A47 Blofield to North Burlingham Dualling

Scheme Number: TR010040

Volume 6
6.1 Environmental Statement
Chapter 5 – Air Quality

APFP Regulation 5(2)(a)

Planning Act 2008

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

December 2020

Infrastructure Planning

Planning Act 2008

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

A47 Blofield to North Burlingham Development Consent Order 202[x]

CHAPTER 5
AIR QUALITY

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5. Air quality

5.1. Introduction

5.1.1. Air quality is a consideration when the introduction of a scheme results in a change of emissions in the air. Air quality is assessed by measuring concentrations of select pollutants in the air, and the impact these pollutants have on sensitive receptor locations at relevant human and ecological exposure. These pollutants include nitrogen oxides (NO_x) nitrogen dioxide (NO_2) and particulate matters (PM_{10} and $PM_{2.5}$), all which originate from vehicle exhaust emissions.

5.1.2. As part of the Environmental Impact Assessment (EIA) process, this Environmental Assessment Report (EAR) chapter reports the potential significant effects for Air Quality as a result of the Proposed Scheme. This assessment includes a review of the existing baseline conditions and considers the potential impacts of air quality associated with the Proposed Scheme on human health and ecosystems. Proportionate mitigation and enhancement have also been identified.

5.1.3. The approach to this assessment follows the Scoping Report (February 2018) and subsequent issued Scoping Opinion (March 2018) (**TR010040/APP/6.6**) for the Proposed Scheme. The approach follows the most up to date guidance in the Design Manual for Roads an Bridges (DMRB), LA 105 Air Quality (hereafter referred to as LA 105).

5.1.4. The main chapter text is supported by appendices 5.1 to 5.3 (**TR010040/APP/6.2**), which contain:

- 5.1 – Air quality modelling process
- 5.2 – Air quality verification and model adjustment
- 5.3 – Receptor results

5.2. Competent expert evidence

5.2.1. The competent expert is a Technical Director BSc MIES MIAQM who is the technical authority for this chapter. They have over 25 years' experience in the air quality field and have prepared multiple road traffic assessments following best practice for EIA over the length of their career.

5.3. Legislation and policy framework

5.3.1. The protection of public health is covered by the following criteria:

- Legally binding mandatory limit values set by the European Union (EU) – implemented by the Air Quality Standards Regulations 2010.

- Objectives outlined in the UK National Air Quality Strategy (NAQS) where local authorities are required to achieve the limit values set by the EU – implemented by the Air Quality (England) Regulations 2015.
- The air quality objectives relevant to this assessment are outlined in Table 5-1. The National air quality objectives (AQO) for nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$) are the same as the EU limit values.

Table 5-1 : Air quality objectives for NO_2 and PM_{10} for protection of human health

Pollutant	Air quality objectives	
	Concentration	Averaging time
NO_2	200 µg/m^3	One-hour mean concentration should not be exceeded greater than18 times a year
	40 µg/m^3	Annual mean concentration
PM_{10}	50 µg/m^3	Twenty-four-hour mean concentration should not exceed greater than 35 times a year
	40 µg/m^3	Annual mean concentration
$PM_{2.5}$	25 µg/m^3	Annual mean concentration
NOx	30 µg/m^3	Annual mean concentration (target value for the protection of vegetation and ecosystems)

5.3.2. Table 5-2 summarises the legislation, regulatory and policy framework applicable in this assessment and air quality.

Table 5-2 : Summary of legislation, regulatory and policy framework

Scale	Legislation or regulation	Summary
European	EU Directive on ambient air quality (2008/50/EC)	The EU directives outlines the mandatory limit values for different pollutants including NO_2 and PM_{10}, which are considered key pollutants related to traffic. The directive supersedes previous air quality directives (excluding the Fourth Daughter Directive) and outlines a new regulatory framework for $PM_{2.5}$. Member states can postpone attainment deadlines under the directive. Defra assesses and reports annually on compliance with the limit values to the European Commission. The UK is divided into 43 zones, where the status of each zone in relation to the EU limit values is determined by the maximum measured or modelled concentration of that zone. The key pollutants of concern are NO_2 and PM_{10}. Zones can achieve compliance when everywhere within the zone does not exceed the EU limit value, there are exceptions to where the EU limit value applies.
National	Part IV of the Environment Act 1995	Sets guidelines for managing and protecting air quality within the UK and for local air quality management. It requires local authorities to regularly review and assess their local air quality and identify any exceedances of the Air Quality Strategy (AQS). The AQOs only apply to locations where members of the public may be regularly exposed. Where an AQMA has been declared, it requires local authorities to prepare an air quality action plan (AQAP) describing the pollutant reducing measures which have been put in place.

Scale	Legislation or regulation	Summary
	National Planning Policy Framework (NPPF) 2019	Paragraph 181 of the NPPF states: *"Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan."*
	The National Networks National Policy Statement (NN NSP)	The NN NSP sets out planning guidance for promoters of nationally significant infrastructure projects (NSIPs), and the basis for the examination by the Examining Authority and decisions by the Secretary of State It recognises that *"increases in emissions of pollutants during the construction or operation phases of projects on the national networks can result in the worsening of local air quality (though they can also have beneficial effects on air quality, for example through reduced congestion). Increased emissions can contribute to adverse impacts on human health, on protected species and habitats."* The environmental statement for a proposed project should describe: • The existing air quality levels • Air quality forecast at the time of the Proposed Scheme opening, assuming the Proposed Scheme is not built and then taking into account the impact of the Proposed Scheme • Detail any significant air quality effects, their mitigation and any residual effects discussing both the operational and construction stages and the impacts of road traffic generated by the project. Paragraphs 5.12 and 5.13 of the NN NSP provides advice for decision makers: "*The secretary of State must give air quality considerations substantial weight where, after taking into account mitigation, a project would lead to a significant air quality impact in relation to EIA and/or where they lead to a deterioration in air quality in a zone/agglomeration."* *"the secretary of State should refuse consent where, after taking into account mitigation, the air quality impact of the Proposed Scheme will:* • *Result in a zone/agglomeration which is currently reported as being compliant with the Air Quality Directive becoming non-compliant.* • *Affect the ability of a non-compliant area to achieve compliance within the most recent timescales reported to a European Commission at the time of the decision."*
	The Air Quality Strategy (AQS)	Outlines air quality standards and objectives to protect people's health and the environment.
	The Air Quality (Standards) Regulations 2010 (SI 2010/2001)	Provides statuary backing to the UK National Air Quality Standards (AQS) in England.

Scale	Legislation or regulation	Summary
	Clean Air Strategy 2019	National strategy outlining the actions required from both the government and society to improve air quality. It includes updated goals to reduce public exposure to $PM_{2.5}$ as recommended by the World Health Organisation
	Highways England Air Quality Strategy 2017	Outlines Highways England's approach to improving air quality as part of the 2015 to 2020 Road Investment Strategy. The strategy details the following actions to improve air quality: • Exploring new and innovative approaches to improve air quality, such as air quality barriers. • Working with key stakeholders such as DfT and Defra to develop and deliver policies to improve air quality. • Where appropriate, designing out or mitigating poor air quality for Highways England road schemes. • Improving air quality monitoring across the Highways England road network for example by installing 50 new continuous air quality monitoring stations. • Working to optimise use of the road network for example by informing customers of alternative routes for journeys to avoid sensitive area.
	UK Plan for Tackling Roadside Nitrogen Dioxide Concentrations 2017	This plan details the government's plan to reduce NO_2 concentrations within statutory limits within the shortest possible time. The plan identifies several local authorities with exceedances of the NO_2 objective and requires them to undertake a local assessment to consider the best options to achieve compliance.
Local	Development Management DPD 2015 – Broadland District Council	The Development Management Development Plan Document (DPD) is a local plan in accordance with the Town and Country Planning England Regulations 2012. It incorporates the Broadland Development Plan and sets out policies that are to be applied throughout the Broadland planning area. The local plan contains the following policy, Policy EN4: Pollution and states: *"Development proposals will be expected to include an assessment of the extent of potential pollution. Where pollution may be an issue, adequate mitigation measures will be required. Development will only be permitted where there will be no significant adverse impact upon amenity, human health or the natural environment*."

