A47 North Tuddenham to Easton Dualling

Scheme Number: TR010038

Volume 6
6.1 Environmental Statement
Chapter 11 – Noise and Vibration

APFP Regulation 5(2)(a)

Planning Act 2008

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Infrastructure Planning

Planning Act 2008

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

The A47 North Tuddenham to Easton Development Consent Order 202[x]

ENVIRONMENTAL STATEMENT CHAPTER 11 NOISE AND VIBRATION

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11. Noise and vibration

11.1. Introduction

11.1.1. Highways England (the applicant) has submitted an application for an order to grant a development consent order (DCO) for the North Tuddenham to Easton Dualling Scheme (hereafter referred to as 'the Proposed Scheme'). The Proposed Scheme comprises the dualling of a section of the A47 between North Tuddenham and Easton, including the creation of two grade separated junctions (Wood Lane junction and Norwich Road junction), associated side road alterations and walking, cycling and horse-riding connections. The section of A47 road is currently unable to cope with the high traffic volume and there are limited opportunities to overtake slower moving vehicles on the single carriageway. The Proposed Scheme aims to reduce congestion related delay, improve journey time reliability and increase the overall capacity of the A47.

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 (ES) presenting the likely significant environmental effects of the Proposed Scheme.

11.1.3. As part of the EIA process, this 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 (September 2019) (**TR010038/APP/6.5**) and subsequent agreed Scoping Opinion (November 2019) (**TR010038/APP/6.6**) for the Proposed Scheme, in combination with the most up to date Design Manual for Roads and Bridges (DMRB) LA 111 Noise and vibration, revision 2, hereafter referred to as DMRB LA 111.

11.1.5. The main chapter text is supported by the following:

- Appendices
    - Appendix 11.1: Glossary of terms (**TR010038/APP/6.3**)
    - Appendix 11.2: Legislation and policy framework (**TR010038/APP/6.3**)
    - Appendix 11.3: Baseline noise survey (**TR010038/APP/6.3**)
    - Appendix 11.4: Traffic data comparison and model validation (**TR010038/APP/6.3**)
    - Appendix 11.5: Construction noise assessment (**TR010038/APP/6.3**)

- Figures
  - Figure 11.1: Noise location plan (**TR010038/APP/6.2**)
  - Figure 11.2: Operational noise barriers (**TR010038/APP/6.2**)
  - Figures 11.3 to 11.6: Road traffic noise level contours for each scenario (refer to Section 11.4) (**TR010038/APP/6.2**)
  - Figures 11.7 to 11.9: Noise difference contours for each comparison (refer to Section 11.4) (**TR010038/APP/6.2**)
  - Figure 11.10: Location of significant operational noise effects (**TR010038/APP/6.2**)
  - Figures 11.11 to 28: Construction noise level contours for each stage (refer to Table 11.5 for construction stage) (**TR010038/APP/6.2**)

11.2. Competent expert evidence

11.2.1. The competent expert has a BEng and MSc (environmental and architectural acoustics) and is a Member of the Institute of Acoustics (MIOA). The competent expert is an acoustician with 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.

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 Appendix 11.2 (**TR010038/APP/6.3**). A list of relevant policies, standards and guidance is provided below.

11.3.2. Full references are provided in Section 11.13.17.

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, 2014 (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 Broadland District Council Development Management Development Plan Document (DPD), 2015

11.3.11. This document guides planning officers and applicants on how planning is decided upon in the Broadland District Council area.

The South Norfolk Council Development Management Policies DPD (2015)

11.3.12. This document forms part of a set of documents that together constitute a Local Plan for the future development of South Norfolk.

WHO Night Noise Guidelines for Europe, 2009

11.3.13. The WHO Night Noise Guidelines for Europe were 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 (ENGER), 2018

11.3.14. The WHO ENGER provides 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 for Europe.

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

11.3.15. BS 5228 Part 1 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

11.3.16. 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 ground borne vibration

11.3.17. 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 104 Environmental assessment and monitoring. Revision 2, 2020

11.3.18. DMRB LA 104 sets out the requirements for environmental assessment of highways projects, including reporting and monitoring of significant adverse environmental effects.

DMRB LA 111 Noise and vibration, Revision 2, 2020

11.3.19. 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

11.3.20. 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

11.3.21. 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

11.3.22. 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

11.3.23. 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.

The Institute of Environmental Management and Assessment (IEMA) Guidelines for Environmental Noise Impact Assessment

11.3.24. The IEMA Guidelines set out key principles and advice on how to effectively integrate noise impacts and effects into the consenting process of all types of development, from EIA to smaller scale projects.

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

11.3.25. 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

11.3.26. 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

11.3.27. 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 Appendix 11.2 (**TR010038/APP/6.3**). 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 on noise and vibration (DMRB LA 111, revision 2, 2020), the Scoping Report (2019) (**TR010038/APP/6.5**) for the Proposed Scheme has been reviewed. The Scoping Report is considered to remain valid, however, some elements have been amended to account for the updated guidance. These amendments are presented in Table 11-1 below.

Table 11.1: Summary of scoping updates

Scoping document	Scoping item	Comment on Original Scope (2019)	Updated Scope (2020)
Scoping Report, 2019	Study area - operational noise	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 performed at any sensitive receptor within 600m of a road where this is the possibility of a change of 1 dB $L_{A10,18hr}$ upon Proposed Scheme opening, or 3 dB $L_{A10,18hr}$ in the long-term. Outside of the 1km area, sensitive receptors are identified adjacent to roads	Operational noise study area includes the area within 600m of new road links or road links physically changed or bypassed by the Proposed Scheme plus the area within 50m of other road links with potential to experience a short term basic noise level change of more than 1.0 dB(A) as a result of the Proposed Scheme.

Scoping document	Scoping item	Comment on Original Scope (2019)	Updated Scope (2020)
		where the change in received road traffic noise level would, as a result of the Proposed Scheme, increase or decrease by at least 1 dB $L_{A10,18hr}$ on opening or 3 dB in the long-term.	
	Study area - construction noise	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.	A study area of 300m from the closest construction activity was considered sufficient to evaluate the potential for significant effects at noise sensitive receptors.
	Gas main diversion construction noise and vibration	Not defined	It is understood that gas main diversion works are proposed during construction stage. As such, the gas pipeline construction works have been included in the assessment.
	Study area - construction vibration	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.
	Significance criteria – construction noise	Example Method: '2 to 5 dB(A) change' (BS 5228 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 Appendix 11.1 (**TR010038/APP/6.3**)) shall be established in accordance with Table 3.12 of DMRB LA 111. LOAEL based on baseline noise levels $L_{Aeq,T}$ and SOAEL threshold level determined as per BS 5228-1:2009+A1:2014 Section E3.2 and Table E.1
	Significance criteria – operational noise	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.
Scoping Opinion	Operational vibration	The ES should assess impacts from operational vibration where significant effects are likely to occur.	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. Broadland District Council and South Norfolk Council jointly submitted comments on the Proposed Scheme via email on 16 October 2019. These were included in the Scoping Opinion (2019) (**TR010038/APP/6.6**) and are available online[1].

11.4.5. Regarding noise and vibration Broadland District Council and South Norfolk Council stated; "*We suggest that the reduction of traffic noise levels by the use of low noise surfacing and screening would obviously be a very worthwhile enhancement. We look forward to reviewing the existing and proposed noise map modelling*."

11.4.6. Broadland District Council, South Norfolk Council and Breckland Council were consulted via email in February and March 2020 regarding our proposal to undertake a baseline noise survey in the area of the Proposed Scheme. In the email, the monitoring locations and survey methodology were outlined.

11.4.7. The Environmental Protection Officer at Breckland Council stated that they "have no issues with the proposed methodology or survey positions". The Environmental Management Officer at South Norfolk Council informed us that the Environmental Health Officer at Broadland District Council was "picking up this project" on their behalf.

11.4.8. The Environmental Health Officer at Broadland District Council stated that he "had no comment at this stage". Based on subsequent comments received from the Environmental Health Officer at Broadland District Council, Honingham Parish Council were then consulted regarding the survey. Due to the consultation with the Parish Council the monitoring locations were amended and incorporated into the baseline noise survey undertaken in September 2020..

Assessment method: Baseline survey and validation

11.4.9. As part of the assessment, a baseline noise survey was carried out in September 2020 at positions representing noise-sensitive receptors in the vicinity of the 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 survey are presented in Appendix 11.3 (**TR010038/APP/6.3**).

11.4.10. 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.

[1] https://infrastructure.planninginspectorate.gov.uk/projects/eastern/a47-north-tuddenham-to-easton/

11.4.11. The baseline noise survey was undertaken in September 2020 during the global COVID-19 pandemic but during a period when lockdown restrictions were relatively relaxed. In order to account for uncertainty in traffic volumes, a comparison between September 2019 and September 2020 traffic data for the A47 was carried out. The influence of the pandemic on road traffic noise levels has then been estimated through road traffic noise level predictions for each year. This is discussed further in Section 11.7.

Assessment method: Construction noise and vibration

11.4.1. The assessment of construction noise has been carried out for a study area within 300m of the Proposed Scheme, and the assessment of construction vibration assessment has focused on the 21 receptors that are closest to the construction works. These study areas include receptors at which there is the greatest potential for significant effects due to construction noise or vibration.

11.4.2. 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 level of noise from each phase of the construction activity 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 Appendix 11.5 (**TR010038/APP/6.3**).
- 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 BS 5228. 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.

11.4.3. 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.

11.4.4. The magnitude of the construction noise impact varies for each location within the study area. The impact magnitudes are presented in contour form within Figures 11.11 to 11.28(**TR010038/APP/6.2**). The number of receptors within each impact magnitude have then been counted and are presented in Section 11.8.

11.4.5. 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

11.4.6. 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.

11.4.7. 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.

Construction vibration LOAEL and SOAEL

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

11.4.9. 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

11.4.10. The construction traffic noise assessment has taken the baseline noise level to be consistent with the Do-Minimum Opening Year 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 significance of the short-term change in road traffic noise is considered using the method presented in DMRB LA 111 Table 3.17.

11.4.11. 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 Appendix 11.5 (**TR010038/APP/6.3**).

Assessment method: Operational noise

11.4.12. DMRB LA 111 requires that road traffic noise levels are predicted for four scenarios (as defined in Appendix 11.1, **TR010038/APP/6.3**), 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)

11.4.13. 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.

[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. This scenario excludes the Norwich Western Link.
[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. This scenario excludes the Norwich Western Link.

11.4.14. 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
- DSFY minus DMOY: This presents the long-term change in road traffic noise with the Proposed Scheme

11.4.15. 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 11.7.

11.4.16. 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.

11.4.17. 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

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

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

Determining significance

11.4.19. 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.

11.4.20. 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.

11.4.21. 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. 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.
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.

11.4.22. This assessment method is explained further in Appendix 11.2 (**TR010038/APP/6.3**).

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 Principal Contractor.

11.5.2. Details of the construction phases, location of the representative sample of noise sensitive receptors, assumptions of plant used in the assessment and predicted construction noise levels are presented in Appendix 11.5 (**TR010038/APP/6.3**).

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 National Grid works, road tie-ins and traffic management. These will need to be considered in further detail as construction methods are refined and proposals for night-time work discussed and agreed with the environmental health department at the local authority.

11.5.5. The prediction of construction noise from the proposed National Grid works allow for the plant assumptions in Appendix 11.5 (**TR010038/APP/6.3**) and the assumption that these works would occur 24 hours a day, seven days a week for up to three months.

11.5.6. It is assumed that the permanent noise barriers will not be constructed prior to main construction work phases.

11.5.7. It is assumed that any vibratory rollers used during construction will have two vibrating drums, a maximum drum vibration amplitude of 0.5mm and a drum width of 1m. This assumption is based on professional judgement and works on previous schemes.

11.5.8. All piling will be rotary bored as confirmed by the Principal Contractor.

11.5.9. 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

11.5.10. The proposed construction traffic haul routes are all within 10m of the Proposed Scheme carriageway and will be included within the outline Traffic Management Plan (**TR010038/APP/7.5**). These are positioned within the regions in where construction noise from each construction stage has been predicted as described above. Noise from haul road vehicle movements are included within the construction noise predictions and are not considered separately.

11.5.11. It is assumed that most construction traffic movements will be to and from the four proposed compound areas via the existing A47. It is assumed that the majority of heavy vehicle movements, arriving to and departing from the site, will occur on the A47, and that fewer movements occur on smaller roads for access to the areas in which the construction works are proposed.

11.5.12. The maximum number of site-wide lorry trips per day for any construction stage is assumed to not exceed 150. This 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 additional heavy vehicle movements (including return journeys) have been included in the construction traffic assessment. This then enables the identification of the roads which are most suitable for use by construction traffic.

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

- Mattishall Lane and Church Lane are within a construction area, and therefore construction traffic impacts are considered as part of the main construction noise assessment, not based on the change in traffic flows in the construction traffic assessment.
- It is assumed that roads other than those detailed above will not typically be used by heavy construction vehicles associated with the construction of the Proposed Scheme. This is to be controlled in the outline Traffic Management Plan (**TR010038/APP/7.5**).

