

National Grid Cable Tunnel Replacement Project

Environmental Statement Volume VI

Chapter 19 Noise and Vibration - Gravesend

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Quality information

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19 Noise and Vibration

19.1 Introduction

- 19.1.1 This chapter assesses the likely significant effects of the Tilbury to Grain and Tilbury to Kingsnorth (TKRE) Cable Tunnel Replacement Project (“the Proposed Development”) on noise and vibration receptors during the construction and operational phases.
- 19.1.2 This chapter also identifies any additional mitigation measures to prevent, minimise or control likely adverse effects on noise and vibration receptors arising from the Proposed Development.
- 19.1.3 This chapter should be read together with the introductory chapters of this Environmental Statement (ES) Volume II (Chapters 1 – 6). This noise and vibration assessment has been informed by data from Chapter 18: Traffic and Transport.
- 19.1.4 This chapter is supported by the following appendices (Volume VI) and figures:
- Appendix 11.1: Human Hearing and Acoustic Terminology.
 - Appendix 11.2: National Grid Thames Tunnel 400kv, Gravesend, Kent / Tilbury, Essex Baseline Noise and Vibration Monitoring Report.
 - Appendix 11.3: Noise and Vibration Calculations and Modelling; and
 - Figure 19-1: Noise Monitoring Locations and Sensitive Receptors.

19.2 Relevant Legislation, Policy and Guidance

Introduction

- 19.2.1 The section of this chapter provides an overview of the relevant legislation, planning policy and technical guidance relevant to the noise and vibration assessment.

Legislation

- 19.2.2 The following pieces of legislation apply specifically to the noise and vibration assessment:
- The Control of Pollution Act 1974 (CoPA) (Ref 19-1) requires that Best Practicable Means (BPM), as defined in Section 72 of the CoPA, are adopted to control construction noise on any given site. Sections 60 and 61 of the CoPA provide the main legislation regarding enabling works and construction site noise and vibration. If noise complaints are received, a Section 60 notice may be issued by the Local Authority imposing requirements as to the way in which the works are to be carried out. Section 61 of the CoPA provides a means to apply for prior consent to carry out noise generating activities during construction and allows the Local Authority to attach conditions to the consent.
 - The Environmental Protection Act 1990 (EPA) (Ref 19-2) prescribes a statutory nuisance as noise (and vibration) emitted from premises (including land) that is prejudicial to health or a nuisance. Local Authorities are required to investigate any public complaints of noise, and if they are satisfied that a statutory nuisance exists, or is likely to occur or recur, they must serve a noise abatement notice. A notice is served on the person responsible for the nuisance. It requires either simply the abatement of the nuisance or works to abate the nuisance to be carried out, or it prohibits or restricts the activity. In determining if a noise complaint amounts to a statutory nuisance the Local Authority can take account of various guidance documents and existing case law as no statutory noise limits currently exist for defining a statutory nuisance. Demonstrating the use of BPM to minimise sound levels is an accepted defence against failure to comply with a noise abatement notice.

National Policy

19.2.3 National Planning Policy relevant to this noise and vibration assessment are detailed in Table 19-1.

Table 19-1: National Planning Policy

Policy Reference	Policy Context
National Policy Statements	
Overarching National Policy Statement for Energy (EN-1) published July 2011 (Ref 19-3)	
Section 5.11, Paragraph 5.11.4	<i>“Where noise impacts are likely to arise from the proposed development, the applicant should include the following in the noise assessment:</i> <i>• a description of the noise generating aspects of the development proposal leading to noise impacts, including the identification of any distinctive tonal, impulsive or low frequency characteristics of the noise;</i> <i>• identification of noise sensitive premises and noise sensitive areas that may be affected;</i> <i>• the characteristics of the existing noise environment;</i> <i>• a prediction of how the noise environment will change with the proposed development;</i> <i>• in the shorter term such as during the construction period;</i> <i>• in the longer term during the operating life of the infrastructure;</i> <i>• at particular times of the day, evening and night as appropriate.</i> <i>• an assessment of the effect of predicted changes in the noise environment on any noise sensitive premises and noise sensitive areas; and measures to be employed in mitigating noise. The nature and extent of the noise assessment should be proportionate to the likely noise impact.”</i>
Section 5.11, Paragraph 5.11.5	<i>“The noise impact of ancillary activities associated with the development, such as increased road and rail traffic movements, or other forms of transportation, should also be considered.”</i>
Section 5.11, Paragraph 5.11.6	<i>“Operational noise, with respect to human receptors, should be assessed using the principles of the relevant British Standards and other guidance. Further information on assessment of particular noise sources may be contained in the technology-specific NPSSs. In particular, for renewables (EN-3) and electricity networks (EN-5) there is assessment guidance for specific features of those technologies. For the prediction, assessment and management of construction noise, reference should be made to any relevant British Standards and other guidance which also give examples of mitigation strategies.”</i>
Section 5.11, Paragraph 5.11.7	<i>“The applicant should consult Environment Agency (EA) and Natural England (NE), or the Countryside Council for Wales (CCW), as necessary and in particular with regard to assessment of noise on protected species or other wildlife. The results of any noise surveys and predictions may inform the ecological assessment. The seasonality of potentially affected species in nearby sites may also need to be taken into account.”</i>
Section 5.11, Paragraph 5.11.9	To aid the Secretary of State in decision making, paragraph 5.11.9 of NPS EN-1 sets out the three aims relating to noise emissions from new developments:

