy travels through the material. 'Sound insulation' refers to the ability of a material to stop sound travelling through it.
Structure-borne sound	Transmission of sound energy as vibrations inside the structure of a building. Can be used an alternative term to impact sound, however, structure-borne will usually refer to noise transmitted into a structure from mechanical sources, rather than human sources.

A.2 – Subjective Changes in Sound Level

Table A.2 – Subjective loudness from an increase or decrease in sound pressure level

Change in sound pressure level	Relative change in sound power energy (multiplier)		Change in apparent subjective loudness (for mid-frequency range)
	Decrease	Increase	
3 dB	1/2	2	'Just perceptible'
5 dB	1/3	3	'Clearly noticeable'
10 dB	1/10	10	'Half or twice as loud'
20 dB	1/100	100	'Much quieter, or louder'

Appendix B – National Planning Policies

B.1 – National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these are expected to be applied. The NPPF provides a framework within which local people and their council can produce their own distinctive local and neighbourhood plans. With explicit reference to noise, the NPPF states that *"Planning policies and decisions should contribute to and enhance the natural and local environment by ... preventing new and existing development from contributing to, being put at unacceptable risk from ... noise pollution"*.

B.2 – Noise Policy Statement for England (NPSE)

The NPPF refers to the Noise Policy Statement for England (NPSE), which applies to most forms of noise including environmental noise. The NPSE sets out the long-term vision of Government policy which is to *"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development."* It aims that *"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

The use of the terms *"significant adverse"* and *"adverse"* are key phrases within the NPSE. The guidance establishes the concept of how the level of adverse effect on health and quality of life can be referenced including:

- **NOEL – No Observed Effect Level** - This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- **LOAEL – Lowest Observed Adverse Effect Level** - This is the level above which *adverse* effects on health and quality of life can be detected.
- **SOAEL – Significant Observed Adverse Effect Level** - This is the level above which *significant adverse* effects on health and quality of life occur.

Under the first aim of the NPSE (*"avoid significant adverse impacts on health and quality of life"*), an impact in line with SOAEL should be avoided. Under the second aim (*"mitigate and minimise adverse impacts on health and quality of life"*), where the impact lies somewhere between LOAEL and SOAEL, requiring that all reasonable steps are taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development, but does not mean that such adverse effects cannot occur.

B.3 - Planning Practice Guidance on Noise (PPG-N)

The Planning Practice Guidance on Noise (PPG-N) is part of a suite of web-based guidance which is intended to support the implementation of the policies in the NPPF and the NPSE.

It aids in expanding on the definitions from the NPSE of NOEL, LOAEL and SOAEL, by linking these terms to 'examples of outcomes', i.e. changes in behaviour and/or attitude to noise. The table below summarises the guidance from PPG-N in this regard.

Table B.1 – Noise exposure hierarchy based on the likely average response – adapted from PPG-N

Perception	Examples of outcomes	Increasing effect level	Action
NOEL - No Observed Effect Level ¹			
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
LOAEL - Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up the volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
SOAEL - Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to a change in the acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate the effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent
¹ This line is an assumption of the adverse effect level and is not explicitly referenced by PPG-N, though this appears to be a safe assumption.			

Appendix C – Existing Noise Climate

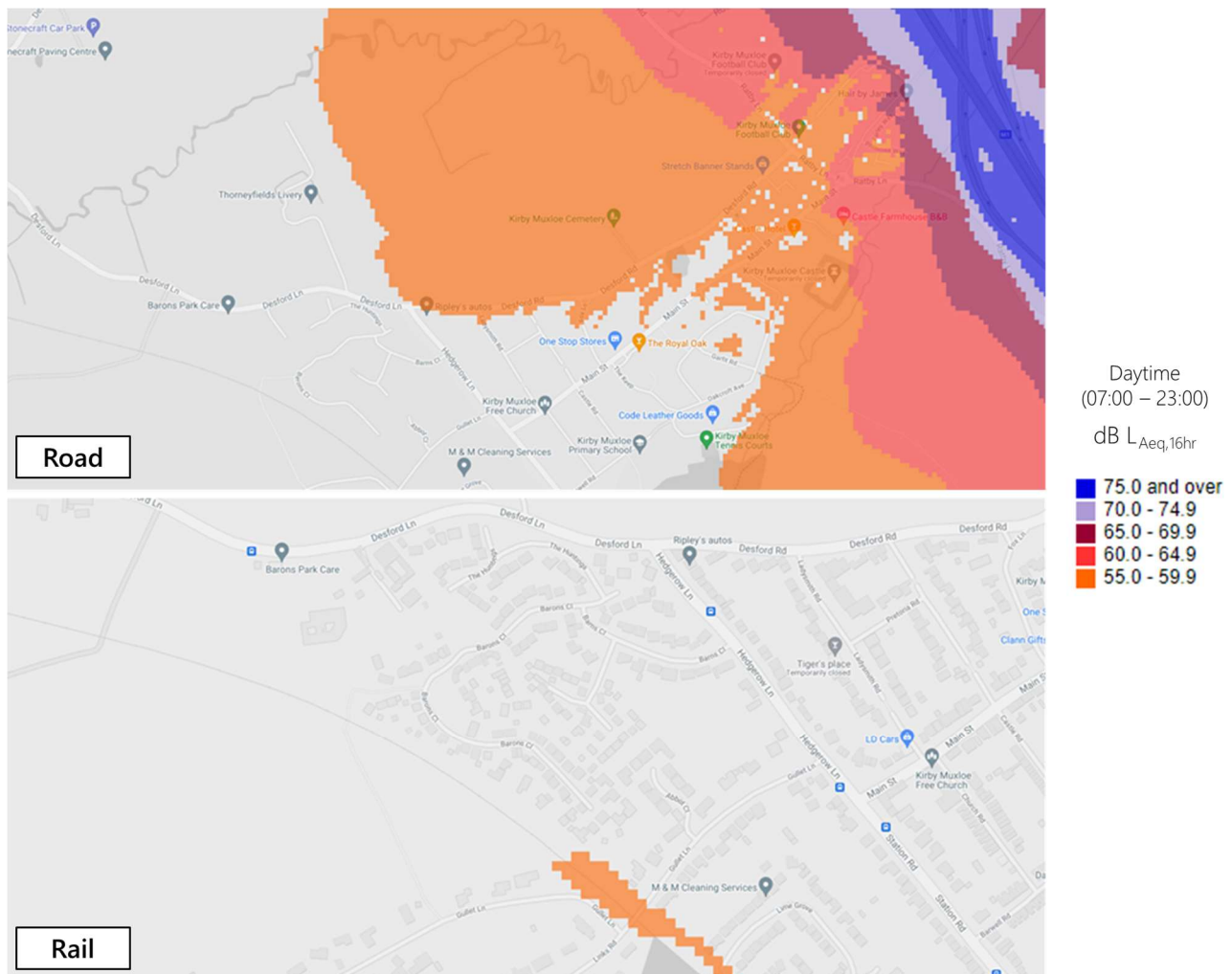
C.1 – Strategic Noise Mapping Data from DEFRA

