



Persimmon Homes

**Reserved Matters Application (Phase 2)
and Discharge of Conditions,
North Littlehampton**

**Noise Assessment
February 2018**

Executive Park, Avalon Way, Anstey, Leicester, LE7 7GR





Document Control

Project: Reserved Matters Application (Phase 2) and Discharge of Condition
Client: Persimmon Homes
Job Number: A095004
File Origin: O:\Acoustics Air Quality and Noise\Active Projects\A095004

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Issue	Date	Status
1	20 th March 2017	First Issue
2	8 th September 2017	Second Issue – Updated Site Layout & Mitigation Details
3	19 th September 2017	Third Issue – Minor Amendments
4	8 th February 2018	Fourth Issue – Minor Amendments



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1.0 Introduction

1.1 Purpose of this Report

This report also discharges presents the findings of a noise assessment for a reserved matters application for Phase 2 residential development by Persimmon Homes, comprising Parcel C1 and part Parcels B2, B4 and C2 in north Littlehampton and the discharge of conditions 37 and 38 of planning permission ref LU-47-11 which state:

"37 In addition to the measures described in Condition 36 above, any development on land within Noise Exposure Category C and D shall incorporate noise mitigation measures details of which are to be submitted to, and approved in writing by, the Local Planning Authority. These measures shall thereafter be permanently maintained."

"38 All ground level private amenity spaces shall have a predicted noise level of less than or equal to L_{Aeq} , 55dB (measured over a 1 hour period) within the first 5 metres from the building facade"

This version of the report, involves the removal of a typographical error in section 6 of the report.

A description of the existing noise environment in and around the site is provided. Noise surveys have been undertaken and the results used to verify predictions of the short-term and long-term effects of noise. The noise levels from the proposed development have been predicted at local representative receptors using CADNA noise modelling software which incorporates ISO 9613 and CRTN methodologies and calculations.

A list of acoustic terminology and abbreviations used in this report is provided in Appendix A and a set of location plans and noise contour plots relevant to the assessment are presented in Appendix B.

1.2 Legislative Context (England)

PPG24 (from which Noise Exposure Categories were defined) was replaced by NPPF on 27 March 2012. With regard to noise and planning NPPF contains the following 4 short statements (section 123):

- A. Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- B. 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;



- C. 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; and
- D. 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.

The national Planning Practice Guidance (PPG) web-based resource was launched by the Department for Communities and Local Government (DCLG) on 6 March 2014 to support the National Planning Policy Framework and make it more accessible. The overall aim of the guidance, tying in with the principals of the NPPF and the Explanatory Note of the Noise Policy Statement for England, is to identify whether the overall effect of noise exposure is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation.

A summary of the effects of noise exposure associated with both noise generating developments and noise sensitive developments is presented within the PPG: Noise and repeated as follows:

Table 1.1 Noise Exposure Hierarchy

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 (NOEL)	No Specific Measures Required
Lowest Observed Adverse Effect Level (LOAEL)			
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; closing windows for some of the time because of the noise. Potential for non-awakening 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 (SOAEL)			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. having to keep windows closed most of the time, avoiding certain activities during periods of intrusion. 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	Unacceptable Observed Adverse Effect	Prevent



Perception	Examples of Outcomes	Increasing Effect Level	Action
	sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory		

The NPPF, NSPE and PPG do not, however, present absolute noise level criteria which define SOAEL, LOAEL and NOEL which is applicable to all sources of noise in all situations. Therefore, within the context of the Proposed Development, the extant planning permission, national planning policy and appropriate guidance documents including the 'World Health Organisation Community Noise Guidelines' (1999) and 'BS 8233 – Guidance on Sound Insulation and Noise Reduction for Buildings' (2014), Section 2.0 presents the noise level criteria used as a basis of this assessment.



2.0 Assessment Criteria

2.1 Internal Noise Assessment Criteria

In order to enable the assessment of the proposed development in terms of LOAEL and SOAEL, Table 2.1 presents equivalent noise levels and associated actions with the target noise level criteria identified. For the purpose of this assessment, the target noise level criteria are noted in *italics* in the table below.

Table 2.1 Noise Level Criteria and Actions

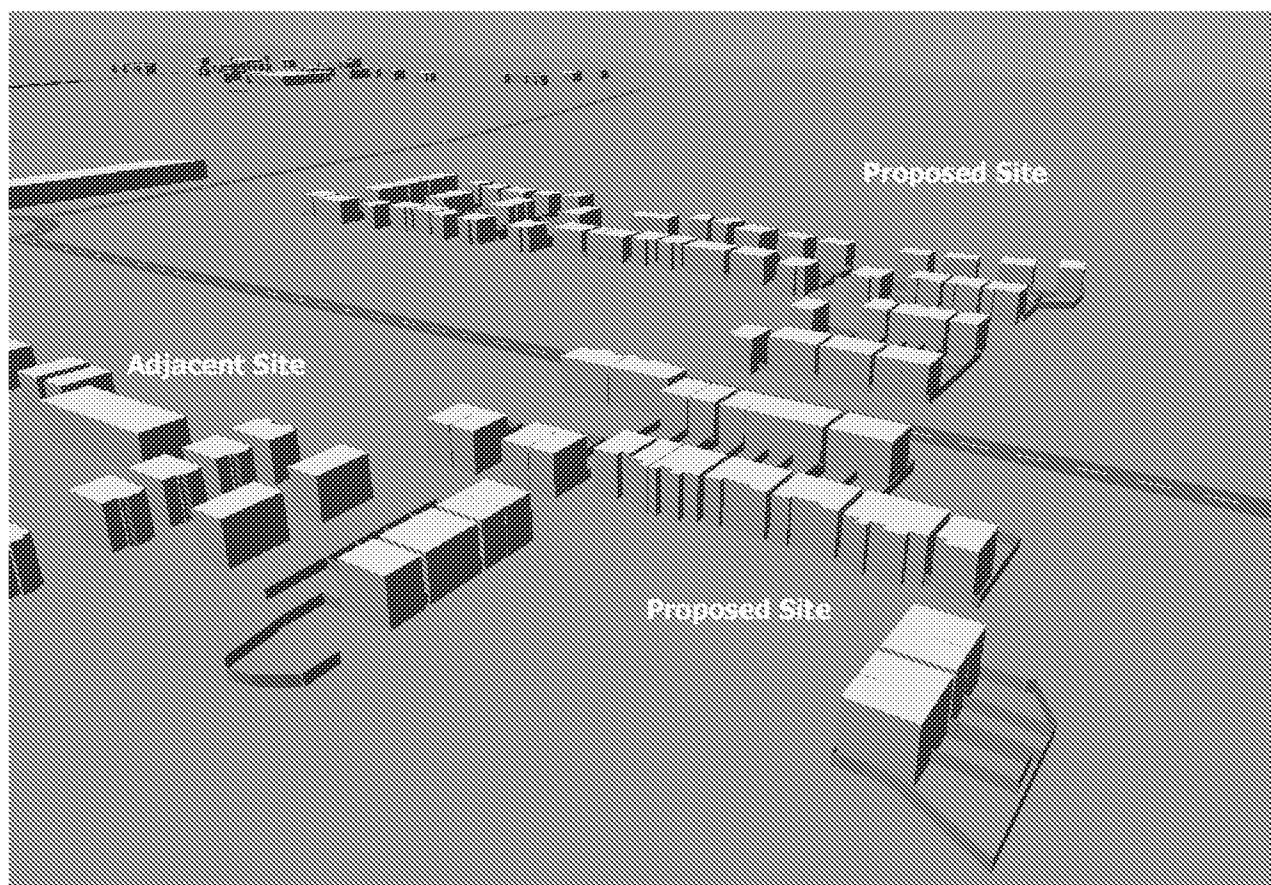
Noise Level Criteria	Effect Level	Action / Justification
Bedrooms – 30 dBL _{Aeq,8hours} / 45 dBL _{Amax} Living Rooms – 30 dBL _{Aeq,16hours} External Amenity Space – 50 dBL _{Aeq,16hours}	No Observed Adverse Effect Level	None Within BS8233 / WHO criteria
Noise levels exceed: Bedrooms – 30 dBL _{Aeq,8hours} / 45 dBL _{Amax} Living Rooms – 35 dBL _{Aeq,16hours} External Amenity Space – 55 dBL _{Aeq,16hours}	Lowest Observed Adverse Effect Level	Mitigate to achieve: <i>Bedrooms – 30 dBL_{Aeq,8hours} / 45 dBL_{Amax}</i> <i>Living Rooms – 35 dBL_{Aeq,16hours}</i> <i>External Amenity Space – 55 dBL_{Aeq,16hours}</i> Within BS8233 / WHO criteria
Noise levels exceed: Bedrooms – 30 dBL _{Aeq,8hours} Living Rooms – 35 dBL _{Aeq,16hours} External Amenity Space – 55 dBL _{Aeq,16hours}	Significant Observed Adverse Effect	Avoid However, if due to other design considerations noise criteria is not achievable or that the target criteria can be achieved for certain periods (e.g. when windows are closed), the following noise levels may be acceptable as an upper limit: Bedrooms – 35 dBL _{Aeq,8hours} Living Rooms – 40 dBL _{Aeq,16hours} External Amenity Space – 60 dBL _{Aeq,16hours} This is on the basis that the guideline noise values do not represent people's response to noise in all cases with the specified criteria only a marginal exceedance of the target criteria.
Noise levels with mitigation exceed: Bedrooms – 35 dBL _{Aeq,8hours} Living Rooms – 40 dBL _{Aeq,16hours} External Amenity Space – 60 dBL _{Aeq,16hours}	Unacceptable Observed Adverse Effect	Prevent

