Land South and East of Adastral Park
Martlesham, Ipswich

Noise Appraisal

Carlyle Land Ltd and Commercial Estates Group

Brookbanks

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1 Introduction

1.1 Brookbanks Consulting Ltd is appointed by Carlyle Land Ltd and Commercial Estates Group to assess the noise environment in support of a planning application for development on land to the South and East of Adastral Park, Ipswich comprising:

- Up to 2,000 homes
- Employment area of c0.6ha (use class B1)
- Primary local centre (comprising use classes A1, A2, A3, A4, A5, B1, C3, D1 and D2)
- Secondary local centre (comprising possible use classes A1, A3, A5 and D2)
- School
- Green infrastructure (including Suitable Accessible Natural Greenspace (SANGs)
- Outdoor play areas
- Sports ground and allotments / community orchards
- Public footpaths and cycleways
- Vehicle accesses and associated infrastructure

1.2 This report has been prepared by Brookbanks Consultants Ltd to present the findings of an assessment of the effects of the Proposed Development on noise and vibration during both the construction and post-completion stages.

1.3 In particular, this report has regard to the generated noise from vehicular traffic adjacent to the Site. This noise assessment will be used to determine what measures, if any are required to achieve a suitable noise environment for the Proposed Development.

1.4 Human subjects, under laboratory conditions, are generally only capable of noticing changes in steady noise levels of no less than 3 dB(A). Additionally, environmental noise rarely reaches the sound pressure levels associated with hearing impairment. However, noise can cause annoyance and therefore the potential impact needs to be assessed.

1.5 The following sections of this report will consider the Site conditions and assess the appropriateness of the Site for the Proposed Development in accordance with national noise guidance.

1.6 The site location is indicated overleaf.

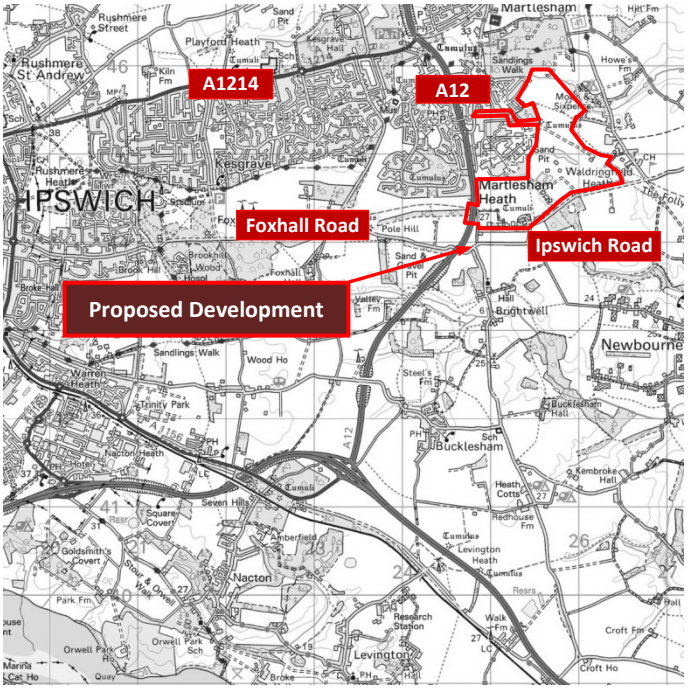

Figure 1a: Site location

2 Legislation and Planning Context

Assessment approach

2.1 Methods of assessment have been employed that are consistent with current guidance and best practice in planning policy and British Standards documents to ensure that the findings of this assessment are accurate and robust.

The Control of Pollution Act 1974

2.2 The Control of Pollution Act 1974 section 62 and 63 contains powers for local authorities to deal with noise and vibration from construction and demolition sites.

The Planning and Compulsory Purchase Act 2004

2.3 The Planning and Compulsory Purchase Act 2004 requires local authorities to draw up local Development plans. Setting the broad framework for acceptable Development in their area and reconciling the conflicts inherent in Development.

2.4 Under the Town and Country Planning Act 1990, local planning authorities may include planning conditions to Planning Consents which could include controls on the emission of noise. Advice on the use of these powers is given to English authorities in the light of the Government's Noise Policy Statement for England in the National Planning Policy Framework.

National Planning Policy Framework (March 2012)

2.5 The National Planning Policy Framework ("NPPF") published in March 2012 sets out the Government's National Planning Policies for England and how these can be applied in plan-making and decision-taking. Current planning law requires Local Authorities to determine planning applications in accordance with the local development plan unless there are material considerations which require them to reach a different decision.

2.6 Paragraph 123 of NPPF indicates that planning policies and decisions should aim to:

- Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- Mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;
- Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established;
- Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

Noise Policy Statement for England

2.7 The Noise Policy Statement for England of March 2010 (Defra 2010) provides a more overarching policy statement on the approach to noise in England. The NPSE provides guidance on the management of noise from sustainable development without placing unreasonable cost or time restraints on sustainable developments.

2.8 This Noise Policy Statement for England (NPSE) sets out the long term vision of Government noise policy, 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.'

2.9 The NPSE indicates that noise should not be considered in isolation of the wider benefits of a proposal. The intention is to minimise noise impacts as far as is reasonably practicable. NSPE defines three Noise Policy Aims:

- Avoid significant adverse impact on health and quality of life;
- Mitigate and minimise adverse impacts on health and quality of life;
- Where possible, contribute to the improvement of health and quality of life.

2.10 The explanatory note of NPSE defines the following terms:

"There are two established concepts from toxicology that are currently being applied to noise impacts. They are:

- ***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."*

2.11 The NPSE does not provide a numerical value for the SOAEL, stating at paragraph 2.22:

"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available."

2.12 The first aim of the NPSE is:

"Avoid significant adverse impact on health and quality of life"

2.13 To meet the first aim of the NPSE the resultant noise levels as a result of the proposed development should be below the Significant Observed Adverse Effect Level (SOAEL) at the noise sensitive properties.

2.14 The second aim of the NPSE is:

"Mitigate and minimise adverse impacts on health and quality of life"

2.15 To meet the second aim of the NPSE the resultant noise levels as a result of the proposed development should be below the Significant Observed Adverse Effect Level (SOAEL) but above the Lowest Observed Adverse Effect Level (LOAEL) at the nearest noise sensitive properties.

2.16 Third Aim of the NPSE is where possible, the noise levels as a result of the proposed development at the nearest residential property should be lower than the existing noise levels improving the noise climate for the local community.

National Planning Practice Guidance NPPG, 2014

2.17 In March 2014 National Planning Practice Guidance (NPPG) was published. The section entitled "Noise" provides the following general advice and relates to paragraph 123 of the NPPF.

2.18 The main objectives are to:

- *avoid noise from giving rise to significant adverse impacts4 on health and quality of life as a result of new development.*
- *mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions.*
- *recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established.*
- *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.*

2.19 A summary of the effects of noise exposure associated with both noise generating developments and noise sensitive developments is presented within the NPPG as indicated below.

