

M25 junction 28 improvement scheme TR010029 6.1 Environmental Statement Chapter 5: Air quality

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



Infrastructure Planning

Planning Act 2008

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

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6.1 ENVIRONMENTAL STATEMENT CHAPTER 5: AIR QUALITY

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Executive summary

A review of baseline conditions shows that there are two Air Quality Management Areas (AQMAs) in the study area which could be affected by the Scheme. Air quality monitoring data shows that there are exceedances of the annual mean Air Quality Strategy (AQS) objective for NO₂ within the study area at roadside and kerbside sites, and within the AQMAs. PM₁₀ concentrations are below the objectives.

During construction, there is the potential for increased emissions of dust, however, with the application of appropriate mitigation measures, significant adverse effects at nearby receptors would be unlikely. Additional traffic during construction was considered unlikely to significantly adversely affect air quality, as it is not expected to meet the criteria for assessment.

During operation, the assessment showed that overall there was not considered to be a significant adverse effect on air quality. There are not expected to be any exceedances of the NO₂ annual mean AQS objective at the selected human health receptors in the opening year, both with and without the Scheme. There was expected to be a low risk of non-compliance for meeting the EU Limit Values with the Scheme.

5. Air quality

5.1 Introduction

5.1.1 This chapter reports on the results of the air quality assessment of the Scheme. It identifies and presents the existing baseline air quality conditions in the Scheme area, identifies the potential impacts on air quality associated with the Scheme on human health receptors both during construction and operation, and discusses mitigation measures that could be applied to mitigate any potentially significant adverse effects.

5.2 Competent expert evidence

5.2.1 This air quality assessment has been undertaken by a Chartered Scientist (BSc, CSci) who holds full professional membership with the Institution of Environmental Sciences and Institute of Air Quality Management. They have over 20 years of knowledge and experience in air quality assessment and have used their knowledge and professional judgement to undertake this assessment.

5.3 Legislative and policy framework

Air quality criteria

5.3.1 There are two sets of air quality criteria for the protection of public health: legally binding, mandatory limit values set by the European Union (EU); and objectives set out in the UK National Air Quality Strategy (AQS)¹, which local authorities are required to work towards achieving. The EU limit values are implemented in The Air Quality Standards Regulations 2010 (SI 2010/1001)², and the AQS objectives are implemented in The Air Quality (England) Regulations (SI 2000/928)³ and The Air Quality (England) (Amendments) Regulations (SI 2002/3043)⁴.

5.3.2 Air quality criteria relevant to the air quality assessment are summarised in Table 5.1. The criteria for nitrogen dioxide (NO₂) and particulate matter (PM₁₀ and PM_{2.5}) are the same for both the EU limit values and the AQS objectives.

Table 5.1: Relevant human health air quality criteria

Pollutant	Criteria
NO ₂	1-hour mean concentration should not exceed 200 µg/m ³ > 18 times a year
	Annual mean concentration should not exceed 40 µg/m ³
PM ₁₀	24-hour mean concentration should not exceed 50 µg/m ³ > 35 times a year
	Annual mean concentration should not exceed 40 µg/m ³
PM _{2.5}	Annual mean concentration should not exceed 25 µg/m ³

¹ DEFRA (2007) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. [Online] Available from: <https://www.gov.uk/government/publications/2010-to-2015-government-policy-environmental-quality/2010-to-2015-government-policy-environmental-quality#appendix-5-international-european-and-national-standards-for-air-quality> [Accessed 2019]

² The National Archives (2010) The Air Quality Standards Regulations 2010: [Online] Available from: <http://www.legislation.gov.uk/uksi/2010/1001/contents/made> [Accessed 2019]

³ The National Archives (2000) The Air Quality (England) Regulations 2000: [Online] Available from: <http://www.legislation.gov.uk/uksi/2000/928/contents/made> [Accessed 2019]

⁴ The National Archives (2002) The Air Quality (England) (Amended) Regulations 2002: [Online] Available from: <http://www.legislation.gov.uk/uksi/2002/3043/contents> [Accessed 2019]

Dust deposition

5.3.3 There are no national standards or guidelines for dust deposition currently set for the UK, nor by the European Union or any international organisation. This is mainly due to the difficulty in setting a standard given that dust is normally a perceptual problem rather than related to health effects. Typically, assessments use an indicative threshold for the *likelihood of complaint* for instance, in residential areas a dust deposition flux (as an average measured over a month using a passive deposition gauge) of 200 mg/m²/day or greater.

Planning policy and framework

5.3.4 Table 5.2 below summarises the legislation, regulatory and policy framework applicable to air quality. It should be noted that both of the relevant local authorities are in the process of updating their local plans.

Table 5.2: Legislation, regulatory and policy framework for air quality

Scale	Legislation/ regulation	Summary of requirements
National	National Planning Policy Framework (NPPF) 2019 ⁵	<p>Paragraph 181 of the NPPF requires local planning authorities (LPAs) to take account of air quality in plan making.</p> <p>Paragraph 181: “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 (AQMAs) 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 AQMAs and Clean Air Zones is consistent with the local air quality action plan.”</p>
	National Networks National Policy Statement (NPS NN) ⁶	<p>The NPS NN provides policy and guidance relating to the development of NSIPs. It recognises (paragraph 5.3) that increased emissions of pollutants during construction or operation of projects on national networks can contribute to adverse impacts on human health, on protected species and habitats. An ES is required for projects that may have significant air quality effects and this should describe (paragraph 5.7):</p> <ul style="list-style-type: none"> • Existing air quality levels; • Forecasts of air quality at the time of opening, assuming that the scheme is not built (the future baseline) and taking account of the impact of the scheme; and • Any significant air quality effects, their mitigation and any residual effects, distinguishing between the

⁵ MHCLG (2019) National Planning Policy Framework, Retrieved 2019 from <https://www.gov.uk/government/publications/national-planning-policy-framework--2>

⁶ DfT (2014) National Networks National Policy Statement. Retrieved 2019 from <https://www.gov.uk/government/publications/national-policy-statement-for-national-networks>

Scale	Legislation/ regulation	Summary of requirements
		<p>construction and operation stages and taking account of the impact of road traffic generated by the project.</p> <p>Paragraphs 5.11, 5.12 and 5.13 of the NN NPS require a judgement to be made as to the risk of a project affecting the UK's ability to comply with the Air Quality Directive.</p> <p>Paragraph 5.11: "Air quality considerations are likely to be particularly relevant where schemes are proposed: within or adjacent to AQMAs; roads identified as being above Limit Values or nature conservation sites; and where changes are sufficient to bring about the need for a new AQMA or change the size of an existing AQMA; or bring about changes to exceedances of the Limit Values, or where they may have the potential to impact on nature conservation sites."</p> <p>Paragraph 5.12: "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."</p> <p>Paragraph 5.13: "The Secretary of State should refuse consent where, after taking into account mitigation, the air quality impacts of the scheme will: result in a zone/agglomeration which is currently reported as being compliant; or affect the ability of a non-compliant area to achieve compliance with the most recent timescales reported to the European Commission at the time of the decision."</p>
	The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (AQS) 2007	UK legislation which sets out air quality standards and objectives, to protect people's health and the environment.
	The Air Quality (Standards) Regulations 2010 (SI 2010/2001)	English legislation which sets legally binding limit values for human health and vegetation set in Directives 2008/50/EC and 2004/107/EC on ambient air quality.
	The Air Quality (England) Regulations 2000 (SI 2000/928) and The Air Quality (England) (Amendments) Regulations (SI 2002/3043)	English legislation which sets the objectives given in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland, applicable to local air quality management.
	Environment Act 1995 (Part IV)	Legislation which sets out provisions for protecting air quality in the UK and for local air quality management. Local authorities are required to regularly review and assess local air quality and identify areas where AQS objectives may be exceeded. Where the authority has declared an AQMA, it is required to prepare an Air Quality Action Plan (AQAP) describing pollution reduction measures it will put in place.