Noise mapping data for major transport routes have been published online³ by DEFRA. The website says the following:

"This publication explains which noise sources were included in 2017 strategic noise mapping process. It provides summary maps for major road and rail sources and provides links to the detailed Geographic Information Systems (GIS) noise datasets. This data will help transport authorities to better identify and prioritise relevant local action on noise. It will also be useful for planners, academics and others working to assess noise and its impacts."

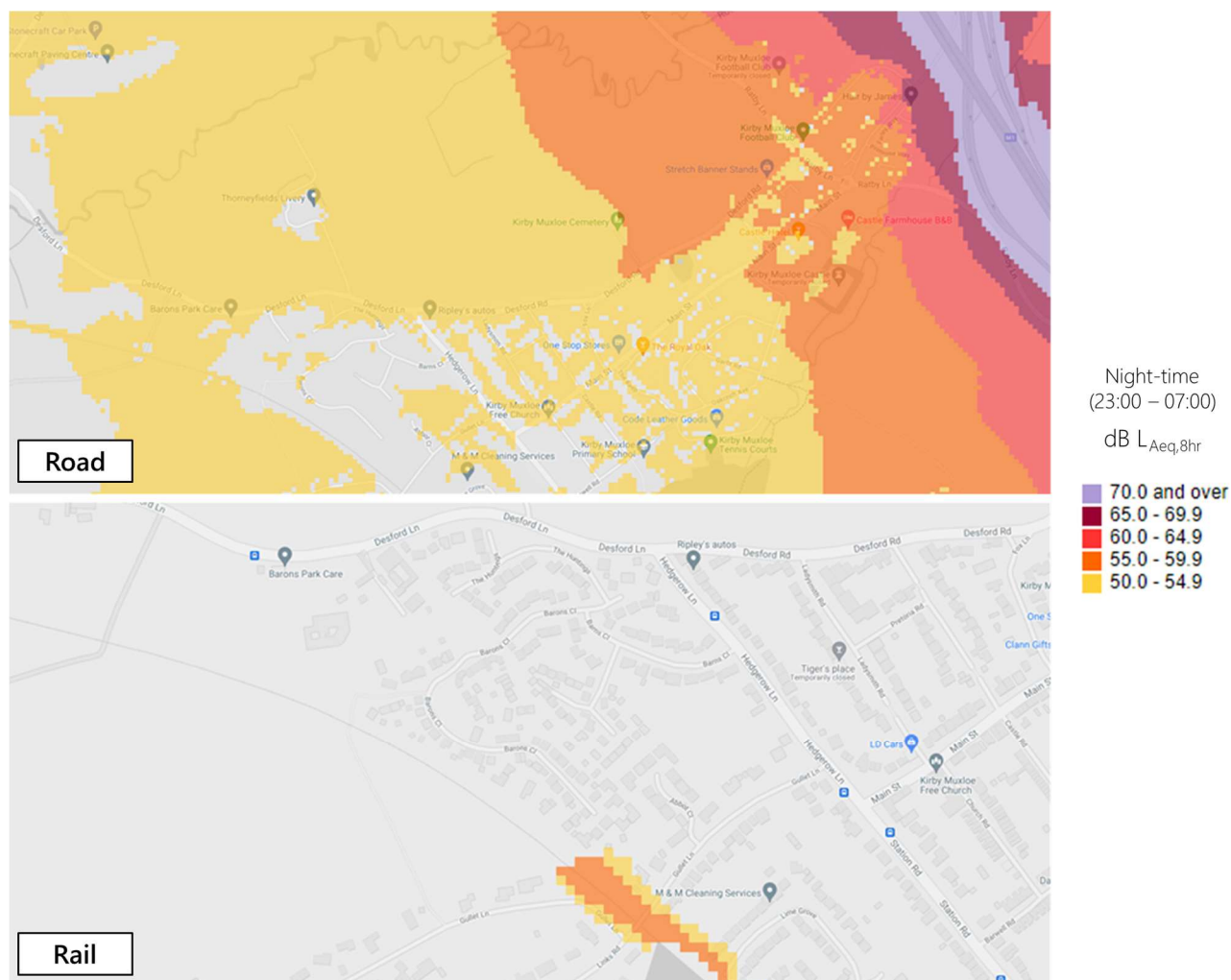
The noise maps below/overleaf show the DEFRA noise emission data for the site from local roads and railways.