Perception	Examples of Outcomes	Increasing Effect Level	Action
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
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 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

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 change in 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 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

Figure 2a: Noise Exposure Hierarchy

2.20 The guidance identifies that the subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation. These factors include:

- The source and absolute level of the noise together with the time of day it occurs;
- For non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise;
- The spectral content of the noise (i.e. whether or not the noise contains particular high or low frequency content) and the general character of the noise.

2.21 More specific factors to consider when relevant:

- Where applicable, the cumulative impacts of more than one source should be taken into account;
- Consideration should also be given to whether adverse internal effects can be completely removed by closing windows;
- If external 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.

2.22 In relation to how noise can be mitigated, this is dependent on the type of development being considered and the character of the proposed location. In general, for noise making developments, there are four broad types of mitigation:

- Engineering: reducing the noise generated at source and/or containing the noise generated;
- Layout: where possible, optimising the distance between the source and noise-sensitive receptors and/or incorporating good design to minimise noise transmission through the use of screening by natural or purpose built barriers, or other buildings;
- Using planning conditions/obligations to restrict activities allowed on the site at certain times and/or specifying permissible noise levels differentiating as appropriate between different times of day, such as evenings and late at night;
- Mitigating the impact on areas likely to be affected by noise including through noise insulation when the impact is on a building.

2.23 There are further considerations relating to mitigation of noise on residential developments. The noise impact may be partially off-set if the residents of those dwellings have access to:

- A relatively quiet facade (containing windows to habitable rooms) as part of their dwelling, and/or;
- A relatively quiet external amenity space for their sole use or a relatively quiet, protected, nearby external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings;

- A relatively quiet, protected, external publically accessible amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5 minutes walking distance).

Application of the Noise Policy Statement for England (Defra)

2.24 For the purposes of this assessment, the recommended noise levels have been defined as follows:

External Noise (Daytime)

- NOEL: noise levels less than 50 dB;
- LOAEL: noise levels between the 50 dB and 55 dB;
- SOAEL: noise levels above the upper 55 dB.

Internal Noise (Night-time)

- NOEL: noise levels less than 30 dB;
- LOAEL: noise levels between the 30 dB and 35 dB;
- SOAEL: noise levels above the upper 35 dB.

British Standard 8233:2014: Sound Insulation and Noise Reduction for Buildings

2.25 BS8233:2014[1] gives recommendations for the control of noise in and around buildings and suggests appropriate criteria and internal noise limits for habitable rooms of residential dwellings.

2.26 The standard goes onto to provide details of the approach to be taken when assessing the design in terms of planning:

- Assess the site, identify significant existing and potential noise sources, measure or estimate noise levels and evaluate layout options;
- Determine design noise levels for spaces in and around the buildings;
- Determine sound insulation of the building envelope, including the ventilation strategy;
- Identify internal sound insulation requirements;
- Identify and design appropriate noise control measures;
- Establish quality control and ensure good workmanship.

2.27 In accordance with the requirements of BS8233:2014, the following internal and daytime noise limits will need to be met within sensitive rooms of the residential dwellings:

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35dB $LA_{eq\ (16\ hour)}$	-
Dining	Dining room	40dB $LA_{eq\ (16\ hour)}$	-
Sleeping / Daytime resting	Bedroom	35dB $LA_{eq\ (16\ hour)}$	30dB $LA_{eq\ (8\ hour)}$
External Amenity Space	Gardens	55dB $LA_{eq,\ T}$	-

Figure 2b: BS8233 recommended noise levels

2.28 In considering the application of the outdoor criteria, it is important to take account of the feasibility of achieving such a level. A review of 'Health effect-based noise assessment methods: A review and feasibility study' (National Physics Laboratory report CMAM16 HMSO) reported the following:

[1] British Standard 8233:1999; Sound Insulation and Noise Reduction for Buildings

"Perhaps the main weakness is that they fail to consider the practicality of actually being able to achieve any of the stated values. From the recent national survey of noise exposure carried out in England and Wales that around 56% of the population are exposed to daytime noise levels receding 55dB. The percentage exposed above the guidline values could not be significantly reduced without drastic action to virtually eliminate road traffic noise from the vicinity of houses. The social and economic consequences of such action would be likely to be far greater than any environmental advantages of reducing the proportion of the population annoyed by noise. There is no evidence that anything other than a small minority of the population expose at such noise levels find them to be particularly onerous in the context of their daily lives."

2.29 Due to the difficulty in satisfying the external criteria, the BS provides an over-arching consideration of how to treat outdoor areas:

"However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited."

Calculation of Road Traffic Noise

2.30 Road traffic noise levels are typically measures and predicted in units of $L_{A10\ (18\ hour)}$ dB in accordance to Calculation of Road Traffic Noise (CRTN). The L_{A10} is the A-weighted sound level in decibels exceeded for 10% of the measurement period, which in this case is 06:00 and 24:00. The noise index has been shown to correlate best with people's annoyance due to road traffic noise. L_{A10} noise levels measured over any three hours between 10:00 to 17:00 are typically 1 dB (A) higher than the L_{A10} over the 18 hour period (CRTN paragraph 43).

British Standard 5228: Code of Practice for Noise and Vibration Control on Construction and Open Sites

2.31 BS5228: 'Code of Practice for Noise and Vibration Control on Construction and Open Sites' (British Standards Institution 2009, as amended) sets out the methodology to predict construction noise and the control of noise and vibration. It provides guidance on methods of predicting and measuring noise and assessing its impact on those exposed to it, and also recommendations for basic methods of vibration control.

2.32 At this stage, the detailed means of construction, including matters such as the actual plant and equipment to be used, is not known. Such matters can be controlled through the use of appropriate conditions on any planning consent. The lack of detail at this stage means that the assessment of construction effects can only be qualitative, but nonetheless the detail available is sufficient to demonstrate that the construction phase can proceed without undue or significant adverse effects on the surrounding community.

2.33 Annex B in BS5228-2:2009 sets out guidance on effects of vibration levels of construction noise. Receptors to vibration have been identified as heritage sites such as nearby listed buildings and other noise sensitive receptors.

2.34 Human beings are very sensitive to vibration, BS5228-2:2009 suggesting that the threshold of perception typically being in the peak particle velocity (PPV) range of 0.14mm/s to 0.3mm/s. Vibration above these levels can disturb, startle, cause annoyance or interfere with work activities. Vibration nuisance is often associated with the assumption that if vibration can be felt then damage is inevitable. However, considerably greater levels of vibration are required to cause damage to buildings and structures.

2.35 The standard provides guidance for identifying the significance of noise and vibration levels from surface construction activity. Significance can be considered in relation to fixed limits for noise and vibration, or alternatively in considering the potential change in the ambient noise level with the addition of construction noise.

