A47/A11 Thickthorn Junction

Scheme Number: TR010037

Volume 6
6.1 Environmental Statement
Chapter 11 – Noise and Vibration

APFP Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

The A47/A11 Thickthorn Junction Development Consent Order 202[x]

ENVIRONMENTAL STATEMENT CHAPTER 11 NOISE AND VIBRATION

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Table of contents

Tables

Figures (TR1010037/APP/6.2) (APP-071)

Appendices (TR1010037/APP/6.3) (APP-109)

11. Noise and vibration

11.1. Introduction

11.1.1. Highways England (the Applicant) has submitted an application for a development consent order (DCO) for the A47/A11 Thickthorn Junction (hereafter referred to as 'the Proposed Scheme'). The Proposed Scheme will create one new connector road between the A11 and A47 and provide a new link road between Cantley Lane South and the B1172 Norwich Road for continued access to the Thickthorn Interchange. Two new underpasses and two new overbridges will also be constructed along with improvements to the Thickthorn roundabout. The Proposed Scheme will reroute traffic away from the existing Thickthorn Interchange, which currently experiences delays and high levels of congestion during peak hours.

11.1.2. Under the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017, the Proposed Scheme is an Environmental Impact Assessment (EIA) development and as such requires submission of an Environmental Statement presenting the likely significant environmental effects of the Proposed Scheme.

11.1.3. As part of the EIA process, this Environmental Statement (ES) chapter reports the predicted significant effects for noise and vibration as a result of the Proposed Scheme. This assessment includes a review of the existing baseline conditions, consideration of the potential impacts, identification of proportionate mitigation and evaluation of residual effects and their significance.

11.1.4. The approach to this assessment follows the methodology set out in the Scoping Report (February 2018) (**TR010037/APP/6.5**) (APP-120) in combination with the most up to date guidance in the Design Manual for Roads and Bridges (DMRB) LA 111 Noise and vibration, revision 2, hereafter referred to as DMRB LA 111.

11.2. Competent expert evidence

11.2.1. The competent expert for this assessment is an acoustician with a BEng and MSc (environmental and architectural acoustics) and who is a Member of the Institute of Acoustics (MIOA). The competent expert has over 15 years in practice delivering and managing environmental noise assessments for challenging projects, both in the UK and internationally. This includes EIA and non-EIA projects in a range of sectors, such as large residential developments, office and commercial premises, industrial facilities (including manufacturing, data centres and energy plants), wind farms and road schemes. They have used their EIA knowledge and professional judgement in identifying the likely significant impacts

associated with the Proposed Scheme and providing technical guidance through the assessment process.

11.3. Legislative and policy framework

11.3.1. The relevant policy, standards and guidance documents used to inform the noise and vibration impact assessment are summarised in ES Appendix 11.2 (**TR010037/APP/6.3**) (APP-109). A list and summary of relevant policies, standards and guidance is provided below.

11.3.2. Full references are also provided in Section 11.13.

Control of Pollution Act, 1974

11.3.3. The Control of Pollution Act 1974 offers protection against disturbance to residents that might be affected by construction activity.

Noise Insulation Regulations, 1975 (amended 1988)

11.3.4. The Noise Insulation Regulation provides obligatory and discretionary provision of noise mitigation measures for dwellings adjacent to new highways.

National Policy Statement for National Networks (NPS NN)

11.3.5. The NPS NN sets out the Government's vision and policy for the future development of the Nationally Significant Infrastructure Projects (NSIP) on the national road and rail networks in England.

National Planning Policy Framework, 2019 (NPPF)

11.3.6. The NPPF sets out the Government's planning policies for England and how these should be applied. It provides a framework within which local development plans can be produced.

Noise Policy Statement for England, 2010 (NPSE)

11.3.7. The NPSE sets out policy that seeks to promote good health and good quality of life through effective management of noise within the context of Government policy on sustainable development. This is to be achieved by avoiding significant adverse impacts on health and quality of life, mitigating and minimising adverse impacts on health and quality of life and, where possible, contributing to the improvement of health and quality of life.

Planning Practice Guidance – Noise, 2019 (PPG-N)

11.3.8. The PPG-N provides guidance on how the policy set out in NPPF may be interpreted in practice. It suggests that for plan-making and decision taking local

planning authorities should take into account whether the overall effect of the noise exposure is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level.

Noise Action Plans 2019

11.3.9. Noise Action Plans have been published by the Department for Environment, Food, and Rural Affairs (DEFRA) and requires determination, through noise mapping, of exposure to environmental noise from major transportation sources and in agglomerations, provision of information to the public on environmental noise and its effects, adoption of action plans to manage environmental noise and preservation of environmental noise quality where it is good.

Highways England policy on Road Investment Strategy (RIS) (current at the time of writing)

11.3.10. Part of the RIS includes noise as a Key Performance Indicator (KPI) for Highways England. The reduction of noise impacts from the strategic road network through the application of quieter surfaces and noise barriers are given as a benefit of capital renewals projects.

The South Norfolk Council Development Management Policies DPD (2015)

11.3.11. The DPD forms part of a set of documents that together constitute a Development Plan for the future development of the area. It refers to adverse effects due to noise and makes references to the requirements of NPPF.

WHO Night Noise Guidelines for Europe, 2009

11.3.12. The WHO Night Noise Guidelines for Europe was published for the development of future legislation and policy action in the area of assessment and control of night noise exposure. It also sets noise levels at which adverse health effects are observed.

WHO Environmental Noise Guidelines for the European Region 2018

11.3.13. The main purpose of these guidelines is to provide recommendations for protecting human health from exposure to environmental noise originating from various sources, including transportation noise. The current guidelines complement the Night Noise Guidelines from 2009.

British Standard (BS) 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise

11.3.14. BS 5228 Part 1 of the standard provides a methodology for predicting and assessing noise levels generated by fixed and mobile plant used for a range of typical construction operations.

BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration

11.3.15. BS 5228 Part 2 of the standard provides guidance on the effect of vibration and the likelihood it will cause complaint and cosmetic damage to buildings and gives recommendations for methods of vibration control.

BS 7385-2:1993 Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration

11.3.16. BS 7385-2 gives guidance on the assessment of the possibility of vibration-induced damage in buildings due to a variety of sources and identifies the factors which influence the vibration response of buildings.

DMRB LA 111 Noise and vibration, Revision 2, 2020

11.3.17. DMRB LA 111 sets out the requirements for noise and vibration assessments from road projects, applying a proportionate and consistent approach using best practice and ensuring compliance with relevant legislation.

DMRB LD 119 Roadside environmental mitigation and enhancement, Revision 0, 2020

11.3.18. DMRB LD 119 sets out the requirements for the design of roadside environmental mitigation and enhancement on highway projects.

DMRB CD 236 Surface course materials for construction, 2020

11.3.19. DMRB CD 236 provides requirements for pavement surfacing for both flexible and rigid pavements.

BS EN 1793-2:2012 Road traffic noise reducing devices. Test method for determining the acoustic performance. Intrinsic characteristics of airborne sound insulation under diffuse sound field conditions

11.3.20. BS EN 1793-2:2012 specifies the laboratory method for measuring the airborne sound insulation performance of road traffic noise reducing devices in reverberant conditions.

Calculation of Road Traffic Noise (CRTN), 1988

11.3.21. CRTN provides procedures for predicting the level of road traffic noise accounting for the traffic parameters and sound propagation effects to nearby sensitive receptors such as the absorption of sound by the ground and the screening and reflection effects of intervening or nearby structures and buildings.

BS 7445-1:2003 Description and measurement of environmental noise. Guide to quantities and procedures.

11.3.22. This part of BS 7445 defines the basic quantities to be used for the description of noise in community environments and describes basic procedures for the determination of these quantities.

Transport Research Laboratory (TRL), Converting the UK traffic noise index $L_{A10,18hr}$ to EU noise indices for noise mapping, 2002

11.3.23. This TRL study (hereafter referred to as the 'TRL conversion study') presents methods for converting the UK traffic noise index, dB $L_{A10,18hr}$, to EU noise indices. The evidence base for each option is presented along with the advantages and disadvantages of each method.

TRL, Groundborne vibration caused by mechanised construction works, 2000

11.3.24. This TRL study presents a review of current knowledge of groundborne vibration transmission from construction works. The report presents methods of predicting vibration levels from different mechanised construction activities, accounting for the characteristics of the plant and site conditions.

11.4. Assessment methodology

11.4.1. This section sets out the approach and methods adopted for the assessment of noise and vibration. The assessment methodology is in accordance within DMRB LA 111 and accounts for the above policy and guidance.

11.4.2. Further detail regarding the assessment approach within DMRB LA 111 is presented in ES Appendix 11.2 (**TR010037/APP/6.3**) (APP-109). The assumptions incorporated into each assessment are described in Section 11.5.

Update to guidance and scope of assessment

11.4.3. Following a review of changes to DMRB guidance on noise and vibration (DMRB LA 111, revision 2, 2020), the Scoping Report (2018) (**TR010037/APP/6.5**) (APP-120) for the Proposed Scheme has been reviewed. The Scoping Report is considered to remain valid, however, some elements have been amended for the

noise and vibration assessment methodology. These are presented in Table 11-1 below.

