Supplementary Air Quality Assessment:

Beddington Energy Recovery Facility, Sutton

December 2022

Experts in air quality management & assessment

Document Control

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Contents

1 Introduction

1.1 This report describes the potential air quality impacts associated with the proposed variation in operations of the existing Beddington Energy Recovery Facility (ERF) and Waste Transfer Station (WTS) on Beddington Lane, Croydon, in the London Borough of Sutton (LBS). Viridor operates the ERF and WTS. The facility is regulated by the Environment Agency (EA) under the environmental permitting regime. Viridor have submitted an application to the EA to vary the ERF's existing permit to (among other things) increase its processing capacity to 382,286 tonnes of waste per annum[1].

1.2 The facility lies within a borough-wide Air Quality Management Area (AQMA) declared by LBS for exceedances of the annual and 1-hour mean nitrogen dioxide (NO_2) and annual and 24-hour mean PM_{10} objectives. The increase in throughput will lead to an increase in emissions from the Energy from Waste (EfW) facility, and may lead to an increase in traffic flows on local roads from additional waste being brought to the site; the emissions from both have the potential to impact air quality at existing sensitive receptors.

1.3 The impacts of changes in emissions from the EfW have been assessed in the Air Quality Assessment submitted in support of the permit variation application (herein referred to as the Permit AQA) (Gair Consulting Ltd, 2022), but that assessment did not include impacts from the road traffic, which are not normally assessed in permit applications. The present assessment has been commissioned by LBS in order to take account of both the concentrations presented in the Permit AQA, and from the potential increase in traffic emissions, and therefore supplements the Permit AQA. The main air pollutants of concern related to road traffic emissions are nitrogen dioxide and fine particulate matter (PM_{10} and $PM_{2.5}$); other pollutants emitted from the ERF have not been considered here as they are adequately covered in the Permit AQA. The location and setting of the facility are shown in Figure 1.

1.4 This report describes existing local air quality conditions (base year 2019; 2020 was not used due to the impacts of the Covid-19 pandemic, discussed further in Paragraphs 3.14 and 3.15), and the predicted air quality in the future assuming that the proposed changes do, or do not proceed. An additional baseline is considered whereby the ERF is not operational at the site. The assessment of traffic-related impacts focuses on 2023, which is the most conservative assumption.

1.5 After the assessment was carried out, some further information was provided by Viridor, indicating that the assumptions made in this assessment regarding traffic flows generated by the facility, both without and with the proposed changes, are conservative.

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1 The original permit was for 302,500 tonnes per annum, but a variation was granted on 9 December 2020 to allow for the processing of up to 347,422 tonnes per annum.

1.6 This report has been prepared taking into account all relevant local and national guidance and regulations.

Figure 1: Beddington ERF Setting in the Context of Air Quality

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2 Assessment Criteria

2.1 The Government has established a set of air quality standards and objectives to protect human health. The 'standards' are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air Quality (England) Regulations (2000) and the Air Quality (England) (Amendment) Regulations (2002).

2.2 The UK-wide objectives for nitrogen dioxide and PM_{10} were to have been achieved by 2005 and 2004 respectively, and continue to apply in all future years thereafter. The $PM_{2.5}$ objective was to be achieved by 2020. Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded at roadside locations where the annual mean concentration is below 60 $\mu g/m^3$ (Defra, 2022a). Therefore, 1-hour nitrogen dioxide concentrations will only be considered if the annual mean concentration is above this level. Measurements have also shown that the 24-hour mean PM_{10} objective could be exceeded at roadside locations where the annual mean concentration is above 32 $\mu g/m^3$ (Defra, 2022a). The predicted annual mean PM_{10} concentrations are thus used as a proxy to determine the likelihood of an exceedance of the 24-hour mean PM_{10} objective. Where predicted annual mean concentrations are below 32 $\mu g/m^3$ it is unlikely that the 24-hour mean objective will be exceeded.

2.3 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. The Greater London Authority (GLA) explains where these objectives will apply in London (GLA, 2019a). The annual mean objectives for nitrogen dioxide and PM_{10} are considered to apply at the façades of residential properties, schools, hospitals and care homes etc., the gardens of residential properties, school playgrounds and the grounds of hospitals and care homes. The 24-hour mean objective for PM_{10} is considered to apply at the same locations as the annual mean objective, as well as at hotels. The 1-hour mean objective for nitrogen dioxide applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets.

2.4 Defra has also set objectives and targets for concentrations of $PM_{2.5}$. The objective for $PM_{2.5}$ is not set in regulations and there is no requirement for local authorities to meet it. Because this objective is not set in regulations, it is not formally defined. It was originally set as an annual mean concentration of 25 $\mu g/m^3$ but, following changes to the limit value for $PM_{2.5}$ (see Paragraph 2.5) through the EU Exit Regulations 2020, a value of 20 $\mu g/m^3$ is now commonly used.

2.5 EU Directive 2008/50/EC (The European Parliament and the Council of the European Union, 2008) sets limit values for nitrogen dioxide, PM_{10} and $PM_{2.5}$, and is implemented in UK law through the Air

Quality Standards Regulations (2010)[2]. The limit values for nitrogen dioxide, PM_{10} and $PM_{2.5}$ are the same numerical concentrations as the UK objectives, but achievement of the limit values is a national obligation rather than a local one. In the UK, only monitoring and modelling carried out by UK Central Government meets the specification required to assess compliance with the limit values. Central Government does not normally recognise local authority monitoring or local modelling studies when determining the likelihood of the limit values being exceeded, unless such studies have been audited and approved by Defra and DfT's Joint Air Quality Unit (JAQU).

2.6 The relevant air quality criteria for this assessment are provided in Table 1.

Table 1: Air Quality Criteria for Nitrogen Dioxide, PM_{10} and $PM_{2.5}$

Pollutant	Time Period	Objective
Nitrogen Dioxide	1-hour Mean	200 µg/m³ not to be exceeded more than 18 times a year
	Annual Mean	40 µg/m³
PM_{10}	24-hour Mean	50 µg/m³ not to be exceeded more than 35 times a year
	Annual Mean	40 µg/m³ [a]
$PM_{2.5}$ [b]	Annual Mean	20 µg/m³

[a] A proxy value of 32 µg/m³ as an annual mean is used in this assessment to assess the likelihood of the 24-hour mean PM_{10} objective being exceeded. Measurements have shown that, above this concentration, exceedances of the 24-hour mean PM_{10} objective are possible (Defra, 2022a).

[b] The $PM_{2.5}$ objective, which was to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

2.7 In March 2022, Defra began consultation on new targets for $PM_{2.5}$ concentrations in England. One proposed target is to achieve $PM_{2.5}$ concentration of 10 µg/m³ at relevant national monitoring sites by 2040. This would be accompanied by a target to reduce overall population exposure to $PM_{2.5}$, which will be assessed by national government using its own measurements. If adopted, these targets will apply to national government; it is not yet clear how these will apply to local government and, as such, are not considered further in this assessment.

GLA $PM_{2.5}$ Target

2.8 The GLA has set a target to achieve an annual mean $PM_{2.5}$ concentration of 10 µg/m³ by 2030. This target was derived from an air quality guideline set by the World Health Organisation (WHO) in 2005. In 2021, WHO updated its guidelines, but the London Environment Strategy (GLA, 2018) considers the 2005 guideline of 10 µg/m³. While there is no explicit requirement to assess against the GLA target of 10 µg/m³, it has nevertheless been included within this assessment.

[2] As amended through The Air Quality Standards (Amendment) Regulations 2016 and The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020.

3 Assessment Approach

Study Area

3.1 The study area for the assessment has been identified using professional judgement, focussing on the areas where impacts are anticipated to be greatest. Specifically, the assessment has focussed on Beddington Lane. Figure 1 in Section 1 of this report effectively shows the study area.

Receptors

3.2 Concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ have been predicted at a number of locations adjacent to Beddington Lane. Receptors have been identified to represent a range of exposure, including worst-case locations (these being at the façades of the residential properties closest to the sources). When selecting receptors, particular attention has been paid to assessing impacts close to junctions, where traffic may become congested and where there is a combined effect of several road links, and close to those roads where the estimated traffic increases as a result of the proposed changes will be greatest.

3.3 Eight existing residential properties have been identified as receptors for the assessment. They are described in Table 2, along with the nearest and most relevant receptor assessed in the Permit AQA, and shown in Figure 2. In addition, concentrations have been modelled at the ST5 automatic monitoring site and ST25 and BL diffusion tube monitoring sites, all located adjacent to Beddington Lane, in order to verify the model outputs (see Appendix A3 for verification method).

Table 2: Description of Receptor Locations

Receptor	Type	X coordinate	Y coordinate	Heights Modelled (m) [a]	Relevant Receptor from Permit AQA
R01	Residential	529423.6	167179.7	1.5	BL2
R02	Residential	529441.9	167135.1	1.5	BL4
R03	Residential	530070.6	166028.1	1.5	R7
R04	Residential	530127.0	165541.1	1.5	R8
R05	Residential	530147.1	165317.3	1.5	
R06	Residential	530152.5	165275.2	1.5	
R07	Residential	530027.3	165070.6	1.5	
R08	Residential	530040.2	165019.4	1.5	

[a] A height of 1.5 m is used to represent ground-floor level exposure.

