Norwich Western Link Environmental Statement Chapter 6: Air Quality

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Glossary of Abbreviations and Defined Terms

The definition of key terms used in this report are provided below. These definitions have been developed by reference to the definitions used in EU and UK legislation and guidance relevant to Air Quality as well as professional judgement based on knowledge and experience of similar schemes in the context of the Proposed Scheme.

Term	Definition
AADT	Annual average daily traffic.
Air quality objective	A policy target, generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedances within a specific timescale (see also Air quality standard).
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive subgroups (see also Air quality objective).
Air quality target	A policy or statutory target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedances within a specific timescale (see also Air quality standard).
AQMA	Air Quality Management Area.
Ambient air	Outdoor air.
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year.
Automatic Urban and Rural Network	The automatic air quality monitoring network used by Defra in determining compliance against limit values (see Limit value).

Term	Definition
ARN	Affected road network.
Background concentration or deposition rate	The ambient level of pollution that is not affected by local sources of pollution.
Critical level	Concentration of a pollutant in the ambient air above which direct adverse impacts on sensitive vegetation may occur.
Critical load	An estimate of exposure to pollutants, above which significant harmful effects on specified sensitive elements of the environment are likely to occur.
Data capture	The percentage of all the possible measurements for a given period that were validly measured.
Defra	Department for Environment, Food and Rural Affairs.
Dust	Dust comprises particles typically in the size range 1-75 micrometres in aerodynamic diameter and is created through the action of crushing and abrasive forces on materials
Exceedance	A period of time where the concentration of a pollutant is greater than the relevant air quality standard.
Limit value	A legally binding air quality parameter that must not be exceeded (see also air quality standard).
LAQM	Local Air Quality Management.
Model verification	Comparison of modelled results against local monitoring data.
NO_2	Nitrogen dioxide.
NO_x	Nitrogen oxides including nitrogen dioxide and nitrogen monoxide.
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5 micrometres.

Term	Definition
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 micrometres.
PCM	Pollution Climate Mapping.
$\mu g/m^3$	Micrograms per cubic metre. Unit of concentration in terms of mass per unit volume. A concentration of $1\mu g/m^3$ means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.
NH_3	Ammonia.
Uncertainty	A measure, associated with the result of a measurement, which characterizes the range of values within which the true value is expected to lie. Uncertainty is usually expressed as the range within which the true value is expected to lie with a 95% probability, where standard statistical and other procedures have been used to evaluate this figure. Uncertainty is more clearly defined than the closely related parameter 'accuracy' and has replaced it on recent European legislation.

6 Introduction

6.1.1 This chapter assesses and reports on the impact of any likely significant effects arising from the Proposed Scheme regarding air quality.

6.1.2 A description of the assessment methodology, the baseline conditions and summary of the likely significant effects and associated mitigation and monitoring measures are provided within this chapter.

6.1.3 This chapter (and its associated figures and appendices) are intended to be read as part of the wider Environmental Statement, with particular reference to **Environmental Statement Chapter 5: Approach to EIA** (Document Reference: 3.05.00), **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00), **Environmental Statement Chapter 16: Population and Human Health** (Document Reference: 3.16.00), **Environmental Statement Chapter 19: Traffic and Transport** (Document Reference: 3.19.00), and **Environmental Statement Chapter 20: Cumulative Effects** (Document Reference: 3.20.00).

6.2 Legislative Framework, Policy and Guidance

Legislative Framework

- The applicable legislative framework in respect of air quality standards is summarised as follows:
- The Environmental Protection Act 1990, Part III in relation to prevention of statutory nuisance being caused by emissions from construction site activities by using Best Practicable Means (**Ref. 6.1**).
- The Environment Act 1995, Part IV (**Ref. 6.2**) which sets out the requirements for a National Air Quality Strategy and places Local Air Quality Management (LAQM) obligations on local authorities to assess and tackle air pollution (**Ref. 6.3**). Where a local authority determines that one or more objective(s) is / are not likely to be met then it is

required to declare one or more Air Quality Management Area(s) (AQMA) and produce an Action Plan to improve air quality.

- The Environment Act 2021, Schedule 11 which amends Part IV of the Environment Act 1995 (**Ref. 6.4**) in relation to the LAQM framework. This provision is in place is to strengthen the LAQM framework and enable greater cooperation at local level, bringing more organisations into the process of improving air quality. Air quality targets for $PM_{2.5}$ set under the Act are:
    - Annual mean concentration target for a maximum concentration of 10µg/m^3 to be met across England by 2040, with an interim target of 12µg/m^3 for 2028; and
    - Population exposure reduction target for a 35% reduction in population exposure by 2040 (compared to a base year of 2018) (**Ref. 6.5**).
- The Air Quality (England) Regulations 2000 (as amended 2002) (**Ref. 6.6**, **Ref. 6.7**), which sets out ambient air quality objectives, as required by the National Air Quality Strategy which was published by the Secretary of State in accordance with section 80 of the Environment Act 1990.
- The Air Quality Standards Regulations 2010 (as amended 2016) (**Ref. 6.8**, **Ref. 6.9**), which set mandatory limit values, target values and critical levels for ambient air pollutants to be met at national level.

6.2.1 The relevant ambient air quality standards as included in the above legislation are set out in Table 6-1 below.

Table 6-1 Relevant Air Quality Standards

Pollutant	Concentration in micrograms per cubic metre (µg/m³)	Number of exceedances allowed in a calendar year	Set in regulations as
Annual mean nitrogen dioxide (NO_2)	40	None	Objective and limit value
1-hour mean NO_2	200	No more than 18	Objective and limit value
Annual mean nitrogen oxides (NOx)	30	None	Critical level for the protection of vegetation
Annual mean PM_{10} (coarse particulate matter, less than 10 micrometres in diameter)	40	None	Objective and limit value
24 hour mean PM_{10}	50	No more than 35	Objective and limit value
Annual mean $PM_{2.5}$ (fine particulate matter, less than 2.5 micrometres in diameter)	20	None	Limit value
Annual mean $PM_{2.5}$	12	None	Interim target for 2028
Annual mean $PM_{2.5}$	10	None	Target for 2040

Policy

6.2.2 Relevant policy is summarised in Table 6-2 below.

Table 6-2 Relevant Policy

Policy	Comment
National Planning Policy Framework (as revised on 19 December 2023) (**Ref. 6.10**)	The document encompasses the Government's overall planning policies for England and sets out how these are to be applied. The core underpinning principal of the Framework is the presumption in favour of sustainable development, defined as: *"…meeting the needs of the present without compromising the ability of future generations to meet their own needs."*
National Air Quality Strategy (**Ref. 6.11**)	The Government's policy on air quality within the UK is set out in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland (AQS). The AQS provides a framework for reducing air pollution in the UK with the aim of meeting mandatory limit values.

Guidance

6.2.3 The guidance documents listed in Table 6-3 below have been used in the preparation of this chapter.

Table 6-3 Relevant Guidance

Guidance	Comment
Design Manual for Roads and Bridges document LA 105 Air Quality (LA 105) (**Ref. 6.12**)	This guidance provides a framework for assessing, mitigating and reporting the effects of motorway and all-purpose trunk road projects on air quality. The LA 105 approach to considering construction phase air quality impacts was adopted as most appropriate for road schemes. This guidance was used to examine the expected changes in road traffic and road alignment to determine the affected road network and operational phase Study Area. The guidance was taken into consideration in determining the significance of effects in relation to human receptors.

Guidance	Comment
A guide to the assessment of air quality impacts on designated nature conservation sites (**Ref. 6.13**)	This guidance was referred to in determining the operational phase air quality impacts at ecological receptors. Whilst it makes reference to LA 105, it goes further in recommending consideration of ammonia emissions: *"5.5.4.2 The DMRB methodology[...] only requires the assessment of NOx emissions and nitrogen deposition. It does not consider NH_3 or its contribution to nitrogen deposition. As road transport is a source of ammonia, albeit a small source compared to agriculture at a national level, consideration should be given to including it and its contribution to local nitrogen deposition."* In-combination impacts for the Proposed Scheme opening and design years at designated sites have been predicted following this guidance.
Local Air Quality Management Technical Guidance LAQM.TG(22) (**Ref. 6.14**)	This guidance includes the relevant good practice procedures for air quality modelling implemented within this assessment.

6.3 Consultation, Scope, Methodology and Significance Criteria

Consultation Undertaken to Date

6.3.1 Table 6-4 below summarises the consultation undertaken in preparation of this assessment.

Table 6-4 Summary of Consultation Undertaken

Body / organisation	Role / representative	Meeting dates and other forms of consultation	Summary of outcome of discussions
Broadland District Council and South Norfolk District Council ('Broadland DC and S Norfolk DC').	Environmental Management Officer.	Consultation on 04.02.2020 by email. Consultation again on 08.09.2022 by email. No response was received until 03.04.2023 (phone call) due to local authority staff changes.	Consultation on approach at EIA scoping stage. Methodology confirmed as generally acceptable. Agreement that targets for $PM_{2.5}$ (2028 interim, 2040) are accounted for.
Breckland District Council ('Breckland DC').	Team Leader Environmental Protection and Enforcement.	Consultation on 08.09.2022 with response on 06.10.2022 (by email).	Breckland DC confirmed scope and approach as acceptable and asked for any development in proximity to the route to be taken into account.
Norwich City Council ('Norwich CC').	Public Protection Officer.	Consultation via email sent on 08.09.2022 with response on 06.10.2022 (by email).	Norwich CC confirmed approach as acceptable and highlighted that its Air Quality Action Plan should be considered.

Scope of the Assessment

6.3.2 The scope of this assessment has been established through a formal scoping process. As outlined in **Environmental Statement Chapter 5: Approach to EIA** (Document Reference: 3.05.00), a Scoping Opinion was received in October 2020 and a subsequent Scoping Opinion Addendum was received in

September 2022. The Scoping Opinion responses provided by the consultees in relation to the air quality assessment are set out in Table 6-5 below.

Table 6-5 Scoping Opinion Responses

Consultee	Comments provided in Scoping Response	Response to comments
Norfolk CC County Planning Authority (2022)	*"The Addendum identifies that the alignment refinement does not affect what is scoped in or out of the assessment as per the Original Scoping Opinion and therefore no change is proposed to the methodology and no change to the scope of the EIA is proposed in the Addendum, in relation to Air Quality.* *In Table 5-5 of the Original Scoping Report – Elements Scoped In or Out of Further Assessment, proposes to scope out emissions from plant and machinery during the construction phase. The District Council Environmental Health Officer advised that they were content that this is scoped out, however, they also advised that all plant and machinery used should be maintained to ensure that emissions are minimised, with particular care taken with semi static plant.* *The CPA notes that the Original Scoping Report sets out methodology for Air Quality Assessment in accordance with current best practice. Within the scope of Air Quality, the ES should consider the impacts of the proposed development on public health and take account of the risks of air pollution, road and dust and emissions and how these can be managed or reduced during the operation of the project.* *The CPA advises that consideration should be given to Public Health England's 2019 "net health gain" principles which are intended to deliver an overall benefit to people's health. Any new development should be clean by design, incorporating interventions into design to reduce emissions, exposure to pollutants and contribute to better air quality management, applicable irrespective of air quality assessments. The CPA accordingly recommends that these principles are considered in addition to standard methodologies.* *The Environment Act 2021 introduces a binding duty on the government to bring forward at least two new air quality targets by October 2022; the impact of the proposal on these targets should be reflected in the EIA.* *The scope of Air Quality also falls within other ES chapters, including biodiversity. Information on air pollution impacts and the sensitivity of different habitats / designated sites can be found on the Air Pollution Information System www.apis.ac.uk"*	Emissions from plant and machinery used during the construction phase of the Proposed Scheme has been scoped out of this assessment, as agreed in the Scoping Opinion. Assessment of the impacts of the proposed development on air quality at human receptors has been undertaken for both the construction and operational phases of the Proposed Development (see **Section 6.6** of this chapter).