Table 11-1: Summary of scoping updates

Scoping document	Scoping item	Comment on original scope (2018)	Updated scope (2020)
Scoping Report, 2018	Operational noise study area	Study area identified as an area within 1km of the physical works associated with the Proposed Scheme. Within this study area, road traffic noise predictions are performed at any sensitive receptor within 600m of a road where this is the possibility of a change of 1dB $L_{A10,18hr}$ upon Proposed Scheme opening, or 3dB $L_{A10,18hr}$ in the long term. Outside of the 1km area, sensitive receptors are identified adjacent to roads where the change in received road traffic noise level would, as a result of the Proposed Scheme, increase or decrease by at least 1dB $L_{A10,18hr}$ on opening or 3dB in the long term.	Operational study area includes the area within 600m of new road links or road links physically changed or bypassed by the project plus 200m around the new merge lane on to the A11 from Station Lane and 50m around NIA[1] 4965.
	Construction noise study area	The study area is the same as that defined for assessment of operational noise impacts. Assessment will be limited to areas where total noise (calculated construction noise plus baseline noise) exceeds baseline noise levels.	Based on a review of proposed construction methods and plant, and in line with DMRB LA 111 guidance, a study area of 300m from the closest construction activity was considered sufficient to evaluate the potential for significant construction noise effects at noise sensitive receptors.
	Construction vibration study area	Not defined.	DMRB LA 111 notes that a study area encompassing a 100m area from vibration generating activity is normally sufficient. However, given the expected methods of work, a study area encompassing a 30m area from vibration generating activity was considered sufficient to evaluate the potential for significant effects due to vibration at sensitive receptors.
	Construction noise methodology and significance criteria	Example Method 2 – 5dB(A) change (Annex E 'Significance of Noise Effects' Section E.3.3) will be adopted for the assessment of effects at sensitive receptors.	The lowest observed adverse effect level (LOAEL) and significant observed adverse effect level (SOAEL) (defined in ES Appendix 11.1) (**TR010037/APP/6.3**) (APP-109) have been established in accordance with Table 3.12 of DMRB LA 111. LOAEL based on baseline noise levels $L_{Aeq,T}$ and SOAEL

[1] Noise Important Areas (NIAs), as defined in ES Appendix 11-1

Scoping document	Scoping item	Comment on original scope (2018)	Updated scope (2020)
			threshold level determined as per BS 5228-1:2009+A1:2014 Section E3.2 and Table E.1.
	Operational noise significance criteria	Table 11.2 of the Scoping Report summarises proposed LOAEL and SOAEL values, based upon those adopted for other recent infrastructure schemes.	LOAELs and SOAELs are set out in DMRB LA 111 Table 3.49.1 for all noise sensitive receptors.
	Operational vibration	Disturbance from vibration may be quantified along similar lines to nuisance from noise.	DMRB LA 111 states that "*Operational vibration is scoped out of the assessment methodology as a maintained road surface will be free of irregularities as part of the project design and under general maintenance, so operational vibration will not have the potential to lead to significant adverse effects*". As such, operational vibration has been scoped out of this assessment

Consultation

11.4.4. The Environmental Protection Department of South Norfolk Council were consulted on 13 July 2020. The consultation email outlined the proposed approach to the assessment of noise and vibration due to the Proposed Scheme, advising that the assessment would be carried out in accordance with DMRB LA 111, Revision 2.

11.4.5. The use of baseline noise survey data obtained in May 2018 was reviewed and agreed by the South Norfolk Council to be valid for this assessment. Details of this survey are presented in ES Appendix 11.3 (**TR010037/APP/6.3**) **(APP-109)**.

11.4.6. A request was made for information regarding any consented developments that may go ahead before the Opening Year of the Proposed Scheme. This information was provided with reference the Cringleford residential extension development both north and south of the A11 to the east of the existing A47/A11 Thickthorn Junction. This development was permitted under planning permission 2014/00025 and subsequently varied by planning permission 2017/2120.

Assessment method: Baseline survey and validation

11.4.7. As part of the assessment, a baseline noise survey was carried out in May 2018 at positions representing noise-sensitive receptors in the vicinity of Proposed Scheme. Environmental noise levels measured during the survey have been analysed to determine the UK road traffic noise index, dB $L_{A10,18hr}$, at each

position. Full details of the baseline survey are presented in ES Appendix 11.3 (**TR010037/APP/6.3**) (APP-109).

11.4.8. The measured road traffic noise levels have then been compared with the Do Minimum Opening Year scenario road traffic noise model to determine whether any adjustment to the model is necessary. This is discussed further in Section 11.7.

Assessment method: Construction noise and vibration

11.4.9. The assessment of construction noise and vibration has been carried out for representative receptors within the construction noise and vibration study areas. These are detailed in Section 11.6 and identified in ES Figure 11.1 (**TR010037/APP/6.2**) (APP-071).

11.4.10. The level of noise and vibration due to construction has been estimated at sensitive receptors, by applying the following methods.

Prediction method: construction noise

- The construction noise assessment includes the following noise sources:
  - Construction plant in use on the project~~;~~
  - Construction compounds~~; and~~
  - Traffic on haul roads not part of the public highway.
- The construction noise assessment is focused on 12 representative receptor positions. These positions represent the receptors within the study area closest to the proposed construction works at which potentially significant construction noise effects could occur.
- The representative positions were selected as either a single receptor, or as a position representing the worst-affected receptor in a group of receptors.
- The level of noise from each construction stage has been predicted using the Datakustik Cadna/A® noise modelling software, by applying the calculation methodologies within BS 5228-1.
- Each construction stage has been modelled as an area source representing each construction works location.
- Each area source is assigned the cumulative sound power level of all plant and activity occurring during the stage. This cumulative sound power level accounts for the type and sound output of each plant item, the number of plant items and the expected on-time for each activity as presented in ES Appendix 11.5 **(TR010037/APP/6.3)** (APP-109).
- The construction noise levels predicted using this method represent the average construction noise level that will occur over the duration of each construction stage, accounting for the long-term movement of plant and activities over the works area.

Prediction method: construction vibration

- Construction vibration has been predicted only for the activities which have the potential to result in the highest levels of vibration. These activities are piling and compaction. Vibrating rollers are proposed for use during earthworks, road formation and surfacing works.
- The level of vibration during compaction have been estimated using Annex E of BS 5228 and the TRL report *Ground-borne Vibration Caused by Mechanised Construction Works*.
- The level of vibration during compaction applies the empirical relationship within BS 5228 that reports the vibration level at which there is a 33% chance of this level being exceeded. This represents the vibration level that is towards the upper end of vibration due to compaction and represents the reasonable worst-case scenario.
- There is no defined prediction methodology for rotary bored piling within the BS5228. However, BS 5228 includes a method of estimating the level of vibration from vibratory piling and this is known to result in higher levels of vibration than rotary bored piling. As a precautionary approach, vibration from rotary bored piling is assumed to be the same as vibratory piling and this prediction method has been applied. These predictions represent the worst-case scenario.

11.4.11. The magnitude of the construction noise or vibration impact is then determined by comparing the predicted levels against the construction LOAEL and SOAEL values, as presented below. The likelihood of significant effects has then been considered accounting for factors such as the hours of work and duration of the works.

11.4.12. The magnitude of the construction noise impact varies for each location within the study area. The impact magnitudes for each representative receptor are presented within ES Appendix 11.5 **(TR010037/APP/6.3)** (APP-109) and summarised with Section 11.6 of this chapter.

11.4.13. The magnitude of construction vibration impact has been determined for each activity and for the closest receptors to the works. These impacts are presented in Section 11.8.

Construction noise LOAEL and SOAEL

11.4.14. The LOAEL at each location is equal to the baseline ambient noise level ($L_{Aeq,Day}$) at that location. These baseline noise levels have been estimated from the Do-Minimum Opening Year road traffic noise model and the application of the conversions within the TRL study.

11.4.15. The SOAEL at each location is determined as per DMRB LA 111, which references BS 5228-1 Section E3.2 and Table E.1 (the ‘ABC Method’). This

method allows a SOAEL to be defined that accounts for the existing ambient noise level in that location. For daytime construction activity, the SOAEL is either 65 dB, 70 dB, or 75 dB $L_{Aeq,T,}$ depending on the existing ambient noise level in that location. The SOAEL values for evening and weekend works are then 10 dB lower than for daytime, and the SOAEL values for night-time works are 20 dB lower than for daytime.

11.4.16. Details of LOAEL and SOAEL values for each representative receptor location are presented in ES Appendix 11.5, Table 11.5.2 (**TR010037/APP/6.3**) (APP-109).

Construction vibration LOAEL and SOAEL

11.4.17. The LOAEL for construction vibration is 0.3 mm/s (Peak Particle Velocity PPV) which may be just perceptible in residential environments.

11.4.18. The SOAEL for construction vibration is 1.0 mm/s (PPV) which is the level that is likely to cause complaint but can be tolerated if prior warning and explanation has been given to residents.

Assessment method: Construction traffic and diversions

11.4.19. The assessment of construction traffic which uses public highways has taken the baseline noise level to be consistent with the do-minimum opening year (DMOY) road traffic noise levels. The approach for the construction traffic assessment has been to identify the change in road traffic noise on the existing road network due to additional heavy vehicle movements. The magnitude of impact from construction traffic is considered with reference Table 3.17 of DMRB LA 111.

11.4.20. Traffic diversions due to road closures that are required to carry out the proposed construction works are considered in accordance with the methodology presented in DMRB LA 111. The available information on road closures is presented in the Outline Traffic Management Plan (**TR010037/APP/7.5**) (APP-129).

Assessment method: Operational noise

11.4.21. The operational noise study area is detailed in Section 11.6 and identified in ES Figure 11.1 (**TR010037/APP/6.2**) (APP-071).

11.4.22. DMRB LA 111 requires that road traffic noise levels are predicted for four scenarios (as defined in ES Appendix 11.1, **TR010037/APP/6.3**) (APP-109), as follows:

- Do-minimum[2] in the opening year (DMOY)
- Do-minimum in the future year (DMFY)
- Do-something[3] in the opening year (DSOY)
- Do-something in the future year (DSFY)

11.4.23. A road traffic noise model has been constructed for each scenario, the assumptions for which are presented in Section 11.5. These models apply the Calculation of Road Traffic Noise methodology, accounting for the forecast traffic volumes, characteristics and speeds.

11.4.24. Noise level contours have then been produced to present road traffic noise levels across the study area within each scenario. Noise difference contours are also presented for the following comparisons:

- DMFY minus DMOY: This presents the long-term change in road traffic noise without the Proposed Scheme;
- DSOY minus DMOY: This presents the short-term change in road traffic noise on the opening of the Proposed Scheme; and
- DSFY minus DMOY: This presents the long-term change in road traffic noise with the Proposed Scheme.

11.4.25. For each of the three comparisons described above, the number of receptors within the operational study area that are subject to no change, negligible, minor, moderate or major magnitude of impact (that may be either increases or decreases) are reported in Section 11.8.

11.4.26. For noise sensitive receptors within buildings, the assessment of the change in road traffic noise has been undertaken for the position predicted to experience the greatest magnitude of noise change, in accordance with DMRB LA 111.