3.0 Assessment Methodology

3.1 Noise Modelling Methodology

Three dimensional noise modelling has been undertaken based on the monitoring data to predict L_{Aeq} and L_{Amax} noise levels at a large number of locations both horizontally and vertically. CADNA noise modelling software has been used. This model is based on the Department of Transport Calculation of Road Traffic Noise (CRTN) and ISO 9613 noise propagation methodology and allows for detailed prediction of noise levels to be undertaken for large numbers of receptor points and different noise emission scenarios both horizontally and vertically.

Figure 3.1 CADNA Noise Model



The modelling software calculates noise levels based on the emission parameters and spatial settings that are entered. Input data, assumptions and model settings as given in the table below have been used.

**Table 3.1 Modelling Parameters Sources and Input Data**

Parameter	Source	Details
Horizontal distances – around site	Ordnance Survey	Ordnance Survey
Ground levels – around site	Ordnance Survey	Ordnance Survey
Ground levels – other areas	Site Observations and Ordnance Survey	OS 1:25,000 contours and OS 1:10,000 spot heights.
Traffic data, main surrounding roads	WYGE	Traffic flows for local roads based on WYGE observations and experience.
Traffic data – local roads	WYGE	Traffic flows for local roads based on WYGE observations and experience.
Building heights – around site	WYGE Observations	8 m height for two storey residential properties, and 4 m for Bungalows
Barrier heights	WYGE Observations	All existing barriers at 1.0 m with the exception of hedges and trees which are assumed to offer no noise protection.
Receptor positions	WYGE	1 m from façade, height of 1.5 m for ground floor, 4 m for first floor properties with ground floor or bungalow dormer windows. 7 m for dormer windows on two storey properties. 1.5 m height for model grid and monitoring locations for validation.
Reflections	WYGE	First order reflections have been applied based on mirror image sources
Absorbent Ground	CADNA	Frequency dependant ground absorption has been applied based on values specified in VDI 2714/16 clause 6.3.
Façade Correction	CADNA	Façade corrections have been incorporated into the modelling
Gradient	CADNA	Gradient for each road has been calculated from the height information using the 'calc slope of roads' tool

It is acknowledged that a number of these parameters will affect the overall noise levels presented in this report. However, it should be noted that certain assumptions made, as identified above, are worst case.

3.2 Noise Modelling Methodology

3.2.1 Model Verification

The model was verified by modelling the monitoring locations for the 'existing' weekday scenario. Daytime and night-time L_{Aeq} and night-time L_{Amax} scenarios have been verified. The comparison between the monitoring and modelling results (including contributions from local roads) are shown in the tables below.

**Table 3.2 Modelled vs. Monitored Results L_{Aeq} ; daytime 07:00 – 23:00**

Location	Monitored L_{Aeq}	Modelled L_{Aeq}	Difference between Monitored and Modelled Results
LT1	68.0	68.1	0.1
LT2	60.9	61.5	0.6
LT3	66.0	65.8	-0.2
ST1	70.7	70.7	0.0
ST2	53.1	54.3	1.2
ST3	62.9	63.4	0.5
ST4	55.7	56.1	0.4
ST5	77.0	76.7	-0.3
ST6	82.1	82.1	0.0

All values are sound pressure levels in dB re: 2×10^{-5} Pa

Table 3.3 Modelled vs. Monitored Results L_{Aeq} ; night-time 23:00– 07:00

Location	Monitored L_{Aeq}	Modelled L_{Aeq}	Difference between Monitored and Modelled Results
LT1	62.7	62.7	0.0
LT2	56.8	56.2	-0.6
LT3	59.8	61.3	1.5
ST1	64.2	65.2	1.0
ST2	38.9	42.8	3.9
ST3	39.0	56.3	17.3
ST4	45.4	54.8	9.4
ST5	71.1	71.6	0.5
ST6	77.4	77.6	0.2

All values are sound pressure levels in dB re: 2×10^{-5} Pa

Table 3.4 Modelled vs. Monitored Results L_{Amax} ; night-time 23:00– 07:00

Location	Monitored L_{Amax}	Modelled L_{Amax}	Difference between Monitored and Modelled Results
LT1	84.5	84.4	-0.1
LT2	89.4	89.2	-0.2
LT3	92.9	91.5	-1.4
ST1	81.0	86.5	5.5
ST2	50.2	62.7	12.5
ST3	84.2	83.3	-0.9
ST4	67.0	69.9	2.9
ST5	90.5	88.7	-1.8
ST6	96.3	96.0	-0.3
LT1	84.5	84.4	-0.1

All values are sound pressure levels in dB re: 2×10^{-5} Pa

The verification points in tables 3.2 and 3.3 show a divergence between monitored and modelled results of no more than 3 dB with exception of locations ST2 - ST4 during the night-time L_{Aeq} scenarios. These



differences are probably due to the low number of cars passing during the short-term 15 minute measurements.

ST1 and ST2 show a divergence of more than 3 dB for the night-time L_{Amax} scenario (table 3.4) where the model is predicting a higher level than was recorded during short term measurements. These differences are probably due to the low number of cars passing during the short-term 15 minute measurements.

Accordingly, Toddington Lane immediately south of the site and the development link road running through the site and has been modelled based upon the predicted traffic flows included in Table 3.5 below with a night-time correction applied.

