A47 Wansford to Sutton Dualling

Scheme Number: TR010039

Volume 6
6.1 Environmental Statement
Chapter 11 – Noise and Vibration

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Planning Act 2008

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

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A47 Wansford to Sutton Development Consent Order 202[x]

ENVIRONMENTAL STATEMENT
Chapter 11 – Noise and Vibration

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Rev 0	July 2021	Application Issue
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Table of contents

Tables

11. Noise and vibration

11.1. Introduction

11.1.1. Highways England (the Applicant) has submitted an application for a development consent order (DCO) for the A47 Wansford to Sutton Scheme (hereafter referred to as 'the Proposed Scheme'). The Proposed Scheme comprises the dualling of a section of the A47 between Wansford to Sutton; improvements to the A47 Wansford junction; creation of the A47 Sutton Heath roundabout to replace the Nene Way roundabout; associated side road alterations; and walking, cycling and horse-riding connections.

11.1.2. This 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. Full details of the Proposed Scheme are provided in Environmental Statement Chapter 2 Proposed Scheme (**TR010039/APP/6.1**).

11.1.3. The key elements of the Proposed Scheme include:

- approximately 2.6km of new dual carriageway constructed largely offline of the existing A47, including the construction of two new underpasses
- a new free-flow link road connecting the existing A1 southbound carriageway to the new A47 eastbound carriageway
- a new link road from the Wansford eastern roundabout to provide access to Sacrewell Farm, the petrol filling station and the Anglian Water pumping station
- closure of the existing access to Sacrewell Farm with a new underpass connecting to the farm from the link road provided
- a new slip road from the new A47 westbound carriageway also providing access to the petrol filling station
- a link road from the new A47 Sutton Heath roundabout, linking into Sutton Heath Road and Langley Bush Road
- new junction arrangements for access to Sutton Heath Road and Langley Bush Road
- closure of the existing accesses to the A47 from Sutton Heath Road, Sutton Drift and Upton Road
- new passing places and limited widening along Upton Drift (also referenced as Main Road)
- new walking and cycling routes, including a new underpass at the disused railway
- new safer access to the properties on the A1, north of Windgate Way
- installation of boundary fencing, safety barriers and signage

- new drainage systems including:
  - two new outfalls to the River Nene
  - a new outfall to Wittering Brook
  - extension of the A1 culvert at the Mill Stream
  - realignment and extension of the A47 Wansford Sluice
  - compensatory flood storage
  - drainage ditch interceptors
  - new attenuation basins, with pollution control devices, to control discharges to local watercourses
- River Nene compensatory flood storage area
- works to alter or divert utilities infrastructure such as electricity lines, water pipelines and telecommunications lines
- temporary compounds, material storage areas and vehicle parking required during construction
- environmental mitigation measures

11.1.4. 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.

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

11.1.6. The approach to this assessment follows the methodology set out in the Scoping Report (February 2018) (**TR010039/APP/6.5**) and subsequent agreed Scoping Opinion (March 2018) (**TR010039/APP/6.6**) for the Proposed Scheme, in combination with the most up to date guidance in the Design Manual for Roads and Bridges (DMRB) LA 111 Noise and vibration, revision 2, hereafter referred to as DMRB LA 111.

11.2. Competent expert evidence

11.2.1. The competent expert has a BSc (acoustics and music) and is a Member of the Institute of Acoustics (MIOA). The competent expert is an acoustician with over 9 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 data centres), and road schemes.

11.2.2. The main chapter text is supported by the following appendices (**TR010039/APP/6.3**) and figures (**TR010039/APP/6.2**).

- Appendix 11.1: Glossary of terms
- Appendix 11.2: Legislation and policy framework
- Appendix 11.3: Baseline noise survey
- Appendix 11.4: Model validation
- Appendix 11.5: Construction noise assessment

- Figure 11.1: Noise location plan
- Figure 11.2: Road traffic noise level contours: Do-Minimum Opening Year
- Figure 11.3: Road traffic noise level contours: Do-Minimum Future Year
- Figure 11.4: Road traffic noise level contours: Do-Something Opening year
- Figure 11.5: Road traffic noise level contours: Do-Something Future Year
- Figure 11.6: Noise difference contour: Long-term noise change without the Proposed Scheme
- Figure 11.7: Noise difference contour: Short-term noise change with the Proposed Scheme
- Figure 11.8: Noise difference contour: Long-term noise change with the Proposed Scheme
- Figure 11.9 to 11.12: Construction noise impact magnitudes for each stage with predicted significant effects (refer to Table 11-11 and 11-12. for construction stages)
- Figure 11.13 to 11.16: Construction noise impact magnitudes for each stage with predicted significant effects plus mitigation measures (refer to Table 11.19 for construction stages)

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 below; further details are presented in Appendix 11.2 (**TR010039/APP/6.3**).

11.3.2. Full references are also provided in Section 11.13.

Control of Pollution Act, 1974

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

Noise Insulation Regulations, 1975 (amended 1988)

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

National Networks National Policy Statement, 2014 (NN NPS)

11.3.5. NN NPS 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 revised NPPF sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other developments can be produced.

Noise Policy Statement for England, 2010 (NPSE)

11.3.7. NPSE seeks to promote good health and good quality of life through effective management of noise with the context of Government policy on sustainable development 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. 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. In addition, 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)

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.

Peterborough City Council Local Plan, 2019

11.3.11. The Peterborough Local Plan contains the planning policies for the growth and regeneration of Peterborough and the surrounding villages up to 2036.

WHO Night Noise Guidelines for Europe, 2009

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

WHO Environmental Noise Guidelines for the European Region 2018

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

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

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

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

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

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

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

DMRB LA 104 Environmental assessment and monitoring. Revision 2, 2020

11.3.17. 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

11.3.18. DMRB LA111 sets out the requirements for noise and vibration assessments for 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

11.3.19. 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

11.3.20. 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

11.3.21. 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

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

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

11.3.23. 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

11.3.24. 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

11.3.25. This TRL study presents a review of current knowledge of ground vibration transmission and adds new information specific to construction works. The report presents methods of predicting vibration levels from all different mechanised construction activities, accounting for the characteristics on 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 with 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 (**TR010039/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 guidance on noise and vibration (DMRB LA 111, revision 2, 2020), the Scoping Report (2018) (**TR010039/APP/6.5**) and Scoping Opinion (2018) (**TR010039/APP/6.6**) for the Proposed Scheme has been reviewed. The Scoping Report is considered to remain valid, however, some elements have been amended for the noise and vibration assessment methodology. These are presented in Table 11-1 below.

Table 11-1: Summary of scoping updates

Scoping document	Scoping item	Comment on original scope (2018)	Updated scope (2020)
Scoping Report, 2018	Operational noise study area	Study area identified as an area within 1 km of the physical works associated with the Proposed Scheme. Within this study area, road traffic noise predictions are performed at any sensitive receptor within 600m of a road where this is the possibility of a change of 1dB $L_{A10,18hr}$ upon Proposed Scheme opening, or 3dB $L_{A10,18hr}$ in the long term. Outside of the 1km area, sensitive receptors are identified adjacent to roads where the change in received road traffic noise level would, as a result of the Proposed Scheme, increase or decrease by at least 1dB $L_{A10,18hr}$ on opening or 3dB in the long term.	Operational study area includes the area within 600m of new road links or road links physically changed or bypassed by the project and the area within 50 metres of other road links with potential to experience a short term basic noise level (BNL) change of more than 1.0dB(A) as a result of the Proposed Scheme. The operational study area has not been extended to cover the Upton works due to low traffic flows in this area.
	Construction noise study area	The study area is the same as that defined for assessment of operational noise impacts. Assessment will be limited to areas where total noise (calculated construction noise plus baseline noise) exceeds baseline noise levels.	Based on a review of proposed construction methods and plant, and in line with DMRB LA 111 guidance, a study area of 300m from the closest construction activity was considered to be sufficient.
	Construction vibration study area	Not defined.	DMRB LA 111 notes that a study area encompassing a 100m area from vibration generating activity is normally sufficient. However, given the expected methods of work, a study area encompassing a 30m area from vibration generating activity was considered sufficient to evaluate the potential for significant effects due to vibration at sensitive receptors.
	Construction noise methodology and significance criteria	Example Method 2 – 5dB(A) change (Annex E 'Significance of Noise Effects' Section E.3.3) will be adopted for the assessment of effects at sensitive receptors.	The lowest observed adverse effect level (LOAEL) and significant observed adverse effect level (SOAEL) (as defined in Volume 3 Appendix 11.1) (**TR010039/APP/6.3**) and discussed in Section 11.4 have been 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.

