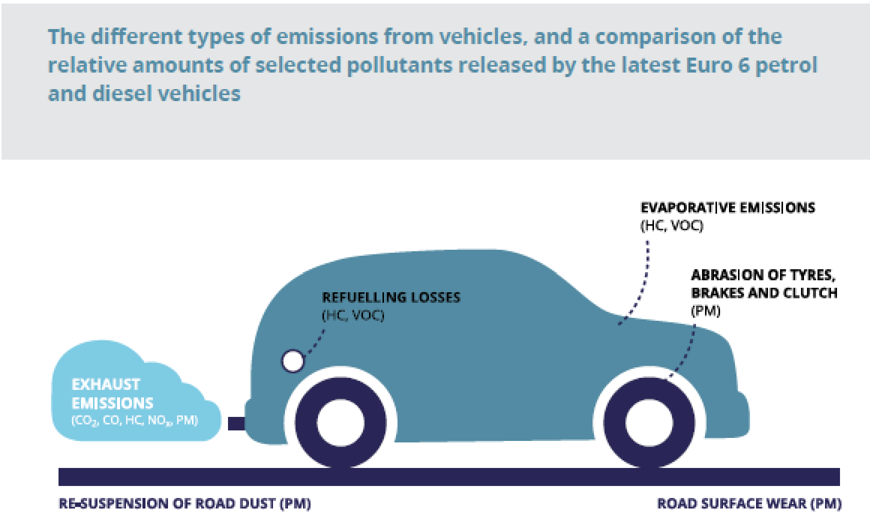
Appendix 9.1 – Operational Assessment

1 Atmospheric Dispersion Modelling Methodology

Summary of Key Pollutants Considered

1.1 For the operational phase of the proposed development, the main pollutants from road traffic with potential for local air quality impacts are nitrogen oxides (NO_x) and particulate matter (PM_{10}). Emissions of total NO_x from combustion sources comprise nitric oxide (NO) and NO_2. The NO oxidises in the atmosphere to form NO_2. The assessment of operational impacts therefore focuses on changes in NO_2 and PM_{10} concentrations. The impact from fine particulate matter, known as $PM_{2.5}$ (a subset of PM_{10}) concentrations has also been considered.

Figure 1.1 Types of Vehicle Emissions

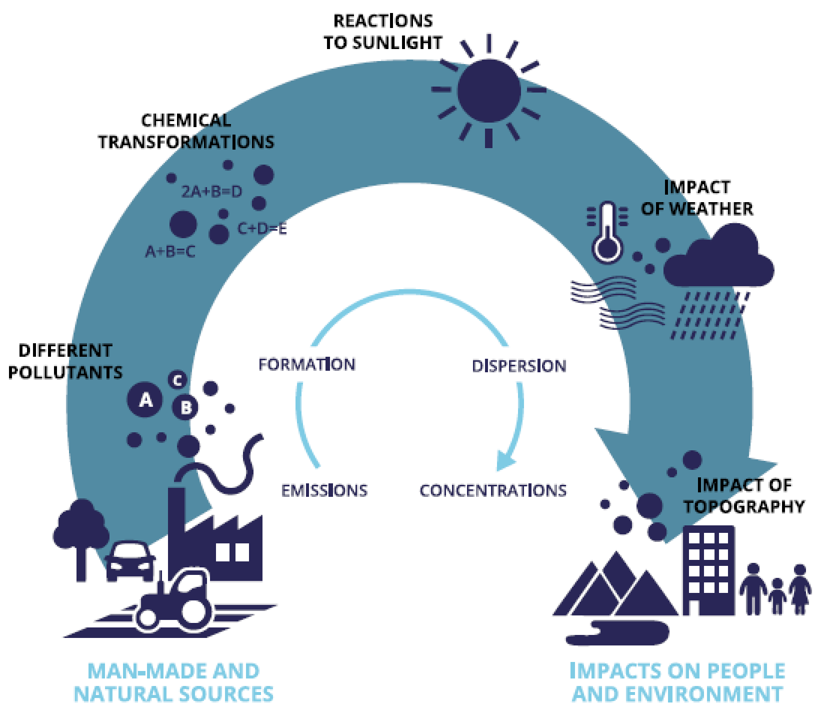


Source: European Environment Agency (2016) Explaining Road Transport Emissions: A Non-technical Guide

Atmospheric Dispersion Modelling of Pollutant Concentrations

1.2 In urban areas, pollutant concentrations are primarily determined by the balance between pollutant emissions that increase concentrations, and the ability of the atmosphere to reduce and remove pollutants by dispersion, advection, reaction and deposition. An atmospheric dispersion model is used as a practical way to simulate these complex processes; such a model requires a range of input data, which can include emissions rates, meteorological data and local topographical information. The model used and the input data relevant to this assessment are described in the following sub-sections.