Consultee	Comments provided in Scoping Response	Response to comments
Norfolk CC Public Health Department (2022)	*"The scoping opinion clearly sets out the process for thorough air quality assessments as per industry standard guidelines and practice.* *As you will be aware, the air pollution-human health landscape is changing, not least with the outcome of the inquest into the death of Ella Afoo-Kissi-Debra (December 2020), and the reiteration from expert witnesses that air pollution is a public health risk regardless of legal threshold limits.* *With this in mind, Public Health suggests that the proposals for Norwich Western Link give consideration to Public Health England's 2019 "net health gain" principles (reference here: https://www.gov.uk/government/publications/improving-outdoor-air-quality-and-health-review-of-interventions) which, is adopted, intend to deliver an overall benefit to people's health. In effect this means that any new development should be clean by design, incorporating interventions into design to reduce emissions, exposure to pollutants and contribute to better air quality management, applicable irrespective of air quality assessments.* *Public Health recommends that these principles are considered in addition to standard methodologies.* *The scoping document provided to us for review contains the current targets regarding particulate matter. We note the Environment Bill 2021 introduces a legally binding duty on the government to bring forward at least two new air quality targets by October 2022, which we would expect to see reflected in the EIA."*	Population and human health effects are addressed in **Environmental Statement Chapter 16: Population and Human Health** (Document Reference: 3.16.00). All relevant air quality legislation and policy concerning protection of public health has been considered in the assessment.

Consultee	Comments provided in Scoping Response	Response to comments
Natural England (2022)	*"Air quality in the UK has improved over recent decades but air pollution remains a significant issue. For example, approximately 85% of protected nature conservation sites are currently in exceedance of nitrogen levels where harm is expected (critical load) and approximately 87% of sites exceed the level of ammonia where harm is expected for lower plants (critical level of 1µg) [1]. A priority action in the England Biodiversity Strategy is to reduce air pollution impacts on biodiversity. The Government's Clean Air Strategy also has a number of targets to reduce emissions including to reduce damaging deposition of reactive forms of nitrogen by 17% over England's protected priority sensitive habitats by 2030, to reduce emissions of ammonia against the 2005 baseline by 16% by 2030 and to reduce emissions of NOx and SO_2 against a 2005 baseline of 73% and 88% respectively by 2030. Shared Nitrogen Action Plans (SNAPs) have also been identified as a tool to reduce environmental damage from air pollution.* *The planning system plays a key role in determining the location of developments which may give rise to pollution, either directly, or from traffic generation, and hence planning decisions can have a significant impact on the quality of air, water and land. The ES should take account of the risks of air pollution and how these can be managed or reduced. This should include taking account of any strategic solutions or SNAPs, which may be being developed or implemented to mitigate the impacts on air quality. Further information on air pollution impacts and the sensitivity of different habitats/designated sites can be found on the Air Pollution Information System (www.apis.ac.uk).* *Information on air pollution modelling, screening and assessment can be found on the following websites:* *• SCAIL Combustion and SCAIL Agriculture - http://www.scail.ceh.ac.uk/* *• Ammonia assessment for agricultural development https://www.gov.uk/guidance/intensivefarming-risk-assessment-for-your-environmental-permit* *• Environment Agency Screening Tool for industrial emissions https://www.gov.uk/guidance/airemissions-risk-assessment-for-your-environmental-permit* *• Defra Local Air Quality Management Area Tool (Industrial Emission Screening Tool) – England http://www.airqualityengland.co.uk/laqm"*	Impacts on annual mean NOx, ammonia (NH_3) and nitrogen deposition have been determined for all designated sites within 200m of the affected road network. The impacts have been assessed and identified for the Proposed Scheme alone and in-combination with other plans and projects (cumulative impacts). The effects as a result of these impacts are assessed in **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00). The sensitivity of different habitats / designated sites has been determined with reference to the Air Pollution Information System (APIS) and in discussion with the authors of **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00). The information on air pollution modelling, screening and assessment provided in Natural England's comments on the scoping report is not relevant to road schemes.

Consultee	Comments provided in Scoping Response	Response to comments
Broadland EHO (2022)	*"Air Quality Scoping document sets out methodology for Air Quality Assessment in accordance with current best practice. The EIA should include consideration and discussion around the 2 new legally binding air quality targets which are to be brought forward by October 2022 as set out in the Environment Act 2021."*	All relevant legislation has been considered in the assessment, including the legally binding targets set out in the Environment Act 2021 (see **Section 6.2** of this chapter).

Elements Scoped out of the Assessment

6.3.3 The elements shown in Table 6-6 are not considered to give rise to likely significant effects as a result of the Proposed Scheme so they have not been considered further within this assessment.

Table 6-6 Elements Scoped Out of the Assessment

Element scoped out	Justification
Emissions from plant and machinery	Emissions from construction plant and machinery are unlikely to give rise to significant effects. Plant and machinery will be moved around the site. Emissions will be transitory in nature and are consequently unlikely to have a significant impact. Emissions controls are set out in the Code of Construction Practice and Outline Construction Environmental Management Plan (OCEMP) – refer to **Environmental Statement - Appendix 3.1: Outline Construction Environmental Management Plan (CEMP)** (Document Reference: 3.03.01).

Elements Scoped into the Assessment

Construction Phase

6.3.4 The following elements are considered to have the potential to give rise to likely significant effects during construction of the Proposed Scheme and have therefore been considered within this assessment:

- Dust generated during construction impacting human and ecological receptors;
- Emissions from road traffic in relation to human health at human receptors; and

- Emissions from road traffic in relation to sensitive habitats at ecological receptors.

Operational Phase

6.3.5 The following elements are considered to have the potential to give rise to likely significant effects during operation of the Proposed Scheme and have therefore been considered within this assessment:

- Emissions from road traffic in relation to human health at human receptors; and
- Emissions from road traffic in relation to sensitive habitats at ecological receptors.

Extent of the Study Area

Construction Phase

6.3.6 For the construction phase, LA 105 requires consideration of potential dust impacts within 200 metres of construction activities (dust impacts beyond 200 metres are likely to be negligible and are not likely to result in a significant effect). For this assessment, a precautionary assumption was made in that all areas within the Red Line Boundary may be subject to construction activities that have the potential to generate dust at some point during construction.

6.3.7 For construction traffic, the affected road network (ARN) was determined using adopted criteria set out in LA 105 for inclusion in the air quality assessment. The criteria are:

- The total annual average daily traffic (AADT) (all motorised vehicle types) flow changes by 1,000 or more; or
- The AADT flow of heavy duty vehicles (HDV – including heavy goods vehicles, buses and coaches over 3.5 tonnes gross weight) changes by 200 or more; or
- Road alignment change of 5m or more.

6.3.8 The dominant factor in determining the construction phase ARN was the change in AADT flow of HDVs. The change in total AADT remain well below the 1,000 vehicle threshold. LA 105 also limits consideration of impacts from road traffic to within 200 metres of the ARN (on the assumption that beyond this distance any impacts should be negligible).

6.3.9 **Figure 6.1** in **Environmental Statement Chapter 6: Air Quality - Appendix 6.9: Air Quality Figures** (Document Reference: 3.06.09) shows the construction phase Study Area.

Operational Phase

6.3.10 For operational traffic, the ARN was determined using the aforementioned LA 105 criteria. Unlike the construction phase, the dominant factor in determining the ARN was change in total AADT flow. The operational phase ARN is more extensive than for the construction phase due to the Proposed Scheme being open to general traffic.

6.3.11 **Figure 6.2** in **Environmental Statement Chapter 6: Air Quality - Appendix 6.9: Air Quality Figures** (Document Reference: 3.06.09) shows the operational phase Study Area.

Method of Baseline Data Collation

Desk Study

6.3.12 Air quality data for NO_2, PM_{10} and $PM_{2.5}$ were obtained for the Study Area from Broadland DC and S Norfolk DC, Breckland DC and Norwich CC Air Quality Annual Status Reports (**Ref. 6.15**, **Ref. 6.16**, **Ref. 6.17**). This was supplemented with data from Defra's Pollution Climate Mapping (PCM) model **(Ref. 6.18**, **Ref. 6.19**) that are indicative of current and future baseline roadside and background concentrations.

Surveys

6.3.13 WSP conducted an air quality survey at ten roadside locations using NO_2 diffusion tubes, over the period from September 2019 to February 2020. The locations were chosen along existing roads that are likely to be impacted by

the Proposed Scheme. The survey data were treated according to Defra LAQM.TG(22) (**Ref. 6.14**) procedure to give annual mean concentrations for a base year of 2019. Further detail including results is given in the **Baseline Conditions** section of this ES chapter.

6.4 Assessment Methodology

Construction Phase

6.4.1 The methodology follows guidance set out the LA 105. The assessment considers the construction dust risk potential (Table 6-7 below) and the sensitivity of the receiving environment in terms of human and ecological receptors (Table 6-8 below). Receptors are shown in **Figure 6.1** in **Environmental Statement Chapter 6: Air Quality - Appendix 6.9: Air Quality Figures** (Document Reference: 3.06.09)..

Table 6-7 Construction Dust Risk Potential

Risk	Examples of the types of project as given in LA 105
Large	Large smart motorway projects, bypass and major junction improvements.
Small	Junction congestion relief projects i.e. small junction improvements, signalling changes. Short smart motorway projects.

Table 6-8 Receiving Environment's Sensitivity to Construction Dust in Relation to Distance from Construction Activities

Risk Potential	0 to 50m	50 to 100m	100 to 200m
Large	High	High	Low
Small	High	Low	Low

6.4.2 Potential air quality impacts due to construction traffic were also considered in the assessment. The expected period of construction is approximately 25 months, which is close to but over the LA 105 assessment threshold of two years (24 months). Increases in vehicle numbers are likely to exceed the LA 105 assessment criterion for HDV of 200 or more AADT, but not the criterion for total traffic of 1,000 or more AADT. There are only three ARN links with qualifying changes, namely:

- Ringland Lane, increase of 272 HDV AADT (a change of 294 AADT for total traffic);
- Marl Hill Road, increase of 272 HDV AADT (a change of 294 AADT for total traffic); and
- A1270 Broadland Northway, increase of 202 HDV AADT (a change of 234 AADT for total traffic).