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

Consultation

11.4.4. Fenland District Council, Peterborough City Council, South Kesteven District Council, Sutton Parish Council and Wansford Parish Council were asked to submit comments on the Proposed Scheme via the Scoping process. These were included in the Scoping Opinion (2018) (**TR010039/APP/6.6**) and are available online.[1]

11.4.5. Fenland District Council, Peterborough City Council and South Kesteven District Council had no comment to make regarding noise or vibration. Sutton Parish Council stated the following;

"*Wansford Parish Council has serious concerns about noise and vibration impacts on their residents. Whilst of a different nature, there will clearly be an increase in adverse noise effects in Sutton too.*

Moving the road closer to the river Nene will increase the levels of noise and vibration, significantly degrading the habitat for wildlife.

The noise and vibration from the upgraded road must be fully investigated and the results made public before any decisions are made." (p. 101)

11.4.6. Wansford Parish Council echoed the concerns of Sutton Parish Council. In addition they stated:

[1] https://infrastructure.planninginspectorate.gov.uk/projects/eastern/a47-wansford-to-sutton/

"*Any changes to the A47 close to Wansford will have a major effect on the noise and vibrations experienced by the residents of Old North Road, Black Swann Spinney and Robinswood. This was demonstrated the last time that the road was modified*." (p. 120)

11.4.7. Table 11-2 has been included to provide responses to the comments from Wansford Parish Council and Sutton Parish Council.

Table 11-2: Response to Parish council comments

Parish Council Comment	Response
"…there will clearly be an increase in adverse noise effects in Sutton too." (Sutton Parish Council)	There are 39 dwellings that have been identified in Sutton within the operational study area. The following list states the predicted change in magnitude of road traffic noise level (dB $L_{A10,18hr}$) associated with the opening year of the Proposed Scheme in Sutton: • One dwelling (Deep Springs) is predicted to experience a minor decrease in road traffic noise of -2.7dB. • Nine dwellings are predicted to experience a negligible increase in road traffic noise (0.4 to 0.9dB). • 28 dwellings are predicted to experience a minor increase in road traffic noise (1.0 to 1.8dB). When the Proposed Scheme is operational a majority of dwellings in Sutton are predicted to experience a minor adverse increase in road traffic noise. However, with the exception of Heath House, absolute road traffic noise levels are predicted to remain below the LOAEL in all scenarios. Therefore, adverse effects on health and quality of life are unlikely to occur due to the predicted minor increase in road traffic noise level. It is noted that the Proposed Scheme alignment (west of Sutton Heath) was moved further north due to consultation with Sutton. This design change slightly reduced the noise increases that would have been predicted if the alignment had not been moved.
"Moving the road closer to the river Nene will increase the levels of noise and vibration, significantly degrading the habitat for wildlife." (both Sutton Parish Council and Wansford Parish Council)	Due to the opening of the Proposed Scheme, a majority of the River Nene and the River Nene banks are predicted to experience an increase in road traffic noise level, however this is predicted to be negligible. Approximately 32mof the River Nene banks are predicted to experience a minor increase in road traffic noise level (1.0 to 1.4dB). Approximately 540m of the River Nene is expected to experience a minor road traffic noise level increase (1.0 to 2.9dB). Approximately 120m of the River Nene is predicted to experience a moderate increase (3.0 to 3.4dB). The increase in road traffic noise has been minimised as far as practicable through the provision of a noise reducing road surface. The noise changes discussed here are shown in Figure 11.7 (**TR010039/APP/6.2**).
"The noise and vibration from the upgraded road must be fully investigated and the results made public before any decisions are made." (both Sutton Parish Council and Wansford Parish Council)	This chapter has reported the effects of highways noise and vibration associated with the construction and operation of the Proposed Scheme and will be made publicly available via the Highways England website.
"Any changes to the A47 close to Wansford will have a major effect on the noise and	No significant effect, beneficial or adverse, is predicted due to the operation of the Proposed Scheme for residents located on Old North Road, Black Swann Spinney and Robinswood.

Parish Council Comment	Response
vibrations experienced by the residents of Old North Road, Black Swann Spinney and Robinswood. This was demonstrated the last time that the road was modified." (Wansford Parish Council)	The following list states the predicted change in road traffic noise level (dB $L_{A10,18hr}$) associated with the opening year of the Proposed Scheme at three locations in Wansford: • Dwellings on Black Swan Spinney are predicted to experience change in road traffic noise level of +0.1 to +0.5dB $L_{A10,18hr}$. • Dwellings on Old North Road are predicted to experience change in road traffic noise level of 0.0 to +0.7dB $L_{A10,18hr}$. • Dwellings on Robinswood are predicted to experience change in road traffic noise level of -0.1 to +0.3dB $L_{A10,18hr}$. All of these changes are less than 1 dB $L_{A10,18hr}$. This magnitude of change is negligible and not likely to be a perceptible change.

Assessment method: Baseline survey and validation

11.4.8. As part of the assessment, a baseline noise survey was carried out in May and June 2018 at positions representing noise-sensitive receptors in the vicinity of Proposed Scheme. Environmental noise levels measured during the survey have been analysed to determine the UK road traffic noise index, dB $L_{A10,18hr}$, at each position. Full details of the baseline survey are presented in Appendix 11.3 (**TR010039/APP/6.3**).

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

Assessment method: Construction noise

11.4.10. The assessment of construction noise has been carried out for a study area within 300m of the Proposed Scheme. This study area includes receptors at which there is the greatest potential for significant effects due to construction noise.

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

Prediction method: construction noise

11.4.12. 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.

11.4.13. 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 (**TR010039/APP/6.3**).

11.4.14. 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.

LOAEL and SOAEL: Construction noise

11.4.15. 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.

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.

Daytime working includes weekday periods from 0700 – 1900. Night working includes 2300 – 0700 each day. Evening and weekend working covers all periods not covered by daytime or night time working.

Magnitude of impact: Construction noise

11.4.16. The magnitude of the construction noise impact is determined by comparing the predicted levels against the construction LOAEL and SOAEL values, as presented above.

11.4.17. The magnitude of impact of construction noise is determined in accordance with the following criteria.

Table 11-3: Magnitude of impact for construction noise

Magnitude of Impact	Construction Noise Level
Major	Above or equal to SOAEL +5dB
Moderate	Above or equal to SOAEL and below SOAEL +5dB
Minor	Above or equal to LOAEL and below SOAEL
Negligible	Below LOAEL

11.4.18. The impact magnitudes are presented in contour form for the construction stages which are predicted to result in moderate or major magnitudes of impact within Figures 11.9 to 11.12 and 11.17 to 11.23 (**TR010039/APP/6.2**). The number of receptors within each impact magnitude have then been counted and are presented in Section 11.8.

Determining significance: Construction noise

11.4.19. For construction noise 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.

11.4.20. The significant noise effect in the terms of this EIA is not necessarily a significant adverse impact on health and quality of life as detailed in the NN NPS. A summary of the findings against the NN NPS aims is provided separately in Table 11-23.

Assessment method: Construction Vibration

11.4.21. The assessment of construction vibration has focused on the 7 receptors that are closest to the construction works. This therefore includes the receptors at which there is the greatest potential for significant effects due to construction vibration.

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

Prediction method: construction vibration

11.4.23. Construction vibration has been predicted only for the activities which have the potential to result in the highest levels of vibration. This is limited to compaction works in this instance; piling is likely to be required to construct overbridges and possible elsewhere for the retained cuttings however this will not occur within 30m to a sensitive receptor and therefore will not exceed the SOAEL (refer to Table 11-13). Vibrating rollers are proposed for use during earthworks, road formation, surfacing works, compound construction, drainage, utility diversion, placing subbase and structure formation.

11.4.24. The level of vibration during compaction has been estimated using Annex E of BS 5228 and the TRL report Ground-borne Vibration Caused by Mechanised Construction Works.

11.4.25. The BS 5228 calculation method for vibration during compaction produces three results for the Peak Particle Velocity (PPV); one which has a 50% chance of being exceeded, one with a 33% chance, and once with a 5% chance of been exceeded. In this assessment, the value which has a 33% chance of being exceeded has been presented. This represents the vibration level that is towards the upper end of vibration due to compaction and represents the reasonable worst-case scenario against which the significance of the effect can be evaluated.

LOAEL and SOAEL: Construction vibration

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

11.4.27. 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.

Magnitude of impact: Construction vibration

11.4.28. The magnitude of the construction vibration impact is determined by comparing the predicted levels against the construction LOAEL and SOAEL values, as presented above.