11.4.27. For noise sensitive receptors located outdoors (i.e. Public Rights of Way (PRoW), Sites of Special Scientific Interest (SSSI) and cemeteries), the assessment of changes in road traffic noise has been undertaken for daytime, assuming that these receptors are not sensitive during the night. For PRoW spanning a considerable length or area, the assessment considers the noise impact at the majority length or are rather than at a specific single location.

Operational noise LOAEL and SOAEL

11.4.28. The LOAELs and SOAELs values for operational road traffic noise are presented within

[2] Do Minimum: The existing road network without the Proposed Scheme but with changes to highways or developments that would occur independently of the Proposed Scheme.
[3] Do-Something: The future road network assuming the Proposed Scheme is operational and with changes to highways or developments that would occur independently of the Proposed Scheme.

~~11.4.28.~~ Table 11-2

11.4.29. ~~Table 11-2~~. These are consistent with the effect levels established within DMRB LA 111 Table 3.49.1.

Table 11-2: Operational noise LOAELs and SOAELs for all receptors

Time period	LOAEL	SOAEL
Day (06:00-24:00)	55 dB $L_{A10,18hr}$ facade	68 dB $L_{A10,18hr}$ facade
Night (23:00-07:00)	40 dB $L_{night,outside}$ (free-field)	55 dB $L_{night,outside}$ (free-field)

11.4.30. For outdoor receptors, such as PRoW, the daytime effect levels are 3dB lower since these receptors are in free-field conditions.

Determining significance

11.4.31. The LOAEL and SOAEL values for each potential effect have been presented above with the significance criteria for the assessment of construction noise and vibration, construction traffic, and operational noise.

11.4.32. For construction effects, DMRB LA 111 advises that a significant effect would occur when a moderate or major impact is expected for 10 or more days or nights in any 15 consecutive days or nights; or for a total number of days exceeding 40 in any six consecutive months.

11.4.33. For operational noise, DMRB LA 111 advises that, for an initial assessment of significance, a moderate or major magnitude of change in road traffic noise in the short-term is be classed as 'significant'. Further assessment is then required to determine the final operational significance. This involves the consideration of the context and circumstance of each change in road traffic noise. The context and circumstance considerations are stated within DMRB LA 111 Table 3.60 which is also presented in Table 11-3~~Table 11-3~~. Road traffic noise changes that have of a minor, moderate or major magnitude in the short-term are potentially significant once the context and circumstance has been considered.

Table 11-3: Determining final operational significance on noise sensitive buildings

Local Circumstance	Influence of Significance Judgement
Noise level change (is the magnitude of change close to the minor/moderate boundary?)	1) Noise level changes within 1 dB of the top of the 'minor' range can indicate that it is more appropriate to determine a likely significant effect. 2) Noise level changes within 1 dB of the bottom of a 'moderate; range can indicate that it is more appropriate to consider a change is not a likely significant effect.
Differing magnitude of impact in the long-term and/or future year to magnitude of impact in the short-term	1) Where the long-term impact is predicted to be greater than the short-term impact, it can be appropriate to conclude that a minor change in the short term is a likely significant effect. Where the long-term impact is predicted to be less than the short term it can be appropriate to conclude that a moderate or major change in the short term is not significant. 2) A similar change in the long-term and non-project noise change can indicate that the change is not due to the project and not an indication of a likely significant effect.
Absolute noise level with reference to LOAEL and SOAEL (by design this includes sensitivity of receptor)	1) A noise change where all do-something absolute noise levels are below SOAEL requires no modification of the initial assessment. 2) Where any do-something absolute noise levels are above the SOAEL, a noise change in the short-term of 1.0 dB or over results in a likely significant effect.

Local Circumstance	Influence of Significance Judgement
Location of noise sensitive parts of a receptor	1) If the sensitive parts of a receptor are protected from the noise source, it can be appropriate to conclude a moderate or major magnitude of change in the short-term and/or long-term is not a likely significant effect. 2) Conversely, if the sensitive parts of the receptor are exposed to the noise source, it can be more appropriate to conclude a minor change in the short-term and/or long term is a likely significant effect. 3) It is only necessary to look in detail at individual receptors in terms of this circumstance where the decision on whether the noise change gives rise to a significant environmental effect is marginal.
Acoustic context	1) If a project changes the acoustic character of an area, it can be appropriate to conclude a minor magnitude of change in the short-term and/or long-term is a likely significant effect.
Likely perception of change by residents	1) If the project results in obvious changes to the landscape or setting of a receptor, it is likely that noise level changes will be more acutely perceived by the noise sensitive receptors. In these cases, it can be appropriate to conclude that a minor change in the short-term and/or long-term is a likely significant effect. 2) Conversely, if the project results in no obvious changes for the landscape, particularly if the road is not visible from the receptor, it can be appropriate to conclude that a moderate change in the short-term and/or long-term is not a likely significant effect.

11.4.34. This assessment method is explained further in ES Appendix 11.2 **(TR010037/APP/6.3)** (APP-109).

11.5. Assessment assumptions and limitations

Construction noise and vibration

11.5.1. Outline information regarding construction programme, schedule, construction compounds, works phasing and diversion routes have been made available at this stage by the Contractors.

11.5.2. Details of the construction stages, location of the representative sample of noise sensitive receptors, assumptions of plant used in the assessment and predicted construction noise levels are presented in ES Appendix 11.5 **(TR010037/APP/6.3)** (APP-109). The 12 noise sensitive receptors used in the construction noise assessment are also presented in ES Figure 11.1 (Noise location plan) **(TR010037/APP/6.2)** (APP-071).

11.5.3. The majority of the construction work will take place during the daytime. This assessment assumes that typical construction times will be between 07:00-19:00 on weekdays and 07:00-19:00 on Saturdays.

11.5.4. Night-time or weekend works will be required at some stages, such as to construct works accesses, road tie-ins and the underpasses associated with the A11-A47 connector road. These will need to be considered in further detail as construction methods are refined and proposals for night-time work discussed with the Environmental Health Department at South Norfolk Council.

11.5.5. There are currently two construction methodology options for the underpasses (the box-push method or the top-down method). Details of both construction methodologies are presented in ES Chapter 2, The proposed scheme **(TR010037/APP/6.1)** (APP-039). The preferred construction methodology has not yet been decided upon, and therefore both options are assessed in this Chapter.

11.5.6. Vibrating rollers are proposed for use during earthworks, road formation and surfacing works. It is assumed that any vibratory rollers used during construction will have two vibrating drums, a maximum drum vibration amplitude of 0.5 mm and a drum width of 1m. This assumption is based on professional judgement and works on previous schemes.

11.5.7. Based on the outline construction information, it is expected that all piling will be rotary bored and will occur only during the structure formation construction stages.

11.5.8. The outline construction programme has been reviewed to determine the risk of a significant effect occurring, in accordance with DMRB LA 111. Where the risk of a likely significant effect is identified, monitoring and further detailed assessment works will be required by the Principal Contractor, in discussion with the local authority to agree the final plant proposals and work durations.

Construction traffic

11.5.9. The proposed construction traffic haul routes are positioned within the regions in where construction noise from each construction stage will also be present. Noise from haul road vehicle movements are included within the construction noise predictions and are not considered separately.

11.5.10. The construction compound areas are presented in ES Figure 2.1 (The Proposed Scheme) **(TR010037/APP/6.2)** (APP-054) and comprise a primary area to the south of the B1172 and a satellite compound to the south of the A11.

11.5.11. It is assumed that most construction traffic movements will be to and from the two proposed compound areas during daytime. It is assumed that the majority of heavy vehicle movements, arriving to and departing from the compounds, will occur on the trunk road network (A47, A11 and B1172). Cantley Lane South is to be used to access construction stages, such as the footbridge, but it will not be used to provide general access from off-site to the site compounds. This will be included in within the Traffic Management Plan **(TR010037/APP/7.5)** (APP-129).

11.5.12. The maximum number of site-wide lorry trips per day for any construction stage is assumed to not exceed 150. This is number of vehicles is considered to be the reasonable worst-case scenario and is based on professional judgement with

input from the Principal Contractor. Therefore, a total of 300 heavy vehicle movements (including return journeys) have been included in the construction traffic assessment on the A47, A11 and B1172.

11.5.13. A number of assumptions are made regarding other nearby roads as follows:

- Cantley Lane South will also be used for access, however, this is for significantly fewer construction stages, and therefore 50 heavy vehicle movements are assumed to occur per day on this road, based on professional judgement.
- It is assumed that roads other than those detailed above will not typically be used by heavy construction vehicles associated with the construction of Proposed Scheme. This is to be controlled in the Traffic Management Plan **(TR010037/APP/7.5)** (APP-129).

Operational noise

11.5.14. Table 11-4~~Table 11-4~~ describes the assumptions and limitations associated with the noise model used to inform the operational noise assessment.

Table 11-4: Noise model assumptions and limitations

Model element	Assumption and limitations
Traffic data	• The level of road traffic noise from the road network has been predicted using traffic data provided. $L_{A10,18hr}$ traffic noise levels have been predicted using Datakustik CadnaA® noise modelling software, in accordance with CRTN methodology and the modifications and guidance stated in DMRB LA 111. • L_{night} traffic noise levels have been calculated using the TRL conversion study. The choice of conversion method accounts for the type of road and the expected diurnal variation in traffic volumes and are the methods deemed most appropriate by the competent expert.[4] • The noise predictions contain the same inherent assumptions that were built into the traffic model to predict traffic flows, composition and speed at each link. For a 1dB change to occur traffic flows need to increase by 25% or decrease by 20% (all other variables being equal). Therefore, small errors in traffic flow forecasts are unlikely to significantly affect results. • The Scheme opening year is assumed to be 2025 and the future year 2040.
Road alignments	• The road alignments have been modelled based on geo-referenced shapefiles that reflect the design as described in Chapter 2 (The Proposed Scheme). • These have been supplemented by OS MasterMap Topography Layer and Google Maps Satellite data.
Norwich Western Link (NWL)	• The NWL, a proposed road scheme between the A47 / Wood Lane (B1535) junction and the Fakenham Road (A1067), has been included in both the Do-Minimum and the Do-Something scenarios within this report. • The NWL is more than 10 km from the Proposed Scheme and therefore outside of all study areas and not present within the operational noise model. However, to align the noise model with the uncertainty log considered in the traffic model (which includes the NWL as detailed in the Transport Assessment contained within the Case for the Scheme (**TR010037/APP/7.1**) (APP-125), any effect of the NWL on road traffic flows has been incorporated in the road traffic noise predictions for the Proposed Scheme.
Road surfaces	• All rural roads have been assumed as comprising a hot-rolled asphalt surface.