Scale	Legislation/ regulation	Summary of requirements
	Road Investment Strategy (RIS) 2015 – 2020 and Strategic Business Plan 2015 ⁷	By 2040 DfT aspires to a network that will be sustainable with “zero breaches of air quality regulations and major reductions in carbon emissions across the network”.
	RIS2 2020 – 2025 ⁸	DfT has specified that actions for air quality during RIS2 should include “work to identify and implement measures to address NO2 exceedances on the SRN and supporting the work of local authorities to develop and implement their clean air plans, where there are interactions with the SRN.” By 2050 it is aimed that “the majority of all vehicles using the SRN, including almost all cars and vans, are zero emission at the tailpipe, transforming the impact of the SRN on air quality and carbon emissions.”
	Highways England Delivery Plan 2015-2020 ⁹	The Highways England Delivery Plan 2015-2020 identifies Highways England’s commitment to investing £75m “in a range of projects to reduce pollution and ensure the air around the network is clean and healthy”. The Highways England Delivery Plan Update 2018-2019 ¹⁰ sets out indicators that will be used to measure performance, including, of relevance to air quality, the number of air quality pilot studies completed.
	Highways England Air Quality Strategy 2017 ¹¹	Sets out Highways England’s approach to improving air quality. As part of the strategy, Highways England has identified four priority action areas; policy, planning, monitoring and operational management, and has committed to “where appropriate, design out or mitigate poor air quality for our schemes”.
	National Air Quality Plan 2017 ¹²	The UK plan for tackling roadside nitrogen dioxide concentrations which sets out the approach for meeting the statutory EU limit values for nitrogen dioxide in the shortest possible time.
	Clean Air Strategy 2019 ¹³	National strategy setting out the action that is required from across all parts of government and society to tackle air pollution and reduce emissions from transport, homes, farming and industry. It includes new goals to reduce public exposure to PM _{2.5} , as recommended by the World Health Organisation.
Regional	London Plan 2016 ¹⁴	The London Plan is the statutory Spatial Development Strategy for Greater London. Policy 7.14 Improving Air

⁷ DfT and Highways Agency (2015) Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, March 2015. Retrieved 2019 from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/408514/ris-for-2015-16-road-period-web-version.pdf

⁸ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/872252/road-investment-strategy-2-2020-2025.pdf

⁹ Highways England (2015) Highways England Delivery Plan 2015-2020. Retrieved 2019 from <https://www.gov.uk/government/publications/highways-england-delivery-plan-2015-2020>

¹⁰ Highways England (2018) Highways England Delivery Plan 2018-2019. Retrieved 2019 from <https://www.gov.uk/government/publications/highways-england-delivery-plan-update-2018-to-2019>

¹¹ Highways England (2017) Air Quality Strategy. Retrieved 2019 from <https://www.gov.uk/government/publications/highways-england-air-quality-strategy>

¹² Defra (2017) Retrieved 2019 from <https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017>

¹³ Defra (2019) Clean Air Strategy 2019. Retrieved February 2019 from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/770715/clean-air-strategy-2019.pdf

¹⁴ Greater London Authority (2016) The London Plan. Retrieved 2019 from <https://www.london.gov.uk/what-we-do/planning/london-plan/current-london-plan/london-plan-2016-pdf>

Scale	Legislation/ regulation	Summary of requirements
		Quality sets out considerations for local authorities when making development planning decisions.
	Draft New London Plan ¹⁵	The new London Plan is undergoing examination in public. Policy SI1 Improving Air Quality aims to ensure that new developments are designed and built, as far as is possible, to improve local air quality and reduce the extent to which the public are exposed to poor air quality.
Local	Brentwood Borough Council Replacement Local Plan (2005) ¹⁶	Policy CP1 General Development Criteria, point vii notes that “any development proposal would not have an unacceptable detrimental impact on health, the environment or amenity due to the release of pollutants to land, water or air (including noise, fumes, vibration, smells, smoke, ash, dust and grit)”. Policy PC6 Transport Pollution states “all new transport proposals and improvements to existing transport infrastructure and services will be assessed against their impact on air quality, noise levels and visual amenity, and will need to be designed so as to minimise any negative impacts and, where necessary incorporate reasonable and appropriate mitigation measures”.
	Brentwood Borough Council Local Plan (2019) (Draft Pre-Submission) ¹⁷	Policy SP05 Construction Management states that “during construction major development is required to minimise levels of noise, vibration, artificial light, odour, air quality, fumes or dust pollution”. Policy NE05 Air Quality covers points regarding the air quality assessment of development.
	Brentwood Borough Council Air Quality Action Plan (2008) ¹⁸	The plan describes three specific schemes to help reduce congestion including: the M25 Junction 28/A12/Brook Street improvement; Junction 27 to 30 M25 Widening; and Wilson’s Corner in Brentwood town centre. In addition, the AQAP describes general measures to be taken such as the implementation of Low Emission Zones, park and ride facilities, travel plans, freight management, and the promotion of public transport services, walking, cycling and bus priority measures. Brentwood Borough Council will also encourage Essex County Council’s Local Transport Plan that comprises the Essex Transport Strategy.
	London Borough of Havering Council Local Development Framework (2008) ¹⁹	The Core Strategy as part of the Local Development Framework contains policies relating to air quality. Core Policy 15 Environmental Management notes new development should reduce its environmental impact to ensure it does not singularly or cumulatively breach air quality targets. Policy DC52 Air Quality states that “planning permission will only be granted where new development, both singularly and cumulatively, does not cause significant harm to air quality, and does not cause a breach of the targets set in Havering’s Air Quality Management Area

¹⁵ Retrieved 2019 from <https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/draft-new-london-plan/>

¹⁶ Brentwood Borough Council (2005) <http://www.brentwood.gov.uk/blp/>

¹⁷ Brentwood Borough Council (2019) Brentwood Local Plan Pre-Submission Document. Retrieved 2019 from <http://www.brentwood.gov.uk/pdf/31012019170028000000.pdf>

¹⁸ Brentwood Borough Council (2008) Brentwood Borough Council Air Quality Action Plan. Retrieved 2019 from https://uk-air.defra.gov.uk/assets/documents/no2ten/Local_zone29_Brentwood_AQActionplan_1.pdf

¹⁹ London Borough of Havering (2008) Core Strategy and Development Control Policies Development Plan Document. Retrieved 2019 from https://www.havering.gov.uk/download/downloads/id/1632/core_strategy_development_control.pdf

Scale	Legislation/ regulation	Summary of requirements
		Action Plan. A formal assessment will be required where it is suspected that a development is likely to cause a breach of emission levels for prescribed pollutants. Where the assessment confirms a breach, planning permission will only be granted if suitable mitigation measures are put in place through conditions or legal agreement”.
	London Borough of Havering Council Local Plan (Proposed Submission Version) (2017) ²⁰	Policy 33 Air Quality notes the Council’s commitment to improve air quality in Havering thus improving the health and wellbeing of residents. Policy 34 Managing Pollution notes that the Council will support development proposals that do not unduly impact upon amenity, human health, and the natural environment by dust, and odour pollution [inter alia].
	London Borough of Havering Air Quality Action Plan 2018 - 2023 ²¹	<p>The Action Plan details four action policies with the aims of:</p> <ul style="list-style-type: none"> • Continuing to meet national objectives for 1,3-butadiene, benzene, carbon monoxide, lead and PM10. • Continue to reduce concentrations of PM10 and PM2.5. • Continue to reduce concentrations of NO2 to meet the national objective for NO2. <p>Action Policy 1 focusses on air quality monitoring and modelling.</p> <p>Action Policy 2 focusses on public health and awareness raising to encourage smarter travel.</p> <p>Action Policy 3 aims to reduce emissions from buildings and developments.</p> <p>Action Policy 4 aims to reduce emissions from transport.</p>

Table Source: Various

5.4 Study area

- 5.4.1 The air quality assessment study area is set in accordance with the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 1 HA 207/07 Air Quality²².
- 5.4.2 The air quality study area for assessing the potential effects of construction dust during the construction phase is defined as the area within 200 m of the construction site, as set out in DMRB HA 207/07 (paragraph 3.45). The Development Consent Order (DCO) boundary includes the construction areas and has been used to define the study area for construction.
- 5.4.3 The air quality study area for traffic during the operational phase is determined in accordance with traffic change criteria set out in the DMRB HA 207/07, which defines the Affected Road Network (ARN) for local air quality assessment (paragraph 3.12). An assessment is required where there are receptors identified within 200 m of the ARN.

²⁰ London Borough of Havering (2017) Havering Local Plan - Proposed Submission Version. Retrieved 2019 from https://www.havering.gov.uk/download/downloads/id/1909/lbhlp1_-_proposed_submission_local_plan_2016-2031.pdf

²¹ London Borough of Havering (2018) Air Quality Action Plan 2018-2023. Retrieved 2019 from https://drive.google.com/file/d/1bUUa5NIWmgdPw368Rex0WoaNpxVvR3_-/view

²²DfT (2007). DMRB Volume 11, Section 3, Part 1 HA 207/07 Air Quality. [Online] Available from: <http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/ha20707.pdf> [Accessed 2019]

- 5.4.4 The study area for the local air quality assessment is situated within the administrative boundaries of Brentwood Borough Council and the London Borough of Havering. It includes the area within 200 m of the Scheme extent, including the existing M25 junction 28, the M25 north and south of the junction and the A12.
- 5.4.5 The study area for local air quality during operation is provided in Figure 5.1 (application document TR010029/APP/6.2) which shows sensitive human health receptors and designated ecological sites within 200 m of the ARN where applicable. The study area for construction dust is shown in Figure 5.2.
- 5.4.6 For the regional air quality assessment, the study area includes all roads in the traffic model provided for the assessment.