11.4.29. The magnitude of impact of construction vibration is determined in accordance with the following criteria.

Table 11-4: Vibration level – magnitude of impact

Magnitude	Vibration level
Major	Above or equal to 10mm/s PPV
Moderate	Above or equal to SOAEL and below 10 mm/s PPV
Minor	Above or equal to LOAEL and below SOAEL
Negligible	Below LOAEL

11.4.30. The magnitude of construction vibration impact has been determined as per details presented above for the worst-case construction activities with regards to vibration, and for the closest receptors to the works. These impacts are presented in Section 11.8.

Determining significance: Construction vibration

11.4.31. For construction vibration 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.

11.4.32. The significant noise effect in the terms of this EIA is not necessarily a significant adverse impact on health and quality of life as detailed in the NN NPS. A summary of the findings against the NN NPS aims is provided separately in Table 11-23.

Assessment method: Construction traffic

11.4.33. The assessment of construction traffic has been carried out for roads which are likely to be used by construction traffic.

11.4.34. The level of noise increase due to construction traffic has been predicted for these roads, and therefore for sensitive receptors which are impacted by noise from these roads, by applying the following methods.

Prediction method: construction traffic

11.4.35. 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.

Magnitude of impact: Construction traffic

11.4.36. The magnitude of impact for the short-term change in road traffic noise due to construction is considered using the method presented in DMRB LA 111 Table 3.17, using the criteria below.

Table 11-5: Magnitude of impact for construction traffic

Magnitude of Impact	Increase in Road Traffic Noise due to construction traffic (dB)
Major	Greater than or equal to 5.0
Moderate	Greater than or equal to 3.0 and less than 5.0
Minor	Greater than or equal to 1.0 and less than 3.0
Negligible	Less than 1.0

Determining significance: Construction traffic

11.4.37. For construction traffic noise 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.

11.4.38. The significant noise effect in the terms of this EIA is not necessarily a significant adverse impact on health and quality of life as detailed in the NN NPS. A summary of the findings against the NN NPS aims is provided separately in Table 11-23.

Assessment method: Diversions routes

11.4.39. 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 which does not involve quantitative assessment of impact magnitudes. The determination of impact magnitudes and significant effects is detailed as part of the assessments presented in this chapter.

Assessment method: Operational noise

11.4.40. The assessment of operational noise has been carried out for a study area within 600m of the new or altered links. This study area includes receptors at which there is the greatest potential for significant effects due to operational noise. The study area does not extend to include the works at Upton; the operational traffic flow changes in this area are not deemed significant due to low traffic flows, and the location of the receptors.

11.4.41. The level of noise change due to operation has been predicted at sensitive receptors, by applying the following methods.

Prediction method: Operational noise

11.4.42. DMRB LA 111 requires that road traffic noise levels are predicted and assessed for four scenarios, 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)

11.4.43. 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

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

Calculation of Road Traffic Noise methodology, accounting for the forecast traffic volumes, characteristics, and speeds.

11.4.44. 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

11.4.45. 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.

11.4.46. 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.

11.4.47. 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 the daytime period only, assuming that these receptors are not sensitive during the night. For PRoW and SSSI which span a considerable length or area, the assessment considers the noise impact at the majority length rather than at a specific single location.

11.4.48. A minor amendment to the road alignment near to the location of the Sutton Heath Bog SSSI has been made further to the operational noise modelling that has been undertaken.

11.4.49. The nearest residential noise sensitive receptor to the minor alignment change is Heath House. Area specific modelling has demonstrated that the alignment change would result in an increase in noise level, when comparing the DSOY new alignment to the DSOY previous alignment, of 0.1 dB meaning that the short-term noise change increases from 1.8 dB $L_{A10,18hr}$ to 1.9 dB $L_{A10,18hr}$. A similar difference between the alignments is predicted in the long-term. It is therefore concluded that the minor alignment change does not alter the outcomes of the assessment.

LOAEL and SOAEL: Operational noise

11.4.50. The LOAEL and SOAEL values for operational road traffic noise are presented within Table 11-6. These are consistent with the effect levels established within DMRB LA 111 Table 3.49.1.

Table 11-6: Operational noise LOAELs and SOAELs for all receptors

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

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

Magnitude of impact: Operational noise

11.4.52. The magnitude of impact for the operational noise change in the short-term is defined as in Table 11-7.

Table 11-7: Magnitude of change - short-term

Short-term magnitude	Short-term noise change (dB $L_{A10,18hr}$ or L_{night})
Major	Greater than or equal to 5.0
Moderate	3.0 to 4.9
Minor	1.0 to 2.9
Negligible	less than 1.0

11.4.53. The magnitude of impact for the operational noise change in the long-term is defined as in Table 11-8.

Table 11-8: Magnitude of change - long-term

Long-term magnitude	Long-term noise change (dB $L_{A10,18hr}$ or L_{night})
Major	Greater than or equal to 10.0
Moderate	5.0 to 9.9
Minor	3.0 to 4.9
Negligible	less than 3.0

Determining significance: Operational noise

11.4.54. 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 are also presented in Table 11-9. Road traffic noise changes that have a minor, moderate or major magnitude in the short-term are potentially significant once the context and circumstance has been considered.

Table 11-9: 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.

11.4.55. The significant noise effect in the terms of this ES is not necessarily a significant adverse impact on health and quality of life as detailed in the NN NPS. A summary of the findings against the NN NPS aims is provided separately in Table 11-23.

11.5. Assessment assumptions and limitations

Construction noise and vibration

11.5.1. Information regarding construction programme, schedule, construction compounds, works phasing, construction plant, and diversion routes have been provided within Chapter 2 The Proposed Scheme (**TR010039/APP/6.1**) and the Environmental Management Plan (EMP) (**TR010039/APP/7.5**) .

11.5.2. Details of the construction phases, plant used and predicted construction noise levels are presented in Appendix 11.5 (**TR010039/APP/6.3**). Study areas for construction noise and vibration are presented in Figure 11.1 (Noise Location Plan) (**TR010039/APP/6.2**). Five main construction phases are assessed, plus site clearance, compound construction/operation, and the passing place/resurfacing works near Upton. Each construction phase has a number of construction stages, and each stage has one or more types of construction activity associated with it. Each construction activity requires certain plant types which are used to assess the noise emissions for each construction stage.

11.5.3. The majority of the construction work will take place during the daytime and on Saturday afternoons; typical construction times will be between 07:00-19:00 on weekdays and Saturdays.

11.5.4. Night-time or weekend works will be required at some stages, such as, road tie-ins and traffic management. Night works will take place from 20:00- 06:00. There may be exceptions to these hours for oversized deliveries, and junction tie-ins. There are likely to be extended working hours in the summer months to take advantage of the daylight or weather. 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. Sufficient detail on plant types, duration, and location is not available at this stage and therefore the EMP (**TR010039/APP/7.5**) contains the provisions in objective G1 (within the Record of Enviromental Actions and Commitments (REAC)) in which night-time or weekend work may take place.

11.5.5. The assessment of compaction vibration is based on vibratory rollers with two vibrating drums, a maximum drum vibration amplitude of 0.5mm and a drum width of 1m.

11.5.6. All piling will be undertaken using rotary bored piling techniques.

11.5.7. The construction information has been reviewed and assessed 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.

11.5.8. Provision is made in the EMP (**TR010039/APP/7.5**) in objective NV1 (within the (REAC) for any deviation from the measures on which the assessment has been undertaken.

Construction traffic

11.5.9. The proposed construction traffic haul routes (as shown on Figure 2.3 **TR010039/APP/6.2**) generally run in line with the Proposed Scheme carriageway, therefore noise from haul road vehicle movements are included within the construction noise predictions and are not considered separately.

11.5.10. Most construction traffic movements should be to and from the two proposed compound areas located at Sacrewell Farm and Sutton Heath Road via the existing A47. On this basis, the majority of heavy vehicle movements, arriving to and departing from the site, should occur on the A47, and that movements should only occur on smaller roads for access where these roads are within areas which are under construction (and are therefore considered in the construction noise assessment).

11.5.11. The maximum number of site-wide lorry trips per day for any phase 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 on the A47 and the A1. On this basis, the expected additional vehicle movements have been assessed on the following roads:

- A47 eastbound, immediately east of the junction with the A1
- A47 westbound, immediately west of the junction with the A1
- A1 northbound, immediately north of the junction with the A47
- A1 southbound, immediately south of the junction with the A47

11.5.12. Roads other than those detailed above should not typically be used by heavy construction vehicles associated with the construction of the proposed scheme. This is controlled in the Outline Traffic Management Plan (**TR010039/APP/7.6**).

