M54 to M6 Link Road

TR010054

Volume 6

6.3 Environmental Statement Appendices

Appendix 5.1 Air Quality Methodology

Regulation 5(2)(a)

Planning Act 2008

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

January 2020

Infrastructure Planning

Planning Act 2008

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

M54 to M6 Link Road

Development Consent Order 202[ ]

6.3 Environmental Statement Appendices

Appendix 5.1 Air Quality Methodology

Regulation Number	Regulation 5(2)(a)
Planning Inspectorate Scheme Reference	TR010054
Application Document Reference	6.3
Author	M54 to M6 Link Road Project Team and Highways England

Version	Date	Status of Version
1	January 2020	DCO Application

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1 Construction Dust Assessment

1.1.1 The Design Manual for Roads and Bridges (DMRB) construction phase assessment for air quality requires the air quality assessor to identify key sensitive receptor locations that may require mitigation to reduce the effects of dust emissions and to propose methods of mitigation. These mitigation measures are set out in the Outline Environmental Management Plan (OEMP) [TR010054/APP/6.11] for the Scheme.

1.1.2 As such, sensitive receptors located along the Scheme that may be impacted during the construction phase have been identified (namely those located closest to the Scheme and routes which would be affected by construction works, up to a maximum distance of 200 m away). The potential for adverse dust effects upon these receptors has been assessed qualitatively, taking into account the mitigation measures applicable to the control of construction dust as detailed in Appendix 5.4 [TR010054/APP/6.3].

2 Construction Phase Traffic Assessment

2.1.1 The construction phase traffic assessment considers the additional HGV movements introduced to the road network due to construction of the Scheme, along with the effects of construction phase traffic management. Whilst the construction of the Scheme will be undertaken in a phased manner, a single construction phase scenario is considered. For this scenario, the following assumptions have been made:

- peak construction vehicle movements would occur in, and the assessment will therefore focus on, the year 2021; and
- the traffic management intervention on the M54 motorway at Junction 1 would also occur in 2021.

2.1.2 The traffic management intervention involves the flow of eastbound traffic on the M54 through Junction 1. Instead of all vehicles proceeding on the main eastbound carriageway through the junction, a proportion of HGVs will be diverted up the eastbound off slip and then backdown the eastbound on slip before re-joining the main eastbound carriage way. As well as change in flows and distribution of traffic due to this intervention, the assessment also accounts for a change in speed to reflect the reduced speed limit, and the length of that restriction.

2.1.3 Exact origins and destinations of HGV movements within the construction period are not currently known, therefore assumptions have been made in order to assess the potential effects of the construction period. It is assumed that the origin of the source material is independent of their destination, therefore around half of the deliveries are likely to be to the nearest compound (either northern or southern), and half would be to the furthest compound. The deliveries to the furthest compound would travel the length of the A460.

2.1.4 The assessment assumes a 10-hour working day, with deliveries distributed evenly across the day. The assessment considers the number of deliveries for the busiest three-month period during the construction of the Scheme and applies this over a whole year. Additionally, once the haul road is completed HGVs would use the haul road in preference to the A460, thereby reducing the impact of the construction of the scheme on receptors along this road compared to those assessed here.

2.1.5 The same air quality assessment methodology as set out for the operational phase in the local operational air quality assessment has been followed for the construction phase.

3 Local Operational Air Quality Assessment

3.1.1 Operational impacts have been assessed using traffic data sourced from the Traffic Model and where relevant further developed using Scheme design details.

3.1.2 The affected road network (ARN) has been identified by applying the DMRB (HA207/07) screening criteria for local air quality assessment, which are as follows:

- road alignment would change by 5 m or more; or
- annual average daily traffic (AADT) flows would change by 1,000 or more; or
- heavy duty vehicles (HDV) (vehicles greater than 3.5 tonnes, including buses and coaches) flows would change by 200 AADT or more; or
- daily average speeds would change by 10 km/hr or more; or
- peak hour speed would change by 20 km/hr or more.

3.1.3 These criteria have been used to determine the air quality study area for both the construction and operational phases.

3.1.4 The air quality assessment has considered those areas where a change in traffic above the criteria identified above occurs in the immediate area along and around the Scheme as shown on Figure 5.1 [TR010054/APP/6.2] for the construction and operation of the Scheme. Figure 5.1 [TR010054/APP/6.2] shows that affected roads in the operational phase pass through or are adjacent to Air Quality Management Areas (AQMA) in Cannock, Lichfield, Sandwell, South Staffordshire, Walsall and Wolverhampton. Although it is noted that some of these are City and Borough wide AQMAs (rather than small focused AQMAs around areas of exceedance) and the presence of these AQMAs does not necessarily mean that there is an exceedance of an air quality objective value within 200 m of the ARN.

3.1.5 For this local operational assessment, the Scheme and all affected roads have been assessed at a detailed level of assessment. As detailed in the DMRB, a detailed level assessment uses dispersion modelling to estimate pollutant concentrations more accurately, taking into account additional variables (e.g. meteorological data and variations in flow across the day) that are not examined in a simple level assessment (e.g. spreadsheet-based calculations without detailed meteorological data). The detailed assessment of local air quality reported herein has used the Cambridge Environmental Research Consultants (CERC) Atmospheric Dispersion Modelling System (ADMS) Roads dispersion model (version 4.1.1) to predict road pollutant contributions at identified sensitive receptors.

3.1.6 Predictions have been made for the baseline year (2017) and the opening year (2024) with the Scheme (Do-Something) and without the Scheme (Do-Minimum). On the basis of these predictions, the change in key pollutant concentrations (NO_2, PM_{10} and $PM_{2.5}$) associated with the Scheme have been established.

3.1.7 Predictions have been verified by comparing the baseline modelling predictions and baseline air quality monitoring data. Where systematic bias is clearly evident in the base year verification, an adjustment factor has been calculated (as set out in Section 3.7) and applied to bring modelled concentrations more into line with monitored concentrations.

3.1.8 A key element of the local operational detailed assessment is the rate of improvement in air quality over time as cleaner road vehicles enter the national vehicle fleet. The methodology outlined within Interim Advice Note (IAN) 170/12 v3, on the assessment of future NO_X and NO_2 projections, has been used in this assessment. The method considers The Department of Environment, Food and Rural Affairs (Defra's) advice on long-term trends related to roadside NO_2 concentrations, which suggests that there is a gap between current projected vehicle emission reductions and projections on the annual rate of improvements in ambient air quality as previously published in Defra's technical guidance and observed trends. Consequently, Highways England developed a set of NO_2 projection factors to inform scheme air quality assessments and these projections are referred to as LTT_{E6}.

3.1.9 The assessment of local air quality impacts described in this assessment has made used of LTT_{E6}. Whilst it may be narrowing, it is considered that there is still the potential for a gap between current projected vehicle emission reductions and projections on the annual rate of improvements in ambient air quality as previously published by Defra. It is considered that such an approach is more robust than assuming the full projection in vehicle emissions between now and the years of assessment.

3.1.10 The methodology, known as 'Gap Analysis', involves the completion of air quality modelling and verification, to correct verified modelled total NO_2 concentrations. Following verification of the modelled results, they are then adjusted to represent the observed long-term trend (LTT_{E6}) profile described in IAN 170/12.