5.5 Assessment methodology

- 5.5.1 The air quality assessment for the Scheme has been undertaken following the guidance given in the DMRB HA 207/07 and associated Interim Advice Notes (IANs), and includes:
1. Discussion of existing baseline conditions.
 2. Identification of sensitive receptors and AQMAs, and production of constraints maps.
 3. Qualitative assessment of the likely effect on local air quality during construction.
 4. Assessment of the likely changes in local air pollutant concentrations and nitrogen deposition rates during operation at selected receptors.
 5. Assessment of significance of the local air quality effects including an assessment of compliance with the EU Air Quality Directive.
 6. Assessment of the likely changes in regional emissions during operation.
 7. Identification of the need for mitigation measures where appropriate, and assessment of residual effects following the application of mitigation.

Existing air quality information

- 5.5.2 A summary of existing air quality information has been provided which updates the information previously collated for the Environmental Scoping Report to include the additional information for the revised study area.

Constraints map

- 5.5.3 A constraints map for the Scheme air quality study area has been produced and is shown in Figure 5.1. The constraints map includes: affected roads, 200 m boundary from affected roads, sensitive receptors, AQMA boundaries, and exceedance areas of air quality criteria (where known) with and without the Scheme.

Effects on air quality during construction

- 5.5.4 A qualitative assessment of impacts on local air quality from construction dust has been undertaken in accordance with the DMRB. The assessment has taken into account the nature of any proposed construction activities that have the

potential to generate dust and the location of sensitive receptors within 200 m of the Scheme construction works that could be at risk of being affected.

- 5.5.5 A qualitative assessment of vehicle emissions during construction as a result of additional vehicle movements travelling to and from the construction site has also been undertaken.

Effects on air quality during operation

- 5.5.6 The air quality assessment has been undertaken following the relevant guidance given in the DMRB HA 207/07 and associated IANs.

- 5.5.7 Due to the complexity of the Scheme and the potential for significant effects, a detailed local air quality assessment has been undertaken to estimate NO₂ and PM₁₀ concentrations at selected human health receptors in the Scheme opening year. The local assessment is undertaken for the opening year, rather than the design year, as this can be considered the worst year for air quality. Pollutant concentrations are likely to be lower in later years, due to continued expected improvements in emissions in future years, in accordance with the DMRB HA 207/07 (paragraph 3.6).

- 5.5.8 A detailed level of assessment has been undertaken for regional emissions of oxides of nitrogen (NO_x), PM₁₀ and carbon dioxide (CO₂) for the opening and design years.

- 5.5.9 PM_{2.5} is not included in the assessment as there is not considered to be a risk of the annual mean air quality criterion being exceeded. This is explained in more detail in Appendix 5.1, section 5.1 (application document TR010029/APP/6.3). Measured concentrations at nearby monitoring sites are included in the baseline conditions section for supporting information.

- 5.5.10 The key scenarios included in the assessment were:

- Base year (2015) – for model verification – local and regional assessment
- Projected base year (2022) – for long term trends assessment – local assessment only
- Opening year (2022) for both the without (Do Minimum (DM)) and with Scheme (Do Something (DS)) scenarios – local and regional assessments
- Design year (2037) DM and DS scenarios – regional assessment only

- 5.5.11 Traffic data were provided from the strategic SATURN traffic model for the air quality assessment for the Scheme to enable the ARN for the local air quality assessment to be determined.

- 5.5.12 An affected road for the purposes of a local air quality assessment is defined in DMRB HA 207/07 (paragraph 3.12) as a road that meets any of the following criteria:

- Road alignment will change by 5 m or more
- Daily traffic flows will change by 1,000 annual average daily traffic (AADT) or more
- Heavy Duty Vehicle (HDV) flows will change by 200 AADT or more
- Daily average speed will change by 10 km/hr or more
- Peak hour speed will change by 20 km/hr or more

- 5.5.13 The changes are applied to roads, rather than modelled links, and so where relevant are determined under two-way traffic conditions. The affected roads are provided in Figures 5.3 to 5.7 in Volume 3. There were no roads affected by the HDV criterion.

Local air quality

- 5.5.14 The local air quality assessment was undertaken using the Atmospheric Dispersion Modelling System (ADMS) Roads dispersion modelling software (version 4.1.1.0). This is a dispersion model commonly used in the UK for the assessment of proposed developments. As the study area was contained to the immediate vicinity of junction 28, all sensitive receptors were included in the local air quality assessment, including those receptors considered for short-term impacts. The local authorities within the air quality study area were also contacted to discuss if there were any receptors required to be included within the air quality assessment. Receptors are provided in Appendix 5.1, section 5.2, and shown in Figure 5.8 and discussed further in section 5.7 below.
- 5.5.15 The hourly emissions data input to the dispersion model were estimated using Highways England speed band emission factors (based on Department for Environment, Food and Rural Affairs (Defra's) Emissions Factors Toolkit v8²³), hourly flows of Light Duty Vehicles (LDV) and HDV, during am, inter, pm and off peak periods, and speeds input as a speed category, as determined in accordance with IAN 185/15 on speed banding. In addition, information on road alignment, road width and local meteorological data (taken from London City Airport for the base year 2015) were input into the dispersion model.

Traffic conditions

- 5.5.16 Traffic data were supplied in spreadsheet format in accordance with the Major Projects' Instructions (MPI)-29-082014. The ADMS Roads model was set up with a unit emission rate entered into the model for each road link. To replicate the change in emissions over the course of a day, a time varying emissions file was created containing the estimated emissions for each hour. Further details of the modelling approach are provided in Appendix 5.1 (section 5.3).

Background concentrations

- 5.5.17 The output from the dispersion model provides estimates of the contribution from road traffic emissions to annual mean concentrations of NO_x and PM₁₀ at discrete receptor locations. These concentrations are then combined with estimates of background concentrations, to account for other sources of air pollution, to derive total annual mean concentrations for comparison with air quality criteria.
- 5.5.18 Background concentrations have been derived from Defra's background maps (2015 reference year) and compared with measured data at the nearest background sites to the study area, to ensure the mapped estimates are appropriate. The comparison of mapped and measured concentrations is provided in Appendix 5.1, section 5.4 which shows that the mapped estimates for NO₂ are shown to be underestimating at all sites. At seven of the eleven sites compared, the mapped concentration is within 30% of the monitored concentration. There are no monitoring sites in the vicinity of the study area

²³ Available here: <https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html>

which measure concentrations of PM₁₀ at background sites. The background mapped concentrations are therefore considered appropriate to use in the assessment, consistent with best practice and were used unadjusted. Any underestimate is taken into account during the verification process, which compares total modelled and monitored concentrations as discussed at 5.5.21.

- 5.5.19 To avoid double counting the contribution from modelled road sources, the in-square contributions from motorways, trunk roads, and primary A roads were removed from the total mapped background NO₂ concentrations, using the Defra NO₂ Adjustment for NO_x sector removal tool v6.0, November 2017.

NO_x to NO₂ conversion

- 5.5.20 Annual mean concentrations of NO₂ were derived from modelled road NO_x concentrations using the most up to date version of Defra's NO_x to NO₂ calculator at the time of the assessment (version 6.1, October 2017). The traffic mix and local authority data used for the conversion were selected according to the locations of the receptors.

Verification

- 5.5.21 The annual mean NO₂ concentrations for the base year were verified by means of comparison against available ratified monitoring data and adjusted where appropriate, with reference to Defra's LAQM.TG(16)²⁴. Further details are provided in Appendix 5.1 (section 5.5). Initially, the modelled results were found to be underestimating. A comparison of modelled and monitored road NO_x concentrations showed that an adjustment factor of 2.18 should be applied throughout the air quality study area. Once adjusted, modelled NO₂ concentrations were within 25% of the monitored concentrations at all ten sites, and within 10% of the monitored concentrations at seven of the ten sites. The model performance was considered to be acceptable in accordance with Defra's LAQM.TG(16). The model performance statistics are presented in Table 5.6 in Appendix 5.1.
- 5.5.22 In the absence of monitored PM₁₀ concentrations in the study area against which modelled concentrations could be verified, the model adjustment factor derived for modelled road NO_x was also applied to modelled PM₁₀ concentrations. This approach is suggested within LAQM.TG(16) and is considered likely to provide a conservative estimate of the contribution of modelled roads to ambient PM₁₀ concentrations.

