Chapter Fifteen ◆ Noise and Vibration

INTRODUCTION

15.1 This chapter provides a preliminary assessment of noise and vibration associated with the Proposed Development. Higher levels of noise can affect human health as well as having a negative impact on wildlife and the enjoyment of both built and natural environments.

15.2 'Noise' as used in the naming of this chapter is taken to include any unwanted tactile vibration as well as audible noise. For clarity, the terms 'noise' and 'vibration' are used throughout the assessment to distinguish between the two aspects of 'noise'.

15.3 The movement of people on and off the Project Site through road, rail and ferry traffic will have the potential to affect noise and vibration levels in and around the Project Site. In addition, the noise and vibration caused by the construction and operation of facilities and plant has been included in the assessment of noise impact.

15.4 This chapter outlines the currently available project information, the relevant national and local policy and guidance documents and details the following assessment topics:

- Baseline conditions currently existing at the Project Site and surrounding area;
- the potential effect of noise and vibration caused by likely construction activities;
- the potential effect of noise and vibration caused by operation of the Proposed Development; and
- mitigation measures to reduce / offset any significant adverse effects from noise.

15.5 Construction of the Proposed Development will give rise to temporary noise and vibration impacts (although the propagation distance of the latter will be more limited). The construction assessment is based on BS 5228-1 (2009+A1 2014) guidance.

15.6 The assessment of noise and vibration has been undertaken based on the prediction of future traffic flows (road, rail and ferry) which is presented in detail in chapter 9 of this PEIR.

METHODOLOGY AND DATA SOURCES

Study Areas

15.7 Sensitive receptors are located where noise or vibration can have a negative impact on humans, wildlife or ecologically sensitive sites including residential properties, schools and

care homes in the vicinity of the Project Site as well as the same receptor types located along roads leading to the Project Site and therefore affected by the construction and operation of the Proposed Development.

15.8 Ecological Sites of Special Scientific Interest (SSSI's) around the Kent and Essex Project Site include the following locations:

- The West Thurrock Lagoon and Marshes;
- Darenth Woods;
- Lions Pit;
- Hangman's Wood and Deneholes;
- Swanscombe Skull Site; and
- Baker's Hole;

15.9 The ES, submitted as part of the DCO application, will also provide an assessment of noise and vibration effects on those areas identified as being of specific concern, these include:

- The Botany Marshes Local Wildlife Site;
- Blackduck Marshes;
- Thames Estuary SPA; and
- Ramsar Site.

Limitations

15.10 As surveys are ongoing, this PEIR chapter is based on information and currently available data for assessments.

15.11 Any gaps in information or data identified will be considered and addressed within the ES.

EIA Scoping Opinion

15.12 A Scoping Report for the Project Site was submitted to the Planning Inspectorate on 15th June 2020. The report contained the noise and vibration assessment scope that is proposed for use in the preparation of the Environmental Statement. At this point, in the development of the PEIR (July 2020) the Secretary of State's Scoping Opinion has not yet been received. However, the Secretary of State's 2014 Scoping Opinion (which covered the Kent Project Site area only) for the London Resort offered a series of recommendations pertinent to the assessment of noise and vibration. These are identified in table 15.1

(overleaf) and are noted below. These will be replaced with updated response when available.

Table 15.1: Summary of 2014 EIA scoping opinion and response

2014 Scoping Opinion Paragraph Number	2014 Scoping Opinion Comment	2020 Response
3.60	The Secretary of State recommends that the methodology and choice of noise receptors should be agreed with the relevant local environmental health officers within local planning authorities, and other relevant consultees (e.g. the EA, NE or the Ebbsfleet Development Corporation) as required. The Secretary of State draws attention to the responses from DBC and GBC regarding the criteria and standards applied in the assessment and the need to agree baseline and methodology.	Environmental Health Officers from local planning authorities and other relevant consultees (as listed in Paragraph 15.13) are being contacted directly during the 2020 statutory consultation phase and asked to review the current noise monitoring locations within this PEIR and propose key locations where further baseline noise data should be measured, if any.
3.61	The Secretary of State notes the proposed methodologies for predicting and assessing potential noise and vibration impacts. The Scoping Report does not however explain the proposed method of assessing the potential noise impacts (e.g. cheers, shouts and entertainment/music) generated by the proposed rides, attractions and event spaces in the development. This information should be provided in the ES, with reference to the methodologies used for other similar types of developments in England. Consideration may also need to be given to existing sources of noise and vibration in the area and any impact they may have on the proposals, for example (as for air quality) existing wharves as highlighted by the PLA.	At this preliminary assessment stage, visitor attractions are modelled as a series of noise sources that represent segments of a visitor attraction / ride where riders are predicted to be screaming. The model assessment shows the sound propagation extent of maximum A-weighted decibel levels (measured during a noise survey of a large European visitor attraction) from assumed ride / screaming locations. The effects of noise and vibration on the development will be evaluated for the ES.
3.62	The Scoping Report illustrates the proposed general location of various components of the project; however, the potential impacts and receptors could vary	This will be investigated further for the ES. Current investigations look at the impact of traffic movement increases due to London Resort

2014 Scoping Opinion Paragraph Number	2014 Scoping Opinion Comment	2020 Response
	according to the characteristics (e.g. design, size, configuration) of the components (including the rides/attractions) at any given time. The assessment should therefore describe and assess the impacts based on the proposed maximum development parameters. The ES should also explain clearly how proposed DCO requirements control potential impacts within the assessment parameters.	operation, ride noise sound propagation and construction noise activities at the site boundary.
3.63	Potential noise sources during construction and operation should be clearly described. The ES should also describe the potential receptors for these impacts and how these might vary with potential changes to the design/configuration of the project following commencement.	Initial construction assessments have been conducted for the PEIR, investigating the noise impact of different Earthworks, Piling, Paving and General Construction sources. Noise sensitive receivers located near potential construction activities have been highlighted within the chapter. This will be further investigated for the ES.
3.64	The ES should describe the types of vehicles and plant to be used during the construction phase and assess the characteristics of impacts (e.g. type and magnitude) that these would generate. This should include an assessment of the proposed piling works. The assessment should be informed by the anticipated working hours of the construction phase, and these should be subject to agreement from the local authorities.	The noise survey measurements, traffic flows and construction activity plant item noise sources (including piling activities) used within initial assessments have been detailed within this chapter.
3.65	The noise and vibration assessments should take account of potential traffic movements along access routes, especially during the construction phase. The results from the noise and vibration assessments will also provide information to inform the ecological assessments therefore, the ES should include cross-referencing to	Noise modelling in this section is informed by the LDP 2038 design day visitor predictions. The traffic flows input onto the access roads is based on a worst-case peak flow prediction of 77,000-day visitors in the year 2038, to evaluate how

2014 Scoping Opinion Paragraph Number	2014 Scoping Opinion Comment	2020 Response
	relevant chapters/appendices as appropriate. Noise and vibration levels from works along the foreshore of the River Thames (potentially affecting birds and marine ecology) should be assessed.	Construction traffic will be assessed for the full ES. The noise impact of the development on SSSI's and areas of interest identified within the Project's Ecology team will be assessed for the full ES.
3.66	The ES should describe clearly the proposals for mitigating potentially significant adverse effects, and the Secretary of State's viewpoint in this regard is echoed by comments provided by DBC regarding the need for detailed proposals for mitigation and a detailed consideration of residual effects. This should include consideration of how noise complaints during construction and operation could be monitored.	Examples of mitigation measures that can be used where reasonably practicable to control construction noise have been detailed in the Chapter. Methods of monitoring construction noise will be provided in the full ES.

15.13 During the course of the assessment work leading up to the ES and the DCO application, consultation will be undertaken with:

- Kent County Council;
- Dartford Borough Council;
- Gravesham Borough Council;
- Thurrock Borough Council;
- Environment Agency;
- Natural England; and
- Ebbsfleet Development Corporation.

15.14 The consultations with the organisations listed above will be used to confirm:

- The extent of baseline noise and vibration surveys;

- the identification of noise sensitive receptors; and
- the choice of noise indices (L_{10}, L_{eq}, L_{max} etc.) for use in different components of the assessment.

Baseline Noise Level Study

Noise and vibration surveys

15.15 Between December 2014 and February 2020, Buro Happold, on behalf of the Applicant, conducted multiple noise surveys in and around the Kent Project Site to establish the baseline ambient noise levels around the Proposed Development. The measurements were conducted with the microphone(s) positioned on a tripod and located approximately 1.5 m above ground level. All of these results, including the earliest examples, are considered to still be valid given that the area is not considered to have experienced changes which would dramatically impact the noise climate.

15.16 A further noise survey is planned to assess the baseline conditions around Tilbury Town, north of the River Thames at the Essex Project Site. This has however been postponed due to the COVID-19 pandemic. Noise measurements undertaken during lockdown conditions are not considered to be representative of the typical environment, as such, they will be postponed until there is more representative activity occurring in the area. For the purposes of conducting an indicative assessment within this chapter, $L_{Aeq,16hrs}$ road traffic noise data (Source: Department for Environment, Food and Rural Affairs, Road Noise) has been used to assess the potential noise climate changes around the Essex Project Site to operational traffic.

15.17 In the event that typical noise climate conditions do not return to the area in time for the ES assessment, Tilbury2 noise monitoring data is being investigated as a contingency option for understanding the typical noise climate around Tilbury Town.

15.18 Environmental Health Officers from local planning authorities and other relevant consultees (as listed in Paragraph 15.13) are being contacted directly during the 2020 statutory consultation phase and asked to review the current noise monitoring locations within this PEIR and propose key locations where further baseline noise data should be measured, if any.

15.19 The noise survey methodology adopted complies with the requirements of BS 7445-1:2003. Description and measurement of environmental noise. Guide to quantities and procedures.

15.20 Further baseline vibration data, in addition to that already established as explained in paragraph 15.12 and 15.13 above, will be collected throughout 2020 and will be reported in full in the ES submitted as part of the DCO application, following consultation with the bodies listed in Paragraph 15.17, alongside the key sources of ground-borne vibration

(railways and roads serving particularly heavy vehicles) and predictions made of the distance over which such vibration decays to below general ambient levels.

Site description

15.21 The Kent Project Site lies within Dartford and Gravesham Borough Councils in Kent, the channel tunnel railway line runs beneath the area and it is bounded by the following:

North

- River Thames.

East

- Industrial development;
- Ebbsfleet United Football Ground; and
- pockets of residential development.

South

- Swanscombe residential development;
- Swanscombe;
- Ebbsfleet International and Northfleet railway stations;
- Sawyer's Lake; and
- residential developments near the A2(T) Highway.

West

- Residential development in Greenhithe.

15.22 The Essex Project Site is bounded by the following:

North

- Tilbury Town residential development;

East

- Riverside business centre;
- Tilbury fort; and
- Tilbury2.