Figure C.1 – DEFRA noise maps – Daytime (07:00 – 23:00) – dB L_{Aeq,16hr}



3 - <http://www.extrium.co.uk/noiseviewer.html>

Figure C.2 – DEFRA noise maps –Night-time (23:00 – 07:00) – dB L_{Aeq,8hr}



Appendix D – Noise Mapping

The noise predictions within this report have been undertaken using the proprietary software CadnaA® by DataKustik, a 3-D noise mapping package that implements a wide range of national and international standards, guidelines and calculation algorithms, including those set out in ISO 9613-2:1996.

The noise model accounts for the topography of the land-based on data available from the Ordnance Survey. All of the objects within the model (buildings, roads, barriers, foliage, etc) have been imported from OpenStreetMap. Lastly, the scaled site plan, floor plan, and elevation for the proposed development have been accounted for in the model.

The noise model has been used to predict the resulting daytime (16-hour) and night-time (8-hour) L_{Aeq} noise levels across the site, and the 10th highest night-time L_{Amax} levels.

The noise map model has assumed:

- downwind propagation, i.e. a wind direction that assists the propagation of sound from source to receptor, as a worst-case.
- a ground absorption factor of 0.5 in all areas;
- a maximum reflection factor of three where buildings and barriers are assumed to have a 'smooth' reflective façade, as a worst-case;
- that noise sources do not have strong radiation patterns and therefore radiate equally in all directions;
- façade receptor points representing the worst-case floor;
- atmospheric sound absorption based upon a temperature of 10°C and a humidity level of 70%, as per Table 2 of ISO 9613-2:1996.

The images on the following pages contain the results of the mapping and the model setup.