[4] For all roads, the dB L_{night} index has been determined by applying TRL Method 3. This application of this method provides reliable results for most roads and this simple method was considered commensurate with the scale of the Proposed Scheme.

Model element	Assumption and limitations
	• The existing surface of the A47 and A11 trunk road has been modelled based on data from the Highways England Pavement Management System (HAPMS). This includes concrete surface on the A11 to the west of the Thickthorn junction except at the approach. • For the 'Do-Something' scenarios, a hot rolled asphalt surface is assumed for new carriageways and a like-for-like resurfacing is assumed for altered existing carriageways.
Topography	• The topography for the core study area has been modelled based on 5 metre Digital Terrain Model (DTM) supplied by Highways England through the GeoStore. Digital Terrain/Surface Model - ©Astrium Ltd and Bluesky International Ltd. • The contours created from the DTM are at 1 metre intervals (vertical resolution). • The topography contours modelled for the Proposed Scheme were produced based on 3D drawings provided by the Highways engineering team. • The topography contours modelled for the Proposed Scheme replace the DTM topography at areas within the red line boundary for all Do-Something scenarios.
Buildings	• Buildings have been modelled based on OS Mastermap (Highways England Geostore) data. • Building heights have been derived from eave height data from the above dataset and combined with Google Maps data. • Future residential receptors at the Cringleford residential extension committed development has been allocated based on information available in the planning portal and drawings provided by the developer. 143 buildings have been assumed to be located north of the A11 and 216 buildings to the south of the A11. This is based on information available in the planning portal (planning permission 2017/2120) and drawings provided by the developer. • Close boarded fences or walls at property boundaries have not been included in the model.
Ground cover	• Intervening ground between any road and a receiver has been modelled as acoustically absorbent based on the rural nature of the area. • Buildings and roads have been included as acoustically hard (i.e. reflective).
Address data	• Address and receptor sensitivity data has been defined from OS AddressBase Plus data.
PROW	• PRoW data was obtained from Norfolk County Council at https://maps.norfolk.gov.uk/highways/#. Some ProW span over a considerable area/length and their use is of a transient nature. The assessment of the potential noise impacts has been undertaken across the total area/length of these NSRs to provide a balanced approach, considering the impact at the majority of the path rather than at a specific single location. • For PRoW, the assessment is based on worst-case road traffic noise predictions at the closest part of the PRoW to the Proposed Scheme.
Survey data	• The noise survey undertaken in May 2018 has been used to inform the noise model and for characterising the sound climate. • For the reported comparison between measured noise levels and predicted noise levels, the Cringleford residential extension committed development was not included in the noise model specifically used for this comparison, to reflect the actual build-up of the area and noise propagation at the time of the survey.

11.5.15. Data collection and analysis complemented by the assumptions stated above ensure the robustness of the assessment.

11.6. Study area

11.6.1. The study areas considered in the assessment are identified in ES Figure 11.1 **(TR010037/APP/6.2)** (APP-071) and explained below.

Construction noise and vibration

11.6.2. For the construction noise assessment, the study area has been defined as the area that is 300m from the closest construction activity. DMRB LA 111 paragraph

3.5 Note 1 states that this is normally sufficient to encompass the receptors that will potentially be affected by construction noise.

11.6.3. For the construction vibration assessment, DMRB LA 111 notes that a study area encompassing a 100m area from vibration-generating activity is normally sufficient. Given the expected methods of work and based on professional judgement, a study area encompassing 30m area from vibration generating activity is considered appropriate for identifying potentially significant effects since beyond this distance construction vibration, including from rotary piling and vibratory rollers would not lead to significant adverse effects. This is discussed further in Section 11.8.

11.6.4. Some construction works would require temporary diversions of traffic on public highways due to road closures. A diversion route study area has been defined to include a 25m width from the kerb line of the diversion routes as per DMRB LA 111 paragraph 3.7.

Construction traffic and diversions

11.6.5. For the construction traffic assessment, DMRB LA 111 paragraph 3.8 states that a study area shall be defined to include a 50m width from the kerb line of public roads with the potential for an increase in the baseline noise level of 1dB(A) or more as a result of the addition of construction traffic to existing traffic levels. As shown later in the chapter, increases in the baseline noise level due to the addition of construction related traffic are predicted to remain below 1dB(A). Therefore, a study area for the construction traffic assessment is considered unnecessary, and the likelihood of any significant effect is determined through assessment of the road traffic noise increase alone along specified roads, not at specific receptors.

Operation

11.6.6. The operational study area for this assessment has been defined as the area within 600m of new road links or road links physically changed or bypassed by the project. There are no roads links outside of this area with the potential to experience a short-term basic noise level change of more than 1.0 dB(A), as described in DMRB LA 111. However, the study area has been extended to include the following relevant areas:

- To the south west of the main works, the design of the proposed scheme includes a new merge lane on to the A11 from Station Lane and the study area therefore includes a 200m buffer around this altered link. This is sufficient to include the adjacent receptors.
- The study area has been extended to include all receptors within NIA 4965, which lies north of the A11 at the edge of the original 600m buffer.

11.7. Baseline conditions

11.7.1. In order to establish the baseline sound conditions, noise monitoring was undertaken in the vicinity of the Proposed Scheme in May 2018. Full details of the survey undertaken are presented in ES Appendix 11.3 (**TR010037/APP/6.3**) (APP-109). Noise monitoring positions are also identified in ES Figure 11.1 (**TR010037/APP/6.2**) (APP-071).

11.7.2. Measured baseline results have been compared with the predicted road traffic noise index, dB $L_{A10,18hr}$ for the Do-Minimum Opening Year scenario. This comparison is shown in ES Appendix 11.4 (**TR010037/APP/6.3**) (APP-109).

11.7.3. The comparison between measured and modelled road traffic noise levels presented in ES Appendix 11.4 (**TR010037/APP/6.3)** (APP-109) demonstrates a robust level of validation. The baseline noise survey is considered valid for use in this assessment. The model results are considered robust for representing the do-minimum opening year scenario and no amendments were applied.

11.7.4. The construction vibration baseline is assumed to be zero due to the absence of construction work prior to project commencement.

Receptors within the construction noise and vibration study area

11.7.5. Within the 300m construction noise study area, a total of 481 noise and vibration sensitive receptors have been identified. These include future receptors within the Cringleford residential development.

11.7.6. Construction noise and vibration levels and their effects have been assessed at a representative sample of 12 receptor positions. These receptors are located closest to the works and represent the locations at which construction noise and vibration levels are expected to be the greatest. Each representative position was selected either to represent a single receptor, or to represent a group of receptors where the existing noise climate is similar.

11.7.7. The representative receptor positions used in the assessment are shown in ES Figure 11.1 (**TR010037/APP/6.2**) (APP-071). Where receptors are grouped, ES Figure 11.1 shows the receptors to which the predicted effects apply.

11.7.8. There are a very large number of properties within the diversion route study area. It is not proportionate to assess the impact of diversions at individual receptors along these routes. The likelihood of significant effect is determined through assessment of the road traffic noise changes alone along specified roads, not at specific receptors. This further detailed later in Section 11.8 of this chapter.

Receptors within the operational noise study area

11.7.9. Within the operational noise study area, a total of 601 existing noise sensitive receptors have been identified within the operational study area. These include 11 non-residential noise sensitive receptors.

11.7.10. The location of the residential receptors can be grouped as follows:

- Residential receptors around Cringleford, east of the Thickthorn junction, both north and south of the A11. This includes NIA 4965 north of the A11.
- Residential dwellings along both sides of Cantley Lane South.
- A small number of dwellings along Intwood Road east of the A47.
- Residential dwellings along Norwich Road (B1172).
- A small number of dwellings east of Station Lane and south of the A11.

11.7.11. The 11 non-residential sensitive receptors within the study area are:

- Six Public Rights of Way (PROW) south of the A11, both west and east of the A47 (Cringleford FP1, FP2, FP3, FP4a, Hethersett FP6 and Keswick BR5)[5].
- Scheduled monument (Two Tumuli in Big Wood) south of the A11 and immediately east of the proposed Cantley Lane Link Road.
- Travelodge hotel west of the Thickthorn junction and north of the A11.
- Nellies Nursery north of Norwich Road.
- Cringleford surgery on Cantley Lane east of the A47.

11.7.12. One Noise Important Area (NIA 4965, Norfolk County Council area) is identified within the operational study area and contains 12 dwellings.

11.7.13. Consented development receptors have also been included where these are planned to be located within the operational study area. There are 359 proposed receptors at a residential development in Cringleford, east of the Thickthorn junction, that has been included within the assessment.

11.7.14. The operational study area, noise sensitive receptors and NIAs are shown in ES Figure 11.1 (**TR010037/APP/6.2**) **(APP-071)**.

[5] It is noted that FP4a footbridge over the A47 will change location with the Proposed Scheme. It is also noted that Bridleway Cringleford BR5 is removed as part of the Proposed Scheme and has not been considered further within the assessment.

Value of receptors

11.7.15. Noise affects people in different ways. This may include factors such as annoyance and sleep disturbance, enjoyment of spaces, ability to communicate with others and ability to concentrate at home or at work.

11.7.16. Different receptors may be subject to the same sources and at the same times, but the significance is not the same (for example, dwellings which are occupied at night and commercial premises which are not occupied at night). Consequently, it is not appropriate to consider a single criterion when assessing the sensitivity of a receptor within an existing noise environment.

11.7.17. This assessment is focused on receptors with high sensitivity to noise and vibration. Most receptors that would be affected by noise and vibration arising from the Proposed Scheme are dwellings. However, there are other types of high sensitivity receptors in the study area that have been considered in the assessment, such as village halls, schools, places of worship and public rights of way.

