The Great Grid Upgrade

Sea Link

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Contents

Table of Tables

Table of Plates

Air Quality Modelling Methodology

1.1 Air quality model inputs

1.1.1 The Atmospheric Dispersion Modelling System ADMS-Roads (version 5.0) was used to predict nitrogen dioxide (NO_2), particulate matter less than 10 microns in diameter (PM_{10}) and particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) concentrations at sensitive human receptors in the study area. Oxides of nitrogen (NOx) concentrations have been predicted at ecological receptors.

1.1.2 The construction vehicle emissions assessment considered the following scenarios:

- Base Year (2023) – predicted baseline air quality scenario, used to characterise the air quality baseline and to carry out model verification;
- Do-Nothing (2030) – predicted future air quality scenario in the Proposed Project's worst case construction year, without the Proposed Project; and
- Do-Something (2030) – predicted future air quality scenario in the Proposed Project's worst case construction year, with the Proposed Project.

1.1.3 The dispersion model was built by digitising links from the traffic data to the Ordnance Survey (OS) Open Roads data and assigning road widths based on aerial imagery.

1.1.4 The following inputs and tools informed the air quality modelling assessment, each of which is explained in the following sections:

- traffic data;
- emission factors toolkit (EFT);
- Oxides of nitrogen NO_X to NO_2 conversion;
- meteorological data;
- background pollutant concentrations; and
- receptors.

Traffic data

1.1.5 Traffic data used in the assessment is based on that used in **Application Document 6.2.3.8 Part 3 Kent Chapter 8 Air Quality** and comprised the total number of vehicles, the number of Light Duty Vehicles (LDVs) and Heavy Duty Vehicles (HDVs) and speeds for the Base Year, Do-Nothing and Do-Something scenarios. Speed limits were provided in the absence of measured data.

1.1.6 Table 1.1 below presents the traffic data used in the assessment.

Table 1.1 Traffic data

Road Link ID	Road Name	Total Annual Average Daily Traffic (AADT)			HDV			Speed (mph)
		2023 Base Year	Do-Nothing 2030	Do-Something 2030	2023 Base Year	Do-Nothing 2030	Do-Something 2030	
K-RL1	A299 Hengist Way (between the Monkton and Minster Roundabouts)	23,805	25,912	26,102	1,310	1,426	1,514	70
K-RL2	A299 Hengist Way (between the Minster and Cliffsend Roundabouts)	23,727	25,827	26,017	1,274	1,387	1,475	70
K-RL3	A299 Hengist Way (between the Cliffsend and the Sevenscore Roundabouts)	20,290	22,086	22,276	1,220	1,328	1,416	70
K-RL4	A299 Hengist Way (east of the	25,556	27,819	27,856	997	1,085	1,096	50

Road Link ID	Road Name	Total Annual Average Daily Traffic (AADT)			HDV			Speed (mph)
		2023 Base Year	Do-Nothing 2030	Do-Something 2030	2023 Base Year	Do-Nothing 2030	Do-Something 2030	
	Sevenscore Roundabout, within study area)							
K-RL5a	A256 Richborough Way (between the Sevenscore and Ebbsfleet Roundabouts) - north of K-BM02	23,217	25,273	25,555	1,194	1,299	1,406	70
K-RL5b	A256 Richborough Way (between the Sevenscore and Ebbsfleet Roundabouts) - south of K-BM02	23,217	25,273	25,555	1,194	1,299	1,406	70
K-RL6	A256 Ramsgate Road (south	26,475	28,819	28,874	1,370	1,492	1,503	50

Road Link ID	Road Name	Total Annual Average Daily Traffic (AADT)			HDV			Speed (mph)
		2023 Base Year	Do-Nothing 2030	Do-Something 2030	2023 Base Year	Do-Nothing 2030	Do-Something 2030	
	of the Ebbsfleet Roundabout, within study area)							
K-RL7	Sandwich Road (between Ebbsfleet Roundabout and Lord of the Manor Roundabout)	3,885	4,229	4,263	71	77	89	37
K-RL8	Ebbsfleet Lane	491	534	558	6	7	15	26
K-RL9	Cottington Link Road	1,856	2,020	2,030	26	28	30	60
	Tothill Street	10,015	-*	-	279	-	-	30

*Provided for verification purposes only and does not comprise part of the construction route. As such, flows are only available for the base year.