Appendix D.1 – Existing Site

Figure D.1 – 3D views of the model setup – existing site

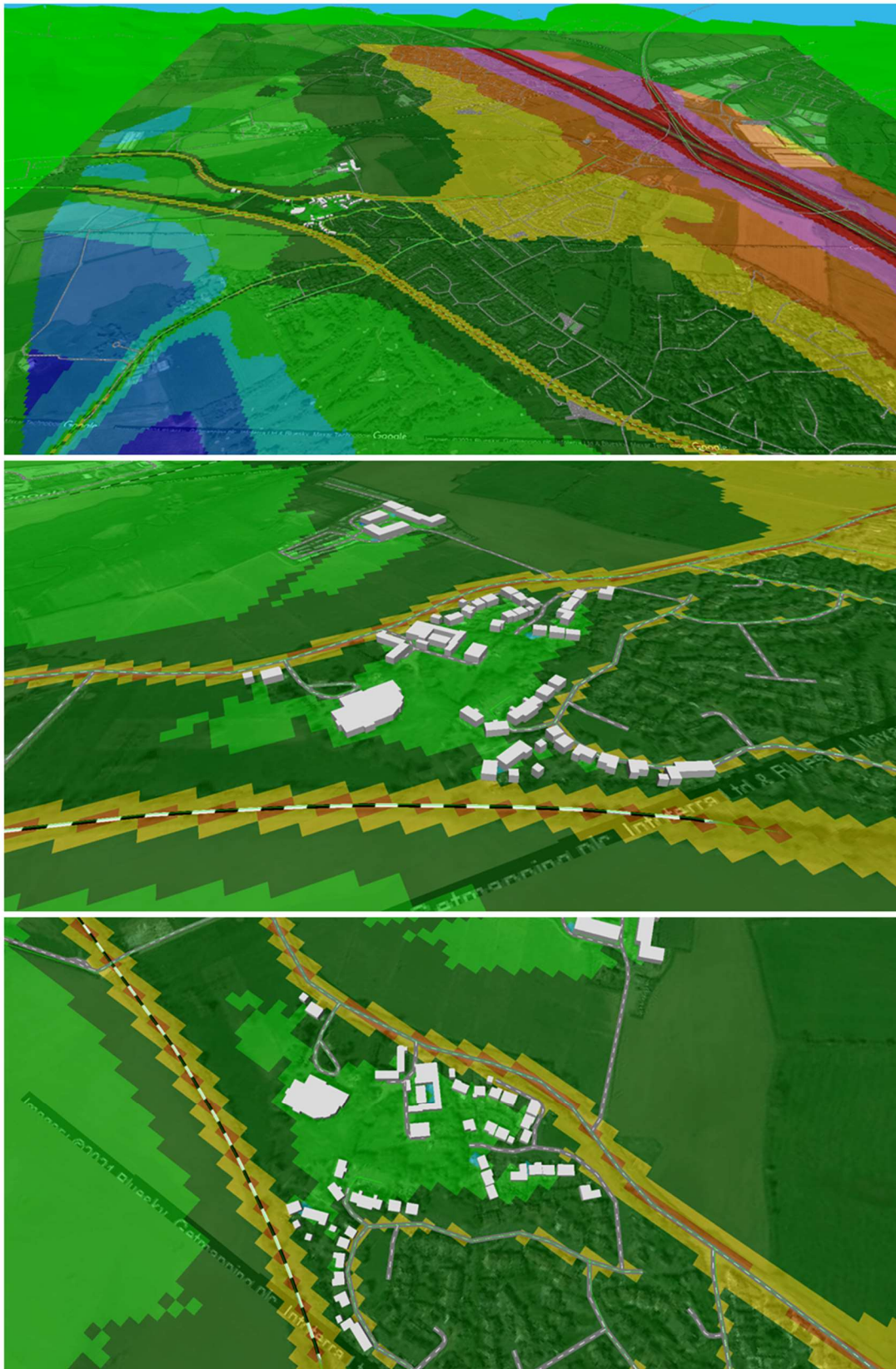


Figure D.2 - Existing site - Predicted dB L_{Aeq,16hr} external ambient noise levels – Daytime (07:00 – 23:00) – surrounding area

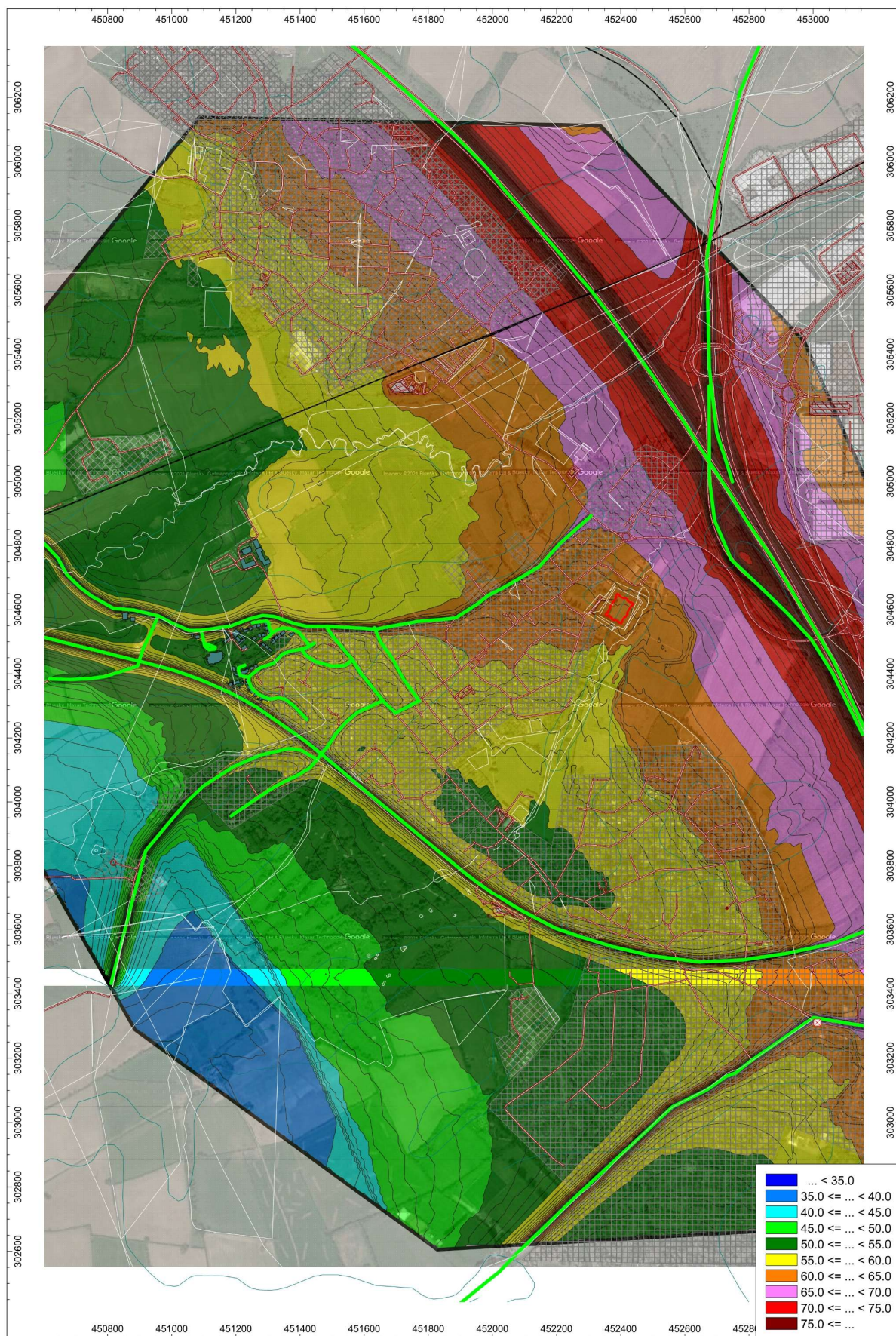


Figure D.3 – Existing site – Predicted dB $L_{Aeq,16hr}$ external ambient noise levels – Daytime (07:00 – 23:00) – site view

