The London Resort Development Consent Order

BC080001

Environmental Statement
Volume 1: Main Statement

Chapter 15 – Noise and vibration

Document reference: 6.1.15
Revision: 00

December 2020

Planning Act 2008
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009
Regulation 5(2)(a)
The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017
Regulation 12(1)

[This page is intentionally left blank]

Chapter Fifteen ◆ Noise and Vibration

INTRODUCTION

15.1 This chapter of the Environmental Statement (ES) assesses the likely environmental effects of the Proposed Development with respect to noise and vibration.

15.2 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.

15.3 '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'.

15.4 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.

15.5 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;
- mitigation measures to prevent, reduce / offset any significant adverse effects from noise; and
- the likely residual effects after measures have been adopted.

15.6 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) (*Code of practice for noise and vibration control on construction and open sites)* guidance.

15.7 The assessment of traffic noise and vibration from the operation of the London Resort has been undertaken based on the future traffic flow predictions (road, rail and ferry) presented in detail in chapter 9, Land Transport of this ES (document reference 6.1.9). In accordance with the Design Manual for Roads and Bridges (DRMB) the noise impact is assessed against the more onerous short-term threshold values, evaluating significance as

a +1 decibel (dB) noise climate change at the façades of noise sensitive receptors.

15.8 Other assessments of the operation of the London Resort have collected noise survey data (presented in Appendix 15.1, document reference 6.2.15.1), to analyse the potential noise impacts from the Proposed Development's passenger ferry service as well as the propagation of maximum noise levels from rides and attractions (inclusive of mechanical 'clanking' and visitor scream noise sources inherent with theme park attractions).

METHODOLOGY AND DATA SOURCES

EIA Scoping

15.9 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 within this Environmental Statement.

15.10 The comments and responses pertinent to noise and vibration are summarised below in Table 15.1.

Table 15.1: Summary of 2014 EIA scoping opinion and responses

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) have been contacted during the 2020 statutory consultation phase. The noise monitoring locations within this ES have been agreed with local planning authorities during the consultation as detailed in Table 15.4. Noise survey information detailed in Appendix 15.1 (document reference 6.2.15.1) and Diagram 15.1 of the report.
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	A noise survey of rides and attractions was conducted at Europa Park (Germany). The measured $L_{A,max,f}$ noise levels (inclusive of attraction and ride music, mechanical clanking and

Paragraph Number	2014 Scoping Opinion Comment	2020 Response
	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.	scream noise) are modelled as a series of noise sources that represent visitor attraction / ride masterplan locations and positions where visitors are predicted to be screaming. The model assessment in the ES shows the sound propagation extent of maximum A-weighted decibel levels. Appendix 15.1 (document reference 6.2.15.1) details the noise survey data from Europa Park. Appendix 15.4 (document reference 6.2.15.4) details the operational assessments. Ride noise is specifically discussed in Paragraph 15.119 to 15.129 of this Chapter.
3.62	The Scoping Report illustrates the proposed general location of various components of the project; however, the potential impacts and receptors could vary 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.	Investigations look at worst-case noise propagation scenarios using CadnaA® 3D noise modelling software (discussed Paragraph 15.22 to 15.27). Construction noise source sound power levels and assessment criteria for noise impact significance are based on BS 5228-1:2009:A1:2014 criteria. Visitor predictions use peak design day figures to assess the future noise impact of London Resort operation, ride noise sound propagation and construction noise activities at the site boundary. The Assessment of Likely Significant Effects from operational noise sources are discussed in Appendix 15.4 (document reference 6.2.15.4) and from Paragraph 15.109 to 15.168 in the ES. Assessments have utilised the DCO Order limits plan

Paragraph Number	2014 Scoping Opinion Comment	2020 Response
		for Dartford Borough Council, Gravesham Borough Council and Thurrock Council Meetings (Issued by APT, 13/10/2020).
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.	The magnitude and significance of Earthworks, Piling, Paving and General Construction noise sources have been investigated in the ES. Noise sensitive receptors have been highlighted and assessed within the Chapter and in detail in Appendix 15.3 (document reference 6.2.15.3). The methodology was agreed with local authority representatives during October 2020 consultation shown in Table 15.4.
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 construction noise assessments in Appendix 15.3 (document reference 6.2.15.3) use BS 5228-1:2009:A1:2014 sound power level data. The noise impact from numerous different sources are assessed for the various Project Site locations and construction phases. The assessment considers and outlines the projects construction working hours. The Assessment of Likely Significant Effects from construction noise sources are discussed in Appendix 15.3 and from Paragraph 15.86 to 15.106 in the ES.
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	Noise modelling in this section is informed by transport consultant prediction data. The operational traffic noise assessment within the ES compares baseline noise models produced from measured noise level data to the predicted

Paragraph Number	2014 Scoping Opinion Comment	2020 Response
	should include cross-referencing to 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.	traffic flow data at the point of reaching maturity for the London Resort (taken to be in 2038). Observed and construction traffic flows have been used to assess the magnitude of impact on the NSRs due to construction traffic during key construction years prior to and during the construction of the specific Resort access roads (2023 and 2024). The Assessment of Likely Significant Effects from construction noise sources are discussed in Appendix 15.3 (document reference 6.2.15.3) and from Paragraph 15.104 to 15.106 in the ES. Noise and vibration levels from works along the foreshore of the River Thames are assessed in Appendix 15.3 (document reference 6.2.15.3). The significance of noise impacts on local fauna and flora is further discussed in the Terrestrial Ecology and Biodiversity ES chapter 12 (document reference 6.1.12).
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.	Mitigation measures that can be used to control construction and operational noise have been detailed in the Chapter and provided in Appendix 15.5 (document reference 6.2.15.5). These measures can and will applied if required to reduce residual noise impacts.

15.11 A further Scoping Report for the London Resort was submitted to the Planning Inspectorate on 15th June 2020. The report contained the noise and vibration assessment

scope that was proposed in the preparation of this Environmental Statement. The responses obtained from the Planning Inspectorate are documented in Table 15.2 below.

Table 15.2: Summary of 2020 scoping opinion and responses

Paragraph Number	2020 Scoping Opinion Comment	2020 Response
4.8.2 / 14.7	The Scoping Report states that due to 'attenuation resulting from distance', only ecological receptors within 200m of the red line boundary will be assessed. However, the proposed 200m to the Proposed Development – study area for ecological receptors has not been explained and this appears to be an arbitrary figure. The Inspectorate notes that the Swanscombe Marine Conservation Zone is not mentioned, despite the Proposed Development being partly within it. The Scoping Report notes that the West Thurrock Lagoon and Marshes SSSI is outside of the 200m zone, but this does not appear to account for the greater propagation of sound over water. The ES should assess noise impacts on sensitive ecological receptors where significant effects are likely to occur. The Applicant should make effort to agree the approach to the assessment with relevant consultation bodies.	The extent of SSSI noise assessment has been included in the ES to consider the following locations (inclusive of areas >200m from the red line site boundary). Whilst typically ecologically sensitive designated sites within 200m of the Project Site are assessed, the following ES considers the worst-case noise impacts from London Resort Construction and Operation, on each of the sensitive receptors identified Chapter 12 of the ES Terrestrial Ecology and Biodiversity (Paragraphs 15.154 to 15.168, document reference 6.1.12). The inclusion of these SSSIs within the noise assessment has been agreed with the 2020 consultation meeting detailed in Table 15.4. The effects of construction or operation noise sources on marine ecology requires specialist assessments. Ecological impacts are further discussed in Chapter 12 of the ES (document reference 6.1.12).
4.8.3 / 4.11	The assessment in the ES should also have regard to the requirements of BS 8233:2014 Guidance on sound insulation and noise reduction for buildings. This will be relevant for the consideration of effects on hotels, offices, the conference centre, and accommodation within the Proposed Development. The World Health Organisation Guidelines for Community Noise (2018) are also relevant.	Commentary on predicted environmental levels and their effect on achieving BS 8233 standards of interior noise has been provided in the ES. External amenity spaces have been assessed against WHO guidance.
4.8.4 /14.13, Table 14.1	The ES should describe and assess the noise impacts based on the proposed maximum	This has been implemented within the Environmental Statement

Paragraph Number	2020 Scoping Opinion Comment	2020 Response
	development parameters. The ES should explain clearly how any proposed DCO requirements would address the potential impacts associated with the assessment parameters.	chapter Appendix 15.2 (document reference 6.2.15.2) contains the technical guidance and planning policies used to form the assessment criteria of construction and operational development noise.
4.8.5 / 14.13, Table 14.1	The ES should assess noise impacts during construction and operation taking account of relevant receptors, types of vehicles and plant to be used during the construction phase, proposed piling works, and results from the noise and vibration assessments – particularly for potential traffic movements along access routes.	The ES includes assessment of both construction and operational noise (respectively detailed in Appendix 15.3 and 15.4). Construction noise assessment takes into account the details listed in the comment.
4.8.6/ 4.13, Table 14.1 14.39 – 14.45	The Scoping Report outlines some potential avoidance and mitigation measures for the construction and operational phases, but only in the most general terms. The ES should address the opportunities to reduce noise impacts through application of available construction techniques and approaches. Any measures relied upon in the assessment to control noise impacts should be clearly described and secured. With regard to underwater noise, the use of vibro-piling instead of impact hammer/percussive piling may reduce impacts of underwater noise and vibration, and use of 'soft-starts' for piling and backhoe dredgers instead of trailer suction hopper dredger (TSHD) can also reduce the risk of effects on marine mammals and fish. Works can also be phased to avoid sensitive seasons for marine species.	The mitigation section of the noise and vibration chapter of the ES includes a comprehensive appraisal of appropriate (including modern) opportunities for noise and vibration mitigation. Mitigation measures that can be used to control construction and operational noise have been detailed in the chapter and provided in Appendix 15.5 (document reference 6.2.15.5). These measures can and will applied if required to reduce residual noise impacts.
4.8.7 / 4.19	The Scoping Report provides no information regarding the locations, durations or technical aspects of proposed noise and vibration surveys, but states that these will be agreed with the local planning authorities, the Ebbsfleet Development Corporation and other relevant consultees. The Applicant should make efforts to agree	Agreement on baseline noise data locations and protocols has been secured from the relevant consultees (questions and responses during 2020 consultation is provided in Table 15.4).

Paragraph Number	2020 Scoping Opinion Comment	2020 Response
	the approach to collecting baseline noise data with relevant consultees.	
4.8.8/14.20 14.22	The Scoping Report mentions the creation of a 3D acoustic model of the baseline noise levels in and around the Proposed Development, and the collection of baseline vibration data too. The assessment in the ES should be based on relevant baseline information and indicate the likely maximum distances and maximum levels of different forms of noise generated during construction, operation and decommissioning. The noise impact assessments should also assess noise and vibration levels that occupiers of existing properties would be predicted to experience during all phases.	This methodology has been followed in the carrying out of assessments and preparation of this ES chapter.
4.8.9 / 14.32	Noise and vibration modelling at the Proposed Development will apparently be modelled for three scenarios – 1) baseline (2020), 2) future opening year without development, and 3) future opening year with development. The Proposed Development may well evolve in two phases however, with Gate 1 opening in 2024 (57ha) and Gate 2 (25ha) when fully built at a date to be determined, the latter with construction continuing to take place whilst some attractions and facilities are open. The Inspectorate believes that such alternate scenarios should be assessed as well to ensure that the worst case has been assessed.	The assessment of both construction and operational noise (and vibration) has been undertaken for both Gate 1 opening and then both Gate 1 and Gate 2 in operation. The assessment can be found in detail in Appendix 15.4 (document reference 6.2.15.4)..
4.8.10 / 14.46 14.54	The Scoping Report lists a series of uncertainties associated with modelling noise effects of the Proposed Development. These are generalised and reflect the overall uncertainty and lack of detail associated within the Scoping Report. The Applicant should make effort to reduce the level of uncertainty regarding the proposals in the ES in order to ensure that the assessment is robust.	The noise and vibration chapter of the ES discusses the level of uncertainty and how it has been reduced. See Paragraphs 15.35 to 15.27 of the chapter.

Paragraph Number	2020 Scoping Opinion Comment	2020 Response
4.8.11	No baseline acoustic data from the existing Proposed Development areas are provided in the Scoping Report, nor any assessments of noise levels for construction and operation phases. The scoping document does not provide detail on monitoring locations, durations, or values for Lowest Observed Adverse Effect Level (LOAEL) and Significant Observed Adverse Effect Level (SOAEL). This information should be included in the assessment of noise in the ES. The ES should also take into account impacts from music and sound effects generated by proposed rides and entertainments and by events that might utilise fireworks, thunder flashes, explosions or other noise generating effects, by cheering, clapping, shouting and screaming, by the movement of terrestrial vehicles and watercraft on, off or around the Proposed Development, and by items of fixed plant such as generators and air conditioning. The assessment should cross-refer to other relevant aspect chapters (e.g. ecology) where impacts from noise and vibration to sensitive receptors may be significant. The ES should also assess impacts from increased underwater noise and vibration on marine organisms from activities such as piling and dredging.	All of these items are included in the ES chapter. Appendix 15.1 (document reference 6.2.15.1) details the measurement locations and corresponding noise survey data. Other relevant discipline chapters are cross-referenced in the ES chapter. Chapter 12 of the ES Terrestrial Ecology and Biodiversity (document reference 6.1.12).
4.8.12	The ES will have to address the impact of noise and vibration generated during the construction and operation of the Proposed Development on the operational wharves, loading facilities and existing businesses on the eastern side of the Kent Project Site, but also the impacts of these commercial operations on the hotels, offices and other areas within the completed resort. The impact on residential properties to the south and west of the Proposed	A comprehensive assessment of the impact of noise and vibration, including that from the operation of wharves and other industrial sites is included in the ES (in Appendix 15.4). This assessment includes noise from land and marine vehicle movements.