5.4. Assessment methodology

5.4.1. This section describes the methodology which has been used for the assessment of air quality for both the construction and operational phase of the Proposed Scheme. The assessment methodology for the air quality assessment is based on the following guidance:

- DMRB LA 105 Air Quality published by Highways England, November 2019 now superseded by HA207/07 and corresponding IANs
- The Department for Environment, Food and Rural Affairs' (DEFRA) Local Air Quality Management (LAQM) technical guidance (hereafter referred to as LAQM.TG(16))

5.4.2. The level of assessment was identified using guidance given in LA 105. The level of assessment is based on the risk potential of the project with the sensitvity of

the receiving environment. The project's risk potential was classified as high risk as the Proposed Scheme falls into the category of "major bypass and motorway junction improvements". The receiving environmental sensitivity was also classified as high due to the large numbers of human and ecological receptors identified within 50m of the roads triggering the traffic screening criteria. Based on this assessment it was determined that a detailed assessment was required.

5.4.3. Sensitive human receptor locations and designated sites within 200m of the road links triggered by the screening criteria were selected to be included in the air quality assessment. Sensitive receptors include residential properties, schools and hospitals closest to the road, junction and anticipiated to experience highest pollutant concentrations.

5.4.4. The air quality assessment, following the outlined guidance, includes:

- the discussion of existing baseline conditions
- the identification of sensitive receptors and Air Quality Management Areas (AQMA), shown on constrainsts maps
- a qualitative assessment of the effect on air quality during the construction phase
- a detailed assessment of the changes in pollutant concentrations on local air quality, including nitrogen deposition rates, during the operational phase at selected sensitive receptors
- the determination of significant air quality effects, including a compliance assessment with the EU Air Quality Directive
- the identification of mitigation measures where appropriate

Construction phase

5.4.5. Following a review of the new DMRB guidance, the construction dust methodology outlined in the Scoping Opinion, which follows the Institute of Air Quality Management (IAQM) guidance on the assessment of dust from demolition and construction, has now been superseded by LA 105.

Construction dust

5.4.6. A qualitative assessment of potential dust effects was undertaken in accordance with LA 105. The assessment determined the construction dust risk potential of the proposed scheme to the receiving environment. The receiving environment sensitivity to construction dust was also determined. The appropriate measures were identified to support mitigation, outlined in section 5.9.1.

Construction traffic

5.4.7. LA 105 advises where construction activities are programmed to last less than two years, it is unlikely there will be a significant effect on air quality or affect the UK's ability to comply with the Air Quality Directive. As construction activities are

programmed to last less than two years the assessment of construction activities on traffic movements were screened out, in line with paragraph 2.60 in LA 105.

Operational phase – local air quality

Assessment scenarios

5.4.8. The local air quality assessment was undertaken using the Atmospheric Dispersion Modelling System (ADMS) Roads Dispersion modelling software (version 5.0.0.1) and focuses on concentrations of air pollutants which can have an impact at local level. The assessment considered emissions of NOx, NO_2 and PM_{10}. The key scenarios included in the assessment were:

- baseline year 2015 - for model verification
- projected base year 2025 – for long term trends assessment
- opening year without the Proposed Scheme – Do-Minimum (DM) 2025
- opening year with the Proposed Scheme – Do-Something (DS) 2025

5.4.9. Where there are no PM_{10} exceedances of the air quality annual mean objective observed in the base year, no further assessment of PM_{10} in the Do-Minimum and Do-Something scenarios is required.

5.4.10. LA 105 states that there is no need to model $PM_{2.5}$ as the UK currently meets its legal requirements for the achievement of the $PM_{2.5}$ air quality annual mean objective. However, PM_{10} concentrations will be used to demonstrate the project does not impact on the $PM_{2.5}$ air quality objectives. For comparison with the $PM_{2.5}$ air quality objective all predicted PM_{10} concentrations are assumed to be $PM_{2.5}$. Therefore, if the predicted PM_{10} concentration is less that the $PM_{2.5}$ annual mean objective it can be assumed that there will be no exceedances of the $PM_{2.5}$ air quality objective and therefore, screened out from further assessment

5.4.11. The baseline conditions were determined by reviewing air quality information in annual status reports, published by the local authorities. Information provided in these reports include historic monitoring data and current air quality concerns within the local authority. This information has allowed current baseline pollutant concentrations within the study area to be mapped.

5.4.12. These data were used to verify the model against air quality monitoring data. A model verification year of 2015 has been used in accordance with the traffic data provided for the Proposed Scheme.

5.4.13. Due to the potential for significant effects, the local air quality assessment has been undertaken for the opening year. This is when pollutants are expected to be worst-case in terms of local air quality impacts, continued improvements in emissions are expected in future years. The local air quality assessment has

compared the predicted NO_2 and PM_{10} annual mean concentrations against the relevant air quality objectives, this approach is consistent with LA 105.

Traffic data

5.4.14. Outputs from a strategic transport model developed for the Proposed Scheme have been used for this assessment. Full details of the transport model used can be found in the A47 Blofield to North Burlingham Transport Modelling Package. Data on vehicle flows, speed bands and percent HDVs were available for the following periods in the assessed scenarios:

- AM peak period (07:00 to 10:00)
- Inter-peak period (10:00 to 16:00)
- PM peak period (16:00 to 19:00)
- Off-peak period (19:00 to 07:00)

5.4.15. The hourly diurnal traffic flow characteristics were used to estimate the emissions data using the Highways England Speed Band Emissions Factors Toolkit (EFT V2.3). This spreadsheet used the hourly flows of both heavy duty vehicles (HDV) and light duty vehicles (LDV) for each time period along with speed data for each speed band category to derive the emissions data. In addition, information on road alignment, road width and local meteorological data (taken from Norwich Airport for the base year 2015) were input into the dispersion model.