3.1.11 The approach developed by Highways England takes account of the known discrepancies between measured NO_2 trends and pre-Euro 6/VI EFT projections which is based on roadside measurements taken before Euro 6/VI vehicles entered the UK fleet i.e. pre-2015 data. The adjusted results from this Gap Analysis are presented in Appendix 5.3 [TR010054/APP/6.3].

3.1.12 The determination of significance for the local operational air quality assessment has been undertaken using methods set out in IAN 174/13 'Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 Air Quality (HA207/07)'. The significance criteria comprise a series of key questions as set out in Section 3.9.

3.1.13 The significance of local air quality effects has been determined on the basis of LTT_{E6} information as this is currently considered by Highways England to be the most reasonable worst case representation of future air quality in 2021, 2024 and 2026. Defra Local Air Quality Management (LAQM) guidance and tools, such as the NO_X to NO_2 conversion approach and background maps, have also been used as required by DMRB and associated IANs.

3.1.14 Further details of the assessment methodology including the inputs used in CERCs ADMS-Roads model (including meteorology data), model post-processing (e.g. NO_X to NO_2 conversion) and the approach taken to model verification (including all monitoring locations used in the verification process) are presented in the following sub-sections.

3.1.15 Representative sensitive receptors (e.g. residential properties) have been selected for assessment within the local air quality assessment. These include those sensitive receptors placed closest to the ARN.

3.1.16 The predicted air quality impacts of the Scheme are evaluated against relevant national, regional and local air quality planning policy.

3.1.17 An evaluation of the significance of the local air quality assessment findings at sensitive receptors for health and designated ecological sites has been undertaken in accordance with Highways England guidance IAN 174/13.

3.1.18 The significance of the effects on European and nationally designated habitat sites, including the magnitude of change in NOx and / or nitrogen deposition, are considered as part of the Ecology and Nature Conservation assessment (see Chapter 8: Biodiversity of the Environmental Statement [TR010054/APP/6.1]).

3.2 Detailed model inputs

3.2.1 To undertake the assessment of road traffic emissions during the operational phases of the Scheme, the latest version of ADMS-Roads has been used to quantify pollution levels at selected receptors. ADMS-Roads is a modern dispersion model that has an extensive published track record of use in the UK for the assessment of local air quality impacts, including model validation and verification studies (CERC, 2017).

3.2.2 Table 1 outlines the key model inputs utilised in the ADMS-Roads modelling local air quality assessment.

Table 1: Modelled input parameters

Variables	Model Input
Surface roughness at source	0.5 m
Minimum Monin-Obukhov length for stable conditions	10 m
Terrain types	Flat
Receptor location	x,y coordinates determined by GIS z height of 1.5m for human receptors, 0m for ecological receptors.
Emissions	NO_X, PM_{10}
Emission factors	As per IAN 185/15 (updated emission factors)*
Meteorological data	1 year (2017) hourly sequential data from Shawbury Meteorology Station
Emission profiles	Emissions have been calculated for am peak, inter-peak, pm peak and off peak traffic profiles
Receptors	Selected receptors
Model output	Long-term annual mean NO_X concentrations (µg/m^3) Long-term annual mean PM_{10} concentrations (µg/m^3)

Variables	Model Input
* Updated IAN 185/15 emissions tool issued by Highways England	

3.3 Meteorological data

3.3.1 Meteorological data from Shawbury for 2017 has been used in the assessment. This meteorological site is located approximately 43 km to the west-north-west of the Scheme itself and 19 km north-west of the western extent of the ARN. A wind rose for this site is presented in Figure 1.

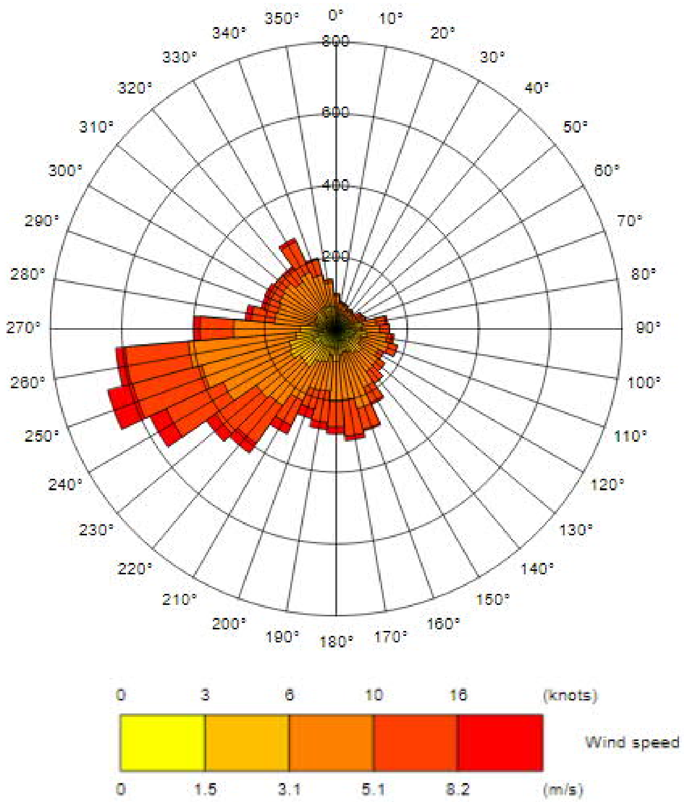


Figure 1: Shawbury 2017 Wind Rose

3.4 Background Concentrations

3.4.1 Annual average background concentrations were taken from Defra's most recent 1x1 km background maps and adjusted using Defra's adjustment tool removing emissions from road traffic following motorways and primary or trunk A roads. The data used in the assessment are presented for the centre of each 1x1 km grid square in Table 2. The Defra background concentrations have also been compared against Local Authority background monitoring (Appendix 5.2 [TR010054/APP/6.3]), which has suggested no uplift is required.

Table 2: Background map pollution estimates

Year (Scenario)	Pollutant	Minimum Concentration (µg/m^3)	Maximum Concentration (µg/m^3)
2017	NO_X	3.2 (321500,286500)	38.5 (400500,298500)
	NO_2	2.6 (321500,286500)	24.5 (400500,298500)
	PM_{10}	7.9 (323500,333500)	18.0 (404500,301500)
	$PM_{2.5}$	5.4 (323500,333500)	12.0 (405500,301500)
2021	NO_X	2.7 (321500,286500)	49.1 (408500,288500)
	NO_2	2.2 (321500,286500)	29.0 (408500,288500)
	PM_{10}	7.4 (323500,333500)	18.5 (447500,312500)
	$PM_{2.5}$	5.0 (323500,333500)	13.9 (414500282500)
2024	NO_X	2.5 (325500,287500)	28.8 (400500,298500)
	NO_2	2.0 (325500,287500)	19.3 (400500,298500)
	PM_{10}	7.2 (323500,333500)	17.1 (405500,301500)
	$PM_{2.5}$	4.8 (323500,333500)	11.6 (405500,301500)

3.5 Traffic data

3.5.1 The air quality assessment has utilised Annual Average Hourly Traffic data for the am peak (07:00 to 10:00), inter peak (10:00 to 16:00), pm peak (16:00 to 19:00) and off peak (19:00 to 07:00) time frames during the Scheme opening year within the detailed air quality assessment of local air quality.