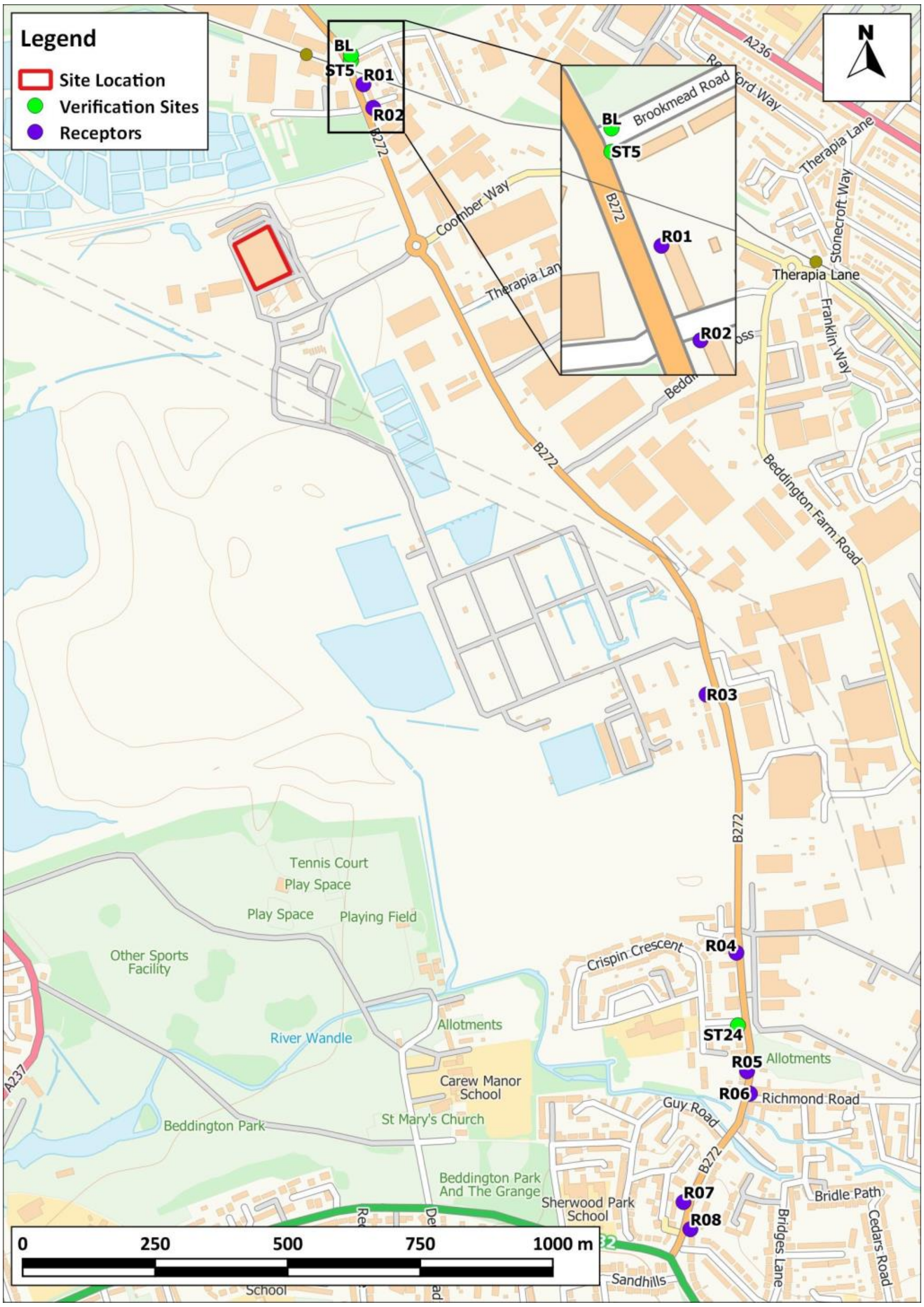

Figure 2: Receptor and Verification Site Locations

3.4 Selected receptors may be representative of air quality conditions at a number of properties; consideration has been given to how many sensitive locations each modelled receptor represents when considering the impacts of the proposed development and the overall significance of effects.

Existing Conditions

3.5 Existing sources of emissions and baseline air quality conditions within the study area have been defined using a number of approaches:

- information on existing air quality has been obtained by collating the results of monitoring carried out by the local authority; and
- background concentrations have been defined using Defra's 2018-based background maps (Defra, 2022b). These cover the whole of the UK on a 1x1 km grid. The background annual mean nitrogen dioxide and PM_{10} maps for 2019 have been calibrated against local measurements made at the ST8 industrial automatic monitoring site. The measured nitrogen dioxide concentration at this site in 2019 was 25.1 µg/m^3, while the mapped background for the grid square within which it lies was 18.9 µg/m^3. All mapped background nitrogen dioxide concentrations have therefore been calibrated by applying a factor of 1.33. The measured PM_{10} concentration at the same site in 2019 was 17 µg/m^3, while the mapped background was 16.3 µg/m^3. All mapped background PM_{10} concentrations have therefore calibrated by applying a factor of 1.04. Mapped background concentrations of $PM_{2.5}$ have not been adjusted.

Impacts of the Beddington ERF

3.6 The assessment takes into account the additional emissions from the increased operation of the EfW within the ERF, which have been extracted from the Permit AQA, as shown in Table 3. These predicted maximum concentrations have been added to the "With Changes" scenario.

Table 3: Maximum Predicted Concentrations for the Proposed Changes, as set out in the Permit AQA (µg/m^3)

Receptor	NO_2	PM_{10}	$PM_{2.5}$	Relevant Receptor from Permit AQA
R01	0.140	0.012	0.012	BL2
R02	0.140	0.012	0.012	BL4
R03	0.220	0.019	0.019	R7
R04	0.120	0.011	0.011	R8
R05	0.120	0.011	0.011	
R06	0.120	0.011	0.011	
R07	0.120	0.011	0.011	
R08	0.120	0.011	0.011	

Road Traffic Impacts

Modelling Methodology

3.7 Concentrations have been predicted using the ADMS-Roads dispersion model, with vehicle emissions derived using Defra's Emission Factor Toolkit (EFT) (v11.0) (Defra, 2022b). Details of the model inputs and the model verification are provided in Appendix A3.

Assessment Scenarios

3.8 Nitrogen dioxide, PM_{10} and $PM_{2.5}$ concentrations have been predicted for the following scenarios:

- base year 2019;
- 2023 without the proposed changes;
- 2023 without the ERF; and
- 2023 with the proposed changes, including the additional contribution from the Beddington ERF.

3.9 Predictions for 2023 are based on a return to 'typical' activity levels and assume no impact as a result of the Covid-19 pandemic in this year, to ensure a worst-case assessment (as the influence of the pandemic has generally been to reduce concentrations of the pollutants considered in this assessment); see Paragraphs 3.14 and 3.15.

Impact Description

3.10 The approach developed jointly by Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM)[3] (Moorcroft and Barrowcliffe et al, 2017) has been used in describing the modelled impacts. The approach identifies impacts at individual receptors based on the percentage change in concentrations relative to the relevant air quality objective, rounded to the nearest whole number, and the absolute concentration relative to the objective. Table 4 sets out the method for determining the impact descriptor for annual mean concentrations at individual receptors, having been adapted from the table presented in the guidance document. For the assessment criterion the term Air Quality Assessment Level or AQAL has been adopted, as it covers all pollutants, i.e. those with and without formal standards. Typically, as is the case for this assessment, the AQAL will be the air quality objective value or the GLA target. Note that impacts may be adverse or beneficial, depending on whether the change in concentration is positive or negative.

3 The IAQM is the professional body for air quality practitioners in the UK.

Table 4: Air Quality Impact Descriptors for Individual Receptors for All Pollutants [a]

Long-Term Average Concentration At Receptor In Assessment Year [b]	Change in concentration relative to AQAL [c]				
	0%	1%	2-5%	6-10%	>10%
75% or less of AQAL	Negligible	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Negligible	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Negligible	Moderate	Substantial	Substantial	Substantial

[a] Values are rounded to the nearest whole number.

[b] This is the "Without Scheme" concentration where there is a decrease in pollutant concentration and the "With Scheme" concentration where there is an increase.

[c] AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, GLA target or an Environment Agency 'Environmental Assessment Level (EAL)'.

Uncertainty

3.11 There are many components that contribute to the uncertainty of modelling predictions. The road traffic emissions dispersion model used in this assessment is dependent upon the traffic data that have been input, which will have inherent uncertainties associated with them. There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms.

3.12 An important stage in the process is model verification, which involves comparing the model output with measured concentrations (see Appendix A3). Because the model has been verified (albeit no adjustment has been applied), there can be reasonable confidence in the prediction of base year (2019) concentrations.

3.13 Predicting pollutant concentrations in a future year will always be subject to greater uncertainty. For obvious reasons, the model cannot be verified in the future, and it is necessary to rely on a series of projections provided by DfT and Defra as to what will happen to traffic volumes, background pollutant concentrations and vehicle emissions. Historic versions of Defra's EFT tended to over-state emissions reductions into the future. However, analyses of the most recent versions of Defra's EFT carried out by AQC (2020a; 2020b) suggest that, on balance, these versions are unlikely to over-state the rate at which NOx emissions decline in the future at an 'average' site in the UK. In practice, the balance of evidence suggests that NOx concentrations are most likely to decline more quickly in the future, on average, than predicted by the current EFT, especially against a base year of 2016 or later. Using EFT v11.0 for future-year forecasts in this report thus provides a robust assessment, given that the model has been verified against measurements made in 2019.

3.14 Forecasts of future-year concentrations are usually based on measurements made during a recent year. They then take account of projected changes over time to factors such as the composition of the vehicle fleet and the uptake of other new technologies, as well as population increases etc. In early 2020, activity in the UK was disrupted by the Covid-19 pandemic. As a result, concentrations of traffic-related air pollutants fell appreciably (Defra Air Quality Expert Group, 2020). While the pandemic may cause long-lasting changes to travel activity patterns, it is reasonable to expect a return to more typical activity levels in the future. Thus, 2020 is likely to present as an atypically low pollution year for roadside pollutant concentrations, as is 2021.

3.15 It is not currently possible to make robust predictions of the rate at which travel activity patterns will return to historically-normal levels; or the extent of any long-lasting changes to travel behaviour. The most robust approach to making future-year projections is thus to base these on measurements made during 2019, and to use activity forecasts made before the impact of the pandemic was understood, which is the approach that has been taken in this assessment.

3.16 Changes were made to the LEZ and the Ultra Low Emission Zone (ULEZ) in 2021. The changes can be expected to significantly reduce NOx emissions in London; however, they are not reflected in Defra's latest EFT and thus have not been considered in this assessment. The assessment presented in this report is, therefore, very much worst-case in this regard, and it is expected that background concentrations, baseline concentrations, and the impacts of the proposed changes, will be lower than described in Sections 4 and 5 of this report. Appendix A4 discusses uncertainties regarding the future fleet mix in London and the scale of the reduction in NOx emissions that can be expected with the adoption of these changes.

3.17 This assessment has also considered the GLA target for $PM_{2.5}$. Whilst the overall approach is essentially unchanged from an assessment against the objectives, it must be recognised that there is increased uncertainty as the criterion is numerically reduced. By way of example a 0.5% increase in a PM_{10} concentration with regard to the objective is 0.2 µg/m^3, whereas a 0.5% increase in a $PM_{2.5}$ concentration with regard to the GLA target is just 0.05 µg/m^3. While such increases can be predicted (as the model will generate outputs to many decimal places), such small increases must be treated with increased caution.