Operational noise

11.5.14. Table 11.4 describes the assumptions and limitations associated with the road traffic noise model and the operational noise assessment.

Table 11.4: Operational 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.

Model element	Assumption and limitations
	• 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. Traffic flows need to increase by 25% or decrease by 20% (all other variables being equal) for a 1dB change to occur. Therefore, small errors in traffic flow forecasts are unlikely to significantly affect the results. • The Proposed 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) (**TR010038/APP/6.1**). • These have been supplemented by OS MasterMap and Google Maps Satellite data.
Norwich Western Link (NWL)	• The NWL, which is proposed to link to the A47 via a new junction at Wood Lane (B1535), has been excluded from both the Do-Minimum and the Do-Something scenarios discussed within the main body of this chapter. • However, the NWL has been included in the Do-Something scenarios for the assessment of cumulative noise and vibration effects. • It has been assumed that a low noise surface (-3.5 dB Road Surface Influence) will be used along the high-speed sections of the NWL. The use of a low noise surface is common practice for new high-speed trunk roads.
Honingham Lane	• For the core assessment, Honingham Lane has been modelled as 'open' in the Do-Minimum scenarios and 'closed' in the Do-Something scenarios. • For the cumulative assessment, Honingham Lane has been modelled as 'open' in all scenarios.
Road surfaces	• All rural roads have been assumed as comprising a hot-rolled asphalt surface. • For all 'Do-Minimum' scenarios, the surface of the A47 trunk road has been modelled based on data from the Highways England Pavement Management System (HAPMS), with -2.5 dB Road Surface Influence (RSI) modelled for sections comprising existing low noise surfacing (LNS) in both the 'Do-Minimum Opening Year' and 'Do-Minimum Future Year' scenarios. • For all 'Do-Something' scenarios, a low noise surface (-3.5 dB Road Surface Influence) has been included along the high speed sections of the Proposed Scheme (and the NWL for the cumulative assessment).
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 topography for the cumulative study area have been modelled based on 1m and 2m DTM data obtained from Defra Data Services Platform. • 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 DCO 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. • A total of 207 future residential receptors and one village hall at the Easton Village residential extension (a committed development) have been allocated based on information available in the planning portal.

[4] For all non-motorway roads, the dB L_{night} index has been determined by applying TRL Method 3: non-motorways (an empirical relationship derived from noise measurements on urban roads).
For trunk roads within the study area, the dB L_{night} index has been determined in accordance with TRL Method 2 which accounts for expected night-time traffic volume and characteristics. TRL Method 3: motorways (an empirical relationship derived from noise measurements on major motorways England) is considered inappropriate for the smaller scale of trunk road in East Anglia.

Model element	Assumption and limitations
Ground cover	• Intervening ground between any road and a receiver has been modelled as acoustically absorbent through rural areas, and mixed ground (50% hard ground) in built-up areas. • 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 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 noise sensitive receptors to provide a balanced approach, considering the impact at the majority of the path rather than at a specific single location. • With the exception of motels/hotels etc., non-residential noise sensitive receptors within the study area are not considered sensitive at night, and therefore have not been included in the night-time assessment tables.
Survey data and traffic comparison	• The noise survey undertaken in September 2020 is considered robust and has been used to inform the noise model and for characterising the sound climate. • The noise survey data has been validated by comparing publicly available traffic data on the A47 at Honingham between September 2019 and September 2020. That is, to ensure that the survey data is valid despite occurring during the COVID-19 pandemic. It is noted that a national lockdown was not in force during the survey (or the preceding three months), however, it is likely that the proportion of people working from home was greater during the survey than in 2019. • To establish the potential changes in road traffic noise due to the effects of the COVID-19 pandemic, the basic noise level has been determined from traffic data from 2019 and 2020 for the A47 at Honingham. These calculations are in accordance with CRTN and incorporate an assumed 0% heavy goods vehicles, zero road gradient and a road traffic speed of 75km/h.

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

11.6. Study area

Construction noise and vibration

11.6.1. For the construction noise assessment, the study area has been defined as the area that is 300m from the closest construction activity.

11.6.2. For the construction vibration assessment, DMRB LA 111 notes that a study area encompassing a 100m area from vibration generating activity is normally sufficient, adding that variations in the study area can be defined for individual projects. Given the expected methods of work, a study area encompassing a 30m area from vibration-generating activity is considered appropriate for identifying potentially worst-case significant effects since beyond this distance construction vibration, including from rotary piling, would not lead to significant adverse effects. This is discussed further in Section 11.8.

11.6.3. Some construction works would require temporary diversions of traffic on public roads where they interface with key construction activities. 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.

Construction traffic

11.6.4. For the construction traffic assessment, DMRB LA 111 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 1 dB(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 1 dB(A). Therefore, a study area for the construction traffic assessment is considered unnecessary, and the likelihood of significant effect is determined through assessment of the road traffic noise changes alone along specified roads, not at specific receptors.

Operation

11.6.5. 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 Proposed Scheme. This has been extended to include the area 50m either side of road links 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.

11.7. Baseline conditions

11.7.1. In order to establish the baseline sound conditions, noise monitoring was undertaken along the route of the Proposed Scheme in September 2020. Full details of the survey are presented in Appendix 11.3 (**TR010038/APP/6.3**).

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 within Appendix 11.4 (**TR010038/APP/6.3**).

11.7.3. It is acknowledged that there is a degree of uncertainty in the survey results due to the impact of the COVID-19 pandemic on traffic flows, and hence in noise levels. Although, at the time of the survey, there had been a gradual increase in road traffic flows towards those which existed prior to the outbreak of the pandemic, it is also recognised that the normality experienced before the pandemic had yet to return fully.

11.7.4. The IOA and ANC joint guidance on the impact of COVID-19 pandemic (version 5 dated 1 September 2020, current during the time of the survey) recommended a shift in emphasis to the return of site survey measurements as the default position, and acknowledges that indications suggest that road traffic is returning to pre-COVID-19 conditions, albeit it is not the same. It also states that "*For transport schemes, there may still need to be some reliance on predicted sound levels to describe the baseline conditions, with a corresponding need to source flow/activity data. There are now many sources of transport data available and*

these should be used, where possible, along with previously made direct site measurements to describe baseline conditions".

11.7.5. Traffic data from September 2020 during the survey period has been compared with traffic data from September 2019 (before UK lockdown). The purpose of this comparison was to understand the potential impact of any traffic decreases during the month of the baseline noise survey, compared to typical traffic flows in the absence of the COVID-19 pandemic.

11.7.6. When accounting for the above, the comparison between measured and modelled road traffic noise levels presented in Appendix 11.4 (**TR010038/APP/6.3)** 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.

Noise sensitive receptors within the construction noise study area

11.7.7. A total of 601 existing noise sensitive receptors have been identified within the 300m construction noise study area.

11.7.8. Construction noise levels and impact magnitudes have been assessed for each receptor within the construction noise study area for each construction stage.

11.7.9. Construction vibration has been assessed at a representative sample of the 21 closest noise sensitive receptors to the construction works. These receptors are located closest to the works and represent the locations at which construction vibration levels are expected to be the greatest. The representative receptor positions used in the assessment are shown in Figure 11.1 (**TR010038/APP/6.2**).

11.7.10. 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.

Noise sensitive receptors within the operational noise study area

11.7.11. Within the operational noise study area, a total of 1,877 noise sensitive receptors have been identified. These comprise:

- 1,435 existing dwellings
- 28 non-residential noise sensitive receptors situated within buildings, such as churches, schools and village halls
- 41 non-residential receptors situated outside of buildings, such as tennis courts, a bowling green, church cemeteries, PRoW and SSSI

- 207 dwellings at the Easton Village residential extension (a committed development)

11.7.12. Further noise sensitive receptors identified within the operational noise study area include designated areas. These are four Noise Important Areas (NIA), identified on the A47 at Hockering and to the east of Hockering.

- IA_ID:5200, asset owner HE
- IA_ID:5201, asset owner HE
- IA_ID:5202, asset owner HE
- IA_ID:6287, asset owner HE

11.7.13. There are two SSSI that intersect with the operational noise study area and have been included in the assessment of operational noise:

- Hockering Wood (reference TG 072 143)
- River Wensum (reference TG 023 176)

11.7.14. The River Wensum has been split into two sections. River Wensum 1 intersects Lyng Road and River Wensum 2 intersects Ringland Road.

11.7.15. The operational study area, noise sensitive receptors, SSSIs and NIAs are shown in Figure 11.1 (**TR010038/APP/6.2**).

Value of receptors

11.7.16. 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.

11.7.17. 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.

11.7.18. 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 PRoWs.

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 (**TR010038/APP/6.5**), 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 Proposed Scheme has the potential to adversely affect noise sensitive receptors within the 300m study area.

11.8.4. Details of the construction phasing, construction stages, the proposed plant for each stage, and the associated noise levels used for the assessment are presented in the Appendix 11.5 (**TR010038/APP/6.3**). The noise maps which present the predicted impacts for each set of construction stages are shown in Figures 11.11 to 11.28 (**TR010038/APP/6.2**). Maps are shown for each construction stage without mitigation, and with mitigation for those which present a moderate or major magnitude of impact.

11.8.5. The number of receptors for areas at which a moderate or major magnitude of impact could occur for each set of construction stages are presented in Table 11.5. The impacts identified would potentially experience a temporary moderate or major magnitude of impact without mitigation.

Table 11.5: Number of receptors predicted to experience moderate and major construction noise impacts

Construction stages	Description of activity	Figure references (TR010038/APP/6.2)	Magnitude of impact	Number of receptors predicted to experience impact	Receptors affected
1 – Pre-works (daytime)	National grid gas main diversion	Figure 11.11	Moderate	0	-
			Major	0	-

Construction stages	Description of activity	Figure references (TR010038/APP/6.2)	Magnitude of impact	Number of receptors predicted to experience impact	Receptors affected
1 – Pre-works (night-time)	National grid gas main diversion	Figures 11.25 and 11.26	Moderate	7	Merrywood House, Berry Hall, Rosemary Cottage, Tanglewood Barn, 1 & 2 Berry Hall Cottages
			Major	1	
2 – 5	Site set-up All compounds set-up All compounds operational use Utility works	Figure 11.12	Moderate	0	-
			Major	0	-
6 – 16	Structures	Figure 11.13	Moderate	0	-
			Major	0	-
17 – 25	Drainage basins	Figures 11.14 and 11.20	Moderate	2	Acorn Barn, Oak Tree Barn, Oak Farm, Pond View
			Major	2	
26 – 31	Highways mainline works	Figures 11.15 and 11.21	Moderate	2	Oak Farm, Pond View
			Major	0	
32 – 50	Junction works	Figures 11.16 and 11.22	Moderate	6	3 & 5 Hall Drive; Church Lodge; Church Farm Cottage & Church Farm House; St Andrew's Church
			Major	0	
51 – 65	Side roads and access tracks	Figures 11.17 and 11.23	Moderate	24	The Yard Plots 1 and 2; Hillview & 1 to 6 Mattishall Lane; St Michaels Church; West Grove; 1, 3, 5, 7, 9, 8, 10, 12, 14 Hall Drive; 38a, 38, 40, 42, 44, Corner Cottage The Street; St Andrew's Church, Church Lodge; Church Farm Cottage, Church Farm Barn & Church Farm House; St Peter's Church; 116, 120 & 122 Dereham Road
			Major	11	
66 – 69 (nights & weekends)	Highways tie-in works	Figures 11.18, 11.24, 11.27 and 11.28	Moderate	≈285	See para 11.8.10.
			Major		

Construction stages	Description of activity	Figure references (TR010038/APP/6.2)	Magnitude of impact	Number of receptors predicted to experience impact	Receptors affected
70 – 71	Landscaping and site removal	Figure 11.19	Moderate	0	-
			Major	0	-

11.8.6. 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 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.

11.8.8. The durations for which plant will be operating for each construction stage have not yet been finalised by the Principal Contractor. At this stage, a precautionary 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 construction stages. The pre-works stage comprising the national grid diversion works is currently scheduled to operate 24 hours a day, seven days a week. The duration of these works is not defined at this stage but could occur for up to three months.

11.8.9. For road surfacing works (stages 11 to 70), the Principal 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. The noise maps for the tie-in construction stages 66 to 69 show a large number of residential properties within the moderate or major adverse impact regions. It is considered unlikely that the tie in works would occur adjacent to individual receptors for 10 or more days or nights in any 15 consecutive days or nights (or for a total number of days or nights exceeding 40 in any six consecutive months). However, due to the sensitive period during which these works will occur, the Principal Contractor shall implement mitigation including the application of best practicable means of noise control.

11.8.11. DMRB LA 111 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.

11.8.12. 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

11.8.13. 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	

11.8.14. The majority of sensitive receptors are beyond 30m from the closest construction activity. For these receptors the magnitude of vibration is predicted to be no greater than a temporary minor adverse impact. At receptors located further from the Proposed Scheme, the construction vibration impact would be less.