3.6 Post model processing

3.6.1 To accompany the publication of the guidance document Local Air Quality Management Technical Guidance LAQM.TG(09) (and latterly LAQM.TG(16)), a NO_X to NO_2 converter was made available as a tool to calculate the road NO_2 contribution from modelled road NO_X contributions. The tool comes in the form of an MS Excel spreadsheet and uses borough specific data to calculate annual mean concentrations of NO_X. This tool was used to calculate the total NO_2 concentrations at receptors from the modelled road NOx contribution and associated background concentration. Due to the location of the Scheme, the 'All other-urban UK traffic' setting has been selected.

3.7 Model verification

3.7.1 The model predictions presented have been verified against monitoring data. The monitoring data used for model verification includes that sourced from local authority's, under their Local Air Quality Management duties, and from surveys commissioned by Highways England. A number of surveys undertaken by Highways England have been utilised for the purpose of model verification. This data was gathered at varying times and durations between May 2012 and August 2014.

3.7.2 For the purpose of model verification, monitored annual mean NO_2 data is required that is representative of conditions in the existing baseline year of assessment. In order to project the various sets of Highways England survey data into annual mean values for the existing baseline year of this assessment (2017), an exercise known as annualisation has been undertaken, following an approach described in Defra Local Air Quality Management guidance. This approach uses NO_2 data gathered by the reference method (chemiluminescence) at multiple sites to calculate an annualisation factor, based on the relationship between the data gathered over the same periods of each Highways England survey and the annual mean data for 2017. The annualisation factor is then added to the period mean for each monitoring location in each Highways England survey, before an additional factor is applied to account for diffusion tube bias. This process is summarised in Table 3 for the Highways England monitoring locations used in the model verification exercise.

Table 3: Annualisation of Highways England monitoring data

Site ID	Period mean	Bias adjustment factor[1]	Bias adjusted period mean	Annualisation factor[2]	Annualised Mean (2017)
M54M6TL_001_0813	43.3	0.87/0.83	36.6	0.81	29.7
M54M6TL_002_0813	47.3	0.87/0.83	39.9	0.81	32.4
M54M6TL_003_0813	23.0	0.87/0.83	19.3	0.82	15.7
M54M6TL_004_0813	30.9	0.87/0.83	26.1	0.81	21.2
M54M6TL_005_0813	27.0	0.87/0.83	22.7	0.77	17.4
M54M6TL_006_0813	32.8	0.87/0.83	27.6	0.80	22.1
M54M6TL_007_0813	38.6	0.87/0.83	32.7	0.79	25.7
M54M6TL_008_0813	26.8	0.87/0.83	22.6	0.81	18.3
M54M6TL_009_0813	44.6	0.87/0.83	37.7	0.81	30.7
M54M6TL_010_0813	26.8	0.87/0.83	22.6	0.81	18.4
M54M6TL_011_0813	38.5	0.87/0.83	32.4	0.80	25.9
M54M6TL_012_0813	34.8	0.87/0.83	29.4	0.80	23.4
M54M6TL_013_0813	29.3	0.87/0.83	22.8	0.81	18.5
M54M6TL_014_0813	33.4	0.87/0.83	25.4	0.79	20.0

Site ID	Period mean	Bias adjustment factor[1]	Bias adjusted period mean	Annualisation factor[2]	Annualised Mean (2017)
M54M6TL_015_0813	35.3	0.87/0.83	27.2	0.81	22.1
M54M6TL_016_0813	36.1	0.87/0.83	28.3	0.81	23.0
M54M6TL_017_0813	36.5	0.87/0.83	28.2	0.81	22.9
M54M6TL_019_0813	34.2	0.87/0.83	27.5	0.81	22.3
M54M6TL_020_0813	44.5	0.87/0.83	34.0	0.81	27.7
M54M6TL_021_0813	40.7	0.87/0.83	31.6	0.81	25.7
M54M6TL_022_0813	50.4	0.87/0.83	38.7	0.80	31.0
M54M6TL_023_0813	54.2	0.87/0.83	42.2	0.81	34.3
M54M6TL_025_0813	44.4	0.87/0.83	34.6	0.81	28.1
M54M6TL_028_0813	34.6	0.87/0.83	26.5	0.81	21.5
M54M6TL_029_0813	31.2	0.87/0.83	24.5	0.82	20.0
M54M6TL_030_0813	27.0	0.87/0.83	20.6	0.81	16.7
M54M6TL_033_0813	48.4	0.87/0.83	38.0	0.81	30.8
M54M6TL_034_0813	35.3	0.87/0.83	27.9	0.81	22.7
M6J10AJ13_001_0710	33.4	0.96/0.95	32.0	0.73	23.4
M6J10AJ13_002_0710	33.6	0.96/0.95	32.2	0.73	23.5
M6J10AJ13_003_0710	31.6	0.96/0.95	30.3	0.73	22.1
M6J10AJ13_006_0710	33.8	0.96/0.95	32.4	0.73	23.6
M6J10AJ13_007_0710	25.8	0.96/0.95	24.7	0.73	18.0
M6J10AJ13_008_0710	41.0	0.96/0.95	39.2	0.61	24.1
M6J10AJ13_009_0710	33.9	0.96/0.95	32.5	0.74	24.2

Site ID	Period mean	Bias adjustment factor[1]	Bias adjusted period mean	Annualisation factor[2]	Annualised Mean (2017)
M6J10AJ13_011_0710	34.4	0.96/0.95	32.9	0.73	24.0
M6J10AJ13_012_0710	33.1	0.96/0.95	31.8	0.87	27.7
M6J10AJ13_013_0710	30.7	0.96/0.95	29.5	0.96	28.2
M6J10AJ13_014_0710	39.5	0.96/0.95	37.9	0.86	32.5
M6J10AJ13_015_0710	37.6	0.96/0.95	36.1	0.86	30.9
M6J10AJ13_016_0710	49.8	0.96/0.95	47.7	0.73	34.8
M6J10AJ13_017_0710	39.6	0.96/0.95	37.9	0.73	27.7
M6J10AJ13_018_0710	36.6	0.96/0.95	35.0	0.73	25.6
M6J10AJ13_019_0710	30.9	0.96/0.95	29.6	0.73	21.6
M6J10AJ13_020_0710	34.1	0.96/0.95	32.7	0.71	23.1
M6J10AJ13_021_0710	29.2	0.96/0.95	28.0	0.73	20.4
M6J10AJ13_025_1012	32.7	0.96/0.95	31.3	0.61	19.2
M6J10AJ13_026_1012	35.1	0.96/0.95	33.6	0.60	20.2
M6J10AJ13_027_1012	44.6	0.96/0.95	42.6	0.61	26.2
M6J10AJ13_028_1012	42.1	0.96/0.95	40.2	0.60	24.2
M6J10AJ13_040_1012	31.2	0.96/0.95	29.8	0.60	17.9
M6J13J15_001_0813	30.6	0.87/0.83	25.9	0.81	20.9
M6J13J15_002_0813	47.7	0.87/0.83	39.6	0.84	33.4
M6J13J15_003_0813	23.6	0.87/0.83	19.9	0.81	16.1
M6J13J15_004_0813	36.0	0.87/0.83	30.4	0.81	24.6
M6J13J15_005_0813	42.2	0.87/0.83	35.4	0.83	29.3

Site ID	Period mean	Bias adjustment factor[1]	Bias adjusted period mean	Annualisation factor[2]	Annualised Mean (2017)
M6J13J15_006_0813	27.1	0.87/0.83	23.1	0.75	17.2
M6J13J15_007_0813	43.5	0.87/0.83	36.7	0.81	29.7
M6J13J15_008_0813	34.4	0.87/083	29.1	0.81	23.5
M6J13J15_009_0813	27.7	0.87/0.83	23.4	0.81	18.9

[1] Bias adjustment factor taken from Defra's National Bias Adjustment Spreadsheet for the laboratory and diffusion tube preparation method. Where two factors are present, this accounts for when a survey period contained months across two calendar years.

