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Viking CCS Pipeline

9.29 Technical Note on Air Quality Modelling

Document Reference: EN070008/EXAM/9.29

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a Harbour Energy Company
PINS Reference: EN070008
Planning Act 2008 (as amended)
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 - Regulation 5(2)(q)
Date: June 2024

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Project name:
Viking CCS Pipeline

Project ref:
60668955

From:
GH

Date:
May 2024

Technical Note on Construction Traffic Air Quality Modelling

Subject: Viking CCS Pipeline – Construction Traffic Emissions

Introduction

1. The air quality assessment undertaken for the Viking CCS Pipeline Project, as reported in Environmental Statement Chapter 14 Air Quality [**APP-056**] considered the potential for significant effects to occur using a qualitative approach rather than a quantitative (modelled) approach. This approach was adopted despite some of the predicted increases exceeded the indicative screening criteria levels set by the Institute of Air Quality Management (IAQM) and Environmental Protection UK (EPUK) (Ref 1). Exceedance of the indicative screening criteria does not automatically mean that modelling is required. According to the IAQM planning guidance the screening criteria set out in that guidance are "*precautionary and should be treated as indicative*". The guidance states that they "*function as a sensitive 'trigger' for initiating an assessment in cases where there is a possibility of significant effects arising on local air quality*". There was not considered to be a possibility of significant effects arising for several reasons, which were:

    - the limited number of links affected to any notable level by construction traffic associated with the Proposed Development,
    - the magnitude of change in traffic flows anticipated and their limited duration, and
    - the good standard of existing air quality across the study area.

2. This qualitative approach was therefore considered proportionate given the indicative nature of the IAQM and EPUK screening criteria.

3. During DCO examination, a Relevant Representation submitted by the UK Health Security Agency [RR-113] requested that a quantitative assessment of construction traffic emissions be undertaken, due to the traffic impact of the Project exceeding the indicative screening criteria for detailed assessment set by the IAQM and EPUK, and

screening criteria set by National Highways (Ref 1), on some roads included in the Project's Transport Assessment. The DCO ExA's First Written Questions also requested that such an assessment be undertaken and submitted during the ongoing DCO examination process.

4. In its response to the First Written Questions, the Applicant committed to undertake modelling of the links with exceedances of the IAQM and EPUK trigger values to demonstrate that the qualitative assessment findings were correct. This Technical Note presents the quantitative assessment of construction phase traffic emissions on these links.

Methodology

Overview

5. The quantitative assessment of construction traffic emissions utilised the current version of the dispersion modelling software ADMS Roads (version 5.0.1.3). The assessment predicted the road traffic contribution to total pollutant concentrations of annual mean NO_2, annual mean PM_{10} and annual mean $PM_{2.5}$, at receptors adjacent to key construction traffic routes. Road traffic contributions were predicted for the following scenarios:

   - Existing baseline (2022) - representing existing conditions;
   - Future baseline (2026) – year of peak construction without the Project; and
   - Future construction (2026) – year of peak construction with the Project.

6. Predictions of the road traffic contribution to short-term concentrations of NO_2 and PM_{10} have not been specifically quantified. Instead, reference is made to Defra and IAQM and EPUK guidance (Ref 1, Ref 5), which report that hourly mean NO_2 concentrations are most likely to be in exceedance of the air quality standard when annual mean concentrations are in excess of 60 µg/m^3, and that daily mean PM_{10} concentrations are most likely to be in exceedance of the air quality standard when annual mean concentrations are in excess of 32 µg/m^3.

7. The impact of construction traffic emissions is determined with reference to published guidance based on the quantification of the magnitude of change between the future baseline and future construction scenarios. This process is illustrated in the Figure 1 below.

Figure 1: IAQM/EPUK Impact Descriptors

Long term average Concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

8. The impact descriptors are applied to individual receptors only. The determination of the effect of these impacts is considered collectively across the entire study area, based on professional judgement. Negligible to slight impacts are unlikely to results in

an effect considered to be significant. Moderate impacts may be considered to have a significant effect, subject to the context in which those impacts occur. Isolated locations of moderate impacts may not constitute a significant effect where most other locations experience negligible or slight impacts. Substantial impacts at any sensitive locations will almost certainly result in a significant effect and mitigation is likely to be required to reduce impacts at such locations.