Paragraph Number	2020 Scoping Opinion Comment	2020 Response
	Development will have to be very carefully modelled and mitigated in the ES, along with the impact of projected car park noise on receptors in and around the Kent and Essex Project Sites from vehicles in the car parks, and the noise of crowds gathering outside the venue entrances on the Kent and Essex Project Sites. The regular ferry connections from the Essex to the Kent Project Sites may create a 'corridor' of potential above and below water noise impacts across and along the River Thames, which will also need to be examined.	
4.8.13	Noise and vibration assessments will have to be linked to timetable considerations, such as whether the Proposed Development will be in operation 365 days a year and throughout all holiday periods. When open in the evening, there is potential for noise and vibration to propagate and impact more extensively than during the day.	Day, evening and night-time assessments of noise are included in the ES.
N/A P91 (of PDF)	Reliance on Fastrack is likely to lead to the need for increased services, reducing the headway between buses. Where service levels are required to be increased, the impact on the local traffic network, junctions and noise and air quality impacts on the local environment should be assessed.	The Fast-track buses are included in the road traffic noise assessment in Appendix 15.4 (document reference 6.2.15.4).
N/A P99 (of PDF)	The assessment should include consideration of the impacts from the evening uses and venues proposed, as well as impacts away from the Resort at transport interchanges and other locations where visitors/ employees/construction workers may gather. There is little mention of the evaluation of associated development, such as hotels/convention centre.	These considerations and assessments are included in the ES, see Appendix 15.4 for detail of operation London Resort noise impact assessments (document reference 6.2.15.4).

Paragraph Number	2020 Scoping Opinion Comment	2020 Response
N/A P100 (of PDF)	The Council notes that a floating pontoon is proposed to serve Thames Clipper, which will extend from Bells Wharf towards Ingress Park (a waterfront residential development). As noise cannot be attenuated well over water this should be assessed in detail with regard to the impact on the adjacent existing dwellings as well as the new residential development (with a resolution to grant planning permission subject to a legal agreement) which will extend over the foreshore on a pier structure.	Noise propagation from the pontoon is included in the ES chapter. Appendix 15.1 contains the noise survey data used for the desktop noise model assessments of London Resort operation in Appendix 15.4 (document reference 6.2.15.4).
N/A P100 (of PDF)	Para14.11 - the list of guidance should also include BS 6472-1:2008 Guide to the evaluation of human exposure to vibration and the World Health Organisation publication "Environmental Noise Guidelines for the European Region" as appropriate reference documents.	Noted and included within the ES chapter. A full list of the planning policy and guidance documents is provided in Appendix 15.2 (document reference 6.2.15.2).
N/A P100 (of PDF)	Para 14.22 - No reference is made to the noise during the operational phase generated by associated development e.g. Event spaces and gathering of crowds at locations outside the Resort.	An assessment of Event Spaces has been included in the noise assessment in the ES. The desktop noise model study can be found in Appendix 15.4, mitigation measures to reduce noise propagation are provided in Appendix 15.5 (document reference 6.2.15.4).
N/A P100 (of PDF)	Potential mitigation will of course be dependent upon the assessments, but details put forward to reduce noise should be included and assessed within the EIA, wherever possible.	Noted and mitigation measures are included in the ES chapter (and in detail in Appendix 15.5).
N/A P133 (of PDF)	It is unclear why the project has chosen its specific boundaries for the impacts on noise and vibration. This is important due to the increase in boat traffic particularly clipper services, that do not current operate in this area, but also that 200 metres may not be sufficient distance for excluding disturbance to both marine mammals and birds utilising	Whilst typically ecologically sensitive designated sites within 200m of the Project Site are assessed, the following ES considers the worst-case noise impacts from London Resort Construction and Operation on each of the sensitive receptors identified in Chapter 12 of the ES

Paragraph Number	2020 Scoping Opinion Comment	2020 Response
	the estuary. Therefore, West Thurrock Lagoon and Marshes should be included in this assessment. The assessment must consider the full range of activities that may take place at the resort including (but not limited to) construction, specific boat traffic, the use of fireworks, music, and events etc.	Terrestrial Ecology and Biodiversity' (Paragraphs 15.154 to 15.168, document reference 6.1.12).
N/A P160 (of PDF)	In paragraph 14.11 there is no mention of BS8233:2014 or the WHO Guidelines for Community Noise, both of which are relevant in terms of acceptable internal (and external) noise levels. The Council would expect noise impact assessments to (also) consider the levels that occupiers of affected properties would be predicted to experience during all phases and for mitigation to include sufficient steps to ensure they are not exceeded.	Commentary on predicted environmental levels and their effect on achieving BS 8233 standards of interior noise are be provided in the ES. External amenity spaces have been assessed against WHO guidance. A full list of the planning policy and guidance documents is provided in Appendix 15.2 (document reference 6.2.15.2).
N/A (P261 of PDF)	When undertaking the noise assessment, it must be undertaken using both BS 8233 and BS 4142. This is because when assessing noise of an industrial nature, from premises such as wharves, the assessments require that the 'rating level' of the noise is determined. The rating level is the noise emission level plus a correction (which is determined using the provisions of BS 4142) for the character of the noise, which can then be compared to the background sound level (BS 4142) or guideline values (BS 233). It is recommended that the wharf operators are contacted prior to any baseline monitoring noise monitoring taking place to ensure that representative noise levels will be obtained.	Noted and included within the ES chapter. Limiting plant rating level calculations are undertaken for the fixed infrastructure compound proposals in Appendix 15.4 (document reference 6.2.15.4).

Consultation Events

15.12 In addition to scoping opinion and responses, leading up to the DCO application, consultation events were undertaken with the public and with local authority representatives.

15.13 The noise and vibration related queries and responses from the public consultation events (held via webinar) are shown in Table 15.3.

Table 15.3: Summary of 2020 London Resort public consultation questions and answers

Public Consultation Questions	2020 Response
Will noise from the Resort keep me awake at night?	The planning of the Resort has taken noise from rides and attractions into account as well as the movement of people and goods around the site into account. Predicted noise levels are compared with existing levels measured across the development site to ensure that any impacts on local residents are designed out.
Will noise from construction traffic stop me enjoying my garden or balcony?	The noise from construction traffic accessing the Project Site, and from the use of construction machinery on the Project Site have been predicted to ensure that good construction management can be used to minimise impacts on local residents for the duration of the construction period.
Will increasing road traffic make my neighbourhood noisier?	The development of the Resort means a reduction in some heavier and noisier traffic due to the current land usage will be replaced by quieter; lighter vehicles. The changes may result in lower noise levels in several neighbourhoods.
Will vibration from construction activities damage my property?	Ground borne vibration from construction traffic and activities are being predicted and these predictions are showing that they vibration levels are likely to be too low to affect existing properties around the development.

15.14 The section 42 consultation undertaken in the summer of 2020 enabled all stakeholders to formally feedback on the Preliminary Environment Impact Report (PEIR) for the London Resort, which included the draft noise and vibration chapter. A summary of the issues raised during this consultation and responses to these comments are presented in table 15.4 below.

Table 15.4: Summary of PEIR comments (2020) and responses

Consultee	Comment	Response
Dartford Borough Council	The Council notes that there is a commitment to discuss the methodology of the assessment and the noise receptors with the Council's Environmental Health advisors and welcomes this. However, there has been no discussion yet with regard to this methodology and the Council is	The Noise and Vibration Assessments were discussed with DBC on the 23rd October 2020 and the receptors for the assessment were presented to DBC (see Appendix 15.1 and paragraphs 15.16 and 15.17).

Consultee	Comment	Response
	concerned about the limited time that now may be available to discuss and agree such detail.	
Dartford Borough Council	The assessment should include consideration of the impacts from the evening uses and venues proposed, as well as impacts away from the Resort at transport interchanges and other locations where visitors/ employees/construction workers may gather. There is little mention of the evaluation of associated development such as hotels/convention centre.	The Noise and Vibration Assessment in Appendix 15.4 (document reference 6.2.15.4) includes consideration of noise from outdoor events and gatherings of people such as those connected with the hotels or Conference Centre within the ES.
Dartford Borough Council	The Council notes that a floating pontoon is proposed to serve Thames Clipper, which will extend from Bells Wharf towards Ingress Park (a waterfront residential development). As noise cannot be attenuated well over water this should be assessed in detail with regard to the impact on the adjacent existing dwellings as well as the new residential development (with a resolution to grant planning permission subject to a legal agreement) which will extend over the foreshore on a pier structure.	The Noise and Vibration Assessment includes modelling of the noise from vessels using the floating pontoon. This noise is assessed for both northern and southern banks of the river within the ES.
Dartford Borough Council	There is no assessment of residential receptors near infrastructure buildings, particularly those buildings proposed to the rear of Swanscombe High Street.	The London Resort infrastructure compounds are assessed in the ES and given plant noise breakout limits. In line with BS 4142:2014+A12019, the aim is to attain a noise level 10dB below the existing background noise environment at the nearby residential Noise Sensitive Receptors (NSRs).
Gravesham Borough Council	As with Air Quality this is a topic area where a technical meeting has been requested by the applicant. Accordingly, the comments here are general and limited since more detailed	The Noise and Vibration Assessment was discussed with GBC on the 23rd October 2020 [which was subsequent to the GBC consultation comments].

Consultee	Comment	Response
	input will come through the more detailed technical engagement.	
Gravesham Borough Council	The site will require a considerable amount of construction activity, which with Gate 2 will run along with the operation of Gate 1. A comprehensive code of construction practice hours of the operation of the resort, shielding of equipment etc. will be required to minimise the implications especially for any nearby residential properties. The applicant should investigate if there are any noise sensitive businesses in the vicinity.	The impact of construction noise and vibration from both Gate 1 and Gate 2 construction are considered in Appendix 15.3 assessments. A map of noise sensitive receptors are included in the assessment
Gravesham Borough Council	Appreciating the difficulties of doing this it is important that an illustrative construction programme is produced to understand how various operations may fit together. This has to include construction traffic routing which to start with at least can only use existing infrastructure until a route can be provided along the future access road alignment. Piling will be a particular concern in relation to vibration. Past experience has shown that vibration transmission through chalk can produce unpredictable impacts. On the Gravesham side at least, it is known the underlying chalk dips steeply downwards towards the river in the vicinity of Stonebridge Road. Understanding the chalk/alluvium boundary across the entire site has implications for depth of piling and therefore the noise impacts.	The assessment of construction noise and vibration has been considered in stages mirroring the anticipated construction staged plan. Appendix 15.3 (document reference 6.2.15.3) provides a worst-case noise impact assessment from piling activities; a further assessment of construction activities will be conducted when the equipment and method is ascertained. Flight auger piling is expected due to ground condition (rather than impact / percussive / vibro-percussive) this would provide reduced vibration levels and impact.
Gravesham Borough Council	The operation of the Resort gives rise to traffic and related noise implications for which methodologies are well established. Traffic modelling results are needed before this traffic element can be analysed. The operation of the resort will however produce its own noise profile and it is noted that the	The points raised have been included in the Noise and Vibration Assessment. The context and setting of the Europa Park measurements are given in the ES.

Consultee	Comment	Response
	chapter makes references to screams for example. It is proposed to use Europa Park as a comparator and it will be necessary to explain clearly factors such a setting, degree of containment of rides etc. may influence the results. It is not clear at this stage to what degree in the Resort noise making activities will be inside buildings, though the latter will give rise to noise (plant and machinery) in their own right.	
Ebbsfleet Development Corporation	This is a large site and construction is identified over 6 main phases covering a long timeframe. Each of the six phases identified in paragraph 15.70 should be assessed rather than just 2020, 2038 and 2 "slice years", with effects during each phase considered against the receptors anticipated at that phase. For example, the impact upon the operation of Gate 1 of Gate 2 being constructed should be assessed. It is accepted that this was not possible in the PEIR but by the time of the ES this information should be available and where each phase is not considered justification should be given.	Rather than evaluating just 2020 and 2038 construction years, the ES is considering the multiple construction phases and locations around the Kent and Essex Project Sites.
Ebbsfleet Development Corporation	It is accepted that noise from screams would be dominant relative to the attractions, however, these would be impulsive with periods in between where screaming was not happening but "mechanical" noise from the rides may be apparent. There is no reason why in the noise model should not also include engines, gearboxes and other static noise generating equipment to consider the "whole" noise of the ride – the static plant aspect of the rides is being largely ignored in the methodology proposed. As such the methodology proposed to consider	LA,max,f and LAeq,T sound pressure levels from the operation of the London Resort rides are considered in the ES, respectively assessing peaks caused by 'screams', and the other noise periods dominated by mechanical noise (e.g. the typical clanking sound caused by rides moving to higher altitudes).

Consultee	Comment	Response
	scream noise as Lmax levels is accepted, however, the whole noise from the ride (screams, mechanical etc) should also be considered in the ES against an accepted time base. Paragraph 15.86 notes that noise from cheers, shouts and music generated by the proposed rides will be dependent to some degree on the final selection and design of the facilities, their placement and orientation on site. As the applicant notes in chapter 1 of the PEIR the parameters for the proposed development should be sufficiently detailed to enable a proper assessment of the likely significant environmental effects, in line with Advice Note Nine: Using the Rochdale Envelope issued by PINS (July 2018, v3) and should be on a worst case scenario basis (as noted in paragraph 15.69 in relation to construction uncertainties.)	
Ebbsfleet Development Corporation	The park is likely to operate amplified music to some degree on all open days, this is likely to be vastly in excess of 12 days per year. As such we do not agree that LA90 +15dB would be acceptable based upon the likely number of events and open days per year at the resort. The implementation of a limit of this nature is highly likely to result in complaints and be unacceptable to local residents. The LPA would be unlikely to accept this as a limit based upon the number of occurrences likely to be associated with the resort and therefore alternative limits for activity noise should be considered based upon the a much higher number of operational days per year.	Noise level limits due to external amplified noise sources have been revised in the ES based on a sound propagation assessment.
Ebbsfleet Development Corporation	Confirmation necessary as to whether this map is just vehicles accessing the car park or if it includes consideration of noise generated within the carpark.	Carpark noise is considered in the ES within the operational traffic assessments in the Kent and Essex Project Sites (in Appendix 15.4).