Figure 1.2 Air Pollution: From Emissions to Exposure



Source: European Environment Agency (2016) Explaining Road Transport Emissions: A Non-technical Guide

1.3 The atmospheric pollutant concentrations in an urban area depend not only on local sources at a street scale, but also on the background pollutant level made up of the local urban-wide background, together with regional pollution and pollution from more remote sources brought in on the incoming air mass. This background contribution needs to be added to the fraction from the modelled sources, and is usually obtained from measurements or estimates of urban background concentrations for the area in locations that are not directly affected by local emissions sources.

1.4 The ADMS-Roads model has been used in this assessment to predict the air quality impacts from changes in traffic on the local road network. This is a version of the Atmospheric Dispersion Modelling System (ADMS), a formally validated model developed in the UK by Cambridge Environmental Research Consultants Ltd (CERC) and widely used in the UK and internationally for regulatory purposes.

Model Input Data

Meteorological Data

1.5 ADMS-Roads requires detailed meteorological data as an input. The most representative observing station for the region of the study area that supplies all the data in the required format is Milford Haven approximately 7 km west of the application site. Meteorological data from that station for 2018 have been used within the dispersion model. The wind rose is presented in Figure 9.1.1.

Traffic Data

1.6 Traffic data used in the assessment have been provided by the project's transport consultants. The traffic flow data provided for the operational assessment are summarised in Table 9.1.1 below.

Table 9.1.1 Traffic Data Used Within the Assessment (2020)

	Road Link	Without Development Traffic		With Development Traffic		Speed Limit kph
		24-hr Annual Average Daily Traffic flow	%HGV	24-hr Annual Average Daily Traffic flow	%HGV	
	Admiralty Way/ Site access					
1	Admiralty Way	466	0.0%	466	0.0%	48
2	Meyrick Owen Way	1285	7.1%	2299	7.1%	48
3	Admiralty Way south	889	10.6%	889	10.6%	48
4	Whites Farm Way	964	4.6%	1978	4.6%	48
	Fort Road/ Admiralty Way					
5	Fort Road	685	5.4%	685	5.4%	48
6	Admiralty Way	922	1.0%	922	1.0%	48
7	Melville Street	1285	5.1%	1285	5.1%	48
8	Melville Terrace	661	4.2%	661	4.2%	48
	Melville Street mini roundabout					
9	Market Street north	1830	1.9%	1989	1.9%	48
10	Melville Street east	2025	2.6%	2184	2.6%	48
11	Market Street south	65	0.0%	65	0.0%	48
12	Melville Street west	1006	5.6%	1006	5.6%	48
	Meyrick Owen Way					
13	Meyrick Owen Way (w)	1616	18.4%	2630	18.4%	48
14	Market street	1914	3.8%	2073	3.8%	48
15	Meyrick Owen Way (east)	3455	12.6%	4469	12.6%	48
	Pembroke Street mini roundabout					
16	Market street	2626	2.0%	2785	2.0%	48
17	B4322	3576	1.6%	3894	1.6%	48
18	Pembroke Street north	2030	2.3%	2189	2.3%	48
	Gate One Access					
19	Front Street	70	6.4%	394	6.4%	48
20	Gate One Access	689	29.7%	689	29.7%	16
21	Western Way	5396	6.9%	5720	6.9%	48
22	Commercial Row	5075	5.3%	5723	5.3%	48
	Western Way roundabout					
23	Western Way	6135	4.4%	6734	4.4%	48
24	Pier Road	2809	3.5%	2858	3.5%	48
25	A4139 London Road	8798	4.5%	9350	4.5%	48
26	B4322	4960	3.0%	4960	3.0%	48
27	Tremeyrick Way	4035	0.9%	4084	0.9%	48
	Waterloo Road roundabout					

	Road Link	Without Development Traffic		With Development Traffic		Speed Limit kph
		24-hr Annual Average Daily Traffic flow	%HGV	24-hr Annual Average Daily Traffic flow	%HGV	
28	Waterloo Road	12018	5.4%	12268	5.4%	48
29	A4139 London Road east	18570	4.8%	18871	4.8%	48
30	A4139 London Road west	11065	2.9%	11616	2.9%	48

1.7 The average speed on each road has been reduced by 10 $km.hr^{-1}$ near receptors to take into account the possibility of slow-moving traffic near junctions and at roundabouts in accordance with LAQM.TG16.