6.4.3 Given that the LA 105 criteria for inclusion in air quality assessment are only just met and the construction period is marginally longer than two years, a qualitative assessment was undertaken, based on the available evidence and professional judgement.

Operational Phase

6.4.4 The Proposed Scheme is assumed to be open by 2029. The design year for the Proposed Scheme is 2044. The following scenarios were modelled:

- Base year 2019, for model verification and base year concentrations;
- Projected base year to 2029, for assessing in-combination impacts at designated sites;

- Projected base year to 2044, for assessing in-combination impacts at designated sites;
- Do minimum (DM) 2029 (without the Proposed Scheme);
- Do something (DS) 2029 (with the Proposed Scheme);
- DM 2044 (without the Proposed Scheme at designated sites only); and
- DS 2044 (with the Proposed Scheme at designated sites only).

6.4.5 The road traffic data used in the assessment can be found in **Environmental Statement Chapter 6: Air Quality - Appendix 6.1: Traffic Data** (Document Reference: 3.06.01). These data were derived from the Norwich Area Transportation Strategy (NATS) model which was used in developing the **Transport Assessment (TA)**(Document Reference Document 4.01.00). The assessment was based on modelling without traffic mitigation measures as the worst case; further information on this can be found in **Environmental Statement Chapter 6: Air Quality - Appendix 6.2: Traffic Mitigation** (Document Reference: 3.06.02).

6.4.6 To determine the air quality impacts of the Proposed Scheme and enable the assessment of effects, detailed air quality modelling was undertaken to predict road traffic emissions contributions to concentrations of:

- NO_2, PM_{10} and $PM_{2.5}$ at human receptors; and,
- Concentrations of NH_3 and nitrogen deposition at ecological receptors.

6.4.7 The projected based year scenarios represent 2019 traffic conditions but assume improvements in vehicle emissions and background air quality as expected for 2029 and 2044. Doing this enables the in-combination air quality impacts to be reported for ecological receptors in support of the assessment presented in **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00). The projected base year scenarios assume zero growth in traffic from 2019 thereby allowing the air quality impacts of the

Proposed Scheme in-combination with other plans and projects to be assessed for 2029 and 2044.

6.4.8 The modelling was undertaken using ADMS-Roads (**Ref. 6.20**) detailed dispersion modelling software.

6.4.9 **Environmental Statement Chapter 6: Air Quality - Appendix 6.3: Operational Phase: Methodology** (Document Reference: 3.06.03) provides detailed information on the how road traffic emissions were derived, the dispersion modelling was undertaken, and model outputs were then processed to determine annual mean concentrations of NO_2, PM_{10}, $PM_{2.5}$, NOx, NH_3 and nitrogen deposition for each scenario. **Environmental Statement Chapter 6: Air Quality - Appendix 6.3: Operational Phase: Methodology** (Document Reference: 3.06.03) also includes details of the model verification.

6.4.10 NO_2, PM_{10} and $PM_{2.5}$ concentrations were modelled at a selection of human receptors where the changes in pollutant concentrations with the Proposed Scheme are likely to be greatest, such as at road junctions and within 200 metres of the Proposed Scheme.

6.4.11 For ecological receptors, NOx and NH_3 concentrations and nitrogen deposition rates were modelled at 10m intervals along transects within the Study Area of up to 200 metres from the affected road network.

Significance Criteria

Construction Phase

6.4.12 LA 105 guidance suggests that with suitable best practice construction mitigation in place, which is determined on the basis of professional judgement of the risks, the impacts of construction dust are unlikely to cause a significant air quality effect.

Operational Phase

Human receptors

6.4.13 For impacts at human receptors, the significance of effect was determined with reference to LA 105 guidance. The guidance applies to impacts on annual mean NO_2 and PM_{10} concentrations in the opening year only, although consideration was also given in this assessment to $PM_{2.5}$.

6.4.14 According to LA 105, any impacts that occur below the annual mean standard for NO_2 or PM_{10} (see Table 6-1) are deemed 'not significant'. Impacts that create, make worse or remove an exceedance of a standard where the change in annual mean NO_2 or PM_{10} concentration is greater than 0.4µg/m^3 may be considered to constitute a significant effect; however, this also depends on the magnitudes of the impact(s) and the numbers of human receptors that are likely to be affected. Furthermore, determination of significant effect also needs consideration of the compliance risk in relation to the standard (as a limit value) for annual mean NO_2 (see Table 6-1), which takes into account future baseline predictions of roadside concentrations from Defra's PCM model. Ultimately, the determination of a significant effect relies on professional judgement of the available evidence.

Ecological receptors

6.4.15 For ecological receptors, consideration of significance expands on LA 105 guidance, which focuses on nitrogen deposition impacts in the opening year only. This assessment considers the impacts on annual mean NOx and NH_3 concentrations and nitrogen deposition in the opening and design years. The same 1% change criterion for ruling out a significant effect as given in LA 105 was applied. For NOx and NH_3, if the change is less than 1% of the relevant critical level then the effect is deemed not significant. For nitrogen deposition, if the change is less than 1% of the relevant lower critical load then effect is deemed not significant. However, where a change is greater than 1% of the relevant critical level / load the effect cannot be discounted as not significant and must be considered by a qualified Ecologist. The significance of effects

for ecological receptors is therefore reported in **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00).

6.5 Baseline Conditions

Local Air Quality Management Status

6.5.1 An overview of baseline air quality conditions is given in Table 6-9 below. Local authority monitoring sites are shown in Figure 6-5 in **Environmental Statement Chapter 6: Air Quality - Appendix 6.9: Air Quality Figures** (Document Reference: 3.06.09). Overall, it can be concluded that baseline air quality is good within the Study Area.

Table 6-9 Baseline Conditions

Local Authority	Available Data	Summary
Breckland DC	At the time of writing, the latest information published by Breckland DC is for 2022. The concentrations at NO_2 monitoring sites have been well below the 40µg/m^3 standard within the past three years. The only AQMA for NO_2 within the district is the Swaffham AQMA. Within the Study Area for the Proposed Scheme, the main sources of NO_x are road traffic emissions from the A1067, A47 and A1075. There are no monitoring sites within the Study Area (the nearest are within Dereham). Defra's predicted roadside NO_2 concentrations within the Study Area are well below the 40µg/m^3 standard. The highest concentration for 2019 is 23.5µg/m^3 on the A47 (census ID 802074965). Defra's predicted background NO_2 concentrations are well below the 40µg/m^3 standard. There is one monitoring site for PM_{10} and no monitoring sites for $PM_{2.5}$ within the district. There are no AQMAs for PM_{10} and $PM_{2.5}$. PM_{10} at East Wretham are well below the 40µg/m^3 standard. Furthermore, from the PM_{10} at East Wretham, Breckland DC has reported that $PM_{2.5}$ concentrations are likely to be well below the standard of 20µg/m^3. Within the Study Area, the main sources of PM_{10} and $PM_{2.5}$ are road traffic generated emissions from the A1067, A47 and A1075. Defra's predicted roadside PM_{10} and $PM_{2.5}$ concentrations within the Study Area are well below the relevant standards. The highest PM_{10} concentration for 2019 is 10.3µg/m^3 on the A1075 (census ID 802074967). The concentration for $PM_{2.5}$ is lower. Defra's predicted background PM_{10} and $PM_{2.5}$ concentrations are well below the respective standards.	Overall, baseline air quality is likely to be good within the Study Area.

Local Authority	Available Data	Summary
Broadland DC	At the time of writing, the latest information published by Broadland DC is for 2022. Concentrations at all NO_2 monitoring sites within the district have been well below the 40µg/m^3 standard in recent years. There are no AQMAs for NO_2 within the district. Within the Study Area, the main sources of NO_x are road traffic emissions from vehicles on the A1067, A1270, A140, A1042 and A47. There are no monitoring sites within the Study Area. Defra's predicted roadside NO_2 concentrations within the Study Area are well below the 40µg/m^3 standard. The highest concentration for 2019 is 31.7µg/m^3 on the A140 (census ID 802026505). Defra's predicted background NO_2 concentrations are well below the 40µg/m^3 standard. There are no monitoring sites or AQMAs for PM_{10} or $PM_{2.5}$ within the district. Within the Study Area, the main sources of PM_{10} and $PM_{2.5}$ are road traffic generated emissions from the A1067, A1270, A140, A1042 and A47. Defra's predicted roadside PM_{10} and $PM_{2.5}$ concentrations within the Study Area are well below the relevant standards. The highest concentration for 2019 is 10.8µg/m^3 on the A1402 (census ID 802056469). The concentration for $PM_{2.5}$ is lower. Defra's predicted background PM_{10} and $PM_{2.5}$ concentrations are well below the respective standards.	Overall, baseline air quality is likely to be good within the Study Area.

Local Authority	Available Data	Summary
South Norfolk DC	At the time of writing, the latest information published by South Norfolk DC is for 2022. Concentrations at all NO_2 monitoring sites within the district have been below the 40µg/m^3 standard in recent years. There are no AQMAs for NO_2 within the district. Within the Study Area, the main sources of NO_x, PM_{10} and $PM_{2.5}$ are road traffic emissions from vehicles on the A11 and A47. In 2022, there were nine South Norfolk DC monitoring sites within the Study Area: DT1 on Newmarket Road; DT2 on Longwater Lane at Costessey; DT9 on Kirkby Bedon Road, Bixley; DT11 at Thickthorn Cottages off the B1172 Norwich Rd; DT17 on West End at Costessey, DT23 on Norwich Road at Costessey; DT27 on Lord Nelson Drive at Costessey; DT28 on Riverside Court at Costessey; and DT29 on Broad Street at Harleston. The highest concentration was 24.9µg/m^3 at DT17. Defra's predicted roadside NO_2 concentrations within the Study Area are well below the 40µg/m^3 standard. The highest concentration for 2019 is 26.8µg/m^3 on the A1074 (census ID 802058422). Defra's predicted background NO_2 concentrations are well below the 40µg/m^3 standard. There are no monitoring sites or AQMAs for PM_{10} and $PM_{2.5}$ within the district. Defra's predicted roadside PM_{10} and $PM_{2.5}$ concentrations within the Study Area are well below the relevant standards. The highest concentration for 2019 is 10.7µg/m^3 on the A1074 (census ID 802058422). The concentration for $PM_{2.5}$ is lower. Defra's predicted background PM_{10} and $PM_{2.5}$ concentrations are well below the respective standards.	Overall, baseline air quality is likely to be good within the Study Area.