2.36 There are no national noise criteria for limiting noise from construction sites. BS 5228 Annex E gives guidance on the significance of noise effects from construction and recommends the ABC method to establish construction noise limits.

2.37 The ABC method involves rounding the existing ambient noise levels to the nearest 5 dB for the appropriate time period and then comparing these levels to the total noise level, including construction noise. If the total noise level exceeds the existing rounded value, then a significant effect is deemed to have occurred.

Building Bulletin 93: Acoustic Design of Schools

2.38 BB93 provides guidance on external and internal noise levels to be achieved at school development sites. The BB93 identifies that the following daytime noise levels should be achieved:

- An upper limit of 60db LAeq (30 minutes) at the boundary of external premises for teaching and recreation
- 55 db LAeq (30 minutes) in unoccupied playgrounds, playing fields and other outdoor areas
- 50 db LAeq (30 minutes) in at least one area of the unoccupied playgrounds, playing fields and other outdoor areas, to ensure suitable noise levels for outdoor teaching
- Indoor ambient noise limits in schools between 30 and 40 db LAeq (30 minutes) depending on the use of the room

2.39 The most dominate noise source which could affect the primary school is traffic related. The application is submitted in outline with all matters reserved. The precise location of the school building will be subject to future reserved matters applications.

Significance Criteria

2.40 The format of this section of the report follows a standard study pattern, by setting out an appraisal of the baseline conditions, followed by a description of the Proposed Development features and an identification of the potential environmental effects due to the Proposed Development. The importance of each mechanism and an assessment of each potential effect are then considered along with any mitigation measures and recommendations for further investigations where necessary.

2.41 Methods of assessment have been employed that are consistent with current guidance and recommendations in the form of statutory documents and recognised publications to ensure that the findings represent a robust approach to the Assessment.

2.42 The criteria for determining the sensitivity of receptors is provided in Table 11.6 below.

Sensitivity	Typical Descriptors
Very High	Internationally or nationally protected endangered species which is also known to be noise sensitive (i.e. noise may change breeding habits or threaten species in some other way)
High	Dwellings, habitats supporting locally important wildlife communities that are sensitive to noise
Medium	Schools, hospitals, quiet recreation areas
Low	Officers, cafes/bars with external areas
Negligible	Industrial, retail

Figure 2d: Sensitivity of Receptor

2.43 The DMRB Volume 11, Section 3, Part 7: Environmental Assessment Procedure is used for the assessment of operational noise impacts for road schemes and gives guidance on the magnitude of impact from noise changes upon the local environment. The significance of predicted increases in road traffic noise as a result of the Proposed Development has been assessed according to the criteria described below.

2.44 The tables below outline the criteria for determining the magnitude in relation to changes in traffic noise, with short term relating to the first occupation of the development with longer term relating to 10 years after opening.

Magnitude	Change in Traffic Noise (dB)
Major	5 +
Moderate	3 – 4.9
Minor	1 – 2.9
Negligible	0.1 – 0.9

Figure 2e: Magnitude of Effect – Short Term

Magnitude	Change in Traffic Noise (dB)
Major	10 +
Moderate	5 – 9.9
Minor	3 – 4.9
Negligible	0.1 – 2.9

Figure 2f: Magnitude of Effect – Long Term

2.45 BS5228: 'Code of Practice for noise and vibration control on construction and open sites' is the methodology for the prediction of construction noise, and control of noise and vibration. Significance can be considered in relation to fixed limits for noise and vibration, or alternatively in considering the potential change in the ambient noise level with the addition of construction noise for the purposes of the proposed development. This significance can be assessed using the criteria below.

Magnitude	Change in Traffic Noise (dB)
Major	5 +
Minor	0.1 – 4.9

Figure 2g: Magnitude of Change

3 Consultation

3.1 During the development of this assessment the Environmental Health Department within Suffolk Coastal District Council have been consulted regarding the proposals.

3.2 This included the agreement that British Standard 8233:2014, being based on the CRTN, is the most appropriate method to assess the noise environment.

4 Baseline Conditions

Baseline Monitoring

4.1 Existing Noise measurements have been carried out adjacent to the roads on the boundary and running through the Site. The results have been used to validate the 3D noise mapping produced by SoundPLAN.

4.2 Daytime and night time noise levels have been monitored over a 24 hour period, together with manned recording.

4.3 All acoustic measurement equipment used during the noise surveys conformed to Type 1 specification of British Standard 61672: 2003: Electroacoustics, Part 1 Specifications.

Equipment Description	Manufacturer	Serial number
Sound Level Meter	Norsonic 118	28952
Sound Level Meter	Norsonic 118	30559
Acoustic Calibrator	Norsonic 1251	32856

Figure 4a: Survey equipment

4.4 The surveys were completed in accordance with relevant guidance such as BS7445:2003; Description and Measurement of Environmental noise. The survey recorded LAeq, LAmax, LA10 and LA90 noise levels for both day time and night time. The monitoring locations are indicated below:

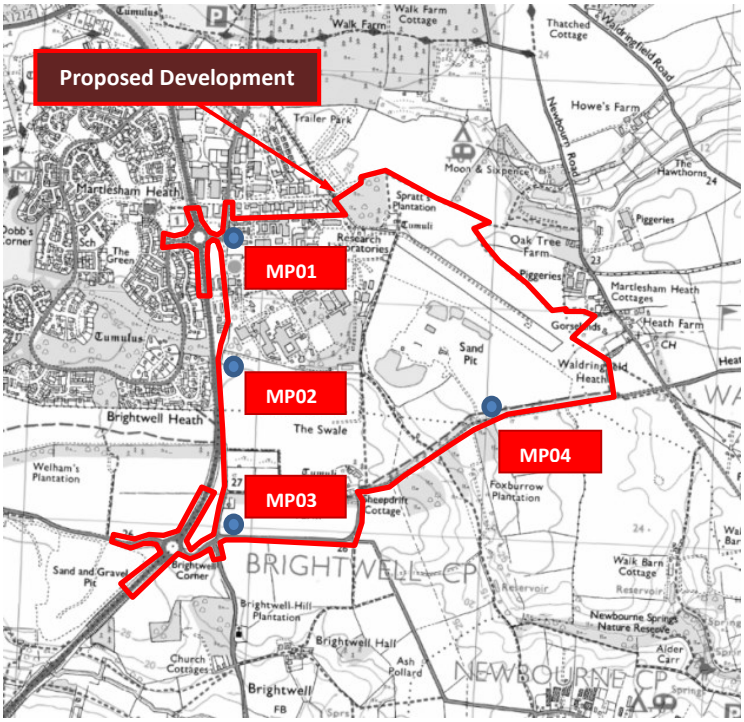

Figure 4b: Survey locations

4.5 The results of the noise monitoring are illustrated below. The points of monitoring where adjacent to the highway and therefore reflect the highest noise levels generated by the traffic levels, with traffic being identified as the predominant noise source.