11.8.15. 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.

11.8.16. 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, Acorn Barn, Oak Tree Barn, Oak Farm, at a minimum distance of 8m from the proposed highways works, and the culvert works S08 and S08a.
- Eight residential properties, The Yard Plots 1 and 2, 1 to 6 Mattishall Lane, at a minimum distance of 12m from the proposed highway works.
- One residential property Sycamore Farm at a minimum distance of 20m from the proposed highway works.

- One residential property, West Grove, at a minimum distance of 26m from the proposed highway works.
- Two residential properties 46 & 48 Dereham Road, at a minimum distance of 20m from the proposed highway works.
- One residential property, 9 Hall Drive at a minimum distance of 25m from the proposed highway works.
- One residential property, Church Lodge at a minimum distance of 10m from the proposed highway works.
- Four residential properties, 110, 116, 120, 122 Dereham Road at a minimum distance of 15m from the proposed highway works.

11.8.17. Based on the data provided in 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.

11.8.18. 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. 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)
Acorn Barn, Oak Tree Barn, Oak Farm	Steady state of operation	3	2.7 (moderate)
	During start-up and run-down	3	3.1 (moderate)
The Yard Plots 1 and 2, 1 to 6 Mattishall Lane	Steady state of operation	8	1.5 (moderate)
	During start-up and run-down	8	1.9 (moderate)
Sycamore Farm	Steady state of operation	1	0.7 (minor)
	During start-up and run-down	1	1.0 (moderate)
West Grove	Steady state of operation	1	0.5 (minor)
	During start-up and run-down	1	0.7 (minor)
46 & 48 Dereham Road	Steady state of operation	2	0.7 (minor)
	During start-up and run-down	2	1.0 (moderate)
9 Hall Drive	Steady state of operation	1	0.5 (minor)
	During start-up and run-down	1	0.8 (minor)

Receptor	Operation	Number of residential properties affected	Vibration level PPV, mm/s (magnitude of impact)
Church Lodge	Steady state of operation	1	2.0 (moderate)
	During start-up and run-down	1	2.4 (moderate)
110, 116, 120, 122 Dereham Road	Steady state of operation	4	1.1 (moderate)
	During start-up and run-down	4	1.4 (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.			

11.8.19. The predicted vibration levels are above the SOAEL (1.0 mm/s) for certain receptors. At these receptors, construction vibration from the typical earthworks, road formation and surfacing works at these receptors is predicted to result in a moderate adverse impact.

11.8.20. All piling will be rotary bored and will only occur during the structure formation construction stage. There is one structure proposed with construction at less than 30m from a sensitive receptor. This is S08, the extension of the existing west culvert which is approximately 9m from two residential properties; Acorn Barn and Oak Tree Barn.

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

11.8.22. By applying the assumptions within Section 11.5, it is expected that rotary piling would result in vibration levels of no more than 1.6 mm/s PPV at Acorn Barn and Oak Tree Barn. The worst-case magnitude of impact due to vibration from piling works is therefore predicted to be moderate adverse.

11.8.23. 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. In this case, the worst case predicted impact would apply, for example, at Acorn Barn, where the predicted impact is moderate for vibratory rollers, and moderate for piling, the combined impact would be moderate for simultaneous use.

11.8.24. 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 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.

11.8.25. 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 formation construction stage could occur for longer than these durations.

11.8.26. 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

11.8.27. 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.

11.8.28. 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.

11.8.29. Table 11.8 below presents baseline traffic flows and the change in road traffic noise that is expected due to the addition of construction traffic during the daytime for each road within the study area.

Table 11.8: Predicted noise increases due to construction 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	33037	67	6	+0.2	Negligible
Lyng Road	244	61	9	+8.8	Major
Sandy Lane	38	53	68	+10.8	Major
Wood Lane	2158	55	1	+3.6	Moderate
Berrys Lane	4187	50	3	+2.1	Minor

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
Dereham Road	435	36	8	+7.7	Major
Norwich Road	1213	37	3	+5.5	Major
Taverham Road	37	40	8	+17.5	Major
Blind Lane	540	48	0	+8.7	Major
Church Lane	3971	38	0	+3.2	Moderate
Ringland Road	3971	38	0	+3.2	Moderate

11.8.30. As can be seen in Table 11-7, the impact of the increase in the road traffic noise level is predicted to range from negligible to major. For this reason, mitigation measures are required to avoid significant adverse effects in some locations. Appropriate means of mitigating noise from construction traffic are presented in Section 11-9.

Operational noise

11.8.31. Table 11.9 to Table 11.11 present 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.

11.8.32. The figures provided (**TR010038/APP/6.2**) 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 (Do-Minimum Future Year minus Do-Minimum Opening Year)
- Short-term noise change with the Proposed Scheme (Do-Something Opening Year minus Do-Minimum Opening Year)
- Long-term noise change with the Proposed Scheme (Do-Something Future Year minus Do-Minimum Opening Year)

11.8.33. 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 to the operation of the Proposed Scheme are 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)

11.8.34. Table 11.9 compares road traffic noise levels for the Do-Minimum Opening Year scenario with the Do-Minimum Future Year scenario.

11.8.35. The additional number of dwellings affected at the committed Easton Village residential extension (a committed development) are presented in brackets. Non-residential receptors situated within buildings have been included in this table. Non-residential receptors situated outside of buildings such as PRoW and SSSI have been excluded from this table.

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	1094 (207)	19	1078 (20)	14
	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	93	3	18 (8)	0
Decrease in noise level	<3.0	Negligible	248	6	339 (179)	0
	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

11.8.36. The changes in road traffic noise level shown in 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)

11.8.37. Table 11.10 compares road traffic noise levels for the Do-Something Opening Year scenario with the Do-Minimum Opening Year scenario.

11.8.38. The changes take account of the embedded mitigation measures described in Section 11.9.

11.8.39. The additional number of receptors affected at the Easton Village residential extension (a committed development) are presented in brackets. All non-

residential receptors have been included in this table. That is, non-residential receptors situated outside of buildings such as PRoW and SSSI have been included.

11.8.40. The changes in road traffic noise level shown in Table 11.10 are due to the Proposed Scheme over the short-term and result from:

- the proposed realignment of the A47;
- the junction layout change where Heath Road/Lyng Road meets the A47;
- removal of the existing roundabout at Easton village; and
- changes in traffic flows and speeds on the local road network.

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	253 (73)	12	129 (7)	0
	1.0 – 2.9	Minor	125 (129)	12	60 (2)	3
	3.0 – 4.9	Moderate	25 (4)	6	21 (1)	0
	>5.0	Major	172 (1)	9	167	2
No Change	0.0	No Change	46	0	45 (3)	0
Decrease in noise level	<1.0	Negligible	389	10	261 (49)	6
	1.0 – 2.9	Minor	263	11	599 (145)	2
	3.0 – 4.9	Moderate	101	3	86	1
	>5.0	Major	61	6	67	0

Explanation of off-line impacts

11.8.41. With the Proposed Scheme in place road traffic noise level reductions are predicted at receptors adjacent to the following roads:

- Hockering to Greensgate: Heath Road / Hockering Road / Rectory Road / Weston Hall Road
- Walnut Tree Lane (B1535)
- Weston Green to Merryhill Country Park: Breck Road / The Broadway
- Easton to Ringland Hills: Ringland Road / Church Lane
- Berrys Lane

11.8.42. Increases in road traffic noise levels are predicted at the receptors adjacent to the following roads with the Proposed Scheme in place.

- Lyng and on Lyng Road (between the Lyng Road / Stone Road junction and the A1067)
- Sandy Lane (between the existing A47 and Walnut Tree Lane)

11.8.43. Increases in road traffic noise levels are also predicted at The River Wensum SSSI (near Lyng Road), St Margaret's Church cemetery (near Lyng Road) and a PRoW in Lyng.

11.8.44. The majority of the changes in road traffic noise levels are due to the expected changes in road users' behaviour caused by the Proposed Scheme, especially for long distance trips. In the opening year with the Proposed Scheme, the traffic model demonstrates that users from the east to Fakenham are more likely to use the A47 then turn to Lyng Road/Heath Road via Lyng to join the A1067. Whereas without the Proposed Scheme, these road users are more likely to use the local roads via Weston Green to Lenwade before joining the A1067.

11.8.45. 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.

Beneficial impacts due to the Proposed Scheme upon opening

11.8.46. Beneficial impacts are predicted in the short-term upon opening of the Proposed Scheme due to expected changes in road users' behaviour and the realignment of the A47 further away from the villages of Hockering and Honingham.

11.8.47. The 263 dwellings predicted to experience a minor beneficial impact are located as follows:

- Hockering (134)
- Taverham (61)
- Ringland / Ringland Road (19)
- Easton (16)
- Honingham (8)
- Barford / Marlingford (6)
- Heath Road / Stone Road (5)
- Barnham Broom (4)
- Bramble Drive / Park Lane (3)
- North Tuddenham (3)
- Sandy Lane (2)
- Weston Green (1)
- The Broadway (1)

11.8.48. The 101 dwellings predicted to experience a moderate beneficial impact are located as follows:

- Ringland / Ringland Road (51)
- Hockering (44)
- Greensgate (2)
- Bramble Drive / Park Lane (1)

- Honingham (1)
- Rectory Road (1)
- Heath Road / Stone Road (1)

11.8.49. The 61 dwellings predicted to experience a major beneficial impact are located as follows:

- Hockering (39)
- Greensgate (9)
- Heath Road / Stone Road (6)
- Bramble Drive / Park Lane (2)
- Ringland / Ringland Road (2)
- The Broadway (2)
- Honingham (1)

11.8.50. The eleven non-residential sensitive receptors predicted to experience a minor beneficial impact are located as follows:

- Barnham Broom Road / Honingham Road (5)
- Hockering (3)
- Taverham (1)
- St Michael's Church cemetery
- PRoW: Hockering FP9

11.8.51. The three non-residential sensitive receptors predicted to experience a moderate beneficial impact are:

- Gables End, The Street, Hockering
- SSSI River Wensum 2 (the section that intersects Ringland Road)
- The Bowling Green, The Street, Honingham

11.8.52. The six non-residential sensitive receptors predicted to experience a major beneficial impact are:

- PRoW: Hockering FP11
- PRoW: Hockering FP3
- PRoW: Hockering FP10
- PRoW: Honingham FP5
- PRoW: Weston Longville FP3
- PRoW: Weston Longville FP4

Adverse impacts due to the Proposed Scheme upon opening

11.8.53. Adverse impacts are predicted in the short-term upon opening of the Proposed Scheme due to:

- the introduction of a high-speed dual carriageway in a rural area

- the expected increase in road users along the Proposed Scheme and parts of the surrounding road network
- the expected change in road users' behaviour brought about by the Proposed Scheme
- the removal of the existing roundabout at Easton

11.8.54. A large number (125) of existing dwellings are predicted to experience a minor adverse impact due to the Proposed Scheme upon opening. These are located as follows:

- Honingham (46)
- North Tuddenham (15)
- Low Road / Lyng Road (12)
- Church Lane / Rotten Row (11)
- Sandy Lane (9)
- Easton (9)
- Berry Hall (7)
- Colton (4)
- Bramble Drive / Park Lane (3)
- Taverham Road (3)
- Hockering (1)
- Berrys Lane (1)
- Barford / Marlingford (1)
- Weston Green (1)
- Lyng / Lyng Road (1)
- Hillcrest, Dereham Road, East Tuddenham

11.8.55. The 25 existing dwellings predicted to experience a moderate adverse impact due to the Proposed Scheme upon opening are located as follows:

- Church Lane / Rotten Row (10)
- Weston Green (5)
- Low Road / Lyng Road (4)
- Wood Lane / Walnut Tree Lane (3)
- Mattishall Lane (2)
- Honingham (1)

11.8.56. The 172 existing dwellings predicted to experience a major adverse impact due to the Proposed Scheme upon opening are located as follows:

- Lyng / Lyng Road (159)
- Hall Farm (5)
- Mattishall Lane (5)
- Hockering (2)
- Church Lane / Rotten Row (1)

11.8.57. The dwellings in Lyng and along Lyng Road predicted to experience major adverse impacts are due to traffic re-routing as described in paragraph 11.8.44. More specifically; the Proposed Scheme alters the junction where Lyng Road meets the A47. This junction alteration is expected to improve access to Lyng Road for users of the A47 which, in turn, is expected to increase traffic flows along Heath Road/Lyng Road in the Do-Something scenarios. Of the 159 dwellings in Lyng or on Lyng Road predicted to have a major adverse impact in the opening year, 77 are predicted to be subject to road traffic noise levels below the LOAEL with the Proposed Scheme in place.

11.8.58. The dwellings on Mattishall Lane and Church Farm are predicted to experience major adverse impacts despite mitigation being included. This is discussed further in section 11.10.

11.8.59. At Hall Farm Cottages, Hockering Nursery and Newgate, major adverse noise impacts are expected due to the Proposed Scheme. Mitigation in the form of noise barriers is not effective at this location, as discussed in section 11.10.