South

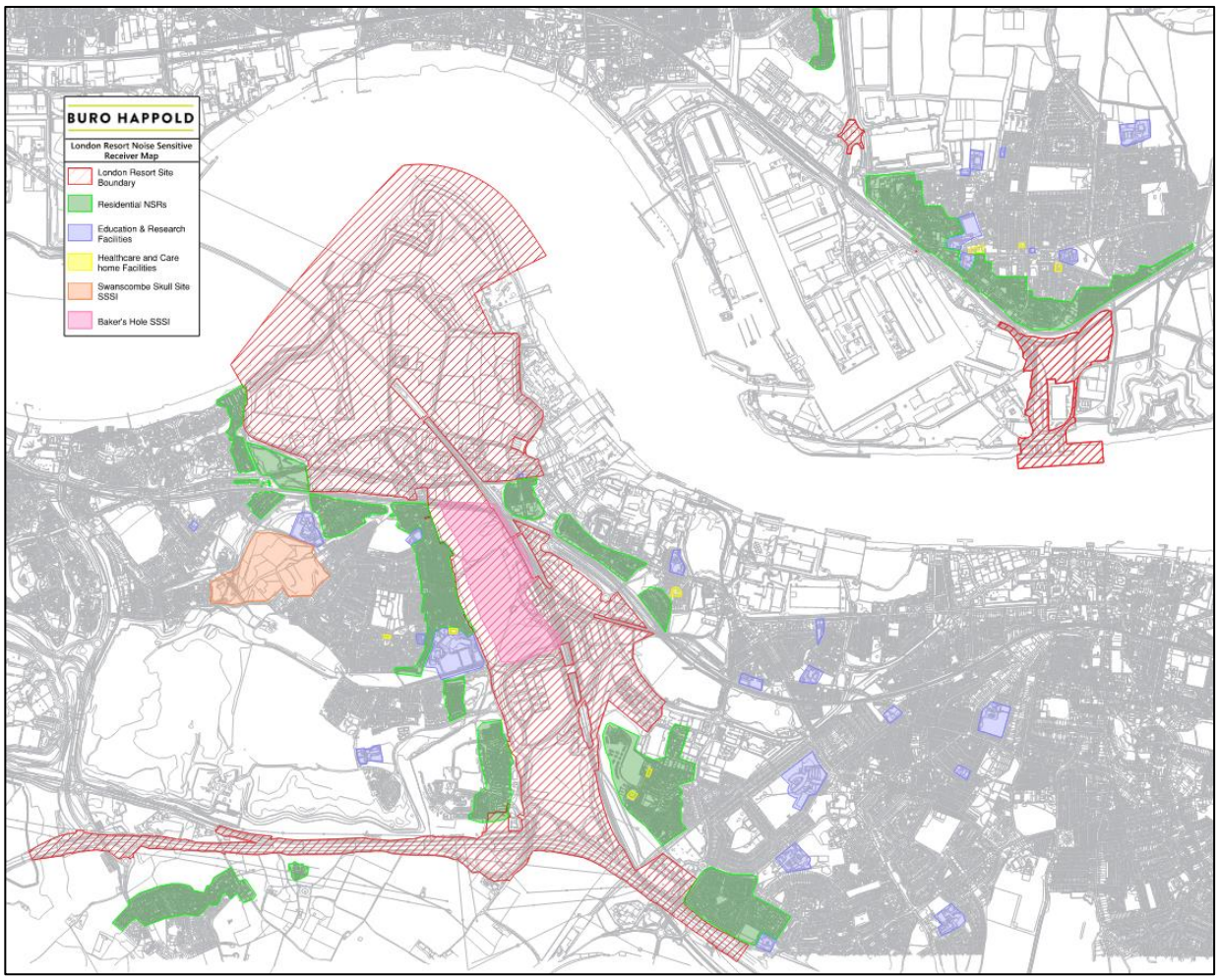
- The River Thames.

West

- Tilbury docks; and
- Industrial development.

15.23 Figure 15.1 illustrates the Project Site boundary and noise sensitive receptors (NSRs) for the London Resort.

Figure 15.1: Kent and Essex Project Site map, illustrating NSR locations.



15.24 The following education and research facility NSRs, shown in Figure 15.1, have been identified to be located near to the Project Site:

Kent Project Site NSRs

- Knockhall's Early Birds Nursery and Primary School;

- Springfield Lodge Day Nursery;
- The Crayland's School;
- Cygnets Preschool;
- Saplings Nursery;
- Manor Community Primary School;
- Ebbsfleet Academy;
- Cherry Orchard Primary Academy;
- Snowden Hill Nursery;
- Hope School;
- Painters Ash Primary School;
- Northfleet School for Girls;
- Northfleet Technology College;
- Shears Green Infant and Junior School;
- Copperfield Academy;
- St Botolph's Church of England Primary;
- St Josephs;
- Rosherville Church of England Primary; and
- Lawn Community Primary.

Essex Project Site NSRs

- Lansdowne Primary Academy;
- St Mary's RC Primary;
- Olive AP Academy;
- Helping Hands Day Nursery;

- Little Pirates Nursery;
- Tilbury Children's Centre; and
- Tilbury Manor Junior School and Pioneer Academy.

15.25 The following healthcare and care-home facility NSRs, shown in Figure 15.1, have been identified to be located near to the Project Site:

Kent Project Site NSRs

- Swanscombe Health Clinic;
- Swanscombe Health Centre;
- Eastgate Counselling;
- Kesson House Care Home; and
- Blue Care Facilities.

Essex Project Site NSRs

- Abbey Healthcare;
- BS Care Management;
- The Shehadeh Medical Centre; and
- Tilbury Health Centre.

Noise survey locations

15.26 Noise surveys have been undertaken at selected locations around the Kent Project Site on the following dates:

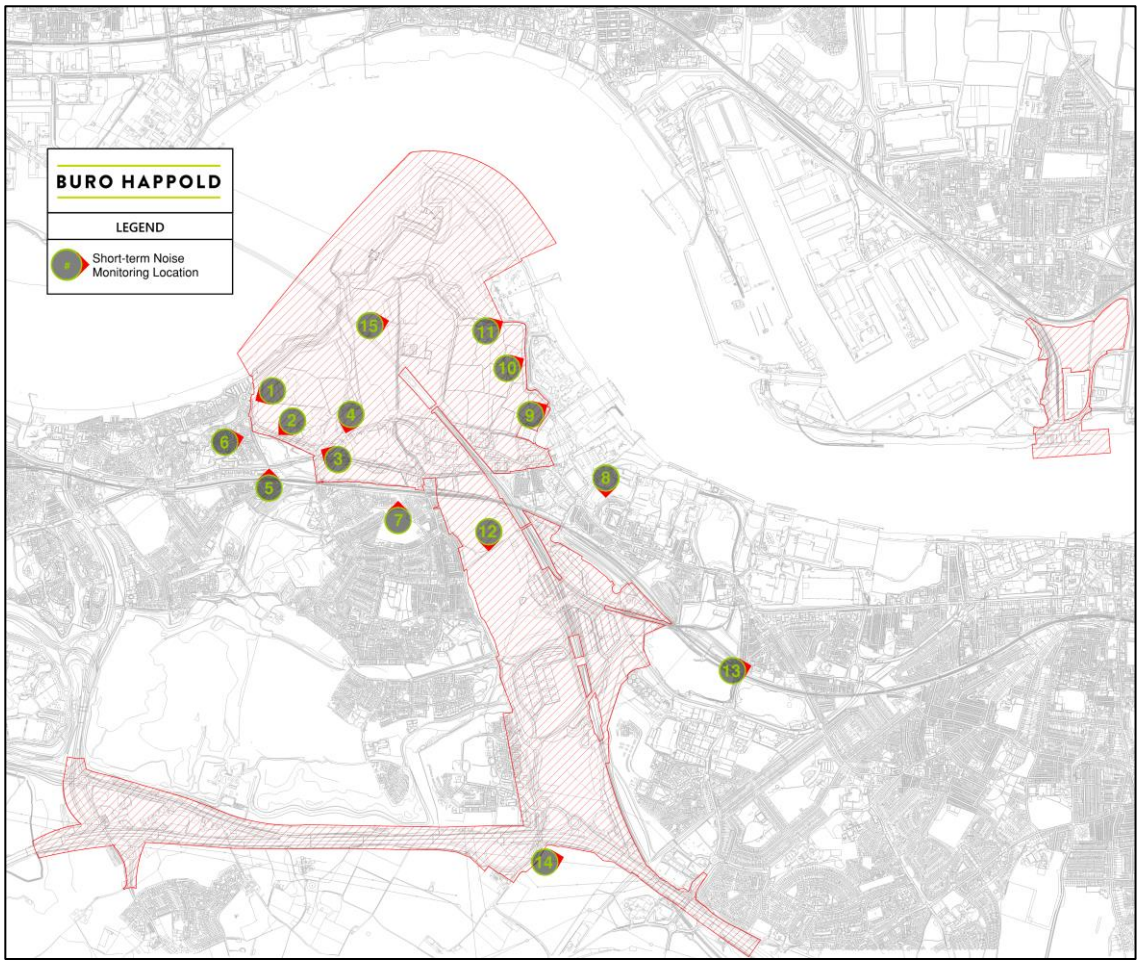
- 9th December 2014;
- 5th March 2015;
- 23rd July 2015;
- 13th March 2020 (prior to COVID-19 lockdown).

15.27 The locations of noise survey monitoring positions are as follows:

1. Stonely Crescent, Greenhithe;
2. 12-15 Tiltman Avenue, Greenhithe;
3. Manor Way (Roundabout), Swanscombe;
4. Manor Way (Whitecliff Park), Swanscombe;
5. London Road (Lover's Lane), Greenhithe;
6. 24 Duncannon Place, Greenhithe;
7. 71 Pentstemon Drive, Swanscombe;
8. 79 Wallis Park Northfleet, Gravesend;
9. Manor Way Northfleet, Gravesend;
10. Manor Way Northfleet, Gravesend;
11. Manor Way Northfleet, Gravesend;
12. Located off the footpath adjacent to 98 Stanhope Road, Swanscombe;
13. 54 York Road, Gravesend;
14. Farmland adjacent to the A2(T). Access along unpaved road off Foxhounds Lane Southfleet, Gravesend; and
15. A long-term nose survey monitoring position on Swanscombe Marshes.

15.28 Appendix 15.1 contains baseline noise monitoring details, providing the short-term $L_{AF,max}$, $L_{Aeq,T}$ and L_{A90} measurement data from the monitoring in 2014, 2015 and 2020.

Figure 15.2: Approximate monitoring locations around the Kent Project Site.



15.29 The baseline noise environment in and around the Kent Project Site includes contributions from the following sources of noise:

- Road traffic noise using the existing principal east-west routes past the Kent Project Site: the A226 London Road to the north and the A2(T) to the south.
- Road traffic using the principal north-south route past the Kent Project Site: the B259 Stanhope Road and the B2175 Dover Road.
- Rail traffic on the east west network rail lines serving Greenhithe, Swanscombe and Northfleet stations.
- Rail traffic on the high speed (HS1) rail lines serving (and passing through) Ebbsfleet International Station.
- Sources of industrial noise to the west of Swanscombe Marshes off Lower Road / Manor Road.
- Sources of industrial noise south of Swanscombe Marshes and north of London Road off Manor Way.

- Road traffic noise from local roads.
- Marine traffic on the Thames.
- Existing wharves on the Thames.
- Occasional aircraft overflight.

15.30 The baseline vibration environment in and around the Kent Project Site includes contributions from:

- Rail traffic on the east west network rail lines serving Greenhithe, Swanscombe and Northfleet stations.
- Rail traffic on the HS1 railway, including noise associated with trains stopping at Ebbsfleet International Station.
- Road traffic (including that servicing local industrial premises).

15.31 The monitoring locations (Figure 15.2) and measurements obtained at those locations (Appendix 15.1) were used to calibrate the 3D acoustic modelling for the noise propagation assessment.

15.32 The baseline noise environment around the Essex Project Site is to be confirmed from an attended noise survey. The following sources are anticipated based on Department for Environment, Food and Rural Affairs $L_{Aeq,16hr}$ road traffic data (shown in Appendix 15.1) and typical activities around the Essex project site:

- Road traffic noise from the A1089.
- Industrial noise from Tilbury Docks.
- Motor vehicle noise from car distribution centres.
- Rail noise from Tilbury Town trainlines.
- Marine traffic on the Thames.
- Road traffic from local Tilbury Town roads.

15.33 The baseline vibration environment around the Essex Project Site is to be confirmed from an attended noise / vibration survey. Environmental Health Officers are asked to review this PEIR and propose key locations where baseline vibration data (if any) requires monitoring. The following sources are currently anticipated:

- Rail traffic on the network rail lines serving Tilbury Town;
- Road traffic (including that servicing local industrial premises).

- Industrial vibration at Tilbury Docks.

Noise survey instrumentation

15.34 The measurements at the Kent Project Site were conducted using Class A sound level meters, which were calibrated by UKAS-approved laboratories in accordance with the required schedule of frequency. No significant drift was observed (≤±0.5dB) before and after noise survey measurements giving the devices a Class 1 performance specification as of British Standard 61672-1:2013, Electroacoustics, *Sound Level Meters*. Calibration certificates are available upon request.

15.35 Noise surveys were undertaken using an NL52 Type 1 (Serial # 620872) and a BLUE SOLO 01 (Serial # 61193) sound level meter. The sound level meters were calibrated using a B&K 4231 calibrator (Serial # 2342813).

15.36 The meter was programmed to log various noise parameters, including L_{Aeq}, L_{Amax}, and L_{A90} at each measurement location. The measurement periods were selected to represent typical weekday daytime noise levels.

Meteorological conditions

15.37 The weather conditions for the noise surveys were within the limits provided within the environmental noise survey standard BS 7445-1:2003. '*Description and measurement of environmental noise. Guide to quantities and procedures'*.

15.38 Weather conditions during the surveys were dry, temperatures ranged between 1˚C and 16˚C and wind speeds were below 5m/s.