11.8. Potential impacts

11.8.1. The potential impacts due to construction and operation of the Proposed Scheme are presented in this section. As agreed within the Scoping Report (**TR010037/APP/6.5**) (APP-120), the following aspects are considered:

- Noise arising due to the construction of the Proposed Scheme;
- Vibration arising due to the construction of the Proposed Scheme;
- The change in road traffic noise due to heavy vehicle traffic associated with the construction of the Proposed Scheme;
- The change in road traffic noise due to the diversion routes associated with the construction of the Proposed Scheme;
- The change in road traffic noise due to the operation of the Proposed Scheme (in the short-term and long-term).

11.8.2. Appropriate means of mitigation are then presented in Section 11.9 and the significance of the effects that would occur from each noise and vibration impact are discussed in Section 11.10.

Construction noise

11.8.3. Construction noise generated by the project has the potential to adversely affect noise sensitive receptors within the 300m study area.

11.8.4. Details of the construction stages, the proposed plant for each stage, and the associated noise levels used for the assessment are presented in the ES Appendix 11.5 (**TR010037/APP/6.3**) (APP-109). The key construction stages are

site set-up, utility works, structure works and highway works (including tie-in to existing roads).

11.8.5. Construction noise predictions have been carried out for the representative receptor locations presented in ES Figure 11.1 (**TR010037/APP/6.2**) (APP-071). The predicted construction noise levels for each construction stage are presented in ES Appendix 11.5 (**TR010037/APP/6.3**) (APP-109). Details of the construction stages during which a moderate or major magnitude of impact could occur are presented in Table 11-5~~Table 11-5~~.

Table 11-5: Moderate and major magnitude of noise impacts during construction

Construction stage	Activity	Representative receptor	Predicted construction noise level $L_{Aeq,T}$ (dB façade)	SOAEL $L_{Aeq,T}$ (dB)	Magnitude of impact
1. **Site set up**	Set Site	R6	67	65 ~~(Saturday evening)~~	Moderate ~~(Saturday evening)~~
		R10	66	65 ~~(Saturday evening)~~	Moderate ~~(Saturday evening)~~
2. **Utilities**	Allowance for utility works	R6	68	65	Moderate
		R10	74	65	Major
		R11	72	65	Major
		R12	74	65	Major
4. **Structures –** Ward's Wood Underpass (Box Push Night-time Works Only)	(Box push construction) Site preparation, construct north and south headwall, box construction, box slide and underpass completion.	R8	61	58	Moderate
5. **Structures-** S04 Cantley Lane underpass (box push night-time works only)	(Box push construction) Site preparation, construct north and south headwall, box construction, box slide and underpass completion.	R6	58	56	Moderate
		R11	62	56	Major
		R12	56	55	Moderate
10. **Structures-** S45 Cantley Lane Footbridge	North abutment, south abutment and bridge completion	R6	69	65 ~~(Saturday evening)~~	Moderate ~~(Saturday evening)~~
11. **Structures-** S46- Cantley Lane South culvert	Excavate, install culvert units, construct eastern and western headwall, backfill culvert units, construct carriageway over and complete finishing works	R10	79	65	Major
12. **Structures-** S47- Cantley	Excavate, install culvert units, construct eastern and western headwall,	R10	79	65	Major

Construction stage	Activity	Representative receptor	Predicted construction noise level $L_{Aeq,T}$ (dB façade)	SOAEL $L_{Aeq,T}$ (dB)	Magnitude of impact
Stream diversion culvert	backfill culvert units, construct carriageway over and complete finishing works				
17. **Highway Works-** A11 - A47 Connector Road (North of A47) (night-time works only)	Top soil excavation and fill, top of batter ditch, top of batter drainage, drainage installation, carriageway construction, edge of carriageway detail, surfacing, A47 tie in.	R4	59	55	Moderate
		R6	65	56	Major
		R11	59	56	Moderate
23. **Highway Works-** Cantley Lane improvements	Top soil strip, ditch, fill, new underground drainage storage, drainage, carriageway construction and gullies, NFD, finishing and landscaping, kerb, footway construction.	R10	69	65 (60 Saturday evening)	Moderate (Major Saturday evening)

11.8.6. Table 11-5~~Table 11-5~~ shows that some receptors which are close to certain construction stages would potentially experience a temporary moderate or major magnitude of impact without mitigation.

11.8.7. DMRB LA 111 paragraph 3.19 advises that a significant noise effect would occur when a moderate or major impact is expected for 10 or more days or nights in any 15 consecutive days or nights; or for a total number of days exceeding 40 in any six consecutive months.

11.8.8. The durations for which plant will be operating for each phase of work have not yet been finalised by the Contractor. At this stage, a precautionary worst-case approach has been adopted, considering that the assessed construction activities have the potential to exceed the above durations. In reality, this may not happen for all phases of work.

11.8.9. For road surfacing (part of construction stages 13 to 24), the Contractor is expected to work linearly. It is unlikely that the works would occur near to the identified receptors for 10 or more days or nights in any 15 consecutive days or nights (or for a total number of days exceeding 40 in any six consecutive months).

11.8.10. Section 11.9 presents specific noise mitigation measures and best practice techniques that are expected to reduce the magnitude of the impacts occurring due to construction noise.

Construction vibration

11.8.11. Table 11-6~~Table 11-6~~ sets out indicative distances, based on historical field measurements, at which certain construction activities are expected to result in a level of vibration below 1mm/s peak particle velocity (PPV).

Table 11-6: Distances at which vibration may be just perceptible

Construction Activities	Farthest distance at which vibration levels could exceed the SOEAL of 1mm/s, metres
Rotary Bored Piling[1]	30
Bulldozer[2]	20
Tunnelling machine in soil[2]	15
Heavy Vehicles (e.g. dump trucks)[2]	10
[1] BS5228-2 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration, Table D.6 [2] Transport Research Laboratory (TRL), Research Report 53, Ground vibration caused by civil engineering works, Figure 3	

11.8.12. Compaction and piling activities are the two types of work with potential to result in construction vibration exceeding the SOAEL value of 1 mm/s PPV at receptors within 30m of the proposed works.

11.8.13. There are sensitive properties located within 30m of construction activity that could experience moderate or major construction vibration impacts due to vibratory compaction. These properties and their distance to the works are detailed below:

- Three residential properties at receptor R9 at a minimum distance of 5m from the proposed highways works;
- Six residential properties at receptor R10 at a minimum distance of 10m from the proposed highways works; and
- Four residential properties at receptor R11 at a minimum distance of 16m from the proposed highways works.

11.8.14. Based on the data provided in Table 11-6~~Table 11-6~~, vibration levels at these receptors are likely to be perceptible and have the potential to be above the SOAEL value. Therefore, further assessment of construction vibration due to compaction and piling has been undertaken.

11.8.15. For earthworks, road formation and surfacing works, calculations of vibration from vibratory rollers have been undertaken. The predicted level of vibration at the receptors within 30m of the works are presented in Table 11-7~~Table 11-7~~. The table shows the predicted vibration levels due to steady state of operation, and due to start-up and run-down. The predicted vibration levels are expected to occur where compaction works occur at the closest works position to each receptor.

Table 11-7: Predicted ground borne vibration levels arising from vibratory rollers and compactors

Receptor	Operation	Number of residential properties affected	Vibration level PPV, mm/s (magnitude of impact)
R9	Steady state of operation	3	4.9 (moderate)
	During start-up and run-down	3	5.2 (moderate)
R10	Steady state of operation	6	2.0 (moderate)
	During start-up and run-down	6	2.4 (moderate)
R11	Steady state of operation	4	1.0 (moderate)
	During start-up and run-down	4	1.3 (moderate)
Note: There is a 33% chance that the presented vibration levels will be exceeded due to vibratory compaction. The presented vibration levels are considered to be the reasonable worst-case scenario.			

11.8.16. The predicted vibration levels are above the SOAEL (1.0 mm/s). At these receptors, the magnitude of the construction vibration impact from vibratory compaction is moderate adverse where these works occur at the closest point to each receptor.

11.8.17. Due to structure works, rotary piling is expected to occur at less than 30m from a sensitive receptor in the following locations:

- Receptor R11: approximately 25m from the S45 Cantley Lane footbridge works; and
- Receptor R10: approximately 16m from the S46 and S47 Cantley Lane culverts.

11.8.18. The piling works will require careful consideration once the proposed construction methodologies are finalised. The proposed methodology is based on rotary bored piling which typically produces lower levels of vibration than other piling methodologies.

11.8.19. By applying the assumptions within Section 11.5, it is predicted that rotary piling would result in vibration levels of no more than 1.3 mm/s PPV at receptor R10 and no more than 0.7 mm/s PPV at receptor R11. The worst-case magnitude of impact due to vibration from piling works is therefore predicted to be moderate at R10 and minor at R11.

11.8.20. If piling works were to occur at the same time as the vibratory roller works then the predicted impact is not predicted to change at any of the receptor locations.

11.8.21. The primary cause of community concern in relation to construction vibration generally relates to building damage. However, with reference to BS 7385-2: 1993, minor cosmetic damage in light or unreinforced buildings, without existing defects, would require levels of at least 15 mm/s PPV. Based on the expected

type of construction plant and the distances to the nearest buildings, it is considered extremely unlikely that minor cosmetic damage would occur.

11.8.22. The above assessment has demonstrated that, in terms of human perception of construction vibration, some construction activities would result a moderate adverse impact in some locations. There is limited likelihood of compaction works occurring at fixed positions near individual receptors for 10 or more days or nights in any 15 consecutive days or nights (or for a total number of days exceeding 40 in any six consecutive months) since this work is expected to progress linearly along the Proposed Scheme. However, vibration from the static works such as structure works could occur for longer than these durations.

11.8.23. For this reason, Section 11.9 presents specific vibration mitigation measures and best practice techniques that are expected to reduce the potential for significant effects occurring due to vibration from piling and compaction works. The assessment of significant effects is then presented in Section 11.10.

Construction traffic and diversions

11.8.24. The change in road traffic noise due to the additional traffic flows associated with the construction of the Proposed Scheme has the potential to affect sensitive receptors located along existing roads used by these vehicles. The potential for construction traffic noise impacts is dependent on the volume of construction traffic and the routing.