11.5.13. Access to other areas such as Sutton Heath Road and Sacrewell Farm will be from the A47, via the haul roads which follow the Proposed Scheme alignment or via the areas proposed for construction. Movements on the haul roads and within

construction areas are therefore considered as part of the construction noise assessment, and not the construction traffic noise assessment.

Construction Diversion Routes

11.5.14. Any A47 road closures would require a strategic diversion using the A1, A1139, and A1260. No other diversion routes are expected to be necessary other than to accommodate local traffic within the closure points.

Operational noise

11.5.15. Table 11-10 describes the assumptions and limitations associated with the noise model and the operational noise assessment.

Table 11-10: 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. L_{night} traffic noise levels have been calculated using TRL Method 3. • L_{night} traffic noise levels have been calculated using the TRL conversion study. The choice of conversion method accounts for the type of road and the expected diurnal variation in traffic volumes and are the methods deemed most appropriate by the competent expert[4]. • The noise predictions contain the same inherent assumptions that were built into the traffic model to predict traffic flows, composition, and speed at each link. For a 1dB change to occur traffic flows need to increase by 25% or decrease by 20% (all other variables being equal). Therefore, small errors in traffic flow forecasts are unlikely to significantly affect results. • The Proposed Scheme opening year is assumed to be 2025 and the future year is assumed to be 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) (**TR010039/APP/6.1**). • These have been supplemented by OS MasterMap and Google Maps Satellite data.
Road surfaces	• All rural roads have been assumed as comprising a hot-rolled asphalt surface. • The existing surface of the A47 and A11 trunk road has been modelled based on data from the Highways England Pavement Management System (HAPMS). • For the 'Do-Something' scenarios, a low noise surface (-2.5dB Road Surface Influence) has been included along high-speed sections of the Proposed Scheme. • Bridge deck extents have been included as comprising hot-rolled asphalt.
Topography	• The topography for the core study area has been modelled based on 5 metre Digital Terrain Model (DTM) supplied by Highways England through the GeoStore. Digital Terrain/Surface Model - ©Astrium Ltd and Bluesky International Ltd. • The contours created from the DTM are at 1 metre intervals (vertical resolution). • The topography contours modelled for the Proposed Scheme were produced based on 3D drawings provided by the Highways engineering team.

[4] For all roads, the dB L_{night} index has been determined by applying TRL Method 3: motorways & non-motorways (an empirical relationship derived from noise measurements on urban roads). As per DMRB LA 111 guidance, TRL Method 3 provides reliable results for most UK roads.

Model element	Assumption and limitations
	• The topography contours modelled for the Proposed Scheme replace the DTM topography at areas within the Proposed Scheme 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. • An existing close-boarded wooden fence between the A47 (east-bound), the A11 (north-bound) and dwellings located on Robins Wood, Black Swan Spinney and Noise Important Area (NIA) 5303 has been included as a 1.0 metre high reflective noise barrier in all scenarios. Other close boarded fences or walls at property boundaries have not been included in the model. • It is understood that the dwelling at Noise Important Area NIA 5304 (Old Station House) is currently uninhabitable and will be demolished before the opening year of the Proposed Scheme (2025). Therefore, this receptor and the associated buildings are not included in this assessment.
Ground cover	• Urban areas, watercourses, roads and building footprints have been included as acoustically reflective. • The remainder of intervening ground between roads and receivers has been modelled as acoustically absorbent as the remainder of the Proposed Scheme corridor passes through rural areas.
Address data	• Address and receptor sensitivity data has been defined from OS AddressBase Plus data. • Public Rights of Way data was obtained from Norfolk County Council at https://maps.norfolk.gov.uk/highways/#
PRoW	• PRoW data was obtained from Peterborough City Council and Northamptonshire County Council. Some ProW and SSSI span over a considerable area/length and their use is of a transient nature. The assessment of the potential noise impacts has been undertaken across the total area/length of these NSRs to provide a balanced approach, considering the impact at the majority of the path rather than at a specific single location. • For PRoW, the assessment is based on worst-case road traffic noise predictions at the closest part of the PRoW to the Proposed Scheme.
Survey data	• The noise survey undertaken in May and June 2018 has been used to inform the noise model and for characterising the sound climate.

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

11.6. Study area

11.6.1. The study areas considered in the assessment are identified in Figure 11.1 (**TR010039/APP/6.2**) and explained below.

Construction noise and vibration

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

11.6.3. For the construction vibration assessment, DMRB LA 111 notes that a study area encompassing a 100m area from vibration generating activity is normally sufficient. Given the expected methods of work and based on professional

judgement, a study area encompassing 30m area from vibration generating activity is considered appropriate for identifying potentially significant effects since beyond this distance construction vibration, including from the use of vibratory rollers would not lead to significant adverse effects. This is discussed further in Section 11.8.

Construction traffic

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

Diversion Routes

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

Operation

11.6.6. The operational study area for this assessment has been defined as the area within 600m of new road links or road links physically changed or bypassed by the project. There are no road links outside of this area with the potential to experience a short-term BNL of 3.0dB(A) or more. Road links predicted to have a short-term BNL change of more than 1.0dB(A) beyond this area are also predicted to have road traffic noise levels well below SOAEL due to the project. These road links have not been included in the model because the risk of likely significant effects is very low on these links. This is because a minor noise change where SOAEL is not met or exceeded due to the Proposed Scheme is considered to be not significant according to DMRB LA 111.

11.7. Baseline conditions

11.7.1. In order to establish the baseline sound conditions, noise monitoring was undertaken in the vicinity of the Proposed Scheme in May and June 2018. Full

details of the survey undertaken are presented Appendix 11.3 (**TR010039/APP/6.3**). Noise monitoring positions are also identified in Figure 11.1 (**TR010039/APP/6.2**).

11.7.2. Measured baseline results have been compared with the predicted road traffic noise index, dB $L_{A10,18hr}$ for the Do-Minimum Opening Year scenario. This comparison is shown in Appendix 11.4 (**TR010039/APP/6.3**).

11.7.3. The comparison between measured and modelled road traffic noise levels presented in Appendix 11.4 (**TR010039/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 have been applied.

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

Receptors within the construction noise and vibration study areas

11.7.5. A total of 249 existing noise sensitive receptors have been identified within the 300m construction noise study area.

11.7.6. Construction noise levels and impact magnitudes have been assessed for each construction phase and are mapped at all locations within the construction noise study area.

11.7.7. Construction vibration has been assessed at a representative sample of the 7 closest 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.

11.7.8. In terms of the road traffic diversion routes study area, there could be a very large number of properties within the diversion route study area; however it is not proportionate to assess the impact of diversions at individual receptors along these routes. The likelihood of significant effect is determined through a review of the potential routes, and not the noise level changes along these routes.

Receptors within the operational noise study area

11.7.9. Within the operational noise study area, a total of 382 noise sensitive receptors have been identified. These include 33 non-residential noise sensitive receptors, such as:

- Public Rights of Way (PRoW)
- A hotel
- A B&B
- A cricket club
- A community centre
- A museum
- Two churches and their associated cemeteries

11.7.10. Further noise sensitive receptors identified within the operational noise study area include designated areas. These are two NIA[5], identified on the A1:

- IA_ID: 5305, asset owner HE
- IA_ID: 5303, asset owner HE

11.7.11. NIA 5304 has been excluded from the assessment of operational noise as the residential building in the NIA is to be demolished.

11.7.12. There are two Sites of Special Scientific Interest (SSSI) identified within the operational study area and have been included in the assessment of operational noise:

- Sutton Heath and Bog (reference TF08900)
- Wansford Pasture (reference TL069994)

11.7.13. The operational study area, noise sensitive receptors, SSSIs and NIAs are shown in Figure 11.1 (**TR010039/APP/6.2**).

Value of receptors

11.7.14. 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.

11.7.15. 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.

11.7.16. This assessment is focused on receptors with high sensitivity to noise and vibration. Most receptors that would be affected by noise and vibration arising

[5] Noise Important Areas are areas particularly affected by noise. They are defined in the Noise Action Plans as the area where the 1% of the population that are affected by the highest noise levels from major roads are located according to the results of the strategic noise mapping.

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 PRoW.

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 (**TR010039/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 project has the potential to adversely affect noise sensitive receptors within the 300m study area.

11.8.4. The noise maps which present the predicted impacts for each set of construction stages are shown in Figures 11.9 to 11.30 (**TR010039/APP/6.2**); maps are presented with and without mitigation, only for the construction stages for which moderate or major impacts are predicted without mitigation. Where different periods have been assessed, and both result in moderate or major impacts, only the worst-case is presented as a Figure.