1.1.8 Speeds were reduced to model reduced speeds at junctions and roundabouts in accordance with guidance provided in LAQM.TG(22) (Department for Environment, Food and Rural Affairs, 2022).

Emission factor tool kit

1.1.9 Road traffic emission factors for NO_X, PM_{10} and $PM_{2.5}$ were generated from the Emission Factors Toolkit (EFT) v12.1 released August 2024 (Department for Environment, Food and Rural Affairs, 2024). The road traffic emission factors were derived from the total number of vehicles and percentage HDVs from the traffic data, and the speed limits.

NO_X to NO_2 conversion

1.1.10 In accordance with Local Air Quality Management Technical Guidance LAQM.TG(22) (Department for Environment, Food and Rural Affairs, 2022), all modelled road-based concentrations of NO_x were converted to annual mean NO_2 using the 'NO_x to NO_2' calculator (Department for Environment, Food and Rural Affairs, 2024).

1.1.11 Within the calculator, the traffic mix 'All non-urban UK traffic' was selected as being most representative of the modelled road network, and the local authority 'Thanet' was selected.

Meteorological data

1.1.12 Meteorological data recorded at Manston Airport during 2023 was used for the dispersion model. The wind rose for this meteorological site is displayed in Plate 1.1 below.

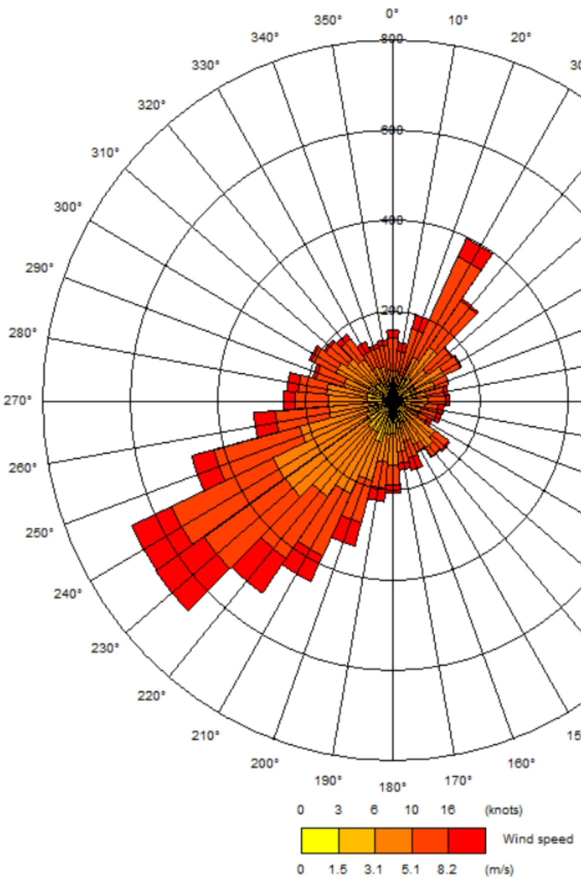

Plate 1.1 2023 Wind rose for Manston Airport

1.1.13 A surface roughness value of 0.5 m and minimum Monin-Obukhov length of 10 m was used in the dispersion modelling. These parameters, which are determined by land use, influence wind patterns and atmospheric turbulence and, therefore, affect pollution dispersion. These values were selected as they were judged to be most representative of the predominant land use dispersion characteristics across the study area.

Background pollutant concentrations

1.1.14 Total air pollutant concentrations comprise a background and local component, both of which must be independently considered for the air quality assessment. The background component is determined by regional, national, and international emissions, and often represents a significant proportion of the total pollutant concentration. The local component is affected by emissions from sources such as roads and chimney stacks, which are less well mixed locally and add to the background concentration.

1.1.15 Background pollutant concentrations are spatially and temporally variable throughout the UK and have been obtained for NO_x, NO_2, PM_{10} and $PM_{2.5}$ from the UK-AIR website (Department for Environment, Food and Rural Affairs, 2024). Defra provides predictions based on a grid at a resolution of 1 km^2 across the whole of the UK and forecast from a base year of 2021. There are no background automatic monitoring stations in the vicinity of the Proposed Project for which 2023 data was available. As such, Defra background maps for 2023 were used for modelling of the Base Year scenario and 2030 for the Do-Nothing and Do-Something scenarios. The background concentrations used for the modelling are presented in Table 1.2 and 1.3, for 2023 and 2030, respectively.