Background concentrations

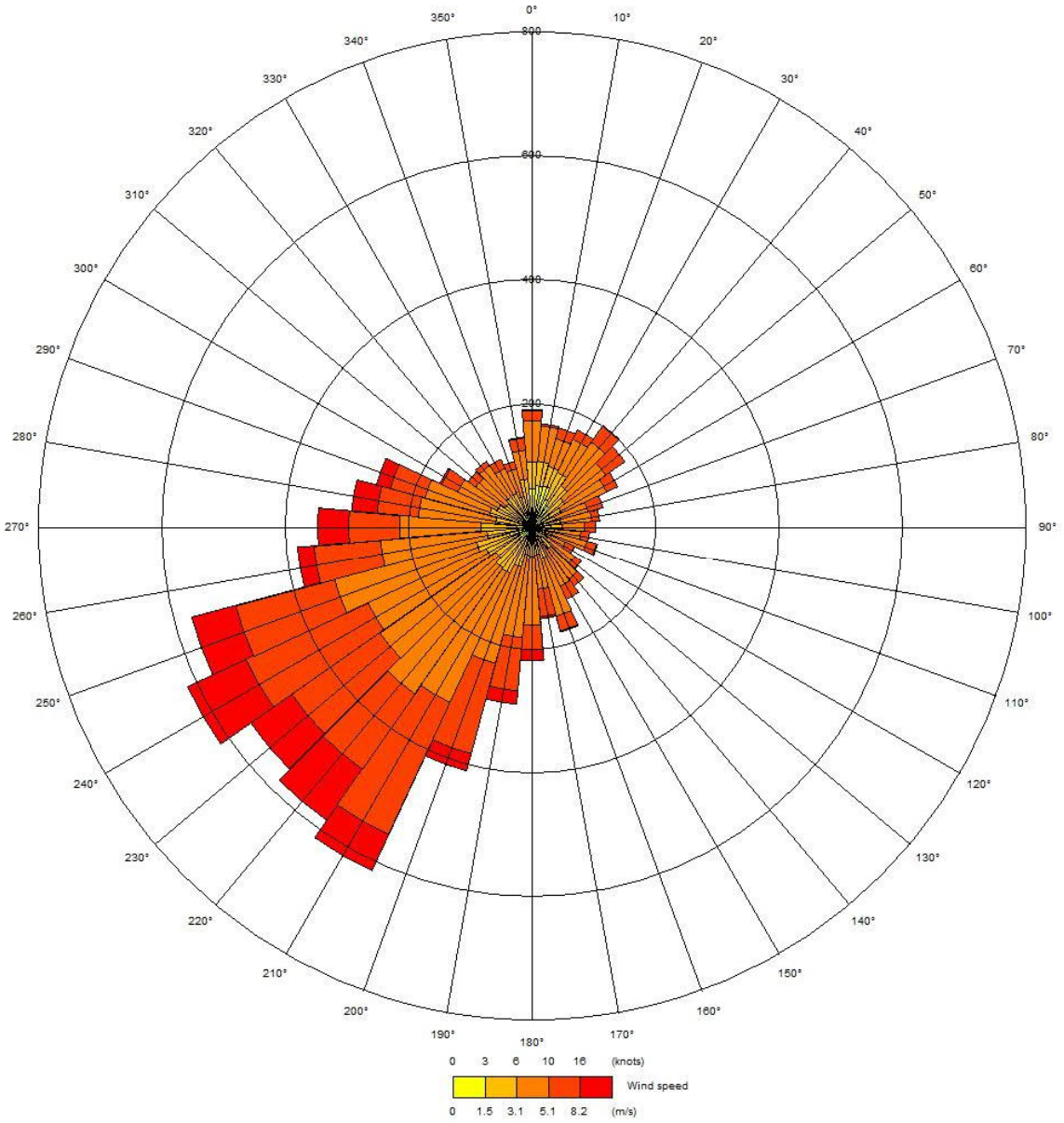
5.4.16. The results output from the air quality dispersion model estimates the contribution from road traffic emissions to annual mean concentrations of NO_x and PM_{10} at selected sensitive receptors. These concentrations are combined with background concentration estimates, to account for other sources of air pollution not being modelled. This derives a total annual mean concentration which can then be compared against the relevant air quality objective.

5.4.17. Background concentrations have been taken from Defra's background maps, further details can be found in section 5.7.16.

Met data

5.4.18. Hourly sequential meteorological data for the base year of 2015, measured at the closest meteorological site at Norwich Airport were used for the air quality assessment. The wind rose for 2015 is presented in Diagram 5-1 which highlights predominant wind directions from the west and south-west, which are associated with the highest wind speeds. For full details on the model input parameters for this study see Appendix 5.1 (Air Quality Dispersion Modelling process (**TR010040/APP/6.2**)).

Diagram 5-1: Norwich 2015 wind rose



NO_x to NO_2 conversion

5.4.19. NO_2 annual mean concentrations were derived from the modelled road NO_x concentrations using Defra's NO_x to NO_2 calculator (version 7.1.1 for HE), which was the most recent version at the time of the assessment. The Broadland District was selected as the local authority data used for the conversion, as this is where most selected receptors are located. "All UK traffic" was selected for the traffic mix.

Verification

5.4.20. The model verification process has been conducted in accordance to the guidance outlined in LAQM.TG (16). The annual mean NO_2 concentrations for the 2015 base year were verified by comparing against available monitored data.

The modelled road NO_x was compared against measured Road NOx and adjusted accordingly, in line with the guidance to account for systematic bias. The adjustment factor produced by the model verification has been applied to the modelling outputs. For full details on verification see Appendix 5.2 – Air quality verification and model adjustment (**TR010040/APP/6.2**).

5.4.21. Due to the absence of monitored PM_{10} concentrations within the study area, the adjustment factor derived from the modelled road NO_x comparison was applied to the modelled PM_{10} concentrations. This approach is consistent with the guidance outlined in LAQM TG.(16).

Long-term trends

5.4.22. To ensure that the modelled roadside NO_2 concentrations are not too optimistic and to account for uncertainties in predicted future roadside nitrogen dioxide concentrations, a process known as “gap analysis” is completed, as outlined in LA 105. An additional scenario is included within the air quality assessment to enable the gap analysis. Gap analysis is the application of adjustment factors which take into account the assumed roadside rates of reduction in NOx and NO_2 within Defra’s modelling tools when compared to observed roadside monitoring trends.

5.4.23. The additional scenario is called the projected base year and is modelled using the base year traffic data with the opening year vehicle emission factors and background concentrations. The final results for the opening year are then adjusted accordingly from the gap factors produced to reflect the long-term trend profile. The Interim Highways Agency Long Term Gap Analysis Calculator v1.1 (LTTE6) is used to produce the gap factor and adjust the opening year results.

Compliance with EU Directive on ambient air quality

5.4.24. Evaluation of compliance with EU limit values has been undertaken in accordance with guidance outlined in LA 105. Where qualifying features along each Pollution Climate Mapping (PCM) link are identified, the air quality assessment will model NO_2 concentrations for:

- the nearest qualifying feature along the PCM link where concentrations are highest
- a 4m point from the running lane in the same location as the qualifying feature to be compared against the national PCM modelled point

Update to guidance and scope of assessment

5.4.25. The scope of this assessment has been updated from the Scoping Report for the Proposed Scheme (February 2018) following changes to DMRB guidance in 2019 from HA207/07 to LA 105. A summary of these key changes has been

provided in Table 5-3. The key change is with regards to the screening criteria of how to determine an appropriate study area for the local assessment.