Monitoring Position	Daytime LAeq 16hr	Night time LAeq 8hr
MP01	66	56
MP02	63	56
MP03	67	57
MP04	57	46

Figure 4c: Recorded noise environment

4.6 The result of the noise modelling indicates that the majority of the sites will lie within the requirements of BS 8233. The noise survey reports the noise levels adjacent to the A12 Dual Carriageway and Ipswich Road. These levels will decrease when moving into the site.

Existing Receptors

4.7 There are no receptors within the site boundary. The closest receptors are located to the south of the site boundary, along Ipswich Road.

5 Potential Effects – Construction Stage

5.1 During the construction stage, it is envisaged that earthworks, installation of necessary services and building construction would form the main noise impacts upon existing residential properties in the environs of the site.

5.2 At the time of writing, it is considered that the impact of construction traffic would be negligible. The temporary increase in traffic due to construction is likely to be indiscernible from daily variations in traffic flow.

5.3 Although the final details of the construction activities cannot be finalised until construction contractors have been confirmed, construction noise levels have been predicted using the sound pressure levels for typical construction plant as described in BS 5228: 2009 Part 1. The sound pressure levels in BS 5228 have been presented as a LAeq at a distance of 10 m. A high percentage for the 'on-time' (the length of time that the equipment remains active on site) has been assumed so as to present a reasonable worst case.

5.4 The table below presents a list of generic construction plant that could potentially be used on site, together with an estimate on the length of time the construction plant is used.

Plant Description	BS5228 Reference	Sound level at 10m	On time %
Angle Grinder	Table C4 No. 93	80	40
Asphalt Paver	Table C5 No. 33	75	60
Circular Saw	Table C4 No. 72	79	40
Compressor	Table C5 No. 5	75	80
Concrete Pump and mixer truck discharging	Table C4 No. 28	79	80
Concrete Saw	Table C4 No. 71	85	10
Delivery Lorry	Table C2 No. 35	80	70
Diesel Generator	Table C4 No. 84	74	100
Dozer	Table C5 No. 12	77	60
Dumpers	Table C4 No. 9	77	60
Excavator	Table C5 No. 34	82	75
Percussion Drill	Table C4 No. 69	85	40
Pneumatic Breaker	Table D2 No.2	81	40
Poker Vibrator	Table C4 No. 33	78	80
Road Planer	Table C5 No. 7	82	70
Roller Compactor	Table C5 No. 29	76	60
Telescopic Handler	Table C4 No. 54	79	75
Tower Crane	Table C4 No. 49	77	60
Tracked Excavator	Table C5 No. 18	80	70
Tracked Excavator fitted with Breaker	Table D2 No. 5	91	70
Tracked Mobile Crane	Table C4 No. 52	75	60
Vibratory Roller (22t)	Table C5 No. 28	77	60
Water Pump	Table C2 No. 45	65	75
Welder	Table C3 No. 31	73	40

Figure 5a: List of Construction Plant and Associated Sound Levels

5.5 The above table identifies a list of plant that could be used across the site, to identify the likely construction noise; the likely construction process on site has been identified. This include:

- Site mobilisation
- Road Construction
- Site Clearance
- Building construction

5.6 Following this, the likely construction plant to be used during the identified construction processes has then been identified. The combined noise output has been calculated using the following methodology.

5.7 The on-time correction factor has been extracted from Figure F5 within BS5288.

5.8 The construction noise impacts have been calculated using the following formula as described in BS5228:

$$K_h = 20 \times LOG\frac{R}{r}$$

Where:

K_h = the correction for propagation across hard ground
R = the distance to the receptor location
r = the distance of 10 m at which the SPL has been measured

5.9 Where more than one piece of the same equipment is used in a construction activity, the following equation has been used to determine the total noise level generated:

Combined noise level = x + 10*log10(N)

Where:

x = noise level from a single piece
N = the number of items of equipment used

5.10 To calculate the combined noise level for a construction process the following equation has been used to combine the noise levels from the individual construction plant:

Combined event = $10*\log10 (10^{(L_1/10)} + 10^{(L_2/10)} + 10^{(L_3/10)} + ... + 10^{(L_n/10)})$

Where:

L1 = individual noise event

5.11 A worst case scenario has been presented by considering propagation across hard ground and by not considering screening provided by topographical features, buildings or other structures.

5.12 The following tables present the total noise levels expected to be generated by the construction process occurring on site.

5.13 The potential noise impacts during the construction stage are presented below.

Plant	Number	Noise level at 10m	Noise level at 20m	Noise level at 50m	Noise level at 100m	Noise level at 200m
Delivery Lorry	1	80	74	66	60	54
Tracked Mobile Crane	1	75	69	61	55	49
Telescopic Handler	1	79	73	65	59	53
Wheeled loader	1	78	72	64	58	52
Dozer	1	77	71	63	57	51
Dumpers	2	80	74	66	60	54
Diesel generator	1	74	68	60	54	48
Total		87	81	73	67	61

Figure 5b: Site Mobilisation Noise Levels

Plant	Number	Noise level at 10m	Noise level at 20m	Noise level at 50m	Noise level at 100m	Noise level at 200m
Road Planer	1	82	76	68	62	56
Tracked Excavator	1	80	74	66	60	54
Dozer (Spreading fill)	1	77	71	63	57	51
Dumpers	2	80	74	66	60	54
Vibratory Roller (22t)	1	77	71	63	57	51
Asphalt Paver	1	75	69	61	55	49
Diesel Generator	1	74	68	60	54	48
Total		87	81	73	67	61

Figure 5c: Road Construction Noise levels

Plant	Number	Noise level at 10m	Noise level at 20m	Noise level at 50m	Noise level at 100m	Noise level at 200m
Dumpers	2	80	74	66	60	54
Tracked Excavator	1	80	74	66	60	54
Lorry	1	79	73	65	59	53
Dozer	2	77	71	63	57	51
Compressor	1	75	69	61	55	49
Diesel Generator	1	74	68	60	54	48
Total		86	80	72	66	60

Figure 5d: Site Clearance Noise levels

Plant	Number	Noise level at 10m	Noise level at 20m	Noise level at 50m	Noise level at 100m	Noise level at 200m
Tracked Excavator	1	80	74	66	60	54
Diesel Generator	1	74	68	60	54	48
Dumpers	1	80	74	66	60	54
Telescopic Handler	1	79	73	65	59	53
Concrete Pump & Concrete mixer truck discharging	1	79	73	65	59	53
Poker Vibrator	2	78	72	64	58	52
Compressor	2	75	69	61	55	49
Total		87	81	73	67	61

Figure 5e: Building Construction Noise Levels

5.14 Construction activities can produce high noise levels, particularly close to source. Construction noise tends to fluctuate and is usually of fairly short duration related to particular activities. The construction noise impacts would depend on the proximity of construction activities to nearby receptor locations.