Long term trends

- 5.5.23 To account for future year uncertainties in emission, the assessment was undertaken in accordance with IAN 170/12 v3 on the assessment of future NO_x and NO₂ projections on long term trends. Air quality assessments following the latest Defra emission factors have been considered to be overly optimistic in some cases. IAN 170/12 v3 requires that steps are taken to adjust the estimated total NO₂ concentrations from modelling, termed *gap analysis* in order to better reflect future trends. An additional scenario (projected base year) is required to enable the gap analysis to be completed. The projected base year scenario is modelled using the base year traffic data with the opening year vehicle emission

²⁴ Defra (2018) Local Air Quality Management Technical Guidance (TG16) Available at: <https://laqm.defra.gov.uk/technical-guidance/>

factors and background concentrations. The results for the opening year are then adjusted to represent the observed long-term trend profile.

- 5.5.24 Analysis of trends in annual mean NO₂ concentrations has been undertaken using the Finnish Meteorological Institute MAKESENS (v1) spreadsheet²⁵ using the annual time series data for relevant monitoring sites. The analysis identifies where there is a statistically significant trend in monitored annual mean NO₂ concentrations at sites with suitably robust data for use in the selection of long-term trend factors. In this case the analysis was carried out for all monitoring sites within the study area with sufficient data, as well as continuous monitoring sites, and diffusion tubes in background locations outside of the study area. In this case the more conservative Highways England 170/12 v3 projection factors are deemed to be the most appropriate, based on the analysis of monitoring data trend analysis as presented in Appendix 5.1 (section 5.6), which showed that within the study area the trend in concentrations at the majority of sites was flat or upward, with none of the sites showing a significant trend in concentrations. Outside of the study area the results were mixed with some sites showing an increasing trend in concentrations and others a decreasing trend, which was deemed to be significant at only one site.

Compliance with EU limit values

- 5.5.25 Evaluation of compliance with EU limit values has been undertaken in accordance with IAN 175/13, using the baseline scenario from Defra's Pollution Climate Mapping (PCM) model.

Comparison with short term objectives

- 5.5.26 Commentary on potential exceedances of the 1-hour mean NO₂ AQS objective is possible with reference to Defra's LAQM.TG(16). The guidance suggests that if annual mean concentrations of NO₂ do not exceed 60 µg/m³ then it is unlikely that hourly mean concentrations would exceed the objective for the 1-hour mean.
- 5.5.27 Defra's LAQM.TG(16) was also used to derive the number of exceedances of the 24-hour mean PM₁₀ AQS objective, of which 35 are permitted. The method is based on the relationship between the number of 24-hour exceedances of 50 µg/m³ and the annual mean concentration derived from UK Automatic Network Sites. This is described in the equation below:

Equation 5.1 – Calculation of PM₁₀ 24-hour mean exceedances

Number of exceedances of 24-hour mean of 50 µg/m³ = $-18.5 + 0.00145 * a^3 + (206/a)$

Where a = total annual mean PM₁₀ concentration

Magnitude of impact classification

- 5.5.28 Descriptors for magnitude of change in ambient concentrations of NO₂ and PM₁₀ are provided in IAN 174/13. The changes in magnitude, which are based on an assumed measure of uncertainty (MoU) of 10%, may be described as imperceptible, small, medium or large, depending on the change in concentration relative to the air quality criterion as shown in Table 5.3.

²⁵ Available at <https://en.ilmatieteenlaitos.fi/makesens>. The MAKESENS application was developed as part of the work carried out under the European Monitoring and Evaluation Programme (EMEP).

Table 5.3: Magnitude of change criteria for local air quality

Magnitude of change in concentration	Value of change in annual mean NO ₂ and PM ₁₀
Large (>4 µg/m ³)	Greater than full MoU value of 10% of the air quality objective (4 µg/m ³)
Medium (>2 to 4 µg/m ³)	Greater than half of the MoU (2 µg/m ³), but less than the full MoU (4 µg/m ³) of 10% of the air quality objective
Small (>0.4 to 2 µg/m ³)	More than 1% of the objective (0.4 µg/m ³) and less than half of the MoU i.e. 5% (2 µg/m ³). The full MoU is 10% of the air quality objective (4 µg/m ³)
Imperceptible (≤0.4 µg/m ³)	Less than or equal to 1% of objective (0.4 µg/m ³)

Significance

- 5.5.29 Evaluation of the significance of the effect of the Scheme on local air quality has been undertaken in accordance with IAN 174/13. The number of receptors that fall within the *small*, *medium* and *large* magnitude of change categories is calculated and compared to the guidelines presented in Table 5.4.
- 5.5.30 Significant air quality effects are only identified for receptors where AQS objectives are exceeded with or without the Scheme. Where the changes in concentrations are less than 1% of the AQS objective (i.e. less than 0.4 µg/m³) then the change at these receptors is considered to be *imperceptible* and can be excluded from the judgement on significance.

Table 5.4: Number of receptors constituting a significant effect for air quality

Magnitude of change in concentration	Number of receptors with	
	Worsening of air quality objective already above objective or creation of a new exceedance	Improvement of an air quality objective already above objective or the removal of an existing exceedance
Large (>4 µg/m ³)	1 to 10	1 to 10
Medium (>2 to 4 µg/m ³)	10 to 30	10 to 30
Small (>0.4 to 2 µg/m ³)	30 to 60	30 to 60

Regional emissions

- 5.5.31 The regional air quality assessment consisted of calculating annual emissions of NO_x, PM₁₀ and CO₂. Emissions were calculated for all road links in the section of traffic model provided, as these links were all considered to be within the traffic reliability area. A detailed level of assessment was undertaken, given that there are expected to be changes in peak hour speeds. The key scenarios for assessment are:

- Base year (2015)
- Opening year (2022), for both the DM and DS cases
- Design year (2037), for both the DM and DS cases

5.6 Assumptions and limitations

5.6.1 Any air quality model has inherent areas of uncertainty, including:

- The traffic data used in the air quality model
- The suitability of emissions data
- Simplifications in model algorithms and empirical relationships that are used to simulate complex physical and chemical processes in the atmosphere
- The suitability of background concentrations
- The suitability of meteorological data

5.6.2 Uncertainty associated with traffic data has been minimised by using a validated traffic model.

5.6.3 Uncertainties associated with emissions data have been minimised by using the most up to date speed-band emission factors available and by applying IAN 170/12 v3 for long term trends.

5.6.4 Uncertainties associated with model algorithms and empirical relationships have been minimised by using algorithms and relationships that have been independently validated²⁶ and judged as fit for purpose.

5.6.5 Another uncertainty is with using historical meteorological data to estimate future concentrations. The key limiting assumption is that conditions in the future will be the same as in the past; however, in reality no two years are the same. In line with best practice²³, the same year of meteorological data (consistent with the base year used for the model verification and adjustment process) has been used in future year modelling to allow any adjustments to be applied in future cases.

5.7 Baseline conditions

5.7.1 Information on existing ambient air quality i.e. baseline conditions, and identification of potential air quality constraints to the Scheme has been determined through reference to the following sources:

- AQMA mapping (Defra, 2018)²⁷
- Defra's PCM model data for the latest available base year (2015)²⁸
- Highways England project specific NO₂ diffusion tube survey data
- Local Authority LAQM Reports (London Borough of Havering, 2017 Brentwood Borough Council 2017²⁹)

²⁶ <http://www.cerc.co.uk/environmental-software/model-validation.html>

²⁷ <http://uk-air.defra.gov.uk/aqma/maps>, accessed September 2017

²⁸ <http://uk-air.defra.gov.uk/data/gis-mapping>, accessed 04/09/17

²⁹ Supplementary monitoring data has been provided prior to the publish of the latest Brentwood LAQM Report

- Natural England (NE) MAGIC website (Natural England, 2016)³⁰ to identify boundaries of any designated ecological sites
- Ordnance Survey (OS) base mapping to identify locations of sensitive receptors (residential properties, schools, hospitals and elderly care homes)

5.7.2 Figure 5.1 shows the air quality constraints within the study area.

Pollutants

5.7.3 The air pollutants of concern in the context of the local air quality assessment for the Scheme are NO₂ and PM₁₀, as these pollutants are most likely to be present in ambient air at concentrations close to or above statutory limit values at receptors near to roads. The regional assessment of vehicle emissions associated with the Scheme considers NO_x, CO₂ and PM₁₀. PM_{2.5} is not required to be assessed as discussed in Appendix 5.1, section 5.1, however information on measured concentrations is provided in this section for information purposes. Further information on pollutants is provided below.