Local Authority	Available Data	Summary
Norwich CC	At the time of writing, the latest information published by Norwich CC is for 2022. Concentrations at NO_2 monitoring sites have indicated exceedances of the 40µg/m^3 standard within the centre of Norwich. The only AQMA for NO_2 within the district is the Central Norwich AQMA. Within the Study Area, the main sources of NO_x, PM_{10} and $PM_{2.5}$ are road traffic emissions from vehicles on the A11, A1074, A140, A1402 and A1042. There are no Norwich CC NO_2 monitoring sites or AQMAs within the Study Area. Defra's predicted roadside NO_2 concentrations within the Study Area are well below the 40µg/m^3 standard. The highest concentration for 2019 is 33.2µg/m^3 on the A1054 (census ID 802008756). Defra's predicted background NO_2 concentrations are slightly higher than the surrounding rural areas but still well below the 40µg/m^3 standard. PM_{10} and $PM_{2.5}$ are monitored at one roadside site (CM1, Castle Meadow) and one background site (CM2, Lakenfields). The annual mean concentrations are below the relevant standards for PM_{10} and $PM_{2.5}$. There are no AQMAs for PM_{10} or $PM_{2.5}$ within the district. There are no PM_{10} or $PM_{2.5}$ monitoring sites within the Study Area. Defra's predicted roadside PM_{10} and $PM_{2.5}$ concentrations within the Study Area are well below the relevant standards. The highest concentration for 2019 is 10.7µg/m^3 on the A1074 (census ID 802058101). The concentration for $PM_{2.5}$ is lower. Defra's predicted background PM_{10} and $PM_{2.5}$ concentrations are well below the respective standards.	Overall, baseline air quality is likely to be good within the Study Area.

WSP NO_2 Monitoring

6.5.2 Annual mean NO_2 concentrations for 2019 are set out in Table 6-10. Monitoring locations are shown in **Figure 6.5** in **Environmental Statement Chapter 6: Air Quality - Appendix 6.9: Air Quality Figures** (Document Reference: 3.06.09). All concentrations are well below the air quality standard of 40µg/m^3.

Table 6-10 WSP Baseline Monitoring: Annual mean NO_2 (µg/m^3) for 2019

Site ID	Site Name	Concentration
NWL_1	Castle Meadow	Insufficient data capture
NWL_2	A1067 Fakenham Road	19.8
NWL_3	A1067 Fakenham Road	23.3
NWL_4	River Wensum at Proposed Scheme crossing point	Site access not granted
NWL_5	A1067 over the River Wensum at Attlebridge	18.8
NWL_6	A1067 at Lenwade	17.0
NWL_7	A47 north of Honingham	28.1
NWL_8	A47 west of Easton	9.9
NWL_9	A1074 Dereham Rd, New Costessey	25.2
NWL_10	A1074 Dereham Rd, Norwich	22.9

Table notes:

a) All sites were located at roadside.

b) Annualisation of survey data has been undertaken for 2019 in accordance with Defra LAQM.TG(22) procedure. This process used ratified monitoring data from established Automatic Urban and Rural Network background sites at Norwich Lakenfields and Wicken Fen covering the period 01.01.2019 to 06.01.2020 inclusive, and a bias adjustment factor of 0.89 (national factor for 2019 Gradko 50% TEA / acetone diffusion tube preparation).

c) The diffusion tube at site NWL_1 was co-located with the Norwich CC Castle Meadow (CM1) continuous automatic monitoring station. Only two months of data were collected due to tubes going missing between changeovers.

Defra Pollution Climate Mapping

Roadside Concentrations

6.5.3 The PCM model shows no exceedances of limit values for pollutant concentrations (Table 6-1) at roadside within the Study Area in the 2019 base year.

Background Concentrations

6.5.4 Table 6-11 gives background concentrations of NO_2, PM_{10}, $PM_{2.5}$ for 2019 across the Study Area. The concentrations are well below the respective air quality standards (Table 6-1) and reflect the predominately rural nature of the Study Area.

Table 6-11 Background Annual Mean NO2, PM10 and PM2.5 Concentrations (µg/m3)

Year	Average NO_2 (Minimum, Maximum)	Average PM_{10} (Minimum, Maximum)	Average $PM_{2.5}$ (Minimum, Maximum)
2019	9.38 (7.18, 15.53)	15.55 (13.34, 18.18)	9.38 (8.55, 10.77)
2029	7.04 (5.58, 11.48)	14.35 (12.20, 16.93)	8.42 (7.63, 9.67)
2030	6.94 (5.51, 11.32)	14.35 (12.20, 16.95)	8.42 (7.63, 9.65)

Future Baseline

6.5.5 Pollutant concentrations in the future are anticipated to decrease. This is due to the replacement of older, more polluting vehicles with newer, cleaner vehicles as emissions technologies improve and with the introduction of

electric vehicles into the fleet. This is reflected in Defra's PCM model predictions for roadside and background concentrations.

6.5.6 Table 6-11 gives predicted background concentrations of NO_2, PM_{10}, $PM_{2.5}$ for the 2029 opening year, and 2030 across the Study Area. As Defra's projections do not extend beyond 2030 the background concentrations for 2030 were assumed as representative of conditions in the 2044 design year.

6.6 Sensitive Receptors

6.6.1 All receptors selected in this assessment are considered to be highly sensitive to changes in pollutant levels.

6.6.2 For the construction dust assessment, 158 human receptors, comprising residential properties, have been identified within the construction phase Study Area as shown in **Figure 6.1** in **Environmental Statement Chapter 6: Air Quality - Appendix 6.9: Air Quality Figures** (Document Reference: 3.06.09); ecological receptors are also shown.

6.6.3 For the construction phase traffic assessment, seven human receptors (residential properties), two designated sites and six veteran trees have been identified within 200 metres of the ARN as shown in **Figure 6.1** in **Environmental Statement Chapter 6: Air Quality - Appendix 6.9: Air Quality Figures** (Document Reference: 3.06.09).

6.6.4 A total of 94 representative human receptors were included in the assessment for the operational phase. The locations were chosen where changes in pollutant concentrations are likely to be greatest, such as at road junctions and within 200 metres of the Proposed Scheme. **Figure 6.3** in **Environmental Statement Chapter 6: Air Quality - Appendix 6.9: Air Quality Figures** (Document Reference: 3.06.09) shows the locations of human receptors. Details are given in **Environmental Statement Chapter 6: Air Quality - Appendix 6.4: Operational Phase: Human Receptors** (Document Reference: 3.06.04).

6.6.5 **Figure 6.4** in **Environmental Statement Chapter 6: Air Quality - Appendix 6.9: Air Quality Figures** (Document Reference: 3.06.09) shows the location and name of ecological sites (37 in total) and veteran trees (73 in total) within the operational phase Study Area. For each of these, **Figure 6.4 Environmental Statement Chapter 6: Air Quality - Appendix 6.9: Air Quality Figures** (Document Reference: 3.06.09) also shows the representative receptor transect locations (59 in total) and associated identification (ID). Each receptor transects comprises a number of points along a straight line extending perpendicular from the centreline of the nearest affected road into the adjacent ecological site. The air quality impacts are determined for each point in each receptor transect. The designated ecological sites within the operational phase Study Area include:

Two Special Areas of Conservation (SAC)

- Norfolk Valley Fens (receptor ID: ECO55)
- River Wensum (receptor ID: ECO26, ECO28, ECO39, ECO42, ECO50, ECO66)

Four Sites of Special Scientific Interest (SSSI)

- Alderford Common (receptor ID: ECO54)
- Potter & Scarning Fens, East Dereham (receptor ID: ECO55)
- River Wensum (receptor ID: ECO26, ECO28, ECO39, ECO42, ECO50, ECO66)
- Sweetbriar Road Meadows, Norwich (receptor ID: ECO48)

Two Ancient Woodland (AW)

- Church Wood (receptor ID: ECO72)
- Primrose Grove (receptor ID: ECO38, ECO62)

Twenty-eight County Wildlife Sites (CWS)

- Attlebridge Hills (receptor ID: ECO35, ECO36)

- Bawburgh / Colney Gravel Pits (receptor ID: ECO70, ECO89)
- Botany Bay Farm (receptor ID: ECO25)
- Broom & Spring Hills (receptor ID: ECO53)
- Church Hill Common (receptor ID: ECO65)
- Church Meadow, Alder Carr, Three Corner Thicket and Nursery Plantation (receptor ID: ECO2, ECO3)
- Fen Plantation (receptor ID: ECO17)
- Fen West of East Tuddenham (receptor ID: ECO34)
- Great Witchingham Common (receptor ID: ECO12)
- Hellesdon Pastures (receptor ID: ECO64)
- Land adjoining Foxburrow Plantation (receptor ID: ECO16, ECO37)
- Lenwade Pits (East) (receptor ID: ECO23)
- Lenwade Pits (West) (receptor ID: ECO30)
- Long Dell and Westlodge Hills (receptor ID: ECO60, ECO71)
- Marriott's Way (receptor ID: ECO13)
- Mouse Wood (receptor ID: ECO1)
- Old Covert, Wood Lane (receptor ID: ECO18)
- Primrose Grove, Ringland (receptor ID: ECO63)
- Taverham Mill (receptor ID: ECO8)
- Walsingham Plantation (receptor ID: ECO7, ECO21)
- Weston Meadow (receptor ID: ECO31)
- Intwood Carr (receptor ID: ECO76)
- Meadow Farm Meadow (receptor ID: ECO77)

- Earlham and Colney Marshes (receptor ID: ECO78)
- Horsham Meadows (receptor ID: ECO79)
- East Hills (receptor ID: ECO80)
- River Yare (receptor ID: ECO87, ECO88)
- River Tud at Easton and Honingham (receptor ID: ECO81, ECO82, ECO83, ECO84)

One Nature Reserve (NR)

- Fakenham Road (receptor ID: ECO85, ECO86)

6.6.6 Further locational details of ecological receptors are given in **Environmental Statement Chapter 6: Air Quality - Appendix 6.5: Operational Phase: Ecological Receptors** (Document Reference: 3.06.05).

Assessment of Potential Effects, Mitigation, Monitoring and Residual Effects

Construction Phase

6.6.7 The assessment of dust impacts and effects as a result of the Proposed Scheme is set out in Table 6-12. The assessment of air quality impacts due to construction traffic is given in Table 6-13.