5.15 The construction noise impacts predicted above indicate that the impacts could be observed by sensitive receptors within 150 m of the site. The predicted noise levels are based on a possible worst case scenario. Propagation across hard ground has been assumed and no screening from topographical features or other structures has been assumed.

5.16 The majority of existing residential dwellings lie over 150 m from the centre of the site (and therefore is not hard ground without screening for most residential properties), meaning the highest value identified for noise levels at 150m

(maximum) would be 61 dB, which is below the Category A threshold (ABC method) of 65 dB. A Construction and Environmental Management Plan (CEMP) is recommended to be used to ensure minimal disruption to nearby residences during the construction process.

6 Potential Effects – Vibration

6.1 Ground-borne vibration is often a cause for concern to future residents, especially in relation to construction.

6.2 BS 6472 presents vibration levels that could induce the probability of human discomfort due to ground-borne vibration. These are more stringent than those recommended for structural damage. Compliance with BS 6472 criteria should ensure that building damage is unlikely.

6.3 Vibration transmitted from construction activities through the ground to the receiver cannot be reliably calculated at this stage. Factors affecting ground borne vibration such as rock/soil type, water content and solid damping will greatly influence the way in which vibration travels through the ground.

6.4 There is no reason to suggest that vibration impacts cannot be adequately controlled. This is based on the information provided by publicly available geological data and the type of construction work that would take place on a residential site.

7 SoundPLAN Model

7.1 In order to predict the future noise environment across the site, a 3D noise model has been generated through the SoundPLAN computer software package. This was established through the following steps:

- Production of a 3D ground profile
- Confirming location of existing highways
- Defining existing traffic levels
- Confirming future traffic levels
- Confirming location of development

7.2 The 3D SoundPLAN model is then used to predict noise levels across the site as illustrated in drawing nos: 10391-NM-01B and 10391-NM-02B in Appendix B. To ensure that the 3D model is appropriate, the base line results were compared with noise levels recorded on site. This is demonstrated below.

Monitoring Position	Monitored	Predicted
MP01	66	65
MP02	63	64
MP03	67	67
MP04	57	56

Table 7a: Daytime Modelled Noise Levels (dB)

Monitoring Position	Monitored	Predicted
MP01	56	56
MP02	56	55
MP03	57	58
MP04	46	53

Table 7b: Night-time Modelled Noise Levels (dB)

7.3 This indicates that the predicted levels reflect the monitored noise environment. Therefore, it is concluded that the 3D SoundPLAN model is appropriate to assess and predict the future noise levels.

8 Potential Effects – BS8233 Internal levels

BS8233:2014 Assessment of Day Time Noise Levels in Living Rooms

8.1 BS8233 indicates a desirable daytime noise level of 35dB L_{Aeq}. The calculated noise levels have been used to determine likely noise levels in the Proposed Development, and therefore the extent of noise attenuation required. The maximum recorded values (L_{Aeq}) according to the model are shown below in comparison to the modelling outputs recorded in the survey.

Location	2027 with Development
Adjacent to A12 Dual Carriageway	63.4
Adjacent to Ipswich Road	58.4
Primary School	50.4

Table 8a: Daytime Façade Modelled Noise Levels (dB)

8.2 The area closest to the A12 Dual Carriageway shows a typical maximum day time noise level of 63.4 dB. As indicated, façade noise levels will be attenuated through window glazing. The internal noise levels are identified below.

Location	2027 with Development
Adjacent to A12 Dual Carriageway	30.4
Adjacent to Ipswich Road	25.4
Primary School	17.4

Table 8b: Daytime Internal Modelled Noise Levels (dB)

8.3 This demonstrates that the BS8233 daytime noise standards will be achieved. This is further illustrated in drawing no: 10391-NM-03B in Appendix B.

BS8233:2014 Assessment of Night Time Noise Levels in Bedrooms

8.4 BS8233 indicates that a night time noise level of 30 dB L_{Aeq} represents an acceptable standard in bedrooms. The calculated noise levels have been used to determine likely noise levels and the extent of attenuation required. The maximum recorded values (L_{Aeq}) according to the model are shown overleaf.

Location	2027 with Development
Adjacent to A12 Dual Carriageway	60.5
Adjacent to Ipswich Road	58.4
Primary School	43.9

Table 8c: Night-time Façade Modelled Noise Levels (dB)

8.5 The area closest to the A12 Dual Carriageway shows a typical maximum night-time noise level of 60.5 dB. As indicated, façade noise levels will be attenuated through window glazing. The internal noise levels are identified below.

Location	2027 with Development
Adjacent to A12 Dual Carriageway	27.5
Adjacent to Ipswich Road	25.4
Primary School	10.9

Table 8d: Night-time Internal Modelled Noise Levels (dB)

8.6 This demonstrates that the BS8233 night-time noise standards will be achieved. This is further illustrated in drawing no: 10391-NM-04B in Appendix B.

Potential Mitigation

8.7 The above assessment clearly demonstrates that with closed windows the BS8233 internal noise levels will be met. However, opening windows for ventilation purposes will increase noise levels. Therefore, alternative means of ventilation for those properties fronting the highway may be necessary.

8.8 It is considered appropriate to consider the use of air brick ventilation and / or trickle vents on the properties fronting the A12 Dual Carriageway and Ipswich Road, as marked in yellow in Figure 8e below. This will provide adequate ventilation when the windows are closed.

8.9 The affected properties are highlighted below.

Figure 8e: Properties requiring Double Glazing and venting as discussed in 8.7 to 8.8

8.10 The assessment also indicates that appropriate external noise levels in back gardens can be easily achieved due to being shielded from traffic noise sources by housing.

9 Potential Effects – BS8233 External levels

9.1 BS8233 indicates that for traditional external areas that are used for amenity space, such as gardens and patios, an upper guideline value of 55 dB LAeq,T is acceptable during the daytime. However, BS8233 also recognises that the guideline values are not achievable in all circumstances, such as city centres or urban areas adjoining the transport network.

9.2 BS8233 identifies that in such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but external noise should not be prohibitive on development delivery.

9.3 A review of the noise environment across the site has indicated that for the majority of the site, the external noise does not exceed 55 dB during the daytime within the residential area of the site at night-time. Acceptable noise levels would be achieved through the setback of residences which would act as a noise shield for the majority of the amenity space.

9.4 However as indicated in drawing no: 10391-NM-05B in Appendix B, the area adjacent to the A12 Dual Carriageway experiences excessive noise levels, as well as the area allocated for school playing fields adjacent to Ipswich Road. The majority of this land and/or residences would experience noise levels higher than the 55db following completion of the development in 2027. Therefore mitigation is required here.

9.5 As indicated in drawing no: 10391-NM-06B in Appendix B, acceptable noise levels in this part of the site could be achieved through the construction of a 5m Height Noise Barrier adjacent to the A12 and a 2m Height Noise Barrier adjacent to Ipswich Road. These could be in the form of an earth bund, or an earth bund combined with an acoustic fence. This presents a flexible approach that will be defined during reserved matters.