Nitrogen dioxide / Oxides of nitrogen

5.7.4 NO₂ is a secondary pollutant produced by the oxidation of nitric oxide (NO). NO and NO₂ are collectively termed NO_x. About a third of the UK NO_x emissions are from road transport³¹. The majority of NO_x emitted from vehicles is in the form of NO, which oxidises rapidly in the presence of ozone (O₃) to form NO₂. In high concentrations, NO₂ can affect the respiratory system and can also enhance the response to allergens in sensitive individuals. Additionally, there is increasing awareness of an association between long-term average concentrations (chronic exposure) of NO₂ and mortality. NO does not have any observable effect on human health at the range of concentrations found in ambient air. Elevated concentrations of NO_x can have an adverse effect on vegetation, including leaf or needle damage and reduced growth. Deposition of pollutants derived from oxides of nitrogen emission contribute to acidification and/or eutrophication of sensitive habitats.

Particulate matter

5.7.5 The principal sources of *primary* polluting particles are combustion processes, which include traffic and industry. Road transport produces around 12% of primary PM₁₀ emissions in the UK³², of which the majority of emissions are from diesel engines. Finer fractions of particulate matter are associated with a range of symptoms of ill health including effects on the respiratory and cardiovascular systems, on asthma and on mortality.

Carbon dioxide

5.7.6 Carbon dioxide (CO₂) is a greenhouse gas and is used as an indicator of the wider scale, non-local effects of transport schemes. Exposure to CO₂ does not affect human health or ecology at ambient levels and so is not significant as a local air pollutant but is important for its national and international role in climate change.

³⁰ <http://magic.defra.gov.uk/>

³¹ <http://naei.beis.gov.uk/data/>

³² <http://naei.beis.gov.uk/data/>

Other pollutants

- 5.7.7 National assessments³³ have demonstrated that there is no risk of exceedance of the air quality objectives set for 1,3-butadiene, benzene, carbon monoxide, lead or sulphur dioxide due to emissions from traffic anywhere in the UK. These pollutants are therefore not considered further as there is not considered to be a potential for significant effects associated with these pollutants.
- 5.7.8 In addition to these air pollutants, dust may be generated during the construction phase in areas adjacent to the Scheme and associated works areas. Dust per se is not considered as a local air pollutant but may cause a perceived loss of amenity and can give rise to soiling (dust deposition).

AQMAs

- 5.7.9 There are three AQMAs currently designated within the Brentwood Borough Council administrative area. All of these AQMAs have been declared for exceeding the annual mean NO₂ objective. The Scheme is partially located within AQMA No. 2 for Brook Street, and it is considered unlikely that the other AQMAs will be affected as they are not within 200 m of the ARN.
- 5.7.10 London Borough of Havering has declared its entire borough an AQMA for exceeding the annual mean NO₂ AQS objective and the 24-hour mean PM₁₀ AQS objective. The Scheme is also partially located within this AQMA. Details of the AQMAs within the air quality study area are provided in Table 5.5 and shown in Figure 5.1.

Table 5.5: Description of AQMAs within the air quality study area

Local authority	Name	Air quality criteria exceeded	Description
Brentwood Borough Council	AQMA No. 2	NO ₂ annual mean	The AQMA comprises parts of Brook Street, Brentwood and the A12.
London Borough of Havering	Havering AQMA	NO ₂ annual mean PM ₁₀ 24-hour mean	An area encompassing the entire Borough of Havering.

Table Source: Brentwood data from Brentwood 2018 Air Quality Annual Status Report; Havering data from Havering Air Quality Annual Status Report for 2017

Defra pollution climate mapping (PCM)

- 5.7.11 Defra's PCM model outputs are used in annual reporting to the EU regarding compliance with the limit values. This model provides estimates of roadside concentrations of pollutants, including annual mean NO₂ and PM₁₀. The modelled roadside concentration comprises a background component together with a roadside increment.
- 5.7.12 Not all roads are included within the PCM model. In the vicinity of the air quality study area, Defra's PCM model only includes the A12 east and west of junction 28, and the A1023 Brook Street.
- 5.7.13 For the NO₂ projections based on the 2015 reference year, which are used in Defra's most recent NO₂ Plan, there were roadside exceedances of the annual

³³ <https://www.gov.uk/government/publications/the-air-quality-strategy-for-england-scotland-wales-and-northern-ireland-volume-1>

mean NO₂ EU limit value of 40 µg/m³ on the A12 both east and west of junction 28, but not on the A1023. However, by the opening year, the roadside concentrations were projected to be below the EU limit value. Defra PCM links for 2015 are illustrated in Figure 5.1.

- 5.7.14 The PCM model has, however, recently been updated for the 2017 reference year. These data indicate there is still an exceedance of the annual mean NO₂ EU limit value on the A12 in 2017, however compliance should be achieved by 2019.

Air quality monitoring

- 5.7.15 Air quality monitoring data from continuous monitoring stations (CMS) and passive diffusion tubes within and close to the air quality study area are described below and shown in Figure 5.1.
- 5.7.16 Connect Plus³⁴ have measured NO₂ concentrations using diffusion tubes at a number of sites around the M25 on behalf of Highways England. The survey commenced in September 2013. One of the sites (CP7) is located close to the Scheme. The annual mean NO₂ concentrations for this monitoring site between September 2014 and 2015 are tabulated in Table 5.6. The results show that measured pollutant concentrations at site CP7 exceeded the NO₂ annual mean AQS objective during all three monitoring periods. Site CP7 is located at the junction of Brook Street (A1023) with the M25 junction 28, with relevant exposure within 50 m.

Table 5.6: Connect Plus annual mean NO₂ diffusion tube monitoring results (µg/m³)

Site ID	X	Y	Sept 2013 - Sept 2014	Sept 2014 - Sept 2015	Sept 2015 - Sept 2016
CP7	556913	192380	40.2	40.8	46.9

Table Source: Connect Plus: Maintenance and Operation Environmental Management Plan, Volume 2, Section 3, Part 1

- 5.7.17 Highways England also conducted a six month diffusion tube survey (between February and August 2016) at 25 locations near to junction 28, to inform the assessment of the Scheme. As the base year of the air quality assessment is 2015, data have been adjusted for this year accordingly. The results have been annualised, following analysis of data from three urban background continuous monitoring stations within 50 miles of the Scheme (Redbridge Ley Street, Thurrock, and Barking and Dagenham Scrattons Farm) in accordance with LAQM (TG(16)) to represent a full data capture for the year 2015. The annualised results were then adjusted using a factor of 0.91 derived from Defra's bias adjustment spreadsheet (version 09/17) for diffusion tubes prepared by Staffordshire Scientifics Group using 20% triethanolamine (TEA) in water. The results are provided in Table 5.7 and Figure 5.1. The results show that the NO₂ annual mean AQS objective of 40 µg/m³ was exceeded at two sites in 2015. Both sites (HE01 (~5 m from road edge), and HE22 (~10 m from road edge)) are located on Brook Street close to M25 junction 28 and within the Brentwood Borough Council AQMA No.2.