[2] Annualisation factors calculated through the comparison of period mean and annual mean (2017) concentrations at Stoke-on-Trent, Aston Hill and Walsall Woodlands automatic continuous monitoring stations.

3.7.3 Following the annualisation of the Highways England survey monitoring data, the verification factors used to adjust raw model outputs are presented in Table 4, and bias adjustment graphs presented in **Error! Reference source not found.** to Figure 5, where a graph is appropriate (only a single monitoring location available for the verification at Cannock Chase AQMA No.2).

Table 4: Verification Details

Description of area applied	Adjustment factor	Root Mean Square Error (RMSE)	Fractional bias
General model performance – outside of AQMAs	0.69	4.9	0.0
Muckley Corner AQMA	1.47	7.9	0.0
Wedges Mills AQMA	1.58	1.9	0.0
Oak Farm AQMA	1.54	1.8	0.0
Cannock Chase AQMA No.2	1.34	0.0	0.0

3.7.4 Table 4 shows that general model performance at locations outside of designated AQMAs was to over-predict annual mean NO_2 concentrations by 31% on average. Instead of applying the factor of 0.69 to the receptors represented by these monitoring locations, a conservative approach was adopted by applying a factor of 1.00. Thereby accepting the over-prediction of the road NO_X contribution at these locations and, therefore, conservatively reporting total concentration in all scenarios that are higher than would have been had the calculated factor been applied. At locations within the AQMAs, the model tended to under predict by between 34% to 58% on average. The calculated adjustment factors reported in Table 4 for these locations have been applied to the receptors represented by them within the respective AQMAs.

3.7.5 The adjustment factors were applied to the predicted road NO_X concentrations prior to the conversion of road NO_X to total NO_2 concentrations at the receptors.

Figure 2: Bias adjustment graph (overall model)

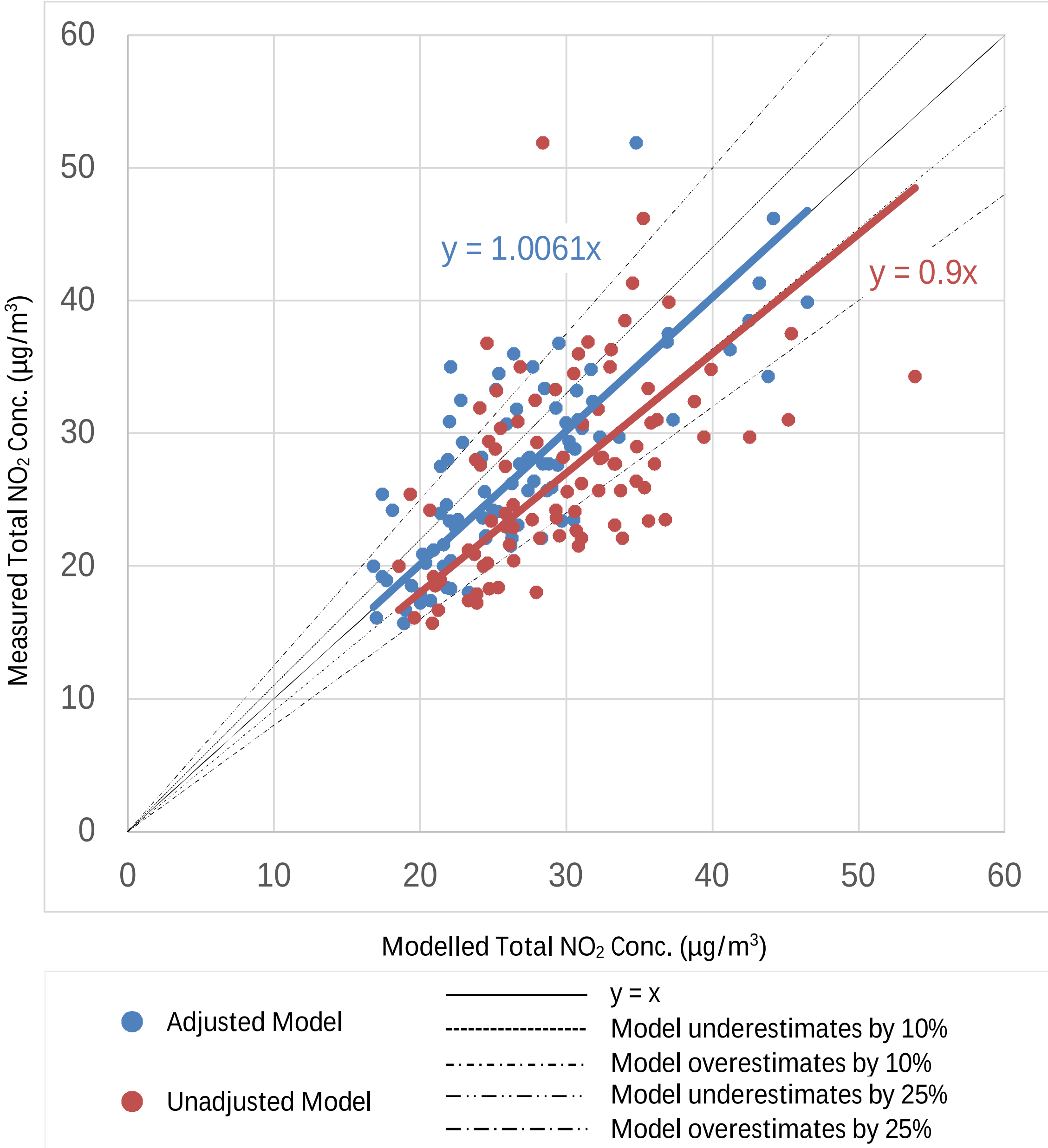


Figure 3: Bias adjustment graph (Oak Farm AQMA)