11.8.25. In order to determine the potential construction traffic noise impact, road traffic noise predictions have been undertaken on all roads in close vicinity to each compound. This then enables the identification of the roads which are most suitable for use by construction traffic.

11.8.26. Table 11-8~~Table 11-8~~ below presents baseline traffic flows and the change in road traffic noise that is expected due to the addition construction traffic during the daytime for each road within the study area.

Table 11-8: Expected noise increases due to construction related traffic during the daytime

Assumed route	Baseline traffic flow (18-hour AAWT)	Baseline traffic Speed (km/h)	Baseline traffic % HGV	Expected increase in road traffic noise level (dB(A))	Magnitude of impact
A47 northbound, immediately north of the junction with the A11	21176	104	5	+0.3	Negligible
A47 southbound, immediately south of the junction with the A11	21176	104	5	+0.3	Negligible
A11 eastbound, immediately east of the junction with the A47	43210	41	3	+0.3	Negligible

Assumed route	Baseline traffic flow (18-hour AAWT)	Baseline traffic Speed (km/h)	Baseline traffic % HGV	Expected increase in road traffic noise level (dB(A))	Magnitude of impact
A11 westbound, immediately west of the junction with the A47	49322	95	5	+0.1	Negligible
B1172 westbound, west of the junction with the A47 and the A11	13344	65	3	+0.6	Negligible
Cantley Lane South, east of the A11	713	61	25	+0.9	Negligible

11.8.27. As can be seen in Table 11-7, the impact of the increase in road traffic noise level is predicted to be negligible for all routes. This is subject to the implementation of appropriate vehicle routing controls in the Outline Traffic Management Plan **(TR010037/APP/7.5)** (APP-129). Appropriate means of mitigating noise from construction traffic are presented in Section 11-9.

11.8.28. DMRB LA 111 paragraph 3.7 Note 2 states that the sudden change of traffic levels on diversion routes, as a result of night-time closures, is likely to cause disturbance to receptors next to (within 25m of) the road. It notes that a major magnitude of impact should generally be determined at any noise sensitive receptors within the diversion study area where the routes are used at night. Due to the large scale of the road closures required, the proposed diversion routes for this scheme would use mainly A-roads. Where this is the case, the magnitude of impact due to road traffic noise from diverted traffic will be less. This is discussed further in 11.10.

Operational noise

11.8.29. Table 11-9~~Table 11-9~~ to Table 11-11~~Table 11-11~~ the changes in road traffic noise level that are predicted at all dwellings and non-residential sensitive receptors within the operational study area. The short-term noise change (*Do-Something Opening Year versus Do-Minimum Opening Year)* and long-term noise change (*Do-Something Future Year* versus *Do-Minimum Opening Year*) have been used for determining where significant effects due to operational road traffic noise could occur.

11.8.30. The figures provided (ES Figures 11.2 to 11.8, **TR010037/APP/6.2**) (APP-071) include noise contour maps that illustrate $L_{A10,18hr}$ road traffic noise levels for each scenario. Noise difference contours are also presented which illustrate the predicted change in road traffic noise for the following comparisons:

- Long-term noise change without the Proposed Scheme (DMFY minus DMOY)
- Short-term noise change with the Proposed Scheme (DSOY minus DMOY)
- Long-term noise change with the Proposed Scheme (DSFY minus DMOY)

11.8.31. The predicted operational impacts are presented in the following section. The embedded mitigation measures are then described in Section 11.9. The significance of effects predicted to occur due the operation of the Proposed Scheme is then presented and discussed in Section 11.10.

Noise changes over the long-term without the Proposed Scheme

(Do-Minimum Future Year versus Do-Minimum Opening Year)

11.8.32. Table 11-9~~Table 11-9~~ compares road traffic noise levels for the Do-Minimum Opening Year scenario with the Do-Minimum Future Year scenario (the "non-project noise change").

11.8.33. The additional number of dwellings affected at the committed Cringleford residential development are presented in brackets.

Table 11-9: Summary of long-term noise changes, without the Proposed Scheme

Scenario/Comparison: Do-Minimum Opening Year 2025 versus Do-Minimum Future Year 2040						
Change in noise level, dB(A)		Magnitude of impact	Daytime, dB $L_{A10,18hr}$		Night-time, dB $L_{night,outside}$	
			Number of dwellings	Number of non-residential sensitive receptors	Number of dwellings	Number of non-residential sensitive receptors
Increase in noise level	<3.0	Negligible	574 (319)	7	557 (313)	7
	3.0 – 4.9	Minor	0	0	0	0
	5.0 – 9.9	Moderate	0	0	0	0
	>10.0	Major	0	0	0	0
No Change	0.0	No Change	2 (29)	0	21 (34)	0
Decrease in noise level	<3.0	Negligible	14 (11)	4	12 (12)	4
	3.0 – 4.9	Minor	0	0	0	0
	5.0 – 9.9	Moderate	0	0	0	0
	>10.0	Major	0	0	0	0

11.8.34. The changes in road traffic noise level shown in Table 11-9~~Table 11-9~~ occur over the long-term without the Proposed Scheme and result from changes in traffic volume and traffic speed on the existing road network. Without the Proposed Scheme, all receptors are predicted to experience negligible or no change in road traffic noise level.

Noise changes due to the Proposed Scheme upon opening

(Do-Something Opening Year versus Do-Minimum Opening Year)

11.8.35. Table 11-10~~Table 11-10~~ compares road traffic noise levels for the Do-Something Opening Year scenario with the Do-Minimum Opening Year scenario.

11.8.36. The additional number of dwellings affected at the committed Cringleford residential development are presented in brackets.

11.8.37. The changes in road traffic noise shown in Table 11-10~~Table 11-10~~ are due to the Proposed Scheme over the short-term and result from changes in traffic flows and speeds on the existing road network, as well as the addition of new road links (A11-A47 connector road and Cantley Lane South to B1172 Norwich Road link road) and removal of the existing access to Cantley Lane South.

Table 11-10: Summary of short-term noise changes, with the Proposed Scheme

Scenario/Comparison: Do-Minimum Opening Year 2025 versus Do-Something Opening Year 2025						
Change in noise level, dB(A)		Magnitude of impact	Daytime, dB $L_{A10,18hr}$		Night-time, dB $L_{night,outside}$	
			Number of dwellings	Number of non-residential sensitive receptors	Number of dwellings	Number of non-residential sensitive receptors
Increase in noise level	<1.0	Negligible	109 (60)	1	55 (44)	1
	1.0 – 2.9	Minor	0 (8)	1	0 (1)	0
	3.0 – 4.9	Moderate	0	0	0	0
	>5.0	Major	0	0	0	0
No Change	0.0	No Change	148 (70)	1	126 (56)	1
Decrease in noise level	<1.0	Negligible	327 (221)	4	406 (258)	7
	1.0 – 2.9	Minor	6	3	3	1
	3.0 – 4.9	Moderate	0	1	0	1
	>5.0	Major	0	0	0	0

11.8.38. Table 11-10~~Table 11-10~~ demonstrates that, the majority of receptors will experience either no change or a negligible change in road traffic noise level over the short-term as a result of the Proposed Scheme.

11.8.39. However, a minor or moderate change in road traffic noise is predicted at a small number of receptors as follows:

- Eight receptors at the Cringleford residential extension are predicted to experience an increase in road traffic noise level of 1.0 to 1.2 dB (minor adverse impact), mostly due to the expected increase in traffic flows along Cantley Lane east of the A47.
- One non-residential sensitive receptor, Cringleford Doctor's Surgery, is predicted to experience an increase in road traffic noise level of 1.2 dB (minor adverse impact), due to the expected increase in traffic flows along Cantley Lane east of the A47.
- Six residential dwellings along Cantley Lane South are predicted to experience a reduction in road traffic noise level of between 1.0 and 2.2 dB (minor beneficial impact), due to the removal of this section of road.
- Three non-residential noise sensitive receptors are predicted to experience a minor beneficial impact. These are the southern tumuli in Big Wood (a scheduled monument) and users of Public Rights of Way Cringleford FP4A and Hethersett FP6.
- One non-residential noise sensitive receptor, the northern tumuli in Big Wood, is predicted to experience a reduction in road traffic noise level of

3.3 dB (moderate beneficial impact), mostly due to the changes in topography at the elevated Cantley Lane link road, which provides screening to noise from the A11.

11.8.40. The significance of these changes in road traffic noise level increases, and the predicted road traffic noise levels with respect to LOAEL and SOAEL, are discussed in Section 11.10.

Noise changes over the long-term with the Proposed Scheme
(Do-Something Future Year versus Do-Minimum Opening Year)

11.8.41. Table 11-11~~Table 11-11~~ compares road traffic noise levels for the Do-Something Future Year scenario with the Do-Minimum Opening Year scenario. The changes in road traffic noise due to the Proposed Scheme over the long-term are due to changes in traffic flows and speeds, as well as the addition of new road links and removal of the existing access to Cantley Lane South.

11.8.42. The additional number of dwellings affected at the committed Cringleford residential development are presented in brackets.

Table 11-11: Summary of long-term noise changes, with the Proposed Scheme

Scenario/Comparison: Do-Minimum Opening Year 2025 versus Do-Something Future Year 2040						
Change in Noise Level (dB(A))		Magnitude of Impact	Daytime, dB $L_{A10,18hr}$		Night-time, dB $L_{night,outside}$	
			Number of Dwellings	Number of non-residential Sensitive Receptors	Number of Dwellings	Number of non-residential Sensitive Receptors
Increase in noise level dB	<3.0	Negligible	472 (331)	7	426 (306)	7
	3.0 – 4.9	Minor	0	0	0	0
	5.0 – 9.9	Moderate	0	0	0	0
	>10.0	Major	0	0	0	0
No Change	0.0	No Change	61 (25)	0	83 (44)	0
Decrease in noise level	<3.0	Negligible	57 (3)	4	81 (9)	4
	3.0 – 4.9	Minor	0	0	0	0
	5.0 – 9.9	Moderate	0	0	0	0
	>10.0	Major	0	0	0	0

11.8.43. Table 11-11~~Table 11-11~~ demonstrates that, within the study area, all receptors are predicted to experience negligible or no change in road traffic noise level due to the Proposed Scheme over the long-term.