Consultee	Comment	Response
	The only aspect of the resort on the north side of the River Thames is the car park and as such the impacts of this need to be fully considered including noise from the actual car park usage and not just vehicles accessing the facility.	Noise sources have been modelled as area sources that breakout of the Kent and Essex Project Site parking areas.
Ebbsfleet Development Corporation	The plan would have benefitted from a clearer identification of where receptors are to consider the noise contours and the levels at these receptors to corroborate the conclusions presented in the following text. The contours are limited to Lmax levels associated with screams. We would also consider that LAeq,T noise from the site should be considered accounting for time corrected screams and mechanical noise from rides as well as noise associated with collections of people and piped music. Whilst we accept that this would require some lateral thinking to achieve, it is possible and should be undertaken to fully consider activity noise within the park and not to unduly dismiss what could be significant cumulative noise at the nearest sensitive receptors	LA,max,f and LAeq,T sound pressure levels from the operation of the London Resort Gate 1 and Gate 2 rides and attractions are considered in the ES (detailed in Appendix 15.4). A map of noise sensitive receptors (in Figure 15.1) has been produced to benefit clarity of the NSRs under consideration in the Kent and Essex Project Sites.
Marine Management Organisation	Chapter 13 sets out the cumulative and in-combination effects of the project. Section 13.216 refers to underwater noise and vibration effects, particularly plans/projects which involve piling activity could have cumulative effects on fish and marine mammals. The MMO would expect to see modelling of this noise. Similarly, 13.217 refers to dredging activity. Again, the MMO would expect to see modelling of these effects.	Consideration of underwater noise is not included in the Noise and Vibration assessment. A worst-case noise impact assessment from piling activities is reported in Appendix 15.3. Flight auger (rather than impact / percussive / vibro-percussive) piling would reduce the underwater noise impact. The ES has provided a noise model assessment of the impact of dredging activities. Appendix 15.1 contains the noise survey study.

Consultee	Comment	Response
Marine Management Organisation	The MMO is encouraged by the information provided regarding underwater noise/vibration and the effect that this is expected to have upon fish but would expect to see modelling to support this. Further the MMO acknowledges that information regarding the potential effect of underwater noise arising from piling and dredging activity and vessel use on sensitive marine receptors within the River Thames has been expanded since the scoping report. As above the MMO expect to see a robust consideration of our points supported by evidence.	The impacts of the noise assessments within this Chapter on Flora and Fauna is further assessed in the Terrestrial Ecology and Biodiversity chapter (Chapter 12) of the ES (document reference 6.1.12).
Marine Management Organisation	Section 15.115 refers to additional assessment areas that will be investigated in the Environmental Statement (ES). However, this does not fully satisfy the concern raised in the scoping response dated 20 July 2020 which outlined that the MMO expect to see robust evidence as to whether underwater noise is likely to propagate across the width of the estuary and cause an acoustic 'barrier' to fish movement and migration.	
Marine Management Organisation	An underwater noise assessment should be presented, using appropriate unweighted metrics, which should use either modelling or case studies of a similar nature to support conclusions made on the likelihood and significance of impact.	
Marine Management Organisation	The various hearing capabilities of those fish species that will be spawning near to, or migrating past the site, during the months/weeks that piling will be taking place should be considered. Please refer to Popper et al. (2014) for guidelines on the classification of fish into four categories	

Consultee	Comment	Response
	based on the presence/absence of a swim bladder, and for appropriate assessment of the potential impacts of noise on fish including injury, mortality and behavioural impacts.	
Marine Management Organisation	An estimate of the duration for the installation of each pile and the month/s in which piling, and dredging will be carried out should be outlined in the ES. This should discuss the timing of piling and dredging works in relation to the sensitive spawning and migration periods of tidal Thames fish to determine whether the mitigation measures described in the supporting information will be adequate.	This level of detail into the construction and piling methods for the Proposed Development are not yet available for the project. Due to this, construction noise assessments in Appendix 15.3 investigate the noise impact from worst-case construction noise sources (using BS 5228-1:2009+A1:2014 ABC methodology and sound power level data). Appendix 15.4 contains and assessment of low frequency noise propagation from dredging work on the Proposed Development locations.
Marine Management Organisation	The MMO notes that this chapter includes details regarding methodology to assess cumulative impacts, in-combination effects, and consultation. As outlined in section 2 of this response the MMO would expect to see modelling of the predicted noise, vibration and sediment plumes	Construction noise from London Resort is assessed in Appendix 15.3 (document reference 6.2.15.3).
Environment Agency	The noise measurements being taken have not considered ecological receptors and have only taken into account human features of the surrounding area. There is no baseline data from along the River Thames, or from the proposed retained area of Botany Marshes, close to the actual development site. It is only assessed on its eastern edge adjacent to the industrial area. The vibrational impact of any construction work close or in	The suggestions from the EA are included in the Noise and Vibration Assessment within this ES chapter. The noise impact of London Resort construction and operation on sites of Ecological and Biodiversity are provided within the Chapter. The impact on Flora and Fauna is further assessed in Chapter 10 of the ES. Baseline noise climate measurements have been conducted at 21 monitoring

Consultee	Comment	Response
	Black Duck Marsh will need to be considered. Proposed mitigation will need to factor in ecology.	locations. The data and notes from the surveys used for ES assessments are detailed in Appendix 15.3 (document reference 6.2.15.3).
Natural England	Swanscombe Marine Conservation Zone Natural England welcomes the proposed use of soft-start piling and vibro-piling methods, and piling at low tide to reduce noise levels in the marine environment.	Consideration of underwater noise is not included in the Noise and Vibration assessment. Flight auger (rather than impact / percussive / vibro-percussive) would minimise the underwater noise impact. The noise associated with dredger movements is included in the operational assessments (see Appendix 15.4).
High Speed 1	Demonstrate that noise from the railway is not increased by the LRCH proposals.	Railway noise is included in the Noise and Vibration assessment and within this ES chapter. SEL data was collected for the local trains as detailed in Appendix 15.1.
High Speed 1	Construction activities and the permanent solution for resort and transport link should not create any noise, fumes or other air quality issues for travelling public or for safe operation of stations and railway assets.	The assessment for noise and vibration can be found in Chapter 15 of the ES (document reference 6.1.15) and air quality in Chapter 16 of the ES (document reference 6.1.16).

15.15 A meeting was held with representatives from Dartford Borough Council, Gravesham Borough Council and Ebbsfleet Development Corporation on Friday 23rd October 2020. This meeting was led by the consultant team undertaking the noise and vibration assessment.

15.16 The aim of the meeting with local authority representatives was to outline and discuss the noise assessments being conducted within the ES. Against scoping opinion comments in tables 15.1 and 15.2, session objectives included: confirming baseline survey locations, noise sensitive receptor considerations and the suitability of the proposed operational and construction noise assessment scope and methodologies (including the agreement of assessment criteria and NSR groups).

15.17 The following responses provide a summary of the approach to the assessment within this ES, addressing the queries and concerns raised by Local Authority representatives:

- Mechanical noise considerations were confirmed for the ride noise assessments. Car park noise has been incorporated in operational traffic assessments.

- CadnaA® noise modelling software is used to understand the propagation of sound over the Thames. In-situ measurements have been collected to conduct a noise breakout assessment of the key noise features from passenger ferry transport vehicles.

- In response to a query about the potential wind effects on noise propagation across the Project Site to noise sensitive receptors, the effects of wind have been evaluated within this ES.

- CadnaA® 2019 software was considered for the sound propagation assessments. The software is considered suitable, calculating 3-Dimensional sound propagation to ISO 9613 methodology. The 3D element is key to the ride noise propagation assessments with point sources placed at heights (e.g. ride peaks) where screams are anticipated to originate from. Moving point sources were discussed, however the lack of ride design information is likely to prevent this type of assessment methodology for the ES.

- The limitations of basing traffic noise impact significance on DMRB guidance is recognised. The operational traffic noise impact assessment in the ES is based on a +1dB noise level increase opposed to the less stringent targets within the DMRB.

Assessment Approach

15.18 This ES chapter has been undertaken in accordance with best practice and has been informed by the guidance documentation described in the Section "Relevant Law, Policy and Guidance" within this chapter.

15.19 The assessment methodologies include:

- Baseline noise and vibration climate study

    - Environmental noise and vibration surveys undertaken around the Kent and Essex Project Sites to understand the existing $L_{Aeq,t}$, $L_{A90,t}$, $L_{A10,T}$ and $L_{Af,max}$ noise climate (Description and measurement of environmental noise in BS 7445-1, 2003 and Guide to Evaluation of Human Exposure to Vibration in Building in BS 6472); and

    - Review of noise sensitive receptors around the Kent and Essex Project Sites.

    - The measurement locations, data and survey notes are detailed in Appendix 15.1.

- Construction noise environmental impacts

- Construction noise prediction methodology (ABC method of BS 5229-1:2009+A1:2014);
- Construction noise significance (Annex E of BS 5228-1:2009 + A1:2014); and
- Construction traffic noise prediction methodology (Design Manual for Roads and Bridges, 2011).

- Operational noise environmental impacts
  - Traffic noise prediction methodology (Design Manual for Roads and Bridges, 2011);
  - Internal and external noise criteria from external noise sources (BS 8233:2014 and the World Health Organisation's "guidelines for community noise", 1999);
  - Mechanical plant and equipment prediction method (BS 4142:2014+A1:2019);
  - Noise from external events with amplified music and speech (The 1995 Code of Practice on Environmental Noise at Concerts);
  - Ride noise impact prediction methodology (Threshold of community audibility taken to be 5dB below the measurement $L_{A90,t}$ background noise environment);
  - Passenger ferry noise impact prediction methodology (BS 8233:2014); and
  - Twin-engine helicopter noise. (Civil Aviation Authority, Aviation Noise & Health, c2015).

15.20 The methodology for assessing the significance of effect is based on the sensitivity of the receptor and the numerical difference between the baseline level and predicted level.

15.21 The assessment of traffic noise is based on data obtained by the applicant. The applicant cannot take responsibility for the accuracy or reliability of the data that is used to investigate future traffic flow scenarios.

Noise modelling methodology

CadnaA® prediction software

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

15.23 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.

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

- The ground conditions in and around the Kent and Essex Project Sites were found to consist of roads, residential houses, and green spaces (e.g. Swanscombe Marshes and external residential amenity spaces) therefore the ground has been modelled as semisoft with a ground absorption coefficient of 0.5. This value is altered to 0 for specific assessments focused on the propagation of noise over the River Thames (more suitable modelling approach for the high reflectivity of water);
- 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

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

15.26 This uncertainty has been reduced by cross-referencing the levels of predicted noise impact against the spot measurements captured around the Kent and Essex Project Sites.

15.27 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 have been 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.

Assessment of Effects

15.28 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

15.29 A summary of the prediction methodologies used within this ES chapter is presented in Table 15.5.

Table 15.5: 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	BS 8233 and WHO

Receptor sensitivity

15.30 The criteria used to assess receptor sensitivity is described in Table 15.6.

Table 15.6: 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: Residential properties, hospitals, care homes, hotels, schools, universities, research facilities, national parks.
Moderate	The receptor has moderate capacity to absorb change without significantly altering its present character, or it is of high importance. Examples: Offices, shops, outdoor amenity spaces (e.g. parks and gardens), long distance footpaths, doctor surgeries, sport facilities, places of worship.
Low	The receptor is tolerant to change without detriment to its character, or it is of low or local importance. Examples: Warehouses, light industry, car parks, agricultural land.
Negligible	Heavy industry, motorways and railway line.

15.31 For the assessment of the Proposed Development, only high sensitivity receptors have been assessed, to identify the worst-case impacts.

Magnitude of change / impact

15.32 The criteria used to assess how far an effect deviates from the baseline condition, i.e. the magnitude of change, are described in Table 15.7.

Table 15.7: Criteria for determining the magnitude of change / impact at sensitive receptors

Magnitude	Criteria
Large	Total loss or major / substantial alteration to key elements/features of the baseline (pre-development) conditions such that the post development character / composition / attributes will be fundamentally changed.
Medium	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character / composition / attributes of the baseline will be materially changed.
Small	A minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible / detectable but not material. The underlying character / composition / attributes of the baseline condition will be similar to the pre-development circumstances/situation.
Negligible	Very little change from baseline conditions. Change barely distinguishable, approximating to a 'no change' situation.

15.33 Table 15.8 presents a summary of the quantitative criteria used to assess the magnitude of impact of each assessment.

Table 15.8: Summary of criteria for determining the magnitude of impact at sensitive receptors

Magnitude	Criteria
Large	Construction noise: +10 dB > Assessment category Construction vibration on humans: 10 $mm \cdot s^{-1}$ Peak Particle Velocity (PPV) Construction vibration on buildings: Reinforced or framed structures / Industrial and heavy commercial buildings: • Greater than 200 mm/s (millimetres per second) at 4 Hz (hertz) 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 Traffic (Long-term): 10 dB or more - $L_{A10,18hr}$ noise change Operational Building Services: +10 dB or more

Magnitude	Criteria
Medium	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
Small	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 • 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

Magnitude	Criteria
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 evaluation

15.34 The significance of a potential effect is derived by considering both the sensitivity of the feature and the magnitude of change, as demonstrated in Table 15.9.

Table 15.9: Matrix for determining the significance of effects

		Magnitude of change / impact			
		Large	**Medium**	**Small**	**Negligible**
Receptor sensitivity	**High**	Major	Major	Moderate/Minor	Negligible
	Moderate	Major	Moderate	Minor	Negligible

	Low	Moderate/Minor	Minor	Minor	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

15.35 Note that moderate and major effects are considered to be 'significant'.

15.36 Moderate / minor effect cells will be evaluated by professional judgement on a case-by-case basis to determine the suitable level of significance.

15.37 Effects can also be described, for example, as:

- Beneficial or adverse;
- Permanent or reversible;
- Short, medium or long term; and
- Significant (major or substantial) or insignificant (indiscernible or minor).

15.38 The significance of noise and vibration effects have also been assessed in the light of the Human Health impacts (see Chapter 8 of the ES, document reference 6.1.8) and Terrestrial and Freshwater Ecology & Biodiversity impacts (Chapter 12 of the ES, document reference 6.1.12).

RELEVANT LAW, POLICY AND GUIDANCE

15.39 The relevant law, policy and best practice guidance that has been taken into account when undertaking the EIA noise and vibration assessments for the Proposed Development is outlined below. A more detailed review of the Planning Policy and Technical Guidance is provided in Appendix 15.2 (document reference 6.2.15.2).

National Policy Statements

15.40 National Policy Statements (NPS) set out the need for government's policies to deliver Nationally Significant Infrastructure Projects (NSIPs) in England. Chapter five of this ES 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); and

- Noise and vibration (NPS paragraphs 5.186 – 5.200).

Other National Law and Policy

15.41 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;

- The National Planning Policy Framework 2019;

- The Noise Policy Statement for England 2010; and

- National Planning Practice Guidance on Noise 2014 (as updated).