9.6 Through Reserved Matters, careful design and selection of the noise attenuation will be offered which fulfils a dual function of noise dampening plus integration into the wider landscaping aspirations. For the purpose of this assessment, the masterplan is shown below together with the section of the site that requires a noise barrier.

Figure 9a: Section of Acoustic Barriers along amenity space.

10 Off Site Sensitive Receptors

10.1 Traffic noise predictions have been made using the CRTN prediction methodology. The methodology has been used to predict the magnitude of any change in noise level resulting from the development proposals at the roadside of the local network. A road's Basic Noise Level (BNL) represents the free-field noise level at a distance of 10m from the carriageway. The BNL is based on traffic flow and composition. Other factors like screening or distance remain constant between modelled scenarios. Therefore, the difference between the BNL reflects the actual noise change at an identified receptor. This can be used to provide an indication of the noise level changes associated with the development.

10.2 The predicted changes in noise level, identified with respect to the road traffic noise impact assessment criteria, are identified in the map and presented in the table below, indicating the 2026 scenario with and without the completed development impact respectively.

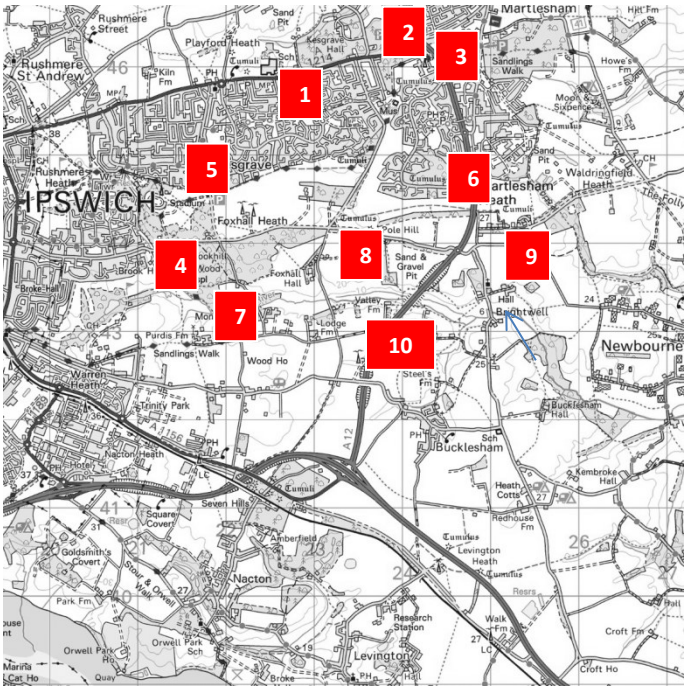

Figure 7c: Link Count Locations

	Link	2026 Basic Noise (dB) without Development	2026 Basic Noise (dB) with Development	Noise Impact (dB)	Long Term Effect
1	A1214 Woodbridge Road	71.9	72.2	0.3	Negligible
2	A12 Dual Carriageway (North)	75.4	75.5	0.1	Negligible
3	A1214 Main Road	66.6	66.7	0.1	Negligible
4	Foxhall Road (West)	71.2	71.5	0.3	Negligible
5	Bell Lane	64.8	65.6	0.7	Negligible
6	A12 Dual Carriageway (Central)	75.6	75.9	0.2	Negligible
7	Monument Farm Lane	57.0	57.0	0.0	Negligible
8	Foxhall Road (East)	71.7	72.1	0.4	Negligible
9	Ipswich Road	67.1	68.4	1.3	Negligible
10	A12 Dual Carriageway (South)	76.1	76.2	0.2	Negligible

Figure 7d: Predicted Noise Levels within Local Road Network

10.3 This demonstrates that the majority of the receptors will experience a negligible increase with minor increases reported adjacent to the development. It is considered that an increase of less than 3db is not discernible and therefore it is concluded that the development will have a negligible impact.

11 Conclusion

11.1 Traffic noise from the A12 Dual Carriageway and Ipswich Road is the most significant noise source. The Site lies mostly within the requirements of BS 8233; therefore the local noise environment gives no reason not to proceed with the Proposed Development. Internal noise levels inside the proposed dwellings can be provided within acceptable limits through the following mitigation measures.

- CEMP
- Passive ventilation systems and double glazing for those residential properties exceeding the requirements of BS 8233 and those closest to the A12 Dual Carriageway and Ipswich Road.
- Internal layout of properties to consider the location of lounge and bedroom areas for properties fronting onto the A12 Dual Carriageway and Ipswich Road.
- Site layout to consider the orientation of residential buildings to reduce sight lines onto the A12 Dual Carriageway and Ipswich Road.
- External space above the guideline of 55db could be mitigated with the appropriate placement of acoustic fencing.

11.2 This Noise Assessment demonstrates that the Proposed Development will not be significantly affected by the noise levels in the immediate vicinity. It is also anticipated from this that noise impacts arising out of the proposed development are negligible. The maximum internal noise level with the inclusion of window glazing is 30.2 dB during the daytime and 27.1 Db at night which achieves the required standards as set by BS 8233.

11.3 It is therefore concluded the Proposed Development is consistent with relevant planning policy guidance and its location on the Site should be supported from a noise perspective.

12 Limitations

12.1 The conclusions and recommendations highlighted above are limited to the general availability of background information and the Proposed Development of the Site.

12.2 Third party information has been used in the preparation of this report, which Brookbanks Consulting Ltd, by necessity assumes is correct at the time of writing. While all reasonable checks have been made on data sources and the accuracy of data, Brookbanks Consulting Ltd accepts no liability for same.

12.3 The benefits of this report are provided to Carlyle Land and Commercial Estates Group for the Proposed Development at Land South and East of Adastral Park in Martlesham near Ipswich.

12.4 Brookbanks Consulting Ltd excludes third party rights for the information contained in the report.

Appendix A – Noise Terminology

The scale used to identify noise sources is the decibel (dB) scale which extends from 0 to 140 decibels (dB) corresponding to the intensity of the sound pressure level. The ear recognises sound, based on pitch and frequencies. Microphones cannot record noise in the same way; to counter this, the noise-measuring instrument applies a correction to correspond more closely to the frequency response of the ear. The correction factor is called "A Weighting" and the resulting measurements are written as dB(A). Typical dB(A) noise levels for familiar noise are indicated below.