Table 1.2 Background pollutant concentrations 2023

Pollutant	Concentration (µg/m^3) for Grid Square 631500,165500*	Concentration (µg/m^3) for Grid Square 633500,163500	Concentration (µg/m^3) for Grid Square 633500,162500
NO_2	7.6	7.5	7.5
PM_{10}	-	11.7	10.5
$PM_{2.5}$	-	5.9	5.7
NOx	9.7	9.6	9.6

*Used for verification only, therefore only NO_2 and NOx required for the Base Year.

Table 1.3 Future background pollutant concentrations 2030

Pollutant	Concentration (µg/m^3) for Grid Square 633500,163500	Concentration (µg/m3) for Grid Square 633500,162500
NO_2	5.9	5.9
PM_{10}	11.2	10.0
$PM_{2.5}$	5.4	5.2
NOx	7.4	7.4

Receptors

1.1.16 The study area for assessment of construction vehicle emissions is an area within 200 m of the construction traffic routes that exceed the IAQM and EPUK Development Control screening criteria (Institute of Air Quality Management and Environmental Protection UK, 2017), in accordance with DMRB LA105 (National Highways (formerly Highways England), 2024). Worst case sensitive receptors were selected from within the study area; receptor locations are presented in **Application Document 6.4.3.8.4 Air Quality Receptor and Verification Locations**.

1.2 Assessment of short-term NO_2 and PM_{10} concentrations

1.2.1 LAQM.TG(22) (Department for Environment, Food and Rural Affairs, 2022) advises that exceedances of the 1-hour mean NO_2 AQS objective are unlikely to occur where the annual mean is less than 60 µg/m^3. Therefore, exceedances of 60 µg/m^3 as an annual mean are used as an indicator of potential exceedances of the 1-hour mean NO_2 AQS objective.

1.2.2 The prediction of daily mean concentrations of PM_{10} is available as an output option within the ADMS roads dispersion model for comparison against the short-term air quality objective. However, as the model output for annual mean concentrations is considered more accurate than the modelling of the daily mean, an empirical relationship has been used to determine daily mean PM_{10} concentrations. In accordance with LAQM.TG(16) (2016), the following formula was used:

No. of 24-hour mean exceedances = -18.5 + 0.00145 x annual mean^3 + (206 / annual mean)

1.2.3 Based on this formula, an exceedance of the 24-hour mean PM_{10} AQS objective is unlikely to occur where the annual mean PM_{10} concentration is less than 32 µg/m^3.

1.3 Nitrogen (N) Deposition

1.3.1 Road traffic NO_x and ammonia (NH_3) emissions contribute to nutrient N deposition and can therefore lead to adverse effects on ecological receptors. Where the road criteria is exceeded and where there is a change in modelled concentrations, the assessment of N deposition comprises the following key stages:

- Obtaining background N deposition rates from the Air Pollution Information System (APIS) database (Centre for Ecology and Hydrology, 2024) for the 1 km by 1 km grid square(s) corresponding with the designated site receptor and habitat type, whether moorland (short vegetation) or forest (tall vegetation).
- Calculation of annual mean road NO_2 concentrations at the designated site receptor for the Base Year, Do Nothing and Do Something scenarios.
- Conversion of road NO_2 concentrations to N deposition (1µg/m^3 of NO_2 = 0.14 kgN/ha/yr for grassland type habitats and 1µg/m^3 of NO_2 = 0.29 kgN/ha/yr for forests and similar habitats).
- Estimation of the N deposition contribution from NH_3 using the National Highways Ammonia Tool.
- Adding the road N deposition from both NO_2 and NH_3 to the APIS background N deposition and comparing with the lower critical load (LCL) for the habitat in question. Critical loads for N deposition represent the exposure below which there should be no significant harmful effects on sensitive elements of the ecosystem (according to current knowledge).

1.4 Model verification

1.4.1 The comparison of modelled concentrations with local monitored concentrations is a process termed ‘verification’. Model verification identifies any discrepancies between modelled and measured concentrations, which can arise for a range of reasons. The following are examples of potential causes of such discrepancies:

- background pollutant concentration uncertainties;
- meteorological data uncertainties;
- traffic data uncertainties;

- emission factor uncertainties; and
- overall limitations of the ability of the dispersion model to model dispersion in a complex urban environment.

1.4.2 The verification process involves a review of the modelled pollutant concentrations against corresponding monitoring data to determine how well the air quality model has performed. Depending on the outcome it may be considered that the model has performed adequately and that there is no need to adjust any of the modelled results.