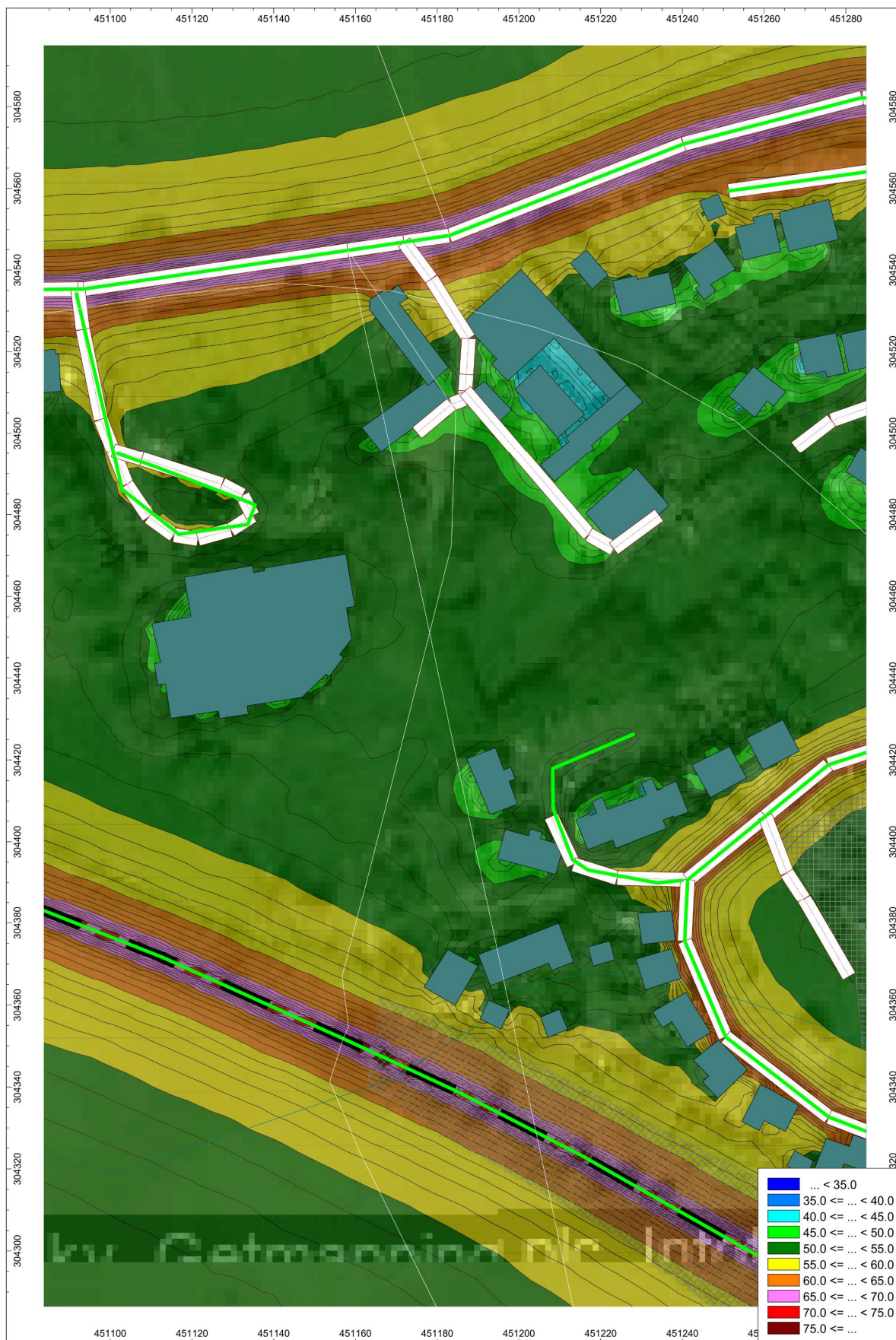
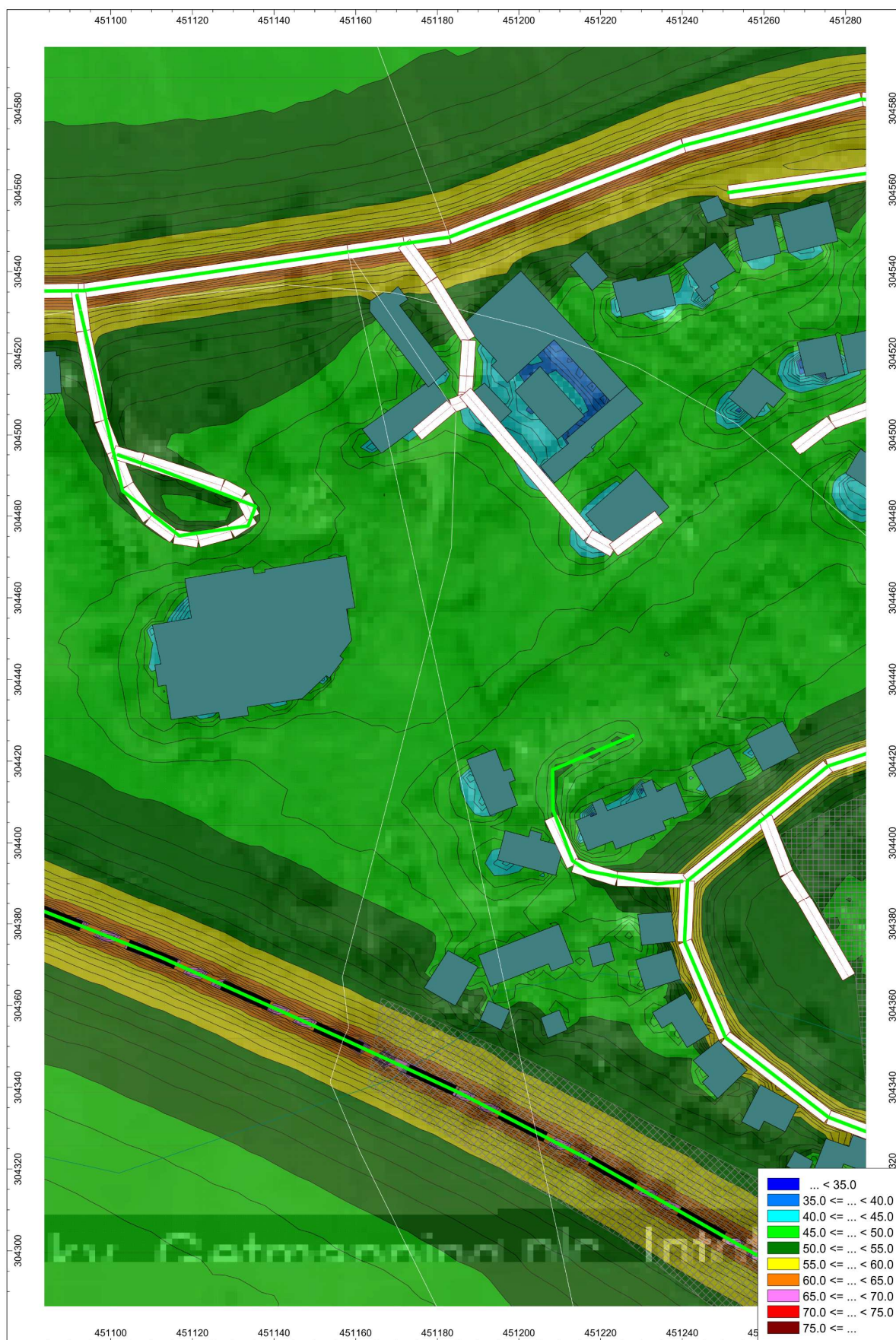