11.8.60. At Easton Village residential extension, a single dwelling is predicted to experience a major adverse impact due to the increase in road traffic noise in the opening year. However, the road traffic noise levels are predicted to remain below the LOAEL.

11.8.61. None of the dwellings at which a major adverse impact occurs, will be subject to road traffic noise levels above the SOAEL with the Proposed Scheme.

11.8.62. There are 12 non-residential sensitive receptors predicted to experience a minor adverse impact due to the Proposed Scheme upon opening. These are:

- The Buttery, Berrys Lane, East Tuddenham
- Hall, Fox Lane, North Tuddenham
- Church of St Peter, Derham Road, Easton
- OSR: Tennis Courts at Berry Hall
- PRoW: East Tuddenham FP3
- PRoW: East Tuddenham FP4
- PRoW: East Tuddenham FP2
- PRoW: East Tuddenham FP6
- PRoW: East Tuddenham FP7
- PRoW: East Tuddenham FP10
- PRoW: East Tuddenham FP8
- PRoW: Honingham FP4

11.8.63. There are six non-residential sensitive receptors predicted to experience a moderate adverse impact due to the Proposed Scheme upon opening. These are:

- The Stables, Rotten Row, East Tuddenham
- The Retreat, Rotten Row, East Tuddenham
- Luke's Barn, Riverside Farm, Rotten Row, East Tuddenham
- OSR: St Margaret's Church cemetery
- PRoW: Honingham RB1
- SSSI: River Wensum 1 (Lyng)

11.8.64. There are nine non-residential sensitive receptors predicted to experience a major adverse impact due to the Proposed Scheme upon opening. These are:

- The Stables, Primrose Green, Lyng
- The Orchard, Primrose Green, Lyng
- St Andrew's Church, Honingham
- PRoW: Hockering FP8
- PRoW: Hockering FP7
- PRoW: East Tuddenham FP9
- PRoW: Lyng RB1
- PRoW: Lyng RB12
- PRoW: Lyng FP17

11.8.65. At The Stables, The Orchard and St Andrew's Church, road traffic noise levels are predicted to be below LOAEL in the opening year of the Proposed Scheme.

11.8.66. At the PRoW given above, it is predicted that road traffic noise levels will be below SOAEL with the Proposed Scheme in place.

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

11.8.67. 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:

- the proposed realignment of the A47
- the junction layout change where Heath Road/Lyng Road meets the A47
- removal of the existing roundabout at Easton village
- changes in traffic flows and speeds on the local road network

11.8.68. The changes take account of the embedded mitigation measures described in paragraphs 11.9.24.

11.8.69. The additional number of dwellings affected at the committed Easton Village 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	694 (194)	30	160 (3)	4
	3.0 – 4.9	Minor	38 (11)	6	15	0
	5.0 – 9.9	Moderate	175 (2)	10	163	2
	>10.0	Major	1	1	1	0
No Change	0.0	No Change	30	2	36	1
Decrease in noise level	<3.0	Negligible	404	12	545 (170)	4
	3.0 – 4.9	Minor	50	2	416 (34)	3
	5.0 – 9.9	Moderate	38	5	87	0
	>10.0	Major	5	1	12	0

11.8.70. Table 11.11 demonstrates that, within the study area, the majority of noise sensitive receptors are predicted to have a negligible or no noise change due to the Proposed Scheme over the long-term.

Beneficial impacts due to the Proposed Scheme over the long-term

11.8.71. With the Proposed Scheme, 50 existing dwellings are predicted to experience a minor beneficial impact over the long-term. These are located as follows:

- Hockering (41)
- Heath Road / Stone Road (3)
- Honingham (2)
- Greensgate (2)
- Bramble Drive / Park Lane (1)
- Rectory Road (1)

11.8.72. The 38 existing dwellings predicted to experience a moderate beneficial impact due to the Proposed Scheme over the long-term are located as follows:

- Hockering (25)
- Heath Road / Stone Road (4)
- Greensgate (4)
- Ringland / Ringland Road (2)
- The Broadway (2)
- Bramble Drive / Park Lane (1)

11.8.73. The five existing dwellings predicted to experience a major beneficial impact due to the Proposed Scheme over the long-term are located as follows:

- Annexe, Greensgate Thatch, Rectory Road, Weston Longville

- The Duckeries, Rectory Road, Weston Longville
- 1 Greensgate Cottage, Rectory Road, Weston Longville
- Annexe, The Duckeries, Rectory Road, Weston Longville
- Greensgate Thatch, Rectory Road, Weston Longville

11.8.74. The two non-residential sensitive receptors predicted to have a minor beneficial impact due to the Proposed Scheme over the long-term are The Bowling Green, The Street, Honingham and Gables End, The Street Hockering. The five non-residential sensitive receptors predicted to have a moderate beneficial impact are the following PRoW:

- Hockering FP3
- Hockering FP10
- Honingham FP5
- Weston Longville FP3
- Weston Longville FP4

11.8.75. The non-residential sensitive receptor predicted to have a major beneficial impact is PRoW: Hockering FP11.

Adverse impacts due to the Proposed Scheme over the long-term

11.8.76. Adverse impacts predicted in the long-term caused by the Proposed Scheme are due to:

- the expected increase in road users along the Proposed Scheme and parts of the surrounding road network;
- the introduction of a high-speed dual carriageway in a rural area;
- the expected change in road users' behaviour brought about by the Proposed Scheme; and
- the removal of the existing roundabout at Easton.

11.8.77. Over the long-term; there are 38 existing dwellings predicted to experience a minor adverse impact due to the Proposed Scheme. These are located as follows:

- Church Lane / Rotten Row (12)
- Easton Village residential extension (11)
- Sandy Lane (6)
- Low Road / Lyng Road (6)
- Taverham Road (5)
- Weston Green (4)
- Wood Lane / Walnut Tree Lane (3)
- Honingham (1)
- Mattishall Lane (1)

11.8.78. At all of these dwellings, the predicted road traffic noise level in both do-something scenarios is below the SOAEL.

11.8.79. The 175 existing dwellings predicted to experience a moderate adverse impact due to the Proposed Scheme over the long term are located as follows:

- Lyng / Lyng Road (159)
- Mattishall Lane (6)
- Hall Farm (5)
- Church Lane / Rotten Row (4)
- Hockering Nursery

11.8.80. The dwellings in Lyng and along Lyng Road predicted to have moderate adverse impacts are due to traffic re-routing as described in paragraph 11.8.44. At all of these dwellings, the predicted road traffic noise level in both Do-Something scenarios is below the SOAEL. Of the 159 dwellings in Lyng or on Lyng Road predicted to have a major adverse impact in the opening year, 77 are predicted to be subject to road traffic noise levels below the LOAEL with the Proposed Scheme in place.

11.8.81. The one existing dwelling predicted to have a major adverse impact due to the Proposed Scheme over the long term is Newgate, Gypsy Lane, Hockering. At Newgate, mitigation in the form of noise barriers has been excluded, as discussed in section 11.10.

11.8.82. At Newgate, the predicted road traffic noise level in both Do-Something scenarios is below the SOAEL.

11.8.83. The six non-residential receptors predicted to experience a minor adverse impact due to the Proposed Scheme over the long-term are located as follows:

- The Retreat, Rotten Row, East Tuddenham
- The Stables, Rotten Row, East Tuddenham
- Luke's Barn, Riverside Farm, Rotten Row, East Tuddenham
- PRoW: East Tuddenham FP2
- PRoW: East Tuddenham FP10
- PRoW: Honingham RB1

11.8.84. The ten non-residential receptors predicted to have a moderate adverse impact over the long-term are as follows:

- St Andrew's Church, Honingham
- The Stables, Primrose Green, Lyng
- The Orchard, Primrose Green, Lyng
- OSR: St Margaret's Church cemetery
- PRoW: Hockering FP8

- PRoW: East Tuddenham FP9
- PRoW: Lyng RB1
- PRoW: Lyng RB12
- PRoW: Lyng FP17
- SSSI: River Wensum 1 (Lyng)

11.8.85. At St Andrew's Church and The Stables, predicted road traffic noise levels with the Proposed Scheme are below the SOAEL. At The Orchard, predicted road traffic noise levels are below the LOAEL. Noise increases at the St Andrew's Church are due to the realignment of the A47. A noise barrier at this location was considered as part of the EIA and this is discussed further in Section11.9.29.

11.8.86. The one non-residential receptor predicted to have a major adverse impact over the long-term is PRoW: Hockering FP7.

11.8.87. At all of the outdoor receptors, the predicted road traffic noise levels with the Proposed Scheme are below the SOAEL. Predicted road traffic noise levels with the Proposed Scheme are below the LOAEL at the River Wensum and St Margaret's Church cemetery. Operational noise effects with reference to LOAELs and SOAELs are discussed further in Section 11.10.

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. Measures in this section 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 (**TR010038/APP/6.8**).

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. Where possible, it is recommended that the permanent noise barriers that form part of the embedded mitigation for operational noise shall be built as early as possible in the construction programme so that they can offer noise mitigation during the construction stages. This would avoid the need for temporary barriers in the same location.

11.9.6. Mitigation measures in the form of temporary noise barriers or site hoarding shall be considered to mitigate construction noise effects at the residential receptors presented in Table 11-12. These shall be provided where construction activity in the vicinity of the receptor is expected to 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.

11.9.7. 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 Address	Construction stage
Merrywood House, Berry Hall, Rosemary Cottage, Tanglewood Barn, 1 & 2 Berry Hall Cottages,	1 – Pre-works (national grid gas main diversion)
Acorn Barn, Oak Tree Barn, Oak Farm,	17 – 25 (drainage basin works adjacent to receptors)
Oak Farm	26 – 31 (highway mainline works adjacent to the receptor)
3 & 9 Hall Drive Church Lodge Church Farm Cottage & Church Farm House St Andrew's Church	32 – 50 (junction works adjacent to the receptors)
The Yard Plots 1 and 2 Hillview & 1 to 6 Mattishall Lane, St Michael's Church, West Grove NR20 3JL; 1, 3, 5, 7, 9, 8, 10, 12, & 14 Hall Drive 38a, 38, 40, 42, 44, & Corner Cottage, The Street; St Andrew's Church; Church Lodge; Church Farm Cottage, Church Farm Barn & Church Farm House; St Peter's Church; 116, 120 & 122 Dereham Road .	51 – 65 (side road and access track works adjacent to the receptors)

11.9.8. A residual significant moderate adverse impact due to construction noise is predicted at Acorn Barn when accounting for the above mitigation measures.

11.9.9. Therefore, in addition, the Principal Contractor shall review working methods, and carry out further detailed assessments of construction noise based on finalised plant type and duration information.

11.9.10. Where there is still potential for moderate adverse impacts, the Principal Contractor may carry out noise monitoring during relevant periods of the construction programme at positions that represent Acorn Barn. Real-time alerts can be provided to notify the Principal Contractor when noise from construction 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.

11.9.11. The identified receptors in Table 11-12 do not include those shown for the overnight/weekend tie-in works in Appendix 11.5 (**TR010038/APP/6.3**). There are a large number of potentially affected receptors, and therefore it is likely that temporary noise barriers will be required to screen nearby sensitive receptors from the tie-in works.

11.9.12. In addition to the above mitigation measures, best practice noise and vibration mitigation techniques shall be employed and included in the Environmental Management Plan (**TR010038/APP/6.8**) and 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 Principal 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.

11.9.13. 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 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. Letter drops explaining this will aid communication with the local community. A dedicated site contact for the public and a complaints-handling procedure shall also be put in place.

11.9.14. For temporary traffic diversion routes, the noise mitigation measures should include the use of more than one diversion route for different closures. There are currently 17 proposed full carriageway closures.

11.9.15. The proposals currently include for one diversion route for HGV traffic, and one for light vehicles. The HGV route is via A roads, and therefore repeated use of this route is not considered likely to cause significant noise effects due to existing traffic levels.

11.9.16. Different diversion routes for light vehicles should be included to spread any potential increases in traffic and associated roadside noise levels on these roads, particularly during periods of required night-time diversions. Diversions should be via A roads where possible. For each principal diversion the Principal Contractor shall review the options for temporary traffic management and diversion routes will be used following the least noise sensitive routes. Residents along routes likely to be affected by night-time traffic diversions with potential for significant noise effects will be notified in advance of arrangements.

11.9.17. 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.

11.9.18. Construction vibration from piling at the extension of the existing west culvert 9m from Acorn Barn and Oak Tree Barn 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

11.9.19. On the basis of the assumed numbers of HGV movements, construction related traffic can use the existing A47, the proposed roads, and Berrys Lane as required.

11.9.20. Use of other local roads should be avoided. Additionally, construction related traffic arriving from offsite shall be routed via the existing A47 and the haul road following the Proposed Scheme alignment only. This shall be implemented in the outline Traffic Management Plan (**TR010038/APP/7.5**).

11.9.21. Detailed noise impact assessments shall be undertaken by the Principal Contractor before these routes are used, and these shall be included in the outline Traffic Management Plan (**TR010038/APP/7.5**). Details shall be provided to the local authority for approval.