Technical Guidance and Best Practice Documents

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

- British Standard BS4142:2014+A1:2019, 'Methods for rating industrial noise affecting mixed residential and industrial areas';

- 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';

- British Standard BS6472-1:2008 Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting;

- British Standard BS7445-1:2003, 'Description and measurement of environmental noise. Guide for quantities and procedures';

- British Standard BS8233:2014 'Guidance on sound insulation and noise reduction for buildings';

- Calculation of Road Traffic Noise (CRTN), Department of Transport, 1988;

- Design Manual for Roads and Bridges (DMRB), LA111, 2020, 'Noise and vibration';
- Institute of Environmental Management & Assessment (IEMA) Guidance Note No. 1, 'Guidance for the environmental assessment of road traffic', 1993;
- Representation Statement of Network Rail (High Speed) & High Speed 1 Asset Protection, Response to Stage 4 Planning Consultation, June 2015;
- World Health Organisation, 'Guidelines for community noise', 1999; and
- World Health Organisation, 'Night noise guidelines for Europe', 2009.

Local Policies and Plans

15.43 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; and
- Thurrock Core Strategies and Policies for Management of Development adopted January 2015.

Guidance Criteria for Operational and Construction Noise Impact Assessment

BS 5228-1:2009+A1:2014, Construction noise significance and target

15.44 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.

15.45 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 15.10.

Table 15.10: 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.

15.46 Throughout this assessment, the term 'daytime' has been used to describe a single assessment for the entire operating hours of the development being 07:00-23:00 therefore including daytime, evening but not night-time hours.

BS 4142:2014+A1:2019, Operational building services noise

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

15.48 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 receptor and the context in which the sound occurs.

15.49 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.

15.50 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 be out in Table 15.8, based on the type and impact of the features. BS 4142:2014+A1:2019.

Operational noise from external event spaces

15.51 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 15.11):

Table 15.11: External event music noise level guidance (Source: 15.53 The Code of Practice on Environmental Noise at Concerts, 1995).

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

15.52 The London Resort is likely to hold significantly more events than the 4 to 12 guidance criteria in Table 15.10. Due to this, it is more suitable to control the noise level from loudspeaker sound systems to levels below the existing background noise level at NSRs (0 dB exceedance over a 15minute period). Aiming for negligible audibility against the background noise should minimise potential annoyance or disturbance at nearby residential areas due to the Resort events.

15.53 The potential for external loudspeakers to exceed this target is assessed within this ES.

BS 8233:2014 and WHO indoor and outdoor noise level guidance criteria

15.54 Table 15.12 has been taken from Table 1 of the WHO Guidelines for Community Noise, 1999 document. It provides guidance for suitable indoor and outdoor ambient noise levels for dwellings during the daytime (07:00-23:00). The levels shown are in line with current BS 8233:2014 criteria.

Table 15.12: Indoor and Outdoor noise level guidance criteria for dwellings (Source: BS 8233:2014 and WHO, 1999).

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	-

15.55 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).

15.56 Table 15.12 includes hotels and other residential premises within the limits of the Proposed Development

BASELINE CONDITIONS

15.57 This section details the baseline Kent and Essex Project Sites in relation to noise and vibration.

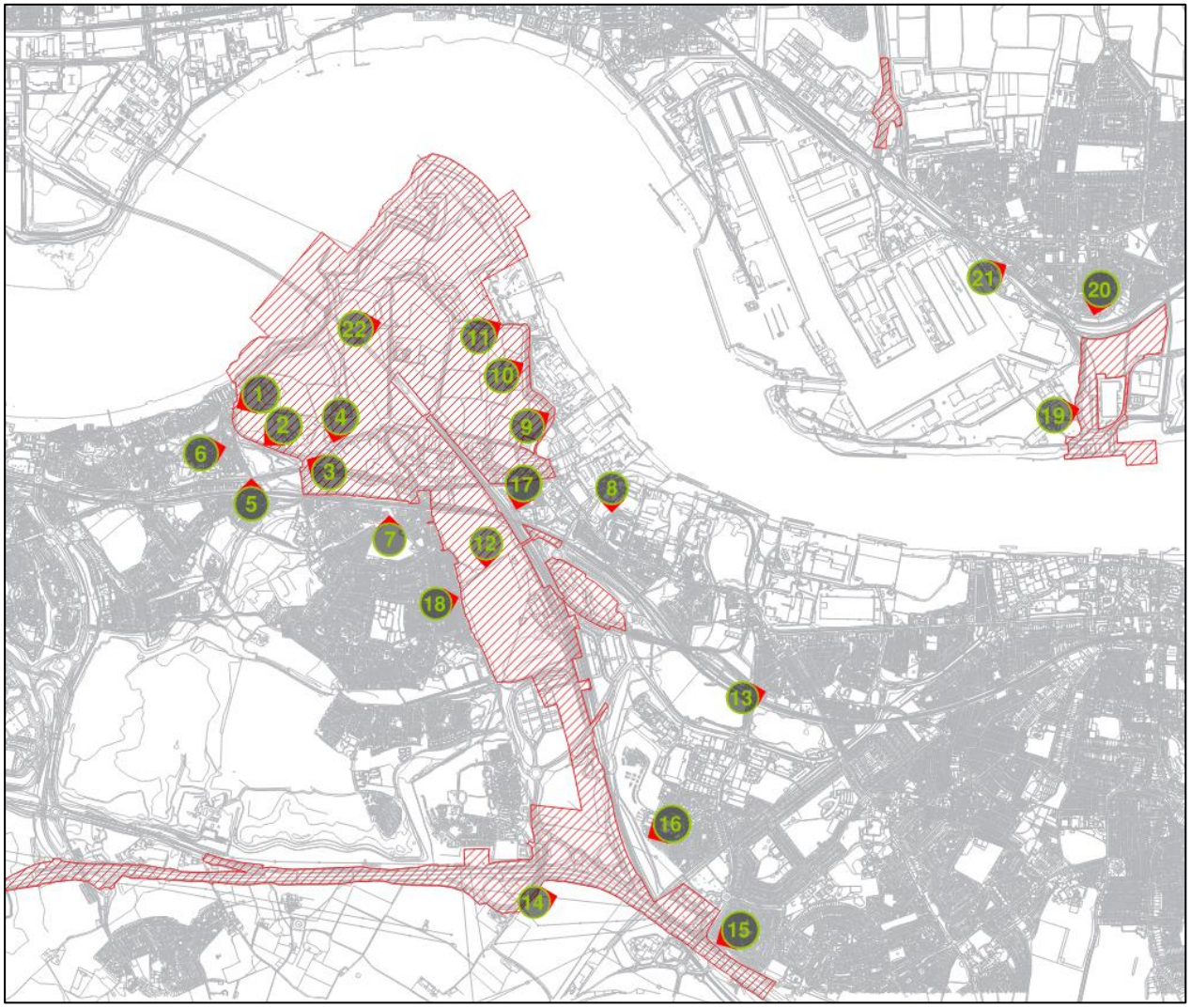
Noise and vibration surveys

15.58 Between December 2014 and October 2020, multiple noise surveys were conducted in and around the Kent and Essex Project Sites to establish the baseline ambient noise levels around the Proposed Development.

15.59 Results from surveys in 2014 and 2015 are considered to still be valid given that the area is not considered to have experienced changes which would dramatically impact the noise climate.

15.60 The monitoring locations and results are detailed Appendix 15.1. Diagram 15.1 illustrates the assessment locations.

Diagram 15.1: Illustration of noise and vibration survey locations around the Kent and Essex Project Site DCO limits



15.61 The measurements were conducted using Class A sound level meters, which were calibrated before and after the measurements. No significant drift was observed.

15.62 The measurements were conducted with the microphone(s) positioned on a tripod and located approximately 1.5 m above ground level. Weather conditions during the surveys were dry, with temperature between approx. 10 and 26˚C, and wind speeds up to 5m/s (occasional gust).

15.63 The desktop assessment within this ES has used the ambient noise levels from the environmental surveys to create a 3D noise model of the Kent and Essex Project Sites.

15.64 The weather conditions for the noise surveys were within the limits provided within the environmental noise survey standard BS 7445-1:2003.

15.65 The noise survey methodology adopted complies with the requirements of BS 7445-1:2003.

15.66 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.

15.67 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).
- Sources of industrial noise around the manorway business park (due to be removed on the development of London Resort).

15.68 The baseline noise and vibration environment in and around the Essex Project Site was noted on-site to include contributions from the following sources:

- Industrial noise and vibration from activities in the port of Tilbury.
- Local industrial noise and vibration sources from scrapyard and metal work businesses operating along Dock Road.
- Road traffic noise from the A1089 (noted to be a route for lorries travelling to and from the port).
- Rail traffic noise and vibration operating at and through the Tilbury Town train station.

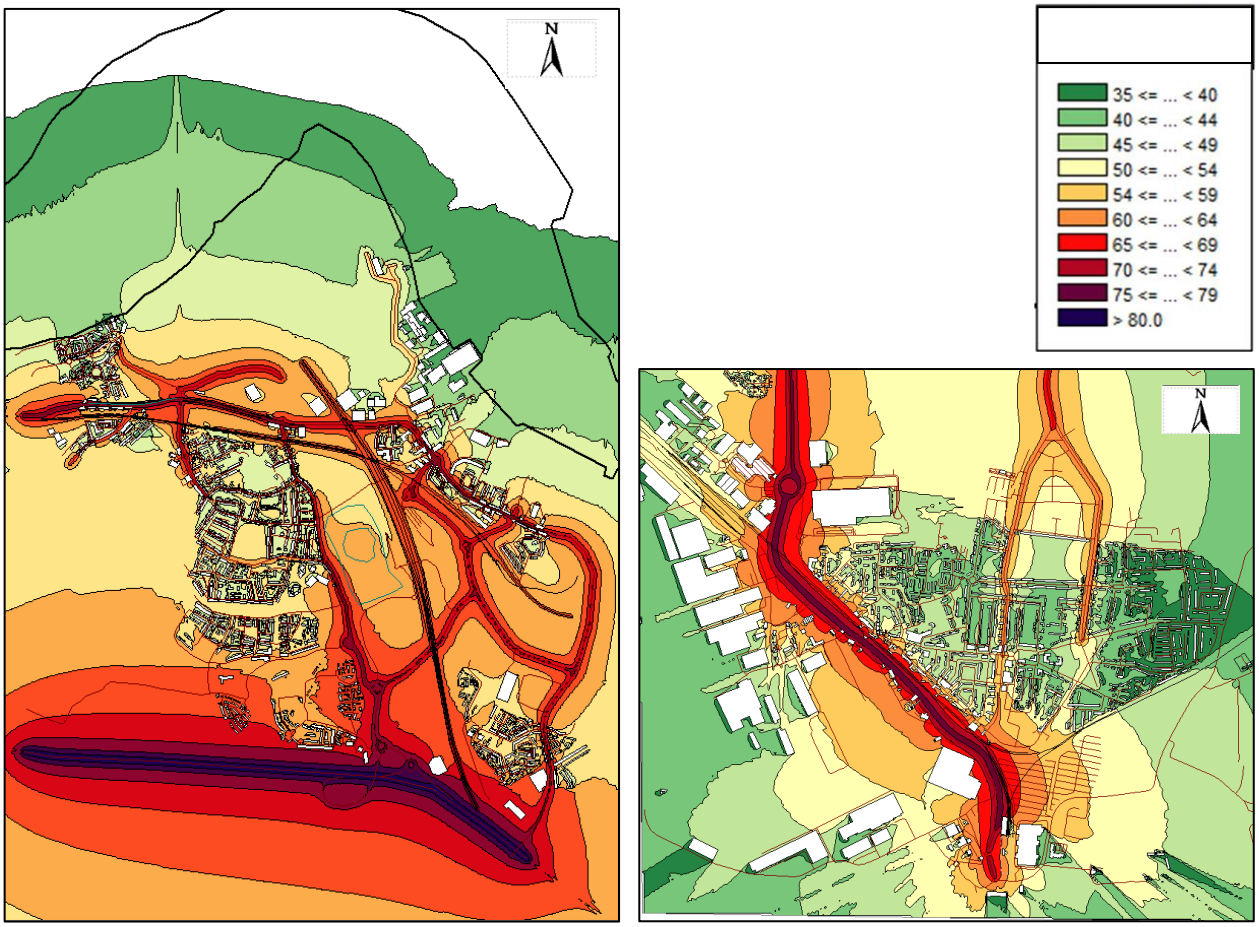
15.69 At each noise survey location conducted in the Kent and Essex Project Sites there was found to be no evidence of tactile vibration due to road traffic or other sources during the site visits.

15.70 As such, vibration is not considered to be a significant issue at either the Kent or Essex Project Sites, in the elements of the Proposed Development that comprise the erection of buildings.

15.71 There is, in addition, the potential for impact on marine life due to construction vibration created on land transmitting to underwater noise. Therefore, the river Thames is an NSR itself.

15.72 Diagram 15.2 shows the modelling results for the typical noise climate that currently exists around the Kent and Essex Project Sites in terms of $L_{Aeq,18hour.}$ This, and other baseline models, have been calibrated to reproduce the results of noise surveys at each of the noise survey locations in the model.

Diagram 15.2: Calculated daytime (07:00-23:00) levels LAeq,18hr dB(A) for the area surrounding the Kent (Left) and Essex (right) Project Sites. Models calibrated to baseline noise survey and transport consultant traffic movement data.



Noise survey instrumentation

15.73 The noise survey measurements 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.

15.74 The meters were programmed to log various noise parameters, including L_{Aeq}, L_{Amax}, L_{A90} and L_{A10} at each measurement location. The measurement periods were selected to represent typical weekday daytime (07:00-23:00) noise levels.

15.75 Appendix 15.1 provides a full table of the instrumentation used during the noise surveys.

15.76 The instrumentation used was calibrated by UKAS-approved laboratories in accordance with the required schedule of frequency. It is, however, noted that the degree of measurement tolerance of most Type 1 sound level analysers is approximately 1-2 dB,

meaning that two independently verified meters could measure the same sound level and report marginally differing values.

15.77 There is little that can realistically be done to avoid this phenomenon; however, this supports the assertion that professional judgement must be used in concert with quantitative values when making conclusions in support of the assessment.