3.2.2 Traffic Noise Data

All roads expected to make a significant contribution have been included within this assessment. Traffic flows and HGV percentages for the proposed Lyminster Bypass and Toddington Lane have been based on traffic data provided by Mayer Brown. Estimates of the vehicle speeds have been made based upon the speed restrictions currently in force in the area.

Table 3.5 Lyminster Bypass Traffic Data

Road	18hr AAWT	HGV %	Speed (kmph)
Lyminster Bypass	15092	05	48
Toddington Lane	10210	08	48
Development Link Road East	7882	05	48

A correction has been made to correct the predicted 18 hour L_{A10} traffic noise levels to 16 hour L_{Aeq} noise levels using the following formula, as provided within PPG 24:

$$L_{Aeq}(16\text{hour}) = L_{A10}(18\text{hour}) - 2\text{dB}$$

During the night-time period, a correction of $0.9 \times L_{A10,18\text{hours}} - 3.77$ has been applied to each link within the $L_{A10,18\text{hours}}$ noise model to derive the $L_{Aeq,8\text{hours}}$ which follows the guidance provided within DMRB.

3.2.3 Proposed Commercial Noise Data

Noise levels from the proposed car parking area have been determined based upon observations within existing foodstores during busy daytime periods. $L_{Aeq}(1\text{ hr})$ noise levels are modelled as area sources across the entire car park as 54 dB at 1.5m height.



3.2.4 Sensitive Receptors

Existing noise levels have been assessed at properties across the site with respect to direct noise from the existing ambient noise climate surrounding the site. The locations of the proposed receptors are shown on SK02 of Appendix B.

Table 3.6 Residential Receptor Locations

Ref.	Description	Closest Source	Approximate Distance To Source (m)	Height (m)
R01	South-East of Site	Central Link Road	86.0	4.0
R02	South-East of Site	Retail	68.0	4.0
R03	South-East of Site	Central Link Road	56.0	4.0
R04	South-East of Site	Retail	17.0	4.0
R05	South-East of Site	Central Link Road	14.0	4.0
R06	East of Site	Central Link Road	16.0	4.0
R07	East of Site	Central Link Road	17.0	4.0
R08	East of Site	Central Link Road	60.0	4.0
R09	East of Site	Central Link Road	74.0	4.0
R10	North-East of Site	Central Link Road	127.0	4.0
R11	North of Site	Retail	70.0	4.0
R12	North of Site	Retail	70.0	4.0
R13	North-West of Site	Retail	61.0	4.0
R14	North-West of Site	Retail	57.0	4.0
R15	North-West of Site	Retail	14.0	4.0
R16	Centre of Site	Retail	21.0	4.0

Table 3.7 Private External Amenity Area Receptor Locations

Ref.	Description	Closest Source	Approximate Distance To Source (m)	Height (m)
G01	South-East of Site	Central Link Road	88.0	1.0
G02	South-East of Site	Retail	47.0	1.0
G03	South-East of Site	Central Link Road	30.0	1.0
G04	East of Site	Central Link Road	35.0	1.0
G05	North-East of Site	Central Link Road	110.0	1.0
G06	North-East of Site	Central Link Road	91.0	1.0
G07	North of Site	Retail	61.0	1.0
G08	North of Site	Retail	47.0	1.0
G09	North-West of Site	Retail	51.0	1.0
G10	North-West of Site	Retail	53.0	1.0
G11	North-West of Site	Retail	27.0	1.0

Table 3.8 above summarises receptor locations that have been selected to represent worst-case residential receptors with respect to direct noise from the commercial areas of the site. The locations of the receptors are shown on SK03 in Appendix B.



4.0 Noise Survey

4.1 Noise Survey Methodology

A monitoring survey was undertaken to characterise baseline ambient noise levels currently experienced on the site and to establish the relative local background and traffic noise levels. Equipment used during the survey included:

B&K 2260	Environmental Noise Analyser (WYG1)	s/n	2361273
B&K 4231	Calibrator	s/n	2176211
Rion NL-52	Environmental Noise Analyser (WYG13)	s/n	620858
Rion NL-52	Environmental Noise Analyser (WYG14)	s/n	610212
Rion NL-52	Environmental Noise Analyser (WYG15)	s/n	1221575

The measurement equipment was checked against the appropriate calibrator at the beginning and end of the measurements, in accordance with recommended practice and no drift was observed. The accuracy of the calibrators can be traced to National Physical Laboratory Standards, calibration certificates for which are available on request.

A baseline monitoring survey was undertaken at nine locations (as specified in the following table and shown in SK01 of Appendix B) from Wednesday 8th October 2014 to Tuesday 14th October 2014. Attended short term measurements were undertaken at six locations during the day, evening and night-time periods with three additional locations being measured unattended over a 115 hour period. The raw data collected from the long term monitoring is available upon request.

Measurements were taken in general accordance with BS 7445-1:2003 *The Description and Measurement of Environmental Noise: Guide to quantities and procedures*. Weather conditions during the survey period were observed as being dry with scattered showers. Anemometer readings confirmed that wind speeds were less than 5 ms⁻¹ at all times during the survey with a predominant westerly wind direction.

Table 4.1 Noise Monitoring Locations

Ref	Description	Grid Reference	
		X	Y
LT1	Junction of Lyminster Road and Mill Lane	502721.4	104064
LT2	Land behind Empress Close along the rail line	502967.4	103855.4
LT3	Land north of Sunflower Close, along the rail line.	504450.3	103646.6
ST1	Junction of Lyminster Road and Mill Lane	502709.3	104046.0
ST2	On Fuller's Walk, next to play area.	502935.2	104092.9
ST3	Along Toddington Lane behind garden centre.	503043.6	103926.4
ST4	At the junction of Empress Close and Hearnfield Road.	502917.0	103871.9
ST5	At the junction of Worthing Road and Landsdowne Road.	502975.7	103420.4
ST6	Along Norway Lane adjacent to the A259.	503962.7	103483.7



4.2 Noise Survey Results

Existing ambient noise levels around the site are dominated by road traffic noise from the A259 (Worthing Road) and the West Coastway railway line.

Ambient and background noise levels are usually described using the L_{Aeq} index (a form of energy average) and the L_{A90} index (i.e. the level exceeded for 90% of the measurement period) respectively. Road traffic noise is generally described using the L_{A10} index (i.e. the level exceeded for 10% of the measurement period).

The results of the statistical measurements and frequency measurements conducted during the survey are summarised in the following table. All values are sound pressure levels in dB (re: 2×10^{-5} Pa).

Table 4.2 Results of Baseline Noise Monitoring Survey (Average Levels)