Table 5-3 : Update to guidance and scope of assessment

Scoping Report (old DMRB HA207/07)	Update (new DMRB LA 105)
Screening criteria for study area for local assessment: • Road alignment will change by 5m or more • Daily traffic flows will change by 1,000 Annual Average Daily Traffic (AADT) or more • Heavy duty vehicles (HDV) flows will change by 200 AADT or more • Daily average speed will change by 10km/hr or more • Peak hour speed will change by 20km/hr or more	Screening criteria for study area for local assessment: • Road alignment will change by 5m or more • Daily traffic flows will change by 1,000 Annual Average Daily Traffic (AADT) or more • Heavy duty vehicles (HDV) flows will change by 200 AADT or more • A change in speed band
Guidance from IANs published by Highways England	Now superseded by LA 105
Compliance risk assessment (outlined in IAN 175/13): • All road links which intersect the PCM model to be considered • Identify opening year NO_2 concentrations from the PCM model • Calculate total NO_2 concentrations with formula • Scheme NO_2 calculated by modelling receptors within 200m of road links intersecting PCM model • Identify any exceedances of EU limit value with increases greater than 0.4 µg/m^3 as a result of the project in the opening year	Compliance risk assessment: • Only road links which trigger the screening criteria on PCM links to be considered • Selection of nearest qualifying features to be modelled • The area 25m around junctions shall be excluded from the compliance risk assessment, irrespective of whether there are any sensitive receptors or public access within 15m of the edge of the roads within the junction. • Local model 4m point validation to compare against the national PCM modelled output • Identify any exceedances of EU limit value with increases greater than 0.4 µg/m^3 as a result of the project in the opening year
Designated site assessment: • Identify all sites sensitive to nitrogen within 200m of study area • Obtain total average nitrogen deposition for 5km grid square • Calculate NO_2 for all transects in habitats • Estimate dry deposition of NO_2 in transects • Compare deposition rates with critical loads	Designated site assessment: • Identify all sites sensitive to nitrogen within 200m of study area • Additional designated habitats to be assessed • Calculate road NO_x & NO_2 of all transects in habitats • Convert road NOx into nitrogen deposition rate • Identify if N deposition with the project is less than the applicable lower critical load • Identify if change in nitrogen deposition with and without the project is less than 1% of the lower critical load
Regional assessment	No longer required in LA 105

Consultation

5.4.26. Consultation was undertaken with Highways England to discuss the base year traffic data of 2015 and the assessment approach for the ES. It was concluded

the most recent available tools for assessment will be used in the assessment alongside the 2015 baseline traffic data.

Assessment criteria

Human health

5.4.27. LA 105 outlines guidance for evaluating significant air quality effects for a project for sensitive human receptors.

5.4.28. Only sensitive receptors where the outputs from the air quality modelling predict an exceedance in the Do-Minimum (opening year without Proposed Scheme) and / or the Do-Something (opening year with Proposed Scheme) scenario are assessed for significance. The differences in concentrations between the DM and DS scenarios, along with the numbers of receptors, are used to determine the level of significance as outlined in Table 5-4.

Table 5-4 : Judgement of significant air quality effects

Magnitude of change in concentration (µg/m^3 *)	Value of change in annual average NO_2 and PM_{10}	Total Number of receptors with:	
		Worsening of an air quality at sensitive receptor above the air quality threshold or the creation of a new exceedance	Improvement of an air quality at sensitive receptor above the air quality threshold or the removal of an existing exceedance
Large	Greater than 4 µg/m^3		
Medium	Greater than 2 µg/m^3		
Small	Greater than 0.4µg/m^3		
Total change		Sum of above	Sum of above

* Micrograms per cubic meter

5.4.29. A conclusion of no likely significant effect for human health receptors can be determined if:

- modelled concentrations for human health are less than the air quality thresholds
- the difference in the concentrations between the Do-Minimum and Do-Something scenarios are imperceptible i.e less than 1% (or 0.4 µg/m^3) of the air quality threshold

5.4.30. LA 105 outlines a framework to provide guidance on the number of receptors which might result in a significant effect for each category within the magnitude of change criteria. Should the change in concentrations be greater than 1% of the

air quality threshold then sensitive receptors will be assigned to the select criteria in Table 5-5.

Table 5-5 : Guideline to the number of properties informing a judgement of significant air quality effects

Magnitude of change in annual mean NO_2 or PM_{10} ($\mu g/m^3$)	Guideline bands for number of receptors with:	
	Worsening of an air quality objective already above the objective or the creation of a new exceedance	Improvement of an air quality objective already above the objective or the removal of an existing exceedance
Large (>4)	1 to 10	1 to 10
Medium (>2)	10 to 30	10 to 30
Small (>0.4)	30 to 60	30 to 60

5.4.31. The guidelines set out in Table 5-5 provide a guide to the change in concentrations at receptors along with the numbers of receptors affected. Consideration of both has determined whether the Proposed Scheme is likely to trigger a significant effect.

5.4.32. Where the number of properties resides between the lower an upper guideline bands for any of the magnitude of change bands, as outlined in Table 5-5, the following criteria has been used:

1. The absolute concentration at each receptor ie is the modelled concentration 40 $\mu g/m^3$ or 60 $\mu g/m^3$
2. How many receptors are there in each of the magnitude of change criteria ie doe the project create more worsening than improvements
3. The magnitude of change in concentration at each receptor e.g 0.6 $\mu g/m^3$ or 1.8 $\mu g/m^3$

5.4.33. Where the total number of receptors are greater than the upper guideline band in any of the magnitude categories the project would trigger a significant air quality effect.

5.4.34. Where the numbers of receptors are less than the guideline band for each magnitude of change then the project would not trigger a significant air quality effect for human health.

5.4.35. The air quality assessment has therefore determined the number of properties falling between the lower and upper guideline bands for any magnitude of change criteria.

5.4.36. The compliance of the Proposed Scheme with EU limit values will be assessed using guidance outlined in LA 105.

Ecological

5.4.37. Following guidance outlined in LA 105, all designated sites within 200m of the ARN sensitive to nitrogen (N) deposition have been assessed within the air quality assessment. The professional judgment of a biodiversity professional has been used to determine which habitats are sensitive to N deposition.

5.4.38. Professional judgement was used when selecting the ecological receptors. Transects were created on designated sites which are nearest roads triggering the highest change in flows. These transects represent the most sensitive location to changes in air quality concentrations and subject to the highest pollutant concentrations. A transect will be created within each qualifying designated site at 10m from roadside at the closest location within the designated site. Then at 10m intervals up to a maximum distance of 200m.

5.4.39. The impact from N deposition on the designated habits shall be completed using the outputs from the air quality modelling.

5.4.40. Where the total nitrogen deposition exceeds the lower critical load and the change in N deposition exceeds 1% of the critical load the competent biodiversity expert will use the flow diagram in Figure 2.98 of LA105 to determine if the air quality effects on the habitat are significant.

5.5. Assessment assumptions and limitations

5.5.1. Air quality modelling predictions will be based on the most reasonable, robust and representative methodologies in accordance with best practice guidance. However, there is an inherent level of uncertainty associated with model predictions:

- Uncertainties with traffic forecasts – baseline data provided was for the year 2015. This adds extra uncertainty with the data as traffic flows and background concentrations will not be representative of the current climate.
- Uncertainties with vehicle emissions predictions.
- At the time of undertaking the air quality assessment the most recently available tools were used,
- 2017 background maps were back casted to the year 2015, using a factor produced by Defra. This factor may add a margin of error to the background maps used in this assessment.
- The suitability of meteorological data.
- Simplifications made within modelling calculations or post processing of the data that represent atmospheric dispersion or chemical reactions.
- Whilst there are these uncertainties in the air quality modelling. The modelling has been verified against baseline year measurement data in

accordance with LAQM TG(16). This verification factor is applied to the baseline and Do-Minimum and Do-Something scenarios.

- The identification of sensitive receptors was based on OS Address Base Plus data. There is the possibility that these data do not contain properties which have been recently built and therefore may not been considered within the air quality assessment. All efforts were made to identify and consider such properties within the assessment.

5.6. Study area

Construction phase

5.6.1. The following criteria, outlined in LA 105, was used to determine the construction dust risk potential of the project:

Table 5-6 : Construction dust risk potential

Risk	Examples of the types of project
Large	large smart motorway projects, bypass and major motorway junction improvements.
Small	junction congestion relief project i.e. small junction improvements, signalling changes. short smart motorway projects.

5.6.2. The dust risk potential for the project was classified as large due to the nature of the improvements of the Proposed Scheme, involving major bypass and motorway junction improvements.