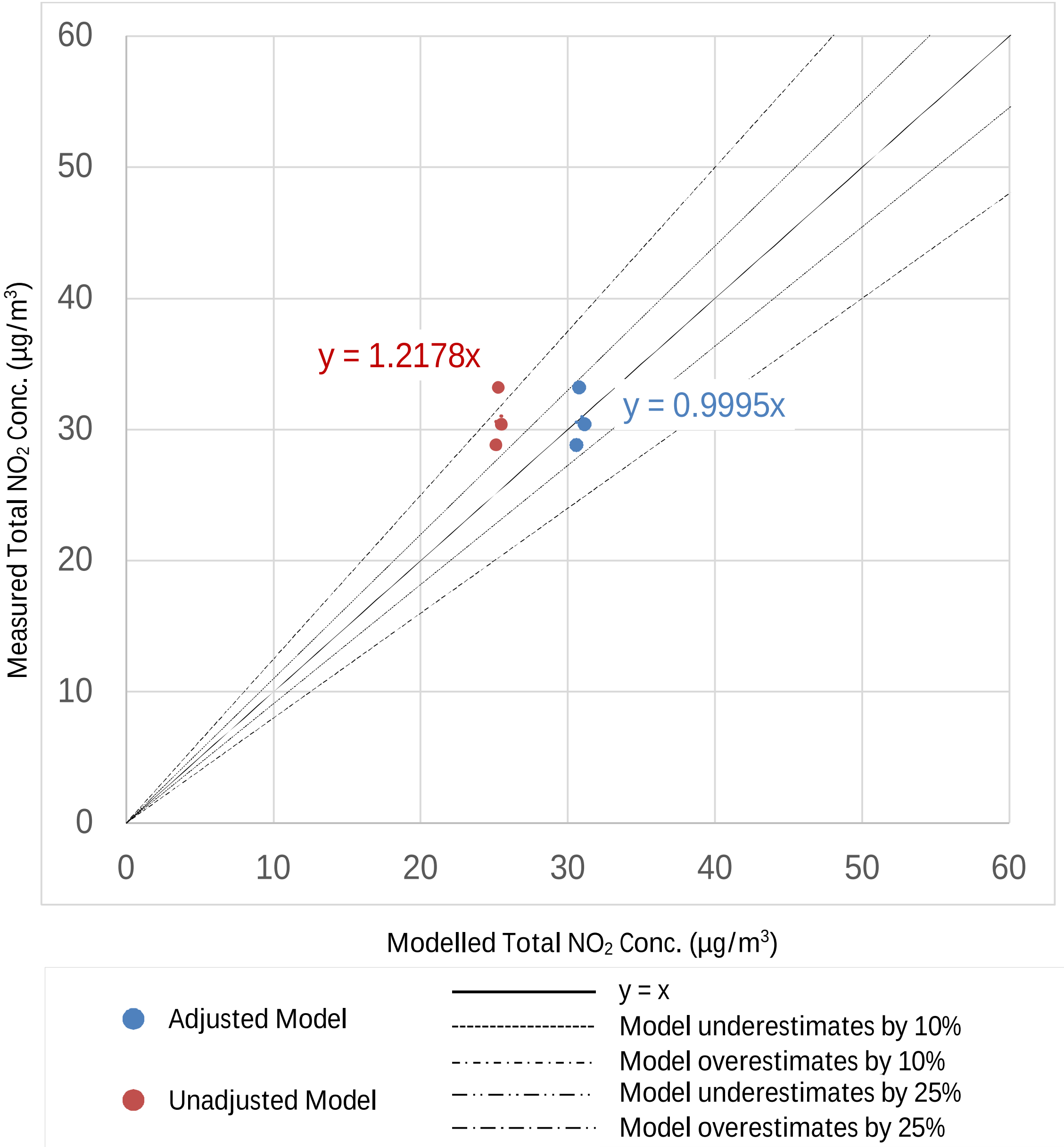


Figure 4: Bias adjustment graph (Wedge Mills AQMA)

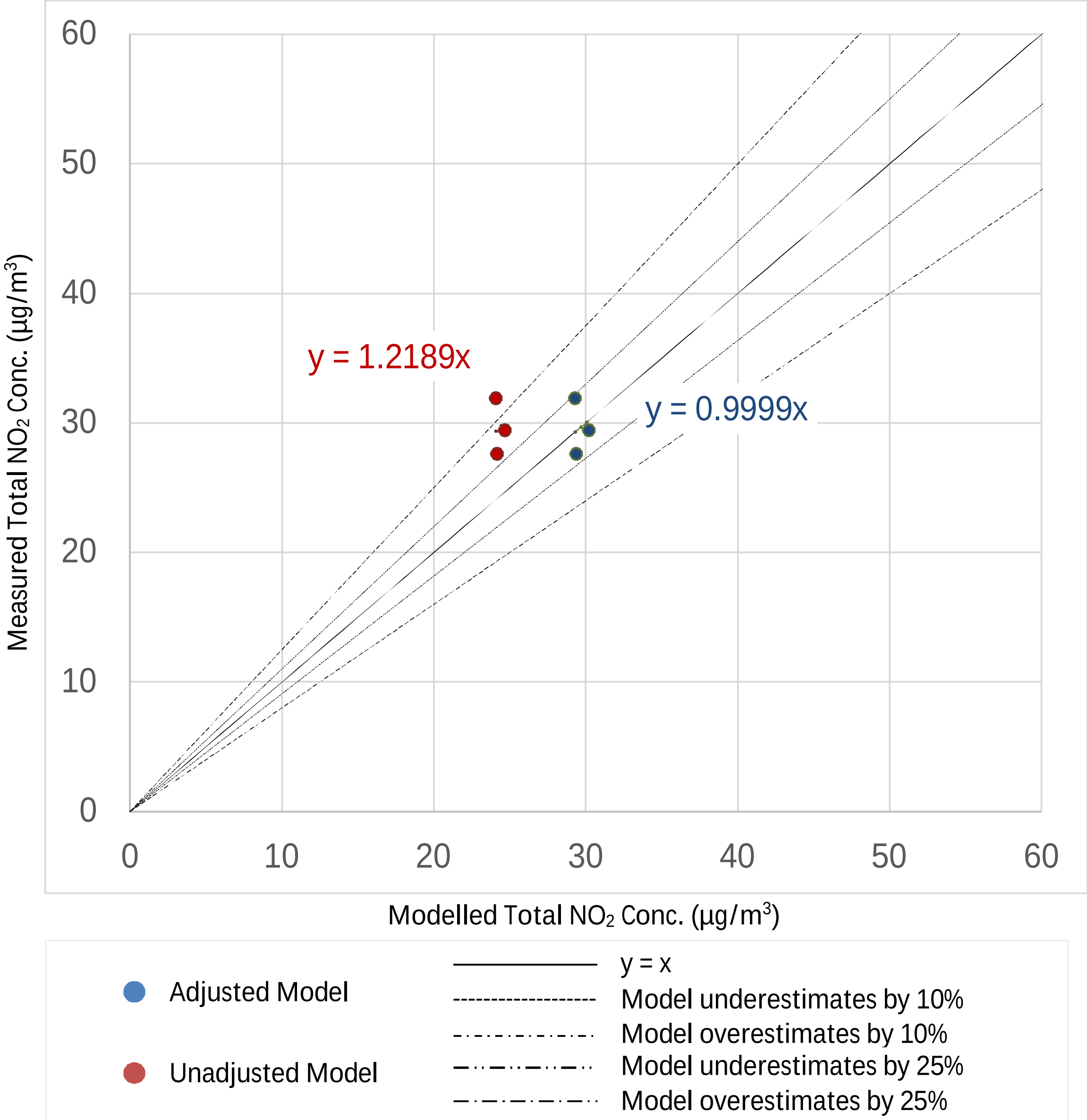
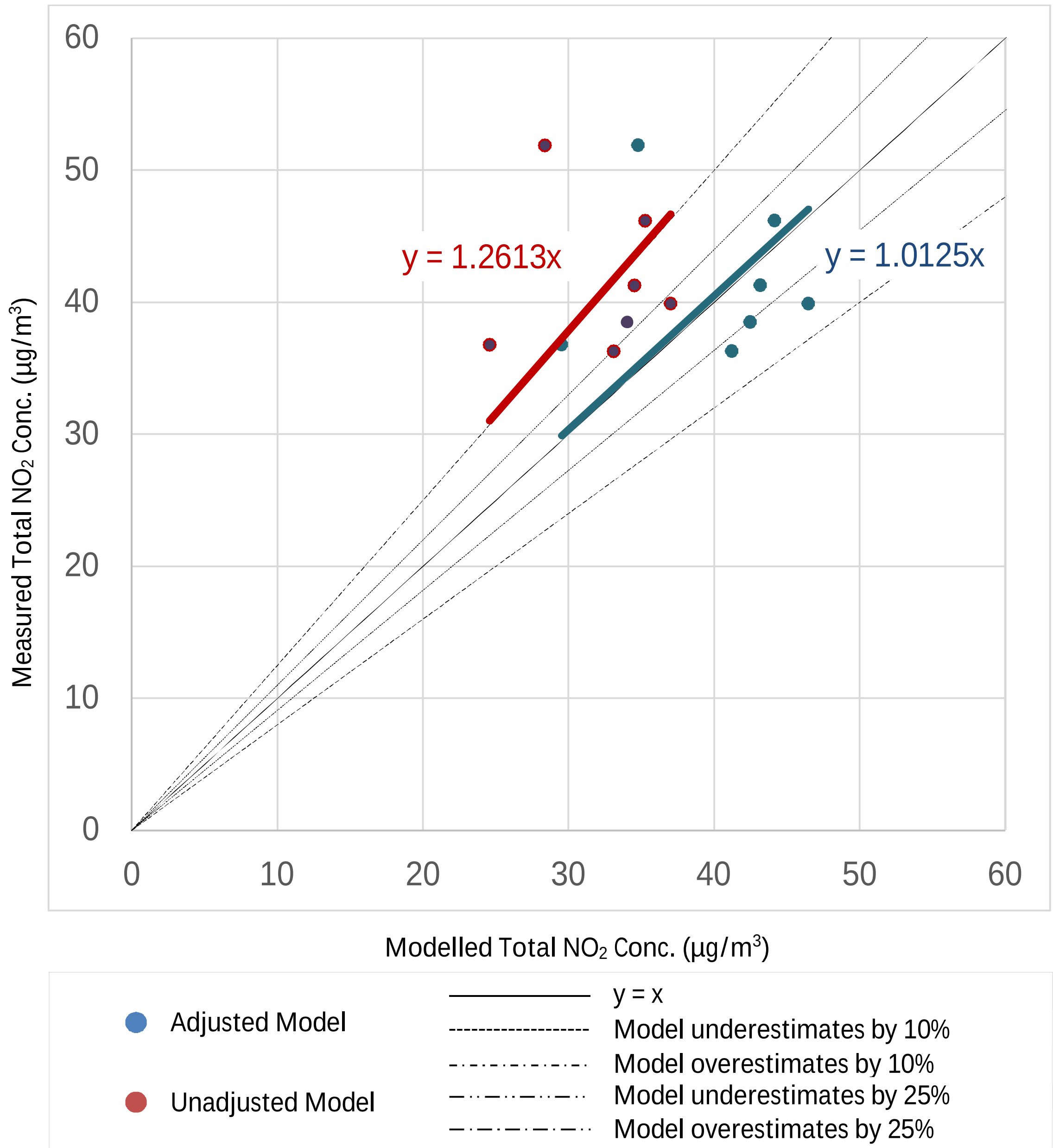