Policy Reference	Policy Context
	• “avoid significant adverse impacts on health and quality of life from noise; • mitigate and minimise other adverse impacts on health and quality of life from noise; and • where possible, contribute to improvements to health and quality of life through the effective management and control of noise”.
Draft Overarching National Policy Statement for Energy (EN-1) published November 2023 (Ref 19-4)	
Section 5.12	“Where noise impacts are likely to arise from the proposed development, the applicant should include the following in the noise assessment: • a description of the noise generating aspects of the development proposal leading to noise impacts, including the identification of any distinctive tonal, impulsive, low frequency or temporal characteristics of the noise • identification of noise sensitive receptors and noise sensitive areas that may be affected • the characteristics of the existing noise environment • a prediction of how the noise environment will change with the proposed development – in the shorter term, such as during the construction period – in the longer term, during the operating life of the infrastructure – At particular times of the day, evening and night (and weekends) as appropriate, and at different times of year • an assessment of the effect of predicted changes in the noise environment on any noise-sensitive receptors, including an assessment of any likely impact on health and quality of life / well-being where appropriate, particularly among those disadvantaged by other factors who are often disproportionately affected by noise-sensitive areas • if likely to cause disturbance, an assessment of the effect of underwater or subterranean noise • all reasonable steps taken to mitigate and minimise potential adverse effects on health and quality of life”
National Policy Statement for Electricity Networks Infrastructure (EN-5) published November 2023 (Ref 19-5)	
Section 2.9 Paragraph 2.9.19	“In brief, the Horlock Rules state that applicants should: [...] keep visual, noise and other environmental effect to a reasonably practicable minimum.”
Section 2.9 Paragraph 2.9.40 to 2.9.42	“For the assessment of noise from overhead lines, the applicant must use an appropriate method to determine the sound level produced by the line in both dry and wet weather conditions, in addition to assessing the impact on noise-sensitive receptors. For instance, the applicant may use an appropriate noise modelling tool or tools for the prediction of overhead line noise and its propagation over distance, such as an ISO 9613-2 or Technical Report TR(T)94. When assessing the impact of noise generated by overhead lines in wet weather relative to existing background sound levels, the applicant

Policy Reference	Policy Context
	<i>should consider the effect of varying background sound levels due to rainfall."</i>
Section 2.10 Paragraph 2.10.9	<i>Applicants must consider the following measures:</i> <i>• the positioning of lines to help mitigate noise;</i> <i>• ensuring that the appropriately sized conductor arrangement is used to minimise potential noise;</i> <i>• quality assurance through manufacturing and transportation to avoid damage to overhead line conductors which can increase potential noise effects;</i> <i>• ensuring that conductors are kept clean and free of surface contaminants during stringing/installation; and</i> <i>• the selection of quieter cost-effective plants.</i>
National Planning Policy Framework (Ref 19-7)	
Paragraph 174	<i>"Planning policies and decisions should contribute to and enhance the natural and local environment by:[...] e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans."</i>
Paragraph 185	<i>"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should: a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life; b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason..."</i>
Noise Policy Statement for England (Ref 19-8)	

Policy Reference	Policy Context
	The Noise Policy Statement for England (NPSE) seeks to clarify the underlying principles and aims in existing policy documents, legislation, and guidance that relate to noise. The statement applies to all forms of noise, including environmental noise, neighbour noise and neighbourhood noise. The NPSE sets out the long-term vision of the government's noise policy, which is to <i>"promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development"</i>. This long-term vision is supported by three aims: <i>"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:</i> • <i>Avoid significant adverse impacts on health and quality of life;</i> • <i>Mitigate and minimise adverse impacts on health and quality of life; and</i> • <i>Where possible, contribute to the improvements of health and quality of life."</i> The 'Explanatory Note' within the NPSE provides further guidance on defining 'significant adverse effects' and 'adverse effects' using the concepts: • No Observed Effect Level (NOEL) – the level below which no effect can be detected. Below this level, there is no detectable effect on health and quality of life due to noise; • Lowest Observable Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected; and • Significant Observed Adverse Effect Level (SOAEL) - the level above which significant adverse effects on health and quality of life occur. With reference to the SOAEL, the NPSE states: <i>"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available."</i> For situations where sound levels are between the LOAEL and SOAEL, all reasonable steps should be taken to mitigate and minimise the effects. However, this does not mean that such adverse effects cannot occur.

Local Planning Policy

19.2.4 Local Planning Policies relevant to this noise and vibration assessment are detailed in Table 19-2.

Table 19-2: Local Planning Policy

Policy Reference	Policy Context
Gravesham Local Plan Core Strategy (Ref 19-9)	
Policy CS19 Development and Design Principles	<i>New development will be located, designed and constructed to:</i> • <i>avoid adverse environmental impacts from pollution, including noise, air, odour and light pollution, and land contamination.</i>

Guidance

19.2.5 This noise and vibration assessment has been carried out in accordance with the following:

Planning Practice Guidance Noise

19.2.6 The Planning Practice Guidance concerned with noise (PPGN) (Ref 19-10) advises that:

“Noise needs to be considered when development may create additional noise, or would be sensitive to the prevailing acoustic environment (including any anticipated changes to that environment from activities that are permitted but not yet commenced)”.

- 19.2.7 It also provides guidelines that are designed to assist with the implementation of the NPPF.
- 19.2.8 The PPG states that local planning authorities should take account of the acoustic environment and in doing so consider:
- *“whether or not a significant adverse effect is occurring or likely to occur;*
 - *whether or not an adverse effect is occurring or likely to occur; and*
 - *whether or not a good standard of amenity can be achieved.”*
- 19.2.9 Factors to be considered in determining whether noise is a concern are identified including the absolute noise level of the source, the existing ambient noise climate, time of day, frequency of occurrence, duration, character of the noise, and cumulative effects.
- 19.2.10 Further details on the hierarchy of noise effects are presented in Table 19-3, which has been reproduced from PPGN.