5.6.3. Once the construction dust risk potential has been classified, the receiving environment sensitivity was determined using the criteria outlined in Table 5-7. The receiving environment sensitivity for the project was classed as high due to the presence of receptors within 50m and 100m from construction activities. A constraints map identifying sensitive receptors within 0-50m, 50-100m and 100-200m of construction activities can be found in Figure 5-9 (TR010040/APP/6.3).

Table 5-7: Receiving environment sensitivity to construction dust

Construction dust risk potential	Distance from construction activities		
	0-50m	50-100m	100-200m
Large	High	High	Low
Small	High	Low	Low

5.6.4. The dust risk potential and receiving environment sensitivity was used to inform the measures to support the proposed mitigation.

Operational phase – local air quality

5.6.5. The location of the Proposed Scheme and key environmental constraints can be found in Figure 5-1 (**TR010040/APP/6.3**).

5.6.6. The following screening criteria, outlined in LA 105, were used to identify roads which are likely to be impacted by the Proposed Scheme. Roads which triggered the screening criteria below are required to be considered within the air quality assessment:

- An annual average daily traffic (AADT) flow change of 1,000 or more
- A heavy duty vehicle (HDV) flow change of 200 or more
- A change in speed band
- A change in carriageway alignment by greather than 5m

5.6.7. Once the road links triggering the screening criteria are identified, all adjoining roads, with modelled traffic data, within 200m are required to be selected. This forms the air quality study area and is known as the Affected road network (ARN). The ARN is shown in Figure 5-2 (**TR010040/APP/6.3**).

5.6.8. The ARN was selected from the traffic model known as the traffic reliability area (TRA). The TRA spanned a large spacial extent and covered all areas sensitive to changes in air quality appropriate for this assessment.

5.6.9. The level of assessment was identified using guidance outlined in LA 105 and the flow diagram in Figure 2.10 of LA105. The level of assessment is based on the risk of the project with the sensitvity of the receiving environment. The project's risk potential was classified as high risk as the Proposed Scheme fell into the category of "major bypass and motorway junction improvements" given in LA 105. The receiving environmental sensitivity was also classified as high due to the large number of sensitive receptors identified within 50m of the roads triggering the traffic screening criteria. Based on this assessment it was determined that a detailed assessment was required.

5.6.10. The locations which represent human exposure for each triggered link were identified. These were predominantly residential receptors, but also include hospitals and schools. The receptor locations are shown in Figure 5-3 (**TR010040/APP/6.3**).

5.6.11. All designated sites which include Special Areas of Conservation , Ramsar and Special Protection Areas (SPAs). Local wildlife sites, ancient woodland and veteran trees within 200m of the triggered links were identified. Designated sites contain features which may be sensitive to pollutants in the air which have the potential to adversley affect vegetation. The designated sites were assessed by a biodiversity professional for those sensitive to nitrogen deposition and included in

the assessment. The designated sites identified for this air quality assessment are shown in Figure 5-4 (**TR010040/APP/6.3**).

5.6.12. To model sensitive ecological receptors, a transect was created within each qualifying designated site at 10m intervals starting from the nearest point of the designated habitat from the road. The transect was modelled at a maximum distance of 200m.

5.6.13. The modelled road NO_x concentrations were converted to road NO_2 for each point along the transect, for the base, Do-Minimum and Do-Something scenarios. The road NO_2 was then converted to dry nutrient nitrogen (N) deposition rate (kg N/ha/yr) and assessed.

5.7. Baseline conditions

5.7.1. To determine the significance of an impact, it is important to outline and understand baseline conditions in and around the study area. This allows a comparison to be drawn against any potential changes in the assessment of the air quality.

5.7.2. For the purpose of this assessment, a desk-based study was undertaken where air quality data were obtained from the following sources:

- Department for Environment, Food and Rural Affairs (Defra) – LAQM 1km x 1km grid background maps
- Highways England – NOx-NO_2 calculator, Speed Band Emissions Factors EFT, LAQM back casting background factors, Interim HA long term gap analysis calculator (LTTE6)
- Broadland District Council Annual Status Reports
- Norwich City Council
- Defra Pollution Climate Mapping (PCM)
- Defra Air Quality Management Areas (AQMA) interactive map

Local air quality

5.7.3. The Proposed Scheme is located within the administrative boundary of Broadland District Council. However, the ARN spans over three administrative boundaries: Broadland District Council, Great Yarmouth Borough Council and North Norfolk District Council.

5.7.4. There are no AQMAs currently declared in Broadland District Council. The closest AQMA is located over 9.5km to the north-east, within Norwich City Centre. Norwich City Council declared the AQMA for the exceedances of the annual mean nitrogen dioxide (NO_2) objective in 2012.

Air quality monitoring

Local authority monitoring

5.7.5. For the purpose of this assessment, a baseline year of 2015 has been modelled in accordance with the baseline traffic data provided.

5.7.6. At the time of undertaking this assessment the 2019 measurement data were not yet available. For a full summary of Broadland District Council monitoring data ranging from years 2015 to 2018, please refer to Appendix 5.1 (**TR010040/APP/6.2**).

5.7.7. There were no automatic monitoring stations within Broadland District Council for the year 2015. Within Norwich there are two automatic monitoring sites. The nearest automatic site is Lakenfields and is located approximately 1km west of the ARN. This site is part of the Defra automatic and urban rural network (AURN) and classified as an urban background site. The other automatic monitoring site is Castle Meadow which is classified as a roadside monitoring site.

5.7.8. Due to the distance from the ARN and the Proposed Scheme, these automatic monitoring sites were not used within the assessment for model verification. However, they were used within the assessment for quality assurance and background concentrations. The Lakenfields urban background monitoring site was used for comparison against the Defra background maps to demonstrate the reliability of the maps in predicting the local background concentrations around the ARN. The Castle Meadow roadside monitoring location was used to undertake a co-location study for the Proposed Scheme specific monitoring. This roadside location was identified as being representative of the Blofield study area, as the locations where scheme specific monitoring was undertaken were roadside locations.

5.7.9. In 2015, Broadland District Council undertook non-automatic diffusion tube monitoring at 16 sites to assess compliance with the annual mean NO_2 air quality. There are four diffusion tubes located within the ARN and representative of the study area. The closest to the Proposed Scheme is located on Main Road next to Yarmouth Road on the A47. The other diffusion tubes are located on Dussindale Drive, Norwich Road and Cox Hill Road. There were no exceedances of the NO_2 annual mean objective in the year 2015. Full details of the local authority monitoring locations and 2015 NO_2 annual mean concentrations used within this assessment can be found in Table 5-8.

5.7.10. The monitoring outlined in Table 5-8 below was used for verification purposes, as outlined in Appendix 5.2 (**TR010040/APP/6.2**). The locations of these monitoring points can be found in Figure 5-5 (**TR010040/APP/6.3**).

Table 5-8 : 2015 Non-automatic monitoring sites

Site	Location	Site classification	National grid		2015 annual mean NO_2 concentration (µg/m^3)
			X	Y	
BN1	A47 North Burlingham	Kerbside	636268	310000	28.4
BN2	Norwich Road, Acle	Kerbside	639713	310237	18.3
BN3	Cox Hill, Beighton	Kerbside	638094	308891	13.3
BN5	Dussingdale, Thorpe	Roadside	627755	309440	20.2

Scheme specific monitoring

5.7.11. To determine the current baseline conditions around the study area, a six month nitrogen dioxide survey was conducted for the purpose of this air quality assessment. The diffusion tube survey ran from September 2019 to March 2020. This monitoring was conducted to supplement the existing monitoring in place by Broadland District Council.