Assumptions

3.18 It is necessary to make a number of assumptions when carrying out an air quality assessment; in order to account for some of the uncertainty in the approach, as described above, assumptions made have generally sought to reflect a realistic worst-case scenario. Key assumptions made in carrying out this assessment include:

- that the proposed development is complete and fully operational in 2023, to provide a worst-case assessment;
- that the Kenley meteorological monitoring station appropriately represents conditions in the study area (this is discussed further in Appendix A3);

- for the 2023 "No ERF" scenario, that the Beddington ERF site is not producing any operational traffic. In this scenario, the estimated traffic generated by the ERF as set out in the 2012 planning application ('the 2012 AQA') for the Beddington ERF (RWDI, 2012) has been removed from the future baseline scenario. This scenario reduced HGV flows on the local road network to almost zero on the A232 west of Beddington Lane, which is not considered realistic, but is very conservative as a baseline;
- the increase in vehicle flows as a result of the proposed changes have been assumed based on traffic data set out in the 2012 AQA, and the proposed increase in waste throughput; and
- that the additional traffic movements in the "With Changes" will follow the same distribution across the road network as set out in the 2012 AQA. The reduction of traffic flows in the "No ERF" scenario follows the same distribution.

3.19 The 2012 AQA states that "*The development is expected to increase traffic flows by 666 daily two-way vehicle movements in 2023, when the site is fully operational*", and "*The vast majority of the traffic associated with the ERF plant will be HGVs*". However, neither the 2012 AQA, nor the Transport Assessment undertaken for the 2012 planning application state how many of those vehicles would be HGVs. To ensure a worst-case assessment, it has been assumed that all site vehicle movements are HGVs.

3.20 The original environmental permit for the ERF allowed for the processing of up to 302,500 tonnes of waste per annum. It is proposed to increase the processing capacity to 382,286 tonnes per annum, i.e. an increase equivalent to 79,786 tonnes per annum (26.4%). It is assumed that the additional waste throughput directly correlates with the number of vehicle movements generated by the site, and therefore the proposed changes will lead to an increase of 176 HGV movements.

3.21 The London Atmospheric Emissions Inventory (LAEI) traffic data include flows for electric vehicles, which generate no tailpipe emissions, but will generate some particulate matter through brake and tyre wear and resuspension. The EFT's default inputs do not allow for electric vehicles to be entered separately, thus the electric vehicles have been grouped with cars and the EFT's default assumptions on electric vehicle proportions have been used when calculating emissions. While this may mean that the proportion of electric vehicles is understated when compared to that in the LAEI (as the proportions in the EFT are very low), this is unlikely to have significantly affected the predicted concentrations and will not have affected the conclusions of the assessment. This is because electric vehicle flows are extremely low in comparison to those of other vehicles.

Assessment of Significance

3.22 There is no official guidance in the UK in relation to development control on how to assess the significance of air quality impacts. The approach developed jointly by EPUK and the IAQM (Moorcroft and Barrowcliffe et al, 2017) has therefore been used. The overall significance of the air quality impacts is determined using professional judgement, taking account of the impact descriptors; the experience of the consultants preparing the report is set out in Appendix A2. Full details of the EPUK/IAQM approach are provided in Appendix A1.

4 Baseline Conditions

Relevant Features

4.1 The Beddington ERF facility is located off Beddington Lane. The nearest residential properties are located approximately 185 m to the northeast, adjacent to Beddington Lane. The site is bounded by the Croydon Rifle and Pistol Club to the north, Beddington Power Plant to the south, light industry/commercial uses to the east and Beddington Farmlands to the west.

4.2 The facility is located within an AQMA.

Local Air Quality Monitoring

4.3 LBS currently operates four automatic monitoring stations within its area, including monitors ST5, ST8 and ST9, which are adjacent or close to Beddington Lane (monitor ST8 was decommissioned and relocated to ST9 in October 2020). The Council also operates a number of nitrogen dioxide monitoring sites using diffusion tubes prepared and analysed by Gradko (using the 20% TEA in water method). These include two adjacent to Beddington Lane. Annual mean nitrogen dioxide results for the years 2015 to 2020 are summarised in Table 5, while results relating to the 1-hour mean nitrogen dioxide objective are summarised in Table 6. The monitoring locations are shown in Figure 3. The monitoring data have been taken from LBS's 2020 Annual Status Report (London Borough of Sutton, 2021).

Table 5: Summary of Annual Mean NO_2 Monitoring (2015-2020) ($\mu g/m^3$)

Site No.	Site Type	Location	2015	2016	2017	2018	2019	2020
ST5	Industrial (Roadside) [a]	Beddington Lane North	36	32	29	29	23	36
ST8	Industrial	Beddington Lane	27	30	25	25	25	19 [b]
ST9	Roadside	Beddington Village	-	-	-	-	-	22 [b]
ST24	Roadside	Derry Road	27	31	26	29	26	19
BL	Roadside	Beddington Lane	-	34	32	29	29	26 [b]
Objective			**40**					

[a] Described in the 2020 ASR as Industrial.

[b] Low data capture; 55% at ST8, 11% at ST9 and 58% at BL.

Table 6: **Number of Hours with NO_2 Concentrations Above 200 µg/m³**

Site No.	Site Type	Location	2015	2016	2017	2018	2019	2020
ST5	Industrial (Roadside) [a]	Beddington Lane North	0 (99.8)	0	0	0	0	0
ST8	Industrial	Beddington Lane	0	0	0	0	0	0 (73.1)
ST9	Roadside	Beddington Village	-	-	-	-	-	0 (72.1)
Objective			**18 (200) [b]**					

[a] Described in the 2020 ASR as Industrial.

[b] Values in brackets are 99.79th percentiles, which are presented where data capture is <75%.

4.4 Annual mean concentrations are below the objective at all monitoring sites for all years presented. There have been no exceedances of the 1-hour mean objective close to Beddington Lane.

4.5 While 2020 results have been presented in this Section for completeness, they are not relied upon in any way as they will not be representative of 'typical' air quality conditions due to the considerable impact of the Covid-19 pandemic on traffic volumes and thus pollutant concentrations.

4.6 The ST5, ST8 and ST9 monitoring stations also measure PM_{10} concentrations, and ST5 measures $PM_{2.5}$ concentrations. Annual mean results for the years 2015 to 2020 are summarised in Table 7, while results relating to the daily mean objective are summarised in Table 8.

4.7 There have been no exceedances of the PM_{10} or $PM_{2.5}$ objectives in recent years. Annual mean $PM_{2.5}$ concentrations exceeded the GLA target every year between 2015 and 2019, but not in 2020.

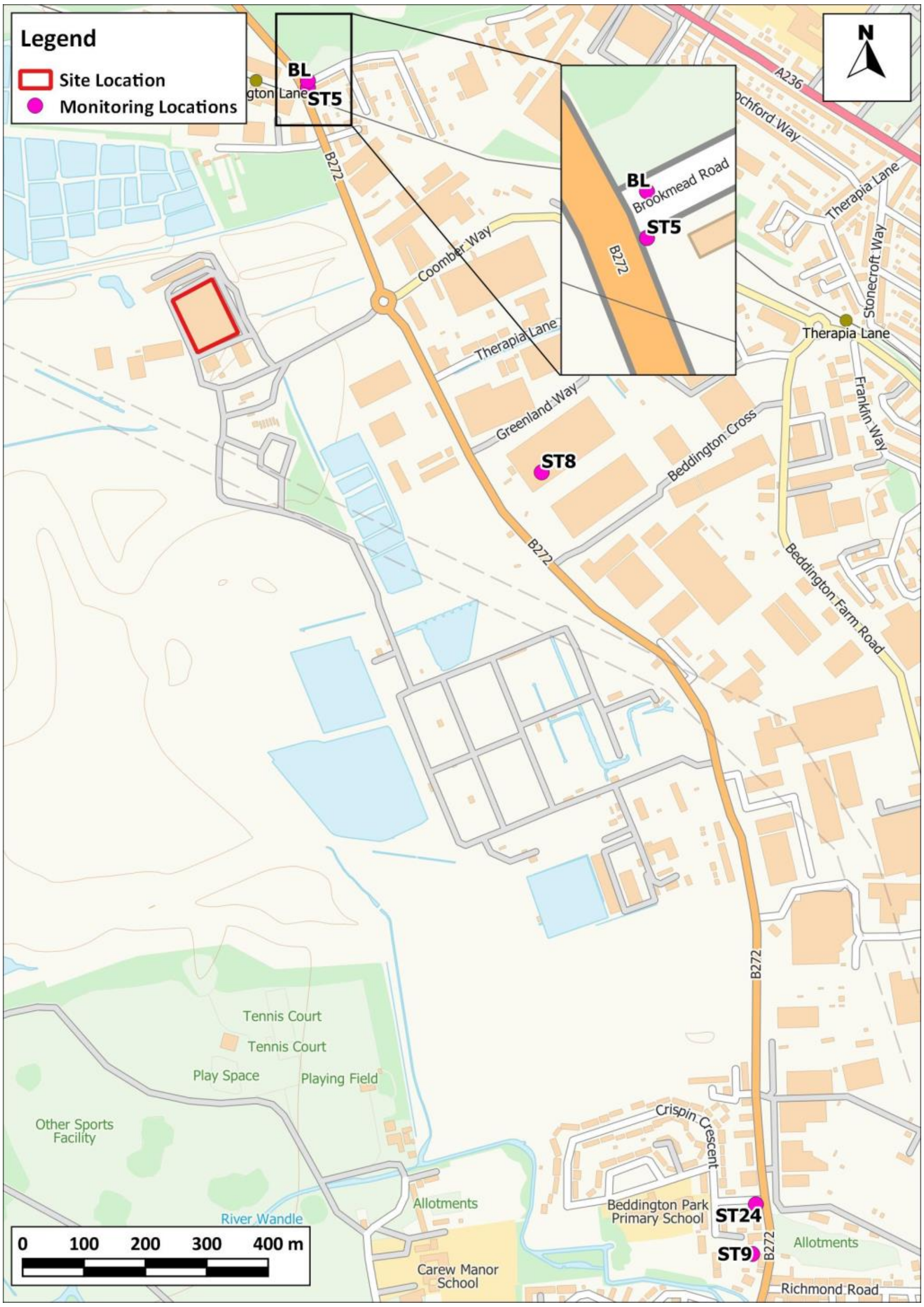

Figure 3: Monitoring Locations

Table 7: Summary of Annual Mean PM_{10} and $PM_{2.5}$ Monitoring (2015-2020) (µg/m³)

Site No.	Site Type	Location	2015	2016	2017	2018	2019	2020
PM_{10}								
ST5	Industrial (Roadside) [a]	Beddington Lane North	24	24	31	22	22	21
ST8	Industrial	Beddington Lane	19	23	23	22	17	15 [b]
ST9	Roadside	Beddington Village	-	-	-	-	-	15 [b]
Objective			40					
$PM_{2.5}$								
ST5	Industrial (Roadside) [a]	Beddington Lane North	15	14	15	12	12	9
Objective/GLA target			20/10 [c]					

[a] Described in the 2020 ASR as Industrial.

