NORTH FALLS

Offshore Wind Farm

ENVIRONMENTAL STATEMENT

Appendix 20.4 Detailed Modelling Assessment Methodology – Human Receptors

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Glossary of Acronyms

AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System for Roads
Defra	Department for the Environment Food and Rural Affairs
EPUK	Environmental Protection UK
EFT	Emissions Factor Toolkit
IAQM	Institute of Air Quality Management
RMSE	Root Mean Square Error

Glossary of Terminology

The Applicant	North Falls Offshore Wind Farm Limited (NFOW)
The Project or 'North Falls'	North Falls Offshore Wind Farm, including all onshore and offshore infrastructure
Onshore project area	The boundary in which all onshore infrastructure required for the Project will be located (i.e. landfall; onshore cable route, accesses, construction compounds; onshore substation and national grid substation extension), as considered within the PEIR.

1 Introduction

1. The detailed assessment methodology used to assess the likely significant effect of exhaust emissions from construction-generated road vehicles accessing the onshore project area is described below.

2 Dispersion model

2. Dispersion modelling was completed using the Atmospheric Dispersion Modelling System for Roads (ADMS-Roads) v5.0.1.3. The main pollutants of concern for human health as a result of vehicle emissions are annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$. Concentrations of these pollutants were therefore the focus of the ADMS-Roads assessment.

3 Traffic data

3. Twenty-four-hour Annual Average Daily Traffic (AADT) flows and HGV percentages were derived for the worst-case construction year. The traffic data for the assessment is detailed in ES Appendix 20.2 Air Quality Assessment Traffic Data (Document Reference: 3.3.24).

4. Traffic speeds were included in the air dispersion model as follows:

   - Large roundabouts were modelled at 40km/h;
   - Small roundabout and queues were modelled at 20km/h; and
   - Speed data for free-flowing traffic conditions were obtained from average speeds recorded during the traffic count surveys (discussed in ES Chapter 27 Traffic and Transport (Document Reference: 3.1.29)) where applicable, or national speed limits.

4 Emission factors

5. Emission factors were obtained from the Emission Factor Toolkit (EFT) v12.0.1 provided by the Department for the Environment Food and Rural Affairs (Defra) (Defra, 2023). 2022 emission factors were used in the verification/base year assessment and emission factors for 2027 were used in the future year 'without North Falls' and 'with North Falls' scenarios.

6. There has historically been uncertainty in the future vehicle emissions projections in previous versions of the EFT, particularly v8.0 and earlier. However, evidence was published to suggest that v9.0 of the EFT onwards provide a reasonable prediction of vehicle emissions into the future and therefore sensitivity testing is not required (Air Quality Consultants, 2020). Given this evidence, the use of 2027 emission factors in the assessment are considered to be appropriate.

7. The use of future year emission factors has been agreed with the Environmental Protection Officer at Tendring District Council during discussions held as part of the evidence plan process (pers. comm., 9 November 2022).

5 Meteorological data

8. The two closest meteorological stations to the onshore project area are Wattisham and Shoeburyness, located 31.6km to the north-west and 39.4km to the south-west respectively. Wattisham station is located considerably further inland than the study area and the difference in elevation is 61.3m. Shoeburyness station borders the coastline and therefore the meteorological conditions experienced will be heavily influenced by the North Sea.

9. The next closest station is at Southend, located 43km to the south-west, with an elevation difference of -10.7m. This station is located 12km from the coastline, which is expected to be more representative of the general study area. The missing data in 2022 was 1.3%, and therefore data from the Southend station is considered to be more representative of the overall study area.

10. The use of Southend recording station data has been agreed with the Environmental Protection Officer at Tendring District Council during discussions held as part of the evidence plan process (pers. comm., 9 November 2022).

11. Plate 5.1 shows the wind rose of meteorological conditions recorded at the Southend station in 2022. The prevailing wind direction recorded was from the south-west.