³⁴ <https://www.connectplusm25.co.uk/>

Table 5.7: Highways England diffusion tube monitoring results (NO₂)

Site ID	HE site ID	X	Y	Unadjusted 2016 average (Feb – Aug)	2015 adjusted average (µg/m ³)
HE01	M25J28I_001_0116	557030	192496	65.2	58.0
HE02	M25J28I_002_0116	557531	192749	43.5	36.9
HE03	M25J28I_003_0116	557043	191854	31.4	27.9
HE04	M25J28I_004_0116	557162	191987	31.7	28.2
HE05	M25J28I_005_0116	556788	191618	29.9	26.6
HE06	M25J28I_006_0116	557956	192219	26.8	23.8
HE07	M25J28I_007_0116	557001	193790	30.4	27.0
HE08	M25J28I_008_0116	555057	194239	21.0	18.9
HE09	M25J28I_009_0116	553977	194554	23.0	20.5
HE10	M25J28I_010_0116	554061	193978	31.1	27.5
HE11	M25J28I_011_0116	554371	193091	22.8	20.3
HE12	M25J28I_012_0116	554868	192605	23.5	20.9
HE13	M25J28I_013_0116	556000	191900	41.8	37.2
HE14	M25J28I_014_0116	555631	191678	40.6	36.1
HE15	M25J28I_015_0116	555801	191784	43.1	38.4
HE16	M25J28I_016_0116	557925	192992	32.1	28.6
HE17	M25J28I_017_0116	557313	190348	40.1	36.5
HE18	M25J28I_018_0116	557724	190420	27.0	24.0
HE19	M25J28I_019_0116	557744	190009	27.9	24.8
HE20	M25J28I_020_0116	555392	192385	23.5	21.0
HE21	M25J28I_021_0116	557693	193181	33.4	29.7
HE22	M25J28I_022_0116	556933	192382	50.9	45.4
HE23	M25J28I_023_0116	557416	192880	34.4	29.3
HE24	M25J28I_024_0116	557177	193141	25.6	22.6
HE25	M25J28I_025_0116	553917	191852	25.2	22.5

Values in **bold** exceed the annual mean AQS objective

Table Source: Highways England air quality monitoring data

Local Authority air quality monitoring

Continuous monitoring

5.7.18 Table 5.8 provides the annual mean NO₂ concentrations from the CMS sites within Brentwood Borough Council and London Borough of Havering between 2013 and 2018. The results show that NO₂ concentrations were below the annual mean AQS objective of 40 µg/m³ at both the Rainham CMS and Brentford Council Office CMS, however exceedances were recorded at the roadside Romford CMS in 2014 and 2017. The 1-hour mean AQS objective was met in all years at all sites.

- 5.7.19 Table 5.9 provides the annual mean PM₁₀ concentrations from the CMS in the London Borough of Havering between 2013 and 2018.
- 5.7.20 Table 5.10 shows the number of exceedances of 24-hour mean PM₁₀ standard at the CMS in London Borough of Havering between 2013 and 2018. PM₁₀ concentrations were below both the annual mean and daily mean AQS objectives in all years at both sites.

Table 5.8: Annual mean NO₂ concentrations from continuous monitoring stations (µg/m³), 2013 – 2018

Site ID	Local Authority	Site type	X, Y	2013	2014	2015	2016	2017	2018
BRW1 Council Office	Brentwood Borough Council	Urban Background	559860, 193617	25.0	22.5	24.0	24.5	22.2	Site closed
HV1 Rainham	London Borough of Havering	Roadside	553127, 182506	30.2	35.3	32.0	34.0	34.3	30.0
HV3 Romford	London Borough of Havering	Roadside	551108, 188257	34.0	57.5*	35.0	38.0	40.0	38.0

* Data capture below 75%

Exceedances of annual mean NO₂ UK AQS objective are highlighted in bold

Table Source: Brentwood Borough Council, 2018 Air Quality Annual Status Report (ASR), London Borough of Havering, Havering Air Quality Annual Status Report for 2018, plus email communication with environmental health officers at each local authority.

Table 5.9: Annual mean PM₁₀ monitoring results (µg/m³), 2013 – 2018

Site ID	Local authority	Site type	X, Y	2013	2014	2015	2016	2017	2018
HV1 Rainham	London Borough of Havering	Roadside	553127, 182506	-	19	18	19	18	17
HV3 Romford	London Borough of Havering	Roadside	551108, 188257	24	25	24	15	19	20

- Data not available / monitoring not undertaken

Table Source: London Borough of Havering, 2018, Havering Air Quality Annual Status Report for 2017

Table 5.10: Number of exceedances of 24-hour mean PM₁₀ standard 2013 – 2018

Site ID	Local authority	Site type	X, Y	2013	2014	2015	2016	2017	2018
HV1 Rainham	London Borough of Havering	Roadside	553127, 182506	-	3	3	6	4	1
HV3 Romford	London Borough of Havering	Roadside	551108, 188257	6	11	9	5	-	2

Site ID	Local authority	Site type	X, Y	2013	2014	2015	2016	2017	2018
- Data not available / monitoring not undertaken									

Table Source: London Borough of Havering, 2018, Havering Air Quality Annual Status Report for 2017

5.7.21 Table 5.11 provides the annual mean PM_{2.5} concentrations between 2013 and 2018 from the CMS in London Borough of Havering located approximately 10 km from the Scheme. PM_{2.5} concentrations were below the annual mean AQS objective of 25 µg/m³ in all years for which data was available.

Table 5.11: Annual mean PM_{2.5} monitoring results (µg/m³), 2013 – 2018

Site ID	Local authority	Site type	X, Y	2013	2014	2015	2016	2017	2018
HV1 Rainham	London Borough of Havering	Roadside	553127, 182506	-	12	11	12	12	11
- Data not available / monitoring not undertaken									

Passive monitoring

5.7.22 Passive monitoring of NO₂ using diffusion tubes is undertaken by both local authorities. A summary of the Brentwood Borough Council monitoring data from 2013 to 2018 (where available) at sites within the air quality study area are presented in Table 5.12 and Figure 5.1. There are no monitoring sites within London Borough of Havering which are located within the air quality study area. Annual mean NO₂ concentrations exceeded the AQS objective of 40 µg/m³ at one site (BRW 5) located between the A12 westbound off-slip and Brook Street, although this is a roadside site and not representative of exposure.

Table 5.12: Bias adjusted annual mean NO₂ diffusion tube monitoring results (µg/m³) within the air quality study area

Site ID	Site type	X, Y coords	2013	2014	2015	2016	2017	2018
Brentwood Borough Council								
BRW 5	Roadside	556887,192412	45.9	40.0	42.7	46.0	47.0	39.6
BRW 6	Roadside	557014,192493	37.7	33.1	38.1	39.3	37.6	34.2
BRW 7	Roadside	557118,191978	27.5	24.5	26.0	26.6	29.6	25.2
BRW 16	Urban Background	557379,192900	32.5	26.7	27.2	29.1	31.4	28.1
BRW 32	Urban Background	556964,192288	34.9	30.0	32.6	33.1	35.8	29.7
Values in bold exceed the annual mean AQS objective								

Table Source: Brentwood Borough Council, 2018, 2018 Air Quality Annual Status Report (ASR), and email communication with the environmental health officer.

Receptors

5.7.23 Receptors that are potentially sensitive to changes in air quality are defined in DMRB HA 207/07 as housing, schools, hospitals and designated species or habitats within sites designated for their ecological value, located within 200 m of the ARN.

- 5.7.24 It is best practice, in accordance with DMRB guidance to select human health receptors which are expected to have the largest changes in pollutant concentrations, as well as those likely to have the highest concentrations. These include those receptors closest to the roads affected by the Scheme, those that are representative of large numbers of properties, those that house the young, the elderly and other susceptible populations, as well as those near junctions, or locations with queuing traffic.
- 5.7.25 The receptors selected for assessment are provided in Appendix 5.1, section 5.2, and include all sensitive receptors within the study area, including those near M25 junction 28 and in the Havering AQMA, and Brentwood AQMA No. 2. Additional receptors selected at the request of stakeholders included Putwell Bridge Farm, Grove Farm, the Caravan Park, Putwell Bridge (south west of junction 28) and Maylands Golf Club.
- 5.7.26 There are no designated ecological sites within the air quality study area. No additional ecological receptors were requested for assessment by the local authorities during consultation.

5.8 Potential impacts

- 5.8.1 The Scheme has the potential to affect local air quality, both during construction and once in operation. Any effect during construction would be temporary.