11.9. Design, mitigation and enhancement measures

11.9.1. The design interventions and mitigation measures that have been introduced to reduce the potential for significant effects due to noise and vibration from the

construction and operation of the Proposed Scheme are presented in this section.

11.9.2. Mitigation measures within this section will be secured in the Environmental Management Plan (**TR010037/APP/7.4**) (APP-128)~~,~~ and are in line with the aims and associated actions of National Policy Statement for National Networks (NPS NN) as detailed in DMRB LA 111 Table E/1.3.

Construction noise and vibration

11.9.3. Construction works will take place mainly during the daytime. Construction works outside of the normal construction hours of 07:00-19:00 weekday and 07:00-19:00 on Saturdays shall be minimised as far as practicable, as detailed in the Environmental Management Plan (**TR010037/APP/7.4**) (APP-128).

11.9.4. Where it is determined that there is a risk of significant effect, or works outside of the normal construction hours are unavoidable (for example certain tie-in works, national grid diversion works), the Principal Contractor will need to undertake further detailed assessments of noise and vibration due to construction, implement best practicable means, consult with the environmental health department at the local authority, and agree appropriate methods of mitigation and monitoring that account for the location of works, hours of work and expected duration. This could form part of a Section 61 prior consent application under the Control of Pollution Act 1974, or a less formal route may be possible pending discussions with the Local Authority.

11.9.5. Table 11-12~~Table 11-12~~ presents the construction stages for which construction noise is likely to result in significant effects without mitigation. Mitigation measures in the form of temporary noise barriers or site hoarding be considered to mitigate construction noise effects at the receptors presented in Table 11-11. This is only necessary where construction activity in the vicinity of the receptor will exceed 10 days or nights in any 15 consecutive days or nights; or for a total number of days exceeding 40 in any six consecutive months.

11.9.6. The precise locations and heights of the temporary barriers is to be determined by the Principal Contractor and confirmed to the local authority as part of the further detailed construction noise assessments.

Table 11-12: Construction stages and receptors for which temporary noise barriers are required as specific construction noise mitigation measures

Receptor Reference	Receptor Address	Construction stage
R~~0~~4	North Side Farm, 8 Meadow Farm Drive, Cringleford NR4 6TR	17 (night-time only)
R~~0~~6	Cringleford residential extension development	1 (during all construction hours) 2 (during all construction hours) 5 (night-time push box method only) 10 (during all construction hours) 17 (night-time only)
R~~0~~8	Travelodge, Thickthorn Services	4 (night-time push box method only)
R10	Bridge Cottages, Meadow Farm Cottages, and 128 Cantley Lane NR4 6TF	1 (during all construction hours) 2 (during all construction hours) 11 (during all construction hours) 12 (during all construction hours) 23 (during all construction hours)
R11	102, 104, 106, 108 Cantley Lane, NR4 6TD	2 (during all construction hours) 5 (night-time push box method only) 17 (night-time)
R12	110, 112, 114, 116, 118, 120, 122, 124 Cantley Lane, NR4 6TD	2 (during all construction hours) 5 (night-time push box method only)

11.9.7. In addition to the temporary noise barriers, where there is still potential for moderate adverse impacts, the Principal Contractor may carry out noise monitoring during construction stages 11 and 12 (culvert works) at a position representing the dwellings at receptor R10. Real-time alerts can be provided to notify the Principal Contractor when noise from works approaches the defined SOAEL levels, at which time methods of work can be altered. This will help to ensure that significant effects due to construction noise are avoided.

11.9.8. In addition to the above mitigation measures, best practice noise and vibration mitigation techniques shall be employed to include the following:

- Select quieter plant than the preliminary construction plant used within this assessment.
- Ensure equipment is maintained, in good working order, and is used in accordance with the manufacturer's instructions.
- Use equipment that is fitted with silencers or mufflers.
- Set time restrictions on certain noisy and vibratory activities such as earthworks and surfacing.
- Manage deliveries to prevent queuing of site traffic.
- Do not leave plant running unnecessarily.

- Plant with highly directional sound emissions shall be angled so that the direction of highest sound emissions does not face towards receptors where possible.
- Materials to be lowered instead of dropped from height.
- Alternative reversing warning systems such as white noise alarms shall be employed.
- The Contractor shall advise members of the construction team during toolbox talk briefings on quieter working methods.
- Any fixed plant such as generators shall be positioned at least 20m from nearest receptor and shall have temporary/mobile noise screens erected around them where possible and necessary.

11.9.9. The potential effects of construction noise and vibration on local community receptors can be lessened by effective communication. Good public relations are invaluable in securing public acceptance of construction noise. People are typically more tolerant of construction noise and vibration if they understand the reason for it, the likely duration, start and finish dates, and that measures are being employed to reduce noise and vibration as far as practicable. Communication with the community could be undertaken through letter drops or through a Community Liaison Officer. Information shall be readily available at the website as the project progresses that would allow residents to easily get in touch with the relevant point of contact for the construction site. A complaints-handling procedure shall also be put in place.

11.9.10. For construction activities that could result in vibration levels at nearby receptors that exceed SOAEL (such as piling or compaction works within 30m of residential receptors), the Principal Contractor shall:

- carry these works out only during the daytime (as currently proposed);
- inform the occupiers of the likely times and duration of works at least one week prior to works commencing;
- monitor the vibration levels; and
- subject to securing permission from property owners, carry out a building condition survey to identify any sensitive aspects of the building and to ensure the current status of the building is recorded.

11.9.11. Construction vibration from piling works within 30m of receptors R9, R10 and R11 will need to be considered carefully by the Principal Contractor due to the proximity of these receptors to the works. Further detailed assessments of construction vibration shall be undertaken by the Principal Contractor demonstrating how significant effects due to vibration are avoided; this assessment shall be prepared by the Principal Contractor for agreement with the local authority.

Construction traffic

11.9.12. On the basis of the assumed numbers of HGV movements, construction related traffic can use the existing A47, A11 and B1172 as required.

11.9.13. Use of other local roads should be avoided. Additionally, construction related traffic arriving from offsite shall be routed via the existing trunk roads only. This shall be implemented in the Traffic Management Plan (**TR010037/APP/7.5**) **(APP-129)**.

11.9.14. If significant night-time construction traffic might be required at any stage, further assessment should be considered by the Principal Contractor and discussed with the Local Authority to agree on suitable routes.

11.9.15. For temporary traffic diversion routes, the noise mitigation measures include the use of more than one diversion route for different closures. The proposals include four different diversion routes to spread any potential increases in traffic and associated roadside noise levels on these roads, particularly during periods of required night-time diversions. For each principal diversion, the Principal Contractor shall review the possibility of temporary traffic management and diversion routes to follow the least noise sensitive routes. Residents along routes likely to be affected by night-time traffic diversions for several days shall notified in advance of these diversions coming into operation.

11.9.16. Detailed noise impact assessments shall be undertaken by the Principal Contractor before these routes are used, and these shall be included in the Traffic Management Plan (**TR010037/APP/7.5**) **(APP-129)**. Details shall be provided to South Norfolk Council for discussion.

Operational noise

11.9.17. The assessment concludes that mitigation is not necessary to avoid significant adverse traffic noise effects due to the Proposed Scheme's operation.

11.10. Assessment of likely significant effects

11.10.1. The residual effects due to noise and vibration once mitigation has been employed are presented in this section.

Construction noise

11.10.2. With temporary noise barriers, the potential for significant effects due to noise from the construction of the Proposed Scheme is reduced. The magnitude of impact with mitigation is presented in Table 11-13~~Table 11-13~~ and the assessment of residual significant effects is explained further below.

Table 11-13: Construction noise impacts with mitigation

Receptor Reference	Receptor Address	Construction Stage	Magnitude of impact (mitigated)
R4	North Side Farm, 8 Meadow Farm Drive, Cringleford NR4 6TR	17 (night-time only)	Negligible
R6	Cringleford residential extension development	2 (during all construction hours) 5 (night-time box push only) 17 (night-time only)	Negligible
R8	Travelodge, Thickthorn Services	4 (night-time box push only)	Negligible
R10	Bridge Cottages, Meadow Farm Cottages, and 128 Cantley Lane NR4 6TF	2 (during all construction hours) 11 (during all construction hours) 12(during all construction hours) 23 (during all construction hours)	Moderate (for stages 11 and 12) Minor (for stages 2 and 23)
R11	102, 104, 106, 108 Cantley Lane, NR4 6TD	2 (during all construction hours) 5 (night-time box push only) 17 (night-time only)	Minor or Negligible
R12	110, 112, 114, 116, 118, 120, 122, 124 Cantley Lane, NR4 6TD	2 (during all construction hours) 5 (night-time box push only)	Minor or Negligible

11.10.3. A residual moderate adverse impact is predicted from culvert structure works at receptor R10, potentially affecting six residential properties. This would result in significant effects where these construction activities take place for 10 or more days or nights in any 15 consecutive days or nights, or for a total number of days exceeding 40 in any 6 consecutive months.

11.10.4. Given that the assessment has identified the potential for significant effects the Principal Contractor shall undertake further detailed construction noise assessments, on the basis of confirmed plant types and durations, where the construction stage identified above is expected to exceed the durations which would cause the adverse impacts to result in significant effects. The assessments shall contain details of the proposed construction methodologies, mitigation measures proposed, and the durations that each item of plant will be in each specific site location.

11.10.5. Particular focus for the detailed construction noise assessment will be required for the culvert structure works which could potentially result in significant effects at the dwellings represented by receptor R10. Construction noise monitoring with real-time alerts shall be considered where the risk of significant effects cannot be eliminated. These alerts would notify the Principal Contractor when noise from works approaches the defined SOAEL levels, at which time methods of work can be altered.

11.10.6. Significant effects could occur due to noise from night-time works if they were to occur for 10 or more days or nights in any 15 consecutive days or nights, or for a total number of days exceeding 40 in any 6 consecutive months. This will need to be considered further by the Principal Contractor as part of the further detailed construction noise assessments.