Approx. noise level	Noise Example
10 dB	Normal breathing
20 dB	Rustling leaves, mosquito
30 dB	Whisper
40 dB	Stream, refrigerator humming
50 dB	Quiet office
60 dB	Normal conversation
70 dB	In car noise without radio
80 dB	Vacuum cleaner / washing machine
90 dB	Lawnmower
100 dB	Train
110 dB	Pneumatic Drill
120 dB	Thunder
130 dB	Plane taking off
140 dB	Threshold of pain

Table AP1: Noise Level Descriptions

The noise levels indicated above are sound pressure levels (SPL) and describe the noise level at a single point in space. Noise levels at a receptor vary over time depending on the occurring noise generating activities. The following indices are used to take into account noise level variation over time:

- LAeq T is the equivalent continuous sound level and is the sound level over the time period (T). It is possible to consider this level as the ambient noise encompassing all noise at a given time. LAeq T is considered the best general purpose index for environmental noise.
- LA90 T represents the noise level exceeded for 90% of the measurement period and is used to indicate quieter times during the measurement period. It is usually referred to as the background noise level.
- LA10 T refers to the level exceeded for 10% of the measurement period. LA10 T is widely used as a descriptor of traffic noise.
- LAmax is maximum recorded noise level during the measurement period.

Appendix B – Noise Mapping Results

- 10391-NM-01B – 2017 Baseline Daytime Noise Contours
- 10391-NM-02B – 2017 Baseline Night-time Noise Contours
- 10391-NM-03B – 2027 with Development Daytime Noise Contours
- 10391-NM-04B – 2027 with Development Night-time Noise Contours
- 10391-NM-05B – 2027 with Development 55dB External Daytime Noise Contours
- 10391-NM-06B – 2027 with Development and Protection 55dB External Daytime Noise Contours

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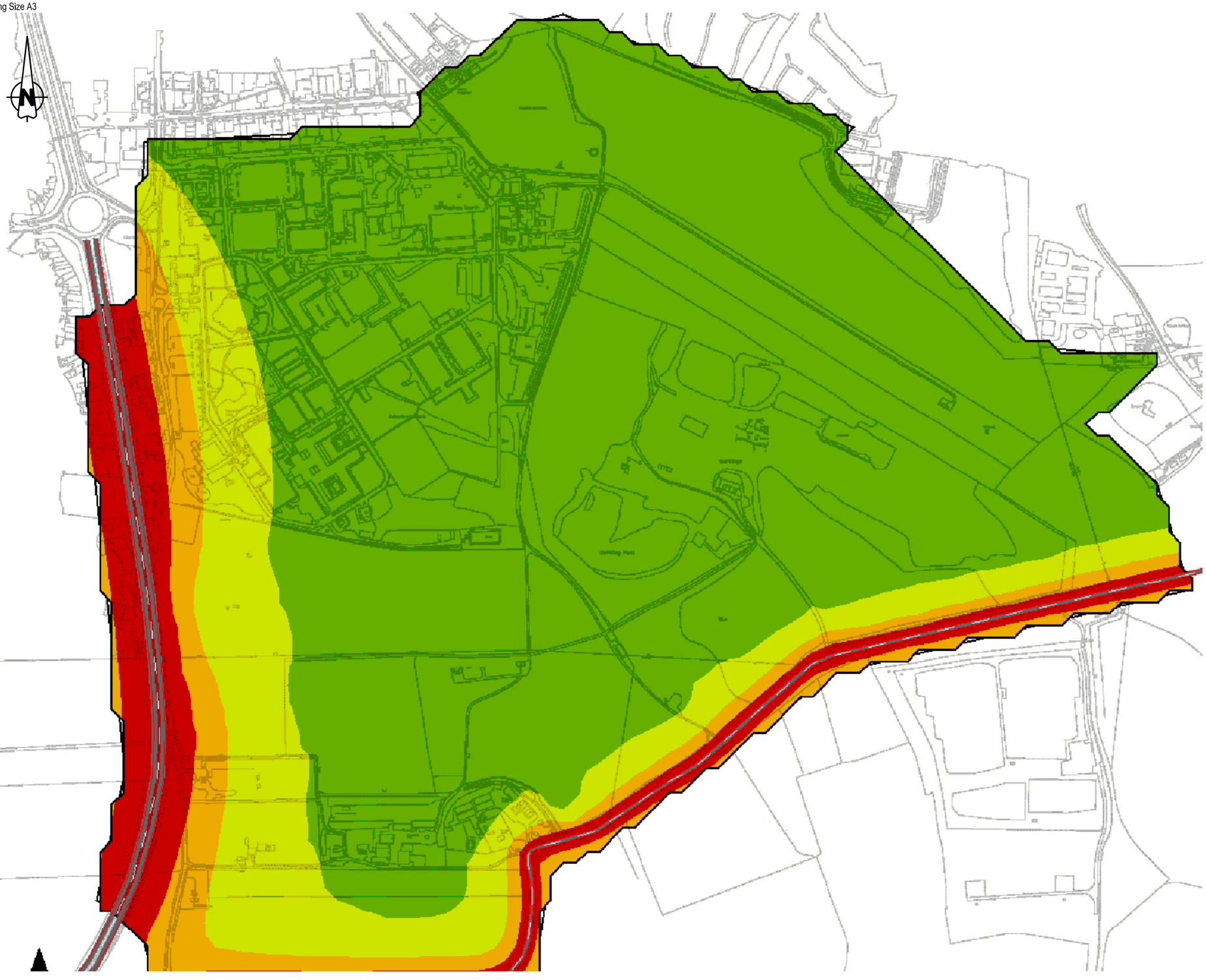

Construction Design and Management (CDM) Key Residual Risks

Contractors entering the site should gain permission from the relevant land owners and/or principle contractor working on site at the time of entry. Contractors shall be responsible for carrying out their own risk assessments and for liaising with the relevant services companies and authorities. Listed below are Site Specific key risks associated with the project.

1) Overhead and underground services
2) Street Lighting Cables
3) Working adjacent to water courses and flood plain
4) Soft ground conditions
5) Working adjacent to live highways and railway line
6) Unchartered services
7) Existing buildings with potential asbestos hazards

NOTES:

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Key:

Levels in dB:

- 0 - 55
- 55 - 60
- 60 - 65
- Over 65

B	Updates to reflect traffic flows.	MDM	LW	PAB 14.09.17
A	Amendments as per client's requests.	MDM	LW	PAB 10.03.17
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Land South and East of Adastral Park, Ipswich