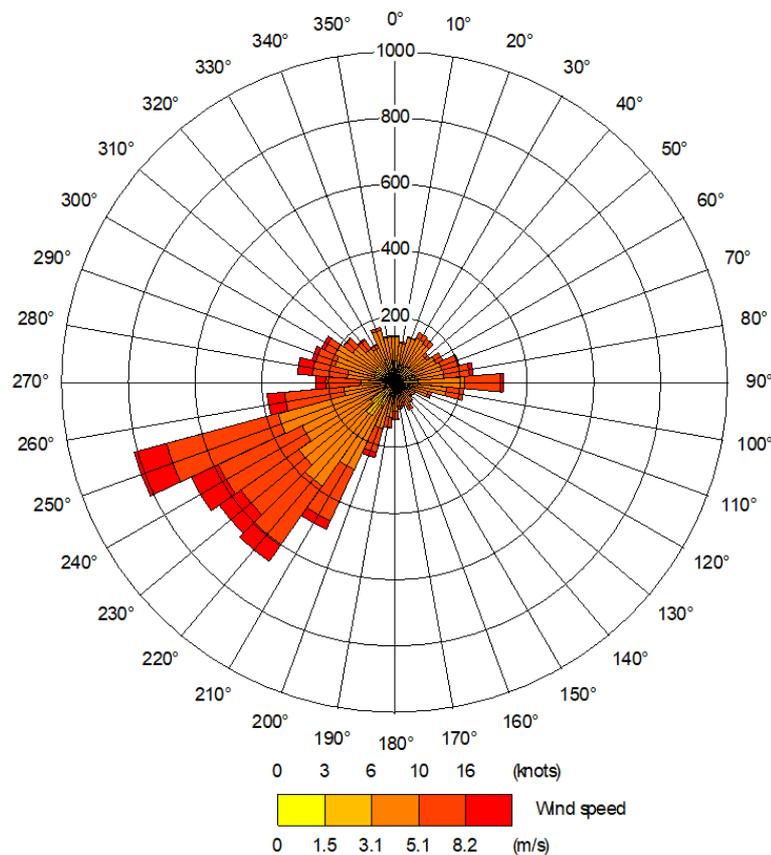
Construction

Dust emissions

- 5.8.2 There is the potential for elevated dust deposition and soiling at properties within 200 m of the DCO boundary as a consequence of the works, if dust raising activities are not effectively controlled and mitigated. The level and distribution of dust emissions would vary according to the duration and location of activity, weather conditions, and the effectiveness of suppression measures.
- 5.8.3 The main site compound will be located to the west of junction 28 and will be accessed from the A12. A satellite compound will be located to the west of the M25 north of junction 28.
- 5.8.4 Receptors within 200 m of the DCO boundary are shown in Figure 5.2. The Scheme has the potential for construction dust to affect approximately 460 receptors, the majority of which are located near the A12 at the eastern and western extents of the Scheme. There is one receptor representing the Caravan Park, Putwell Bridge (south west of junction 28) and one receptor to represent the part of Maylands Golf Club covering the 1st and 2nd holes. There are no designated ecological sites within 200 m of the DCO boundary, although there are parcels of Ancient Woodland which could be affected including: the Lower Vicarage Ancient Woodland site located to the north east of junction 28; Jacksons Wood and Coombegreen Wood located over 1.5 km to the south of junction 28; and The Osiers site located over 1.5 km to the north of junction 28.
- 5.8.5 The prevailing winds recorded at London City Airport meteorological station (approximately 18.5 km south west of the Scheme) are from the south-west as shown in the windrose in Figure 5.1a below. The highest windspeeds are also recorded from this direction. This suggests that the wind is more likely to transport dust raised on site towards the north east of the construction works. Figure 5.2 shows the area potentially likely to be affected by construction dust.

Receptors to the north east of the construction works include properties near Brook Street, and Vicarage Wood Ancient Woodland.

Figure 5.1a: Windrose for London City Airport meteorological station (2015)



Construction traffic

- 5.8.6 An increase in vehicle movements is expected during the construction period, as a result of workers and heavy goods vehicles (HGVs) travelling to and from site. At this stage it is anticipated that the maximum number of HGV movements would be 75 per day, with all traffic expected to use trunk roads including the M25 and A12. In addition, there are expected to be workers travelling to site using cars or vans, although the numbers of LDV movements travelling to site per day are likely to be fewer than 100. These numbers of vehicles expected to travel to site would be less than both the 200 HDV per day and 1000 AADT criteria for an air quality assessment as discussed in section 5.5. Any effect at receptors can therefore be considered likely to be imperceptible.
- 5.8.7 There will be the need for occasional overnight closures of the A12 between Gallows Corner and junction 28, and of the slip roads at junction 28 to allow for installation of traffic management layouts. Diversion routes will be set up which will include the A127, M25, and A12, as necessary. Given the temporary nature of these diversion routes, they are considered unlikely to affect local air quality.

Operation

Local air quality

- 5.8.8 Concentrations were estimated for the opening year at 77 selected human health receptors. In addition, two receptors were selected for comparison with the short-term air quality criteria. Both the road NO_x and PM₁₀ concentrations were adjusted following verification, details of which are provided in Appendix 5.1, section 5.5. Concentrations of both NO₂ and PM₁₀ were compared with relevant UK AQS objectives to determine whether there were likely to be any exceedances.
- 5.8.9 Modelling has been undertaken using IAN 170/12 v3 to determine the future year concentrations. This approach is considered to be a conservative approach in accounting for the uncertainty in long-term trends and has therefore been used as the basis for determining the impact and significance of the changes and for determining compliance with the EU Air Quality Directive. Results are presented in Appendix 5.1, section 5.7. The results for changes in annual mean NO₂ concentrations at receptors using the IAN 170/12 v3 approach are provided in Figure 5.8.
- 5.8.10 There are not expected to be any exceedances of the NO₂ annual mean AQS objective at the selected human health receptors in the opening year, both with and without the Scheme. The highest estimated concentration with the Scheme in 2022 is expected to be 38.9 µg/m³.
- 5.8.11 Four receptors included within the traveller's site to the south of the A12 (R75 to R78) are expected to have a decrease in NO₂ concentrations with the Scheme, ranging between -0.5 and -1.8 µg/m³ (varying according to distance from the A12, with the greatest decrease at the location closest to the A12). This is primarily due to the A12 eastbound off-slip relocating approximately 50 m north at this location. In addition, the entrance to the slip is being shifted approximately 230 m to the west of the traveller's site, meaning traffic will be leaving the A12 before travelling past the traveller's site.
- 5.8.12 Five receptors representing buildings at Grove Farm to the north west of junction 28 (R6, R71, R72, R73 and R74) are expected to have an increase in NO₂ concentrations ranging between +0.5 to +1.0 µg/m³. These changes are primarily due to the A12 eastbound off-slip being realigned approximately 20 m closer to these buildings. In addition, the new M25 anti-clockwise off-slip loop surrounds the site and joins the A12 approximately 70 m to the south of Grove Farm.
- 5.8.13 All other receptors are expected to experience an imperceptible change (≤0.4 µg/m³) in NO₂ concentrations with the Scheme, including at locations within the AQMs.
- 5.8.14 In line with Defra's technical guidance LAQM.TG(16), there are not expected to be any receptors with exceedances of the 1-hour mean AQS objective with the Scheme, given that annual mean NO₂ concentrations at all receptor locations are estimated to be below 60 µg/m³.
- 5.8.15 There are not expected to be any exceedances of the PM₁₀ annual mean or daily mean AQS objectives. The changes in annual mean concentrations at all receptors are expected to be imperceptible.

Compliance risk assessment

- 5.8.16 Compliance with the EU Air Quality Directive has been considered using the principles in IAN 175/13 where Defra PCM model links coincide with the modelled area to aid the assessment of significance of effect.
- 5.8.17 Defra Air Quality Plans were published in 2017, which aid the consideration of compliance. The closest PCM links to the air quality study area, are the A12 east and west of junction 28 and the A1023 Brook Street. The majority of these links are located within the Eastern (UK0029) UK ambient air quality reporting zone, however parts of the A12, further west of junction 28 are included in the Greater London Urban Area (UK0001) UK ambient air quality reporting zones.
- 5.8.18 According to the PCM datasets none of the roads within the air quality study area are expected to exceed the NO₂ annual mean EU limit value in the opening year of the Scheme (2022). The maximum annual mean NO₂ concentrations for these links in the PCM model are 21.3 µg/m³ for Brook Street and 31.2 µg/m³ for the A12, which are below the EU limit value.
- 5.8.19 Using the updated 2019 projections (with a reference year of 2017) the maximum NO₂ concentration across the roads considered within the study area is projected to be 31.6 µg/m³ in the opening year (2022) for the A12. Given that the maximum increase in annual mean NO₂ concentrations at a receptor included in the assessment is 1.0 µg/m³ at receptor R72 (located at a building on Grove Farm), the highest roadside NO₂ annual mean concentration is calculated to be 32.6 µg/m³ (using the Defra PCM 2019 modelled output). This is below the EU limit value of 40 µg/m³.
- 5.8.20 The Scheme is therefore considered to be at low risk of not achieving compliance with the EU Air Quality Directive.