Period	Duration (T)	Monitoring Date and Times	Location	$L_{Aeq,T}$ (dB)	$L_{Amax,T}$ (dB)	$L_{Amin,T}$ (dB)	$L_{A10,T}$ (dB)	$L_{A90,T}$ (dB)
Day 07:00 - 23:00	44 hours	08/10/2014 - 13/10/2014 07:00 - 23:00	LT1	68.0	101.7	36.3	71.2	53.0
Night 23:00 - 07:00	24 hours	08/10/2014 - 13/10/2014 23:00 - 07:00		62.7	84.5	28.9	60.5	43.9
Weekend Day 07:00 - 23:00	32 hours	11/10/2014 - 12/10/2014 07:00 - 23:00		67.1	103.6	36.1	70.6	49.7
Weekend Night 23:00 - 07:00	16 hours	11/10/2014 - 12/10/2014 23:00 - 07:00		60.0	84.3	25.6	58.3	36.6
Day 07:00 - 23:00	44 hours	08/10/2014 - 13/10/2014 07:00 - 23:00	LT2	60.9	96.5	34.7	55.7	47.3
Night 23:00 - 07:00	24 hours	08/10/2014 - 13/10/2014 23:00 - 07:00		56.8	85.0	26.5	51.2	42.9
Weekend Day 07:00 - 23:00	32 hours	11/10/2014 - 12/10/2014 07:00 - 23:00		60.3	89.4	33.7	53.0	45.0
Weekend Night 23:00 - 07:00	16 hours	11/10/2014 - 12/10/2014 23:00 - 07:00		55.8	89.3	23.4	43.9	34.8
Day 07:00 - 23:00	44 hours	08/10/2014 - 13/10/2014 07:00 - 23:00	LT3	66.0	108.9	36.0	62.4	55.4
Night 23:00 - 07:00	24 hours	08/10/2014 - 13/10/2014 23:00 - 07:00		59.8	94.1	28.3	55.7	44.8
Weekend Day 07:00 - 23:00	32 hours	11/10/2014 - 12/10/2014 07:00 - 23:00		65.9	102.2	35.6	60.9	53.1
Weekend Night 23:00 - 07:00	16 hours	11/10/2014 - 12/10/2014 23:00 - 07:00		59.8	90.6	24.5	53.5	37.9
Day 07:00 - 19:00	15 Mins	14/10/2014 11:28	ST1	70.7	91.8	42.6	73.9	52.5
	15 Mins	14/10/2014 11:48	ST2	53.1	74.2	38.6	54.6	42.1
	15 Mins	14/10/2014 12:07	ST3	62.9	84.2	39.0	63.0	41.8
	15 Mins	14/10/2014 12:26	ST4	55.7	74.0	40.3	55.3	42.7

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Period	Duration (T)	Monitoring Date and Times	Location	$L_{Aeq,T}$ (dB)	$L_{Amax,T}$ (dB)	$L_{Amin,T}$ (dB)	$L_{A10,T}$ (dB)	$L_{A90,T}$ (dB)
	15 Mins	14/10/2014 13:09	ST5	77.0	92.3	54.3	80.5	67.7
	15 Mins	14/10/2014 10:38	ST6	82.1	93.6	59.7	86.8	68.6
Evening 19:00 - 23:00	15 Mins	13/10/2014 21:05	ST1	70.0	85.7	35.4	74.2	42.2
	15 Mins	13/10/2014 21:26	ST2	45.4	62.7	36.8	46.6	40.7
	15 Mins	13/10/2014 21:48	ST3	63.2	83.5	37.1	57.5	39.6
	15 Mins	13/10/2014 22:09	ST4	52.4	75.6	37.7	47.4	40.6
	15 Mins	13/10/2014 20:44	ST5	74.4	89.5	43.7	78.8	53.1
	15 Mins	13/10/2014 20:21	ST6	77.5	94.2	46.4	80.8	55.7
	15 Mins	13/10/2014 23:52	ST1	64.2	81.0	35.5	67.9	41.6
Night 23:00 - 07:00	15 Mins	14/10/2014 00:12	ST2	38.9	50.2	32.1	41.3	34.8
	15 Mins	14/10/2014 00:31	ST3	39.0	53.7	31.7	41.4	35.1
	15 Mins	14/10/2014 00:50	ST4	45.4	67.0	34.7	43.7	36.9
	15 Mins	13/10/2014 23:30	ST5	71.1	90.5	35.9	74.0	41.5
	15 Mins	13/10/2014 23:05	ST6	77.4	96.3	41.7	80.2	46.6

All values are sound pressure levels in dB re: 2×10^{-5} Pa



5.0 Assessment of Key Effects

5.1 Noise Intrusion Assessment

Internal noise levels within potential dwellings have been assessed both with windows open, where a reduction from a partially open window of 10 dB has been used, and with windows closed where an assumption of glazing with specification R_w 30 dB (e.g 6/12/6mm double glazing or equivalent) has been used. These assessments include noise from existing roads and proposed access roads throughout the development. These proposed roads are located through the centre of the site and to the south-east of the development.

The results presented in Tables 5.1 – 5.3 below show the predicted noise intrusion levels at properties across the site. The recommended WHO/BS 8233 internal noise levels are met across the site during the night-time, assuming a windows-closed scenario, however majority of façades are predicted to exceed the relevant criteria (L_{Aeq} , L_{Amax}) with windows open during the night time. In order to achieve the recommended internal noise criteria, a range of mitigation measures are outlined in Section 6.1 of this report; SK05 in Appendix B shows the glazing requirements for living rooms and bedrooms of the proposed development. In order to meet both ventilation and internal noise criteria all habitable rooms on site require ventilation which is equal to or greater than the sound reduction required.

Table 5.1 Daytime Noise Intrusion Levels L_{Aeq} 16 hour

Location	External L_{Aeq} at 1m from facade	Internal L_{Aeq} with windows open	Internal L_{Aeq} with windows closed	Criteria Internal L_{Aeq}
R1	51.6	41.6	21.6	35
R2	56.5	46.5	26.5	35
R3	54.0	44.0	24.0	35
R4	51.0	41.0	21.0	35
R5	65.2	55.2	35.2	35
R6	65.6	55.6	35.6	35
R7	62.3	52.3	32.3	35
R8	45.1	35.1	15.1	35
R9	56.9	46.9	26.9	35
R10	50.0	40.0	20.0	35
R11	50.1	40.1	20.1	35
R12	51.7	41.7	21.7	35
R13	53.9	43.9	23.9	35
R14	53.3	43.3	23.3	35
R15	59.2	49.2	29.2	35
R16	58.2	48.2	28.2	35

All values are sound pressure levels in dB re: 2×10^{-5} Pa.

**Table 5.2 Night-time Noise Intrusion Levels L_{Aeq} 8 hour**

Location	External L_{Aeq} at 1m from facade	Internal L_{Aeq} with windows open	Internal L_{Aeq} with windows closed	Criteria Internal L_{Aeq}
R1	46.1	36.1	16.1	30
R2	51.5	41.5	21.5	30
R3	49.6	39.6	19.6	30
R4	46.0	36.0	16.0	30
R5	50.4	40.4	20.4	30
R6	53.9	43.9	23.9	30
R7	48.9	38.9	18.9	30
R8	40.6	30.6	10.6	30
R9	48.6	38.6	18.6	30
R10	42.6	32.6	12.6	30
R11	42.9	32.9	12.9	30
R12	44.6	34.6	14.6	30
R13	45.8	35.8	15.8	30
R14	50.9	40.9	20.9	30
R15	51.4	41.4	21.4	30
R16	50.0	40.0	20.0	30

All values are sound pressure levels in dB re: 2×10^{-5} Pa.

Table 5.3 Night-time Noise Intrusion Levels L_{Amax}

Location	External L_{Amax} at 1m from facade	Internal L_{Amax} with windows open	Internal L_{Amax} with windows closed	Criteria Internal L_{Amax}
R1	67.9	57.9	37.9	45
R2	71.4	61.4	41.4	45
R3	69.7	59.7	39.7	45
R4	68.0	58.0	38.0	45
R5	74.8	64.8	44.8	45
R6	76.1	66.1	46.1	45
R7	72.3	62.3	42.3	45
R8	60.2	50.2	30.2	45
R9	69.0	59.0	39.0	45
R10	62.9	52.9	32.9	45
R11	63.1	53.1	33.1	45
R12	64.7	54.7	34.7	45
R13	66.2	56.2	36.2	45
R14	71.5	61.5	41.5	45
R15	71.1	61.1	41.1	45
R16	70.2	60.2	40.2	45

All values are sound pressure levels in dB re: 2×10^{-5} Pa.