Figure 5: Bias adjustment graph (Muckley Corner AQMA)



3.7.6 The factors were also applied to the predicted road PM_{10} and $PM_{2.5}$ concentrations in the absence of any monitoring data within the study area with which to calculate specific verification factors for PM_{10}.

3.7.7 Table 5 contains details of the all monitoring sites used within the verification, including the verification zone for which they have been used to calculate model adjustment factors.

Table 5: Monitoring data used in model verification

Site ID	X	Y	Monitored Total NO_2 (µg/m^3)	Monitored Road NO_X (µg/m^3)	Modelled Road NO_X (µg/m^3)	Modelled Total NO_2 Before Adjustment (µg/m^3)	Modelled Total NO_2 After Adjustment (µg/m^3)
M54M6TL_001_0813[1]	394224	304946	29.7	30.0	51.9	39.4	39.4
M54M6TL_002_0813[1]	394399	305464	32.4	36.0	50.6	38.8	38.8
M54M6TL_003_0813[1]	394676	305432	15.7	2.2	12.0	20.8	20.8
M54M6TL_004_0813[1]	396138	303737	21.2	11.4	15.7	23.3	23.3
M54M6TL_005_0813[1]	393841	303468	17.4	4.8	16.3	23.3	23.3
M54M6TL_006_0813[1]	391683	304180	22.1	11.7	24.1	28.2	28.2
M54M6TL_007_0813[1]	391568	304683	25.7	18.9	32.7	32.2	32.2
M54M6TL_008_0813[1]	391448	304675	18.3	4.4	16.9	24.7	24.7
M54M6TL_009_0813[1]	394733	306064	30.7	34.2	35.2	31.1	31.1
M54M6TL_010_0813[1]	394713	306102	18.4	9.1	23.0	25.4	25.4
M54M6TL_011_0813[1]	395917	306857	25.9	24.4	44.9	35.3	35.3
M54M6TL_012_0813[1]	396531	306122	23.4	15.6	18.5	24.9	24.9
M54M6TL_013_0813[1]	397218	306936	18.5	5.5	10.5	21.1	21.1
M54M6TL_014_0813[1]	397310	307113	20.0	8.8	17.4	24.3	24.3
M54M6TL_015_0813[1]	396348	307621	22.1	13.6	32.2	31.0	31.0
M54M6TL_016_0813[1]	396638	308307	23.0	16.7	22.4	25.8	25.8
M54M6TL_017_0813[1]	396884	309187	22.9	18.5	25.6	26.4	26.4
M54M6TL_019_0813[1]	394116	308810	22.3	19.2	34.2	29.5	29.5
M54M6TL_020_0813[1]	397027	304396	27.7	22.1	34.1	33.4	33.4

Site ID	X	Y	Monitored Total NO_2 (µg/m^3)	Monitored Road NO_X (µg/m^3)	Modelled Road NO_X (µg/m^3)	Modelled Total NO_2 Before Adjustment (µg/m^3)	Modelled Total NO_2 After Adjustment (µg/m^3)
M54M6TL_021_0813[1]	397194	304700	25.7	17.9	35.0	33.7	33.7
M54M6TL_022_0813[1]	398119	301916	31.0	27.7	60.8	45.2	45.2
M54M6TL_023_0813[1]	398215	301970	34.3	34.9	83.4	53.9	53.9
M54M6TL_025_0813[1]	398167	308452	28.1	24.4	33.4	32.3	32.3
M54M6TL_028_0813[1]	401959	307241	21.5	12.1	31.3	30.8	30.8
M54M6TL_029_0813[1]	403333	307005	20.0	13.5	10.7	18.5	18.5
M54M6TL_030_0813[1]	404575	307082	16.7	5.4	14.1	21.2	21.2
M54M6TL_033_0813[1]	398011	308563	30.8	30.2	41.3	35.8	35.8
M54M6TL_034_0813[1]	398686	308150	22.7	13.2	29.9	30.7	30.7
M6J10AJ13_001_0710[1]	396957	303269	23.4	15.7	41.9	35.6	35.6
M6J10AJ13_002_0710[1]	396994	303433	23.5	16.1	44.5	36.8	36.8
M6J10AJ13_003_0710[1]	396555	304038	22.1	13.7	38.4	33.8	33.8
M6J10AJ13_006_0710[1]	394657	308500	23.6	21.8	33.7	29.3	29.3
M6J10AJ13_007_0710[1]	394140	308783	18.0	10.7	30.8	27.9	27.9
M6J10AJ13_008_0710[1]	393643	310049	24.1	22.0	35.7	30.6	30.6
M6J10AJ13_009_0710[1]	392630	310258	24.2	23.5	16.5	20.7	20.7
M6J10AJ13_011_0710[1]	393179	313866	24.0	25.5	29.2	25.8	25.8
M6J10AJ13_012_0710[1]	393242	313962	27.7	33.2	51.9	36.1	36.1
M6J10AJ13_013_0710[1]	393213	313967	28.2	34.3	37.7	29.8	29.8
M6J10AJ13_014_0710[1]	393179	313984	32.5	43.6	33.6	27.9	27.9