Table 6-12 Assessment of potential effects, additional mitigation, residual effects and monitoring of dust generated during construction

Item	Description
Sensitive receptors	There are 158 residential properties (human receptors), 15 designated sites and 34 veteran trees with within the Study Area. The designated sites include: the River Wensum SAC and SSSI; Attlebridge Hills CWS; Wensum Pastures CWS; Wensum Pastures at Morton Hall CWS; Broom & Spring Hills CWS; Mouse Wood AW and CWS; Gravel Pit Plantation and Church Hill CWS; Weston Meadow and Common Meadow Carr CWS; Church Hill Common CWS; Fakenham Road CWS; Primrose Grove AW; Foxburrow plantation CWS; and Old Covert Wood CWS. Human and ecological receptors are shown in **Figure 6.1**.
Potential effects	The dust risk potential for the Proposed Scheme is 'large' (Table 6-7). As sensitive receptors are identified within 50m from the construction activities the sensitivity of the receiving environment is 'high'. Without appropriate mitigation it is considered that construction dust impacts resulting in soiling or discolouration of exposed surfaces could have a significant adverse effect in terms of amenity, particularly at human receptors.
Additional mitigation	The construction contractor will be required use Best Practicable Means to mitigate potential dust impacts. The requirements are set out the **Outline Construction Environmental Management Plan (OCEMP)** (Document Reference: 3.03.01). Some examples of typical measures include: Storage of potentially dusty materials as far as practicable from sensitive receptors and with appropriate screening / containment to minimise dust emissions. Promptly clear any spillages of potentially dusty materials. Minimise material drop heights and avoid double handling. Avoid burning of any materials. Enforcement of vehicle speed limits on site. Regular inspection and maintenance of haul road surfaces. Damping down of unpaved surfaces during dry conditions to minimise dust emissions. Ensure all loads of potentially dusty materials leaving the site are covered to prevent dust emissions / loss of materials during transit. Regular inspection and cleansing of all paved surfaces including the public highway in the vicinity of site access points. Use vacuum sweepers for cleaning of hard paving / public highway as deemed required.
Residual effects and monitoring	With appropriate mitigation the effect associated with construction dust is **not significant**. The contractor will be required to routinely monitor the effectiveness of dust mitigation. Regular inspections will be undertaken to monitor dust. The frequency of monitoring will be increased when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions. This requirement is set out in the **OCEMP** (Document Reference: 3.03.01).

Table 6-13 Assessment of potential effects, additional mitigation, residual effects and monitoring of emissions from construction traffic

Item	Description
Sensitive receptors	There are seven residential properties (human receptors) within 200m of ARN links including: Rectory Farm off Marl Hill Road (128m from the road), Street Farmhouse on Fakenham Road at the junction with Marl Hill Road (15m from the junction), and five residential properties on Fakenham Road to the north of the junction with Marl Hill Road (between 45m and 200m from the junction). There are two designated sites and six veteran trees within 200m of ARN links. The designated sites include: Attlebridge Hills CWS (150m from the A1270) and Walsingham Plantation CWS (150m from the A1270). The veteran trees include: 4 (120m from Ringland Lane), 5 (60m from the junction of Ringland Lane and Marl Hill Rd), 72 (177m from Marl Hill Rd), 38 (165m from A1270), 45 (195m from A1270), and 71 (145m from A1270). Human and ecological receptors are shown in **Figure 6-1** in **Environmental Statement Chapter 6: Air Quality - Appendix 6.9: Air Quality Figures** (Document Reference: 3.06.09).
Potential effects	Given that baseline concentrations of air pollutants are well below air quality standards (and therefore meet the objectives), the relatively short duration of the construction phase (approximately 25 months), the expected numbers of HDVs which just exceed the LA 105 criterion for air quality assessment, and taking into account the proximities of receptors, it is likely that air quality impacts at human and ecological receptors during the construction phase would be negligible.
Additional mitigation	The construction contractor will be required to control vehicle emissions as set out in the **OCEMP** (Document Reference: 3.03.01).
Residual effects and monitoring	The effect associated with emissions from construction traffic in relation to human receptors is **not significant**. No monitoring is required. The effect on ecological receptors and monitoring requirement is addressed in **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00).

Operational Phase

Opening Year 2029

6.6.8 The assessment of impacts in relation to human and ecological receptors in the opening year is set out in Table 6-14 and Table 6-15 respectively.

Table 6-14 Assessment of potential effects, additional mitigation, residual effects and monitoring during operation for human receptors in the opening year.

Item	Description
Sensitive receptors	A total of 94 representative human receptors have been included in this assessment. These receptors are shown in **Figure 6-3** in **Environmental Statement Chapter 6: Air Quality - Appendix 6.9: Air Quality Figures** (Document Reference: 3.06.09), with details given in **Environmental Statement Chapter 6: Air Quality - Appendix 6.4: Operational Phase: Human Receptors** (Document Reference: 3.06.04).
Potential effects	The potential effects of the Proposed Scheme were assessed by comparing the results of the DS scenario against the DM scenario for 2029. All impacts at human receptors are negligible. The most notable impacts are discussed below. Detailed results for all receptors are included in **Environmental Statement Chapter 6: Air Quality - Appendix 6.6: Operational Phase: Human Receptor Results** (Document Reference: 3.06.06). The local air quality impacts of the Proposed Scheme in the opening year were assessed looking at the predicted changes in annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations at sensitive human receptors. The predicted annual mean NO_2 concentrations range between 6.5µg/m^3 and 16.6µg/m^3 in the DM scenario, and between 6.4µg/m^3 and 16.1µg/m^3 in the DS scenario. The concentrations are well below the standard of 40µg/m^3 at all receptors in both scenarios. The biggest increase with the Proposed Scheme is +1.1µg/m^3 at receptor 56. The biggest reduction is -0.9µg/m^3 at receptor 13 and 14. The predicted annual mean PM_{10} concentrations range between 12.8µg/m^3 and 19.0µg/m^3 in the DM scenario, and between 12.8µg/m^3 and 18.8µg/m^3 in the DS scenario. The annual mean PM_{10} concentrations are well below the standard of 40µg/m^3 at all receptors in both scenarios. The biggest increase with the Proposed Scheme is +0.5µg/m^3 at receptor 56. The biggest reduction is -0.4µg/m^3 at receptor 14 and 35. The predicted annual mean $PM_{2.5}$ concentrations range between 8.0µg/m^3 and 11.0µg/m^3 in the DM scenario, and between 8.0µg/m^3 and 10.8µg/m^3 in the DS scenario. The predicted annual mean $PM_{2.5}$ concentrations are well below the standard of 20µg/m^3 at all receptors in both scenarios. The predicted 2029 concentrations are below the UK interim target of 12µg/m^3 (to be achieved by 2028). The biggest increase with the Proposed Scheme is +0.3µg/m^3 at receptor 56. The biggest reduction is -0.2µg/m^3 at receptors 13, 14, 18, 21, 35, 50, 53.
Additional mitigation	The change in pollutant concentrations attributable to traffic emissions associated with the operational phase of the Proposed Scheme (i.e. impacts on local air quality) are negligible (themselves not warranting the need for mitigation). Therefore, no additional mitigation for impacts at human receptors.
Residual effects and monitoring	As none of the predicted concentrations exceed any of the standards in either the DM or DS scenarios, the effect in relation to human receptors is **not significant**. No monitoring is required.

Table 6-15 Assessment of potential impacts, additional mitigation, residual effects and monitoring during operation for ecological receptors in the opening year

Item	Description
Sensitive receptors	There are 37 designated sites and 73 veteran trees within 200m of roads that are expected to experience increased or reduced traffic levels as a result of the Proposed Scheme. Of the 37 designated sites, several are affected by the changes on the affected road network in different locations, for example the River Wensum SAC and SSSI which is crossed by the affected road network multiple times. The impacts on annual mean NOx, NH_3 and nitrogen deposition have been predicted at all affected locations totalling 59 transects of receptor points extending up to 200m within affected designated sites and 73 receptor points each representative of an affected veteran tree. These receptors are shown in **Figure 6-4** in **Environmental Statement Chapter 6: Air Quality - Appendix 6.9: Air Quality Figures** (Document Reference: 3.06.09), with details given in **Environmental Statement Chapter 6.6: Air Quality - Appendix 6.5: Operational Phase: Ecological Receptors** (Document Reference: 3.06.05).
Potential impacts	The potential impacts of the Proposed Scheme were assessed by comparing the DS scenario against the DM scenario. The impacts are summarised for each pollutant below. Detailed results for all transect receptors are included in **Environmental Statement Chapter 6: Air Quality - Appendix 6.7: Operational Phase: Ecological Receptor Results** (Document Reference: 3.06.07). Impacts on NOx (CLvl = 30µg/m^3) CLvl not exceeded. Negligible impacts. Fifty-two receptors: ECO1, ECO2, ECO3, ECO7, ECO8, ECO12, ECO13, ECO17, ECO18, ECO21, ECO23, ECO25, ECO26, ECO28, ECO30, ECO31, ECO34, ECO35, ECO36, ECO38, ECO42, ECO48, ECO50, ECO53, ECO54, ECO55, ECO60, ECO61, ECO62, ECO64, ECO65, ECO66, ECO67, ECO68, ECO69, ECO70, ECO71, ECO72, ECO73, ECO74, ECO75, ECO77, ECO78, ECO79, ECO80, ECO83, ECO85, ECO86, ECO87, ECO88, ECO89. Seventy-three veteran trees: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73. CLvl exceeded and increases above 1% of the CLvl. Adverse impacts are not negligible. No beneficial impacts. Three transects: ECO16, ECO37, ECO63. Zero veteran trees. CLvl exceeded but no increases above 1% of the CLvl. No adverse impacts. Some beneficial impacts. One transects: ECO76. Zero veteran trees. CLvl exceeded but no increases above 1% of the CLvl. Negligible adverse impacts. No beneficial impacts. Three transects: ECO81, ECO82, ECO84. Zero veteran trees. Impacts on NH_3 (CLvl = 1µg/m^3 for sites with lichen and bryophytes, or 3µg/m^3 for sites with higher plants only) CLvl exceeded but no increases above 1% of CLvl. No adverse impacts. Some beneficial impacts. Twenty-one transects: ECO1, ECO8, ECO30, ECO31, ECO42, ECO48, ECO60, ECO61, ECO64, ECO65, ECO66, ECO67, ECO68, ECO69, ECO70, ECO75, ECO76, ECO77, ECO78, ECO79, ECO80. Fifteen veteran trees: 5, 27, 30, 31, 42, 44, 46, 48, 51, 55, 58, 61, 66, 68, 70. CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. No beneficial impacts. Twenty-two transects: ECO2, ECO7, ECO13, ECO16, ECO21, ECO28, ECO35, ECO37, ECO38, ECO39, ECO53, ECO54, ECO55, ECO62, ECO63, ECO72, ECO81, ECO82, ECO83, ECO84, ECO85, ECO86. Twenty-nine veteran trees: 1, 2, 3, 4, 6, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 38, 39, 45, 56, 60, 71. CLvl exceeded but no increases above 1% of CLvl. Negligible adverse impacts. No beneficial impacts. Four transects: ECO3, ECO17, ECO34, ECO73. Eleven veteran trees: 15, 28, 32, 41, 43, 47, 53, 57, 62, 63, 69. CLvl exceeded but no increases above 1% of CLvl. No adverse impacts. No beneficial impacts. Six transects: ECO12, ECO23, ECO71, ECO87, ECO88, ECO89. Eighteen veteran trees: 7, 29, 33, 34, 35, 36, 37, 40, 49, 50, 52, 54, 59, 64, 65, 67, 72, 73. CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. Some beneficial impacts at one transect: ECO18. Zero veteran trees. CLvl exceeded but no increases above 1% of CLvl. Negligible adverse impacts. Some beneficial impacts. Three transects: ECO25, ECO36, ECO74. Zero veteran trees. CLvl not exceeded. Negligible impacts. Two transects: ECO26, ECO50. Zero veteran trees. Impacts on nitrogen deposition Lower CLd exceeded but no increases above 1% of lower CLd. Negligible adverse impacts. Some beneficial impacts. Nine transects: ECO1, ECO8, ECO25, ECO36, ECO60, ECO65, ECO69, ECO74, ECO79. Zero veteran trees. Lower CLd exceeded but no increases above 1% of lower CLd. Negligible adverse impacts. No beneficial impacts. Four transects: ECO3, ECO17, ECO71, ECO73. Twelve veteran trees: 7, 28, 32, 41, 43, 47, 53, 57, 62, 63, 65, 69. Lower CLd exceeded but no increases above 1% of lower CLd. No adverse impacts. Some beneficial impacts. Twenty-two transects: ECO12, ECO23, ECO26, ECO30, ECO31, ECO42, ECO48, ECO50, ECO61, ECO64, ECO66, ECO67, ECO68, ECO70, ECO75, ECO76, ECO77, ECO78, ECO79, ECO80, ECO87, ECO88, ECO89. Twenty-nine veteran trees: 5, 27, 29, 30, 31, 33, 34, 35, 36, 40, 42, 44, 46, 48, 50, 51, 52, 54, 55, 58, 59, 61, 64, 66, 67, 68, 70, 72, 73. Lower CLd exceeded but no increases above 1% of lower CLd. No adverse impacts. No beneficial impacts. No transects. Two veteran trees: 37, 49. Lower CLd exceeded and increases above 1% of lower CLd. Adverse impacts are not negligible. No beneficial impacts. Twenty-three transects: ECO2, ECO7, ECO13, ECO16, ECO21, ECO28, ECO34, ECO35, ECO37, ECO38, ECO39, ECO53, ECO54, ECO55, ECO62, ECO63, ECO72, ECO81, ECO82, ECO83, ECO84, ECO85, ECO86. Thirty veteran trees: 1, 2, 3, 4, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 38, 39, 45, 56, 60, 71. Lower CLd exceeded and increases above 1% of lower CLd. Adverse impacts are not negligible. Some beneficial impacts at one transect: ECO18. Zero veteran trees.