Site Description

15.78 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.

15.79 The Essex Project Site is bounded by the following:

North

- Tilbury Town residential development;

East

- Riverside business centre;
- Tilbury fort; and

- Port of Tilbury London - Tilbury2.

South

- The River Thames.

West

- Tilbury docks; and
- Industrial development.

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

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

Table 15.13: Kent and Essex Project Site education and research facility NSRs

Kent Project Site NSRs	Essex Project Site NSRs
Knockhall's Early Birds Nursery and Primary School	Lansdowne Primary Academy
Springfield Lodge Day Nursery	St Mary's RC Primary
The Crayland's School	Olive AP Academy
Cygnets Preschool	Helping Hands Day Nursery
Saplings Nursery	Little Pirates Nursery
Manor Community Primary School	Tilbury Children's Centre
Ebbsfleet Academy	Tilbury Manor Junior School and Pioneer 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	
Lawn Community Primary	

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

Table 15.14: Kent and Essex Project Site healthcare and care-home facility NSRs

Kent Project Site NSRs	Essex Project Site NSRs
Swanscombe Health Clinic	Abbey Healthcare
Swanscombe Health Centre	BS Care Management
Eastgate Counselling	The Shehadeh Medical Centre
Kesson House Care Home	Tilbury Health Centre
Blue Care Facilities	

15.83 In addition to the NSRs identified above, sensitive receptors are located where noise and vibration has the potential to have a negative impact on wildlife or ecologically sensitive sites.

15.84 The Terrestrial Ecology and Biodiversity assessment in Chapter 10 of the ES, identifies the Ecological Sites of Special Scientific Interest (SSSIs) around the Kent and Essex Project Site. The potential noise impact on these receptors shown in Table 12.10 are assessed within this Chapter.

ASSESSMENT OF LIKELY SIGNIFICANT EFFECTS

Construction Effects

Relevant aspects of the Proposed Development

15.85 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. Likewise, ground-borne vibration, if of sufficient magnitude, can lead to human disturbance and/or (more rarely) building damage.

15.86 Some of the existing noise sensitive receptors which have already been identified are located in close proximity to the boundaries of the different construction sites; the residential areas being the ones more prone to suffer from construction disturbances. These impacts will be greatest during early stages of the project, for example during groundworks, sub and superstructure work of the development. The project will be split into a number of sections and delivered in phases (as of the Projects Construction Method Statement), which will help to minimise the impact of construction on the local environment.

15.87 A construction vibration assessment has been undertaken for receptors within 30m of the construction sites boundaries. This is detailed in Appendix 15.3 (document reference 6.2.15.3).

15.88 The construction phases and groupings of NSRs used in construction noise assessments are shown in Figure 15.2.

Potential noise impacts of construction and the significance

15.89 Based on the predicted noise levels from construction (found in Appendix 15.3), the significance of effect from construction noise at each identified NSR is summarised in Table 15.15, Table 15.16 and Table 15.17. It should be noted that these significances are based on un-mitigated noise levels with no hoardings around the perimeter of the Project Site. This is therefore representative of a worst-case scenario.

Table 15.15: Significance of effect due to the construction of Gates 1 and 2 (Kent Project Site)

Noise Sensitive Receptor	Gate 1 Earthworks	Gate 1 General Construction	Gate 2 Earthworks	Gate 2 General Construction
1	Negligible	Negligible	Minor adverse	Major adverse
2	Negligible	Negligible	Negligible	Negligible
3	Negligible	Negligible	Negligible	Negligible
4	Negligible	Negligible	Negligible	Negligible
5	Negligible	Negligible	Negligible	Negligible
6	Negligible	Negligible	Negligible	Negligible
7	Negligible	Negligible	Negligible	Negligible

Table 15.16: Significance of effect due to the construction of the Hotel, new access road and plant compound (Kent Project Site)

Noise Sensitive Receptor	Hotel Earthworks	Hotel General Construction	Access Road Earthworks	Access Road General Construction	Plant Compound Paving
1	Negligible	Negligible	Negligible	Negligible	Negligible
2	Negligible	Minor adverse	Negligible	Negligible	Negligible
3	Negligible	Negligible	Negligible	Negligible	Negligible
4	Negligible	Negligible	Negligible	Negligible	Negligible
5	Negligible	Negligible	Negligible	Negligible	Negligible
6	Negligible	Negligible	Negligible	Negligible	Negligible
7	Negligible	Negligible	Negligible	Negligible	Negligible

Table 15.17: Significance of effect due to the construction of a car park at the Essex Project Site

Noise Sensitive Receptor	Car Park Earthworks	Car Park General Construction
8	Negligible	Negligible

Effect of Wind on Propagation of Construction Noise

15.90 The effect of winds on the noise impact of construction noise for the NSRs to the north across the Thames in Essex has been assessed.

15.91 Construction activity for Gate 1 is the furthest to the north and has the likelihood to have the most significance of effect on NSR 7 (group shown in Figure 15-4). Therefore, General construction activities has been modelled with and without the effects of winds, including both southerly and northerly winds.

Table 15.18: Construction noise assessment – Gate 1 – General construction

NSR #	Ambient LAeq noise level due to construction noise– dB(A)			Magnitude of impact	Significance of effect
	No wind	Prevailing Southerly winds	Occasional Northerly winds		
7	46	46	38	Negligible	Negligible

15.92 Table 15.18 shows that southerly winds do not increase the estimated construction noise at NSR 7, and that northerly winds decrease noise levels due to construction; this results in a negligible effect.

Potential ground-borne vibration impacts of construction and the significance

15.93 Ground-borne vibration from construction activities is assessed for human response and effects on nearby buildings.

15.94 In the absence of highly detailed information regarding the proposed construction activities and plant/equipment (see the Construction Method Statement), 'worst case' assumptions have been made in this assessment.

15.95 Vibration levels of typical plant and equipment have been extrapolated from BS 5228-2 and CALTRAN Standard Plans 2004. Using empirical prediction formulas contained in BS 5228-2:2009, the vibration level can be predicted at the nearest affected vibration sensitive receptor.

15.96 Table 15.19 identifies the reference peak particle velocity (PPV, $mm.s^{-1}$) for each type of equipment that produces ground-borne vibration that is of significance. The predicted PPV level at 25 metres from the Kent Project Site boundary is also provided (this is the approximate distance of potential plant locations to the nearest receptor, NSR 1). The magnitude of impact from construction vibration at the closest NSR is summarised in the last two columns of this same table.

Table 15.19: Reference and estimated PPV–Significance of effect from construction vibration exposure at 25 m from Kent Project Site boundary (NSR 1)

Construction activity	Equipment	Reference PPV at 7.6 m -mm/s	Estimated PPV at 25 m from site boundary - mm/s	Magnitude of impact for exposure to humans	Magnitude of impact on buildings
Site preparation and excavation	Vibratory roller	5.33	1.14	Medium	Negligible
	Large bulldozer	2.26	0.48	Small	Negligible
	Hydraulic breakers	6.10	1.30	Medium	Negligible
	Jackhammer	0.89	0.19	Negligible	Negligible
Piling	Rotary bored piling	BS5228-2:2009 (ref 104)	0.02	No change	Negligible
Other	Loaded trucks	1.93	0.41	Small	Negligible

15.97 As presented in Table 15.19, exposure to humans from construction vibration range from small to medium magnitude of impact. This is based on a typical selection of construction plant and equipment assessed at the boundary of the Kent Project Site (at the location nearest to sensitive receptors). No significant effects due to construction vibration are expected at sensitive receptors located more than 30 m away from the site boundary given that it is assumed that the vibration caused by construction activities can be controlled through an environmental management plan.

15.98 The significance of effect of vibration exposure to humans at the identified NSRs (as identified on Figure 15.1) are presented in Table 15.20 below.

Table 15.20: Significance of effect – Vibration exposure to humans

NSR	Receptor sensitivity	Distance to site boundary	Construction phase	Magnitude of impact	Significance of effect
NSR 1	High	25 m	Site preparation and excavation	Medium	Minor adverse
			Piling	Negligible	Negligible
			Other	Small	Minor adverse
NSR 2	High	40 m	Site preparation and excavation	Small	Minor adverse
			Piling	Negligible	Negligible
			Other	Negligible	Negligible
NSR 3 - 8	High	>95 m	Site preparation and excavation	Negligible	Negligible
			Piling	Negligible	Negligible

NSR	Receptor sensitivity	Distance to site boundary	Construction phase	Magnitude of impact	Significance of effect
			Other	Negligible	Negligible

15.99 Table 15.20 shows a significance of effect of up to minor adverse at highly sensitive receptors located less than 40 m from the Kent Project site boundary during the site preparation and excavation phase. It should be noted that these are un-mitigated vibration levels with plant and equipment operating at the Kent and Essex site boundaries, and therefore representative of a worst-case scenario.

15.100 A vibration with a magnitude of impact categorised as "medium" is likely to cause complaints in residential areas; however, if prior warning and explanation is provided to the residents it can be tolerated (British Standard 5228-2, 2009).

15.101 The significance of effect of vibration on buildings at the identified NSRs are presented in Table 15.21.

Table 15.21: Significance of effect - vibration on buildings

NSR	Receptor sensitivity	Magnitude of impact	Effect significance
NSR 1	High	Negligible	Negligible
NSR 2	High	Negligible	Negligible
NSR 3 - 8	High	Negligible	Negligible

15.102 Table 15.21 shows negligible significance of effect for vibration on buildings at all NSRs.

Construction Traffic

15.103 Annual average weekday traffic (AAWT) flow counts have been carried out for the Proposed Development. Observed and construction traffic flows have been used to assess the magnitude of impact on the NSRs due to construction traffic during key construction years prior to and during the construction of the specific London Resort Access roads (2023 and 2024).

15.104 Calculations can be found in Appendix 15.3, showing the predicted change in traffic noise level and the magnitude of impact. Results show the greatest significance of effect will occur by roads identified to have a 'small' magnitude of noise impact. A minor adverse significance is predicted in the following locations:

- A2260;
- A2 slip road;
- Milton Road;

- Milton Street; and
- Mounts road

15.105 The impact due to construction traffic during the key construction years without the specific London Resort access in 2023 and 2024 is calculated to produce noise significance below the SOAEL rating and are therefore not considered a significant noise issue.

Operational Noise Effects

15.106 3D acoustic modelling was undertaken on CadnaA® 2019 acoustic software to predict how the operation of the Proposed Development affects the existing noise climate of the area under maximum development parameters.

15.107 Appendix 15.4 details the calculations and modelling outputs produced from the assessment of the following operational scenarios:

- Traffic noise assessment, comparing baseline noise models produced from measured noise level data (Appendix 15.1) to predicted traffic flow data at the point of reaching maturity for the London Resort operation (taken to be in 2038);
- Assessment of ride and attraction noise impact assessment for noise sensitive receptors surrounding the Kent Site and those in Essex (located across the River Thames);
- Assessment of noise limits for the Proposed Development's fixed utility buildings and mechanical plant locations;
- Assessment of noise breakout from external loudspeaker systems located within the pay line of the London Resort to investigate the potential impact of outdoor events with amplified music or speech;
- Passenger ferry noise impact to sensitive receptors in the Kent and Essex Project Sites.
- Assessment of the potential impact of low frequency noise propagation from dredgers landing material at the existing CEMEX wharf on proposed London Resort accommodation buildings.
- Noise limits and typical stand-off distances for helicopter landing locations.

Operational Traffic

15.108 Traffic noise predictions have been calculated using predicted traffic flows provided by LRCH's transport consultants based on their arrivals and departures profile during a peak visitor design day in 2038. 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.

15.109 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. 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.

15.110 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).

15.111 The colours within the following 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).

Diagram 15.3: Image showing the difference between the LA10,18hr (dB) noise climate during 2038 London Resort operation design day and baseline ambient noise level conditions around the Kent Project Site.