Traffic Data

9. The competent expert in traffic and transport provided traffic data for the construction phase of the Project. This included 24-hour daily average traffic flow, percentage HGV and typical speed for all road links considered in the Transport Assessment. Data was provided for two phases of the construction works – pipe delivery and construction site access. The construction traffic data for both phases was considered to represent a precautionary estimate of traffic impacts as an annual daily average, having been based on daily flows during the peak week of each phase of construction.

10. The traffic data for both pipe delivery and construction site access was screened using the screening criteria published by the IAQM/EPUK and National Highways (Ref 1,Ref 2) and where the screening criteria was exceeded, the maximum traffic impact on each link between the two construction phases was taken forward for assessment. The screening criteria are summarised as follows:

    - IAQM and EPUK guidance:
        - An increase in 2-way Light Duty Vehicles of 500 or more per average day and/or an increase in 2-way Heavy Duty Vehicles of 100 or more per average day outside of an Air Quality Management Area; or
        - An increase in Light Duty Vehicles of 100 or more and/or an increase in Heavy Duty Vehicles of 25 or more inside of an Air Quality Management Area.
    - National Highways guidance
        - An increase in 2-way total vehicle movements of 1000 or more per average day and/or an increase in 2-way Heavy Duty Vehicles of 200 or more per average day.

11. In total across the two construction phases, 10 links were found to exceed IAQM/EPUK screening criteria and of those, four links were also found to also exceed the National Highways screening criteria. Details for these links are provided in Table 1.

12. Of the links that exceeded the traffic screening criteria, only those with air quality sensitive exposure within 200m of them are considered in the quantitative assessment. 200m is the distance within which air quality impacts should be quantified when following the National Highways DMRB guidance (Ref 2), noting that the IAQM/EPUK guidance (Ref 1) does not provide an alternative distance.

Table 1: Links Exceeding IAQM/EPUK and DMRB Screening Criteria

		Do Minimum		Do Something		IAQM/EPUK Screening Criteria		DMRB Screening Criteria	
Link ID	Link Description	AADT Flows	% HDV	AADT Flows	% HDV	LDVs (Change of >500 AADT)	HDVs (Change of >100 AADT)	LDVs (Change of >1000 AADT)	HDVs (Change of >200 AADT)
2	A1173 - Matthew Ford Way	6092	11.0	7190	13.4	**Yes**	**Yes**	No	**Yes**
3	A160 – Humber Road, Harborough R'bout to Mandy R'bout	11260	40.3	11513	40.4	No	**Yes**	No	No
6	A18 – Barton Street	6323	15.5	6846	15.8	No	**Yes**	No	No
12	A18 – Barton Street	5567	17.0	6070	17.3	No	**Yes**	No	No
18	A1173 – Riby Road	3485	16.1	4299	18.9	**Yes**	**Yes**	No	**Yes**
19	A18 – Barton Street North	13039	14.2	13788	14.9	**Yes**	**Yes**	No	**Yes**
20	A18 – Barton Street South	10471	13.2	11118	13.7	**Yes**	**Yes**	No	No
44	A160 – Harborough R'bout to Brocklesby Interchange	15037	41.5	15302	41.6	No	**Yes**	No	No
78	A180 – Between A1173 and A160	22715	9.6	23620	10.5	**Yes**	**Yes**	No	**Yes**

		Do Minimum		Do Something		IAQM/EPUK Screening Criteria		DMRB Screening Criteria	
Link ID	Link Description	AADT Flows	% HDV	AADT Flows	% HDV	LDVs (Change of >500 AADT)	HDVs (Change of >100 AADT)	LDVs (Change of >1000 AADT)	HDVs (Change of >200 AADT)
80	Rosper Road	3800	41.7	4053	41.9	No	**Yes**	No	No