5.7.12. The monitoring was measured and reported at three locations along the Proposed Scheme (two roadside and one urban background). These locations were representative of sensitive receptors and road emission sources where pollutant concentrations are high.

5.7.13. As outlined above, for quality control purposes triplicate tubes were collocated at the automatic site at Castle Meadow in Norwich, this follows LAQM TG(16) best practice. The locations of all monitoring sites in relation to the Proposed Scheme are shown in Figure 5-6 (**TR010040/APP/6.3**).

5.7.14. At the time of the modelling assessment the 2019 automatic measurements data were still provisional. These data were used with caution to bias adjust and annualise. The bias adjustment and annualization was completed in accordance with LAQM.TG(16) to provide a 2019 annual mean NO_2 concentration. The monitoring survey concluded that there were no exceedances of the annual mean NO_2 objective within the vicinity of the Proposed Scheme. The highest concentration measured within the study area was 31 µg/m^3 at Blofield 3 (located next to Norwich Road). This is well below the NO_2 annual mean objective of 40 µg/m^3. Final bias adjusted and annualised results for the monitoring survey can be found in Table 5-9. The full methodology for bias adjustment and annualisation can be found in Appendix 5.2 (**TR010040/APP/6.2**).

Table 5-9 : Diffusion tube monitoring results for 2019

Site	Location	Site classification	National grid		2019 annual mean NO_2 concentration ($\mu g/m^3$)
			X	Y	
Blofield 1	Norwich Road, A47	Roadside	637748	309895	17
Blofield 2	Main Street, North Burlingham	Urban Background	636566	310028	13
Blofield 3	Norwich Road, A47	Roadside	636921	309908	31
Colocation 1	Norwich Castle Meadow Automatic Station	Roadside	623202	308615	39(41)*
Colocation 2		Roadside	623202	308615	39 (41)
Colocation 3		Roadside	623202	308615	40 (41)

* 2019 Annual Mean recorded at Castle Meadow monitoring station provided in brackets.

5.7.15. At the time of completing the assessment 2019 measurement data had not been published. Many of the Councils have yet to publish their Annual Status Reports for 2019 measurement data due to COVID 19. At the time of the assessment the provisional data from Castle Meadow indicated that there had been a substantial decrease in annual mean NO_2 concentrations between 2018 and 2019. At this time, it was not clear if this was a localised reduction or one seen across the wider area. As the baseline assessment was 2015 there was no robust method to calculate an appropriate factor to adjust these scheme specific 2019 measurement data to a 2015 equivalent. Therefore, the Proposed Scheme specific monitoring data could not be used for model verification purposes. Full details of the model varication can be found in Appendix 5.2 (**TR010040/APP/6.2**).

Background mapping

5.7.16. Background pollutant maps provide estimates of background concentrations for specific pollutants. They are used to better understand the contribution of local sources to pollutant concentrations. Defra provides estimates of background pollution concentrations for NO_x, NO_2 and PM_{10} across the UK for each 1km grid square for every year from 2017 to 2030. Background pollution maps have been obtained from Defra for this assessment.

5.7.17. The most recent 2017 based background maps were used for this assessment. Due to a baseline year of 2015, the DEFRA background back-casting NOx factor was used to produce 2015 annual mean NOx concentrations from the 2017 based background maps. The nearest urban background monitoring site at Lakenfields was used to calculate a 2017 to 2015 back casting factor for PM_{10}

5.7.18. A comparison between the back casted 2015 background values against the concentrations recorded at the nearest urban background monitoring site at Lakenfields can be found in Table 5-10. Full details of the factor used can be found in Appendix 5.1 (**TR010040/APP/6.2**).

5.7.19. The range of background NOx and PM_{10} concentrations for the study area and around the Proposed Scheme can be found in Table 5-11. Concentrations for the base year (2015) and opening year (2025) have been presented. A more detailed breakdown of background concentrations per 1km grid square can be found in Appendix 5.1 (**TR010040/APP/6.2**).

Table 5-10 : Background concentration comparison

Grid square	NO_x (µg/m^3)		PM_{10} (µg/m^3)	
	Back-casted 2015 concentration	Measured NO_x concentration	Back-casted 2015 concentration	Measured PM_{10} concentration
623500_306500	20.0	16.0	13.3	15.0

Table 5-11 : Background mapped concentrations for baseline and opening year

Year	Range	NO_x (µg/m^3)	PM_{10} (µg/m^3)
2015	Across the study area	12.5 - 50.9	12.4 – 15.2
2025	Across the study area	9.4 – 40.4	12.1 – 15.1

Pollution Climate Mapping model

5.7.20. Defra's Pollution Climate Mapping (PCM) is used to report compliance with the EU Directive (EU directive 2008/50/EC) and provides NO_2 concentrations for several roads across the UK for a selection of futures. The PCM model projections used in the assessment were released in 2019, with a reference year of 2017.

5.7.21. To determine whether the project is at risk of compliance with the EU directive, the study area is compared with the PCM network published by Defra. There were a handful of PCM links coinciding with the study area, east of the Proposed Scheme within Great Yarmouth. In accordance with LA 105, qualifying sensitive receptors within a select distance of the PCM road links were modelled to determine whether the Proposed Scheme in place would affect the UK's ability to comply with the EU Air Quality Directive. The PCM receptors and their corresponding PCM link ID modelled in the air quality assessment can be found in Table 5-12.

5.7.22. The full PCM road network and receptors modelled can be found in Figure 5-7 (**TR010040/APP/6.3**).

Table 5-12 : Modelled PCM receptors

Modelled receptor ID	X	Y	Corresponding PCM road census ID	Road
PCM_3	652066	304907	29011	A12
PCM_4	652030	304854	29011	A12

Selected sensitive receptors

5.7.23. Sensitive receptors have been chosen following the guidance outlined in LA 105. For each scenario a mixture of residential, hospitals and schools have been chosen for this assessment. A degree of professional judgement was used when selecting the receptors, where receptors located nearest to the roads triggering the screening criteria were selected. It should be noted that for each triggered link only one receptor representing the closest receptor was chosen. These receptors were considered the most sensitive to changes in air quality concentrations, and subject to the highest road traffic emissions A summary of the number and types of receptors per scenario is detailed in Table 5-13.

Table 5-13 : Receptor summary per modelled scenario

Modelled scenario	Receptor type	Count	Total
Base - 2015	Residential	144	155
	School	5	
	Hospital	6	
DM & DS 2025	Residential	162	179
	School	11	
	Hospital	6	

5.7.24. The affected road network had a number of road links which didn't exist in the 2015 baseline. This has resulted in fewer sensitive receptors in the 2015 baseline than the 2025 DM and DS. A full detailed summary of receptor locations can be found in Appendix 5.3 (**TR010040/APP/6.2**).

Ecological receptors

5.7.25. There were three designated ecological sites identified as being sensitive to nitrogen deposition within 200m of the ARN:

- Breydon Water – SPA, Ramsar

- Broadland – SPA, Ramsar
- The Broads - SAC

5.7.26. The location of these ecological transects can be found in Figure 5-8 (**TR010040/APP/6.3**), along with the full results along each transect in Appendix 5.3 (**TR010040/APP/6.2**).

5.8. Potential impacts

5.8.1. This section presents the findings of the assessment of potential impacts on air quality.

Operation

Local air quality: human health

NO_2 results

5.8.2. This section presents the potential impacts of the Proposed Scheme on local air quality within the study area. The presentation of annual mean NO_2 concentrations include sensitive receptors along locations with the greatest change resulting with the Proposed Scheme in place. Modelled sensitive receptors can be found in Figure 5-3 (**TR010040/APP/6.3**).