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 Tables 11-11 and 11-12. These impacts would potentially result in a temporary moderate or major adverse magnitude of impact without mitigation. Table 11-11 presents the results of the daytime period assessment and covers the planned works from 0700 to 1900 on weekdays and 0700 to 1300 on Saturdays. Table 11-12 presents the results of the evening and weekend period assessment and covers the planned works from 1300 to 1900 on Saturdays.

Table 11-11: Moderate and major noise impacts during daytime construction (0700 to 1900 weekdays, 0700 to 1300 Saturdays)

Construction Phase	Construction Stage	Magnitude of impact	Number of receptors predicted to experience impact	Receptors affected
Preworks & Phase 1	Site clearance & Utility works	Moderate	0	-
		Major	4	6, 8, 10, 12 Great North Road, PE8 6HJ
Compounds	Compound set-up and operation	Moderate	1	Sacrewell Farm and Country Centre, PE8 6HJ
		Major	0	-
Phase 2	Kerbs & Gullies	Moderate	0	-
		Major	0	-
	Drainage	Moderate	0	-
		Major	0	-
	Structures	Moderate	0	-
		Major	0	-
	Earthworks	Moderate	0	-
		Major	0	-
	Finishing works	Moderate	0	-
		Major	0	-
Phase 3	Earthworks	Moderate	0	-
		Major	0	-
	Demolition	Moderate	0	-
		Major	0	-
	Drainage	Moderate	0	-
		Major	0	-
	Finishing Works	Moderate	0	-
		Major	0	-
	Placing Subbase	Moderate	0	-
		Major	0	-
Phase 4	Drainage	Moderate	0	-
		Major	0	-
	Earthworks	Moderate	0	-
		Major	0	-
	Finishing Works	Moderate	0	-

Construction Phase	Construction Stage	Magnitude of impact	Number of receptors predicted to experience impact	Receptors affected
		Major	0	-
	Kerbs & Gullies	Moderate	0	-
		Major	0	-
	Placing Subbase	Moderate	0	-
		Major	0	-
	Structures	Moderate	0	-
		Major	0	-
Phase 5	Site clearance, utility, carriageway construction	Moderate	0	-
		Major	4	6, 8, 10, 12 Great North Road, PE8 6HJ
Upton Works	Site clearance, placing subbase and resurfacing	Moderate	1	Model Farm, PE6 7BB
		Major	0	-

Table 11-12: Moderate and major noise impacts during evening and weekend construction (1300 to 1900 Saturdays)

Construction Phase	Construction Stage	Magnitude of impact	Number of receptors predicted to experience impact	Receptors affected
Preworks & Phase 1	Site clearance & Utility works	Moderate	2	Mill House, PE8 6HJ. Sutton Heath Bog, SSSI.
		Major	5	6, 8, 10, 12 Great North Road, PE8 6HJ. Sacrewell Farm and Country Centre, PE8 6HJ.
Compounds	Compound set-up and operation	Moderate	1	Mill House, PE8 6HJ.
		Major	1	Sacrewell Farm and Country Centre, PE8 6HJ
Phase 2	Kerbs & Gullies	Moderate	0	-
		Major	0	-
	Drainage	Moderate	1	Sacrewell Farm and Country Centre, PE8 6HJ
		Major	0	-
	Structures	Moderate	0	-
		Major	0	-

Construction Phase	Construction Stage	Magnitude of impact	Number of receptors predicted to experience impact	Receptors affected
	Earthworks	Moderate	1	Sacrewell Farm and Country Centre, PE8 6HJ
		Major	0	-
	Finishing works	Moderate	2	Mill House, PE8 6HJ. Sutton Heath Bog, SSSI.
		Major	1	Sacrewell Farm and Country Centre, PE8 6HJ
Phase 3	Earthworks	Moderate	0	-
		Major	0	-
	Demolition	Moderate	0	-
		Major	0	-
	Drainage	Moderate	0	-
		Major	0	-
	Finishing Works	Moderate	0	-
		Major	0	-
	Placing Subbase	Moderate	0	-
		Major	0	-
Phase 4	Drainage	Moderate	0	-
		Major	0	-
	Earthworks	Moderate	0	-
		Major	0	-
	Finishing Works	Moderate	0	-
		Major	0	-
	Kerbs & Gullies	Moderate	0	-
		Major	0	-
	Placing Subbase	Moderate	0	-
		Major	0	-
	Structures	Moderate	0	-
		Major	0	-
Phase 5	Site clearance, utility, carriageway construction	Moderate	0	-
		Major	4	6, 8, 10, 12 Great North Road, PE8 6HJ
Upton Works		Moderate	1	Glebe House, PE6 7BD

Construction Phase	Construction Stage	Magnitude of impact	Number of receptors predicted to experience impact	Receptors affected
	Site clearance, placing subbase and resurfacing	Major	1	Model Farm, PE6 7BB

11.8.6. Tables 11-11 and 11-12 show that the closest receptors to some construction activities will potentially experience a temporary moderate or major magnitude of impact without mitigation.

11.8.7. DMRB LA 111 paragraph 3.19 advises that construction noise shall constitute a significant effect where it is determined that a moderate or major impact will occur for a duration of 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 of work have not yet been finalised by the Principal Contractor. At this stage, a precautionary worst-case approach has been adopted, considering that the assessed construction activities have the potential to exceed the above durations. In reality, this may not happen for all phases of work.

11.8.9. Tie-in construction works are likely to occur during the night-time period. No plant information is available for these works at this stage; however, it is possible that moderate or major adverse impacts could occur because of these works. 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) and therefore noise from tie-in works is unlikely to constitute a significant effect. Due to the sensitive period during which these works will occur, the Principal Contractor shall implement mitigation including further detailed assessments and the application of best practicable means of noise control.

11.8.10. Section 11.9 presents specific noise mitigation measures and best practice techniques that are expected to reduce the potential for significant effect to occur due to construction noise.

Construction vibration

11.8.11. Table 11-13 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 11-13: Distances at which vibration will not exceed SOAEL

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

11.8.12. Most 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.

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

- 1 & 2 Abbotts Wood Cottages, Great North Road, PE8 6HJ – approximately 19m from the nearest works area
- 6, 8, 10, 12 Great North Road, PE8 6HJ – approximately 9 to 15m from the nearest works area
- Deep Springs, PE5 7XP – approximately 26m from the nearest works area.

11.8.14. Based on the data presented in Table 11-13, typical works using heavy vehicles such as dump trucks should not typically exceed the SOAEL at any of the receptors. There is however potential for works using bulldozers to exceed the SOAEL value of 1 mm/s PPV at 1 & 2 Abbotts Wood Cottages and 6, 8, 10, and 12 Great North Road.

11.8.15. Piling will not occur within 30m of the identified receptors and therefore compaction is the only other type 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. Vibrating rollers are proposed for use during earthworks, road formation, surfacing works, compound construction, drainage, utility diversion, placing subbase and structure formation.

11.8.17. For these construction stages, 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 11-14. 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 11-14: Predicted ground borne vibration levels arising from vibratory rollers and compactor

Receptor	Operation	Number of residential properties affected	Vibration level PPV, mm/s (magnitude of impact)
1 & 2 Abbotts Wood Cottages, PE8 6HJ	Steady state of operation	2	1.5 (moderate)
	During start-up and run-down	2	1.9 (moderate)
6, 8, 10, 12 Great North Road, PE8 6HJ	Steady state of operation	4	2.0 (moderate)
	During start-up and run-down	4	2.4 (moderate)
Deep Springs, PE5 7XP	Steady state of operation	1	0.5 (minor)
	During start-up and run-down	1	0.7 (minor)
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.			

11.8.18. 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, surfacing works, compound construction, drainage, utility diversion, placing subbase and structure formation is predicted to result in a moderate adverse impact.

11.8.19. 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.

11.8.20. Resurfacing works which are proposed near Upton will occur near to Model Farm, Church Walk, PE6 7BB which is a Grade 2 Listed Building. The main works will be approximately 42m from the dwelling, and therefore vibration is not expected to exceed the SOAEL at this receptor.

11.8.21. The boundary wall of Model Farm is also Grade 2 Listed, and this is close to the proposed compaction works. This is not an occupied receptor and therefore the LOAEL and SOAEL used in this assessment do not apply here. The exact positioning of the compaction works, in relation to the wall is not known at this stage. There is a risk of compactor vibration exceeding 15mm/s PPV at distances closer than approximately 4m to the wall. The Principal Contractor shall implement mitigation measures for these works to ensure that vibration from the proposed works does not cause damage to the Listed Wall.