Table 19-3: Planning Practice Guidance Noise Exposure Hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not present	No effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g., turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude, or other physiological response, e.g., avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening, and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area	Significant Observed Adverse Effect	Avoid

Perception	Examples of Outcomes	Increasing Effect Level	Action
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g., regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g., auditory and non-auditory	Unacceptable Adverse Effect	Prevent

British Standard 4142:2014

- 19.2.11 BS: 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound' (Ref 19-11) describes methods for rating and assessing sound of an industrial and/or commercial nature including sound from fixed installations which comprise mechanical and electrical equipment.

British Standard 5228 (2009+A1:2014) Parts 1 and 2

- 19.2.12 BS: 5228 'Code of practice for noise and vibration control on construction and open sites' Part 1 (Ref 19-12) provides a 'best practice' guide for noise control and includes sound power level (L_w) data for individual plant as well as a calculation method for noise from construction activities. Part 2 (Ref 19-13) of the standard provides recommendations for basic methods of vibration control relating to construction and open sites.

British Standard 8233:2014

- 19.2.13 BS: 8233 'Sound Insulation and Noise Reduction for Buildings– Code of Practice' (Ref 6) provides criteria for the assessment of internal noise levels for various uses including dwellings and commercial properties. It also provides guidelines for external noise in amenity areas.

Design Manual for Roads and Bridges (2020)

- 19.2.14 National Highways' Design Manual for Roads and Bridges Sustainability & Environment Appraisal LA 111 Noise and Vibration (DMRB) (Ref 19-14) This document sets out the requirements for assessing and reporting the effects of highways' noise and vibration from construction, operation and maintenance projects.

Calculation of Road Traffic Noise (1998)

- 19.2.15 The Department of Transport/Welsh Office Memorandum 'Calculation of Road Traffic Noise' (CRTN) (Ref 19-15) describes procedures for traffic noise calculation and is suitable for environmental assessments of schemes where road traffic may have an effect.

World Health Organisation (1999)

- 19.2.16 The World Health Organisation's (WHO) 'Guidelines for Community Noise' (Ref 19-17) recommend external daytime and evening environmental noise limits and internal night-time limits to avoid sleep disturbance.

19.3 Scope and Methodology

Study Area

- 19.3.1 The Study Area for construction and operational noise effects includes receptors within 1km of the new headhouses and within 300m of the construction site boundaries. These distances have been selected based on previous experience that operational noise sources are likely to be negligible at distances greater than 1km and that construction noise predictions are generally reliable up 300m (based on guidance in BS 5228-1 (Ref 19-12)).

Scope and Assessment Methodology

- 19.3.2 The scope of this assessment covers the following noise and vibration elements associated with the Proposed Development:
- Noise and vibration associated with construction works; and
 - Road traffic associated with construction works.
 - Noise and vibration effects associated with the decommissioning phase are assumed to be no worse than those assessed for the construction phase and therefore the decommissioning phase has not been further assessed in this chapter.

Desk Study

Potential Construction Effects

- 19.3.3 A screening distance of 300m for construction noise, which has been selected as guidance in BS 5228-1 (Ref 19-12) indicates that construction noise predictions are generally reliable up 300m. Additionally, a study area of 50m either side of construction traffic routes has been defined based on guidance in the DMRB (Ref 19-14).
- 19.3.4 As there are receptors at a closest distance of approximately 50m to the Gravesend Site (Thameside Campus National Maritime Training Centre, and Metropolitan Police Special Training Centre), there is potential for significant construction noise and vibration effects. As these receptors will only be occupied during the day, they will not be impacted by out-of-hours work that will occur during tunnelling.
- 19.3.5 All receptors are sufficiently far from work sites such that construction vibration emissions are unlikely to be perceptible with the exception of impact piling required for new pylons. Consequently, a construction impact piling vibration assessment is scoped in.
- 19.3.6 The level of temporary vibration from tunnelling at sensitive receptors is dependent on the tunnel depth, distance to receptors and ground conditions. Based on the tunnel shaft depth of approximately 40m and tunnel depth of approximately 34m aOD to 32m aOD and the distance to nearest sensitive receptor, tunnelling induced vibration effects would not be significant. Consequently, an assessment of vibration effects due to tunnelling activities is scoped out.
- 19.3.7 Construction traffic may influence noise levels due to traffic on the local road network. As such, an assessment of construction traffic noise is scoped in.

Potential Operational Effects

- 19.3.8 There are no operational noise sources within the Gravesend headhouse and its function is to provide access to the shaft. Consequently, an operational noise assessment is scoped out.
- 19.3.9 New overhead lines and a pylon will replace existing infrastructure. Although the location of pylons and alignment of overhead lines at the Gravesend Site would be marginally different than the current layout, the changes are not anticipated to result in a material change in noise levels. As such, an assessment of overhead line noise is scoped out.

Summary of Assessment Scope

19.3.10 The scope of the noise and vibration assessment for the Gravesend site covers:

- Construction noise;
- Construction vibration – piling; and
- Construction traffic.

19.4 Consultation

19.4.1 On 22nd September 2023, an email was sent to Thurrock Council and Gravesham Borough Council containing a noise survey summary which set out the baseline noise survey undertaken for the Proposed Development as well as the proposal to scope out construction and operational vibration.

19.4.2 A response was received from Gravesham Borough Council on the 13th November 2023 where it was agreed to scope out construction and operational vibration. Gravesham Borough Council also confirmed that they agree with the nearest sensitive receptors identified and also advised that they would expect to see reference to British Standards such as BS4142, BS8233 and BS5228. These British Standards are referenced throughout this chapter.

19.4.3 Although it was agreed that construction vibration could be scoped out; impact piling is proposed as part of the construction methodology, high levels of vibration could be generated. Consequently, the scope includes an assessment of potential effects due to vibration induced by piling activities.