[b] Low data capture; 38% at monitor ST8 and 20% at ST9.

[c] The 20 µg/m³ $PM_{2.5}$ objective, which was to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it. 10 µg/m³ is the GLA target for annual mean $PM_{2.5}$; again, there is no requirement for local authorities to meet this.

Table 8: Number of Days with PM_{10} Concentrations Above 50 µg/m³

Site No.	Site Type	Location	2015	2016	2017	2018	2019	2020
ST5	Industrial (Roadside) [a]	Beddington Lane North	13	5 (34)	21	2	13	8
ST8	Industrial	Beddington Lane	8	8 (37)	5	2	4	0 (23.3)
ST9	Roadside	Beddington Village	-	-	-	-	-	1 (26.2)
Objective			30 (50) [b]					

[a] Described in the 2020 ASR as Industrial.

[b] Values in brackets are 90.4th percentiles, which are presented where data capture is <85%.

Background Concentrations

4.8 Estimated background concentrations in the study area are set out in Table 9 and are all below the objectives. A range of values is presented as the study area covers multiple 1x1 km grid squares.

Table 9: Estimated Annual Mean Background Pollutant Concentrations in 2019 and 2023 (µg/m^3)

Year	NO_2	PM_{10}	$PM_{2.5}$
2019	25.5 - 27.2	16.9 - 17.9	11.2 - 11.8
2023	21.7 - 23.2	16.0 - 16.9	10.5 - 11.1
Objective / GLA target	**40**	**40**	**20/10 [a]**

[a] The 20 µg/m^3 $PM_{2.5}$ objective, which was to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it. 10 µg/m^3 is the GLA target for annual mean $PM_{2.5}$; again, there is no requirement for local authorities to meet this.

Baseline Dispersion Model Results

4.9 Baseline concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ have been modelled at each of the existing receptor locations (see Figure 2 and Table 2 for receptor locations). The results, which cover both the existing (2019) and future year (2023) baselines (Without Changes and No ERF), are set out in Table 10 for nitrogen dioxide and Table 11 for PM_{10} and $PM_{2.5}$.

Table 10: Modelled Annual Mean Baseline Concentrations of Nitrogen Dioxide (µg/m^3) at Existing Receptors

Receptor	2019	2023 Without Changes	2023 No ERF
R01	29.1	24.1	23.9
R02	28.9	23.9	23.7
R03	28.8	24.3	24.2
R04	31.9	26.2	26.0
R05	31.5	25.9	25.7
R06	32.7	26.7	26.5
R07	30.8	25.4	25.3
R08	32.3	26.4	26.2
Objective	**40**		

Table 11: Modelled Annual Mean Baseline Concentrations of PM_{10} and $PM_{2.5}$ at Existing Receptors ($\mu g/m^3$)

Receptor	PM_{10} [a]			$PM_{2.5}$		
	2019	2023 Without Changes	2023 No ERF	2019	2023 Without Changes	2023 No ERF
R01	17.8	16.8	16.8	11.7	11.0	11.0
R02	17.8	16.8	16.7	11.7	11.0	11.0
R03	18.2	17.2	17.2	12.0	11.3	11.2
R04	18.1	17.1	17.0	11.9	11.1	11.1
R05	18.0	17.0	16.9	11.8	11.1	11.0
R06	18.2	17.2	17.1	11.9	11.2	11.2
R07	17.8	16.8	16.7	11.7	11.0	10.9
R08	18.0	17.0	16.9	11.8	11.1	11.0
Assessment Criterion	32 [a]			20 [b] / 10 [c]		

[a] While the annual mean PM_{10} objective is 40 $\mu g/m^3$, 32 $\mu g/m^3$ is the annual mean concentration above which an exceedance of the 24-hour mean PM_{10} objective is possible, as outlined in LAQM.TG (Defra, 2022a). A value of 32 $\mu g/m^3$ is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017).

[b] The 20 $\mu g/m^3$ $PM_{2.5}$ objective, which was to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

[c] 10 $\mu g/m^3$ is the GLA target for annual mean $PM_{2.5}$.

4.10 The predicted annual mean concentrations of nitrogen dioxide are all below the objective in 2019 at and 2023. The annual mean nitrogen dioxide concentrations are below 60 $\mu g/m^3$ at every receptor in both 2019 and 2023; it is, therefore, unlikely that the 1-hour mean nitrogen dioxide objective will be exceeded (see Paragraph 2.2).

4.11 The predicted annual mean concentrations of PM_{10} and $PM_{2.5}$ are below the objectives in both 2019 and 2023 at all receptors. The annual mean PM_{10} concentrations are below 32 $\mu g/m^3$ and it is, therefore, unlikely that the 24-hour mean PM_{10} objective will be exceeded.

4.12 The annual mean concentrations of $PM_{2.5}$ exceed the GLA target in both 2019 and 2023. Exceedances of the guideline are common, and their nationwide achievement is very unlikely to be possible before 2030, especially in London (Defra, 2019). As such, it is unsurprising that there are exceedances.

4.13 These results are consistent with the conclusions of LBS in the outcome of its air quality review and assessment work in that they have concluded that there are no exceedances of the objectives, and none have been modelled.

5 Impact Assessment

5.1 Based on the assumed increase in traffic flow and distribution of that traffic, the proposed changes are expected to increase Annual Average Daily Traffic (AADT) flows by approximately 78 HGVs on Beddington Lane to the north of the site, and 72 HGVs to the south of the site. The focus of the detailed assessment is on Beddington Lane alone, and it takes into account the additional emissions from the increased operation of the EfW within the ERF, which have been extracted from the Permit AQA (Paragraph 3.6).

Nitrogen Dioxide

5.2 Predicted annual mean concentrations of nitrogen dioxide in 2023 for existing receptors are set out in Table 12 for both the "Without Changes" and "With Changes" scenarios, and in Table 13 for both the "No ERF" and "With Changes" scenarios. The impact at each receptor is also described using the impact descriptors given in Table 4.

Table 12: Predicted Impacts on Annual Mean Nitrogen Dioxide Concentrations in 2023 (µg/m^3) (Without Changes vs With Changes)

Receptor	Without Changes	With Changes	% Change [a]	Impact Descriptor
R01	24.1	24.2	0	Negligible
R02	23.9	24.1	0	Negligible
R03	24.3	24.5	1	Negligible
R04	26.2	26.4	0	Negligible
R05	25.9	26.1	0	Negligible
R06	26.7	26.9	0	Negligible
R07	25.4	25.6	0	Negligible
R08	26.4	26.6	0	Negligible
Objective	40		-	-

[a] % changes are relative to the objective and have been rounded to the nearest whole number.

5.3 The annual mean nitrogen dioxide concentrations are well below the objective at all receptors. The changes in concentrations are zero at seven receptors and 1% at the remaining receptor. All of the impacts are described as *negligible*.

Table 13: Predicted Impacts on Annual Mean Nitrogen Dioxide Concentrations in 2023 (µg/m^3) (No ERF vs With Changes)

Receptor	No ERF	With Changes	% Change [a]	Impact Descriptor
R01	23.9	24.2	1	Negligible
R02	23.7	24.1	1	Negligible
R03	24.2	24.5	1	Negligible
R04	26.0	26.4	1	Negligible
R05	25.7	26.1	1	Negligible
R06	26.5	26.9	1	Negligible
R07	25.3	25.6	1	Negligible
R08	26.2	26.6	1	Negligible
Objective	40		-	-

[a] % changes are relative to the objective and have been rounded to the nearest whole number.

5.4 The annual mean nitrogen dioxide concentrations are well below the objective at all receptors. The changes in concentrations are 1% at all receptors and the impacts are described as *negligible*.

PM_{10} and $PM_{2.5}$

5.5 Predicted annual mean concentrations of PM_{10} and $PM_{2.5}$ in 2023 for existing receptors are set out in Table 14 for both the “Without Changes” and “With Changes” scenarios, and in Table 15 for both the “No ERF” and “With Changes” scenarios. The impacts at each receptor are also described using the impact descriptors given in Table 4.

Table 14: Predicted Impacts on Annual Mean PM_{10} and $PM_{2.5}$ Concentrations in 2023 (Without Changes vs With Changes)

Receptor	Annual Mean PM_{10} (µg/m^3)				Annual Mean $PM_{2.5}$ (µg/m^3)			
	Without Changes	With Changes	% Change [a]	Impact Descriptor	Without Changes	With Changes	% Change [a]	Impact Descriptor
R01	16.8	16.8	0	Negligible	11.0	11.0	0	Negligible
R02	16.8	16.8	0	Negligible	11.0	11.0	0	Negligible
R03	17.2	17.2	0	Negligible	11.3	11.3	0	Negligible
R04	17.1	17.1	0	Negligible	11.1	11.1	0	Negligible
R05	17.0	17.0	0	Negligible	11.1	11.1	0	Negligible
R06	17.2	17.2	0	Negligible	11.2	11.2	0	Negligible
R07	16.8	16.8	0	Negligible	11.0	11.0	0	Negligible
R08	17.0	17.0	0	Negligible	11.1	11.1	0	Negligible
Criterion	32 [b]		-	-	20 [c]		-	-

[a] % changes are relative to the criterion and have been rounded to the nearest whole number.

[b] While the annual mean PM_{10} objective is 40 µg/m^3, 32 µg/m^3 is the annual mean concentration above which an exceedance of the 24-hour mean PM_{10} objective is possible, as outlined in LAQM.TG22 (Defra, 2022a). A value of 32 µg/m^3 is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017).