2017 Baseline Daytime Noise Contours

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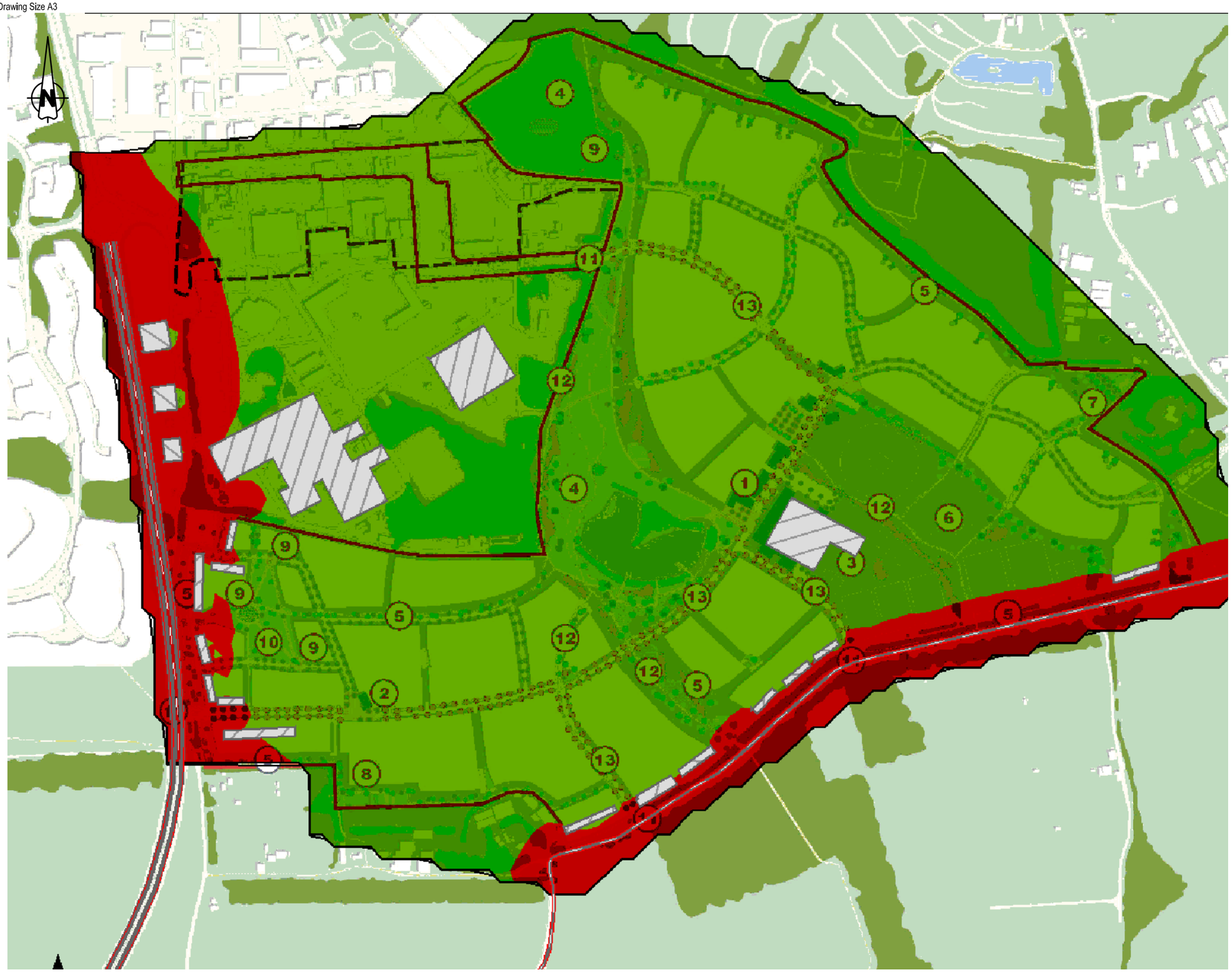

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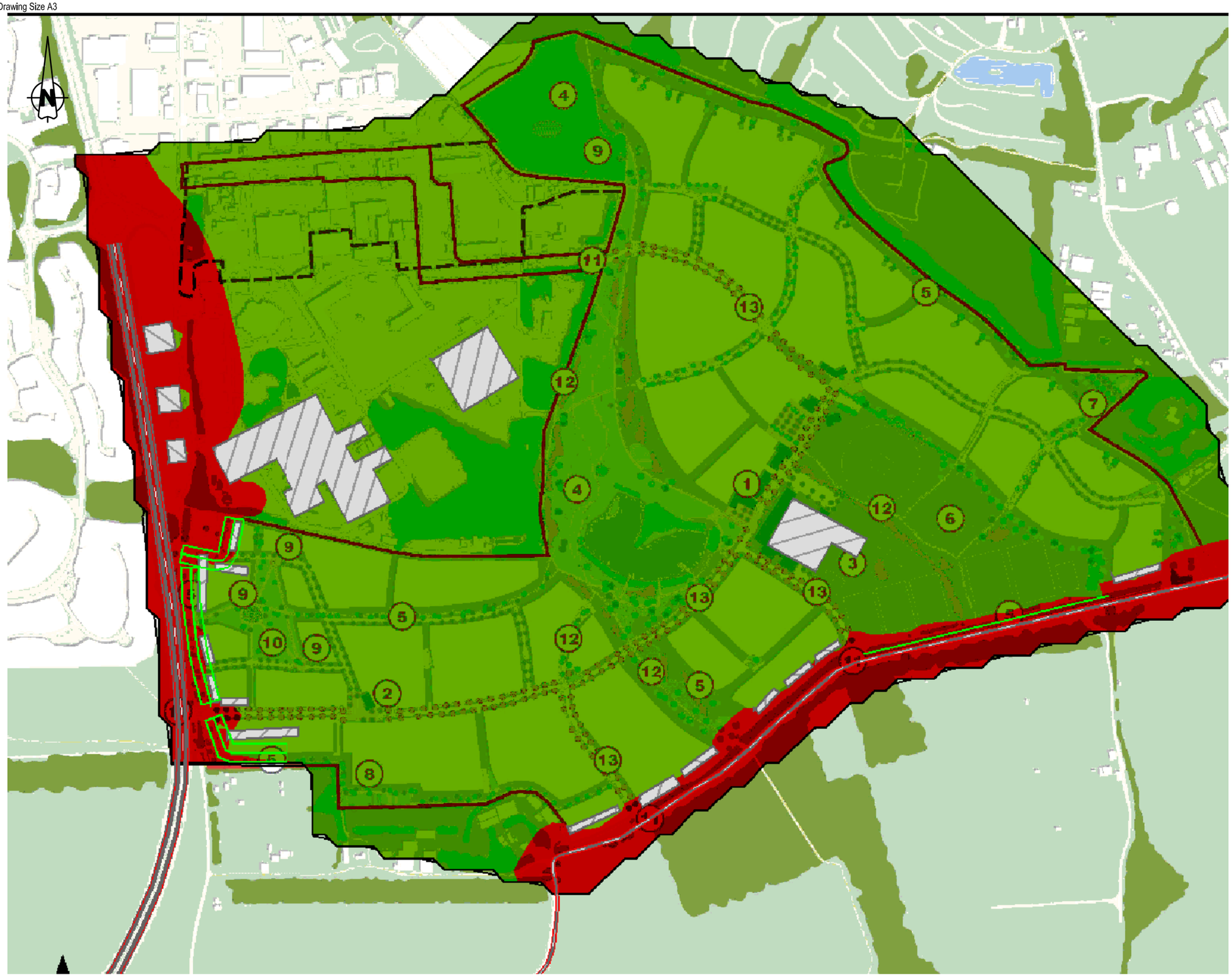

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Over 55

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Land South and East of Adastral Park, Ipswich

2027 with Development and Protection 55dB External Daytime Noise Contours

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