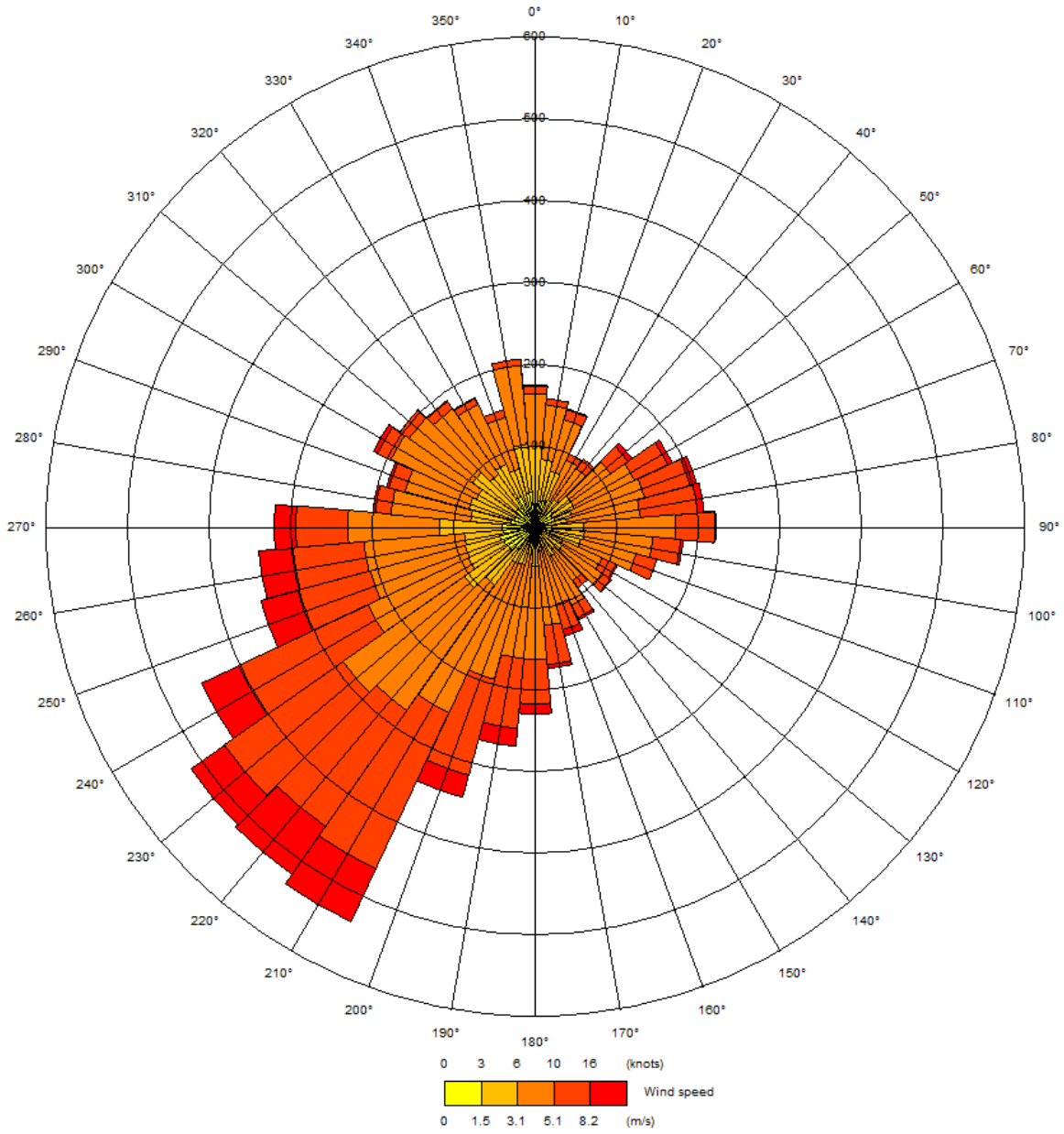

Plate 5.1 Southend Recording Station Wind Rose (2022)

6 Surface Roughness

12. Surface roughness is a value (in metres) which is used to modify the wind profile within the model to represent the spatial density, orientation and height of obstacles on the Earth's surface to the approaching wind. A surface roughness of 0.3m was selected to represent the study area as well as the met site which is representative of 'Agricultural areas (max)'.

7 Model verification

13. Model verification is the process of adjusting model outputs to improve the consistency of modelling results with respect to available monitored data. In this

assessment, model uncertainty has been minimised following Defra (2022) and Institute of Air Quality Management (IAQM) and Environmental Protection UK (EPUK) (2017) guidance.

14. Dispersion models may perform differently at background, roadside, and kerbside sites. Therefore, as the assessment is mainly concerned with predicted pollutant concentrations near the roadside, only roadside monitoring sites located within the study area were used for the purpose of model verification and adjustment.

15. Monitoring locations within the study area were reviewed to establish the suitability for use in model verification. This includes sites operated by Tendring District Council and Colchester Borough Council. Locations were considered where the assessed road links provided sufficient representation of road traffic sources that would affect monitored concentrations at that point. Monitoring locations that were situated in proximity to several road links for which traffic data were not provided were discounted on the basis that modelled concentrations would be underestimated.

16. A review of the monitoring data identified four roadside NO_2 diffusion tubes located on the considered road network with available data for 2022. These diffusion tubes and the reason for their inclusion or exclusion in the verification process are detailed in Table 1.