[c] The $PM_{2.5}$ objective, which was to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

5.6 The annual mean PM_{10} and $PM_{2.5}$ concentrations are below the relevant criteria at all receptors, with or without the proposed changes. The changes in PM_{10} and $PM_{2.5}$ concentrations are zero at all receptors. All of the impacts are described as *negligible*. Furthermore, as the annual mean PM_{10} concentrations are below 32 µg/m^3, it is unlikely that the 24-hour mean PM_{10} objective will be exceeded at any of the receptors.

Table 15: Predicted Impacts on Annual Mean PM_{10} and $PM_{2.5}$ Concentrations in 2023 (No ERF vs With Changes)

Receptor	Annual Mean PM_{10} (µg/m³)				Annual Mean $PM_{2.5}$ (µg/m³)			
	No ERF	With Changes	% Change [a]	Impact Descriptor	No ERF	With Changes	% Change [a]	Impact Descriptor
R01	16.8	16.8	0	Negligible	11.0	11.0	0	Negligible
R02	16.7	16.8	0	Negligible	11.0	11.0	0	Negligible
R03	17.2	17.2	0	Negligible	11.2	11.3	0	Negligible
R04	17.0	17.1	0	Negligible	11.1	11.1	0	Negligible
R05	16.9	17.0	0	Negligible	11.0	11.1	0	Negligible
R06	17.1	17.2	0	Negligible	11.2	11.2	0	Negligible
R07	16.7	16.8	0	Negligible	10.9	11.0	0	Negligible
R08	16.9	17.0	0	Negligible	11.0	11.1	0	Negligible
Criterion	**32 [b]**		**-**	**-**	**20 [c]**		**-**	**-**

[a] % changes are relative to the criterion and have been rounded to the nearest whole number.

[b] While the annual mean PM_{10} objective is 40 µg/m³, 32 µg/m³ is the annual mean concentration above which an exceedance of the 24-hour mean PM_{10} objective is possible, as outlined in LAQM.TG22 (Defra, 2022a). A value of 32 µg/m³ is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017).

[c] The $PM_{2.5}$ objective, which was to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

5.7 The annual mean PM_{10} and $PM_{2.5}$ concentrations are below the relevant criteria at all receptors. The changes in PM_{10} and $PM_{2.5}$ concentrations are zero at all receptors. All of the impacts are described as *negligible*. Furthermore, as the annual mean PM_{10} concentrations are below 32 µg/m³, it is unlikely that the 24-hour mean PM_{10} objective will be exceeded at any of the receptors.

5.8 Table 16 and Table 17 presents the same $PM_{2.5}$ concentrations as Table 14 and Table 15, respectively, but assesses the impacts against the GLA target for this pollutant.

Table 16: Assessment of Annual Mean $PM_{2.5}$ Concentrations in 2023 against the GLA Target (Without Changes vs With Changes)

Receptor	Annual Mean $PM_{2.5}$ (µg/m^3)			
	Without Changes	With Changes	% Change [a]	Impact Descriptor
R01	11.0	11.0	0	Negligible
R02	11.0	11.0	0	Negligible
R03	11.3	11.3	0	Negligible
R04	11.1	11.1	0	Negligible
R05	11.1	11.1	0	Negligible
R06	11.2	11.2	0	Negligible
R07	11.0	11.0	0	Negligible
R08	11.1	11.1	0	Negligible
GLA Target	10		-	-

[a] % changes are relative to the guideline and have been rounded to the nearest whole number.

Table 17: Assessment of Annual Mean $PM_{2.5}$ Concentrations in 2023 against the GLA Target (No ERF vs With Changes)

Receptor	Annual Mean $PM_{2.5}$ (µg/m^3)			
	No ERF	With Changes	% Change [a]	Impact Descriptor
R01	11.0	11.0	0	Negligible
R02	11.0	11.0	0	Negligible
R03	11.2	11.3	0	Negligible
R04	11.1	11.1	1	Moderate Adverse
R05	11.0	11.1	1	Moderate Adverse
R06	11.2	11.2	1	Moderate Adverse
R07	10.9	11.0	0	Negligible
R08	11.0	11.1	0	Negligible
GLA Target	10		-	-

[a] % changes are relative to the guideline and have been rounded to the nearest whole number.

5.9 In both scenarios, the annual mean concentrations of $PM_{2.5}$ exceed the GLA target with or without the proposed changes. In the comparison between the No ERF and With Changes scenarios, the impacts at three receptors are described as Moderate Adverse, as the changes on concentrations are 1% of the target value (when rounded). It is, however, noted that this scenario is not realistic, and does not reflect the likely increase in HGV flows as a result of the proposed changes.

5.10 Exceedances of the guideline are common, and its achievement is very unlikely to be possible before 2030, especially in London (Defra, 2019). As such, it is unsurprising that there are exceedances. Based on the rate of reduction in Defra's background maps, it is judged that the guideline may be achieved by 2030. It is, however, clear from Table 14 that the contribution of the proposed changes to annual mean $PM_{2.5}$ concentrations is small (<0.03 µg/m^3), and unlikely to significantly delay achievement of the guideline.

Significance of Operational Air Quality Effects

5.11 The operational air quality effects without mitigation are judged to be ‘not significant’. This professional judgement is made in accordance with the methodology set out in Appendix A1, and takes account of the assessment that pollutant concentrations at all of the selected worst-case existing receptors along the local road network will be well below the air quality objectives, and all of the impacts for the Without Changes vs With Changes scenarios are predicted to be *negligible*. While there are *Moderate Adverse* $PM_{2.5}$ impacts at three receptors in the No ERF vs With Changes scenario, this scenario compares against the GLA target, which is currently not a UK objective.

6 Conclusions

6.1 The assessment has considered the impacts of the proposed increase in waste throughput of the Beddington ERF on local air quality in terms of emissions from road traffic generated by additional vehicles and from the EfW itself. The assessment has been based on measurements made during 2019, and pre-pandemic activity and emissions forecasts, to ensure a worst-case assessment that does not take into account temporary reductions in pollutant concentrations as a result of reduced activity levels during the Covid-19 pandemic.

6.2 The assessment has demonstrated that pollutant concentrations will be well below the objectives at all existing receptors in 2023, with or without the proposed changes, and that the emissions from the additional traffic generated by the proposed changes, and the EfW itself, will have a *Negligible* impact on air quality conditions at all existing receptors along the local road network, when assessed against the UK air quality objectives. When comparing a scenario where there is no operation on the site with the proposed changes and assessing against the GLA $PM_{2.5}$ target, the impacts are described as *Moderate Adverse* at three receptors.

6.3 The overall operational air quality effects of the proposed changes are judged to be ‘not significant’.

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8 Glossary

AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System model for Roads
AQAL	Air Quality Assessment Level
AQC	Air Quality Consultants
AQMA	Air Quality Management Area
CHP	Combined Heat and Power
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EFT	Emission Factor Toolkit
EPUK	Environmental Protection UK
EU	European Union
EV	Electric Vehicle
Exceedance	A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure
GLA	Greater London Authority
HDV	Heavy Duty Vehicles (> 3.5 tonnes)
HGV	Heavy Goods Vehicle
HMSO	Her Majesty's Stationery Office
IAQM	Institute of Air Quality Management
JAQU	Joint Air Quality Unit
kph	Kilometres Per hour
LAEI	London Atmospheric Emissions Inventory
LAQM	Local Air Quality Management
LBS	London Borough of Sutton
LDV	Light Duty Vehicles (<3.5 tonnes)
LEZ	Low Emission Zone
LGV	Light Goods Vehicle

µg/m^3	Microgrammes per cubic metre
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (taken to be NO_2 + NO)
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
PM_{10}	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
$PM_{2.5}$	Small airborne particles less than 2.5 micrometres in aerodynamic diameter
PPG	Planning Practice Guidance
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal
TEA	Triethanolamine – used to absorb nitrogen dioxide
TEMPro	Trip End Model Presentation Program
TfL	Transport for London
ULEZ	Ultra Low Emission Zone
WHO	World Health Organisation

9 Appendices

A1 EPUK & IAQM Planning for Air Quality Guidance

A1.1 The guidance issued by EPUK and IAQM (Moorcroft and Barrowcliffe et al, 2017) is comprehensive in its explanation of the place of air quality in the planning regime. Key sections of the guidance not already mentioned above are set out below.

Air Quality as a Material Consideration

"Any air quality issue that relates to land use and its development is capable of being a material planning consideration. The weight, however, given to air quality in making a planning application decision, in addition to the policies in the local plan, will depend on such factors as:

- *the severity of the impacts on air quality;*
- *the air quality in the area surrounding the proposed development;*
- *the likely use of the development, i.e. the length of time people are likely to be exposed at that location; and*
- *the positive benefits provided through other material considerations".*

Recommended Best Practice

A1.2 The guidance goes into detail on how all development proposals can and should adopt good design principles that reduce emissions and contribute to better air quality management. It states:

"The basic concept is that good practice to reduce emissions and exposure is incorporated into all developments at the outset, at a scale commensurate with the emissions".

A1.3 The guidance sets out a number of good practice principles that should be applied to all developments that:

- include 10 or more dwellings;
- where the number of dwellings is not known, residential development is carried out on a site of more than 0.5 ha;
- provide more than 1,000 m^2 of commercial floorspace;
- are carried out on land of 1 ha or more.

A1.4 The good practice principles are that:

- New developments should not contravene the Council's Air Quality Action Plan, or render any of the measures unworkable;
- Wherever possible, new developments should not create a new "street canyon", as this inhibits pollution dispersion;

- Delivering sustainable development should be the key theme of any application;
- New development should be designed to minimise public exposure to pollution sources, e.g. by locating habitable rooms away from busy roads;
- The provision of at least 1 Electric Vehicle (EV) “rapid charge” point per 10 residential dwellings and/or 1000 m^2 of commercial floorspace. Where on-site parking is provided for residential dwellings, EV charging points for each parking space should be made available;
- Where development generates significant additional traffic, provision of a detailed travel plan (with provision to measure its implementation and effect) which sets out measures to encourage sustainable means of transport (public, cycling and walking) via subsidised or free-ticketing, improved links to bus stops, improved infrastructure and layouts to improve accessibility and safety;
- All gas-fired boilers to meet a minimum standard of <40 mgNOx/kWh;
- Where emissions are likely to impact on an AQMA, all gas-fired CHP plant to meet a minimum emissions standard of:
  - Spark ignition engine: 250 mgNOx/Nm^3;
  - Compression ignition engine: 400 mgNOx/Nm^3;
  - Gas turbine: 50 mgNOx/Nm^3.
- A presumption should be to use natural gas-fired installations. Where biomass is proposed within an urban area it is to meet minimum emissions standards of 275 mgNOx/Nm^3 and 25 mgPM/Nm^3.