Regional air quality

- 5.8.21 Estimated annual emissions of NO_x, PM₁₀ and CO₂ are provided in Table 5.13.
- 5.8.22 Pollutant emissions in the opening year are expected to change with the Scheme by up to 0.1%, in line with the increase in vehicle kilometres travelled of 0.1%. In the 2037 design year, emissions are expected to increase with the Scheme by between 0.3% and 0.5% for PM₁₀ and CO₂, in line with the expected 0.2% increase in vehicle kilometres travelled. Emissions of NO_x are expected to increase with the Scheme by 1.3%, slightly above the increase in vehicle kilometres travelled as a result of an increase in traffic on the M25 northbound immediately before the new loop road and a corresponding change in speed along this section.
- 5.8.23 Emissions of NO_x and PM₁₀ are expected to decrease overall from the base year by the 2022 opening year despite an increase in total vehicle kilometres travelled, because of improvements in vehicle technology. By the 2037 design year emissions of NO_x are still expected to decrease, although emissions of PM₁₀ are expected to marginally increase compared to the base year.
- 5.8.24 Emissions of CO₂ are expected to increase by 4.0% in the opening year compared to the base year, and by 27.9% in the 2037 design year compared to the base year. This is because of an overall increase in vehicle kilometres travelled with the Scheme of 33.2%.

Table 5.13: Regional emissions results

Year	Scenario	NOx (kg/yr)	PM ₁₀ (kg/yr)	CO ₂ (t/yr)	Vehicle kms travelled/year
2015	Base	2,054,157	132,568	802,160	3,485,361,252
2022	DM	1,106,552	116,841	834,010	3,895,932,421
	DS	1,107,675	116,903	834,367	3,900,637,310
	Change with DS	+1,123	+62	+357	+4,704,889
	% Change from DM	+0.1%	+0.1%	+0.0%	+0.1%
	% Change from Base	-46.1%	-11.8%	4.0%	+11.9%
2037	DM	747,341	135,081	1,020,747	4,631,892,833
	DS	756,727	135,533	1,025,610	4,642,633,720
	Change with DS	+9,385	+452	+4,863	+10,740,887
	% Change from DM	+1.3%	+0.3%	+0.5%	+0.2%
	% Change from Base	-63.2%	+2.2%	+27.9%	+33.2%

5.9 Design, mitigation and enhancement measures

Construction

5.9.1 Mitigation measures to control dust during construction would be specified within contract documentation and incorporated into the Outline Construction Environmental Management Plan (CEMP) (application document TR010029/APP/7.2) and the Register of Environmental Actions and Commitments (REAC) (application document TR010029/APP/7.3) which in turn are secured through requirement 4 of the DCO (application document TR010029/APP/3.1). The precise measures would depend on the intended construction methods and the degree of dust generation at each site. Such measures may include but would not necessarily be limited to:

- Regular water-spraying and sweeping of unpaved and paved roads to minimise dust and remove mud and debris.
- Using wheel washes, shaker bars or rotating bristles for vehicles leaving the site where appropriate to minimise the amount of mud and debris deposited on the roads.
- Sheeting vehicles carrying dusty materials to prevent materials being blown from the vehicles whilst travelling.
- Enforcing speed limits for vehicles on unmade surfaces to minimise dust entrainment and dispersion.
- Ensuring any temporary site roads are no wider than necessary to minimise their surface area.
- Damping down of surfaces prior to their being worked.

- Storing dusty materials away from site boundaries and in appropriate containment (for example, sheeting, sacks, barrels etc.).

5.9.2 If necessary, monitoring parameters and a programme would be established.

Operation

5.9.3 As discussed in section 5.10 below, the assessment indicated that there are not expected to be any significant adverse effects with the Scheme for the human health receptors. As such no mitigation measures have been proposed.

5.10 Assessment of effects

Significant effects

Construction

5.10.1 Any adverse air quality effects due to construction will be temporary and can be suitably minimised by the application of standard and appropriate mitigation measures. On this basis, there is unlikely to be a significant effect on air quality due to the construction of the Scheme.

Operation

5.10.2 In accordance with the IAN 174/13, Table 5.14 outlines the evaluation of local air quality significance of the Scheme. None of the receptors are estimated to exceed the annual mean NO₂ air quality objective, or the PM₁₀ air quality objectives hence the Scheme is not expected to have a significant effect on human health receptors.

Table 5.14: Overall evaluation of local air quality significance

Key criteria questions	Yes/no
Is there a risk that environmental standards will be breached?	No – no receptors are expected to exceed the NO ₂ or PM ₁₀ AQS objectives either with or without the Scheme.
Will there be a large change in environmental conditions?	No - no receptors are expected to have a large increase.
Will the effect continue for a long time?	No - the change is only expected to be small which is expected to be reversible within approximately 2 to 6 years.
Will many people be affected?	No.
Is there a risk that designated sites, areas, or features will be affected?	No – there are no designated sites within 200 m of the ARN.
Will it be difficult to avoid or reduce or repair or compensate for the effect?	N/A.
On balance is the overall effect significant?	On balance, the overall effect is not expected to be significant for human health receptors. There are no receptors which are expected to exceed NO ₂ or PM ₁₀ AQS objectives with or without the Scheme. Changes with the Scheme are expected to be small or imperceptible.

Residual effects

Construction

- 5.10.3 Any adverse air quality effects due to construction would be temporary and could be suitably minimised by the application of standard and appropriate mitigation measures. On this basis, there is unlikely to be a significant residual effect on air quality due to the construction of the Scheme.

Operation

- 5.10.4 The results of the assessment have shown that in accordance with IAN 174/13, the Scheme is not expected to have a significant effect on air quality. As no mitigation measures are proposed, the residual impacts will be the same as those without mitigation.
- 5.10.5 There would not be any significant residual effect at any receptor.

5.11 Cumulative effects

- 5.11.1 Relevant committed developments in the area which could interact with the Scheme are described in the Assessment of Cumulative Effects chapter (Chapter 15). During construction, a number of developments including the proposed cycle way on Brook Street, Land east of Nags Head Lane, Gardens of Peace (formerly known as Land at Oak Farm) and various parcels of land marked for wind developments could potentially affect receptors within the air quality study area for construction, if this takes place over the same period. With appropriate mitigation measures in place, any adverse effects resulting from construction dust would be minimised such that there would not be any significant residual effect on the receptors affected by these proposals.
- 5.11.2 Additional traffic from specific committed developments was taken into account within the traffic modelling, meaning that the air quality assessment during operation already takes into consideration cumulative effects. The Lower Thames Crossing is included in the traffic modelling, however as its opening year is expected to occur after the opening year for this Scheme, its effects are only noted in the assessment for the design year.

5.12 NPS NN compliance

- 5.12.1 In line with the national guidance described in section 5.3, the NPS NN requires a judgement to be made as to the risk of a project affecting the UK's ability to comply with the Air Quality Directive. The assessment has shown that the changes in local air quality at the selected human health receptors are all small or imperceptible. The Scheme is not expected to result in a significant adverse effect on air quality. There is not expected to be a compliance risk with regards to the UK's ability to comply with the Air Quality Directive. The Scheme is therefore expected to be compliant with the NPS NN.

5.13 Monitoring

- 5.13.1 Given that the Scheme is not expected to have any significant adverse effects on air quality, no monitoring is required.

5.14 Summary

- 5.14.1 An air quality assessment has been undertaken for the Scheme.
- 5.14.2 A review of baseline conditions has shown there are two AQMAs which could be affected by the Scheme. These AQMAs are located to the west of junction 28 covering the London Borough of Havering and a smaller area to the east of junction 28 at Brook Street.
- 5.14.3 Air quality monitoring data shows that there are exceedances of the annual mean AQS objective for NO₂ within the study area adjacent to Brook Street in recent years. PM₁₀ concentrations are not monitored within the study area but are below the objectives, at nearby monitoring sites. There are two sections of PCM links in the study area which exceed the annual mean NO₂ EU limit value in 2015, however these are modelled to be compliant in the opening year.
- 5.14.4 During construction, there is the potential for increased emissions of dust, however, with the application of appropriate mitigation significant effects at nearby receptors would be unlikely. Additional traffic during construction is considered unlikely to affect air quality.
- 5.14.5 The assessment showed that no receptors were expected to exceed the annual mean NO₂ AQS objective. No receptors were expected to exceed the 1-hour mean AQS objective with the Scheme.
- 5.14.6 There are not expected to be any exceedances of the annual mean or daily mean PM₁₀ AQS objectives.
- 5.14.7 There are not expected to be any Defra PCM links in the air quality study area that would exceed the annual mean NO₂ EU limit value in 2022 and changes in concentrations would not result in exceedances in 2022 or beyond. There is not expected to be a compliance risk due to the Scheme.
- 5.14.8 During operation, the assessment has shown that overall there is not considered to be a significant adverse effect on air quality.

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