Receptors

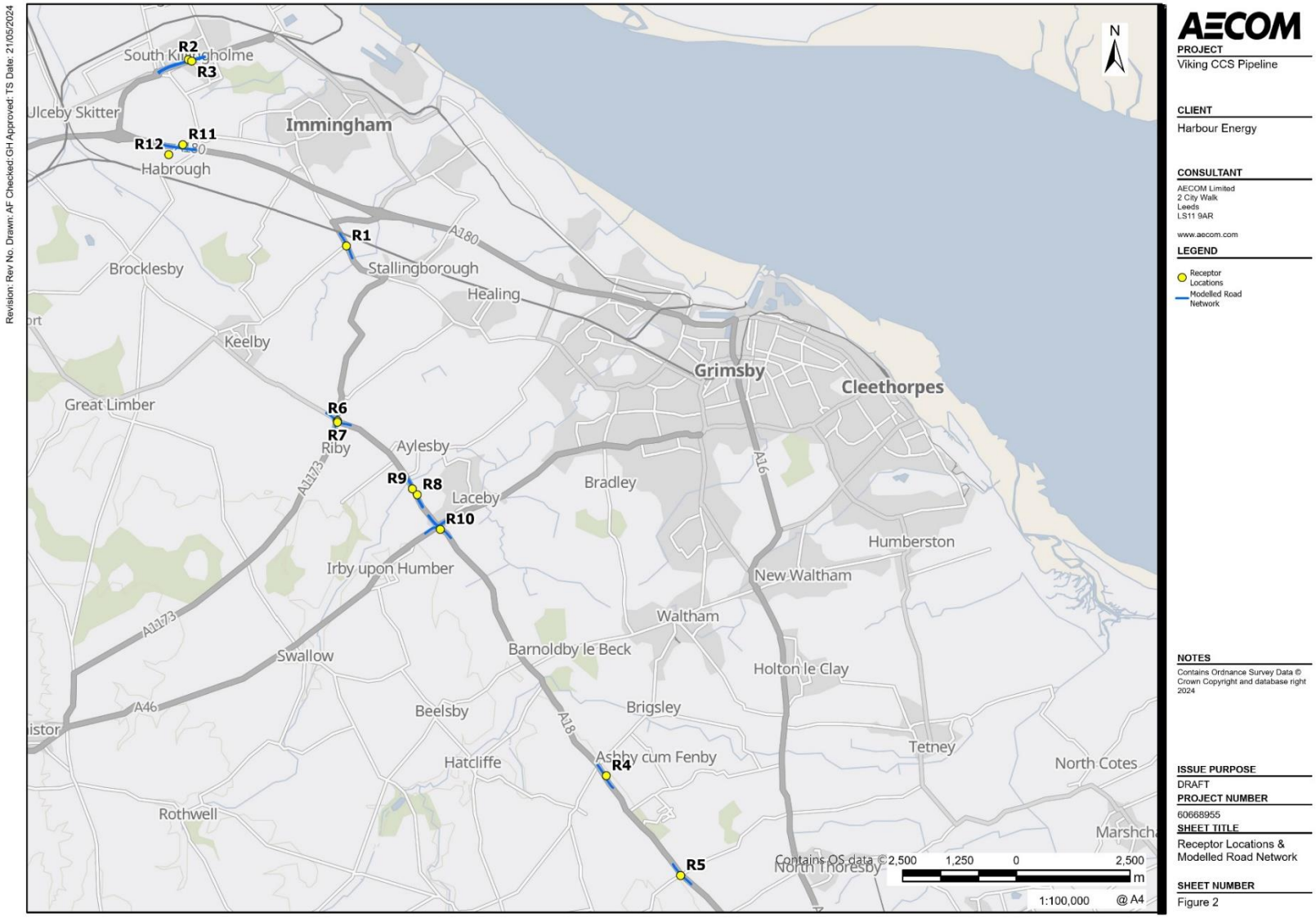
13. Having identified the links that exceed the relevant screening criteria, aerial photography of these sections of road was reviewed to identify those that had air quality sensitive exposure (e.g. residential property, schools, or medical facilities) within 200m of them. The following road links that exceeded the screening criteria did not have relevant air quality exposure within 200m of them and therefore they have not been included in the quantitative assessment.

    - A160 - Between Harborough Roundabout and Brocklesby Interchange (link 44 in Table 1); and
    - Rosper Road (link 80 in Table 1).

14. Of the road links that did have sensitive exposure within 200m of them, the nearest receptor to each of the roads was taken forward for assessment, to present likely worst-case impacts. The locations of these receptors are shown in

15. Figure 2. Modelled road links were extended beyond 200m of each adjacent receptor to comply with the distance criteria set by the National Highways DMRB guidance (Ref 2) .

Figure 2: Receptor Locations and Modelled Road Network



Background Pollutant Concentration Data

16. The dispersion model predicts the road traffic contribution to pollutant concentrations at each receptor. To report total pollutant concentrations for comparison against the air quality objectives, these predicted contributions are added to a background pollutant concentration.

17. Defra publishes maps of background pollutant concentrations for each 1km x 1km grid square covering the whole of the UK (Ref 3). The most recent release of the background maps uses 2018 baseline data as the reference year, and provides projections of background concentrations of NO_2, PM_{10} and $PM_{2.5}$ from 2018 to 2030.