5.1.1 Private External Amenity Area Noise Levels

Daytime noise levels in gardens and private external spaces of the proposed development have been assessed in the table below. The location of the 'garden' receptor locations are shown on SK02 in Appendix B.

Table 5.4 Private External Amenity Area Noise Levels $L_{Aeq,16hr}$

Ref	External $L_{Aeq,16hr}$ Daytime	BS 8233 Upper Limit Criteria L_{Aeq}
G1	54.8	55.0
G2	47.8	55.0
G3	49.1	55.0
G4	45.9	55.0
G5	52.8	55.0
G6	45.8	55.0
G7	47.9	55.0
G8	47.6	55.0
G9	47.6	55.0
G10	46.3	55.0
G11	51.4	55.0

All values are sound pressure levels in dB re: 2×10^{-5} Pa.

The results in the table above show that daytime L_{Aeq} noise levels within private external amenity areas are predicted to be within the BS 8233 Upper limit (55 dB) and therefore condition 38 planning permission reference LU-47-11 can be discharged.



6.0 Noise Mitigation

6.1 Internal Noise Mitigation

The mitigation measures below are sufficient to reduce the effects of any noticeable and disruptive noise from the surrounding environment by helping to prevent noise levels exceeding BS 8233 criteria for L_{Aeq} and L_{Amax} within all areas of the proposed development.

In accordance with the requirements of Condition 37 of planning permission ref LU-47-11, the glazing strategy provided in SK05 has been designed to achieve internal daytime L_{Aeq} of 35 dB, an internal night-time L_{Aeq} of 30 dB and an internal night-time L_{Amax} of 45 dB in habitable rooms of the proposed development. Throughout the proposed development noise sensitive rooms such as bedrooms and living-rooms on all façades would require ventilation with a sound reduction equal to the glazing due to the proximity of the proposed access roads to the north, through the centre of the development. Ventilation can be provided in several ways from acoustic trickle vents (which need to have a minimum sound reduction equal to or greater than the glazing), other passive ventilation systems or mechanical ventilations systems.

Passive ventilators with a sound reduction of greater than $D_{n,e,w} + C_{tr}$ 32 dB will be installed. It is understood that Greenwoods 400L trickle vent ($D_{n,e,w}$ 34 dB) will be fitted to the dwellings which meet or exceed the required sound reduction. Therefore it is not considered that a mechanical means of ventilation will be required to be installed within the proposed dwellings.

Dwellings with façades facing the access road through the centre of the site and dwellings to the east of the site would require enhanced glazing in order to meet internal target noise levels (as shown in SK05 in Appendix B and detailed below):

- Plot 80 which requires $R_w + C_{tr}$ 31 dB glazing is designed to be house type 'Lumley' (Drawing ref: 543_PL_LUMLEY_P_100). It should be noted that sensitive rooms such as the living room and bedrooms are exposed to the effect of the Central Link Road.
- Plots 82-86 which require $R_w + C_{tr}$ 31 dB glazing are designed to be house type 'Leicester' (drawing ref: 543_PL_LEICESTER_P_100). It should be noted that the living rooms is positioned to the rear of the house and therefore shielded from the Central Link Road.
- Plots 99-100 which require $R_w + C_{tr}$ 32 dB glazing which is designed to be an apartment block (drawing ref: 543_PL_AP_BLOCK_P_100). Bedrooms are exposed to the effects of the Central Link Road.

Dwellings to the centre and west of the site require glazing and ventilation of with a minimum sound reduction of $R_w + C_{tr}$ 30 dB.

6.1.1 Details of Enhanced Glazing

The following glazing to be installed on all properties across the development site:

**Table 6.1 Pilkington Glass Attenuation**

Glazing Required (mm)	125	250	500	1000	2000	4000	$R_w + C_{tr}$
10mm / (6 – 16mm) / 4 mm (Insulated Glass Unit)	24	21	32	37	42	43	30
10mm / (6 – 16mm) / 6 mm (Insulated Glass Unit)	24	24	32	37	37	44	32
6/16/6.8 Pilkington Optiphon	22	27	35	42	41	48	33

The installation of this glazing will achieve internal noise criteria across the development site. Details of the acoustic test data and ventilation product data are presented in Appendix C.

6.2 Private Amenity Area Noise Mitigation

Noise levels within private amenity areas (within 5 metres of dwellings) meet the noise level criteria outlined in BS 8233/WHO upper guideline of 55 dB. Additionally, noise levels meet the criteria outlined in Condition 38 and therefore the requirements of Condition are 38 met.

All fences throughout the development will be constructed from brick or solid timber panels with no gaps and be a minimum of 1.8 metres high; the proposed acoustic fence detail is provided in Appendix E.



7.0 Conclusions

Conditions 37 and 38

In accordance with the requirements of Conditions 37 and 38 of planning permission ref LU-47-11, a glazing and ventilation strategy has been provided which achieves both ventilation and internal ambient noise level requirements of L_{Aeq} daytime 35 dB, L_{Aeq} night-time of 30 dB and L_{Amax} night-time of 45 dB in all residential bedroom and living spaces of the proposed development. The suggested glazing specifications are achievable. Standard double glazing is sufficient across the majority of the site in order to achieve the target internal noise levels when windows are closed, however ventilation such as passive trickle vents will be required for habitable areas (living rooms and bedrooms) of all properties across the site and enhanced glazing is required for 6 buildings facing both the site access road through the centre of the site, in order to meet internal targets for noise levels.

All private external amenity areas receptors are below BS 8233 Upper Limit Criteria levels for L_{Aeq} with fences constructed from brick or solid timber panels with no gaps and be a minimum of 1.8 metres high.

The requirements of Conditions 37 & 38 of planning permission ref LU-47-11 are met and can therefore be discharged.

NPPF 123 A & B

In considering the NPPF test in section 123, points A & B. The proposed development is not expected to have an 'adverse impact' on health or quality of life. Similarly, with regard to NPPF (123) point B, it is considered that all 'adverse impacts on health and quality of life' (relating to noise) are mitigated by the use of an appropriate glazing and ventilation strategy.

NPPF 123 C & D

Given that nearby the site is surrounded by similarly residential properties to the south of the site, it is not considered that any existing businesses wanting to develop would be particularly restricted by the introduction of the new sensitive use of the proposed development.

Planning Practice Guidance: Noise

It is considered that the noise mitigation in Section 6.1 of this report is sufficient to reduce the effects of any noticeable and disruptive noise being currently emitted from the surrounding environment by helping to prevent noise levels exceeding BS 8233 criteria for L_{Aeq} and L_{Amax} within all areas of the proposed development.