11.8.22. The above assessment has demonstrated that, in terms of human perception of construction vibration, some construction activities would result a moderate adverse impact in some locations. There is limited likelihood of compaction works occurring at fixed positions near individual receptors for 10 or more days or nights (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 phases could occur for longer than these durations.

11.8.23. For this reason, Section 11.9 presents specific vibration mitigation measures and best practice techniques that are expected to reduce the potential for significant effects occurring due to vibration from compaction works. Mitigation measures should also be implemented to ensure that damage is not caused to the Listed Wall at Model Farm. The assessment of significant effects is then presented in Section 11.10.

Construction traffic

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

11.8.25. Most construction traffic movements should be to and from the two proposed compound areas via the existing A47, haul roads, or construction areas.

11.8.26. Given the difference in road traffic flows between the A47, the A1, and the surrounding local roads, the majority of construction related traffic shall not use any roads other than these to access site.

11.8.27. Table 11-15 below presents the baseline traffic flows on each road and the change in road traffic noise that is expected due to the addition of 300 construction vehicle movements during the daytime.

Table 11-15: Predicted noise increases due to construction traffic during the daytime

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 eastbound, immediately east of the junction with the A1	28058	67	9	0.2	Negligible
A47 westbound, immediately west of the junction with the A1	16321	66	12	0.3	Negligible
A1 northbound, immediately north of the junction with the A47	57684	80	17	0.1	Negligible
A1 southbound, immediately south of the junction with the A47	58708	87	17	0.1	Negligible

11.8.28. As can be seen in Table 11-15, provided that construction related traffic use only the A47 and the A1 during the daytime, the maximum number of trips per day as described in the assessment assumptions and limitations is predicted to increase the baseline road traffic noise level by less than 1.0dB, and therefore the magnitude of impact is negligible.

Construction Diversions Routes

11.8.29. DMRB LA 111 states that the sudden change of traffic levels on diversion routes, due to 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.

11.8.30. However, this determination is on the basis that the carriageway closures result in traffic being diverted onto local roads that normally experience lower traffic

levels at night. The proposed diversion routes in this instance comprise the use of trunk roads only (other than for local traffic within the closure points).

11.8.31. Therefore, it is determined that diversion routes used due to night-time closures are likely to result in a temporary minor magnitude of impact.

11.8.32. Section 11.9 presents specific noise mitigation measures and best practice techniques that are expected to further reduce the potential for significant effect occurring due to traffic diversions.

Operational noise

11.8.33. Tables 11-16 to 11-18 present the changes in road traffic noise 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.

11.8.34. The figures provided (Figure 11.2 – Figure 11.8, **TR010039/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 (DMFY minus DMOY)
- Short-term noise change with the Proposed Scheme (DSOY minus DMOY)
- Long-term noise change with the Proposed Scheme (DSFY minus DMOY)

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

Noise changes over the long-term without the Proposed Scheme
(Do-Minimum Future Year versus Do-Minimum Opening Year)

11.8.36. Table 11-16 compares road traffic noise levels for the Do-Minimum Opening Year scenario with the Do-Minimum Future Year scenario (the “non-project noise change”).

11.8.37. Outdoor non-residential receptors such as PRoW, church cemeteries and SSSI have been excluded.

Table 11-16: 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	180	4	139	1
	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	21	0	42	0
Decrease in noise level	<3.0	Negligible	148	4	168	1
	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

11.8.38. The changes in road traffic noise level shown in Table 11-16 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)

11.8.39. Table 11-17 compares road traffic noise levels for the Do-Something Opening Year scenario with the Do-Minimum Opening Year scenario.

11.8.40. Outdoor non-residential receptors such as PRoW, church cemeteries and SSSI have been included.

11.8.41. The changes in road traffic noise shown in Table 11-17 are due to the Proposed Scheme over the short-term and result from changes in traffic flows and speeds on the existing network, as well as the proposed realignment of the A47.

Table 11-17: 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	267	17	282	1
	1.0 – 2.9	Minor	33	4	12	0
	3.0 – 4.9	Moderate	0	0	0	0
	>5.0	Major	0	2	0	0
No Change	0.0	No Change	36	6	48	1
Decrease in noise level	<1.0	Negligible	12	3	6	0
	1.0 – 2.9	Minor	1	1	1	0
	3.0 – 4.9	Moderate	0	0	0	0
	>5.0	Major	0	0	0	0

11.8.42. Table 11-17 demonstrates that the majority of receptors will experience either no change or a negligible change in road traffic noise level over the short-term as a result of the Proposed Scheme.

Beneficial impact due to the Proposed Scheme upon opening

11.8.43. Beneficial impacts are predicted in the short term upon opening of the Proposed Scheme due to the realignment of the A47. The dwelling predicted to experience a minor beneficial impact upon opening is Deep Springs, Leicester Road, Sutton, PE5 7XP. No dwellings are predicted to experience moderate or major beneficial impacts upon opening of the Proposed Scheme.

11.8.44. Dwellings situated within NIA 5303 and 5305 are predicted to experience a negligible noise change due to the opening of the Proposed Scheme.

11.8.45. The non-residential sensitive receptor predicted to have a minor beneficial impact due to the Proposed Scheme over the short-term is PRoW: Permissive Footpath 113, Wansford, Peterborough (ID 785). No non-residential sensitive receptors are predicted to have a moderate or major beneficial impact due to the Proposed Scheme over the short-term.

Adverse impacts due to the Proposed Scheme upon opening

11.8.46. Adverse impacts are predicted in the short-term upon opening of the Proposed Scheme due to the expected increase in road users along the Proposed Scheme

and parts of the surrounding network and the removal of the roundabout where the existing A47 meets Old Peterborough Road.

11.8.47. A small number (33) of dwellings are predicted to experience a minor adverse impact due to the Proposed Scheme upon opening. Four of these are located in Wansford and 29 are located in Sutton. No dwellings are predicted to experience moderate or major adverse impact due to the Proposed Scheme upon opening.

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

- Sacrewell Farm and Country Centre, Great North Road, Thornaugh
- PRoW: Footpath 1, Sutton, Peterborough
- PRoW: Footpath 4 Nene Way, Wansford, Peterborough
- SSSI: Sutton Heath and Bog

11.8.49. No non-residential sensitive receptors are predicted to experience moderate adverse impact due to the Proposed Scheme upon opening.

11.8.50. There are two non-residential sensitive receptors predicted to experience a major adverse impact due to the Proposed Scheme upon opening. These are PRoW: Hereward Way Footpath, Wansford, Peterborough and Footpath 4, Wansford, Peterborough. These are discussed further in Section 11.10.

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

11.8.51. Table 11-18 compares road traffic noise levels for the Do-Something Future Year scenario with the Do-Minimum Opening Year scenario. The changes in road traffic noise due to the Proposed Scheme over the long-term are due to changes in traffic flows and speeds, as well as the proposed realignment of the A47. The changes take account of the embedded mitigation measures described in section 11.9.

11.8.52. Outdoor non-residential receptors such as PRoW, church cemeteries and SSSI have been included.

Table 11-18: 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	281	22	261	1
	3.0 – 4.9	Minor	0	0	0	0
	5.0 – 9.9	Moderate	0	1	0	0
	>10.0	Major	0	1	0	0
No Change	0.0	No Change	24	5	39	1
Decrease in noise level	<3.0	Negligible	44	3	49	0
	3.0 – 4.9	Minor	0	1	0	0
	5.0 – 9.9	Moderate	0	0	0	0
	>10.0	Major	0	0	0	0

11.8.53. Table 11-18 demonstrates that, within the study area, the majority of receptors are predicted to experience 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

11.8.54. No dwellings are predicted to experience minor, moderate or major beneficial impacts due to the Proposed Scheme over the long-term.

11.8.55. One non-residential receptor is expected to experience a minor beneficial impact which is PRoW: Footpath 113, Wansford, Peterborough.

Adverse impacts due to the Proposed Scheme over the long term

11.8.56. No dwellings are predicted to experience minor, moderate or major adverse impacts due to the Proposed Scheme over the long-term.

11.8.57. One non-residential receptor predicted to experience a moderate adverse impact due to the Proposed Scheme over the long-term which is PRoW: Footpath 4, Wansford, Peterborough (ID 459).

11.8.58. One non-residential receptor predicted to experience a major adverse impact due to the Proposed Scheme over the long-term which is PRoW: Hereward Way Footpath, Wansford. These 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. Mitigation measures in this section are secured in by EMP (**TR010039/APP/7.5**) and are in line with the aims and associated actions of National Policy Statement for National Networks (NPS NN) as detailed in DMRB LA 111 Table E/1.3.