Vibration

15.39 At each noise survey location there was found to be no tactile evidence of vibration due to road traffic or other sources, during site visits at the Kent Project Site. As such, vibration is not considered to be a significant issue at the Kent Project Site.

15.40 review the current noise monitoring locations

Road traffic data

15.41 The COVID-19 pandemic has impacted the suitability of conducting additional noise survey measurements around the Project Site, with lockdown conditions not considered to be representative of a typical noise environment.

15.42 To support preliminary assessments of the potential noise impact, due to increased traffic flows resulting from Proposed Development, baseline conditions have utilised road traffic

statistics and $L_{Aeq,16hrs}$ noise level data. The suitability of this noise index will be agreed with the consultees listed in Paragraph 15.17.

15.43 Appendix 15.1 provides further details on the baseline information. In particular it sets out:

- The 2018 average daily traffic flow data used to establish baseline conditions to the south of the Proposed Development around the A2(T) (Source: Department of Transport, Road Traffic Statistics).

- $L_{Aeq,16hrs}$ road traffic noise data (Source: Department for Environment, Food and Rural Affairs, Road Noise). Used for a preliminary assessment of noise climate changes to the north of the river at Tilbury Town.

Assessment Methodology

15.44 This section presents the methodologies used to assess potential noise and vibration impacts during the construction and operational phases of the Proposed Development. Methods are based on relevant planning policies and standards detailed in the 'Relevant Law, Policy and Guidance' section of this Chapter.

Noise modelling methodology

CadnaA® prediction software

15.45 Potential noise levels as a result of the construction and operation of the Proposed Development have been undertaken using the CadnaA® software.

15.46 CadnaA® is a three-dimensional noise modelling software package that predicts noise levels based on the appropriate input data e.g. location and orientation of equipment and sound power data. The software package can take into account a variety of information about the site including topography, buildings, and potential noise sources.

15.47 The following assumptions, widely adopted for environmental noise mapping, have been made when producing the noise models for the Proposed Development:

- The ground conditions around the Kent Project Site were found to consist of roads, residential houses, and green space (Swanscombe Marshes) therefore the ground has been modelled as semisoft with a ground absorption coefficient of 0.5;

- Air temperature and relative humidity have been assumed to be at typical CadnaA input levels of 10°C and 70%. CadnaA software calculates air absorption according to ISO 9613-1;

- It is assumed that all building façades are structured and therefore they have been given an absorption coefficient of 0.37; and
- Three orders of reflection have been modelled.

Modelling uncertainty

15.48 Typically, an uncertainty within a range of approximately +/- 3 dB could be expected from computer noise modelling software.

15.49 This uncertainty will be controlled as far as practicable by cross-referencing the levels of predicted noise impact against the spot measurements captured around the Project Site.

15.50 The operational road traffic noise model used in this assessment is dependent upon the levels of traffic data that have been input, which will have inherent uncertainties associated with them. Sensitivity analyses will be undertaken to establish the influence of these uncertainties on the final assessment. Assumptions will be modified accordingly to ensure a robust assessment of the worst-case impacts are reported in the ES.

Ground-Borne vibration prediction methodology

15.51 No significant ground borne vibration is expected from the operation of the Proposed Development. This assumption is based on observations made when conducting a noise survey at Europa Park, Germany and takes account of the large distances to the nearest residential properties.

15.52 Prediction of ground-borne vibration, due to construction, has yet to be undertaken. It will be based on the methodologies set out in BS 5228-2 (2009 +A1 2014). The standard provides Peak Particle Velocity (PPV) levels based on different soil conditions for typical plant and equipment used for construction and provides the empirical prediction formulas based on known ground conditions and measured data.

15.53 There are few construction activities with the potential to cause a major vibration impact. However, some activities including demolition, excavation and piling have the potential to cause a major noise or vibration impact.

15.54 Vibration is assessed for effects on humans and cosmetic damage for buildings.

Construction noise and vibration prediction methodology

Construction noise and vibration modelling

15.55 Potential construction noise levels have been predicted in the CadnaA® software using the methodology outlined in BS 5228-1:2009+A1:2014. The potential noise levels generated by construction activities is predicated on the following variables:

- Sound power level of the plant and equipment used on-site.

- Period of time at which the on-site plant and equipment is operating (known as the on time).

- The distance between the construction site and noise sensitive locations.

- Attenuation due to barrier effects and ground absorption.

15.56 In order to assess the noise generated by construction activities, it is necessary to have information on the type and number of plant and equipment, a programme of works, percentage on times and the location of the activities.

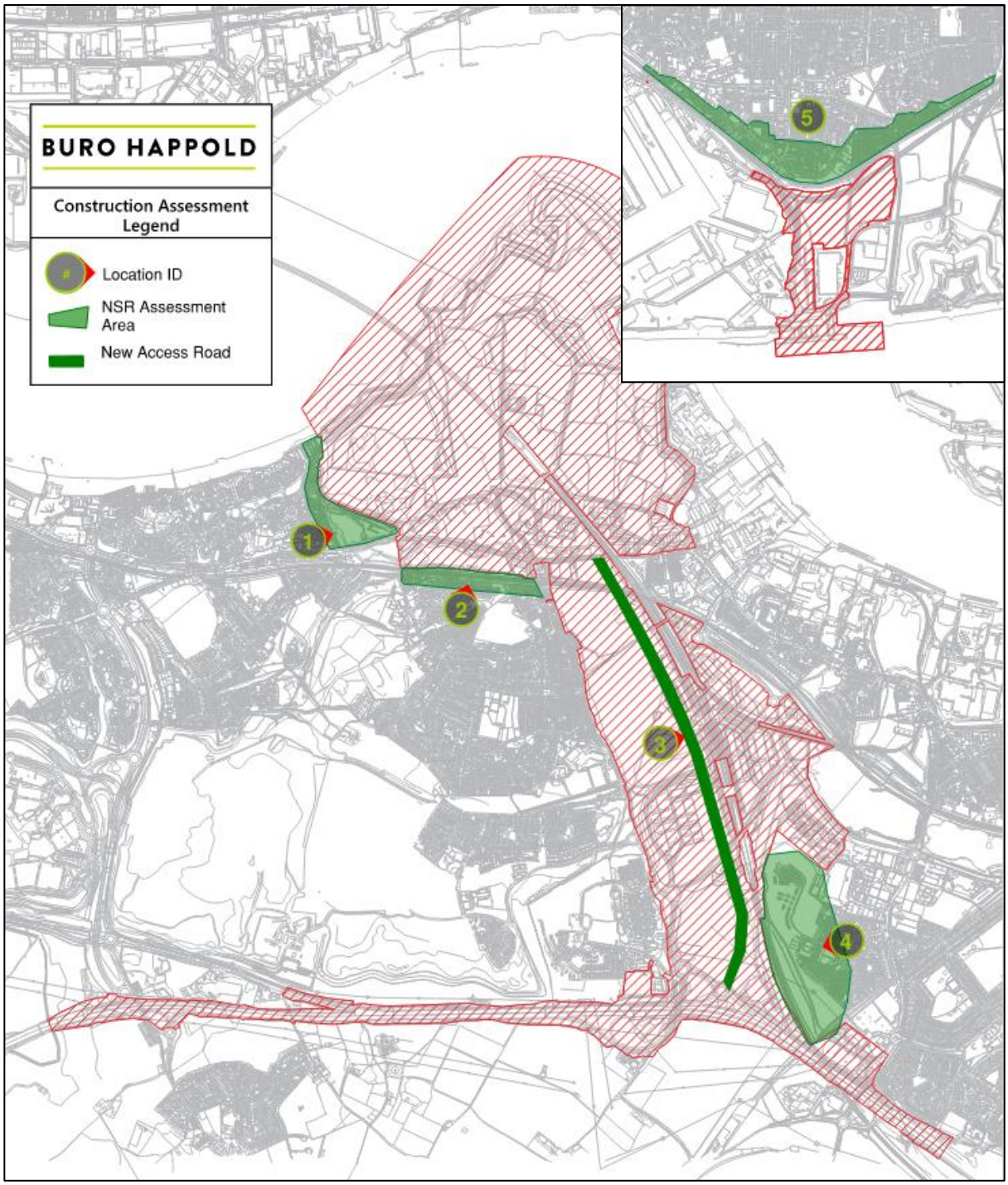
15.57 Preliminary assumptions on the number, type and location of significant items of construction plant have been made for the predictions shown in this Chapter.

15.58 Further construction noise and vibration assessments will be conducted as part of the assessment contained within the ES and at receptor locations that have been agreed with the consultees listed in Paragraph 15.17.

Construction noise modelling inputs and assumptions

15.59 Preliminary assessments of construction noise have been undertaken using 3D acoustic modelling (CadnaA) at NSRs located near to the Project Site boundary. The assessed locations are illustrated in Figure 15.3.

Figure 15.3: Preliminary Project Site construction noise assessment locations.



15.60 The following construction scenarios, as detailed in Table 15.2, have been modelled in each of the preliminary assessment locations.

Table 15.2: Summary of construction scenarios for each assessment location, ('x' indicates scenario assessment has been conducted at this point in the drafting of the PEIR (July 2020).

ID	Location	Construction Scenario			
		Earthworks	Paving	Piling	General Construction
1	North-West NSRs, near Gate Two construction (Kent)	x	x	x	x
2	North NSRs, near staff hotel construction (Kent)	-	-	-	x
3	London Resort access road construction (Kent)	x	x	-	x
4	South east NSRs, near access roads construction (Kent)	x	x	-	x
5	Tilbury Docks parking lot construction (Essex)	-	x	-	x

Earthworks

15.61 The following plant equipment and quantities have been assumed for the site Earthworks based on plant item noise data in British Standards 5228-1:2009 + A1 2014 Code of practice for noise and vibration control on construction and open sites.

Table 15.3: Assumed plant noise levels during site earthworks.

BS5228 Table & Ref no.	Equipment	Octave band sound pressure levels at 10 m (dB), Hz							
		63	125	250	500	1k	2k	4k	8k
C.5 #14	Bulldozer	77	86	75	75	82	80	73	67
C.5 #16	Articulated dump truck	88	90	80	79	76	71	65	61
C.5 #18	Tracked excavator	76	79	75	75	76	73	70	65

Paving

15.62 The following plant items have been assumed for paving works.

Table 15.4: Assumed plant noise levels during site paving.

BS5228 Table & Ref no.	Equipment	Octave band sound pressure levels at 10 m (dB), Hz							
		63	125	250	500	1k	2k	4k	8k
C.5 #32	Asphalt Paver (+ tipper lorry)	87	84	81	80	79	76	74	67
C.5 #24	Vibratory Roller	89	82	76	77	72	74	81	61

Piling

15.63 The following plant items have been assumed for different piling work types.

Table 15.5: Assumed plant noise levels during site piling.

BS5228 Table & Ref no.	Equipment	Octave band sound pressure levels at 10 m (dB), Hz							
		63	125	250	500	1k	2k	4k	8k
C.3 #1	Hydraulic hammer rig	82	82	82	89	83	78	75	70
C.3 #8	Vibratory piling rig	83	82	79	82	84	82	77	67
C.3 #14	Large rotary bored piling rig	84	92	81	80	78	76	68	61

General Construction

15.64 The following plant items have been assumed for general construction works.

Table 15.5: Assumed plant noise levels during site piling.

BS5228 Table & Ref no.	Equipment	Octave band sound pressure levels at 10 m (dB), Hz							
		63	125	250	500	1k	2k	4k	8k
C.3 #1	Concrete mixer truck	82	82	82	89	83	78	75	70
C.3 #8	Truck mounted concrete pump + boom arm	83	82	79	82	84	82	77	67
C.3 #14	Diesel generator	84	92	81	80	78	76	68	61
C.3 #27	Vibro-displacement and compaction of stone	91	84	79	77	74	69	70	59

Construction Traffic

15.65 Construction activity generally increases traffic flow rates on, to and from the development in the short term. Examples include truck deliveries and contractor vehicle movements.

15.66 In order to assess the noise generated by construction traffic, it is necessary to have information on the type of construction activities planned and a programme of works. This is part of the design development process that is currently underway and therefore an assessment of the noise generated by construction traffic will be undertaken and reported in the ES.

15.67 Procedures described in Department of Transport / Welsh Office Memorandum '*Calculation of Road Traffic Noise*' (1998) will be used for calculating and measuring road traffic noise due to construction activities.