5.8.3. Modelling has been undertaken using the approach outlined in LA 105, using the Interim HA Long Term Gap Analysis Calculator v1.1 (LTTE6). This approach is considered the most robust in projecting and estimating the future concentrations in 2025 and considers the uncertainty associated in long-term trends. These results have formed the basis in estimating the impact and significance of the Proposed Scheme on selected sensitive receptors, alongside determining compliance with the EU directive for annual mean NO_2 concentrations.

5.8.4. The full set of results for annual mean concentrations and the changes (increases and decreases) in NO_2 concentrations between the DM 2025 and DS 2025 opening years can be found in Appendix 5.3 (**TR010040/APP/6.2**).

5.8.5. The total annual mean NO_2 concentrations were estimated for the opening year with and without the Proposed Scheme at 179 sensitive human receptors. The NO_2 concentrations were adjusted following verification outlined in Appendix 5.2 (**TR010040/APP/6.2**). The final concentrations were compared to the AQOs to determine whether there are any exceedances.

5.8.6. There are no exceedances of the NO_2 annual mean objective at any of the selected sensitive human receptors in the opening year with and without the Proposed Scheme. Annual mean NO_2 concentrations were well below the AQO of 40 µg/m^3 across all modelled receptors in the DM 2025 and DS 2025 scenarios.

5.8.7. The maximum modelled annual mean NO_2 concentrations in the DM and DS scenario were 26.3 µg/m^3 and 26.6 µg/m^3 respectively at receptor 177, located on Ladbrook Road in Great Yarmouth next to the A47. This concentration is more representative of the area of Great Yarmouth as it is more densely populated with higher background concentrations. The receptor is also located next to a road triggering a higher level of flow change (an increase of 1689 AADT) as a result of the Proposed Scheme in place. The predicted annual mean NO_2 is well below the AQO of 40 µg/m^3.

5.8.8. The greatest increase in annual mean NO_2 concentration is predicted to occur at receptor 25 located on Yarmouth Road, next to the A47. The receptor indicates an increase in annual mean NO_2 concentrations from 14.9 µg/m^3 to 17.5 µg/m^3, an increase of 2.6 µg/m^3. This increase is as a result of the Proposed Scheme moving the new road closer to the properties by 4 meters on Yarmouth Road. This receptor is also located adjacent to a road triggering a higher level of flow change of 5322 AADT with the Proposed Scheme in place. However, the predicted annual mean concentration is well below the AQO of 40 µg/m^3 in both the DM and DS scenarios.

5.8.9. The greatest improvement in annual mean NO_2 concentrations is expected to occur at receptors 15 and 81. Receptor 15 shows a decrease in NO_2 concentrations from 8.4 µg/m^3 in the DM Scenario to 7.8 µg/m^3 in the DS scenario. Receptor 81 shows a decrease from 14.7 µg/m^3 in the DM scenario to 14.2 µg/m^3 in the DS. Both receptors are located within the village of Blofield. Receptor 15 and 81, located on Strumpshaw Road and the Street, respectively are predicted to experience a reduction in flows by over 1279 AADT for Strumpshaw Road and 1097 AADT for The Street. Resulting in an improvement in annual mean NO_2 concentrations across all modelled receptors within this area of the village of Blofield.

5.8.10. Overall, 121 of the 179 receptors are expected to show a deterioration in air quality, with 54 showing an improvement in air quality with the Proposed Scheme in place. Although a large number of receptors are showing a deterioration, the predicted air quality concentrations are well below the AQO.

5.8.11. In accordance with LAQM TG.(16) guidance, an annual mean concentration of greater than 60 µg/m^3 would indicate a possible exceedance of the one-hour objective of 200 µg/m^3. The likelihood of an exceedance of the one-hour objective is unlikely as all modelled concentrations were well below the annual mean concentration of 60 µg/m^3.

PM_{10} results

5.8.12. The PM_{10} concentrations were adjusted according to the methodology outlined in Appendix 5.2 (**TR010040/APP/6.2**). There are no predicted exceedances of the

PM_{10} annual mean AQOs in the baseline year. The highest concentration was recorded at receptor 136 at 16.6 µg/m^3. All annual mean concentrations are predicted to be well below the 40 µg/m^3 AQO. In line with LA 105, with no exceedances being reported in the baseline scenario, PM_{10} was not modelled in the Do-Minimum and Do-Something scenarios.

5.8.13. If assumed, as worst case, that all of the predicted PM_{10} concentrations are $PM_{2.5}$ for the baseline scenario at all specified receptors, this would also indicate that there would be no exceedances of the $PM_{2.5}$ air quality objective of 25 µg/m^3.

Compliance with EU limits

5.8.14. Following verification of the modelling results, the Proposed Scheme does not indicate any exceedances of the NO_2 EU limit value with any increases of greater than 0.4 µg/m^3. Although a change of greater than 10% was observed between the PCM model output and the opening year modelled values, the local 4m point validation results show there are no exceedances in the modelled opening year concentrations. It was also concluded the outputs of the projected traffic and the local air quality modelling were robust. The Proposed Scheme does not affect the UK's reported ability to comply with the Air Quality Directive in the shortest timescales possible. Full modelled results for the EU compliance risk assessment and the local 4m validation results can be found in Table 5-14 and Table 5-15

Table 5-14 : EU Compliance risk assessment results

Modelled receptor ID	Corresponding PCM road census ID	2025 modelled concentration (µg/m^3)		DM-DS	Exceedance of EU limit value? (>0.4µg/m^3)
		DM	DS		
PCM_3	29011	17.8	18.0	0.2	No
PCM_4	29011	18.4	18.6	0.3	No

Table 5-15 : Local model 4m point validation results

Modelled receptor ID	Corresponding PCM road census ID	2025 PCM model	2025 opening year modelled concentration (µg/m^3	% difference
PCM_4m_5	29011	29.2	18.1	38
PCM_4m_6			18.8	35.6

Ecological receptors

5.8.15. Of the three ecological transects modelled in the assessment, transect number 1 - Breydon Water (SPA, Ramsar) predicted annual mean NO_x concentrations

greater than the annual mean NO_x objective of 30 µg/m^3 in the Baseline, Do-Minimum and Do-Something scenarios.

5.8.16. The ecological receptors closest to the edge of the designated sites exceeded the objective in transect 1.

5.8.17. Table 5-16 details the results for the points within the transect which were closest to the road and edge of the designated sites, predicting the highest concentrations. Receptors beyond this point did not exceed the NO_x AQO of 30 µg/m^3 and have not been presented in Table 5-16. The full set of results along all transects can be found in Appendix 5.3 (**TR010040/APP/6.2**).

5.8.18. The Proposed Scheme has predicted a slight increase in annual mean NO_x concentrations at the designated site. This is largely due to the designated site being located within close proximity to the A47 in Great Yarmouth. This road will experience a high level of traffic change (an increase in AADT by 1058 vehicles) with the Proposed Scheme in place.

Table 5-16 : Ecological designated site transect results

Transect	Transect ID	Distance from road (m)	Annual mean NOx concentration (µg/m^3)			
			Base 2015	DM 2025	DS 2025	DS - DM
1 - Breydon Water SPA, Breydon Water Ramsar	Breydon_Water_01	10	**92.7**	**51.9**	**52.8**	0.9
	Breydon_Water_02	20	**64.7**	**37.6**	**38.1**	0.5
	Breydon_Water_03	30	**52.2**	**31.1**	**31.5**	0.4
	Breydon_Water_04	40	**45.5**	27.7	28.0	0.3
	Breydon_Water_05	50	**41.1**	25.5	25.8	0.3
	Breydon_Water_06	60	**38.0**	23.9	24.2	0.3

Note: Exceedances of the AQO have been highlighted in bold

Nitrogen deposition assessment

5.8.19. As exceedances of the annual mean NO_x were observed in all three modelled scenarios for Transect IDs 1 to 3, a nitrogen deposition assessment was conducted to assess whether there was potential for a significant impact to be predicted.