Construction noise and vibration

11.9.3. Construction works will take place mainly during the daytime. Construction works outside of the normal construction hours of 07:00-19:00 weekday and 07:00-19:00 on Saturdays shall be minimised as far as practicable, as detailed in the EMP (**TR010039/APP/7.5**). The majority of the construction work will take place during the daytime and on Saturday afternoons; typical construction times will be between 07:00-19:00 on weekdays and 07:00-19:00 on Saturdays.

11.9.4. Night-time or weekend works will be required at some stages, such as, road tie-ins and traffic management. Night works will take place from 20:00- 06:00. There may be exceptions to these hours for oversized deliveries, and junction tie-ins. There are likely to be extended working hours in the summer months to take advantage of the daylight or weather.

11.9.5. Where it is determined that a there is a risk of significant effect, where the Principal Contractor's preferred plant departs considerably from the plant which has been used for this assessment, as defined within Appendix 11.5 (**TR010039/APP/6.3**), or where works outside of the normal construction hours are unavoidable (for example certain tie-in works), the Principal Contractor will need to assess noise and vibration, 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.

11.9.6. Mitigation measures in the form of temporary noise barriers or site hoarding shall be provided at the areas represented by the residential receptors presented in Table 11-19. This is only necessary where construction activity in the vicinity of

the receptor will exceed 10 days or nights in any 15 consecutive days or nights; or for a total number of days exceeding 40 in any six consecutive months.

11.9.7. 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 11-19: Construction phases and receptors for which temporary noise barriers are required as specific construction noise mitigation measures

Receptor Address	Construction stage
6, 8, 10, 12 Great North Road, PE8 6HJ.	Preworks & Phase 1 – site clearance and utility works. Stage 5 - Site clearance, utility, carriageway construction
Mill House, PE8 6HJ.	Preworks & Phase 1 – site clearance and utility works.* Compound set-up and operation.* Phase 2 – finishing works.*
Sutton Heath Bog, SSSI.	Preworks & Phase 1 – site clearance and utility works.* Phase 2 – finishing works.*
Sacrewell Farm and Country Centre, PE8 6HJ	Preworks & Phase 1 – site clearance and utility works.* Compound set-up and operation. Phase 2 – drainage.* Phase 2 – earthworks.* Phase 2 – finishing works.*
Model Farm PE6 7BB	Upton resurfacing works
Glebe House PE6 7BD	Upton resurfacing works
*Mitigation works required due to proposed weekend works (1300 – 1900 on Saturdays)	

11.9.8. Temporary noise barriers are predicted to mitigate the potential for significant noise effects at all receptors, with the exception of 6, 8, 10 and 12 Great North Road, where a moderate adverse impact is predicted during the preworks, phase 1, and stage 5 works when works occur outside daytime hours. Construction works in the vicinity of these receptors should therefore not occur during the proposed weekend hours of 1300 – 1900 where possible. Where this is not possible, the Principal Contractor shall implement mitigation including further detailed assessments and the application of best practicable means of noise control.

11.9.9. In addition to the above mitigation measures, best practicable means for noise and vibration mitigation shall be employed and included in the EMP (**TR010039/APP/7.5**) to include the following where possible:

- Ensure the proposed plant noise emissions are similar or below the preliminary construction plant noise levels used within this assessment; and that the plant is the quietest available for the proposed use.
- 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 where available.
- 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.

11.9.10. The potential effects of construction noise and vibration on local community receptors can be lessened by effective communication. Good public relations are invaluable in securing public acceptance of construction noise. People are typically more tolerant of construction noise and vibration if they understand the reason for it, the likely duration, start and finish dates, and that measures are being employed to reduce noise and vibration as far as practicable. Letter drops explaining this would aid communication with the local community. A dedicated site contact for the public and a complaints-handling procedure shall also be put in place.

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

- inform the occupiers of the likely times and duration of works at least one week prior to works commencing
- carry these works out during the daytime (as currently proposed)
- monitor the vibration levels
- 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

11.9.12. These construction vibration mitigation measures are required for works generating significant levels of vibration in the vicinity of the following receptors:

- 1 & 2 Abbotts Wood Cottages, Great North Road, PE8 6HJ
- 6, 8, 10, 12 Great North Road, PE8 6HJ

11.9.13. For construction activities that could result in building damage to the Grade 2 Listed Wall at Model Farm, the Principal Contractor shall:

- subject to securing permission from property owners, carry out a condition survey to identify any sensitive aspects of the wall and to ensure the current status of the wall is recorded
- Carry out a construction vibration assessment to identify the expected vibration level that will occur during compaction works near to the wall (based on the minimum distance, and the confirmed compactor plant details)
- Chose appropriate plant to ensure vibration levels expected to cause building damage do not occur
- Monitor vibration at the location of the wall where compaction works (or equivalent) occur within approximately 10m of the wall

11.9.14. Where pilling is used to construct overbridges and retained cuttings, rotary piling techniques will be used.

Construction traffic

11.9.15. Based on the assumed numbers of HGV movements, construction related traffic can use the existing A47 and the A1 as required.

11.9.16. 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 roads which follow the Proposed Scheme alignment only. This shall be implemented in the OTMP (**TR010039/APP/7.6**).

11.9.17. Should it be determined that other routes are required for construction related traffic, detailed noise impact assessments shall be undertaken by the Principal Contractor before these routes are used, and these shall be included in the OTMP (**TR010039/APP/7.6**). Details shall be provided to the Local Authority for approval. Should the alternative routes result in noise effects that require mitigation, this may include temporary screening, provision of noise insulation, or use of an alternative route.

Diversion Routes

11.9.18. For temporary traffic diversion routes, the noise mitigation measures should include the use of trunk roads only.

11.9.19. 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.

11.9.20. If local roads do need to be used, different routes should be chosen for each closure, and 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.

Operational noise

11.9.21. As part of the Proposed Scheme, 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 2.5dB $L_{A10,18hr}$ when compared with hot rolled asphalt surfacing.

11.9.22. The extents of the low-noise road surface are presented in Table 11-20.

Table 11-20: Low-noise road surface extents

Name	Location	Start Coordinates (X,Y)	End Coordinates (X,Y)	Approximate length (km)
A47 carriageway eastbound	Wansford to Sutton	507703, 299756	510240, 299210	2.6
A47 carriageway westbound	Sutton to Wansford	510237, 299195	507977, 299728	2.3

11.9.23. The assessment concludes that mitigation in the form of noise barriers is not necessary to avoid significant adverse operational noise effects at residential receptors and therefore these have not been included.

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. Subject to the provision of temporary noise barriers, implementation of best practicable means, construction noise monitoring where required, use of trunk

roads only for diversion routes, and the mitigation measures described within Section 11.9, construction noise is not predicted to result in any significant adverse residual effects.

Construction vibration

11.10.3. The predicted vibration levels for earthworks, road formation, surfacing works, compound construction, drainage, utility diversion, placing subbase and structure formation 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 6 residential properties.

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

11.10.5. 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.

11.10.6. However, vibration from the static works such as structure formation 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.

11.10.7. Compaction works (or other construction work types with high vibration emissions) which occur within approximately 10m of the Listed Wall at Model Farm shall be designed so that vibration emissions are sufficiently limited at this location, and vibration monitoring shall be undertaken where necessary.

11.10.8. 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 constitute a significant effect at any vibration-sensitive receptor.

Construction traffic

11.10.9. Provided that construction related traffic uses only the A47, A1, and haul roads which follow the Proposed Scheme alignment, increases in the basic noise level of roads used for construction traffic are predicted to have a negligible 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 (**TR010039/APP/7.6**).

Diversion routes

11.10.10. The magnitude of impact due to noise from diversion routes is predicted to be minor. The change in road traffic noise during temporary traffic diversions are therefore not expected to constitute a significant effect.

Operational noise

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

11.10.12. An initial assessment of operational noise significance at noise sensitive receptors is summarised in this section and in Table 11-21. DMRB LA 111 states that for this initial assessment a moderate or major magnitude of impact at noise sensitive receptors are classed as 'Significant'.

Table 11-21: 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	2	0	0	0
Not significant	321	295	59	56

11.10.13. Table 11-21 demonstrates that, for a majority of noise sensitive receptors within the operational study area, the effects associated with the change in road traffic noise due to the Proposed Scheme are not significant.

11.10.14. For receptors located within buildings, all minor adverse and beneficial impacts are predicted to have absolute noise levels below the SOAEL and the long-term impact is predicted to be minor or negligible. As such, these minor impacts are not predicted to have significant noise effects.