Site ID	X	Y	Monitored Total NO_2 (µg/m³)	Monitored Road NO_X (µg/m³)	Modelled Road NO_X (µg/m³)	Modelled Total NO_2 Before Adjustment (µg/m³)	Modelled Total NO_2 After Adjustment (µg/m³)
M6J10AJ13_015_0710[1]	393152	313988	30.9	40.2	31.1	26.7	26.7
M6J10AJ13_016_0710[1]	393326	313959	34.8	49.0	60.9	39.9	39.9
M6J10AJ13_017_0710[1]	393347	313945	27.7	33.2	45.5	33.3	33.3
M6J10AJ13_018_0710[1]	393371	313941	25.6	28.7	38.3	30.0	30.0
M6J10AJ13_019_0710[1]	393420	313932	21.6	20.5	29.9	26.1	26.1
M6J10AJ13_020_0710[1]	393524	315330	23.1	24.0	46.0	33.3	33.3
M6J10AJ13_021_0710[1]	393019	318074	20.4	16.1	28.3	26.4	26.4
M6J10AJ13_025_1012[1]	392748	318084	19.2	19.1	22.5	20.9	20.9
M6J10AJ13_026_1012[1]	391243	310706	20.2	18.3	27.3	24.6	24.6
M6J10AJ13_027_1012[1]	396348	307621	26.2	21.9	32.2	31.0	31.0
M6J10AJ13_028_1012[1]	397610	308200	24.2	18.0	28.7	29.3	29.3
M6J10AJ13_040_1012[1]	393197	314061	17.9	13.3	25.2	23.9	23.9
M6J13J15_001_0813[1]	392495	310307	20.9	17.0	22.6	23.7	23.7
M6J13J15_002_0813[1]	393340	313945	33.4	45.8	50.8	35.6	35.6
M6J13J15_003_0813[1]	393096	313034	16.1	9.7	16.6	19.6	19.6
M6J13J15_004_0813[1]	393179	313866	24.6	26.6	30.4	26.4	26.4
M6J13J15_005_0813[1]	393186	313971	29.3	36.7	33.8	28.0	28.0
M6J13J15_006_0813[1]	393197	314061	17.2	12.0	25.2	23.9	23.9
M6J13J15_007_0813[1]	393502	315360	29.7	37.9	67.9	42.5	42.5
M6J13J15_008_0813[1]	393420	315243	23.5	24.8	33.6	27.7	27.7

Site ID	X	Y	Monitored Total NO_2 (µg/m³)	Monitored Road NO_X (µg/m³)	Modelled Road NO_X (µg/m³)	Modelled Total NO_2 Before Adjustment (µg/m³)	Modelled Total NO_2 After Adjustment (µg/m³)
M6J13J15_009_0813[1]	392794	318312	18.9	18.5	23.5	21.4	21.4
54WS[1]	398250	308427	37.5	45.1	64.1	45.4	45.4
67WS[1]	398051	308512	28.2	24.6	33.8	32.5	32.5
A4[1]	391258	302199	36.0	41.9	30.4	30.8	30.8
A52A[1]	408893	306549	31.8	37.8	38.6	32.2	32.2
A52B[1]	408667	306500	34.5	43.9	35.0	30.5	30.5
A53[1]	412063	305379	25.4	24.2	12.0	19.3	19.3
BTLB[1]	397952	308567	35.0	41.3	36.8	33.0	33.0
CAN[1]	393004	300864	28.0	20.4	11.7	23.8	23.8
PE[1]	393179	313866	35.0	49.4	31.4	26.9	26.9
PE11[1]	393519	315327	26.4	30.9	49.4	34.8	34.8
PE2[1]	393179	313866	27.5	32.8	29.2	25.8	25.8
STA1[1]	391390	299803	29.0	18.8	31.3	34.8	34.8
STA5-7[1]	391258	302199	33.3	35.9	27.0	29.3	29.3
STA9A[1]	391535	303346	31.0	26.6	38.1	36.2	36.2
MUC1[2]	408155	306511	39.9	56.5	49.7	37.0	46.5
MUC1ABC[2]	408155	306511	41.3	59.9	44.0	34.5	43.2
MUC2[2]	408165	306487	36.3	48.0	40.7	33.1	41.2
MUC3[2]	408097	306468	51.9	87.0	30.4	28.4	34.8
MUC4[2]	408023	306501	38.5	53.2	42.8	34.0	42.5

Site ID	X	Y	Monitored Total NO_2 (µg/m³)	Monitored Road NO_X (µg/m³)	Modelled Road NO_X (µg/m³)	Modelled Total NO_2 Before Adjustment (µg/m³)	Modelled Total NO_2 After Adjustment (µg/m³)
MUC5[2]	408030	306516	46.2	72.1	45.7	35.3	44.2
MUC6[2]	408169	306565	36.8	49.2	22.4	24.6	29.5
SA2[3]	396716	308742	29.4	29.9	20.0	24.7	30.2
SA5[3]	396704	308673	31.9	35.3	18.8	24.1	29.3
SA6[3]	396701	308613	27.6	26.1	18.9	24.1	29.4
HA2[4]	394775	309758	33.2	38.7	21.7	25.2	30.7
HA5[4]	394828	309737	28.8	29.1	21.5	25.1	30.6
HA6[4]	394905	309708	30.4	32.6	22.2	25.5	31.1
268WS[5]	400731	307419	36.9	47.9	35.7	31.5	36.9

1 Adjustment factor of 1.0 applied. 2 Adjustment factor of 1.47 applied. 3 Adjustment factor of 1.58 applied. 4 Adjustment factor of 1.54 applied. 5 Adjustment factor of 1.34 applied.

3.8 Magnitude of change

3.8.1 With regard to road traffic, the change in pollutant concentrations compared to Do Minimum concentrations has been quantified at selected sensitive receptors. The absolute magnitudes of pollutant concentrations in the baseline and Do Minimum scenarios have also been quantified and these have been used to consider the risk of the air quality limit values being exceeded in each scenario.

3.8.2 For a change of a given magnitude (increase or decrease) in pollutant concentrations, IAN 174/13 contains descriptors of the magnitude of change at individual sensitive receptors. For example, a change in predicted annual average concentrations of NO_2 or PM_{10} of less than 0.4µg/m^3 is considered to be so small as to be imperceptible. A change (impact) that is imperceptible, given normal bounds of variation, would not be capable of having a direct effect on local air quality that could be considered to be significant. The magnitude of change is divided into four classes as defined in Table 6.