5.8.20. The background nitrogen deposition rates (kg N/ha/yr) were sourced from the Air Pollution Information System (APIS) website. The APIS website was used to identify which feature of the Breydon Water SPA and Ramsar habitats were the most sensitive to nitrogen deposition. The species with the lowest critical load rate for the Breydon Water SPA was used as worst case in the assessment.

5.8.21. The most sensitive site feature for Breydon Water is the Sterna hirundo (common tern). The relevant nitrogen critical load class is the coastal stable dune grasslands – acid type which has the most sensitive critical load. A summary of the background and critical load values used in this assessment is presented in Table 5-17.

Table 5-17 : Background nitrogen deposition rates and critical load values for Sterna hirundo

Site Feature	Nitrogen critical load class	Critical Load (kg N/ha/yr)	Average background nitrogen deposition rate (kg N/ha/yr)	Species sensitive to nitrogen deposition?
Sterna hirundo (common tern)	Coastal stable dune grasslands – acid type	8-10	14.3	Yes

5.8.22. The modelled road NO_x was converted to road NO_2 using the NO_x-NO_2 calculator. The following equations outlines the steps taken to obtain a total receptor nitrogen deposition rate.

$$1.\ Conversion\ rate\ for\ grassland\ and\ similar\ habitats = 0.14\ kg\frac{N}{ha}{yr}\ (obtained\ from\ LA105)$$

$$2.\ Road\ NO_2\ x\ conversion\ rate\ (0.14) = dry\ nutrient\ (N) deposition\ rate\ (kg\frac{N}{ha}{yr})$$

$$3.\ Dry\ nutrient\ (N)\ deposition\ rate + background\ nitrogen\ deposition\ rate = \boldsymbol{total\ receptor\ nitrogen\ deposition\ rate}$$

5.8.23. The total receptor nitrogen deposition rate was compared against the critical load values of the most sensitive site feature for the designated habitat. This approach is consistent with LA 105. Results for the comparison against the critical load values are presented in Table 5-18.

Table 5-18 : Comparison of total nitrogen deposition rates against the critical load

Transect receptor ID	Distance from road (m)	Total nitrogen deposition rate (kg N/ha/yr)				DM-DS as % of lower critical load
		Base 2015	DM 2025	DS 2025	DM-DS	
Breydon_Water_01	10	18.79	16.84	16.89	0.06	0.7
Breydon_Water_02	20	17.21	15.89	15.93	0.04	0.46
Breydon_Water_03	30	16.44	15.45	15.48	0.03	0.35

5.8.24. The total nitrogen deposition rate is above the lowest critical load range of eight for all three scenarios, however the change in deposition resulting from the Proposed Scheme is less than 1% of the lowest critical load value. The highest change as a percentage of the lower critical load value is 0.7%. In accordance with LA 105, no significant effects are recorded.

Assessment of significant effects

Construction

5.8.25. As construction activities are programmed to last less than two years, it is unlikely there would be a significant effect on air quality or affect the UK's ability to comply with the Air Quality Directive. The construction traffic assessment was therefore screened out of the assessment.

5.8.26. With the recommendation of best practice construction mitigation measures in place, the impact of construction dust is considered highly unlikely to trigger a significant air quality effect. Therefore, in accordance with LA 105, no significant effects on sensitive receptors have been identified.

Operation

5.8.27. There are no receptors expected to exceed the annual mean NO_2 AQO in the opening year scenarios, all modelled receptors have predicted annual mean NO_2 concentrations well below the objective. In accordance with LA 105, no significant effects on human health or ecological receptors have been identified as a result of the Proposed Scheme in place.

5.9. Design mitigation and enhancement measures

Construction

5.9.1. The construction dust assessment has concluded there are no significant effects with the Proposed Scheme for human and ecological receptors. The assessment has been used to inform the best practice mitigation measures in the environmental management plan (EMP (**TR010040/APP/7.7**)). Based on a construction dust risk potential of high for the project, the following activities are recommended to monitor the effectiveness of the proposed mitigation measures which will be included in the EMP:

1. Development of dust management plan with measures to monitor effectiveness of mitigation as part of the EMP;

2. Daily onsite and off-site inspections to be included in EMP

3. Record of complaints/exceptional dust events to be included in EMP

Air quality

5.9.2. The air quality assessment has concluded there are no significant adverse effects with the Proposed Scheme for human health and ecological receptors. With no significant effects being reported, no mitigation measures have been proposed.

5.10. Assessment of likely significant effects

5.10.1. As no significant effects have been identified in the air quality assessment, and no mitigation measures been recommended, there will not be any significant residual effects on sensitive or ecological receptors.

5.11. Monitoring

5.11.1. As no significant effects on human health and ecological receptors have been identified as a result of the Proposed Scheme in place, additional air quality monitoring is not required.

5.12. Summary

5.12.1. A detailed air quality assessment has been undertaken to assess the air quality impact during the operational phase of the Proposed Scheme.

5.12.2. A baseline desk study identified there were no AQMAs within close proximity to the Proposed Scheme. The nearest AQMA is located over 9.5km to the north-east within Norwich City Centre, declared by Norwich City Council. A review of the local monitoring data shows there are no exceedances of the annual mean NO_2 AQO. There were no monitoring sites measuring PM_{10} data within the study area. A Highways England six month monitoring study was conducted to supplement current available monitoring data and identify pollutant conditions. There were no exceedances of the annual mean NO_2 AQO observed form the monitoring study.

5.12.3. The air quality assessment predicted concentrations at all human health receptors to be well below the AQS objective of 40 µg/m^3. Overall, 121 of the 179 receptors are expected to show a deterioration in air quality, with 54 showing an improvement in air quality with the Proposed Scheme in place. Although a large number of receptors are showing a deterioration, the predicted air quality concentrations are well below the AQO with the majority of receptors indicating a small or imperceptible change.

5.12.4. The greatest increase in pollutant concentrations occurred at residential receptor number 25, located next to Yarmouth Road on the A47, with an increased concentration of 2.6 µg/m^3 once the Proposed Scheme is in place. Although this receptor showed the greatest worsening, the air quality concentrations are still well below the AQO. The change in concentration is a result of the Proposed

Scheme bringing the road alignment closer to the residential receptor, hence increasing exposure.

5.12.5. Baseline results have shown annual mean PM_{10} concentrations to be well below the AQO, with all receptors indicating an imperceptible change with the Proposed Scheme in place. As a result, PM_{10} was not included in the opening year modelling scenarios.

5.12.6. The air quality assessment included assessing compliance with the EU directive. PCM links were identified in the study area and receptors modelled. There were no PCM links where the predicted annual mean NO2 concentration was greater than the EU limit value for NO2.There were also no PCM links where the NO2 annual mean concentration increased by greater than 0.4 µg/m3 as a result of the project in the opening year, therefore no risk to the reported date of compliance.

5.12.7. There were no exceedances of the one-hour mean NO_2 AQO.

5.12.8. The air quality assessment has concluded there will be no significant effects on air quality at human and ecological receptors as a result of the Proposed Scheme.

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