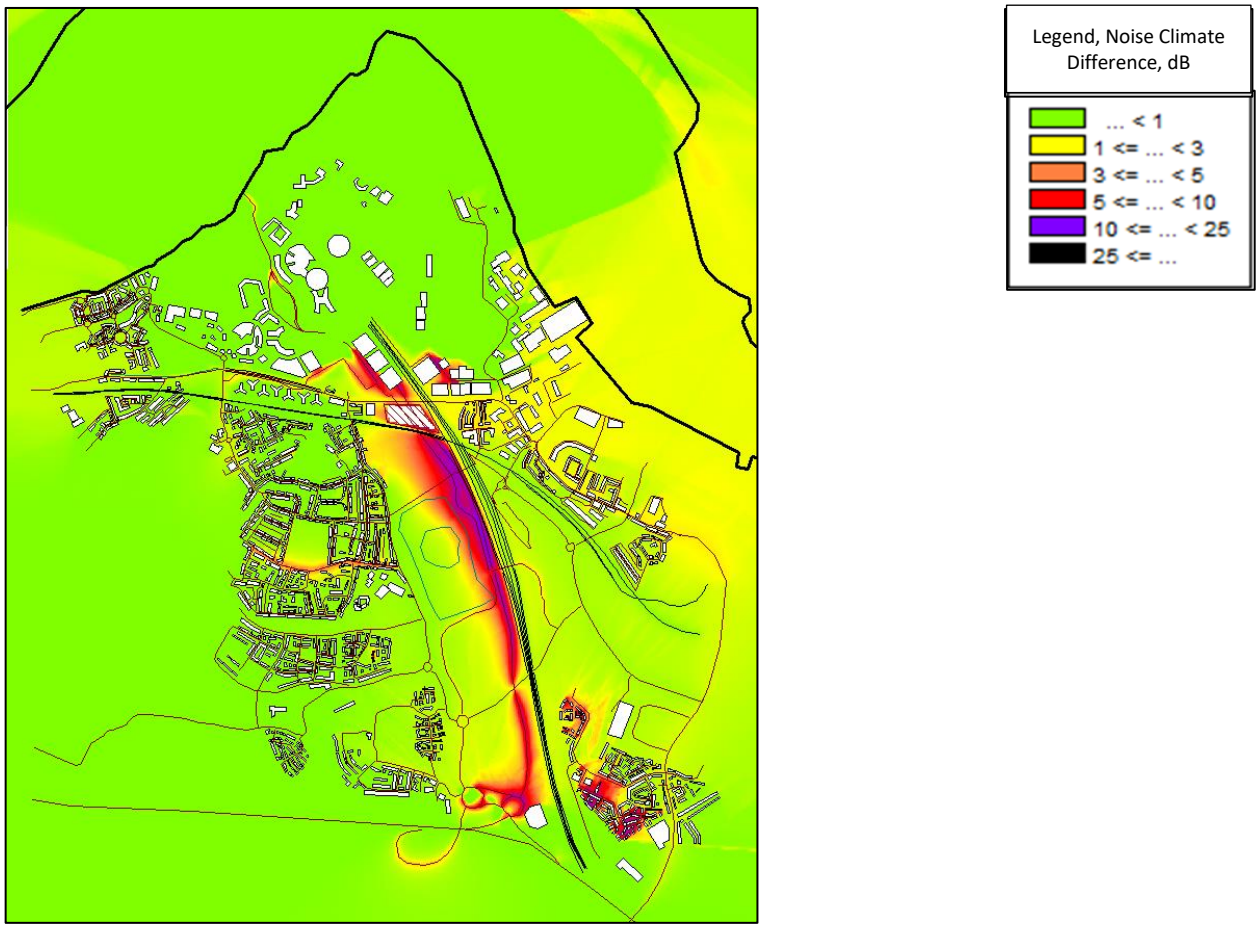
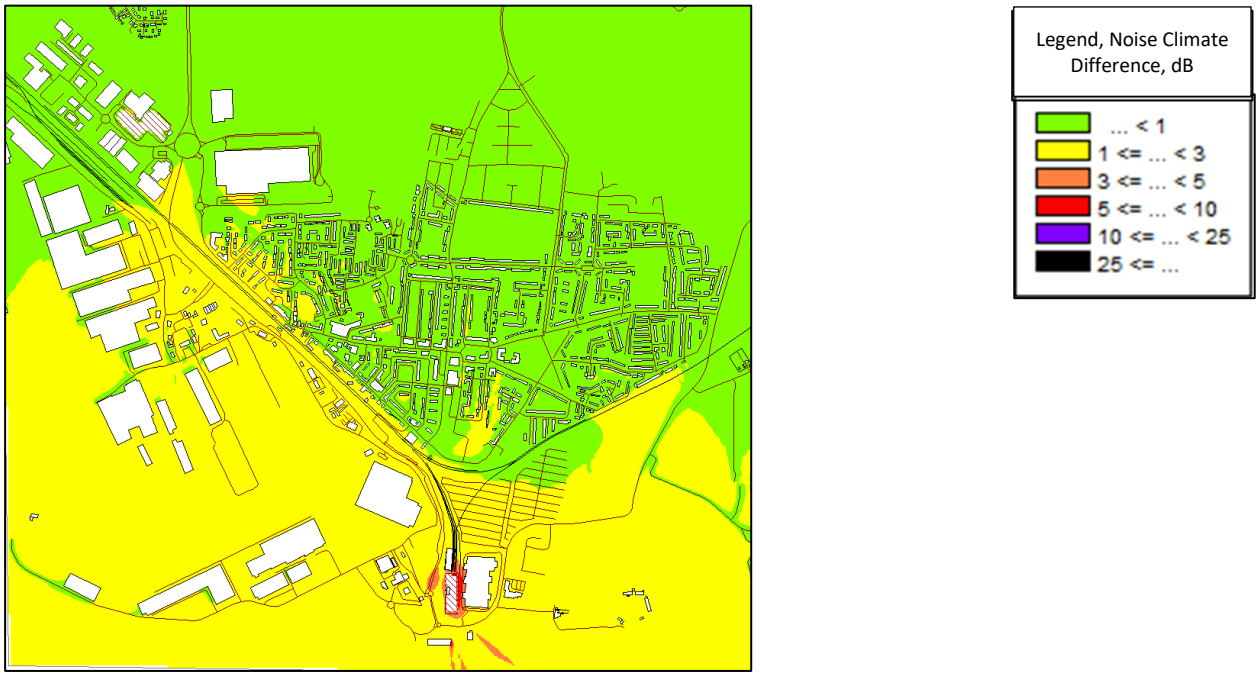


Diagram 15.4: Image showing the difference between the LA10,18hr (dB) noise climate during 2038 London Resort operation design day and baseline ambient noise level conditions around the Essex Project Site.



15.112 The following breakdown of affected areas is limited to developments in a direct line of sight to the new access roads, and those located near to the A1089 in the Essex Project Site.

15.113 Diagrams 15.3 and 15.4 show ambient noise level increases by 1 dB (Low impact magnitude) for properties in the following NSR locations:

Table 15.22: Kent and Essex Project Site NSRs with a +1dB LA10,18hour noise level change.

South East of Access Road	North East of Access Road	West of Access Road	Essex Project Site
Conrad Mews	Robinson Way (Including Phoenix Court and Back Eagle Drive)	High Street	Dock Road
Marlow Close		Stanhope Street	Melbourne Road
Thackeray Drive			Church Road
Wellesley Corner	Snowdon Hill		Ellerman Road
Caxton Park			Newton Road
Colby Mews			Hume Avenue
Springhead Parkway			
Paris Drive			

Stratford Way
Amsterdam Way

15.114 Appendix 15.4 contains sensitivity analysis assessments conducted to evaluate the potential impact of the following scenarios:

- Variations in predicted traffic flows for the 2038 design day scenario, taken to be the point of London Resort operational maturity; and
- The effect of strong southerly winds, on sound propagation from the A2(T) and London Resort access roads to NSRs.

15.115 Investigating the effect of increasing transport consultant predictions by 50%, showed small magnitude of noise effects were maintained (minor adverse noise impact significance) from each of the local roads. Only the A2(T) slip road link 132, 135 and 136 (Appendix 15.4, document reference 6.2.15.4) increase to medium magnitudes and therefore more significant noise climate changes.

15.116 As the closest NSR grouping is located approximately 400m away from these locations and is shielded by barrier attenuation, the Resort operational traffic is not considered to cause a noise issue at these locations.

15.117 Against comments received during consultation, the effect of strong southerly winds ($15ms^{-1}$) on the noise propagation from the A2(T) was investigated. Figure 15.2.7 in Appendix 15.4 showed a low sensitivity between the noise impact at NSRs and the variation from the typical wind conditions.

Ride and Attraction Noise Impact Assessment

15.118 Noise measurements taken by the assessment team at a large European visitor attraction (Europa Park, Germany) showed that the sound of shouting and screaming dominates the overall noise level of the typical ride or attraction. Tabulated SEL and $L_{A,max,f}$ measurement data (including mechanical clanking noise events) has been provided for reference in Appendix 15.1.

15.119 It should be noted that noise from screams, mechanical clanking 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 (e.g. placement and orientation on site).

15.120 Visitor attractions have been modelled as a series of noise sources (in a 3D space) that represent segments of a visitor attractions / ride where $L_{A,max,f}$ peak occur (inclusive of either scream or mechanical clanking noise). The simulations are detailed in Appendix 15.4.

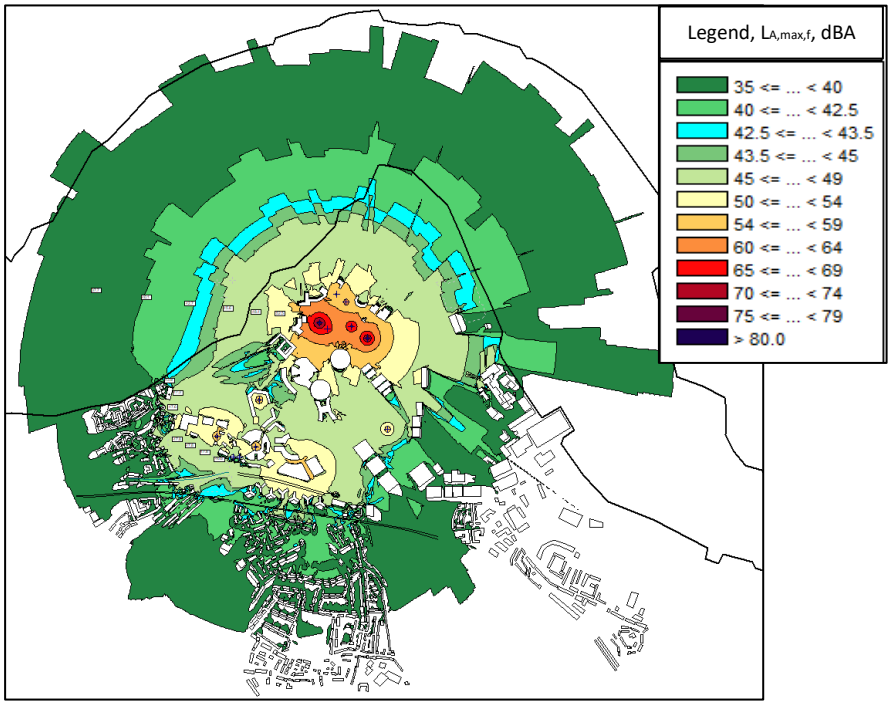
15.121 The assessments are considered to provide a worst-case noise impact study, basing significance on the likelihood of rides and attractions being clearly audible outside residential premises when all other peak noise sources are absent. This represents the quiet time between road traffic events when the noise from a ride or attraction (including shouts and screams) is most likely to be audible.

15.122 The assumption is that $L_{A,max,f}$ noise levels more than 5dB below background (L_{A90}) noise levels are unlikely to be clearly audible, even when occurring in the gaps between other peak noise events such as road traffic. The lowest background noise level measured on-site was 48 dB(A) at monitoring location 1 (to the West of Gate 2, as detailed in Appendix 15.1). Against this an $L_{A,max,f}$ of 43 dB(A) is taken to be a threshold level for audibility of ride noise in the following assessments.

15.123 The baseline L_{A90} noise climate measurements are considered to be the more suitable and worst-case assessment parameters due to the baseline $L_{Aeq,t}$ noise climate to the south and east of Gate 2 being strongly influenced by the peaks in noise caused by the movements of HGV vehicles along Manor Way. As these HGV movements will cease due to the construction of the London Resort, future baseline measurements may not include the noise emissions from these sources.

15.124 The noise propagation from Gate 1 and 2 rides are shown in the diagram below.

Diagram 15.5: Calculated daytime (07:00-23:00) 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.



15.125 Modelling showed $L_{A,max,f}$ noise levels solely from Gate 1 rides to be unlikely to produce NSR noise levels in excess of the 43 dBA threshold.

15.126 Including the concurrent noise levels from Gate 1 and Gate 2 rides and attractions, Diagram 15.5 predicts noise levels above the threshold at the following NSR locations:

Table 15.23: Kent Project Site NSRs with noise levels predicted above the 43dB(A) threshold

Likely Noise Impact	Less Likely Noise Impact
Wainwright Avenue	Knockhall Road
Stonely Crescent	Ingress Gardens
Tiltman Avenue	Craylands Lane
Vaughan Avenue	Craylands Square
Duncannon Place	Caspian Way
Reed Court	Penstemon Drive
	Orchard Road
	Alma Road

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

15.128 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.

15.129 Table 15.4.7 (in Appendix 15.4) includes NSRs where it is less likely for noise from rides and attractions (screams and mechanical noise) to be audible. At these locations, audibility would depend on their being a sufficiently lengthy gap in road traffic noise on London Road. Nevertheless, they are included here for completeness.

15.130 A worst-case sensitivity test was conducted on the concurrent Gate 1 and Gate 2 ride and attraction operation. With 0 ground absorption (simulating the reflectivity of water) and 15ms^{-1} southerly winds, $L_{A,max,f}$ noise levels were shown to be well below the threshold at NSRs across the River Thames (Essex Project Site).

Fixed Plant Noise Limit

15.131 The London Resort plant items and plant compounds will be designed using BS 4142:2014+A1:2019 methodology to attain a rating level ($L_{Ar,T}$) that is 10dB below the existing background noise level ($L_{A90,T}$) at NSRs.

15.132 Attaining a rating level that is equal to or greater than 10dB below the existing background sound level, is considered to produce a 'no change' noise impact at the NSRs with a zero dB background noise creep.

15.133 The following assessments identify the required plant limits 1 metre from the façades of the fixed plant compound proposals, to attain the criteria above at NSRs groupings shown in Figure 15.3. The DCO application proposes all plant compounds are to be located within the Kent Project Site.

Table 15.24: Kent Project Site plant compound limits

Plant Compound ID	Existing (LA90,T) Background Noise Level - dBA	LAr,T BS 4142 Target - dBA	Distance to NSRs (m)	Rating Level ($L_{Ar,T}$) Plant Limit 1m from Current Plant Compound Proposal - dBA
1	44	34	200	84
2	44	34	50	68
3	48	38	88	77
4	45	35	275	84
5	41	31	100	71

Assessment of Noise from External Events and Outdoor Gatherings of Crowds

15.134 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. The most onerous criteria is provided for venues with 4 to 12 concert days per year. In this case:

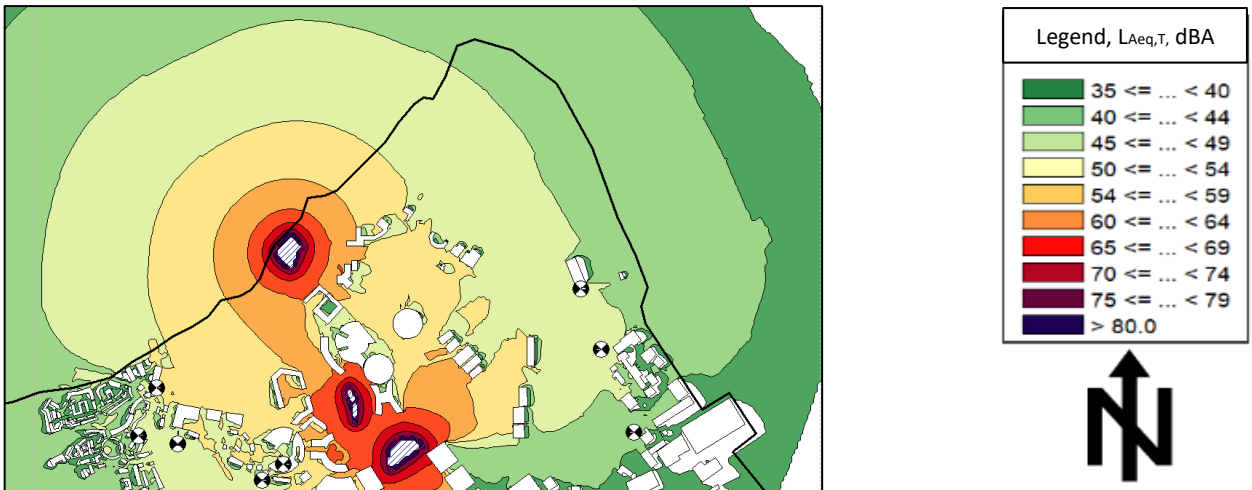
"*The music noise level should not exceed the background noise level by more than 15 dB(A) over a 15-minute period".*

15.135 The entertainment performances and external loudspeaker applications in the Resort are likely to require lower sound pressure levels than the large-scale concerts considered by the Code of Practice on Environmental Noise Concert. However, these events could be daily, therefore it is considered suitable to restrict the noise breakout from external events to more stringent levels than the guidance criteria.