A1.5 The guidance also outlines that offsetting emissions might be used as a mitigation measure for a proposed development. However, it states that:

“It is important that obligations to include offsetting are proportional to the nature and scale of development proposed and the level of concern about air quality; such offsetting can be based on a quantification of the emissions associated with the development. These emissions can be assigned a value, based on the “damage cost approach” used by Defra, and then applied as an indicator of the level of offsetting required, or as a financial obligation on the developer. Unless some form of benchmarking is applied, it is impractical to include building emissions in this approach, but if the boiler and CHP emissions are consistent with the standards as described above then this is not essential”.

A1.6 The guidance offers a widely used approach for quantifying costs associated with pollutant emissions from transport. It also outlines the following typical measures that may be considered to offset emissions, stating that measures to offset emissions may also be applied as post assessment mitigation:

- Support and promotion of car clubs;
- Contributions to low emission vehicle refuelling infrastructure;
- Provision of incentives for the uptake of low emission vehicles;
- Financial support to low emission public transport options; and
- Improvements to cycling and walking infrastructures.

Screening

Impacts of the Local Area on the Development

"There may be a requirement to carry out an air quality assessment for the impacts of the local area's emissions on the proposed development itself, to assess the exposure that residents or users might experience. This will need to be a matter of judgement and should take into account:

- *the background and future baseline air quality and whether this will be likely to approach or exceed the values set by air quality objectives;*
- *the presence and location of Air Quality Management Areas as an indicator of local hotspots where the air quality objectives may be exceeded;*
- *the presence of a heavily trafficked road, with emissions that could give rise to sufficiently high concentrations of pollutants (in particular nitrogen dioxide), that would cause unacceptably high exposure for users of the new development; and*
- *the presence of a source of odour and/or dust that may affect amenity for future occupants of the development".*

Impacts of the Development on the Local Area

A1.7 The guidance sets out two stages of screening criteria that can be used to identify whether a detailed air quality assessment is required, in terms of the impact of the development on the local area. The first stage is that you should proceed to the second stage if any of the following apply:

- 10 or more residential units or a site area of more than 0.5 ha residential use; and/or
- more than 1,000 m^2 of floor space for all other uses or a site area greater than 1 ha.

A1.8 Coupled with any of the following:

- the development has more than 10 parking spaces; and/or
- the development will have a centralised energy facility or other centralised combustion process.

A1.9 If the above do not apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area. If they do apply then you proceed to stage 2, which sets out indicative criteria for requiring an air quality assessment. The stage 2 criteria relating to vehicle emissions are set out below:

- the development will lead to a change in LDV flows of more than 100 AADT within or adjacent to an AQMA or more than 500 AADT elsewhere;
- the development will lead to a change in HDV flows of more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
- the development will lead to a realigning of roads (i.e. changing the proximity of receptors to traffic lanes) where the change is 5m or more and the road is within an AQMA;
- the development will introduce a new junction or remove an existing junction near to relevant receptors, and the junction will cause traffic to significantly change vehicle acceleration/deceleration, e.g. traffic lights or roundabouts;
- the development will introduce or change a bus station where bus flows will change by more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere; and
- the development will have an underground car park with more than 100 movements per day (total in and out) with an extraction system that exhausts within 20 m of a relevant receptor.

A1.10 The criteria are more stringent where the traffic impacts may arise on roads where concentrations are close to the objective. The presence of an AQMA is taken to indicate the possibility of being close to the objective, but where whole authority AQMAs are present and it is known that the affected roads have concentrations below 90% of the objective, the less stringent criteria are likely to be more appropriate.

A1.11 On combustion processes (including standby emergency generators and shipping) where there is a risk of impacts at relevant receptors, the guidance states that:

"Typically, any combustion plant where the single or combined NOx emission rate is less than 5 mg/sec is unlikely to give rise to impacts, provided that the emissions are released from a vent or stack in a location and at a height that provides adequate dispersion. As a guide, the 5 mg/s criterion equates to a 450 kW ultra-low NOx gas boiler or a 30kW CHP unit operating at <95mg/Nm^3.

In situations where the emissions are released close to buildings with relevant receptors, or where the dispersion of the plume may be adversely affected by the size and/or height of adjacent buildings (including situations where the stack height is lower than the receptor) then consideration will need to be given to potential impacts at much lower emission rates.

Conversely, where existing nitrogen dioxide concentrations are low, and where the dispersion conditions are favourable, a much higher emission rate may be acceptable".

A1.12 Should none of the above apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area, provided that professional judgement is applied; the guidance importantly states the following:

"The criteria provided are precautionary and should be treated as indicative. They are intended to function as a sensitive 'trigger' for initiating an assessment in cases where there is a possibility of significant effects arising on local air quality. This possibility will, self-evidently, not be realised in many cases. The criteria should not be applied rigidly; in some instances, it may be appropriate to amend them on the basis of professional judgement, bearing in mind that the objective is to identify situations where there is a possibility of a significant effect on local air quality".

A1.13 Even if a development cannot be screened out, the guidance is clear that a detailed assessment is not necessarily required:

"The use of a Simple Assessment may be appropriate, where it will clearly suffice for the purposes of reaching a conclusion on the significance of effects on local air quality. The principle underlying this guidance is that any assessment should provide enough evidence that will lead to a sound conclusion on the presence, or otherwise, of a significant effect on local air quality. A Simple Assessment will be appropriate, if it can provide this evidence. Similarly, it may be possible to conduct a quantitative assessment that does not require the use of a dispersion model run on a computer".

A1.14 The guidance also outlines what the content of the air quality assessment should include, and this has been adhered to in the production of this report.

Assessment of Significance

A1.15 There is no official guidance in the UK in relation to development control on how to describe the nature of air quality impacts, nor how to assess their significance. The approach within the EPUK/IAQM guidance has, therefore, been used in this assessment. This approach involves a two stage process:

- a qualitative or quantitative description of the impacts on local air quality arising from the development; and
- a judgement on the overall significance of the effects of any impacts.

A1.16 The guidance recommends that the assessment of significance should be based on professional judgement, with the overall air quality impact of the development described as either 'significant' or 'not significant'. In drawing this conclusion, the following factors should be taken into account:

- the existing and future air quality in the absence of the development;
- the extent of current and future population exposure to the impacts;
- the influence and validity of any assumptions adopted when undertaking the prediction of impacts;
- the potential for cumulative impacts and, in such circumstances, several impacts that are described as '*slight*' individually could, taken together, be regarded as having a significant effect for the purposes of air quality management in an area, especially where it is proving difficult to reduce concentrations of a pollutant. Conversely, a '*moderate*' or '*substantial*' impact may not have a significant effect if it is confined to a very small area and where it is not obviously the cause of harm to human health; and
- the judgement on significance relates to the consequences of the impacts; will they have an effect on human health that could be considered as significant? In the majority of cases, the impacts from an individual development will be insufficiently large to result in measurable changes in health outcomes that could be regarded as significant by health care professionals.

A1.17 The guidance is clear that other factors may be relevant in individual cases. It also states that the effect on the residents of any new development where the air quality is such that an air quality objective is not met will be judged as significant. For people working at new developments in this situation, the same will not be true as occupational exposure standards are different, although any assessment may wish to draw attention to the undesirability of the exposure.

A1.18 A judgement of the significance should be made by a competent professional who is suitably qualified. A summary of the professional experience of the staff contributing to this assessment is provided in Appendix A2.

A2 Professional Experience

Martin Peirce, BSc (Hons), MSc, MIEncSci, MIAQM

Mr Peirce has some thirty years' experience in environmental modelling and assessment, most relating to air quality and carbon and greenhouse gases (GHGs). He has extensive experience in the calculation of emissions to air and compiling emission inventories, for both local air quality assessments and carbon footprinting. For air quality, he also has extensive expertise in modelling the atmospheric dispersion of pollutants for comparison against regulatory limits and for assessment of health and environmental impacts. He has prepared assessments in support of Environmental Impact Assessments (EIA), permit applications and planning applications (under both Town and Country Planning Act (TCPA) and Development Consent Order (DCO) regimes). He has particular experience in modelling aviation and transport sources, non-road mobile machinery, construction and industrial sources.

Dr Kate Wilkins, BSc (Hons) MSc PhD MIEnvSc MIAQM

Dr Wilkins is a Senior Consultant with AQC with over nine years' postgraduate and work experience in the field of Environmental and Earth Sciences. Since joining AQC in January 2018, she has undertaken numerous air quality impact assessments for road traffic, combustion plant and construction dust throughout the UK for both standalone assessments and for EIAs, and has also prepared local authority reports and literature reviews. She has contributed her technical skills in programming and specialist software to a range of large-scale projects, including the third runway at Heathrow airport. Previously, Kate completed a PhD at the University of Bristol, researching atmospheric dispersion modelling and satellite remote sensing of volcanic ash. Prior to her PhD she spent a year working at the Environment Agency in Flood Risk Management. She is a Member of both the Institute of Air Quality Management and the Institution of Environmental Sciences.

A3 Modelling Methodology

Model Inputs

A3.1 Predictions have been carried out using the ADMS-Roads dispersion model (v5). The model requires the user to provide various input data, including emissions from each section of road and the road characteristics (including road width). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the EFT (Version 11.0) published by Defra (2022b). Model input parameters are summarised in Table A3.1 and, where considered necessary, discussed further below.