Construction Uncertainties

15.68 There are additional uncertainties on the selection of plant for the different construction activities. To reduce the uncertainties, typical selections have been made based on guidance in in British Standards 5228-1:2009 + A1 2014 Code of practice for noise and vibration control on construction and open sites.

15.69 There are uncertainties on construction phasing, which means that early constructions may provide noise screening to some noise sensitive receptors later in the construction sequencing. At this preliminary stage, assessments have considered a worst-case scenario with no noise screening. Any assumptions on construction phasing employed in the modelling will be made explicit.

15.70 Due to the size of the Proposed Development, construction is expected to occur in phases over several years. An indicative construction plan for the Proposed Development is as follows:

- 2022 – Construction work commences (earliest DCO can be made is mid 2022);
- 2023 – Construction Peak;
- 2024 – Gate One opening;
- 2025 – First Full Year after One opening;
- 2029 – Gate Two opening; and
- 2038 – Maturity of the Proposed Development.

15.71 The ES will report on the environmental conditions on the Project Site in 2020 (when the application is submitted) against those anticipated in 2038, as a result of the current masterplan being built and operating.

15.72 Construction will also require assessment at intermediate/slice years of 2025 and 2029 due to the relatively long build out of the Proposed Development and different building phases.

Operational noise prediction methodology

15.73 CadnaA® noise models have been used to make a preliminary assessment of the effects of the operational noise of the Proposed Development. The assessments compare two scenarios:

1. **Baseline 2020** -This scenario includes noise from existing roads and rail, but excludes noise from building services / fixed items of plant, visitor attractions and the new A2(T) access road. This model is informed by noise survey results, detailed in Appendix 15.1. Daytime L_{Aeq} levels are predicted.

2. **Operation 2038 -**The operational case for the London Resort involves evaluating noise from traffic movements as well as items of fixed plant and the noise from rides and attractions. At this point in the drafting of the PEIR (July 2020) the assessment excludes building services noise and maintains baseline noise levels from rail sources unchanged.

Prediction methodology for fixed items of plant

15.74 In order to assess the noise generated by the Proposed Development's building services, it is necessary to have information on the type and number of plant items, percentage on-times, and the location of fixed plant.

15.75 This is part of the design development that is currently underway for the Proposed Development and therefore an assessment of the noise generated by fixed plant items reported on in the ES which will be submitted as part of the application for the Proposed Development.

15.76 The noise from fixed items of plant will be assessed using the principles of BS4142:2014+A1:2019. The assessment parameter is the 'rating level' $L_{AR,T}$ of the plant noise assessed at the position of residential properties compared with the 'background' level LA90.

Prediction methodology for road and rail traffic noise

15.77 Guidance on the impact assessment of noise from traffic moving to, from and within the Proposed Development is provided in the IEMA Guidance Note No. 1 *Guidance for the Environmental Assessment of Road Traffic*. The document recommends assessment where traffic flows will increase by more than 30% (or the number of heavy goods vehicles will increase by more than 30%), and where specifically sensitive areas experience traffic flow increases of 10% or more. The guidance indicates that projected changes in traffic of less than 10% create no discernible environmental noise impact.

15.78 In order to assess the noise from operational traffic noise it has been assumed that Kent Project Site traffic will be directed away from London Road. Therefore, the principal operational road traffic noise effect will be largely confined to the A2(T) and the London Resort access road -planned to run from the A2(T) to the Proposed Development alongside Ebbsfleet station trainlines. For the Essex Project Site traffic, it has been assumed traffic will be directed along the A1089, away from local Grays and Tilbury Town roads.

15.79 Traffic noise predictions have been calculated using predicted traffic flows provided by WSP based on their arrivals and departures profile. The predictions are based on methodologies and procedures detailed in Calculation of Road Traffic Noise (CRTN) and predicated on number of parameters such as:

- 18-hour traffic flows (between 06:00 and 00:00 hours);
- percentage of heavy vehicles;
- vehicle speeds; and
- road gradients.

15.80 The magnitude of effect was calculated by subtracting the predicted noise levels from existing traffic flows (2020) from the predicted future noise levels due to the operation of the Proposed Development (2038).

15.81 To assess the railway noise surrounding the Proposed Development at the Kent Project Site, the figures in Appendix 15.1 were used - these provide a record of measured single event levels for train movements stopping and passing through Ebbsfleet Station.

Prediction methodology for London Resort visitor attractions

15.82 There is no single relevant published source of guidance on the assessment of noise from cheers, shouts and entertainment music generated by the proposed rides and attractions in the leisure Core of the Proposed Development. The methodology for the assessment will be confirmed with relevant consultees as design development progresses. The results of the assessment will be presented in the ES which will be submitted as part of the application of the Proposed Development.

15.83 Noise measurements taken by the assessment team at a large European visitor attraction (Europa Park, Germany) showed that the sound of shouts and screaming dominates the overall noise level of the typical ride or attraction. The tabulated SEL measurement data has been provided for reference in Appendix 15-1.

15.84 At this preliminary assessment stage, visitor attractions are modelled as a series of noise sources that represent segments of a visitor attraction / ride where riders are predicted to be screaming. The model assessment within this chapter shows the sound propagation extent of maximum A-weighted decibel levels (measured during a noise survey of a large European visitor attraction) from assumed ride / screaming locations.

Operational Uncertainties

15.85 The operational road traffic noise model used in this assessment is dependent upon the levels of traffic data that have been input, which will have inherent uncertainties associated with them.

15.86 Noise from cheers, shouts and entertainment/music generated by the proposed rides, attractions and event spaces in the Leisure Core will be dependent to some degree on the final selection and design of facilities, their placement and orientation on site.

15.87 The noise produced from train movements is dependent upon the frequency of services. This is subject to variability based on future alterations to the frequency and distribution of timetabled services.

Summary of prediction methodologies

15.88 A summary of the prediction methodologies used within this PEIR chapter and to be used in future ES assessments, are presented in Table 15.6.

Table 15.6: Summary of the guidance documents and standards used for predicting noise and vibration from potential noise sources.

Potential source of noise and vibration	Prediction method
Construction, Noise, Vibration, Traffic	BS 5228, BS 6472, CRTN, DMRB, CRN
Operational Noise Impact (Building Services, Traffic, visitor attractions)	BS 4142, CRTN, DMRB
Internal Noise and Sound Insulation Requirements (Detailed in 15.103)	BS 8233 and WHO

Significance criteria for noise and vibration assessments

15.89 This section presents the significance criteria used to assess potential noise and vibration impacts during the construction and operational phases of the Proposed Development. Methods are based on relevant planning policies and standards detailed in the relevant law, policy and best practice guidance section

Construction noise significance and targets

15.90 The criteria for the significance of construction noise upon NSRs are derived from Annex E of BS 5228-1:2009+A1:2014. This criterion is based on the total construction noise level which is the combination of the pre-existing ambient noise level plus construction noise.

15.91 The significance of construction noise can be determined using the ABC method which sets an appropriate “Assessment Category” that is derived from the pre-existing ambient noise level. If the total construction noise level exceeds the Assessment Category value, then a significant effect is deemed to occur. The assessment categories are set out in Table 15.7, with the magnitude of effect given in Table 15.8.

Table 15.7: Threshold of significant effect at dwellings.

Evaluation period	Assessment category (dB L_{Aeq})		
	A	**B**	**C**
Night-time (23:00-07:00)	45	50	55
Evening and Weekends*	55	60	65
Daytime (07:00-19:00)	65	70	75

**19:00 - 23:00 weekdays, 13:00 - 23:00 Saturdays and 07:00 - 23:00 Sundays.*

Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.

Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as Category A values.

Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than Category A values.

The Category (A, B or C) is to be determined separately for each time period and the lowest noise category is then used throughout the 24-hour cycle, e.g. a site which is Category A by day and Category B or C in the evening and night will be treated as Category A for day, evening and night.

Table 15.8: Magnitude of impact from construction noise.

Magnitude of impact	Total construction noise level
Major	+10 dB > Assessment Category
Moderate	5 to 10 dB > Assessment Category
Minor	3 to 5 dB > Assessment Category
Negligible	1 to 3 dB > Assessment Category
No change	< Assessment Category

Construction vibration significance and targets

15.92 Guidance on the human response to vibration is presented in Annex B, Table B.1 of BS 5228-2:2009+A1:2014. These levels have been reproduced in Table 15.9 alongside the magnitude of impact.

Table 15.9: Criteria for determining the magnitude of impact of vibration levels on humans (BS 5228:2009+A1:2014).

Magnitude of impact	Peak particle velocity (PPV) level	Effect
Major	10 $mm \cdot s^{-1}$	Vibration is likely to be intolerable for any more than a very brief exposure to this level

Magnitude of impact	Peak particle velocity (PPV) level	Effect
Moderate	1.0 mm·s^{-1}	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents
Minor	0.3 mm·s^{-1}	Vibration might be just perceptible in residential environments
Negligible	0.14 mm·s^{-1}	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration

15.93 Guidance on vibration effects on buildings can be found in Annex B, Table B.2 of BS 5228-2:2009. These levels have been reproduced in Table 15.10 with the magnitude of vibrational impact shown in Table 15.11.

Table 15.10: Transient vibration guide values for cosmetic damage.

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
1.Reinforced or framed structures 2.Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	50 mm/s at 4 Hz and above
1.Unreinforced or light framed structures 2.Residential or light commercial buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Note 1 Values referred to are at the base of the building

Note 2 For line 2, at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.

Table 15.11: Criteria for determining magnitude of impact vibration levels on buildings (derived from BS 5228-2:2009).

Type of building	Magnitude	Criteria
1.Reinforced or framed structures 2.Industrial and heavy commercial buildings	Major	Greater than 200 mm/s at 4 Hz and above
	Moderate	Greater than 100 mm/s at 4 Hz and above
	Low	Greater than 50 mm/s at 4 Hz and above
	Negligible	Lower than 50 mm/s at 4 Hz and above

1.Unreinforced or light framed structures 2.Residential or light commercial buildings	Major	Greater than: 60 mm/s at 4 Hz increasing to 80 mm/s at 15 Hz	Greater than: 80 mm/s at 15 Hz increasing to 200 mm/s at 40 Hz and above
	Moderate	Greater than: 30 mm/s at 4 Hz increasing to 40 mm/s at 15 Hz	Greater than : 40 mm/s at 15 Hz increasing to 100 mm/s at 40 Hz and above
	Low	Greater than: 15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	Greater than: 20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
	Negligible	Lower than: 15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	Lower than: 20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Operational traffic noise

15.94 A short-term increase in road traffic noise of 1 decibel (dB) is considered to be just perceptible by most people. A description of classifying the magnitude of impacts for short-term traffic noise is presented in Table 15.12.

Table 15.12: Criteria for determining magnitude of impact of noise changes in the short term after completion of the Proposed Development (Source: DMRB).

Magnitude	**Criteria** **$L_{A10,18hr}$ noise change from existing traffic levels**
Major	5 dB or more
Moderate	3 – 4.9 dB
Low	1 – 2.9 dB
Negligible	0.1 – 0.9 dB
No change	0 dB

15.95 According to the Design Manual for Roads and Bridges (DMRB), a 3 dB $L_{A10, 18h}$ change in the long term (typically 15 years after project opening) is considered perceptible. The magnitude of impacts for long-term traffic noise is presented in Table 15-13.

Table 15.13: Criteria for determining magnitude of impact of noise changes in the long term after completion of the Proposed Development (Source: DMRB).

Magnitude of impact	**Criteria** **$L_{A10,18hr}$ noise change from existing traffic levels**
Major	10 dB or more
Moderate	5 – 9.9 dB
Low	3 – 4.9 dB
Negligible	0.1 – 2.9 dB
No change	0 dB

Operational building services noise

15.96 BS4142:2014+A1:2019 utilises various descriptors to assess the impact of sound associated with proposed industrial/commercial activities on existing noise-sensitive receivers or the impact and likely suitability of siting new noise-sensitive receivers in the vicinity of existing industrial / commercial noise sources.

15.97 The magnitude of the impact of an industrial and/or commercial source is assessed by examining the difference between the 'Rating Level' of the specific sound source associated with the Proposed Development, and the 'Background Sound Level' measured at a location representative of the nearest noise sensitive receiver and the context in which the sound occurs.

15.98 The lower a rating level is relative to the measured background sound level, the less likely the specific sound source will cause adverse or significantly adverse impacts. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context. The magnitude of the noise level impact derived from BS 4142:2014+A1:2019 is shown in the table below.