Appendices



Appendix A – Acoustic Terminology and Abbreviations

Acoustic Terminology

- dB** Sound levels from any source can be measured in frequency bands in order to provide detailed information about the spectral content of the noise, i.e. whether it is high-pitched, low-pitched, or with no distinct tonal character. These measurements are usually undertaken in octave or third octave frequency bands. If these values are summed logarithmically, a single dB figure is obtained. This is usually not very helpful as it simply describes the total amount of acoustic energy measured and does not take any account of the ear's ability to hear certain frequencies more readily than others.
- dB(A)** Instead, the dBA figure is used, as this is found to relate better to the loudness of the sound heard. The dBA figure is obtained by subtracting an appropriate correction, which represents the variation in the ear's ability to hear different frequencies, from the individual octave or third octave band values, before summing them logarithmically. As a result the single dBA value provides a good representation of how loud a sound is.
- L_{Aeq}** Since almost all sounds vary or fluctuate with time it is helpful, instead of having an instantaneous value to describe the noise event, to have an average of the total acoustic energy experienced over its duration. The L_{Aeq, 07:00 – 23:00} for example, describes the equivalent continuous noise level over the 12 hour period between 7 am and 11 pm. During this time period the L_{pA} at any particular time is likely to have been either greater or lower than the L_{Aeq, 07:00 – 23:00}.
- L_{Amin}** The L_{Amin} is the quietest instantaneous noise level. This is usually the quietest 125 milliseconds measured during any given period of time.
- L_{Amax}** The L_{Amax} is the loudest instantaneous noise level. This is usually the loudest 125 milliseconds measured during any given period of time.
- L_n** Another method of describing, with a single value, a noise level which varies over a given time period is, instead of considering the average amount of acoustic energy, to consider the length of time for which a particular noise level is exceeded. If a level of x dBA is exceeded for say 6 minutes within one hour, then that level can be described as being exceeded for 10% of the total measurement period. This is denoted as the L_{A10, 1 hr} = x dB.
- The L_{A10} index is often used in the description of road traffic noise, whilst the L_{A90}, the noise level exceeded for 90% of the measurement period, is the usual descriptor for underlying background noise. L_{A1} and L_{Amax} are common descriptors of construction noise.
- R_w** The *weighted sound reduction index* determined using the above *measurement* procedure, but weighted in accordance with the procedures set down in BS EN ISO 717-1. Partitioning and building board manufacturers commonly use this index to describe the inherent sound insulation performance of their products.



Abbreviations

CADNA – Computer Aided Noise Abatement

DMRB – Design Manual for Roads and Bridges

HGV – Heavy Goods Vehicle

PPG – Planning Practice Guidance

UDP – Unitary Development Plan

UKAS – United Kingdom Accreditation Service

WYGE – WYG Environment



Appendix B – Sketches

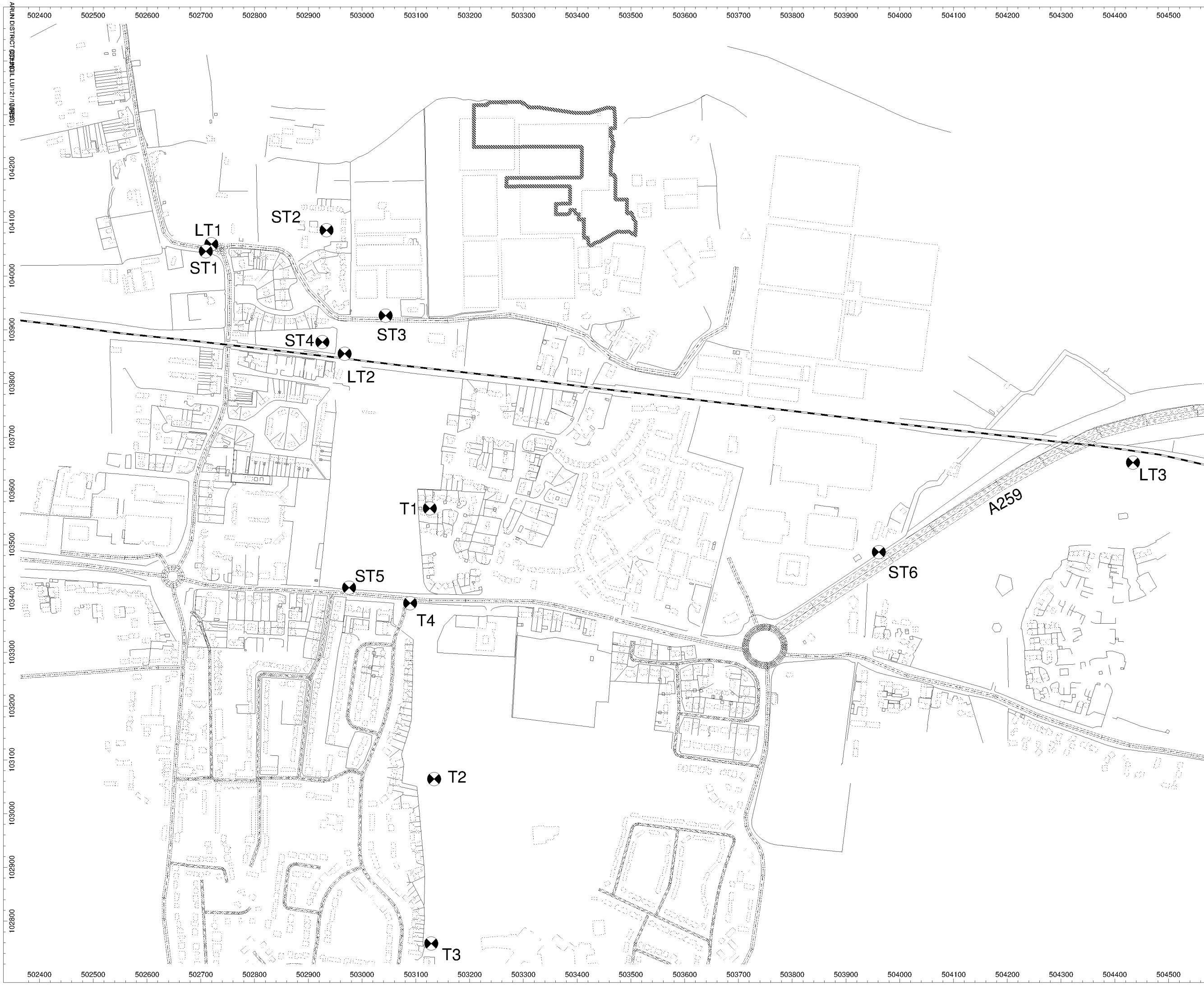
SK01 Noise Monitoring Locations

SK02 Site Layout and Receptor Locations

SK03 Daytime $L_{Aeq,16hr}$

SK04 Night-time $L_{Aeq,8hr}$

SK05 Glazing and Ventilation Strategy



Client:
Persimmon Homes

Project:
Reserved Matters Application
(Phase 2) and Discharge
of Conditions,
North Littlehampton

Project Number:
A095004

Drawing Title / Scenario:
Noise & Vibration
Monitoring Locations

Drawing Number:
SK01

Key:

Site Boundary: -----

Site Boundary:

Scale : Not to scale

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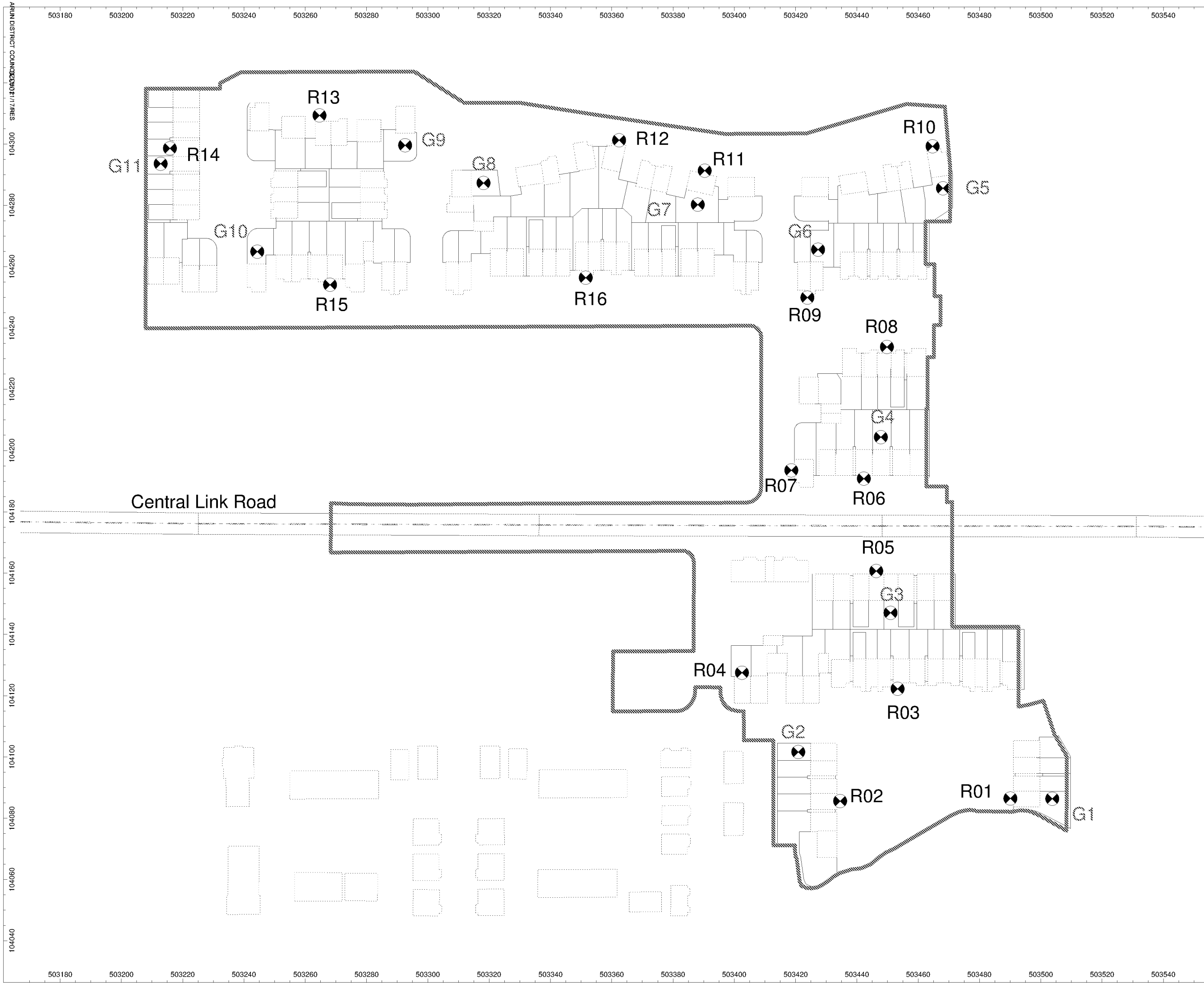
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Client:
Persimmon Homes

Project:
Reserved Matters Application
(Phase 2) and Discharge
of Conditions,
North Littlehampton

Project Number:
A095004

Drawing Title / Scenario:
Proposed Receptor
Locations

Drawing Number:
SK02

Key:
Site Boundary: 

Scale : Not to scale

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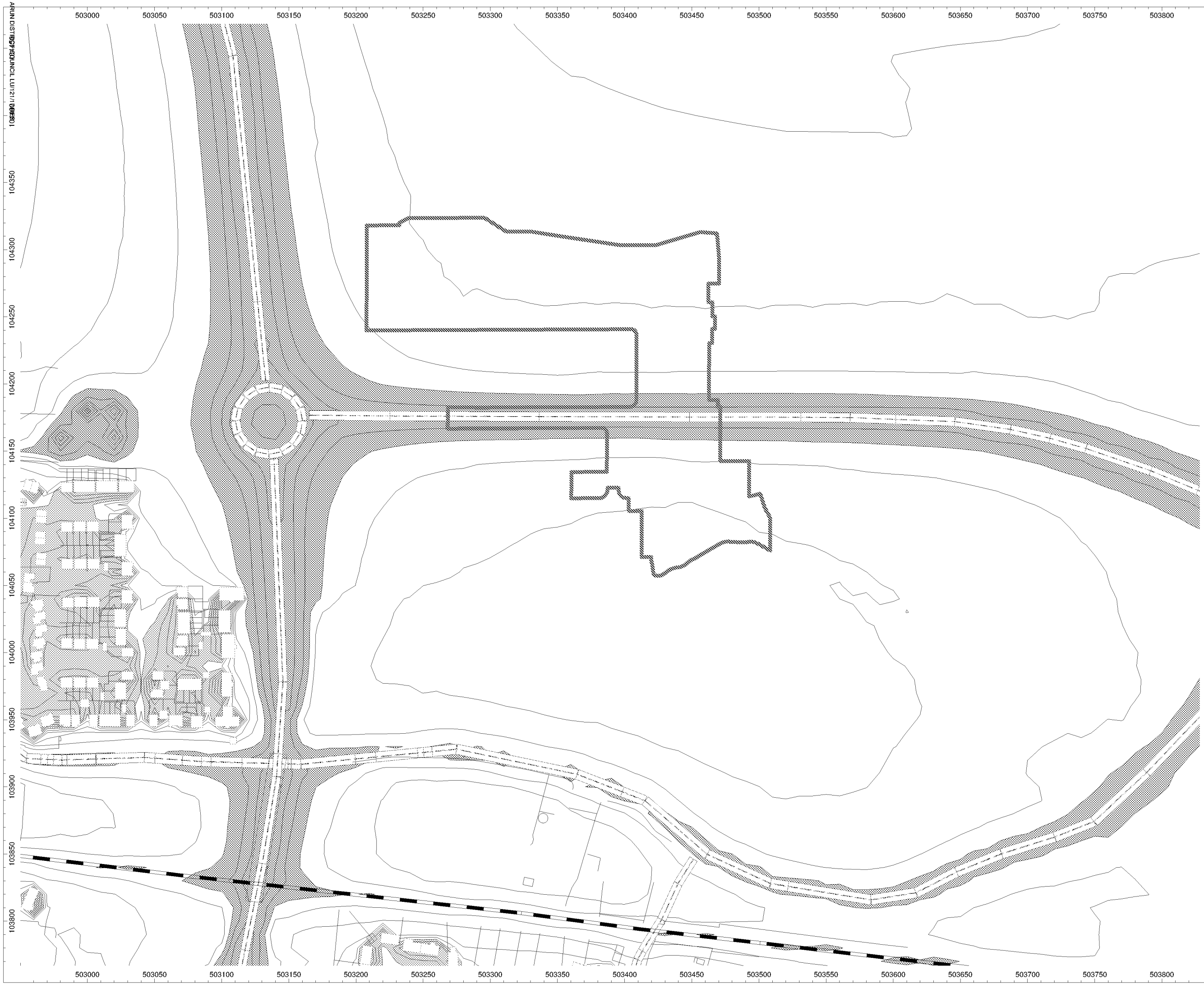
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Client:
Persimmon Homes

Project:
Reserved Matters &
Discharge of Conditions

Project Number:
A095004

Drawing Title / Scenario:
Existing Daytime
LAeq, 16hr Noise Levels

Drawing Number:
SK05

Key:

Site Boundary: -----

0.0 - 55.0 dB
55.0 - 65.0 dB
65.0 - 75.0 dB
> 75.0 dB

Scale : Not to scale

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Client:
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Project:
Reserved Matters &
Discharge of Conditions

Project Number:
A095004

Drawing Title / Scenario:
Existing Night-time
LAeq, 8hr Noise Levels

Drawing Number:
SK05

Key:

Site Boundary: -----

- 0.0 - 55.0 dB
- 55.0 - 65.0 dB
- 65.0 - 75.0 dB
- > 75.0 dB

Scale : Not to scale

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Client:
Persimmon Homes

Project:
Reserved Matters &
Discharge of Conditions

Project Number:
A095004

Drawing Title / Scenario:
Enhanced Glazing
Plan

Drawing Number:
SK05

Key:
Site Boundary:

Enhanced Glazing &
Alternative Ventilation:

Scale : Not to scale

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Appendix C – Consultation Response Received from Arun District Council

ADC Comment 1

Alternative means of 'ventilation required throughout the development for noise sensitive rooms such as bedrooms and living rooms on all facades.' The method of such ventilation for each property, or each group of properties with like characteristics, to be prescribed, (including detail of noise reduction capability) and agreed with this Department. Acoustically treated, mechanical mean of ventilation is likely to be required in those properties most affected by intrusive noise.