Operation

11.9.22. As part of the mitigation measures embedded within the Proposed Scheme design, the A47 dual carriageway shall be surfaced with a low-noise road surface. For this high-speed carriageway, the surface material shall be specified to reduce road traffic noise by 3.5dB $L_{A10,18hr}$ when compared with hot-rolled asphalt. A low-noise surface of this specification has been included as part of the Proposed Scheme design in order to reduce the number of adverse operational noise effects. The low-noise road surface will be extended approximately 0.5km (from start coordinates: 613145, 310952; to end coordinates: 612659, 210996) to the east of the tie in works to reduce noise levels at NIA5202.

11.9.23. The low-noise road surface shall be provided on both carriageways of the Proposed Scheme between North Tuddenham to Easton (9km in each direction) and for the proposed connector road between the main dual carriageway and the existing A47 in the vicinity of St Peter's Church (0.5km).

11.9.24. Noise barriers have been included as part of the embedded mitigation of the Proposed Scheme design at the locations described in Table 11.13 and presented in Figure 11.2 (**TR010038/APP/6.2**).

Table 11.13: Permanent noise barrier requirements

Name	Location	Proposed height (m)	Proposed length (m)	Type	Insertion loss, IL (dB)	Sound insulation category
Barrier 1	Mattishall Lane (south)	3.0	310	Absorptive (class A3)	6.7	B2
Barrier 2	Mattishall Lane (north)	3.0	300	Absorptive (class A3)	2.9	B2
Barrier 3	Rotten Row & Church Lane	3.0	850	Reflective	3.4	B2
Barrier 4	St Peter's Church cemetery	2.0	94	Reflective	2.4	B2

11.9.25. The heights of Barrier 1 and Barrier 3 must be regarded as the height difference between the top of the acoustic barrier and the local height of the carriageway. The heights of Barrier 2 and Barrier 4 must be regarded as the height difference between the top of the acoustic barrier and the local ground height.

11.9.26. The required noise barrier specification is also presented in Table 11.13 and has been determined in accordance with DMRB LD 119. The required category of airborne sound insulation category is specified as per BS EN 1793-2. The category of absorptive performance is specified as per BS EN 1793-1 and in accordance with the stated requirements with DMRB LA 111.

11.9.27. The landscape and visual effects of the acoustic barriers are assessed in Chapter 7 (Landscape and visual effects) (**TR010038/APP/6.1**) and are incorporated into the Environmental Masterplan (**TR010038/APP/6.8**).

11.9.28. Moderate and major changes in road traffic noise are predicted at some receptors in Lyng, close to Lyng Road. Provision of acoustic barriers along Lyng Road is not considered practical since it would obstruct access. These roads are maintained by the local authority and therefore a change in road surface is outside of the remit of the Proposed Scheme. In addition, no receptors at this location meet the criteria for insulation work under the Noise Insulation Regulations since predicted road traffic noise levels are below the SOAEL.

11.9.29. Moderate or major noise changes are also predicted at other receptors where the Proposed Scheme is the main source of road traffic noise. Additional barriers were considered at the following locations:

- Hockering Nursery and Newgate, Gypsy Lane in Hockering: Upon Proposed Scheme opening year, the road traffic noise level is expected to be 60 dB $L_{A10,18hr}$ at Hockering Nursery and 64 dB $L_{A10,18hr}$ at Newgate. A barrier 610m long and 3m high was assessed and was predicted to reduce the road traffic noise level by 2 dB at Hockering Nursery and by 4 dB at Newgate. However,

the magnitude of the adverse impact at these receptors was not affected even with the substantial length of barrier. Therefore, a barrier at this location has not been provided as it would not reduce the magnitude of impact or influence the assessment conclusions.

- Hall Farm and 1 to 4 Hall Farm Cottages: Upon Proposed Scheme opening year, the road traffic noise level is expected to range from 55 to 58 dB $L_{A10,18hr}$ at these receptors. A barrier 442m long and 3m high was assessed and was predicted to reduce the road traffic noise level by between 0 and 2 dB at these receptors. No change in the magnitude of the adverse impact is predicted at these receptors even with the substantial length of barrier, and the benefit of the barrier would not be perceptible at some of these receptors. Given the length of barrier required for the small predicted noise changes, provision of a barrier at this location would not be proportionate.
- St Andrew's Church: Upon Proposed Scheme opening year, the road traffic noise level is expected to be 55 dB $L_{A10,18hr}$. A barrier 410m long and 3m high was assessed and was predicted to reduce the road traffic noise level by 1 dB. Given the length of barrier required for a just perceptible noise change, and the heritage setting sensitivities at this location, provision of a barrier would not be proportionate.

11.9.30. Therefore, it is considered the barriers proposed are in accordance with NPS NN as the mitigation measures are considered to be proportionate and reasonable.

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, which may include the early provision of the permanent noise barriers, potential for significant effects due to noise from the construction of the Proposed Scheme remains at one receptor. The magnitude of impact with mitigation is presented in Table 11.14 and the assessment of residual significant effects explained further below.

Table 11.14: Predicted moderate and major magnitude of impacts with temporary noise barriers

Receptor Address	Construction Stage	Magnitude of impact (mitigated)
Acorn Barn, Lyng Road	17 – 25 (drainage basin works adjacent to the receptor)	Moderate

11.10.3. A residual moderate adverse impact is predicted from drainage basin works at Acorn Barn. 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. Each drainage basin is currently scheduled for approximately two months

construction work, although the details regarding how long each item of plant would be operational for within this period are yet to be confirmed.

11.10.4. There is also potential for residual moderate or major impacts at a large number of residential properties where tie-in works occur during night times and/or weekends. The Principal Contractor is to undertake further detailed assessments on the out-of-hours works to determine the impacts and agree working methods with the Environmental Health Department at the local authority.

11.10.5. 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.

11.10.6. In summary, subject to the provision of temporary noise barriers, implementation of best practicable means, construction noise monitoring where required, use of multiple temporary traffic diversion routes, and the mitigation measures described within Section 11.9, construction noise is not predicted to result in significant adverse residual effects at the vast majority of receptors. A significant effect is predicted at Acorn Barn during the adjacent drainage basin works if the works exceed the timescales detailed above but this should only be for a limited period of two months.

11.10.7. 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.

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.

11.10.9. Mitigation measures have been 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 the extension of the existing west culvert 9m from Acorn Barn and Oak Tree Barn.

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. 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 are therefore not expected to result in any significant effects.

11.10.14. Provided that construction related traffic uses only the existing A47, the Proposed Scheme, and Berrys Lane, increases in the basic noise level of roads used for construction traffic are predicted to have a negligible to minor magnitude of impact. Therefore, no significant adverse noise effects due to construction traffic are predicted. This will be controlled in the outline Traffic Management Plan (**TR010038/APP/7.5**).

Operation

11.10.15. The changes in road traffic noise that result from the Proposed Scheme have been reported in accordance with DMRB LA 104 and DMRB LA 111 and include the mitigation measures described in Section 11.9.

11.10.16. An initial assessment of operational noise significance at noise sensitive receptors is summarised in this section and in Table 11.15. A moderate or major magnitude of impact at noise sensitive receptors is classed as ‘Significant’.

11.10.17. The number of dwellings affected at Easton Village residential extension (a committed development) are presented in brackets.

Table 11.15: 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	212 (5)	190 (1)	171	154
Not significant	402 (202)	192 (9)	719	913 (197)

11.10.18. Table 11.15 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 DMRB LA 111 Table 3.60 (reproduced in Appendix 11.2 (**TR010038/APP/6.3**)).

11.10.20. Following the justifications within DMRB LA 111 Table 3.60, final operational noise significance at the identified noise sensitive receptors and Noise Important Areas has been determined. This is presented in Table 11.16

11.10.21. Given the large number of noise sensitive receptors in the operational noise study area, receptors have been grouped into locations at which there is a similar magnitude of impact.

Table 11.16: Final operational noise significance summary table

Receptor Group	Magnitude of change	Conclusion of Significance of Environmental Effect	Justification of Significance Conclusion
Noise Important Area 5200 (36 receptors)	Moderate/major beneficial in the short-term, moderate beneficial over the long-term.	Significant beneficial	All the receptors within this Noise Important Area are predicted to experience a moderate or major beneficial impact in the short-term due to the Proposed Scheme. Over the long-term the impacts are predicted to be moderate beneficial for 22 receptors. Therefore, this beneficial effect is considered to be significant at 22 receptors.
Noise Important Area 5200 (14 receptors)	Moderate/major beneficial in the short-term, minor beneficial over the long-term	Not significant	The remaining receptors within this Noise Important Area are predicted to experience a moderate/major beneficial impact due to the Proposed Scheme in the short-term and a minor beneficial impact over the long-term. Overall, this beneficial effect is considered to be not significant.

Receptor Group	Magnitude of change	Conclusion of Significance of Environmental Effect	Justification of Significance Conclusion
Noise Important Area 5201 (10 receptors)	Minor adverse/negligible/minor beneficial in the short-term, negligible over the long-term.	Not significant	The noise changes at this Noise Important Area are predicted to be minor or negligible over the short and long-term. Overall, these effects are considered to be not significant.
Noise Important Area 6287 (Church Lodge, Taverham Road)	Major beneficial in the short-term, minor beneficial in the long-term.	Not significant	This receptor is predicted to experience a major beneficial impact in the short-term due to the Proposed Scheme. However, over the long-term the impact is minor beneficial and not significant. Overall, this beneficial effect is considered to be not significant.
Noise Important Area 5202 (25 receptors)	Minor beneficial or negligible in the short-term, negligible in the long-term.	Not significant	Receptors at this Noise Important Area are predicted to experience a minor beneficial or negligible impact in the short-term due to the Proposed Scheme. However, over the long-term the impacts are negligible. Therefore, this beneficial effect is considered to be not significant.
Hockering (3 receptors)	Major beneficial in the short-term, moderate beneficial in the long-term.	Significant beneficial	These receptors, outside of NIA 5200, are predicted to experience a major beneficial impact in the short-term and moderate beneficial impact over the long-term. Overall, this beneficial effect is considered to be significant.
Hockering (remaining receptors)	Major/moderate beneficial in the short-term, minor/negligible beneficial over the long-term.	Not significant	These remaining receptors are predicted to experience a moderate or major beneficial impact due to the Proposed Scheme in the short-term are predicted to have a minor beneficial or negligible impact over the long-term. Overall, this beneficial effect is considered to be not significant.
Greensgate (9 receptors)	Major beneficial in the short-term, major/moderate beneficial in the long-term.	Not significant	These receptors are predicted to experience a major or moderate beneficial impact due to the Proposed Scheme over the short and long-term. However, road traffic noise levels are predicted to be below LOAEL in all scenarios at all receptors. Although the change in road traffic noise is significant, overall, this beneficial effect is considered to be not significant.
Greensgate (1 receptor)	Moderate/major beneficial in the short-term, minor beneficial in the long-term.	Not significant	For the remaining receptor, the impact is predicted to be moderate beneficial in the short-term and minor beneficial over the long-term. Overall, this beneficial effect is considered to be not significant.
Ringland / Ringland Road (2 receptors)	Major beneficial in the short-term, moderate beneficial over the long-term.	Significant beneficial	These receptors are predicted to experience a major beneficial impact in the short-term and a moderate beneficial impact over the long-term. Overall, this beneficial effect is considered to be significant.

Receptor Group	Magnitude of change	Conclusion of Significance of Environmental Effect	Justification of Significance Conclusion
Ringland / Ringland Road (51 receptors)	Moderate beneficial in the short-term, negligible in the long-term.	Not significant	These receptors are predicted to experience a moderate beneficial impact due to the Proposed Scheme over the short-term. Over the long-term this initial beneficial impact reduces to negligible. Overall, this beneficial effect is considered to be not significant.
Park Lane, Hockering (1 receptor)	Major beneficial in the short-term, moderate beneficial over the long-term.	Significant beneficial	This receptor is predicted to experience a major beneficial impact in the short-term and a moderate beneficial impact over the long-term. Road traffic noise levels are predicted to be above LOAEL in all scenarios. Overall, this beneficial effect is considered to be significant.
Heath Road / Stone Road (4 receptors)	Major beneficial in the short-term, moderate beneficial over the long-term.	Not significant	These receptors are predicted to experience a major beneficial impact in the short-term and a moderate beneficial impact over the long-term. However, road traffic noise levels are predicted to be below LOAEL in all scenarios at all receptors. Although the change in road traffic noise is significant, overall, this beneficial effect is considered to be not significant.
Heath Road / Stone Road (3 receptors)	Major beneficial in the short-term, minor beneficial over the long-term.	Not significant	These receptors are predicted to experience major beneficial impacts due to the Proposed Scheme over the short-term. Over the long-term this initial beneficial impact reduces to minor. Overall, this beneficial effect is considered to be not significant.
The Broadway (2 receptors)	Major beneficial in the short-term, moderate beneficial over the long-term.	Not significant	These receptors are predicted to experience a major beneficial impact in the short-term and a moderate beneficial impact over the long-term. However, road traffic noise levels are predicted to be below LOAEL in all scenarios at all receptors. Although the change in road traffic noise is significant, overall, this beneficial effect is considered to be not significant.
9 Hall House, Hall Drive, Honingham	Moderate beneficial in the short-term, minor beneficial in the long-term.	Not significant	This receptor is predicted to experience a moderate beneficial impact due to the Proposed Scheme in the short-term and a minor beneficial over the long-term. Overall, this beneficial effect is considered to be not significant.
Glebe Farm, Rectory Road	Major beneficial in the short-term, minor beneficial over the long-term.	Not significant	This receptor is predicted to experience a major beneficial impact due to the Proposed Scheme over the short-term. Over the long-term this initial beneficial impact reduce to minor. Overall, this beneficial effect is considered to be not significant.