Table 15.14: Criteria for determining magnitude of impact noise levels (derived from BS 4142: 2014 +A1 2019).

Magnitude of impact	Criteria	
	Description	**BS 4142 Rating**
Major	+ 10 dB or more	Indication of a significant adverse impact (complaints are likely)
Moderate	+ 5 dB	Indication of an adverse impact
Low	0 to 5 dB *	Not defined
Negligible	0 to - 10 dB or less *	Indication of low impact

* *Depending on context*

15.99 If the proposed plant noise contains attention catching features (tonal, intermittent, impulsive features, or is clearly distinguishable against the residual noise climate), the plant should be designed to achieve a limit below those set out in Table 15.7, based on the type and impact of the features. BS 4142:2014+A1:2019.

Operational noise from external event spaces

15.100 The Code of Practice on Environmental Noise at Concerts (1995) provides useful guidance for developments which will have amplified external music that may affect nearby noise sensitive receptors. Table 1 in Section 3 of the document provides limits on Music Noise Levels (MNL) at 1 metre from the façade of any noise sensitive premises for events held between the hours of 09:00 and 23:00. This table has been reproduced below (Table 15.15):

Table 15.15: External event music noise level guidance.

Concert days per calendar year, per venue	Venue Category	Guideline
1 to 3	Urban Stadia or Arenas	The music noise level should not exceed 75 dB(A) over a 15-minute period
1 to 3	Other Urban and Rural Venues	The music noise level should not exceed 65 dB(A) over a 15-minute period
4 to 12	All Venues	The music noise level should not exceed the background noise level by more than 15 dB(A) over a 15-minute period

15.101 For events held in the external locations at London, due to the number of events per year it is likely suitable to control the music noise level loudspeaker sound systems as to not exceed the background noise level of the area by more than 15 dB(A) over a 15 minute period (outside of the event site). Provided by the Chartered Institute of Environmental Health, adhering to this guidance should minimise potential annoyance or disturbance at nearby residential areas due to London Resort events.

Receptor sensitivity

15.102 The criteria for determining receptor sensitivity are shown in the Table 15.16 below.

Table 15.16: Criteria for determining receptor sensitivity.

Sensitivity	Criteria
High	The receptor has little ability to absorb change without altering its present character, or it is of international or national importance. Examples: Resting / sleeping activities e.g. Residential properties, hospitals, care homes,
Medium	The receptor has moderate capacity to absorb change without significantly altering its present character, or it is of high importance. Examples: Studying, teaching and learning activities e.g. schools, universities, research facilities
Low	The receptor is tolerant to some change without detriment to its character, or it is of low or local importance. Examples: Office building, shops, sport facilities
Negligible	Commercial activities not requiring particular concentration e.g. Heavy industry, motorways and railway line.

Magnitude of noise impact

15.103 The magnitude of a noise impact is defined in Table 15.17. It is found by comparing the numerical predicted noise and/or vibration with baseline conditions. Table 15.18 provides a summary of the noise criteria detailed within this section against magnitude.

Table 15.17: Definition of criteria for determining effect magnitude.

Magnitude of impact	Criteria
Major	The receptor has little ability to absorb change without altering its present character, or it is of international or national importance. Examples: Resting / sleeping activities e.g. Residential properties, hospitals, care homes,
Moderate	The receptor has moderate capacity to absorb change without significantly altering its present character, or it is of high importance. Examples: Studying, teaching and learning activities e.g. schools, universities, research facilities
Low	The receptor is tolerant to some change without detriment to its character, or it is of low or local importance. Examples: Office building, shops, sport facilities
Negligible	Commercial activities not requiring particular concentration e.g. Heavy industry, motorways and railway line.

Table 15.18: Summary of criteria to determine magnitude of noise or vibration impact.

Magnitude	Criteria
Major	Construction noise: +10 dB > Assessment category Construction vibration on humans: 10 mm·s^{-1} PPV Construction vibration on buildings: Reinforced or framed structures / Industrial and heavy commercial buildings: • Greater than 200 mm/s at 4 Hz and above Unreinforced or light framed structures / Residential or light commercial buildings: • Greater than 60 mm/s at 4 Hz increasing to 80 mm/s at 15 Hz • Greater than 80 mm/s at 15 Hz increasing to 200 mm/s at 40 Hz and above Traffic (Short-term): 5 dB or more - $L_{A10,18hr}$ noise change

Magnitude	Criteria
	Traffic (Long-term): 10 dB or more - $L_{A10,18hr}$ noise change Operational Building Services: +10 dB or more
Moderate	Construction noise: 5 to 10 dB > Assessment category Construction vibration on humans: 1.0 mm·s^{-1} PPV Construction vibration on buildings: Reinforced or framed structures / Industrial and heavy commercial buildings: • Greater than 100 mm/s at 4 Hz and above Unreinforced or light framed structures / Residential or light commercial buildings: • Greater than 30 mm/s at 4 Hz increasing to 40 mm/s at 15 Hz • Greater than 40 mm/s at 15 Hz increasing to 100 mm/s at 40 Hz and above Traffic (Short-term): 3-4.9 dB or more - $L_{A10,18hr}$ noise change Traffic (Long-term): 5-9.9 dB or more - $L_{A10,18hr}$ noise change Operational Building Services: + 5 dB
Low	Construction noise: 3 to 5 dB > Assessment category Construction vibration on humans: 0.3 mm·s^{-1} PPV Construction vibration on buildings: Reinforced or framed structures / Industrial and heavy commercial buildings: • Greater than 50 mm/s at 4 Hz and above Unreinforced or light framed structures / Residential or light commercial buildings: • Greater than 15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz

Magnitude	Criteria
	• Greater than 20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above Traffic (Short-term): 1-2.9 dB or more - $L_{A10,18hr}$ noise change Traffic (Long-term): 3-4.9 dB or more - $L_{A10,18hr}$ noise change Operational Building Services: 0 – 5 dB
Negligible	Construction noise: 1 to 3 dB > Assessment category Construction traffic: 0.1 – 0.9 dB or more - $L_{A10,18hr}$ noise change Construction vibration on humans: 0.14 mm·s^{-1} PPV Construction vibration on buildings: Reinforced or framed structures / Industrial and heavy commercial Buildings: • Lower than 50 mm/s at 4 Hz and above Unreinforced or light framed structures / Residential or light commercial buildings: • Lower than 15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz • Lower than 20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above Traffic (Short-term): 0.1-0.9 dB or more - $L_{A10,18hr}$ noise change Traffic (Long-term): 0.1-2.9 dB or more - $L_{A10,18hr}$ noise change Operational Building Services: -10 (or less) to 0 dB
No change	Construction noise: < Assessment category Traffic (Short-term): 0 dB or more - $L_{A10,18hr}$ noise change Traffic (Long-term): 0 dB or more - $L_{A10,18hr}$ noise change

Significance of noise impact

15.104 The significance of a potential effect is derived by considering both the sensitivity of the feature and the magnitude of change, this is demonstrated by Table 15.19.:

Table 15.19: Noise impact significance matrix.

		Receptor sensitivity			
		High	**Medium**	**Low**	**Negligible**
Effect magnitude	**Major**	Major	Major	*Moderate / Minor	Indiscernible
	Moderate	Major	Moderate	Minor	Indiscernible
	Low	*Moderate / Minor	Minor	Minor	Indiscernible
	Negligible	Indiscernible	Indiscernible	Indiscernible	Indiscernible

Note: Effects are deemed to be significant when moderate and major effects are obtained from the Table above.
* *Moderate / minor effect cells will be evaluated by professional judgement on a case-by-case basis to determine the suitable level of significance.*

Environmental noise targets

15.105 The World Health Organisation (WHO) provides guideline values for community noise in particular environments. Table 15.20 has been taken from Table 1 of the WHO document Guidelines for Community Noise 1999. It describes guidance for indoor and outdoor ambient noise levels for dwellings during the daytime.

Table 15.20: Indoor and Outdoor noise level guidance criteria for dwellings.

Specific environment	**Critical health effect(s)**	**LAeq,T [dB(A)]**	**Time base [hours]**	**LAmax [dB(A)]**
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Living rooms	Speech intelligibility & moderate annoyance, daytime and evening	35	16	-

15.106 WHO 2009 guidelines suggest that a $L_{night,\ outside}$ of 40 dB should be the target of the night noise guideline (NNG) to prevent sleep disturbance. This level is referred to as the lowest observed adverse effect level (LOAEL). These guidelines may be considered as an extension to, as well as an update of, the previous WHO Guidelines for Community Noise (1999).

RELEVANT LAW, POLICY AND GUIDANCE

15.107 The relevant law, policy and best practice guidance that has been taken into account when undertaking the EIA for the Proposed Development is outlined below.

National Policy Statements

15.108 National Policy Statements (NPS) set out the need for government's policies to deliver Nationally Significant Infrastructure Projects (NSIPs) in England. Chapter three of this report explains that there is no NPS for business and commercial NSIP projects. However, to the extent that the Proposed Development includes transport and highways infrastructure, regard has been had to relevant policy in the NPS for National Networks including:

- Environmental and social impacts (NPS paragraphs 3.2 to 3.5);
- Criteria for 'good design' for national network infrastructure (NPS paragraphs 4.28 – 4.35);
- Pollution control and other environmental protection regimes (NPS paragraphs 4.48 – 4.56);
- Noise and vibration (NPS paragraphs 5.186 – 5.200).

Other national law and policy

15.109 The assessment gives regard to relevant provisions in the following:

- The Land Compensation Act 1973 Part 1;
- Sections 60 and 61 of the Control of Pollution Act 1974;
- The Noise Insulation Regulations 1975 (amended 1988);
- The National Planning Policy Framework 2019.

Technical guidance and best practice documents

15.110 The assessment uses the following technical guidance and best practice documents:

- British Standard BS5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites – Part 1: Noise';
- British Standard BS5228-2:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration';

- Design Manual for Roads and Bridges (DMRB), LA111, 2020, 'Noise and vibration';
- Calculation of Road Traffic Noise (CRTN), Department of Transport, 1988;
- IEMA Guidance Note No 1, 'Guidance for the environmental assessment of road traffic', 1993;
- British Standard BS4142:2014+A1:2019, 'Methods for rating industrial noise affecting mixed residential and industrial areas';
- British Standard BS7445-1:2003, 'Description and measurement of environmental noise. Guide for quantities and procedures';
- World Health Organisation, 'Guidelines for community noise', 1999;
- World Health Organisation, 'Night noise guidelines for Europe', 2009.
- Representation Statement of Network Rail (High Speed) & High Speed 1 Asset Protection, Response to Stage 4 Planning Consultation, June 2015.

Local policies and plans

15.111 The assessment also considers the following locally relevant policy and guidance:

- Kent County Council Environment Strategy (Kent State of the Environment 2015);
- Dartford Development Policies Plan, adopted 2017;
- Gravesham Local Plan Core Strategy, adopted 2014;
- Thurrock Core Strategies and Policies for Management of Development, adopted January 2015; and

BASELINE CONDITIONS

15.112 This section presents the results of preliminary baseline 3D-acoustic modelling assessments.

15.113 For the purposes of assessing the current masterplan, the Proposed Development has been assessed against the current baseline noise climate (methodology detailed in 'methodology and data sources' section of this chapter).

15.114 The baseline conditions are effectively used to help define the 'character' of the areas and therefore do not consider the construction of a major infrastructure scheme e.g. the HS1

rail line. Construction works the masterplan enabling works would be expected to change the baseline conditions significantly from the current baseline. As such, it is proposed that future assessments should take into account a number of slice years when construction of the masterplan would be at their peaks.

15.115 The following additional assessment areas will be investigated in the Environmental Statement:

- Effects from noise and vibration generated during construction and operational phase of the Proposed Development on nearby ecological receptors.
- Effects of water-borne noise on marine life.
- The potential for cumulative effects to take place as a result of the Proposed Development and other cumulative developments, during construction and operation.

Baseline noise climate

15.116 As discussed in the 'Methodology and data sources' section, the baseline noise climate around the Proposed Development was captured by calibrating a CadnaA model to noise survey and traffic count data (provided in Appendix 15.1).

15.117 Figure 15.4 shows the modelling results for the typical noise climate that currently exists around the Kent Project Site in terms of $L_{Aeq,18hour}$.

15.118 Figure 15.5 shows the modelling results for the typical noise climate that currently exists around the Essex Project Site in terms of $L_{Aeq,18hour}$.