18. The background pollutant concentrations used to inform this quantitative assessment are shown in Table 2. They are based on the assessment years of 2022 (existing baseline) and 2026 (year of peak construction with and without the Project).

Table 2: Background Pollutant Concentrations

		2022 Annual Mean Concentration (µg/m^3)				2026 Annual Mean Concentration (µg/m^3)			
Receptor	Background Grid Cell (x,y)	NO_2	NO_X	PM_{10}	$PM_{2.5}$	NO_2	NO_X	PM_{10}	$PM_{2.5}$
R1	514500, 415500	9.8	12.9	16.7	9.0	8.9	11.6	16.3	8.7
R2	515500, 416500	10.3	13.6	14.3	8.4	9.3	12.3	13.9	8.1
R3	515500, 416500	10.3	13.6	14.3	8.4	9.3	12.3	13.9	8.1
R4	524500, 400500	8.1	10.4	15.2	8.2	7.3	9.3	14.7	7.8
R5	526500, 398500	7.8	10.1	15.1	8.1	7.1	9.1	14.6	7.8
R6	518500, 408500	8.7	11.4	15.4	8.3	7.8	10.1	14.9	7.9
R7	518500, 408500	8.7	11.4	15.4	8.3	7.8	10.1	14.9	7.9
R8	520500, 406500	9.3	12.2	15.3	8.3	8.4	10.9	14.9	7.9
R9	520500, 406500	9.3	12.2	15.3	8.3	8.4	10.9	14.9	7.9
R10	520500, 405500	8.9	11.6	15.2	8.2	8.0	10.4	14.8	7.9
R11	515500, 414500	9.9	13.1	16.3	8.8	9.1	11.9	15.9	8.4
R12	514500, 414500	9.6	12.7	16.6	8.9	8.7	11.4	16.2	8.6

Meteorological Data

19. One year (2022) of hourly sequential observation data from Humberside Airport meteorological station has been used in this assessment. The station is approximately 3-4km to the southwest of the sections of study area in South Killingholme and Habrough, 5-7km to the west-northwest of the sections of the study area in Riby and Laceby, and 11-12km to the northwest of the sections of the study area at Ashby Hill. It is considered that this meteorological station is a representative dataset of conditions experienced within those areas.

Model Verification

20. When using modelling techniques to predict pollutant contributions at specific locations, it is necessary to make a comparison between the dispersion model outputs and any available roadside monitoring data, to ensure that the model is reproducing actual observations as closely as possible. Modelling results are subject to systematic and random error; such errors arise due to many factors, such as uncertainty in the traffic data, the composition of the vehicle fleet, the representativeness of the meteorological dataset to localised conditions, and the presence of existing emissions sources not fully accounted for in the model.

21. Where systematic bias is evident in the base year verification, modelled results are factored to better match the monitoring data and reduce the overall uncertainty in the model predictions. The accuracy of the future year modelling results is relative to the accuracy of the base year results, therefore greater confidence can be placed in the future year concentrations if good agreement is found for the baseline year.

22. The verification exercise undertaken to inform this quantitative assessment was based on Defra's Local Air Quality Management - Technical Guidance (LAQM TG22) (Ref 5). The verification exercise was limited to sections of the modelled road network where existing baseline monitoring data was available.

23. Annual mean nitrogen dioxide (NO_2) concentrations were predicted at the three monitoring sites located within the study area in 2022, which were considered suitable for use in model verification. These monitoring locations were all situated adjacent to the A160. The concentrations were then compared against the monitored concentrations for that same year. Adjustment factors were derived to bring modelled concentrations into line with monitored concentrations, where necessary. This process is summarised in Table 3.

Table 3: Model Verification

Diffusion Tube ID	Pre-adjustment Modelled		Monitored		Pre-adjustment Comparison		Road NO_X Adjustment Factor		Post-adjustment Modelled		Post-adjustment Comparison	
	Total NO_2	Road NO_X	Total NO_2	Road NO_X	Total NO_2	Road NO_X	Per Location	Ave	Total NO_2	Road NO_X	Total NO_2	Road NO_X
DT14	4.1	12.1	26.1	31.3	-53.7	-87%	7.55	7.84	26.7	32.5	2.2	4%
DT15	1.7	11.2	16.7	11.9	-32.8	-85%	6.81		17.7	13.7	5.7	15%
DT16	2.9	11.9	23.8	25.8	-50.1	-89%	8.79		22.4	23.0	-5.8	-11%

24. Pre-adjustment, the dispersion model underpredicted total NO_2 concentrations and road NO_X contributions. To account for the underprediction, a factor of 7.84 was calculated. Such a factor is higher than often desirable, but review of model inputs suggested that no additional detail could make the model perform better at the locations of the monitoring data.