1.4.3 Alternatively, the model may perform poorly against the monitoring data (acceptable limits of model verification performance are set out in LAQM.TG(22) (Department for Environment, Food and Rural Affairs, 2022)), in which case there is a need to check all the input data to ensure that it is reasonable and accurately represented in the air quality modelling process. Where all input data, such as traffic data, emissions rates, and background concentrations have been checked and considered reasonable, then the modelled results may require adjustment to best align them with the monitoring data. This may be either a single verification adjustment factor to be applied to the modelled concentrations across the study area or a range of different adjustment factors to account for different situations within the study area.

Residual uncertainty and model performance

1.4.4 Residual uncertainty may remain after systematic error or ‘overall model accuracy’ has been accounted for in the final predictions. Residual uncertainty may be considered synonymous with the ‘residual inaccuracies’ of the model predictions, i.e. how wide the scatter or residual variability of the predicted values compare with the monitored ‘true value’, once systematic error has been allowed for. The quantification of final model accuracy provides an estimate of how the final predictions may deviate from the ‘true’ (monitored) values at the same location over the same period. It must, though, be recognised that some of the residual uncertainty will be down to uncertainties in the monitored values. This is greater for monitoring using diffusion tubes than for automatic monitors.

1.4.5 The air quality monitoring data collected as part of this assessment and detailed in the baseline section was reviewed to determine the suitability of each of the monitoring locations for inclusion in the model verification process.

1.4.6 The model Base Year is 2023, therefore monitoring data representative of 2023 was acquired to inform the model verification process.

1.4.7 Monitoring data was collated (as presented in **Application Document 6.3.3.8.C Appendix 3.8.C Air Quality Monitoring Data**). Determination of the suitability of the collected monitoring data for inclusion into the verification exercise, used the following criteria:

- monitoring sites that are within 200 m of the ARN; and
- monitoring sites with at least 75% data capture in 2023.

1.4.8 Following the site selection process outlined in the criteria above, one diffusion tube monitoring site at the location shown in **Application Document 6.4.2.8.4 Air Quality Receptor and Verification Locations was used for model verification**. Comparison of modelled total NO2 compared with monitored NO2 (Table 1.4) indicated that the model underpredicted the NO2 concentration at this location.

Verification methodology

1.4.9 The verification method followed the process detailed in LAQM.TG(22) (Department for Environment, Food and Rural Affairs, 2022), which involves comparing modelled and monitored road NO_x concentrations. The diffusion tube road NO_x concentration was calculated using the latest version of the Defra NO_x to NO_2 calculator (Department for Environment, Food and Rural Affairs, 2024), because diffusion tubes only measure NO_2 and do not directly measure NO_x.

1.4.10 For the monitoring site, the relevant 1x1 km 2023 background concentration for NO_X and NO_2 were acquired by using the 2021 reference year Defra background maps (Department for Environment, Food and Rural Affairs, 2024), as presented in Table 1.2.

1.4.11 Table 1.4 summarises the background NO_2 concentration, unadjusted modelled and monitored road NO_x concentrations, and unadjusted modelled and monitored total NO_2 concentrations at the diffusion tube site.

Table 1.4 Diffusion tube monitored and unadjusted modelled results 2023 (total NO_2 and road NOx)

X OS Grid Ref	Y OS Grid Ref	Background NO_2 (µg/m^3)	Monitored total NO_2 (µg/m^3)	Modelled total NO_2 (µg/m^3)	Ratio of monitored vs modelled total NO_2	Monitored road NO_x (µg/m^3)	Modelled road NOx (µg/m^3)	Ratio of monitored vs modelled road NOx
631054	165478	7.6	16.1	10.1	1.6	18.3	5.1	3.6

1.4.12 The verification factor derived from the model verification as shown in Table 1.4 was 3.6, showing the model underestimates NO_2 concentrations in relation to the monitored concentrations. Whilst verification using more than one monitoring location is preferred, it is noted that the verification factor derived for the Suffolk Onshore Scheme is very similar (3.8). As such, use of the derived verification factor is considered appropriate and it has been applied to the modelling results for all receptors. The same verification factor was applied for NO_x, PM_{10} and $PM_{2.5}$ modelled results at each relevant receptor, as PM_{10} and $PM_{2.5}$ monitoring data was not available for verification purposes.

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