Figure 15.4: Calculated daytime levels LAeq,18hr dB(A) for the area surrounding the Kent Project Site, calibrated to baseline noise survey and traffic movement data.

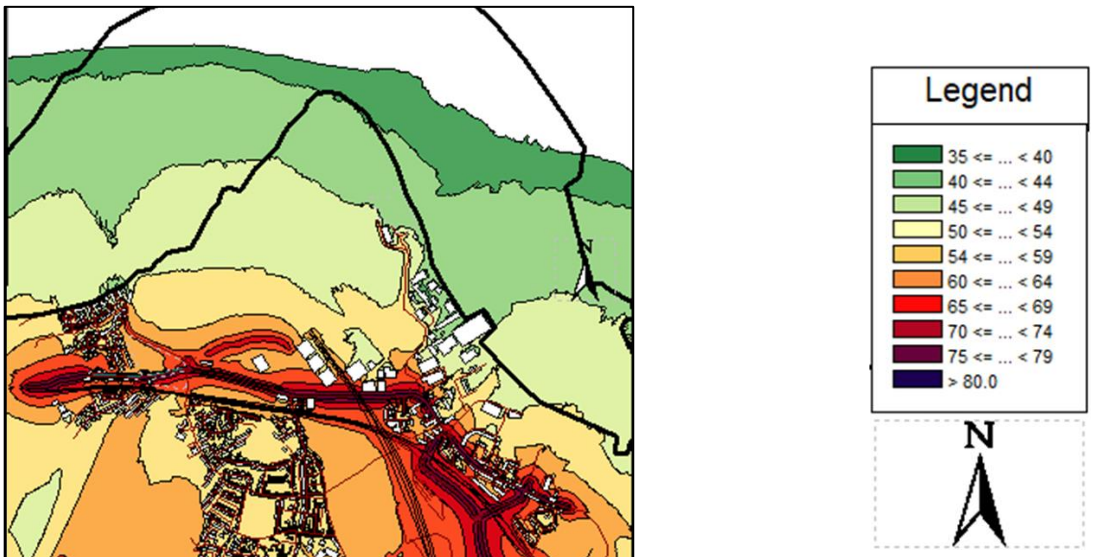
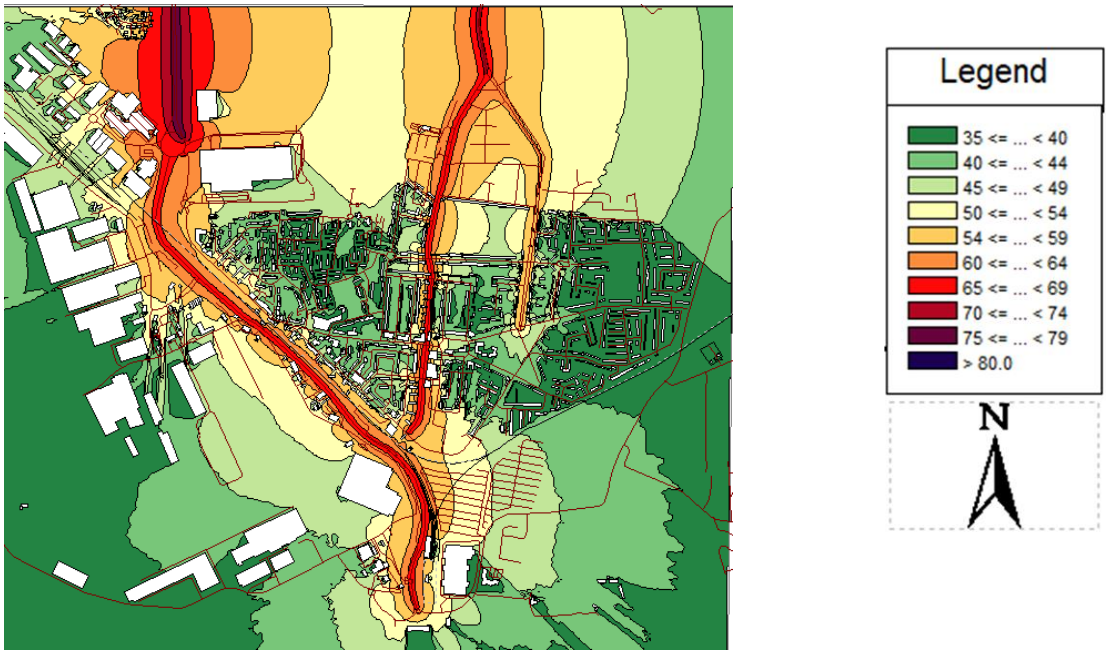


Figure 15.5: Calculated daytime levels LAeq,18hr dB(A) for the area surrounding the Essex Project Site, calibrated to noise data from the Department for Environment, Food & Rural Affairs.



Construction noise impact

15.119 Construction work operations are usually characterised by temporary increases in ambient noise levels which may result in short-term disturbance to nearby receptors, including an increase of traffic noise levels due to construction traffic.

15.120 Dwellings within close proximity to the Kent Project Site boundary are expected to be affected to some extent during construction activities, due to the short distance to the works. Figure 15-3 has illustrated the existing noise sensitive receptors around the site boundary of the site, which will be more prone to construction disturbances.

15.121 It is typical at this stage of design development not to have specific information regarding the proposed construction activities, type of plant and equipment, percentage on times and locations of plant. Therefore, in order to carry out a robust assessment, assumptions based on a realistic worst-case scenario have been made in the assessment of the significance of construction noise.

15.122 Noise levels of typical plant and equipment were taken from BS 5228-1: 2009 +A1 2014, an industry standard approach. These levels were then predicted at the nearest noise sensitive receptors. The prediction is based on a likely worst-case scenario whereby construction plant and equipment will be operating during the following times:

- Monday – Friday: 8 am – 6 pm; and
- Saturday: 8 am – 1 pm

15.123 Based on the predicted noise levels from construction, significance of effect from construction noise at each identified NSR will be summarised in a table for the ES. It should be noted that these significances are based on un-mitigated noise levels with all plant operating simultaneously 100% of the time with hoardings around the perimeter of the site with a minimum safe height of 2.4m. This is therefore representative of a worst-case scenario.

Operational noise impact

15.124 The modelling reported in this section is intended to predict how the 'switching on' of the London Resort operation affects the existing noise climate of the area. The model includes:

- Noise from roads (using measured noise levels to calibrate existing traffic data and predicted data for new access road traffic flows).

- Noise from trains (using the measured noise levels to calibrate Thameslink and Southwestern train services and the train timetables and SEL data for HS1 services).

- Noise from the rides including the shouts and screams of visitors.

15.125 The modelling does not currently include noise due to the operation of London Resort building services or any construction noise that is concurrent with the operation of the London Resort.

15.126 Appendix 15.3 provides a full breakdown of the operational assessment, detailing input data alongside model results.

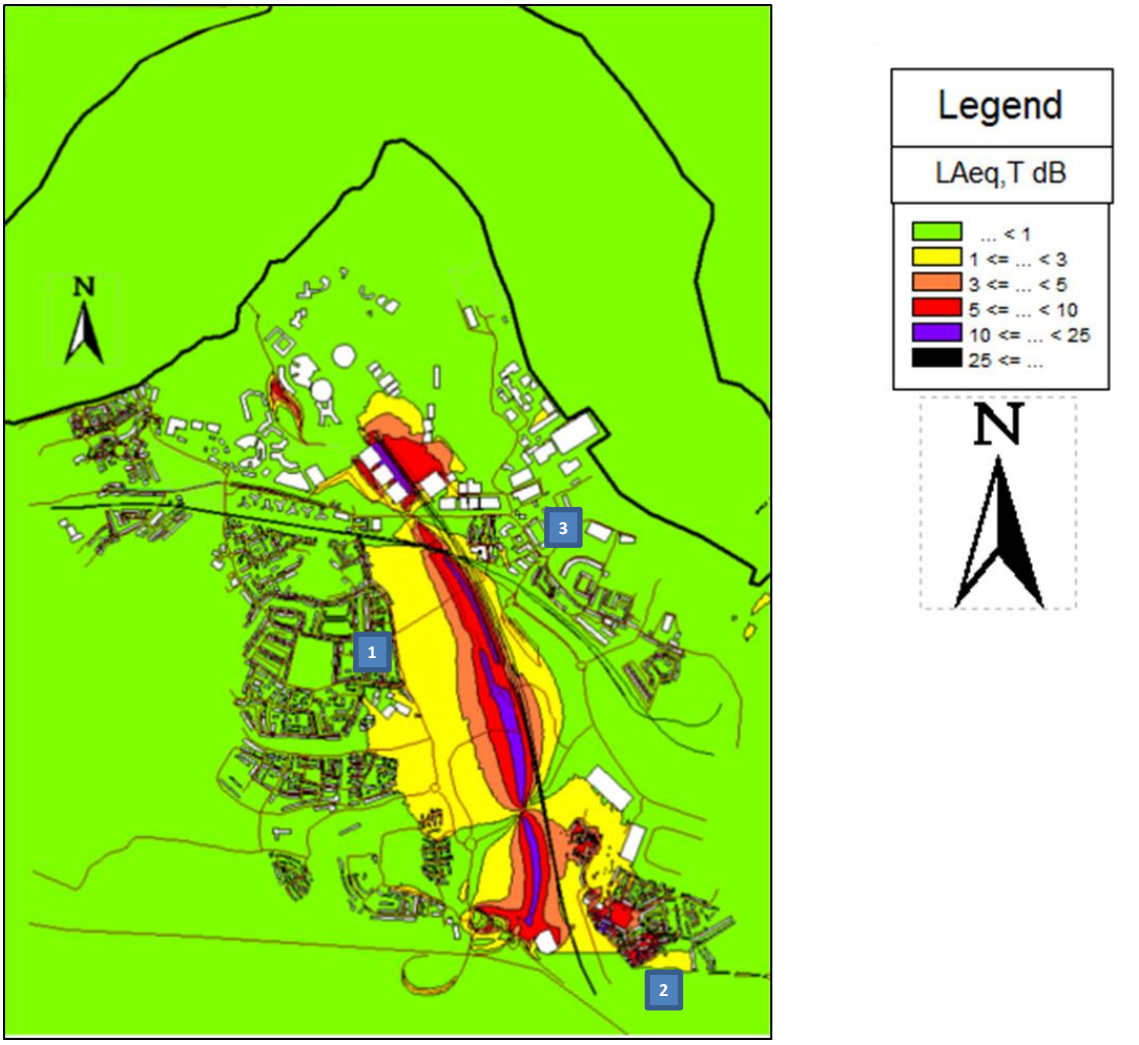
Increased local traffic flows due to London Resort operation

15.127 The noise model in this section is informed by the LDP 2038 design day visitor predictions. The traffic flows input onto the access roads is based on a worst-case peak flow prediction of 77,000 day visitors in the year 2038.

15.128 The colours within the noise contours represent the following calculated changes to the noise levels of the area:

- The purple area shows the distance at which the noise from London Resort traffic flows will likely cause the existing noise climate to increase by a level equal to or greater than 10 dB.
- The red area shows the limiting distance at which the noise from London Resort traffic flows will likely cause the existing noise climate to increase by a level between 5 and 10 dB.
- The orange area shows the limiting distance at which the noise from London Resort traffic flows will likely cause the existing noise climate to increase by a level between 3 and 5 dB.
- The yellow area shows the limiting distance at which the noise from London Resort traffic flows will likely cause the existing noise climate to increase by a level between 1 and 3 dB.
- The green areas show the locations where the noise from London Resort traffic flows will likely have a minimal to no effect on the baseline ambient noise level of the region (level changes between 0 and 1 dB).

Figure 15.6: Difference between the noise caused by the operation of the Kent Project Site in 2038 and the baseline ambient noise levels. Levels shown are differences in daytime $L_{Aeq,18\ hour}$ (dB). Areas of interest marked with ID numbers for the descriptions below.



15.129 Figure 15.6 considers the effect of road traffic noise around the Kent Project. The modelling prediction shows the new access road from the A2(T) to cause the most significant changes when the Proposed Development becomes operational in 2024.