19.5 Assessment Methodology

Receptor Sensitivity

19.5.1 Potential sensitive receptors (i.e., buildings whose occupants may be disturbed by adverse noise and vibration levels, and structures that are sensitive to vibration) have been taken into consideration when assessing the effects associated with noise and vibration levels from the construction phase of the Proposed Development

19.5.2 The type of receptors that may experience significant effects due to the construction of the Proposed Development are identified in Table 19-4 as residential and non-residential.

19.5.3 Non-human receptors such as bird species have been considered for assessment but are presented in ES Volume IV Chapter 15: Biodiversity - Gravesend.

Table 19-4: Receptor Types

Receptor Group	Receptors In Group
Residential	Individual dwellings and private open spaces (e.g., gardens).
Non-residential	Non-residential community facilities such as schools, hospitals, places of worship, and noise sensitive commercial properties.

19.5.4 Noise and vibration effects due to the Proposed Development have been considered at nearby sensitive receptors. A number of receptors that may potentially be affected have been considered in this assessment. The sensitive receptors considered are the nearest receptors to the Proposed Development (i.e., the receptors that will experience the highest levels of noise and vibration). Although noise and vibration may be perceivable at other receptors in the area around the Proposed Development, effects will not be significant if they are suitably controlled at the identified receptors.

Gravesend Receptors

19.5.5 The nearest sensitive receptors to the Gravesend Site are the National Maritime Training Centre and the Metropolitan Police Specialist Training Centre, which are non-residential receptors located directly to the west of the Gravesend Site at a minimum distance of approximately 50m. The nearest

residential receptors are located near to Dalefield Way, to the south of the Gravesend Site at a distance of approximately 700m south-east..

19.5.6 A summary of sensitive receptors is presented in Table 19-5.

Table 19-5: Gravesend Sensitive Receptors

Receptor	Receptor Type	Daytime Construction Noise and Vibration
National Maritime Training Centre	Non-residential – Training Centre	✓
Metropolitan Police Specialist Training Centre	Non-residential – Training Centre	✓

Baseline Monitoring

19.5.7 Baseline noise monitoring was carried out by Southdowns Environmental Consultants in April and June 2023. The survey comprised unattended continuous noise monitoring over a 2-month period and attended noise and vibration measurements over 1-day periods. Full details of the survey methodology and results are presented in National Grid Thames Tunnel 400kv, Gravesend, Kent / Tilbury, Essex Baseline Noise And Vibration Monitoring Report No 2302382-SEC-00001-02 enclosed in ES Volume VI Appendix 11.2.

19.5.8 Unattended noise monitoring was undertaken at the Gravesend National Grid site (LT1) location between from 18th April to 19th June 2023. Additionally, attended noise measurements were obtained at the Gravesend National Grid on 18th May 2023 at locations ST1 to ST3.

19.5.9 Noise monitoring locations for the Gravesend site are presented in Figure 19-1.

19.5.10 . These also show the location of the nearest noise sensitive properties.

19.5.11 The baseline noise environment in the vicinity of the Gravesend Site is influenced by a number of different noise sources as follows:

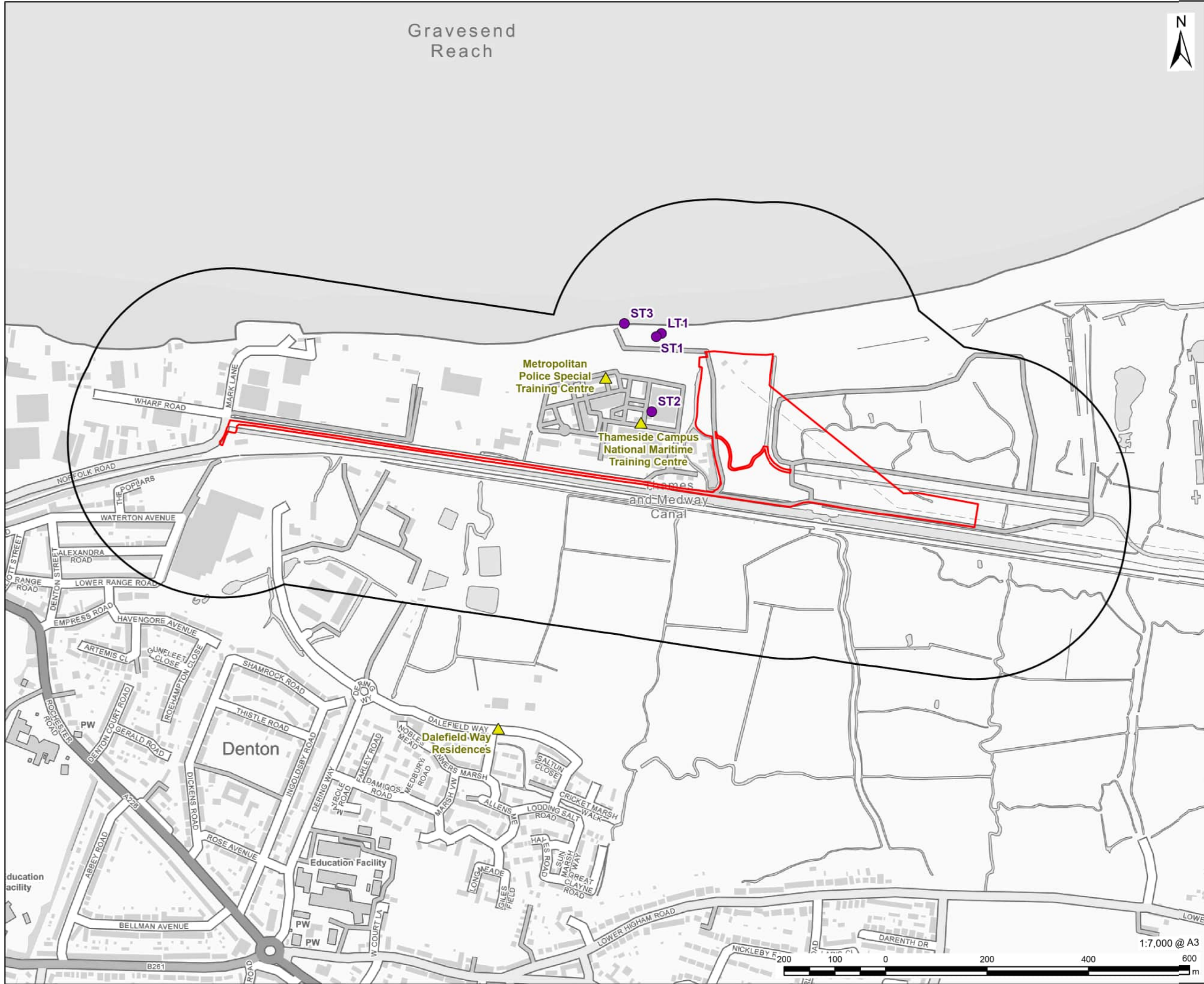
- Eastcourt Marshes Electricity Substation;
- Milton Rifle Range;
- Southern K9 Training area;
- Concrete works and associated heavy vehicle movements;
- River traffic on The Thames; and
- Rail traffic.