Figure D.4 – Existing site – Predicted dB $L_{Aeq,8hr}$ external ambient noise levels – Night-time (23:00 – 07:00)



Appendix D.2 – Proposed Development

Figure D.5 – 3D views of the model setup – proposed development

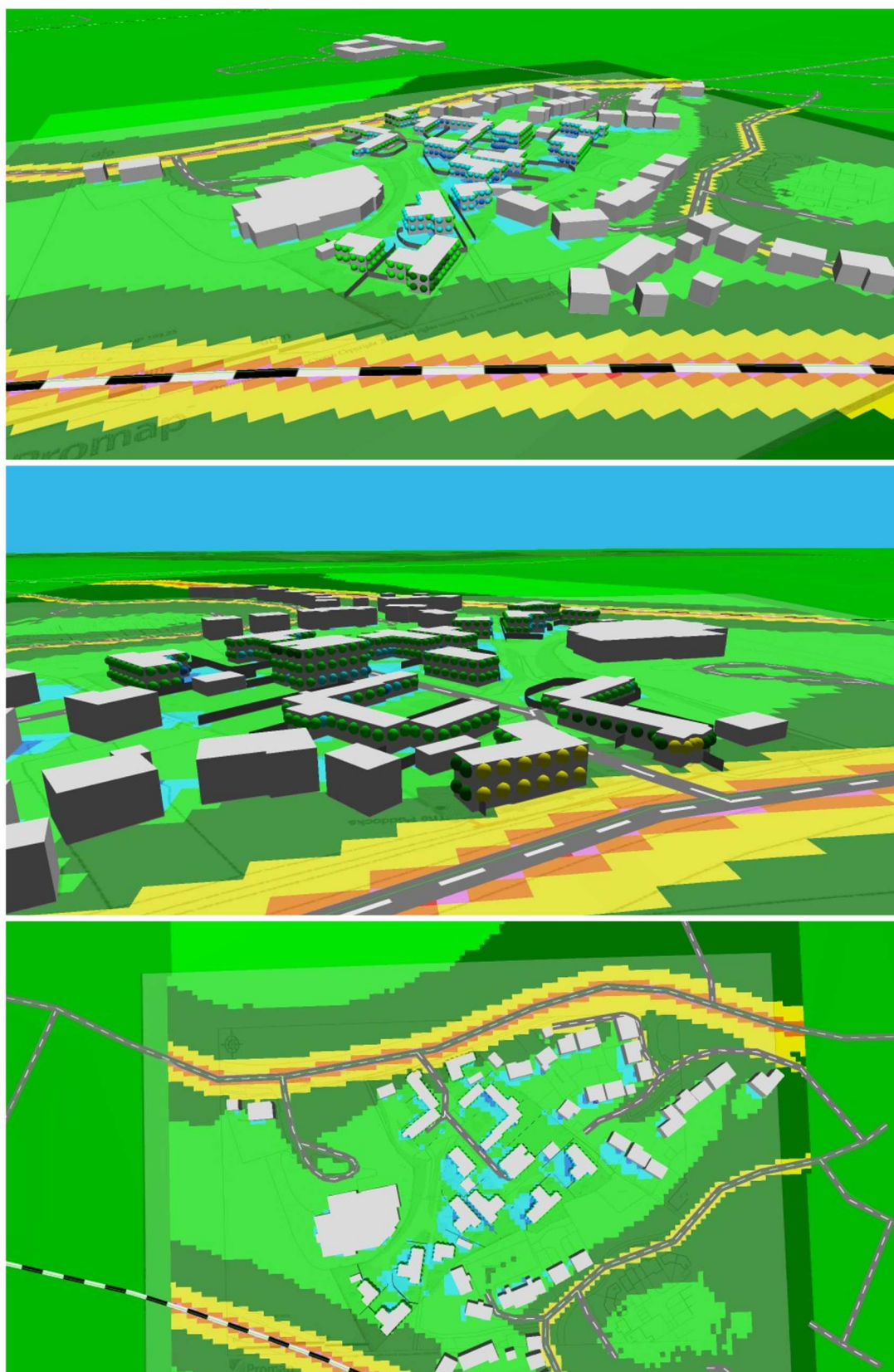
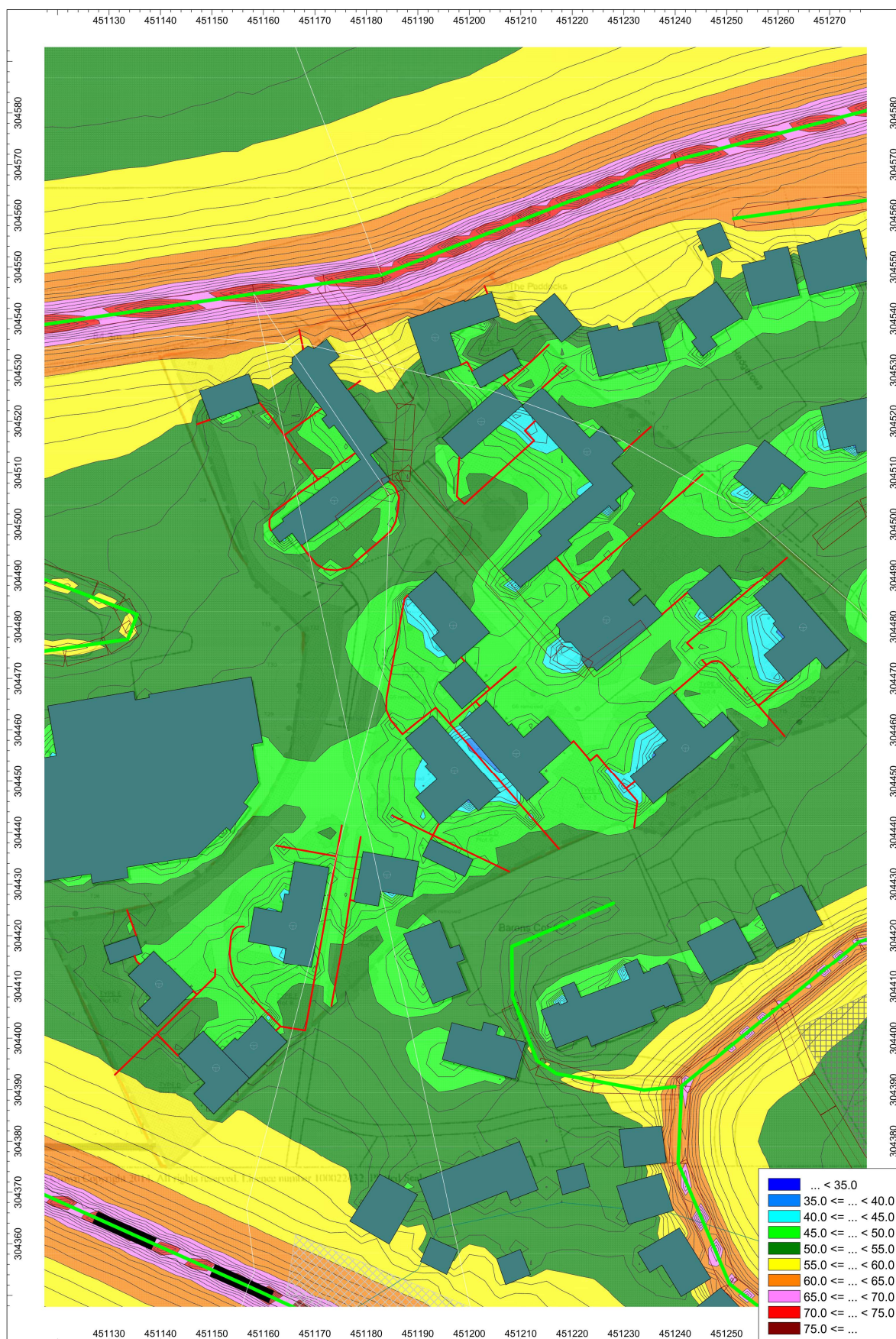