15.130 In the area of residential properties to the south of the Kent Project and to the west of the access road (ID 1 in Figure 15.6), traffic movement calculations show ambient noise level increases by 1 dB for properties in:

- High Street (eastern side)
- Stanhope Road (eastern side / western side when there are no eastern side houses)
- Stanhope Street (eastern end)

- Merriall Close (northern end)
- Park View (eastern end)
- Weldon Road (eastern end)
- Candy Dene (eastern end)
- Ackers Drive (north side)

15.131 In the area of residential properties to the south of the Kent Project Site and to the east of the access road (ID 2 in Figure 15.6), traffic movement calculations show ambient noise level increases by at least 1 dB for properties in:

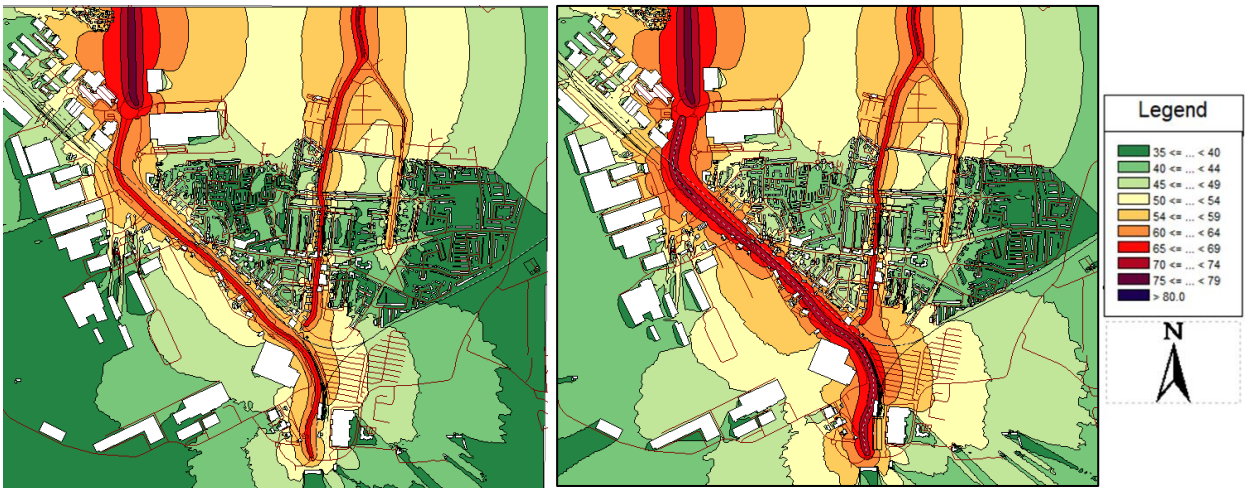
- Conrad Mews
- Marlow Close
- Thackeray Drive
- Wellesley Corner
- Caxton Park
- Colby Mews
- Springhead Parkway
- Paris Drive
- Stratford Way
- Amsterdam Way

15.132 In the area of residential properties to the east of the Kent Project Site (ID 3 in Figure 15.6), traffic movement calculations show ambient noise level increases by at least 1 dB for properties in:

- Snowdon Hill
- Robinson Way (including Phoenix Court, Black Eagle Drive)

15.133 The assessments above are limited to only those dwellings with a direct line of sight to the new access road.

Figure 15.7: Calculated daytime levels $L_{Aeq,18hr}$ dB(A) for the Tilbury Town area, calibrated to baseline 2018 traffic movement noise data (left image) and to 2038 predicted traffic movement noise data (right image).



15.134 Figure 15.7 considers the effect of road traffic noise around the Essex Project Site. The modelling prediction shows the effects of increased traffic along the A1089 when the Proposed Development is 'switched on'.

15.135 On collection of baseline noise survey data around the Essex Project Site, the potential noise impact from increased traffic flows on residential properties can be more accurately determined. At this preliminary stage, ambient noise level increases by at least 1 dB are primarily expected at properties along Dock Road and those in direct lines of sight of the A1089.

Impact of ride / 'scream' noise to London Resort operation

15.136 The following figures provide a comparison between the baseline ambient noise climate and the predicted noise climate due the operation of attractions and rides using $L_{A,max,f}$ as the noise index.

15.137 In the modelling of the noise from the attractions and rides shown in Figure 15.8 six outdoor rides have been modelled in Gate One. In Figure 15.9 a further three outdoor rides have been modelled in Gate Two along with a series of 'boxed' (indoor) rides. This is in line with the design development of the Proposed Development.

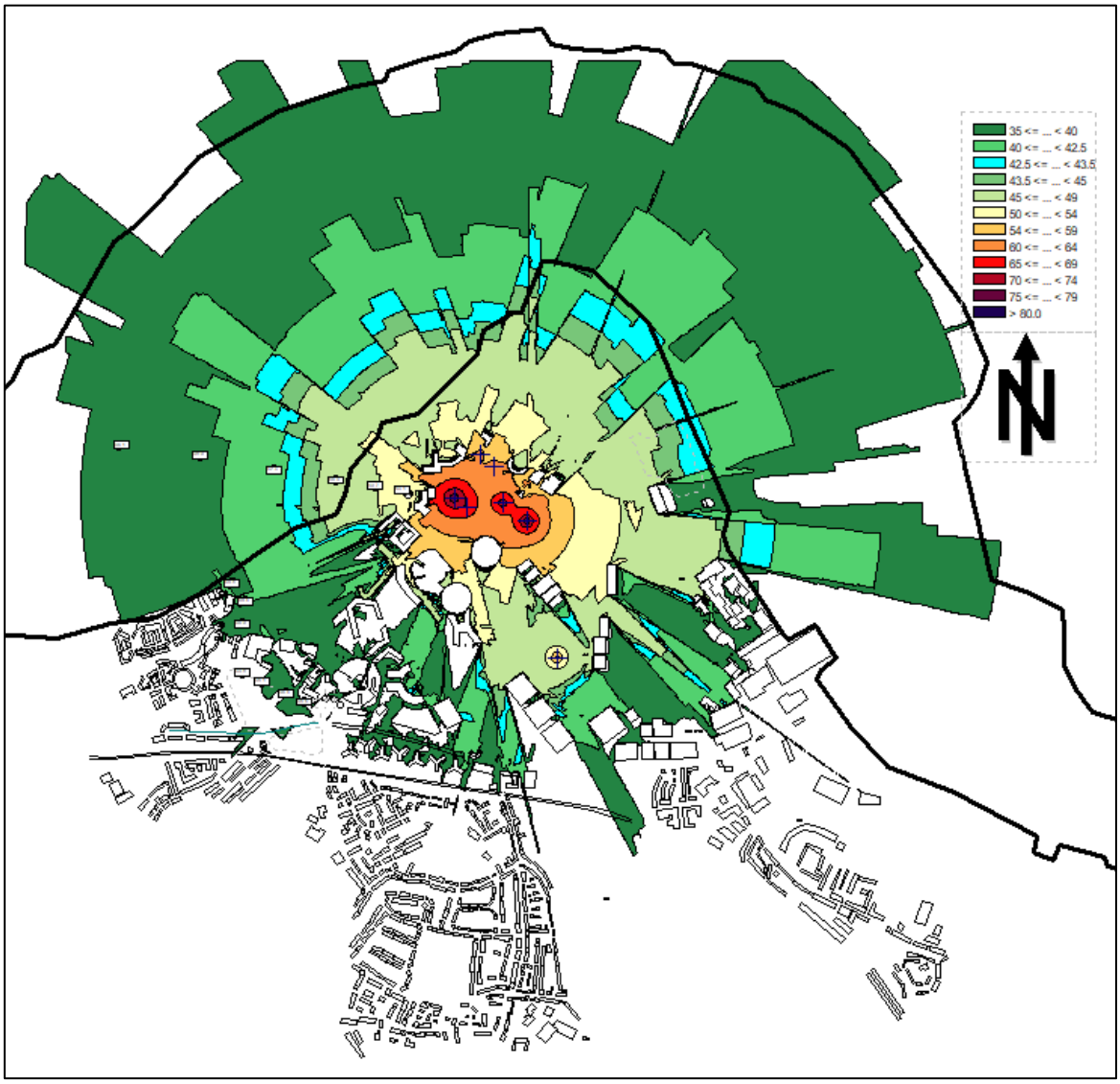
15.138 Close inspection of the $L_{A,max,f}$ noise survey data in conjunction with 3D acoustic modelling has shown that the current noise climate to the south and east of Gate Two is strongly influenced by the peaks in noise caused by the movements of HGV vehicles along Manor Way. These will cease due to the construction of the London Resort. However, comparing the future $L_{A,max,f}$ from rides and attractions to the current peak noise levels which are highly influenced by HGV movements is not a reliable predictor as future baseline measurements might not include such vehicle movements.

15.139 The assessment is therefore based on the likelihood of rides and attractions being clearly audible outside residential premises when all other peak noise sources are absent. This represents the quiet time between road traffic events when the noise from a ride or attraction (including shouts and screams) might be audible.

15.140 The assumption made here is that $L_{A,max,f}$ noise levels that are more than 5dB below background (LA90) noise levels are unlikely to be clearly audible, even in the gaps between other peak noise events such as road traffic.

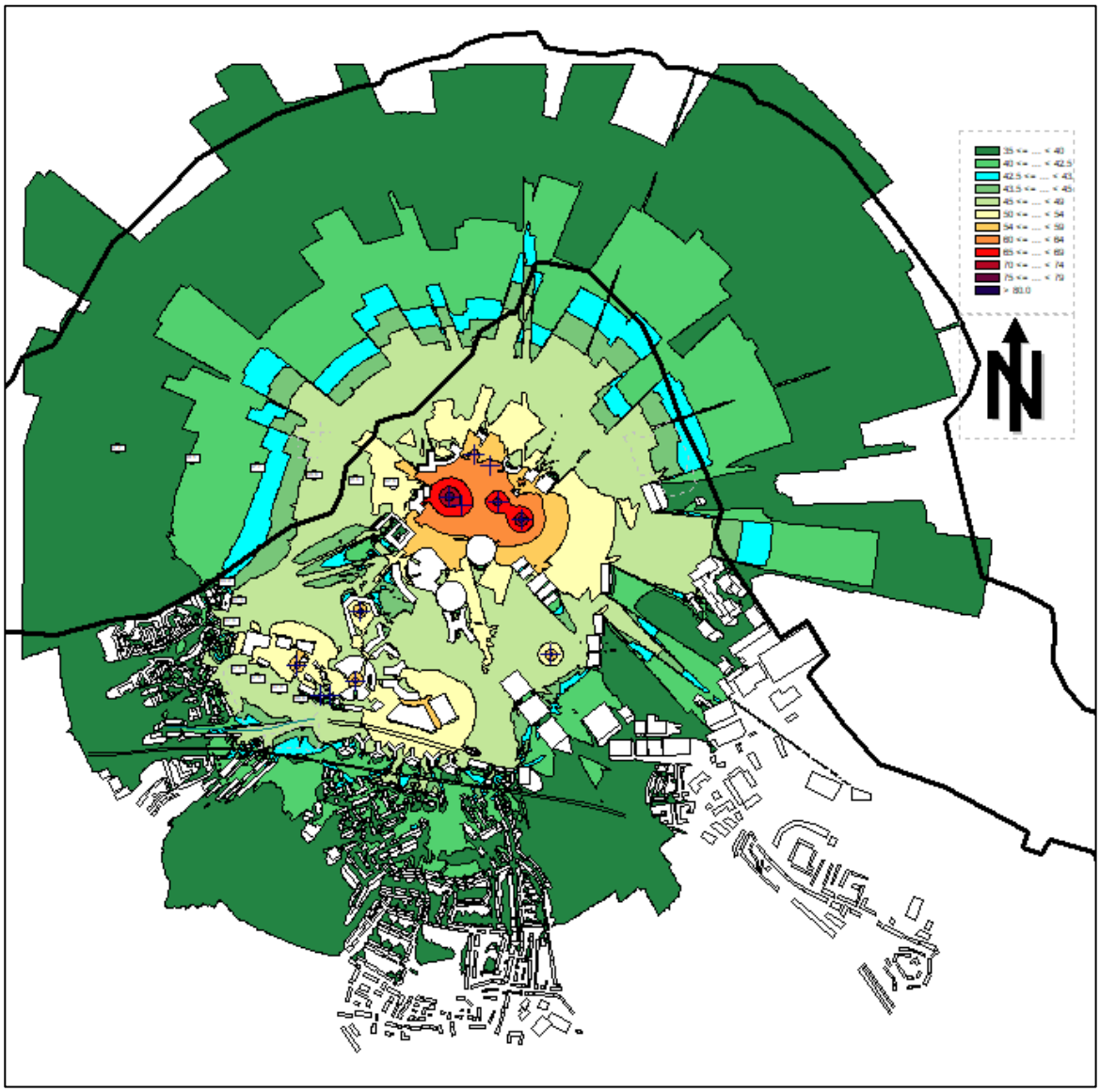
15.141 The lowest background noise levels measured during onsite noise surveys was found to be 48 dB(A) (at monitoring location 1, shown in Appendix 15.1). Therefore, the $L_{A,max,f}$ of 43 dB(A) is taken to be a threshold level for audibility of ride noise.