Item	Description
Additional mitigation	Refer to **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00)
Residual effects and monitoring	Refer to **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00)

Design Year 2044

6.6.9 The assessment of impacts in relation to ecological receptors in the design year are given in Table 6-16.

Table 6-16 Assessment of potential impacts, additional mitigation, residual effects and monitoring during operation for ecological receptors in the design year

Item	Description
Sensitive receptors	There are 37 designated sites and 73 veteran trees within 200m of roads that are expected to experience increased or reduced traffic levels with the Proposed Scheme. Of the 37 designated sites several are affected by the changes on the affected road network in different locations, for example the River Wensum SAC / SSSI which is crossed by the affected road network multiple times. The impacts on annual mean NOx, NH_3 and nitrogen deposition have been predicted at all affected locations totalling 59 transects of receptor points extending up to 200m within affected designated sites and 73 receptor points each representative of an affected veteran tree. These receptors are shown in **Figure 6-4** in **Environmental Statement Chapter 6: Air Quality - Appendix 6.9: Air Quality Figures** (Document Reference: 3.06.09), with details given in **Environmental Statement Chapter 6: Air Quality - Appendix 6.5: Operational Phase: Ecological Receptors** (Document Reference: 3.06.05).
Potential impacts	The potential impacts of the Proposed Scheme were assessed by comparing the DS scenario against the DM scenario. The impacts are summarised for each pollutant below. Detailed results for all transect receptors are included in **Environmental Statement Chapter 6: Air Quality - Appendix 6.7: Operational Phase: Ecological Receptor Results** (Document Reference: 3.06.07). Impacts on NOx (CLvl = 30µg/m^3) CLvl not exceeded. Negligible impacts. Forty-eight transects: ECO1, ECO2, ECO3, ECO7, ECO8, ECO12, ECO13, ECO17, ECO18, ECO21, ECO23, ECO25, ECO26, ECO30, ECO31, ECO34, ECO35, ECO36, ECO38, ECO42, ECO48, ECO50, ECO53, ECO54, ECO55, ECO61, ECO62, ECO64, ECO65, ECO66, ECO67, ECO68, ECO69, ECO70, ECO71, ECO72, ECO73, ECO74, ECO75, ECO77, ECO78, ECO79, ECO80, ECO83, ECO86, ECO87, ECO88, ECO89. Seventy-three veteran trees: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73. CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. No beneficial impacts. Six transects: ECO16, ECO28, ECO37, ECO39, ECO60, ECO63. Zero veteran trees. CLvl exceeded but no increase above 1% of CLvl. Negligible adverse impacts. No beneficial impacts. Four transect: ECO81, CO82, ECO84, ECO85. CLvl exceeded but no increase above 1% of CLvl. No adverse impacts. Some beneficial impacts. One transect: ECO76. Impacts on NH_3 (CLvl = 1µg/m^3 for sites with lichen and bryophytes, or 3µg/m^3 for sites with higher plants only) CLvl exceeded but no increases above 1% of CLvl. No adverse impacts. Some beneficial impacts. Twenty-two transects: ECO1, ECO8, ECO23, ECO30, ECO31, ECO36, ECO42, ECO48, ECO50, ECO61, ECO64, ECO65, ECO66, ECO67, ECO68, ECO69, ECO74, ECO75, ECO76, ECO77, ECO78, ECO80. Twenty-seven veteran trees: 5, 27, 29, 30, 31, 33, 34, 40, 42, 44, 46, 48, 50, 51, 52, 54, 55, 58, 59, 61, 64, 66, 67, 68, 70, 72, 73. CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. No beneficial impacts. Twenty-three transects: ECO2, ECO3, ECO7, ECO13, ECO16, ECO21, ECO28, ECO35, ECO37, ECO38, ECO39, ECO53, ECO54, ECO55, ECO60, ECO62, ECO63, ECO81, ECO82, ECO83, ECO84, ECO85, ECO86. Thirty veteran trees: 1, 2, 3, 4, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 38, 39, 43, 45, 56, 60, 71. CLvl exceeded but no increases above 1% of CLvl. No adverse impacts. No beneficial impacts. Five transects: ECO12, ECO70, ECO87, ECO88, ECO89. Six veteran trees: 35, 36, 37, 49, 57, 65. CLvl exceeded but no increases above 1% of CLvl. Negligible adverse impacts. Some beneficial impacts. Two transects: ECO25, ECO79. Zero veteran trees. CLvl exceeded but no increases above 1% of CLvl. Negligible adverse impacts. No beneficial impacts. Five transects: ECO17, ECO34, ECO71, ECO72, ECO73. Ten veteran trees: 7, 28, 32, 41, 43, 47, 53, 62, 63, 69. CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. Some beneficial impacts at one transect: ECO18. Zero veteran trees. CLvl not exceeded. Negligible impacts. One transect: ECO26. Zero veteran trees. Impacts on nitrogen deposition Lower CLd exceeded but no increases above 1% of lower CLd. Negligible adverse impacts. Some beneficial impacts. Six transects: ECO8, ECO25, ECO36, ECO65, ECO74, ECO79. Zero veteran trees. Lower CLd exceeded and increases above 1% of lower CLd. Adverse impacts are not negligible. No beneficial impacts. Twenty-four transects: ECO2, ECO3, ECO7, ECO13, ECO16, ECO21, ECO28, ECO34, ECO35, ECO37, ECO38, ECO39, ECO53, ECO54, ECO55, ECO60, ECO62, ECO63, ECO81, ECO82, ECO83, ECO84, ECO85, ECO86. Thirty-two veteran trees: 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 38, 39, 43, 45, 56, 60, 71. Lower CLd exceeded but no increases above 1% of lower CLd. No adverse impacts. Some beneficial impacts. Twenty-four transects: ECO1, ECO12, ECO23, ECO26, ECO30, ECO31, ECO42, ECO48, ECO50, ECO61, ECO64, ECO66, ECO67, ECO68, ECO69, ECO70, ECO75, ECO76, ECO77, ECO78, ECO80, ECO87, ECO88, ECO89. Thirty-one veteran trees: 5, 27, 29, 30, 31, 33, 34, 35, 36, 37, 40, 42, 44, 46, 48, 49, 50, 51, 52, 54, 55, 58, 59, 61, 64, 66, 67, 68, 70, 72, 73. Lower CLd exceeded but no increases above 1% of lower CLd. Negligible adverse impacts. No beneficial impacts. Four transects: ECO17, ECO71, ECO72, ECO73. Ten veteran trees: 28, 32, 41, 47, 53, 57, 62, 63, 65, 69. Lower CLd exceeded and increases above 1% of lower CLd. Adverse impacts are not negligible. Some beneficial impacts at one transect: ECO18. Zero veteran trees.
Additional mitigation	Refer to **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00)

Item	Description
Residual effects and monitoring	Refer to **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00)

Cumulative Impacts

6.6.10 Details of air quality impacts in-combination with committed development are given in **Environmental Statement Chapter 6: Air Quality - Appendix 6.8: Assessment of Cumulative Impacts** (Document Reference: 3.06.08). All impacts would be negligible. Significance of effect is addressed in **Environmental Statement Chapter 20: Cumulative Effects** (Document Reference: 3.20.00).

In-combination Impacts at Designated Sites

6.6.11 To support **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00), for ecological receptors, in-combination air quality impacts as a consequence of the Proposed Scheme were determined. The in-combination air quality impacts were determined by comparing the DS scenario with the projected base year scenario for both the opening year and design year.

Opening Year 2029

6.6.12 The assessment of in-combination impacts in relation to ecological receptors in the opening year are given in Table 6-17.