Table 6: Modelled input parameters

Magnitude of change (µg/m^3)	Value of change in annual average NO_2 and PM_{10}
Large (>4)	Greater than full measure of uncertainty (MoU) value of 10% of the air quality objective (4 µg/m^3)
Medium (>2 to 4)	Greater than half of the MoU (2µg/m^3), but less than the full MoU (4µg/m^3) of 10% of the air quality objective
Small (>0.4 to 2)	More than 1% of 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)	Less than or equal to 1% of the objective (0.4 µg/m^3)

3.8.3 The magnitude of the change in the predicted number of exceedances of the 24-hour objective is directly derived from the predicted annual average value using the relationship defined in LAQM.TG(16) (Defra, 2016b). The magnitude descriptors for 24-hour average PM_{10} are equal to the percentage changes set out above.

3.8.4 Research projects completed on behalf of Defra and the Devolved Administrations by Laxen and Marner in 2003 and AEAT in 2008 have concluded that the hourly average NO_2 objective is unlikely to be exceeded if annual average concentrations are predicted to be less than 60 µg/m^3. Therefore, this assessment evaluates the likelihood of exceeding the hourly average NO_2 objective by comparing predicted annual average NO_2 concentrations at all receptors to an annual average equivalent threshold of 60 µg/m^3 NO_2. Where predicted concentrations are below this value, it can be concluded that the hourly average NO_2 objective (200 µg/m^3 NO_2 not more than 18 times per year) is likely to be achieved.

3.9 Significance of effect

3.9.1 All relevant human receptors that have been selected to represent locations where people are likely to be present are based on potential impacts on human health. The air quality objective values have been set at concentrations that provide protection to all members of society, including more vulnerable groups such as the very young, elderly or unwell. As such, the sensitivity of receptors was considered in the definition of the air quality objective values. Therefore, no additional subdivision of human health receptors on the basis of building or location type is necessary because the receptor sensitivity already takes account of a worst case for effects on human receptors.

3.9.2 The significance of local operational air quality effects for the Scheme is based on the guidance presented in the IAN 174/13, which recommends that key criteria for air quality are considered including:

- Is there a risk that environmental standards will be breached?
- Is there a high probability of the effect occurring?
- Will there be a large change in environmental conditions?
- Will the effect continue for a long time?
- Will many people be affected?
- Is there a risk that protected sites, areas or features will be affected?
- Will it be difficult to avoid, or reduce or repair or compensate for the effect?

3.9.3 Following the collation of information to address the above questions, an informed professional judgement on the significance of local air quality effects for public exposure and nationally designated ecosystems has been established.

3.9.4 The scope of IAN 174/13 includes the assessment of significant local air quality effects for public exposure and European or nationally designated ecosystems only. Changes in regional emissions and the assessment of construction dust impacts continue to be reported as described in DMRB and as described in Section 4 and Appendix 5.4 [TR010054/APP/6.3].

3.10 Overall assessment of significance

3.10.1 The questions set out in paragraph 3.9.2 form the basis for determining likely significant local operational air quality effects for sensitive receptors. The question of how many people would be affected has been addressed by reference to the number of receptors predicted to experience small, medium and large changes in air quality. Where numbers of affected receptors are above the upper thresholds listed in Table 7 for locations above the air quality objective, this may suggest significant air quality effects are more likely.

Table 7: Guideline for number of properties constituting a significant effect (IAN 174/13)

Magnitude of change in NO_2 or PM_{10} ($\mu g/m^3$)	No. of Receptors with:	
	Worsening of air quality already above objective or creation of a new exceedance	Improvement of air quality already above objective or the removal of an existing exceedance
Large (>4)	1 to 10	1 to 10
Medium (>2 to 4)	10 to 30	10 to 30
Small (>0.4 to 2)	30 to 60	30 to 60

3.10.2 The overall significance of predicted effects on local air quality is also evaluated in the context of relevant national (i.e. NPSNN) and local air quality planning policy and the findings of the compliance risk assessment.

3.11 Local air quality compliance risk assessment

3.11.1 The compliance risk assessment considers the potential effect of the Scheme operation upon the future compliance of zones as reported by the Defra to the European Commission.

3.11.2 An assessment of compliance with the EU Directive on Ambient Air Quality (2008/50/EC) has been undertaken using IAN 175/13. The assessment has used the results of the local air quality modelling overlaid on the Defra compliance network provided to Highways England to establish whether, for each road, the change in NO_2 concentrations, would result in:

- a compliant zone becoming non-compliant; and/ or
- delay Defra's date for achieving compliance for the zone i.e. the change on a road link would result in a concentration higher than the existing maximum value in the zone; and/ or
- an increase in the length of roads in exceedance in the zone which would be greater than 1% when compared to the previous road length.

3.11.3 This assessment enables scheme assessors to undertake and report on the risk of a scheme being non-compliant with the EU Directive. The evaluation of significance also includes information on compliance risks in relation to the EU Directive.

3.12 WebTAG plan level assessment

3.12.1 DMRB states that the assessment of air quality in relation to highways schemes should report the results of the local air quality WebTAG appraisal (plan level), as completed in line with the guidance set out by the Air Quality Sub Objective.

3.12.2 The plan level WebTAG appraisal provides an indication of the overall change in operational air quality as associated with the Scheme.

3.12.3 The plan level methodology within the WebTAG guidance aims to quantify the change in exposure at properties in the opening year as a result of a scheme, through the quantification of exposure for all DMRB local affected roads. The methodology follows a number of steps including:

- Identification of the affected road network in the opening year, which is the same as the DMRB local air quality affected road network, and the design year (2039).
- Quantification of the number of properties within 0 - 50 m, 50 - 100 m, 100 – 150 m and 150 - 200 m bands, from the affected roads.
- The calculation of concentrations within each band at 20 m, 70 m, 115 m and 175 m from the road centreline using the DMRB spreadsheet tool.
- Calculation of property weighted NO_2 and $PM_{2.5}$ concentrations.
- Calculation of the total numbers of properties that improve, worsen or stay the same for each pollutant.

- Calculation of an overall assessment score for NO_2 and $PM_{2.5}$.

3.12.4 An overall positive score indicates an overall worsening air quality and an overall negative score indicates an overall improvement.

4 Regional Air Quality Assessment

4.1.1 An assessment of regional emissions of NO_X, PM_{10} and carbon dioxide is undertaken in accordance with DMRB HA207/07 using vehicle emission factors implemented in Defra's Emissions Factor Toolkit (EFT). The key scenarios to be modelled are:

- the existing base situation (2017);
- Do-Minimum and Do-Something for the Scheme in the first full year of opening (expected to be 2024); and
- Do-Minimum and Do-Something for the Scheme in a future year (expected to be 2039).

4.1.2 The results of the regional assessment (annual emissions, change in emissions with the Scheme and distance travelled) are presented in tabular format, together with interpretive text.

4.1.3 The regional assessment is a reporting requirement of DMRB. The regional assessment outcomes do not have defined significance criteria but are presented and described to inform the assessment of overall change.

4.1.4 Both NO_X and PM_{10} regional emissions are reported for the ARN within the TRA however, regional emissions of carbon dioxide are reported for the traffic network as a whole.