Receptor Group	Magnitude of change	Conclusion of Significance of Environmental Effect	Justification of Significance Conclusion
Lyng / Lyng Road (83 receptors)	Major adverse in the short-term, moderate/major adverse over the long-term.	Significant adverse	These receptors are predicted to experience a major adverse impact in the short-term and a moderate or major adverse impact over the long-term due to the effects of the Proposed Scheme on traffic flows on Lyng Road. Do-Something road traffic noise levels are predicted to be between the LOAEL and the SOAEL at all receptors. The highest predicted Do-Something road traffic noise level in Lyng is 66 dB $L_{A10,18hr}$ at 10 Heath Road, Lyng (in the future year). Therefore, because of the change in road traffic noise level that is predicted to occur due to the effects of the Proposed Scheme on traffic flows on Lyng Road, this adverse effect is considered to be significant.
Lyng / Lyng Road (76 receptors)	Major adverse in the short-term, moderate/major adverse in the long-term	Not significant	These receptors are predicted to experience a major adverse impact in the short-term and a moderate adverse impact over the long-term due to the effects of the Proposed Scheme on traffic flows on Lyng Road. However, Do-Something road traffic noise levels are predicted to be below LOAEL at all receptors. Although the change in road traffic noise is significant, overall, this adverse effect is considered to be not significant as levels are below LOAEL.
Church Lane / Rotten Row (2 receptors)	Major/moderate adverse in the short-term, moderate adverse over the long-term.	Significant adverse	These receptors are predicted to experience a moderate or major adverse impact in the short-term and a moderate adverse impact over the long-term due to the Proposed Scheme. Do-Something road traffic noise levels are predicted to be below the SOAEL and above the LOAEL at both receptors. The highest Do-Something road traffic noise level is predicted be 58 dB $L_{A10,18hr}$ at Riverside Farm (in the future year). Therefore, due to the change in road traffic noise level that is predicted to occur due to the Proposed Scheme, this adverse effect is considered to be significant. The proposed mitigation in the form of a low-noise surface and an acoustic barrier is not sufficient to avoid all significant adverse noise effects.
Church Lane / Rotten Row (10 receptors)	Moderate adverse in the short-term, minor adverse over the long-term.	Not significant	These receptors are predicted to experience a moderate adverse impact in the short-term and a minor adverse impact over the long-term due to the Proposed Scheme. Overall, this adverse effect is considered to be not significant.

Receptor Group	Magnitude of change	Conclusion of Significance of Environmental Effect	Justification of Significance Conclusion
Rose Cottage, Rotten Row (1 receptor)	Moderate adverse in the short-term, moderate adverse over the long-term.	Not significant	This receptor is predicted to experience a moderate adverse impact in the short-term and a moderate adverse impact over the long-term due to the Proposed Scheme. However, Do-Something road traffic noise levels are predicted to be below LOAEL. Although the change in road traffic noise is significant, overall, this adverse effect is considered to be not significant.
Mattishall Lane (6 receptors)	Major/moderate adverse in the short-term, moderate adverse in the long term	Significant adverse	These receptors are predicted to experience a major or moderate adverse impact in the short-term and a moderate adverse impact over the long-term due to the Proposed Scheme. Do-Something road traffic noise levels are predicted to be below SOAEL and above LOAEL for all receptors. The highest Do-Something road traffic noise level is predicted to be 62 dB $L_{A10,18hr}$ (in the future year) at Hillview. Therefore, due to the change in road traffic noise level that is predicted to occur due to the Proposed Scheme, this adverse effect is considered to be significant. The proposed mitigation in the form of a low-noise surface and an acoustic barrier is not sufficient to avoid all significant adverse noise effects.
Easton Village residential extension (6 receptors)	Major/moderate adverse in the short-term, moderate/minor adverse over the long-term.	Not significant	These receptors are predicted to experience a major or moderate adverse impact due to the Proposed Scheme in the short-term. Over the long-term the magnitude of impact is predicted to be moderate or minor adverse. However, Do-Something road traffic noise levels are predicted to be below LOAEL at all receptors. Although the change in road traffic noise is significant at two receptors, overall, this adverse effect is considered to be not significant.
Hall Farm and Hall Farm Cottages, Honingham (5 receptors)	Major adverse in the short-term, moderate adverse in the long term	Significant adverse	These receptors are predicted to experience a major adverse impact in the short-term and a moderate adverse impact over the long-term due to the Proposed Scheme. Do-Something road traffic noise levels are predicted to be below SOAEL and above LOAEL at all receptors. The highest Do-Something road traffic noise level is predicted be 58 dB $L_{A10,18hr}$ (in the future year) at Hall Farm. Therefore, because of the change in road traffic noise level that is predicted to occur due to the Proposed Scheme, this adverse effect is considered to be significant. A noise barrier is not proposed at this locations it is not a proportionate or reasonable mitigation measure.. This is discussed further in 11.9.29. Mitigation in the form of a low-noise surface along the length of the Proposed Scheme has been included, however, this is not sufficient to avoid significant adverse noise effects in this location.

Receptor Group	Magnitude of change	Conclusion of Significance of Environmental Effect	Justification of Significance Conclusion
Weston Green (5 receptors)	Moderate adverse in the short-term, minor/negligible adverse over the long-term.	Not significant	These receptors are predicted to experience moderate adverse impact due to the Proposed Scheme over the short-term. Over the long-term the adverse impacts reduce to minor or negligible adverse. Overall, this adverse effect is considered to be not significant.
Low Road / Lyng Road (3 receptors)	Moderate adverse in the short-term, minor adverse over the long-term.	Not significant	These receptors are predicted to experience moderate adverse impact due to the Proposed Scheme over the short-term. Over the long-term the adverse impacts reduce to minor adverse. Overall, this adverse effect is considered to be not significant.
Wood Lane (3 receptors)	Moderate adverse in the short-term, minor adverse over the long-term.	Not significant	These receptors are predicted to experience moderate adverse impact due to the Proposed Scheme over the short-term. Over the long-term the adverse impacts reduce to minor adverse. Overall, this adverse effect is considered to be not significant.
St Andrew's Church, Honingham	Major adverse in the short-term, moderate adverse over the long-term.	Significant adverse	This receptor is predicted to experience major adverse impact due to the Proposed Scheme in the short-term and moderate adverse impact over the long-term. Do-Something road traffic noise levels are predicted to be below the SOAEL and above the LOAEL at this receptor. The highest Do-Something road traffic noise level is predicted be 56 dB $L_{A10,18hr}$ (in the future year). Therefore, due to the change in road traffic noise level that is predicted to occur due to the Proposed Scheme, this adverse effect is considered to be significant. A noise barrier is not proposed at this location as it is not a proportionate or reasonable mitigation measure. This is discussed further in 11.9.29. Mitigation in the form of a low-noise surface along the length of the Proposed Scheme has been included, however, this is not sufficient to avoid significant adverse noise effects at this location.
Red Barn Cottage, Blind Lane, Honingham	Moderate adverse in the short-term, minor adverse over the long-term.	Not significant	The receptor at this location is predicted to experience a moderate adverse impact due to the Proposed Scheme in the short-term. Over the long-term this initially significant adverse effect reduces to minor adverse. Overall, this initial adverse effect is considered to be not significant.

Receptor Group	Magnitude of change	Conclusion of Significance of Environmental Effect	Justification of Significance Conclusion
Newgate, Gypsy Lane and Hockering Nursery in Hockering (2 receptors)	Major adverse in the short-term, major/moderate adverse over the long-term	Significant adverse	These receptors are predicted to experience major adverse impact due to the Proposed Scheme in the short-term and moderate or major adverse impact over the long-term. Do-Something road traffic noise levels are predicted to be below the SOAEL and above the LOAEL at these receptors. The highest Do-Something road traffic noise level is predicted be 64 dB $L_{A10,18hr}$ at Newgate (in the future year). Therefore, because of the change in road traffic noise level that is predicted to occur due to the Proposed Scheme, this adverse effect is considered to be significant. A noise barrier is not proposed at this location as it is not a proportionate or reasonable mitigation measure. This is discussed further in 11.9.29. Mitigation in the form of a low-noise surface along the length of the Proposed Scheme has been included, however, this is not sufficient to avoid significant adverse noise effects at this location.
Public rights of way (PRoW): Hockering FP11, FP3 and FP10	Major beneficial in the short-term, moderate/major beneficial over the long-term.	Significant beneficial	These non-residential receptors are predicted to experience a major beneficial impact due to the Proposed Scheme in the short-term and a moderate or major beneficial impact over the long-term. Therefore, this beneficial effect is considered to be significant.
The Bowling Green, The Street, Honingham	Moderate beneficial in the short-term, minor beneficial in the long-term	Not significant	At this non-residential receptor the impacts are predicted to be moderate beneficial in the short-term and minor beneficial over the long-term. Overall, this beneficial effect is considered to be not significant.
Public rights of way (PRoW): Honingham FP5, Weston Longville FP3 and FP4	Major beneficial in the short-term, moderate beneficial in the long term	Not significant	At these non-residential receptors, the impacts are predicted to vary with location and are major beneficial in magnitude in the short-term and moderate beneficial in magnitude over the long-term. However, Do-Something road traffic noise levels are predicted to be below LOAEL along the majority of the length of the PRoW. Overall, these effects are considered to be not significant.
SSSI: River Wensum (the area that intersects Ringland Road)	Moderate beneficial in the short-term, negligible beneficial in the long term	Not significant	This non-residential receptor is predicted to experience a moderate beneficial impact due to the Proposed Scheme in the short-term reducing to a negligible impact over the long-term. Overall, this beneficial effect is considered to be not significant

Receptor Group	Magnitude of change	Conclusion of Significance of Environmental Effect	Justification of Significance Conclusion
SSSI: River Wensum (the section that intersects Lyng Road)	Moderate adverse in the short-term, moderate adverse in the long term	Not significant	This non-residential receptor is predicted to experience a moderate adverse impact due to the Proposed Scheme in the short-term and a moderate adverse impact over the long-term. However, Do-Something road traffic noise levels are predicted to be below LOAEL along the majority of the length. Overall, these effects are considered to be not significant due to the relatively low level of road traffic noise across the majority of the SSSI. The adverse changes in road traffic noise are due to off-line traffic changes explained in paragraph 11.8.44.
St Margaret's Church cemetery	Moderate adverse in the short-term, moderate adverse in the long term	Not significant	This non-residential receptor is predicted to experience a moderate adverse impact due to the Proposed Scheme over both the short and long-term. Do-Something road traffic noise levels are predicted to be below the LOAEL across the cemetery. Overall, this adverse effect is considered to be not significant due to the relatively low level of road traffic noise across the cemetery.
Public rights of way (PRoW): Hockering FP8, FP7, East Tuddenham FP9, Honingham RB1, Lyng RB1, RB12 and FP17	Major/moderate adverse in the short-term, major/moderate adverse in the long-term	Significant adverse	These non-residential receptors are predicted to experience a major or moderate adverse impact due to the Proposed Scheme over both the short and long-term. Therefore, this adverse effect is considered to be significant. The significant adverse effect predicted at the PRoW in Lyng are due to off-line traffic changes as described in paragraph 11.8.44.

11.10.22. A number of significant residual traffic noise effects are predicted due of the operation of the Proposed Scheme, both adverse and beneficial. These are presented in Figure 11.10 (**TR010038/APP/6.2**) and listed below:

- Significant beneficial noise effects are predicted at:
  - Noise Important Area 5200
  - Three receptors in Hockering (outside of Noise Important Area 5200)
  - Two receptors on Ringland Road
  - Two receptors on The Broadway
  - Three PRoW: Hockering FP3, FP10 and FP11
- Significant adverse noise effects are predicted at:
  - Eighty-three receptors in Lyng or on Lyng Road (north of the A47)
  - Two receptors on Church Lane
  - Six receptors on Mattishall Lane
  - Hall Farm and Hall Farm Cottages
  - St Andrew's Church, Honingham
  - Hockering Nursery and Newgate, Gypsy Lane, Hockering

- Seven PRoW Hockering FP8, FP7, East Tuddenham FP9, Honingham RB1, Lyng RB1, RB12 and FP17

11.10.23. The assessment identifies that there are no dwellings where the façade noise level is at least 68 dB $L_{A10,18h}$ and the noise from the new or altered highways causes the total level to increase by at least 1dB. As such, no properties are forecast to be eligible for insulation under the Noise Insulation Regulations.