25. Following the application of the adjustment factor to the modelled road NO_X contributions, the model performed a lot better, with post-adjustment total NO_2 concentrations within 6% of monitored concentrations.

26. Whilst the adjustment factor calculated was higher than desired, the Root Mean Square Error (RMSE) calculation is used to demonstrate if the verification of a model is robust. According to Defra guidance, the RMSE value should be within 25% of the air quality standards (which equates to 10 µg/m^3) and ideally within 10% (which equates to 4 µg/m^3). The RMSE of the pre-adjustment model was 11 µg/m^3. The RMSE of the post-adjustment model was 1 µg/m^3. Following adjustment, the model is considered to be robust.

27. It should be noted that the three monitoring locations use to inform the assessment are all located adjacent to the A160 Humber Road. No monitoring locations were present on any of the other road links identified within the study area. As such, it has been assumed that the performance of the model at locations adjacent to the A160 is representative of model performance at locations adjacent to the other links considered in the assessment, including sections of the A1173, A180 and A18. Given the elevated factor calculated, it is considered likely that this will represent a precautionary approach at these other locations.

28. In the absence of appropriate PM10 and PM2.5 monitoring within the study area, the adjustment factors calculated for NO2 were applied to modelled PM10 and PM2.5¬ outputs, as recommended in LAQM TG(22) (Ref 5).

Results

29. Predicted pollutant concentrations at selected sensitive receptors for the “Base”, “Do Minimum” and “Do Something” scenarios are provided in Table 4, Table 5 and Table 6.

Table 4: Modelled NO_2 Concentrations at Receptors

Receptor	2022 Base Modelled NO_2 Concentration (µg/m^3)	2026 DM Modelled NO_2 Concentration (µg/m^3)	2026 DS Modelled NO_2 Concentration (µg/m^3)	Change in annual mean NO_2 Concentration (µg/m^3)
R1	12.3	10.6	10.9	+0.3
R2	21.1	15.6	15.7	+0.1
R3	19.8	14.9	15.0	+0.1
R4	12.4	10.0	10.3	+0.2
R5	10.3	8.6	8.8	+0.1

Receptor	2022 Base Modelled NO_2 Concentration ($\mu g/m^3$)	2026 DM Modelled NO_2 Concentration ($\mu g/m^3$)	2026 DS Modelled NO_2 Concentration ($\mu g/m^3$)	Change in annual mean NO_2 Concentration ($\mu g/m^3$)
R6	28.7	20.8	21.4	+0.6
R7	22.3	16.6	16.9	+0.3
R8	21.5	16.2	16.3	+0.1
R9	17.3	13.5	13.5	+0.1
R10	20.4	15.4	15.8	+0.3
R11	18.3	14.3	14.4	<+0.1
R12	11.0	9.6	9.6	<+0.1

30. Table 4 shows the following:

- Existing baseline, future baseline and future construction phase concentrations are well below the air quality objective (40 µg/m3) and there is considered to be no risk of an exceedance occurring.
- The construction of the Project does not cause an exceedance of the air quality standard, nor does it make an existing exceedance worse.
- Based on the magnitude of change predicted and total concentrations at all receptors, the impact of the construction of the Project on annual mean NO2 is described as negligible and the effect is not significant.
- Annual mean concentrations are below the 60 µg/m3 indicator to suggest that the hourly mean air quality objective is not exceeded in any scenario.