15.136 It is more suitable to control the noise level from loudspeaker sound systems to levels below the existing ambient noise level at NSRs. This target should minimise potential annoyance or disturbance at nearby residential areas due to the external London Resort events.

15.137 The diagram below contains a worst-case analysis of the potential noise breakout due to external loudspeaker events within the London Resort pay line. The modelled area sources represent potential locations for entertainment as well as an external conference exhibition space near the Proposed Development's hotel accommodations.

Diagram15.6: Calculated daytime (07:00-23:00) $L_{Aeq,t}$ dB(A) noise breakout from areas of potential external loudspeaker locations.



15.138 Diagram 15.6 shows suitable noise levels at NSR receptor locations, when operating external loudspeakers to attain 80 dBA at the border of the event space proposals (shows in the model).

15.139 $L_{Aeq,T}$ noise levels below 48 dBA are calculated within the model at the environmental noise survey locations 1, 2 and 3 (detailed in Appendix 15.1). As the lowest existing noise climate $L_{Aeq,T}$ was measured to be 53 dBA at monitoring location 1, diagram 15.6 evidences external events can be held at the London Resort.

15.140 The model considers a worst-case noise breakout considering external event areas as omnidirectional sources with no stage shielding. Through acoustic design of the external event stages, controlling line array directivities and focusing loudspeakers away from NSR locations, noise levels at NSRs can be further reduced to maintain noise levels below the $L_{Aeq,T}$ environment recorded at the year of the event. This is explained further below in the mitigation section.

15.141 The assessment compares the baseline ambient noise climate model (produced from measured noise level data as detailed in Appendix 15.1) and the predicted noise climate due to a passenger ferry.

15.142 For the Passenger Ferry services, the number of arrivals / departures at the pier during daytime (07:00-23:00) hours have been considered to be four per hour at peak time. Using this information, the $L_{Aeq,T}$ was calculated to give the total sound energy over the daytime period (07:00-2300). This then enables the noise levels from passing and departing passenger ferries to be compared against the sites existing noise climate as shown in Diagram 15.7 and Diagram 15.8.

Diagram 15.7 Acoustic Daytime (07:00-23:00) $L_{Aeq,T}$ dB(A) departing and passing boats predicted noise levels at the Kent Project Site.

Diagram 15.8: Acoustic Daytime (07:00-23:00) $L_{Aeq,T}$ dB(A) Departing and passing boats predicted noise levels at the Essex Project Site.

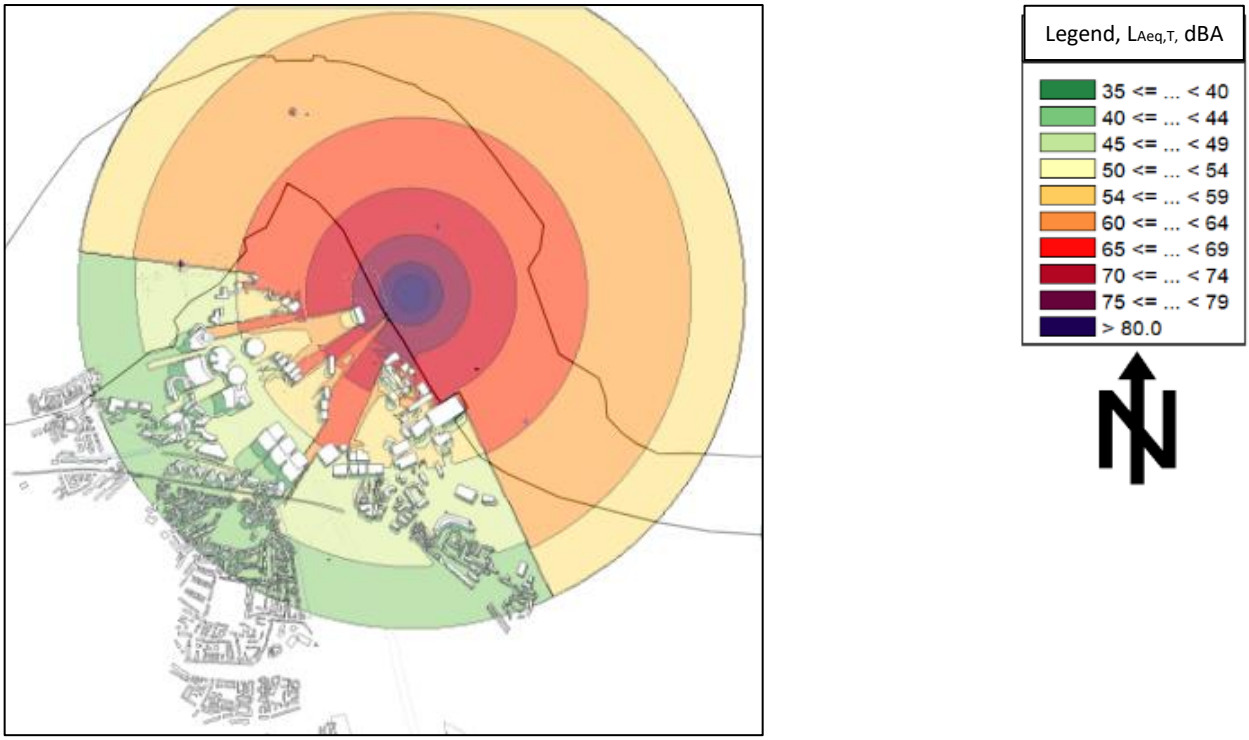
15.143 The acoustic models of the boats demonstrate that there should be no change in noise level at the Kent and Essex Project Sites or existing noise sensitive receptors. This is due to distance attenuation and other, higher, level noise sources at the Kent and Essex Project Sites effectively "masking" the noise from the boats at the pier. Overall, the noise climate is primarily associated with industrial noise and road traffic e.g. on Dartford Crossing.

Assessment of the Noise Impact of CEMEX Dredgers

15.144 The assessment evaluates how the operation of the existing dredger will affect the noise sensitive receptors within the limits of the Proposed Development.

15.145 The proposed London Resort residential / worker accommodation is approximately 1200m from the dredger position. As can be seen from Diagram 15.9, the Kent Project site is subject to moderate noise levels as a result of the dredger operation.

Diagram 15.9: Acoustic Daytime (07:00-23:00) $L_{Aeq,T}$ dB(A) Dredger predicted noise levels at the Kent Project Site.



15.146 The impact of the noise from the dredger operation is demonstrated in the model with the green (under $L_{Aeq,t}$ 40dB) and purple noise contours (maximum).

15.147 Whilst the acoustic noise model shows sound pressure levels at the eastern Kent Project Site boundary ranging from 61dB to 67dB. The hotels are predicted to experience levels up to 54 dB. The Proposed Development's sensitive hotel and residential accommodation receptors benefit from the shielding provided by the Proposed Developments buildings to the north-east of the Kent Project Site.

15.148 It is considered likely that the low frequency noise from this operation will be a determining factor for the external glazing requirements of the proposed noise sensitive receptors at the Kent Project Site.

Noise Impact and Limits for London Resort Helicopter Operations

15.149 The Proposed Development is required to incorporate a helicopter pad into the facility design with a primary purpose of providing life safety access for air ambulance landing events. Based on equivalent operations at Disneyland Paris, the number of helicopter movements is expected to be limited to a maximum of eight per week. It is noted that 50% of those movements would be attributable to Very Important Persons (VIP) / private transport movements.

15.150 Based on UK general aviation (although mostly fixed wing aircrafts) an $L_{Aeq,16hour}$ noise level of 54 dB(A) is considered to be the threshold of community annoyance due to aircraft movements. 63 dB(A) and 69 dB(A) $L_{Aeq,16hour}$ levels are respectively seen as the limits to medium and high annoyance from aircraft movements. Adhering to the 54 dBA $L_{Aeq,16hour}$ level should reduce potential annoyance due to the use of the London Resort Helicopter Pads at the nearby residential areas.

15.151 The European Union Aviation Safety Agency (EASA) publish a database of certified noise levels from rotary aircraft. Within the database, effective perceived noise levels (EPNdB's) provide a measure of relative noisiness from an aircraft, ranging from 80.2 to 100.4 EPNdB during take-off events. London Resort has been classified to be in a congested area based on the London Resort Helipad Evaluation (Issued by M Bowman, 5th October 2020). The twin-engine helicopters potentially landing at the Kent Project Site, are likely to produce noise levels with the EPNdB range above.

15.152 The stand-off distances (propagation distance for sound pressure decay below 35dB $L_{Aeq,T}$) for the different helicopter EPNdB levels were calculated to range from 0.2km (80EPNdB aircrafts) 1.2km (100EPNdB aircrafts).

15.153 To achieve the 54 dB(A) $L_{Aeq,16hour}$ threshold, the permissible number of helicopter take-offs within a 16-hour period is dependent on the types of helicopters entering the Resort. In studying single event noise levels (SELs) from helicopter take-offs a 90 EPNdB helicopter would be limited to approximately 10 take-off events, whilst 30 take-off events would be permissible with the significantly smaller 80 EPNdB aircrafts.

15.154 Based on the expected number of flights per week and the daily 54 dB(A) $L_{Aeq,16hour}$ threshold for community annoyance. Landing events at the London Resort helicopter pad are not expected to create significant noise effects / annoyance at nearby residential areas.

Noise Impact on Sites of Ecological and Biodiversity Importance

15.155 In addition to noise impact assessment of the existing NSRs identified above, sensitive receptors are located where noise and vibration has the potential to have a negative impact on wildlife or ecologically sensitive sites.

15.156 Whilst typically ecologically sensitive designated sites within 200m of the Project Site are assessed, the following section considers the worst-case noise impacts from London Resort Construction and Operation, on each of the sensitive receptors identified Chapter 10 of the ES 'Terrestrial Ecology and Biodiversity'.

London Resort Construction

15.157 Within the construction noise assessment in Appendix 15.3, Table 15.3.3 provides indicative plant type and equipment during construction activities. General Construction was shown to produce the greatest sound power level of 124 dBA.

15.158 Figures 15.4 to 15.9 show the extent of $L_{Aeq,t}$ noise propagation above the existing background noise climate due to the General Construction assessments within Appendix 15.3 (conducted for each construction area affected by the different London Resort phases).

15.159 CadnaA® noise maps have been overlaid onto the 'Statutory Designations Plan' (Issued by EDP, 4th November 2020), showing the extent of construction noise propagation causing an $L_{Aeq,t}$ sound pressure level increase greater than 3dB. Areas outside of these extents (less than 3dB noise climate changes) are considered to have a low magnitude of noise impact and negligible noise impact significance on the flora and fauna situated in the sites of ecological and biodiversity importance.

15.160 The Ecological and Biodiverse Sites shown to potentially be affected by noise climate changes greater than 3 dB $L_{Aeq,t}$ due Resort Construction noise are:

- Black Duck Marsh (due to Gate 1 and Gate 2 construction);
- Broadness Grassland (due to Gate 1 construction of the London Resort pier); and
- Bamber Pit and Bakers Hole (due to infrastructure compound and access road construction activities).

15.161 The temporary construction noise impact at the sites listed above are limited to the London Resort construction periods (07:00-19:00 weekdays). No noise climate changes are expected due to construction after these periods. These can be reduced through the noise mitigation measures discussed in the following section 'Avoidance and Mitigation Measures'.

15.162 Minor adverse noise impacts are expected at Botany Marsh (as well as to the south and

east of the Black Duck Marsh and Broadness Grassland site). This is due to already significant baseline noise and vibration levels from HGV and industrial operations within the Manor Way business park and CEMEX concrete works facility.

15.163 The worst-case noise propagation across the River Thames (occurring during Gate 1 construction in Figure 15.1) has been assessed against the propagation of sound to $L_{Aeq,t}$ levels below 45 dBA. Figure 15.1 shows negligible noise climate changes due to London Resort General Construction activities are expected in Ecological and Biodiverse Sites located across the River Thames from the Kent Project Site (e.g. West Thurrock Lagoon and Marshes).

London Resort Operation

15.164 Figures 15.10 to 15.12 overlay Appendix 15.4 operational traffic, ride and attraction and passenger ferry noise breakout assessments onto the 'Statutory Designations Plan' (BC080001, Issued 4th November 2020).

15.165 Figure 15.10 shows the increased traffic movements during 2038 London Resort design day predictions to have the potential to increase the noise climate by +3dB solely in eastern areas of Bakers Hole and Bamber Pit (located next to the new London Resort Access Road).

15.166 Negligible noise climate changes are expected in the Essex Project Site due to 2038 design day vehicle movements to the Tilbury London Resort Car Park (set out in Figure 15.10). This is due to the significant industrial and HGV vehicle noise and vibration already present around the Essex Project Site.

15.167 Figure 15.11 demonstrates noise from London Resort rides and attractions is expected to be audible within Black Duck Marsh, Broadness Green and Botany Marsh ecological sites.

15.168 The operational noise impacts on the sites above are limited to the operational hours of the resort. Negligible impacts are expected between 23:00-0700. These can be reduced through the noise mitigation measures discussed in the following section 'Avoidance and Mitigation Measures'.

15.169 Figure 15.12 demonstrates noise from London Resort passenger ferries is not expected to cause adverse sound pressure level increases at the EDP Ecological and Biodiverse Sites.