Considered in Section 6 above and detailed provided in Appendix D below.

ADC Comment 2

'Enhanced Glazing' Those properties requiring enhanced glazing to be prescribed and detail of noise attention to be provided to the satisfaction of this Department.

Considered in Section 6 above and detailed provided in Appendix D below.

ADC Comment 3

'Building Design and Layout' Please provide the agreed layout of buildings and position of noise sensitive rooms within these in relation to the main sources of noise ie roads, in order to demonstrate the way in which building orientation and internal arrangement have been design to reduce external noise impact.

Considered in Section 6 above.

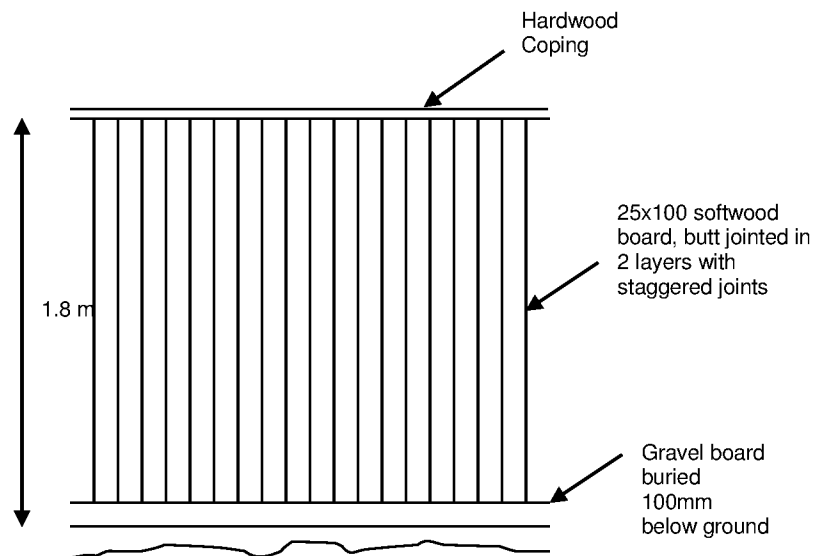
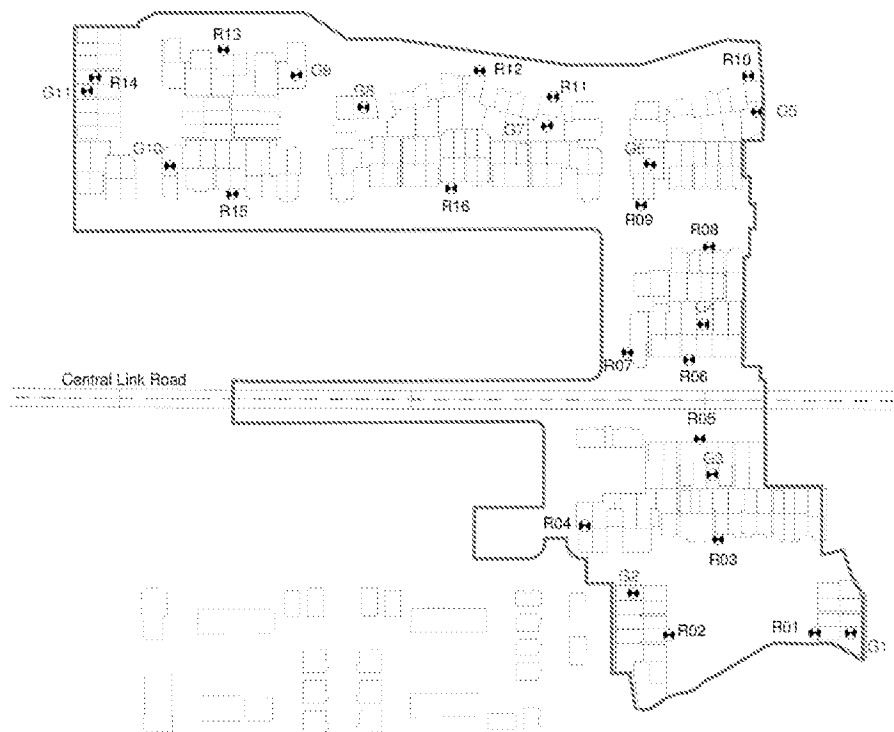
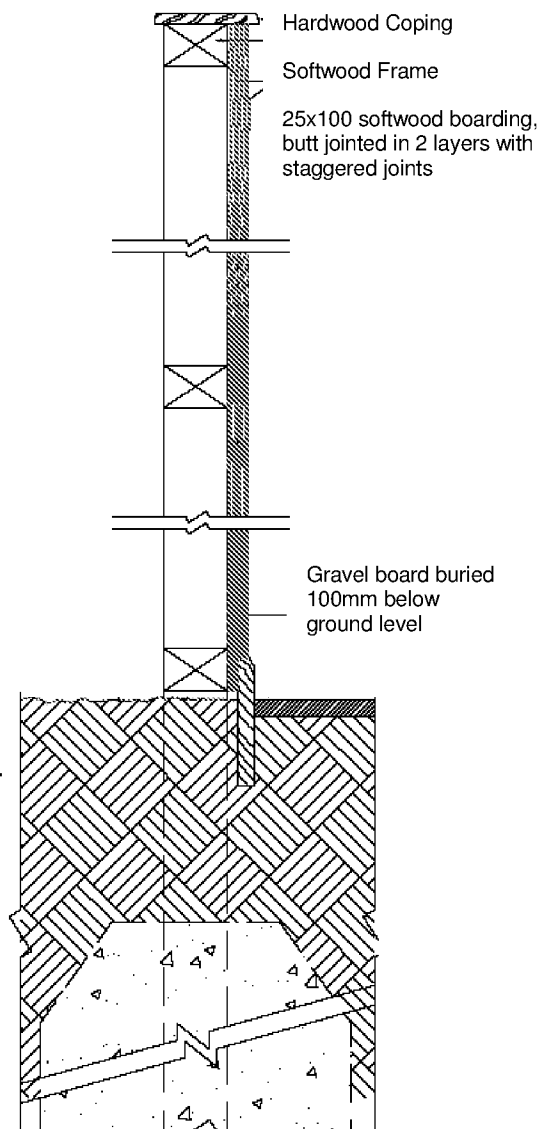
ADC Comment 4

'Fencing' Please provide detail of where acoustic fences will be positioned in order to achieve the desired mitigation. Please also provide detail of proposed acoustic fencing specification.

Provided in Appendix E Below.



Appendix D – Acoustic Fence Detail



Client:

Persimmon Homes

Project:

Reserved Matters Application
(Phase 2) & Discharge of
Conditions, North
Littlehampton

Project Number:

A095004

Site Address:

North Littlehampton

Drawing Title / Scenario:

Garden Fence Detail

Scale: Not to Scale

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