Table 5: Modelled PM_{10} Concentrations at Receptors

Receptor	2022 Base Modelled PM_{10} Concentration ($\mu g/m^3$)	2026 DM Modelled PM_{10} Concentration ($\mu g/m^3$)	2026 DS Modelled PM_{10} Concentration ($\mu g/m^3$)	Change in annual mean PM_{10} Concentration ($\mu g/m^3$)
R1	16.5	16.1	16.3	+0.2
R2	18.1	17.8	18.6	+0.8
R3	17.6	17.3	18.0	+0.7
R4	16.6	16.2	16.3	+0.1
R5	15.9	15.5	15.5	+0.1
R6	21.6	21.4	21.8	+0.4

Receptor	2022 Base Modelled PM_{10} Concentration ($\mu g/m^3$)	2026 DM Modelled PM_{10} Concentration ($\mu g/m^3$)	2026 DS Modelled PM_{10} Concentration ($\mu g/m^3$)	Change in annual mean PM_{10} Concentration ($\mu g/m^3$)
R7	19.5	19.2	19.4	+0.2
R8	19.0	18.5	18.7	+0.2
R9	17.7	17.3	17.4	+0.1
R10	18.6	18.2	18.4	+0.2
R11	18.2	17.7	17.8	+0.1
R12	16.9	16.5	16.5	<+0.1

31. Table 5 shows the following:

- Existing baseline, future baseline and future construction phase concentrations are well below the air quality objective (40 µg/m3) and there is considered to be no risk of an exceedance occurring.
- The construction of the Project does not cause an exceedance of the air quality standard, nor does it make an existing exceedance worse.
- Based on the magnitude of change predicted and total concentrations at all receptors, the impact of the construction of the Project on annual mean PM10 is described as negligible and the effect is not significant.
- Annual mean concentrations are below the 32 µg/m3 indicator to suggest that the daily mean air quality objective is not exceeded in any scenario.

Table 6: Modelled $PM_{2.5}$ Concentrations at Receptors

Receptor	2022 Base Modelled $PM_{2.5}$ Concentration ($\mu g/m^3$)	2026 DM Modelled $PM_{2.5}$ Concentration ($\mu g/m^3$)	2026 DS Modelled $PM_{2.5}$ Concentration ($\mu g/m^3$)	Change in annual mean $PM_{2.5}$ Concentration ($\mu g/m^3$)
R1	9.0	8.6	8.7	+0.1
R2	10.5	10.2	10.6	+0.4
R3	10.3	9.9	10.3	+0.4
R4	9.0	8.6	8.7	+0.1
R5	8.6	8.2	8.3	<+0.1
R6	11.8	11.4	11.7	+0.2
R7	10.6	10.3	10.4	+0.1

Receptor	2022 Base Modelled $PM_{2.5}$ Concentration ($\mu g/m^3$)	2026 DM Modelled $PM_{2.5}$ Concentration ($\mu g/m^3$)	2026 DS Modelled $PM_{2.5}$ Concentration ($\mu g/m^3$)	Change in annual mean $PM_{2.5}$ Concentration ($\mu g/m^3$)
R8	10.3	9.9	10.0	+0.1
R9	9.6	9.2	9.3	+0.1
R10	10.1	9.7	9.8	+0.1
R11	9.8	9.5	9.5	<+0.1
R12	9.1	8.7	8.7	<+0.1

32. Table 6 shows the following:

- Existing baseline, future baseline and future construction phase concentrations are well below the air quality objective (20 µg/m3) and there is considered to be no risk of an exceedance occurring.
- The construction of the Project does not cause an exceedance of the air quality standard, nor does it make an existing exceedance worse.
- Based on the magnitude of change predicted and total concentrations at all receptors, the impact of the construction of the Project on annual mean PM2.5 is described as negligible, and the effect is not significant.

Conclusions

33. Project construction phase traffic data has been screened to identify links which exceed the screening criteria set out in IAQM and EPUK guidance and National Highways guidance.

34. Road links that exceeded the screening criteria have been modelled where there is sensitive air quality exposure within 200m of those links.

35. The modelling has determined that the impact of Project construction traffic emissions is negligible for all pollutants considered at all receptors considered. The effect of such an impact is not considered to be significant.

36. The quantitative assessment reported in this Technical Note confirms the conclusions reported in ES Chapter 14 Air Quality [**APP-056**]. Construction phase road traffic emissions impacts would not have a significant effect on local air quality.

References

Ref 1: Institute of Air Quality Management/Environmental Protections UK (2017). *Land-Use Planning & Development Control: Planning For Air Quality*

Ref 2: National Highways (2019). *LA105 'Air Quality'*

Ref 3: DEFRA (2024). *Air Quality Assessment*, available at: https://laqm.defra.gov.uk/air-quality-assessment/

Ref 4: DEFRA (2024). *UK Air Quality Limits*, available at: https://uk-air.defra.gov.uk/air-pollution/uk-limits.php

Ref 5: Defra (2022). *Local Air Quality Management Technical Guidance (TG22).*