1.8 The modelled road links are illustrated in Figure 9.2 of Volume 1 of the Environmental Statement. Traffic generated by the development is not expected to travel as far as Westgate Hill AQMA.

Traffic Emission Factors

1.9 The modelling has been undertaken using Defra's 2017 emission factor toolkit (version 8.0) which draws on emissions generated by the European Environment Agency (EEA) COPERT 5 emission calculation tool.

Receptors

1.10 The air quality assessment predicts the impacts at locations that could be sensitive to any changes. For assessing human-health impacts, such sensitive receptors should be selected where the public is regularly present and likely to be exposed over the averaging period of the objective. LAQM.TG16 provides examples of exposure locations and these are summarised in Table 9.1.2 below.

Table 9.1.2 Examples of Where Air Quality Objectives Apply

Averaging Period	Objectives should apply at:	Objectives should generally not apply at:
Annual-mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building's façades), or any other location where public exposure is expected to be short-term.
Daily-mean	All locations where the annual-mean objective would apply, together with hotels. Gardens of residential properties.	Kerbside sites (as opposed to locations at the building's façade), or any other location where public exposure is expected to be short-term.

Averaging Period	Objectives should apply at:	Objectives should generally not apply at:
Hourly-mean	All locations where the annual and 24 hour mean would apply. Kerbside sites (e.g. pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations to which the public might reasonably be expected to spend 1-hour or longer.	Kerbside sites where the public would not be expected to have regular access.

1.11 The approaches used to predict the concentrations for these different averaging periods are described below.

Long-Term Pollutant Predictions

1.12 Annual-mean NOx and PM_{10} concentrations have been predicted at representative sensitive receptors using ADMS-Roads, then added to relevant background concentrations. Primary NO in the NOX emissions is converted to NO_2 to a degree determined by the availability of atmospheric oxidants locally and the strength of sunlight. For road traffic sources, annual-mean NO_2 concentrations have been derived from the modelled road-related annual-mean NO_x concentration using Defra's calculator [1].

Short-Term Pollutant Predictions

1.13 In order to predict the likelihood of exceedances of the hourly-mean AQS objectives for NO_2 and the daily-mean AQS objective for PM_{10}, the following relationships between the short-term and the annual-mean values at each receptor have been considered.

Hourly-Mean AQS Objective for NO_2

1.14 Research undertaken in support of LAQM.TG16 has indicated that the hourly-mean limit value and objective for NO_2 is unlikely to be exceeded at a roadside location where the annual-mean NO_2 concentration is less than 60 µg.m^{-3}. The threshold of 60 µg.m^{-3} NO_2 has been used the guideline for considering a likely exceedance of the hourly-mean nitrogen dioxide objective.

Daily-Mean AQS Objective for PM_{10}

1.15 The number of exceedances of the daily-mean AQS objective for PM_{10} of 50 µg.m^{-3} may be estimated using the relationship set out in LAQM.TG16:

Number of Exceedances of Daily Mean of 50 µg.m^{-3} = -18.5 + 0.00145 * (Predicted Annual-mean PM_{10})^3 + 206 / (Predicted Annual-mean PM_{10} Concentration)

1.16 This relationship indicates that the daily-mean AQS objective for PM_{10} is likely to be met if the predicted annual-mean PM_{10} concentration is 31.8 µg.m^{-3} or less.

1.17 The daily mean objective is therefore not considered further within this assessment if the annual-mean PM_{10} concentration is predicted to be less than 31.50 µg.m^{-3}.