19.5.12 At nearby sensitive receptors, the baseline noise environment is also influenced by road traffic noise.

19.5.13 A summary of daytime and night-time baseline noise levels is presented in Table 19-6.

Table 19-6: Gravesend Baseline Noise Data

Site	Locations	Day (0700-2300)		Night (2300-0700)	
		$L_{Aeq,15min}$	$L_{A90,15min}$	$L_{Aeq,15min}$	$L_{A90,15min}$
Gravesend	LT1	51	45	47	45
	ST1	61	49	56	49
	ST2	57	45	52	45
	ST3	59	47	54	47



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LEGEND

- Red Line Boundary (Above Ground)
- 300m Study Area
- Noise Monitoring Location
- Sensitive Receptor

NOTES

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ISSUE PURPOSE

Environmental Statement

PROJECT NUMBER

60677311

FIGURE TITLE

Noise Monitoring Locations and Sensitive Receptors (Gravesend)

FIGURE NUMBER

Figure 19.1

Assessment Methodology

- 19.5.14 A new source of noise is assessed through the absolute noise level it generates at sensitive receptors. Where an exceedance of the defined Significant Observed Adverse Effect Level (SOAEL) for each noise source occurs, it is an indication of a likely significant effect. However, where an existing noise source is changed (i.e., construction traffic changing road traffic noise levels), the assessment of the effect level due to the change in noise refers to guidance within the DMRB (Ref 19-14) and consideration of the absolute noise level based on national policy guidance.
- 19.5.15 Government policy for noise is based on community exposure response relationships and noise insulation of a typical dwelling. Consequently, an assessment based on Lowest Observable Adverse Effect Level (LOAELs) and SOAELs cannot be applied to non-residential sensitive receptors. As such, the approach to the assessment of non-residential receptors differs from that adopted for residential receptors. Non-residential receptors are considered on a case-by-case basis by considering the applicable design criteria for good internal noise levels.

Construction Noise

- 19.5.16 Noise levels experienced by sensitive receptors during construction works depend upon several variables, the most significant of which are:
- the noise generated by plant or equipment used on site, generally expressed as sound power levels (L_w);
 - the periods of use of the plant on site, known as its 'on-time';
 - the distance between the noise/vibration source and the receptor;
 - the noise attenuation due to ground absorption, air absorption and barrier effects;
 - in some instances, the reflection of noise due to the presence of hard surfaces such as the sides of buildings; and
 - the time of day or night the works are undertaken.

Construction Phase

- 19.5.17 The construction of the Proposed Development is anticipated to commence in 2024 (for early mobilisation) and 2025 (for the main works) and complete in 2028. The core working hours for the rest of the construction activities will be between 8:00 – 18:00 (Monday to Sunday). Special circumstances could include continual 24 hour working during operation of the Tunnel Boring Machine (TBM). No works are to be undertaken out of hours (subject to TBM delivery), on Bank Holidays without prior consultation and agreement with the relevant LHAs.

Construction Noise Criteria

- 19.5.18 Noise generated by construction works have been predicted following guidance from BS 5228-1 'Code of practice for noise and vibration control on construction and open sites' (Ref 19-12), which provides a realistic estimate of sound propagation from construction plant. The predictions use representative noise source data for typical items of plant that are used in such developments (ES Volume VI Appendix 11.3).
- 19.5.19 Annex E of BS 5228-1 provides example methods for the assessment of the significance of construction noise effects. With reference to the NPSE, the LOAEL and SOAEL thresholds have been set in Table 19-7 below.

Table 19-7: Thresholds of Potential Effects of Construction Noise at Residential Buildings

Time Periods	Threshold Value ($L_{Aeq,T}$ dB)	
	LOAEL	SOAEL
Day (07:00 – 19:00) Saturday (07:00 – 13:00)	65	75
Evening (19.00 – 23.00) Weekends (13.00–23.00 Saturdays and 07.00–23.00 Sundays)	55	65
Night (23.00 – 07.00)	45	55

19.5.20 Although there is currently a lack of evidence relating to health effects from construction noise, the method for assessing construction noise effects is defined based on the current industry standard approach followed in other applications for development consent.

Construction Vibration Criteria

19.5.21 BS 5228-2 'Code of practice for noise and vibration control on construction and open sites' (Ref 19-13) provides guidance on the human response to vibration within occupied buildings. This provides a simple method of determining annoyance alongside evaluation of cosmetic damage associated with construction and decommissioning induced vibration.