11.10.15. There are two receptors where the effects associated with the change in road traffic noise due to the Proposed Scheme are initially significant. These are both PRoW.

11.10.16. For receptors at which the effects are initially deemed significant, DMRB LA 111 requires the final operational significance to be determined using the justifications in LA 111 Table 3.60 (reproduced in Appendix 11.2 (**TR010039/APP/6.3**)). The final operational noise significance at the two identified PRoWs has been determined and are presented in Table 11-22. In addition, NIAs have been included.

Table 11-22: Final operational noise significance summary table

Receptor Group	Magnitude of change	Conclusion of Significance of Environmental Effect	Justification of Significance Conclusion
Noise Important Area 5303 (21 receptors)	Negligible adverse in the short-term, negligible adverse over the long-term.	Not significant	All receptors within this NIA are predicted to experience a negligible adverse impact over the short-term and long-term due to the Proposed Scheme. Overall, this effect is considered to be not significant at all receptors.
Noise Important Area 5305 (4 receptors)	No change/negligible adverse in the short-term, no change/negligible adverse/negligible beneficial over the long-term.	Not significant	All receptors within this NIA are predicted to experience no change or negligible impact over the short-term and long-term due to the Proposed Scheme. Overall, this effect is considered to be not significant at all receptors.
PRoW: Hereward Way (road entrance to Sacrewell), Wansford, Peterborough	60% negligible adverse, 30% minor adverse and 10% moderate adverse in the short-term. 85% negligible adverse and 15% minor adverse over the long-term.	Not significant	Current users of this 600-metre-long PRoW are required to cross the existing A47 carriageway to join onto Nene Way. As part of the Proposed Scheme, this PRoW will be closed and diverted underneath the Proposed Scheme (via the new grade-separated access to Sacrewell). Considering the PROW as a whole, the sections of the PROW where the road traffic noise level is equal to or above the SOAEL is smaller in the Do-Something scenario than in the Do-Minimum scenario. Furthermore, due to the grade-separation, the future users of the PRoW will spend less time exposed to road traffic noise levels equal to or above exceed SOAEL than in the Do-Minimum scenario. Overall, this effect is considered to be not significant.
PRoW: Footpath 4, Wansford, Peterborough (road entrance to Sacrewell)	5% negligible beneficial, 55% minor adverse, 20% moderate adverse and 20% major adverse in the short-term. 50% negligible adverse, 25% minor adverse and 25% moderate adverse over the long-term.	Not significant	Currently this 120-metre-long PRoW connects Footpath 1 (Sutton) and Footpath 4, Nene Way (Wansford) with the existing A47 carriageway. This PROW is to be closed as part of the Proposed Scheme and will be realigned as part of the new access to Sacrewell Farm. Since this PRoW is proposed to be closed, this effect is considered to be not significant.

11.10.17. In accordance with DMRB LA 111, no significant residual traffic noise effects, adverse or beneficial, are predicted due to the operation of the Proposed Scheme.

11.10.18. The assessment identifies that there are no dwellings where the façade noise level is at least 68dB $L_{A10,18h}$ and the noise from the new or altered highways causes the total level to increase by at least 1.0dB. As such, no properties are forecast to be eligible for insulation under the Noise Insulation Regulations.

11.11. Monitoring

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

Construction

11.11.2. Impacts that are likely to constitute 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:

- Checking that noise and vibration management procedures and practices are sufficient to ensure that significant adverse effects are avoided.
- Verification that specific noise and vibration mitigation measures are in place for activities where there is potential for likely significant effects to occur in their absence.
- Measurement of vibration during bulldozer, compaction, or vibratory rolling works where these occur within 30m of vibration sensitive receptors.
- Measurement of vibration during construction works which occur within 10m of the Listed Wall at Model Farm.

Operation

11.11.3. Impacts that are likely to constitute significant environmental effects from noise during operation shall be monitored and include:

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

11.11.4. 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 due to 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 ES 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, military activities, aircraft etc.

11.11.5. Operational noise and vibration monitoring is therefore not recommended.

11.12. Summary

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

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

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

11.12.4. A construction noise assessment has been undertaken, identifying that adverse impacts that are likely to constitute 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. 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. Furthermore, there are 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.

11.12.5. An assessment of potential construction vibration impacts has identified 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. The Proposed Scheme is not predicted to give rise to significant vibration effects subject to monitoring and effective implementation of the identified mitigation.

11.12.6. A construction traffic assessment has been undertaken. It is concluded that, provided that the anticipated vehicle movements and routes are restricted as described in this chapter and defined in the Outline Traffic Management Plan (**TR010039/APP/7.6**) potential significant effects are unlikely.

11.12.7. 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 utilise trunk roads where possible, the noise increase due to diverted traffic is not likely to constitute a significant effect. Should it be determined that local roads need to be used as diversion routes, mitigation measures, including use of varying routes, and advance notice to residents, are proposed.

11.12.8. The assessment of operational noise includes embedded mitigation in the form of a low noise surface along high-speed sections of the Proposed Scheme. The assessment of operational noise demonstrates that there are no significant adverse or significant beneficial noise effects expected due to changes in road traffic noise. This applies at all receptors within the study area and the NIAs identified.

11.12.9. The assessment identifies proportionate and reasonable actions to avoid significant adverse impacts on health and quality of life from noise and vibration as a result of the Proposed Development, providing compliance with the main objectives of the National Planning Policy Framework, Noise Policy Statement for England, Planning Practice Guidance on noise and NNNPS.

11.12.10. The aims of the NNNPS and associated actions are listed in DMRB LA111. A summary of responses is set out in Table 11-23.

Table 11-23: NN NPS Aims and associated actions

NN NPS Aims	Action
Aim 1: Avoid significant adverse impacts on health and quality of life from noise as a result of the new development.	Table E/1.3 of DMRB LA111 defines a significant adverse noise effect in NPS NN policy terms as a noise level above SOAEL.

NN NPS Aims	Action
NOTE: Significant adverse noise effects occur when noise levels are above SOAEL.	Noise levels are predicted to be below the SOAEL for construction noise when including for the mitigation measures detailed in section 11.9. Existing operational noise within the study area exceeds the SOAEL at some receptors. Operational noise from the Proposed Scheme, considering the mitigation measures detailed in Section 11.9, is not predicted to result in significant increases at receptors with noise levels which currently exceed the SOAEL. No properties qualify for noise insultation. Therefore, the Proposed Scheme meets this policy aim of NN NPS.
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 adverse impacts are detailed in section 11.9. Measures include a noise reducing surface along high-speed sections of the Proposed Scheme to mitigate operational noise, and temporary noise barriers and use of best practicable means to mitigate construction noise. Mitigation measures are detailed in the EMP (**TR010039/APP/7.5**) and the Outline Traffic Management Plan (**TR010039/APP/7.6**) and secured as a requirement in the DCO. Therefore, the Proposed Scheme meets this policy aim of NN NPS.
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.	As a result of the measures (actions) proposed in section 11.9, noise emissions from construction and operation are reduced. No perceptible change in road traffic noise levels is expected at Noise Important Areas. Reductions in operational noise occur at some receptors as a result of the Proposed Scheme. Therefore, the Proposed Scheme meets this policy aim of NN NPS.

11.13. References

- British Standards Institution (1993). BS 7385-2:1993. Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration.
- British Standards Institution (2008). BS 5228-1:2009+A1:2014. Code of practice for noise and vibration control on construction and open sites. Noise.
- British Standards Institution (2008). BS 5228-2:2009+A1:2014. Code of practice for noise and vibration control on construction and open sites. Vibration.
- British Standards Institution (2012). 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.
- Highways England (2020). Design Manual for Roads and Bridges CD 236 – Surface course materials for construction.
- Highways England (2020). Design Manual for Roads and Bridges LA 104 - Environmental assessment and monitoring.
- Highways England (2020). Design Manual for Roads and Bridges, LA 111: Noise and Vibration. Revision 2.
- Highways England (2020). Design Manual for Roads and Bridges, LD 119: Roadside environmental mitigation and enhancement.
- Highways England (2020). Design Manual for Roads and Bridges, Suite of documents, current revisions at the time of writing.
- HMSO (1988). The Calculation of Road Traffic Noise (CRTN).
- Transport Research Laboratory (TRL) (2002). Converting the UK traffic noise index $L_{A10,18hr}$ to EU noise indices for noise mapping.
- Transport Research Laboratory Limited (2000). Groundborne vibration caused by mechanised construction works.

11.14. Glossary

11.14.1. A glossary of terms and definitions is included in Appendix 11.1 (**TR010039/APP/6.3**).