Figure D.6 – Proposed development - dB LAeq,16hr in outdoor amenity areas (1.5m grid height) – Daytime (07:00 – 23:00)



84.3m

The Puddocks

Hedgrows

Track

Barons Court

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Legend:

- ... < 35.0
- 35.0 <= ... < 40.0
- 40.0 <= ... < 45.0
- 45.0 <= ... < 50.0
- 50.0 <= ... < 55.0
- 55.0 <= ... < 60.0
- 60.0 <= ... < 65.0
- 65.0 <= ... < 70.0
- 70.0 <= ... < 75.0
- 75.0 <= ...

Figure D.8 – Proposed development - Predicted façade dB $L_{Aeq,8hr}$ exposure levels – Night-time (23:00 – 07:00)



Figure D.9 – Proposed development - Predicted façade dB L_{AFmax} (10th highest) exposure levels – Night-time (23:00 – 07:00)



Appendix E – Example Façade Constructions

E.1 - Glazing

Table E.1 – Example glazing constructions and associated sound reduction indices

Single / Double / Triple	Configuration	Manufacturer	R _w + C _{tr} (dB)
Double	4 (12) 4	Saint Gobain	26
Double	4 (12) 6	Saint Gobain	29
Double	5 (12) 4	Saint Gobain	29
Double	4 (16) 8	Saint Gobain	30
Double	4 (12) 6.8P	Pilkington	30
Double	4 (10) 10	Saint Gobain	31
Double	6 (25) 4	Saint Gobain	31
Double	8 (18) 6	Saint Gobain	32
Double	8.8L (12) 8.8P	Pilkington	32
Double	4 (6) 10	Saint Gobain	33
Triple	4 (12) 4 (12) 8.4S	Saint Gobain	33
Double	4 (16) 8.8P	Pilkington	33
Double	10 (15) 6	Saint Gobain	34
Double	8 (6) 8.8S	Saint Gobain	34
Double	6 (16) 8.8P	Pilkington	34
Double	10 (6) 8.8S	Saint Gobain	35
Double	6 (24) 10	Saint Gobain	35
Double	6 (12) 9.5A	Saint Gobain	35
Triple	8 (12) 4 (12) 8.8P	Pilkington	35
Double	8 (12) 8.8A	Saint Gobain	36
Double	10 (12) 8.8A	Saint Gobain	37
Double	8.4A (16) 10.4A	Saint Gobain	38
Double	8.8P (16) 12.8P	Pilkington	39
Double	10 (16) 12.4A	Saint Gobain	40
Double	12.8A (15) 12.8A	Saint Gobain	41
Double	9.1P (20) 13.1P	Pilkington	42
Double	9.1P (20) 17.1P	Pilkington	43
Double	16.8A (15) 16.8A	Saint Gobain	44
Double	9.1P (20Arg) 17.1P	Pilkington	44
NOTATION A = Stadip Silence S = Stadip P = Optiphon L = Optilam Arg = Argon Cavity			
Suitable for living spaces on : Exposure 1 Exposure 2 Exposure 3			

E.2 - Ventilators

For each additional ventilator, the required $D_{n,e,w} + C_{tr}$ should be increased by $10\log(n)$, where 'n' is the number of ventilators. The $D_{n,e,w} + C_{tr}$ must be assessed in the **open position**.

Table E.2 – Example ventilator products and associated sound reduction indices

Product	D _{n,e,w} + C _{tr} (dB)		
Duco DucoTop 60 SR (over window frame) – Corto STD	25		
Duco DucoTop 60 SR (over window frame) – Corto AK	26		
Duco DucoTop 60 SR (over window frame) – Grando STD	27		
Duco DucoTop 60 SR (over window frame) – Corto AK+	28		
Duco DucoTop 60 SR (over window frame) – Alto AK	30		
Titon Invent	30		
Duco DucoTop 60 SR (over window frame) – Grando AK	31		
Titon Hit & Miss HM5050	31		
Duco DucoTop 60 SR (over window frame) – Medio AK+	32		
Duco DucoStrip Slimline	32		
Duco GlasMax – Air slot 20mm	32		
Ryttons R2700 Window trickle ventilator (412mm wide)	33		
Titon SF 3300 EA Vent	33		
Greenwood Slotvent 3000S	33		
Duco GlasMax – Air slot 10mm	34		
Greenwood 2000D	35		
Duco DucoTop 60 SR (over window frame) – Largo AK+	35		
Duco DucoMax Corto 15	36		
Duco DucoTop 60 SR (over window frame) – Grando AK+	37		
Duco DucoMax Medio 25	37		
Duco DucoMax Alto 25	38		
Titon SF Xtra Sound Attenuator	39		
Willan Fresh 100dB	40		
Greenwood Airvac Acoustic Air Brick AAB-4000	40		
Duco DucoMax Corto 10	41		
Duco DucoMax Medio 15	42		
Greenwood EHA574	42		
Duco DucoMax Alto 15	43		
Duco DucoMax Alto 10	45		
Suitable for living spaces on :	Exposure 1	Exposure 2	Exposure 3



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