Figure 15.8: Calculated daytime levels $L_{A,max,f}$ dB(A) for the area surrounding the Kent Project Site with only the Gate One rides and attractions in operation (no road traffic or any other sources of noise modelled). 43 dB(A) noise climate threshold is indicated in blue.



15.142 Figure 15.8 which considers the effect of the operation of the Gate One rides and attractions only, shows that using $L_{A,max,f}$ as the noise index, rides are not predicted to produce $L_{A,max,f}$ levels in excess of the 43 dB(A) threshold.

Figure 15.9: Calculated daytime levels $L_{A,max,f}$ dB(A) for the area surrounding The Kent Project Site, with the Gate One and Gate Two rides and attractions in operation (no road traffic or any other sources of noise modelled). 43 dB(A) noise climate threshold is indicated in blue.



15.143 Figure 15.9 includes noise from rides and attractions at both Gate One and Gate Two. In this case, noise levels are predicted above the threshold at the following residential premise locations:

- Wainwright Avenue

- Stonely Crescent
- Tiltman Avenue
- Vaughan Avenue
- Duncannon Place
- Reed Court
- *Knockhall Road*
- *Ingress Gardens*
- *Craylands Lane*
- *Craylands Square*
- *Caspian Way*
- *Pentstemon Drive*
- *Orchard Road*
- *Alma Road*

15.144 The assessments above are limited to only those dwellings with a direct line of sight to the new rides and attractions.

15.145 Additionally, any new housing in the land between Tiltman Avenue and London Road with a direct line of sight to the new rides and attractions would be predicted noise levels above the threshold.

15.146 The locations picked out in italics are south of London Road. It is less likely for noise from rides and attractions (including shouts and screams) to be audible at these locations as this would depend on their being a sufficiently lengthy gap in road traffic noise on London Road. Nevertheless, they are included here for completeness.

15.147 Shown in Figures 15.8 and 15.9, the modelling exercise also predicted ride noise operation to not cause significant effects to NSRs North of the River Thames in Thurrock areas. Distance attenuation to areas north of the Thames causes noise levels to be below the 43 dB(A) significance threshold.

Sites of special scientific interest (SSSI)

15.148 For the full ES report, future assessments will be conducted to look specifically into the impact of operation of the Proposed Development on the following SSSI's:

- The West Thurrock Lagoon and Marshes;
- Darenth Woods;
- Lions Pit;
- Hangman's Wood;
- Deneholes SSSI;
- Swanscombe Skull Site; and
- Bakers' Hole; and

Ecology Chapter Assessment Areas

15.149 For the full ES report, future assessments will be conducted to look specifically into the impact of operation of the Proposed Development on the following noise sensitive ecological receivers:

- The Botany Marshes Local Wildlife Site;
- Blackduck Marshes;
- Thames Estuary SPA; and
- Ramsar Site.

POTENTIAL SIGNIFICANT ENVIRONMENTAL EFFECTS OF THE PROPOSED DEVELOPMENT

15.150 In addition to the assessments set out above, the potential significant effects arising from the construction phase and operational phase of the Proposed Development that will be outlined in greater detail in the assessment reported on in the ES are as follows:

- Effects from noise and vibration generated during the construction phase, including from earthworks, demolition, piling and general construction on noise or vibration sensitive receptors. These receptors will be identified through consultation with relevant local consultees.

- Effects on noise sensitive receptors from noise (or vibration) generated during the operational phase including from cheers, shouts and entertainment music generated by the proposed rides, by the movement of vehicles on, off or around the Project Site and by items of fixed plant as required to service the operation.

PROPOSED MITIGATION

15.151 The preceding assessment of effect significance shows that there are limited instances where construction noise requires mitigation.

15.152 It is necessary to ensure that the best practicable means (BPM), found in BS 5228-1:2009 +A1 2014 and BS 5228-2:2009 +A1 2014, are employed to minimise noise and vibration. Examples can be found below.

Construction noise

15.153 Where residential occupiers are likely to be affected by noise, the hours of work will normally be restricted to:

- Monday – Friday: 8am – 6pm;
- Saturday: 8am – 1pm; and
- Sunday and Bank Holidays: All work outside these core times will be by agreement with the LPAs.

15.154 All vehicles and plant arriving at and leaving the Project Site by the local road network, will comply with the same restrictions on hours. The main contractor will be held responsible for ensuring these instructions are given to all drivers, including those delivering site materials. The working hours may also be restricted through planning conditions. Any deviation from these hours will require prior approval. All operations outside these hours where they impact on the local roads and community will be subject to the contractor seeking the LPAs approval and where appropriate informing the local residents who are directly affected in advance.

15.155 Examples of mitigation measures that can be used to control construction noise are found in Section 8 of BS 5228-1:2009 +A1 2014.

Construction vibration

15.156 Construction vibration is temporary and for short periods of time. Best practice construction mitigation measures can also be incorporated to ensure the vibration impacts are reduced.

15.157 Examples of mitigation measures which can be used to control construction vibration are

found in Section 8 of BS 5228-2:2009 +A1 2014. These examples include:

- Substitute plant and/or methods with less obtrusive plant and/or methods,
- Where reasonably practical, move vibrating equipment away from identified NSRs,
- Vibration isolation of stationary plant,
- Selecting less intrusive methods of piling,
- Employ cut-off trenches which are analogous to noise barriers, and
- Pre-auguring before installing the piles.

Table 15.21 Summary of construction mitigation measures (BS 5228-1:2009 +A1 2014 and BS 5228-2:2009 +A1 2014).

Adverse effect	Mitigation measure	Means of implementation	Timing	Essential / desirable
Construction noise and vibration disturbance at adjacent buildings	Inform all occupiers of adjacent buildings about: - Scale and nature of works - When they are to take place - Who to contact in case of disturbance	Incorporated into Construction Environmental Management Plan	During demolition and construction	Essential
Noise from works	Shielding on the site from Solid temporary barrier (surface density of not less than 7 kg/m^2) or other topographical feature Position site huts to provide additional screening of works	Incorporated into Construction Environmental Management Plan	During demolition and construction	Essential
Noise from machinery	Low noise attenuated exhaust system should be selected for excavators, dozers, dump, trucks and cranes Selection of low noise attenuated exhaust systems for machinery	Incorporated into Construction Environmental Management Plan	During demolition and construction	Essential

Adverse effect	Mitigation measure	Means of implementation	Timing	Essential / desirable
	Minimum use of crane engines Crane engines should be run as little as is necessary for the task to be completed	Incorporated into Construction Environmental Management Plan	During demolition and construction	Desirable
Noise from piling	Noise reducing systems for pilling The use of conventional impact hammers should, wherever possible, be avoided. Any pile driving is to be carried out by plant equipped with a recognised noise reducing system.	Incorporated into Construction Environmental Management Plan	During piling	Desirable
Noise from HGVs	HGVs should not be left idling and should only have engines turned on when specifically needed: 15 mins in every hour for engines on	Incorporated into Construction Environmental Management Plan	During demolition and construction	Essential
Noise from hand-tools	Hand tools (particularly compressor powered tools) should be used with some element of shielding between the user and the receptor Shielding should completely cut line of sight between user and receiver Position site huts to provide additional screening of works	Incorporated into Construction Environmental Management Plan	During demolition and construction	Essential
Noise from plant and equipment	Use of electricity instead of diesel/petrol generators All plant and equipment should be powered by mains electricity in preference to locally powered sources such as	Incorporated into Construction Environmental Management Plan	During construction	Desirable

Adverse effect	Mitigation measure	Means of implementation	Timing	Essential / desirable
	diesel generators. Hand tools should also be electrically powered rather than petrol or diesel driven			
Vibratory equipment	Location of vibratory equipment far from sensitive receptors - Located as far from sensitive premises as possible - Less intrusive methods of piling	Incorporated into Construction Environmental Management Plan	During demolition and construction	Essential

RESIDUAL ENVIRONMENTAL EFFECTS

15.158 The residual environment effects will be set out once mitigation measures have been applied. These will be available in the Environmental Statement in the DCO submission.

CUMULATIVE AND IN-COMBINATION EFFECTS

15.159 A cumulative effects assessment will be carried out and the results reported on in the ES. Other proposed developments/activities that might have a cumulative or in-combination effect upon noise or vibration will be considered.

15.160 Cumulative effects are multiple effects on the same habitat, arising from a proposed development in combination with all developments that have been built and are operational. In-combination effects are those that might arise from the development proposed in combination with other plans and projects that are proposed or consented but not yet built and operational (i.e. those developments that are separate from the baseline).

15.161 For example, construction works for developments such as LTC, A2 B&E and the Proposed Development would be expected to change the baseline conditions more significantly when considered simultaneously. As such, it is proposed that future assessments should take into account a number of slice years when construction of the masterplan runs concurrently with the other peak development works.

CLIMATE CHANGE

15.162 The noise and vibration assessments are based on non-climate related sources; therefore, a change in the climate conditions is not expected to change the operational noise and vibration assessment carried out.

SUMMARY AND CONCLUSIONS

15.163 This chapter presents methodology proposals and preliminary results in relation to noise impact assessments of the Proposed Development around the Kent and Essex Project Site.

15.164 Baseline noise climate conditions have been identified and modelled using CadnaA prediction software. Appendix 15.1 contains the noise survey data collected around the Kent Project Site and the Department for Environment, Food and Rural Affairs traffic noise data used in indicative Essex Project Site assessments - until noise measurements can be undertaken during a more representative typical noise environment, which is less affected by the currently lower COVID-19 noise climates.

15.165 Source - Pathway – Receptor analyses have been undertaken, providing an assessment of the potential noise impact due to the operation of the Proposed Development. The baseline conditions around the Project Site have been assessed against 2038 operational predictions for:

- Increased traffic flows on the $L_{Aeq,18hour}$ noise climates; and
- Propagation of $L_{A,max,f}$ ride noise and visitor screams from Gate One and Gate Two Masterplan ride locations (Available up to the July 2020).

15.166 In considering the effect of road traffic noise, the influx of vehicle movements along the proposed access road of the A2(T) (Kent Project Site) and the A1089 (Essex Project Site), were shown to cause the greatest changes to the $L_{Aeq,18hour}$ noise climates. Affected properties in a direct line of site to these roads were logged in the Baseline Conditions section and Appendix 15.3.

15.167 The impact due to Ride and Scream noise from operation of the Proposed Development has been assessed by comparing $L_{A,max,f}$ levels against the existing background noise climate around the Kent Project Site (48 dB(A) measured during the noise surveys at monitoring location 1, shown in Appendix 15.1). An $L_{A,max,f}$ noise level 5 dB below this existing background noise climate was taken to be the threshold value for determining significance and NSR audibility of the operational noise (43 dB(A) threshold). The assessment determined the following:

- Gate One rides were not predicted to produce $L_{A,max,f}$ levels in excess of the 43 dB(A) threshold at NSRs.
- The locations of NSRs where Ride and Scream noise is likely to be audible from

Gate Two rides (typical those in a direct line of site to the rides) were logged in the Baseline Conditions section and Appendix 15.3.

15.168 Noise from Rides and Screams is not expected to propagate across the River Thames into Thurrock District Areas, with $L_{A,max,f}$ noise levels shown to be below the threshold level.

15.169 An assessment into the potential noise impact from the different construction phases of the Proposed Development is currently in production. Currently within this chapter, Kent and Essex Project Sites have been divided into assessment zones, construction noise sources have been identified and provided for reference, and a placeholder for the assessment of noise impact significance has been outlined. The assessment will be presented in full in the ES.

15.170 Mitigation measures that could be used to reduce noise levels at receptor locations where reasonably practicable have been provided.

15.171 The impact of noise due to the construction and the operation of the Proposed Development on SSSI's and Ecologically Sensitive Sites will be assessed in full in the ES.

15.172 The residual environmental effects, cumulative and in-combination effects and description of climate change impacts will also be included in the full ES.