AVOIDANCE AND MITIGATION MEASURES

15.170 The proposed avoidance and mitigation measures have been included in detail in Appendix 15.5. Examples of mitigation measures that can be used to control the Project's Earthworks, General Construction, Paving and Piling construction noise and vibration activities provided in Appendix 15.5 (document reference 6.2.15.5), in line with Section 8 of BS 5228-1:2009+A1:2014.

15.171 The proposed mitigation detailed within this section and Appendix 15.5 (document reference 6.2.15.5) will be secured through the outline CEMP (document reference 6.2.3.2) and as the CEMP remains a live document throughout the construction stages, it will be managed and updated accordingly by the Principal Contractor.

15.172 To reduce the noise impacts identified due to the operation of London Resort, the following mitigation measured have been identified:

Road traffic noise

15.173 Acoustic modelling shows that the impact from road traffic noise is mostly confined to NSRs with an unobstructed line of sight to the new Access Road. Options for mitigating these low magnitude impacts further include earth bunds, low height roadside noise barriers, reduced vehicle speeds or the choice of lower noise road surfaces.

Rides and attractions

15.174 Acoustic modelling shows the magnitude of noise impact to be low magnitude. Further mitigation of mechanical 'clanking' noises is best provided at source through the use of strict noise performance criteria given to the ride manufacturers. The sound of people screaming can be mitigated through the deliberate positioning of 'scream zones' (where the motion of the ride encourages screams) in locations where the orientation of the ride minimises the sound reaching the NSRs.

Infrastructure compounds

15.175 Limiting noise levels have been provided for fixed infrastructure compound to prevent noise impacts on local NSRs. London Resort plant items and plant compounds will be designed using BS 4142:2014+A1:2019 methodology to attain a rating level ($L_{Ar,T}$) that is 10dB below the existing background noise level ($L_{A90,T}$) at NSRs.

Passenger Ferry

15.176 Acoustic modelling shows the noise level due to the operation of the passenger ferry to be greatest when it is manoeuvring close to shore. The propagation of noise can be mitigated by the positioning of buildings to act as noise screens and by using carefully positioned noise barriers.

Outdoor London Resort events

15.177 Noise from loudspeaker systems used for outdoor events can be controlled by the following mitigation measures:

- Limiting the sound pressure level of loudspeaker systems to levels below the existing ambient noise level at NSRs;

- Optimising line array loudspeaker directivities to control noise emissions within the London Resort entertainment locations, reducing noise spill out of the external areas;

- Design external events spaces, so that loudspeakers are directed away from existing NSRs.

RESIDUAL ENVIRONMENTAL EFFECTS

15.178 A summary of residual impacts during construction is provided in Table 15.27.

Table 15.27: Summary of residual effects during construction on Kent and Essex Project Site NSRs

NSR #	Effect	Significance before mitigation	Supplementary mitigation	Residual effect significance
1	Gate 1 Earthworks	Negligible	N/A	Negligible
	Gate 1 General Construction	Negligible	N/A	Negligible
	Gate 2 Earthworks	**Minor adverse**	**N/A**	**Minor adverse**
	Gate 2 General Construction	**Major adverse**	**See Appendix 15.5**	**Minor adverse**
	Hotel Earthworks	Negligible	N/A	Negligible
	Hotel General Construction	Negligible	N/A	Negligible
	Access Road Earthworks	Negligible	N/A	Negligible
	Access Road General Construction	Negligible	N/A	Negligible
	Plant Compound Paving	Negligible	N/A	Negligible
2	Gate 1 Earthworks	Negligible	N/A	Negligible
	Gate 1 General Construction	Negligible	N/A	Negligible
	Gate 2 Earthworks	Negligible	N/A	Negligible
	Gate 2 General Construction	Negligible	N/A	Negligible
	Hotel Earthworks	Negligible	N/A	Negligible
	Hotel General Construction	**Minor adverse**	**N/A**	**Minor adverse**
	Access Road Earthworks	Negligible	N/A	Negligible
	Access Road General Construction	Negligible	N/A	Negligible
	Plant Compound Paving	Negligible	N/A	Negligible
3	Gate 1 Earthworks	Negligible	N/A	Negligible

NSR #	Effect	Significance before mitigation	Supplementary mitigation	Residual effect significance
	Gate 1 General Construction	Negligible	N/A	Negligible
	Gate 2 Earthworks	Negligible	N/A	Negligible
	Gate 2 General Construction	Negligible	N/A	Negligible
	Hotel Earthworks	Negligible	N/A	Negligible
	Hotel General Construction	Negligible	N/A	Negligible
	Access Road Earthworks	Negligible	N/A	Negligible
	Access Road General Construction	Negligible	N/A	Negligible
	Plant Compound Paving	Negligible	N/A	Negligible
4	Gate 1 Earthworks	Negligible	N/A	Negligible
	Gate 1 General Construction	Negligible	N/A	Negligible
	Gate 2 Earthworks	Negligible	N/A	Negligible
	Gate 2 General Construction	Negligible	N/A	Negligible
	Hotel Earthworks	Negligible	N/A	Negligible
	Hotel General Construction	Negligible	N/A	Negligible
	Access Road Earthworks	Negligible	N/A	Negligible
	Access Road General Construction	Negligible	N/A	Negligible
	Plant Compound Paving	Negligible	N/A	Negligible
5	Gate 1 Earthworks	Negligible	N/A	Negligible
	Gate 1 General Construction	Negligible	N/A	Negligible
	Gate 2 Earthworks	Negligible	N/A	Negligible
	Gate 2 General Construction	Negligible	N/A	Negligible
	Hotel Earthworks	Negligible	N/A	Negligible
	Hotel General Construction	Negligible	N/A	Negligible
	Access Road Earthworks	Negligible	N/A	Negligible
	Access Road General Construction	Negligible	N/A	Negligible
	Plant Compound Paving	Negligible	N/A	Negligible
6	Gate 1 Earthworks	Negligible	N/A	Negligible

NSR #	Effect	Significance before mitigation	Supplementary mitigation	Residual effect significance
	Gate 1 General Construction	Negligible	N/A	Negligible
	Gate 2 Earthworks	Negligible	N/A	Negligible
	Gate 2 General Construction	Negligible	N/A	Negligible
	Hotel Earthworks	Negligible	N/A	Negligible
	Hotel General Construction	Negligible	N/A	Negligible
	Access Road Earthworks	Negligible	N/A	Negligible
	Access Road General Construction	Negligible	N/A	Negligible
	Plant Compound Paving	Negligible	N/A	Negligible
7	Gate 1 Earthworks	Negligible	N/A	Negligible
	Gate 1 General Construction	Negligible	N/A	Negligible
	Gate 2 Earthworks	Negligible	N/A	Negligible
	Gate 2 General Construction	Negligible	N/A	Negligible
	Hotel Earthworks	Negligible	N/A	Negligible
	Hotel General Construction	Negligible	N/A	Negligible
	Access Road Earthworks	Negligible	N/A	Negligible
	Access Road General Construction	Negligible	N/A	Negligible
	Plant Compound Paving	Negligible	N/A	Negligible
8	Car Park Earthworks	Negligible	N/A	Negligible
	Car Park General Construction	Negligible	N/A	Negligible

15.179 On implementation of supplementary mitigation measures along with good site practice, the worst-case residual demolition and construction impacts to the existing environment are considered to produce a 'minor adverse' significance around Gate 2 and the hotel for the duration of general construction activities. This impact is considered to be acceptable.

15.180 Likewise, if the operational mitigation measures are implemented, residual effects are likely to be reduced to negligible or minor adverse impacts at existing NSRs.

CLIMATE CHANGE

15.181 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.

CUMULATIVE, IN-COMBINATION AND TRANSBOUNDARY EFFECTS

15.182 A shortlist of schemes have been considered for the cumulative effect's assessment (see Chapter 22 for the cumulative schemes). These are chosen as those developments where traffic flows interact with the Proposed Development:

- Scheme 3. Lower Thames Crossing;
- Scheme 10. A2 Bean & Ebbsfleet Junction Improvement Works;

15.183 They are also chosen as those developments within sufficient close proximity (taken to be 800m distance from the London Resort site boundary where there is clear line of sight to noise sensitive receptors falling to 200m where the noise path is screened by topography or buildings) to consider the cumulative impact of either construction noise (and vibration) or the noise from fixed plant being:

- Scheme 9. Eastern Quarry, Swanscombe;
- Scheme 17. The Pier;
- Scheme 18, 19. Land West of Springfield Road;
- Scheme 29. Canning Town Area 8;
- Scheme 42. Land off Tillman Avenue;

15.184 They are also chosen as those within sufficiently close proximity likely to emit industrial noise being:

- Scheme 43. Bulk Aggregates impact terminal.

Demolition and Construction

15.185 Whilst it is not practicable to undertake a quantitative assessment of the cumulative noise and vibration effects on this number of cumulative schemes it is likely that cumulative noise and vibration levels will have an adverse effect. However, this is reliant on the location of the receptors relative to the Project Site and other developments.

15.186 It is not unusual for demolition and construction activities to take place on more than one development site in proximity to each other and the contractor(s) for the London Resort site will undertake regular liaison meetings and reviews with neighbouring sites to plan works so that they do not cause unnecessary disruption.

15.187 Additional noise impacts at the identified receptors may occur if demolition and construction activities take place simultaneously. The cumulative impact will be dependent on the exact activities taking place at each location; however, the introduction of site hoardings and compliance with the mitigation measures detailed in Appendix 15.3 will reduce these impacts as far as possible assuming that the other schemes will also incorporate best available mitigation measures during their demolition and construction phases.

15.188 Detailed assessments of construction noise are not available for all the cumulative schemes. Therefore, it is not possible to undertake a quantitative assessment of the cumulative noise impact. However, the close proximity of Schemes 9, 17,18 & 19, 42 to receptors already deemed to be sensitive to noise from the construction of the London Resort means that cumulative effects are likely to occur at some of the construction phases of London Resort: particularly Gate Two construction for Schemes 17,42 and the construction of the Access Road for Schemes 9, 18 & 19.

Fixed Plant Noise

15.189 Cumulative noise from fixed plant and equipment during the operational stage of the developments should follow the legislative requirements for fixed plant. It is assumed that the design of fixed plant and equipment at the developments identified above will follow the prevailing local authority policies as well, resulting in an overall negligible effect on the nearby receptors.

Industrial Noise

15.190 The Bulk Aggregates Import Terminal in Scheme 43 will have a temporal noise profile that is reliant on the tides. Therefore, its noise impact will vary depending on the time of day (or night) that vessels are unloaded, and the terminal operators will need an operational noise plan to take this into account. The movement of material from the Bulk Aggregates site by road will have additional impact. Good operational management by Bulk Aggregate employees will be required, routing vehicles out of the local area through a range of routes rather than one.

Road Traffic Noise

15.191 Intensification of traffic on local roads due to the cumulative effect of the London Resort, Scheme 3 and Scheme 10 will cause an increase in noise at noise sensitive receptors. The increase noise from vehicles moving along the A2(T) may cause more than a +1dB change to the noise climate compared to existing conditions.

CONCLUSIONS

15.192 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 and Essex Project Sites.

15.193 An assessment into the potential noise impact from the different construction phases of the Proposed Development was conducted to BS 5228-1 methodology. The findings of the assessments were logged in the 'Assessment of Significant Effects' section and Appendix 15.3.

15.194 The construction noise assessments within the ES identified the noise impact of the following:

- Predicted noise levels from construction have been used to assess the significance of effect from construction noise, from different phases of construction, at each identified Noise Sensitive Receptor (NSR), using Annex E of BS 5228-1:2009+A1:2014.

- The magnitude of impact from construction vibration at the closest NSRs using reference PPV for each type of equipment that produces ground-borne vibration

- Construction traffic impacts based on transport predictions for future flows during 2023 and 2024. These were assessed as they are considered to represent the worst-case construction years during the development of Gate 1 facilities and the London Resort future access road.

15.195 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:

- Traffic noise assessment, comparing baseline noise models produced from measured noise level data (Appendix 15.1) to predicted traffic flow data at the point of reaching maturity for the London Resort operation (taken to be in 2038);

- Assessment of ride and attraction noise impact assessment for noise sensitive receptors surrounding the Kent Site and those in Essex (located across the River Thames);

- Assessment of noise limits for the Proposed Development's fixed utility buildings and mechanical plant locations;

- Assessment of noise breakout from external loudspeaker systems located within the pay line of the London Resort to investigate the potential impact of outdoor events with amplified music or speech;

- Passenger ferry noise impact to sensitive receptors in the Kent and Essex Project Sites.

- Assessment of the potential impact of low frequency noise propagation from dredgers landing material at the existing CEMEX wharf, on proposed London Resort accommodation buildings.

- Noise limits and typical stand-off distances for helicopter landing locations.

15.196 The findings of these assessments were logged in the 'Assessment of Significant Effects' section and Appendix 15.4.

15.197 Mitigation measures that could be used to reduce noise levels at receptor locations where reasonably practicable have been provided in detail in Appendix 15.5 and within the Chapter in the Avoidance and Mitigation Measures section of the Chapter.

15.198 If these supplementary mitigation measures are implemented along with good site practice, the worst-case residual demolition and construction impacts to the existing environment are considered to produce a 'minor adverse' significance around Gate 2 and the hotel for the duration of general construction activities. This impact is considered to be acceptable.

15.199 Likewise, if the operational mitigation measures are implemented, residual effects are likely to be reduced to negligible or minor adverse impacts at existing NSRs.

15.200 The ES has demonstrated that the noise impact of the London Resort development can be controlled to levels below thresholds for community annoyance at the existing residential premises in the Kent and Essex Project Sites.

15.201 The greatest residual noise impact for sites identified as sensitive receptors within the 'Terrestrial Ecology and Biodiversity' Chapter of the ES were at the Black Duck Marsh, Broadness Green, Bamber Pit and Bakers Hole. This impact is expected due to London Resort construction and operational activities occurring within these ecological spaces, on implementation of mitigation measures, moderate to high noise impact significance is still anticipated in the areas located near to the construction or operational sources.

15.202 Negligible noise impacts are expected at sites of ecological and biodiversity importance sites outside of the DCO limits and across the River Thames.

LIST OF APPENDICES

Reference	Title
Appendix 15.1	Baseline noise monitoring
Appendix 15.2	Planning policy and technical guidance
Appendix 15.3	Construction noise and vibration assessment
Appendix 15.4	Operational noise and vibration assessment
Appendix 15.5	Construction noise and vibration mitigation