11.10.7. In summary, subject to the provision of temporary noise barriers, implementation of best practicable means, construction noise monitoring where required, further detailed construction noise assessments for the key construction stages once the Principal Contractor construction methodologies are refined, and the mitigation measures described within Section 11.9, construction noise is not predicted to result in significant adverse residual effects.

Construction vibration

11.10.8. The predicted vibration levels for earthworks, road formation, surfacing works and piling are generally above the SOAEL for receptors located within 30m of the construction works. Without mitigation, significant effects due to construction vibration is expected to occur at 19 residential properties (R9, R10 and R11).

11.10.9. Mitigation measures are proposed such as early communication with affected receptor residents, pre-condition surveys, and vibration monitoring.

11.10.10. In addition to above, a significant effect would only occur if SOAEL levels are exceeded for 10 or more days or nights in any 15 consecutive days or nights; or a total number of days exceeding 40 in any 6 consecutive months. In reality, the use of compaction plant that causes high levels of vibration at the closest point to these receptors will not occur for periods of several days since this work is expected to progress linearly along the Proposed Scheme.

11.10.11. However, vibration from the static works such as structure formation construction stage could occur for longer durations and shall be considered in further detailed construction vibration assessments by the Principal Contractor on the basis of finalised work durations. This assessment should consider construction vibration from piling at receptor R11 due to the S45 Cantley Lane footbridge works and at receptor R10 due to S46 and S47 Cantley Lane culvert works.

11.10.12. Based on the assessments detailed above and where mitigation is implemented in line within Section 11.9, vibration due to construction activity is not expected to result in any significant effects at any vibration-sensitive receptor.

Construction traffic and diversions

11.10.13. On the basis of the assumptions within this chapter, provided that construction related traffic uses only the A47, A11 and B1172 roads for site access, the change in basic noise level on roads used for construction traffic will be negligible. Therefore, no significant adverse noise effects due to construction traffic are predicted. This will be controlled in the Traffic Management Plan **(TR010037/APP/7.5)** (APP-129).

11.10.14. Further to the noise mitigation measures applied to the temporary traffic diversions, including consideration of multiple diversion routes, diversion via alternative trunk roads, and prior notification, the magnitude of impact is predicted to be minor. The change in road traffic noise during temporary traffic diversions is therefore not expected to result in any significant effects.

Operational noise

11.10.15. The changes in road traffic noise predicted to result from the Proposed Scheme have been reported in accordance with DMRB LA 111 and LA 104.

11.10.16. An initial assessment of operational noise significance at noise sensitive receptors is summarised in this section and in Table 11-14~~Table 11-14~~. DMRB LA 111 states that for this initial assessment a moderate or major magnitude of impact at noise sensitive receptors are classed as 'Significant'.

11.10.17. The number of existing receptors affected are presented without brackets. In addition, the number of dwellings affected at the Cringleford residential extension committed development that expected to be complete in the Opening Year are presented in brackets.

Table 11-14: Summary of the initial assessment of operational noise significance

Initial assessment of operational noise significance	Number of receptors at which the initial assessment of operational noise is significant or not significant			
	Adverse		Beneficial	
	Daytime, dB $L_{A10,18hr}$	Night-time, dB $L_{night,outside}$	Daytime, dB $L_{A10,18hr}$	Night-time, dB $L_{night,outside}$
Significant	0	0	1	1
Not significant	111 (319)	56 (313)	340 (40)	417 (12)

11.10.18. Table 11-14~~Table 11-14~~ demonstrates that, at the majority of noise sensitive receptors within the study area, the effects that result from the change in road traffic noise that occurs due to the Proposed Scheme are not significant.

11.10.19. For receptors at which the effects are initially deemed significant, DMRB LA 111 requires the final operational significance to be determined using the

justifications in LA 111 Table 3.60 (reproduced in ES Appendix 11.2 (**TR010037/APP/6.3**) (APP-109)).

11.10.20. All minor adverse and beneficial impacts are predicted at noise sensitive receptors with absolute noise levels below the SOAEL and the long-term impact is predicted to be negligible. As such, all minor impacts are not predicted to have significant noise effects.

11.10.21. The moderate beneficial noise impact is predicted to occur at the western barrow in Big Wood (a scheduled monument). The predicted reduction in road traffic noise levels is 3.3 dB, towards the lower end of the 'moderate' range. Furthermore, the long-term impact of the Proposed Scheme is predicted to be negligible. Overall, this beneficial effect is considered to be not significant.

11.10.22. It is concluded the changes in road traffic noise that will occur due to the operation of the Proposed Scheme are not expected to result in any significant operational effects.

11.11. Monitoring

11.11.1. The requirements for monitoring in relation to noise and vibration are presented below.

Construction

11.11.2. Potential significant environmental effects from noise or vibration during construction shall be monitored, as advised in DMRB LA 111. Monitoring shall include the following:

- Checking that noise and vibration management procedures and best practices are sufficient to ensure that significant adverse effects are avoided.
- Verification that specific noise and vibration mitigation measures are in place for activities where there is potential for likely significant effects to occur in their absence.
- Measurement of noise during relevant construction activity at positions that represent receptor R10.
- Measurement of vibration during piling or compaction works where these works occur within 30m of dwellings represented by receptors R9, R10 and R11.

Operation

11.11.3. The assessment identifies that further mitigation is not necessary to avoid significant adverse traffic noise effects due to the Proposed Scheme's operation. Therefore, monitoring of likely significant noise effects is not required.

11.12. Summary

11.12.1. This chapter considers the potential noise and vibration impacts of the Proposed Scheme on noise sensitive receptors.

11.12.2. The study areas for construction noise, construction vibration and operational noise assessments have been determined using DMRB. Noise modelling has been undertaken for all noise sensitive receptors within the corresponding construction and operational study areas.

11.12.3. As part of the assessment a baseline noise survey was undertaken in May 2018 to gain an understanding of the existing noise climate within the vicinity of the Proposed Scheme. The long-term measurement results correlate reasonably well with the predicted values at those locations. No adjustments to the noise model were considered necessary based on the findings of the survey.

11.12.4. A construction noise assessment has been undertaken, identifying that significant effects would occur without mitigation at some of the receptors closest to construction works. Suitable means of minimising the potential for significant adverse effects have been presented including the provision of temporary acoustic barriers, further construction noise assessment for key construction activities and construction noise monitoring in some locations. Particular focus for the detailed construction noise assessment will be required for the culvert structure works. Construction noise monitoring with real-time alerts shall be considered where the risk of significant effects cannot be eliminated to alert the Principal Contractor when noise from works approaches the SOAEL. Where all mitigation is implemented effectively, no significant residual construction noise effects are predicted.

11.12.5. An assessment of potential construction vibration impacts identifies that significant effects would occur without mitigation at the closest receptors to vibration-generating activities. Therefore, prior warning of residents, pre-condition building surveys, restrictions on the timings of the works, and vibration monitoring are proposed as mitigation at the closest properties to these works. It is also necessary for the Principal Contractor to carry out further detailed assessments of vibration from piling at receptors in the vicinity of the S45 Cantley Lane footbridge works and the S46 and S47 Cantley Lane culvert works. Vibration due to construction is not expected to result in any significant effects subject to the effective implementation of this mitigation.

11.12.6. A construction traffic assessment has been undertaken. It is concluded that, provided that vehicle movements and routes are restricted as described in this chapter and defined in the Traffic Management Plan, potential significant effects are unlikely.

11.12.7. An assessment of operational noise has been carried out and demonstrates that there are no significant adverse or significant beneficial noise effects expected due to changes in road traffic noise. This applies at all receptors within the study area and the NIAs. Mitigation is not necessary to avoid significant adverse operational traffic noise effects.

11.12.8. When considering the potential impacts against the LOAEL and SOAEL values, the Proposed Scheme meets the policy aims of NPS NN and NPSE. For aim 1, the Proposed Scheme would not result any operational noise levels above the SOAEL. For aim 2, other adverse impacts would be mitigated and minimised as far as reasonably practicable through the design and alignment of the Proposed Scheme. For aim 3, the Proposed Scheme would provide a reduction in road traffic noise level in some areas.

11.12.9. The aims of the NPS NN and associated actions are listed in DMRB LA 111. A summary of responses is set out in Table 11-15~~Table 11-15~~.

Table 11-15: NPS NN Aims and associated actions

NPS NN Aims	Action
Aim 1: Avoid significant adverse impacts on health and quality of life from noise as a result of the new development. NOTE: Significant adverse noise effects occur when noise levels are above SOAEL.	For each receptor or group of receptors, the mitigation measures (actions) used to reduce noise exposure in relation to SOAEL have been summarised in Table 11-12~~Table 11-12~~. Where possible, significant environmental effects have been avoided through design and mitigation measures. Table E/1.3 defines a significant adverse noise effect in NPS NN policy terms as a noise level above SOAEL. The Proposed Scheme does not result in the operational noise exposure increasing above the SOAEL at any receptor and no properties qualify for noise insulation. Therefore, the Proposed Scheme meets this policy aim of NPS NN.
Aim 2: Mitigate and minimise other adverse impacts on health and quality of life from noise from the new development. NOTE: Other adverse impacts occur when noise levels are between LOAEL and SOAEL.	All design and mitigation measures (actions) to minimise other adverse impacts have been detailed in section 11.9. ~~Measures~~ Construction noise mitigation includes temporary noise barriers and restrictions on the use of plant ~~during the construction phase~~. ~~During the o~~Operational ~~phase~~ noise mitigation ~~measures include permanent noise barriers and~~ consists of low noise surfacing. Mitigation measures are detailed in the EMP (**TR010037/APP/7.4**) (**APP-128**) and Outline Traffic Management Plan (**TR010037/APP/7.5**) (**APP-129**) and secured as a requirement in the DCO. Therefore, the Proposed Scheme meets this policy aim of NPS NN.
Aim 3: Contribute to improvements to health and quality of life through the effective management and control of noise, where possible. NOTE: Applies to all noise levels.	Beneficial effects are anticipated in some areas as a result of the Proposed Scheme. These have been summarised in Section 11.10. Therefore, the Proposed Scheme meets this policy aim of NPS NN.

11.13. References

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11.14. Glossary

11.14.1. A glossary of terms and definitions is included in ES Appendix 11.1 (**TR010037/APP/6.3**) **(APP-109)**.