11.10.24. A majority of the significant adverse noise effects are as a result of the expected change in road user behaviour brought about by the Proposed Scheme. In the opening year and with the Proposed Scheme, the traffic model forecasts that users from the east to Fakenham are more likely to use the A47 then turn to Lyng Road/Heath Road via Lyng to join the A1067. Whereas without the Proposed Scheme in place these road users are more likely to use the local roads via Weston Green to Lenwade before joining the A1067.

11.10.25. Despite mitigation being included, significant adverse effects are expected at six dwellings on Mattishall Lane and two receptors on Rotten Row/Church Lane. Mitigation comprising a low noise surface and a 3m high barrier has been included between these receptors and the Proposed Scheme. The mitigation is predicted to provide a perceptible reduction in noise levels for these receptors. However, significant adverse effects are still expected because this mitigation is not enough to off-set the introduction of a high-speed dual carriageway into a rural area.

11.10.26. Significant adverse noise effects are expected at a small number of receptors where acoustic barriers would not be proportionate or reasonable mitigation measures. However, road traffic noise levels at these properties has been minimised as far as practicable through the provision of a noise reducing surface.

11.11. Cumulative Effects

Overview

11.11.1. There is potential significant cumulative noise and vibration effects occurring due to the combined effects of the construction and operation phases of the Proposed Scheme and the construction and operation phases of the proposed Norwich Western Link (NWL) road.

11.11.2. The NWL road is a proposed 6.1km dual carriageway road to connect the western end of Broadland Northway to the A47 trunk road west of Norwich to the Wood Lane (B1535) junction of the Proposed Scheme.

11.11.3. Whilst no planning application for the NWL has been submitted at the time of reporting, public consultation has been undertaken in May 2020. Construction is indicatively planned to commence in 2023 until late 2025.

11.11.4. This section presents consideration of the likely cumulative noise and vibration effects assuming both schemes occur simultaneously.

Construction

11.11.5. Construction noise and vibration due to the construction of the Proposed Scheme and also due to the construction of the proposed NWL has the potential to affect sensitive receptors. Potential impacts include noise and vibration from construction activity and the change in road traffic noise due to construction traffic.

11.11.6. The two schemes run perpendicular to each other, and therefore receptors at which construction noise or vibration from both schemes could be experienced at the same time are those located in the vicinity of the junction of the Proposed Scheme and the proposed NWL. At other locations, construction noise or vibration will primarily originate from the single closest scheme.

11.11.7. Subject to the implementation of the mitigation within Section 11.9, noise from construction of the Proposed Scheme is not expected to result in any significant effects at the receptors closest to junction of the Proposed Scheme and the proposed NWL. There are no noise sensitive receptors within a distance of 300m of this junction and predicted construction noise levels at the closest receptors are relatively low. Construction noise from the proposed NWL will be subject to assessment as part of the EIA for that scheme, and noise mitigation measures will need to be identified at that point to avoid significant construction noise effects. Given the above, the cumulative effects due to construction noise are not expected to be significant at any receptor within the study area.

11.11.8. Vibration from the construction of either scheme will be localised to specific construction activities (such as piling or compaction). The level of vibration due to construction of either scheme at the receptors closest to junction of the two schemes will be very low due to the distances involved. As with construction noise, construction vibration mitigation measures will also need to be considered as part of the NWL EIA to avoid significant construction vibration effects. For these reasons, cumulative effects due to construction vibration are not expected to be significant at any receptor within the study area.

11.11.9. The change in road traffic noise that will occur due to construction traffic associated with the Proposed Scheme is not expected to result in any significant effects subject to the mitigation measures stated within Section 11.9. Changes in road traffic noise due to the construction traffic associated within the proposed NWL will be assessed as part of the EIA for that scheme and this may influence construction traffic routing. At this stage, it is anticipated that construction traffic for both the Proposed Scheme and the southern part of the proposed NWL will

be routed along the existing A47. However, given the baseline level of traffic using this road, it is unlikely that the cumulative construction traffic flow would be sufficient to result in a perceptible change in road traffic noise. The cumulative effects of construction traffic noise are not expected to be significant.

Operation

Study area and receptors

11.11.10. The cumulative assessment study area comprises the core scenario study area plus an extended study area to include the area within 600m of the proposed NWL and the area within 50m of road links where a basic noise level change of 1.0 dB or more in the short term is predicted.

11.11.11. Roads within the above study area at which the magnitude of basic noise level change was minor (between 1.0 and 2.9 dB) and where the predicted road traffic noise level at the closest receptor was expected to be below the SOAEL were not included in the model. These minor impacts are classed as ‘not significant’ according to DMRB LA 111 and there is no reason to modify this. As such, noise changes along these roads are not expected to result in any significant effects.

11.11.12. A total of 652 additional dwellings have been identified within the extension to the study area, that is, within the cumulative study area but outside the core scenario study area. A total of 20 other sensitive receptors have also been identified, 10 in buildings (six of them also sensitive at night) and ten outside buildings.

Cumulative Impacts

11.11.13. This section presents the predicted change in road traffic noise level when both the Proposed Scheme and the NWL are complete. These noise changes are referred to as the “cumulative operational impacts”. Table 11.17 and Table 11.18 present the cumulative operational impacts in the short-term and long-term respectively.

11.11.14. The cumulative operational impacts take account of the mitigation measures embedded into the design of the Proposed Scheme as described in Section 11.9. It is also assumed that a low noise road surface will be applied to the NWL, as this is common practice for new high-speed trunk roads in England. No other mitigation measures associated with the NWL have been included in the noise model.

11.11.15. The cumulative operational impacts at the receptors within the core scenario study area are presented in the tables below. The cumulative operational impacts at the receptors that are within the cumulative study area but not within the core scenario study area (including those directly affected by the NWL scheme itself)

are presented within brackets. The cumulative operational impacts at non-residential receptors are presented in the same way.

Noise changes with the Proposed Scheme and the NWL assuming simultaneous opening

11.11.16. Table 11.17 presents the cumulative operational impacts assuming both scheme open simultaneously (Cumulative Do-Something Opening Year scenario versus the Do-Minimum Opening Year scenario).

Table 11.17: Summary of short-term cumulative noise changes, with the Proposed Scheme and the NWL

Scenario/Comparison: Do-Minimum Opening Year 2025 versus cumulative 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	472 (100)	9 (1)	154 (192)	0 (0)
	1.0 – 2.9	Minor	282 (209)	23 (7)	143 (118)	6 (1)
	3.0 – 4.9	Moderate	119 (9)	7 (2)	181 (8)	5 (0)
	>5.0	Major	102 (20)	9 (3)	22 (18)	0 (0)
No Change	0.0	No Change	87 (2)	0 (0)	56 (1)	0 (0)
Decrease in noise level	<1.0	Negligible	357 (100)	9 (5)	311 (179)	0 (4)
	1.0 – 2.9	Minor	137 (162)	3 (1)	636 (84)	2 (0)
	3.0 – 4.9	Moderate	57 (23)	5 (1)	84 (27)	0 (1)
	>5.0	Major	29 (27)	4 (0)	55 (25)	1 (0)

Short-term noise changes at receptors within the core scenario study area

11.11.17. The majority of the cumulative operation impacts at receptors within the core scenario study area are predicted to be negligible or minor changes.

11.11.18. The majority of the moderate and major increases are predicted at Lyng/Lyng Road. Moderate and major increases are also predicted at receptors around Mattishall Lane and Church Lane. This is generally the case in the core assessment. Dwellings along The Street at Ringland, The Broadway and Sandy Lane are also predicted to experience major or moderate noise increases not present in the core assessment.

11.11.19. The majority of noise decreases are predicted at Hockering close to the existing A47, due to the re-alignment of the Proposed Scheme to the south, with lower traffic using the by-passed A47. This is also the case in the core assessment.

11.11.20. Noise decreases are also predicted at Heath Road, Stone Road and Rectory Road due to traffic re-routing. This is also the case in the core assessment.

Short-term noise changes at receptors outside of the core scenario study area

11.11.21. The majority of the cumulative operational impacts at the additional receptors outside of the core scenario study area are predicted to be negligible or minor increases or decreases.

11.11.22. Moderate and major decreases are predicted to occur along Dereham Road/Mill Street (B1147) and at Weston Longville along Honingham Road/Church Street/Woodforde Close due to traffic re-routing from these roads onto NWL.

11.11.23. Major increases in road traffic noise are predicted at receptors within 600m of the NWL, although the predicted road traffic noise levels are all below the LOAEL. Some moderate increases are predicted along the A1067 Fakenham Road (between Broadland Northway and Beech Avenue), at facades facing the NWL.

Noise changes with the Proposed Scheme and the NWL over the long-term

11.11.24. Table 11.18 presents the cumulative operational impacts over the long-term assuming both schemes are operational (Cumulative Do-Something Future Year scenario versus the Do-Minimum Opening Year scenario).

Table 11.18: Summary of long-term noise changes, with the Proposed Scheme and the NWL

Scenario/Comparison: Do-Minimum Opening Year 2025 versus cumulative 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	942 (315)	33 (3)	786 (314)	6 (1)
	3.0 – 4.9	Minor	87 (9)	3 (6)	68 (14)	3 (0)
	5.0 – 9.9	Moderate	194 (13)	14 (3)	196 (10)	2 (0)
	>10.0	Major	2 (13)	1 (1)	5 (18)	0 (0)
No Change	0.0	No Change	39 (3)	0 (0)	98 (2)	0 (0)
Decrease in noise level	<3.0	Negligible	276 (254)	10 (6)	385 (261)	2 (4)
	3.0 – 4.9	Minor	58 (15)	2 (1)	51 (20)	0 (1)
	5.0 – 9.9	Moderate	38 (30)	6 (0)	49 (13)	1 (0)
	>10.0	Major	6 (0)	0 (0)	4 (0)	0 (0)

Long-term noise changes at receptors within the core scenario study area

11.11.25. Over the long-term, the majority of the cumulative noise changes at the receptors within the core study area are predicted to be negligible or minor changes.

11.11.26. The majority of the moderate increases in noise levels are predicted at Lyng/Lyng Road, due to traffic re-routing. Major and moderate noise increases are also predicted at receptors around Mattishall Lane and Church Lane, as in the core assessment. Dwellings along The Street at Ringland, The Broadway and Sandy

Lane are also predicted to experience moderate noise increases not present in the core assessment, although with relatively low road traffic noise levels.

11.11.27. The majority of noise decreases are predicted at Hockering close to the existing A47, due to the re-alignment of the trunk road.

11.11.28. Noise decreases are also predicted at Heath Road, Stone Road and Rectory Road due to traffic re-routing.

Long-term noise changes at receptors outside of the core scenario study area

11.11.29. Over the long-term, the majority of the cumulative noise changes at the additional receptors outside of the core scenario study area are predicted to be negligible.

11.11.30. Moderate decrease in noise levels are predicted to occur along Dereham Road/Mill Street (B1147) and at Weston Longville along Honingham Road/Church Street/Woodforde Close due to traffic re-routing, as traffic is switching their route from these minor roads onto NWL.

11.11.31. Major and moderate increases in road traffic noise are predicted at receptors within 600m of the proposed NWL, although all road traffic noise levels are predicted to be below the LOAEL.

Assessment of cumulative operational effects

11.11.32. An initial assessment of the significance of the cumulative operational impacts at noise sensitive receptors is summarised Table 11.19. Moderate or major impacts at noise sensitive receptors are classed as ‘Significant’.

11.11.33. The number of receptors within the core scenario study area are presented without brackets. The number of receptors within the expanded study area (including those directly affected by the NWL) are presented within brackets.

Table 11.19: Summary of the initial assessment of cumulative 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	237 (34)	208 (26)	95 (51)	140 (53)
Not significant	873 (319)	359 (312)	506 (268)	949 (267)

11.11.34. Comparing the above cumulative assessment for receptors within the core scenario study area (Table 11.19 without numbers in brackets) with the initial

assessment of the Proposed Scheme (Table 11.15, including numbers within brackets), the following conclusions can be drawn:

- With both schemes, there are 20 additional receptors with significant adverse effects
- With both schemes, there are 76 fewer receptors with significant beneficial effects
- For the majority of the receptors, the addition of the NWL results in a change from negligible or minor beneficial effects to negligible or minor adverse effects. These effects are not significant.

Cumulative effects at receptors within the core scenario study area

11.11.35. Table 11.19 shows that the initial assessment of significance for adverse effects at a majority of noise sensitive receptors within the core study area is not significant.

11.11.36. Following the justifications within DMRB LA 111 Table 3.60, final operational noise significance at the identified noise sensitive receptors has been determined.