Table A3.1: Summary of Model Inputs

Model Parameter	Value Used
Terrain Effects Modelled?	No
Variable Surface Roughness File Used?	No
Urban Canopy Flow Used?	Yes
Advanced Street Canyons Modelled?	No
Noise Barriers Modelled?	No
Meteorological Monitoring Site	Kenley
Meteorological Data Year	2019
Dispersion Site Surface Roughness Length (m)	0.5
Dispersion Site Minimum MO Length (m)	30
Met Site Surface Roughness Length (m)	0.2
Met Site Minimum MO Length (m)	1
Gradients?	No

A3.2 Baseline traffic data have been taken from the LAEI (GLA, 2019b). The 2019 AADT flows have been factored forwards to the assessment year of 2023 using growth factors derived using the TEMPro System v7.2 (DfT, 2017). Traffic flows for 2023 in the No ERF scenario are assumed to equal the 2023 baseline flows, minus 666 HGVs, distributed across the road network as described in Paragraph 3.18. Traffic speeds have been based on those presented in the LAEI, with some having been adjusted based on professional judgement, taking account of the road layout, speed limits and the proximity to a junction. The traffic data used in this assessment are summarised in Table A3.2. Diurnal and monthly flow profiles for the traffic have been derived from the national profiles published by DfT (2020).

Table A3.2: Summary of Traffic Data used in the Assessment (AADT Flows)

Road Link	AADT	% Car	% Taxi (black cab)	% LGV	% HGV	% Bus and Coach	% Motorcycle
2019							
A232 west of Beddington Lane	21,643	77.4	0.5	16.4	0.6	3.5	1.7
A232 east of Beddington Lane	20,859 – 21,432	76.3 - 77.3	0.8	16.3 - 16.5	1.5	2.2 - 3.4	1.7
Beddington Lane south of Marlowe Way	14,208 – 17,464	78.0 - 79.9	0.9 - 1.1	14.3 - 15.1	1.7 - 2.1	1.8 - 2.2	1.4
Beddington Lane south of Coomber Way	8,359 – 12,224	73.7 - 77.5	1.2 - 1.5	15.1 - 16.3	3.1 - 4.6	1.7 - 2.5	1.4
Beddington Lane south of Croydon Road	9,907 – 9,981	71.4 - 73.2	1.2 - 1.4	16.1 - 17.3	5.1 - 6.9	1.8 - 2.8	1.4
2023 (Without Changes)							
A232 west of Beddington Lane	22,528	77.4	0.5	16.4	0.6	3.5	1.7
A232 east of Beddington Lane	21,712 – 22,309	76.3 - 77.3	0.8	16.3 - 16.5	1.5	2.2 - 3.4	1.7
Beddington Lane south of Marlowe Way	14,789 – 18,178	78.0 - 79.9	0.9 - 1.1	14.3 - 15.1	1.7 - 2.1	1.8 - 2.2	1.4
Beddington Lane south of Coomber Way	8,701 – 12,724	73.7 - 77.5	1.2 - 1.5	15.1 - 16.3	3.1 - 4.6	1.7 - 2.5	1.4
Beddington Lane south of Croydon Road	10,312 – 10,389	71.4 - 73.2	1.2 - 1.4	16.1 - 17.3	5.1 - 6.9	1.8 - 2.8	1.4
2023 (With Changes)							
A232 west of Beddington Lane	22,565	77.2	0.5	16.4	0.8	3.5	1.7
A232 east of Beddington Lane	21,749 – 22,345	76.1 - 77.2	0.8	16.3 - 16.5	1.7	2.1 - 3.4	1.7
Beddington Lane south of Marlowe Way	14,863 – 18,252	77.6 - 79.6	0.9 - 1.1	14.2 - 15.1	2.1 - 2.6	1.8 - 2.2	1.4
Beddington Lane south of	8,774 – 12,797	73.1 - 77.1	1.2 - 1.5	15.0 - 16.1	3.6 - 5.4	1.7 - 2.5	1.4

Road Link	AADT	% Car	% Taxi (black cab)	% LGV	% HGV	% Bus and Coach	% Motorcycle
2019							
Coomber Way							
Beddington Lane south of Croydon Road	10,390 – 10,467	70.9 - 72.6	1.2 - 1.4	15.9 - 17.2	5.9 - 7.6	1.7 - 2.8	1.4
2023 (With No ERF)							
A232 west of Beddington Lane	22,388	77.8	0.5	16.5	0	3.5	1.7
A232 east of Beddington Lane	21,572 – 22,169	76.7 - 77.8	0.8	16.4 - 16.6	0.9	2.2 - 3.5	1.7
Beddington Lane south of Marlowe Way	14,511 – 17,900	79.5 - 81.1	0.9 - 1.1	14.5 - 15.4	0.2 - 0.3	1.8 - 2.3	1.4
Beddington Lane south of Coomber Way	8,424 – 12,447	76.2 - 79.2	1.3 - 1.5	15.4 - 16.8	0.9 - 1.5	1.7 - 2.6	1.4
Beddington Lane south of Croydon Road	10,018 – 10,095	73.5 - 75.3	1.2 - 1.4	16.5 - 17.8	2.4 - 4.2	1.8 - 2.9	1.4

A3.3 Figure A3.1 shows the road network included within the model, along with the speed at which each link was modelled.

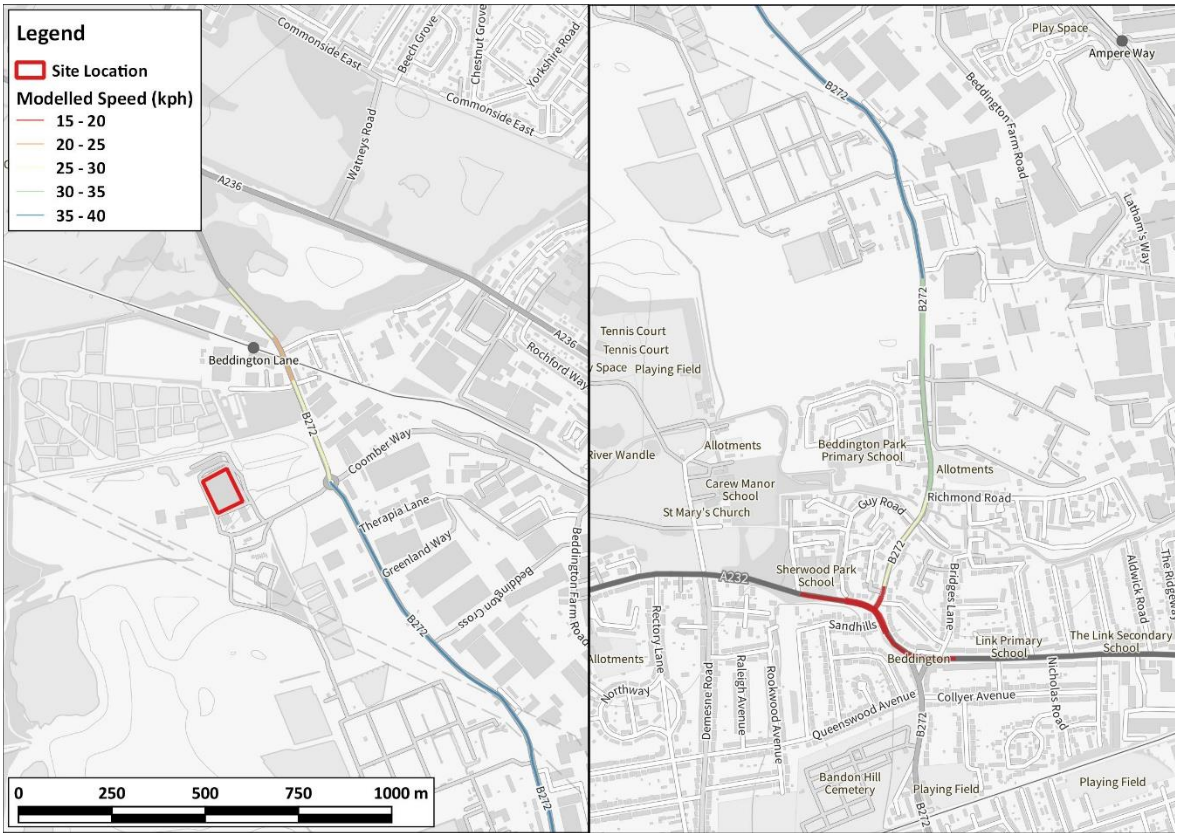

Figure A3.1: Modelled Road Network & Speed

A3.4 Hourly sequential meteorological data in sectors of 10 degrees from Kenley for 2019 have been used in the model. The Kenley meteorological monitoring station is located at Kenley Aerodrome, approximately 9.5 km to the southeast of the Beddington ERF. Both the site and the Kenley meteorological monitoring station are located in the south of London where they will be influenced by the effects of inland meteorology. The measurements from this site are considered to provide the most robust basis to predict meteorology within the model domain. A wind rose for the site for the year 2019 is provided in Figure A3.2. Raw data were provided by the Met Office and processed by AQC for use in ADMS.

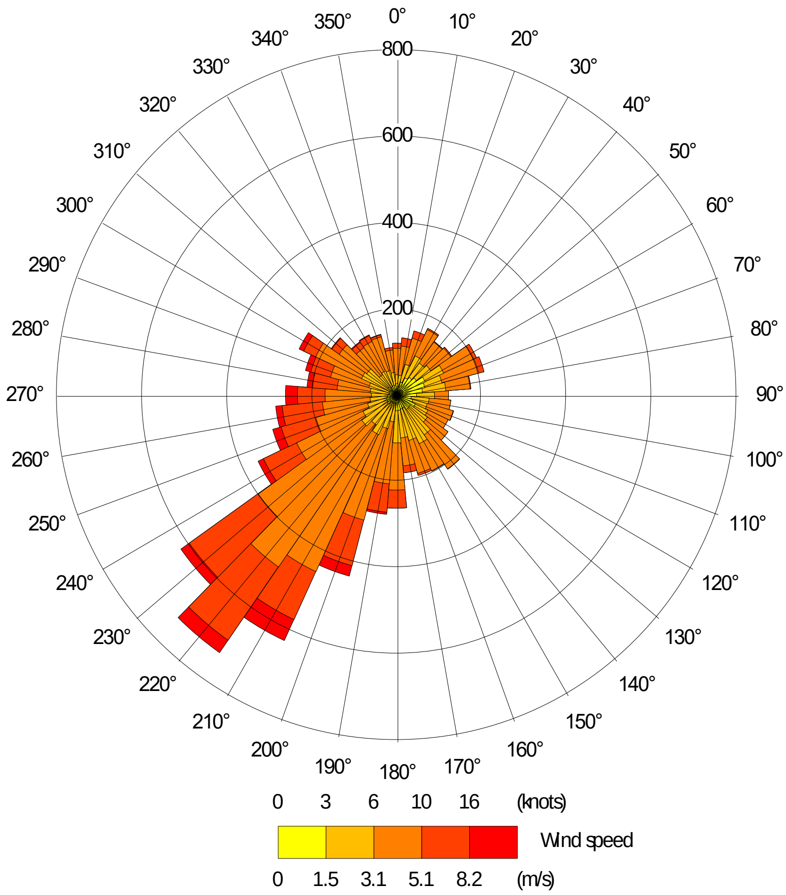

Figure A3.2: Wind Rose

Model Verification

A3.5 Evidence collected over many years has shown that, in most urban areas, dispersion modelling relying upon Defra's EFT has tended to systematically under-predict roadside nitrogen dioxide concentrations. To account for this, it is necessary to adjust the model against local measurements. The model has been run to predict annual mean nitrogen dioxide concentrations during 2019 at the ST5 automatic monitor and BL and ST24 diffusion tube monitoring sites. These sites have been selected because they considered to be representative of existing receptors along the road network.