19.5.22 Table 19-8 details Peak Particle Velocity (PPV) levels during construction (a standard measure of vibration effects) and their potential effect on humans.

Table 19-8: Criteria for Construction Vibration (Human Response)

Magnitude of Impact	PPV Vibration Level	BS 5228-2 Description of Impact
LOAEL	0.3 mm/s	Vibration might be just perceptible in residential environments
SOAEL	1.0 mm/s	It is likely that vibration of this level will cause complaint, but it can be tolerated if prior warning and explanation has been given to residents.

19.5.23 The recommended PPV vibration limits for transient vibration, above which cosmetic damage could occur for different types of buildings are provided in BS 5228-2 and presented in Table 19-9. For these limits, 'minor damage' is possible at vibration magnitudes that are greater than twice those given in Table 19-9, and 'major damage' can occur at values greater than four times the tabulated values. Consequently, the significance of effect has been provided based on the sensitivity of a building to vibration induced cosmetic damage. Cosmetic damage would precede the onset of any structural damage.

Table 19-9: Transient Vibration Guide Values for Cosmetic Damage

Type of building	Peak component particle velocity in frequency range of predominant pulse, at which cosmetic damage could occur	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures, Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	50 mm/s at 4 Hz and above
Industrial and heavy commercial buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Note 1: A potential negligible effect (not significant) is indicated at vibration levels up to the threshold values. Note 2: A potential minor adverse effect (not significant) is indicated at vibration levels up to a magnitude of twice the threshold values. Note 3: A potential moderate adverse effect (significant) is indicated at vibration levels up to a magnitude of four times the threshold values. Note 4: A potential major adverse effect (significant) is indicated at vibration levels equal to or greater than a magnitude of four times the threshold values		

Construction Traffic Noise

19.5.24 Road traffic noise levels have been calculated with reference to the methodology included within the CRTN, which provides an equation for the calculation of the Basic Noise Level (BNL) from a road in terms of the 18-hour Average Annual Weekday Traffic (AAWT) flow from 06:00 to 24:00. The temporary changes in road traffic noise levels along the local road network due to construction traffic have been assessed based on short-term changes in noise from Table 3.54a of the DMRB LA111 (Ref 19-14). Assessment criteria are presented in Table 19-10.

Table 19-10: Construction Traffic Noise Assessment Criteria

Effect Level	Magnitude Criteria
Negligible	≥ 0 dB and < 1 dB
Minor	≥ 1 dB and < 3 dB
Moderate	≥ 3 dB and < 5 dB
Major	≥ 5 dB

19.5.25 Construction traffic noise has been assessed for a representative worst-case day during the construction stage based on information in ES Volume II Chapter 3: Project Description. Predicted construction traffic noise levels along the main access routes have been compared to measured ambient noise levels so a potential change in noise can be derived.

Non-Residential Receptors

19.5.26 Design guides for good internal conditions in non-residential receptors are set indoors. The following non-residential receptors that are sensitive to noise are as follows:

- Training Centre.
- Office.

19.5.27 BS 8233 (Ref 19-16) provides guidance on suitable design ranges for internal noise levels in buildings. For offices and training rooms the levels are 35-45dB $L_{Aeq,T}$. For the purposes of this assessment, it is assumed each building fabric would attenuate noise by a minimum of 30dB.

Consequently, an external screening threshold of 75 dB $L_{Aeq,T}$ has been adopted for the daytime. An exceedance of this threshold is considered an indication of a significant effect.

Defining an Effect

- 19.5.28 All noise effects are local, only affecting the Proposed Development and nearby sensitive receptors, and are direct in nature; however, defining a likely effect and whether it is significant or not depends on the nature of a noise source. A new source of noise is assessed through the absolute noise level it generates at sensitive receptors. This assessment follows guidance for identification of significant effects set out in national policy. Where an existing noise source is changed, an assessment of the significance of effect due to the change in noise using guidance within the DMRB and consideration of the absolute noise level based on national policy guidance.
- 19.5.29 Likely effects for new sources of noise (i.e., construction and building services plant) have been defined based on guidance set out in national policy. Where an exceedance of the defined SOAEL for each noise source occurs, it is an indication of a likely significant effect.
- 19.5.30 Although a significant effect due to construction activities may be determined through an assessment based on exceedances of the defined SOAELs for construction noise and vibration, additional consideration of the overall significance of the effect for temporary construction activities will be provided through qualitative discussion of the following:
- Duration of temporary likely effects;
 - Frequency of events; and
 - Receptor type.

Assumptions and Limitations

Baseline Assumptions and Limitations

- 19.5.31 Any measurement of existing ambient or background sound levels will be subject to a degree of uncertainty. Environmental sound levels vary between days, weeks, and throughout the year due to variations in source levels and conditions, meteorological effects on sound propagation, and other factors. Hence, any measurement survey can only provide a sample of the ambient levels. Every effort has been made to ensure that measurements are undertaken in such a way as to provide a representative sample of conditions, such as avoiding periods of adverse weather conditions, and school holiday periods (which are often considered to result in atypical sound levels). However, a small degree of uncertainty will always remain in the values taken from such a measurement survey.

Noise Model Assumptions

- 19.5.32 A series of industry standard assumptions have been made for the generation of the construction noise model as follows:
- Surrounding ground conditions have been modelled as 80% soft ground;
 - Air temperature has been assumed to be 10 degrees and humidity 80%, which are considered typical annual average weather conditions for the area under consideration;
 - One order of reflection has been modelled;
 - Land topography has been incorporated into the noise modelling; and
 - All receptor points have been set at a standard height of 1.5 m above local ground levels to calculate representative noise levels at sensitive receptors.