Table 6-17 Assessment of potential in-combination impacts, additional mitigation, residual effects and monitoring during operation for ecological receptors in the opening year

Item	**Description**
Sensitive receptors	There are 37 designated sites and 73 veteran trees within 200m of roads that are expected to experience increased or reduced traffic levels with the Proposed Scheme. Of the 37designated sites several are affected by the changes on the affected road network in different locations, for example the River Wensum SAC / SSSI which is crossed by the affected road network multiple times. The impacts on annual mean NOx, NH_3 and nitrogen deposition have been predicted at all affected locations totalling 59 transects of receptor points extending up to 200m within affected designated sites and 73 receptor points each representative of an affected veteran tree. These receptors are shown in **Figure 6-4** in **Environmental Statement Chapter 6: Air Quality - Appendix 6.9: Air Quality Figures** (Document Reference: 3.06.09), with details given in **Environmental Statement Chapter 6: Air Quality - Appendix 6.5: Operational Phase: Ecological Receptors** (Document Reference: 3.06.05).
Potential impacts	The potential in-combination impacts of the Proposed Scheme were assessed by comparing the DS scenario against the projected base year for 2029. The impacts are summarised for each pollutant below. Detailed results for all transect receptors are included in **Environmental Statement Chapter 6: Air Quality - Appendix 6.7: Operational Phase: Ecological Receptor Results** (Document Reference: 3.06.07). **In-combination impacts on NOx (CLvl = 30µg/m^3)** • CLvl not exceeded. Negligible impacts. Thirty-eight transects: ECO1, ECO2, ECO3, ECO7, ECO8, ECO12, ECO13, ECO17, ECO18, ECO21, ECO23, ECO25, ECO28, ECO30, ECO34, ECO35, ECO36, ECO38, ECO39, ECO50, ECO53, ECO54, ECO55, ECO60, ECO61, ECO62, ECO65, ECO68, ECO69, ECO71, ECO72, ECO73, ECO74, ECO75, ECO79, ECO83, ECO85, ECO86. Fifty-seven veteran trees: 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, 29, 32, 34, 35, 36, 37, 38, 39, 40, 41, 43, 45, 47, 49, 50, 52, 53, 54, 56, 57, 59, 60, 62, 63, 64, 65, 67, 68, 69, 71, 73. • CLvl not exceeded. Negligible impacts. The Scheme does not contribute to adverse impacts. Fourteen transects: ECO26, ECO31, ECO42, ECO48, ECO64, ECO66, ECO67, ECO70, ECO77, ECO78, ECO80, ECO87, ECO88, ECO89. Sixteen veteran trees: 5, 27, 30, 31, 33, 42, 44, 46, 48, 51, 55, 58, 61, 66, 70, 72. • CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. No beneficial impacts. Three transects: ECO16, ECO37, ECO63. Zero veteran trees. • CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. No beneficial impacts. The Scheme does not contribute to adverse impacts. One transect: ECO76. Zero veteran trees. **In-combination impacts on NH_3 (CLvl = 1µg/m^3 for sites with lichen and bryophytes, or 3µg/m^3 for sites with higher plants only)** • CLvl exceeded but no increases above 1% of CLvl. Negligible adverse impacts. Some beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. Four transects: ECO48, ECO64, ECO65, ECO69. Zero veteran trees. • CLvl exceeded but no increases above 1% of CLvl. No adverse impacts. No beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. Zero transects. Seven veteran trees: 33, 35, 36, 37, 49, 65, 72. • CLvl exceeded but no increases above 1% of CLvl. Negligible adverse impacts. No beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. One transect: ECO89. Three veteran trees: 44, 50, 70. • CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. No beneficial impacts. Twenty-four: ECO2, ECO7, ECO13, ECO16, ECO18, ECO25, ECO28, ECO34, ECO35, ECO37, ECO38, ECO39, ECO53, ECO54, ECO55, ECO62, ECO63, ECO72, ECO73, ECO81, ECO82, ECO84, ECO85, ECO86. Twenty-nine veteran trees: 1, 2, 3, 4, 6, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 38, 39, 45, 56, 60, 71. • CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. Some beneficial impacts. Three transects: ECO3, ECO21, ECO83. Zero veteran trees. • CLvl exceeded but no increases above 1% of CLvl. No adverse impacts. Some beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. Nine transects: ECO12, ECO23, ECO30, ECO31, ECO42, ECO61, ECO66, ECO75. Nineteen veteran trees: 5, 27, 29, 30, 31, 34, 40, 46, 48, 51, 52, 54, 59, 61, 64, 66, 67, 68, 73. • CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. No beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. Thirteen transects: ECO1, ECO8, ECO60, ECO67, ECO70, ECO71, ECO76, ECO77, ECO78, ECO79, ECO80, ECO87, ECO88. Four veteran trees: 7, 42, 55, 58. • CLvl exceeded but no increases above 1% of CLvl. Negligible adverse impacts. Some beneficial impacts. Two transects: ECO36, ECO74. Zero veteran trees. • CLvl exceeded but no increases above 1% of CLvl. Negligible adverse impacts. No beneficial impacts. One transect: ECO17. Nine veteran trees: 15, 28, 32, 41, 43, 47, 57, 62, 63. • CLvl exceeded but no increases above 1% of CLvl. No adverse impacts. Some beneficial impacts. Zero transects. Two veteran trees: 53, 69. • CLvl not exceeded. Negligible impacts. The Proposed Scheme does not contribute to adverse impacts. Two transects: ECO26, ECO50. Zero veteran trees. **In-combination impacts on nitrogen deposition** • Lower CLd exceeded and increases above 1% of lower CLd. Adverse impacts are not negligible. Some beneficial impacts. Three transects: ECO3, ECO21, ECO83. Zero veteran trees. • Lower CLd exceeded and increases above 1% of lower CLd. Adverse impacts are not negligible. No beneficial impacts. Thirty transects: ECO2, ECO7, ECO8, ECO13, ECO16, ECO17, ECO18, ECO25, ECO28, ECO34, ECO35, ECO37, ECO38, ECO39, ECO53, ECO54, ECO55, ECO62 ECO63, ECO71, ECO72, ECO73, ECO81, ECO82, ECO84, ECO85, ECO86. Thirty-seven veteran trees: 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, 32, 38, 39, 41, 43, 45, 47, 56, 60, 63, 71. • Lower CLd exceeded but no increases above 1% of lower CLd. No adverse impacts. Some beneficial impacts. Zero transects. Two veteran trees: 53, 69. • Lower CLd exceeded and increases above 1% of lower CLd. Adverse impacts are not negligible. No beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. Nine transects: ECO67, ECO70, ECO76, ECO77, ECO78, ECO80, ECO87, ECO88, ECO89. Five veteran trees: 42, 44, 55, 58, 70. • Lower CLd exceeded but no increases above 1% of lower CLd. Negligible adverse impacts. Some beneficial impacts. Four transects: ECO36, ECO65, ECO69, ECO74. Zero veteran trees. • Lower CLd exceeded but no increases above 1% of lower CLd. No adverse impacts. Some beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. Ten transects: ECO12, ECO23, ECO30, ECO31, ECO42, ECO50, ECO61, ECO66, ECO68, ECO75. Twenty veteran trees: 5, 27, 29, 30, 31, 34, 35, 40, 46, 48, 51, 52, 54, 59, 61, 64, 66, 67, 68, 73. • Lower CLd exceeded but no increases above 1% of lower CLd. Negligible adverse impacts. No beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. One transect: ECO26. Six veteran trees: 33, 36, 37, 49, 50, 72. • Lower CLd exceeded but no increases above 1% of lower CLd. Negligible adverse impacts. Some beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. Two transects: ECO48, ECO64. Zero veteran trees. • Lower CLd exceeded but no increases above 1% of lower CLd. Negligible adverse impacts. No beneficial impacts. Zero transects. Three veteran trees: 57, 62, 65.

Item	**Description**
Additional mitigation	Refer to **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00)
Residual effects and monitoring	Refer to **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00)

Design Year 2044

6.6.13 The assessment of in-combination impacts in relation to ecological receptors in the design year are given in Table 6-18.

Table 6-18 Assessment of potential in-combination impacts, additional mitigation, residual effects and monitoring during operation for ecological receptors in the design year

Item	**Description**
Sensitive receptors	There are 37 designated sites and 73 veteran trees within 200m of roads that are expected to experience increased or reduced traffic levels with the Proposed Scheme. Of the 37 designated sites several are affected by the changes on the affected road network in different locations, for example the River Wensum SAC / SSSI which is crossed by the affected road network multiple times. The impacts on annual mean NOx, NH_3 and nitrogen deposition have been predicted at all affected locations totalling 59 transects of receptor points extending up to 200m within affected designated sites and 73 receptor points each representative of an affected veteran tree. These receptors are shown in **Figure 6-4** in **Environmental Statement Chapter 6: Air Quality - Appendix 6.9: Air Quality Figures** (Document Reference: 3.06.09), with details given in **Environmental Statement Chapter 6: Air Quality - Appendix 6.5: Operational Phase: Ecological Receptors** (Document Reference: 3.06.05).