Nitrogen Dioxide

A3.6 Most nitrogen dioxide (NO_2) is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides ($NOx = NO + NO_2$).

A3.7 The model output of road-NOx (i.e. the component of total NOx coming from road traffic) has been compared with the 'measured' road-NOx. Measured road-NOx has been calculated from the measured NO_2 concentrations and the predicted background NO_2 concentration using the NOx from NO_2 calculator (Version 8.1) available on the Defra LAQM Support website (Defra, 2022b).

A3.8 The unadjusted model has under predicted the road-NOx contribution at monitoring sites ST5 and BL, and overpredicted at site ST24 due to the background concentrations being equal to the measured concentration implying a near-zero road -NOx at that site. An adjustment factor has been determined as the slope of the best-fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (Figure A3.3). The calculated adjustment factor is below unity (0.8324). Therefore, no adjustment been applied to the modelled road-NOx concentration.

A3.9 The total nitrogen dioxide concentrations have then been determined by combining the unadjusted modelled road-NOx concentrations with the predicted background NO_2 concentration within the NOx to NO_2 calculator.

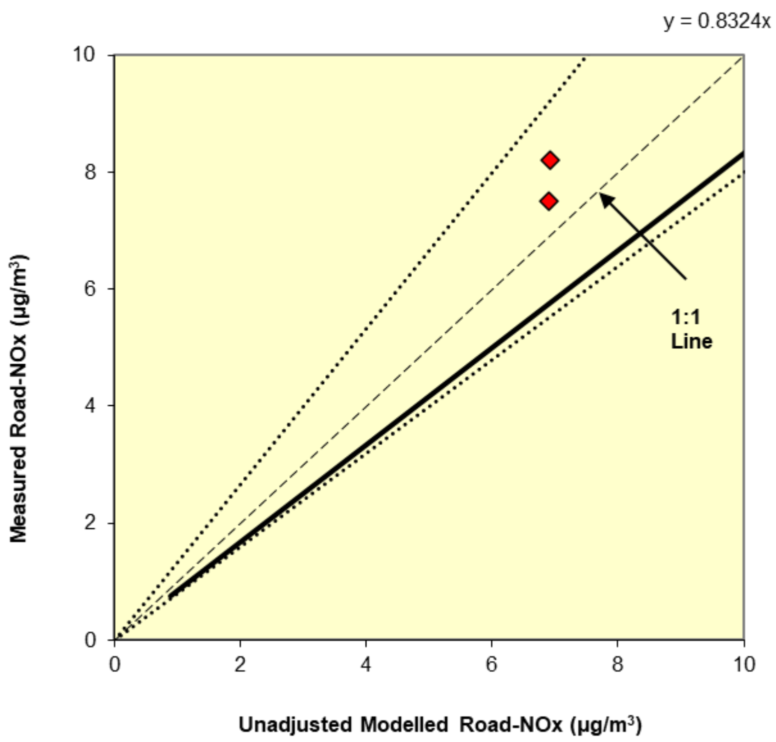

Figure A3.3: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.

PM_{10} and $PM_{2.5}$

A3.10 The approach described above for NOx and nitrogen dioxide determines the road increment of concentrations by subtracting the predicted local background from the roadside measurements. This works well for NOx because the differences between roadside and background concentrations typically represent a large proportion of the total measured value. The same is not true for PM_{10} and

$PM_{2.5}$ concentrations, which are dominated by non-road emissions, even at the roadside. In practice, the influence of a local road on concentrations can often be smaller than the uncertainty in the mapped background concentration. As an example of this, 31% of all roadside and kerbside sites in London which measured $PM_{2.5}$ in 2019 with >75% data capture, recorded an annual mean concentration lower than the equivalent Defra mapped background value. Using measured background concentrations does not provide any significant benefit, owing largely to the spatial resolution of available measurements, but also because of measurement uncertainty. For example, hourly-mean $PM_{2.5}$ concentrations measured at roadside sites are often lower than those measured at nearby urban background sites, while concentrations at urban background sites are often lower than those measured at rural sites.

A3.11 For these reasons, it is not appropriate to calculate the annual mean road-increment to PM_{10} and $PM_{2.5}$ concentrations by subtracting either the mapped background or a local measured background concentration. This, in turn, means that the approach to model adjustment which is described for NOx and NO_2 is not appropriate for PM_{10} and $PM_{2.5}$. Historically, many studies have derived a model adjustment factor for NOx and applied this to PM_{10} and $PM_{2.5}$. This is also not appropriate, since there is no reason to expect the same bias in emissions of NOx, PM_{10} and $PM_{2.5}$.

A3.12 While there is very strong evidence that EFT-based models have consistently under-predicted road-NOx concentrations in urban areas, there is no equivalent evidence for PM_{10} and $PM_{2.5}$.

A3.13 The modelled road PM_{10} and $PM_{2.5}$ concentrations have been compared with the measured concentrations at automatic monitor ST5 to calculate an adjustment factor. The data used to calculate the adjustment factors are provided below:

A3.14 PM_{10}:

- Measured PM_{10}: 22.0 µg/m^3
- Background[4] PM_{10}: 17.2 µg/m^3
- 'Measured' road-PM_{10}: 4.76 µg/m^3
- Modelled road-PM_{10}: 0.52 µg/m^3
- Road- PM_{10} adjustment factor: 4.76/0.52 = **9.12**

A3.15 $PM_{2.5}$:

- Measured $PM_{2.5}$: 11.7 µg/m^3
- Background $PM_{2.5}$: 11.4 µg/m^3
- 'Measured' road-$PM_{2.5}$: 0.34 µg/m^3

4 Uplifted from the Defra mapped background data to give agreement at ST8.

- Modelled road-$PM_{2.5}$: 0.32 µg/m^3
- Road-$PM_{2.5}$ adjustment factor: 0.34/0.32 = **1.08**

A3.16 As shown above, the adjustment factor for PM_{10} is much higher than that for $PM_{2.5}$. An assessment of the area surrounding monitor ST5 indicates that there is a large amount of surface dust in proximity to the monitor which may be a large contributor to measured concentrations at the site. As such, it is not considered appropriate to adjust the modelled road-PM_{10} concentrations, and neither predicted PM_{10} nor $PM_{2.5}$ concentrations have been adjusted.

Post-processing

A3.17 The model predicts road-NOx concentrations at each receptor location. These concentrations have been adjusted using the adjustment factor set out above, which, along with the background NO_2, has been processed through the NOx to NO_2 calculator available on the Defra LAQM Support website (Defra, 2022b). The traffic mix within the calculator has been set to “All London traffic”, which is considered suitable for the study area. The calculator predicts the component of NO_2 based on the adjusted road-NOx and the background NO_2.

A4 London Vehicle Fleet Projections

A4.1 TfL has published an Integrated Impact Assessment (Jacobs, 2017) setting out the impacts of the changes to the LEZ and ULEZ. The assessment predicts that the changes will reduce overall NOx emissions from vehicles in London by 28% in 2021 (32% in Inner London and 27% in Outer London) and by 21% in 2025 (24% in Inner London and 21% in Outer London). The percentage reduction reduces with time due to the natural turnover of the fleet that would have occurred regardless of the introduction of the proposed changes. The proposed changes will not significantly affect emissions in Central London, where the ULEZ will already be implemented, but concentrations here will still reduce due to the lower emissions in surrounding areas.

A4.2 The report projects that the changes will reduce exposure to exceedances of the annual mean nitrogen dioxide objective by 40% and 21% in Central London in 2021 and 2025, respectively; by 4% and 0% in Inner London in 2021 and 2025, respectively; and by 23% and 27% in Outer London in 2021 and 2025, respectively, when compared to the baseline scenario.

A4.3 The changes are not projected to have a significant effect on PM_{10} and $PM_{2.5}$ concentrations, although a small reduction is predicted.

A4.4 AQC's report on the performance of Defra's EFT (AQC, 2020a) also highlighted that the EFT's assumptions regarding future fleet composition in London and across the UK may be over-pessimistic in terms of NOx emissions (and no changes to the fleet mix within London were made between versions 9 and 10 of the EFT). The future fleet projection derived from the EFT for Outer London, for example, shows a very small reduction in the proportion of diesel cars between 2016 and 2030, and a very limited uptake of electric cars. The AQC report highlights that this contrasts with the expectations of many observers, as well as the most recent trends publicised by the media. When considered alongside the future requirements of the LEZ and ULEZ, these future fleet projections seem all the more unrealistic (i.e. worst-case in terms of emissions), as the changes to the LEZ and ULEZ would reasonably be expected to significantly increase the uptake of lower emissions vehicles in London.

A4.5 As outlined in Paragraph 3.16, the changes to the LEZ and ULEZ announced by the Mayor of London in June 2018 are not reflected in Defra's latest EFT and thus have not been considered in this assessment. The potentially over-pessimistic fleet projections built in to the EFT have not been addressed in this report either. Paragraphs A4.1 and A4.2 highlight that the changes to the LEZ and ULEZ will result in significant reductions in vehicle nitrogen oxides emissions and resultant nitrogen dioxide concentrations. The changes might reasonably also be expected to expedite the uptake of cleaner vehicles well beyond that projected in the EFT's fleet projections for London. As such, while the results presented in this report represent a reasonably conservative reflection of likely concentrations and impacts in the absence of the changes to the LEZ and ULEZ, they almost certainly represent an unrealistically worst-case assessment of likely concentrations and impacts bearing in mind the implementation of these changes.