Construction Noise Assumptions and Limitations

- 19.5.33 The assessment of construction noise and vibration has considered construction activities that have the potential to result in significant effects on identified receptors, based on information presented in ES Volume II Chapter 3: Project Description and previous experience of construction sites and professional judgement. These assessments are based on a reasonable representative worst-case scenario.

- 19.5.34 Construction noise calculations have been undertaken based on an example schedule of plant items that are typically used in such developments for the purposes of carrying out a quantitative assessment at this stage (ES Volume VI Appendix 11.3: Noise and Vibration Calculations and Modelling).
- 19.5.35 Construction plant sound source data have been based on information in BS 5228-1 (Ref 19-12). These sound sources are taken to be representative of the plant and/or activities that will be used during the construction process of the Proposed Development. Noise predictions have been carried out to provide a conservative scenario where construction plant is operational nearest to the identified receptors and do not take into account quieter periods when limited activities take place or at further distances. Consequently, noise predictions may overestimate construction noise levels and are therefore considered to be a reasonable likely worst case.
- 19.5.36 It is assumed that non-residential receptor buildings are not occupied outside of core daytime working hours. Consequently, the assessment of non-residential receptors focuses on noise effects during core daytime working hours.

19.6 Mitigation

Embedded Mitigation

Embedded Construction Mitigation Measures

- 19.6.1 Construction noise and vibration mitigation will be secured in the Construction Environmental Management Plan (CEMP) covering 'best practicable means' as defined in Section 72 of the Control of Pollution Act. This mitigation will ensure that all reasonable steps are taken to minimise noise and vibration emissions from construction activities. An Outline CEMP is provided in Appendix 3.1 (ES Volume VI) and will be finalised by the Contractor during detailed design, prior to the start of construction. Construction mitigation, including examples of best practicable means, that will be implemented during construction works and secured in the CEMP are presented below:
- Following any changes to the design, the Contractor would ensure that an updated noise assessment has been carried out to ensure there would be no additional or increase in negative effects on nearby receptors;
 - The majority of works activities would be completed under normal working hours/ restrictions as follows: Monday to Sunday: 08:00 to 18:00 and no working on Bank Holidays unless otherwise agreed with the relevant local authority. The agreed working hours will be set out in the Final CEMP.
 - Closed board fencing would be installed around the construction compounds;
 - A set of generic best practice working methods referred to as Best Practicable Means (BPM) would be employed during the construction phase. Typical BPM are outlined below, which would be refined as individual commitments in the Final CEMP:
 - Unnecessary revving of engines will be avoided, and equipment will be switched off when not in use;
 - Appropriate routing of construction traffic on public roads and along access tracks;
 - Drop heights of materials will be minimised;
 - Plant and vehicles will be sequentially started up rather than all together;
 - Plant will always be used in accordance with manufacturers' instructions. Care will be taken to site equipment away from noise-sensitive areas. Where possible, loading and unloading will also be carried out away from such areas; and
 - Regular and effective maintenance by trained personnel will be undertaken to keep plant and equipment working to manufacturer's specifications..

19.7 Assessment of Effects

Introduction

19.7.1 This section presents the findings of the assessment of the likely significant effects of the Proposed Development in respect of noise and vibration during the construction phase.

Construction Noise

19.7.2 The predicted noise levels demonstrate the level of demolition and construction noise that may occur at sensitive receptors during periods representative of reasonable worst-case construction activity.

19.7.3 Noise emissions during the following construction phases at the Gravesend Site have been modelled:

- Site set up;
- Piling/ excavation;
- Installation; and
- Re-instatement.

19.7.4 The levels of unmitigated noise predicted at the identified receptors during the construction phase are presented in Table 19-11.

Table 19-11: Gravesend Construction Noise Predictions

Receptor	Predicted $L_{Aeq,T}$ dB per Construction Phase			
	Site set up	Piling/ excavation	Installation	Re-instatement
Thameside Campus National Maritime Training Centre	68	66	63	64
Metropolitan Police Special Training Centre	65	62	59	67

19.7.5 Predicted construction noise levels at non-residential receptors during all construction phases of the Proposed Development at the Gravesend Site are below the threshold of 75 dB $L_{Aeq,T}$. As such, construction noise effects are not significant.

Construction Vibration

19.7.6 The potential vibration effects have been calculated at each existing sensitive receptor assuming the piling will generate the highest level of vibration during construction activities. Piling activities include rotary piling at the pit and impact piling for the pylon foundations. The methodology to calculate representative construction vibration levels is presented in ES Volume VI Appendix 11.3.

19.7.7 The estimated distances from identified sensitive receptors to pylon locations and calculated levels of impact piling are presented in Table 19-12. Vibration calculations are described in detail in ES Volume VI Appendix 11.3.

Table 19-12: Gravesend Construction Vibration Predictions

Receptor	Vibration Source	Distance to Nearest Proposed Site	Estimated Level of Vibration	Effect
Thameside Campus National Maritime Training Centre	Impact piling	110 m	0.8 mm/s	Between Lowest Observable Adverse Effect Level (LOAEL) and Significant Observed Adverse Effect Level) SOAEL
Metropolitan Police Special Training Centre	Impact piling	160 m	0.5 mm/s	Between LOAEL and SOAEL

- 19.7.8 Impact piling activities would result in an exceedance of the Lowest Observable Adverse Effect Level (LOAEL). As no exceedances of the SOAEL are calculated, vibration effects are not significant.
- 19.7.9 As exceedances of the LOAEL may occur, all reasonable steps will be taken to mitigate and minimise the effects through adoption of BPM, as defined in Section 72 of the Control of Pollution Act 1974.

Construction Traffic Noise

- 19.7.10 There are forecast to be a peak of 30 two-way construction HGV movements forecast during the shaft construction phase. Construction traffic will access/ egress the Site via from the A226 via Ordnance Road, Canal Road, Norfolk Road and Wharf Road. Although local roads do not experience high levels of baseline traffic flows, the number of forecast peak construction would result in an increase in noise of less than 1 dB, which is equivalent to a Negligible effect and not significant.