Table 1 Model verification diffusion tubes

Local Authority	Site ID	Site Description	Site Type (from TDC's ASR)	Included or Excluded	Reasoning
Tendring District Council	DT14	Bypass A133	Roadside	Included	DT14 is located on Link 22. Link 22 has not been screened in for further assessment; however, due to the absence of suitable verifications sites, Link 22 was included for the purpose of model verification. From satellite imagery the diffusion tube appears to be located within 1m of the kerb of A133 adjacent to tall mature vegetation. With reference to the Defra Technical Guidance (Defra, 2022), this site would therefore be classed as a kerbside site. Kerbside sites are generally not recommended for the adjustment of road traffic modelling results as the inclusion of these sites may lead to an over-adjustment of modelling at roadside sites. However, the classification allocated by Tendring District Council has been retained and the site has been included in the verification process as this provides a robust, conservative assessment. A large hedgerow around 6m in height lines either side of the A133

Local Authority	Site ID	Site Description	Site Type (from TDC's ASR)	Included or Excluded	Reasoning
					adjacent to DT14. As per TG22 (Defra, 2022) vegetation can modify wind flow locally and alter dispersion. Therefore, a street canyon was used along Link 22 to replicate the impact of the vegetation on monitored concentrations.
	DT20	A120	Roadside	Included	DT20 is located on Link 16. The diffusion tube is located between the two lanes of the A120 dual carriageway and within 1m of the kerb of the west bound lane. With reference to Defra Technical Guidance (Defra, 2022), this site would therefore be classed as a kerbside site. As mentioned above, kerbside sites are generally not recommended for the adjustment of road traffic modelling; however, the site has been included to provide a robust assessment.
Chichester Borough Council	CBC131	Lucy Lane North	Roadside	Included	CBC131 is located north of the A120. The site is a suitable roadside monitor.
	CBC132	Lucy Lane South	Roadside	Included	CBC132 is located north of the A120. The site is a suitable roadside monitor.

17. Details of the NO_2 model verification process, undertaken using 2022 monitoring data, are provided in Table 2.

Table 2 Model verification (the adjustment factor is highlighted in bold)

Model Verification	NO_2 Monitoring Location			
	DT14	DT20	CBC131	CBC132
2022 Annual Mean Monitored Total NO_2 Concentration (µg m^{-3})	23.8	15.9	24.5	22.6
2022 Annual Mean Background NO_2 Concentration (µg m^{-3})	7.9	7.8	12.8	12.8
Monitored Road Contribution NOx (total - background) (µg m^{-3})	30.2	15.0	22.4	18.6
Modelled Road Contribution NOx (excludes background) (µg m^{-3})	17.8	8.7	12.0	11.4
Ratio of Monitored Road Contribution NOx / Modelled Road Contribution NOx	1.7	1.7	1.9	1.6

Model Verification	NO_2 Monitoring Location			
	DT14	DT20	CBC131	CBC132
Adjustment Factor for Modelled Road Contribution	**1.7**			
Adjusted Modelled Road Contribution NOx (µg m^{-3})	31.1	15.2	21.1	19.9
Modelled Annual Mean Total NO_2 (based on empirical NOx / NO_2 relationship) (µg m^{-3})	24.0	15.9	23.7	23.1
2022 Monitored Annual Mean Total NO_2 (µg m^{-3})	23.8	15.9	24.5	22.6
% Difference [(modelled - monitored) / monitored] x 100	1%	0%	-3%	2%

18. The Root Mean Square Error (RMSE) is "used to define the average error or uncertainty of the model" and should be within the ideal value of 4µg m^{-3} (i.e. 10% of the annual mean NO_2 Objective of 40µg m^{-3}), as specified in Defra technical guidance (TG22) (Defra, 2022). If the RMSE value is higher than ± 25% of the Objective (i.e. 10µg m^{-3}), Defra guidance recommends that model inputs and verification should be revised. The RMSE of the model was 1µg m^3. Model performance in this assessment was therefore considered to be suitable, as the RMSE was within the ideal value.

19. There is no monitoring of PM_{10} and $PM_{2.5}$ carried out along the links included in the air quality assessment. Therefore, the derived NOx adjustment factor has been applied to the modelled PM_{10} and $PM_{2.5}$ concentrations to provide a conservative assessment (in accordance with guidance in LAQM TG(22) (Defra, 2022)).

8 NOx to NO_2 conversion

20. NOx concentrations were predicted using the ADMS-Roads model. The modelled road contribution of NOx at the identified receptor locations was then converted to NO_2 using the NOx to NO_2 calculator (v8.1) (Defra, 2020b), in accordance with Defra guidance (Defra, 2022).

9 Calculation of short-term pollutant concentrations

21. Defra guidance (Defra, 2022) sets out the method for the calculation of the number of days, in which the PM_{10} 24-hour Objective is exceeded, based on a relationship with the predicted PM_{10} annual mean concentration. The relevant calculation utilised in the prediction of short-term PM_{10} concentrations is:

$$No.\,24\ hour\ mean\ exceedance = -18.5 + 0.00145\ x\ (annual\ mean)^3 + (\frac{206}{annual\ mean})$$

22. Research projects completed on behalf of Defra and the Devolved Administrations (Laxen and Marner, 2003; AEA Technology, 2008) concluded that the hourly mean NO_2 Objective is unlikely to be exceeded if annual mean concentrations are predicted to be less than 60 µg m^{-3}. This value has therefore been used as an annual mean equivalent threshold to evaluate likely exceedance of the hourly mean NO_2 Objective.

10 References

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HARNESSING THE POWER OF NORTH SEA WIND

North Falls Offshore Wind Farm Limited

A joint venture company owned equally by SSE Renewables and RWE.

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