11.11.37. In accordance with DMRB LA 111, a number of significant effects are predicted due of cumulative operational impact of the Proposed Scheme and the NWL. These significant cumulative effects are described below:

- Significant beneficial noise effects at 25 dwellings at Hockering, 17 of which are within the Noise Important Area 5200, due to the re-alignment of the Proposed Scheme to the south, and traffic re-routing along Hockering. These significant beneficial effects occur at the same number of receptors within Hockering as within the core assessment, although five fewer receptors within the Noise Important Area.
- Significant beneficial noise effects at four dwellings at Ringland Road, due to traffic re-routing. These are two more receptors with significant beneficial effects than within the core assessment.
- Significant beneficial noise effects at one dwelling at Heath Road, due to traffic re-routing. These effects do not occur at the core assessment.
- Significant beneficial noise effects also predicted at PRoWs Hockering FP3 and FP11, and PRoW Hockering FP10. These significant beneficial effects occur within the core assessment.
- Significant beneficial noise effects are also predicted at SSSI River Wensum at Ringland and PRoWs Weston Longville FP3 and FP4. These significant beneficial effects do not occur within the core assessment.
- Significant adverse noise effects at 91 dwellings at Lyng/Lyng Road, due to traffic re-routing. There are eight more receptors with significant adverse effects than within the core assessment.
- Significant adverse noise effects at two dwellings around Rotten Row/Church Lane, due to the alignment of the Proposed Scheme. These significant

adverse effects occur at the same number of receptors as within the core assessment.

- Significant adverse noise effects at 6 dwellings at Mattishall Lane, due to the alignment and increased traffic of the Proposed Scheme. These significant adverse effects occur at the same number of receptors as within the core assessment.
- Significant adverse noise effects at 5 dwellings around Hall Farm, due to the alignment and increased traffic of the Proposed Scheme. These significant adverse effects occur at the same number of receptors as within the core assessment.
- Significant adverse noise effects at 2 dwellings at Hockering, due to the alignment and increased traffic along the Proposed Scheme. These significant adverse effects occur at the same number of receptors as within the core assessment.
- Significant adverse noise effects at four dwellings at North Tuddenham, due to traffic re-routing resulting in increased traffic along Norwich Road. These significant adverse effects do not occur within the core assessment and are caused by a minor adverse impact that is significant since cumulative Do-Something road traffic noise levels then exceed SOAEL.
- Significant adverse noise effects at St Andrew's Church at Honingham, due to the alignment and increase traffic of the Proposed Scheme. These significant adverse effects occur within the core assessment.
- Significant adverse noise effects are at SSSI River Wensum at Lyng, PRoW Hockering FP7, PRoW East Tuddenham FP2 and FP9, PRoW Honingham RB1 and PRoWs Lyng RB1, RB12 and FP17. All of these significant adverse effects occur within the core assessment with the exception of the effects at PRoW East Tuddenham FP2. The effects at FP2 are due to road traffic noise originating from the NWL not traffic rerouting.

11.11.38. The majority of the significant cumulative effects at receptors within the core study area, both beneficial and adverse, are present in the core scenario.

11.11.39. However, the addition of the NWL does result in some additional significant effects within the core study area. These are due to changes in traffic flows on the road network when accounting for traffic behaviour changes due to the NWL. These are:

- Five fewer significant beneficial noise effects within the Noise Important Area 5200.
- Two additional significant beneficial noise effects at dwellings at Ringland Road.
- One additional significant beneficial noise effect at one dwelling at Heath Road.
- Three additional significant beneficial effects at SSSI River Wensum at Ringland and PRoWs Weston Longville FP3 and FP4.
- Eight additional significant adverse noise effects at Lyng/Lyng Road.
- Four additional significant adverse noise effects at North Tuddenham along Norwich Road.

- One additional significant adverse effect at PRoW East Tuddenham FP2.

11.11.40. The cumulative assessment has identified that there are no dwellings within the core study area where the façade noise level is at least 68 dB $L_{A10,18hr}$ and the noise from the new or altered carriageways of the Proposed Scheme causes the total level to increase by at least 1 dB. As such, no properties are forecast to be eligible for insulation under the Noise Insulation Regulations due to the Proposed Scheme.

Cumulative effects at receptors outside of the core scenario study area

11.11.41. Table 11.19 shows that the initial assessment of significance for adverse effects at a majority of noise sensitive receptors within the extended study area is not significant.

11.11.42. Following the justifications within DMRB LA 111 Table 3.60, final operational noise significance at the identified noise sensitive receptors has been determined.

11.11.43. In accordance with DMRB LA 111, a number of significant residual cumulative traffic noise effects are predicted outside of the core scenario study area. These effects are considered to be predominantly due to the NWL since these roads were not identified as affected routes for assessment of the Proposed Scheme alone.

11.11.44. The significant effects outside of the core scenario study area are both adverse and beneficial, as listed below:

- Significant beneficial noise effects at four dwellings along Dereham Road/Mill Street (B1147) due to traffic re-routing, as traffic is re-routing from these minor roads onto the NWL.
- Significant adverse noise effects at six dwellings at Swanton Morley along Greengate (B1147) due to traffic re-routing.
- Significant adverse noise effects are also predicted at the SSSI River Wensum, PRoW Ringland FP1, PRoW Attlebridge FP5 and PRoW Attlebridge RB4 due to direct impact from the proposed NWL.

11.11.45. There are no significant adverse effects predicted at the Noise Important Areas within the extended study area.

11.12. Monitoring

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

Construction

11.12.2. Likely significant environmental effects from noise and/or vibration during construction shall be monitored. Monitoring of likely significant effects should include one or more of the following:

- Measurement of noise during relevant construction activity at positions that represent Acorn Barn.
- Measurement of vibration during piling or vibratory compaction where these works occur within 30m of residential receptors.
- 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.
- Checking that noise and vibration management procedures and practices are sufficient to ensure that significant adverse effects are avoided.

Operation

11.12.3. The likely significant environmental effects from noise during operation shall be monitored and include:

- Ensuring mitigation measures included within the project design are incorporated within the as-built project.
- Ensuring specifications of noise mitigation measures, including barriers and low noise surfaces, meet design specifications.

11.12.4. DMRB LA 111 notes that post construction road traffic noise monitoring cannot provide a reliable gauge for whether the operational impacts are greater or less than those predicted in the assessment for the following reasons:

- The assessment is based on annual average conditions with and without the project to ensure a like for like comparison which is not possible to replicate through monitoring within a reasonable timescale.
- Monitoring in the absence of the project would need to be completed before the start of the construction works and would therefore be a number of years before the monitoring with the Proposed Scheme in operation. In addition, the assessment completed for this EIA is based on calculated noise levels from road traffic only, whereas ambient noise monitoring can be affected by other noise sources such as people, agricultural activities, aircraft etc.

11.13. Summary

11.13.1. This chapter presents the potential noise and vibration impacts of the Proposed Scheme on noise sensitive receptors.

11.13.2. The study area for construction noise, construction vibration and operational noise assessments have been determined using DMRB. Noise modelling has

been undertaken for noise sensitive receptors within the corresponding construction and operational study areas.

11.13.3. As part of the assessment a baseline noise survey was undertaken in September 2020 to gain an understanding of the existing noise climate within the vicinity of the Proposed Scheme. The survey results correlate well with the predicted road traffic noise levels when accounting for the differences in traffic volume during the survey and a typical September (without the COVID-19 pandemic). No adjustments to the road traffic noise model were applied.

11.13.4. 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 have been presented including the provision of acoustic barriers and construction noise monitoring. It is also necessary for the Principal Contractor to carry out further detailed construction noise assessments for overnight or weekend works where these could affect sensitive receptors for 10 or more days or nights in any 15 consecutive days or nights. Where all mitigation is implemented effectively, significant residual construction noise effects are not expected at the vast majority of receptors. A significant residual effect would occur at Acorn Barn due to construction noise from the works at the adjacent drainage basin works if these works exceed 10 days in any 15 day period, or 40 days in any 6 month period. Furthermore, there are a large number of receptors that could experience significant effects due to noise from night-time or weekend works and this will also need further consideration once further detail regarding the scope and duration of these work has been defined.

11.13.5. An assessment of potential construction vibration impacts identifying 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 the extension of the existing west culvert 9m from Acorn Barn and Oak Tree Barn. Vibration due to construction is not expected to result in any significant effects subject to the effective implementation of this mitigation.

11.13.6. A construction traffic assessment has been undertaken. It is concluded that, providing the anticipated vehicle movements and routes are restricted as described in this chapter and defined in the outline Traffic Management Plan (**TR010038/APP/7.5**), potential significant effects are unlikely.

11.13.7. Consideration has been given to the traffic diversion routes during road closures required to undertake the construction works. It is concluded that, provided

diversion routes are varied, and utilise trunk roads where possible, potential significant effects are unlikely.

11.13.8. The assessment of operational noise includes embedded mitigation measures in the form of a low noise surface along the Proposed Scheme and four acoustic barriers. The operational noise assessment indicates that there are significant adverse and significant beneficial noise effects expected due to changes in road traffic noise.

11.13.9. Significant beneficial effects are predicted at:

- Noise Important Area 5200
- Three receptors in Hockering (outside of Noise Important Area 5200)
- Two receptors on Ringland Road
- One receptor on Park Lane, Hockering
- Two receptors on The Broadway
- Three PRoW in Hockering

11.13.10. A majority of these significant beneficial effects are due to the expected change in road users' behaviour brought about by the Proposed Scheme and the expected reduction in traffic flows on the existing road network.

11.13.11. Significant adverse traffic noise effects are predicted at the following locations:

- Eighty-three receptors in Lyng or on Lyng Road (north of the A47)
- Two receptors on Church Lane
- Six receptors on Mattishall Lane
- Hall Farm and Hall Farm Cottages
- St Andrew's Church, Honingham
- Hockering Nursery and Newgate, Gypsy Lane in Hockering
- Two PRoW in Hockering, one in East Tuddenham FP9, one in Honingham and three in Lyng

11.13.12. The majority of these effects result from traffic re-routing. Mitigation has not been proposed at locations affected by traffic re-routing due to acoustic barriers being impractical and not possible in some locations.

11.13.13. The effects that are not due to traffic re-routing are due to:

- More road users choosing to access the improved A47 between North Tuddenham and Easton.
- Some effects remaining significant at some locations despite mitigation being included. Further mitigation would result in adverse landscape and visual effects.
- Acoustic barriers in some locations does not change the magnitude of impact and in most cases would only provide marginal benefits. Provision of barriers

in these locations would not be proportionate or reasonable mitigation measures.

11.13.14. With regard to Noise Important Areas, a significant beneficial effect is predicted at Noise Important Area 5200. No significant effects are expected at the remaining Noise Important Areas (5201, 5202 and 6287).

11.13.15. 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, all operational noise levels with the Proposed Scheme would be below SOAEL. For aim 2, mitigation measures are embedded and other adverse impacts would be mitigated and minimised as far as reasonably practicable. For aim 3, the Proposed Scheme would provide a reduction in road traffic noise level in some areas and is predicted to provide an enhancement at the designated Noise Important Areas 5200 and 5202.

11.13.16. The aims of the NPS NN and associated actions are listed in DMRB LA 111. A summary of responses is set out in Table 11.20.

Table 11.20: 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 are summarised in Table 11.12 and Table 11.13. 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. Operational noise exposure with the Proposed Scheme and embedded mitigation is below SOAEL at all receptors and no properties qualify for noise insultation. 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 are detailed in section 11.9. Measures include temporary noise barriers and restrictions on the use of plant during the construction phase. During the operational phase measures include permanent noise barriers and low noise surfacing. Mitigation measures are detailed in the Environmental Management Plan (**TR010038/APP/6.8**) 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 with embedded mitigation. Some of which are due to the expected change in road users' behaviour brought about by the Proposed Scheme and some are due to the Proposed Scheme alignment. These are summarised in Table 11.16. Therefore, the Proposed Scheme meets this policy aim of NPS NN.

11.13.17. An assessment of different project cumulative effects of the Proposed Scheme and the proposed Norwich Western Link (NWL) has been undertaken. The conclusions of the cumulative assessment are as follows:

- No significant effects are expected due to the cumulative level of construction noise and vibration provided that the mitigation identified in this chapter is implemented, and provided that construction effects are considered as part of the NWL EIA.
- No significant cumulative operational effects are predicted at the Noise Important Areas.
- The majority of the significant cumulative operational effects in the core study area for the cumulative assessment are also present in the core assessment.
- The additional significant cumulative operational effects with the core study area are:
    - Five fewer significant beneficial noise effects
    - Six additional significant beneficial noise effects
    - Thirteen additional significant adverse noise effects

- The additional significant cumulative operational effects within the extended study area:
    - Significant beneficial noise effects at four dwellings along Dereham Road/Mill Street (B1147) due to traffic re-routing.
    - Significant adverse noise effects at six dwellings at Swanton Morley along Greengate (B1147) due to traffic re-routing.
    - Significant adverse noise effects at the SSSI River Wensum, PRoW Ringland FP1, PRoW Attlebridge FP5 and PRoW Attlebridge RB4 due to direct impact from the proposed NWL.

11.14. References

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11.15. Glossary

11.15.1. A glossary of terms and definitions is included in Appendix 11.1.