Item	Description
Potential impacts	The potential in-combination impacts of the Proposed Scheme were assessed by comparing the DS scenario against the projected base year for 2044. The impacts are summarised for each pollutant below. Detailed results for all transect receptors are included in **Environmental Statement Chapter 6: Air Quality - Appendix 6.7: Operational Phase: Ecological Receptor Results** (Document Reference: 3.06.07). **In-combination impacts on NOx (CLvl = 30µg/m^3)** • CLvl not exceeded. Negligible impacts. Thirty transects: ECO1, ECO2, ECO3, ECO7, ECO8, ECO13, ECO17, ECO18, ECO21, ECO25, ECO34, ECO35, ECO36, ECO38, ECO50, ECO53, ECO54, ECO55, ECO62, ECO65, ECO68, ECO69, ECO70, ECO71, ECO72, ECO73, ECO74, ECO79, ECO83, ECO86. Fifty-three veteran trees: 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, 32, 34, 35, 36, 37, 38, 39, 40, 41, 43, 45, 47, 49, 52, 53, 56, 57, 59, 60, 62, 63, 64, 65, 67, 69, 71. • CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. No beneficial impacts. Six transects: ECO16, ECO28, ECO37, ECO39, ECO60, ECO63. Zero veteran trees. • CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. No beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. One transect: ECO76. Zero veteran trees. • CLvl exceeded but no increases above 1% of CLvl. Negligible adverse impacts. No beneficial impacts. Four transects: ECO81, ECO82, ECO84, ECO85. Zero veteran trees. • CLvl not exceeded. Negligible impacts. The Proposed Scheme does not contribute to adverse impacts. Eighteen transects: ECO12, ECO23, ECO26, ECO30, ECO31, ECO42, ECO48, ECO61, ECO64, ECO66, ECO67, ECO70, ECO75, ECO77, ECO78, ECO80, ECO87, ECO88, ECO89. Twenty veteran trees: 5, 27, 29, 30, 31, 33, 42, 44, 46, 48, 50, 51, 54, 55, 58, 61, 66, 68, 70, 72. **In-combination impacts on NH_3 (CLvl = 1µg/m^3 for sites with lichen and bryophytes, or 3µg/m^3 for sites with higher plants only)** • CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. No beneficial impacts. Twenty-seven transects: ECO2, ECO7, ECO8, ECO13, ECO16, ECO18, ECO25, ECO28, ECO34, ECO35, ECO37, ECO38, ECO39, ECO53, ECO54, ECO55, ECO60, ECO62, ECO63, ECO71, ECO72, ECO73, ECO79, ECO81, ECO82, ECO84, ECO85, ECO86. Thirty-five veteran trees: 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, 38, 39, 41, 43, 45, 47, 56, 60, 71. • CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. No beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. Thirteen transects: ECO1, ECO8, ECO36, ECO48, ECO67, ECO70, ECO76, ECO77, ECO78, ECO80, ECO87, ECO88, ECO89. Six veteran tres: 42, 44, 55, 57, 58, 70. • CLvl exceeded but no increases above 1% of CLvl. Negligible adverse impacts. Some beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. Four transects: ECO65, ECO69, ECO74, ECO75. Zero veteran trees. • CLvl exceeded but no increases above 1% of CLvl. Negligible adverse impacts. No beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. One transect: ECO64. Six veteran trees: 33, 37, 49, 50, 65, 72. • CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. Some beneficial impacts. Three transects: ECO3, ECO21, ECO83. Zero veteran trees. • CLvl exceeded but no increases above 1% of CLvl. No adverse impacts. Some beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. Seven transects: ECO30, ECO31, ECO42, ECO50, ECO61, ECO66, ECO68. Seventeen veteran trees:5, 27, 29, 30, 31, 34, 40, 46, 48, 51, 59, 61, 64, 66, 67, 68, 73. • CLvl exceeded but no increases above 1% of CLvl. Negligible adverse impacts. No beneficial impacts. One transect: ECO17. Three veteran tree: 32, 62, 63. • CLvl exceeded but no increases above 1% of CLvl. No adverse impacts. No beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. Two transects: ECO12, ECO23. Four veteran trees: 35, 36, 52, 54. • CLvl exceeded but no increases above 1% of CLvl. No adverse impacts. No beneficial impacts. Zero transects. One veteran tree: 69. • CLvl exceeded but no increases above 1% of CLvl. No adverse impacts. Some beneficial impacts. Zero transects. One veteran tree: 53. • CLvl not exceeded. Negligible impacts. The Proposed Scheme does not contribute to adverse impacts. One transect: ECO26. Zero veteran trees. **In-combination impacts on nitrogen deposition** • Lower CLd exceeded and increases above 1% of lower CLd. Adverse impacts are not negligible. Some beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. One transect: ECO69. Zero veteran trees. • Lower CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. No beneficial impacts. Thirty transects: ECO2, ECO7, ECO8, ECO13, ECO16, ECO17, ECO18, ECO25, ECO28, ECO34, ECO35, ECO37, ECO38, ECO39, ECO53, ECO54, ECO55, ECO60, ECO62, ECO63, ECO71, ECO72, ECO73, ECO79, ECO81, ECO82, ECO84, ECO85, ECO86. Thirty-eight veteran trees: 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, 32, 38, 39, 41, 43, 45, 47, 56, 57, 60, 63, 71. • Lower CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. No beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. Eleven transects: ECO1, ECO48, ECO67, ECO70, ECO76, ECO77, ECO78, ECO80, ECO87, ECO88, ECO89. Five veteran trees: 42, 44, 55, 58, 70. • Lower CLvl exceeded and increases above 1% of CLvl. Adverse impacts are not negligible. Some beneficial impacts. Four transects: ECO3, ECO21, ECO65, ECO83. Zero veteran trees. • Lower CLd exceeded but no increases above 1% of lower CLd. Negligible adverse impacts. No beneficial impacts. Zero transects. Three veteran trees: 62, 65, 69. • Lower CLd exceeded but no increases above 1% of lower CLd. Negligible adverse impacts. No beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. Four transects: ECO12, ECO23, ECO26, ECO64. Seven veteran trees: 33, 35, 36, 37, 49, 50, 72. • Lower CLd exceeded but no increases above 1% of lower CLd. Negligible adverse impacts. Some beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. Two transect: ECO68, ECO75. Zero veteran trees. • Lower CLd exceeded but no increases above 1% of lower CLd. No adverse impacts. Some beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. Six transects: ECO30, ECO31, ECO42, ECO50, ECO61, ECO66. Eighteen veteran trees: 5, 27, 29, 30, 31, 34, 40, 46, 48, 51, 54, 59, 61, 64, 66, 67, 68, 73. • Lower CLd exceeded but no increases above 1% of lower CLd. No adverse impacts. Some beneficial impacts. Zero transects. One veteran tree: 53. • Lower CLd exceeded but no increases above 1% of lower CLd. No adverse impacts. No beneficial impacts. The Proposed Scheme does not contribute to adverse impacts. Zero transects. One veteran tree: 52. • Lower CLd exceeded but no increases above 1% of lower CLd. Negligible adverse impacts. Some beneficial impacts. One transect: ECO74. Zero veteran trees.
Additional mitigation	Refer to **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00)

Item	**Description**
Residual effects and monitoring	Refer to **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00)

In-combination climate change impacts

6.6.14 Climate change will affect weather patterns which will in-turn affect the distribution and levels of air pollutants. Although it is not practicable to quantify how climate change may affect the findings presented in this chapter, it is considered that the influence of climate change is unlikely to substantially affect the findings of this assessment within the timeframe considered.

6.6.15 The Royal Society's report on 'Effects of net-zero policies and climate change on air quality' (Ref. 6.21) examines how climate change itself is expected to affect air quality in the UK by influencing emissions, atmospheric processing and transport of many pollutants. Some of these effects are likely to slow or temporarily reverse improvements in air quality. They are also likely to lead to changes in the seasonal and geographical variations in air quality. For example, pollution events associated with secondary pollutants such as ozone and particulate matter are likely to become more common in summer months with more frequent intense heatwaves. Conversely, pollution events in warmer winter months may reduce as stable atmospheric conditions under which pollution levels build up become less frequent.

6.6.16 The report also sets out how the changing climate, and the net zero measures adopted to limit further warming, can affect air quality. Net zero measures will generally compliment measures being implemented through legislation and policy to improve local air quality, with progressive reductions in vehicle exhaust emissions of NOx and particulate matter (PM_{10} and $PM_{2.5}$) expected to continue for the foreseeable future.

6.6.17 The Royal Society's report also discusses possible mitigation measures that could be considered alongside net zero measures to limit negative effects on air quality.

6.6.18 Assuming the worst case, in the absence of large reductions in NH_3 from agriculture, UK emissions of NH_3 are expected to grow in response to a warmer climate and will dominate nitrogen deposition and effects on ecosystems and contribute substantially to human health effects (due to

secondary particulate formation) through to 2050. This has been reflected in the air quality assessment as far as is possible by assuming the 'business as usual' scenario for background NH_3 concentrations as set out in the Joint Nature Conservation Committee's Nitrogen Futures report (Ref. 6.22). This scenario assumes that emissions steadily increase. The air quality modelling undertaken for the assessment has also assumed vehicle emissions factors which predict higher NH_3 emissions in the future compared to the present day (see **'Environmental Statement Chapter 6: Air Quality - Appendix 6.3: Operational Phase: Methodology' (Document Reference: 3.06.03)**).

6.7 Opportunities for Environmental Enhancement

6.7.1 No opportunities for enhancement have been identified.

6.8 Difficulties and Uncertainties

6.8.1 Due to A47 North Tuddenham to Easton programme delays there is some uncertainty concerning construction traffic routing. Consideration of this aspect has been considered using the best information available at the time.

6.8.2 The dispersion model software used in this assessment simulates complex real-world processes in necessarily simplified terms and as such there will always be some uncertainty in the predictions. This is minimised as far as possible by the software developer regularly upgrading and testing (validating) model algorithms to improve predictive ability. Additionally, dispersion modelling relies on input data that are generated by actual measurement (such as meteorological data) or modelling (such as traffic data) with some degree of inherent uncertainty.

6.8.3 For the modelling with ADMS-Roads, to minimise the degree of uncertainty as far as possible, base year model predictions have been verified against roadside monitoring data, with adjustment to compensate for systematic under-estimation of pollutant concentrations. This process can never eliminate uncertainty entirely from subsequent adjusted model predictions but does ensure that the assessment undertaken is as robust as possible.

6.8.4 As explained in **Section 6.1.8**, due to limited Defra projections, the vehicle emissions factors and background pollution data used in this assessment are not forecast beyond 2030. The impacts that are reported in this chapter for 2029 (human and ecological receptors) and 2044 (ecological receptors only) therefore don't account for any improvements in air quality that would occur after 2030. In this respect, the air quality assessment is conservative.

6.9 Summary

6.9.1 **Table 6-19** provides a summary of the findings of the assessment.

Table 6-19 Summary of air quality effects

Key to table:
P / T = Permanent or Temporary, D / I = Direct or Indirect, ST / MT / LT = Short Term, Medium Term or Long Term, N/A = Not Applicable

Receptors	Potential Effects	Additional Mitigation	Residual Effects	Monitoring
Construction Phase (dust) There are 158 residential properties (human receptors), 15 designated sites and 34 veteran trees within the Study Area. The designated sites include: the River Wensum SAC and SSSI; Attlebridge Hills CWS; Wensum Pastures CWS; Wensum Pastures at Morton Hall CWS; Broom & Spring Hills CWS; Mouse Wood AW and CWS; Gravel Pit Plantation and Church Hill CWS; Weston Meadow and Common Meadow Carr CWS; Church Hill Common CWS; Fakenham Road CWS; Primrose Grove AW; Foxburrow plantation CWS; and Old Covert Wood CWS.	The dust risk potential for the Proposed Scheme is 'large'.	The construction contractor would be required use Best Practicable Means to mitigate potential dust impacts. The requirements are set out in the **OCEMP** (Document Reference: 3.03.01).	Negligible (not significant) T / D / ST	The construction contractor would be required to routinely monitor the effectiveness of dust mitigation by undertaking and recording regular visual inspections during dry conditions. This requirement is set out in the OCEMP.
Construction Phase (traffic emissions) There are seven residential properties (human receptors) within 200m of ARN links including: Rectory Farm off Marl Hill Road (128m from the road), Street Farmhouse on Fakenham Road at the junction with Marl Hill Road (15m from the junction), and five residential properties on Fakenham Road to the north of the junction with Marl Hill Road (between 45m and 200m from the junction). There are two designated sites and six veteran trees within 200m of ARN links. The designated sites include: Attlebridge Hills CWS (150m from the A1270), and Walsingham Plantation CWS (150m from the A1270). The veteran trees include: 4 (120m from Ringland Lane), 5 (60m from the junction of Ringland Lane and Marl Hill Rd), 72 (177m from Marl Hill Rd), 38 (165m from A1270), 45 (195m from A1270), and 71 (145m from A1270).	Changes in ambient concentrations of air pollutants. All impacts are likely to be negligible.	The construction contractor would be required to control vehicle emissions as set out in the **OCEMP** (Document Reference: 3.03.01).	Negligible (not significant) in relation to human receptors T / D / ST For ecological receptors refer to **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00)	None for human receptors. For ecological receptors refer to **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00)

Receptors	Potential Effects	Additional Mitigation	Residual Effects	Monitoring
Operational Phase (traffic emissions) Human receptors (residential properties)	Changes in ambient concentrations of NO_2, PM_{10} and $PM_{2.5}$. All impacts (adverse and beneficial) are predicted to be negligible.	None.	Negligible (not significant) P / D / LT	None
Operational Phase (traffic emission) Ecological receptors	Changes in ambient concentrations of NOx and NH_3, and nitrogen deposition. Beneficial and adverse impacts have been predicted.	Refer to **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00)	Refer to **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00)	Refer to **Environmental Statement Chapter 10: Biodiversity** (Document Reference: 3.10.00)

6.10 References

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