Fugitive PM_{10} Emissions

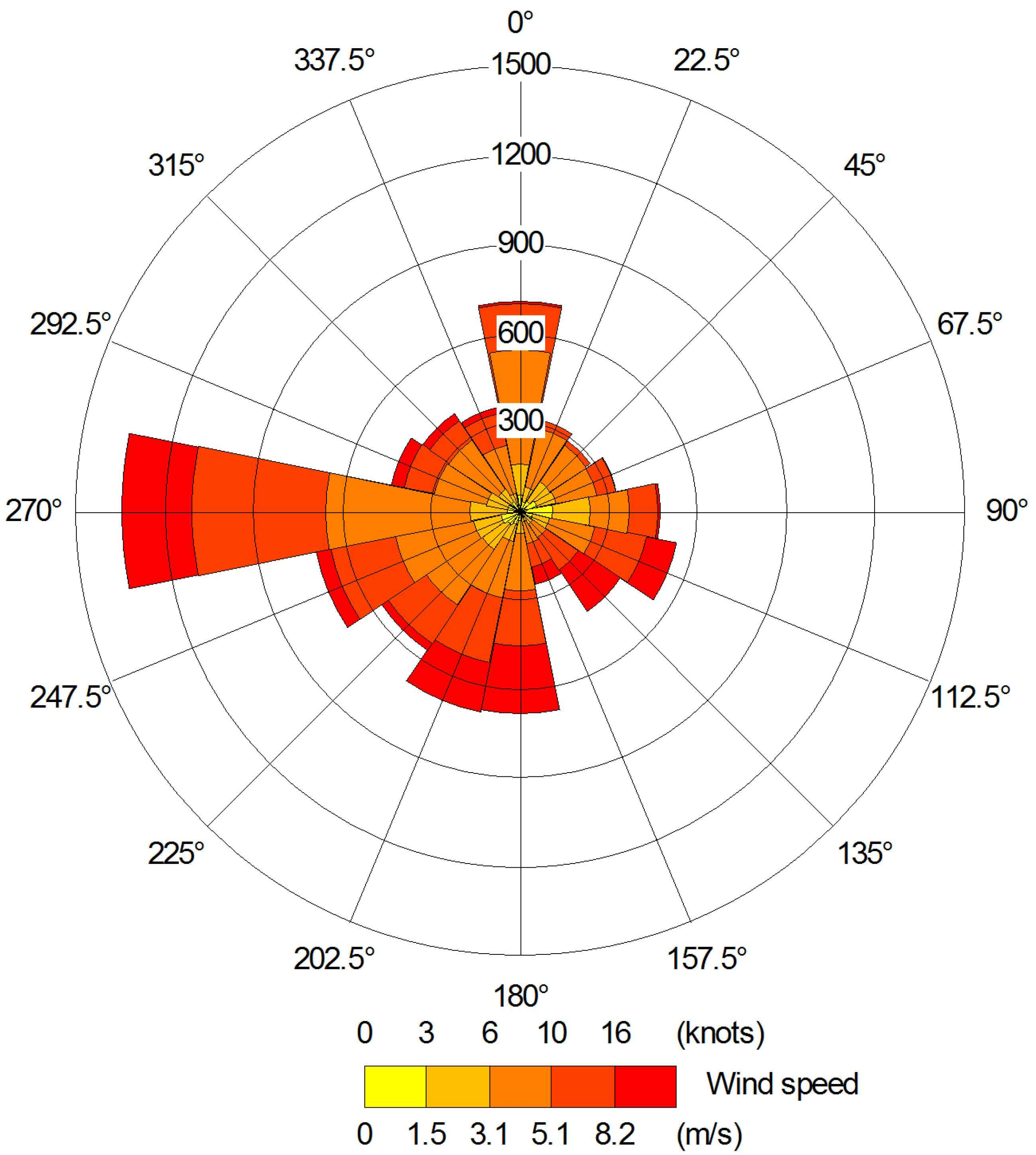
1.18 Transport PM_{10} emissions arise from both the tailpipe exhausts and from fugitive sources such as brake and tyre wear and re-suspended road dust. Improvements in vehicle technologies are reducing PM_{10} exhaust emissions; therefore, the relative importance of fugitive PM_{10} emissions is increasing. Current official vehicle emission factors for particulate matter include brake dust and tyre wear which studies suggest may account for approximately one-third of the total particulate emissions from road transport; but not re-suspended road dust (which remains unquantified).

Glossary

AADT	Annual Average Daily Traffic Flow
ADMS	Atmospheric Dispersion Modelling System
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
Effect	The consequences of an impact, experienced by a receptor
EPUK	Environmental Protection UK
HGV	Heavy Goods Vehicle
IAQM	Institute of Air Quality Management
Impact	The change in atmospheric pollutant concentration and/or dust deposition. A scheme can have an 'impact' on atmospheric pollutant concentration but no effect, for instance if there are no receptors to experience the impact.
LGV	Light Goods Vehicle
R&A	Review and Assessment
Receptor	A person, their land or property and ecologically sensitive sites that may be affected by air quality.

References

1 http://laqm.defra.gov.uk/review-and-assessment/tools/tools.html



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