19.8 Additional Mitigation

- 19.8.1 No additional mitigation is deemed to be required.

19.9 Residual Effects

19.9.1 This assessment of noise and vibration effects has been undertaken after the implementation of embedded mitigation. Please see Table 19-13 below.

Table 19-13: Assessment of Noise and Vibration Effects

Receptor	Value/Sensitivity	Potential Impact	Embedded Mitigation	Additional Mitigation	Magnitude	Significance
Construction Phase						
Gravesend Training Centres	Non-residential	Construction noise	Best Practicable Means	None	Below LOAEL	Not significant
Gravesend Training Centres	Non-residential	Vibration from impact piling	Best Practicable Means	None	Above LOAEL	Not significant
All Gravesend Receptors	Non-residential/ Residential	Construction traffic noise	Best Practicable Means	None	Negligible	Not significant

19.10 Summary

- 19.10.1 Due to the distance between the Gravesend Site and sensitive receptors, and baseline background noise levels in comparison to construction phase noise levels, no significant noise or vibration effects are expected during the construction phase.

19.11 References

Ref 19-1 Her Majesty's Stationery Office (1974); Control of Pollution Act. Available at: <https://www.legislation.gov.uk/ukpga/1974/40>

Ref 19-2 Her Majesty's Stationery Office (1990); Environmental Protection Act. Available at: <https://www.legislation.gov.uk/ukpga/1990/43/contents>

Ref 19-3 Department for Energy Security and Net Zero (2023); Overarching National Policy Statement for Energy (EN-1). Available at: <https://assets.publishing.service.gov.uk/media/655dc190d03a8d001207fe33/overarching-nps-for-energy-en1.pdf>

Ref 19-4 Department of Energy and Climate Change (2011); Overarching National Policy Statement for Energy (EN-1). Available at: <https://assets.publishing.service.gov.uk/media/5a79522de5274a2acd18bd53/1938-overarching-nps-for-energy-en1.pdf>

Ref 19-5 Department for Energy Security and Net Zero (2023); National Policy Statement for Electricity Networks Infrastructure (EN-5). Available at: <https://assets.publishing.service.gov.uk/media/655dc25e046ed400148b9dca/nps-electricity-networks-infrastructure-en5.pdf>

Ref 19-6 Department of Energy and Climate Change (2011); National Policy Statement for Electricity Networks Infrastructure (EN-5). Available at: <https://assets.publishing.service.gov.uk/media/5a74877840f0b61938c7e2d9/1942-national-policy-statement-electricity-networks.pdf>

Ref 19-7 Department for Levelling Up, Housing and Communities (2023); National Planning Policy Framework. Available at: <https://www.gov.uk/government/publications/national-planning-policy-framework--2>.

Ref 19-8 Department for Environment Food and Rural Affairs (2010); Noise Policy Statement for England. Available at: <https://www.gov.uk/government/publications/noise-policy-statement-for-england>

Ref 19-9 Gravesham Borough Council (Adopted 2014). Gravesham Local Plan Core Strategy. Available at: <https://www.gravesham.gov.uk/local-plan-policy/local-plan>

Ref 19-10 Ministry of Housing, Communities & Local Government (2019); Planning Practice Guidance – Noise. Available at: <https://www.gov.uk/guidance/noise--2>

Ref 19-11 British Standards Institute (2014 with 2019 amendments); BS 4142 – Methods for rating and assessing industrial and commercial sound, BSi, London.

Ref 19-12 British Standards Institute (2009 with 2014 amendments) BS 5228:2009+A1:2014 – Code of practice for noise and vibration control on construction and open sites. Noise, BSi, London.

Ref 19-13 British Standards Institute (2009) BS 5228:2009 – Code of practice for noise and vibration control on construction and open sites. Vibration, BSi, London.

Ref 19-14 Highways England (2020); Design Manual for Road and Bridges LA111: Noise and Vibration. Available at: <https://www.standardsforhighways.co.uk/tses/attachments/cc8cfcf7-c235-4052-8d32-d5398796b364?inline=true>

Ref 19-15 Department of Transport/Welsh Office (1988); Calculation of Road Traffic Noise. Her Majesty's Stationery Office, London.

Ref 19-16 British Standards Institute (2014); BS 8233 – Guidance on sound insulation and noise reduction for buildings, BSi, London.

Ref 19-17 World Health Organization (1999); Guidelines for Community Noise. Available at: <https://www.who.int/publications/i/item/a68672>

Ref 19-18 International Organization for Standardization (ISO) (1996). ISO 9613-2 Acoustics – Attenuation of sound during propagation outdoors: Part 2: General method of calculation.

19.12 Abbreviations

Site	Reason for Designation
AAWT	Average Annual Weekday Traffic
aOD	above Ordnance Datum
BNL	Basic Noise Level
CCW	Countryside Council for Wales
CEMP	Construction Environmental Management Plan
CoPA	Control of Pollution Act 1974
CRTN	Calculation of Road Traffic Noise
dB	Decibel
DMRB	Design Manual for Roads and Bridges
EA	Environment Agency
EPA	Environmental Protection Act 1990
ES	Environmental Statement
HGV	Heavy Goods Vehicle
LOAEL	Lowest Observable Adverse Effect Level
NOEL	No Observed Effect Level
NPSE	Noise Policy Statement for England
PPGN	Planning Practice Guidance concerned with noise
PPV	Peak Particle Velocity
SOAEL	Significant Observed Adverse Effect Level
TBM	Tunnel Boring Machine
TKRE	Tilbury to Grain and Tilbury to Kingsnorth
WHO	World Health Organisation

